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FINAL SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

SEQUOYAH NUCLEAR PLANT UNITS 1 AND 2 LICENSE RENEWAL

Hamilton County, Tennessee

PREPARED BY:
TENNESSEE VALLEY AUTHORITY

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Final Supplemental Environmental Impact Statement **June 2011**

Proposed project: Sequoyah Nuclear Plant Units 1 and 2 License Renewal
Hamilton County, Tennessee

Lead agency: Tennessee Valley Authority

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Abstract: TVA proposes to submit an application to renew the operating licenses for Sequoyah Nuclear Plant (SQN), Units 1 and 2, in Hamilton County, Tennessee. License renewal would permit operation for an additional 20 years past the current operating license terms that expire in 2020 for Unit 1 and in 2021 for Unit 2. License renewal would involve continuation of normal operations, maintenance, and refueling. The license renewal program would not require major new construction, alterations, or refurbishment to SQN to maintain consistency with the current licensing basis. The purposes of the proposed action are to (1) obtain extended licenses to operate SQN Units 1 and 2 to help meet the identified need for power between 2020 and 2031; (2) maximize use of existing assets; and (3) support TVA's efforts to reduce the carbon emissions of its generating system.

In addition to continuing to operate SQN, TVA evaluated alternative methods for supplying electrical power. Relative to SQN, the No Action Alternative would involve ceasing operation of SQN when the current operating licenses expire, and using other methods to provide necessary capacity and energy. TVA examined various supply-side and demand-side options, including some that require construction of new generation facilities. Feasible alternatives evaluated in more detail are construction of a new nuclear plant or a new natural gas-fired plant.

TVA has prepared this supplemental environmental impact statement to inform decision makers and the public about the potential environmental impacts that would result from renewing SQN operating licenses. This document supplements the original 1974 *Final Environmental Statement Sequoyah Nuclear Plant Units 1 and 2* (TVA 1974a). TVA will use this information in addition to input provided by reviewing agencies, tribes, and the public to make an informed decision about renewing SQN operating licenses.

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SUMMARY

S.1. PURPOSE OF AND NEED FOR THE PROPOSED ACTION

The current operating licenses for Sequoyah Nuclear Plant (SQN) expire at midnight on September 17, 2020, and September 15, 2021, for Units 1 and 2 respectively. The Tennessee Valley Authority (TVA) must decide whether to submit a license renewal application (LRA) to the U.S. Nuclear Regulatory Commission (NRC) to extend the operating licenses of the two units for an additional 20 years beyond their current license terms.

As an integral part of TVA's current generation portfolio, SQN provides substantive base load generation to the TVA power system. Renewal of the current operating licenses would allow SQN to continue supplying approximately 2,400 megawatts electric (MWe) installed capacity of safe, clean, reliable, and cost-effective base load power in the period between 2020 and 2041. The license renewal program would not require major new construction, alterations, or refurbishment to SQN to maintain consistency with the current licensing basis. Furthermore, because nuclear processes produce substantially less air pollutants compared to fossil-fueled generation sources, continued operation of SQN would support TVA's efforts to reduce the carbon emissions of its generating system.

Demand for electricity in the TVA power service area has grown at the average rate of 2.3 percent per year from 1990 to 2008. Although the 2008 – 2009 economic recession has slowed load growth in the short term and added uncertainty to the forecast of power needs, economic recovery is expected, and future power needs are projected to grow at a rate that requires additional generating capacity.

The purposes of the proposed action are to (1) obtain extended licenses to operate SQN Units 1 and 2 to help meet the identified need for power between 2020 and 2031; (2) maximize use of existing assets; and (3) support TVA's efforts to reduce the carbon emissions of its generating system.

SQN Units 1 and 2 are pressurized light water reactors with a capacity of approximately 1,200 MWe each. SQN began commercial operation with Unit 1 in July 1981 and Unit 2 in June 1982. The SQN site is composed of approximately 630 acres that includes approximately 525 acres of land known as the industrial site and approximately 105 acres known as the training area peninsula. SQN is located near the geographical center of Hamilton County, Tennessee, on a peninsula on the western shore of Chickamauga Reservoir at Tennessee River mile (TRM) 484.5. SQN is close to the city of Soddy-Daisy, Tennessee, and is approximately 18 miles northeast of the Chattanooga, Tennessee, city center.

The purpose of this supplemental environmental impact statement (SEIS) is to inform decision makers, agencies, and the public about the potential environmental impacts that would result from the proposed action and alternatives.

This SEIS supplements the original *Final Environmental Statement, Sequoyah Nuclear Plant Units 1 and 2* that TVA prepared in 1974 to evaluate the impacts of constructing and operating SQN. Information from the 1974 final environmental statement (FES) was analyzed and updated where needed to develop this SEIS. Additionally, information from other related environmental reviews was used to develop this SEIS.

This SEIS also updates the need for power analysis based upon the current TVA power system, TVA policies, forecasted economic conditions, costs of fuel and technology, and other contributing factors. In its Integrated Resource Plan (IRP), released in March 2011 (TVA 2011a), TVA assumed for analysis purposes that existing nuclear plants such as SQN would continue to be the backbone of TVA's power supply in the future. This SEIS uses information and analyses from the IRP EIS process, particularly for load forecasting and evaluation of energy generation portfolios designed to meet forecast needs.

This SEIS also incorporates information from the NRC's *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (NRC 1996) in which the NRC considered the environmental effects of 20-year renewals of nuclear power plant operating licenses (results are codified in 10 CFR Part 51).

S.2. ALTERNATIVES INCLUDING THE PROPOSED ACTION

Alternatives were analyzed in addition to the continuing operation of SQN by license renewal. TVA considered alternatives for the generating capacity and energy needed to provide approximately 2,400 MWe of base load power between 2020 and 2041. Potential options for meeting TVA's purpose and need include the range of supply-side and demand-side actions identified in TVA's IRP process. TVA reviewed options that would require new generating capacity, options that would not require new generating capacity, and a combination of those alternatives.

The Action Alternative, relative to SQN, is to take the action necessary to continue operation of SQN and would result in pursuing renewal of the operating licenses. Taking no action to renew the SQN operating licenses would result in ceasing operation of SQN Unit 1 in 2020 and Unit 2 in 2021. Subsequently, TVA would need to rely on alternate means to meet the demand for power that SQN provides. Therefore, in this SEIS, implementing an alternate way to provide the capacity and energy otherwise generated by SQN is described as part of the No Action Alternative.

Eventual decommissioning of SQN would be necessary regardless of TVA's decision to pursue license renewal. SQN would undergo decommissioning at the end of the current licenses, or at the end of the license renewal period. SQN would be placed in a safe condition and all fuel removed from the reactor. Decommissioning activities would begin after the permanent and safe shutdown of the units is achieved and after the formal decommissioning plans are approved by the NRC.

Safe storage of spent fuel would also be necessary whether SQN operating licenses are renewed or not. SQN has an independent spent fuel storage installation (ISFSI) used to safely store spent fuel in licensed and approved dry cask storage containers on site. This ISFSI is licensed separately from the SQN operating units and would remain in place until the U.S. Department of Energy (DOE) takes possession of the spent fuel and removes it from the site for permanent disposal or processing.

Transmission lines connecting SQN to the electric power grid would be operated whether SQN is operated or shut down. Operation and maintenance of transmission lines does not depend upon the decision to renew SQN operating licenses; proposed maintenance would be identical regardless of the decision to pursue license renewal. Therefore, operation of transmission lines and maintenance of rights-of-way (ROWs) are not addressed in this SEIS.

<u>Alternative 1 – SQN Units 1 and 2 License Renewal – Action Alternative</u>

The proposed action is for TVA to submit an LRA to the NRC to extend the expiration dates for SQN's operating licenses. Renewal of the current operating licenses would permit operation for an additional 20 years past the current operating license terms that expire at midnight on September 17, 2020, and September 15, 2021, for Units 1 and 2, respectively. The NRC would evaluate TVA's LRA and the potential environmental impacts of granting renewed licenses. If this alternative is granted, SQN would be available as a base load generation plant until 2040 for Unit 1 and 2041 for Unit 2.

The license renewal program would not require major new construction, alterations, or refurbishment to SQN to maintain consistency with the current licensing basis. Nor would it require changes to the programs, processes, or procedures currently in use. No changes to operational limits or permit requirements would be necessary to comply with current regulations. Other than the continued normal operations, refueling, and maintenance for an additional 20 years, no significant changes would be needed to continue current operation of SQN Units 1 and 2. If the DOE does not take responsibility for the permanent storage and disposal of spent fuel before 2026, expansion of the on-site ISFSI may be required to support SQN operations during the period of license renewal.

<u>Alternative 2 – SQN Units 1 and 2 Shutdown – No Action Alternative</u>

If no action were taken by TVA, the operating licenses for SQN would expire in September 2020 and 2021 for Units 1 and 2 respectively. If the operating licenses expire, SQN would shut down and enter decommissioning. The TVA power service area would be shorted approximately 2,400 MWe of reliable base load generation and electric service could be disrupted during periods of peak demand on the TVA system.

If SQN were shut down, TVA would need to build new capacity to meet demand, in addition to operating existing resources, implementing approved new projects (e.g., Watts Bar Nuclear Plant Unit 2 projected to begin operating in 2013), and pursuing other planned expansion. Two power generation options were evaluated based upon cost optimization planning strategies: Alternative 2a, which includes construction and operation of a new advanced nuclear facility, and Alternative 2b, which includes construction and operation of multiple new natural gas-fired combined-cycle units.

<u>Alternative 2a – New Nuclear Generation</u>

Under Alternative 2a, TVA would identify a suitable site and decide the type of approved reactor technology. TVA would evaluate the various available approved reactor technologies and decide which would best meet the TVA mission and goals. TVA is exploring potential use of the Advanced Passive 1000 (AP1000) reactor technology at the Bellefonte nuclear site. Technology-related specifics used in this SEIS are examples only, and most are examples of the AP1000 technology design.

Based on the currently approved advanced reactor design technologies, TVA assumes it would require at least two new units to replace the existing SQN units. Under Alternative

2a, TVA would construct a new nuclear power plant at an alternate site. Construction locations may include a greenfield (i.e., undisturbed) site or a brownfield site. It is estimated that the new plant site would require 1,000 acres; additional land for transmission lines and other facilities could be necessary, depending upon existing infrastructure.

It is assumed that the new nuclear power plant would have an initial 40-year license term with the opportunity to renew for an additional 20-year license term. The AP1000 plant design is for 60 years. Operation of a new nuclear plant would support the TVA goal of reducing carbon emissions from electrical power generation.

Alternative 2b – New Natural Gas Generation

Under Alternative 2b, TVA would identify a suitable site and design a new natural gas-fired facility. TVA would most likely use combined-cycle type generation units, because they are more efficient than simple cycle units.

TVA recently evaluated construction and operation of a combustion turbine/combined-cycle plant at the John Sevier Fossil Plant (JSF) in Hawkins County, Tennessee. It would be feasible to complete the permitting process for a similar new natural gas-fired generation if Alternative 2b were adopted. For this SEIS, the JSF project is used as an example of facility design, construction, and potential environmental impacts.

S.3. SUMMARY OF ENVIRONMENTAL CONSEQUENCES

Potential environmental impacts of the proposed project and the power generation alternatives are briefly summarized in Table S-1.

S.4. PREFERRED ALTERNATIVE

Based upon the evaluations presented in this SEIS, and considering environmental impacts, costs, electrical generation needs of the TVA system, and TVA goals and policies, TVA has identified Alternative 1 – SQN Units 1 and 2 License Renewal as the preferred alternative. Implementing the preferred alternative would provide the Tennessee Valley with an additional 20 years of reliable base load power while promoting TVA's efforts to reduce carbon emissions, make beneficial use of existing assets, and deliver power at the lowest feasible cost.

S.5. PUBLIC REVIEW OF THE DRAFT SEIS

A notice of intent (NOI) to prepare the SEIS was published in the *Federal Register* on Monday, April 12, 2010 (see Appendix A). The NOI described the SQN plant and its location, summarized the proposed action and alternatives, enumerated the environmental issues to be addressed in the SEIS, and detailed the scoping process. The deadline for comments was May 11, 2010.

The draft SEIS was available for public comment for 45 days following publication of the notice of availability (NOA) in the *Federal Register* in November 2010 (see Appendix A). At the close of the public comment period, TVA responded to the substantive comments received as provided in Appendix D of this document and incorporated any necessary changes into the final SEIS (FSEIS). The completed FSEIS will be transmitted to the U.S.

Environmental Protection Agency (EPA), which will publish another NOA in the *Federal Register*. TVA will make a decision on the proposed action no sooner than 30 days after the EPA's NOA of this FSEIS is published in the *Federal Register*. This decision will be based on the project purpose and need, anticipated environmental impacts as documented in the FSEIS, and cost, schedule, technological, and other considerations. To document the decision, TVA will issue a formal record of decision (ROD).

Table S-1. Summary of the Environmental Impacts of the Action and No Action Alternatives

Resource	Attribute/Potential Effects	Alternative		
		1 – SQN License Renewal	2a – SQN Shutdown and New Nuclear Generation	2b – SQN Shutdown and New Natural Gas-Fired Generation
Surface Water	Chemical or thermal degradation of surface water quality.	There would be no major construction activities. All releases to surface water would be controlled as per NPDES permits and remain minor. SQN complies with current NRC and TDEC regulations. No change is anticipated regarding potential impacts from the current level of minor impacts anticipated. Direct, indirect, and cumulative effects of chemical and thermal discharges would be minor.	Temporary and minor impacts from sedimentation and erosion during construction. No cumulative construction impacts are anticipated. Compliance with NPDES permit would limit potential impacts. Cooler discharge due to closed- cycle cooling. Thermal impacts would be minor and would be mitigated by derating if necessary. Direct, indirect, and cumulative effects of chemical discharges would be minor.	Alternative 2b would be similar to Alternative 2a and would have similar impacts on surface water.
	Changes to hydrology and consumptive use of surface water.	No change in current level of minor impacts to water supply. No cumulative effects to water supply are expected.	Impacts would depend on the volume of water withdrawn for makeup and the source of water. A new plant would be built with a closed-cycle cooling system, increasing surface water consumption. Overall impacts of water use could be minor during normal flows and possibly substantial during extreme low-flow conditions.	Effects on water supply would be similar to Alternative 2a, but on a smaller scale. Impacts would be minor.

Resource	Attribute/Potential Effects	Alternative		
		1 – SQN License Renewal	2a – SQN Shutdown and New Nuclear Generation	2b – SQN Shutdown and New Natural Gas-Fired Generation
Groundwater	Chemical and radiological impacts to groundwater quality.	Minor impacts.	Minor radiological impacts on groundwater quality.	No radiological impact on groundwater.
	Groundwater use.	No groundwater use. No impact anticipated.	If used for sanitary and potable water, there could be a minor impact. If used for makeup water and/or cooling water, then impacts could be moderate to substantial.	Alternative 2b would be similar to Alternative 2a and would have similar impacts on the groundwater resource.
Floodplain and Flood Risk	Construction or modification of the floodplain.	No increase in flood risk in the Chickamauga Reservoir watershed.	All proposed construction would be evaluated to ensure consistency with Executive Order 11988. Dredging would be a repetitive action with minor impacts.	Alternative 2b would be similar to Alternative 2a and would have similar impacts on the floodplain.
	Flooding of the plant site from the river, lake, or probable maximum precipitation.	No cumulative effects to flood risk.		

Resource	Attribute/Potential Effects	Alternative		
		1 – SQN License Renewal	2a – SQN Shutdown and New Nuclear Generation	2b – SQN Shutdown and New Natural Gas-Fired Generation
Wetlands	Destruction of wetlands or degradation of wetland functions.	No impact.	Impacts due to construction, including transmission lines, would range from minor to substantial. Consistent with Executive Order 11990, a new plant would not be constructed in wetlands unless there were no practicable alternative.	Alternative 2b would be similar to Alternative 2a and would have similar impacts on any wetlands.
Aquatic Ecology	Destruction of aquatic organisms; degradation or destruction of aquatic habitat.	No new impact. No change from current minor impacts on fish populations from impingement and entrainment. Thermal impacts to aquatic species in Chickamauga Reservoir would continue to be minor.	Impacts could range from minor to substantial depending on plant design, organisms present, source water, and receiving water. Dredging would have minor direct and indirect effects. An NPDES permit regulating discharge and temperature of toxic substances would be required.	Alternative 2b would be similar to Alternative 2a and would have similar impacts on the aquatic ecology.

Resource	Attribute/Potential Effects	Alternative		
		1 – SQN License Renewal	**2a – SQN Shutdown and New Nuclear Generation**	**2b – SQN Shutdown and New Natural Gas-Fired Generation**
Terrestrial Ecology	Removal or degradation of terrestrial vegetation, wildlife habitat, and/or wildlife.	No substantial change from current SQN operations. No indirect effects.	Substantial direct impacts could occur from clearing and construction operations if a greenfield site is selected. Minor indirect impacts may occur. Likely to result in minor cumulative impacts due to potential collective habitat loss, habitat fragmentation, and decreased biological diversity. Construction of associated transmission lines could result in minor cumulative impacts. Impacts less likely if construction occurs on a brownfield site.	Alternative 2b would result in impacts similar to those associated with Alternative 2a, but would be smaller in scale due to smaller size.

Resource	Attribute/Potential Effects	Alternative		
		1 – SQN License Renewal	**2a – SQN Shutdown and New Nuclear Generation**	**2b – SQN Shutdown and New Natural Gas-Fired Generation**
Endangered and Threatened Species	Mortality, harm, or harassment of federally listed or state-listed species including impacts to their critical habitat.	No new direct impacts. No indirect or cumulative impacts.	Clearing and construction could result in substantial direct impacts, depending upon the location chosen. Minor to substantial indirect impacts associated with potential habitat loss and fragmentation, and decreased biological diversity could occur. Site-specific environmental review would identify protected species and their habitats. TVA would comply with the Endangered Species Act, and evaluate measures to avoid or minimize impacts.	Alternative 2b would result in impacts similar to those associated with Alternative 2a.
Natural Areas	Degradation of the value or quality of natural areas.	No new direct impacts. No indirect or cumulative impacts.	Direct impacts are unlikely. New plant would be constructed at a distance from most natural areas. Minor indirect and minor to substantial cumulative impacts may occur because of habitat loss and fragmentation, and decreased biodiversity.	Alternative 2b would result in impacts similar to those associated with Alternative 2a.

Resource	Attribute/Potential Effects	Alternative		
		1 – SQN License Renewal	2a – SQN Shutdown and New Nuclear Generation	2b – SQN Shutdown and New Natural Gas-Fired Generation
Recreation	Degradation or elimination of recreational facilities or opportunities.	No impacts.	Impacts could range from minor to moderate, depending upon site location. Potential adverse impacts resulting from construction and operation would be evaluated.	Alternative 2b would result in impacts similar to those associated with Alternative 2a.
Archaeology and Historic Structures	Damage to archaeological sites or historic structures.	No direct, indirect, or cumulative effects within SQN site or vicinity are expected.	Depending on the site, the effects could range from minor to substantial. Direct, indirect, and cumulative impacts would be evaluated, with historic properties identified and managed per the National Historic Preservation Act Section 106 process.	Alternative 2b would result in impacts similar to those associated with Alternative 2a.
Visual	Effects on scenic quality, degradation of visual resources.	No new impacts.	Potential removal of SQN structures would make the SQN site less visible. The level of impact anticipated during construction and operation would range from minor to moderate.	Alternative 2b would result in impacts similar to those associated with Alternative 2a.

Resource	Attribute/Potential Effects	Alternative		
		1 – SQN License Renewal	**2a – SQN Shutdown and New Nuclear Generation**	**2b – SQN Shutdown and New Natural Gas-Fired Generation**
Noise	Generation of noise at levels causing a nuisance to the community.	Impacts would be minor; no change from the current condition.	Noise associated with construction would be minor for the surrounding communities, and minor to moderate for the nearest residents. Noise associated with operation of a new plant is expected to be minor. Construction noise associated with new transmission systems is expected to be minor.	Alternative 2b would result in impacts similar to those associated with Alternative 2a.
Socioeconomics and Environmental Justice	Changes in local population, employment, and incomes.	No changes in operating employment levels. No new impacts to population, local employment, or income.	Impacts range from minor to moderate, depending upon the size of the population and existing amenities near the selected site. The action could result in the creation of new direct and indirect jobs during construction. The closure of the SQN plant and subsequent loss of operational jobs would have a negligible effect on the socioeconomic conditions in Hamilton County.	Alternative 2b would result in impacts similar to those associated with Alternative 2a, but on a smaller scale.

Resource	Attribute/Potential Effects	Alternative		
		1 – SQN License Renewal	2a – SQN Shutdown and New Nuclear Generation	2b – SQN Shutdown and New Natural Gas-Fired Generation
	Disproportionate effects on low-income and/or minority populations.	No disproportionate effects on low-income or minority populations.	Potential effects might disproportionately impact minority or low-income communities depending on location. Negligible socioeconomic impacts expected with the closure of SQN; therefore, no disproportionate impacts to minority and low-income populations.	Alternative 2b would result in impacts similar to those associated with Alternative 2a, but on a smaller scale.
	Changes in availability of housing.	No changes or new impacts.	Impacts on local and regional housing markets would be location dependent and range from minor to substantial. Potential short-term, minor negative effects on the housing market, specifically in Hamilton County.	Alternative 2b would result in impacts similar to those associated with Alternative 2a, but on a smaller scale.

Resource	Attribute/Potential Effects	Alternative		
		1 – SQN License Renewal	2a – SQN Shutdown and New Nuclear Generation	2b – SQN Shutdown and New Natural Gas-Fired Generation
	Effects on water supply and wastewater.	No changes or new impacts.	Interconnecting to existing systems could require the development of additional capacity. Increased population could require the development of additional capacity. Demand on the Hamilton County water and wastewater systems would lessen, but impact would be negligible.	Alternative 2b would result in impacts similar to those associated with Alternative 2a, but on a smaller scale.
	Police, fire, and medical services.	No changes or new impacts.	Support from local emergency service providers would be necessary during construction and operation. Demand for emergency services near SQN may lessen, but impact would be minor and temporary due to growth trend in the county.	Alternative 2b would result in impacts similar to those associated with Alternative 2a, but on a smaller scale.

Resource	Attribute/Potential Effects	Alternative		
		1 – SQN License Renewal	2a – SQN Shutdown and New Nuclear Generation	2b – SQN Shutdown and New Natural Gas-Fired Generation
	Schools and education.	No changes or new impacts.	The costs of providing education for additional students should be offset by the increase in tax revenues and plant-equivalent payments. Demand for school services near SQN may lessen, but impact would be minor and temporary due to growth trend in the county.	Alternative 2b would result in impacts similar to those associated with Alternative 2a, but would be on a smaller scale.
	Changes in land use, land acquisition, land conversion, or road locations.	No changes in on-site land use and no new off-site impacts.	No change in land use at SQN is anticipated. Depending on the location of the new plant site, ROWs, the transmission inter-tie connection, and rail spur could result in potentially substantial land-use impacts.	There could be a resulting decrease in off-site land-use impacts due to decreased demand for uranium supplies.
	Local government revenues.	No impact on local government revenues.	In-lieu-of tax payments would have a positive and beneficial impact on local government revenues. The amount of in-lieu-of tax payments Hamilton County receives likely would not be impacted if SQN were shut down.	Alternative 2b would result in impacts similar to those associated with Alternative 2a, but on a smaller scale.

Resource	Attribute/Potential Effects	Alternative		
		1 – SQN License Renewal	2a – SQN Shutdown and New Nuclear Generation	2b – SQN Shutdown and New Natural Gas-Fired Generation
	Elevated levels of traffic from construction work force and deliveries.	No changes or new impacts expected.	Mitigation of potential transportation impacts due to the location of a facility may be necessary due to expected increases in construction and operation traffic. Traffic would decline on SQN access roads.	Alternative 2b would result in impacts similar to those associated with Alternative 2a, but on a smaller scale.
Solid and Hazardous Waste	Generation and disposal of solid and hazardous waste.	No impacts from construction. Minor indirect impact of off-site disposal in permitted landfills.	Minor indirect impact during construction and operation from off-site disposal in permitted landfills are likely. Minor cumulative impacts expected.	Alternative 2b would result in impacts similar to those associated with Alternative 2a.
Seismology	Seismic adequacy.	No changes or new impacts are expected.	No adverse seismic effects anticipated. Extensive seismic analysis required prior to choosing a location. Impacts related to seismic activity would be minor.	Alternative 2b would result in impacts similar to those associated with Alternative 2a. Seismic evaluations would not be as rigorous as required for a new nuclear plant.

Resource	Attribute/Potential Effects	Alternative		
		1 – SQN License Renewal	2a – SQN Shutdown and New Nuclear Generation	2b – SQN Shutdown and New Natural Gas-Fired Generation
Air Quality	Emissions resulting in increases of air pollutants.	SQN is not a significant source of pollutants, and the impact of operation for an additional 20-year period would be minor.	Construction impacts are short term and can be mitigated in many cases. The overall impacts to air quality would be minor if there were no existing air quality issues; however, the impacts could be potentially large if the site were in a nonattainment area. Small indirect impacts off site and no cumulative impacts due to construction. Impact of a nuclear plant on air quality would be minor. TVA would obtain appropriate permits and maintain air emissions in compliance with regulatory limits.	Construction impacts of a new natural gas-fired plant would be expected to be similar to Alternative 2a. Depending on the chosen location, operation of typical combined-cycle combustion turbine gas-fired generation plants have minor to moderate impacts on air quality. Air emissions would meet all required regulations.
	Local meteorology and meteorological conditions.	Operation of SQN has no noticeable effects on the local meteorology, with the exception of a slight increase in frequency, duration, and intensity of steam fogs forming at the river surface.	A new nuclear plant is not expected to adversely affect local meteorological conditions.	A new natural gas-fired plant is not expected to adversely affect local meteorological conditions.

Resource	Attribute/Potential Effects	Alternative		
		1 – SQN License Renewal	2a – SQN Shutdown and New Nuclear Generation	2b – SQN Shutdown and New Natural Gas-Fired Generation
	Climatology and effects due to climate change.	The impacts from global climate change and greenhouse gas emissions upon SQN would be expected to be minor. Cumulative impacts over an additional 20 years of operation would offset millions of tons of greenhouse gases that otherwise would be produced by fossil fuel-fired generation. License renewal would provide TVA flexibility in reducing greenhouse gas emissions from its portfolio of generating assets.	Impacts from global climate change and greenhouse gas emissions would be expected to be minor.	A natural gas-fired plant would contribute a considerable amount of greenhouse gas emissions for the life of the plant. The impacts are direct and indirect, as well as potentially cumulative.
	Radiological gaseous emissions.	All radioactive effluents would be released in accordance with applicable regulations, and the impact from those effluent releases would be minor. Indirect and cumulative impacts would be minor.	There would be no radioactive effects during the construction of a new nuclear plant. There would be no expected observable direct or indirect impacts from radioactive gaseous releases from a new nuclear facility during normal operations.	There would be no radioactive impacts from the construction or operation of a new natural gas-fired plant.
	Gasoline and diesel emissions from vehicles and equipment.	No changes or new impacts would occur.	Minor impacts from vehicular and equipment emissions, controlled to meet applicable regulatory requirements.	

Resource	Attribute/Potential Effects	Alternative		
		1 – SQN License Renewal	2a – SQN Shutdown and New Nuclear Generation	2b – SQN Shutdown and New Natural Gas-Fired Generation
Radiological Effects	Effects to humans and nonhuman biota from normal radiological releases.	Annual doses to the public are well within regulatory limits; no observable health impacts are expected. No changes or new impacts are expected. Doses to nonhuman biota would be well below regulatory limits; no noticeable effects are expected.	Radiological effects to humans and biota would be similar to SQN and within all applicable release limits.	Radiological effects not applicable to natural gas-fired turbines.
Uranium Fuel Effects	Radioactive waste volumes and disposal.	Low-level radioactive waste would remain a minor impact on the available landfill capacity. The indirect and cumulative impacts on licensed landfills would be minor.	Operating nuclear power plant would produce low-level radioactive waste similar to SQN and would be a minor impact.	No radioactive waste generated.
	Radioactive gaseous and liquid releases.	By maintaining radioactive gaseous releases within regulatory limits, the impact to the public would be minor. The impact from radioactive liquids released from SQN is minor.	Releases of radioactive liquid and gaseous effluents would be in accordance with applicable federal regulations, resulting in minor impact.	No release of radioactive effluents.

Resource	Attribute/Potential Effects	Alternative		
		1 – SQN License Renewal	2a – SQN Shutdown and New Nuclear Generation	2b – SQN Shutdown and New Natural Gas-Fired Generation
	Radioactive waste transportation.	The impact to members of the public resulting from processing, storage, and transportation of solid low-level radioactive waste is minor.	Impacts from transportation of low-level radioactive waste would be minor, similar to SQN.	No radioactive waste would be transported.
	Spent fuel.	Minor impacts from the operation of the ISFSI, as it is operated in accordance with all applicable regulations.	Minor impacts from spent fuel storage.	No spent fuel generated.
Plant Safety	Postulated design-basis accidents.	In all cases, the doses to an assumed individual at the exclusion area boundary and low population zone are a fraction of the regulatory dose limits. Environmental risks due to postulated radiological accidents are minor. If a design-basis accident occurred, impacts would be minor, and limited by plant design and the emergency actions of trained TVA personnel.	The new nuclear plant would be designed specifically for the selected technology, which would be approved by the NRC and would meet all design-basis accident criteria.	This section is not applicable to Alternative 2b.

Resource	Attribute/Potential Effects	Alternative		
		1 – SQN License Renewal	2a – SQN Shutdown and New Nuclear Generation	2b – SQN Shutdown and New Natural Gas-Fired Generation
	Severe accidents.	Severe accident analysis indicates that the risk is minor and meets all safety goals.	The new nuclear plant would be designed specifically for the selected technology, which would be approved by the NRC and would meet all severe accident criteria.	This section is not applicable to Alternative 2b.
	Plant security.	Notwithstanding the very remote risk of a terrorist attack affecting operations, TVA increased the level of security readiness, improved physical security measures, and increased its security arrangements with local and federal law enforcement agencies at all of its nuclear generating facilities, and TVA is in compliance with all regulations on plant security.	Security requirements would be met as directed by federal requirements similar to SQN.	TVA would maintain appropriate security at a natural gas-fired plant. However, the requirements and standards for plant security at such a facility would be less than required for a nuclear-powered facility.

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ACRONYMS, ABBREVIATIONS, AND SYMBOLS

@	at symbol, abbreviation for the word at
$\pm$	plus or minus
§	section
°C	degree Celsius
°F	degree Fahrenheit
ΔT	temperature rise
A.C.	alternating current
ACHP	Advisory Council on Historic Preservation
ALARA	as low as reasonably achievable
AMR	aging management review
AP1000	Advanced Passive 1000
APE	area of potential effects
AREOR	annual radiological environmental operating report
ARERR	annual radioactive effluent release report
B/CTP	biocide/corrosion treatment plan
BFN	Browns Ferry Nuclear Plant
bgs	below ground surface
BLEU	blended low-enriched uranium
BLN	Bellefonte Nuclear Plant
BMP	best management practice
B.P.	before present
BTEX	benzene, toluene, ethyl-benzene, and xylenes
BTU	British thermal unit
BWR	boiling water reactor
CAA	Clean Air Act
$CACO_3$	calcium chloride
CAES	compressed air energy storage
CCS	carbon capture and storage
CCW	condenser circulating water
CEDE	committed effective dose equivalent
CEQ	Council on Environmental Quality
CESQG	conditionally exempt small quantity generator
CFR	Code of Federal Regulations
cfs	cubic feet per second
CLB	current licensing basis

CLWR	commercial light water reactor
CO	carbon monoxide
CO_2	carbon dioxide
COLA	combined operating license application
CRP	conservation reserve program
CSP	concentrating solar power
CWA	Clean Water Act
DAW	dry active waste
dB	decibel
dBA	A-weighted decibel
DBA	design-basis accident
DECON	decommissioning strategy – prompt dismantlement
DO	dissolved oxygen
DOE	U.S. Department of Energy
DSEIS	draft supplemental environmental impact statement
DSN	discharge serial number
dT_d/dt	temperature rate of change
EA	environmental assessment
EAB	exclusion area boundary
EDE	effective dose equivalent
EDR	Environmental Data Resources
EEDR	energy efficiency and demand response
e.g.	for example (Latin term)
EIS	environmental impact statement
ENTOMB	decommissioning strategy – encasement
EO	Executive Order
EPA	U.S. Environmental Protection Agency
EPRI	Electric Power Research Institute
EPZ	emergency planning zone
ERCW	essential raw cooling water
ESA	Endangered Species Act
et seq.	and following (Latin term)
F/EF	Fujita tornado scale ranging from 1 to 5/ Enhanced Fujita
FES	final environmental statement
FEIS	final environmental impact statement
FHA	fuel handling accident
FOST	fuel oil storage tank

FRP	flood risk profile
FSEIS	final supplemental environmental impact statement
ft	foot (feet)
FY	fiscal year
g	acceleration due to gravity
GCC	global climate change
gdp	gallons per day
GEIS	*Generic Environmental Impact Statement for License Renewal of Nuclear Power Plants* (NUREG-1437)
GHG	greenhouse gas
GNEP	Global Nuclear Energy Partnership
gpm	gallons per minute
GWh	gigawatt hour
GWPS	gaseous waste processing system
GWSI	groundwater site inventory
HAP	hazardous air pollutant
HEPA	high efficiency particulate air
HEU	highly enriched uranium
HIC	high integrity container
HiRM	Hiwassee River mile
HOLTEC	Holtec International
HPA	habitat protection area
HRSG	heat recovery steam generator
HUD	U.S. Department of Housing and Urban Development
I&I	irreversible and irretrievable
I-75	Interstate 75
i.e.	that is (Latin term)
IMP	internal monitoring point
IPA	integrated plant assessment
IPCC	Intergovernmental Panel on Climate Change
IRP	Integrated Resource Plan
ISFSI	independent spent fuel storage installation
JSF	John Sevier Fossil Plant
JSF CC	John Sevier Fossil Combined-Cycle Plant
kV	kilovolt
kW	kilowatt
kWh	kilowatt hour

$kWh/m^2/day$	kilowatt hour per square meter per day
lb	pound
Ldn	day-night average noise level
LEFM	leading edge flow measurement
LEU	low enriched uranium
LLRW	low-level radioactive waste
LPZ	low population zone
LRA	license renewal application
LWPS	liquid waste processing system
LWR	light water reactor
m	meter
m^2	meter squared
m^3	cubic meter
M	moment magnitude
MM	modified Mercalli
MACCS	MELCOR Accident Consequence Code System
mbLg	measured Lg wave magnitude
MEI	maximally exposed individual
MFTDS	modulated filter transfer demineralization system
MGD	millions of gallons per day
mg/L	milligram per liter
MOX	mixed oxide
MPC-32	32-capacity multipurpose canister
mrad	millirad
mrem	millirem
mrem/qtr	mrem per quarter
msl	mean sea level
MS-SRV	main steam-safety release valve
MSA	metropolitan statistical area
MSDS	material safety data sheet
MSS	mobile solidification system
MSW	municipal solid waste
mt	metric tons
MTBE	methyl tert-butyl ether
MTU	metric ton uranium
MW	megawatt
MWD	megawatt-day

MWD/MTU	megawatt-day/metric ton uranium
MWe	megawatts electric
MWh	megawatt hour
N_2O	nitrous oxide
NA	not applicable
NAAQS	National Ambient Air Quality Standards
NaS	sodium sulfur
NCDC	National Climatic Data Center
NEI	Nuclear Energy Institute
NEPA	National Environmental Policy Act
NHIP	Natural Heritage Inventory Program
NHPA	National Historic Preservation Act
nm	nautical mile
NOA	notice of availability
NOI	notice of intent
NO_2	nitrogen dioxide
NO_x	nitrogen oxides
NPDES	national pollutant discharge elimination system
NPS	National Park Service
NRC	U.S. Nuclear Regulatory Commission
NREL	National Renewable Energy Laboratory
NRHP	National Register of Historic Places
NRI	Nationwide Rivers Inventory
NUREG	U.S. Nuclear Regulatory Commission Regulation
NWI	National Wetland Inventory
NWSR	National Wild and Scenic Rivers
O_3	ozone
OBE	operating basis earthquake
ODCM	offsite dose calculation manual
OSF	on-site storage facility
PCB	polychlorinated biphenyls
pCi/L	picocuries per liter
PM	particulate matter
$PM_{2.5}$	particulate matter with a diameter or less than 2.5 microns
PM_{10}	particulate matter with an aerodynamic diameter of up to 10 microns
PMF	probable maximum flood
PMP	probable maximum precipitation

ppm	parts per million
PPA	power purchase agreement
PRT	pressurizer relief tank
PSA	probabilistic safety assessment
PSD	prevention of significant deterioration
PV	photovoltaic
PVRR	present value of revenue requirements
PWR	pressurized water reactor
radwaste	radioactive waste
RBI	reservoir benthic index
RCCA	rod cluster control assembly
RCRA	Resource Conservation and Recovery Act
REMP	radiological environmental monitoring program
RFAI	reservoir fish assemblage index
ROD	record of decision
ROG	reactive organic gases
ROS	reservoir operations study
ROW	right-of-way
RWST	refueling water storage tank
SAFSTOR	decommissioning strategy – delayed DECON
sec/m^3	seconds per cubic meter
SEIS	supplemental environmental impact statement
SHPO	state historical preservation officer
SO_2	sulfur dioxide
SO_x	sulfur oxides
SPCC	spill prevention, control, and countermeasures
SPD	surplus plutonium disposition
sq mi	square mile
SQG	small quantity generator
SQN	Sequoyah Nuclear Plant
SRST	spent resin storage tank
SSC	structures, systems, and components
SSE	safe shutdown earthquake
SEIS	supplemental environmental impact statement
SR 319	State Road 319
T_d	downstream temperature
TDEC	Tennessee Department of Environment and Conservation

TDOT	Tennessee Department of Transportation
TEDE	total effective dose equivalent
THC	Tennessee Historical Commission
TLAA	time-limited aging analysis
TMDL	total maximum daily load
TPBAR	tritium-producing burnable absorber rod
TPH	total petroleum hydrocarbons
TRM	Tennessee River mile
TVA	Tennessee Valley Authority
TWRA	Tennessee Wildlife Resources Agency
UFC	uranium fuel cycle
UFSAR	updated final safety analysis report
UO_2	uranium dioxide
US 27	U.S. Highway 27
USC	U.S. Code
USDA	U.S. Department of Agriculture
USDOT	U.S. Department of Transportation
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
UST	underground storage tank
UTCBER	University of Tennessee Center for Business and Economic Research
VCT	volume control tank
VOC	volatile organic compound
WAW	wet active waste
WBN	Watts Bar Nuclear Plant
WGA	waste gas analyzer
WNA	World Nuclear Association
WPC	TDEC Division of Water Pollution Control (or water pollution control)
X/Q	atmospheric dispersion factor
yd^3	cubic yard

CHAPTER 1

1.0 PURPOSE OF AND NEED FOR PROPOSED ACTION

The current operating licenses for Sequoyah Nuclear Plant (SQN) expire at midnight on September 17, 2020, and September 15, 2021, for Units 1 and 2, respectively. The Tennessee Valley Authority (TVA) must decide whether to submit a license renewal application (LRA) to the U.S. Nuclear Regulatory Commission (NRC) to extend the operating licenses of the two units for an additional 20 years beyond their current license terms.

As an integral part of TVA's current generation portfolio, SQN provides substantive base load generation to the TVA power system. Renewal of the current operating licenses would allow SQN to continue supplying approximately 2,400 megawatts electric (MWe) installed capacity of reliable and cost-effective power in the period between 2020 and 2040.

TVA operates the nation's largest public power system, producing 4 percent of all electricity in the nation. It serves about nine million people in the seven-state TVA power service area (Figure 1-1). Historically, net system requirements grew at an average rate of 2.3 percent (1990 – 2008) before the recent economic downturn. Consistent with current forecasting and power system planning models, TVA expects peak load and net system power requirements to increase through 2029 (Section 1.3). TVA has an obligation to meet this need while maintaining low-cost, reliable power for consumers in the power service area. Consistent with its Environmental Policy, TVA also plans to use cleaner energy options and energy efficiency initiatives to reduce the intensity of carbon emissions from its power system.

In its Integrated Resource Plan (IRP), TVA assumed that existing nuclear plants, including SQN, would continue to be the backbone of TVA's power supply in the future. The IRP forecasts the power supply demands and options to meet those demands through the year 2029 (TVA 2011a).

The purposes of the proposed action are to (1) obtain extended licenses to operate SQN Units 1 and 2 to help meet the identified need for power between 2020 and 2031; (2) maximize use of existing assets; and (3) support TVA's efforts to reduce the carbon emissions of its generating system.

Renewal of SQN operating licenses would involve continuation of normal operations, maintenance, and refueling. These activities would continue to be managed in accordance with TVA programs and procedures. SQN has an on-site independent spent fuel storage installation (ISFSI) using dry cask storage. As a related future action, expansion of the on-site spent fuel storage capacity may be required by 2026 to support SQN operations during the period of license renewal if the U.S. Department of Energy (DOE) does not take responsibility for the permanent storage and disposal of the on-site spent fuel. This expansion would potentially require the construction of an additional concrete storage pad similar to the one used for the current ISFSI. Existing equipment and procedures would continue to be used to store the spent fuel. No refurbishments, as described in Sections 2.6 and 3.1 of federal guidelines, *Generic Environmental Impact Statement for License Renewal of Nuclear Power Plants* (NRC 1996), would occur during the license renewal term.

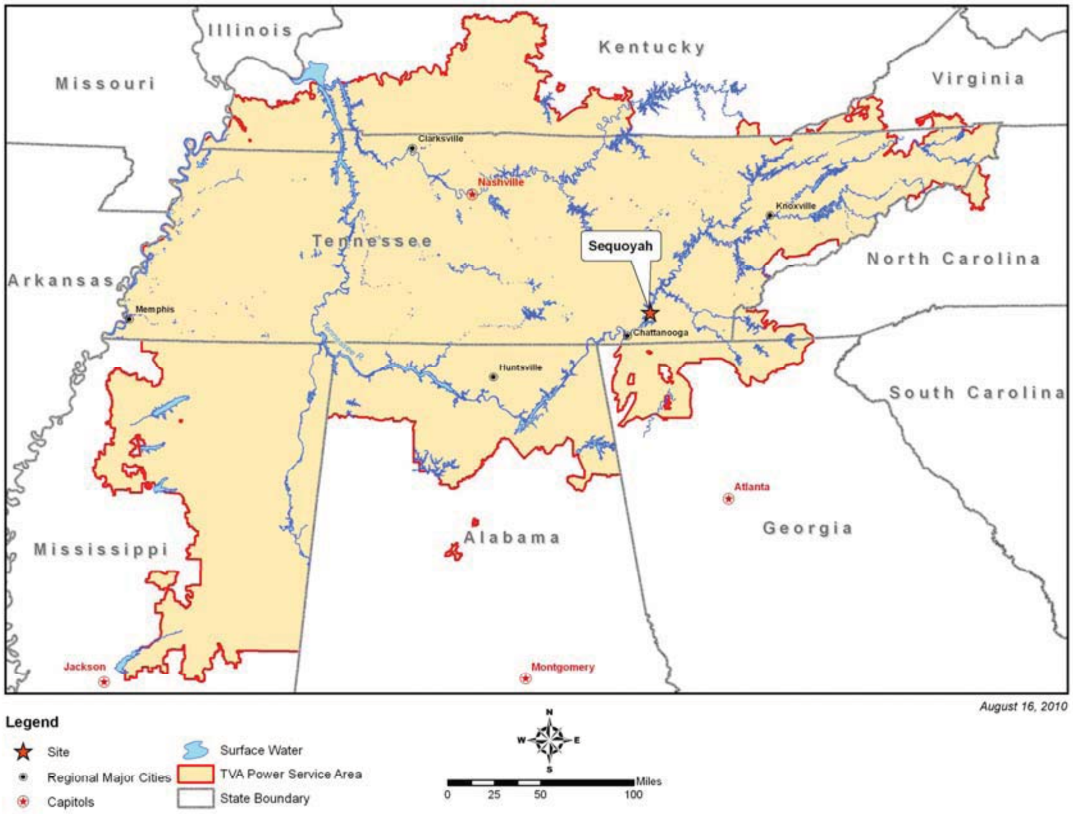

Figure 1-1. TVA Power Service Area

TVA has prepared this supplemental environmental impact statement (SEIS) to inform TVA decision-makers, agencies, and the public of the potential environmental impacts associated with operating SQN for an additional 20-year period, that is, until 2040 for Unit 1 and 2041 for Unit 2. Based in part on this evaluation of impacts, TVA will decide whether to submit the LRA and thereby pursue renewal of the operating licenses necessary to continue operating SQN. Subsequently, the NRC would evaluate TVA's LRA and conduct its own environmental review to evaluate the potential environmental impacts of granting renewed licenses. As part of the LRA, TVA would submit an environmental report describing the potential environmental impacts of renewing SQN operating licenses.

1.1. Brief History and Description of SQN

SQN began commercial operation of Unit 1 in July 1981 and Unit 2 in June 1982. The SQN site is approximately 630 acres that includes approximately 525 acres of land known as the industrial site and approximately 105 acres known as the training area peninsula. SQN is near the geographical center of Hamilton County, Tennessee, on a peninsula on the western shore of Chickamauga Reservoir at Tennessee River mile (TRM) 484.5. SQN is close to the city of Soddy-Daisy, Tennessee, and approximately 18 miles northeast of the Chattanooga, Tennessee, city center (Figures 1-2 and 1-3). (DOE 1999)

1.1.1. General Plant Description

The principal structures of SQN consist of two reactor buildings, a turbine building, an auxiliary building, a control building, a service and office building, a diesel generator building, an intake pumping station, essential raw cooling water (ERCW) pumping station, two natural draft cooling towers, 161-kilovolt (kV) and 500-kV switchyards, a condensing water discharge and diffuser system, and an ISFSI. (TVA 2008a, TVA 1974a) Figure 1-4 shows the general features of the facility, the exclusion area boundary (EAB), and protected area. The EAB is the area generally surrounding the site that TVA controls and ensures the public does not reside within this boundary. The protected area is controlled by TVA for access by authorized personnel only. The protected area contains the safety-related equipment needed for the protection of the plant and the health and safety of the public. No residences are permitted within the EAB or protected area.

The site utilizes two pressurized water reactors (PWRs) in the nuclear steam supply system and a circulating water system that withdraws water from, and discharges water to, Chickamauga Reservoir. The cooling system is supplemented by intermittent operation of the cooling towers. After passing through the turbines, the steam is converted back to water by circulating it around tubes carrying cooling water in the condensers. The condensed steam – now water – is returned to the steam generators to repeat the cycle.

Fuel for SQN is made of slightly enriched (< 5 percent by weight) uranium dioxide (UO_2), ceramic cylindrical pellets contained in Zircaloy-4 tubing, which is sealed at the ends to encapsulate the fuel (TVA 2008a). Based on core design values, SQN operates at an individual rod average fuel burnup (burnup is the amount of fuel utilized in the fission process) of no more than 62,000 megawatt-days per metric ton uranium (MWD/MTU) (TVA 2008a), which ensures that peak burnups remain within acceptable limits specified in applicable federal regulations (10 CFR Part 51, Subpart A, Appendix B, Table B-1).

The NRC has approved technical specification changes for the production of tritium in the reactor units. Tritium production could be performed at either one or both reactors as needed. SQN has not actually produced tritium for the DOE as of this date, but the possibility is still a viable option. The production of tritium was evaluated in detail by the DOE in its tritium production final environmental impact statement (FEIS). (DOE 1999) TVA was a cooperating agency with the DOE in development of the environmental impact statement (EIS), and TVA adopted the DOE FEIS in May 2000.

Condenser Circulating Water System

All power plants convert a source of energy or fuel into electricity. Most large plants do so by heating water to create steam, which turns a turbine that drives an electric generator. In PWRs, like the two at SQN, radioactive water is pumped through the reactor core and heated by the fission process. The water is kept under high pressure inside the reactor so it does not boil. The heated water from the reactor passes through tubes inside four steam generators where the heat is transferred to nonradioactive water flowing around the tubes. The nonradioactive water boils and turns to steam. The steam is piped to the turbines. The force of the expanding steam drives the turbines, which spin a magnet in a coil of wire — the generator — to produce electricity. After passing through the turbines, the steam is converted back to water by circulating it around tubes carrying the cooling water from the condenser circulating water (CCW) system. It should be noted that the radioactive water system used in the reactors is not permitted to mix with other nonradioactive water systems.

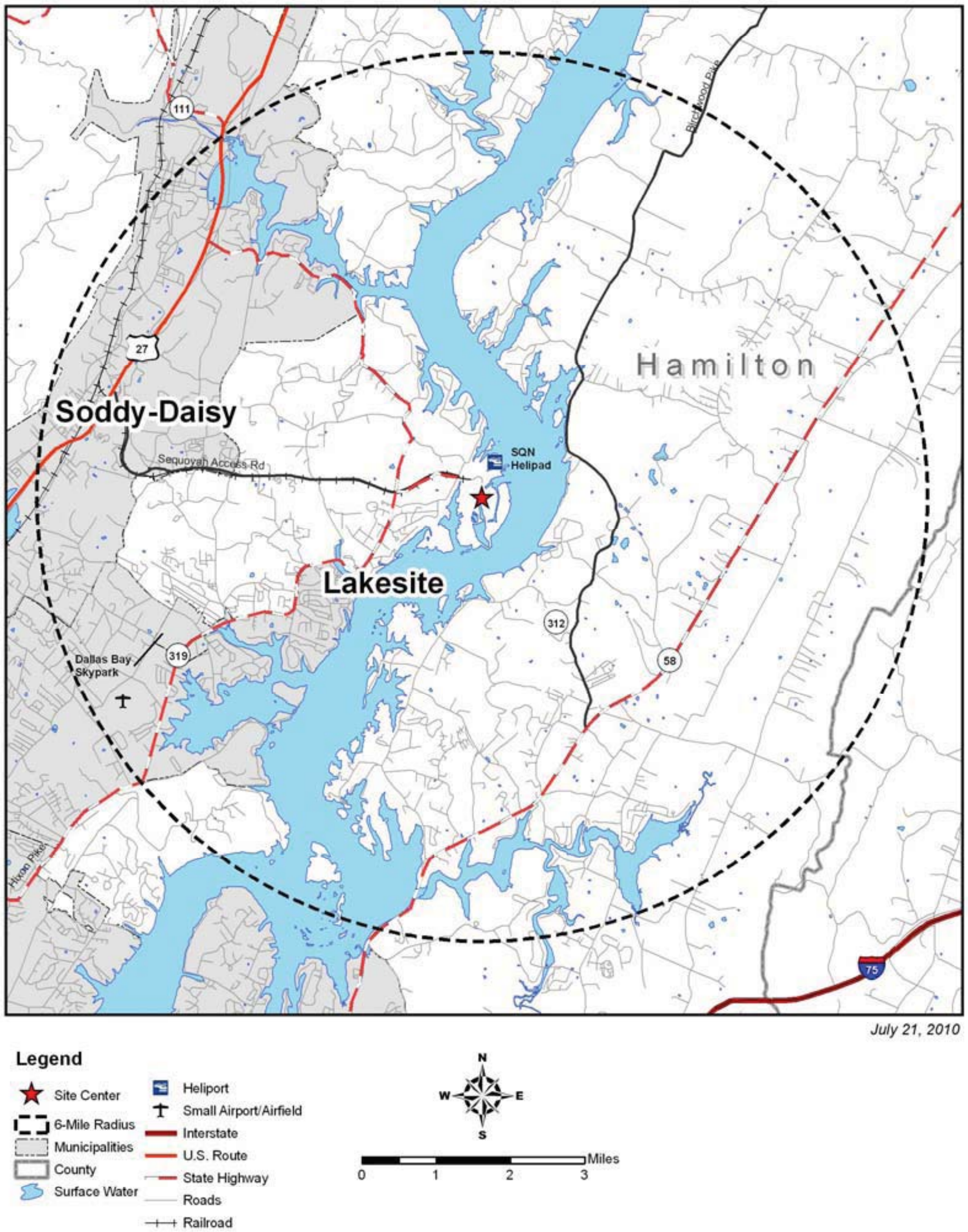

Figure 1-2. 6-Mile Radius of SQN

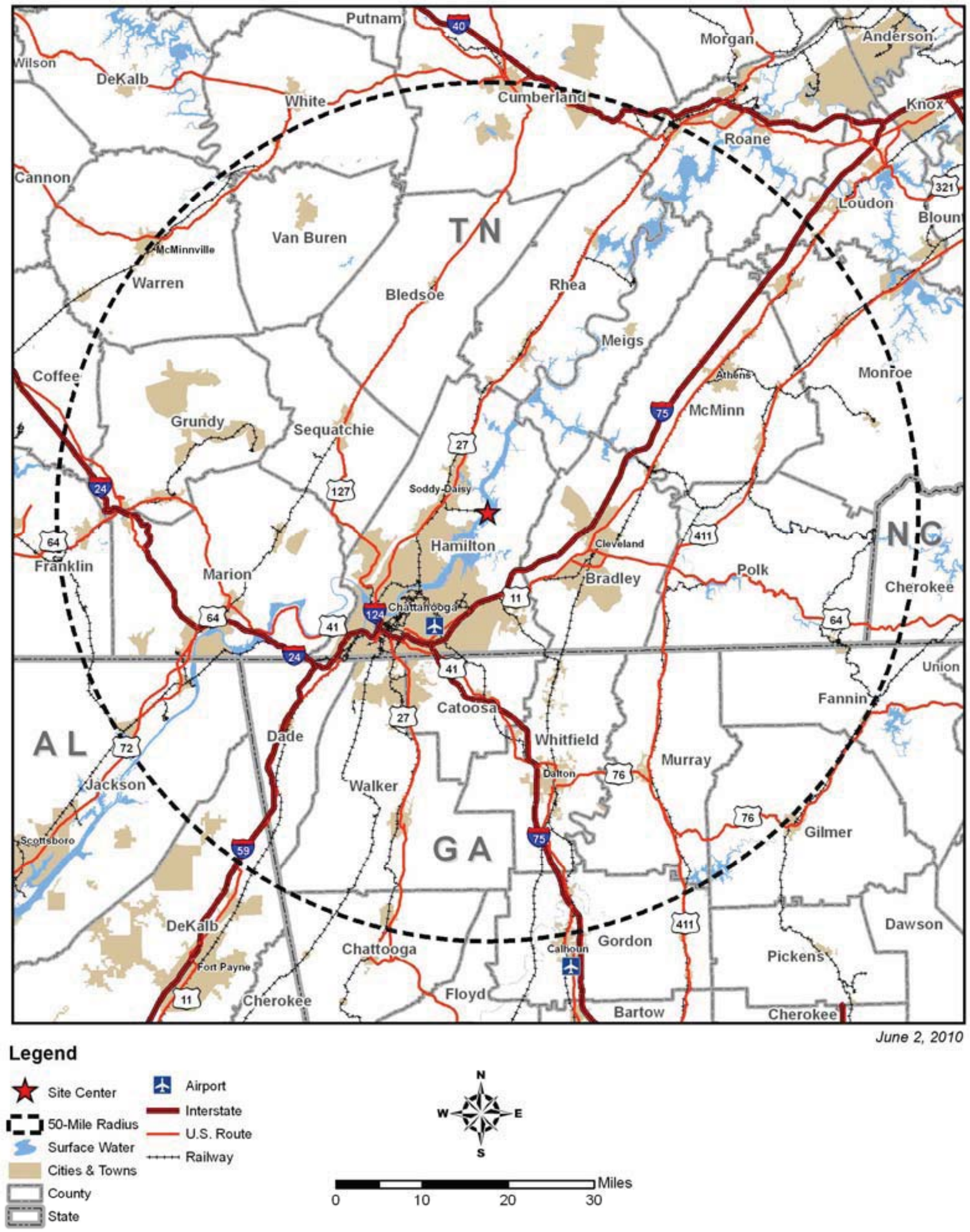

Figure 1-3. 50-Mile Radius of SQN

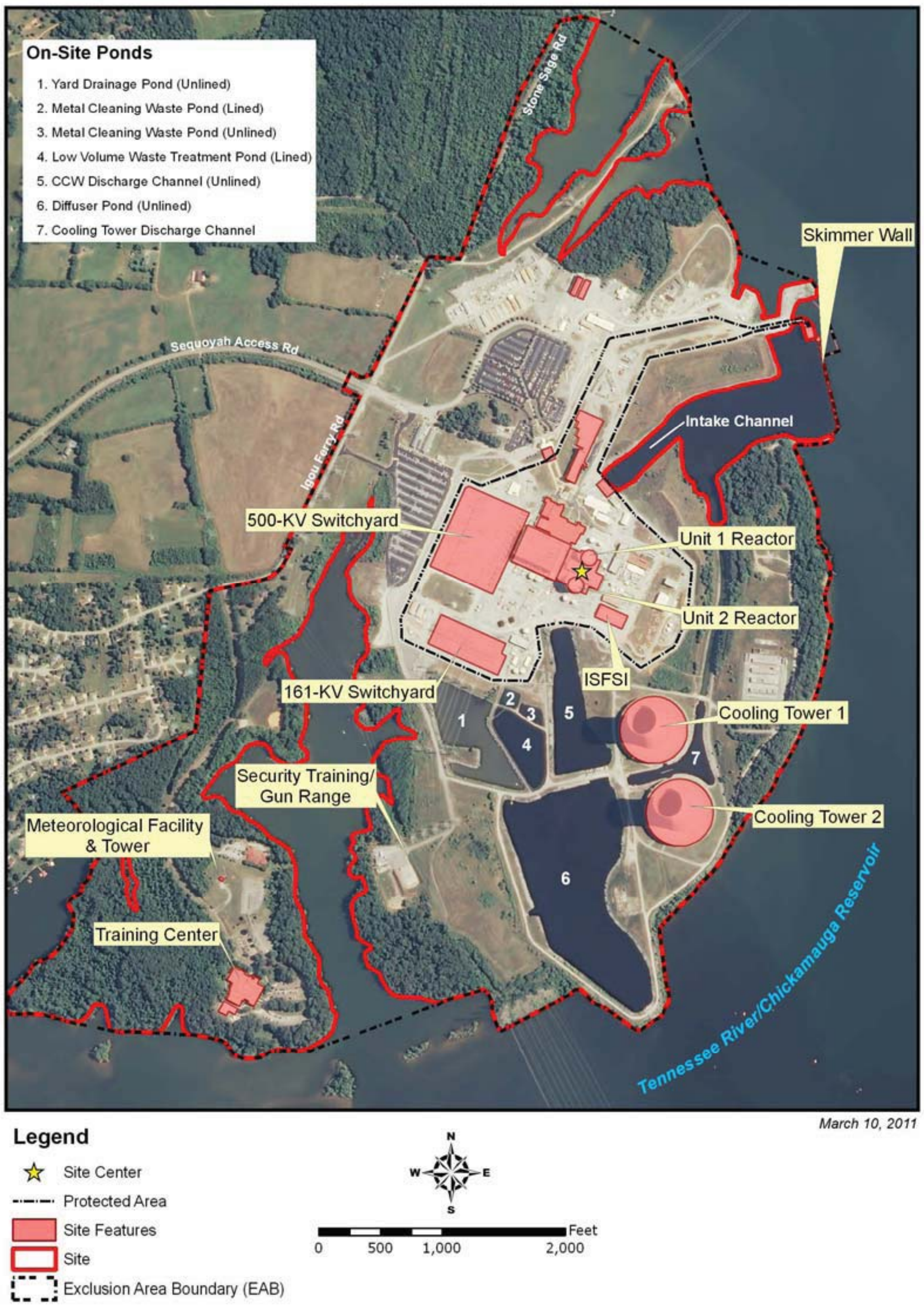

Figure 1-4. Site Layout (Aerial)

CCW is withdrawn from Chickamauga Reservoir at a combined intake structure and pumping station situated at the end of an intake channel, which leads from an intake embayment. The intake pumping station houses the CCW pumps, traveling screens, and screen wash pumps. For each unit, three pumps are provided in the intake pumping station to pump CCW through the condensers. A security boom is located around the ERCW building. An intake skimmer wall also spans the entrance to the embayment.

The skimmer wall has a clear opening length of 550 feet and an opening height of 9.7 feet, with the top of the opening at an elevation of 641 feet above mean sea level (msl), approximately 34 feet below minimum pool elevation of Chickamauga Reservoir. The skimmer wall is designed to allow withdrawal of cooler water from the lower depths of the reservoir. Because of the low elevation of withdrawal, the temperature of the water entering the condensers is normally less than the temperature at the reservoir surface.

An underwater dam across the main river downstream of SQN impounds cooler water in the lower layer of the reservoir, making cooler water available to the plant intake.

The intake conduits that take cooling water to the plant and the discharge conduit that carries cooling water and cooling tower blowdown back to the Chickamauga Reservoir are shown in Figure 3-3. SQN operates in a once-through type cooling, normally called the open mode, for the majority of the year when the cooling tower lift pumps are bypassed. During certain portions of the year, when thermal limit requirements require it, SQN uses a helper mode cooling tower system. The cooling tower lift pumps move water into the cooling towers. Water passes through the cooling towers to reject part of the heat, discharging cooling tower blowdown (wastewater released back into the environment) via a diffuser into the Chickamauga Reservoir. Therefore, only a small amount of water is consumed through evaporation compared to the average flow in the reservoir. For both Units 1 and 2, approximately 7 percent of the average flow is withdrawn from Chickamauga Reservoir, and approximately 7 percent is discharged back to Chickamauga Reservoir at full load. In the helper mode, up to 32,762 gallons per minute (gpm) of additional water (makeup water) is required to make up for that lost by drift, blowdown, or evaporation, which is less than 1 percent of the available average flow through Chickamauga Reservoir. The closed-cycle cooling mode is not currently used, but can be utilized if needed.

The CCW system provides each unit a nominal flow of 535,000 gpm to the main steam turbine condensers. This water flow is a sufficient quantity to condense the steam at an optimum main condenser back pressure and dissipate all rejected heat. The CCW can dissipate a portion of the waste heat directly to the atmosphere by use of the cooling towers in the helper mode when required to meet thermal criteria. The CCW can also provide for dilution and dispersion of routine low-level radioactive liquid wastes. Low-level radioactive effluents are released only in small quantities and in accordance with federal regulations to ensure that the health and safety of the public are protected. This information is discussed in Section 3.17.

In addition to the water supplied for CCW, the CCW system supplies water to the plant raw cooling water pumps and raw service water pumps; this in turn supplies cooling water to nonessential systems (systems not necessary for the safe shutdown of the reactor) (TVA 2008a).

Essential Raw Cooling Water

The ERCW system is designed to supply cooling water to various heat loads in both the primary (radioactive) and secondary (nonradioactive) portions of each unit. Provisions are made to ensure a continuously available flow of cooling water to those systems and components necessary for plant safety during either normal operation or under accident conditions. The ERCW system discharges into the return channel of the natural draft cooling towers and provides a continuous source of blowdown for effluent dilution. (TVA 2008a)

The ERCW system consists of eight ERCW pumps, four traveling water screens, four screen wash pumps, and four strainers in the ERCW pumping station, and associated piping and valves. The ERCW station draws water directly from Chickamauga Reservoir (Figure 3-3). (TVA 2008a)

The ERCW pumping station is located within the plant intake skimmer structure, and has direct connection with the main river channel for all reservoir levels including loss of a downstream dam. The ERCW station and essential equipment therein remain operable during the probable maximum flood and loss of a downstream dam. (TVA 2008a)

Discharge Structure

Heated water is discharged from the condensers or from the cooling towers directly into the diffuser pond, from which it is discharged to the reservoir through two diffuser pipes (Figure 3-5). The upstream and downstream diffuser pipes are 17 feet and 16 feet in diameter, respectively, and the diffuser sections of the discharge pipes are installed in the approximately 900-foot wide navigation channel of Chickamauga Reservoir. Each diffuser section is 350 feet long and has 17 individual 2-inch diameter ports per foot of pipe length.

Flow through the diffuser pipes is controlled by the difference in elevation between the diffuser pond and reservoir surface water levels. At maximum plant capacity, each diffuser discharges about 1,240 cubic feet per second (cfs). When the plant discharge into the pond is reduced, the flow through each diffuser and the difference in elevation between the water level in the pond and the water level in the reservoir drop in a similar manner.

The system is designed to operate in any of three modes: open, helper, or closed. In the open mode, the water bypasses the cooling tower lift pumps and is returned to the reservoir via discharge diffusers and the diffuser pond. In helper mode, the water is pumped into the cooling towers by the lift pumps, passes through the cooling towers where part of the waste heat is liberated directly to the atmosphere, and the cooled water is then returned to the reservoir via the diffuser pond, and the discharge diffusers. In closed mode, the water is pumped through the cooling towers where the waste heat is liberated directly to the atmosphere and returned to the intake channel through the return channel. (TVA 2008a)

Blowdown from the towers is taken from the return channel (cold water channel), mixed with the plant effluent, and discharged directly into the diffuser pond. The system is designed to ensure that under no conditions does radioactive waste backflow into the return channel. The ERCW discharges into the return channel and provides a continuous source of blowdown for effluent dilution. (TVA 2008a)

The diffusers are designed to provide rapid mixing of the discharged effluent with the river flow. Flow is discharged into the diffuser pond via the blowdown line, ERCW system, and CCW system. The two diffusers provide mixing across nearly the entire river channel width. (TVA 2008a)

1.1.2. Transmission Lines

TVA's 1974 final environmental statement (FES) for SQN identifies the 267.25 miles of transmission lines constructed for the purpose of originally connecting SQN to the TVA transmission grid. An additional 20 miles of right-of-way (ROW) were utilized for the line connections to SQN (1974a). Since the FES was published, another 124.45 miles of transmission lines have been added. Table 1-1 provides detailed information on the total of 391.7 miles of transmission lines. TVA is the owner and operator of the lines. SQN Unit 1 is connected into the 500-kV transmission network, and SQN Unit 2 is connected into the 161-kV transmission system (Dennis Lundy, TVA, personal communication, April 20, 2010). The two systems are interconnected at SQN through a 1,200-megavolt ampere, 500 – 161-kV intertie transformer bank.

Table 1-1. SQN Transmission Lines

Line Name	Voltage (kV)	Length (miles)
Sequoyah-Widows Creek Charleston	161	22.48
Sequoyah-Watts Bar Chickamauga No. 1	161	17.07
Sequoyah-Chickamauga No. 2	161	19.53
Sequoyah-East Cleveland	161	29.48
Sequoyah-Concord	161	18.39
Sequoyah-Watts Bar Hydro	161	38.41
Sequoyah-Charleston No. 1	161	20.82
Sequoyah-Charleston No. 2	161	20.82
Sequoyah-Franklin (initial operation at 161 kV)	500	62.77
Sequoyah-Georgia State Line	500	17.48
Sequoyah-Widows Creek*	500	49.46
Sequoyah-Watts Bar No. 1*	500	40.49
Sequoyah-Watts Bar No. 2*	500	34.50

*Transmission lines not included in TVA's 1974 FES for SQN (TVA 2010a).

1.2. The TVA Power System

TVA was established by an Act of Congress in 1933 as a federal agency charged with developing and conserving the natural resources of the Tennessee Valley region and improving the lives of the region's population. From its beginning, TVA's challenge has been to look at economic development and natural resource issues in a comprehensive fashion. TVA was originally managed by a three-member board of directors appointed by the President of the United States and approved by the U.S. Senate. (TVA 2002a) In 2006, pursuant to congressional amendments to the TVA Act, TVA made the transition to a nine-member, part-time board of directors and a full-time chief executive officer. (TVA 2007a)

In 2008, TVA's power system had a generating capacity of about 36,490 megawatts (MW) of total summer net capacity, which included 2,774 MW of purchased power and other agreements (see Table 1-2). TVA's generating system consisted of 280 units producing electrical power. Table 1-2 provides a brief summary of the TVA power generation system reported for 2008. (TVA 2009a) TVA transmits electricity from these facilities over almost 15,954 circuit miles of transmission lines (TVA 2009a). Like other utility systems, TVA has power interchange agreements with utilities surrounding the Tennessee Valley region, and purchases and sells power on an economic basis almost daily (TVA 2010b). TVA owns about 2.4 MW of non-hydro renewable capacity consisting of one small wind farm with three 660-kW turbines on Buffalo Mountain near Oliver Springs, Tennessee, and 15 photovoltaic (PV) installations throughout the TVA region. TVA also co-fires methane from a nearby sewage treatment plant in a boiler at Allen Fossil Plant and co-fires wood waste in a boiler at Colbert Fossil Plant. (TVA 2011a) In addition, TVA purchases power from 15 more commercially owned wind turbines at the Buffalo Mountain, Tennessee, site. As of September 30, 2009, the digester gas co-firing site provided TVA with about 3 MW of renewable summer net capacity. In addition, the wind energy site, the solar energy sites, and the biomass co-firing site provided additional capacity, but it is not considered summer net capacity (TVA 2009a). In addition to the two units at SQN, TVA operates three units at the Browns Ferry Nuclear Plant (BFN) in Alabama, and one unit at the Watts Bar Nuclear Plant (WBN). In 2007, TVA resumed construction of WBN Unit 2, which had been halted in the mid-1980s. Once complete in 2013, this unit will provide an additional 1180 MW of net summer capacity. Detailed description of TVA's nuclear capacity is provided in the IRP EIS, Chapter 3 (TVA 2011a).

TVA is one of the largest producers of electricity in the United States. TVA's power system serves approximately nine million people in a seven-state power system, covering 80,000 square miles (sq mi) (Figure 1-1) (TVA 2007a, TVA 2008a). TVA's electricity is distributed to homes and businesses through a network of 155 power distributors, including municipally owned utilities and electric cooperatives. TVA also sells power directly to 57 large industrial customers and federal facilities (TVA 2011a). The total number of businesses and residential customers served in 2008 was 4,571,600. TVA supplies most of the electricity needs in Tennessee, 31 percent in Mississippi, 24 percent in Alabama, and 26 percent in Kentucky. Its contribution to the electricity needs in Virginia, North Carolina, and Georgia is 3 percent or less. The TVA Act requires the TVA power system to be self supporting and operated on a nonprofit basis, and the TVA Act directs TVA to sell power at rates as low as feasible. (TVA 2010b)

Table 1-2. TVA Power Generation System – 2008

Type	# Units	Capacity (MW)	Percent of TVA System
Coal-Fired	59	14,711	53
Natural Gas and Oil-Fired	93	6,871	2*
Diesel Generator	9	13	*
Nuclear	6	6,624	37
Hydroelectric	113	5,494	8
Renewable Resources		3	<1
Power Purchase and Others		2,774	NA
Total Summer Net Capacity		36,490	

*Part of natural gas 2 percent.
(TVA 2009a)

1.3. Projecting Need for Power

One of TVA's most important responsibilities is meeting the demand for electricity placed on its power system. Thousands of businesses, industries and public facilities, and millions of people, depend on TVA every day to supply their power needs reliably. That responsibility drives the purpose and need for the proposed action described in this SEIS.

To meet this responsibility, TVA forecasts future demand and the need for additional generating resources in the region it serves. A need for additional power exists when future demand exceeds the capabilities of currently available and planned generating resources. Because planning, permitting, and construction of new generating capacity and transmission require a long lead time, TVA must make decisions to build new generating capacity well in advance of the actual need.

This section updates the need for power analysis in TVA's 1974 FES for SQN (TVA 1974a). To determine the need for power between 2020 and 2041, TVA forecasts economic conditions, costs of fuel and technology, and other contributing factors. The planning forecasts include the years between 2011 and 2020 to demonstrate long-term trends. Current power supply resources available to meet the demand for power are identified. TVA uses this comparison to assess the need for power.

Terms used in this section have the following meanings:

- Capacity: The output rating of a generator, measured in MW.
- Demand (also called load): The amount of energy required in a specific time period, typically measured in MW.

- Generation: How much energy or electricity is produced over a specified time period, typically measured in gigawatt hours (GWh).
- Interruptibles: Agreements with end use customers that allow TVA to interrupt service when capacity resources are in short supply. Interruptibles are not included in energy efficiency and demand response (EEDR).
- Peak Load: The maximum load during a specific time period, which could be hourly, annually, seasonally, or monthly.
- Renewables: Resources that provide energy generated from sunlight, wind, rain, tides, and geothermal heat, which are renewable (naturally replenished). Examples in the TVA region include wind, solar, biomass, and hydroelectric.

1.3.1. The Integrated Resource Planning Process

Integrated resource planning (IRP) is a common utility planning process that evaluates supply-side and demand-side energy resources that can be used to meet the future demand for electricity or energy from the utility power system. In December 1995, TVA completed a comprehensive IRP process, including the preparation of *Energy Vision 2020 Integrated Resource Plan Environmental Impact Statement*. The Energy Vision 2020 IRP has been replaced by a new IRP study which included the preparation of another EIS. This IRP was issued in March 2011 and is hereafter referred to as the IRP (TVA 2011a).

This SEIS incorporates information used in the development of the IRP. The IRP EIS identifies TVA's preferred alternative as the recommended planning direction. This is a robust planning strategy that performs best in terms of cost and risk/benefits over the anticipated range of future scenarios. The recommended planning direction is based upon slightly different assumptions than the IRP baseline, which was used for this SQN license renewal analysis. Those differences include a slightly lower load forecast for some scenarios, more idled coal capacity, a new pumped storage project, and more renewable energy resources. Under the recommended planning direction, as with all other planning strategies evaluated in the IRP, it is assumed that SQN Units 1 and 2 continue to operate through 2029.

Assumptions are routinely updated as part of TVA's normal planning process, and study outcomes are reviewed to ensure that findings and recommendations are not dramatically impacted by new data. These adjustments in assumptions did not fundamentally alter the outcome of the baseline from which SQN license renewal options were evaluated. Key resource options selected in the final IRP cases are essentially the same as those identified in the draft study results (such as the identification of Bellefonte Nuclear Plant (BLN) units to meet future needs and the assumption that SQN will continue to operate) with only minor timing changes. Therefore, the need for power, the projected capacity gap, and the anticipated future resources presented in the final IRP do not result in materially different conclusions about the effect of renewing or not renewing the SQN license identified in this SEIS.

1.3.2. Power Demand

TVA's long-term demand forecast is developed from individual forecasts of residential, commercial and industrial sales. These forecasts serve as the basis for planning the TVA power system, budgeting, and financial planning. TVA considers forecasts based upon several potential future conditions, including scenarios for the high and low load growth. A description of TVA's load forecasting methodology is presented in Chapter 4 of the IRP.

Figures 1-5 and 1-6 show the peak load and net system energy requirements forecasts as developed for the IRP. The planning period for the IRP was through 2029, so to arrive at the forecast through 2040, average annual growth through 2029 was assumed to remain constant through 2040. This analysis is based on the spring 2010 reference case, which represents a scenario characterized by moderate load growth, regulatory changes, and cost factors over the planning period. The baseline strategy tested in the IRP allows for nuclear expansion after 2018, assumes idling of 2,150 MW of coal capacity, includes new gas-fired capacity as needed, and includes EEDR development portfolios and wind power purchase agreements (PPAs). The spring 2010 reference case forecast shows relatively steady demand through 2013 and increasing demand after 2014, resulting in 1.3 percent average annual growth in the peak load forecast from 2010 to 2029. That rate of growth has been extended through 2040 in this SEIS. The average annual growth rate in net system requirements is 1.0 percent for the same period. In addition to the spring 2010 reference case, the figures show the high and low forecast scenarios modeled during the IRP.

The high forecast assumes higher demand and energy usage are driven by a combination of favorable economic conditions, retail electricity, and gas price assumptions. It also assumes additional industrial growth in the directly served sector. Peak load and net system requirements are projected to grow at an average annual rate of 2.0 percent and 1.9 percent, respectively, for the 2010 – 2040 time period by extending the growth rates utilized in the IRP for the high load forecast. It would be highly unlikely that the actual load would exceed the high forecast, given the range of possible outcomes used in the forecast.

The low forecast assumes lower demand and energy usage are driven by a combination of unfavorable conditions, including assumptions for economic growth and retail electricity and gas prices. Under the low forecast scenario, peak load and net system requirements are projected to decline at a rate of 0.3 percent and 0.4 percent, respectively, for the 2010 – 2040 time period, based upon the assumptions utilized in the IRP. It would be highly unlikely that the actual load would fall below the low forecast given the range of possible outcomes used in the forecast. While the low forecast is useful in planning, it is not used to determine the operation and construction of power generation assets, as that could pose serious risks to system reliability.

1.3.3. Power Supply

Currently, projects approved by the TVA Board include WBN Unit 2, scheduled to begin operation in 2013, and the new combustion turbine/combined-cycle plant at John Sevier Fossil Plant (JSF), scheduled to begin generating at full capacity in 2012. TVA's generating supply includes a combination of existing TVA-owned resources, budgeted and approved projects (such as new plant additions and uprates to existing assets), and PPAs. The supply includes a diverse portfolio of coal, nuclear, hydroelectric, natural gas and oil, market purchases, and renewable resources designed to provide reliable, affordable power while reducing the risk of disproportionate reliance on any single resource. Each type of generation can be categorized into base load, intermediate, or peaking generation.

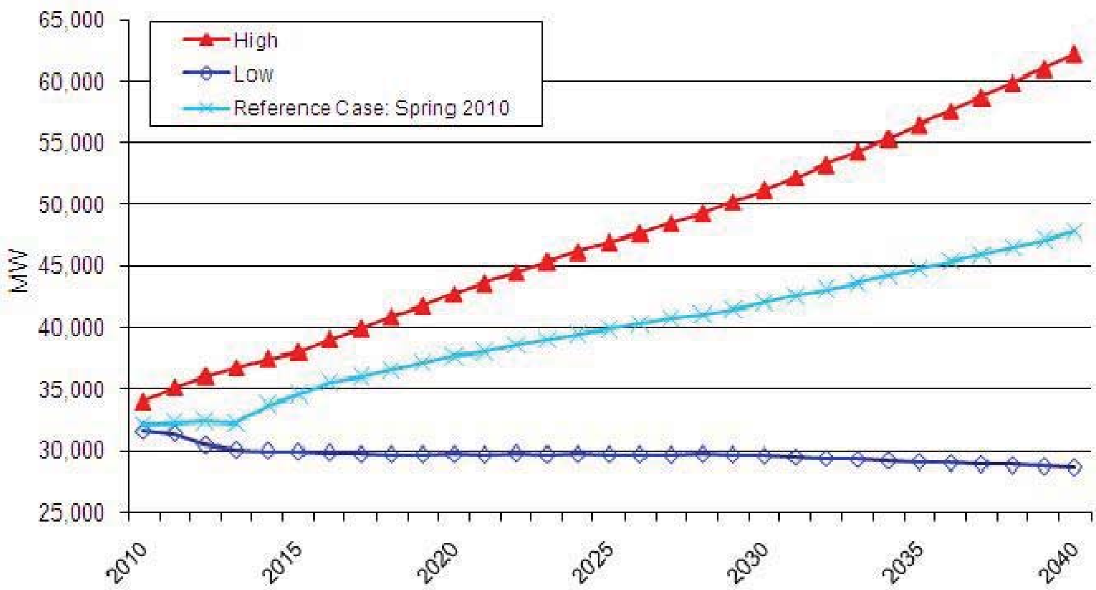

Figure 1-5. Peak Load Forecast

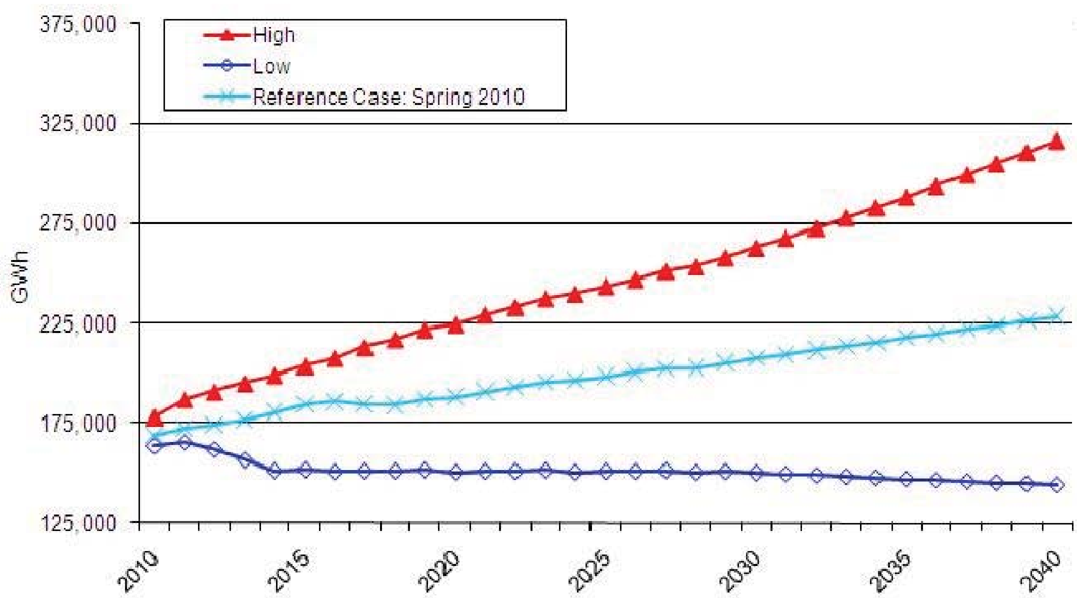

Figure 1-6. Energy Forecast

Base load generators are primarily used to meet continuous energy needs because they have lower operating costs and are expected to be available and operate continuously throughout the day. However, they typically have higher capital costs. This type of energy is generated from technologies that can provide continuous, reliable power over a period of uniform demand; generally, larger coal plants and nuclear plants. Some energy providers may consider combined-cycle plants for incremental base load generation needs, but historically, natural gas prices, when compared to coal and nuclear fuel prices, make combined-cycle an expensive option for larger continuous generation needs.

Intermediate resources are primarily used to fill the gap in generation between base load and peaking needs. These units are required to cycle with more or less output as the energy demand increases and decreases over time (usually during the course of a day). Intermediate units are more costly to operate than base load units but cheaper than peaking units. This type of generation typically comes from natural gas-fired combined-cycle plants and smaller coal plants. Renewable resources such as wind and solar, which are intermittent in nature and have capacity factors typically well below 50 percent, are increasingly used as a source of intermediate generation. It is possible, however, to increase the availability of the energy generated from a solar or wind project with integration of energy storage technologies, but this increases costs.

Peaking units, conversely, are only expected to operate during shorter duration high-demand periods and are essential for maintaining system reliability requirements as they can ramp up quickly to meet sudden demand changes. Typical peaking resources include natural gas-fired combustion turbines, hydroelectric generation, and renewable resources.

TVA's power generation system employs a wide range of technologies to produce electricity and meet the needs of the Tennessee Valley's nine million residents and its directly served commercial customers. See Figure 1-7 for a breakdown of capacity and energy by technology. The 2010 Baseline Portfolio - Firm Capacity pie chart in Figure 1-7 shows the allocation of capacity among TVA's total 37,259 MW, and the 2010 Baseline Portfolio – Generation pie chart shows the allocation based on a total of 166,785 GWh. The pie charts show the majority of energy generated by TVA comes from high capacity factor technologies like coal and nuclear. Gas-powered technologies, represented by the combined-cycle and combustion turbine components, are less expensive to install but have higher operating costs, so are primarily used to meet the demand during intermediate or peak loads.

In 2010, approximately 55 percent of TVA's generation will be produced from coal and natural gas-fired plants (51.8 percent coal; 3.5 percent gas in combustion turbine and combined-cycle plants). Nuclear plants will generate about 32 percent, and hydroelectric plants will produce approximately 12 percent. Most of the remaining capacity need is provided by interruptibles and EEDR programs. Minor amounts of generation and capacity come from diesels and other (non-hydroelectric) renewables.

Figure 1-8 shows the changing composition of existing resources projected to be operated through 2040, and includes operating license renewals for SQN. Shown only are those resources that currently exist or are under contract (such as purchases of renewable, coal, or combined-cycle generation and EEDR programs) and changes to existing resources that are projected and approved, including WBN Unit 2 and the combined-cycle plant at JSF. The renewable energy component of the existing portfolio is primarily composed of wind PPAs. The current EEDR programs are 0.8 percent of the capacity. The IRP forecasts resource capacity through 2029. However, for the SQN SEIS, most resources are forecast at 2029 capacities through 2040. EEDR is forecast to continue to grow at the average annual rate of 3.9 percent through 2040. The total capacity of existing resources decreases primarily because of the idling of 2,150 MW of coal-fired capacity. Total capacity also decreases when PPAs for combined-cycle capacity expire (e.g., approximately 2021 and 2022). Therefore, by 2023, the capacity of the TVA system, based upon current resources including SQN Units 1 and 2, is approximately 34,800 MW.

Figure 1-9 shows the capacity profile without SQN license renewal. Under this scenario, the TVA system capacity is approximately 32,500 MW by 2023.

1.3.4. Need for Power between 2020 and 2040

To ensure enough capacity is available to meet peak demand in most circumstances, including unforeseen contingency, it is necessary to have available additional generating capacity beyond that which is needed to meet peak demand. This additional generating capacity, known as “reserve capacity” or “total reserves,” must be large enough to cover the loss of the largest single operating unit (contingency reserves), be able to respond to moment-by-moment changes in system load (regulating reserves), and replace contingency resources should they fail (replacement reserves). Total reserves must also be sufficient to cover unplanned unit outages, load forecasting error including abnormal weather, and undelivered purchased capacity, among other uncertainties. As typical for the utility industry, TVA plans for total reserves of between 12 and 20 percent of total system load. TVA optimizes its mix of generating assets and purchases to meet these standards. For the IRP and this SEIS, required total reserves were set at 15 percent, which coincides with TVA’s current planning reserve margin target. Therefore, available generating capacity must be adequate to meet the peak demand shown in Figure 1-5 plus 15 percent.

The capacity gap is defined as the difference between the existing firm capacity (adjusted for specified planning strategy inputs) and the firm requirements developed from load forecasts for any particular scenario. Figure 1-10 shows the capacity gap comparing the current resources in Figure 1-8 to the high, baseline and low peak load forecasts in Figure 1-5. Two scenarios are shown, one in which SQN operating licenses are renewed (solid line) and one in which SQN licenses are not renewed (dashed line). Figure 1-11 shows the comparison of current resources to the energy forecasts in Figure 1-6. Figures 1-10 and 1-11 show that under most scenarios, the capacity and generation gaps increase over time, and TVA requires additional capacity and generation to meet forecasted energy needs. EEDR programs could also be used to offset forecasted energy needs. The spring 2010 reference case need for additional generating capacity or EEDR programs is 9,617 MW and 29,086 GWh of additional generation in 2019, growing to 15,513 MW and 44,988 GWh in 2029. Under the reference case, SQN is approved for license renewal and continues to operate. If SQN is not approved for license renewal, the capacity gap grows, beginning in 2020 and 2021, by an additional 2,400 MW, and the generation gap grows by approximately 19,000 GWh.

Chapter 7 of the IRP addresses the alternative strategies by which TVA could acquire additional capacity and generation, as well as EEDR programs, to meet the need for power shown in Figures 1-10 and 1-11 (TVA 2011a). TVA anticipates using a mix of resources, including EEDR programs, renewable resources, natural gas-fired generation, and nuclear generation to provide the additional resources to meet future needs. Given the magnitude of the capacity and energy need, and to avoid the risk of relying on only one fuel or technology, no single resource is used to meet all future energy and capacity requirements.

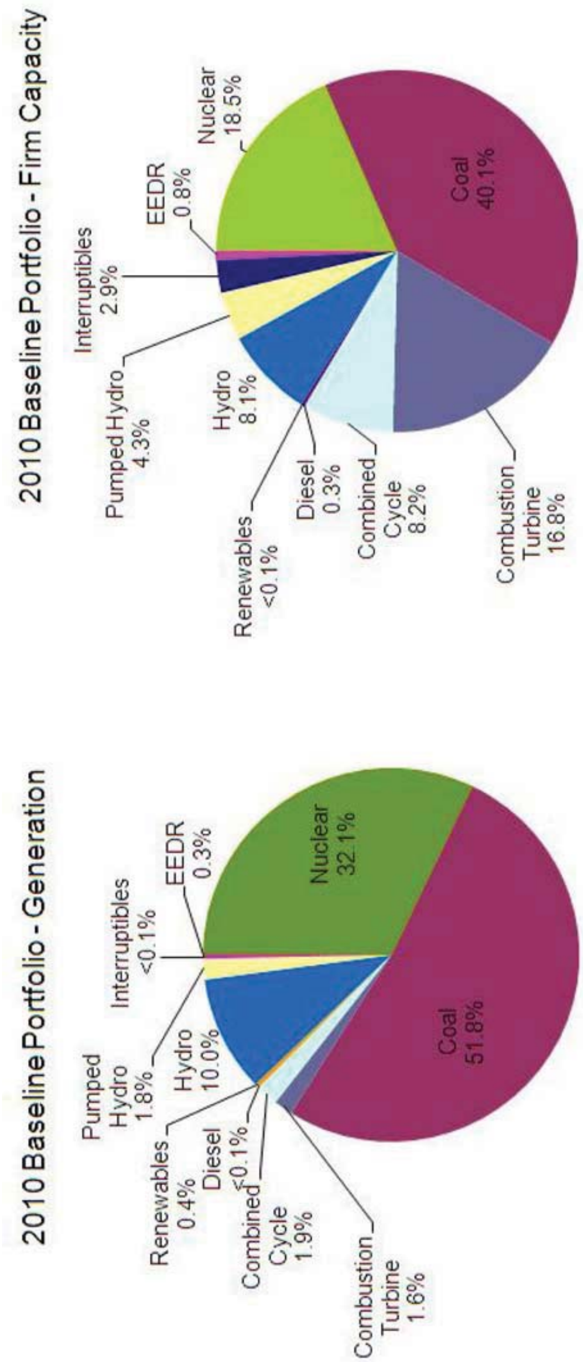

Figure 1-7. Capacity and Energy Mix

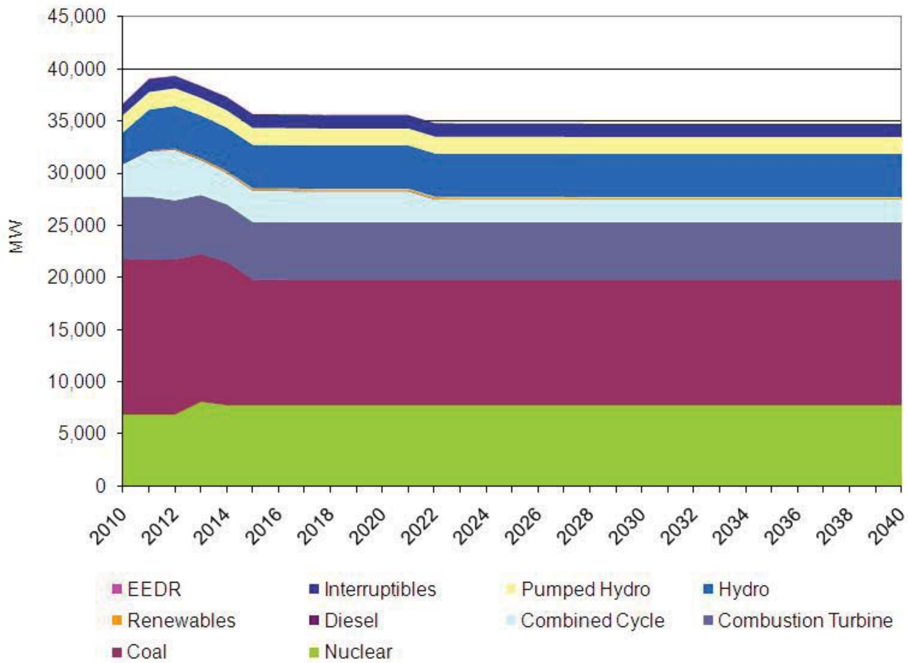

Figure 1-8. Capacity Profile of Current Resources

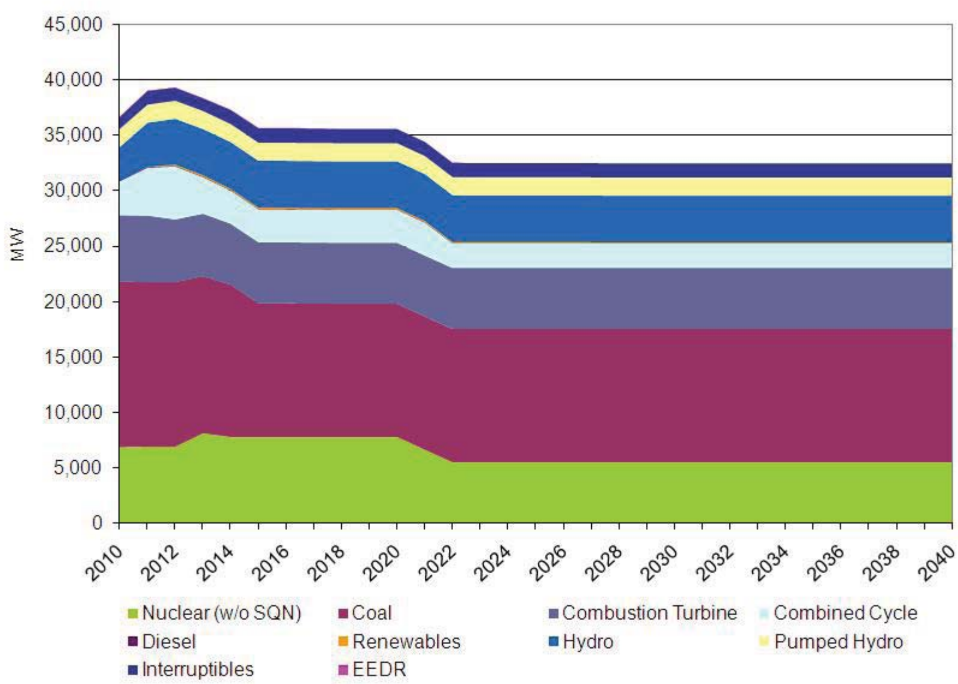

Figure 1-9. Capacity Profile Without SQN License Renewal

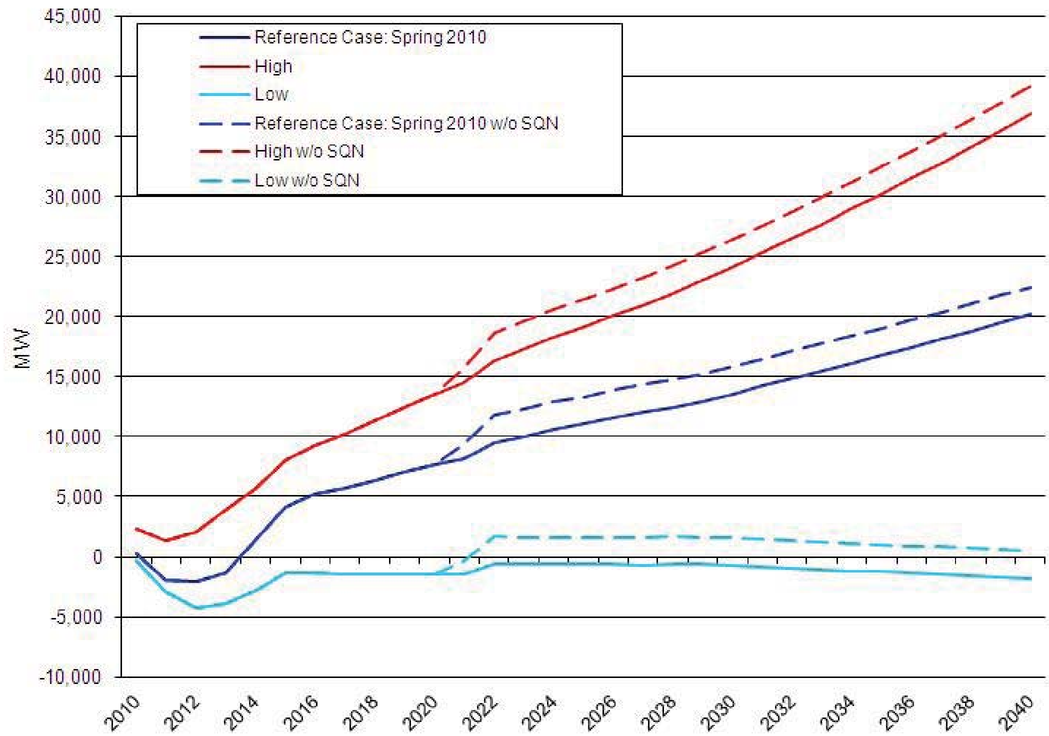

Figure 1-10. Capacity Gap

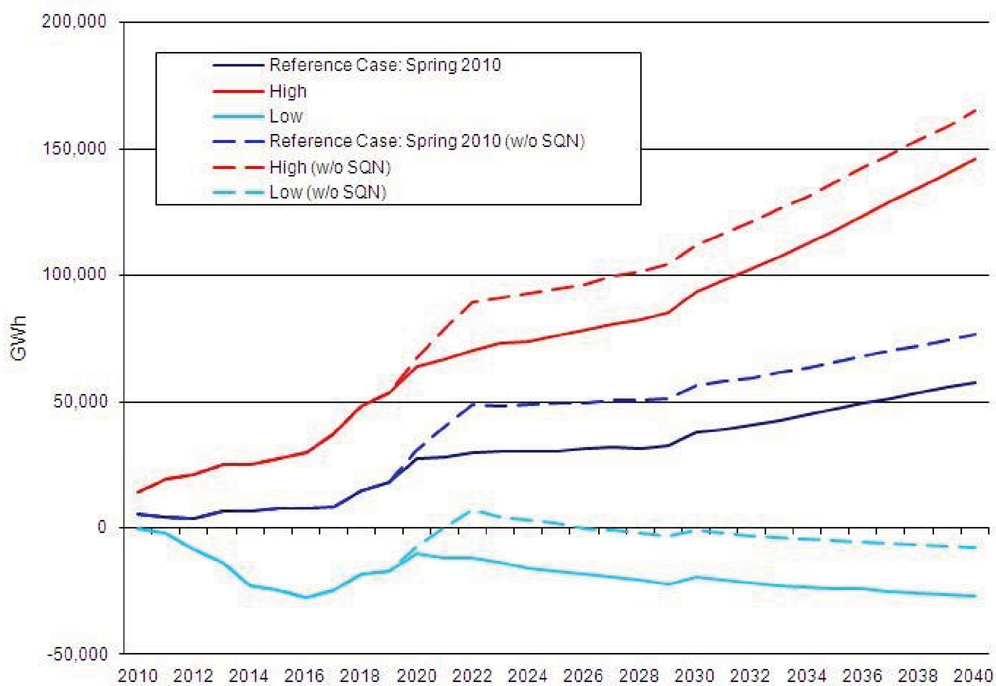

Figure 1-11. Generation Gap

1.4. The NEPA Process

TVA is preparing this SEIS in accordance with the National Environmental Policy Act (NEPA), 42 U.S. Code (USC) Parts 4321 et seq., the regulations published by the Council on Environmental Quality (CEQ) (40 CFR Parts 1500 – 1508), and TVA's procedures implementing NEPA.

The NEPA process requires federal agencies to consider the impact of their proposed actions on the environment before making decisions. If an action is expected to have a significant impact on the environment, the agency proposing the action must develop a study — an environmental impact statement — for public and agency review. This EIS is an analysis of the potential impacts to the natural and human environment from the proposed action, as well as identified alternatives. CEQ regulations (40 CFR §1505.1) require federal agencies to make environmental review documents, comments, and responses a part of each agency's administrative record.

TVA is preparing this supplemental EIS to update information in the original 1974 FES for SQN. Many of the conditions described in the 1974 FES have not significantly changed, including the plant design, systems, structures, and components. Site history, topography, geology, hydrology, and climate, as well as operational parameters, limits, and conditions of operation, remain consistent with the original 1974 FES and are incorporated by reference or, where necessary, additional detail is provided. Changes that have occurred since 1974, including the replacement of Unit 1 steam generators, increase in power output, license amendments, and construction and operation of the ISFSI, are described in related documents or environmental reviews. Future replacement of Unit 2 steam generators is also planned (Section 1.4.1).

1.4.1. Other Pertinent Environmental Reviews and Documents

SQN site-specific, TVA, and generic information in the following documents were evaluated and used where appropriate during the development of the SEIS. These related documents and their contents are discussed below:

Final Environmental Statement, Sequoyah Nuclear Plant Units 1 and 2 (TVA 1974a)

TVA prepared and submitted a comprehensive FES prior to construction activities for SQN Units 1 and 2. This FES included impact analyses for the plant site, surrounding areas, and the proposed transmission corridors. Information from this document was analyzed and updated where needed to develop the SEIS.

In 1978, as requested by the NRC, TVA amended the FES with revised analysis of impacts to the aquatic environment from changes made to the plant prior to its operation. In 1979, the NRC issued an environmental impact appraisal that concluded all potential consequences to the aquatic environment were amenable to acceptable impact control and were appropriately addressed by the U.S. Environmental Protection Agency (EPA) in its drafting of the national pollutant discharge elimination system (NPDES) permit for operation of SQN.

Environmental Assessment and Finding of No Significant Impact for Low-Level Radwaste Management, Sequoyah Nuclear Plant (TVA 1980)

In 1980, TVA revised its plans for treatment and storage of low-level radioactive waste (LLRW) at SQN. TVA prepared an environmental assessment (EA) to consider the potential environmental impacts of this revised plan. The proposed management plan was threefold, consisting of (1) establishing a temporary LLRW management plan, including temporary storage, (2) installing equipment for volume reduction and solidification of LLRW, and (3) constructing facilities to safely store LLRW for the operational life of the plant.

Environmental Assessment and Finding of No Significant Impact – Change in Expiration Dates of Facility Operating License Nos DPR-77 and DPR-79, Tennessee Valley Authority, Sequoyah Nuclear Plant, Units 1 and 2 (TVA 1988)

The original operating license terms for SQN, as supported by the 1974 FES, were to end on May 27, 2010. Accounting for the time required for plant construction, this represented an effective operating license term of approximately 29 years and four months for Unit 1 and 28 years and eight months for Unit 2. TVA submitted an amended application that requested an extension of the operating license expiration dates so the fixed period of the licenses would be 40 years from the date of the operating license issuance for both units. Based on TVA's amended application and associated EA, the NRC staff concluded that there were no significant radiological or nonradiological impacts associated with the extension of the licenses.

Energy Vision 2020 – Integrated Resource Plan and Final Programmatic Environmental Impact Statement (TVA 1995a)

In December 1995, TVA completed this comprehensive environmental review of alternative means of meeting demand for power on the TVA system through the year 2020. The alternative adopted by the TVA Board was a portfolio of various supply- and demand-side energy resources, which included operation of SQN.

Generic Environmental Impact Statement for License Renewal of Nuclear Plants (GEIS, NUREG-1437) (NRC 1996)

This SEIS incorporates information from the GEIS in which the NRC considered the environmental effects of 20-year renewals of nuclear power plant operating licenses (results codified in 10 CFR Part 51). The GEIS identifies 92 environmental issues and reaches generic conclusions on environmental impacts for 69 of those issues that apply to all nuclear plants or to plants with specific design or site characteristics. It is expected that the generic assessment in NRC's GEIS would be relevant to the assessment of impacts of the proposed action at SQN. Information from NRC's GEIS related to the current assessment was referenced following the procedures described in federal regulations unless new and significant information is identified that bears on the GEIS analysis and conclusions (40 CFR §1502.21 – Incorporation By Reference). Additional plant-specific review is conducted for the remaining 23 issues. As part of the NRC's review and approval of the SQN LRA, the NRC will produce a site-specific GEIS supplement for SQN. To date, the NRC has issued 37 site-specific GEIS supplements for 61 current operating nuclear power units. Information from these site-specific GEIS supplements is used and/or incorporated by reference as appropriate.

Environmental Assessment and Finding of No Significant Impact – Low Level Radioactive Waste Transport and Storage Watts Bar and Sequoyah Nuclear Plants (TVA 1999)

TVA evaluated the effects of using the existing SQN on-site facility to store LLRW from SQN, as well as LLRW transported from Watts Bar. TVA concluded there would be no significant impact from implementing the proposed transportation and storage.

Final Environmental Impact Statement for the Production of Tritium in a Commercial Light Water Reactor (DOE 1999)

On December 22, 1998, DOE announced that commercial light water reactors (CLWRs) would be the primary tritium supply technology for the nation's defense needs. The secretary designated the Watts Bar Unit 1 reactor near Spring City, Tennessee, and SQN as the potential CLWRs available for tritium production. TVA was a cooperating agency with DOE in development of the subject FEIS, which evaluated environmental effects associated with tritium production at these three units. TVA adopted the FEIS in May 2000. TVA produces tritium at Watts Bar Unit 1, but does not produce tritium at SQN.

Environmental Assessment and Finding of No Significant Impact – Replacement of Steam Generators, Sequoyah Nuclear Plant, Unit 1 (TVA 2000a)

TVA prepared an EA prior to replacement of the four steam generators in Unit 1 at SQN during the March 2003 scheduled outage. Steam generators, a type of heat exchanger, are large cylindrical pieces of equipment used to produce steam for propelling the turbines, which then spin the generators to produce electric power. The EA evaluated the effects of replacing the steam generators and concluded there would be no or very minimal environmental impact.

Environmental Assessment and Finding of No Significant Impact – Independent Spent Fuel Storage Installation Sequoyah Nuclear Plant (TVA 2000b)

TVA utilizes the NRC's general license to store spent fuel at the SQN on-site ISFSI outdoor dry cask storage facility. A general license is an option available to current commercial nuclear power licensees to store spent fuel outside of the spent fuel pool at an ISFSI. The general license requires the use of a fuel storage system that has been previously approved by the NRC as demonstrated by the issuance of an NRC Certificate of Compliance.

TVA originally screened 13 sites for the construction of the ISFSI at SQN and prepared an EA evaluating the effects of a proposed location and alternatives. In April 2000, TVA prepared an EA and issued a finding of no significant impact for constructing and operating the ISFSI between the entrance road to SQN and the 500-kV switchyard.

Environmental Assessment and Finding of No Significant Impact – Leading Edge Flow Measurements System Installation (TVA 2001)

TVA prepared an EA to evaluate the effects of installing a leading edge flow measurements (LEFM) system for the feed water supply to the steam generators. Installation of the LEFM system facilitated a power increase of 1.3 percent. TVA concluded there was no significant impact to the environment from installation of the LEFM system.

Supplemental Environmental Assessment and Finding of No Significant Impact – Independent Spent Fuel Storage Installation, Sequoyah Nuclear Plant, Hamilton County, Tennessee (TVA 2002b)

TVA prepared this supplemental EA to evaluate a different proposed location for the ISFSI, as well as other changes proposed since the April 2000 EA (TVA 2000b). TVA concluded no significant impact to the environment would occur from constructing and operating the ISFSI on a site southwest of the dry active waste building.

Environmental Assessment for SQN Unit 2 Steam Generator Replacements (TVA 2009h) and *Finding of No Significant Impact for SQN Unit 2 Steam Generator Replacements* (TVA 2009b)

TVA prepared an EA to evaluate the effects of replacing the four steam generators in Unit 2 at SQN and concluded there would be no or very minimal environmental impact..

Environmental Impact Statement for the Integrated Resource Plan (TVA 2011a)

TVA prepared an updated IRP, a comprehensive study of alternatives for meeting the future electrical energy needs of the Tennessee Valley. This document updates the Energy Vision 2020 IRP described above. The purpose of the IRP is to develop a plan that TVA can enact to achieve a sustainable future and meet the energy needs of the Tennessee Valley over the next 20 years. The IRP EIS evaluates the environmental impacts of proposed and alternative supply- and demand-side energy resource strategies to meet the growing demand for energy in the region. This SEIS uses information and analyses from the IRP EIS process, particularly for load forecasting and evaluation of energy generation portfolios designed to meet forecast needs.

Environmental Reviews of Potential Alternate Nuclear Fuels in TVA Reactors

TVA is considering the potential use of nuclear fuels other than low-enriched uranium (LEU) fuel in TVA nuclear reactors, including SQN. Independent of the SQN license renewal process, TVA is coordinating with the DOE on projects regarding two types of nuclear fuel. Both projects involve the DOE's disposition of nuclear materials pursuant to U.S. nuclear non-proliferation policies. Part of TVA's decision-making process on both projects is an environmental review in accordance with NEPA on activities that TVA proposes to conduct.

The DOE's National Nuclear Security Administration recently announced its intent to modify the scope of the *Surplus Plutonium Disposition Supplemental Environmental Impact Statement* (SPD Supplemental EIS), to potentially provide alternative methods of disposing of surplus plutonium (75 FR 41850). The DOE, with TVA as a cooperating agency, is to prepare the SPD Supplemental EIS to analyze the potential environmental impacts of the disposal of plutonium. The use of mixed oxide (MOX) fuel in up to five reactors operated by TVA at SQN and BFN would be included in the analysis. Fabricating MOX fuel entails mixing plutonium oxide with depleted uranium oxide, manufacturing the fuel into pellets, and loading the pellets into fuel assemblies for use in nuclear reactors.

In the original SPD EIS published in 1999, the DOE evaluated environmental impacts of using MOX fuel at three nuclear plants in North Carolina and Virginia. The DOE concluded that the use of MOX fuel in those reactors would not require changes in the procedures for handling radioactive, hazardous, or non-hazardous waste. The use of MOX fuel would not require changes in the use of land or water, and would not result in increased emissions of pollutants to the air or water. In normal operations, the use of MOX fuel would not change the radiation dose to the public or the expected risk of accidents during normal reactor operation. The consequences of design-basis and beyond-design-basis accidents in a reactor burning MOX fuel could result in greater or less risk to the public depending on the type of accident, but the probability of those accidents is very low for reactors burning either LEU or MOX fuel (DOE 1999). If the DOE decides to dispose of some surplus plutonium by loading it in nuclear reactors, several decisions would need to be made by the NRC and TVA before MOX fuel is used at SQN and/or BFN. TVA would need to submit license amendment applications to the NRC.

TVA recently announced a proposal to obtain an additional 27 metric tons (mt) of highly enriched uranium (HEU) into blended low-enriched uranium (BLEU) for use as fuel at BFN or SQN. TVA evaluated the impacts of using 33 mt of HEU-derived fuel at BFN when it adopted the DOE's final EIS, *Disposition of Surplus Highly Enriched Uranium*, which was released in 1996. TVA found that implementation of those activities would result in low environmental and health impacts during normal operations (66 FR 57997). From spring 1999 through fall 2000, TVA conducted a successful limited demonstration at SQN using four fuel assemblies derived from HEU. Results of the test indicated that the HEU-derived fuel performed normally, caused no changes in plant operational parameters, characteristics, or safety, and resulted in no new or additional wastes beyond those occurring with typical operations. LEU fuel derived from the first 33 mt of HEU has been successfully loaded into TVA reactors since 2005.

TVA has not yet proposed to use MOX fuel at SQN and is updating its proposed continued use of HEU-derived (i.e., BLEU) fuel at BFN and SQN. The results of the HEU update are anticipated to be available this year, considered, and referenced in this SEIS. Assuming that TVA proposes to use MOX fuel, the DOE-TVA update of the SPD Supplemental EIS would appropriately consider any cumulative impacts associated with the proposed extension of the SQN operating licenses.

1.4.2. Public Scoping

The NEPA process requires public participation and interagency coordination and review during the preparation of an EIS. This section summarizes TVA's efforts to involve the public, agencies, and tribes to help define the content of the SEIS.

TVA determined that preparing an SEIS would be appropriate to update the 1974 FES by assessing the effects of proposed operation of SQN for an additional 20 years. Although NEPA regulations do not require a public scoping process for the preparation of an SEIS, TVA decided to employ public scoping for this SEIS.

TVA issued a press release on April 9, 2010, announcing that it was preparing an SEIS on the potential effect of extending the licenses for SQN Units 1 and 2 (see Appendix A). A notice of intent (NOI) to prepare the SEIS was published in the *Federal Register* on Monday, April 12, 2010 (see Appendix A). The NOI described the SQN plant and its location, summarized the proposed action and alternatives, enumerated the environmental issues to be addressed in the SEIS, and detailed the scoping process. The deadline for comments was May 11, 2010.

As summarized in the scoping report (Appendix B), a total of seven comment letters were received concerning this SEIS. Comments were received from the Tennessee Department of Environment and Conservation (TDEC), Tennessee Wildlife Resources Agency (TWRA), Tennessee Historical Commission (THC), State Historical Preservation Office (SHPO), United Keetoowah Band of Cherokee Indians in Oklahoma, Seminole Tribe of Florida, Tribal Historic Preservation Office, Alabama-Coushatta Tribe of Texas, Tribal Historic Preservation Office, and the Partnership for Affordable Clean Energy (see Appendix C). No objections were voiced and only minor informational requests were made. These will be addressed as necessary.

1.4.3. Issue and Resource Identification

Based on the scoping process, reviews, and assessments of the proposed action, TVA has determined that the scope of the SEIS should include the following topics:

- Surface Water Resources, Hydrology, and Water Quality – For the surface water resource, the discussion includes chemical and thermal influences on the surface water resource as well as hydrology and consumptive use impacts of the project.

- Groundwater Resources, Hydrology, and Groundwater Quality – Groundwater discussion provides potential chemical impacts and the planned use of the groundwater resource.

- Floodplains and Flood Risk – Discussion of impacts to floodplains and impacts related to the risk of flooding from the Tennessee River and from the probable maximum precipitation event.

- Wetlands – The discussion provides information relevant to SQN on-site wetlands.

- Aquatic and Terrestrial Ecology – The discussed aquatic and terrestrial ecology resource impacts include destruction or degradation of aquatic organisms, terrestrial vegetation, and wildlife.

- Endangered and Threatened Species – The potential for impacts to state-listed or federally threatened or endangered species and/or their habitat are addressed.

- Natural Areas – Natural areas are discussed for potential degradation or loss of quality.

- Recreation – The impacts on recreational resources are discussed.

- Archaeological Resources and Historic Structures – Archaeological and historical resources are evaluated for potential damage from the project.

- Visual Resources – Effects on visual resources and scenic quality are addressed.

- Noise – The potential for nuisance related to noise is addressed.

- Socioeconomics, including Environmental Justice – Socioeconomic resources are discussed dealing with changes in population, employment, income, and tax revenue. The potential for disproportionate effects on low-income populations and minorities is considered along with potential changes in housing, public services such as fire, police, and schools, land use, roads, and resulting traffic.

- Solid and Hazardous Waste – The generation and disposal of solid and hazardous waste are discussed.

- Seismology (i.e., earthquakes) – The discussion includes the seismic adequacy of SQN's design.

- Climatology and Meteorology, Air Quality, and Global Climate Change – Air quality related to the radiological effluents released into the air is discussed, as well as the fossil-fired fuel sources that support the operation of SQN. The effects of local meteorology on dispersion of effluents from proposed power plants are addressed. Also addressed is the contribution of proposed actions to global climate change (GCC), as well as the impacts of possible climate change on proposed actions.

- Radiological Effects of Normal Operations – Radiological effects on the public and on the biota from radiological releases are included.

- Uranium Fuel Use Effects – The discussion addresses radioactive waste, spent fuel, and transportation of radioactive materials.

- Nuclear Plant Safety and Security – Nuclear plant safety includes the discussion of design-basis accidents (DBAs), severe accidents, and nuclear-related radiological materials. The required security associated with the control of radioactive materials is addressed.

Decommissioning, spent fuel storage, and transmission line maintenance would be necessary actions regardless of TVA's decision to pursue license renewal. SQN would undergo decommissioning at the end of the current licenses, or at the end of the license renewal period, if approved by the NRC. A brief introduction of the possible methods and conditions of decommissioning and impacts that the eventual decommissioning of SQN will cause are discussed. Spent fuel would be stored and kept safe at SQN as long as necessary until the DOE takes possession of it. Spent fuel would be created by operating SQN until the end of the operating licenses, current or extended operational period. Potential environmental impacts associated with spent fuel storage are addressed.

Transmission lines connected to SQN are an integral part of the electrical system grid, and would therefore be in use whether SQN is operated or shut down. Maintenance (e.g. clearing vegetation in the ROW) of those transmission lines would likewise be a requirement while SQN is in current or extended operation, and probably beyond the SQN operational period to maintain the vital electrical system grid. Transmission line operation and maintenance does not depend upon the decision to renew SQN operating licenses; proposed maintenance activities and associated environmental effects would be identical regardless of the decision made. Therefore, the operation of transmission lines and maintenance of ROWs are not addressed in this SEIS.

Based upon information gathered during the scoping period, TVA has determined there is no potential to affect the following resources: wild or scenic rivers, scenic highways, park lands, prime farmlands, geological characteristics and resources, or critical or essential habitats. Accordingly, these resources are not addressed in detail.

1.4.4. Projects Included in the Evaluation of Cumulative Effects

Cumulative effects are those resulting from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions.

Cumulative impacts are evaluated by section in Chapter 3 (Affected Environment and Environmental Consequences). Past and present actions near SQN have resulted in a region shaped, in part, by TVA's successful achievement of the purpose and goals set by Congress to improve navigation, control floods, provide for the proper use of marginal lands, provide for industrial development, and provide power at rates as low as feasible, all for the general purpose of fostering the physical, economic, and social development of the Tennessee Valley region. Eastern Tennessee is characterized by primarily rural and suburban land use, with a few urban metropolitan areas. TVA dams and reservoirs reduce the risk of flooding and secure for its residents the benefits of a navigable waterway, while ensuring water quality and availability. Creation of reservoirs along the Tennessee River has provided opportunities for recreation, industrial and municipal development, and growth of shoreline residential and community facilities. TVA's development of electric generation and associated facilities has led to the power system described in Section 1.2.

Cumulative effects of constructing and operating SQN were considered in the 1974 FES. Some SQN operations have been evaluated together with operations of other nuclear plants. Cumulative effects of spent fuel storage and transportation were addressed in DOE's tritium production FEIS (DOE 1999); cumulative effects of transportation of radioactive materials were addressed in NUREG-75/038 (NRC 1975); and cumulative hydrothermal and water supply effects of TVA operations, including SQN, were addressed in the reservoir operations study (ROS) FEIS (TVA 2004a).

Reasonably foreseeable future projects that may contribute to cumulative effects on resources within the SQN region include:

- Potential production of tritium at SQN for the DOE program. DOE has identified the purchase of irradiation services from the WBN and SQN reactor facilities as preferred for the production of tritium. Tritium production could require the addition of employees (fewer than 10 employees per unit), as well as additional plant modifications. It is expected that irradiated fabricating tritium-producing burnable absorber rod (TPBAR) assemblies, nonradioactive waste, and some additional LLRW would be transported off site for processing and disposal. (DOE 1999) To date, SQN has not produced tritium for the DOE, but the option remains open.

- Operation of Watts Bar Nuclear Unit 2 (similar to Watts Bar Nuclear Unit 1 and scheduled for operation in 2013), which would be located in Rhea County on 1,700 acres at the northern end of Chickamauga Reservoir, adjacent to the TVA Watts Bar Dam Reservation at TRM 528 on the western shore of Chickamauga Reservoir.

- Operation of the proposed single BLN nuclear unit (scheduled for operation in 2018) located on a 1,600-acre peninsula on the western shore of Guntersville Reservoir at TRM 392 in Jackson County in northeastern Alabama.

- A potential future project from the Chattanooga-Hamilton County Regional Planning Agency presented in the *2035 Long Range Transportation Plan* to widen the Daisy Dallas Road and a proposed Tennessee River bridge connection to US 27 (CHCRPA 2010).

The cumulative impact of concern for the majority of the projects would be water quality and water use during low-flow conditions along the Tennessee River system. Cumulative impacts on socioeconomic factors are also addressed. SQN's capability to produce tritium for the DOE program is discussed for the potential cumulative impacts on such things as the additional radiation doses, additional spent fuel, added radioactive waste generation, and potential impacts to the public.

Radiological effluent releases in water and air do not normally cause cumulative impacts because the limits for release are so restrictive and based on the principle that once released, below the specified limits, there is no cumulative impact. Appropriate environmental monitoring programs are in place to ensure there are no detectable cumulative effects in the local environment. See Section 3.17 for a description of the radiological environmental monitoring program (REMP).

1.4.5. Review of the Draft and Preparation of the Final SEIS

A notice of availability for the draft SEIS (DSEIS) was published in the *Federal Register* on November 5, 2010 (see Appendix A). Copies of the document were transmitted to state, federal, and local agencies, and federally recognized tribes. It was also available on TVA's website for review. In addition, TVA issued a press release on November 29, 2010, announcing a public meeting and identifying ways for the public to comment on the DSEIS (see Appendix A).

TVA held a public open house on December 2, 2010, at the SQN Training Center in Soddy-Daisy, Tennessee. During the open house, comments on the DSEIS could be made orally to a court reporter, on a web-based comment form using a computer, or by written comment form. TVA staff was available at the open house to answer questions about DSEIS (see Appendix A).

Public comments were accepted November 5, 2010, through December 22, 2010. Nine agencies and individuals commented on the DSEIS via email, and verbal statements. All comments received and TVA's responses to these comments are included in Appendix D.

This final SEIS (FSEIS) reflects revisions in support of the responses to comments on the DSEIS including additional data and clarification about air quality, meteorological conditions, socioeconomics, and updated information on TVA's recently issued IRP.

1.5. Permits, Licenses, and Approvals

Federal and state environmental laws establish standards for radiation exposure in the general environment (areas outside of the NRC-regulated area) and for sources of air pollution, water pollution, and hazardous waste. TVA maintains applicable permits for operation of SQN. Environmental permits contain specific conditions governing operation of SQN emission sources, describe pollution abatement and prevention methods to reduce pollutants, and contain emission limits for the pollutants that would be emitted from the facility. Chapter 5 of this SEIS provides additional information on the permits and licenses maintained by SQN. Table 1-3 provides a list of current permits and licenses that would be maintained throughout the license renewal period. Table 1-4 provides a list of the other federal environmental regulations and guidance that potentially are relevant to plant activities.

Table 1-3. Current Permits (Also Required During License Renewal)

Permit Type	Current Authorizations	Notes
NRC	DPR-77	Current Unit 1 operating license
NRC	DPR-79	Current Unit 2 operating license
NPDES	TN0026450	Permit effective March 1, 2011
Resource Conservation and Recovery Act (RCRA)	TN5640020504	Hazardous waste permit
Radioactive Waste Delivery License	T-TN002-L10	Radioactive waste delivery license for Tennessee
Storm Water Permit	TNR 050015	General storm water permit
Air	4150-30600701-01C	Cooling tower Unit 1
Air	4150-30600701-03C	Cooling tower Unit 2
Air	4150-30700804-06C	Insulation saw A and saw B
Air	4150-10200501-08C	Auxiliary boilers A and B
Air	4150-30703099-09C	Carpenter shop
Air	4150-30900203-10C	Abrasive blasting operation
Air	4150-20200102-11C	Emergency generators 1A, 1B, 2A, and 2B and Generators 1 and 2
Air Asbestos	A-123008	Annual asbestos permit – Hamilton County (renewed as needed)
Solid Waste	DML 331050021	Inert landfill for construction and demolition waste

Table 1-4. Relevant Federal Environmental Regulations and Guidance

Statute / Agency	Authority	Activity Covered
U.S. Nuclear Regulatory Commission	10 CFR Parts 50, 51, and 54	Operation of commercial nuclear plants and license renewal.
Endangered Species Act , U.S. Fish and Wildlife Service	16 USC §1531 et seq.	Consultation with U.S. Fish and Wildlife Service in the event that proposed activities at SQN have potential to affect federally listed species.
Native American Graves Protection and Repatriation Act	25 USC §3001 et seq.	Provides for the repatriation of Native American human remains or cultural items that are excavated from or inadvertently discovered on federal lands.
National Historic Preservation Act of 1966; Alabama, Tennessee, and Georgia Historical Commissions; SHPO; Federal Advisory Council on Historic Conservation	16 USC §470 et seq.	Consultation with state historical preservation officer in the event that proposed activities at SQN have potential to impact historical properties listed, or eligible for listing, on the National Registry of Historical Places.
Executive Order 11514	40 CFR Parts 1500–1508	Requires federal agencies to protect and enhance the quality of the environment and develop procedures to ensure the fullest practicable provisions of timely public information and understanding of federal plans and programs that may have potential environmental impacts that the views of interested parties can be obtained.
Executive Order 11988	10 CFR Part 1022; 18 CFR Part 725	Requires federal agencies to avoid floodplain impacts to the extent practicable.
Executive Order 11990	42 USC 4321 et seq.; 42 USC 4331(b)(3)	Requires federal agencies to avoid direct or indirect support of new construction in wetlands whenever there is a practicable alternative.
Executive Order 13423	42 USC 4321	Subject to the availability of appropriations, requires agencies to implement sustainable practices including energy efficiency, greenhouse gas emissions avoidance or reduction, and petroleum products use reduction.

CHAPTER 2

2.0 ALTERNATIVES INCLUDING THE PROPOSED ACTION

The purposes of the proposed action are to (1) obtain extended licenses to operate SQN Units 1 and 2 to help meet the identified need for power between 2020 and 2031; (2) maximize use of existing assets; and (3) support TVA's efforts to reduce the carbon emissions of its generating system.

In addition to continuing the operation of SQN, TVA screened a broad range of options to identify feasible alternatives available to achieve those purposes. The purpose of this section is to describe the options that were reviewed and discuss why the alternatives evaluated were chosen. A description of the alternatives development process is found in Section 2.1. The Action and No Action alternatives are described in Section 2.2. A comparison of alternatives is provided in Section 2.3. Section 2.4 provides a summary of impacts, and Section 2.5 provides a brief discussion of the preferred alternative. References for this chapter are provided in Chapter 8, Literature Cited.

2.1. Development of Alternatives

To begin the process of identifying, considering, and narrowing down the alternatives to those reasonably addressing the purpose and need of this proposed action, TVA began with the broad range of supply-side and demand-side actions identified in TVA's IRP. TVA reviewed options that would require new generating capacity (Section 2.1.1), options that would not require new generating capacity (Section 2.1.2), and a combination of those alternatives (Section 2.1.3).

The following criteria were applied to select feasible alternatives to evaluate in detail in this SEIS:

- The option must substantially meet the stated purpose and need.
- Supply-side resource options must be capable of delivering capacity and energy comparable to that provided by SQN (either individually or in combination) without substantially greater environmental impacts.
- Resource options must utilize a developed and proven technology, or one that has reasonable prospects of becoming developed and proven in time to deliver sufficient power in 2020.

In the IRP process, TVA used similar thresholds for technology feasibility, availability, and performance as criteria for selecting future energy resource options (TVA 2011a). Energy resource options dismissed from consideration in the IRP were not considered viable sources to meet the purpose and need for this project. Those options considered in the IRP were further screened using the above criteria to determine whether they meet the purpose and need of this project. The results of that screening are reported in Sections 2.1.1., 2.1.2., and 2.1.3.

Additionally, TVA conducted a resource planning study using a similar approach and methodology as used to develop TVA's IRP. The study develops a future generation plan that evaluates factors including unit capacity factors; fuel costs, operating costs, power purchase costs, and other economic factors; and air pollutant emissions allowances. The study is designed to identify the mix of generating resources that would minimize the cost of providing power. In other words, study results show how the TVA generation system could be dispatched over time to provide the least-cost option for providing power.

All portfolio strategies evaluated in the IRP assumed that SQN operating licenses would be renewed. Figure 2-1 shows the existing (below bold black line) and planned (above bold black line) generation resources under the spring 2010 reference case for the IRP planning period (2010 – 2029). Under the recommended planning direction, the decline of existing thermal resources and the identified expansion of renewable and EEDR programs would be slightly greater than under the spring 2010 reference case. As shown in the IRP EIS, the amount and timing of implementation would vary depending upon the future scenario. However, as described in Section 1.3.1 above, these variations from the spring 2010 reference case would not materially change the outcome of the system generation portfolio shown. In this SEIS, forecasts for 2030 through 2041 are extrapolated beyond the IRP planning period assuming that the generation from TVA's existing and planned resources through the end of the SQN license renewal term (2040 – 2041) would be similar to the trends shown in the later years of Figure 2-1.

Figure 2-1 shows that, throughout the planning period, SQN generation is about 18,000 GWh annually, and that a significant generation contribution of about 26,000 GWh annually is provided by renewable resources. The addition of WBN 2 and the combined-cycle plant at JSF contribute to increases in energy provided by existing thermal (coal, gas, and nuclear) resources between 2012 and 2013. Conversely, energy provided by existing thermal resources decreases after about 2015 due to TVA's plans to idle fossil plants. Additional resources needed to meet future energy needs (Figure 1-6) consist of the planned nuclear expansion, planned gas expansion, and avoided generation from new EEDR expansion programs that are part of the IRP portfolio. In this discussion, planned resources are those identified as feasible options in TVA's existing capacity plan, but are not authorized or proposed. These additional resources would be needed even if SQN continues to operate for another 20 years.

TVA also developed future resource planning studies using the spring 2010 reference case and the assumption that SQN units are shut down in 2020 and 2021. Results of this study show the likely means for generating power using a least-cost planning strategy, if TVA takes no action to renew SQN operating licenses. Two scenarios were evaluated in the study. In the first scenario, all resource options that exist in the IRP portfolio were available to meet the need for power. The second scenario was used to model a circumstance where TVA would not construct additional nuclear power plants. In other words, additional nuclear expansion, beyond that already planned in the IRP, was not available to compensate for the loss of SQN. Results of the planning studies are described in Sections 2.1.1.1 and 2.1.1.2.

2.1.1. Alternatives Requiring New Generating Capacity

TVA considered whether building new capacity would address the forecasted need for power. Energy options were examined alone and in combination to determine if the system power requirements could be met by other energy options. Sources discussed in this section are located in the TVA power service area. Sources located outside the TVA power service area are discussed in Section 2.1.2.1.

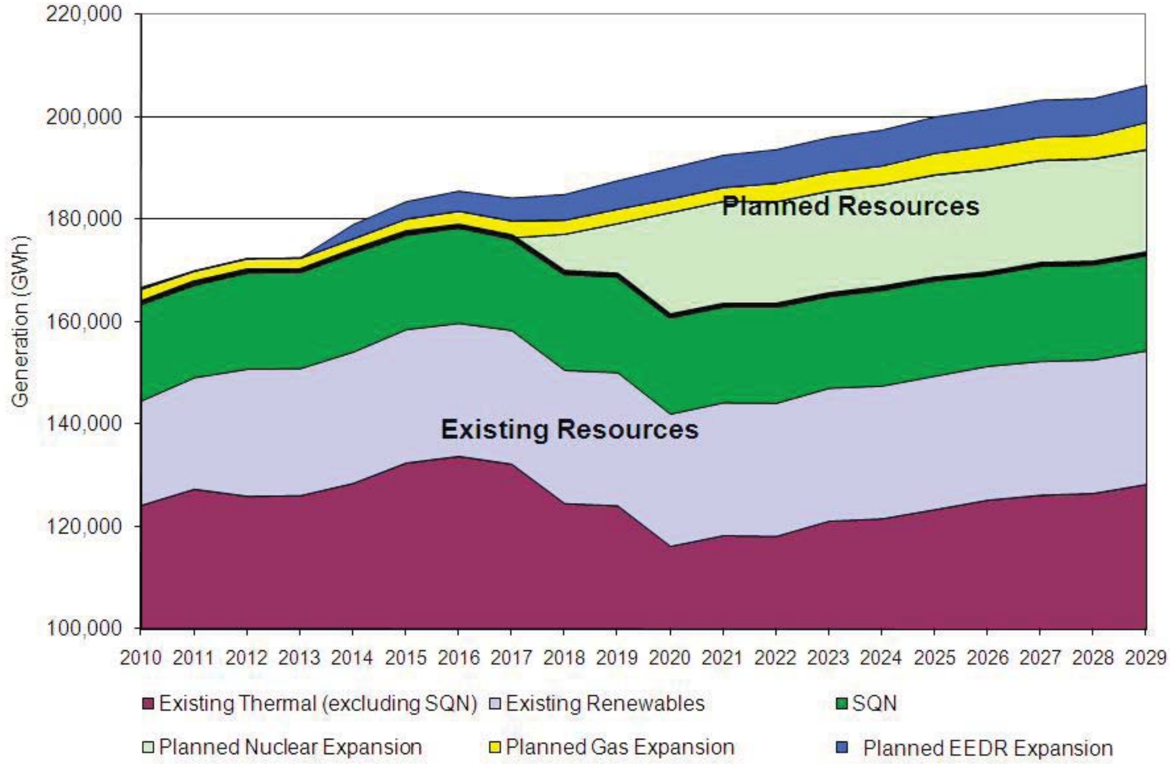

Figure 2-1. TVA System Generation Including Alternative 1 – License Renewal

2.1.1.1. New Nuclear Source

Construction of new nuclear generating capacity is a feasible alternative because nuclear plants produce base load power and have similar environmental impacts during operation as the existing SQN units.

Nuclear expansion is already part of TVA's capacity expansion plans. As described in Section 1.3 above, because the TVA Board has approved construction of WBN Unit 2, it is considered an existing thermal resource in power supply forecasts. In May 2010, TVA issued its final SEIS for the construction and operation of an 1,100 to 1,260 MW nuclear unit at the BLN site. In August 2010, the TVA Board authorized staff to continue engineering activities and the procurement of long-lead time components of BLN Unit 1. TVA's IRP shows that BLN Unit 1 and a second unit (BLN Unit 2) are identified as the least-cost resource options in many of the scenarios (plausible futures) tested in that study, except where there is no forecasted load growth. As in the BLN SEIS, TVA's IRP included the continuing operation of SQN through 2029. Therefore, this SEIS assumes that the proposed BLN Unit 1 will be in operation beginning in 2018, that BLN Unit 2 is needed to meet load even if SQN continues to operate, and therefore neither BLN Unit 1 or 2 is available as an alternative to license renewal at SQN. The IRP EIS also evaluated options for adding nuclear units in addition to a single unit at BLN.

Results of the resource planning study also demonstrated that, given the absence of relatively inexpensive power from SQN, the least-cost option for providing power would include additional nuclear expansion beyond BLN Unit 2. Figure 2-2 shows the generation from existing and planned resources for the IRP planning period (2010 – 2029) with the assumption that SQN is shut down in 2020 – 2021. As before, this assumes that the generation from TVA's existing and planned resources through 2041 would be similar to the trends shown in the later years of Figure 2-2. Figure 2-2 shows that generation from new nuclear units grows to about 18,000 GWh annually by 2027. Between 2020 and 2027, generation would come primarily from existing thermal resources, and to a lesser extent, from gas-fired generation that would be brought online earlier than planned in the spring 2010 reference case because this is the lowest cost means of meeting capacity and energy needs during this initial period. As demand grows and energy prices increase, nuclear units become the lowest cost option and are added. Other resources already planned in the IRP resource portfolio (planned nuclear expansion, planned gas expansion, and avoided generation from new EEDR expansion programs) would contribute about the same amount of energy as they would under Alternative 1.

2.1.1.2. Fossil Fuel Energy Sources

The primary fossil fuel alternatives to nuclear-powered electrical generation at the SQN site are coal-fired generation and natural gas-fired generation. Generation using fuel oil was

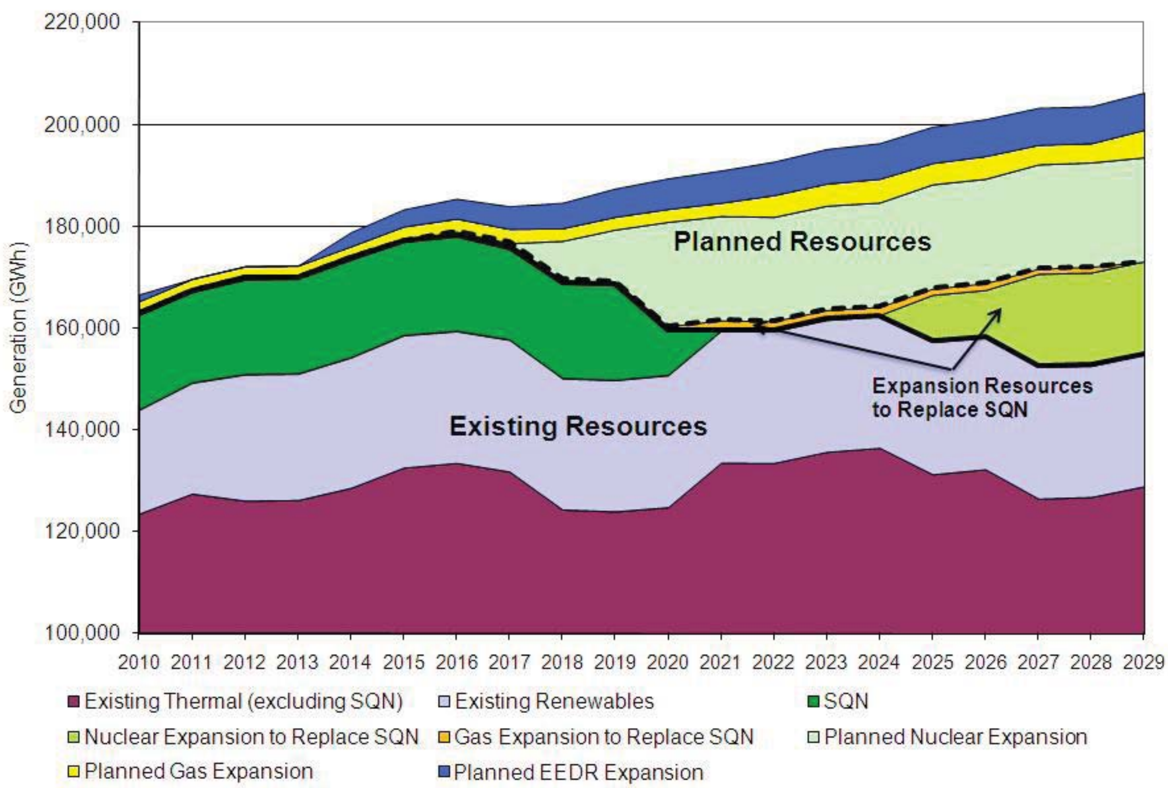

Figure 2-2. TVA System Generation Including Alternative 2a – SQN Shutdown and New Nuclear Generation

not considered a reasonable alternative to SQN license renewal in this SEIS because of higher emissions of nitrogen oxides (NO_x), carbon dioxide (CO_2), and other pollutants (TVA 2011a).

In the IRP EIS, TVA assessed several types of impacts for coal and natural gas-fired plants: air quality, waste management, land use, water use and quality, human health, ecology, socioeconomics, aesthetics, historic and cultural resources, and environmental justice. The potential environmental impacts and merits of coal-fired or gas-fired generation have not changed materially since these options were evaluated in the earlier Energy Vision 2020 IRP.

A coal-fired plant without carbon capture and storage (CCS) would contribute significantly higher amounts of emissions to the air compared to a nuclear plant.

As a means to reduce greenhouse gas (GHG) emissions from coal-fired plants, it may be possible in the future to integrate CCS technologies into conventional pulverized coal, supercritical pulverized coal, and integrated gasification and combined-cycle units. While the capture of CO_2 from a coal-fired facility is conceptually feasible, TVA does not foresee that CCS technology will be developed soon enough for use at coal-fired plants constructed in the time frame of this decision. Consequently, a coal-fired alternative using CCS technology was not considered a reasonable alternative in this SEIS.

The IRP EIS also considered both simple and combined-cycle natural gas-fueled alternatives. Combined-cycle plants direct the exhaust gas from the gas turbine of the simple cycle to a heat recovery steam generator, which feeds an additional steam turbine that drives an additional electric generator. NO_x emissions from the combined-cycle combustion turbine can be controlled, and sulfur dioxide (SO_2) emissions from the natural gas fuel are essentially zero. Their high efficiency and natural gas fuel combine to produce lower CO_2 emissions, and it is possible to construct combustion turbine or combined-cycle units as quickly as three years. Consequently, natural gas-fueled generation was evaluated in more detail in this SEIS.

Results of the resource planning study demonstrated that, without relatively inexpensive power from SQN or the option of additional nuclear expansion, the least-cost option for providing power would include construction of additional natural gas-fired facilities beyond those identified in many of the IRP resource portfolios. Figure 2-3 shows the generation from existing and planned resources for the IRP planning period (2010 – 2029) with the assumption that SQN is shut down in 2020 – 2021 and there is no additional expansion of nuclear units (beyond that already planned in the IRP). As before, it is assumed that the generation from TVA's existing and planned resources through 2041 would be similar to the trends shown in the later years of Figure 2-3. In addition to operating existing and planned resources, new (expansion) natural gas-fired units would be necessary to fully meet forecast generation needs. Generation from existing thermal resources would be increased, primarily by increasing operation of existing coal and natural gas-fired plants that otherwise would not have been operating at maximum capacity. About the same amount of energy would be generated from other resources already planned in the IRP resource portfolio (planned nuclear and gas expansion, and avoided generation from EEDR expansion programs).

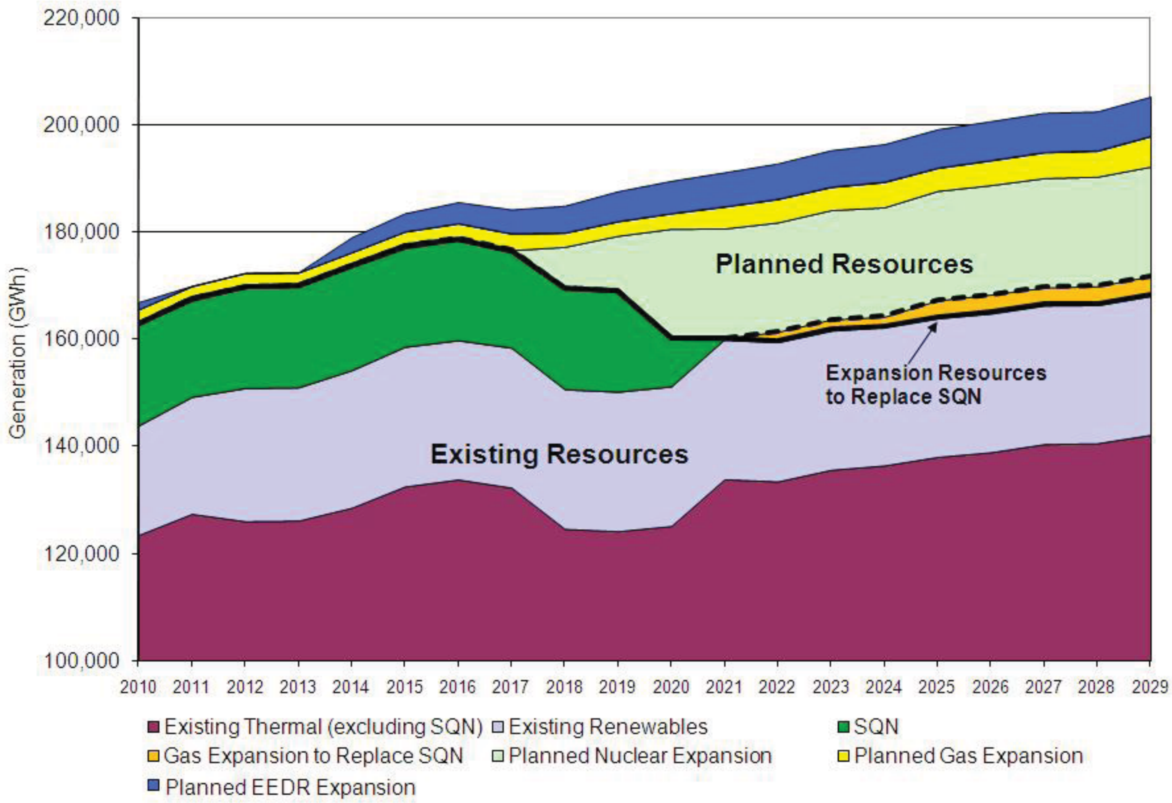

Figure 2-3. TVA System Generation Including Alternative 2b – SQN Shutdown and New Natural Gas-Fired Generation

2.1.1.3. Wind

According to state-by-state wind maps and resource potential estimates from the DOE's Office of Energy Efficiency and Renewable Energy (DOE 2010), approximately 4,200 MW of wind power capacity in the TVA power service area is available at a gross capacity factor of 25 percent or greater, based on turbine hub heights of 80 meters (m). Most current turbine installations have turbine hub heights between 50 to 80 m. However, at a turbine height of 100 m, estimates of the amount of wind capacity in the TVA power service area are as high as 5,700 MW. Hub heights of 100 m are technically feasible with current wind turbine technology, and taller turbines can help make wind power more economically feasible in low wind areas such as the TVA power service area.

Taking into account electrical losses, environmental factors, and wake effects (of surrounding wind turbines), the net capacity factor for the TVA power service area is projected to be 22 percent, which is near the low end of the typical range of net capacity factors for modern utility-scale wind power projects of 20 to 40 percent. Using wind to generate power in the Tennessee Valley is not as efficient as in other regions of the country.

Wind turbines ranging from approximately 250 watts to 5 MW are commercially available today. The average size of wind turbines installed in the United States in 2008 was 1.65 MW. Using the average turbine capacity and above capacity factor for the TVA power service area, approximately 48,200-MW wind projects, each consisting of 121 wind turbines, would be required to generate the annual power generation needed to substantially meet the purpose and need of this project (about 9,600 MW, due to the low capacity factor associated with wind generation). The 48 projects (approximately 5,808 wind turbines) in total would require an estimated 900 sq mi of land, of which 5 percent would be occupied by turbines, access roads, switchyards, and other equipment. The remainder would be required for adequate spacing to minimize wake effects of surrounding turbines. The required area is about the size of the Great Smoky Mountains National Park. Moreover, the expected capital cost increase for installing 100-m hub height wind turbines is 5 – 10 percent over 80-m wind turbines. A substantive increase in capacity factor would be required to recover the higher investment costs. In addition, there are current infrastructure limitations such as erection crane capabilities and tower transportation limitations that present uncertainty in the practical feasibility of 100-m hub heights. Therefore, due to the amount of land, the lack of availability to produce the equivalent annual energy, and the visual impacts of 100-m hub heights, wind power alone is not a reasonable alternative to meet the project purpose and need.

Because the potential and economics for wind energy development in the TVA region are not as great as in other parts of the U.S., TVA anticipates a large portion of wind energy it obtains in the future will be generated outside the TVA region. In addition, because TVA is not eligible for investment and production tax credits available to private developers, TVA assumes future additions of wind generating capacity will be through PPAs (TVA 2011a). Section 2.1.2 below addresses PPAs as an alternative to renewing SQN operating licenses.

2.1.1.4. Solar

Generation from solar power is available in two different technologies: concentrating solar power (CSP) and PV. Due to the low rate of delivery of solar radiation within the TVA power service area, CSP technologies (i.e., solar thermal plants using parabolic troughs, power tower, etc.) were not considered a reasonable alternative in TVA's analysis. For example, direct solar radiation in Memphis, Tennessee, located in the region of the state where solar radiation is highest, is approximately 4.4 kilowatt hours per square meter per day ($kWh/m^2/day$) (NREL 2010), which is below the minimum level of 6.75 $kWh/m^2/day$ required for a viable CSP generating facility (Balir 2006). Solar PV can make use of both direct solar radiation and diffuse horizontal radiation, which is one reason PV is technically feasible in more areas of the United States than CSP technologies.

The average solar radiation for PV technology was estimated from National Renewable Energy Laboratory's (NREL) solar radiation map for the western portion of the TVA power service area as 4.9 $kWh/m^2/day$ (NREL 2010). The solar PV capacity factor in the western portion of the TVA service area is calculated at 17 percent, which is equivalent to approximately four hours of usable solar radiation available each day. Some days have more or less solar radiation available, but this assumption is used to simulate base load operation in the discussion below.

Solar PV generation is assumed to be stored in batteries that generate electricity during periods of no or low solar radiation. Battery storage systems used for energy management are those that have a deployment duration exceeding one hour. Commercially available systems come in standard unit sizes, ranging from 250 kilowatts (kW) to 2 MW. Systems of batteries are assembled to meet the needs of a particular project. One of the largest battery storage systems installed for energy management applications has a 34-MW power capacity with six hours of storage capacity (Mizutani 2009). A sodium sulfur (NaS) standard battery size of 2 MW with six hours of storage capacity and an electrical efficiency of 70 percent was used for the purposes of this evaluation. The battery system would be recharged from the PV modules during daylight and discharged when the PV power is not available. A solar-to-electric efficiency of 8.6 percent is typical for the complete PV panel and battery system.

The total installed land area required for commercial PV on a fixed 30-degree tilt support structure with appropriate spacing between panels for roads and to avoid shadow effects is estimated to be 5.9 acre/MW. Using the above-calculated capacity factor, approximately 351 50-MW PV facilities with a total land area of 103,000 acres (about 161 sq mi) would be required to meet this project's purpose and need. The estimate of land area does not include new transmission lines that would be required and would further increase land use impact. Because a large land area is required to develop such a PV system, this option does not meet the criteria for a reasonable alternative.

2.1.1.5. Biomass

Biomass power plants use organic matter to generate electricity. Biomass is one of the few renewable power options that can be operated at a relatively high capacity factor (85 percent) and is "dispatchable," meaning that its generation can be planned and scheduled much like a conventional fossil-fueled unit. TVA is performing biomass fuel availability surveys in the region, and a comprehensive study is underway to assess the feasibility of converting one or more coal-burning units to biomass fuel. Biomass generation was a qualifying technology in TVA's request for proposal issued in 2008 for renewable resources. However, very few competitive bids sourced from biomass were received. This may suggest doubt in the marketplace about the sustainability of biomass generation in the TVA power service area at reliably competitive prices.

Agricultural and forest resources provide the most prevalent form of biomass fuel available in the TVA power service area. These include agricultural "crop" residues (i.e., by-products of harvest), dedicated energy crops (e.g., switchgrass on Conservation Reserve Program [CRP] lands), forest residues (i.e., waste products from logging operations), and methane gas by-products from livestock manure. Biomass resources such as primary milling residues (i.e., by-products of commercial mills), secondary milling residues (i.e., by-products of woodworking and furniture shops), urban wood residues (i.e., waste wood products from construction, demolition, and residential), and methane gas by-products from landfills and wastewater treatment facilities are not as prevalent in less densely populated regions such as the TVA power service area. Estimates of agricultural residues by state and county were obtained from the U.S. Department of Agriculture's (USDA) National Agricultural Statistics Service (USDA 2009a). Dedicated energy crops by state and county were estimated from data obtained from the Farm Service Agency of the USDA (USDA 2009b). Forest and primary milling residues by state and county were obtained from the U.S. Forest Service Southern Research Station's timber product output reports (USFS 2007). Secondary milling residues, urban wood residues, and methane gas amounts by state were obtained from an NREL report (Milbrandt 2005) and scaled to the area of each state within the TVA power service area.

The capacity and energy from each biomass fuel source was estimated by assuming the most likely generation technology to be used. A stoker or bubbling fluidized bed technology with a heat rate of 15,000 British thermal units (BTU)/kWh was assumed for solid fuel. For methane gas as fuel, an internal combustion engine at a heat rate of 12,500 BTU/kWh was assumed. Approximately 2,500 MW of biomass generation is estimated from agricultural and forest resources. Some 210 MW of biomass generation is estimated from nonutilized primary and secondary mill residues and urban wood residues. Another 60 MW is estimated from landfill and wastewater treatment methane sources. While there is enough biomass available to produce the required base load capacity, the feasible capacity is much lower. There are substantial environmental impacts from converting all CRP land to produce energy crops and removing agricultural residue from the cropland.

Whether based on agricultural or forest resources, or population-based sources, biomass fuel is dispersed and must be collected and processed for use in biomass generating units. Consequently, the cost of collection system infrastructure and diesel fuel generally limits biomass collection to a 50-mile radius, which in turn limits plant capacity to a maximum of 30 – 50 MW. Biomass generating units with required emissions controls provide about the same capacity factor and environmental impacts as a small coal plant. In the context of the purpose and need, a biomass-fired plant does not meet the criteria for a feasible alternative due primarily to impacts on air quality, waste management, and the impacts of biomass fuel collection infrastructure, and is therefore not evaluated in detail in this SEIS.

2.1.1.6. Hydropower

The DOE's Office of Energy Efficiency and Renewable Energy study (DOE 2006) was used to develop an estimate of hydropower resources feasible for development within the TVA power service area. The DOE report estimates the annual average power available for development and, of available, how much would be feasible to develop. Available annual average power is based on those sites not located in zones where hydropower development is unlikely, and not co-located with existing hydropower plants. The determination of availability also did not consider ownership or control of available sites. The project feasibility criteria included such factors as land use and environmental sensitivities, prior development, site access, and load and transmission proximity.

The TVA power service area encompasses much of the state of Tennessee and portions of neighboring states. The portion of available annual average hydropower in each state was determined by estimating the number of sites within the TVA power service area for that state as compared to the number of sites in the entire state. The amount of feasible annual average power in each state was estimated to be in the same proportion as the feasible to available power in that state. Additionally, the annual average power was converted to capacity using state-specific, 30-year average capacity factors reported by the DOE’s Idaho National Laboratory (DOE 2003). Using this approach, the total feasible hydropower capacity is 1,770 MW. None of the feasible capacity estimated in the TVA power service area is categorized as large power (greater than 60 MW). Seventy percent of the feasible capacity was categorized as small hydro (less than 60 MW and greater than 2 MW), and 30 percent was low power resources (less than 2 MW). Low power resources include conventional technology, ultra-low head and kinetic energy turbines, and micro-hydro power. Compared to nuclear generation, new hydropower has lower capacity factors and more severe environmental impacts. Therefore hydropower development in the TVA power service area is not a feasible alternative for meeting the project purpose and need.

2.1.1.7. Geothermal

Geothermal energy is the conversion of heat from within the earth to electricity. Electric power generation from geothermal resources has been a commercial reality in some parts of the United States for several decades. The advantage of geothermal power is the ability to be dispatchable with no emissions. However, there are very few accessible geological formations in the TVA region, making this an unlikely source for renewable energy in the region. Therefore, geothermal alternatives are not considered reasonable alternatives.

2.1.2. Alternatives Not Requiring New Generating Capacity

TVA considered several alternatives that would not require construction of new facilities in the TVA power service area to meet the projected system needs. The alternatives below were evaluated using the criteria listed in Section 2.1, but for the reasons discussed below, were rejected from detailed consideration.

2.1.2.1. Power Purchases

TVA regularly reviews purchased power options (buying energy, capacity, or both from other suppliers for use on the TVA system) and has entered into long-term contracts to obtain firm capacity. TVA has a long-term base load purchase from the Red Hills coal-fired plant for 432 MW, a long-term lease of the Caledonia combustion turbine plant for about 900 MW, a long-term hydroelectric purchase of 362 MW from the Southeastern Power Administration, a long-term hydroelectric purchase of 330 MW from Alcoa Power Generating Inc., long-term PPAs, some of which are conditional, for wind energy resulting from the December 2008 request for proposals for renewable or clean energy sources totaling 1,350 MW, and short-term purchases from the wholesale power market. All long-term purchases continue through at least 2029. Therefore, the use of purchased power is already included in TVA's current and future capacity estimates. Purchasing additional power from other generators was not addressed further because it (1) is already part of TVA's resource portfolio, (2) transfers environmental impacts to another location, and (3) involves additional potential impacts on transmission if sources are outside the TVA power service area. There is also risk that purchased power will not be delivered. As described in Section 1.3.4, TVA must plan total generating reserves to accommodate the potential for undelivered purchased capacity.

2.1.2.2. Repowering/Uprating Electrical Generating Plants

Repowering electrical generating plants is the process by which utilities update, change the fuel source, or change the technology of existing plants to realize gains in efficiency or output. Power uprates would be a potential alternative source of base load electricity. NRC has approved power uprates for TVA's BFN and WBN since 1998, and TVA is seeking additional uprates for its BFN units. However, power uprates are not sufficient by themselves to generate the capacity and energy provided by the SQN units. TVA continues to modernize its hydrogeneration, which increases its hydrogeneration capacity by 90 MW through 2029 as indicated in the IRP. Neither the additional capacity nor additional energy available from hydropower modernization projects is sufficient to provide necessary capacity and energy in the absence of SQN. Also, TVA is considering converting some fossil units to biomass, and studies are underway to support this. Such conversions would change the operational characteristics of converted units, but would not materially address TVA's base load needs. Moreover, TVA is considering laying up additional coal-fired units. Such lay-ups increase the need to acquire resources beyond those that might be needed if SQN operating licenses were not renewed. Therefore, TVA does not consider uprates and other repowering options as feasible alternatives to meet the project purpose and need.

2.1.2.3. Energy Efficiency and Demand Response

As part of the IRP, TVA has developed program initiatives to focus on reducing energy consumption as well as decreasing peak demand. These EEDR program initiatives include the following elements:

- Residential programs for new site-built and manufactured homes, energyright® home evaluations and in-home energy assessments, heat pump and high-efficiency air-conditioning installation and maintenance, and weatherization assistance.

- Commercial and industrial programs providing technical assistance, efficiency advice, incentives, and audits for new and existing facilities.

- Demand response programs for interruptible loads, direct load control, and conservation voltage regulation.

This SEIS incorporates an EEDR program into the reference case and all other portfolios considered, and reflects the energy efficiency that can result from TVA's programmatic efforts. These reductions are in addition to naturally occurring energy savings due to existing legislation and policies, and the independent programs of its distributors. The spring 2010 reference case includes an EEDR program that reduces required energy needs by about 6,300 GWh in the 2020 – 2021 time period.

The IRP evaluates several alternative strategies for the EEDR portfolio. The three highest ranked strategies in the IRP include EEDR alternatives that reduce energy needs by up to an additional 8,500 GWh per year above the reference case — almost the equivalent of one SQN unit. However, the IRP also shows that the need for power in 2020 – 2021 is approximately 39,000 GWh, whereas the largest EEDR portfolio has projected energy savings of about 14,500 GWh in that same time frame. Therefore, even if this EEDR portfolio were implemented successfully, additional resources would still be required to meet the need for power caused by the shutdown of SQN. Some of that need could potentially be met by even more EEDR programs, but implementation challenges (i.e., participation rates, maturity of technology, external economic conditions), may reduce the effectiveness of such additional programs. So EEDR, by itself, would likely not be sufficient to meet or offset the base load power provided by SQN.

2.1.3. Combination of Alternative Sources

Combining alternatives could achieve an energy profile similar to base load operation. There are many possible combinations of the coal, gas, solar, wind, biomass, and hydro alternatives described above. Combinations can utilize storage technology with wind or solar technology, or augment the variability of wind and solar power with the responsive availability of fossil generation (coal and gas) or biomass generation.

Storage technology such as compressed air energy storage (CAES) could be combined with wind generation. TVA has an existing 1,600-MW pumped storage plant at Raccoon Mountain, near Chattanooga, Tennessee. Excess energy from lower-cost generating resources is used to pump water from Nickajack Reservoir to the upper reservoir during periods of low power demand. The pumps are reversible and utilized as turbines to produce power using water from the upper reservoir during periods of high demand. Additional pumped storage sites are available in the TVA power service area and could be developed in place of CAES to store excess wind energy from off-peak periods and produce power in periods when wind power is not available. Pumped storage plants require 2,000 to 3,000 acres for the upper pool, the generating plant, and a lower pool if another reservoir is not available. The environmental impacts associated with construction of a pumped storage plant are typical of projects of this scope and size, including recreation and scenic impacts, potential disruption of terrestrial and aquatic habitats, cultural resource impacts, and socioeconomic impacts.

A CAES facility combines features of pumped hydro storage and combustion turbines. It uses off-peak (i.e., lower cost) energy to compress air, inject it into wells, and store it in an underground reservoir such as an underground salt cavern or aquifer. During periods of high demand, the stored, pressurized air is released, heated, and passed through natural gas-fired turbines which drive the motor/generator. Development of CAES would require identification of a suitable storage location and likely would require construction of a new natural gas-fired plant.

Renewable generation also could be combined with fossil generation instead of a storage technology to provide energy when renewable resources are not available. A natural gas-fired plant generally has fewer environmental impacts than a coal-fired plant. But the natural gas-fired facility alone has environmental impacts greater than nuclear, particularly those related to the emissions of air pollutants and greenhouse gases. As a result, the combination of a natural gas-fired plant and wind, solar, or hydro facilities would have environmental impacts equal to or greater than those of SQN.

Each of the potential combinations discussed above requires large land areas and/or has impacts to air quality due to combustion of natural gas or biomass. Therefore, the environmental impacts of combinations of alternatives are substantially greater than those of the proposed operating license renewals.

2.1.4. Conclusion

TVA concluded in Section 1.3 that new generating capacity between 2020 and 2040 is necessary to maintain system reliability. TVA's existing generating supply consists of a combination of existing TVA-owned resources, budgeted and approved projects (such as new plant additions and uprates to existing assets), and PPAs. This supply includes a diverse combination of coal, nuclear, hydroelectric, natural gas and oil, market purchases, and renewable resources designed to provide reliable, low-cost power while reducing the risk of disproportionate reliance on any single resource.

TVA has considered alternatives to providing capacity and energy in 2020 – 2041, including renewing SQN operating licenses and other alternatives requiring or not requiring new generating capacity. Purchasing additional power from other generators was not addressed further because it is already part of TVA's portfolio of resources, transfers environmental impacts to another location, involves additional potential impacts on transmission if sources are outside the TVA power service area, and has increased risk components to TVA-owned and controlled resources. Power uprates are not sufficient by themselves to meet forecasted capacity needs. Even with substantial energy demand reduction through conservation measures, TVA must still add new generation to balance resources with the projected load requirements.

The addition of other types of generating capacity as an alternative to SQN operating license renewals was also evaluated and included fossil fuel energy sources as well as nuclear and renewable energy sources.

Coal-fired power was found to be least preferable environmentally due primarily to impacts on air quality, waste management, and aesthetics. A coal-fired alternative using CCS technology was not considered a reasonable alternative due to the high capital investment and operating costs and the overall implementation risk of CCS at this stage of development. Oil-fired generation was not considered a reasonable alternative due to high emissions. None of these options are able to substantially meet the purpose and need for the proposed action.

Compared to a nuclear facility, renewable energy sources such as wind and solar have substantial land requirements for generating electricity. Additionally, to provide generation profiles similar to a nuclear unit, they must be coupled with energy storage capacity, which further increases the land requirement to compensate for additional efficiency losses, or with fossil-fueled generation, which increases the impact on air quality. Biomass as a renewable fuel can be used to provide base load power, provided an adequate fuel supply exists; however, the air quality impacts are much greater than with nuclear resources. New hydroelectric power is less environmentally preferable given its lower capacity factors, environmental impacts, and the limited availability of feasible new sites in the TVA territory.

Furthermore, when the system resources study was conducted, none of the resources above, either individually or in combination, were shown to provide the lowest-cost option for operating the TVA system. In the circumstance where SQN was not available to provide capacity and energy, the least-cost option for providing power included construction of new nuclear units, or when nuclear expansion was not an option, construction of new gas-fired combined-cycle units.

New nuclear units are an alternative in this SEIS because they produce base load power and have similar environmental impacts during operation as the existing SQN. Several features of simple cycle combustion turbines, including their relatively low capital cost, short construction times, low emissions, and rapid start-up times, make them attractive for generating peaking power during short periods of high demand, but their lower efficiencies make them unreasonable for generating base load power. Combined-cycle plants are a more feasible alternative in this SEIS because they provide higher efficiency than simple cycle plants and produce relatively low CO_2 emissions, albeit emissions that are still higher than nuclear generation.

2.2. Alternatives

As described in Section 2.1, TVA has considered a wide range of actions to supply approximately 2,400 MWe of base load power generation between the years 2020 and 2041 and to meet the other identified purposes of this proposed action. Relative to SQN, taking action to continue operation would result in pursuing renewal of the operating licenses. Taking no action to renew the SQN operating licenses would result in ceasing operation of SQN Unit 1 in 2020 and Unit 2 in 2021. Subsequently, TVA would need to rely on alternate means to provide adequate capacity and energy in the absence of SQN. As described above, alternatives sufficient to meet the project purpose and need include construction of new generating capacity along with changes in utilization of existing and planned resources. Therefore, in this SEIS, changes in the utilization of TVA power generation assets and the system energy dispatch to compensate for the loss of SQN are key components of implementing a No Action Alternative.

2.2.1. Alternative 1 – SQN Units 1 and 2 License Renewal, Action Alternative

Alternative 1 is to seek renewal of operating licenses to allow for the continued operation of Units 1 and 2 for an additional 20 years. Under Alternative 1, TVA would submit the LRA to the NRC. Assuming the NRC approves the LRA, SQN would be available as a reliable base load generation plant until midnight on September 17, 2040, for Unit 1 and until midnight of September 15, 2041, for Unit 2.

Continued Operation During the License Renewal Period

Under Alternative 1, the two Westinghouse-designed PWRs would continue to operate within the approved design basis and operational limits as allowed by the NRC licenses. Routine operations would include operation at full power for extended periods of time (approximately 18 months for a fuel cycle). Chapter 1 provides a detailed description of the SQN plant.

Under Alternative 1, the SQN nuclear reactors would continue to produce steam in the steam generators and produce electrical power by steam-driven turbine generators. The cooling water needed to support SQN power generation would be drawn from Chickamauga Reservoir. Once-through cooling would be used for the majority of the year, with cooling towers in a helper mode for approximately 112 days per year to ensure SQN complies with regulatory thermal limits. Water from the circulating water system would continue to be discharged into Chickamauga Reservoir in accordance with SQN's NPDES permit. As discussed in Section 3.1, water withdrawal and discharge would continue to be approximately 1,540 millions of gallons per day (MGD) for both units; there is very little consumptive water loss (0.1 MGD) with this method of operation.

Solid LLRW would continue to be generated during the license renewal term. During the license renewal term, the quantity of dry active waste (DAW) processed and shipped off site annually would be expected to be consistent with current annual generation volumes; for example, approximately 121 cubic meters of DAW was generated at SQN in 2008. Routine releases of small amounts of radioactive liquids and gases would also continue during the period of license renewal and would continue to be controlled in accordance with federal regulations to ensure the health and safety of the public. Section 3.18 provides a detailed discussion of radioactive wastes.

Operation of SQN during the period of license renewal would continue to support TVA’s goal of reducing carbon emissions from electrical power generation. Air emissions from nuclear generation are extremely low, with emissions related mostly to the off-site uranium fuel production, transportation, vehicle use, and occasional use of on-site support equipment such as emergency diesel generators and heavy equipment. SQN’s emissions are very low in comparison with fossil-fueled electrical power generation, so the continued operation of SQN would support TVA goals. It is reported that a 1,300-MW nuclear power plant would avoid direct annual emissions of about 8.5 million tons of CO_2 when compared to a similarly sized coal plant (NRC 1996); therefore, SQN avoids approximately 16 million tons of CO_2 annually [(2,400 MW/1,300 MW) * 8.5 million tons = 15.69 million tons] compared to a coal-fired plant. For further discussion of air quality, see Section 3.16.

Routine maintenance and upkeep of SQN would continue through the license renewal period to ensure the safe and reliable operation of both units. All programs, procedures, and training of personnel would ensure the units could continue to operate at a high capacity factor (>90 percent) and produce reliable base load generation.

Current work force requirements, approximately 1,144 personnel, would continue during the additional years of operation. No changes in manpower for normal operations or refueling outage support are anticipated. Very little change to current operational needs would be expected.

SQN would shut down each unit for refueling at the end of each fuel cycle. The refueling outage duration per reactor unit is typically 30 to 33 days. During each refueling outage, spent fuel would be removed from the reactor core and new fuel bundles would replace the older and unusable spent fuel. The unusable spent fuel would be stored in the spent fuel storage pools until they could be moved to the on-site ISFSI that uses dry cask storage.

The renewal of the SQN licenses would allow for the extended period of operation of the units under the same requirements, technical specifications, and limits currently in place. Any changes to the provisions of the operating licenses (i.e., license amendments) would require NRC approval in accordance with applicable regulations. No changes would be expected for the permits currently in place. The current programs, procedures, and permits would be followed; no major changes are needed to implement this alternative.

The routine plant operation and maintenance activities that would be performed during the license renewal period are not refurbishments as described in Sections 2.6 and 3.1 of the GEIS (NRC 1996) and would be managed in accordance with appropriate TVA programs and procedures.

Base Load Generation, Reliability, and Grid Stability

During the license renewal term, SQN would continue to supply approximately 2,400 MWe of base load power for a period of 20 additional years. SQN would be expected to continue to supply reliable power by maintaining an average capacity factor of greater than 90 percent. Due to its large and stable generation capacity, SQN would be able to support transmission grid stability, ensuring consistent electrical frequency and voltage.

Uranium Usage and Spent Fuel

Extended operation during the license renewal period would require the use of additional uranium for the nuclear fuel that would be needed between 2020 and 2041. Approximately 13 additional fuel cycles would be needed per reactor unit, resulting in approximately 2,400 acres of additional land being affected by the uranium mining necessary to fuel SQN (the generic calculation of land use is for the lifetime of a nuclear unit, but is conservative for this analysis of only 20 years). An extended termination date for operations would mean that additional spent fuel must be temporarily stored at an approved storage facility until the DOE can take responsibility for the spent fuel and place it in a permanent disposal or storage facility. An expansion of the spent fuel storage capacity for SQN, in addition to the current ISFSI, would be required to provide temporary storage of the additional spent fuel created from the operation of SQN during the license renewal period.

If the license renewal were approved by the NRC, TVA would have to increase on-site spent fuel storage capacity by 2026. TVA determined there were no significant impacts to the environment from construction and operation of the current on-site ISFSI (TVA 2002c). Similarly, the proposed expansion of SQN spent fuel storage capacity is expected to result in minimal disturbance to the environment. The expansion of SQN storage capacity would only require the construction of an additional concrete pad space and potential security measures. Existing on-site structures and equipment used to handle and place spent fuel into the manufactured concrete casks could be used to support the additional storage space. Programs and procedures used in association with the on-site ISFSI would continue to be used.

Spent fuel that has been removed from the reactors and put in the spent fuel pools for a sufficient duration would be moved to concrete storage packs for dry cask storage, as is currently being done. The additional concrete pad site could continue to use Holtec International (HOLTEC) Hi-Storm 100 (S) B casks and would be of sufficient capacity for handling all additional spent fuel. The HOLTEC-designed 32-capacity multipurpose canister (MPC-32) is being used along with the HOLTEC casks, and likely would be used in the future.

A specific site for the additional concrete storage pad has not been determined, but it would likely be located inside the existing security-protected area. Previous environmental assessments screened 13 potential sites to locate the current ISFSI storage pad, and a similar evaluation would be performed to choose the new additional storage pad location. Depending on the location chosen, the expansion would require minor construction activities that could potentially require excavation of concrete and soil to facilitate construction of the storage pad for the storage of the fuel outside in concrete dry storage modules. The new concrete storage pad would be of similar size and thickness to the existing concrete pad (115 feet by 243 feet and 2.5 feet thick) for the current ISFSI. (TVA 2002c)

Waste

On September 15, 2010, in an NRC staff requirements memorandum, the NRC approved the final revisions to the "Waste Confidence" findings and current regulation (10 CFR 51.23), expressing the NRC's confidence that the nation's spent nuclear fuel can be safely stored for at least 60 years beyond the licensed life of any reactor and that sufficient repository capacity would be available when necessary (NRC 2010).

Non-radioactive waste (general trash, hazardous waste, and special waste) would be generated at the same annual rates as they are currently generated. In 2009, SQN generated 778.1 tons of municipal solid waste (MSW), of which 59.2 tons were recycled. Hazardous waste generated in 2009 was 1,062.6 pounds. Detailed discussion of non-radioactive waste is provided in Section 3.14.

2.2.2. Alternative 2 – SQN Units 1 and 2 Shutdown – No Action Alternative

The No Action Alternative (Alternative 2) is the decision not to renew the SQN operating licenses in accordance with NRC federal regulations. If Alternative 2 is approved, TVA would have to shut down each unit on or before the current license expiration dates. Under Alternative 2, SQN would continue to operate under current licenses until midnight on September 17, 2020, for Unit 1 and midnight September 15, 2021, for Unit 2.

If SQN is shut down as required by the current licenses, each unit would then be required to enter the long-term process of decommissioning. SQN would be placed in a safe condition and all fuel would be removed from the reactor. Once SQN achieves safe shutdown conditions, the current SQN work force (1,144 permanent and contract workers) would decline over a period of a few years to a minimal maintenance size. Decommissioning activities would begin after the permanent and safe shutdown of the units is achieved and after the formal decommissioning plans are approved by the NRC. At this phase of the project, future land-use decisions would be made. During decommissioning, a new but smaller temporary work force would be employed to deconstruct the radioactive components and structures while stored radioactive waste would be shipped off site for permanent disposal. Based on potential new land-use changes, the work force would remove and clear any of the buildings, land, ponds, etc. that would not be part of the new land-use plans for the site property. The goal of decommissioning would be to remove all radioactive materials and return the site to a condition that no longer requires any control or oversight by the NRC. The ISFSI would continue to be regulated by the NRC under its separate general license. The ISFSI would be operated as a separate facility until the DOE takes responsibility for the spent fuel and removes it from the site. Eventual decommissioning of the ISFSI would be conducted according to NRC requirements.

Upon achieving shutdown conditions, the base load electrical power generation capacity would be lost, and TVA's ability to provide adequate power could be affected. TVA has the responsibility to ensure that the loss of SQN electrical base load generation does not adversely impact the TVA transmission system and its customers. If the No Action Alternative is adopted, TVA would adjust the utilization of generation assets to meet power demand. Current forecasting and power system planning models show that, if SQN were shut down, TVA would need to build new capacity in addition to operating existing resources, implementing approved new projects (e.g., WBN Unit 2 projected to operate in 2013), and pursuing other planned expansion. Based upon the evaluation process described in Section 2.1 above, TVA has identified two alternatives to providing power in the absence of SQN. The two alternatives include constructing new nuclear generation (Alternative 2a – New Nuclear Generation) or new natural gas-fired generation (Alternative 2b – New Natural Gas-Fired Generation). If the No Action Alternative is adopted, one of those alternative strategies for meeting power demand could be implemented to meet the need for power in the TVA system.

In addition, if the SQN license is not extended and the plant is shut down, there may be impacts on transmission system reliability that require upgrades and changes to some of TVA's transmission lines and infrastructure. This could include upgrading existing lines and, possibly, building additional lines. The scope of such activities would have to be carefully evaluated, including potential environmental impacts, and would depend on constraints and demands on the TVA system in the future. Depending on the significance of any such changes, additional environmental reviews would be conducted and public input sought.

2.2.2.1. Alternative 2a – New Nuclear Generation

Under Alternative 2a, if power were no longer generated by SQN, TVA would change the way its generation system dispatches power in order to meet forecasted demand. Given that the comparatively inexpensive generation from SQN would not be available, TVA's resource planning studies indicate that the least-cost option for generating power could be provided as shown in Figure 2-2 above. This least-cost option is based on an optimized capacity plan that would minimize the cost of providing power, recognizing that the capacity and energy provided by SQN must be replaced to reliably meet future load demand. This optimized plan includes changes to the commercial operation date of resources otherwise planned in the spring 2010 reference case and the addition of new nuclear capacity beginning in 2025. In addition, increased production from existing resources (both coal and gas-fired) that would not have been operating at maximum capacity factor under Alternative 1 is also required to replace the power that would have been provided by the SQN units.

This option would be more expensive than the option of continuing SQN operations. Additionally, as noted in Section 2.1.1.2, use of any of these fossil-fueled thermal resources would produce substantially more air emissions than nuclear generation for that interim period and would slow TVA's move towards lowering carbon and other air emissions.

Nevertheless, this alternative describes a likely result of taking no action to renew SQN operating licenses.

Construction and Operation

TVA would identify a suitable site and make the decision on the type of approved reactor technology. Since 1997, the NRC has certified four new standard designs for nuclear power plants under federal regulations (10 CFR Part 52, Subpart B). These designs are the 1,300-MW U.S. advanced boiling water reactor (BWR) (10 CFR Part 52, Appendix A), the 1,300-MW System 80+ design (10 CFR Part 52, Appendix B), the 600-MW AP600 design (10 CFR Part 52, Appendix C), and the 1,100-MW Advanced Passive 1000 (AP1000) design (10 CFR Part 52, Appendix D). All of these designs are for advanced light water reactors (LWR). Four additional designs are under review and awaiting certification, and three others are undergoing pre-application reviews. Several designs in pre-application review are not LWRs; these include the helium-cooled, pebble-bed modular reactor, and the heavy water-moderated and cooled advanced Candu reactor. Information provided by the NRC as of June 2010 indicates that 18 applications for combined construction and operation licenses, for a total of 28 units, along with six applications for early site permits, have been submitted to the NRC for review. Four early site permit applications have been approved and issued.

TVA would evaluate the various available approved reactor technologies and decide which would best meet the TVA mission and goals. TVA is exploring potential use of the AP1000 reactor technology at BLN. Technology-related specifics used in this SEIS are examples only, and most are examples of the AP1000 technology design.

Construction of a new nuclear power plant at SQN is not considered feasible due to the lack of available land within the site boundaries. Under Alternative 2a, TVA would construct a new nuclear power plant at an alternate site. Construction locations may include a greenfield (i.e., undisturbed) site or a brownfield site. Siting would be conducted in accordance with the Electric Power Research Institute (EPRI) guidance *Siting Guide: Site Selection and Evaluation Criteria for an Early Site Permit Application Final Report* (EPRI 2002), the NRC Regulatory Guide 4.7 *General Site Suitability Criteria for Nuclear Power Stations* (NRC 1998), and TVA procedures that would include a site-specific environmental review.

When planning new generating facilities, TVA uses several criteria to screen potential sites. Generating facilities are often needed in specific parts of the TVA power service area in order to support the efficient operation and reliability of the transmission system. Once a general area is defined, sites are screened by numerous engineering, environmental, and financial criteria. Specific screening criteria include regional geology and local terrain; proximity to major highways, railroads, and barge access; proximity to major natural gas pipelines; proximity to high-voltage transmission lines; land use and land ownership; regional air quality; sources of process water; the presence of floodplains, proximity to parks and recreation areas; potential impacts to endangered and threatened species, wetlands, and historic properties; and potential impacts to minority and low-income populations. Through this systematic process, TVA attempts to minimize the potential environmental impacts of the construction and operation of new generating facilities. (TVA 2011a)

To select a site and complete the permitting and licensing, as well as the construction, would take several years. The required combined operating license application (COLA) would take up to two years to prepare. The NRC review of the application would take two to three years, and the construction could take five to seven years to complete, based upon TVA's experience (TVA 2010b; TVA 2007b).

It is assumed that the new nuclear power plant would have an initial 40-year license term with the opportunity to renew for an additional 20-year license term. The AP1000 plant design is for 60 years (TVA 2010b).

As stated above, construction of the new nuclear facility would take five to seven years. TVA estimated construction of a single AP1000 nuclear unit would require a peak work force of approximately 3,000 (TVA 2010b); construction of a two-unit project working simultaneously could easily require 5,000 workers. The permanent work force needed to support operation of the new nuclear plant would be expected to be approximately 1,000 permanent workers. If the AP1000 technology were chosen, the work force could be as low as 650 permanent on-site staff (TVA 2010b).

Solid LLRW would be generated by the same methods as SQN. The quantity of DAW processed and shipped off site annually would be expected to be consistent with the annual generation volumes of SQN. Routine releases of radioactive liquids and gases would also occur and would be controlled in accordance with federal regulations to ensure the health and safety of the public. Section 3.18 provides a detailed discussion of radioactive wastes.

Operation of a new nuclear plant would support the TVA goal of reducing carbon emissions from electrical power generation. Air emissions are low due to the nuclear generation, with emissions related mostly to off-site uranium fuel production, transportation, vehicle use of personnel, and the occasional use of on-site support equipment such as emergency diesel generators and heavy equipment. Nuclear power plant emissions are very low in comparison with fossil-fueled electrical power generation, so a new nuclear plant would support TVA goals. It is reported that a 1,300-MW nuclear power plant would avoid annual emissions of about 8.5 million tons of CO_2 when compared to a similarly sized coal plant (NRC 1996). Therefore, a new nuclear plant would avoid millions of tons of CO_2 annually compared to a coal-fired plant. Air quality is further discussed in Section 3.16.

Routine maintenance and upkeep of a new nuclear plant would ensure the safe and reliable operation of both units. All programs, procedures, and training of personnel would ensure the units would be able to continue to operate at a high capacity factor (>90 percent) and produce reliable base load generation.

Alternative 2a would shut down each unit for refueling at the end of each fuel cycle. The refueling outage duration per new unit would be typically one to two months. During each refueling outage, spent fuel would be removed from the reactor core, and new fuel bundles would replace the older and unusable spent fuel. The unusable spent fuel would be stored in the spent fuel storage pools.

The new nuclear plant would operate under the appropriate federal regulations and limits. Programs, procedures, and personnel would be similar to SQN. Routine plant operation and maintenance activities would be performed as allowed by regulations and would be managed in accordance with appropriate TVA programs and procedures.

Uranium Usage

The amount of uranium needed to supply the new advanced design nuclear reactors is slightly greater than the older generation units, resulting in slightly greater spent fuel than that produced by older-generation nuclear plants. Under Alternative 2a, each unit would require approximately 26 fuel cycles for the first 40 years of operation (a fuel cycle is approximately every 18 months), which is the same as the current rate of fuel cycles used at SQN.

Land Use

According to the GEIS, an advanced design LWR requires approximately 500 to 1,000 acres, excluding transmission lines (NRC 1996). TVA's existing nuclear plant sites range from about 600 acres (BLN, SQN) to over 1,500 acres (WBN). Under Alternative 2a, TVA would construct two nuclear units on a site approximately 1,000 acres in size.

Additional land would be required to support new transmission lines. New transmission facilities are typically required to transmit power between two defined points or to improve transmission capacity and/or reliability in a defined area. As with generating facilities, potential transmission line routes, substation locations, and switching station locations are screened by numerous engineering, environmental, and financial criteria. Specific screening criteria include slope, the presence of highways, railroads, and airports, land use and land ownership patterns, proximity to occupied buildings, parks, and recreation areas, and potential impacts to endangered and threatened species, wetlands, and historic properties. TVA also encourages participation by potentially affected landowners in this screening process. (TVA 2011a). In addition, it may be necessary to construct a rail spur or barge slip to an alternate site to bring in equipment during construction.

In the GEIS, the NRC staff estimated that approximately 1 acre per MW would be affected for mining and processing uranium during the operating life of a new nuclear power plant. Therefore, approximately 2,400 acres would be affected by the uranium mining necessary to refuel a new two-unit nuclear plant. (NRC 1996)

Surface Water and Groundwater Use

New intake and discharge structures would need to be constructed to provide water needs for the facility. Water used for the new nuclear plant would be expected to come from a major waterbody. TVA is planning to equip all newly constructed power plants with closed-cycle cooling, as discussed in the IRP EIS, and it would be expected that the cooling systems would use mechanical forced-draft or natural-draft cooling tower technology (TVA 2011a). Volumes of surface water used would be dependent on the reactor technology chosen, the characteristics of the site meteorology and the surface waterbody, and the type of cooling system installed. The single AP1000 unit evaluated for BLN would withdraw water from Guntersville Reservoir at the rate of 24,000 gallons per minute (gpm) (34.56 MGD) and consume 16,000 gpm (23.04 MGD) during operations while discharging 8,000 gpm (11.52 MGD) (TVA 2010b). Plant discharges would be regulated by the state in which the plant is located. Thermal and chemical controls would be implemented in accordance with NPDES permitted limits.

Depending on the hydrology of the chosen site, groundwater may be used for sanitary and potable water at the site. It is not expected that groundwater would be considered for cooling water makeup, although this option has been evaluated.

Waste

Construction-related debris common to any large construction project would be generated during construction activities and removed to an appropriate disposal site, either on site or off site. Construction debris includes waste types such as: dirt, concrete rubble, metal, wood, paper, oil, and chemicals. All debris would be recycled in an approved and licensed facility or disposed of in an approved and permitted landfill.

The wastes associated with operation of a new nuclear power plant have been analyzed, listed in various documents (e.g., NRC 1996), and are similar to the wastes generated at SQN. Volumes would vary based on the reactor technology chosen and specific programs used to control waste generation. Waste generation, handling, and shipping would be in accordance with approved procedures similar to existing procedures for SQN.

Non-radioactive waste (general trash, hazardous waste, and special waste) would be generated at rates similar to those at SQN. The AP1000 single unit would be expected to generate 400 tons per year (800 tons per year for two units) of nonhazardous solid waste. Expected hazardous waste generated by a single AP1000 unit is 1,300 pounds per year (2,600 pounds per year for two units). (TVA 2010b) Detailed discussion of non-radioactive waste is provided in Section 3.14.

2.2.2.2. Alternative 2b – New Natural Gas-Fired Generation

Under Alternative 2b, if power were no longer generated by SQN, TVA would change the way its generation system dispatches power in order to meet forecasted demand. Given that the comparatively inexpensive generation from SQN would not be available, and assuming constructing additional nuclear plants would not be an option, TVA's resource planning studies indicate that the least-cost option for generating power could be provided as shown in Figure 2-3 above.

This optimized plan includes changes in the commercial operation date of new resources otherwise planned in the spring 2010 reference case following shutdown of SQN, along with changes in the utilization of existing resources, and the addition of other new natural gas-fired resources in the period 2025 – 2029. In addition, increased production from existing thermal resources (both coal- and gas-fired) that would not have been operating at maximum capacity factor under Alternative 1 is also required to replace the power that would have been provided by the SQN units.

Under Alternative 2b, TVA would identify a suitable site and design new natural gas-fired facilities. For new natural gas-fired generating units, TVA would most likely construct combined-cycle type generation units, because they are more efficient than simple cycle units. In a combined-cycle configuration, the products of combustion, after leaving the combustion turbine, pass through a heat recovery system that converts this useful energy to steam. This steam is used in a steam turbine to produce additional electric power. (TVA 2010c) Combined-cycle systems, with their more complex heat exchange and steam turbine components, are better suited for continuous base load operation (TVA 2010c).

TVA would construct a new natural gas-fired combined-cycle plant at an alternate site. Locations may include a greenfield (i.e., undisturbed) site or brownfield site. It is estimated that the plant site would require between 110 and 132 acres, and additional land for transmission lines and natural gas pipelines could be necessary, depending upon existing infrastructure.

TVA recently evaluated construction and operation of a combined-cycle plant at the JSF facility in Hawkins County, Tennessee (TVA 2010c). For this SEIS, the JSF combined-cycle plant is used as an example of facility design, construction, and potential environmental impacts. Because no decision has been made on generator technology; TVA would evaluate the various available technologies and decide which would best meet TVA goals. Under the potential resource plan shown in Figure 2-3, two additional JSF-type combined-cycle plants would be built and operated to provide sufficient power generation. Much of the following discussion includes generic information based on two plants similar to the JSF combined-cycle plant as provided in the JSF combined-cycle EA.

Construction of a new natural gas-fired plant at SQN is not considered feasible. The SQN site is too small to place gas-fired units on site, especially before decommissioning is complete (decommissioning must be completed within 60 years of permanent cessation of operations), which would not occur in time to compensate for the loss of power generated by SQN. Under Alternative 2b, TVA would construct a new natural gas-fired combined-cycle plant at an alternate site. Construction locations may include a greenfield (i.e., undisturbed) site or a brownfield site. Obtaining permits such as air, water, NPDES, aquatic, construction, and excavation permits along with the required licenses can be a time-consuming process, and the lead time, especially for greenfield sites, can range from 18 – 36 months depending upon attainment status (TVA 2010c). Siting would be conducted in accordance with TVA procedures, which would include a site-specific environmental review. The site-specific environmental review would identify potential impacts to cultural, archaeological, and biological resources, threatened or endangered species, wetlands, floodplains, recreation resources, natural areas, visual quality, and other sensitive resources.

The anticipated lifespan of the natural gas-fired generation units can be as much as 60 years when used as peaking units; use as base load units would tend to decrease the effective lifespan. TVA conservatively assumes a 30-year lifespan for combined-cycle type plants used as base load generation, but this is primarily an accounting assumption (TVA 2010d).

Construction of the natural gas-fired units would conservatively take approximately two to four years if two plants are built at the same time. TVA estimates construction of a single plant at JSF would take approximately 24 – 26 months (TVA 2010c). Based upon data used for the JSF project, a maximum of about 1,200 construction workers would be needed to build a new facility supplying approximately 1,200 MW. Similarly, NRC information indicates peak employment during construction would be approximately 1,440 workers [(1,200 workers/1,000 MW)*1,200 MW] (NRC 1996). It is assumed that construction of the natural gas-fired facility would occur before 2030, but not before the shutdown of SQN. After construction, the new permanent operation work force would consist of approximately 180 workers [(150 workers/1,000 MW) * 1,200 MW] (NRC 1996).

Preliminary estimates indicate that as much as 0.86 million standard cubic feet per day of natural gas would be needed for the JSF plant. Operation of two natural gas-fired combined-cycle plants as base load resources would emit approximately 1,128 tons of NO_x, 208 tons of SO_2, 576 tons of carbon monoxide (CO), and 274 tons of particulate matter (PM) each year of operation. Air quality standards would have to be met, but the air pollutants for this alternative are far greater than the nuclear alternatives described in this SEIS. (TVA 2010c) On average, a coal-fired plant produces about 2,000 pounds of CO_2 per megawatt hour (MWh) of generation, and natural gas combined-cycle generation produces about 1,000 pounds of CO_2 per MWh. (TVA 2010c)

There would be no radioactive liquids, gases, or solids generated as a result of operation of a natural gas-fired facility.

Land Use

In the GEIS, the NRC estimated that 110 acres are needed for a 1,000-MW natural gas-fired facility (NRC 1996). Assuming 110 acres per 1,000 MW, two natural gas-fired units would therefore require approximately 132 acres. As a rough estimate, construction of two combined-cycle plants could require about twice the 55 acres developed for the JSF combined-cycle plant, or approximately 110 acres (TVA 2010c). For construction at an alternate greenfield site, the full land requirement for a range of 110 to 132 acres for a natural gas-fired facility could be necessary because no existing infrastructure would be available. Additional land would be impacted by construction of transmission lines and natural gas pipelines to serve the plant. The extent of those transmission structures would depend on the characteristics and location of the alternate site. If the plant were constructed on an existing brownfield site near available infrastructure, the amount of land required to be converted to industrial use could be less.

Regardless of where the natural gas-fired plant would be built, additional land would be required for natural gas wells and collection stations. According to NRC data, approximately 4,320 acres [(3,600 acres/1,000 MW)*1,200 MW] would be needed for wells, collection stations, and associated pipelines (NRC 1996). Partially offsetting these off-site land requirements would be the elimination of uranium mining to supply fuel for SQN. In the GEIS, NRC staff estimated that approximately 1 acre per MW would be affected for mining and processing the uranium during the operating life of a nuclear power plant (NRC 1996). Therefore, approximately 2,400 acres of land would no longer be mined to supply fuel to SQN. The final location of the site, pipelines, transmission lines, gas wells, compressor stations, and support equipment would determine the overall impacts on land use.

Surface Water and Groundwater Use

New intake and discharge structures would be constructed to supply cooling water to the new facility. TVA is planning to equip all newly constructed power plants with closed-cycle cooling. Cooling water at an alternate site would likely be withdrawn from a major surface waterbody and be regulated by permit. The JSF combined-cycle plant requires withdrawal of a maximum 7.21 MGD of combined-cycle process water (TVA 2010c), while a plant equal to two JSF plants would require twice that much process water (14.4 MGD). Plant discharges would be regulated by the state in which the plant is located. Thermal and chemical controls would be implemented in accordance with NPDES permitted limits.

Depending on the hydrology of the chosen site, groundwater may be used for sanitary and potable water at the site. It is not expected that groundwater would be considered for cooling water makeup, although the impacts were reviewed for completeness of the groundwater analysis.

Waste

Construction would be similar to construction of any large industrial facility. Construction-related debris would be generated during construction activities and removed to an appropriate disposal site, either on site or off site. Construction debris includes waste types such as dirt, concrete rubble, metal, wood, paper, oil, and chemicals. All debris would be recycled in an approved and licensed facility or disposed of in an approved and permitted landfill.

There are only small amounts of solid waste products from burning natural gas fuel. The waste generation from gas-fired technology would be minimal. Gas firing results in very few combustion by-products because of the clean nature of the fuel. Waste generation would essentially be limited to typical office wastes, waste treatment plant waste, and waste oil.

The primary wastewaters generated by the proposed combined-cycle alternative are cooling tower blowdown, clarifier sludge from the raw water treatment system, reverse osmosis reject from the makeup demineralizer plant, and a combination of heat recovery steam generator (HRSG) blowdown and evaporative cooler blowdown to the blowdown sump. Compressor wash water would be collected and normally disposed off site at an approved wastewater treatment facility.

2.3. Comparison of Alternatives

In this section, proposed actions anticipated under Alternatives 1, 2a, and 2b are compared based upon the information and analysis provided in Section 2.2 and Chapter 3. Alternatives 2a and 2b include changing the way TVA would use existing resources, as well as constructing new generation units. Impacts associated with future deployment of existing resources and expansion resources planned in the spring 2010 reference case are described in the IRP. Chapter 3 and Table 2-1 below provides a comparison of the construction and operational characteristics of SQN as described under the Action Alternative, and the new generation units as described under the No Action Alternative.

Table 2-1. Construction and Operational Characteristics of the Alternatives

Characteristics	Alternative 1 – SQN License Renewal	Alternative 2a – SQN Shutdown and New Nuclear Powered Generation	Alternative 2b – SQN Shutdown and New Natural Gas-fired Generation
Years for license application	One – two years to review license renewal application.	Three years for NRC review and approval of a COLA.	18 – 36 months depending on existing air quality and location.
Years for construction	NA - Operational	Five – seven years with simultaneous construction of both units at the same time.	Two – four years with simultaneous construction of all units at the same time.

Characteristics	Alternative 1 – SQN License Renewal	Alternative 2a – SQN Shutdown and New Nuclear Powered Generation	Alternative 2b – SQN Shutdown and New Natural Gas-fired Generation
Electrical output	2 units = approximately 2,400 MWe	2 units range from 2,000 MWe to 3,400 MWe based on technology chosen.	2 plants = approximately 1,046 MWe
Cooling system	Once-through with cooling towers available to assist when needed to comply with thermal limits.	Closed-cycle	Closed-cycle
Land use	630 acres (525 industrial area and 105 training area peninsula) already in use. No new land is needed for license renewal. Land use can be changed following decommissioning.	Approximately 1,000 acres for 2 new units sited on greenfield site converted from original condition to industrial use, or an existing brownfield site. Land use can be changed following decommissioning.	Range of 110 – 132 acres needed for 2 new plants sited on greenfield site converted from original condition to industrial use, or an existing brownfield site. Land use can be changed following retirement of the plant.
Supporting land use	2,400 acres for mining and manufacture of nuclear fuel.	2,400 acres for mining and manufacture of nuclear fuel.	Up to 4,320 acres for wells, pipelines, compressor stations, etc. (4,320 acres minus 2,400 acres offset for uranium mining elimination results in a net of 1,920 acres).
New transmission, pipelines, ROWs needed	No, already in place.	Substantial acreage could be required depending upon location of the plant.	Substantial acreage could be required depending upon location of the plant.
Construction work force	None, no major construction needed.	5,000 peak work force.	1,200 – 1,440 peak work force.
Operational work force	1,144 current work force.	650 – 1,000 permanent work force.	Approximately 180 permanent work force.

Characteristics	Alternative 1 – SQN License Renewal	Alternative 2a – SQN Shutdown and New Nuclear Powered Generation	Alternative 2b – SQN Shutdown and New Natural Gas-fired Generation
Surface water use	Withdrawal and discharge to Chickamauga Reservoir on the Tennessee River. Withdrawal = 1,540 MGD (open cycle) Discharge = 1,540 MGD (open cycle) Consumptive loss = 0.1 MGD (open cycle) NPDES permit regulates discharge volume and quality.	Likely withdrawal and discharge to a major waterbody using closed-cycle cooling. Withdrawal (AP1000) = 34.56 MGD Discharge (AP1000) = 23.04 MGD Consumptive loss (AP1000) = 11.52 MGD Needs new intake and discharge structures. NPDES permit regulates discharge volume and quality.	Likely withdrawal and discharge to a major waterbody using closed-cycle cooling. Withdrawal (JSF * 2) = 14.4 MGD Discharge of wastewater and cooling tower blowdown for the plant goes to a process pond. Needs new intake and discharge structures. Uses less consumptive water than other alternatives. NPDES permit regulates discharge volume and quality.
Groundwater use	No groundwater is pumped from the area of the site; all potable water comes from off-site sources.	Potential use of groundwater for sanitary and potable uses. Groundwater use for makeup water is not probable.	Potential use of groundwater for sanitary and potable uses. Groundwater use for makeup water is not probable.
Quantities of solid, hazardous, and radioactive waste generated	SQN produces waste in several forms. Solid LLRW generated in 2009 = 121 cubic meters DAW. Municipal solid waste generated in 2009 = 778.1 tons. Hazardous waste generated in 2009 = 1,062.6 pounds. Regular trash from offices and maintenance is contracted for disposal off site. SQN has a RCRA permit for hazardous waste but is often a small quantity generator. Radiological waste,	A new nuclear plant produces waste in forms similar to SQN. Solid LLRW generated would be similar to SQN. Municipal solid waste (AP1000) expected to be 800 tons per year. Hazardous waste (AP1000) expected to be 2,600 pounds per year. Major volumes of dirt, fill, wood, concrete, during construction. Once operational, regular trash from offices and maintenance is normally contracted for disposal off site.	No radioactive waste. Very minor waste volumes. Major volumes of dirt, fill, wood, concrete, during construction. Only normal office, wastewater treatment and oily type waste normally.

Characteristics	Alternative 1 – SQN License Renewal	Alternative 2a – SQN Shutdown and New Nuclear Powered Generation	Alternative 2b – SQN Shutdown and New Natural Gas-fired Generation
	resins, and DAW, and radioactive trash such as rags and clothing are easily handled and packaged for temporary storage and shipment. Spent fuel is stored on site in spent fuel pools and an ISFSI until a permanent DOE repository is created.	A new nuclear plant would require an RCRA permit for hazardous waste, but will normally be a small quantity generator. Radiological waste, resins, DAW, and radioactive trash such as rags and clothing would be easily handled and packaged for temporary storage and shipment. Spent fuel would be stored on site in spent fuel pools and eventually in an ISFSI until a permanent DOE repository is created.	
Air emissions	SQN avoids 16 million tons of CO_2 annually (compared to a coal plant). Nuclear power generation is not a major contributor to air pollutants. Exhaust emissions from machinery and vehicles. Minor air emissions when diesel generators and intermittent sources operate.	A new nuclear plant would be expected to avoid 16 million tons of CO_2 annually (compared to a coal replacement plant). Fugitive dust emissions during construction. Exhaust emissions from machinery and vehicles. Minor air emissions when diesel generators and intermittent sources operate. The nuclear fission process does not contribute to the pollutants or greenhouse gas.	1,128 tons of NO_x, 208 tons of SO_2, 576 tons of CO, and 274 tons of PM produced each year. Natural gas produces approximately 1,000 pounds of CO_2 per MWh. Exhaust emissions from machinery and vehicles. Minor air emissions when diesel generators and intermittent sources operate.
Air emissions of TVA Generating System SO_2 (kTons)	75	89 (2020 – 2024) 78 (2027 – 2029)	92

Characteristics	Alternative 1 – SQN License Renewal	Alternative 2a – SQN Shutdown and New Nuclear Powered Generation	Alternative 2b – SQN Shutdown and New Natural Gas-fired Generation
NO_x (kTons)	35	41 (2020 – 2024) 37 (2027 – 2029)	42
CO_2 (MTons)	74	85 (2020 – 2024) 77 (2027 – 2029)	88
Mercury (lbs)	562	695 (2020 – 2024) 587 (2020 – 2029)	734
Radioactive emissions	Radiation dose to workers and the public within limits specified by federal regulation. SQN radiation dose impacts are currently less than 1 percent of all off-site public dose limits.	Health effects are similar to SQN operation. A new nuclear plant would operate within federal limits and compliance ensures safety of public.	None.

2.4. Summary of Impacts

Table 2-2 below provides a summary of the potential environmental impacts of the Action and No Action Alternatives. As a general guide to the evaluation of impacts for this SEIS, significance is used as a subjective interpretation of the intensity of the impact. As used here, the term **minor** means so small that there will be no alteration of the resource. **Moderate** is used as a term for impacts that can be observed and must be considered as causing some change to the resource. A **substantial** or **major** impact clearly produces an observable impact, and the impact would clearly need to be evaluated for mitigation or producing an impact that may eliminate it from consideration due to a definite negative impact. The terms minor, moderate, and substantial or major are used to evaluate impacts throughout this SEIS.

The Action and No Action alternatives vary significantly in cost. Implementing the No Action Alternative would increase costs by about $4 billion. To determine relative costs associated with implementing the Action and No Action alternatives, TVA calculated the present value of revenue requirements (PVRR), which is the discounted sum of the costs of constructing and operating all existing and planned generating units for 2010 – 2029 (as shown in Figures 2-1, 2-2, and 2-3). Under Alternative 1, the PVRR is $60.33 billion. Under Alternatives 2a and 2b, the PVRR is $64.41 billion and $64.48 billion, respectively. In other words, generation costs between 2010 and 2029 would be between $4.08 billion and $4.15 billion greater if SQN operating licenses were not renewed (as described under the No Action Alternative) than if SQN operating licenses were renewed (as proposed under the Action Alternative).

There are also substantial differences between the alternatives concerning air emissions. Projections of system-wide emissions of SO_2, NO_X, CO_2, and mercury between 2020 and 2029 are show for each alternative in Table 2-1 above. Should TVA decide to take no action to renew SQN operating licenses, the likely increased use of existing gas and coal-fired units, as well as the construction of additional gas units, would increase emissions from those sources. Under Alternative 1, continued operation of SQN helps reduce emissions of carbon and air pollutants, consistent with TVA's environmental policy.

2.5. The Preferred Alternative

TVA has identified Alternative 1 – SQN Units 1 and 2 License Renewal as the preferred alternative. Implementing the preferred alternative would provide the Tennessee Valley with an additional 20 years of reliable base load power while promoting TVA's efforts to reduce carbon emissions, make beneficial use of existing assets, and deliver power at the lowest feasible cost. As an existing plant, continued operation of SQN would not result in additional environmental impacts while contributing to meeting the demand for base load energy sources on the TVA system in the future.

Table 2-2. Summary of the Environmental Impacts of the Action and No Action Alternatives

Resource	Attribute/Potential Effects	Alternative		
		1 – SQN License Renewal	2a – SQN Shutdown and New Nuclear Generation	2b – SQN Shutdown and New Natural Gas-Fired Generation
Surface Water	Chemical or thermal degradation of surface water quality.	There would be no major construction activities. All releases to surface water would be controlled as per NPDES permits and remain minor. SQN complies with current NRC and TDEC regulations. No change anticipated regarding potential impacts from the current level of minor impacts anticipated. Direct, indirect, and cumulative effects of chemical and thermal discharges would be minor.	Temporary and minor impacts from sedimentation and erosion during construction. No cumulative construction impacts are anticipated. Compliance with NPDES permit would limit potential impacts. Cooler discharge due to closed- cycle cooling. Thermal impacts would be minor and would be mitigated by derating if necessary. Direct, indirect, and cumulative effects of chemical discharges would be minor.	Alternative 2b would be similar to Alternative 2a and would have similar impacts on surface water.
	Changes to hydrology and consumptive use of surface water.	No change in current level of minor impacts to water supply. No cumulative effects to water supply are expected.	Impacts would depend on the volume of water withdrawn for makeup and the source of water. A new plant would be built with a closed-cycle cooling system, increasing surface water consumption. Overall impacts of water use could be minor during normal flows and possibly substantial during extreme low-flow conditions.	Effects on water supply would be similar to Alternative 2a, but on a smaller scale. Impacts would be minor.

Resource	Attribute/Potential Effects	Alternative		
		1 – SQN License Renewal	2a – SQN Shutdown and New Nuclear Generation	2b – SQN Shutdown and New Natural Gas-Fired Generation
Groundwater	Chemical and radiological impacts to groundwater quality.	Minor impacts.	Minor radiological impacts on groundwater quality.	No radiological impact on groundwater.
	Groundwater use.	No groundwater use. No impact anticipated.	If used for sanitary and potable water, there could be a minor impact. If used for makeup water and/or cooling water, then impacts could be moderate to substantial.	Alternative 2b would be similar to Alternative 2a and would have similar impacts on the groundwater resource.
Floodplain and Flood Risk	Construction or modification of the floodplain.	No increase in flood risk in the Chickamauga Reservoir watershed.	All proposed construction would be evaluated to ensure consistency with Executive Order 11988. Dredging would be a repetitive action with minor impacts.	Alternative 2b would be similar to Alternative 2a and would have similar impacts on the floodplain.
	Flooding of the plant site from the river, lake, or probable maximum precipitation.	No cumulative effects to flood risk.		

Resource	Attribute/Potential Effects	Alternative		
		1 – SQN License Renewal	2a – SQN Shutdown and New Nuclear Generation	2b – SQN Shutdown and New Natural Gas-Fired Generation
Wetlands	Destruction of wetlands or degradation of wetland functions.	No impact.	Impacts due to construction, including transmission lines, would range from minor to substantial. Consistent with Executive Order 11990, a new plant would not be constructed in wetlands unless there were no practicable alternative.	Alternative 2b would be similar to Alternative 2a and would have similar impacts on any wetlands.
Aquatic Ecology	Destruction of aquatic organisms; degradation or destruction of aquatic habitat.	No new impact. No change from current minor impacts on fish populations from impingement and entrainment. Thermal impacts to aquatic species in Chickamauga Reservoir would continue to be minor.	Impacts could range from minor to substantial depending on plant design, organisms present, source water, and receiving water. Dredging would have minor direct and indirect effects. An NPDES permit regulating discharge and temperature of toxic substances would be required.	Alternative 2b would be similar to Alternative 2a and would have similar impacts on the aquatic ecology.

Resource	Attribute/Potential Effects	Alternative		
		1 – SQN License Renewal	2a – SQN Shutdown and New Nuclear Generation	2b – SQN Shutdown and New Natural Gas-Fired Generation
Terrestrial Ecology	Removal or degradation of terrestrial vegetation, wildlife habitat, and/or wildlife.	No substantial change from current SQN operations. No indirect effects.	Substantial direct impacts could occur from clearing and construction operations if a greenfield site is selected. Minor indirect impacts may occur. Likely to result in minor cumulative impacts due to potential collective habitat loss, habitat fragmentation, and decreased biological diversity. Construction of associated transmission lines could result in minor cumulative impacts. Impacts less likely if construction occurs on a brownfield site.	Alternative 2b would result in impacts similar to those associated with Alternative 2a, but would be smaller in scale due to smaller size.

Resource	Attribute/Potential Effects	Alternative		
		1 – SQN License Renewal	**2a – SQN Shutdown and New Nuclear Generation**	**2b – SQN Shutdown and New Natural Gas-Fired Generation**
Endangered and Threatened Species	Mortality, harm, or harassment of federally listed or state-listed species including impacts to their critical habitat.	No new direct impacts. No indirect or cumulative impacts.	Clearing and construction could result in substantial direct impacts, depending upon the location chosen. Minor to substantial indirect impacts associated with potential habitat loss and fragmentation, and decreased biological diversity could occur. Site-specific environmental review would identify protected species and their habitats. TVA would comply with the Endangered Species Act, and evaluate measures to avoid or minimize impacts.	Alternative 2b would result in impacts similar to those associated with Alternative 2a.
Natural Areas	Degradation of the value or quality of natural areas.	No new direct impacts. No indirect or cumulative impacts.	Direct impacts are unlikely. New plant would be constructed at a distance from most natural areas. Minor indirect and minor to substantial cumulative impacts may occur because of habitat loss and fragmentation, and decreased biodiversity.	Alternative 2b would result in impacts similar to those associated with Alternative 2a.

Resource	Attribute/Potential Effects	Alternative		
		1 – SQN License Renewal	2a – SQN Shutdown and New Nuclear Generation	2b – SQN Shutdown and New Natural Gas-Fired Generation
Recreation	Degradation or elimination of recreational facilities or opportunities.	No impacts.	Impacts could range from minor to moderate, depending upon site location. Potential adverse impacts resulting from construction and operation would be evaluated.	Alternative 2b would result in impacts similar to those associated with Alternative 2a.
Archaeology and Historic Structures	Damage to archaeological sites or historic structures.	No direct, indirect, or cumulative effects within SQN site or vicinity are expected.	Depending on the site, the effects could range from minor to substantial. Direct, indirect, and cumulative impacts would be evaluated, with historic properties identified and managed per the National Historic Preservation Act Section 106 process.	Alternative 2b would result in impacts similar to those associated with Alternative 2a.
Visual	Effects on scenic quality, degradation of visual resources.	No new impacts.	Potential removal of SQN structures would make the SQN site less visible. The level of impact anticipated during construction and operation would range from minor to moderate.	Alternative 2b would result in impacts similar to those associated with Alternative 2a.

Resource	Attribute/Potential Effects	Alternative		
		1 – SQN License Renewal	**2a – SQN Shutdown and New Nuclear Generation**	**2b – SQN Shutdown and New Natural Gas-Fired Generation**
Noise	Generation of noise at levels causing a nuisance to the community.	Impacts would be minor; no change from the current condition.	Noise associated with construction would be minor for the surrounding communities, and minor to moderate for the nearest residents. Noise associated with operation of a new plant is expected to be minor. Construction noise associated with new transmission systems is expected to be minor.	Alternative 2b would result in impacts similar to those associated with Alternative 2a.
Socioeconomics and Environmental Justice	Changes in local population, employment, and incomes.	No changes in operating employment levels. No new impacts to population, local employment, or income.	Impacts range from minor to moderate, depending upon the size of the population and existing amenities near the selected site. The action could result in the creation of new direct and indirect jobs during construction. The closure of the SQN plant and subsequent loss of operational jobs would have a negligible effect on the socioeconomic conditions in Hamilton County.	Alternative 2b would result in impacts similar to those associated with Alternative 2a, but on a smaller scale.

Resource	Attribute/Potential Effects	Alternative		
		1 – SQN License Renewal	2a – SQN Shutdown and New Nuclear Generation	2b – SQN Shutdown and New Natural Gas-Fired Generation
	Disproportionate effects on low-income and/or minority populations.	No disproportionate effects on low-income or minority populations.	Potential effects might disproportionately impact minority or low-income communities depending on location. Negligible socioeconomic impacts expected with the closure of SQN; therefore, no disproportionate impacts to minority and low-income populations.	Alternative 2b would result in impacts similar to those associated with Alternative 2a, but on a smaller scale.
	Changes in availability of housing.	No changes or new impacts.	Impacts on local and regional housing markets would be location dependent and range from minor to substantial. Potential short-term, minor negative effects on the housing market, specifically in Hamilton County.	Alternative 2b would result in impacts similar to those associated with Alternative 2a, but on a smaller scale.

Resource	Attribute/Potential Effects	Alternative		
		1 – SQN License Renewal	2a – SQN Shutdown and New Nuclear Generation	2b – SQN Shutdown and New Natural Gas-Fired Generation
	Effects on water supply and wastewater.	No changes or new impacts.	Interconnecting to existing systems could require the development of additional capacity. Increased population could require the development of additional capacity. Demand on the Hamilton County water and wastewater systems would lessen, but impact would be negligible.	Alternative 2b would result in impacts similar to those associated with Alternative 2a, but on a smaller scale.
	Police, fire, and medical services.	No changes or new impacts.	Support from local emergency service providers would be necessary during construction and operation. Demand for emergency services near SQN may lessen, but impact would be minor and temporary due to growth trend in the county.	Alternative 2b would result in impacts similar to those associated with Alternative 2a, but on a smaller scale.

Resource	Attribute/Potential Effects	Alternative: 1 – SQN License Renewal	Alternative: 2a – SQN Shutdown and New Nuclear Generation	Alternative: 2b – SQN Shutdown and New Natural Gas-Fired Generation
	Schools and education.	No changes or new impacts.	The costs of providing education for additional students should be offset by the increase in tax revenues and plant-equivalent payments. Demand for school services near SQN may lessen, but impact would be minor and temporary due to growth trend in the county.	Alternative 2b would result in impacts similar to those associated with Alternative 2a, but would be on a smaller scale.
	Changes in land use, land acquisition, land conversion, or road locations.	No changes in on-site land use and no new off-site impacts.	No change in land use at SQN is anticipated. Depending on the location of the new plant site, ROWs, the transmission inter-tie connection, and rail spur could result in potentially substantial land-use impacts.	There could be a resulting decrease in off-site land-use impacts due to decreased demand for uranium supplies.
	Local government revenues.	No impact on local government revenues.	In-lieu-of tax payments would have a positive and beneficial impact on local government revenues. The amount of in-lieu-of tax payments Hamilton County receives likely would not be impacted if SQN were shut down.	Alternative 2b would result in impacts similar to those associated with Alternative 2a, but on a smaller scale.

Resource	Attribute/Potential Effects	Alternative		
		1 – SQN License Renewal	**2a – SQN Shutdown and New Nuclear Generation**	**2b – SQN Shutdown and New Natural Gas-Fired Generation**
	Elevated levels of traffic from construction work force and deliveries.	No changes or new impacts expected.	Mitigation of potential transportation impacts due to the location of a facility may be necessary due to expected increases in construction and operation traffic. Traffic would decline on SQN access roads.	Alternative 2b would result in impacts similar to those associated with Alternative 2a, but on a smaller scale.
Solid and Hazardous Waste	Generation and disposal of solid and hazardous waste.	No impacts from construction. Minor indirect impact of off-site disposal in permitted landfills.	Minor indirect impact during construction and operation from off-site disposal in permitted landfills are likely. Minor cumulative impacts expected.	Alternative 2b would result in impacts similar to those associated with Alternative 2a.
Seismology	Seismic adequacy.	No changes or new impacts are expected.	No adverse seismic effects anticipated. Extensive seismic analysis required prior to choosing a location. Impacts related to seismic activity would be minor.	Alternative 2b would result in impacts similar to those associated with Alternative 2a. Seismic evaluations would not be as rigorous as required for a new nuclear plant.

Resource	Attribute/Potential Effects	Alternative		
		1 – SQN License Renewal	2a – SQN Shutdown and New Nuclear Generation	2b – SQN Shutdown and New Natural Gas-Fired Generation
Air Quality	Emissions resulting in increases of air pollutants.	SQN is not a significant source of pollutants, and the impact of operation for an additional 20-year period would be minor.	Construction impacts are short term and can be mitigated in many cases. The overall impacts to air quality would be minor if there were no existing air quality issues; however, the impacts could be potentially large if the site were in a nonattainment area. Small indirect impacts off site and no cumulative impacts due to construction. Impact of a nuclear plant on air quality would be minor. TVA would obtain appropriate permits and maintain air emissions in compliance with regulatory limits.	Construction impacts of a new natural gas-fired plant would be expected to be similar to Alternative 2a. Depending on the chosen location, operation of typical combined-cycle combustion turbine gas-fired generation plants have minor to moderate impacts on air quality. Air emissions would meet all required regulations.
	Local meteorology and meteorological conditions.	Operation of SQN has no noticeable effects on the local meteorology, with the exception of a slight increase in frequency, duration, and intensity of steam fogs forming at the river surface.	A new nuclear plant is not expected to adversely affect local meteorological conditions.	A new natural gas-fired plant is not expected to adversely affect local meteorological conditions.

Resource	Attribute/Potential Effects	Alternative		
		1 – SQN License Renewal	2a – SQN Shutdown and New Nuclear Generation	2b – SQN Shutdown and New Natural Gas-Fired Generation
	Climatology and effects due to climate change.	The impacts from global climate change and greenhouse gas emissions upon SQN would be expected to be minor. Cumulative impacts over an additional 20 years of operation would offset millions of tons of greenhouse gases that otherwise would be produced by fossil fuel-fired generation. License renewal would provide TVA flexibility in reducing greenhouse gas emissions from its portfolio of generating assets.	Impacts from global climate change and greenhouse gas emissions would be expected to be minor.	A natural gas-fired plant would contribute a considerable amount of greenhouse gas emissions for the life of the plant. The impacts are direct and indirect, as well as potentially cumulative.
	Radiological gaseous emissions.	All radioactive effluents would be released in accordance with applicable regulations, and the impact from those effluent releases would be minor. Indirect and cumulative impacts would be minor.	There would be no radioactive effects during the construction of a new nuclear plant. There would be no expected observable direct or indirect impacts from radioactive gaseous releases from a new nuclear facility during normal operations.	There would be no radioactive impacts from the construction or operation of a new natural gas-fired plant.
	Gasoline and diesel emissions from vehicles and equipment.	No changes or new impacts would occur.	Minor impacts from vehicular and equipment emissions, controlled to meet applicable regulatory requirements.	

Resource	Attribute/Potential Effects	Alternative		
		1 – SQN License Renewal	2a – SQN Shutdown and New Nuclear Generation	2b – SQN Shutdown and New Natural Gas-Fired Generation
Radiological Effects	Effects to humans and nonhuman biota from normal radiological releases.	Annual doses to the public are well within regulatory limits; no observable health impacts are expected. No changes or new impacts are expected. Doses to nonhuman biota would be well below regulatory limits; no noticeable effects are expected.	Radiological effects to humans and biota would be similar to SQN and within all applicable release limits.	Radiological effects not applicable to natural gas-fired turbines.
Uranium Fuel Effects	Radioactive waste volumes and disposal.	Low-level radioactive waste would remain a minor impact on the available landfill capacity. The indirect and cumulative impacts on licensed landfills would be minor.	Operating nuclear power plant would produce low-level radioactive waste similar to SQN and would be a minor impact.	No radioactive waste generated.
	Radioactive gaseous and liquid releases.	By maintaining radioactive gaseous releases within regulatory limits, the impact to the public would be minor. The impact from radioactive liquids released from SQN is minor.	Releases of radioactive liquid and gaseous effluents would be in accordance with applicable federal regulations, resulting in minor impact.	No release of radioactive effluents.

Resource	Attribute/Potential Effects	Alternative		
		1 – SQN License Renewal	**2a – SQN Shutdown and New Nuclear Generation**	**2b – SQN Shutdown and New Natural Gas-Fired Generation**
	Radioactive waste transportation.	The impact to members of the public resulting from processing, storage, and transportation of solid low-level radioactive waste is minor.	Impacts from transportation of low-level radioactive waste would be minor, similar to SQN.	No radioactive waste would be transported.
	Spent fuel.	Minor impacts from the operation of the ISFSI, as it is operated in accordance with all applicable regulations.	Minor impacts from spent fuel storage.	No spent fuel generated.
Plant Safety	Postulated design-basis accidents.	In all cases, the doses to an assumed individual at the exclusion area boundary and low population zone are a fraction of the regulatory dose limits. Environmental risks due to postulated radiological accidents are minor. If a design-basis accident occurred, impacts would be minor, and limited by plant design and the emergency actions of trained TVA personnel.	The new nuclear plant would be designed specifically for the selected technology, which would be approved by the NRC and would meet all design-basis accident criteria.	This section is not applicable to Alternative 2b.

Resource	Attribute/Potential Effects	Alternative		
		1 – SQN License Renewal	2a – SQN Shutdown and New Nuclear Generation	2b – SQN Shutdown and New Natural Gas-Fired Generation
	Severe accidents.	Severe accident analysis indicates that the risk is minor and meets all safety goals.	The new nuclear plant would be designed specifically for the selected technology, which would be approved by the NRC and would meet all severe accident criteria.	This section is not applicable to Alternative 2b.
	Plant security.	Notwithstanding the very remote risk of a terrorist attack affecting operations, TVA increased the level of security readiness, improved physical security measures, and increased its security arrangements with local and federal law enforcement agencies at all of its nuclear generating facilities, and TVA is in compliance with all regulations on plant security.	Security requirements would be met as directed by federal requirements similar to SQN.	TVA would maintain appropriate security at a natural gas-fired plant. However, the requirements and standards for plant security at such a facility would be less than required for a nuclear-powered facility.

CHAPTER 3

3.0 AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

SQN has been the subject of several environmental reviews. The environmental consequences of constructing and operating SQN were addressed comprehensively in TVA's 1974 FES (TVA 1974a). Subsequent environmental reviews have updated that original analysis (Section 1.4). This chapter updates the information contained in those earlier reviews, and identifies any new or additional effects that could result from the continued operation of SQN during the period of license renewal. The potential environmental impacts of SQN license renewal and alternatives are addressed.

3.1. Surface Water Resources

The dominant water requirement at most nuclear power plants is cooling water, which in most cases is obtained from surface water bodies. For this reason, most power plants are located near suitable supplies of surface water, such as rivers, reservoirs, or lakes. Because of the interaction between power plants and surface water, issues may arise in terms of both usage and quality. A summary of the surface water hydrology and water quality for SQN, including a discussion about alternatives and their impacts, is presented in this subsection.

3.1.1. Surface Water Hydrology and Water Quality

The Tennessee River system is regulated by a series of 49 active dams and reservoirs managed by TVA (Figure 3-1). TVA operates the Tennessee River system to provide year-round navigation, flood-damage reduction, power generation, improved water quality, water supply, recreation, and economic growth. (Bohac and McCall, 2008)

3.1.1.1. Affected Environment

Surface Water Hydrology

Chickamauga Reservoir, an impoundment of the Tennessee River, extends approximately 59 river miles from Watts Bar Dam in southern Tennessee (TRM 529.9) to Chickamauga Dam in southeast Tennessee (TRM 471). Chickamauga Reservoir has a drainage area of 20,790 sq mi. The reservoir has a shoreline length of 784 miles, a volume of 628,000 acre-feet, and a surface water area of 35,400 acres at normal maximum pool elevation of 682.5 feet msl. The width of the reservoir ranges from 700 feet to 1.7 miles. (TVA 1974a) Average flow of Tennessee River at the Chickamauga Dam is approximately 32,300 cfs (Paul Hopping, TVA, personal communication, July 14, 2010).

Consistent with the TVA Act of 1933, Chickamauga Dam and Reservoir are operated for flood protection, navigation, and power production, as well as for aquatic resources, water supply, and recreation. During normal operations, the surface elevation of Chickamauga Reservoir varies between 676 feet msl in winter and 682.5 feet msl in summer. This variation provides a total fluctuation of 6.5 feet between normal minimum pool in the winter and maximum pool in the summer (TVA 2010e). During high-flow periods, the top of the normal operating elevation range may be exceeded to regulate flood flows. From mid-May to mid-September, TVA varies the elevation of Chickamauga Reservoir by as much as 1 foot to aid in mosquito population control (TVA 2010f).

SQN is located on the western shore of Chickamauga Reservoir at TRM 484.5 (Figures 1-2 and 1-3). TVA's WBN is also located on Chickamauga Reservoir, approximately 31 miles north-northwest of TVA's SQN. (TVA 2008a)

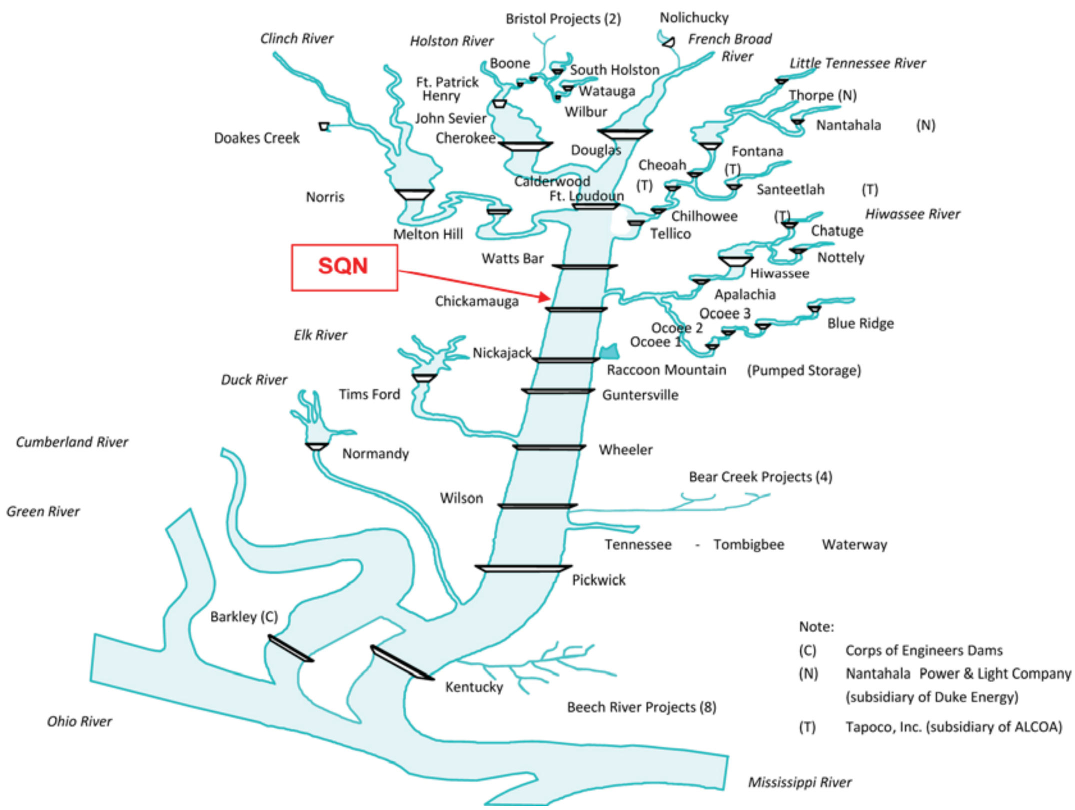

Figure 3-1. TVA Water Control System

Water Quality

The State of Tennessee has designated the reach (river segment of a specific length) of the Tennessee River in the vicinity of SQN for domestic and industrial water supply, fish and aquatic life, recreation, livestock watering, irrigation, and navigation use classifications.

Section 303(d) of the Clean Water Act

The State of Tennessee also assesses the water quality of streams and (biannually) develops a draft 303(d) list for impaired waterbodies. Under Section 303(d) of the 1972 Clean Water Act (CWA), states, territories, and authorized tribes are required to develop lists of impaired waters. These are waters that do not meet water quality standards. The law requires that these jurisdictions establish priority rankings for waters on the lists and develop total maximum daily loads (TMDLs) for these waters.

While Chickamauga Reservoir is not listed on the TDEC 2008, or draft 2010, 303(d) lists for impaired waters, upstream from SQN an unnamed tributary to the Chickamauga Reservoir (between TRM 480 and 481) and the Hiwassee River embayment (TRM 499) are identified on both 303(d) lists (TDEC 2010a). Table 3-1 presents the impairment information from the draft 2010 303(d) list.

The CWA requires that Congress receive a biennial accounting of the water quality for each state. The Tennessee Water Quality Control Act also requires a report on water quality. The TDEC Division of Water Pollution Control (WPC) has primary responsibility for assessment and reporting of the quality of surface waters. Chickamauga Reservoir and the Hiwassee River (tributary) were fully supportive according to the most recent 305(b) report submitted in 2008. The Watts Bar Reservoir (upstream) is considered impaired due to polychlorinated biphenyls (PCB) accumulation in fish tissue. The Nickajack Reservoir (downstream) is only partially supportive due to PCBs and dioxins. (TDEC 2008)

Table 3-1. TDEC Draft 2010 303(d) List of Impaired Tributaries to Chickamauga Reservoir*

Waterbody ID	Impacted Waterbody	County	Cause/TMDL Priority	Pollution Source
TN060200002 008 – 1000	Hiwassee River embayment of Chickamauga Reservoir	Bradley, McMinn	Escherichia coli – NA Mercury – L	Undetermined source. Industrial point source atmospheric disposition.
TN060200002 008 – 2000	Hiwassee River embayment of Chickamauga Reservoir	Bradley, McMinn	Mercury – L	Industrial point source atmospheric disposition.
TN060200001 479 – 1000	Unnamed tributary to Chickamauga Reservoir	Hamilton	Biological integrity loss due to undetermined cause – M	Undetermined source.
TN060200002 001 – 2000	Hiwassee River embayment of Chickamauga Reservoir	Meigs, McMinn, Bradley	Mercury – L	Industrial point source atmospheric disposition.

NA – Not Applicable
L – Low TMDL Priority
M – Moderate TMDL Priority

*Additional information is available in the TDEC draft 2010 303(d) list (TDEC 2010a).

TVA Monitoring Program

TVA has conducted its vital signs monitoring program on Chickamauga Reservoir in alternate years since 1994. The vital signs program uses five metrics to evaluate the ecological health of TVA reservoirs: chlorophyll concentration, fish community health, bottom life, sediment contamination, and dissolved oxygen. Values of good, fair, or poor are assigned to each metric. Scores from monitoring sites in the deep, still area near the Chickamauga Dam (forebay, TRM 472.3), mid-reservoir (TRM 490.5), the Hiwassee River embayment (Hiwassee River mile [HiRM] 8.5), and at the upstream end of the reservoir (inflow, TRM 518 and 529) are combined for a summary score. The data from these sites characterize the Chickamauga Reservoir's biological conditions and water quality near the SQN site. (TVA 2010g)

Based on the metric evaluation, the overall ecological health condition of Chickamauga Reservoir rated good in 2009 (Figure 3-2). Chickamauga's ecological health scores were good in previous years that were monitored, except for 2007 when Chickamauga rated fair. In 2007, three indicators (dissolved oxygen, chlorophyll, and bottom life) were either at the low end of their historic range or lower than in previous years. The lower ratings were largely due to low reservoir flows in 2007, which was the driest year in 118 years of record. Ecological health scores tend to be lower in most Tennessee River reservoirs during years with low flows, because chlorophyll concentrations are typically higher and dissolved oxygen (DO) levels are lower. (TVA 2010g)

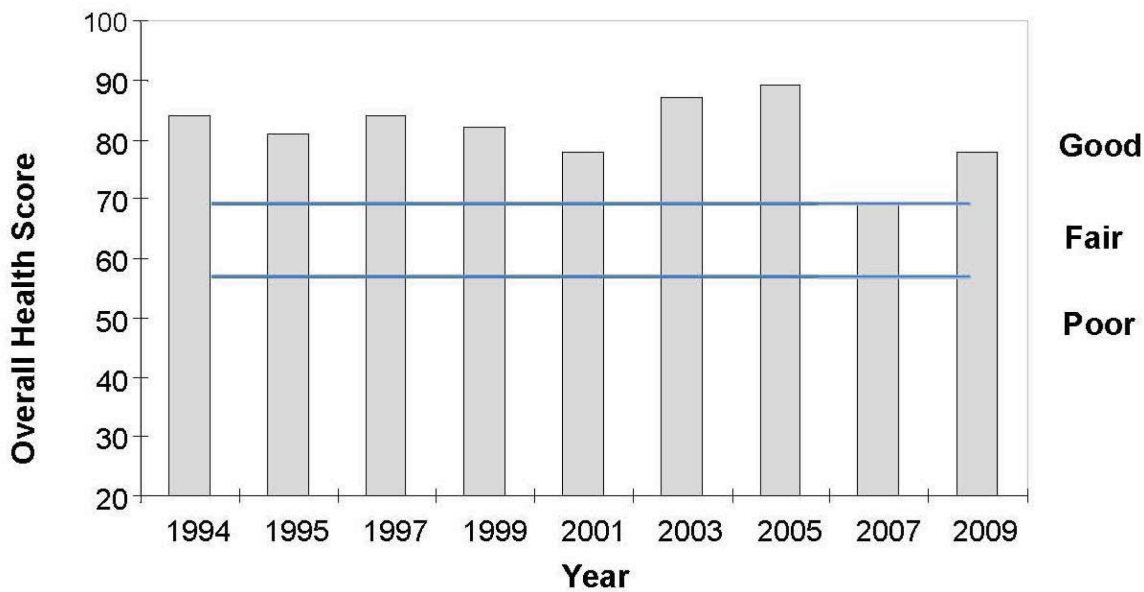

Figure 3-2. Chickamauga Reservoir Ecological Health Ratings, 1994 – 2009

In 2009, the five individual metrics scored good or fair at all sites except for chlorophyll in the forebay and mid-reservoir stations, which rated poor (Table 3-2). These metrics are briefly explained in the paragraphs that follow. (TVA 2010g)

Reservoir Ecological Health Indicators

Dissolved Oxygen

DO levels typically rate good at all monitoring locations (Table 3-2) except during extremely dry, low-flow years such as 2007, which can result in the development of low DO near the bottom and fair ratings.

Table 3-2. Ecological Health Indicators for Chickamauga Reservoir, 2009

Monitoring Locations	Dissolved Oxygen	Chlorophyll	Fish	Bottom Life	Sediment
Forebay	Good	Poor	Fair	Fair	Good
Mid-reservoir	Good	Poor	Fair	Good	Good
Hiwassee River embayment	Good	Good	Fair	Fair	Good
Inflow	*	*	Fair	Good	*

*Not measured at inflow station (TVA 2010g).

Chlorophyll

Chlorophyll ratings have fluctuated between good, fair, and poor at each location, generally in response to reservoir flow conditions. Annual average concentrations indicate a trend of increasing chlorophyll concentrations at the forebay and mid-reservoir, with lower concentrations at the Hiwassee River embayment monitoring location. Elevated concentrations of chlorophyll in the majority of the samples collected at the forebay and mid-reservoir monitoring locations gave those locations a poor rating, while hlorophyll concentrations at the Hiwassee River embayment monitoring location have consistently rated good.

Fish Health

The fish community rated at the high end of the fair range at all monitoring locations. The fish community typically rates good or at the high end of the fair range as it did in 2009.

Bottom Life

Bottom life rated fair at the forebay and Hiwassee River embayment locations and good at the mid-reservoir and inflow locations. Bottom life typically rates between good and fair at each monitoring location. However, bottom life rated at the low end of the fair range at the forebay in 2007, which is lower than in previous years, and poor at the embayment location, because the overall abundance and diversity of animals was lower. The lower rating was likely the result of the low DO conditions that developed along the reservoir bottom in 2007.

Sediment

Sediment quality rated good at all monitoring locations because no PCBs or pesticides were detected, and all metal concentrations were within the expected range. Elevated concentrations of PCBs and selected metals (generally zinc and copper) have been detected in sediment samples from the forebay and Hiwassee River embayment monitoring locations in some previous years.

Fish Consumption Advisories

No fish consumption advisories exist for Chickamauga Reservoir. (TVA 2010g)

Thermophilic Microorganisms

Some thermophilic (heat adapted) microorganisms are pathogens and have potential to affect public health. The plant discharges into a reservoir system, so it is necessary to determine whether discharge characteristics promote survival and reproduction of pathogenic thermophilic microorganisms. Organisms of concern include enteric pathogens *salmonella* and *shigella*, the Pseudomonas *aeruginosa* bacterium, thermophilic *Actinomycetes* (fungi), the many species of *Legionella* bacteria, and pathogenic strains of the free-living *Naegleria* amoeba. (NRC 1996)

Bacteria pathogenic to humans usually thrive at temperatures above 50ºC and are ubiquitous in the environment. During the summer months when SQN ambient temperatures in Chickamauga Reservoir are the warmest, the current NPDES permit specifies that the 24-hour downstream temperature shall not exceed 30.5ºC (86.9ºF), except in cases when the 24-hour ambient temperature exceeds 29.4ºC (84.9ºF). In these cases, the 24-hour downstream temperature can exceed 30.5ºC (86.9ºF) if there are a sufficient number of cooling tower lift pumps in service, but in such situations, the hourly average downstream temperature shall not exceed 33.9ºC (93.0ºF). Impacts to public health from thermophilic microorganisms are not expected.

3.1.1.2. Environmental Consequences

Alternative 1 – License Renewal

For this alternative, there would be no major construction activity. Current plant water withdrawal and discharge water quality would remain the same during the license renewal period. As presented in Subsection 3.1.4.1, treatment chemicals are largely consumed or diluted, leaving very small concentrations by the time they are discharged. The SQN NPDES permit would assure continued compliance with applicable water quality standards and criteria. Therefore, there would be no change in impact from the current level of minor impact.

Alternative 2 – No Action Alternative

Under the No Action Alternative, water quality impacts would be limited to those associated with SQN shutting down, and discharges would be controlled under an NPDES permit associated with discharges for these activities. Given the need for adequate replacement power generation, water quality impacts have been evaluated for the two potential alternatives for replacement power.

Alternative 2a – New Nuclear Generation

For a replacement reactor at an alternate site, new intake and discharge structures would need to be constructed to provide water needs for the facility. The impact would depend on the volume of water withdrawn for makeup, relative to the amount available from the intake source. The characteristics of the surface water impacts would be expected to be minor, because they would be controlled under an NPDES permit that would be regulated by the state in which the plant is located. There is a potential that some erosion and sedimentation may occur during construction; however, construction would be temporary, and the implementation of best management practices (BMP) should limit any potential impacts to surface water quality. No cumulative construction impacts are anticipated; however, potential cumulative impacts should be evaluated prior to construction activities.

If Alternative 2a is constructed and operated, SQN would be shut down. Under Alternative 2a, water quality impacts for the new nuclear plant, depending on the technology chosen and the location, would be bounded by the current discharge at SQN. If the source of water for the new nuclear power plant were different than the source for SQN, the impact of shutting down SQN might reduce the effects on the Tennessee River system, but would transfer impacts to the other waterbody. Potential impacts to water quality would be evaluated prior to licensing a new plant. In addition, maintaining compliance with the plant's NPDES permit would limit potential impacts.

Alternative 2b – New Natural Gas-Fired Generation

Cooling water at an alternate site would likely be withdrawn from a surface waterbody and its discharge would be regulated by permit. Depending on the water source, the impacts on water quality caused by plant discharge could have noticeable impacts. The impacts of a new gas-fired plant utilizing a closed-cycle cooling system at an alternate site are considered minor, because the plant would have to maintain compliance with the plant's NPDES permit. Potential impacts, including cumulative impacts to water quality, would depend on where the plant was located and would be evaluated during the permit process for a new plant.

Water quality impact from sedimentation during construction is categorized as minor. Operation water quality impacts would be similar to, or less than, those from other centralized generating technologies. Surface water impacts would remain minor. (NRC 1996)

3.1.2. Surface Water Uses and Trends

In 2004, the U.S. Geological Survey (USGS) in cooperation with TVA published a report on water use in the Tennessee River watershed based on the year 2000 water use data. Because of the importance of water supply planning, a new updated report, published in 2008, *Water Use in the Tennessee Valley for 2005 and Projected Use in 2030* was prepared based on 2005 data. These data were used by TVA in the development of a new reservoir operating policy and to identify potential areas of water supply concerns throughout the watershed. (Bohac and McCall, 2008)

For the 2008 report, offstream water use in the Tennessee River watershed was estimated for 2005. Water use was categorized as thermoelectric power, industrial, public supply, and irrigation. Water use was then summarized by category. These summary categories are source of water (surface water or groundwater) and location of withdrawal (state, county, hydrologic unit code, and reservoir catchment area). Water returns to the watershed were used to estimate consumptive use. A projection of water use for 2030 was also analyzed. (Bohac and McCall 2008)

Total water withdrawals during 2005 were estimated to average 12,437 MGD of freshwater for offstream uses. The return flow was estimated to be 12,005 MGD or 96.5 percent of the water withdrawn. Consumptive use accounts for the other 3.5 percent of total withdrawals or 432 MGD. (Bohac and McCall 2008)

Out of the 12,437 MGD of water withdrawn from the Tennessee River system, thermoelectric power withdrawals were an estimated 10,531 MGD (84.7 percent of total withdrawals) with a consumptive use of 33 MGD; industrial, 1,179 MGD (9.5 percent of total withdrawals) with a consumptive use of 82 MGD; public supply, 684 MGD (5.5 percent of total withdrawals) with a consumptive use of 273 MGD; and irrigation, 43 MGD (less than 1 percent of total withdrawals) with a consumptive use of 43 MGD (Bohac and McCall 2008).

By 2030, total water withdrawals are projected to decline about 7 percent to 11,551 MGD. By category, water withdrawals are projected to increase as follows: industrial increases 10 percent to 1,300 MGD, public supply increases 32 percent to 905 MGD, and irrigation increases 65 percent to 71 MGD. Thermoelectric water consumptive water use was 33 MGD in 2005. Thermoelectric water withdrawal is expected to decline by 12 percent to 9,275 MGD, reflecting a change in cooling technology for power plants. (Bohac and McCall 2008)

3.1.2.1. Affected Environment

Consumptive and offstream water uses have not resulted in significant use conflicts due to the large volume of reservoir water available, the high river flow rate, and the return of most of the water withdrawn. Total offstream surface water use for Chickamauga Reservoir in 2005 had a withdrawal rate of approximately 1,577 MGD and total return flow of approximately 1,713 MGD that resulted in a positive net water consumption of approximately 136 MGD. (Bohac and McCall 2008) The reason for the positive net water consumption is that WBN withdraws cooling water from Watts Bar Reservoir then discharges to Chickamauga Reservoir.

In addition, regulatory control of withdrawal rates and NPDES permit limits for return water quality also mitigate potential conflicts. Potential trade-offs can occur with instream water uses (e.g., instream use conflicts affect aquatic life, waste assimilation, navigation, power generation, flood control, and lake levels). These potential conflicts are addressed by historic operating procedures, legal requirements, and regulatory procedures. As indicated in Table 3-3, SQN water intake is one of 21 surface water withdrawals within Chickamauga watershed for the Watts Bar, Chickamauga, and Nickajack reservoir catchment areas.

Using open cycle cooling operations for the majority of the year, SQN surface water withdrawals within the Chickamauga Reservoir catchment area in 2005 averaged 1,539.3 MGD (John Higgins, TVA personal communication, March 22, 2010), or approximately 7 percent of the average flow through Chickamauga Reservoir (TVA 2008a). The total return flow in 2005 was 1,539.2 MGD; thus, the net consumptive use was approximately 0.1 MGD. Table 3-3 identifies the Chickamauga watershed water users, the supply source, actual water demands in 2005, and future projections for 2030.

Plant water, except for potable water and fire suppression water, is withdrawn from the Chickamauga Reservoir via the CCW intake pumping station and the ERCW pumping station. Potable water is supplied by the Hixson Utility District (TVA 2008a). Sanitary sewage collected on site is pumped off site to the Moccasin Bend sewage treatment system.

An intake channel of approximately 1,650 feet (GIS Division, ENERCON, personal communication, May 17, 2010) connects Chickamauga Reservoir with the SQN CCW intake pumping station (Figure 3-3). The CCW station has six intake openings about 15 feet wide and 23.5 feet high (TVA 1974a). A skimmer wall is located along the reservoir shoreline to protect the intake channel from floating debris. The CCW pumping station is further protected by a trash rack and traveling screen for each of the intake openings (TVA 1974a).

The ERCW pumping station is located at the upstream end of the intake skimmer wall, and has direct communication with the main river channel for all reservoir levels including loss of downstream dam. The ERCW station and all equipment therein remain operable during the probable maximum flood. The system also has the ability to remain operational during flood and loss of downstream dams. The average ERCW supply header water temperature maximum is less than or equal to 87°F. (TVA 2008a)

The intake conduits that deliver cooling water to the plant and the discharge conduit that returns cooling water to Chickamauga Reservoir are shown in Figure 3-3. When the NPDES river temperature limits are not threatened, SQN operates in a once-through, or open, mode of cooling. In open mode, the loss of cooling water is insignificant, so that the water returned to Chickamauga Reservoir by the plant is essentially the same as that withdrawn by the plant (Table 3-4). For the combined operation of SQN Units 1 and 2 in open mode, the withdrawal and discharge of cooling water by the plant is roughly 7 percent of the average flow through the Chickamauga Reservoir. (TVA 2008a)

During a thermally sensitive period when the water temperature in Chickamauga Reservoir approaches an NPDES limit, the plant will operate in helper mode (cooling towers are put into service). In helper mode, the cooling water is treated by the cooling towers before it is returned to the river. In this mode of operation, loss of cooling water occurs due to evaporation and drift from the cooling towers. The amount of loss depends on a number of factors, such as the amount and temperature of flow delivered to the cooling towers and meteorology. In general, however, the amount of loss in helper mode operation is at most about 37 MGD (the maximum evaporation and drift for each tower is less than 13,000 gpm). (TVA 1974b) This represents a loss of cooling water of less than 0.2 percent of the average annual flow through Chickamauga Reservoir (TVA 2008a).

The withdrawal of cooling water from the Chickamauga Reservoir varies with the number of CCW and ERCW pumps in service. Pumps are removed from service during plant outages and equipment outages. With six CCW pumps in operation at approximately 187,000 gpm each and four ERCW pumps in operation at approximately 11,000 gpm each (TVA 2008a), the maximum withdrawal from the Chickamauga Reservoir is 1,679 MGD.

Table 3-3. Surface Water Withdrawals and Returns in Chickamauga Watershed

Facility Name	Use Type	County	State	TRM[1]	Source/Receiving Body	Total Distance from SQN (river miles)*	Transaction Type	2005 Rate (MGD)	2030 Rate (MGD)
Watts Bar Nuclear Plant – 2 Intakes	TH	Rhea	TN	529.9 & 528.0	Tennessee River	45.4 U & 43.4 U	WD	181.19	249.04[2,3]
Watts Bar Nuclear – 3 Discharge Locations	TH	Rhea	TN	529.2, 527.9 & 527.2	Tennessee River	44.7 U & 43.5 U	RT	173.86	206.65[2,3]
Decatur Sewage Treatment Plant	WW	Meigs	TN	514.8	Tennessee River	30.3 U	RT	0.257	0.452
Dayton Sewage Treatment Plant	WW	Rhea	TN	504.5	Richland Creek embayment	23.8 U	RT	1.665	2.178
Dayton Water Department	PS	Rhea	TN	504.0	Tennessee River	19.5 U	WD	2.507	3.279
Calhoun-Charleston Utility District	PS	McMinn	TN	499.4	Hiwassee River	33.9 U	WD	0.212	0.250
Athens Utility Board-North Mouse Creek Sewage Treatment Plant	WW	McMinn	TN	499.4	North Mouse Creek	53.1 U	RT	0.835	0.988
Athens Utility Board-Oostanaula Creek Sewage Treatment Plant	WW	McMinn	TN	499.4	Oostanaula Creek	65.1 U	RT	2.399	2.840
Benton Sewage Treatment Plant	WW	Polk	TN	499.4	Four Mile Creek	52.1 U	RT	0.037	0.044
Bowater Inc. Southern Division	IN	McMinn	TN	499.4	Hiwassee River	32.9 U	RT	0.510	0.647

Facility Name	Use Type	County	State	TRM[1]	Source/Receiving Body	Total Distance from SQN (river miles)*	Transaction Type	2005 Rate (MGD)	2030 Rate (MGD)
Bowater Inc. Southern Division	IN	McMinn	TN	499.4	Hiwassee River	32.9 U	RT	42.283	53.621
Bowater Inc. Southern Division	IN	McMinn	TN	499.4	Hiwassee River	32.9 U	RT	27.651	35.065
Bowater Newsprint	IN	McMinn	TN	499.4	Hiwassee River	32.9 U	WD	30.880	39.160
Bowater Newsprint	IN	McMinn	TN	499.4	Hiwassee River	32.9 U	WD	39.150	49.648
Cleveland Utilities	PS	Bradley	TN	499.4	Hiwassee River	37.9 U	WD	6.453	8.351
Cleveland Utilities Sewage Treatment Plant	WW	Bradley	TN	499.4	Hiwassee River	31.4 U	RT	8.920	11.544
Englewood Sewage Treatment Plant	WW	McMinn	TN	499.4	Chestuee Creek	90.3 U	RT	0.146	0.173
Etowah Sewage Treatment Plant	WW	McMinn	TN	499.4	Conasauga Creek	61.4 U	RT	1.061	1.255
Hiwassee Utility Commission	PS	Bradley	TN	499.4	Hiwassee River	37.9 U	WD	3.725	4.821
J.M. Huber Corporation Etowah	IN	McMinn	TN	499.4	Conasauga Creek	64.1 U	RT	0.745	0.944
John Manville Corporation	IN	McMinn	TN	499.4	Crockett Spring Creek	69.8 U	RT	0.082	0.104
Niota Waste Water Treatment Plant	WW	McMinn	TN	499.4	Little North Mouse Creek	62.9 U	RT	0.221	0.262

Facility Name	Use Type	County	State	TRM[1]	Source/Receiving Body	Total Distance from SQN (river miles)*	Transaction Type	2005 Rate (MGD)	2030 Rate (MGD)
Olin Chemicals Corporation	IN	Bradley	TN	499.4	Hiwassee River	31.9 U	RT	1.070	1.445
Olin Chemicals Corporation	IN	Bradley	TN	499.4	Hiwassee River	31.9 U	RT	2.602	3.513
Olin Chemicals Corporation	IN	Bradley	TN	499.4	Hiwassee River	31.9 U	RT	1.922	2.594
Olin Corporation	IN	Bradley	TN	499.4	Hiwassee River	31.9 U	WD	3.926	5.301
Soddy-Daisy Falling Water Utility District (est 2005)	PS	Hamilton	TN	487.5	Soddy Creek embayment	7.6 U	WD	1.1	1.2
SQN – CCW	TH	Hamilton	TN	485.1	Tennessee River	0.6 U	WD	1539.300	1447.000
SQN	TH	Hamilton	TN	484.5	Tennessee River	0.0	RT	1539.200	1447.000
SQN – Diffuser	TH	Hamilton	TN	483.6	Tennessee River	0.9 D	RT	1539.200	1447.000
The Honors Course	IR	Hamilton	TN	477.5	Wolftever Creek	26.8 D	WD	0.049	0.044
The Honors Course	IR	Hamilton	TN	477.5	Honor Lake	26.8 D	WD	0.041	0.037
Eastside Utility District	PS	Hamilton	TN	473.0	Tennessee River	11.5 D	WD	8.153	9.260
Invista	IN	Hamilton	TN	470.0	Tennessee River	14.5 D	RT	0.003	0.004

Facility Name	Use Type	County	State	TRM[1]	Source/Receiving Body	Total Distance from SQN (river miles)*	Transaction Type	2005 Rate (MGD)	2030 Rate (MGD)
Invista	IN	Hamilton	TN	470.0	Tennessee River	14.5 D	RT	3.040	3.784
Invista (Dupont)	IN	Hamilton	TN	470.0	Tennessee River	14.5 D	WD	4.189	5.213
Catoosa County Utility (Morris est)	WW	Catoosa	GA	468.0	South Chickamauga Creek	34.1 D	RT	0.020	0.032
CITGO Petroleum Corporation	IN	Hamilton	TN	468.0	Unnamed tributary	28.3 D	RT	0.021	0.026
City of Ringgold	PS	Catoosa	GA	468.0	South Chickamauga Creek	48.5 D	WD	0.556	0.877
Crystal Springs Printworks	IN	Walker	GA	468.0	Crawfish Spring Lake	54.3 D	WD	0.510	0.612
Dow Reichhold Specialty Latex	IN	Walker	GA	468.0	West Chickamauga Creek	70.3 D	RT	0.154	0.185
Fort Oglethorpe-Mitchell Acres	WW	Catoosa	GA	468.0	West Chickamauga Creek	36.6 D	RT	0.030	0.047
National Starch & Chemical Corporation	IN	Hamilton	TN	468.0	South Chickamauga Creek	17.3 D	RT	2.390	2.974

Facility Name	Use Type	County	State	TRM[1]	Source/Receiving Body	Total Distance from SQN (river miles)*	Transaction Type	2005 Rate (MGD)	2030 Rate (MGD)
Ringgold Water Pollution Control Program	WW	Catoosa	GA	468.0	South Chickamauga Creek	48.5 D	RT	0.500	0.788
Walker County Water Pollution Control Program	WW	Walker	GA	468.0	West Chickamauga Creek	52.6 D	RT	1.517	1.650
NA Industries Inc.	IN	Hamilton	TN	467.0	Tennessee River	17.5 D	RT	3.540	4.406
Chattanooga-Moccasin Bend Sewage Treatment Plant	WW	Hamilton	TN	465.3	Tennessee River	21.4 D	RT	43.700	49.637
Tennessee-American Water Company	PS	Hamilton	TN	465.3	Tennessee River	19.2 D	WD	41.575	47.223
US Pipe & Foundry Chattanooga	IN	Hamilton	TN	461.5	Tennessee River	23 D	RT	0.015	0.018
US Pipe & Foundry Chattanooga	IN	Hamilton	TN	461.5	Tennessee River	23 D	RT	0.042	0.052
Chattem Chemicals Inc.	IN	Hamilton	TN	460.5	Unnamed tributary	24.7 D	RT	0.248	0.308
Dade County Water and Sewage Authority	PS	Dade	GA	460.0	Lookout Creek	45.1 D	WD	2.348	3.333
Tenton Water Pollution Control Program	WW	Dade	GA	460.0	Lookout Creek	43.5 D	RT	0.305	0.433
Moccasin Bend Golf Course	IR	Hamilton	TN	459.0	Tennessee River	25.5 D	WD	0.025	0.023

Facility Name	Use Type	County	State	TRM[1]	Source/Receiving Body	Total Distance from SQN (river miles)*	Transaction Type	2005 Rate (MGD)	2030 Rate (MGD)
Signal Mountain Cement Company	MI	Hamilton	TN	455.0	Tennessee River	29.5 D	RT	1.612	1.909
Buzzi Unicem USA – Signal Mountain Plant	IN	Hamilton	TN	454.0	Tennessee River	30.5 D	WD	0.603	0.750
Buzzi Unicem USA – Signal Mountain Plant	IN	Hamilton	TN	454.0	Tennessee River	30.5 D	WD	0.603	0.750
Signal Mountain Waste Water Treatment Plant	WW	Hamilton	TN	454.0	Tennessee River	30.5 D	RT	0.734	0.834

[1] Location of water use on Tennessee River (location of outfall, withdrawal, or convergence of a tributary to Tennessee River).
[2] Response to NRC request for additional information regarding environmental review, Tennessee Valley Authority, Watts Bar Nuclear Plant – Unit 2, Docket No. 50-391, Hydrology H-16.
[3] Assumes two-unit full-load operation in 2030.

PS = Public Supply WD = Withdrawal U = Upstream

IN = Industrial RT = Return D = Downstream

IR = Irrigation

TH = Thermoelectric

MI = Mining

WW = Wastewater

* Distance approximate to SQN (includes all tributaries).

(John Higgins, TVA, personal communication, March 22, 2010). Includes surface water withdrawal/return data from TDEC (2006 data) and USGS, Georgia Water Science Center (2007 data).

(USGS 2010) National Hydrology Dataset

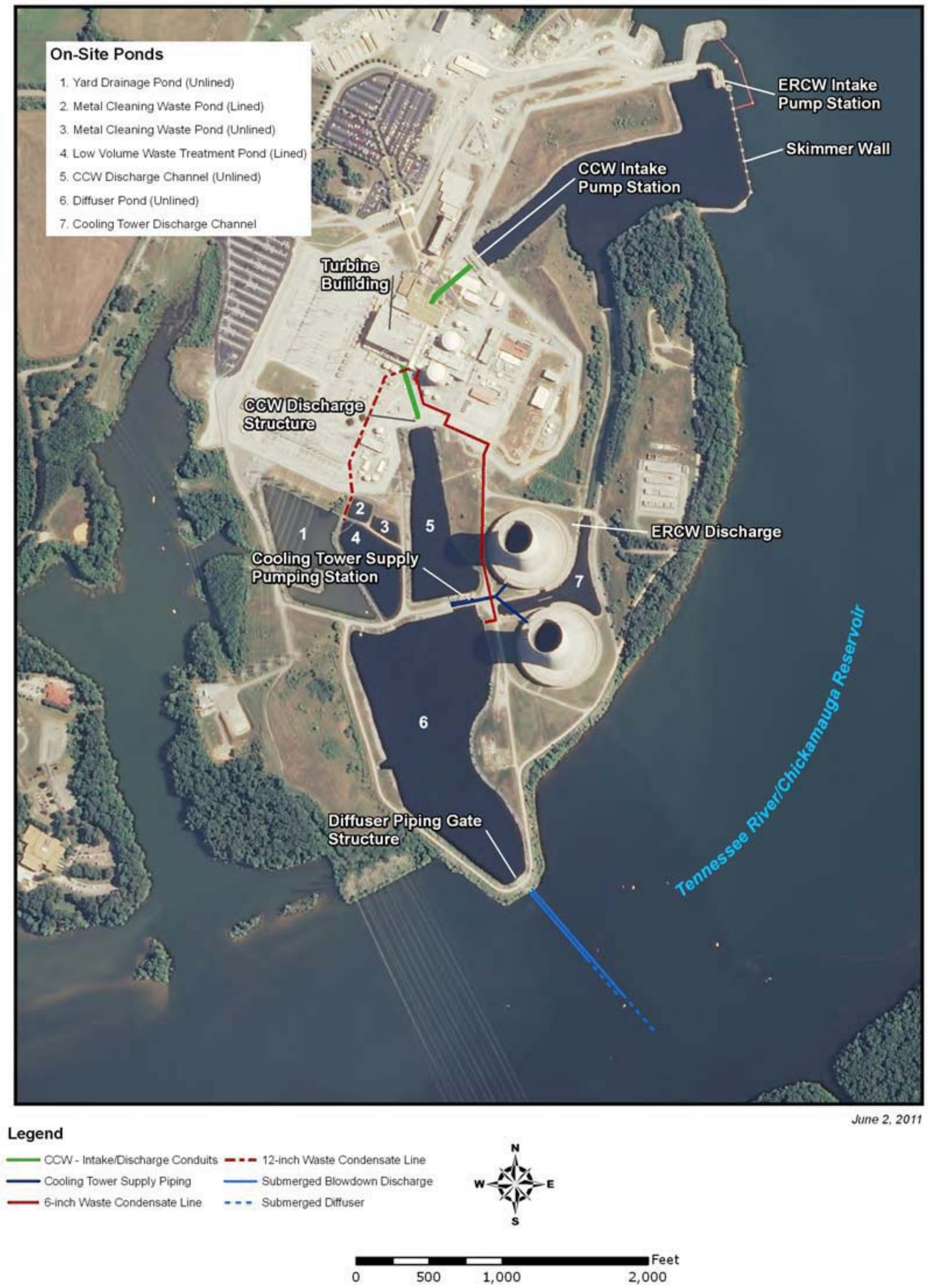

Figure 3-3. SQN Intake and Discharge Facilities

Table 3-4. SQN Water Use for Open Mode and Helper Mode Cooling Operations

Open Mode	Units 1 & 2	Percent Average River Flow*
Discharge	1,068,888 gpm	7%
Withdrawal	1,068,958 gpm	7%
Helper Mode	**Units 1 & 2**	**Percent Average River Flow***
Evaporation (Consumption)	<26,000 gpm	<0.2%

*Average flow at the SQN site is approximately 32,000 cfs (14,361,600 gpm) (Paul Hopping, TVA, personal communication, July 14, 2010).

Hourly flow rates from Chickamauga Dam and Watts Bar Dam from 1976 through 2010 were recorded by TVA. The drainage areas and average flow rates are presented in Table 3-5. (Paul Hopping, TVA, personal communication, July 14, 2010)

Table 3-5. Drainage Area and Average Flow Rate

Location	Drainage Area (sq mi)	Average Flow Rate (cfs)
Watts Bar Dam	17,310	25,900
SQN	20,650	32,000
Chickamauga Dam	20,790	32,300

As discussed in Subsection 3.16, TVA has studied the sensitivity of the river and power systems to extreme meteorology and climate variations (Miller et al. 1993). In terms of water temperature, the studies evaluated the response to changes in meteorology for a typical mainstream reservoir like Chickamauga Reservoir. The results indicate that based solely on changes in air temperature, the average (April through October) natural water temperature in a mainstream reservoir could increase between 0.3°F and 0.5°F for every 1°F increase in air temperature. An assessment of potential climate change in the Tennessee Valley suggests that air temperatures could increase 0.8°C/1.4°F by 2020 and up to 4°C/7.2°F by 2100 (EPRI 2009) for an increase in air temperatures of approximately 2°C/3.6°F by the end of the 20-year license renewal period (2041) of SQN, and the potential increase in water temperatures in Chickamauga Reservoir could range from 0.5°C/1.0°F to 1.1°C/2.0°F (TVA 2010b). Such a temperature rise could impact the operation of both SQN generating units. The facility would have to utilize the helper mode more frequently, and in extreme cases, implement plant derates to maintain compliance with the NPDES permit.

3.1.2.2. Environmental Consequences

Alternative 1 – License Renewal

For this alternative, SQN's surface water withdrawal and discharge volumes during the renewal term are expected to be consistent with the plant's current water withdrawals and discharge volumes. Therefore, impacts to surface water quality would remain unchanged. Based on future water information that indicates a decrease in water withdrawal by 2030 (Bohac and McCall 2008) in the Tennessee River Valley, no cumulative effects are expected from the continued operation of SQN.

Alternative 2 – No Action Alternative

The No Action Alternative is the result of the decision not to extend operation of the SQN units past the current expiration dates of the operating licenses. However, this could lead TVA to a decision to replace the resulting loss of the approximately 2,400 MWe base load generation upon shutdown of SQN. Given the need for adequate replacement power generation, TVA has evaluated in detail two alternative means of doing this.

Alternative 2a – New Nuclear Generation

Surface water use impacts would depend on the volume of water withdrawn for makeup water relative to the amount available from the intake source and the characteristics of the surface water. As stated in Chapter 2, a nuclear or natural gas-fired plant would be built with a closed-cycle cooling system which would increase surface water consumption from operation of the cooling towers; however, the beneficial impact would be a reduction in the number of fish and shellfish entrained or impinged. The overall impacts could be minor for water use impacts during normal flows and possibly substantial impacts during extreme low-flow conditions. Potential impacts can be mitigated by derating (reducing the thermal output of the plant by reducing its electrical power rating) during periods of thermal sensitivity.

Alternative 2b – New Natural Gas-Fired Operation

Surface water use impacts would be expected to be similar but on a smaller scale than those described for Alternative 2a. The volume of water used would be expected to be smaller for a natural gas-fired plant if the waterbodies were of the same size and quality as for the nuclear plant site, and the impact would be expected to be minor.

3.1.3. Hydrothermal Effects of Plant Operation

A summary of the surface water hydrothermal effects of SQN operation including a discussion of alternatives and their impacts is presented in this subsection.

3.1.3.1. Affected Environment

Under Alternative 1, the SQN plant would continue to withdraw water from and discharge cooling water back to Chickamauga Reservoir. The two discharge diffusers each distribute a flow of approximately 535,000 gpm into Chickamauga Reservoir with an average driving head of 7 feet in the diffuser pond. During the once-through open mode cooling operation, which is used the majority of the time, water is discharged to the diffuser pond where it flows through the diffusers into Chickamauga Reservoir. For SQN's cooling tower operations in the helper mode, which averaged 112.7 days per year during 2006 – 2009 (Subsection 3.16.2), two gate structures direct the discharge from the cooling tower into the diffuser pond. Blowdown from the cooling towers is taken from the return channel above the diffuser pond, mixed with the plant radwaste effluent, and discharged directly into the diffuser pond. The system has been designed to ensure that under no conditions does the radwaste backflow into the return channel. (TVA 1974c) Flow from the ERCW system discharges into the return channel, providing a continuous source of water for dilution of plant radwaste effluent.

The SQN heat rejection system is designed to operate in one of three modes: open, helper, or closed. The SQN plant generally operates in open mode. Helper mode operation is used when an NPDES temperature limit for the diffuser outfall is threatened. In open mode, the water bypasses the cooling towers and is returned to the Chickamauga Reservoir through the diffuser pond and the discharge diffusers. In helper mode, the water is diverted to the cooling towers by lift pumps, passes through the cooling towers, where part of the waste heat is dissipated in the atmosphere, and is returned to the reservoir through the diffuser pond and the discharge diffusers. In closed mode, which is not normally used at SQN, water is diverted to the cooling towers where nearly all the waste heat is dissipated in the atmosphere, and is cycled back to the plant intake channel through a discharge control structure and return channel. (TVA 1974c)

For the operation of the two SQN units, cooling water is discharged to Chickamauga Reservoir via the NPDES-permitted Outfall 101, shown in Figure 3-4. The outfall includes a two-pipe multiport diffuser on the bottom of the Tennessee River, as shown in Figure 3-5. The upstream pipe extends about 1,300 feet into the reservoir at an angle of about 90 degrees from the diffuser pond dike. The diffuser section includes the last 350 feet of the pipe and is 17 feet in diameter. The downstream pipe is parallel to and 350 feet shorter than the upstream pipe. The diffuser section of the downstream pipe includes the last 350 feet of the pipe and is 16 feet in diameter. The two diffusers therefore provide mixing across nearly the entire width of the main channel. For both pipes, the outlets for the diffuser section are perpendicular to the axis of the diffuser and pointed downstream. (TVA 2008a)

Current NPDES Permit

SQN's latest site NPDES permit TN0026450 became effective on March 1, 2011. (TDEC 2011). This permit is amended as new wastewater streams are identified. The NPDES permit establishes criteria protective of water quality in the receiving stream. For SQN, TDEC has established criteria to protect Chickamauga Reservoir water quality for its designated uses in domestic and industrial water supply, fish and aquatic life, recreation, livestock watering, irrigation, and navigation use classifications.

Within the permit, point-source discharge outfalls and internal monitoring points (IMPs) are assigned a discharge serial number (DSN). For each discharge point, the NPDES permit establishes limitations as to the types and quantities of effluents, monitoring and reporting requirements, and required sampling locations. SQN is currently authorized to discharge as presented in Table 3-6 and Figure 3-4.

NPDES Permit Temperature Limits and Mixing Zone for Outfall 101

The NPDES permit for SQN identifies the release of cooling water to the Tennessee River through the plant discharge diffusers as Outfall 101. Under the current NPDES permit, the water temperature at the downstream end of the diffuser mixing zone is limited to a maximum 24-hour average of 86.9°F, a maximum 24-hour average temperature rise of 5.4°F for April through October, a maximum 24-hour average temperature rise of 9.0°F for November through March, and a maximum hourly average temperature rate-of-change of ±3.6°F/hour. The November through March limit for the temperature rise was obtained by a 316(a) variance request in 1989 (TVA 2009d). In cases when the 24-hour ambient temperature exceeds 29.4ºC (84.9ºF), the 24-hour downstream temperature can exceed 30.5ºC (86.9ºF) provided that the plant is operated in helper mode. But in all situations, the

Table 3-6. NPDES Permit Point-Source Discharges

Point-Source Discharge	Receiving Body	Water/Wastewater Type	Status
Outfall 101	Tennessee River (Chickamauga Reservoir)	Process and nonprocess wastewater from the diffuser pond that receives condenser circulating water; essential raw cooling water; cooling tower blowdown; raw cooling water; low-volume wastes; miscellaneous low-volume wastes, including various facilities drains and sumps; A/C condensate; steam generator blowdown; high pressure fire protection water; regeneration wastes from condensate demineralizer; and storm water runoff. Receives discharge from IMP 103.	Active
IMP 103	Diffuser Pond	Wastewater from the low volume waste treatment pond that receives condensate demineralizer, turbine building sump, storm water from IMP 107, essential raw cooling water, raw cooling water, and storm water runoff.	Active
IMP 107	Low Volume Waste Treatment Pond	Rain water from the now defunct metal cleaning ponds. No metal cleaning waste is added; rainwater is pumped as needed into IMP 103, which discharges into the diffuser pond (Outfall 101).	Active Last discharged on December 22, 2009.
Outfall 110	Tennessee River (Chickamauga Reservoir)	Backwash wastewater.	Inactive for at least 14 years; remains in the event the plant goes into closed mode.
Outfall 116	Tennessee River (Chickamauga Reservoir)	Backwash wastewater.	Active
Outfall 117	Tennessee River (Chickamauga Reservoir)	Backwash wastewater.	Active
Outfall 118	Intake forebay	Settling pond water and storm water runoff.	Applicable only when the pond is in service. Last discharged on June 9 – 11, 2010.

hourly average downstream temperature at the downstream end of the mixing zone shall not exceed 33.9ºC (93.0ºF). A summary of SQN instream thermal limits for the discharge is shown in Table 3-7.

The NPDES permit specifies the existing mixing zone as an area 750 feet wide, extending 1,500 feet downstream and 275 feet upstream of the diffusers. The justification for the mixing zone is based on a physical model study of the discharge diffusers, which examined the thermal effluent over a wide range of plant and river conditions, including reverse flows in the reservoir. (TVA 2009d)

Table 3-7. NPDES Discharge Limits for SQN Outfall 101 to the Tennessee River

Type of Limit	Averaging (hrs)	NPDES Limit
Max Downstream Temperature, T_d	24	86.9°F
Max Downstream Temperature, T_d	1	93.0°F
Max Temperature Rise, Δ**T**	24	5.4°F/9.0°F
Max Temperature Rate of Change, dT_d/dt	Mixed	3.6°F

*5.4°F is applicable April through October/9.0°F is applicable November through March.
Note: In cases when the 24-hour ambient temperature exceeds 29.4ºC (84.9ºF), the 24-hour downstream temperature can exceed 30.5ºC (86.9ºF), provided that the plant is operated in helper mode. But in all situations, the hourly average downstream temperature at the downstream end of the mixing zone shall not exceed 33.9ºC (93.0ºF).
(TDEC 2011)

<u>**Hydrothermal Modeling of Potential Heat Effects**</u>

Since plant startup in 1981, SQN has conducted about 17 comprehensive surveys of the plant thermal effluents, averaging about one survey for every 18 months of operation (TVA 2009d). The August 2001 NPDES permit for SQN required a number of studies related to Section 316(a) of the CWA. Due to the short span of the 2001 permit, these studies were carried forward in an updated NPDES permit that was effective in September 2005. The studies are related to the plant diffuser discharge to the Tennessee River, identified in the NPDES permit as Outfall 101, and were conducted to further calibrate the numerical model for SQN effluent thermal discharge (TVA 2009c) and to confirm the adequacy of the ambient temperature measurement and the configuration of the mixing zone (TVA 2009d).

The numerical model for SQN effluent discharge computes the temperature at the downstream end of the mixing zone with sufficient accuracy for use as the primary method of verifying NPDES thermal compliance for Outfall 101 (TVA 2009e). The numerical model solves a set of governing equations for the mixing of the plant thermal effluent in Chickamauga Reservoir. The numerical model operates in real time and utilizes a combination of measured and computed values for the temperature, flow, and stage in the river, and the temperature and flow from SQN discharge diffusers. (TVA 2009e)

Figure 3-4. SQN NPDES Permit Discharge Points

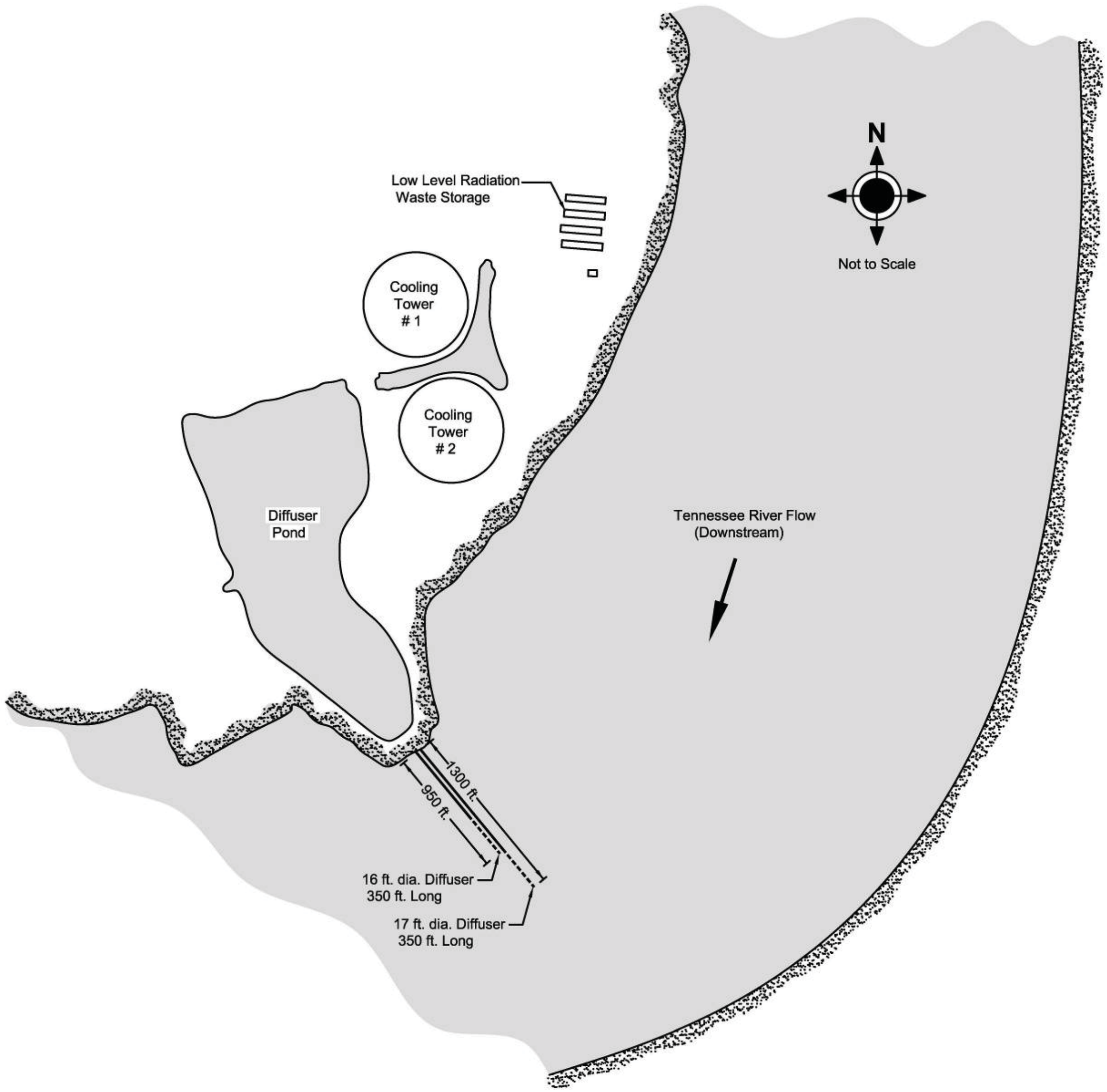

Figure 3-5. SQN Outfall 101

In 1989, a thermal variance was granted for SQN from TDEC's criteria for temperatures under Section 316(a) of the CWA. The request was approved prior to issuance of a permit in 1993. The variance involved allowing a temperature rise of 5°C for the winter operation months, November through March. Section 316(a) allows for variance from established temperature standards as long as permit conditions assure the protection and propagation of a balanced, indigenous population of shellfish, fish, and wildlife in and on the body of water into which the discharge is to be made. Regarding SQN, TDEC determined that the shellfish, fish, and wildlife are being protected. (TDEC 2011)

Due to the evolution in understanding the hydrothermal and biological characteristics of Chickamauga Reservoir, as well as the operational aspects of the nuclear plant and river system, modifications have been necessary over the years in the thermal criteria and monitoring of Outfall 101. The most recent modification, implemented as part of the August 2001 permit, involved changing the period of averaging for the downstream temperature (**Td)** and temperature rise (Δ**T)** from hourly to 24 hours. This modification was done because changes in river flow due to hydro peaking operations were causing unexpected swings in river temperature that could require a near-immediate response by SQN. The hourly averaging placed the plant in situations where thermal violations possibly could not be averted. Previous studies showed that a change from hourly averaging to 24-hour averaging would have no adverse impact on the hydrothermal and biological aspects of Chickamauga Reservoir. However, as part of this change, two special studies were added in the NPDES permit of 2001: one to confirm the adequacy of the ambient temperature measurement, and one to confirm the configuration of the mixing zone. (TVA 2009d)

NPDES monitoring with 24-hour averaging for **Td** and Δ**T** has been in effect since August 2001 with no evidence of adverse impact to the balanced indigenous population of shellfish, fish, and wildlife in Chickamauga Reservoir. Furthermore, the results of the ambient temperature and mixing zone studies suggest that based on current procedures for monitoring the plant thermal compliance, it is very likely that changes in the plant operation that are made to protect the NPDES limits based on 24-hour averaging (e.g., initiating cooling tower operation) also attenuate the most extreme hourly average temperature excursions based on an hourly average. Therefore, the current NPDES permit recommends that the downstream temperature and temperature rise continue to be based on 24-hour averaging. (TVA 2011a) SQN procedures for monitoring water temperatures and operating the plant have successfully maintained thermal compliance for all the instream limits for Outfall 101. There have been no exceedences of the NPDES water temperature limits at SQN.

As presented in Subsection 3.5.2, heat shock to reservoir inhabitants is a site-specific impact that ranges from small to large depending on characteristics of the discharge stream and receiving waters. Plant operations, including the discharge plume, were evaluated for four types of fish considered species of special concern in Chickamauga Reservoir. No instances of attraction or avoidance of the thermal plume have been detected for fish species within the Chickamauga Reservoir (TVA 1995b). Additionally, relatively constant reservoir benthic index (RBI) scores from 2000 – 2009 at TRM 482 indicate the thermal plume is not affecting benthic macroinvertebrates downstream of SQN (TVA 2010i).

As discussed in Subsection 3.16, TVA has studied the sensitivity of the river and power systems to extreme meteorology and climate variations (Miller et al. 1993). In terms of water temperature, the studies evaluated the response to changes in meteorology for a typical mainstream reservoir like Chickamauga Reservoir. The results indicate that based solely on changes in air temperature, the average (April through October) natural water temperature in a mainstream reservoir could increase between 0.3°F and 0.5°F for every 1°F increase in air temperature. An assessment of potential climate change in the Tennessee Valley suggests that air temperatures could increase 0.8°C/1.4°F by 2020 and up to 4°C/7.2°F by 2100 (EPRI 2009). An increase in air temperatures of approximately 2°C/3.6°F could occur by the end of the 20-year license renewal period (2041) of SQN. The potential increase in water temperatures in Chickamauga Reservoir could range from 0.5°C/1.0°F to 1.1°C/2.0°F. (TVA 2010b) Such a temperature rise could impact the operation of SQN generating units. The facility would have to utilize the helper mode operation more frequently, and in extreme cases, implement plant derates to maintain compliance with the NPDES permit.

3.1.3.2. Environmental Consequences

Alternative 1 – License Renewal

For this alternative, SQN Units 1 and 2 would continue to operate within the thermal limits set by SQN's NPDES permit and without measurable adverse impact to the balanced indigenous population during the renewal term. SQN is in compliance with current NRC and TDEC regulations related to thermal discharge evaluation requirements; therefore, no change regarding any potential impact from the current level of minor impact would be anticipated.

Alternative 2 – No Action Alternative

The No Action Alternative is the result of the decision not to extend operation of the SQN units past the current expiration dates of the operating licenses. However, this could lead TVA to a decision to replace the resulting loss of the approximately 2,400-MWe base load generation upon shutdown of SQN. Given the need for adequate replacement power generation, TVA has evaluated in detail two alternative means of doing this.

Alternative 2a and 2b – New Nuclear or New Natural Gas-Fired Generation

The impacts of operations for Alternatives 2a and 2b are similar and discussed together below.

Hydrothermal impact on surface water from a nuclear operation or gas-fired plant would be site specific, and dependent on the volume and temperature of water discharged. As stated in Chapter 2, either type of plant would be built with a closed-cycle cooling system so the facility could obtain an NDPES permit. The beneficial impact would be cooler discharge water; however, the negative impact would be additional surface water consumption from operation of the cooling towers. Discharge would contain dissolved solids and be regulated by the state issuing the NDPES permit. There could be substantial impacts during low river flow conditions; however, the use of cooling towers and plant derate (reduced power) should mitigate this impact. Because the location of the plant has not been determined, any cumulative impacts would have to be evaluated during the plant licensing or permitting process.

3.1.4. Chemical Additives for Plant Operation

A summary of the chemical additives during SQN operation, including a discussion about alternatives and their impacts, is presented in this section.

3.1.4.1. Affected Environment

Brief descriptions of plant cooling treatments discussed in earlier environmental reviews for the TVA site are provided in the following section. A primary area of concern for surface water quality relates to the chemicals added to treat water used for CCW, equipment cooling, fire protection, and potable water in nuclear plant operations that result in chemical discharges. The sources of chemical discharges from SQN would include cooling water discharge, cooling water makeup and ERCW systems, wastes from various makeup water, component water cooling system, reactor coolant system, and yard drainage systems and various sumps.

The source of fire protection water and potable water for SQN is the Hixson Utility District (TVA 2011b; TVA 2008a). The water supplied by this municipal water system is treated off site in accordance with applicable drinking water standards, and no further treatment for potable water usage would be performed on site. The wastewater associated with potable water usage is routed to the sanitary drainage system, which is discharged off site to the Moccasin Bend sewage treatment system (TVA 2008a) where it is treated.

Chemical additives are used in plant cooling water systems for two primary purposes:

1. To inhibit the chemical process of corrosion (rust formation) on metal piping and other plant equipment surfaces.

2. To maintain efficient heat transfer through all plant heat exchangers for heat removal and heat recovery. Optimal heat transfer cannot be achieved unless heat transfer surfaces are clean. Surfaces that have deposits of metal oxides (rust), scale (such as lime deposits), biological fouling (zebra mussel and Asiatic clam), or bacterial coatings experience lower heat transfer efficiency. In addition, certain types of bacteria can accelerate chemical oxidation or corrosion of surfaces through production of various waste products such as sulfate. This phenomenon is referred to as microbiologically influenced corrosion. A discussion of the two major heat-transfer-related (cooling) systems for SQN is provided below.

Overview of the Major SQN Plant Cooling Systems

Condenser Circulating Water System

The CCW system for Units 1 and 2 includes an intake pumping station at the end of the intake channel. The intake pumping station houses six vertically mounted, 187,000-gpm pumps (three pumps per unit) that discharge into dual concrete conduit tunnels leading to each unit's condenser. The station also houses traveling screens and screen wash pumps.

The CCW has no safety function. The ultimate heat sink for all seismic Category I (safety related) cooling water systems is provided by the emergency cooling water system taking suction immediately from the Chickamauga Reservoir and Tennessee River. The following design bases apply to the circulating water system, and additional information related to the CCW is available in Section 10.4.5 of the updated final safety analysis report (UFSAR) for SQN dated 2008.

In addition to the CCW system requirements, the CCW supplies water to the plant raw cooling water pumps and raw service water pumps, which in turn supply cooling water to nonessential systems. Raw cooling water can be supplied by gravity head from the river via the condenser intake tunnels in case of complete outage of the circulating water pumps. (TVA 2008a)

Essential Raw Cooling Water

The ultimate heat sink for all seismic Category I (safety related) cooling water systems is provided by the ERCW system taking suction immediately from the Chickamauga Reservoir and Tennessee River. The ERCW system is designed to supply cooling water to various heat loads in both the primary (radioactive) and secondary (nonradioactive) portions of each unit. If the cooling towers are not in service (open mode), the ERCW discharges provide a continuous source for dilution of the plant effluent. Provisions are made to ensure a continuously available flow of cooling water to those systems and components necessary for plant safety during either normal operation or under accident conditions. The ERCW system consists of eight ERCW pumps, four traveling water screens, four screen wash pumps, four strainers located with the ERCW pumping station, and associated piping and valves. The ERCW station draws water directly from the Chickamauga Reservoir.

During all conditions of operation, the discharge from the various heat exchangers served by the ERCW system go to a seismically qualified open basin with overflow capability, then flow by gravity to the cold water return channel of the cooling towers of the CCW system (TVA 2008a).

Chemicals Added to the Plant Water Cooling Systems

The types of chemicals currently used in operating plant cooling water systems are described as follows:

- Scale Inhibitors. Also called anti-scalants, these chemicals inhibit the formation of lime (calcium oxide) deposits that would otherwise tend to form on the high-temperature surfaces of the heat exchanger tubes and limit the deposition of other chemical forms of oxide scale upon the heat exchanger tubes. Anti-scalants are organic (carbon-based) polymers containing phosphate attachments on the molecule.

- Corrosion Inhibitors. Corrosion inhibitors behave as “oxygen scavengers” and tend to draw up and chemically bind available oxygen, which makes less oxygen locally available to form rust compounds, which are metal oxides.

- Molluscicide. Ammonium chloride or a quaternary amine can be used for zebra mussel and Asiatic clam control.

- Dehalogenation Agent. Sodium bisulfite may be utilized to ensure that the oxidizing biocide (total residual oxidant) discharge limit as it pertains to the total residual halogen, usually chloride, is not exceeded.

- Detoxification Agent. Bentonite clay may be required to detoxify the molluscicide chemical from the water through absorption at a ratio of 5:1 to the quaternary amine.

- Biopenetrant. Non-ionic surfactant (a simple soap) may be applied to increase the efficacy of the oxidizing biocide by cleaning off the surfaces of the biota in order to make the chlorine-based (or other halogen such as bromine-based) biocide or molluscicide chemical penetrate more effectively into the biological material, or biota.

All chemicals are approved prior to use by the appropriate state regulatory agencies, and qualified TVA personnel who determine the best possible chemicals to use based on site-specific needs. TVA's operational philosophy regarding chemical additives for plant operation reflects minimization of chemical use through an optimization program. The optimization program includes (1) monitoring operating plant parameters, (2) continually evaluating water chemistry, and (3) inspecting equipment to minimize the total amount of chemicals added. Prior to use in TVA plants, chemicals undergo an extensive toxicological review and comparison with maximum instream wastewater concentrations to ensure water quality standards are met.

SQN water treatment processes are controlled to comply with state water quality criteria and applicable NPDES permit conditions to ensure protection of the receiving waterbody. The standards and criteria applied by the state in establishing NPDES permit limits and requirements are to protect public health and water resources, as well as to maintain the designated uses for the receiving waterbody.

In accordance with SQN's NPDES permit, a biocide/corrosion treatment plan (B/CTP) annual report was submitted on February 9, 2010, to the WPC. This report provides biomonitoring data from tests conducted during treatments, a summary of all analytical results, the approximate duration in hours of each chemical used, the quantity in pounds of each chemical used, and any minor changes that have occurred in the B/CTP. Based on the analytical and toxicity biomonitoring, the facility maintained compliance with the current NPDES permit. Details related to the B/CTP are presented in the 2009 annual report. (TVA 2010j)

3.1.4.2. Environmental Consequences

<u>Alternative 1 – License Renewal</u>

The volume of the cooling water discharge would continue to be small when compared to river flow, and the treatment chemicals added are largely consumed, leaving very small or non-detectable concentrations by the time they are discharged. The discharge is regulated by a State of Tennessee NPDES permit and would have to meet applicable water quality standards and criteria. Even under adverse conditions and using conservative assumptions, impacts to the environment due to chemical discharges from SQN would be small (TVA 1974a). Therefore, the direct, indirect, and cumulative effects of chemical discharges would be minor.

<u>Alternative 2 – No Action Alternative</u>

The No Action Alternative is the result of the decision not to extend operation of the SQN units past the current expiration dates of the operating licenses. However, this could lead TVA to a decision to replace the resulting loss of the approximately 2,400 MWe base load generation. Given the need for adequate replacement power generation, TVA has evaluated in detail two alternative means of doing this.

Alternative 2a and 2b – New Nuclear or New Natural Gas-Fired Generation

The impacts of Alternatives 2a and 2b generally are similar in that they depend largely upon the sites that would be chosen and the measures taken to reduce or avoid potential impacts. They are discussed together below.

For a new nuclear plant or gas turbine, the treatment chemicals added would be expected to be largely consumed, leaving very small concentrations by the time they are discharged. (The amount of chemicals used for a gas turbine cooling operation would be less than for a nuclear plant based on the smaller scale of the individual units and components and less restrictive requirements on plant components.) Plant discharges would be regulated by the state in which the plant is located. An NPDES permit would be required, and the plant would comply with applicable water quality standards and criteria. Therefore, when the new generation source commences operation, the direct, indirect, and cumulative effects of chemical discharges would be expected to be minor.

3.1.5. Conclusion

Impacts from plant water discharges would be expected to be minor for operating SQN during the period of license renewal. Surface water impacts would be temporarily minor to moderate during construction of alternative new generation units. Only minor direct impacts would be expected at the proposed new operating sites. Indirect impacts or cumulative effects would also be expected to be minor.

3.2. Groundwater Resources

A discussion of groundwater hydrology, use and trends, and quality for SQN is provided in this section.

3.2.1. Affected Environment

Groundwater conditions at SQN have been documented in several reports over time, from TVA's 1974 FES through the *Sequoyah Nuclear Plant Investigation of Tritium Release to Groundwater* (TVA 2007c) and the UFSAR (TVA 2008a). A summary of that groundwater information is provided in this section.

Site Geology

The Conasauga Formation of Middle Cambrian age underlies SQN, providing the foundation bedrock of the plant. Unconsolidated alluvial, terrace, and residual deposits mantle the Conasauga Formation at the site. More recent alluvial deposits associated with the floodplain of the Tennessee River are now covered by the Chickamauga Reservoir. (TVA 2007c)

The Conasauga Formation at the site is composed of several hundred feet of interbedded limestone and shale in varying proportions. The shale, where fresh and unweathered, is dark gray, banded, and somewhat fissile in character. The limestone is predominantly light gray, medium grained to coarse crystalline to oolitic, with many shaly partings. A statistical analysis of the cores obtained from the site indicates a ratio of 56 percent shale to 44 percent limestone. Farther to the southeast and higher in the geologic section, the amount of limestone increases in exposures along the shore of Chickamauga Reservoir. (TVA 2007c)

Cavities and solution openings are not a major problem in the site foundation. Most solution openings are restricted to the upper few feet of bedrock near the overburden/bedrock interface. The insolubility of interbedded shale in deeper bedrock functions as a lithologic control to the development of large solution openings. However, small solution openings and partings may exist at greater depths within the bedrock along faults and joints, especially along synclinal zones. (TVA 2007c)

Soil

Unconsolidated alluvial, terrace, and residual deposits mantle the Conasauga Formation at the site. More recent alluvial deposits associated with the floodplain of the Tennessee River are now covered by Chickamauga Reservoir. Alluvium within the area of the main plant site was removed during construction, and only residual soils remain. In the plant area not mantled by terrace deposits, the Conasauga is overlain by varying thicknesses of residual silt and clay derived from weathering of the underlying shale and limestone. The residual soils are primarily silts and clays grading downward into saprolitic shale of the Conasauga Formation. In a few localized areas, weathered shale is exposed at the ground surface. However, in most exploratory drilling, the residuum depths ranged from 3 to 34 feet. Grain size analyses shows that soils across the site range from fat clay residual material to sand and gravel terrace deposits. (TVA 2007c)

3.2.1.1. Groundwater Hydrology

The peninsula on which SQN is located is underlain by the Conasauga, a poor water-bearing formation. About 2,000 feet northwest of the plant site, the trace of the Kingston Fault separates the Conasauga Shale from a wide belt of Knox Dolomite. The Knox Dolomite is a major water-bearing formation of eastern Tennessee. Based on a comprehensive examination of bedrock coreholes, groundwater in the Conasauga occurs in small openings along fractures and bedding planes. These openings rapidly decrease in size with depth, and few exist below a depth of 300 feet. Groundwater in the Knox Dolomite occurs in solutionally enlarged openings formed along fractures and bedding planes, and also in locally thick cherty clay overburden. (TVA 2008a)

The source of groundwater below the SQN site is derived from incipient infiltration of precipitation. Within overburden soils at the site, groundwater movement is generally downward. Local areas of natural lateral flow occur likely near some streams, topographic lows, and where extensive root systems exist. Groundwater movement might also occur in the vicinity of pipelines due to preferential groundwater flowpaths created by the permeable fill placed around the pipelines during their installation. (TVA 2007c) Groundwater is first encountered at the site between10 to 25 feet below ground surface (bgs) based on recent groundwater depth measurements. (TVA 2009f)

Groundwater movement is expected to occur mainly along the strike of bedrock, to the northeast and southwest, into Chickamauga Reservoir (TVA 2007c). Based on previous analysis, the permeability across strike in the Conasauga Shale is extremely low, and nearly all water movement is in a southwest-northeast direction, along strike. The Conasauga-Knox Dolomite Contact is a hydraulic barrier across which only a very small volume of water could migrate in the event large groundwater withdrawals were made from the adjacent Knox. Although some water can cross this boundary, the permeability normal to strike in the Conasauga is too low to allow development of an extensive cone of depression. (TVA 2008a)

Groundwater also discharges from overburden soils into the reservoir, site drainage channels (i.e., discharge channel), and surface water impoundments (i.e., diffuser pond). Higher surface water levels of Chickamauga Reservoir (April – October) result in corresponding rises in the groundwater table, and the lateral extent of this effect varies with groundwater hydraulic gradients. Lower surface water levels of Chickamauga Reservoir (November – March) result in corresponding declines in the water table along the reservoir periphery. (TVA 2007c)

Pre-construction boring logs collected by TVA suggest that groundwater transmissivity across the strike in the Conasauga Formation is extremely low. The computed mean time of travel of groundwater from SQN to Chickamauga Reservoir is 303 days. Local variations in hydraulic conductivity within the shallow bedrock are primarily controlled by geologic structure and stratigraphy. Shale beds and clay seams provide lithologic restrictions to the vertical movement of groundwater. The Conasauga/Knox contact northwest of the plant has been described as a hydraulic boundary; however, no field testing has been conducted to verify this assumption. The Conasauga Formation porosity is estimated to be about 3 percent based upon results of exploratory drilling. (TVA 2007c)

Groundwater monitoring and testing have been conducted using a network of wells installed at SQN. Eight bedrock wells were installed originally from 1976 through 1981, prior to plant operation. Additional monitoring wells have been installed since that time. During a tritium release investigation in 2007, 23 geoprobe borings were drilled and groundwater samples were collected. Five of the borings were completed as 1-inch monitoring wells to supplement groundwater level measurements and sampling locations. (TVA 2007c). The well locations are shown on Figure 3-6.

3.2.1.2. Groundwater Use and Trends

There are no groundwater supply wells on the SQN site. TVA contracts with the Hixson Utility District to supply potable water and fire protection water to the SQN plant (TVA 2008a; TVA 2011b). Other cooling water and service water systems are supplied from the Chickamauga Reservoir. The residential area around SQN is also on potable water supplied by Hixson Utility District (CHCRPA 2005a). Hixson Utility District uses water supply wells from the Cave Springs area which are located approximately 8 miles southwest of SQN near state Highway 27 (TVA 2007c). Current groundwater withdrawals from the Cave Springs area by the Hixson Utility District average about 8 MGD from two well fields, Cave Springs (6 MGD) and Walkers Corner (1.7 MGD) (USGS 2001).

Results from a USGS groundwater site inventory (GWSI) database retrieval for wells in Hamilton County are provided in the SQN tritium releases to groundwater report (TVA 2007c). The data are a combination of domestic wells, wells installed for specific investigations, and other groundwater sites. Large capacity (i.e., discharge >100 gpm) well locations from the GWSI database are located more than 1.5 miles from SQN. The closest large capacity wells are northwest of SQN. (TVA 2007c) The direction of groundwater movement at SQN is primarily easterly towards the intake and discharge channels based on historical and recent mapping of the potentiometric surface. Exceptions to this directional flux have occurred locally in areas of topographic highs/lows and from leaking water lines serving the site and operation of the diesel fuel oil interceptor trench. (TVA 2007c)

TVA ordered a water well search to determine if there were any new or newly reported water wells (private or public) in the immediate vicinity of the site. Based on the results of an Environmental Data Resources (EDR) GeoCheck® search, no water wells were identified within a 1-mile radius (from the plant centerpoint) of the site (EDR 2010).

Hamilton County groundwater usage in 2005 was 16.4 MGD. Groundwater uses and type of use for Hamilton County are presented in Table 3-8. Hamilton County is the largest user of groundwater in the Tennessee River Valley and also has the largest population. (Bohac and McCall 2008)

Table 3-8. Groundwater Use in Hamilton County, Tennessee for 2005

Industrial	Public Supply	Irrigation	Total Groundwater Withdraw (MGD)
6.72	9.29	0.38	16.4

(Bohac and McCall 2008)

There is a declining trend of groundwater withdrawal from 1995 through 2005. As a result, it is assumed that overall groundwater demand would remain flat for the development of the current reservoir operations policy. Therefore, the increase in water demand would be met from surface water sources. Public supply systems, which comprise 78 percent of the surface water use, are slowly transitioning to surface water sources as treatment plants are upgraded or systems are consolidating to meet higher demand and new drinking water regulations. Surface water systems are not switching to groundwater sources; therefore, it is likely that groundwater withdrawal would continue to decline (Bohac and McCall 2008).

3.2.1.3. Groundwater Quality

Groundwater quality at SQN has been monitored over the years to obtain background concentrations, to examine the effect of on-site disposal practices, and in response to specific incidents. Monitored parameters include radionuclides and organics. SQN participates in the Nuclear Energy Institute (NEI) groundwater protection initiative NEI 07-07 to monitor inadvertent releases of radioactive substances that may result in low but detectable levels of plant-related materials in the groundwater (NEI 2007).

Tritium

As part of the SQN on-site REMP,, quarterly groundwater monitoring for tritium began in 1977 at four bedrock monitoring wells (W-1, W-2, W-4, and W-5) located along the perimeter of the site (Figure 3-6).

On-site REMP groundwater monitoring was reduced to a single well (W-5) in 1980. Tritium was initially observed in SQN groundwater during 1989 sampling at well W-5 in a concentration of 379 picocuries per liter (pCi/L). Tritium was not detected at well W-5 again until 1998. From 1998 through 2001, tritium was consistently observed at concentrations ranging from 401 to 2120 pCi/L at well W-5. No further tritium has been observed at well W-5 since 2001. (TVA 2007c)

Beginning in February 2002, TVA expanded groundwater monitoring at SQN with the addition of 12 groundwater monitoring wells (W-24 – W-28 in 2002 and W-29 – W-35 in 2004) and collection of groundwater samples from existing wells in proximity to known areas of tritium contamination. Since August 2003, more than 200 groundwater sampling events have been conducted. (TVA 2007c)

In 2007, groundwater sampling was conducted at 23 geoprobe borings; the results indicated low tritium concentrations (274 – 661 pCi/L) in borings (GP-1 – GP-7) surrounding the Unit 1 refueling water storage tank (RWST). Borings GP-21, GP-22, GP-25, and GP-26 exhibited low tritium concentrations (332 – 2,700 pCi/L) in the area south-southeast of Unit 2. Boring GP-28, just east of this area, provided a similarly low tritium concentration (394 pCi/L). (TVA 2007c) The highest tritium concentration observed within all geoprobe borings occurred at GP-13 (Table 3-9). Due to the relatively high groundwater tritium concentration at boring GP-13, a 1-inch groundwater monitoring well was installed at this location, and additional groundwater sampling was conducted (TVA 2007c). Four other borings were completed as 1-inch monitoring wells to supplement groundwater level measurements in areas lacking groundwater level information. These wells include GP-7A, GP-7B, GP-10, and GP-24 (TVA 2007c).

Current results suggest that sources of tritiated groundwater are primarily associated with past inadvertent releases of liquids containing radioisotopes. In general, the highest tritium concentrations in the shallow groundwater system are associated with two distinct areas north and south of Units 1 and 2 (Figure 3-7). Although data are sparse for the deeper flow regime (i.e., weathered bedrock and shallow bedrock), the extent of the tritium plume has been bounded horizontally by sampling locations. (TVA 2007c)

Elevated tritium concentrations in groundwater north of Unit 1 suggest that the inadvertent water release from the modulated filter transfer demineralization system (MFTDS) in 1997 is likely the primary source of shallow affected groundwater in this area. The estimated volume of water released by the MFTDS is 600 – 1,000 gallons. A secondary source of tritium concentrations in this area is related to relatively small volumes of water that drain from the RWST moat and have discharged to the ground surface for more than 25 years. Results for tritium detected in catch basin SS-6 near the service building suggest that the observed tritium concentration might be associated with direct discharges to the single line entering this catch basin. (TVA 2007c)

Tritium concentrations in groundwater south of Unit 2 suggest that inadvertent releases from the Unit 2 condensate demineralizer waste evaporator and additional equipment buildings have impacted shallow groundwater in this area. Another source of tritium concentrations in this vicinity is related to the moat drain from the RWST that discharged to the ground surface for more than 25 years. Tritium concentrations at monitoring well W-27 appear to be of an isolated nature and may be related to leakage of the 12-inch waste condensate line. (TVA 2007c)

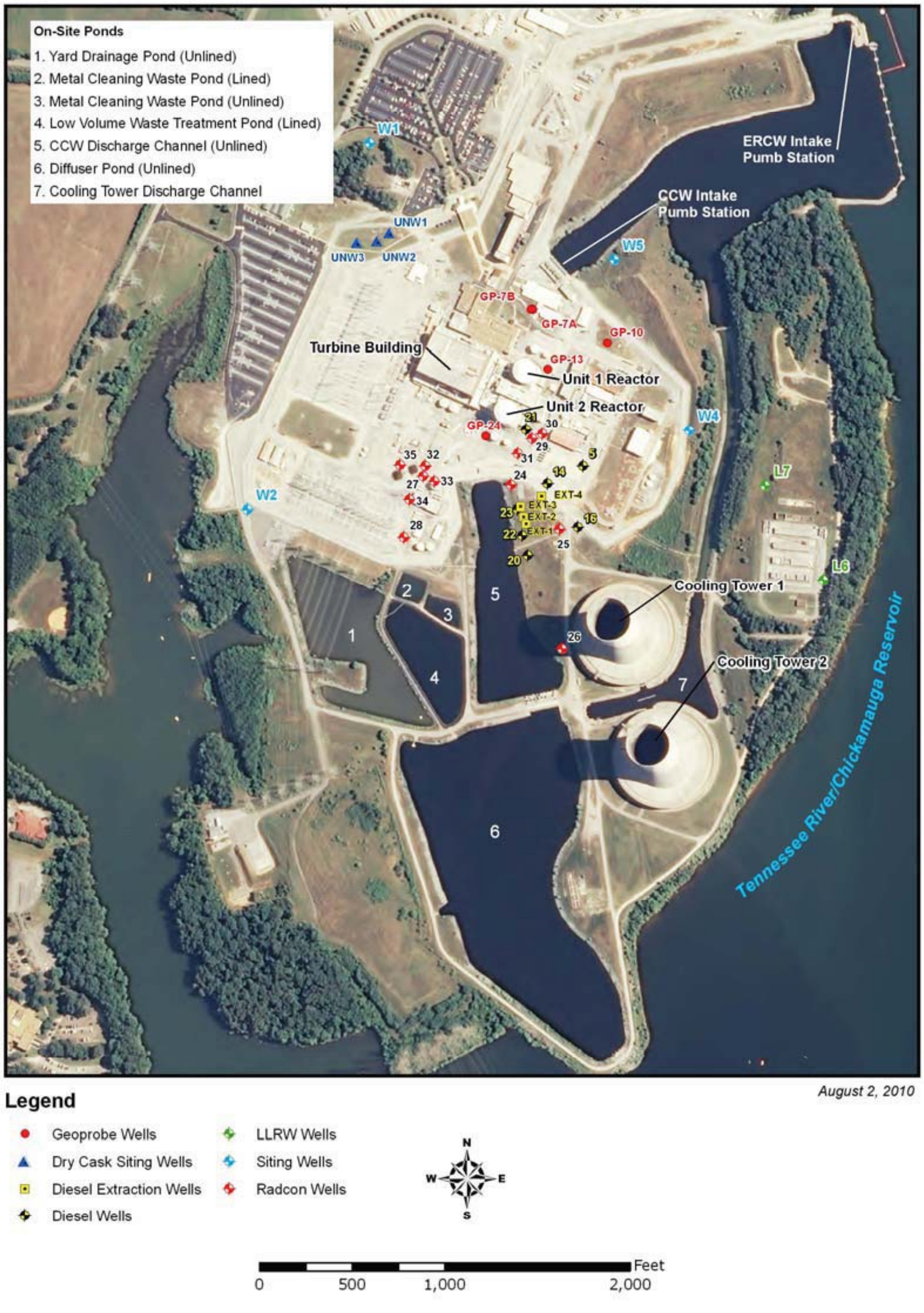

Figure 3-6. Geoprobe and Monitoring Well Locations

Relatively high groundwater samples from several monitoring wells had detectable tritium concentrations; however, there have been no tritium concentrations exceeding the EPA drinking water standard of 20,000 pCi/L for tritium (40 CFR §141.25) (TVA 2007c). The highest tritium concentration detected in 2009 was 8,080 pCi/L in well W-31 (TVA 2009f). Presently, tritium concentrations are being detected in four monitoring wells (GP-13, W-21, W-29, and W-31) (Table 3-9), but not in the other monitoring wells. Since 2008, tritium concentrations in the groundwater samples from the four wells with detectable tritium are all below half of the drinking water standard (less than 10,000 pCi/L), and the trend in tritium concentration is either flat or trending downward, as shown in Table 3-9. (TVA 2009f)

Tritium is not susceptible to attenuation via sorption or biochemical degradation. Reduction of tritium concentrations in the groundwater system at SQN occurs primarily by hydrodynamic dispersion and dilution. However, the fate and transport of tritium in the site groundwater system is also likely to be governed by avenues of relatively rapid groundwater movement that exist within bedding material of larger pipelines and tunnels, and possibly along the weathered bedrock horizon. (TVA 2007c) Tritium reduction also occurs through radioactive decay. Tritium has a half life of 12.32 years and a decay rate of 5.626 percent per year (UMNOLS 2010).

Table 3-9. Summary of Tritium Concentrations

Results	GP-13	Sample Date	W21	Sample Date	W29	Sample Date	W31	Sample Date
Highest Result	18,400	2/27/2007	2,763	3/21/2005	11,490	7/25/2005	19,750	6/14/2005
Lowest Result	7,730	10/16/2009	<270	10/16/2009	466	12/6/2004	2,576	11/24/2004
Most Current	7,730	10/16/2009	<270	10/16/2009	848	4/17/2009	5,338	10/16/2009

Units measured in pCi/L.
(TVA 2009f)

Groundwater and surface water level measurements during the 2007 study confirm that the intake and discharge channels would ultimately receive tritiated groundwater discharge from the site. Dilution ratios in the channels and subsequently the Tennessee River are dependent on plant operation and river flows. (TVA 2007c)

No active remediation has been recommended for the site due to the limited extent of tritium concentrations in groundwater (less than the EPA drinking water standard of 20,000 pCi/L), perceived low exposure and dose risks, and negligible potential for off-site groundwater migration. In addition, measured tritium levels are below 10 CFR Part 20 standards for radiation exposure. As mentioned previously, tritium sources appear to be primarily associated with past inadvertent releases of liquids containing radioisotopes.

In compliance with industry guidelines for groundwater protection initiatives (NEI 2007; EPRI 2007), SQN conducts a hydrogeologic evaluation review every five years. This review updates the predominant groundwater flow characteristics and gradients in a three-dimensional graphic representation of the subsurface based on current site configuration and environmental factors, including complexities in stratigraphy such as bedrock, clay lenses, geologic materials, or aquifers that may have the potential to affect contaminant flow. The next five-year hydrogeologic review for SQN is due in 2012. To support that review, a project is planned to install additional monitoring wells to better characterize the vertical extent of the two tritium plumes. The revised subsurface model will include land surface elevations and water levels, groundwater sources and sinks, hydraulic conductivity, borehole locations, and well construction details. This enhanced characterization is expected to verify the previously predicted migration pathways both spatially and temporally, and to confirm that the tritium sources are legacy spills.

Diesel Fuel Oil

Nine groundwater monitoring wells were installed as part of an assessment of a No. 2 diesel fuel oil release from an underground transfer line (TVA 2007c) where two leaks were identified and repaired (TVA 1993a). A free product plume was delineated, extending from the fuel oil supply line leak to the CCW discharge channel (TVA 1993a). Diesel fuel oil is recovered in an inceptor trench with four diesel extraction wells. A risk assessment was conducted in 1993 to determine the impact to human health and the environment. The risk assessment concluded that diesel fuel constituents, total petroleum hydrocarbons (TPH) and benzene, toluene, ethyl-benzene, and xylenes (BTEX), do not pose a significant risk to human health under the current land- and water-use conditions, and dissolved TPH and BTEX do not pose a significant risk to the environment in the CCW discharge channel or Chickamauga Reservoir (TVA 1993a). Effective with the March 1, 2011, NPDES permit, TDEC concurred that the diesel fuel recovery project could be terminated (TDEC 2011).

On June 26, 2009, a section of piping that supplied No. 2 diesel fuel from SQN's fuel oil storage tanks (FOSTs) to underground storage tanks (USTs) day tanks failed a pressure test. The test was confirmed later that day and on June 27th. The section of piping was 4 inches in diameter and 180 feet long. These USTs were deferred per TDEC Rule 1200-1-15-.01(b)3. Initial response actions per 1200-1-15-06(3) were completed including notification to TDEC's Chattanooga environmental field office, Division of Underground Storage Tanks, and the NRC on June 29, 2009. It should be noted that no drinking water supplies were within 0.10 mile of the petroleum site. Visual inspections of surrounding soils and water revealed no diesel fuel contamination, including free product and vapor hazards, from the suspected piping breach. The UST system was taken out of service when the confirmatory pressure test was completed on June 27, 2009. The last successful pressure test on this section of piping was in April of 2008. Thirteen diesel fuel transfers have occurred since the last successful pressure test (Timothy Cleary, TVA, personal communication, July 24, 2009). Approximately 200 cubic yards (yd^3) of diesel-contaminated soil from the spill have been removed from the spill location. TDEC officially closed this spill contamination case as of August 5, 2010. TVA sent the diesel-contaminated soil to the Rhea County Landfill under Special Waste Approval SPC ID# 72-5106 (TDEC 2010d). All analytical results [BTEX, TPH, methyl tert-butyl ether (MTBE), and naphthalene] for the soil remaining in the excavation area were below the detection limits (Christopher Church, TVA, personal communication, April 28, 2010).

3.2.2. Environmental Consequences

This section addresses impacts to groundwater from site construction and operation of the Action and No Action Alternatives.

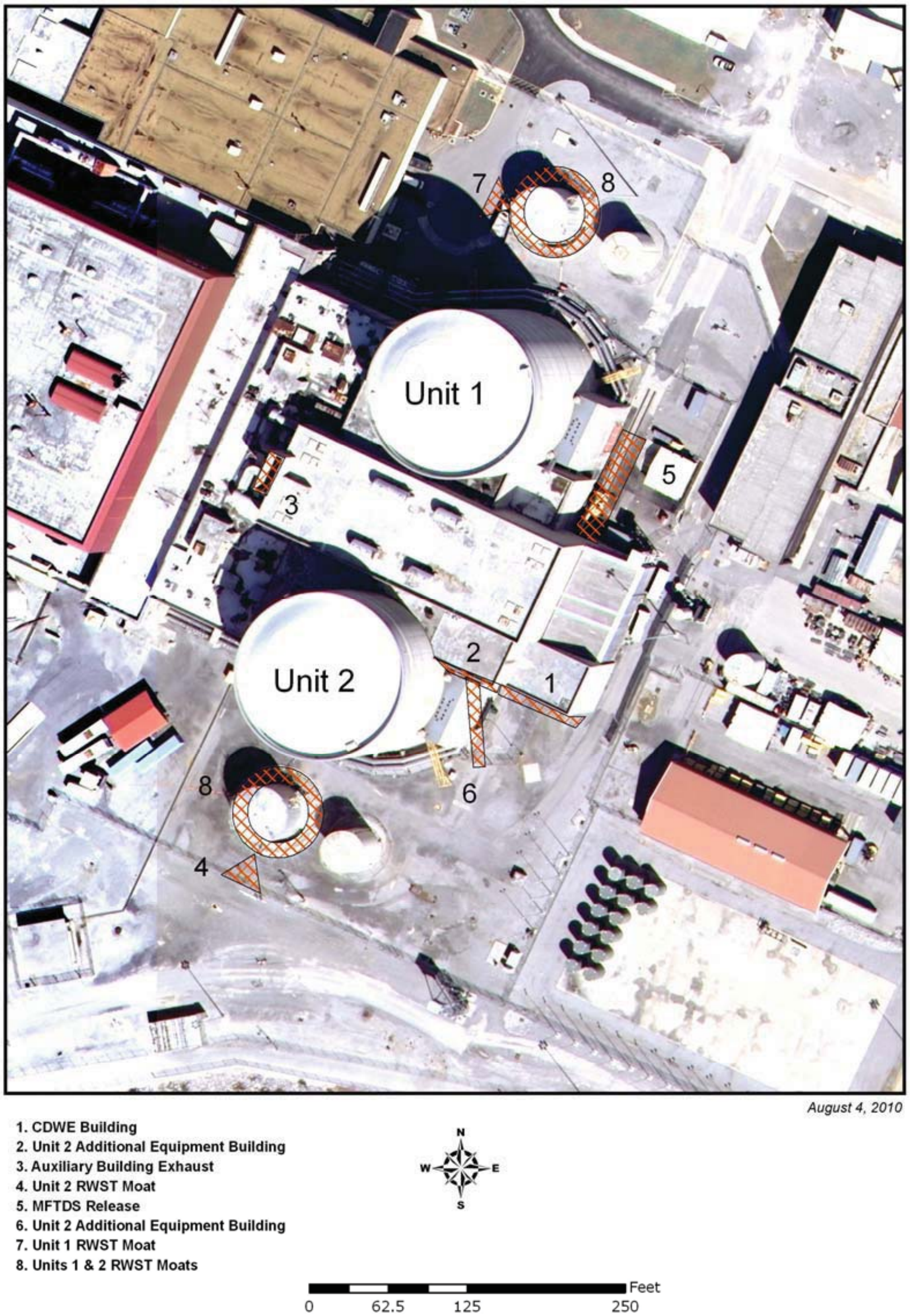

Figure 3-7. Locations of Inadvertent Tritium Releases

Alternative 1 – License Renewal

There is no groundwater use on site, nor is the use of groundwater proposed during the extended license period; therefore, no change in impact is anticipated from the current level of minor impact. The site is currently evaluating tritium impacts to the groundwater from past releases; however, the tritium concentrations are below regulatory action levels and appear to be declining, indicating that there are no active sources. In addition, there are no data showing that any tritium-impacted groundwater has migrated past the site property boundary.

Alternative 2 – No Action

Under the No Action Alternative, there would be no effects to the groundwater hydrology, groundwater use, or groundwater quality. There may be a minor but temporary impact on groundwater quality during shutdown and decommissioning activities. The current use at the SQN site of BMPs for handling chemicals, together with the adherence to spill prevention control and countermeasures (SPCC) programs for the management and cleanup of oils, limit the likelihood that oil or chemicals would reach groundwater. Residual chemicals from past spills and discontinued industrial practices would decrease over time, leading to improvement in water quality.

Alternative 2a – New Nuclear Generation

The impacts of Alternatives 2a and 2b are similar and discussed together with the exception of groundwater impacts from radiological sources, which are discussed below.

Impacts on groundwater quality from radiological sources are expected to be minor. Under Alternative 2a, TVA would comply with the NEI's groundwater protection initiative, NEI 07-07 (NEI 2007). This initiative identifies actions to improve utilities management and response to instances where the inadvertent release of radioactive substances may result in low, but detectible, levels of plant-related radioactive materials in subsurface soils and water. Aspects addressed by the initiative include site hydrology and geology, site risk assessment, on-site groundwater monitoring, and remediation. TVA would provide an annual report related to the results of the groundwater monitoring program at the new nuclear plant as directed in NEI 07-07, as well as having the program peer reviewed by industry experts. Actions taken as a result of the groundwater protection initiative would include an increase in monitoring locations, increased number of samples taken, and the review of programs and procedures for best industry practices. The goal of the groundwater protection initiative would be to reduce any impacts on groundwater from the accidental release of radioactive effluents.

Alternative 2b – New Natural Gas-Fired Generation

Groundwater impacts would depend on the use of groundwater and construction activities required to build the plant. Dewatering activities would likely be needed during foundation construction. If groundwater resources were used for sanitary and potable water use, there would normally be a minor impact because the amount of withdrawal would be minimal. Although it is unlikely that groundwater will be used for makeup and/or cooling water, it would depend on site-specific conditions and therefore the impacts could be moderate to substantial. Overall, groundwater impacts on the aquifer from a nuclear operation or gas-fired plant would be site-specific, and dependent on aquifer recharge and other withdrawals. Under both alternatives, chemicals used during construction would be managed using BMPs, thereby limiting the likelihood of chemical contamination of surface water as well as groundwater. With the adoption of either alternative, nonradiological impacts on groundwater quality are expected to be minor.

3.3. Floodplain and Flood Risk

The federal regulations concerning criteria of design against plant site flooding are provided in U.S. NRC, 10 CFR Part 50, Appendix A Criterion 2 – *Design Bases for Protection Against Natural Phenomena*. Criterion 2 states that structures, systems, and components (SSCs) important to safety shall be designed to withstand the effects of natural phenomena such as earthquakes, tornadoes, hurricanes, floods, tsunamis, and seiches without loss of capability to perform their safety functions. The design bases for these SSCs shall reflect (1) appropriate consideration of the most severe of the natural phenomena historically reported for the site and surrounding area, with sufficient margin for the limited accuracy, quantity, and period of time in which the historical data have been accumulated; (2) appropriate combinations of the effects of normal and accident conditions with the effects of the natural phenomena; and (3) the importance of the safety functions to be performed.

Floodplain and flood risk assessment involves ensuring that facilities would be sited to provide a reasonable level of protection from flooding. In doing so, the requirements of Executive Order (EO) 11988, *Floodplain Management,* would be fulfilled. For non-repetitive actions, EO 11988 states that all proposed facilities must be located outside the limits of the 100-year floodplain unless alternatives are evaluated, which either would identify a better option or support and document a determination of “no practicable alternative” to siting within the floodplain. (42 FR 26951)

The natural phenomena described in the SQN UFSAR Amendment 21 (TVA 2008a) contains information related to potential flooding of the SQN site from the Tennessee River and potential flooding from the local probable maximum precipitation (PMP) occurring within the site drainage. The PMP is defined as the theoretically greatest depth of precipitation for a given duration that is physically possible over a particular drainage area at a certain time of year. In consideration of the limited knowledge of the complicated processes and interrelationships in storms, PMP values are therefore identified as estimates.

Flood impacts are always considered in evaluating activities related to SQN due to the potential of occurrence and the potential for impacts on the health and safety of the public related to SQN. The following section discusses the floodplain and flood-risk related impacts.

3.3.1. Affected Environment

The SQN site is located on a peninsula on the western shore of Chickamauga Reservoir, at TRM 484.5 (TVA 2008a) in Hamilton County, Tennessee (Figure 1-2). The SQN site could be flooded from the Tennessee River as well as from the occurrence of a PMP event within the total watershed and the watershed for the local area of the plant site. Drainage to the Tennessee River has been provided to accommodate runoff from the PMP on the local area of the plant site (TVA 2008a).

The 100-year floodplain for the Tennessee River is the area below elevation 687 feet msl at TRM 484.5. The 500-year floodplain for the Tennessee River is the area below elevation 688.5 feet msl at TRM 484.5. The TVA flood risk profile (FRP) elevation on the Tennessee

River is elevation 689 feet msl at TRM 484.5 (Roger Milstead, TVA, personal communication, February 3, 2010). The FRP is used to control flood damageable development for TVA projects, and residential and commercial development on TVA lands. Hamilton County, Tennessee, has adopted the 100-year flood as the basis for local floodplain regulations, and any new or future development would be consistent with these regulations (CHCRPA 2009b).

For a "critical action," facilities must be protected to the 500-year flood elevation where there is no practicable alternative. A "critical action" is defined in the *Water Resources Council Floodplain Management Guidelines for Implementing Executive Order 11988* as any activities for which even a slight chance of flooding would be too great (43 FR 6030). One of the criteria used in determining if an activity is a critical action is whether essential and irreplaceable records, utilities, and/or emergency services would be lost or become inoperable if flooded. Some SQN facilities fall under the classification of a "critical action"; as such, facilities must be protected to the 500-year flood elevation where there is no practicable alternative. However, TVA would require that critical facilities must be protected to the FRP elevation, which is higher than the 500-year flood elevation. Based on this criterion, all facilities that would force the shutdown or curtailment of power generation, if flooded, would either be located above or flood-proofed to the FRP elevation (elevation 689 feet msl at TRM 484.5). Many of the support facilities that would not impact power generation if flooded would only be subject to evaluation using the 100-year flood (elevation 687 feet msl at TRM 484.5).

The NRC also requires a flood risk evaluation of possible impacts from the Tennessee River probable maximum flood (PMF) and local PMP site drainage. The SQN drainage system was analyzed for a storm producing the PMP on the local area. The site is graded such that runoff would drain away from safety-related structures to drainage channels and subsequently to the Tennessee River. The local area of the SQN plant site would pass the PMP runoff criteria without exceeding the SQN critical plant grade elevation of 706 feet msl. Most safety-related building accesses are located at elevation 706 feet msl or above. Accesses below elevation 706 feet msl are within the powerhouse and would not be exposed to flood water until plant grade is exceeded (TVA 2008a).

The PMF is defined as the most severe flood that can reasonably be predicted to occur at a site as a result of hydrometeorological conditions. It assumes an occurrence of PMP critically centered on the watershed, and a sequence of related meteorological and hydrologic factors typical of extreme storms. Based on the 2009 flood analysis re-verification, the Tennessee River PMF elevation at the SQN site with the current lock configuration at the Chickamauga Dam would be 722 feet msl, which would exceed the SQN critical plant grade elevation of 706 feet msl. The PMF elevation at the SQN site for the final lock configuration after the addition of a new lock at the Chickamauga Dam will also exceed plant grade.

3.3.2. Environmental Consequences

This section addresses the floodplain and flood risk-related impacts from site construction and operation of the Action and No Action Alternatives.

<u>Alternative 1 – License Renewal</u>

Alternative 1 (license renewal) allows for the continued operation of Units 1 and 2 for an additional 20-year period beyond the expiration dates of the current licenses. The license renewal program would not require major new construction, alterations, or refurbishment to SQN to maintain consistency with the current licensing basis.

Because SQN has already been constructed and the major exterior accesses of existing safety-related structures are located at elevation 706 feet msl or above, those accesses are above the 100-year flood (687 feet msl) and FRP elevations (689 feet msl), and therefore the project is consistent with EO 11988. Elevations of the major exterior accesses of safety-related structures are also at or above the local PMP site drainage elevation of 706 feet msl. For conditions where the PMF (722 feet msl) exceeds plant grade, the equipment required to maintain the plant safely during the flood, and for 100 days after the beginning of the flood, is either designed to operate submerged, located above the maximum flood level, or otherwise protected (TVA 2008a). Because license renewal involves an existing nuclear generation facility that would not include any major refurbishment at the facility, continued operation of SQN would not increase the flood risk in the Chickamauga Reservoir watershed, and the plant would not impact upstream flood elevations.

The current on-site ISFSI does not have sufficient capacity to support license renewal. Spent fuel storage capacity would be expanded, under a separate action, by the addition of a separate additional concrete storage pad prior to exceeding on-site spent fuel storage capacity. The location of the new concrete pad has not been determined, but would be located outside of the 100-year floodplain (687 feet msl) and above the FRP elevations (689 feet msl), which would be consistent with EO 11988. If license renewal is approved, the planned expansion of spent fuel storage capacity would also meet NRC requirements to evaluate the facility for the effects of the PMF. In addition, all safety-related structures for a future storage site shall be either above or flood-proofed to the Tennessee River PMF elevation, including wave runup. Therefore, there would be no cumulative effects to flood risk associated with the implementation of Alternative 1.

Alternative 2 – No Action Alternative

If the No Action Alternative were chosen, SQN would shut down and begin decommissioning activities.

Alternative 2a and 2b – New Nuclear or Natural Gas-Fired Generation

Under Alternative 2a or 2b, no construction would occur at the SQN site. Construction and operation of a new nuclear plant for Alternative 2a or a new natural gas-fired plant would be at an alternative site. The physical location of the new construction for Alternative 2a or 2b is unknown. Because Alternative 2a involves a nuclear generating facility, the NRC requires a flood risk evaluation of possible impacts from the PMF and local PMP site drainage for the alternative site. Construction and operation of a new plant would introduce construction impacts and new incremental operational impacts. All proposed construction would be evaluated to ensure consistency with EO 11988. Proper standard erosion-control measures would be followed to minimize the potential for adverse impacts on floodplains.

Dredging could also occur for new construction. TVA likely would dispose of dredged material in an on-site spoils area above the 500-year flood elevation. Therefore, under EO 11988, dredging would be a repetitive action that would result in minor impacts.

Potential floodplain impacts during operation of a new plant would be mitigated, and potential impacts would be minor through the use of BMPs as well as consistency with the requirements of the EO 11988.

Most activities necessary to construct and operate a new natural gas-fired power plant (Alternative 2b) would be similar to those implemented under Alternative 2a and would have similar impacts on the floodplain at the new plant site because all proposed construction would be evaluated to ensure consistency with EO 11988.

3.3.3. Conclusion

Floodplain impacts would be expected to be minor during construction at potential alternative sites, depending on the location. Impacts to floodplains would be minor during operation for all alternatives.

Because of the DOE's delay in receiving spent fuel from nuclear utilities, and assuming current operating conditions, SQN has built an ISFSI that operates under a general license to temporarily store spent nuclear fuel on site. The ISFSI for SQN is dry storage (TVA 2002c), which could be supplemented with a separate additional concrete storage pad for increased storage requirements. Floodplain impacts due to any future additions or changes to the on-site ISFSI capacity are expected to be minor.

3.4. Wetlands

3.4.1. Affected Environment

Wetlands are areas inundated or saturated with surface water or groundwater at a frequency and duration sufficient to support, and under normal circumstances, do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.

Wetlands are regulated under Sections 404 and 401 of the CWA and addressed under EO 11990. To conduct certain activities in the "Waters of the U.S." that may affect wetlands, authorization under a Section 404 permit from the U.S. Army Corps of Engineers is required. Section 401 gives states the authority to certify whether activities permitted under Section 404 are in accordance with state water quality standards. TDEC is responsible for Section 401 water quality certifications in Tennessee. EO 11990 requires all federal agencies to minimize the destruction, loss, or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands in carrying out the agency's responsibilities.

To determine the presence of wetlands within the SQN boundary, the land cover table (Table 3-10) and National Wetland Inventory (NWI) wetland maps were reviewed. Table 3-10, derived from Figure 3-8, indicates 1.3 percent of the site is composed of woody wetlands. Emergent herbaceous wetlands do not exist on site. Areas labeled as woody

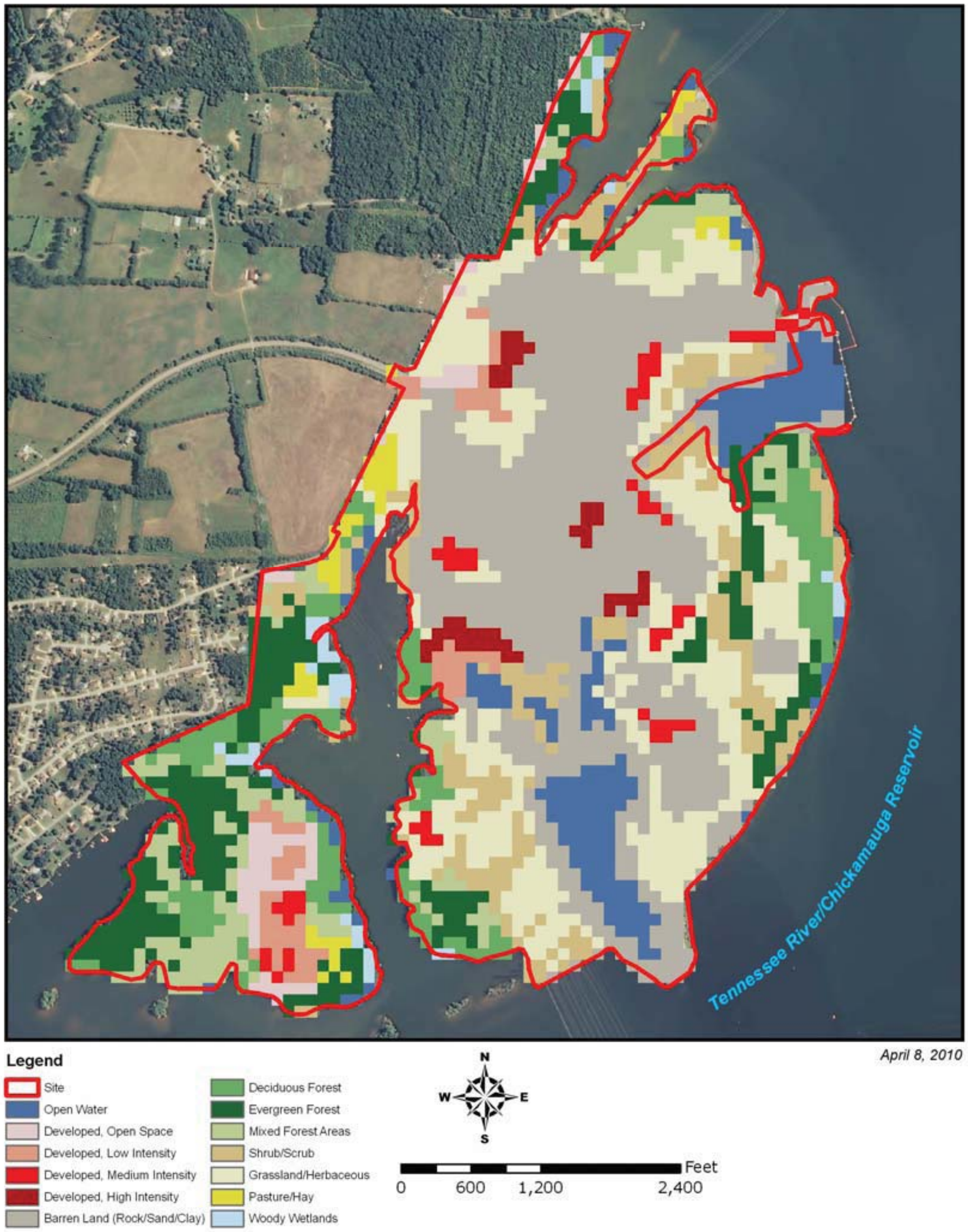

Figure 3-8. SQN Land Cover

wetlands on Figure 3-8 border the Chickamauga Reservoir. Additionally, a single, 0.88-acre wetland classified as PSS1C (palustrine, scrub shrub, broad leafed deciduous, seasonally flooded) is also located on the north side of the plant (Figure 3-9).

Table 3-10. SQN Land Cover

Category	Facility Percentage
Open Water	7.79
Developed – Open Space	2.43
Developed – Low Intensity	2.75
Developed – Medium Intensity	2.04
Developed – High Intensity	1.55
Barren Land (rock/sand/clay)	30.51
Forest – Deciduous	6.73
Forest – Evergreen	10.18
Forest – Mixed	6.69
Scrub/Shrub	9.3
Grassland/Herbaceous	16.88
Pasture/Hay	1.83
Wetlands – Woody	1.3
TOTAL	**100**

(USDA 2001)

NWI maps list most of the aquatic habitat within or adjacent to SQN as wetland acreage. On-site ponds carry the PUBHx (palustrine, unconsolidated bottom, permanently flooded, excavated) classification as defined using the Cowardin method of classification (Cowardin et al. 1979). Four wetland types exist along the Chickamauga Reservoir shoreline adjacent to the SQN site, including:

- L2AB3Fh – lacustrine, littoral, aquatic bed, rooted vascular, semi-permanently flooded, impounded.
- L2AB3Hh – lacustrine, littoral, aquatic bed, rooted vascular, permanently flooded, impounded.
- L2UBHh – lacustrine, littoral, unconsolidated bottom, permanently flooded, impounded.
- L1UBHh – lacustrine, limnetic, aquatic bed, rooted vascular, permanently flooded, impounded.

Figure 3-9. National Wetlands Inventory at SQN Site

Although Chickamauga Reservoir is a run-of-the-river reservoir, seasonal water level fluctuation within the reservoir is substantial enough to sustain wetland areas along the shore.

3.4.2. Environmental Consequences

This section addresses impacts to wetlands from site construction and operation of the Action and No Action Alternatives.

Alternative 1 – License Renewal

Under Alternative 1, no impacts to wetland are anticipated. The license renewal program would not require major new construction, alterations, or refurbishment to SQN to maintain consistency with the current licensing basis. However, expansion of the spent fuel storage capacity by addition of an additional concrete storage pad is assumed. Siting of the additional storage pad would not be in a wetland or other sensitive area. Additionally, the same programs, procedures, permits, and requirements would be followed. Because only minor changes are needed to implement this alternative, no new effects to wetlands are anticipated. Eventually SQN will be shut down and decommissioned, but it is not anticipated that decommissioning activities would have any effect on wetlands.

Alternative 2 – No Action Alternative

Under Alternative 2, the termination of the SQN license and eventual shutdown and decommissioning of SQN are not anticipated to affect area wetlands.

Alternative 2a and 2b – New Nuclear or Natural Gas-Fired Generation

The impacts of Alternatives 2a and 2b are similar and depend upon the locations chosen to site the new plants. They are discussed together below.

The impact to wetlands due to building a new natural gas-fired plant and associated transmission lines would range from minor to substantial depending on the physical location of the plant structures and the quantity and quality of wetlands within the potential plant footprint as well as along transmission line and pipeline corridors. A site-specific environmental review would be conducted to identify wetlands and measures to avoid, minimize, and mitigate impacts as appropriate. TVA actions would comply with the CWA and EO 11990.

3.5. Aquatic Ecology

3.5.1. Affected Environment

TVA has been routinely studying aquatic conditions within the Tennessee River, including Chickamauga Reservoir, as part of its vital signs monitoring program, implemented in 1990 (TVA 2006a). The vital signs monitoring program analyzes five different metrics (dissolved oxygen, chlorophyll, fish, bottom life, and sediment) measured over several different locations within the reservoir to determine a reservoir ecological health rating (Section 3.1). TVA uses its existing vital signs monitoring program collection sites, supplemented with additional fish and benthic macroinvertebrate (bottom life such as insects, mussels, worms, etc.) community monitoring upstream and downstream of SQN to evaluate the effects SQN may have on aquatic ecological communities.

Chickamauga Reservoir ecological health ratings have been classified as “good” in all but one sampling year from 1994 to 2009. In 2007, ecological health ratings for dissolved oxygen and bottom life dropped into the “fair” range. During low-flow years such as 2007, DO decreases along the bottom of the reservoir, which lowers the rating for the DO metric. DO and bottom life measurements are directly proportionate so the bottom life metric also decreased in 2007. Decreases in two of five metrics caused the decrease from “good” to “fair” in 2007.

Fish and macroinvertebrate sample collection is the backbone of the biotic portion of the monitoring program. Fish communities are used to evaluate ecological conditions because of their role in the aquatic food web, and because fish life cycles are long enough to integrate conditions over time. Twelve metrics are scored and summed to determine an overall reservoir fish assemblage index (RFAI) score for each sample collection site. (TVA 2004b)

Benthic macroinvertebrate populations are assessed using the RBI methodology. Because benthic macroinvertebrates are relatively immobile, adverse local impacts to aquatic ecosystems can be detected earlier in benthic macroinvertebrate communities in comparison to fish communities. (TVA 2004b) In the Chickamauga Reservoir, RFAI and RBI data are collected from established sites annually. Supplemental data collected from additional sites near SQN are used in conjunction with RFAI and RBI results to provide an understanding of reservoir conditions over time and determine the effects of various stimuli (e.g., drought conditions or SQN discharge).

Fish Community

In general, reservoir fish communities are different from those found in the river prior to impoundment due to the significant habitat alterations associated with impounding a river. Three flow regimes are common in reservoirs created by impounding rivers. Inflow sections are generally riverine in nature. Transitional zones are located in the mid-reservoir where water velocity decreases due to increased cross-sectional area, suspended materials begin to settle, and water clarity increases. (TVA 2006a) Algal productivity also increases in the transitional zone because of increased water clarity and reduced mixing, which allows the algae to remain in the photic zone, where light reaches, toward the surface of the water column. The forebay area is where water collects behind the dam. Water velocity is diminished and depth increases. (TVA 2005a)

Differences are expected in the fish community along the longitudinal gradient with a more riverine community expected at the upper end of inflow of a reservoir and a more lacustrine (similar to a lake) community expected in the pool near the dam. Other factors to consider in evaluating biotic communities in reservoirs include reservoir operation characteristics such as water depth, fluctuation, drawdown, retention time, stratification, bottom anoxia, substrate type, and stability.

The above factors must be considered in selecting aquatic community characteristics or expectations used to evaluate aquatic resource conditions. Given that reservoirs are artificial systems, TVA developed the RFAI to describe the health of resident fish communities in TVA reservoirs. (TVA 2005a)

The RFAI scores have an intrinsic variability that stems from several sources, including annual variations in air temperature and stream flow; variations in pollutant loadings from nonpoint sources; changes in habitat, such as the extent and density of aquatic vegetation; and natural population cycles and movements of the species being measured (TVA 2009g).

TVA has conducted the RFAI program in Chickamauga Reservoir since 1993. Traditionally, RFAI data in Chickamauga Reservoir are collected from four sites: Chickamauga Reservoir inflow site, TRM 529.0; the transition site (TRM 490.5), which also acts as the SQN upstream site; the forebay site (TRM 472.3); and the Hiwassee River embayment site, HiRM 8.5, to provide information on the health of the fish community throughout the reservoir. (TVA 2006a) In 1999, a site was added at TRM 482.0 downstream of SQN to discern possible effects to the fish community from SQN discharge over time (TVA 2009g). Upstream and downstream sites are identified in Figures 4 and 5 of *Biological Monitoring of the Tennessee River Near Sequoyah Nuclear Plant Discharge Autumn 2009* (TVA 2010i).

SQN is physically positioned where reservoir characteristics shift from the transitional zone to the forebay. Therefore, the site upstream of SQN is scored with transition criteria, and the downstream site is scored using forebay criteria. Accurate comparisons can only be made between sites located in the same reservoir zone (i.e., transition to transition). The physical and chemical composition of a forebay is different than that of a transition; consequently, inherent differences exist among the aquatic communities (e.g., species diversity is often higher in a transition zone than a forebay zone). However, the RFAI is particularly useful in identifying changes at each site over time.

The average RFAI scores at these five sites over all sampling years have remained in the “good” range with a relatively low standard error (Table 3-11). The inflow and upstream sites have an average score of 45 ±0.91 and 45 ±1.23 (good), the downstream and Hiwassee River Embayment sites have an average score of 41 ±1.23 and 42 ± 0.92 (good), and the forebay site averages a score of 43 ±0.89 (good). Averages from 1993 – 1999 are similar to those from 2000 – 2009, indicating stability over time.

During 2008, the upstream site scored 10 points lower than the previous year while the downstream score remained the same. This was the only site in Chickamauga Reservoir that exhibited a decrease in the RFAI score (TVA 2009g). In 2009, the upstream site rebounded, scoring an RFAI of 41 (good) (TVA 2010i).

Interpretations of fish community changes are complex and multifaceted. Fish communities in reservoirs are subjected to highly variable water conditions (e.g., rate of spring warming, discharges, turbidity, water level fluctuation) that affect planktonic food chains, spawning times and success, early survival of different fish species, and interspecific competition between early life stages of fish species (TVA 1993b). RFAI score anomalies are expected in such a dynamic system.

As previously mentioned, TVA has been studying fish populations in Chickamauga Reservoir for decades using a variety of methods such as cove rotenone (using a toxicant to aid in the collection of all fish in a cove), gill netting, creel surveys, and electroshocking. At times, routine surveys indicate a changing population will trigger a focused study to determine reasons behind shifting populations. For example, declining numbers of white bass (*Morone chrysops*), white crappie (*Pomoxis annularis*), sauger (*Stizostedion canadense*), and channel catfish (*Ictalurus punctatus*) based on cove rotenone samples and harvest rates based on creel surveys prompted the Tennessee Department of Health and Environment and TWRA to express concern regarding these populations in 1986 (TVA

1991). TVA conducted four focused studies as a result of the concerns addressed by the State of Tennessee. The results of the four studies follow.

White bass provide year-round fishing on most Tennessee River reservoirs. They are early spring spawners (March – April) and mature adults congregate and run up tributary streams and into tail waters to spawn. White bass are known to transverse the Tennessee River system. Larval fish and egg studies indicate three primary spawning areas; the Hiwassee River, Sewee Creek, and Hunter Shoals. However, yellow bass (*M. mississippiensis)* appear to spawn in greater numbers in the same areas and likely compete for food and habitat. (TVA 1994) Movement of white bass past SQN during and after the spawning migration is apparently not impeded by SQN operation. Recapture of tagged white bass by fishermen in the vicinity of SQN did not indicate an attraction that would result in overharvest or a significant disruption of adult migration to the spawning areas. It seems likely that competition from yellow bass could be a major factor limiting the population of white bass in Chickamauga Reservoir. (TVA 1994)

White crappie populations were investigated in Chickamauga Reservoir from 1986 through 1989 in response to cove rotenone and creel data indicating a decline in the population. White crappie predominantly spawn in large embayments and smaller tributaries throughout the reservoir. The multi-year investigation revealed good survival through the early juvenile stage, but high mortality in their second summer as determined by aging otoliths (structure in the inner ear of vertebrates). Mortality of young crappie appeared to be correlated to an increase in aquatic vegetation, increased numbers of yearling sunfish, yearling largemouth bass, adult largemouth bass, and gizzard shad. Drought years from 1985 – 1988 caused decreased flow through the reservoir, which enabled aquatic vegetation to increase, effectively changing the habitat structure to a state less suitable for white crappie populations. Incidentally, changes that were unfavorable for white crappie proliferation had a positive effect on black crappie (*P. nigromaculatus*) populations. (TVA 1990a)

Population estimates of sauger in Chickamauga Reservoir declined progressively from 1986 – 1990. Sauger are considered a cool-water fish and migrate throughout the reservoir system (TVA 1994) to spawn at Hunter Shoals (TRM 521-522) (TVA 1995c), which is approximately 35 miles upstream of SQN. A thermal variance was approved for SQN in 1993 that raised the maximum instantaneous temperature increase from 3ºC to 5ºC from November through March (TVA 1995c). The sauger population was at a low density in 1993 prior to implementation of the thermal variance. In 1994, after the variance was implemented in November 1993, the resident sauger population was estimated at its highest level since 1986. No attraction to, or avoidance of, the SQN diffuser area was documented for fishermen or sauger based on a SQN creel survey and tags returned during 1993 and 1994. Critical factors determining reproductive success of sauger in Chickamauga Reservoir are an instantaneous minimum water flow of 8,000 cfs in the reservoir and a gradually increasing water temperature during the spawning period. When flow conditions are unsuitable for natural reproduction, stocking of fingerlings into the reservoir is an effective means of producing a viable year class. (TVA 1995c)

Channel catfish in Chickamauga Reservoir are important to both commercial and sport fisheries. Analysis of historical and recent data collected using a variety of sample methods failed to reveal any steadily declining trends in adult channel catfish densities in Chickamauga Reservoir from 1970 – 1990 (TVA 1991). Sport fishing data indicate the total number of channel catfish estimated harvested in 1989 (27,107) was second only to the number harvested during 1976, and estimated biomass in 1989 (23,700 kg) was the highest for the period. Estimated harvest of channel catfish from Chickamauga Reservoir in 1988 and 1989 was much higher than from the mainstream reservoirs immediately upstream (Watts Bar) and downstream (Nickajack). Cove rotenone surveys revealed no significant trend in numbers or biomass of adult channel catfish after analysis of data from 1970 through 1990; however, both numbers and biomass of intermediate size and numbers of young-of-year channel catfish have shown a significant decreasing trend since 1970. Total number of channel catfish of all sizes increased in 1988 to the second-highest number collected since 1970. Gill net sampling in 1986 – 1990, which employed similar gear and methods during roughly the same time period each year, resulted in catch rates that again did not indicate declining abundance of channel catfish in upper Chickamauga Reservoir. (TVA 1991)

Trends in RFAI data over time indicate relative stability according to standard error calculations applied to annual RFAI scores (Table 3-11). As previously mentioned, fish communities are complex and multifaceted, and RFAI scores can change substantially from year to year. When RFAI scores indicate a possible trend, focused surveys are performed to determine probable causes of changes in the reservoir and appropriate mitigation. Analysis over time reveals increasing or decreasing trends are not apparent within the data, as evident by comparing the 1994 – 1999 average with the 2000 – 2009 average displayed in Table 3-11, thus indicating relative stability within the reservoir and effectiveness in TVA management.

Benthic Macroinvertebrate Community

Freshwater macroinvertebrate habitat includes aquatic vegetation, river, and reservoir substrates. The availability of food, nature of the sediment, and current flow generally constitute the primary factors determining the benthic macroinvertebrate distribution patterns. Food is usually the ultimate determinant of macroinvertebrate distribution and abundance. The majority of macroinvertebrates are nonselective feeders taking in a wide range of food substances of acceptable particle dimensions.

Benthic macroinvertebrates serve as a source of food for fish and other higher aquatic life. Presence and absence data can also provide information regarding macroinvertebrate habitat quality. Many species are sensitive to pollution and respond quickly (both positively and negatively) to changes in water quality.

Some have a relatively long and usually complex life cycle of a year or more, and their presence or absence helps describe environmental conditions over a period of time. Because most have limited mobility and are not subject to rapid migrations, they serve as natural monitors of water quality. (TVA 2006a)

Historically, the number and density of macroinvertebrates identified near SQN have been lower than other sampling locations within Chickamauga Reservoir. Substrate data near SQN indicate the silt-to-sand ratio within the substrate near SQN is far reduced from the silt-to-sand ratio measured at other sample locations and would not support as diverse a benthic community. (TVA 1986)

RBI scores are based on seven metrics or characteristics measured for each site (TVA 2004b). Similar to RFAI scores, RBI scores also have an intrinsic variability between samples. (TVA 2010i)

Table 3-11. Summary of RFAI Scores In Chickamauga Reservoir Since 1993

Station	Location	1993	1994	1995	1997	1999	1993 – 1999 Average	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2000 – 2009 Average
Inflow	TRM 529.0	52	52	48	44	42	48	44	46	48	48	42	42	42	42	44	44	45
Transition SQN Upstream	TRM 490.5	51	40	48	39	45	45	46	45	51	42	49	46	47	44	34	41	45
Forebay SQN Downstream	TRM 482.0	-	-	-	-	41	41	48	46	43	45	41	39	35	38	38	37	41
Forebay	TRM 472.3	43	44	47	40	45	44	45	48	46	43	43	46	43	41	41	34	43
Hiwassee River Embayment	HiRM 8.5	46	39	39	40	43	41	43	47	-	36	42	45	-	41	-	42	42

RFAI scores: 12-21 (very poor), 22-31 (poor) 32-40 (fair), 41-50 (good), 51-60 (excellent)
(TVA 2010i)

Six sites sampled for benthic macroinvertebrates include two inflow sites at TRM 527.4 and 518.0, one transition site at TRM 490.5 (SQN upstream site), two forebay sites at TRM 482.0 (SQN downstream site), and TRM 472.3 and HiRM 8.5. Average RBI scores in Chickamauga Reservoir were good except for the site at the HiRM, which scored an average of 23 (fair), aided by one very low RBI score in 2007 (see Table 3-12). (TVA 2009g) The year 2007 was a low-flow year for Chickamauga Reservoir. DO levels dropped in the reservoir, which likely affected benthic macroinvertebrate communities negatively, contributing to the low RBI score.

Benthic macroinvertebrate data collected during 2008 from TRM 490.5 upstream of SQN and 482.0 forebay downstream of SQN, revealed an RBI score of 17 (poor) and 25 (good), respectively. The downstream site was similar to past sampling events; however, the upstream site was uncharacteristically low in 2007 and 2008. The upstream sampling site also received lower RBI scores from 2000 to 2002 but returned with an “excellent” score in 2003 (TVA 2009g). This likely represents natural variation in benthic communities and not a decline related to SQN operation.

RBI variability over time is slightly higher than RFAI variability likely due to sampling protocol and the relative immobility of macroinvertebrates when compared to fish. When sampling for macroinvertebrates, often habitats with high invertebrate concentrations are adjacent to areas of low concentration, which leads to increased variability with regard to invertebrate concentration among samples. (TVA 2005a) For the sampling locations near SQN, some RBI variability is evident from year to year, but no increasing or decreasing trends are apparent. In comparing the averages from 1994 – 1999 and 2000 – 2009, little change is evident, which implies relative stability within the macroinvertebrate community.

As a subset of macroinvertebrates, mollusk populations have been studied throughout the TVA reservoir system since the early 20th century. In 1918, Ortmann documented the freshwater mussel fauna of the upper Tennessee River and concluded that it was the most prolific region in the world for this fauna (Ortmann 1918). In the 1960s, Scruggs and Isom reported the dramatic decline of mussels in the river system, including the reach between Chickamauga Dam (TRM 471) upstream to Watts Bar Dam (TRM 530), citing loss of habitat from impoundment, overharvesting, and water quality degradation as causes (Scruggs 1960; Isom 1969). Isom concluded that suitable habitat for mussels within Chickamauga Reservoir only occurred for 29 miles downstream of Watts Bar Dam with effects of impoundment (e.g., sediment accumulation) as a continuing problem (Isom 1969).

TVA’s 1974 FES on SQN (TVA 1974a) recognized the presence of freshwater mussels (Family: Unionidae) and an active mussel harvest practice within Chickamauga Reservoir during TVA's initial environmental review of the facility; however, it reported that the mussel harvesting activity and a state mussel sanctuary both occurred quite some distance from SQN (i.e., between 24 and 40 miles upstream of SQN in the tail waters of Watts Bar Dam). In 1978 TVA conducted a widespread survey of the mainstem Tennessee River using scuba diving to document the status of freshwater mussels and snails throughout portions of reservoirs between Kentucky Dam and Fort Loudon Dam (TVA 1979); survey efforts in Chickamauga Reservoir included only a 15-mile reach downstream of Watts Bar Dam (i.e., TRM 514.2 – 529). TVA collected 21 species at sites between TRM 520.0 – 521.0 and TRM 526.5 – 528.1, which included the now federally listed as endangered pink mucket (*Lampsilis abrupta*) and dromedary pearly mussel (*Dromus dromas*) at community frequencies of 0.4 and 0.2 percent or less (TVA 1979).

Table 3-12. Summary of RBI Scores in Chickamauga Reservoir Since 1994

Station	Location	1994	1995	1997	1999	1994 – 1999 Average	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2000 – 2009 Average
Inflow	TRM 527.0	-	-	-	-	-	-	29	27	33	35	31	-	23	23	23	28
Inflow	TRM 518.0	19	31	25	21	24	23	29	23	27	35	29	33	25	-	31	27
Transition SQN Upstream	TRM 490.5	33	29	31	31	31	23	25	25	31	31	31	27	21	17	27	27
Forebay SQN Downstream	TRM 482.0	-	-	-	-	-	23	31	29	29	33	31	31	25	25	23	28
Forebay	TRM 472.3	31	27	29	25	28	27	27	21	27	29	27	29	19	25	23	26
Hiwassee River Embayment	HiRM 8.5	17	27	25	21	23	-	21	-	31	-	25	-	13	-	19	23

RBI scores: 7-12 (very poor), 13-18 (poor) 19-23 (fair), 24-29 (good), 30-35 (excellent)
(TVA 2010i)

Ahlstedt and McDonough (1996) reported pre-operational mussel monitoring data (1982 – 1993) from near WBN at TRM 528, which documented the persistence of the endangered pink mucket, but an overall reduction in species and recruitment for most mussel species near WBN prior to operation. In September 2010, TVA surveyed mollusks (mussels and snails) and habitat at three sites that had been surveyed for mussels prior to operation (1983 – 1994) and after operations (1996 – 1997) started at WBN (Third Rock 2010c). The 2010 survey recorded a total of 17 species, including one, old individual each of the federally endangered pink mucket and the proposed endangered sheepnose mussel. Mean mussel density in 2010 was 1.2 mussels/square meter (m^2) and mean catch per hour was 86.1 mussels/hr (Third Rock 2010c). Thus, measures of mussel abundance and species richness in 2010 were very similar to those measured near WBN just before and after its operations began (1992 – 1997).

In addition to mussels, aquatic snails are also an important ecological component of the Tennessee River system, and are considered a highly imperiled taxonomic group within the southeastern United States. Although the TVA Natural Heritage Database (June 2010) indicated no records of state or federally listed aquatic snails within ten miles of SQN, apparently no studies dedicated to assessing the aquatic snail community near SQN have been reported. Data from TVA's RBI monitoring efforts in 2001 – 2009 indicated that aquatic snails are commonly found in Chickamauga Reservoir near SQN (TRM 490.5 and 482.0) at densities averaging 27.7 snails/m^2 (range = 0.0 – 106.7 snails/m^2) among both sites over the nine-year monitoring period. No state or federally listed snail species have been collected at the monitoring sites since the start of monitoring in 2001; however, the RBI monitoring efforts were not meant to fully characterize snail or macroinvertebrate communities, but rather to provide general indications of benthic community health. Few snail taxa have been collected to date from the monitoring sites near SQN. In 2010, TVA's evaluation of the mollusk community near its WBN facility (TRM 528) upstream from SQN found only two species of snails, which occurred at mean site densities ranging from 0.03 to 0.43 snails/m^2 (Third Rock 2010c).

In 2010, TVA conducted a survey of the Tennessee River near SQN (Third Rock 2010a) to document the existing mollusk community (unionid mussels, aquatic snails, and zebra mussel infestation) and habitat conditions in areas that may be affected by plant operations and areas outside the range of potential effects from SQN. TVA studied four sites in the Tennessee River adjacent to SQN in areas that may be affected by plant operations as well as four sites in areas that would not be affected by potential impacts from SQN. Areas most likely to be affected by SQN operations include the water intake and associated skimmer wall, coolant water diffusers and associated mixing zone, and a submersed dam in the historical river channel downstream of the intake site used to help retain colder deep water near the plant intake.

The survey showed that all sites near SQN support relatively low-diversity, low-abundance mussel and snail communities. The study found a total of 280 mussels representing 10 species and 281 snails representing four species. No federally listed mussel or snail species were collected (live or dead) during the study. Mean mussel density among all sites was 0.05 mussels/m^2 from semi-quantitative samples and 0.18 mussels/m^2 from quantitative samples. The highest mussel density of any site was 1.8 mussels/m^2 for any semi-quantitative sample and 0.30 mussels/m^2 for quantitative samples. (Third Rock 2010a)

Mussel species richness and density in the SQN study area are very low compared to other areas of the Tennessee River that still support viable mussel communities (since impoundment), particularly those with listed species like pink mucket. In areas of the mainstem river that still retain quality mussel habitat, species richness typically exceeds 15 species and can exceed 25 species. Mussel densities in these areas are usually two orders of magnitude greater than that observed near SQN (MCD 2006; Dinkins 2008, LEC 2008, Third Rock 2010b). Another indication that the area near SQN does not provide suitable habitat to many mussel species was the lack of apparent recruitment (e.g., very few young individuals) and overall lack of generally suitable substrate conditions throughout the study area (Third Rock 2010a).

Overall mean snail density was 0.2 snails/m^2 from semi-quantitative samples and 1.39 snails/m^2 from quantitative samples. The highest sample densities for snails were 2.90 snails/m^2 (semi-quantitative) and 0.40 snails/m^2 (quantitative) at Sites 5 and 6, respectively (Third Rock 2010a). Like the pattern observed for mussels, general snail abundance was greatest at Sites 5, 6, and 7, which were sites closest to the SQN mixing zone. Because snail habitat (preferably larger rock particles such as cobble, boulder, and bedrock) was sparse throughout the study area, it is not surprising that snail densities were very low at all the sites. Information on snail density is obscure within the Tennessee River mainstem, but in comparison to TVA's monitoring sites at TRM 482.0 and 490.5 where densities averaged 36.3 and 19.1 snails/m^2, respectively, it appears that habitat throughout the SQN study area tends to be poor for snails.

Plankton Communities

Plankton communities are composed of both microscopic and macroscopic algae (phytoplankton) and animals (zooplankton as well as bacteria and various larval forms of free-living and sessile organisms). Similar to terrestrial vascular plants, planktonic algae use energy from the sun and elemental nutrients in the water to transform carbon dioxide into the organic material of their cells. These organisms provide the basis for the food web of aquatic systems and are the principal food of most of the zooplankton and some fish species. Generally, plankton densities in Chickamauga Reservoir increase from upstream to downstream under normal flow regimes (TVA 1990b). However, occasionally reduced cell counts occur at the diffuser location and are thought to be a result of the mixing of the plankton-rich upper and plankton-poor lower stratum caused by the diffuser action in warmer months where stratification is evident in the reservoir rather than a true reduction in plankton cells (TVA 1989).

The plankton community also includes ichthyoplankton, which are the eggs and larvae of fish found mainly in the upper reaches of the water column. The eggs are passive and drift with the water currents. Most fish larvae have a temporary free-floating stage prior to developing the ability to swim effectively. Eggs of some fish species float possibly as a dispersal mechanism and to improve the survival rate of the larvae. Other fish eggs are demersal (i.e., suspended on and or just above the bottom), and some are attached to various substrates. The free-floating eggs are more susceptible to entrainment because they are subject to the currents.

Fish eggs from four locations adjacent to SQN were sampled in 1985. A total of 35,257 eggs were collected in 685 samples. Freshwater drum (*Aplodinotus grunniens*) eggs comprised 99.5 percent of the total (TVA 1986).

Fish larvae collected in 1985 from 685 samples near SQN totaled 121,370. Species of shad dominated at 61 percent of the total followed by sunfish (*Lepomis* spp.) at 17 percent (TVA 1986).

3.5.2. Environmental Consequences

This section addresses impacts to aquatic species from site construction and operation of the Action and No Action Alternatives.

Alternative 1 – License Renewal

Under Alternative 1, no changes in effects to aquatic ecology are anticipated. Impingement and entrainment of aquatic organisms are the most common impacts associated with the intake of water for cooling purposes. Impacts of discharging heated water and chemical treatments back to the reservoir are also of concern for an operational nuclear plant. Thermal plumes within the reservoir can at times attract fish to the warmer water when ambient temperatures are cooler than ideal or repel fish, thus impeding natural migrations through the system. Ongoing impacts of these types, which would continue under Alternative 1, are explained in detail below.

Entrainment

During operational monitoring at SQN from 1981 through 1985, the average hydraulic entrainment of fish larvae was estimated to be 2.8 percent of those passing the plant. In order to compare current level of larval fish and hydraulic entrainment with data collected during operational monitoring, ichthyoplankton sampling was conducted from April through July 2004 (Table 3-13). (TVA 2006b)

In calculating entrainment estimates, one or two species usually comprise a high percentage of the total composition (larvae and eggs), as is the case with clupeids (shad) and freshwater drum in the vicinity of SQN. Freshwater drum spawn in open water while shad spawn near shore, and each female produces thousands of eggs, creating areas in the reservoir with high densities of fish eggs and early larvae. As these high density pulses of eggs and larvae drift downstream, their occurrence within a sampling area during a sample collection, either near the plant intake or in the open reservoir, may substantially affect individual, periodic entrainment estimates. (TVA 2006b) In 2004, freshwater drum eggs comprised 98.8 percent of the total fish eggs collected during all twelve sample periods, demonstrating the extended spawning season for this species. Densities peaked on May 25 at 4,433/1,000m^3 in reservoir samples and on June 2 at 1,594/1,000m^3 in samples collected near the intake. Average seasonal densities for drum eggs were 549 and 652/1,000m^3 in the intake and reservoir samples, respectively. (TVA 2006b)

The estimated total transport of fish eggs (primarily drum eggs) past SQN during 12 weekly sample periods between April 20 and July 12, 2004, was 5.4 billion. The seasonal entrainment estimate for drum eggs was 11.2 percent. (TVA 2006b)

The estimated total transport of fish larvae past SQN during the 12 sampling events from April through July in 2004 was 9.8 billion. Clupeid (shad) larvae comprised 87.9 percent of this total and were entrained at a rate of 15.4 percent of the total passing the plant. The overall estimated rate of entrainment for total fish larvae was 15.6 percent, driven by clupeids as the most dominant taxon. Average seasonal densities of clupeids in the intake vs. reservoir samples were 2,249 and 3,465/1,000m^3 respectively. (TVA 2006b)

Relative abundance for all taxa of larval fish collected during the twelve weekly sample periods of 2004 was dominated by clupeids (87.9 percent), *Morone* (5.5 percent), freshwater drum (3.2 percent), and centrarchids (3.1 percent). Total number of larvae collected for all taxa was 52,881. (TVA 2006b)

Hydraulic entrainment is the portion of Chickamauga Reservoir diverted into the plant by SQN. During the twelve sampling events from April through July 2004, hydraulic entrainment averaged 24.2 percent with a range of 7.4 to 111.1 percent. The peak hydraulic entrainment occurred on May 18, and the lowest was recorded on June 30. The entrainment estimate of 111.1 percent on May 18 was a result of zero release at Chickamauga Dam and 7,100 cfs average release from Watts Bar Dam. (TVA 2006b) The closing of Chickamauga Dam accompanied by minimal releases from Watts Bar Dam causes a temporary sloshing effect within the reservoir. Downstream flow is hindered and at times can be reversed until the reservoir establishes equilibrium. When the flow is substantially reduced or even reversed adjacent to SQN, hydraulic entrainment percentages increase because hydraulic entrainment calculations compare the amount of water flowing past SQN to the amount of water flowing into SQN.

Seasonal mean hydraulic entrainment was 12.2 percent in 1985 compared to 24.2 percent in 2004. Higher hydraulic entrainment was likely the result of a lower reservoir flow rate caused by lower than average runoff from rainfall. This also influenced the total entrainment rate of 15.6 percent for larval fish, which was the highest ever recorded. (TVA 2006b) Sample methods used to collect fish eggs and larvae during 2004 were only slightly different than those used in 1985.

Estimated entrainment of freshwater drum eggs was 11.2 percent in 2004 compared to 16.6 percent in 1985. Drum larval entrainment was estimated at 30.2 percent in 1985 compared to 45.4 percent in 2004. Considering that hydraulic entrainment doubled from 1985 to 2004, this increased rate of entrainment estimated for drum larvae could be expected. Historical data led to the conclusion that substantial spawning by freshwater drum occurs in the vicinity of, or slightly downstream of SQN, producing eggs and larvae that are not subjected to plant entrainment. Even though seasonal larval drum entrainment was abnormally high (45.4 percent) during 2004, it was primarily attributed to the May 18 sample period when the peak density occurred simultaneously with peak hydraulic entrainment (111 percent). (TVA 2006b)

Effects of entrainment on fish communities are measured through the RFAI program outlined in Section 3.5.1. Community assessments in Chickamauga Reservoir near SQN indicate no substantial impacts from current operations of SQN on the fish community near the plant. Furthermore, recent data support conclusions presented in the 1986 historical assessments. Results demonstrate annual variations in the relative abundance and spatial temporal distribution of fish, and fluctuations in reservoir flow are common near SQN. Life history aspects, dynamics of drifting larvae, and fluctuation in reservoir flow past SQN are the primary factors influencing variations observed in the annual entrainment estimates. Variations in fish density and reservoir flow in the Chickamauga transition zone have apparently had little effect on the fish community. (TVA 2006b) Based on the 2004 evaluation and annual RFAI scores for Chickamauga Reservoir, a viable balanced indigenous fish community is present in Chickamauga Reservoir near SQN. Effects of SQN entrainment on fish populations in Chickamauga Reservoir are considered minor. As no change in the amount of water withdrawn is planned, no incremental entrainment impacts would be expected.

Table 3-13. Historical and Current Entrainment Percentages for Fish Eggs and Larvae at SQN for the Years 1981 – 1985 and 2004

	1981	1982	1983	1984	1985	2004
Eggs						
Sciaenidae Freshwater drum	6.7	41.4	22.6	9.7	16.6	11.2
Larvae						
Clupeidae Shad	2.1	1.5	2.7	1.8	1.1	15.4
Cyprinidae Minnows	4.3	4.2	5.9	2.3	3.1	72.6
Catostomidae Suckers	0.0	0.0	6.1	2.6	0.0	0.0
Ictaluridae Catfish	8.4	7.7	9.1	45.9	27.8	0.0
Moronidae Temperate Bass	1.7	2.7	4.8	2.2	2.46	5.0
Centrarchidae Sunfish	1.0	1.8	1.1	0.6	0.7	24.2
Percidae Perch	3.6	1.6	10.7	1.6	3.5	0.0
Sciaenidae Freshwater drum	5.5	25.6	57.8	22.7	30.2	45.4
Total Larvae	2.3	2.2	4.7	2.3	2.6	15.6

(TVA 2006b)

<u>Impingement</u>

Impingement rates were initially monitored to detect impacts to the fish community. In the years monitored, threadfin shad were consistently the most abundant species impinged largely because they have a high fecundity rate, move in large schools, and are intolerant to cold temperatures, often resulting in high mortality rates in winter. In 1985, bluegill (*Lepomis macrochirus*), freshwater drum, yellow bass, and skipjack herring (*Alosa chrysochloris*) also comprised 5 – 7 percent of total numbers impinged. (TVA 1986)

Impingement data during the first seven months of 1985 were similar to the previous four years (i.e., low numbers which do not constitute an adverse environmental impact to the populations of fishes in Chickamauga Reservoir). The 1985 data thus confirmed the conclusion at the end of 1984, that sufficient impingement monitoring has been done to evaluate the impacts of plant operation. (TVA 1986)

In response to the EPA issuance of a 2004 rule for implementing Section 316(b), a rule subsequently suspended in 2007, and in accordance with a proposal for information collection submitted to TDEC in 2005, TVA conducted additional impingement monitoring at SQN to update the impingement database for potential intake effects.

Weekly impingement sampling at SQN from January 2005 to January 2007 resulted in collection of 2,889 fish (22 species) during the first year (January 25, 2005 – January 23, 2006) and 5,766 fish (21 species) during the second year (January 30, 2006 – January 15, 2007). Threadfin shad predominated (91 percent) in the samples, followed by bluegill (2 percent), freshwater drum (2 percent), and channel and blue catfish (1 percent each). All other species contributed less than 1 percent of the total number collected. Rate of impingement was highest during November and December during the first year, while peak impingement occurred during August, October, and November during the second year. Estimated impingement was calculated by extrapolating impingement rates from weekly samples. An estimated 20,223 fish were impinged during the first year and 40,362 during the second. Estimated impingement during the second year was more than double the impingement estimate during the first year due to collection of more than double the threadfin shad. (TVA 2007d)

To determine the impacts impingement has on fish populations, models that estimate the number of impinged fish which would have been expected to survive to either harvestable size/age or to provide forage for other fish were applied to the number of fish impinged for the first (2005 – 2006) and second (2006 – 2007) year of the study. The numbers of fish representing SQN's biological liability for the first and second years of the study were 1,868 and 821, respectively. (TVA 2007d)

Effects of impingement on fish communities would be detected through the RFAI program. SQN operations do not appear to affect community assemblage in Chickamauga Reservoir. Therefore, the effects of impingement on fish populations residing in Chickamauga Reservoir are minor. As no change in the amount of water withdrawal is planned, no incremental impacts with regard to impingement would be expected.

Discharge

Water leaving the condensers can be routed in one of three ways: (1) to the diffuser pond and out the diffuser pipes (open mode); (2) through the cooling towers, then to the diffuser pond and out the diffuser pipes (helper mode); or (3) through the cooling towers and recirculated to the intake (closed mode) with blowdown being discharged through the diffuser pipes. An underwater dam crosses the river channel 75 m upstream from the diffuser, decreasing the likelihood of any warm water wedge extending upstream from the thermal discharge to the plant intake, and impounding cooler water from lower strata of the reservoir near the intake.

Heat shock to reservoir inhabitants is a site-specific impact dependent on characteristics of the discharge stream and receiving waters. Data for hourly dam releases for winter periods (November through March) over 13 years (1976 – 1989) were used to run a finite-difference, unsteady flow model to evaluate the instantaneous river flows at SQN. Based on this simulated computer model, SQN would have exceeded the 3ºC temperature rise limit 27 percent of the time (on an hourly basis) and a 4ºC limit 4 percent of the time during November through March between 1976 and 1989. However, based on 1993 – 1994 and 1994 – 1995 SQN operational data during the field investigations, a water temperature rise of more than 3ºC occurred only once on January 1, 1995. (TVA 1995b)

During normal plant operation, cooling water is discharged into a discharge pond and then into Chickamauga Reservoir. In 1992, TVA submitted a request to increase the temperature change limit in the SQN NPDES permit to 5ºC from 3ºC. A thermal monitoring program was designed to determine if the additional heat load to Chickamauga Reservoir would affect fish populations within the reservoir. SQN operational data during the 1993 – 1994 and 1994 – 1995 field investigations indicate an increase in water temperature beyond 3ºC is an uncommon event for SQN. (TVA 1995b)

The mixing zone downstream of the diffusers is 750 feet wide (TVA 1979) and extends 1,500 feet downstream and 275 feet upstream of the diffusers. Measurements at the diffuser ports indicate the reservoir width, which includes the main or navigation channel and overbank areas inundated by impoundment, is approximately 2,000 feet (USDA 2009c). The main or navigational channel width is approximately 900 feet in the reservoir section adjacent to the plant. The cooling water discharge to the Chickamauga Reservoir is discharged from two 350-foot-long diffusers that extend into the navigational channel.

Over half the width of the reservoir at the SQN site is unaffected by the plume, leaving ample room for mobile species to avoid the plume when traveling the length of the reservoir. Data collected near the SQN diffuser from gillnets, creel census, and fishermen pressure counts during cold weather (November through March) found fish are neither attracted to nor avoid the thermal plume (TVA 1995b). Furthermore, the determination has been made that shellfish, fish, and wildlife are protected by the current discharge regime (TDEC 2011). Therefore, thermal impacts to aquatic species in Chickamauga Reservoir are small.

White bass, white crappie, sauger, and channel catfish have been considered species of concern in Chickamauga Reservoir due largely to their importance as sport fish and various levels of population decline in the 1980s (TVA 1991). Plant operations, including the discharge plume, were evaluated for all four species. No instances of attraction or avoidance of the thermal plume were detected for fish species within the Chickamauga Reservoir (TVA 1990a; TVA 1991; TVA 1994; TVA 1995b). Additionally, relatively constant RBI scores from 2000 – 2009 at TRM 482 indicate the thermal plume is not affecting benthic macroinvertebrates downriver of SQN (TVA 2010i).

Low concentrations of radioactive effluents and treatment chemicals may be present in the cooling water discharge stream during regular operation. Most liquid radioactive effluents from SQN flow into the cooling tower blowdown line that empties into the diffuser pond before being discharged into Chickamauga Reservoir. ERCW discharge flow in the return channel is diverted to the cooling tower blowdown line and monitored to ensure adequate dilution of the liquid radioactive effluent before discharge into the diffuser pond. The turbine building sump is a potential additional source of radioactive effluent in the event of a primary to secondary leak, such as a steam generator tube rupture, resulting in radioactive materials carried over into the secondary wastewater sump system. When the sump is nearly full, the liquid is automatically discharged to the low-volume waste treatment pond or the yard drainage pond. Water in the yard drainage pond overflows and drains by gravity to the diffuser pond, from which it flows to the river via the diffusers. Release of radioactive materials in liquid effluents results in minimal radiological exposure to biota. Radiological monitors and laboratory analysis ensure impacts on aquatic life from radiological releases are minor (Section 3.17).

In drought years, DO levels have been low in Chickamauga Reservoir adjacent to the plant when the reservoir stratifies during summer months. During stratification events, DO levels in the bottom portion of the reservoir become anoxic or nearly anoxic. Water temperature and DO have an inverse relationship. Because cooling water is collected from the lower reaches of the reservoir and then heated above ambient reservoir water temperatures, DO would be expected to be lower in the cooling water discharge stream. Under normal flow, reduction of DO in the blowdown stream is estimated to lower DO less than 0.1 milligrams per liter (mg/L). During extreme low-flow conditions, DO reductions of 0.5 mg/L could be measured as a result of lower DO in the cooling water discharge stream (TVA 1990b). From 1982 – 1985 DO levels decreased 1.17 mg/L from TRM 484.1 to 483.5 (TVA 1986), indicating an additional cause of decreased DO unrelated to plant operations.

Low-flow events encourage stratification with regard to DO as well as temperature. Localized mixing as would be expected at the plant intake and discharge would cause the low DO water at the bottom to mix with the higher DO water at the top, which decreases DO in the upper strata but raises DO in the lower strata. The state criterion for DO is 5 mg/L at a depth of 5 feet. In 1982 and 1985, DO concentrations measured during the summer sampling event at a depth of 5 feet were below the criterion at TRM 483.4 (downstream of the diffuser). Decreased DO concentrations downstream of the diffusers were likely a function of decreased DO in the cooling water discharge stream coupled with mixing action attributed to the underwater dam. (TVA 1986)

When lowered DO levels were measured adjacent to the plant in 1985, a net gain in DO was observed between the Watts Bar tailrace and the Chickamauga tailrace, indicating the low DO adjacent to the plant was localized and temporary (TVA 1986). Additionally, DO measurements collected in August from 1990 to 2009, at a depth of 1.5m (4.9 ft) at TRM 490.5 (nearly 7 miles upstream of the SQN discharge) averaged lower (6.15 ± 0.28 standard error) than DO measurements collected on the same date and depth at TRM 472.3 (about 11 miles downstream of the SQN discharge) (7.10 ± 0.20 standard error). If the SQN discharge had any lasting effect on DO levels in Chickamauga Reservoir, DO measurements would be lower downstream of the discharge.

Operating SQN has little effect on the chemical composition of the water used for cooling. Comparison of preoperational and post-operational levels of alkalinity as calcium chloride ($CaCO_3$), nutrients, minerals, and metal concentrations within the reservoir were similar. Comparisons of intake and discharge water in 1985 revealed significant ($\alpha = 0.10$) differences in sodium, sulfate, and zinc. Although differences were quantifiable, they were not of a magnitude that would change overall water quality (TVA 1986), nor affect the plant's ability to meet water quality standards, and would not, therefore, reduce habitat quality for reservoir inhabitants.

Additional sampling in 1988 and 1989 revealed concentrations of aluminum in the diffuser pond that exceed the chronic toxicity level. Lead concentrations also exceeded the chronic toxicity criterion in the diffuser pond in 1989. Whole effluent toxicity analysis was performed to ensure effluent was not toxic to organisms within the reservoir. Most whole effluent toxicity tests failed to identify toxicity. On the few occasions when toxicity was documented, flows in Chickamauga Reservoir were more than sufficient to avoid toxicity in the receiving water. (TVA 1990b)

In addition to the planned discharges discussed above, accidental discharges are also possible. Routine maintenance activities may result in rare unplanned chemical or petroleum spills near water that could, in turn, affect aquatic life. Adherence to the current SPCC plan would limit the likelihood that any such spills would reach aquatic habitat.

Conclusion

The 2004 316(b) data and recent fish community assessments in Chickamauga Reservoir near SQN, including focused studies on four fish species, show no substantial impacts from current operation of SQN on the fish community near the plant. Furthermore, current 316(b) data support conclusions presented in the 1986 historical assessments. Results demonstrate that annual variations in the relative abundance and spatial temporal distribution of fish and fluctuations in the reservoir flow are common in the vicinity of SQN. Variations in fish density and reservoir flow in the Chickamauga Reservoir transition zone have had little apparent effect on the fish community. Based on the 2004 316(b) evaluation and the annual RFAI scores for Chickamauga Reservoir, a viable balanced indigenous fish community is present in Chickamauga Reservoir in the vicinity of SQN. (TVA 2006b)

TVA has been monitoring conditions within Chickamauga Reservoir annually using a thorough, comprehensive monitoring plan for over a decade. Impacts to aquatic biota associated with the intake and discharge of cooling water are small and do not appear to adversely affect aquatic populations individually or cumulatively.

Alternative 2 – No Action Alternative

The No Action Alternative is the result of the decision not to extend operation of the SQN units past the current expiration dates of the operating licenses. However, this could lead TVA to a decision to replace the resulting loss of the approximately 2,400 MWe base load generation upon shutdown of SQN. Given the need for adequate replacement power generation, TVA has evaluated in detail two alternative means of doing this.

Alternative 2 would also require the shutdown of SQN. Should SQN cease to operate, impacts associated with intake and discharge of SQN would also cease. Impingement, entrainment, and the presence of a thermal discharge plume associated with SQN would no longer affect the aquatic environment. However, impacts to the aquatic biota as a result of SQN operation are minor, and effects to aquatic populations have not been observed.

Alternative 2a – New Nuclear Generation

Effects to aquatic ecosystems associated with building a new nuclear plant would vary depending on the physical location of the plant, the location of the intake and discharge structures, and the type of cooling employed by the plant.

Construction impacts to aquatic ecology are usually preventable by using industry-approved standards to contain sediment runoff and accidental spills. Construction along the banks or in a body of water can be mitigated by using BMPs. However, temporary and localized effects such as increases in turbidity would be expected.

Should dredging be necessary, loss of the local benthic community and temporary increases in turbidity would be expected. Pre-dredge conditions should return as benthic communities re-colonize the area and suspended solids settle out of the water column. Effects from dredging would have only minor direct and indirect effects on aquatic communities.

Effects of operation to aquatic habitat would depend on the nature of the source water quality. The source water for cooling in a plant using a closed-cycle cooling system is concentrated up to four times in the cooling tower operations before being discharged as wastewater blowdown, which concentrates the potential impurities already dissolved in the source water. However, the blowdown stream and all wastewater discharges would be regulated by and in compliance with the site-specific NPDES permit.

Impingement and entrainment effects of operation would also be dependent on the quality of the source water and organisms residing within the local habitat. Intake velocities are required to adhere to 316(b) of the CWA (33 USC Section 1326), which minimizes impingement of aquatic organisms. Intake and discharge volumes are lower from plants using a closed-cycle cooling system (as opposed to a once-through system), but the volume of water required increases as the source water quality decreases (as water quality decreases fewer cycles of concentration are possible), which may affect entrainment, impingement, and effects to organisms sensitive to a thermal plume. However, plants that use a closed-cycle cooling system consume more water through evaporation in the cooling towers than plants using a once-through cooling system.

Aquatic organisms susceptible to entrainment are usually planktonic, and thus quite small with limited swimming ability and subject to the motion of the water. The effects of entrainment would depend on local species residing in the source water and the percentage of source water being routed through the plant.

Cooling water discharge is at times warmer than ambient and causes a thermal plume within the receiving waters. Thermal plumes can impede migration of temperature-sensitive aquatic organisms. During winter months, a thermal plume might attract fish, which could increase predation or cause cold shock should the plant cease operation or the fish be chased out of the plume in an attempt to escape predation.

Additionally, discharge can contain contaminants associated with treatment of the intake water or normal plant operation. Depending on the contaminant load within the cooling tower blowdown stream, impacts could range from minor to substantial. However, an NPDES permit would be required prior to discharge and would regulate toxic substances entering receiving waters.

Impacts to aquatic ecology from building a new nuclear plant could range from minor to substantial depending on the plant design, organisms present, source water, and receiving water. Depending on the proximity of other industry affecting area ecology, cumulative effects may also be apparent.

Alternative 2b – New Natural Gas-Fired Generation

Effects to aquatic ecosystems associated with building a new natural gas powered plant would range from minor to substantial depending upon the physical location of the plant, the location of the intake and discharge structures, and the type of cooling employed by the plant. A natural gas-powered generation plant would employ a cooling system similar to that of a nuclear-powered generation facility. Although the intake demand associated with natural gas-fired generation is substantially less than that of a nuclear powered plant (14.4 MGD compared to 34.56 MGD [Section 2.2.2.1]), impacts associated with thermal and chemical discharge, and impingement/entrainment of organisms, would be similar as described under Alternative 2a.

3.6. Terrestrial Ecology

SQN is located within the Ridge and Valley ecoregion, also known as the Great Valley of East Tennessee. Ecoregions are areas of land or water within an ecosystem that contain a geographically distinct collection of environmental resources (e.g., species, natural communities, environmental conditions). Many state agencies use ecoregions to establish geographically specific environmental standards such as chemical and biological water quality. The Ridge and Valley ecoregion is a relatively low-lying region between the Blue Ridge Mountains to the east and the Cumberland Plateau on the west. As a result of extreme folding and faulting events, the roughly parallel ridges and valleys come in a variety of widths, heights, and geologic materials, including limestone, dolomite, shale, siltstone, sandstone, chert, mudstone, and marble. Springs and caves are relatively numerous. Present-day forests cover about 50 percent of the region. The ecoregion has great aquatic habitat diversity in Tennessee and supports a diverse fish fauna rivaled only by that of the Highland Rim ecoregion. (Griffith 1997)

SQN is an industrial facility where approximately 40 percent of the site is developed and includes a mix of barren land, urbanized open space, and low, medium, and high intensity improvements. SQN also comprises other areas such as open water, forests, grasslands, pastures, and wetlands (Section 3.4). A more detailed discussion of land use at SQN can be found in Section 3.13.8.

The terrestrial flora at SQN includes invasive plant species in habitats such as forest, grasslands, and pastures. Terrestrial species such as Chinese privet (*Ligustrum sinense*), Japanese honeysuckle (*Lonicera japonica*), Japanese stilt grass (*Microstegium vimineum*), multiflora rose (*Rosa multiflora*), and Chinese bush clover or sericea lespedeza (*Lespedeza cuneata*) occur in small populations within these SQN environments and in surrounding areas as well. EO 13112, *Invasive Species,* (64 FR 6183), requires federal agencies like TVA to avoid actions that are likely to cause or promote the introduction or spread of invasive species. This EO defines an invasive nonnative species as any species, including its seeds, eggs, spores, or other biological material capable of propagating that species, which is not native to that ecosystem, and whose introduction does or is likely to cause economic or environmental harm or harm to human health. Invasive nonnative plants can occur as trees, shrubs, vines, grasses, ferns, and forbs. Because they tend to lack many of the natural controls (e.g., insects, animals, and competing plants) that keep them in check in their native environments, they can spread rapidly and out-compete some native plants.

This section characterizes existing terrestrial plants and wildlife as well as invasive species on site and in the general vicinity of SQN, and states potential impacts resulting from implementation of the alternatives described in Chapter 2.

3.6.1. Affected Environment

3.6.1.1. Plants

Vegetation at the SQN site and in the general vicinity has been continuously disturbed via decades of agricultural activities and land development (e.g., residential, light commercial, infrastructure, farming, etc.). Construction of the SQN plant converted approximately 525 acres of mixed hardwood forest, pine forest, pasture and old field into buildings, parking lots, landscaped areas, and other industrial uses. In addition, approximately 2,700 acres of mixed-hardwood forest, hardwood forest, pine forest, pasture, etc. were converted into transmission line ROW (TVA 1974a).

Terrestrial plant communities were assessed during the initial environmental review for the construction of SQN Units 1 and 2; however, TVA's 1974 FES for SQN did not specify the on-site methodology for ecological surveys (e.g., aerial data, plots, transects, or cursory paths) (TVA 1974a). It is assumed that on-site surveys were completed for the tract, and additional data were extracted from a 1969 Bradley-Hamilton County survey (TVA 1974a). Prior to construction of SQN, the peninsula on which the facility is currently located was 93 percent forested (54 percent pine, 32 percent pine-hardwood, 7 percent hardwood). The remaining 7 percent included pasture (3 percent), old field (2 percent), and ROW (2 percent) (TVA 1974a).

Dominant evergreen tree species included shortleaf pine (*Pinus echinata*) and Virginia pine (*P. virginiana*). Other tree species included oak (*Quercus* spp.), hickory (*Carya* spp.), beech (*Fagus* spp.), and other local ridge and valley deciduous species. Field surveys on adjacent property identified the following dominant tree species: white oak (*Q. alba*), post oak (*Q. stellata*), black oak (*Q. velutina*), southern red oak (*Q. falcata*), shagbark hickory (*C. ovata*), mockernut hickory (*C. tomentosa*), yellow poplar (*Liriodendron tulipifera*), and American beech (*F. grandifolia*). (TVA 1974a)

During the January 2010 SQN site walkover, general plant populations were identified that include herbaceous vegetation along fencerows, roadsides, and various unnamed lawn and weedy species. There are also wooded areas adjacent to Chickamauga Reservoir, around the training center, west of the ponds, along the reservoir between intake channel and cooling towers, northwest of the old steam generator storage facility, and in the northern portion of SQN. Common tree species identified during the January 2010 SQN site walkover included short leaf pine and Virginia pine. Other common plants include Japanese honeysuckle, trumpet creeper (*Campsis radicans*), various unnamed lawn species, and weedy species such as crab grass (*Digitaria spp.*). Plant communities on site are representative of hardy species that survive well in an industrial facility setting.

SQN's native flora has been altered extensively by previous disturbance. Common invasive nonnative plant species occurring in and around the area of SQN include Chinese privet, Japanese honeysuckle, Japanese stilt grass, multiflora rose, and Chinese bush clover or sericea lespedeza. All of these species have the potential to affect the native plant communities adversely because of their potential to spread rapidly and displace native flora (TVA 2009h).

3.6.1.2. Wildlife

Terrestrial habitats of SQN offer suitable habitat to a variety of wildlife species, particularly those adapted to urban and semi-urban environments. Chickamauga Reservoir's shorelines are used extensively by a variety of waterfowl and wading bird species. Habitats in the vicinity are used by many species of mammals, birds, amphibians, and reptiles. Table 3-14 presents common wildlife identified at SQN and adjacent areas.

Flooded areas in and around the SQN site provide habitat for beavers and common amphibians such as the American toad and Fowler's toad. The shoreline areas along the Chickamauga Reservoir provide suitable habitat for wading birds such as great blue herons and gulls; however, some shoreline areas have eroded and are covered in riprap, preventing those areas from providing suitable habitat to terrestrial wildlife (TVA 2009h).

During the January 2010 SQN site visit, a heron rookery was identified along the eastern shoreline of SQN near the intake structure in the Chickamauga Reservoir. Approximately

15 to 20 herons were seen nesting in pine trees. Two additional heron colonies occur within 3 miles of SQN.

According to the TVA Natural Heritage Database (TVA 2010k), there are three caves within 6 miles of SQN. Posey Cave, Havens Cave, And Harrison Bluff Cave are all within Hamilton County and within 2.3 miles, 5.9 miles, and 5.95 miles of SQN, respectively. Most caves form through the dissolution of limestone by acidic groundwater, otherwise known as karst topography. Caves accommodate a variety of ecosystems and typically provide an important habitat for many species of wildlife (USFWS 2010a). The TVA Natural Heritage Database identified these caves; however, the database does not list any of the species associated with the caves (TVA 2010k).

3.6.2. Environmental Consequences

This section addresses impacts to terrestrial ecology from site construction and operation of the Action and No Action Alternatives.

Alternative 1 – License Renewal

Under Alternative 1 – Action Alternative, current activities would continue on the existing site, resulting in no new impact to the terrestrial plants and wildlife. Land-use changes would not occur as a result of this alternative; therefore, no indirect effects to terrestrial plants and wildlife are expected. The current on-site ISFSI does not have sufficient capacity to support license renewal. Spent fuel storage capacity would be increased by expanding the ISFSI under a separate licensing process and adding a separate concrete storage pad inside the SQN protected area. Construction and operation of additional space for a new concrete storage pad would be a negligible impact and would not change the land use at SQN. Because the plants and wildlife present on and around the SQN site are common and representative of the area and region, no cumulative impacts to the terrestrial plant and wildlife ecology of the area would be expected under this alternative. Invasive plant species present on site would not be disturbed; therefore, this alternative would not contribute to the introduction of new exotic invasive plant species on or near the SQN site.

Alternative 2 – No Action Alternative

Under the No Action Alternative, the operating licenses of SQN would not be renewed, resulting in shutdown and decommissioning of SQN. Because the terrestrial plants and wildlife present on and around the SQN site are common and representative of the region, no direct, indirect, or cumulative impacts to terrestrial plant and wildlife ecology of the area are expected under this alternative.

Alternative 2a – New Nuclear Generation

A new nuclear plant at an alternate greenfield site would result in potentially substantial land-use impacts. If a brownfield site is selected, potential impacts would be similar; however, the impacts would be smaller, or less intense. Alternative 2a could require approximately 1,000 acres of property plus land to support water lines and the potential construction of a railroad spur or barge dock to transport equipment during construction and operation. In addition, new transmission lines and associated ROWs would be required as part of Alternative 2a. A new nuclear generation facility would integrate into TVA's existing transmission line system with the construction of new transmission lines from the plant site to the power grid system.

Table 3-14. SQN Common Wildlife

Common Name	Scientific Name	Species Type
American toad	*Bufo americanus*	amphibian
Fowler's toad	*Bufo fowleri*	amphibian
Northern cricket frog	*Acris crepitans*	amphibian
Upland chorus frog	*Pseudacris feriarum*	amphibian
American crow	*Corvus brachyrhynchos*	bird
American robin	*Turdus migratorius*	bird
Eastern bluebird	*Sialia sialis*	bird
Great blue herons	*Ardea herodias*	bird
Gulls	*Larus spp.*	bird
Killdeer	*Charadrius vociferus*	bird
Northern cardinal	*Cardinalis cardinalis*	bird
Tree swallow	*Tachycineta bicolor*	bird
Coyote	*Canis latrans*	mammal
Eastern cottontail	*Sylvilagus floridanus*	mammal
Eastern mole	*Scalopus aquaticus*	mammal
Hispid cotton rat	*Sigmodon hispidus*	mammal
Least shrew	*Cryptotis parva*	mammal
North american beaver	*Castor canadensis*	mammal
Striped skunk	*Mephitis mephitis*	mammal
Virginia opossum	*Didelphis virginiana*	mammal
White-tailed deer	*Odocoileus virginianus*	mammal
Black racer	*Coluber constrictor*	reptile
Eastern garter snake	*Thamnophis sirtalis*	reptile
Rat snake	*Zamenis longissimus*	reptile

(TVA 2009h)

Selection of Alternative 2a would require the existing greenfield site setting to be converted into industrial land use by the construction of a nuclear facility similar to the power generation size of SQN. Direct impacts would likely occur to terrestrial plants and wildlife as a result of clearing and construction operations. These impacts could include important terrestrial habitats such as:

- Adjacent shorelines of open waters: ponds, lakes, and large bodies of water.
- Forests: hardwood, pine-hardwood, mixed hardwood, etc.

- Open fields: fallow fields, old fields, barren land, etc.
- Wetlands: forested, scrub shrub, emergent, etc.
- Riparian areas along streams.
- Native grass fields: pastures, agriculture, etc.

Impacts to terrestrial plants could be greater than impacts to wildlife, because many wildlife species have the ability to relocate by their own means. Plant communities in the proposed construction footprint would be cleared to accommodate the new plant site, and wildlife would be displaced. Disturbed areas would be revegetated with native and non-invasive flora species to reduce the introduction and spread of exotic invasive plant species associated with ground disturbance and other construction activities. In addition, wildlife species that recolonize the area are expected to be suited for life in and around an industrial/urban environment.

Minor indirect impacts would likely occur as a result of this alternative. Wildlife are expected to experience minor indirect impacts due to displacement, local habitat loss, and fragmentation. Plant communities would also be expected to experience minor indirect impacts due to habitat fragmentation and land-use conversion (e.g., forested and shrub areas converted into grassy areas, landscaped areas, or fields). Over time, these minor changes may induce larger changes such as alterations in the pattern of land use in and around the new facility and human population density and growth rates that may affect terrestrial plants and wildlife and their habitats.

Adoption of Alternative 2a could result in minor cumulative impacts to terrestrial plants and wildlife because of the potential collective habitat loss, habitat fragmentation, and decreased biological diversity. Construction of a new nuclear plant at an undetermined location along with associated transmission lines in the Tennessee Valley could result in minor cumulative impacts to terrestrial vegetation and wildlife when combined with all of the past, present, and future construction in the region.

Alternative 2b – New Natural Gas-Fired Generation

Adoption of Alternative 2b would result in impacts similar to those associated with Alternative 2a. Alternative 2b could require 110 – 132 acres of land for improvement to construct a plant. Additional land would also be required for a new natural gas pipeline, compressor station, meter stations to serve natural gas to the new plant, and new transmission lines to integrate the new plant into TVA's existing power grid. Gas line and transmission line requirements for a new site would depend on the environmental setting and location of the proposed ROWs. In addition to the land required for a new site and associated transmission lines/pipelines, additional land would be required for natural gas wells and collection stations.

Direct impacts from Alternative 2b are dependent on the location and environmental setting of the site, pipelines, meter stations, compressor station, gas wells, collection stations, and the proposed intake and discharge surface water body. It is expected that direct impacts to terrestrial plants and wildlife species would occur because of the construction of the plant and its associated components. Impacts would be similar to those described in new nuclear generation alternative; see Alternative 2a. Alternative analysis, permitting, and avoidance planning may reduce or offset impacts to these resources, but are not likely to avoid them altogether.

Indirect and cumulative impacts associated with Alternative 2b would be similar to but smaller than those impacts described for Alternative 2a.

3.7. Endangered and Threatened Species

Under the terms of Section 7 of the Endangered Species Act (ESA), 16 USC Section 1536(a)(2), federal agencies are required to ensure that any action authorized, funded, or carried out by such agency is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of critical habitat. The ESA places protected plants and animals into two classifications: endangered and threatened. Endangered species are defined as flora and fauna species faced with danger of imminent extinction. Threatened species are in less danger, but require special protection in order to maintain their populations and prevent them from being endangered. Species of special concern are those where a concern for welfare or risk of endangerment has been documented.

TVA, along with each of the seven valley states, maintains copies of the lists of federal- and state-listed endangered, threatened, or otherwise protected species. TVA also keeps track of where those species have been encountered in the region. This occurrence information is routinely stored in a natural heritage database, where a common format and compatible storage systems facilitate sharing data among agencies. For the 201-county area included in the TVA power service area, the TVA Natural Heritage Database includes occurrence information on about 2,200 federal- and state-protected species (TVA 2010l).

TVA completed a Natural Heritage Database query for a 6-mile radius around SQN in March 2010 (TVA 2010k). Table 3-15 presents the findings of TVA's query that identified known occurrences of threatened or endangered species, and other species of conservation concern within the 6-mile range. The TVA Natural Heritage Database identified known occurrences for a total of 14 species, which include seven plants, four birds, one fish, and two mussels within the 6-mile radius of SQN. No listed species have been identified on the SQN site.

In addition, the U.S. Fish and Wildlife Service (USFWS) critical habitat mapper was reviewed to identify any known critical habitat for threatened or endangered species in Hamilton County. The critical habitat portal is an online service for information regarding the threatened or endangered species final critical habitat designation across the United States. The USFWS critical mapper did not list any critical habitat for Hamilton County (USFWS 2010b).

The state rank and state status is referenced from the TDEC Natural Heritage Inventory Program (NHIP). The state rank of a species in Tennessee is a non-legal rank indicating the rarity and vulnerability of a species at the state level. The state status is the legal listing in Tennessee, and the federal status is the legal listing under the ESA (TDEC 2010b). TDEC and TVA collaborate on a dual natural heritage inventory list and share information on species such as occurrences, rarity, surveys, etc.

The USFWS removed the bald eagle from the ESA list of threatened species on August 8, 2007, and subsequently published the National Bald Eagle Management Guidelines (Eagle Guidelines) to assist the public in understanding protections afforded to and prohibitions related to the bald eagle under the Bald and Golden Eagle Protection Act (16 USC Sections 668–668d) (Eagle Act), the Migratory Bird Treaty Act (16 USC Sections 703–712), and the Lacey Act (16 USC Sections 3371–3378). The Eagle Act prohibits anyone without a permit issued by the Secretary of the Interior from "taking" bald eagles, including their parts, nests, or eggs. The Eagle Act defines "take" as "pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest, or disturb."

Most of the disturbances to aquatic and terrestrial habitats associated with completion of SQN have already occurred. The following sections provide updated information on the presence of federally listed and state-listed species found within a 6-mile radius of SQN, and the potential impacts from proposed alternatives.

3.7.1. Affected Environment

Review of the rare species lists for Hamilton County from TVA's Natural Heritage Database and the TDEC's Natural Heritage Inventory Program indicated three federally listed and 11 additional state-listed species have been recorded within 6 miles of SQN. However, neither those species nor habitat suitable for those species is present on or adjacent to SQN (TVA 2010k).

3.7.2. Environmental Consequences

This section addresses impacts to threatened and endangered species from site construction and operation of the Action and No Action Alternatives.

Alternative 1 – License Renewal

Under Alternative 1 – Action Alternative, current activities would continue on the existing site. There would be no impacts to threatened or endangered species, because there are no known endangered or threatened species on or adjacent to the SQN site (TVA 2010k). The distance between existing threatened or endangered individuals or populations and the SQN site provides ample buffer from the operations originating on the SQN site. In addition, land-use changes would not occur as a result of this alternative; therefore, no indirect or cumulative impacts to these endangered and threatened species would be expected under this alternative.

Alternative 2 – No Action Alternative

Under the No Action Alternative, the SQN operating licenses would not be renewed, resulting in shutdown of SQN. No impacts to threatened or endangered species are expected from the shutdown of SQN under this alternative, because there are no known endangered and threatened species located within or adjacent to the SQN site (TVA 2010k).

Table 3-15. Endangered, Threatened, and Other Species of Conservation Concern Identified Near SQN

Common Name	Scientific Name	Federal Status	State Status	State Rank	Habitat	Notes
Plants						
Gibbous panic-grass	*Sacciolepis striata*	--	S	S1	Flood plains and shallow pools.	The plant was identified in 1985 (amount is unknown) within approximately 1.5 miles of SQN.
Pink lady-slipper	*Cypripedium acaule*	--	S-CE	S4	Piney woods.	Two “clumps” of the plants were identified in 2007 within approximately 6 miles of SQN.
Ovate-leaved arrowhead	*Sagittaria platyphylla*	--	S	S2S3	Swamps and emergent wetlands.	The plant was identified in 1980 (amount is unknown) within approximately 6 miles of SQN.
Fragrant bedstraw	*Galium uniflorum*	--	S	S1	Dry woods.	The plant was identified in 1997 (amount is unknown) within approximately 6 miles of SQN.
Tall larkspur	*Delphinium exaltatum*	--	E	S2	Glades and barrens.	The plant was identified in 1938 (amount is unknown) within approximately 5.75 miles of SQN.
American ginseng	*Panax quinquefolius*	--	S-CE	S3S4	Rich woods.	The plant was identified in 2007 within approximately 6 miles of SQN.
Large-flowered skullcap	*Scutellaria montana*	T	T	S2	Escarpments and dry woods.	Between 3 and 136 plants identified at 27 different locations from 1986 to 2006; locations were between 0.75 mile and 6 miles from SQN.

Common Name	Scientific Name	Federal Status	State Status	State Rank	Habitat	Notes
Birds						
Appalachian's Bewick's wren	*Thryomanes bewickii atlus*	--	E	S1	Brushy areas, scrub and thickets in open country, open and riparian woodland.	A small number (amount is unknown) of this bird was spotted in 1908 within approximately 6 miles of SQN.
Bald eagle	*Haliaeetus leucocephalu s*	--	D	S3	Areas close to large bodies of water.	From 1975 through 2005, between five and seven individuals, a pair, and a nest have been observed along Chickamauga Reservoir between approximately 1 and 6 miles from SQN.
Bachman's sparrow	*Aimophila aestivalis*	--	E	S3B, S4N	Dry open pine or oak woods.	One to two individuals were spotted in 1969 within approximately 3 miles of SQN.
Great egret	*Ardea alba*	--	D	S2B, S3N	In and around marshes, swampy woods, streams, lakes, ponds; fields and meadows.	A nest was identified in 1991 within approximately 5.9 miles SQN.
Fish						
Highfin carpsucker	*Carpiodes velifer*	--	D	S2S3	Large rivers, mostly in Tennessee River drainage.	One individual was identified in 1994 during an electro-fishing survey within approximately 5.75 miles of SQN.

Common Name	Scientific Name	Federal Status	State Status	State Rank	Habitat	Notes
Mussels						
Dromedary pearly mussel	*Dromus dromas*	E	E	S1	Medium to large rivers with riffles and shoals with relatively firm rubble, gravel, and stable substrates.	One individual was identified in 1978 (date may not be accurate) within approximately 3 miles of SQN.
Pink mucket	*Lampsilis abrupta*	E	E	S2	Generally a large river mussel, preferring sand-gravel or rocky substrates with moderate-to-strong currents.	More than one individual was identified (exact amount is unknown) in 1963 (date may not be accurate) within approximately 5.5 miles of SQN.

Status Information
-- = No status
Federal abbreviations: E = Endangered; T = Threatened; C = candidate;
State abbreviations: E = Endangered; T = Threatened; D = Deemed in need of management; S = Special concern; S-CE = Special concern, commercially exploited

Rank Information
S1: Extremely rare and critically imperiled in the state;
S2: Very rare and imperiled within the state;
S3: Rare and uncommon in the state;
S4: Widespread, abundant, and apparently secure within the state, but with cause for long-term concern;
_N: Occurs in Tennessee in a non-breeding status (mostly applies to vertebrates); _B: Breeds in Tennessee

(TVA 2010k; TDEC 2010b; TDEC 2010c)

Alternative 2a – New Nuclear Generation

An alternate greenfield site of approximately 1,000 acres would be needed for Alternative 2a, plus land to support water lines and potentially construct a railroad spur or barge dock to transport equipment during construction and operation. In addition, new transmission lines and associated ROWs would be required as part of Alternative 2a. A new nuclear generation facility would integrate into TVA's existing transmission line system with the construction of new transmission lines from the plant site to the power grid system. A new nuclear plant at an alternate greenfield site would result in potentially substantial land-use impacts.

Direct impacts may occur to threatened or endangered species as a result of clearing and construction operations. Impacts could occur to important threatened or endangered species habitats such as:

- Open waters (e.g., ponds, lakes and large bodies of water).
- Forests (e.g., hardwood, pine-hardwood, mixed hardwood, etc.).
- Waters of the U.S.
    - Wetlands: forested, scrub shrub, emergent, etc.
    - Streams: perennial, intermittent, ephemeral.

Minor indirect impacts may occur as a result of this alternative. Over time, the minor changes may induce larger changes such as alterations in the pattern of land use in and around the new facility, and human population density and growth rates that could alter threatened or endangered species and their habitats.

Minor to severe cumulative impacts may also occur to threatened or endangered species as a result of this alternative because of the potential habitat loss, habitat fragmentation, and decreased biological diversity. Construction of a new plant at an undetermined location and associated power lines in the Tennessee Valley could result in cumulative impacts when combined with all of the past, present, and future construction in the region.

Site-specific environmental reviews would be conducted to identify potential impacts to federally listed and state-listed species and their habitats. Measures to avoid, minimize, or mitigate potential impacts would be evaluated. TVA would comply with the ESA and other applicable regulations pertaining to federally listed and state-listed species.

Alternative 2b – New Natural Gas-Fired Generation

Adoption of Alternative 2b would result in impacts similar to those associated with Alternative 2a. Alternative 2b could require 110 – 132 acres of land for improvement to construct a plant of similar generation size. Additional land would also be required for a new natural gas pipeline, compressor station, meter stations to serve natural gas to the new plant and new transmission lines to integrate the new plant into TVA's existing power grid. Gas line and transmission line requirements for a new site would depend on the environmental setting and location of the proposed ROWs. In addition to the land required for a new site and associated pipelines, additional land would also be required for natural gas wells and collection stations.

Direct impacts from Alternative 2b are dependent on the location and environmental setting of the site, pipelines, meter stations, compressor station, gas wells, collection stations, transmission lines and the proposed intake and discharge surface water body. Direct impacts to endangered and threatened species could occur because of the construction of the plant and its associated components. Ecological surveys, alternative analysis, permitting, and avoidance planning may reduce or offset direct impacts to endangered or threatened species as well.

Indirect and cumulative impacts associated with Alternative 2b are similar to but smaller than those impacts described for Alternative 2a.

Site-specific environmental reviews would be conducted to identify potential impacts to federally listed and state-listed species and their habitats. Measures to avoid, minimize, or mitigate potential impacts would be evaluated. TVA would comply with the ESA and other applicable regulations pertaining to federally listed and state-listed species.

3.8. Natural Areas

Natural areas include managed areas, sites, ecologically significant sites, the U.S. National Park Service's (NPS) Nationwide Rivers Inventory (NRI), and the National Wild and Scenic Rivers (NWSR) system. Managed areas typically have an owner or management entity (e.g., TVA, TWRA, municipalities), but they may or may not have an on-site staff or developed facilities. Ownership by a management entity is the main criterion for calling a natural area a managed area.

The NWSR system was created by Congress in 1968 (Public Law 90-542; 16 USC 1271 et seq.) to protect certain rivers with outstanding natural, cultural, and recreational values in a free-flowing condition for the enjoyment of present and future generations. Section 5(d) of the NWSR Act (16 USC Sections 1271–1287) requires that all planning for the use and development of water and related land resources, consideration shall be given by all federal agencies involved to potential national wild, scenic, and recreational river areas (NWSR 2010). In partial fulfillment of the NWSR Act-Section 5(d), the NPS also compiles and maintains the NRI, which is a register of river segments that potentially qualify as national wild, scenic, or recreational river areas. The NRI also qualifies as a comprehensive plan under Section 10(a)(2)(A) of the Federal Power Act (NPS 2010). This section addresses natural areas on, immediately adjacent to, or within 6 miles of SQN.

3.8.1. Affected Environment

No known natural areas are located within or adjacent to SQN. Within 6 miles of the site, there are nine managed areas. According to the TVA Natural Heritage Database, the boundaries of these natural areas are completely within the 6-mile radius of SQN. Species federally listed as threatened or endangered have been recorded within some of these natural areas and are also located within the 6-mile radius of SQN (TVA 2010k). Federally listed species recorded within 6 miles of SQN are listed in Table 3-15 and described in Section 3.7 above. The following are brief descriptions of natural areas within 6 miles of SQN.

Chigger Point TVA Habitat Protection Area (HPA) − is located on the Chickamauga Reservoir and within approximately 0.8 miles of SQN. It is a 15.4-acre steeply wooded shoreline tract. According to the TVA Natural Heritage Database, a single large-flowered skullcap plant was recorded within this natural area (TVA 2010k).

Chickamauga State Wildlife Management Area − a portion of the 7,500-acre wildlife management area is located within approximately 3 miles of SQN. It is a 300-acre area, managed by the TWRA and located in the Soddy Creek embayment on Chickamauga Reservoir. It is an extensive area of moist mudflats and aquatic bed wetlands, attracting large numbers of shorebirds and waterfowl (TVA 2005b).

Chester Frost Park – is located within approximately 4.6 miles of SQN. The park is located on a 280-acre peninsula island and includes a campground, multiple fishing piers, boat ramps, tennis courts, and a beach. The park is partially open year round. According to the TVA Natural Heritage Database, a single Bachman's sparrow was recorded within this natural area (TVA 2010k).

Holly City Park − is located within approximately 4.8 miles of SQN. The park includes a boat ramp and automobile/boat parking.

Murphy Hill TVA HPA – is located within approximately 5.25 miles of SQN. According to the TVA Natural Heritage Database, five individual large-flowered skullcap plants were recorded within this natural area (TVA 2010k).

Soddy Creek TVA HPA − is located within approximately 2.3 miles of SQN and is a 35.5-acre tract that occupies over a mile of very steep shoreline. According to the TVA Natural Heritage Database, a single dromedary pearly mussel was recorded along the boundary of this natural area (TVA 2010k). Many species of water birds also occupy the nearby shallow waters and mudflats during fall and winter months (TVA 2009h).

Soddy Municipal Park − is located within approximately 5.25 miles of SQN. The park includes baseball fields, fishing, parking areas, and basketball courts.

Ware Branch Bend TVA HPA − is a 41.5-acre tract of steep, rocky shorelines. It is located within approximately 2.3 miles of SQN. It is habitat for large-flowered skullcap and the bald eagle (TVA 2009h). According to the TVA Natural Heritage Database, a single large-flowered skullcap plant was recorded within this natural area (TVA 2010k).

University of Tennessee Friendship Forest − is located within approximately 0.8 miles of SQN. The 680-acre tract is owned by TVA and is leased to the University of Tennessee as a forestry experiment station. It contains some of the oldest documented research on genetic tree breeding and pine management in Tennessee (TVA 2005a, TVA 2009h). According to the TVA Natural Heritage Database, six individual large-flowered skullcap plants and a single Gibbous panic-grass plant were recorded within this natural area (TVA 2010k).

In addition, no streams in the vicinity of the SQN site are included on the NRI or the NWSR databases (NPS 2010, NWSR 2010). The only NWSR resource located in the state of Tennessee is the Obed River, which is approximately 80 miles north and slightly east of the SQN site. The NPS lists the North Chickamauga River as the only NRI resource within Hamilton County. The North Chickamauga River is approximately 7 miles west of the SQN site. These two resources are the closest in proximity to the SQN site, according to their applicable databases.

3.8.2. Environmental Consequences

This section addresses impacts to natural areas from site construction and operation of the Action and No Action Alternatives. Impacts to threatened or endangered species associated with natural areas are described in Section 3.7 above.

Alternative 1 – Licensing Renewal

Under Alternative 1 – Action Alternative, current activities would continue on the existing SQN site, resulting in no impacts to natural areas because there are no known natural areas on or adjacent to the SQN site (TVA 2010k). The distance between existing natural areas and the SQN site provides ample buffer from any operation noise originating from the SQN site. In addition, land-use changes would not occur as a result of this alternative; therefore, no indirect or cumulative impacts to the natural areas would be expected under Alternative 1.

Alternative 2 – No Action Alternative

Under No Action Alternative 2, the SQN operating licenses would not be extended, resulting in the shutdown of SQN. No impacts to natural areas are expected under this alternative, because there are no known natural areas located within or adjacent to the SQN site.

Alternative 2a – New Nuclear Generation

An alternate greenfield site of approximately 1,000 acres would be needed for Alternative 2a, plus land to support water lines and potentially construct a railroad spur or barge dock to transport equipment during construction and operation. In addition, new transmission lines and associated ROWs would be required as part of Alternative 2a. A new nuclear generation facility would be integrated into TVA's existing transmission line system that would include the constructing of new transmission lines from the plant site to the power grid system. A new nuclear plant at an alternate greenfield site could result in potentially extensive land-use impacts.

Under Alternative 2a, land would be improved to construct a nuclear facility of similar power generation size as SQN. It is unlikely that direct impacts to natural areas would occur because of the importance of these resources to local city and county governments, the state of Tennessee, and the federal government. Avoidance planning would likely place any potential new nuclear generation plant at a safe distance from most natural areas.

Minor indirect impacts may occur as a result of Alternative 2a. A new nuclear generation facility would require water for a cooling source as well as a plant discharge point. These typical power plant functions could potentially affect downstream aquatic natural areas with minor changes in water flow, contamination, nutrient loads, etc. Over time, the minor changes may induce larger changes such as alterations in the pattern of land use in and around the new facility, the population density, and population growth rates.

Minor to severe cumulative impacts may also occur to natural areas and any associated threatened or endangered species as a result of this alternative because of potential habitat loss, habitat fragmentation, and decreased biological diversity. Impacts of a new nuclear generation facility may occur at a considerable distance from many natural areas; however, the impacts could be compounded by other land improvements and development in the general area between the facility and any natural area. Construction of a new plant at an undetermined location and associated transmission lines in the Tennessee Valley could result in cumulative impacts when combined with all of the past, present, and future construction in the region.

Alternative 2b – New Natural Gas-Fired Generation

Adoption of Alternative 2b may result in similar minor to substantial cumulative impacts associated with Alternative 2a because a natural gas-powered generation plant would utilize similar resources to that of a nuclear-powered generation facility (e.g., cooling system, water source, discharge source, land, etc.). Alternative 2b could require 110 – 132 acres of land for improvement to construct a plant. In addition to site requirements, additional land would be necessary for a new natural gas pipeline, compressor station, meter station(s), natural gas wells, and collection stations to serve natural gas to the new plant. In addition, new transmission lines to integrate the new plant into TVA's existing power grid would also require additional land.

3.9. Recreation

3.9.1. Affected Environment

SQN has approximately 1,144 workers, the majority of whom reside in Hamilton County (Sections 3.13.1 and 3.13.2). The governments of Hamilton County and its 10 municipalities operate a variety of parks and recreation systems. The largest park systems in Hamilton County are the City of Chattanooga Parks and Recreation Department, with 53 parks and 15 recreation centers covering over 3,400 aces, and facilities operated by Hamilton County Parks and Recreation, with 27 parks and joint-operated school facilities covering 895 acres. Most of Hamilton County's smaller municipalities also have parks and recreation systems. (CHCRPA 2005a)

The SQN site is near the geographical center of Hamilton County, on a peninsula on the western shore of Chickamauga Reservoir. The reservoir is one of a series of highly controlled multiple-use reservoirs on the Tennessee River whose primary uses are flood control, navigation, and the generation of electric power. Secondary uses include industrial and public water supply and waste disposal, commercial fishing, and recreation. Public access areas, boat docks, and residential subdivisions have been developed along the Chickamauga Reservoir shoreline. (TVA 2009i)

As described in the *Sequoyah Nuclear Plant Unit 2 Steam Generator Replacements Environmental Assessment*, there is a local ball field located on the western side of the SQN site near the TVA Training Center and the Live Well Center. No natural areas are located within or adjacent to the site (Figure 3-10). Several natural areas are located within 6 miles of SQN and are described in Section 3.8. (TVA 2009h)

Harrison Bay State Recreation Park is approximately 1.2 miles south of SQN and comprises 1,200 acres with approximately 40 miles of shoreline on Chickamauga Reservoir. Renowned for its boat docking facilities, this park also offers biking and hiking trails, recreational vehicle and tent campsites, lake fishing, an Olympic-sized swimming pool, meeting and picnic facilities, and ballparks. Originally developed as a TVA recreation demonstration area in the 1930s, the park is now part of the Tennessee State Parks System and is managed by TDEC. (TVA 2009h)

Chester Frost Park sits on 455 acres next to Chickamauga Reservoir and includes tennis courts, nine fishing piers, two boat ramps, a sand beach/swimming area, sand volleyball, picnic areas, and playgrounds. The park is operated by the Hamilton County, Tennessee, Parks and Recreation Department. The park has recreational vehicle camping and associated facilities. (HCPR 2010)

Also located on the banks of Chickamauga Reservoir by Chattanooga, 353-acre Booker T. Washington State Park has numerous recreational amenities, including swimming, biking, boating, and fishing (TNSP 2010). In addition, there are many commercial marinas, group camps, and cottage developments, as well as formal and informal public access areas along the reservoir shoreline. The Soddy, Possum, and Sale Creek embayments to the northwest of the site are especially popular with anglers and family boaters. (TVA 2008a)

3.9.2. Environmental Consequences

This section addresses impacts to area recreation from site construction and operation of the Action and No Action Alternatives.

Alternative 1 – License Renewal

Under Alternative 1 – Action Alternative, SQN license renewal would result in no change to the plant site or operations, and there would be no new impacts to area recreation.

Alternative 2 – No Action Alternative

Under the No Action Alternative, cessation of SQN operation would not adversely affect recreational facilities or activities.

Alternative 2a and 2b – New Nuclear or Natural Gas-Fired Generation

The impacts of Alternatives 2a and 2b are similar and discussed together below.

As described in Section 3.13.9, the Hamilton County tax base would not change significantly due to plant closure, and activities at SQN are unrelated to the operation and maintenance of area recreational facilities. Public use is also not anticipated to change should plant operational personnel choose to move from the area, because the county population is expected to continue to increase.

Under Alternative 2a or 2b, a site-specific environmental review would include an investigation of the locations of any national and state parks, public recreation, cultural and historic areas, wild and scenic rivers, etc. These locations would be assessed for potential adverse impacts that could result from construction and operation. Typically, these locations are considered avoidance areas; however, if a potential facility were sited near a recreational, scenic, or culturally significant area, then noise, dust, viewshed, and watershed impacts would be analyzed. The type and level of impact would vary depending upon proximity, mitigation measures, and general construction and operation practices. Impacts could range from minor to moderate. Some examples of potential mitigation methods could be the use of water to minimize dust, limiting noisy activities to specific times, and utilizing landscaping and painting techniques to limit viewshed impacts.

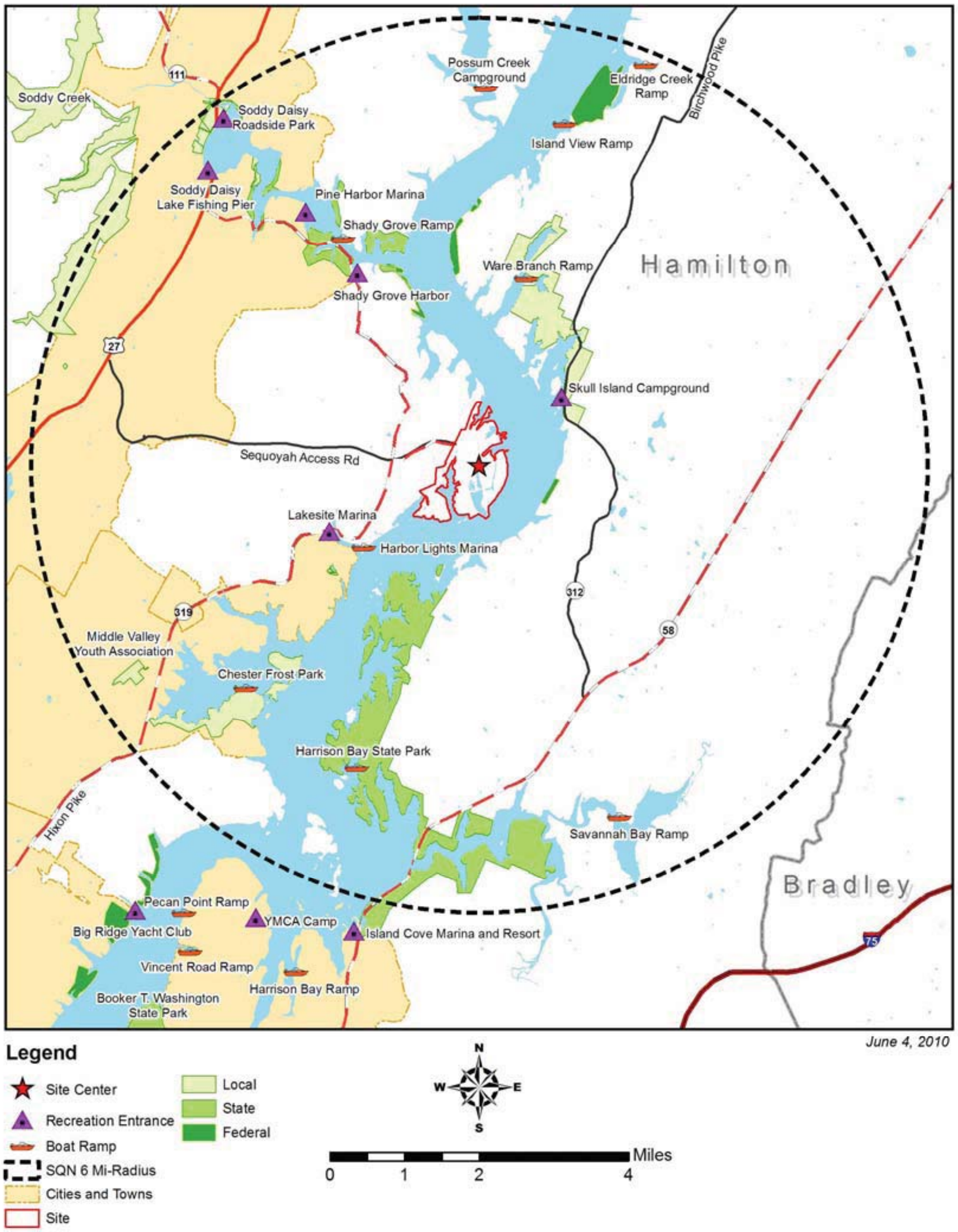

Figure 3-10. Federal, State, and Local Lands Within a 6-Mile Radius of SQN

3.10. Archaeological Resources and Historic Structures

Under the National Historic Preservation Act (NHPA) of 1966, as amended (16 USC 470), TVA as a federal agency is required to identify and manage historic properties located on land affected by TVA undertakings.

Prior to taking any action to implement an undertaking, Section 106 of the NHPA (16 USC 470) requires federal agencies to:

- Take into account the effects of an undertaking on historic properties, including any district, site, building, structure, or object that is included in or eligible for inclusion in the National Register of Historic Places (NRHP).

- Afford the Advisory Council on Historic Preservation (ACHP) a reasonable opportunity to comment on such undertaking.

State historic preservation officers serve as proxies to the ACHP (16 USC 470; 36 CFR Part 800). The Tennessee SHPO has been consulted by TVA concerning the license renewal application for SQN and any potential effects on historic properties (see Appendix C). Consultation included submission of a Phase 1 cultural resource survey report (McKee et al. 2010) and supplemental 10-mile radius architectural sensitivity report (Ted Karpynec, TRC, personal communication, March 22, 2010) documenting the results of records searches and the Phase 1 survey. The investigations were conducted in compliance with Section 106 of the NHPA, as amended, and its implementing regulations (36 CFR Part 800).

As required by federal regulations (36 CFR Part 800), Native American groups recognized as stakeholders at SQN were consulted by TVA with the opportunity for comment (see Appendix C). TVA has consulted with the following federally recognized Indian tribes regarding properties within the proposed project's area of potential effects (APE) that may be of religious and cultural significance to them and eligible for the NRHP: Cherokee Nation, Eastern Band of Cherokee Indians, United Keetoowah Band of Cherokee Indians in Oklahoma, The Chickasaw Nation, Seminole Tribe of Florida, Muscogee (Creek) Nation of Oklahoma, Alabama-Coushatta Tribe of Texas, Alabama-Quassarte Tribal Town, Kialegee Tribal Town, Thlopthlocco Tribal Town, Absentee Shawnee Tribe of Oklahoma, Eastern Shawnee Tribe of Oklahoma, and the Shawnee Tribe.

3.10.1. Affected Environment

SQN lies on a bend in the Tennessee River between river miles 482 and 486. The plant is situated on an irregular peninsula created when the lower floodplain was inundated by the waters of Chickamauga Reservoir in 1940. Presently, the project site is an industrial area with a strongly secured perimeter.

The area surrounding the SQN property is likely to have been continuously occupied by humans since at least 12,000 years before present (B.P.) (McKee et al. 2010). Archaeological records for the Tennessee River valley document four major prehistoric occupational periods with some overlap of cultural markers: the Paleoindian (10,500 – 8000 B.C.), the Archaic (8000 – 600 B.C.), the Woodland (1000 B.C. – A.D. 1000), and the Mississippian (A.D. 1000 – A.D. 1600).

The earliest European contact with what is now Hamilton County consisted of Spanish expeditions in the sixteenth century. When English explorers arrived in the seventeenth century, the Cherokee tribe was the dominant native group, with control of an area including eastern Tennessee, western North Carolina, and northern Georgia (Chapman 1985). American settlers began moving into Cherokee territory in the late eighteenth century, and Hamilton County was established in 1819. In 1838, the Cherokees were removed from the area by federal troops. An acceleration in white settlement followed.

Following European contact and settlement, the project area was used primarily for timber and agriculture. Early roads through the area connected the first county seat of Hamilton County, Dallas, with Chattanooga and Igou’s Ferry, which was located on the SQN site (McKee et al. 2010). Harrison replaced Dallas as the county seat in 1840, leading to the decline of Dallas.

Igou’s Ferry was established by General Samuel Igou on property he owned by the river. The ferry connected roads on the east and west banks. A road near the present-day site still bears the name Igou Ferry Road. General Igou is buried in the Igou Cemetery, still in existence on the SQN site and maintained by TVA (Figure 3-11).

During the Civil War, the Union Army guarded the ferry in 1863 and probably used the farmsteads near the crossing for their camp (McKee et al. 2010). After the war, Dallas declined further, but Igou’s Ferry was still in existence and served by a postal route that followed the west bank of the Tennessee River from Chattanooga. According to a 1913 Tennessee Geological Survey map, Igou’s Ferry was still operational at that time (McKee et al. 2010), but by 1936, a TVA survey of the area showed no active ferry.

TVA surveyed the area again in 1937 in preparation for the creation of Chickamauga Reservoir. A second cemetery was documented on the SQN site, identified as the McGill Cemetery #1 (TVA 1938). Sometime before 1983, the eleven graves from this cemetery were relocated to a nearby cemetery associated with the same family group (McKee et al. 2010).

Chickamauga Reservoir was completed in 1940. The waters of the reservoir covered all lands below the 683-foot contour level, including the site of Igou’s Ferry. Most of the former house sites in SQN were not inundated, and property owners were permitted to retain possession and remove buildings for salvage prior to the end of the calendar year of 1939 (TVA 1942).

The earliest known documentation of cultural resources on the grounds now occupied by SQN (Figure 3-11) was the 1913 recording and testing of site 40HA22 by C.B. Moore (Moore 1915). Moore described the site as containing a mostly undisturbed mound, 52 feet in diameter and 7.5 feet high, and a light scatter of midden material in the surrounding cultivated field. His excavation into the mound identified nine human burials. The site was revisited in 1936 by Buckner, who reported that the mound was still visible with ceramic fragments on the surface (Buckner 1936).

The 1930s produced pre-inundation surveys and related work for the Chickamauga Reservoir. This work included the recording and testing of site 40HA20, known as the McGill Site (different from McGill Cemetery), also located within the current SQN boundaries (Figure 3-11). The results of the testing of 40HA20 are discussed in a compilation on the prehistory of the Chickamauga Reservoir (Lewis and Lewis 1995), where the site is interpreted as a Late Woodland/Early Mississippian mound complex. Site 40HA20 was first recorded for the Tennessee Division of Archaeology Site Survey Records by Buckner in 1936 (Buckner 1936).

During that same year, 1936, Buckner also recorded the only known archaeological sites located outside but within 0.5 miles of the SQN APE. These adjacent sites range from a Late Archaic or later (unknown) period village site with projectile points and ceramics (40HA21) to a Paleoindian/Transitional Paleoindian open habitation/lithic workshop with projectile points and ground-stone tools (40HA43), both now inundated by the Chickamauga Reservoir, to an unknown period burial ground with eight to ten visible stone graves (Buckner 1936).

TVA also surveyed the SQN area in 1937 to produce the original property acquisition map for the Chickamauga Reservoir (TVA 1937). The map documented public and private roads, structures, fields, orchards, fences, property boundaries, and cemeteries, along with other information, and displayed at least fourteen residences and associated structures along with two cemeteries within the current SQN boundaries (McKee et al. 2010). Additional work by TVA on the two cemeteries soon followed with records of names and locations of burials (TVA 1938, TVA 1940). Following the cemetery reports, no known cultural resource investigations occurred on the SQN grounds until 1973, when they were conducted in association with the original construction of SQN.

Because construction began at SQN early in the development of historic preservation regulations, no comprehensive archaeological survey was conducted on the SQN site prior to construction of the plant. TVA conducted an archaeological survey in 1973, but it was conducted after construction of the plant had begun (Calabrese et al. 1973). Although construction was not yet complete, the emphasis of the 1973 report was that both previously recorded archaeological sites (40HA20 and 40HA22) were destroyed during the construction of SQN prior to the archaeological survey (Calabrese et al. 1973, McKee et al. 2010). The 1973 survey located only one intact cemetery (the Igou Cemetery) and remnants suggesting one possible former house.

The past surveys of the area specific to SQN were conducted before the Secretary of the Interior’s Historic Preservation Professional Qualification Standards were issued on September 29, 1983 (48 FR 44716). When TVA began developing assessments for continued production at SQN, new cultural resource surveys were done. Two modern surveys were subsequently conducted at SQN. The first was a 2009 Phase 1 survey (Jones and Karpynec 2009) conducted in the preparation of an environmental assessment (EA) for a proposed SQN steam generator replacement project. The APE for the 2009 undertaking was limited to three separate locations within SQN for potential direct effects and a 0.5-mile (indirect or visual effect) APE for considering architectural resources. As stated in the EA (TVA 2009h), the survey confirmed that the APE had been disturbed previously by the construction of SQN. No cultural resources were identified by the survey, and no historic properties were identified within the 0.5-mile viewshed of the proposed actions.

The second modern investigation was a Phase 1 archaeological survey conducted for the entire SQN site in early 2010 in preparation for the license renewal application (McKee et al. 2010). The APE for the survey was defined as the entire area occupied by SQN (Figure 3-11). The APE for architectural field studies included those portions of a 0.5-mile area surrounding the plant facility where a visual link to the plant was unobstructed by topography or vegetation (McKee et al. 2010).

Figure 3-11. SQN Site With Area of Potential Effects Shown

Note: To protect cultural resources, archaeological site locations are not shown.

Results of the 2010 Phase 1 archaeological survey confirmed the 1973 findings that sites 40HA20 and 40HA22 were destroyed during plant construction. A search of THC records also found no previously recorded architectural resources on SQN or within the 0.5-mile visual APE. Previously identified aboveground resources on SQN included the Igou and the McGill cemeteries. During the records investigation, it was determined that for the original SQN construction, the burials at the McGill Cemetery were disinterred and moved to McGill Cemetery #2, across the Tennessee River (see Appendix C).

The 2010 Phase 1 archaeological survey identified one new site (40HA549) and three isolated finds, none of which were considered eligible for the NRHP. Site 40HA549 was interpreted as a short-term open habitation represented by three artifacts, including one small quartz flake and two complete Early/Middle Archaic projectile points found in two positive shovel tests. The three isolated finds consisted of separate occurrences of lithic flakes and debitage.

Two architectural/aboveground resources were also identified (HS-1 and HS-2). HS-1 is a ca. 1930, one-story gable-front house located beyond the APE but within 0.1 miles of the APE boundary and within the 0.5-mile viewshed. HS-2 is the previously investigated Igou Cemetery located on the SQN APE. Both of these resources are considered ineligible for the NRHP due to a lack of historic and architectural distinction.

The Igou Cemetery (HS-2), which contains about 45 graves, is in the southwestern portion of the APE near the security practice firing range. It is maintained by TVA, and for security reasons, access is only granted by special permission. The cemetery is in no danger of disturbance or destruction from SQN operations as TVA plans to avoid the cemetery in accordance with the Tennessee laws regarding the treatment of human remains (see Appendix C).

As part of the assessment for the LRA, a supplemental records study and report focused on a 10-mile radius sensitivity analysis for potential visual effects on architectural historic properties. The 10-mile radius was drawn from a point equidistant between the two cooling towers at SQN (Figure 3-12). The study considered all previously recorded architectural properties within the radius covering portions of Bradley, Hamilton, and Meigs counties, Tennessee. Architectural information included maps and county architectural survey files housed at the THC in Nashville. (Ted Karpynec, TRC, personal communication, March 22, 2010)

The report located five NRHP-listed properties (Figure 3-12). The Hiram Douglas House (nominated in 1973), the Brown House (nominated in 1973), the Matthews L. Pleasant House (nominated in 1976), and the Retro School (nominated in 2010) are located in Hamilton County. The fifth, in Meigs County, is the Bradford Rymer Barn (nominated in 1982). For the three properties nominated after SQN operations began, potential adverse effects on the visual integrity of the property were already determined inconsequential to the nomination. The two resources nominated in 1973 are both located over 4 miles from SQN, and the view of the cooling towers is blocked by intervening topography. In fact, all five properties are located over 4 miles from SQN, in valleys where intervening topography blocks the view of SQN.

The 10-mile architectural study also reported buildings that have never been assessed as eligible or not eligible for the NRHP, including seven individual buildings, the closest of which is approximately 7.2 miles southeast of SQN, and multiple buildings located in the town of Soddy, including the downtown district, approximately 5.8 miles northwest of SQN. However, none of these properties have been determined eligible for the NRHP by the Tennessee SHPO, and all are at distances and in topographic positions where visual effects from continued operations at SQN are implausible.

The 2010 archaeological survey recommended that no further investigation of cultural resources on the SQN APE (Figure 3-11) is necessary in connection with the license renewal application and any future undertakings at SQN. The 10-mile architectural sensitivity study found that no historic properties would receive adverse effects from continued operation of SQN. In letters dated May 5 and May 20, 2010, TVA received concurrence with the findings and recommendations of the report from the Tennessee SHPO (see Appendix C).

No specific properties of religious or cultural significance were identified through tribal consultation. Comments were received from three of the thirteen tribes contacted: the Alabama-Coushatta Tribe of Texas, the United Keetoowah Band of Cherokee Indians in Oklahoma, and the Seminole Band of Florida. All concurred with the finding of no effects from continued operation of SQN (see Appendix C).

Alternative 2 – No Action Alternative

Under the No Action Alternative, no impact to cultural resources on the SQN site would result from shutting down SQN Units 1 and 2 at the end of the current license term.

Alternative 2a – New Nuclear Generation

Construction of a new nuclear power plant at SQN is not considered feasible due to the lack of available land adjacent to the site. At an alternate greenfield site, given that the undertaking would fall under Section 106 of the NHPA, a cultural resource inventory and sensitivity study would likely be needed for any on-site property that has not been previously (or recently) surveyed. Other lands, if any, acquired to support the plant would also likely be subject to the Section 106 process. All such lands involved in the undertaking would likely need an inventory and evaluation of cultural resources to identify historic properties, and may require avoidance plans or other actions to mitigate adverse effects from proposed ground-disturbing actions and/or visual effects related to physical activities at the plant site.

The studies would likely be needed for all areas of potential disturbance at the proposed plant site and along associated corridors where new construction would occur (e.g., roads, transmission and pipeline corridors, or other ROWs). The effects on cultural resources could, depending on the site, range from minor to substantial. The anticipated NHPA Section 106 process would ensure that direct, indirect, and cumulative effects would be considered for the undertaking, and that any historic properties would be properly identified and managed.

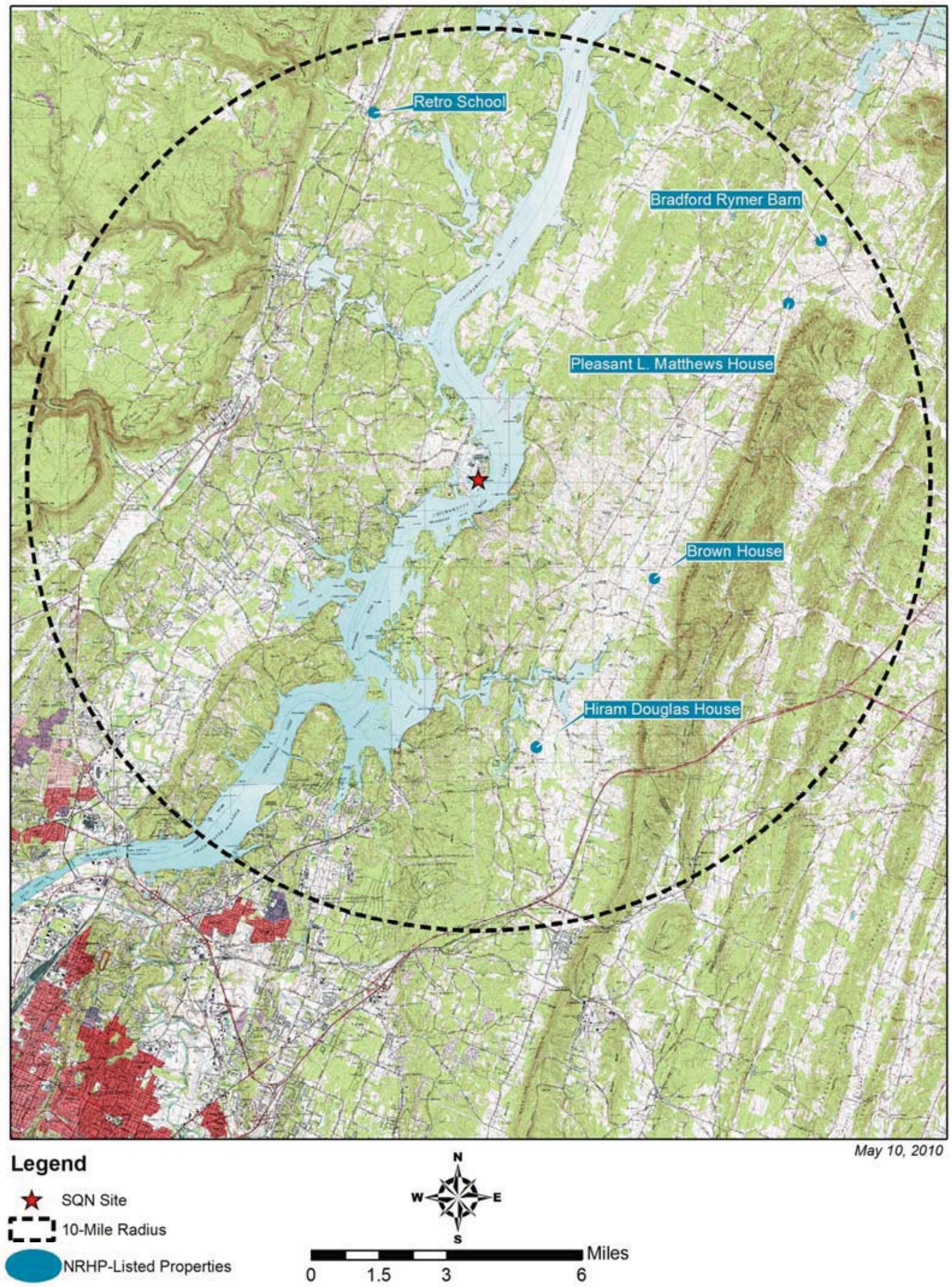

Figure 3-12. SQN 10-Mile Vicinity With Associated Historic Properties

Alternative 2b – New Natural Gas-Fired Generation

The impacts for Alternative 2b are similar to those of Alternative 2a and are described for Alternative 2a. Neither of these No Action Alternatives would have any direct, indirect, or cumulative effects on the historic properties within the SQN APE, as none have been identified. Direct, indirect, or cumulative effects elsewhere due to actions at any alternative location would be addressed within associated studies under the appropriate federal regulations.

3.11. Visual Resources

3.11.1. Affected Environment

SQN is approximately 18 miles northeast of Chattanooga's city center, often referred to as the Scenic City, and 6 miles from Soddy-Daisy (Figures 1-2 and 1-3). This area is characterized by residential subdivisions, urban environments around the cities, and open land. Residential subdivision growth has continued to increase within a 10-mile radius of the plant (Section 3.13.8). There is also some small-scale farming and at least one dairy farm located within 5 miles of the plant. The nearest residence is located 0.5 miles north northwest of the plant, with additional residences to the north, northwest, west, west southwest, and west northwest, located less than 1 mile from the plant. (TVA 2009i)

The tallest buildings on site are the cooling towers at approximately 459 ft. (TVA 1974d). Predominant visual features of SQN include the reactors, powerhouse, cooling towers, and transmission lines and associated structures that can be seen at distances of 1 to 4 miles along the Tennessee River to the north and south. The towers are visible from Harrison Bay State Park located south of the plant. Motorists have broad horizontal views of the plant site from the west along SR 312 (Birchwood Pike), which includes Skull Island recreation area near Cooley Road and a TWRA boat ramp south of Skull Island. Recreationists on the water have similar views from the eastern side of the Tennessee River. However, these views become less dominant closer to the west side of the river near the plant site. Normally between 1 and 4 miles, an observer may find that plant features may be distinguishable; however, the details are obscure and tend to merge into larger patterns. Topography along the bank becomes very steep, and views are obscured by dense, mature hardwood and evergreen trees. Scenic resources and views, including both unique natural features and scenic variety, are common (TVA 2009h).

3.11.2. Environmental Consequences

This section addresses impacts to visual resources from site construction and operation of the Action and No Action Alternatives.

Alternative 1 – License Renewal

Under Alternative 1 – Action Alternative, SQN license renewal would result in no change to the plant site or operations, and there would be no new impacts to the landscape or area visual resources.

Alternative 2 – No Action Alternative

Under No Action Alternative 2, the SQN operating licenses would not be extended, resulting in shutdown of SQN. No impacts to visual resources would occur from the shutdown of SQN, but during decommissioning, the objects currently visible to off-site persons may be removed, depending on future land-use plans. Future land-use options would not be determined until formal decommissioning begins. If Alternative 2 were chosen and SQN were decommissioned, the plant would probably become a brownfield site. Structures would remain in place or might be dismantled to make way for new development. The removal of the cooling towers, transmission lines, or other structures would make the site less visible from the surrounding residential and recreational areas. Should dismantlement of the site become an option, construction cranes would be visible on the skyline, but only for a short-term duration. Otherwise, there would be no change to visual resource impacts in the area.

Alternative 2a or 2b– New Nuclear or Natural Gas-Fired Generation

The impacts of Alternatives 2a and 2b are similar and discussed together below.

Under Alternative 2a or 2b, the impact on the visual resources of an area would be dependent upon the physical, biological, and cultural characteristics of the potential site. Topographical relief, vegetative cover, proximity to the public, rural or urban location, construction and operation practices, facility visual features, and atmospheric conditions are all factors that would influence the perception of how a new facility would impact the visual resources of an area.

During the construction phase, there would be the potential for temporary and minor impacts to visual aesthetics in an area due to the staging of construction materials and site preparation, the introduction of construction cranes, and an increase of dust from additional traffic on local dirt roads. More permanent impacts to the viewshed during the operation phase could result from the cumulative effects of introducing cooling towers or exhaust stacks to the skyline, water vapor plume release, transmission lines, and visibility of other prominent facility features. The level of impact anticipated during construction and operation would range from minor to moderate and vary depending upon viewer distance from the site, the abundance of trees, hilly terrain, and mitigation measures used, such as utilizing landscape materials on site, and painting techniques applied to facility structures.

3.12. Noise

Generating electricity is an industrial process, and the process necessarily produces noise as a result. TVA is aware of the impact that noise can have on the workers at the plant, the public surrounding the site, and the animals within the area. Noise impacts are always considered in evaluating activities related to SQN. The following section discusses noise and related impacts.

3.12.1. Affected Environment

At high levels, noise can cause hearing loss, and at moderate levels, noise can interfere with communication, disrupt sleep, and cause stress. At relatively low levels, noise can cause annoyance. Noise is measured in decibels (dB), a logarithmic unit, so an increase of 3 dB is just noticeable, and an increase of 10 dB is perceived as a doubling of the sound level. Because not all noise frequencies are perceptible to the human ear, A-weighted decibels (dBA) that filter out sound in frequencies above and below human hearing are used for this assessment. Ambient environmental noise is usually assessed using the day-night average noise level (Ldn). The Ldn is a weighted logarithmic 24-hr average with a 10-dB penalty added to noise between 10 p.m. and 7 a.m. to account for the potential for sleep disruption (CERES 2009).

Community noise impacts are typically judged based on the magnitude of the increase above existing background sound levels. There are no federal, state, or local industrial noise statutes for the communities immediately surrounding the SQN site. The EPA recommends an Ldn less than 55 dBA to protect the health and well-being of the public with an adequate margin of safety (EPA 1974). The U.S. Department of Housing and Urban Development (HUD) considers areas with an upper limit Ldn of 65 dBA to be acceptable for residential development (FRA 2010). The Federal Interagency Committee on Noise recommends that a 3-dB increase indicates a possible impact requiring further analysis when the existing Ldn is 65 dBA or less (FICON 1992).

SQN is located in a rural area along the Tennessee River in Hamilton County, Tennessee. There is scattered residential development in the area around the plant site. The nearest resident lives approximately 0.5 miles from the reactor units' centerpoint in the north-northwest direction. There is a subdivision approximately 1 mile north of the plant site as measured from the reactor units' centerpoint, and another within 1 mile of this centerpoint to the west along Hixson Pike, State Route (SR) 319, and Igou Ferry Road. This subdivision is separated from the main part of the SQN site by an embayment that has a border of trees on both sides. There are also residences on the eastern shoreline of Chickamauga Reservoir within 1 mile of the plant site. (TVA 2009h)

Noise sources in the vicinity of the SQN site include river and lake traffic, road traffic, dogs barking, insects, power line hum, and plant equipment at SQN: fans, turbine generators, transformers, cooling towers, compressors, emergency diesels, main steam-safety relief valves (MS-SRV), and emergency sirens. The MS-SRVs occasionally produce loud noises and visible steam and are therefore easily noticed by residents in the vicinity. The release of steam and noise would only be expected for a few hours when these valves are used and that use is rare (fewer than five days per year). Under some atmospheric conditions, a light humming may be noticed directly under 500-kV lines, but this noise is rarely heard outside the ROWs. Emergency sirens are deliberately very loud and easily heard in the community. These sirens provide a warning to area residents as part of the local community emergency plans for various emergencies, such as a tornado warning, as well as serving as a warning for an SQN radiological emergency. Emergency sirens would probably remain part of the community even if SQN were shut down in the future. Average noise levels in rural areas are typically about 40 dBA during the day (TVA 2009h). SQN is an industrial facility in which the average noise levels can approach approximately 65 – 75 dBA or greater on site, although this is not based on actual measurements at SQN (WHO 2001). At the site boundary, the noise levels are consistent with a rural residential area.

3.12.2. Environmental Consequences

Noise impacts are normally a temporary nuisance. The noise is heard, and the background noise level is reestablished to the receptor. If the noise does not cause any damage to the receptor's hearing capability, the receptor's hearing returns to normal. There is normally no cumulative effect of noise unless damage has occurred. After a period of time, even following exposure to occasional loud noise, most of the effects are not permanent and hearing returns to normal after a period of rest from noise exposure. Lasting effects do occur from continuous or repetitive exposure to damaging levels of noise, but that condition is not expected for any off-site receptors exposed to construction or operation noise-producing activities. Workers potentially exposed to damaging levels of noise are required to wear appropriate hearing protection. Noise impacts would be expected to be minor, and no cumulative impacts would be expected for the public or workers.

Alternative 1 – License Renewal

Because there would be no major construction, implementation of the license renewal alternative would have no impact on noise levels near SQN due to construction activities. The planned future expansion spent fuel storage capacity, based on need during the period of license renewal, would be of short duration and follow the construction methods of the current ISFSI, which produced no noticeable impacts from construction noise-producing activities. Therefore, noise is currently a minor impact in the area surrounding SQN, and there are no expected direct or indirect impacts due to noise.

Noise impacts associated with operation of SQN are minor, even with the operation of the cooling towers. The noise sources of motors, generators, pumps, trucks, and cars are typical of an industrial facility. Off-site noise levels are currently similar to the noise levels in a rural residential area and would be expected to remain at the current levels.

During the period of license renewal, no new sources of noise would be introduced. There are no plans for changes to the facility, procedures, or programs that could increase the noise generated from the SQN facility. Therefore, the noise impacts due to license renewal are expected to be minor with no change from the current conditions.

Alternative 2 – No Action Alternative

If the No Action Alternative were chosen, the expected impacts from noise during shutdown of the SQN site would be minor.

Alternative 2a – New Nuclear Generation

Construction

The site of a new nuclear generation alternative is unknown. Noise impacts are dependent on the distance to the nearest critical receptor, so no specific dBA values for receptor locations can be determined. Noise for the construction of a new nuclear plant is expected to be minor to moderate (depending on location and type of sensitive receptor) because most noise-producing construction activities are of short duration (minutes to hours per day) and the construction is temporary, being completed in approximately five to seven years (short-term), and there are numerous mitigation methods that can be implemented to limit the impact of noise.

Sources of noise in the construction of a new nuclear power generation facility are numerous and include large heavy equipment such as bulldozers, draglines, scrapers, and haulers to excavate earth, grade, and prepare for building placement. Other phases of construction would require the use of cranes, front loaders, graders, forklifts, man lifts, compressors, backhoes, dump trucks, a pier driller, and portable welding machines. This type of equipment would generate noise levels up to 98 dB at 50 feet (USDOT 1973). Construction noise of 98 dBA at 50 feet would be about 65 dBA at an approximate half-mile site boundary; a 6 dBA decrease each time the distance is doubled from the source (CERES 2009). This noise level would continue to decrease until reaching the nearest residence or noise-sensitive receptor location (hospital, library, nursing home, etc.). Noise at a sensitive receptor location at 1 mile would be below 60 dBA. Noise from construction equipment is expected to be audible over background noise levels, but it is not expected to cause a noticeable adverse impact. Mitigation measures might include noise shields around stationary equipment, limited hours of operation, properly maintained noise suppression equipment on machinery, and equipment operation limited to the day shift only.

A concrete batch plant would probably be placed on site to provide the large volume of concrete needed to construct the facility. However, the noise level from the batch plant would not exceed the levels from heavy machinery. Limiting most of the construction activities to daytime hours would reduce potential noise impacts.

Depending on site geology and soils, site preparation for the construction of a new nuclear plant may require blasting, which would cause temporary noise impacts. Potential mitigation measures include, but are not limited to, the use of blasting blankets, notification of the surrounding receptors prior to blasting, and limiting blasting activities to daylight hours.

Traffic noise from the commuting of potentially 5,000 workers (Chapter 2) would be noticed and the impact would be moderate. Mitigation can be accomplished by using multiple shifts and encouraging car-pooling activities.

Construction noise associated with new transmission systems are expected to be minor. The construction is usually of short duration, measured in days for each substation or tower location, while access roads and corridors may take a few weeks. The amount of heavy equipment needed to construct transmission systems is considerably less than a major construction site. Cranes and trucks are the major types of heavy equipment, whereas wood-clearing equipment such as chain saws and chippers may be used to clear vegetation. Out of safety concerns, construction activities for transmission systems are usually daytime-only projects, which helps limit the noise interfering with nighttime sleeping hours.

Based on projected noise levels and the temporary duration of construction activities, noise impacts from construction activities associated with Alternative 2a are expected to be minor for the surrounding communities, and minor to moderate for the nearest residents. There is a direct impact on the construction site due to noise, but mitigation measures would be employed, and a formal worker hearing protection program would be implemented that would be similar to the current program in effect at SQN. Indirect impacts off site would be minor and temporary during construction for surrounding animals. Some animals might avoid the area, but many would become accustomed to the noise.

Operation

The major noise source in the operation of a new nuclear plant is normally the cooling tower, with noise level dependent on the type of cooling tower chosen. A reasonable expectation for a nuclear unit with mechanical draft cooling towers is approximately 85 dBA near the tower and 55 dBA at 1,000 feet from the towers. The cooling tower design noise criteria presented are for noise from Babcock and Wilcox PWR cooling towers, which are similar to AP1000 PWR designed cooling towers (TVA 2010b). At the potential nearest residence (approximately 0.5 miles from the site boundary), noise from the cooling tower is expected to be well below 50 dBA, which is similar to rural background noise levels in a typical rural area. These levels would not exceed EPA’s recommendation or HUD’s guideline for residential areas.

The noise sources of motors, generators, pumps, trucks, and cars are typical of an operating industrial facility. The permanent work force would produce traffic noise during its commute to and from work. Off-site noise levels are in line with rural residential areas.

Based on the projected noise levels, noise impacts associated with the implementation of Alternative 2a are expected to be minor for the surrounding communities and the nearest residents. Direct impacts on site would require a formal hearing protection program as per Occupational Safety and Health Administration requirements (29 CFR Part 1910). There would not be any indirect impacts off site needing mitigation. Noise impacts are not normally cumulative and would not provide any cumulative impacts in the long term.

Alternative 2b – New Natural Gas-Fired Generation

Construction

Most activities necessary to construct a new natural gas-fired power plant would be similar to those implemented under Alternative 2a and would have similar impacts on noise levels in the vicinity of the new plant site. Noise impacts from transmission system construction activities would be minor, as explained in the Alternative 2a – New Nuclear Generation section.

Based on projected noise levels and the duration of construction activities, noise impacts from construction activities associated with Alternative 2b are expected to be minor for the surrounding communities, and minor to moderate for the nearest residents. There is a direct impact at the construction site due to noise, but mitigation measures would be employed, and a formal hearing protection program would be implemented that would be similar to the current program in effect at SQN. Indirect impacts would be minor and temporary during construction for animals in the area. Some animals might avoid the area, but many would become accustomed to the noise.

Operation

The operation of a new natural gas-fired plant would have noise sources similar to other large industrial facilities. Cooling towers, fans, pumps, compressors, boilers, etc. are usually on a smaller scale than nuclear or coal plants, but still produce noise as they are used to support plant operations. Natural gas-fired sites are usually smaller than coal or nuclear facilities, and may be located closer to residences or sensitive receptors due to the smaller area required to separate the site from the public. However, noise levels would still be expected to be within acceptable background noise levels at the nearest residence.

Based on projected noise levels, noise impacts from the operation of Alternative 2b are expected to be minor for both the surrounding communities and for the nearest residents.

Conclusion

Impacts from noise would be expected to be minor to moderate during the short term of construction, depending on the type of sensitive receptor and location of the construction. Noise would be a minor impact during operation for all alternatives at the nearest receptor locations off site. Only minor direct impacts would be expected at the proposed operating sites. No indirect impacts or cumulative effects would be expected, and are therefore minor.

3.13. Socioeconomics

3.13.1. Population

This section evaluates population characteristics in Hamilton County and potential socioeconomic impacts of the proposed action alternatives.

3.13.1.1. Affected Environment

Socioeconomic issues associated with SQN were originally evaluated with the SQN FES (TVA 1974a). The FES concluded that the majority of employee settlement would occur in Hamilton County. Because of the county's large population base, socioeconomic impacts associated with the initial construction and operation of SQN were small and ultimately found to not be significant. The demography and population projections for the area surrounding SQN are discussed in the TVA 2008 UFSAR, Section 2.1.3. (TVA 2008a). The UFSAR information was based on 1990 U.S. Census data. Updated data from the 2000 census and other more current sources are provided below.

The population of Hamilton County, Tennessee, as reported in the 2000 census was 307,896, a density of 568 persons per square mile (See Appendix E; USCB 2008a). The U.S. Census 2008 estimate for Hamilton County was 332,848 residents (USCB 2008a).

Because the proposed renewal of the SQN Units 1 and 2 operating licenses would extend plant operations to the year 2041 as described in Chapter 1, the population growth trend established in state-provided population projection data was also extended out to include the years leading up to 2041. For Hamilton County, the University of Tennessee's Center for Business and Economic Research (UTCBER) 2010 – 2030 population projections released June 2009, and again in March 19, 2010, were the analysis data source. These projections utilize the latest decennial census (year 2000) population data and a county population estimate. From these datasets, the Hamilton County ratio of population change was established for 2010 to 2030, and applied to the years 2031 through 2041. Based on June 2009 data, Hamilton County projected population for 2041 is expected to be 339,237. (See Appendix E.) This is a 10.2 percent increase since 2000. The average projected annual growth rate for this period is 0.24 percent (Table 3-16). New population projection data released March 19, 2010, indicate Hamilton County's population could grow at a much greater rate and increase to 420,352 by 2041 (see Appendix E). This is a 36.5 percent increase in population for Hamilton County since 2000, and an average annual growth rate of 0.76 percent a year. These population numbers are subject to change. State projection information, like census data, is updated periodically for public release.

There are three cities in a 50-mile radius of SQN that have a population greater than 25,000. These cities are Chattanooga, Tennessee (18 mi), with an estimated population of 170,880 in 2008; Cleveland, Tennessee (13 mi), with an estimated population of 39,753 in 2008; and Dalton, Georgia (32 mi), with an estimated population of 33,648 in 2008 (Figure 1-3). (USDOT 2008; USCB 2008b; USCB 2008c; USCB 2008d) One of the largest cities near SQN, Soddy-Daisy (6 mi), has a 2008 estimated population of 12,511 residents (Figure 1-2) (USCB 2008e).

The radial population density for the region was estimated from the plant centerpoint of a line connecting the two reactors using the 2000 U.S. Census block data. The radial population was based on county projections obtained from the associated states. (See Appendix E, and USCB 2000a; UACB 2001; GAOPB 2005; NCOSBM 2009a; NCOSBM

2009b; NCOSBM 2009c) The population density was calculated for the total area included in the 20- and 50-mile radius. For the 20-mile radius, the 2000 permanent population was 339 people per square mile. For the 50-mile radius, the 2000 population density was 124 people per square mile.

In addition to the permanent population in the 20- and 50-mile radius, there is a substantial transient population. The transient information was derived from state tourism data. (ATD 2008; GDED 2006; GDED 2010; NCDOC 2008; TDTD 2007; USCB 2000b; USCB 2005) With the addition of the transient population, the total population density in the 20-mile radius increases to 369 people per square mile in 2000. For the 50-mile radius, the total population density increases to 134 people per square mile in 2000.

Table 3-16. Hamilton County Projected Population Estimates and Growth Rates

Year	Hamilton County Projected Population June 2009	Average Annual Growth Rate (percentage per year)	Hamilton County Projected Population March 19, 2010	Average Annual Growth Rate (percentage per year)
2000	307,896*		307,910	
2005	323,426	0.99	323,162	0.97
2010	326,104	0.17	339,551	0.99
2015	327,665	0.10	350,362	0.63
2020	328,290	0.04	363,285	0.73
2025	329,514	0.07	376,747	0.73
2030	329,365	-0.01	390,229	0.71
2035**	335,861	0.39	404,158	0.70
2040**	338,674	0.17	417,653	0.66
2041**	339,237	0.17	420,352	0.65

* US 2000 Census count, Hamilton County population.

** Projected population values for 2035, 2040, and 2041 are based on the extension of the population projection growth trend established in the years 2000 to 2030.

(See Appendix E.)

3.13.1.2. Environmental Consequences

This section addresses impacts to population from site construction and operation of the Action and No Action Alternatives.

Alternative 1 – License Renewal

Under Alternative 1 – Action Alternative, SQN license renewal would result in no changes in operating employment levels at the plant, and there should be no new impacts to population through this action.

Alternative 2 – No Action Alternative

Under No Action Alternative 2, the SQN operating licenses would not be extended, resulting in shutdown of SQN. If the No Action Alternative were chosen, and operation of the SQN plant should cease, the loss of operational jobs and potential relocation of employees would have a negligible effect on the permanent population of Hamilton County, Tennessee. As of 2010, SQN employed a staff of approximately 1,144 permanent and contract employees. Of these, 892 employees, or 78 percent, reside in Hamilton County, Tennessee. (Dennis Lundy, TVA, personal communication, August 3, 2010) SQN employees may decide to move to other power plant locations. These employees comprise 0.3 percent of the population of Hamilton County, based on the 2000 census count. As the county continues to grow as projected, the effect of the potentially reduced area population would be short-lived and the overall impact likely would be minor.

Alternative 2a or 2b – New Nuclear or Natural Gas-Fired Generation

The impacts of Alternatives 2a and 2b are similar and discussed together below.

Should a new nuclear or new natural gas facility be constructed, impacts on the local population would vary, depending on the location. Plants are more likely to be located in low density areas. The level of impacts would vary greatly depending on the work force requirements, which are much greater for a typical nuclear plant than for a typical natural gas plant. During construction, many of the workers (5,000 peak construction work force for a new nuclear facility, and a 1,200 – 1,440 peak work force for a new natural gas facility) are likely to temporarily relocate to the area. However, temporary workers often will commute relatively long distances rather than relocate. A new nuclear plant could require a permanent operational staff of between 650 – 1,000 employees and a new natural gas facility would need approximately 180 employees. A plant operations work force would most likely permanently relocate within commuter range of the new facility. Impacts would depend to a great extent on the size of the population around the site and the availability of housing and amenities. Impacts would be evaluated on a specific project basis and would potentially range from minor to substantial.

3.13.2. Employment and Income

This section addresses the impacts on employment and income in the vicinity of SQN.

3.13.2.1. Affected Environment

As discussed in Section 3.13.1, the 2008 estimated population for Hamilton County was 332,848 people, with a total employment of 251,211 people. Overall, the distribution of employment by industry in Hamilton County is similar to the statewide distribution. Consistent with its metropolitan status, it has relatively fewer workers in farm and farm-related jobs, and relatively more in transportation and warehousing and in finance and insurance. Government employment is 11.6 percent of the total in Hamilton County, slightly below the state level of 12.1 percent (see Table 3-17 for data on major sectors). (BEA 2008a) Total compensation of employees within Hamilton County in 2008 was nearly $10 billion. The annual average wage per job within Hamilton County for 2008 was approximately $38,958, which is slightly less than the state average wage of $39,469. (BEA 2008b)

The fourth largest in the state, the Chattanooga Metropolitan Statistical Area (MSA) has an estimated 2008 population of 520,089 (BEA 2008c). With a combined total personal income of over $18 billion, the Chattanooga MSA employed 321,197 people in 2008, an increase of approximately 23,600 jobs since 2003. (CHCRPA 2005b; BEA 2008a; BEA 2008c) Because Hamilton County dominates the MSA, the industrial distribution of employment in the Chattanooga MSA was similar to that of the county (Table 3-17). (BEA 2008a) Comparatively, the Chattanooga MSA annual average wage for 2008 was less than both the state and Hamilton County averages at $37,433 per year. (BEA 2008b)

Table 3-17. Top Employing NAICS Industry Categories

Category	Number of Jobs		
	Chattanooga MSA	Hamilton County	Tennessee
Construction	20,274	15,267	249,188
Manufacturing	35,107	24,312	375,063
Retail Trade	32,811	24,328	410,433
Transportation and Warehousing	22,277	19,497	176,507
Finance and Insurance	19,934	17,564	160,470
Real Estate, Rental, Leasing	11,547	9,042	156,138
Professional, Scientific, Technical Services	15,484	13,666	188,754
Administrative and Waste Services	18,681	17,748	256,510
Health Care and Social Assistance	29,304	24,651	366,745
Accommodation and Food Services	22,806	18,749	263,888
Other Services	20,531	14,757	234,129
Government	38,249	29,023	454,184

(BEA 2008a)

Unemployment within the Chattanooga MSA, which increased significantly from 2007 to 2009, showed some signs of improvement in 2010 with a 0.2 percent decrease since 2009 (Table 3-18). This decrease in unemployment could be partly due to the addition of new manufacturing, similar to the new Volkswagen automotive assembly plant that is anticipated to bring 2,000 new direct jobs and as many as 12,000 indirect jobs associated with parts supplies. (SDRG 2009) In addition, the Amnicola Industrial Park and other existing industrial parks have prime industrial land available for development, specifically the Enterprise South Industrial Park. A new interstate exchange is nearing completion and will provide direct access to Enterprise South Industrial Park from Interstate-75 (I-75), potentially bringing more industrial jobs to the Chattanooga MSA. (SDRG 2009) Tennessee, by comparison, has not shown signs of improvement, with the unemployed labor force expanding from 4.6 percent in 2007 to 10.8 percent in 2010. (BLS 2008; BLS 2010)

Table 3-18. Chattanooga MSA and Tennessee Unemployment: 2007 – 2010

Geography	2007 (March)	% of Labor Force	2008 (March)	% of Labor Force	2009 (March)	% of Labor Force	2010 (March)	% of Labor Force
Chattanooga (MSA)	9,900	3.8	14,400	5.4	24,900	9.7	24,200	9.5
Tennessee	139,200	4.6	177,500	5.9	320,900	10.6	324,400	10.8

(BLS 2008; BLS 2010)

3.13.2.2. Environmental Consequences

This section addresses impacts to employment and income from site construction and operation of the Action and No Action Alternatives.

Alternative 1 – License Renewal

SQN license renewal would result in no change to operating employment levels at the plant, therefore; there would be no changes to the local economy within the county or region. No new impacts to local employment or income are anticipated through this action.

Alternative 2 – No Action Alternative

Under No Action Alternative 2, the SQN operating licenses would not be extended, resulting in shutdown of SQN.

Alternative 2a or 2b – New Nuclear or Natural Gas-Fired Generation

The impacts of Alternatives 2a and 2b are similar and discussed together below.

If the No Action Alternative were chosen, and operation of the SQN plant should cease, the loss of 1,144 jobs within the region would not likely result in noticeable impacts to the economy. (SQN 2010) However, because a majority of these jobs, including the related indirect jobs, are located in Hamilton County, the level of impact to local communities would depend on whether SQN employees would choose to continue work within or near their current communities, or whether they would choose to find employment elsewhere.

Should a new nuclear or new natural gas facility be constructed at an alternate greenfield site, changes to local employment would be anticipated. A natural gas facility would require a smaller construction and operation work force than that required for a nuclear facility. The necessary construction work force would likely come from local and regional sources, creating hundreds of new direct and indirect jobs for several years. The phasing out of construction personnel and phasing in of a smaller operational work force has the potential to cause a boom and bust scenario, where a community might not only experience a subsequent drop in overall population, but also the need for staffing certain indirect jobs. This could result in substantial employment impacts to local communities and counties near the selected site. An incoming permanent operational work force would help offset the loss of certain jobs and also create others. The overall impact could range from minor to moderate, depending on specific site conditions.

3.13.3. Low-Income and Minority Populations (Environmental Justice)

This section addresses the impacts on low-income and minority populations in the vicinity of SQN.

3.13.3.1. Affected Environment

Regarding environmental justice, EO 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, issued on February 11, 1994, is designed to focus the attention of federal agencies on the human health and environmental effects of its programs, policies, and activities on minority and low-income communities. (59 FR 7629) While TVA is not subject to this executive order, it evaluates potential environmental justice impacts as a matter of policy. The environmental justice review involves identifying potential off-site environmental impacts, their geographic locations, minority and low-income populations that may be affected, the significance of such effects, and whether they are disproportionately high and adverse compared to the population at large within the geographic area, and if so, what mitigative measures are available, and which would be implemented.

According to the 2000 Census “Aggregate of All Minority Races and Hispanic” category, Hamilton County, Tennessee, has a higher percentage of minorities compared to the percentage of minorities within the overall state’s population (Table 3-19). As shown in Table 3-19, the census categories for “Black,” “Asian,” and “Native Hawaiian” are greater for Hamilton County than they are for the state of Tennessee. The “Black” census category, representing 20.1 percent of the county population, represents the greatest minority population difference between the county and state. (USCB 2000c; USCB 2000d)

The 2000 U.S. Census block group that includes the SQN site is number 470650103012. As shown in Table 3-19, within this block group none of the census minority categories, or low-income category, has a higher population percentage than the county or state percentages. (USCB 2000i; USCB 2000j)

The environmental justice evaluation for low-income populations is based on the use of census block groups, the finest resolution of data available for this particular population characteristic. A minority or low-income population is considered present if 1) the minority or low-income population identified in the census block or block group exceeds 50 percent, or 2) the minority or low-income population percentage is significantly greater (typically at least 20 percentage points) than the minority population percentage in the geographic area chosen for comparative analysis (individual states and combined states). (NRC 2004a)

As seen in Figure 3-13, based on environmental justice criteria, no minority population blocks were identified with the SQN census block group 470650103012. Additionally, the SQN block group does not meet the environmental justice criteria to be classified as containing a low-income population. Based on 2000 Census data, Hamilton County has a smaller percentage of low-income populations when compared to the state. As shown in Table 3-19, the county’s low-income population is 12.1 percent, while the state of Tennessee has 13.5 percent. (USCB 2000e; USCB 2000f)

Table 3-19. U.S. Census Race Category and Low-Income Populations

U.S. Census Categories	SQN Block Group 470650103012 Population by Census Category	%	Hamilton County Population by Census Category	%	Tennessee Population by Census Category	%
Black	5	0.4	62,005	20.1	932,809	16.4
American Indian\Alaskan Native	0	0	900	0.3	15,152	0.3
Asian	6	0.5	3924	1.3	56,662	1
Native Hawaiian\other Pacific Islander	0	0	196	0.06	2,205	0.04
Other	0	0	2356	0.8	56,036	1
Two or More Races	9	0.8	3,515	1.1	63,109	1.1
Aggregate of All Minority Races	20	1.7	72,896	23.7	1,125,973	19.8
Hispanic	2	0.2	5,481	1.8	123,838	2.2
Aggregate of All Minority Races and Hispanic	22	1.9	78,377	25.5	1,249,811	22
Low Income - Number of Persons Below Poverty Level (DP-3)	68	5.8	36,308	12.1	746,789	13.5

(USCB 2000c; USCB 2000d; USCB 2000e; USCB 2000f; USCB 2000i; USCB 2000j)

The identified minority population closest to SQN is approximately 1.2 miles away in census block number 470650101012009. The census block contains 12 people total, with 7 people in the "White" category, and 5 people in the "Asian" category. Along with identified individual minority blocks, clusters of blocks containing minority populations are present in the region. The closest cluster to SQN contains 301 people and is approximately 6 miles north of the SQN centerpoint. The blocks in this cluster consist of 122 people in the "White" category, 175 people in the "Black" category, and 4 people in the "Two or More Races" category. The U.S. Census block numbers are 470650102002002, 470650102002004, 470650102002043, and 470650102003079. (NRC 2004a; USCB 2000a)

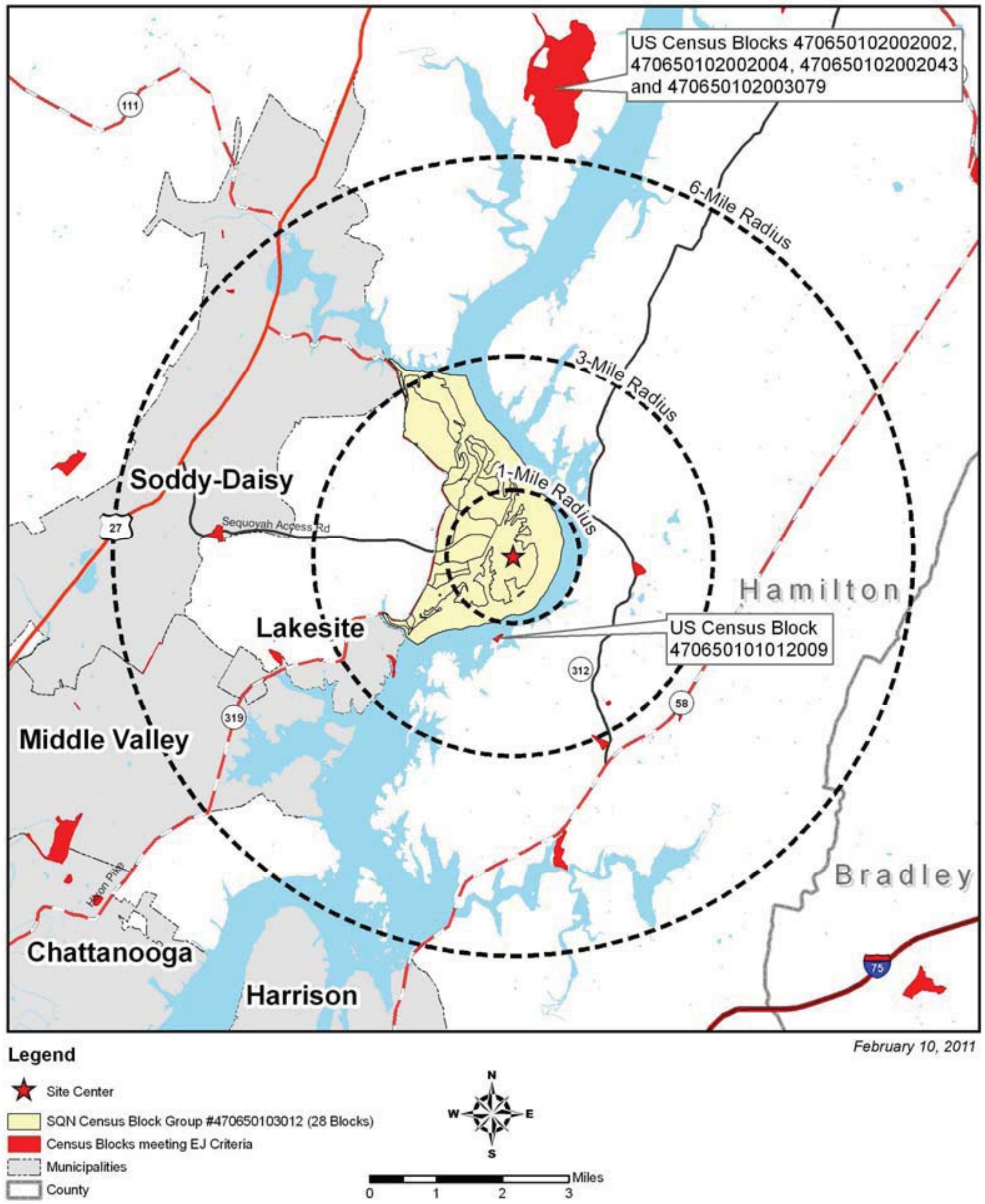

Figure 3-13. Minority Populations Within 6-Mile Radius of SQN

The closest low-income population is approximately 12.6 miles away and located inside the city of Cleveland, Tennessee. It is U.S. Census block group number 470110105003. All of the low-income population block groups are located in or near cities. (NRC 2004a; USCB 2000g)

None of the identified minority and low-income populations meeting the environmental justice criteria are associated with one specific community or geographic area. Instead, they are widely distributed throughout the region.

3.13.3.2. Environmental Consequences

This section addresses impacts to low-income and minority populations from site construction and operation of the Action and No Action Alternatives.

Alternative 1 – License Renewal

Under Alternative 1 – Action Alternative, SQN license renewal would result in no changes in operating employment levels at the plant. In its analysis of current conditions, TVA did not identify any location-dependent, disproportionately high and adverse impacts to minority and low- income populations resulting from operation of SQN. There are beneficial impacts realized, such as taxes paid by TVA and SQN workers. These in turn benefit local public services for the general population, including minority/low-income groups in the community. There should be no new impacts to population through this action.

Alternative 2 – No Action Alternative

Under the No Action Alternative, the loss of operational jobs would not impact disproportionately the minority and low-income populations of Hamilton County, Tennessee. As stated in Subsection 3.13.1, impacts due to a loss of population would have a negligible effect on the permanent population of Hamilton County. Housing costs may slightly decrease, as a result of additional available housing caused by the migration of operational workers. This migration and subsequent reduction in housing costs could have a small temporary beneficial impact on low-income populations. However, these effects would be short-lived if Hamilton County continues to grow as expected, with the overall impact anticipated to be minor.

Alternative 2a or 2b – New Nuclear or Natural Gas-Fired Generation

The impacts of Alternatives 2a and 2b are similar and discussed together below.

Should a new nuclear or a new natural gas facility be constructed, environmental justice issues would depend on the proposed location, and would be analyzed at the appropriate time. Potential impacts that might disproportionately impact minority or low-income communities include, for example, pressure on food and housing prices, or increases in road congestion or noise near residential communities.

3.13.4. Housing

This section addresses impacts to housing in the vicinity of SQN.

3.13.4.1. Affected Environment

To accommodate the increase in population growth as described in Section 3.13.1, the number of total housing units also increased in Hamilton County (Table 3-20). From 1990 to 2000, there was a 9.9 percent increase in total housing units, and an 11.7 percent increase between 2000 and 2008. The vacancy rates fell by 1.2 percent from 1990 to 2000, but rose by 4.2 percent between 2000 and 2008, indicating that more than enough housing was available, even as the county population increased. Median home values for Hamilton County also increased by 52.7 percent between 1990 and 2000, and by 65 percent between 2000 and 2008. Likewise, median rental fees increased in Hamilton County by 78.9 percent between 1990 and 2000. However, the increase in rental rates moderated between 2000 and 2008, with a 33.7 percent increase over the eight-year period. (USCB 1990; USCB 2000h; USCB 2008f)

Hamilton County has land-use and zoning regulations that address county and community priorities, and plans for dealing with the development of subdivisions and housing needs (Section 3.13.8).

Table 3-20. Hamilton County, Tennessee, Housing Statistics 1990, 2000, and 2008

	1990[1]	2000[2]	1990 to 2000 % Change	2008[3]	2000 to 2008 % Change
Total Housing Units	122,588	134,692	9.9	150,476	11.7
Occupied Units	111,799	124,444	11.3	132,773	6.7
Vacant Units	10,789	10,248	-5.0	17,703	72.7
Vacancy Rate (Percent)	8.8%	7.6%	-1.2	11.8%	4.2
Median House Value ($)	62,000	94,700	52.7	156,300	65.0
Median Rent ($/month)	285	510	78.9	682	33.7

1. (USCB 1990)
2. (USCB 2000h)
3. (USCB 2008f) American Community Survey estimates

3.13.4.2. Environmental Consequences

This section addresses impacts to housing from site construction and operation of the Action and No Action Alternatives.

Alternative 1 – License Renewal

Under Alternative 1 – Action Alternative, SQN license renewal would result in no change to operating employment levels at the plant, and no impacts to housing through this action are anticipated.

Alternative 2 – No Action Alternative

Under the No Action Alternative, the SQN operating licenses would not be extended, resulting in shutdown of SQN. Subsequently, the loss of operational jobs could have a dampening effect on the housing market, specifically in Hamilton County. However, the effect would be short-lived if the county continues to grow as expected, with the overall impact likely to be minor.

Alternative 2a or 2b – New Nuclear or Natural Gas-Fired Generation

The impacts of Alternatives 2a and 2b are similar and discussed together below.

Should a new nuclear or a new natural gas facility be constructed, acquiring adequate housing would be necessary for workers during the construction phase for either project, and again during the operational phase.

Depending on a site’s proximity to a large labor force and an area’s economic characteristics, construction workers might choose to commute from their established residences, seek short-term rental facilities within commuter range, or acquire more permanent housing in a local area near a potential site. Residential locations would depend on the availability of suitable housing facilities and local zoning codes, and could be located anywhere within the labor market area. The strains on localized housing markets could lead to increased prices for some types of housing and/or a potential shortage of accommodations. The demand for housing would begin to diminish after the peak construction employment level is reached and essentially disappear by the end of the construction period. Impacts on local and regional housing markets likely would range from minor to moderate if a proposed facility were located in a highly populated area with readily available housing. Impacts could range to substantial if a potential site were located in a sparsely populated area with little or no available housing. Impacts would be smaller for a natural gas facility than for a nuclear facility, due to the lower number of workers required.

An influx of operational workers at a site would phase in during the time period when construction work is phasing out. It is expected that operational workers migrating to an area would require more permanent housing than temporary construction workers, resulting in little or no competition between the two groups. Again the economic characteristics of the area and vacant housing availability would dictate whether the expansion of a housing market would accommodate the specific needs of an operational work force. Any expansion of the housing market may phase in with the arrival of operations workers to the area. Again, impacts on local and regional housing markets likely would be minor to moderate, depending on proximity to a highly populated area and readily available housing. Impacts could range to substantial, if a potential site were located in a sparsely populated area with little or no available housing. With a smaller number of workers required, impacts would be smaller for a natural gas facility than for a nuclear facility.

3.13.5. Water Supply and Wastewater

This section addresses impacts to water supply and wastewater in the vicinity of SQN.

3.13.5.1. Affected Environment

Most Hamilton County residents receive their potable water from one of 10 major providers active in the county. These utility districts are Hixson, Sale Creek, Savannah Valley, Soddy-Daisy/Falling Water, Tennessee-American, Union Fork-Bakewell, Walden’s Ridge, Signal Mountain, Mowbray, and Eastside. Tennessee-American Water, the major provider of public water services in Hamilton County, draws surface water from the Tennessee River. As of 2005, additional water treatment capacity was not a critical issue for Hamilton County. Over 307,000 people are served through these 10 water districts. (CHCRPA 2005a)

TVA contracts with Hixson Utility District to supply potable water to SQN, where the average daily requirement varies according to plant operation and fluctuations in plant personnel population. In 2007, the Hixson Utility District annual average groundwater withdrawal was over 6.70 MGD. (SDRG 2009) This is approximately the same rate of withdrawal reported in 2000. (TDEC 2000) As of April 2010, SQN's most recent monthly consumption of potable water was 388,660 cubic feet, or approximately 97,000 gallons per day (gpd). (TVA 2010m)

Sanitary sewer service in Hamilton County is provided by four entities: the Hamilton County Wastewater Treatment Authority, City of Chattanooga, City of Collegedale, and Town of Lookout Mountain. Moccasin Bend Treatment Plant is a regional facility that serves a population of approximately 400,000 including Chattanooga, the sewered portions of Hamilton County, and parts of counties and municipalities in both Georgia and Tennessee. Since 2001, the plant has undergone approximately $71 million in upgrades. In addition to Chattanooga, the system serves seven suburban areas, including part of Hixson Utility District and the City of Soddy-Daisy. (CHCRPA 2005a) The plant has a design capacity of 160 MGD and is currently functioning at 75 percent of its capacity. While Moccasin Bend is still under capacity and has had upgrades, other wastewater systems in the region need sewer plant and line improvements associated with their aging and/or outdated infrastructure. (SDRG 2009)

At SQN, the maximum quantity of sanitary water to be handled, treated, disposed of, or pumped off site is approximately 70,000 gpd. Sewage collected on site can be pumped off site to the Moccasin Bend sewage treatment system. (TVA 2008a)

3.13.5.2. Environmental Consequences

This section addresses impacts to water supply and wastewater from site construction and operation of the Action and No Action Alternatives.

<u>Alternative 1 – License Renewal</u>

Under Alternative 1 – Action Alternative, SQN license renewal would result in no new change in operating employment levels at the plant. No new impacts to water and wastewater services infrastructure are anticipated through this action.

<u>Alternative 2 – No Action Alternative</u>

Under the No Action Alternative, the SQN operating licenses would not be extended, resulting in shutdown of SQN. There would be less plant-associated demand on the Hamilton County water and wastewater system. However, because some operational workers and families may choose to remain in the county and utilize provided services, plant closure would have minimal influence with regard to lessening demand on system capacity.

Alternative 2a or 2b – New Nuclear or Natural Gas-Fired Generation

The impacts of Alternatives 2a and 2b are similar and discussed together below.

Should a new nuclear or new natural gas facility be constructed, the new plant water and wastewater infrastructure would need to be connected to existing area systems, or on-site options would need to be developed. Connecting to existing systems might require additional capacity to be developed. This could impact area land use (Section 3.13.8).

The arrival of construction and operational workers, and any family members brought to the area to live, would also make demands on a system. Depending on available water and wastewater infrastructure, if the housing market expands to meet worker needs, as described in Section 3.13.4, upgrading existing or building new infrastructure could be required, particularly with the creation of new housing subdivisions. This impact would be defrayed with the expected expansion of the tax base (Section 3.13.9).

3.13.6. Police, Fire, and Medical Services

This section addresses impacts to police, fire, and medical services in the vicinity of SQN.

3.13.6.1. Affected Environment

Hamilton County has a wide array of public safety agencies providing services to its residents, including a number of municipal police departments, the sheriff's department, volunteer and career community fire departments, emergency medical services, and area hospitals.

The Hamilton County Sheriff's Department covers the largest area in the county, and patrols and services the unincorporated portions, the City of Lakesite, and the Town of Walden. Chattanooga, Collegedale, Lookout Mountain, Red Bank, Soddy-Daisy, Signal Mountain, and East Ridge all provide police protection for their municipalities. Ridgeside contracts with the East Ridge Police Department to provide full police services for its residents. (CHCRPA 2005a) The Hamilton County Sheriff's Department Uniformed Patrol Division has about 56 patrol deputies and 43 reserve deputies, along with 12 sergeants and lieutenants providing law enforcement in the county (HCSO 2010).

Chattanooga, Soddy-Daisy, Red Bank, Signal Mountain, and East Ridge provide fire protection to their incorporated residents. Several volunteer fire departments provide protection to both incorporated and unincorporated area residents, including Dallas Bay, Highway 58, Tri Community, Sale Creek, Walden's Ridge, Sequoyah, Mowbray, and Flat Top Volunteer Fire Departments. (CHCRPA 2005a) Hamilton County has approximately 17 fire departments, 47 stations, and 866 career and volunteer firefighters providing fire emergency services (USFA 2010; CHCRPA 2005a).

If a situation evolves where outside emergency support becomes necessary at SQN, the plant communicates its need to a number of local and state emergency service agencies. Along with having its own emergency response capabilities, SQN has local support agreements with Soddy-Daisy Fire Department, the Erlanger Medical Center, and Memorial North Park Hospital in Chattanooga, and the Hamilton County Emergency Medical Service for ambulance support. (Dennis Lundy, TVA, personal communication, March 11, 2010) Erlanger has five Tennessee-based medical campuses, and is licensed for 819 acute-care beds and 50 long-term care beds serving patients from 50 counties within a 150-mile radius (Erlanger 2010). The Memorial Health Care System has 405 licensed acute inpatient services beds system-wide, and an 83-bed capacity at Memorial North Park Hospital, located in the suburb of Hixson (Memorial 2010). Both hospital systems have a wide range of associated physicians and staff who serve public needs.

3.13.6.2. Environmental Consequences

This section addresses impacts to police, fire, and medical services from site construction and operation of the Action and No Action Alternatives.

Alternative 1 – License Renewal

Under Alternative 1 – Action Alternative, SQN license renewal would result in no change to operating employment levels at the plant. No new impacts to emergency services infrastructure are anticipated through this action.

Alternative 2 – No Action Alternative

Under the No Action Alternative, there could be a phased drop in the need for public safety services should operational staff choose to relocate out of the county. As described in Sections 3.13.1 and 3.13.2, Hamilton County has a growing population and a number of employment options. It is likely that the reduced need for public safety services would be offset by the increasing demand from future county population growth.

Alternative 2a or 2b – New Nuclear or Natural Gas-Fired Generation

The impacts of Alternatives 2a and 2b are similar and discussed together below.

Should a new nuclear or new natural gas facility be constructed, the arrangement of support from local emergency service providers would become a necessity during the construction and operation phase. Depending on the proximity to population centers and the availability of emergency services, the influx of construction workers could impact the ability of an area's police, fire, and medical facilities to provide support requiring additional resources. With workers leaving at the end of the construction phase, permanent investments made in the expansion of public safety services would support incoming operational staff and families expected to permanently move to the area as well as other further county population growth.

3.13.7. Schools

This section addresses impacts to schools in the vicinity of SQN.

3.13.7.1. Affected Environment

Hamilton County has one public school district. Based on the 2007 – 2008 school year, the Hamilton County School District has 77 schools with 41,230 students. The student-to-teacher ratio is 14.5 to 1. Near SQN, there are six schools in Soddy-Daisy, including three elementary schools, a middle school, and two high schools. Eight schools are located in the nearby Chattanooga suburb of Hixson, including five elementary schools, two middle schools, and a high school. The city of Chattanooga has 43 schools (NCES 2010a). Based on a 2005 report, 42 county schools are 100 students or more under capacity, 23 schools are fewer than 100 students under capacity, and 10 schools are over their enrollment limits. Soddy-Daisy High was deemed one of the five most crowded schools (CHCRPA 2005a). In the decade prior to the 2007 – 2008 school year, overall enrollment in the Hamilton County public school system dropped by 68 students (TACIR 2008). In addition to the public school system, Hamilton County also has over 12,000 students in approximately 43 private schools (CHCRPA 2005a).

The schools are funded through the Hamilton County Commission by an allocation of the local property tax and half of the local option sales tax (CHCRPA 2005a). The district's budget for 2006 – 2007 was $271 million (HCDE 2009).

In 2008, there were eight 4-year colleges, one community college (2-year), one technology center, and two 2-year private institutions in Hamilton County (TACIR 2008). Nine of those 12 are in Chattanooga, including three 2-year institutions and six 4-year schools. The two public colleges include Chattanooga State Community College and the University of Tennessee at Chattanooga (NCES 2010b).

3.13.7.2. Environmental Consequences

This section addresses impacts to schools from site construction and operation of the Action and No Action Alternatives.

Alternative 1 – License Renewal

Under Alternative 1 – Action Alternative, SQN license renewal would result in no change to operating employment levels at the plant. No new impacts to schools would be anticipated through this action.

Alternative 2 – No Action Alternative

Under the No Action Alternative, the loss of operational jobs could result in a loss of population in Hamilton County where a large percentage of SQN operational workers live (Section 3.13.4). This could have a dampening effect on school attendance, particularly in nearby Soddy-Daisy and Hixson. However, as some operation workers and families could remain in the area and the population in the county is expected to grow, the overall impact is likely to be minor..

Alternative 2a or 2b – New Nuclear or Natural Gas-Fired Generation

The impacts of Alternatives 2a and 2b are similar and discussed together below.

Should a new nuclear or a new natural gas facility be constructed, it is expected that workers with accompanying family members would access available school facilities. For construction workers, the ability to find adequate housing and length of employment are two factors that could dictate whether they opt to have family members present during the construction phase. The arrival of operational workers at a site would phase in during the time period when construction work is phasing out. It is expected that operational workers migrating to an area would be more likely to bring their families, resulting in an increased demand for school facilities.

If a site were located in proximity to a populated metropolitan area with numerous schools, an influx of students would most likely be absorbed into a school system or enrollment would be spread among a number of schools systems, having little impact on resources. Should a plant be sited in a less populated area with fewer educational resources, the influx of new students from construction and operational worker families could cause a strain on a community's educational infrastructure. As described in Section 3.13.9, the arrival of workers and plant would bring in new monies to a region through direct and indirect spending, and in the long run, the costs of providing education for additional students should be offset by the increase in tax revenues and plant equivalent payments.

3.13.8. Land Use

This section addresses impacts to land use in the vicinity of SQN.

3.13.8.1. Affected Environment

Hamilton County, where SQN is located, is situated in southeast Tennessee and comprises approximately 368,479 acres (542 sq mi). The Tennessee River bisects the county from northeast to southwest and accounts for 6 percent of total county area. (CHCRPA 2005a) The SQN site is located along the Tennessee River, approximately 6 miles from the center of Soddy-Daisy and 18 miles from the center of Chattanooga. Soddy-Daisy has a 2008 estimated population of 12,511, which is an increase of approximately 52 percent since 1990 (Figure 1-2) (USCB 2008e). Chattanooga has a 2008 estimated population of 170,880 and is Hamilton County's largest city (USCB 2008b).

Hamilton County has a well-developed, land-use and zoning plan, with every parcel of land carrying a zoning designation (CHCRPA 2005a). It is one of Tennessee's largest counties, with a 2008 estimated population of 332,848 residents (USCB 2008a). Based upon the number and size of parcels, zoning within the county is primarily agricultural (59.64 percent), followed by residential (30.51 percent), manufacturing/industrial (6.58), commercial (2.20), special zoning (0.64), and office (0.12). Subdivision of land for residential lots continues to be prevalent in Hamilton County, with 68 percent occurring in unincorporated areas. (CHCRPA 2005a) Soddy-Daisy has experienced considerable residential subdivision growth between 2000 and 2008, with a peak in 2000 of 235 lots. As of 2009, it had the most housing units permitted among the smaller municipalities. Chattanooga's share of residential subdivisions for the same time period increased a total of 159 new major subdivisions, including 4,085 new lots. (CHCRPA 2009a) This accounts for 38 percent of the county's residential building permit activity, and includes a growing residential investment in Chattanooga's downtown, Alton Park, and the North Shore (CHCRPA 2005a; CHCRPA 2009a). SQN is located in Commission District 1, which has had 80 major subdivisions, including 2,193 lots, zoned between 2000 and 2008, accounting for more than 20 percent of the county's newly zoned subdivisions. (CHCRPA 2009a)

Land use is discussed in detail in the UFSAR, Section 2.1.4. Since 2000, there has been a notable increase in commercial growth and residential development, particularly along highway and interstate corridors. Updated land-use estimates for Hamilton County, shown in Table 3-21, indicate that residential (36.54 percent) and farm-agriculture (23.09 percent) are the two primary land-use types. (CHCRPA 2005a)

Table 3-21. 2005 Hamilton County Land Use

Category	Approx. Acres	% of Total
Residential	117,967	36.54
Commercial -Office	6,446	2.00
Industrial	11,110	3.44

Category	Approx. Acres	% of Total
Transportation	2,408	0.75
Institutional	9,648	2.99
Public Utility	1,534	0.48
Park-Open Space	34,428	10.66
Farm-Agriculture	74,567	23.09
Vacant	63,294	19.60
Other-Unknown	1,479	0.46

(CHCRPA 2005a)

3.13.8.2. Environmental Consequences

This section addresses impacts to land use from site construction and operation of the Action and No Action Alternatives.

Alternative 1 – License Renewal

Under Alternative 1 – Action Alternative, SQN license renewal would result in no changes in land use on site. Additional uranium fuel would be required for SQN during the license renewal time period and would result in approximately 2,400 acres of land being affected by uranium mining operations, resulting in minor to moderate off-site land-use impacts.

Alternative 2 – No Action Alternative

Under the No Action Alternative, no on-site change in land-use patterns would be anticipated. While the plant would undergo decommissioning, the site would probably remain developed. Because uranium fuel would no longer be required at SQN, there could be a resulting decrease in land-use impacts at source uranium mining operations due to reduced demand.

Alternative 2a – New Nuclear Generation

Should a new nuclear power facility be constructed, changes to land use would be anticipated. As discussed in Section 2.2, approximately 1,000 acres of land would be required to construct a new nuclear power facility. If a greenfield site were selected for the new facility, it is probable that land-use changes would occur, with the potential for loss of natural habitat and agricultural land. Should the site selected be a brownfield site (previously disturbed), the level of impact would vary. There would be no net change in off-site land-use impacts from the mining of uranium fuel, if supplies destined to be used during an SQN license renewal period were redirected for use at a new nuclear facility.

Alternative 2b – New Natural Gas-Fired Generation

If a new natural gas facility option were chosen, construction- and operation-related land-use impacts would be anticipated. As described in Section 2.2, a new natural gas facility with a capacity equivalent to SQN would require approximately 110 – 132 acres. Additional land would be required for natural gas wells and collection stations, which could amount to as much as 4,320 acres. Depending on whether the site selected were a greenfield or brownfield site, this could amount to extensive land-use impacts.

For either option, additional land would likely be impacted for transmission, railroad, and pipeline ROWs. Depending on the location of the existing ROWs and the inter-tie connection and rail spur, these alternatives could result in potentially extensive land-use impacts.

3.13.9. Local Government Revenues

This section addresses impacts to local government revenue in the vicinity of SQN.

3.13.9.1. Affected Environment

Section 13 of the TVA Act requires TVA to make in-lieu-of tax payments to states and counties in which TVA conducts power operations or in which TVA has acquired power-producing properties previously subject to state and local taxation. The total amount of these payments is 5 percent of gross revenues from the sale of power during the preceding year, excluding sales or deliveries to other federal agencies and off-system sales with other utilities, with a provision for minimum payments under certain circumstances. (TVA 2009a) The share to each state is apportioned as follows: one half is determined by the percentage of total TVA gross proceeds of power sales within each state; the other half is apportioned by the percentage of book value of TVA power property in each state. Except for certain direct payments that TVA is required to make to counties, distribution of in-lieu-of tax payments within a state is determined by individual state legislation.

TVA tax equivalent payments to the State of Tennessee are distributed according to the Tennessee Code, Title 67, Chapter 9. Under this code, 48.5 percent of the total payments received by the state are distributed to the counties and municipalities of Tennessee. Of this amount, 30 percent is distributed to counties based on county shares of the total state population, 30 percent to counties based on county acreage shares of the state total, and 30 percent to incorporated municipalities based on each municipality's share of the total population of all incorporated municipalities in the state. The remaining 10 percent is allocated to counties on the basis of county shares of TVA-owned land in the state. Thus, only 4.85 percent of the payment to the county varies based on the level of TVA property or facilities in the state. (Tennessee Code 2010)

Total TVA in-lieu-of tax payments for financial year (FY) 2009 were about $505 million, of which Tennessee received $295 million. Estimated payments for FY 2010 are a total of $538 million. (TVA 2009j) This amount would include $320 million to Tennessee.

Hamilton County received $2,677,694 of TVA's in-lieu-of tax payments to the State of Tennessee. Additional money to the cities in Hamilton County totaled $2,091,425, with Chattanooga receiving $1,487,106 and Soddy-Daisy receiving $107,039. (ATVG 2009)

3.13.9.2. Environmental Consequences

This section addresses impacts to local government revenue from site construction and operation of the Action and No Action Alternatives.

Alternative 1 – License Renewal

Under Alternative 1 – Action Alternative, SQN license renewal would result in no new change to operating employment levels at the plant, and no impacts to local governmental revenues are anticipated through this action.

Alternative 2 – No Action Alternative

Under the No Action Alternative, there would be no impact on local government revenues. The amount of payment in lieu of taxes Hamilton County receives is based in part on land ownership, not its usage, so there would be no impact if the SQN plant were closed and the property retains its status as a power system asset. If at some future date TVA were to dispose of the land, the Hamilton County share would decline by a very small percentage. The SQN site is about 3 percent of the total TVA-owned land in Hamilton County. Because only 10 percent of the payment is determined by land ownership, the resulting decrease in the county share of payments from the state would be very small, less than 0.5 percent.

Alternative 2a or 2b – New Nuclear or Natural Gas-Fired Generation

The impacts of Alternatives 2a and 2b are similar and discussed together below.

Should a new nuclear or a new natural gas facility be constructed, revenues for Hamilton County would still be unaffected, unless TVA chose to sell the SQN property, resulting in a very minor decrease as discussed above. If TVA purchased property in Hamilton County for the new nuclear or natural gas facility, local government revenues would increase slightly, as the total amount of TVA-owned land in the county increased. However, the amount of land needed would likely be similar to the SQN site and thus make up only a very small fraction of the total TVA-owned land. Revenue increases would be proportionally small. Should a plant be built outside the state of Tennessee, any TVA in-lieu-of tax payment disbursement to local government would be apportioned based on that state's legislative decision. Whether the local government's existing tax base is small or large, the disbursement would have a positive and beneficial impact.

3.13.10. Transportation

This section addresses impacts to transportation in the vicinity of SQN.

3.13.10.1. Affected Environment

SQN is located in Hamilton County on the western shore of the Tennessee River, outside the cities of Chattanooga, Lakesite, and Soddy-Daisy (Figures 1-2 and 1-3). The major Hamilton County east-west road network on the east side of the river is anchored by I-75 and Interstate-24, both of which pass through Chattanooga. On the west side of the river running north-south, U.S. Highway 27 (US 27) becomes a major expressway in Hamilton County, feeding traffic from Chattanooga to Soddy-Daisy and eastward into Rhea County (Figure 1-3).

SQN personnel access the site from either US 27 or State Road 319 (SR 319) – Hixson Pike, via the Sequoyah Access Road (Figure 1-2). The Sequoyah Access Road runs eastward from US 27 and intersects with SR 319 near the site. In 2008, the average daily traffic volume on US 27, west of the Sequoyah Access Road intersection, was 33,136 vehicles per day. The average daily traffic volume on the Sequoyah Access Road, immediately west of SR 319-Hixson Pike, was 3,526 vehicles per day. Similarly, the 2008 vehicle count on SR 319-Hixson Pike, immediately south of Sequoyah Access Road, was 2,850. (TVA 2009h; TDOT 2008)

Hamilton County's long-range transportation plan forecast for 2030 anticipates greater demand than the currently available capacity on many of the existing roadways, although US 27 is not included in this list. The plan recommends that while increased transit opportunities and other strategies are needed to reduce single-occupancy vehicle travel, capacity additions would still be needed for the most congested roadways. (CHCRPA 2005a)

Chickamauga Reservoir on the Tennessee River is a navigable waterway used by commercial and recreational traffic. Through a series of locks and dams, commercial traffic can travel from Knoxville, Tennessee, located over 100 miles northeast of the site, to the mouth of the Tennessee River at the Ohio River. (TVA 2008a) Commercial and private traffic on the Tennessee River are discussed in detail in the UFSAR, Section 2.2.

The nearest airport is the Dallas Bay Sky Park, which is a general aviation airport located approximately 5.5 miles west southwest of the plant. The Chattanooga Airport is a full-service commercial airport located about 14.5 miles south southwest of the plant. (TVA 2008a) SQN has a private use helipad associated with the plant (Pilot Outlook 2010).

There is no Amtrak service associated with Chattanooga, and there is no local intercity passenger rail service. Two of the nation's largest rail networks currently serve the region, CSX Transportation, Inc. (CSX) and Norfolk Southern Corporation. CSX operates a rail line from Chattanooga to the Tyner area, where it serves several industries. The largest railroad presence in the region is Norfolk Southern Corporation, which is also the operator of the southwest to northeast line running near the site through Soddy-Daisy. A railroad spur runs from the Norfolk Southern line to SQN just outside the EAB. (USDOT 2008; Norfolk Southern Corporation 2010)

3.13.10.2. Environmental Consequences

This section addresses impacts to transportation from site construction and operation of the Action and No Action Alternatives.

<u>Alternative 1 – License Renewal</u>

Under Alternative 1 – Action Alternative, the license renewal program would not require major new construction, alterations, or refurbishment to SQN to maintain consistency with the current licensing basis. In addition, no change to operation at the plant or addition of operation personnel is anticipated. Any future plans to increase capacity of the spent fuel storage capacity at SQN would require a minimal number of construction workers on site for a short duration of time. No resulting impacts to transportation are anticipated due to this action.

<u>Alternative 2 – No Action Alternative</u>

Under the No Action Alternative, the loss of operation jobs would result in a noticeable decline of traffic on SR 319 and other minor arterial and collector roads that feed south off of US 27. This could create an increase of available capacity for these area roads. Overall, any decline in traffic due to plant closure would be offset should future housing subdivisions increase along these road sets and should the anticipated population increases continue for Hamilton County (Sections 3.13.1 and 3.13.8).

Alternative 2a or 2b – New Nuclear or Natural Gas-Fired Generation

The impacts of Alternatives 2a and 2b are similar and discussed together below.

Construction and operation of a new nuclear power facility or new natural gas facility would potentially impact the transportation infrastructure and traffic load on the roadways associated with a site. It is expected that a larger construction and operations work force would be required for a new nuclear facility than would be required for a new natural gas plant. Factors that help determine transportation and traffic impacts from construction and operation of a new facility include:

- Number of construction and/or operational workers and expected vehicles on the road.
- Number of shift changes for construction and/or operational work force.
- Projected population growth rate in the region during the construction and operation period.
- Capacity and condition of existing roads.

Should a new power facility be constructed, the facility could be sited in a manner that would reduce or avoid transportation and traffic impacts. However, mitigation of potential transportation impacts due to the location of a facility may be necessary because of expected increases in construction and operation traffic. This mitigation may include a need for extensive improvements to roadways and intersections (e.g., roadway widening, ramp improvements, and traffic signal installation) on state and local roads. Other mitigation actions could include employee car pooling or off-site parking with organized transportation, such as buses, to the site. Traffic generated as an outcome of construction activities would be temporary and short term. Scheduling for certain construction activities to occur during off-peak hours could also be an option to reduce conflict with normal traffic use on area roads. Traffic related to operation and maintenance at a potential site would utilize any mitigation improvements established during the construction phase. Impacts could range from minor to moderate, depending on project and site-specific conditions.

3.13.11. Cumulative Effects

Potential future area development and construction projects were assessed to determine if in combination with the SQN license renewal action, there would be any cumulative impacts that would affect socioeconomic resources in the SQN area. Two license renewal alternatives were evaluated with the proposed projects. Alternative 1, the Action Alternative, addressed the potential impacts associated with license renewal and the continued operation of SQN. Alternative 2, the No Action Alternative, identified and evaluated any potential impacts associated with the closure of SQN and the construction and operation of either a new nuclear facility or a new natural gas turbine facility elsewhere.

One of the proposed projects is the potential production of tritium at SQN for the DOE. The DOE has identified the purchase of irradiation services from the Watts Bar and Sequoyah reactor facilities as preferred for the production of tritium. Tritium production could require the addition of employees (fewer than 10 per unit) as well as additional plant modifications. It is expected that irradiated fabricating TBPAR assemblies, nonradioactive waste, and some additional LLRW would be transported off site for processing and disposal. (DOE 1999) To date, SQN has not produced tritium for the DOE, but the option remains open.

The second proposed project includes the potential construction of a Tennessee River toll bridge in north Hamilton County, using the Sequoyah Access Road on the west as the connection from US 27 to the river crossing, with the new bridge and toll road connecting to I-75 on the east side of the river. Two proposed routing options branch off the Sequoyah Access Road and would cross the TVA Sequoyah Reservation peninsula either to the east or to the west of the SQN industrial plant. This project is in the feasibility stage and no preferred routing scenarios have been selected.

Cumulative Impacts – Alternative 1 – License Renewal

As discussed in Sections 3.13.1 through 3.13.10, should this alternative be chosen, no socioeconomic impacts are anticipated due to renewal of the SQN license. Most of the impacts described in these sections are driven by changes in population. With no changes anticipated at SQN with current operating practices or employment levels, the possibility of impact is negligible. The only socioeconomic factor not driven by population is land use. There would be minor off-site land-use impacts resulting from the continuation of uranium mining operations supplying fuel to SQN. No changes are anticipated to on-site land use, and no other land-use-related impacts are predicted.

Regarding the potential cumulative impacts of the SQN license renewal action combined with the on-site production of tritium for the DOE, again, no combined socioeconomic impacts from the two actions are anticipated. Because few if any new employees would be hired at SQN due to tritium production, there would be no resulting population growth in the Hamilton County area or negative impact to any community resources. Likewise, neither SQN nor the surrounding area would see any land-use change brought about by the production of tritium.

While employee transportation habits are not expected to change due to license renewal or tritium production, there would be additional transportation of radiological and nonradiological materials off site with the production of tritium. Because of the limited number of shipments, impacts from an increase in traffic near the plant and resulting vehicle emissions would be minor. DOE takes many precautions to ensure the safe transportation of radioactive materials (DOE 1999), and SQN follows all rules and regulations from the U.S. Department of Transportation (USDOT) to transport non-radioactive materials. Because license renewal is not expected to bring about any new impacts to local roads, and the effects of tritium production transportation would be minor, it is anticipated that overall cumulative transportation impacts from these two actions would also be minor.

Regarding environmental justice concerns, no negative impacts were identified that would result from the proposed SQN license renewal. The production of tritium at SQN would also cause no adverse environmental effects to the general population, or to any of the area's socioeconomic resources. Neither is it expected that tritium production would have any effect on particular groups within the general population, including minority and low-income populations. (DOE 1999)

Should construction of the new toll road and bridge proceed, this action on its own would impact the environment and affect the socioeconomic resources of the community at large. To meet anticipated county population growth, the project would promote the efficient movement of vehicles in Hamilton County and increase economic development opportunities along the transportation corridor. Planners would take into consideration likely effects to the environment that may develop, including land-use change, population and business displacement, and the potential for environmental justice issues, etc. It would be expected that the environment and population in the vicinity of the proposed road could experience substantial impacts.

SQN license renewal and tritium production at SQN would not play a role in impacting community socioeconomic resources in combination with the construction and operation of the proposed road. There would be no cumulative effects expected due to the combination of the three actions. It should be noted that because of SQN proximity to the proposed toll road routing options, and the potential crossing of the SQN reservation, it is likely SQN plant operations would experience some of the described toll road impacts, particularly land-use change.

Cumulative Impacts – Alternative 2 – No Action Alternative

Alternative 2, the No Action Alternative, is divided into two options, Alternative 2a and Alternative 2b. Both options entail the end of operations at the SQN site.

The socioeconomic impacts of plant closure would be varied and minor, as discussed in Sections 3.13.1 through 3.13.10. Regarding the cumulative effects of SQN not being able to produce tritium for the DOE, there are alternative options for production at other TVA nuclear facilities. The cumulative impact of this action would be minor. The potential cumulative impacts of the proposed toll road and its proximity to SQN, as described in "Cumulative Impacts – Alternative 1," would no longer be a consideration. TVA would have the option of making the property available for other use.

Alternative 2a is the new nuclear generation option. This option identified any associated socioeconomic impacts related to the construction and operation of a new nuclear facility. Alternative 2b is the new natural gas-fired generation option. As discussed in Sections 3.13.1 through 3.13.10, should these alternatives be chosen, impacts would vary with proximity to associated populated areas and the availability of amenities, housing, and services. Land-use impacts would be site specific. There would likely be moderate to substantial socioeconomic impacts to the communities closest to a site.

There are no socioeconomic cumulative effects of tritium production to consider under Alternative 2a or 2b. The DOE agreement with TVA for the production of tritium is unique to the SQN nuclear facility. Should TVA opt to construct a new nuclear plant elsewhere, reassessment of DOE tritium production need and site specific environmental evaluations would be undertaken at that time. A natural gas facility would not be involved in tritium production.

With Alternative 2a or 2b, should TVA decide to construct and operate an energy facility elsewhere, there could be combined cumulative effects associated with the proposed toll road in Hamilton County. Ultimately, proximity of any proposed facility site to the toll road would be the determining factor. Cumulative effects on socioeconomic factors could be positive in some categories and negative in others, including the creation of new jobs, increased demand for skilled construction workers, wage increases, new economic opportunities, housing demand and subsequent shortages, elevated pricing for commodities and food, overuse of social services, and increased tax revenues, etc.

3.14. Solid and Hazardous Waste

Solid wastes generated in conjunction with operation of SQN, or construction and operation of new alternatives, can be subdivided into seven general categories:

- Construction and demolition debris associated with site activities.
- Municipal solid waste consisting of paper, plastics, garbage, and other items.
- Waste generated from transmission line clearing and maintenance.
- Hazardous wastes and universal wastes as defined under the Resource Conservation and Recovery Act (RCRA) (40 CFR §141.25 Parts 260–273).
- Special wastes as regulated by TDEC.
- Hazardous low-level radioactive solid wastes that consist of spent resins and DAW (i.e., contaminated protective clothing, paper, rags, glassware, and trash).
- Hazardous spent fuel (high-level radioactive waste).

Hazardous low-level radioactive solid waste and hazardous spent fuel are discussed in Section 3.18, not in this section. The first five general categories of solid and hazardous waste are discussed below.

Nonradiological solid wastes are managed in accordance with applicable federal environmental regulations, as well as state and county regulations. Solid wastes are properly stored and disposed of in approved and licensed disposal facilities in accordance with federal, state, and county requirements.

TVA's 1974 FES for SQN addressed expected waste generation resulting from plant construction, normal plant operation activities, hazardous waste generation, transmission line clearing and vegetation control practices, LLRW, spent fuel, and the proposed temporary on-site storage and plans for final permanent disposal of those various wastes (TVA 1974a). Since the FES was written, there have been many improvements to the methods used to reduce solid waste volumes at SQN, and the programs that control these wastes are continually improved. All activities involving handling of waste follow approved procedures, and are performed by trained and qualified personnel.

Construction/Demolition Debris

TVA operates a construction/demolition landfill (Tennessee permit number DML 33-105-0021) within the confines of the SQN site. This landfill is permitted to accept nonhazardous, nonradioactive solid wastes including scrap lumber, bricks, sandblast grit, crushed metal drums, glass, wiring, non-asbestos insulation, roofing materials, building siding, scrap metal, concrete with reinforcing steel and similar construction, and demolition wastes from the SQN site. The landfill is approximately 18 acres in size (TVA 2008b), but has not received any waste for at least 10 years (Michael Browman, TVA, personal communication, January 27, 2010). The landfill permit is still active, but there is currently no intention to use the landfill. Instead, SQN construction/demolition wastes are disposed of in a state-permitted landfill. In the past, construction/demolition wastes have been sent to the Bradley County and Rhea County landfills. Future construction/demolition wastes from SQN will most likely be sent to state-permitted landfills owned/managed by Republic Services National Accounts, LLC (Republic Services) instead, in accordance with the new contracts, as discussed further in the paragraph below.

Municipal Solid Waste (General Plant Trash)

MSW is collected in dumpsters and transported to a state-licensed regional landfill permitted to accept the solid wastes. General trash at SQN typically consists of garbage, paper, plastic, packing materials (metal retaining bands, excelsior, and cardboard), rubber, glass, soft drink and food cans, dead animals and fish, floor sweepings, wood, and textiles. SQN has a waste management contract for the collection and transportation of MSW from SQN to a state-permitted landfill and for the processing of recyclable waste. Until recently (2011), MSW was sent to the Bradley County Landfill (remaining capacity for 48 more years) (Michael Browman, TVA, personal communication, January 27, 2010) and the Rhea County Landfill (Michael Browman, TVA, personal communication, April 25, 2011). Table 3-22 provides the total yearly amounts for MSW collected and shipped for disposal, as well as the annual amounts of recyclable waste processed each year from 1995 through 2009 (Michael Browman, TVA, personal communication, February 26, 2010). MSW is the largest type of nonradiological solid waste generated on site.

The new SQN waste disposal contract with Republic Services will dispose of SQN MSW at a state-licensed, Republic Services owned/managed landfill. It is proposed that all of SQN MSW be sent to the Sand Valley Landfill in Collinsville, Alabama. Republic Services landfills have an average lifespan of 30 years. Republic Services will also be responsible for the majority of the recyclables from SQN. (Michael Browman, TVA, personal communication, April 22, 2011) Recycling of scrap metal at SQN is currently managed by PSC Metals, Inc., of Chattanooga, Tennessee (Michael Browman, TVA, personal communication, April 22, 2011).

Table 3-22. SQN Municipal Solid Waste Yearly Total and Recycle Yearly Total

Year	MSW Yearly Total (Tons)	Recycle Yearly Total (Tons)
1995	854.8	179.1
1996	1305.5	293.7
1997	1432.2	182.6
1998	1826.0	116.4
1999	1918.5	118.9
2000	1857.2	335.5
2001	1745.0	243.3
2002	1462.6	266.7

Year	MSW Yearly Total (Tons)	Recycle Yearly Total (Tons)
2003	1395.0	386.9
2004	1302.3	338.3
2005	2497.1	455.9
2006	3294.3	299.0
2007	862.5	134.0
2008	922.9	134.3
2009	778.1	59.2

(Michael Browman, TVA, personal communication, February 26, 2010)

Waste Generated From Transmission Line Clearing and Maintenance

TVA owns and operates the majority of transmission lines within the TVA system. TVA has developed a comprehensive environmental procedure for the vegetation management of transmission ROWs (TVA 2010n). The procedure provides guidelines regarding maintenance of solid wastes such as tree trimmings and brush from transmission line ROWs and border areas, and roads for maintenance and routine access. For Alternative 1 – License Renewal, TVA would not be required to provide any new transmission lines or structures. Routine maintenance and management would continue to be conducted in accordance with developed guidelines and BMPs (TVA 2010n).

Hazardous Waste

SQN is an industrial facility that generates a variety of wastes classified as hazardous under the RCRA. These wastes typically include paint-related materials, spent solvents used for cleaning and degreasing, as well as universal wastes such as spent batteries and spent mercury-containing lighting. SQN's site designation as a small quantity generator (SQG) or as a conditionally exempt small quantity generator (CESQG) changes based on routine operating conditions and episodic waste generating activities at the site. SQN was a CESQG for the years 2006 and 2007, when it generated 220 pounds or less of waste in any calendar month within the particular year. SQN was classified as an SQG for the years 2008, 2009, and 2010, when it generated more than 220 pounds but less than 2,200 pounds in any calendar month within the particular year. (TVA 2011c). SQN holds an RCRA permit for hazardous waste (TN 5640020504).

TVA operates the hazardous waste storage facility (HWSF) in Muscle Shoals, Alabama, and holds an RCRA Part B permit (AL2640090005) for temporary storage of hazardous wastes. The HWSF serves as a central collection point for most of the SQN-generated hazardous wastes, and maintains contracts with waste treatment and disposal facilities through TVA's Environmental Restricted Awards List process to permanently dispose of wastes.

The majority of hazardous waste generated at SQN is shipped to the HWSF for consolidation, storage, and disposal through approved and licensed facilities. Universal wastes are collected for recycling and shipped to recycling firms listed on the TVA's Environmental Restricted Awards List. Hazardous waste generated by SQN during the years 2004 – 2009 is listed in Table 3-23.

Used oil is generated at SQN as a result of maintenance activities on plant equipment. It is collected, stored on site, and shipped to an approved recycling center for recovery.

Table 3-23. SQN Hazardous Waste Generation for the Years 2004 – 2009

Year	Hazardous Waste Generated (Pounds)
2004	413.6
2005*	10,764.6
2006	444.4
2007	550
2008	880
2009	1062.6

* Increase due to surplus chemical disposal (TVA 2010o)

Special Waste

Special waste is placed in dumpsters and includes materials such as asbestos waste, sandblast grit, alum sludge, resin, and sand from water treatment. The contents of these dumpsters are transported to the Rhea County Landfill (remaining capacity until the year 2027). (Michael Browman, TVA, personal communication, January 27, 2010) It is expected that SQN will continue to use the Rhea County landfill as an alternative for special waste disposal (Michael Browman, TVA, personal communication, April 25, 2011).

Special waste placed in drums is predominantly oily debris, but may include materials such as desiccant, resin, nondestructive examination chemicals, and nonhazardous batteries. These special waste drums are sent to the TVA HWSF permitted by the State of Alabama and located in Muscle Shoals, Alabama. The HWSF stores hazardous waste prior to final disposal in a hazardous waste landfill or incineration at an approved and licensed facility. (Michael Browman, TVA, personal communication, April 22, 2010)

3.14.1. Affected Environment

A review of various types of waste generation at SQN as compared to the TVA 1974 FES shows a reduction in the generation of annual plant solid wastes predicted. It should be noted that solid waste generation follows plant activities. For example, during the Unit 1 steam generator replacement project, waste increased as expected. Similarly, this increase is expected during the Unit 2 steam generator replacement project.

Solid wastes generated in conjunction with operation of SQN include MSW (general plant trash), waste generated from transmission line clearing and maintenance, hazardous wastes, and universal wastes as defined under the RCRA, and special wastes as regulated by TDEC. SQN has in place programs, procedures, and training that ensure the volumes of all solid waste types generated would be as low as practicable.

General plant trash is handled by following a formal program that allows all general trash to be collected, sorted as appropriate for recycling, and disposed of off site in licensed landfills. Transmission line clearing and maintenance follows TVA directions and allows for the proper disposal of the wastes associated with vegetation management and control. SQN is a large industrial facility and generates several types of hazardous waste. These hazardous wastes are controlled by a chemical traffic control program, material safety data sheet (MSDS) training, and formal procedures that help minimize the generation of waste and the proper handling of used chemicals and other hazards.

The hazardous waste generated would be minor, commensurate with the level of activity at the plant. As previously stated, SQN's classification as an SQG or CESQG fluctuates, based on routine operating conditions and episodic plant activities. These hazardous wastes include paints, paint-related materials, solvents, corrosive liquids, leather gloves, discarded chemicals, and parts washer solutions. Just as for the solid waste, the TVA HWSF manages a number of waste management contracts that provide TVA with a variety of hazardous waste disposal options approved by local, state, and federal regulators.

3.14.2. Environmental Consequences

The types and relative amounts of solid wastes generated by the viable alternatives during construction and operation are described below. Recycling of potential waste materials such as water, oils, wood and lumber, plastics, and scrap metal, would potentially reduce the pressure on landfill capacity, mitigating any potential adverse disposal effects.

Because the disposal of solid and hazardous wastes would be in accordance with the applicable regulations at permitted facilities, the new facilities would need to be located in areas with adequate capacity to serve the potential building and operation of the viable alternatives. TVA expects that any adverse effects from the generation, management, and disposal of solid wastes are likely to be minor for Alternative 1 – License Renewal, No Action Alternative 2a – New Nuclear Generation, and No Action Alternative 2b – New Natural Gas-Fired Generation.

Alternative 1 – License Renewal

Construction

For this alternative, there would be no major construction activity. Solid waste generation would continue as currently generated at SQN, and there would be no change in impact from the current level of minor impact. Any construction and demolition waste would be minimal as a result of normal plant operation, and would be disposed of in a state-approved landfill. The future expansion of the spent fuel storage capacity by the addition of a separate concrete storage pad would be expected to result in minor quantities of construction debris and potentially the generation of paint-related hazardous waste that would be sent to the TVA HWSF for eventual disposal elsewhere in a permitted facility. The spent fuel storage capacity would probably be constructed at a different location than the current ISFSI, but would still be constructed on site, and the impact would be expected to be minor.

If Alternative 1 – License Renewal were not chosen, SQN would go into decommissioning at the end of the current license period or before. If the alternative of license renewal were approved, the decommissioning of SQN would be delayed for an additional 20 years. Regardless of which alternative is chosen, decommissioning will occur in the future. Once the decommissioning process is started, the amount of waste generated would change. Use of many of the hazardous chemicals normally used at the plant would cease.

Starting the decommissioning process would shift the waste generated to more demolition-type wastes. Buildings and structures that are not radioactive can be dismantled and recycled or disposed of. The generation of general trash would potentially increase along with soils, concrete rubble, and construction debris. All handling of wastes during the decommissioning phase would be in accordance with applicable rules, regulations, and requirements of local, state, and federal laws. All waste would be properly disposed of in licensed landfills or processed by licensed vendors to recover as much waste as practicable. The impact on the environment from waste during the period of decommissioning would be expected to be minor. Special chemicals used for decontamination would be in accordance with all applicable permits, and personnel would be trained in handling hazardous materials.

Operation

Under Alternative 1 – License Renewal, solid waste would be generated at approximately the same current rates. SQN would most likely vary between CESQG and SQG status for hazardous waste generation. However, in accordance with its Hazardous Waste Minimization Plan, SQN would strive to limit the quantities of hazardous waste generated. Therefore, impacts would be expected to remain minor for hazardous wastes. All solid wastes as discussed would be handled in accordance with applicable rules, regulations, and permits. All wastes would be removed from site and properly disposed of in licensed landfills or recycled and reused. The impacts from solid and hazardous wastes would be expected to be minor.

As previously discussed, solid wastes generated include oily debris (absorbent, floating boom barriers, rags from cleanup, oily gravel, and dirt), spent resin, desiccant, and nonhazardous alkaline batteries. These wastes are shipped to the TVA HWSF for eventual disposal by a contractor in a permitted landfill. Scrap metal is recycled, and any wood waste that cannot be recycled also goes to a permitted landfill.

Types of hazardous waste generated by TVA nuclear plants include paint, paint thinners, paint solids, discarded laboratory chemicals, spent fixer (X-ray solution), parts washer solutions, hydrazine, rags from hydrazine cleanup, and sulfuric acid and sodium hydroxide waste from demineralizer beds and makeup water treatment.

Hazardous wastes are shipped to the TVA HWSF in Muscle Shoals, Alabama, for interim storage prior to disposal at a permitted facility. The TVA HWSF has contracts for hazardous waste disposal by a number of methods with companies that have significant disposal capacity.

TVA evaluated the potential impacts from the construction and operation of the ISFSI and found there would be no significant impact (TVA 2002c). Expansion of the spent fuel storage capacity at SQN is not expected to result in significant impacts.

Alternative 2a – New Nuclear Generation

Construction

The quantities and types of solid waste generated by this option would be determined primarily by the number of acres, the initial condition of the selected site, and the location and type of nuclear technology chosen. Depending on previous land use, forested areas may need to be cleared and old buildings demolished or renovated to make the area suitable for construction. During construction, there would be large volumes of dirt, concrete, wood, metal, and packing materials to dispose of in appropriate landfills. Any construction and demolition wastes generated during the building and renovation process would be managed through the TVA waste disposal contracts to access the permitted disposal capacity or recycling facilities, as needed.

Typical hazardous wastes generated during the construction phase would include paint wastes, paint thinners, dried paint, and cleaning liquids. These hazardous wastes would be sent to the TVA HWSF for disposal elsewhere in a permitted facility.

If Alternative 2a – New Nuclear Generation were chosen for implementation, potentially extensive new transmission lines would need to be installed. The need for new transmission lines, structures, and ROWs has a potential to produce large volumes of solid waste; however, TVA-established management practices would ensure minor impacts.

The likely implementation of a chemical traffic control program early in the construction phase of the Alternative 2a – New Nuclear Generation project would minimize the discarded chemical hazardous waste stream, reducing the pressure on hazardous waste disposal landfill capacity and ultimately mitigating any potential adverse disposal effects.

If Alternative 2a – New Nuclear Generation were chosen, SQN would be shut down by the expiration date of the current licenses and begin the process of decommissioning. Starting the decommissioning process would shift the waste generated to more demolition-type waste. Buildings and structures that are not radioactive could be dismantled and recycled, or disposed of. The amount of general trash would potentially increase along with the amount of soils, concrete rubble, and construction debris. All handling of wastes during the decommissioning phase would be in accordance with applicable rules, regulations and requirements of local, state, and federal laws. All waste would be properly disposed of in licensed landfills or processed by licensed vendors to recover as much waste as practicable. The impact on the environment from waste during the period of decommissioning would be expected to be minor. Special chemicals used for decontamination would be in accordance with all applicable permits, and personnel would be trained in handling hazardous materials.

Operation

Depending on the type of nuclear technology chosen, generation of solid wastes would continue to be similar to SQN. The impacts would be minor.

Alternative 2b – New Natural Gas-Fired Generation

Construction

Site preparation for a new natural gas-fired plant would be similar to Alternative 2a and would result in the generation of some wood and other vegetative waste from clearing and grubbing. Because a new natural gas-fired plant would require the smallest amount of land for construction, it would produce a smaller amount of solid waste and would have a minor impact, as long as appropriate landfills and BMPs are used.

Typical hazardous waste generated during construction would include paint wastes, paint thinners, dried paint, and cleaning liquids.

If Alternative 2b – New Natural Gas-Fired Generation were chosen for implementation, there would potentially need to be extensive new transmission lines and natural gas pipelines installed. Impacts would be expected to be similar to Alternative 2a.

Operation

Anticipated nonradioactive waste for the operation of a new natural gas-fired plant would include small volumes of industrial wastes such as metal, wood, and paper, as well as process wastes such as nonradioactive resins, filters, and sludge from maintenance activities and water processing. General trash would be produced in small quantities due to the small work force. Solid waste from a new natural gas-fired plant would be expected to be minor.

3.14.3. Conclusion

Solid wastes are produced at all power generating facilities and would be a minor impact during construction and operation for all alternatives described. No direct impacts would be expected at the proposed operating sites from removal of waste from the sites. Indirect impacts or cumulative effects would also be expected to be minor when waste is disposed of in approved and licensed landfills. These licensed facilities would provide substantive barriers to separate the waste from at-risk groundwater, and would be capped to minimize the cumulative effect of migration or transportation of waste to the surrounding areas over long periods of time. Impacts from solid wastes would be minor.

3.15. Seismology

3.15.1. Affected Environment

The known seismic history of the southeastern United States suggests that the earthquake hazard is relatively minor at the SQN site. There are no active faults in the vicinity of the site, and there is no physical evidence of any seismic activity at the site.

The site lies in the Southern Appalachian Tectonic Province. This province is bounded on the east by the western edge of the Piedmont Province, on the west by the western limits of the Cumberland Plateau, on the south by the overlap of the Gulf Coastal Plain Province, and on the north by the reentrant in the Valley and Ridge Province near Roanoke, Virginia. (TVA 2008a)

The maximum historic quake reported in the Southern Appalachian Tectonic Province occurred in Giles County, Virginia, in 1897, and was assigned an intensity of modified

Mercalli (MM) VIII. Although this earthquake occurred 285 miles northeast of the site, this intensity is assumed to have occurred at the site for the purpose of defining the safe shutdown earthquake (SSE). (TVA 2008a)

The SQN plant is designed so that all structures, systems, and components important to safety will remain functional when subjected to an SSE with maximum horizontal acceleration of 0.18 g and maximum vertical ground acceleration of 0.12 g. The half-SSE for SQN was therefore 0.09 g (i.e., half of the 0.18 g maximum horizontal ground acceleration) and 0.06 g vertical acceleration (1/2 of the 0.12 g vertical acceleration). (TVA 2008a)

In the course of its review for the original operating license, NRC requested additional information concerning the SQN seismic design basis. This culminated in the development of a site-specific response spectrum. This spectrum represents the 84th percentile of 13 actual earthquake recordings and has a peak acceleration of 0.22 g. This site-specific spectrum was used for evaluation of present designs and not as a design basis. (TVA 2008a)

As a result of the development of the site-specific response spectrum, an SSE of 0.22 g has been considered. 10 CFR Part 100, Appendix A, 1973, regulations no longer require a half SSE; however, applicants are required to select an operating-basis earthquake (OBE) equal to at least half the SSE unless supporting data are presented to clearly justify otherwise. TVA presented such data and justified an OBE of 0.09 g, less than half the present site-specific SSE of 0.22 g and the same as the half-SSE used in earlier seismic analyses. (TVA 2008a)

Section 2.5 of the SQN UFSAR describes the geology and seismicity in the vicinity of SQN and contains a summary of significant regional earthquakes through 1980 (TVA 2008a). The seismic history of the region around SQN from November 1776 through July 1980 is contained in Table 2.5.2-1 of the SQN UFSAR (TVA 2008a). Additional information on surrounding areas can be found in Subsection 2.5.2.3 Seismic History (TVA 2008a). From 1980 to 2010, there have been 246 recorded earthquakes with an average magnitude of 2.9 within a 200-mile radius of SQN (ANSS 2010). Table 3-24 lists the recent seismic history from January 2005 through March 2010 for earthquakes with magnitudes of 2.5 or greater within 200 miles of SQN. The data are based on the earthquake catalog maintained by the Advanced National Seismic System (ANSS 2010).

Table 3-24. Earthquakes Within 200 Miles of SQN (January 2005 – November 2009)*

Date	Time	Latitude (Degrees North)	Longitude (Degrees West)	Depth (km)	Magnitude	Magnitude Type
03/18/2005	01:02:16.3	35.723	-84.164	9.1	2.7	Md
04/05/2005	20:37:42.6	36.147	-83.693	10.0	2.9	Md
04/14/2005	15:38:15.7	35.468	-84.091	15.5	2.8	Md
06/07/2005	16:33:36.7	33.531	-87.304	5.0	2.8	ML
08/25/2005	03:09:41.8	35.880	-82.795	7.9	3.7	Md
08/25/2005	12:56:31.5	35.876	-82.810	8.10	2.5	Md

Date	Time	Latitude (Degrees North)	Longitude (Degrees West)	Depth (km)	Magnitude	Magnitude Type
10/12/2005	06:27:30.1	35.509	-84.544	8.1	3.3	Md
10/25/2005	05:18:10.5	34.429	-85.315	9.1	2.6	Md
04/11/2006	03:29:20.8	35.362	-84.480	19.6	3.3	Md
05/10/2006	12:17:29.2	35.533	-84.396	24.7	3.2	Md
06/16/2006	00:57:26.8	35.512	-83.203	1.37	3.4	Md
07/11/2006	13:45:40.7	33.606	-87.146	1.0	2.8	ML
08/07/2006	08:44:27.7	34.937	-85.461	14.2	2.9	Md
09/05/2006	04:32:42.6	33.705	-82.992	10.2	2.5	Md
10/02/2006	19:56:19.2	35.468	-84.984	8.7	2.5	Md
12/18/2006	08:34:26.5	35.356	-84.351	17.7	3.3	Md
01/03/2007	23:05:45.0	35.916	-83.955	15.3	2.7	Md
01/30/2007	21:20:29:4	33.664	-87.107	1.00	2.6	ML
02/07/2007	00:34:53.6	34.607	-85.308	10.7	2.6	Md
03/23/2007	14:15:33.3	33.652	-87.067	5.0	2.6	ML
05/04/2007	16:16:28.2	33.797	-87.299	5.0	3.0	ML
06/19/2007	18:16:26.8	35.793	-85.362	1.2	3.5	Md
07/27/2007	17:16:39.8	33.834	-87.329	1.0	2.6	ML
10/23/2007	05:16:11.6	35.591	-84.104	21.3	2.8	Md
11/17/2007	19:22:55.7	37.393	-83.087	1.0	2.5	ML
01/23/2008	22:22:13.8	33.739	-87.180	1.0	2.8	ML
02/23/2008	17:03:18.5	33.864	-87.165	1.0	2.6	ML
05/07/2008	16:44:35.1	33.691	-87.211	1.0	2.7	ML
06/23/2008	23:30:20.0	34.925	-84.841	8.8	3.1	Md
06/28/2008	01:40:36.5	33.276	-87.396	5.0	3.1	ML
10/25/2008	23:47:17.3	36.052	-83.604	15.8	2.5	Md
10/31/2008	16:37:34.0	35.768	-84.000	7.6	2.9	Md
11/10/2008	02:29:00.8	35.766	-84.591	25.1	2.5	Md
12/18/2008	00:05:07.1	36.050	-83.592	9.5	3.3	Md
01/27/2009	11:20:12.7	36.773	-84.131	26.1	3.2	Md

Date	Time	Latitude (Degrees North)	Longitude (Degrees West)	Depth (km)	Magnitude	Magnitude Type
01/30/2009	20:32:38.2	33.663	-87.351	1.0	2.9	ML
03/14/2009	22:16:18.6	35.444	-84.127	21.3	2.6	Md
03/16/2009	23:16:29.9	33.689	-87.284	1.0	2.9	ML
03/17/2009	23:27:55.2	33.745	-86.211	7.5	2.5	Md
04/04/2009	20:45:33.7	33.215	-83.202	0.0	3.1	Md
05/23/2009	01:03:31.3	35.592	-84.156	7.8	2.7	Md
08/01/2009	13:38:26.1	35.064	-84.292	5.4	3.2	Md
08/31/2009	14:07:10.2	35.778	-84.124	14.3	3.3	Md
10/02/2009	15:28:47.1	36.048	-83.567	14.5	2.5	Md
10/27/2009	19:13:21.0	33.796	-87.290	1.0	2.9	ML
11/01/2009	17:01:26.3	35.137	-84.854	24.5	3.0	Md
11/06/2009	18:30:10.4	33.748	-87.158	1.0	2.5	ML
ML – Local magnitude						
Md – Duration magnitude						
* - taken from Advanced National Seismic System Earthquake Catalog (ANSS 2010)						

The most significant earthquake near SQN since 1973 was the Fort Payne earthquake that occurred on April 29, 2003, in northeastern Alabama, near the Georgia border (USGS 2009). This earthquake had a measured Lg wave magnitude (mbLg) of 4.9 and a moment magnitude (M) of 4.6 (John Fouke, USGS, personal communication, April 19, 2011). The Fort Payne earthquake caused minor damage, including damage to chimneys, cracked walls and foundations, broken windows, and collapse of a 29-ft wide sinkhole near the epicenter (GSA 2009). Based on reconnaissance in the epicentral area, no landslides were reported, and damage to chimneys was observed only for chimneys with masonry in poor/weakened condition. Other masonry, including chimneys in good condition and several old masonry buildings, did not appear to be damaged. The earthquake occurred at a depth of about 8 to 15 km (5.0 to 9.3 mi). (EC 2009; USGS 2009) There was no noticeable effect on SQN from this earthquake.

Utilizing the USGS's Community Internet Intensity Map, the observed MM intensity at SQN would have been IV to V (USGS 2009). The Fort Payne earthquake magnitude is still lower than that of the maximum historical earthquake in the southern Appalachians, which was the 1897 Giles County, Virginia, earthquake. The 1897 earthquake had a maximum MM of VIII and an estimated body-wave magnitude of 5.8. Therefore, the 2003 Fort Payne earthquake is well within the known historical maximum magnitude earthquake in the southern Appalachian region and is consistent with the earthquake history of the region described in the SQN UFSAR (TVA 2008a).

3.15.2. Environmental Consequences

Given the historic record of seismic activity in the SQN region described above, TVA believes the basis for the SSE described in Section 2.5 of the SQN UFSAR (TVA 2008a) is still valid. The largest historical earthquake in the Southern Appalachian Tectonic Province remains the 1897 Giles County, Virginia, earthquake.

Alternative 1 – License Renewal

For this alternative, there would be no major construction activity. SQN is in compliance with current NRC regulations related to seismic evaluation requirements; therefore, no change regarding any potential impact from the current level of minor impact would be anticipated. The future expansion of the spent fuel storage capacity may result in additional seismic evaluation if required by the NRC.

Alternative 2 – No Action Alternative

The No Action Alternative is the result of the decision not to extend operation of the SQN units past the current expiration dates of the operating licenses. No impacts from potential minor seismic event(s) are expected during shutdown activities. However, shutdown of SQN could lead TVA to replace the resulting loss of the approximately 2,400 MWe base load generation. Given the need for adequate replacement power generation, TVA has evaluated in detail two alternative means of doing so.

Alternative 2a – New Nuclear Operation

A new nuclear plant would be required to meet or exceed the current federal regulations for seismic performance (10 CFR Part 50, Appendix S and Regulatory Guide 1.208). Therefore, the impacts related to seismic activity would be minor.

Alternative 2b – New Natural Gas-Fired Generation

The site chosen for a new natural gas-fired plant would have been evaluated for potential seismic impacts during the site-selection process; however, those impacts would likely be less than those considered for new nuclear construction and operation.

3.15.3. Conclusion

Impacts from a seismic event would be expected to be very minimal during the construction and operational life of the plant for each alternative. Indirect impacts or cumulative effects would also be expected to be minor.

3.16. Climatology, Meteorology, and Air Quality

The TVA 1974 FES for SQN contains a discussion of the climatology, meteorology, and air quality for the SQN site. This section contains information from the FES, the SQN UFSAR, on-site data from 1971, and more recent climatological records from the National Weather Service and the National Climatic Data Center (NCDC), as appropriate.

3.16.1. Affected Environment – Climatology and Meteorology

This section discusses the affected environment consisting of the regional climate and local meteorology. The regional climate section includes the general discussion of the regional climate along with GCC, GHG emissions, and a special focus on the regional climate change in the southeast and the Tennessee River Valley (Valley). Severe weather conditions and the effects on the local environment, as well as the local meteorological characteristics in the SQN area, are also discussed.

3.16.1.1. Regional Climatology

The regional climate and meteorology of the SQN site was first characterized in the TVA 1974 FES for SQN (TVA 1974a). More extensive regional climate information and detailed data summaries, especially for on-site meteorological data, can be found in the SQN UFSAR (TVA 2008a). This section describes the current regional climate, as well as changes that may be expected to the regional climate of the southeast and the Valley. A discussion of the current understanding of GCC, GHG emissions relevant to SQN, and potential alternatives for replacement power generation is also included in this section.

Regional Climate

The Sequoyah site is in the eastern Tennessee portion of the southern Appalachian region which is dominated much of the year by the Azores-Bermuda anticyclonic circulation shown in the annual normal sea level pressure distribution. This circulation over the southeastern United States is most pronounced in the fall and is accompanied by extended periods of fair weather and widespread atmospheric stagnation. In winter, the normal circulation pattern becomes more varied as the eastward-moving migratory high and low pressure systems, associated with the midlatitude westerly current, bring alternating cold and warm air masses into the area with resultant changes in wind direction, wind speed, atmospheric stability, precipitation, and other meteorological elements. In summer, the migratory systems are less frequent and less intense, and the area is under the dominance of the western edge of the Azores-Bermuda anticyclone with a warm moist air influx from the Atlantic Ocean and the Gulf of Mexico. (TVA 2008a)

The terrain features of the region have some effect on the general climate. With the mountain ridge and valley terrain aligned northeast-southwest over eastern Tennessee, there is a definite bimodal upvalley-downvalley wind flow in the lower 500 to 1,000 feet during much of the year. A detectable lake breeze circulation resulting from discontinuities in differential surface heating between land and water is not expected because of the relatively narrow width of the Tennessee River as it flows southwestward through the valley area. (TVA 2008a)

Regional Climate Change in the Southeast and the Valley

Compared to the rest of the United States, the climate of the southeast is warm and wet, with high humidity and mild winters. Average annual temperature across the southeastern United States did not change significantly over the last century; however, since 1970, annual average temperature has risen about 2^{o}F. The greatest seasonal increase in temperature has been during the winter months. Since the 1970s, the number of freezing days in the southeast has declined by four to seven days per year for most of the region. Average autumn precipitation has increased by 30 percent for the region since 1901. There has been an increase in heavy downpours in many parts of the region, while at the same time, the percentage of the region experiencing moderate-to-severe drought increased over the past three decades. (TVA 2010b)

In order to understand future climate scenarios in the TVA region better, TVA contracted with the EPRI to prepare a report on the impacts of GCC on various resources throughout the Valley, including water and air, that could be reasonably anticipated to occur over the 21st century. Emphasis was placed on the near future (through 2050), as high uncertainty exists for longer-range predictions. The basis for this report is the United Nations Intergovernmental Panel on Climate Change's (IPCC's) Fourth Assessment Report, published in 2007, that assumes a medium GHG emissions projection, which does not reflect additional efforts to reduce GHG emissions. In addition to this report, TVA received and reviewed comments on the 2009 EPRI report. The 2009 EPRI report forecasts temperatures to increase as much as +0.8°C between 1990 and 2020, and +4°C by the end of the 21st century in the TVA region. Researchers presented two arguments regarding these estimates. First, based on historical climate records, a change of +0.8°C in 30 years is within the natural climate variations of the region. Second, the +4°C estimate is an "up to" result that is the least likely to occur. Furthermore, evidence suggests that climate models are often too sensitive to CO_2 and overestimate temperature rise.

Precipitation forecasts are more uncertain and vary depending on location in the Valley and time of year. According to the EPRI report, precipitation is forecast to increase in the winter across the Valley as a whole, while in the western portion of the Valley, summers may be drier, and in the eastern portion of the Valley, summers may remain unchanged. Changes in water resource practices may become necessary to adapt to changes in the temporal distribution of precipitation across the region. It is important to emphasize that the current scientific knowledge of climate change is improving, but still contains a great amount of uncertainty. (TVA 2010b)

3.16.1.2. Global Climate Change and Greenhouse Gas Emissions

GCC and its relationship to GHG is an item of intense study and is important to TVA. The topic of GHG and GCC was not discussed in the original 1974 FES for SQN. In common usage, global warming often refers to the warming of the earth that may occur as a result of emissions of GHG in the atmosphere. Global warming can occur from a variety of both natural and anthropogenic causes. Climate change refers to any significant change in measures of climate (such as temperature, precipitation, or wind) lasting for an extended period (decades or longer). The two terms are often used interchangeably, but climate change is broader as it conveys that there are other changes in addition to rising atmospheric temperature. (TVA 2010b)

It is believed that certain substances present in the atmosphere act like the glass in a greenhouse to retain a portion of the heat that is radiated from the surface of the earth. The common term for this phenomenon is the "greenhouse effect," and it is essential for sustaining life on earth. Water vapor and, to a lesser extent, water droplets in the atmosphere are responsible for 90 to 95 percent of the greenhouse effect. The most abundant long-lived GHG are CO_2, methane, and nitrous oxide (N_2O). Both man-made and natural processes produce GHG. According to some sources, increases in the earth's average surface temperatures are linked in part to increasing concentrations of GHG, particularly CO_2, in the atmosphere. This has been a cause for concern among scientists and policymakers. On the international level, this phenomenon has been studied since 1992 by the United Nations Framework Convention on Climate Change, IPCC. (TVA 2010b)

The global carbon cycle is made up of large carbon sources and sinks. Billions of tons of carbon in the form of CO_2 are absorbed by oceans and living biomass (i.e., sinks) and are emitted to the atmosphere annually through natural and man-made processes (i.e., sources). When in equilibrium, carbon fluxes among these various reservoirs are roughly balanced. According to the IPCC (2007), since the Industrial Revolution (i.e., about 1750), global atmospheric concentrations of CO_2 have risen about 36 percent, principally due to the combustion of fossil fuels. (TVA 2010b)

The primary GHG emitted by electric utilities is CO_2 produced by the combustion of coal and other fossil fuels. Worldwide man-made annual CO_2 emissions from utilities are estimated at 29 billion tons, with the United States responsible for 20 percent. U.S. electric utilities, in turn, emit 2.5 billion tons, roughly 39 percent of the U.S. total. TVA's power generation plants are responsible for approximately 114 million tons of annual CO_2 emissions from energy production. (TVA 2010b)

On April 17, 2009, the EPA declared CO_2, methane, N_2O, hydrofluorocarbons, perifluorocarbons, and sulfur hexafluoride to be "pollutants." In July 2011, the EPA expects to propose standards under the Clean Air Act (CAA) for regulating GHG emissions from power generating plants. The volume of GHG emissions results from the efficiency of the technologies utilized to produce and deliver the energy and from the carbon content of the fuel being used.

Table 3-25 demonstrates the differences of CO_2 emissions for various fuels that are used for electricity generation. Considering just the electrical generation process, nuclear and renewable sources (excludes bio-fuels) do not directly produce any measurable CO_2 during generation.

Table 3-25. CO_2 Direct Emissions From Electricity Generation for Various Sources

Fuel	Pounds CO_2 per Million BTU
Sub-bituminous coal	212.7
Bituminous coal	205.3
#6 fuel oil	173.9
Natural gas	117.1
Nuclear	0
Renewable sources	0

(DOE 2007)

3.16.1.3. Local Meteorology

This section discusses the meteorology found in the area of the SQN site including meteorological characteristics of wind direction, wind speed, precipitation, atmospheric stability, and dispersion. Meteorological data have been collected at the site since April 1971 and selected data have been used for the description of the local weather and for the calculation of the dispersion factors. (TVA 2008a) Dispersion factors are important for determining the effects from routine and accident releases of radioactive effluents from SQN. This section provides a discussion of those effects.

Most of the data used in this meteorological description were collected at the on-site meteorological facility (environmental data station) in the four-year period from January 1, 1972 through December 31, 1975. Additional data from the on-site system for the years

2000 – 2009 were included as a comparison, ensuring that the described local meteorological conditions were still valid. Location of this facility with respect to SQN is shown in Figure 1-4. (TVA 2008a)

Wind Direction

Wind rose data and wind frequency data are provided in Appendix F. Data from the 33-foot high wind instruments at the permanent meteorological facility for the January 1972 through December 1975 period represent reasonably well the expected wind conditions in the plant site area. The annual and monthly patterns show the predominant directions from the northeast and southwest quadrants that reflect the orographic channeling effects of the northeast-southwest aligned valley-ridge terrain. (TVA 2008a) Wind rose data for the years 2000 – 2009 from the SQN on-site meteorological data clearly show the same annual and monthly patterns for predominant wind directions as the earlier data sited above (see Appendix F). Wind direction frequency data for the years 1972 – 2009 also confirm the presence of the channeling effects of the valley-ridge terrain (see Appendix F).

For most months, but especially the cooler months of the year, there is a weak secondary maximum of wind frequency from the northwest quadrant. This is most likely associated with post-cold-frontal winds that are most common during the optimum seasons (winter and early spring) for frequent migratory low pressure systems. (TVA 2008a)

The greatest persistence is from the north-northeast, and includes the maximum of 33 hours. Persistence of 24 hours or more occurs with winds from the southwest, north, and northeast. The analysis shows that the occurrence of persistence periods lasting three hours or more is about 59 percent. For persistence of 12 hours or more, the occurrence is about 4 percent. (TVA 2008a) As a confirmation of the earlier data, the persistence data for the years 2000 – 2009 were analyzed and the persistence lasting 3 hours or more had an occurrence of 60.61 percent of the time, and the persistence lasting 12 hours or more had an occurrence of 4.34 percent. Recent on-site data are consistent with earlier data used in the SQN UFSAR. Persistence data are provided in Appendix F.

Wind Speed

The preponderance of winds from the northeast within the 0.6 to 3.4 mph wind speed range is most likely attributable to the anticyclonic circulation that dominates the eastern Tennessee region in the late summer and fall. Also, the identification of wind speeds less than 3.5 mph with stable anticyclonic flow is reflected in the high frequency of occurrence of this range in late summer and early fall, a period during which stable anticyclonic conditions are most common. These low wind speeds occur least often in winter and early spring, a period frequented by the passage of migratory low pressure systems. (TVA 2008a)

Wind speeds 7.5 mph and greater occur most frequently with upvalley winds from the southwest. These wind speeds occur very infrequently with winds from the east-northeast, east, east-southeast, and southeast. The predominance of strong winds from the southwest may be attributable to the channeling of the southerly and southwesterly flow preceding the passage of cold fronts through the area. Winds greater than 7.5 mph are more frequent from November through April, with a maximum of about 32 percent in April; they occur least often in July and August. (TVA 2008a)

Precipitation

Precipitation patterns, based on a 20-year period (1948-1967) of data collection at the TVA rain gauge station #685, 2.5 miles north-northeast of the plant site, show that there are an average of 117 days annually with 0.01 inches or more of precipitation. The average monthly precipitation is 4.81 inches, with the maximum monthly average, 6.76 inches, occurring in March and the minimum monthly average, 2.86 inches, occurring in October. The extreme monthly maximum and minimum is 16.58 inches in November and 0.09 inches in October, respectively. This station was discontinued after 1972, but examination of records for 1968 – 1972 show no changes in extremes. (TVA 2008a)

Precipitation data are provided in Appendix F. On-site precipitation data for the years 1998 – 2009 were analyzed and indicated the annual average rainfall at SQN was 44.90 inches. Rainfall is consistent throughout the year; January and December averaged 4.53 inches each and are the months with the highest average monthly precipitation. October is the month that averages the least precipitation with 2.33 inches. (See Appendix F.)

Snowfall does not occur often in the Sequoyah site area. The average annual snowfall is 4.4 inches and occurs mostly in December through March. The maximum 24-hour snowfall reported at Chattanooga was 20.0 inches in March 1993; the next highest was 10.2 inches in January 1988. (NWS 2010; TVA 2008a)

Severe Weather

Wind storms may occur several times a year, particularly during winter, spring, and summer, with winds exceeding 35 mph and on occasion exceeding 60 mph. The records show the highest wind speed recorded in Chattanooga, Tennessee, prior to 1950 was 82 mph in March 1947. (TVA 2008a) Between 1950 and 2009, the highest wind recorded in Chattanooga, Tennessee, was 63 mph recorded on June 11, 2009. Records of high winds (>57.54 mph) and thunderstorms for Hamilton County, Tennessee, for the years 1950 – 2009 indicated 145 high wind and thunderstorm events taking place during those years (NCDC 2010a). High wind may accompany moderate-to-strong cold frontal passages about 20 to 30 times a year, with the maximum frequency in March and April. (TVA 2008a)

High wind may accompany thunderstorms that occur about 56 days a year with a maximum frequency in July. The distribution of average monthly thunderstorm occurrences recorded during 1931 – 1979 at the Chattanooga National Weather Service Office is as follows.

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1	2	4	5	7	10	11	9	4	1	1	1	56

Severe storm data for 1955 – 1967 show 10 occurrences of hail 0.75 inches or greater in diameter, 20 occurrences of wind storms with speeds of 57.54 mph or greater, and 15 occurrences of tornadoes in the 1-degree latitude-longitude square containing the site. If these severe storm occurrences are assumed to be exclusive of one another, it can be assumed that about 45 severe thunderstorms occurred in the 1-degree square in this 13-year period. The annual occurrence for the square would be about 3.5. A smaller annual occurrence would be expected for the immediate site area, which is much smaller than the 1-degree square for which these statistics apply. (TVA 2008a)

The probability of a tornado occurrence at the site is estimated to be about once in 6,000 years. Despite this low probability, the design of plant Category I structures, those structures that are safety-related and built to withstand natural phenomenon, included consideration of the effects of tornadic winds. (TVA 2008a) Statistics show that during the 49-year period, 1916 – 1964, no tornadoes were reported in Hamilton County, where the Sequoyah site is located. During 1955 – 1967, a total of 15 tornadoes were recorded for the 1-degree latitude-longitude square containing the site, for an annual occurrence of 1.15. Using the principles of geometric probability described by H.C.S. Thom, his frequency data for that 1-degree square, and a tornado path size of 0.284 mi^2, the probability of a tornado striking any point in the plant site area is 4.4×10^{-5}. (TVA 2008a) During the years 1950 – 2009, the number of tornadoes recorded in Hamilton County, Tennessee, was just seven, consisting of two F0s, three F1s, one F2, and one F3 (F = Fujita tornado scale ranges from 1 to 5) magnitude tornadoes (NCDC 2010b).

Hamilton County, Tennessee, was significantly impacted by the April 27, 2011, tornado outbreak in the southeastern United States. Based on preliminary information, several tornadoes, including at least one EF-4 level storm struck the county. However, only three tornadoes (one F/EF-1 and two F/EF-0) appeared to have tracks within 10 miles of SQN (Kenneth Wastrack, TVA, personal communication, May 27, 2011).

The National Severe Storms Forecast Center in Kansas City, Missouri, calculated the tornado return probability for the Sequoyah site based on tornado occurrences within a 30-nautical mile (nm) radius during 1950 – 1986. A circle with a 30-nm radius has an area comparable to a 1-degree latitude-longitude square. Based on the 29 tornado occurrences with path size estimates in the 37-year period, the return probability is 1.635×10^{-4} and the mean return interval is 6,115 years. The annual tornado occurrence in the 30-nm radius circle was 0.84, based on 31 tornadoes reported during that period. During the subsequent period spanning 1987 through October 2002, 23 tornadoes were reported in the same circle. Thus, for the period spanning 1950 through October 2002, 54 tornadoes occurred for an annual occurrence of 1.02. Given the typically small path size of these tornadoes, the return probability and return interval given above would still be representative. (TVA 2008a)

The highest monthly average rainfall near the site area occurs during the winter and early spring months, with March usually having the greatest amount. The maximum 24-hour rainfall reported near the plant site was 7.56 inches in August. High precipitation is also observed in July when air mass thunderstorm activity is common. Minimum precipitation occurs normally in October. (TVA 2008a)

Lightning strike density in the vicinity of the plant is computed at an average of about eight ground strikes per square kilometer per year. These are defined as cloud-to-ground strikes of lightning. (TVA 2008a)

Using NCDC data for Chattanooga, Tennessee, the all-time highest temperature was 106ºF recorded on July 28, 1952, while the all-time lowest temperature was recorded as -10ºF on January 21, 1985. The highest rainfall in a 24-hour period was recorded in Chattanooga, Tennessee, measuring 7.61 inches in March 29-30, 1886. The most rain in one year measured 73.70 inches in 1994, while the average precipitation for Chattanooga is 54.5 inches for the period 1971 – 2000. (NWS 2010)

Meteorological data provided in Appendix F indicate that there has been a slight drop in the maximum temperatures as recorded at SQN. The average temperature has increased slightly, and the minimum temperature has increased noticeably.

Atmospheric Stability

Ten years (January 1, 2000 – December 31, 2009) of on-site temperature difference data from the 30-foot and 150-foot tower levels of the permanent meteorological facility are categorized into seven atmospheric stability groups (Pasquill stability classes A through G). Table 3-26 shows that the Pasquill stability classes E, F, and G occur about 49 percent of the time. The most stable class, G, occurs about 3.5 percent of the time. The total occurrence of the least stable classes, A, B, and C, was about 16.9 percent, while the neutral stability class, D, occurred about 34.1 percent of the time. (See Appendix F.)

Table 3-26. Atmospheric Stability Data Collected at SQN (Percent Occurrence)

Pasquill Stability Class	Vertical Temperature Difference	Percent Occurrence
A (very unstable)	ΔT < -1.9ºC/100m	6.62
B	-1.9ºC < ΔT to -1.7ºC/100m	4.56
C	-1.7ºC < ΔT to -1.5ºC/100m	5.72
D (neutral)	-1.5ºC < ΔT to -0.5ºC/100m	34.10
E	-0.5ºC < ΔT to 1.5ºC/100m	32.11
F	1.5ºC < ΔT to 4.0ºC/100m	13.37
G (very stable)	ΔT > 4.0ºC/100m	3.52
Total of all Classes		100.00

(See Appendix F.)

Dispersion

The transport and dispersion of radioactive materials in the form of aerosols, vapors, or gasses released into the atmosphere from a nuclear power station are a function of the state of the atmosphere along the plume path, the topography of the region, and the characteristics of the effluents themselves. The downwind concentrations of released materials are estimated by atmospheric dispersion models and analysis. Atmospheric dispersion analysis considers two categories of radiological releases: routine and accident. In all cases, the atmospheric dispersion characteristics of the SQN site result in off-site doses within the regulatory limits established by the NRC (10 CFR Part 100) for short-term accident diffusion estimates for effluent releases and regulatory limits established by the NRC (10 CFR Part 20) for normal long-term diffusion estimates for routine effluent releases. Low or small atmospheric dispersion (X/Q) values are indicative of better transport and better dilution of released airborne effluents. Section 3.17 further discusses the relationship of dispersion and estimated radiological dose to the public.

Routine Releases

During normal operation of SQN, all radioactive effluents released to the environment are controlled, sampled, and maintained as low as reasonably achievable (ALARA) in accordance with the *Sequoyah Nuclear Plant Offsite Dose Calculation Manual* (ODCM). This document provides the methodologies, calculations, dose factors, monitor setpoints, limits, and controls for liquid and gaseous effluent releases. This document is reviewed and updated as needed to provide the best possible program to protect the public and monitor and control radioactive effluents. SQN uses annual average data for atmospheric dispersion factors for gaseous effluents based on 40 quarters of recent meteorological data and maximum sector and receptor distances for those sectors. Table 7.1 of the latest ODCM provides the current annual average X/Q factor based on quarterly meteorological data from the on-site meteorological system. The current X/Q factor is based on meteorological data from the years 1986 – 1995 and is determined to be 6.94 E-6 seconds per cubic meter (sec/m^3). (SQN 2009)

Based on the original analysis from the SQN UFSAR, the average annual atmospheric dispersion factors are calculated for locations along 16 radial lines corresponding to the major compass points drawn from the center of the nuclear plant complex. Calculations in each of the 16 sectors are made for the site boundary and for the distances 1, 2, 3, 4, 5, 10, 15, 20, 30, 40, and 50 miles. (TVA 2008a)

SQN calculates atmospheric dispersion factors at the EAB and at the outer boundary of the low population zone (LPZ) boundary (Figure 3-14). In calculating the average annual atmospheric dispersion factors, it is assumed that gaseous effluents are released from a single point. (TVA 2008a)

The favorable atmospheric dispersion characteristics at SQN result in annual gaseous effluent doses within the regulatory limits established by the NRC (Appendix I of 10 CFR Part 50) for any individual (member of the public) in unrestricted areas. Because of favorable atmospheric dispersion at the SQN site, the radioactive doses due to routine gaseous effluents, when added to the radioactive doses due to radioactive liquid effluent releases, meet the regulatory requirements established by the NRC (10 CFR §20.1301) and are minor.

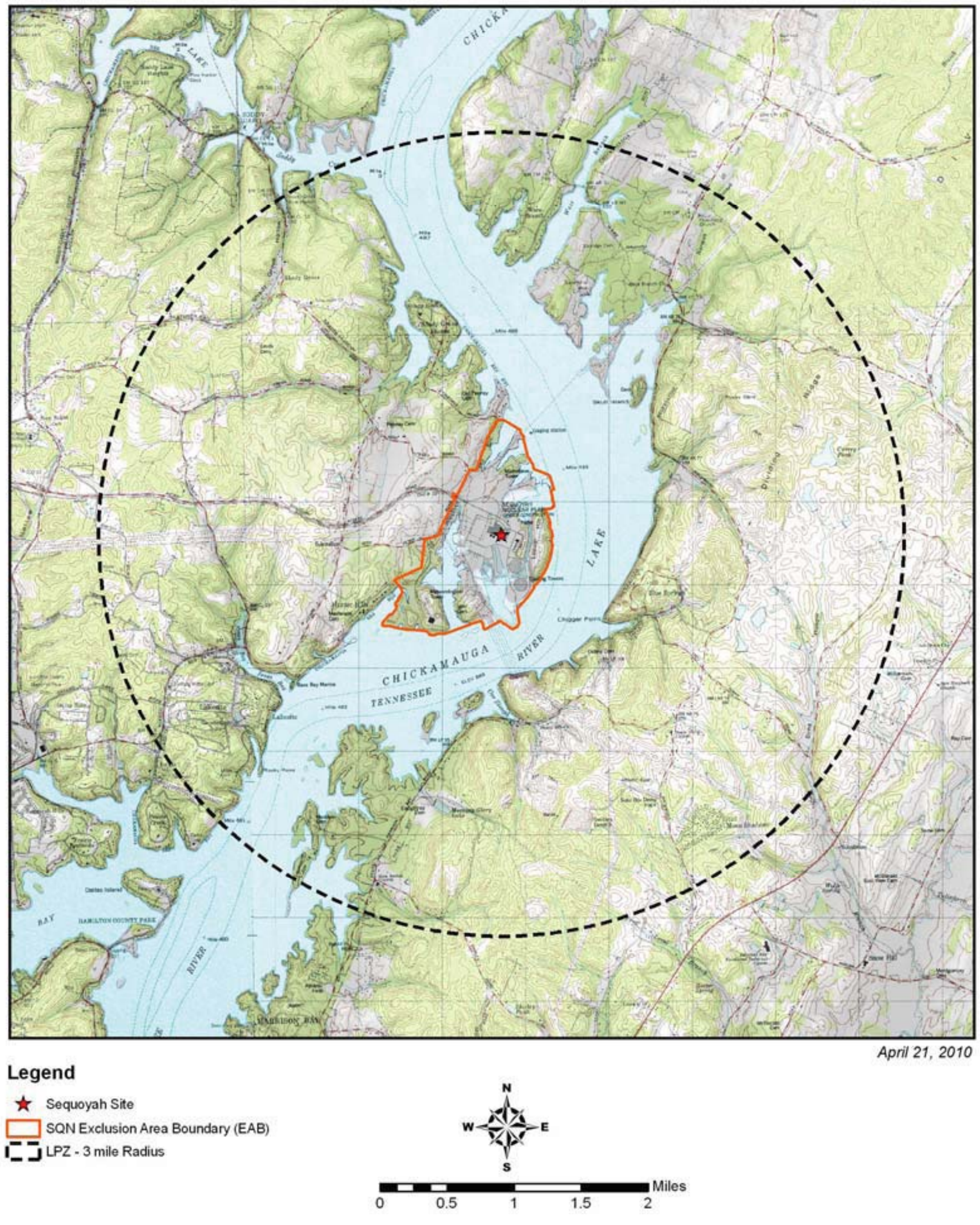

Figure 3-14. SQN Exclusion Area Boundary and Low Population Zone

Accident Releases

The accident X/Q values are determined for time periods of one hour, eight hours, 16 hours, three days, and 26 days after a hypothetical release of radioactive gaseous effluents. The releases are considered ground-level releases because the highest release location, the plant vent, is less than 2.5 times the height of adjacent buildings.

For accident releases, calculations use a release boundary to encompass all release locations and results in higher accident X/Q values at the EAB. Table 3-27 provides the one-hour atmospheric dilution factors at the EAB as an example.

Table 3-27. One-Hour Atmospheric Dilution Factors At EAB (sec/m3)

Release Zone	Distance	5th Percentile	50th Percentile	Average
1	556 meters	0.147 E-2	0.234 E-3	0.369 E-3
2	600 meters	0.130 E-2	0.215 E-3	0.365 E-3
3	509 meters	0.162 E-2	0.258 E-3	0.435 E-3

(TVA 2008a)

For accidental releases to the LPZ, a set distance of 4,828 meters from the SQN site center is used. In accordance with Regulatory Guide 1.145, the 50th percentile probability X/Q values are determined to provide more realistic radioactive doses (Table 3-28). (TVA 2008a)

Table 3-28. Atmospheric Dilution Factors At Outer Boundary of LPZ (sec/m^3)

Average Time	Distance	5th Percentile	50th Percentile	Average
1-hour	4828 meters	0.139 E-3	0.142 E-4	0.319 E-4
8-hour	4828 meters	0.539 E-4	0.980 E-5	0.169 E-4
16-hour	4828 meters	0.717 E-5	0.236 E-5	0.299 E-5
3-day	4828 meters	0.434 E-5	0.176 E-5	0.201 E-5
26-day	4828 meters	0.271 E-5	0.153 E-5	0.148 E-5

(TVA 2008a)

The favorable accident condition atmospheric dispersion characteristics presented in the above tables result in accident radioactive doses at the EAB and LPZ well within the regulatory limits established by the NRC (10 CFR Part 100); therefore, the hypothetical radioactive doses due to accidental releases are minor.

3.16.2. Environmental Consequences – Climatology and Meteorology

This section addresses impacts to climatology and meteorology from site construction and operation of the Action and No Action Alternatives.

The CEQ recently issued draft guidance (CEQ 2010) on how agencies should consider the effects of climate change and GHGs when they describe the environmental impacts of proposed actions in NEPA documents. With the purpose of informing decision-making, CEQ indicated that the NEPA process should incorporate consideration of both the impact of an agency action on the environment through the mechanism of GHG emissions and the impact of changing climate on the agency action.

The guidance includes tools for agency reporting, including that if a proposed action would be reasonably anticipated to cause direct emissions of 25,000 metric tons or more of CO_2-equivalent GHG emissions on an annual basis, agencies should consider this an indicator that a quantitative and qualitative assessment may be meaningful to decision-makers and the public. The reference point of 25,000 metric tons of direct CO_2-equivalent GHG is not a standard for indicating significant or insignificant effects.

For long-term actions with annual direct emissions of less than that amount, CEQ encourages agencies to consider whether the action's long-term emissions should still receive similar analysis. The draft guidance proposes that an agency analysis of GHG emissions should, when possible, include quantification of cumulative emissions over the lifetime of the project, a discussion of measures to reduce emissions, including consideration of reasonable alternatives; and a qualitative discussion of the potential link between such emissions and climate change. The guidance, however, notes that it is not currently useful for the NEPA analysis to attempt to link specific climatological change to particular project emissions, as such direct linkage is difficult to isolate and understand.

The guidance also instructs agencies on appropriate ways to assess the effects of climate change on proposed actions. It does not apply to land and resource management actions and does not propose to regulate GHGs.

Alternative 1 – License Renewal

This section addresses the consequences of implementing the Action and No Action alternatives on the climate, as well as the possible effects of climate change on the implementation of either alternative. Additionally, effects to meteorological conditions are addressed.

As noted above, there are primarily two ways in which SQN would potentially interact with GHG and GCC. The first is the emissions of GHG resulting from the continued operation of SQN; as noted above, these emissions would occur through the life cycle of the plant, including the uranium fuel cycle (UFC). The second is the manner in which GCC could affect operation of the SQN facility itself.

Life-Cycle Nuclear Greenhouse Gas Production and Mitigation Potential

Although nuclear generation does not emit GHGs in large quantities during the normal course of operations, there are GHG emissions involved with the construction of the plant; mining, processing and transportation of nuclear fuels; waste disposal; and decommissioning. Fossil fuels are typically used as part of the infrastructure needed to operate a nuclear power facility, primarily for the manufacture of the fuel used in the nuclear facility. The largest variables in life-cycle GHG emissions of a nuclear plant, aside from the operating lifetime, electrical output, and capacity factor, are the type of uranium enrichment process and the source of power for enrichment facilities. Current enrichment facilities use the energy-intensive gaseous diffusion process largely powered by fossil fuels. New enrichment facilities will use much less energy-intensive processes resulting in reduced nuclear plant life-cycle emissions. The use of nuclear fuel from dismantled nuclear weapons also reduces GHG emissions. While the life-cycle GHG emissions of TVA's nuclear plants have not been determined, estimates of life-cycle GHG emissions of U.S. nuclear plants range from 12 to 61 tons CO_2-equivalent/GWh and average 22.2 tons CO_2-equivalent/GWh (Meier 2002, Fthenakis and Kim 2007, Sovacool 2008).

On a life-cycle-based comparison, nuclear-generated electricity emits far less GHG per kilowatt hour (kWh) than fossil-fueled sources, and according to estimates of GHG emissions from various generation sources (Table 3-29) by the World Nuclear Association (WNA 2009), compares favorably to renewable energy sources. Considering all CO_2 direct and indirect sources in terms of the number of grams of CO_2 equivalent produced per kWh of electricity, nuclear electricity production of CO_2 is a low production source of GHGs when compared to coal, natural gas, hydroelectric, solar, and wind. In a meta-analysis of worldwide data, Sovacool (2008) reported higher emissions of GHGs for the nuclear energy fuel cycle (a mean of 66 gCO_2-equivalent per kWh (range 1.4 to 288 gCO_2 equivalent per kWh) than those reported in WNA 2009. However, a reasonable approximation for GHG emissions for an existing, relicensed U.S.-based reactor is better represented by a mid-point estimate of 39 (short) tons of CO_2-equivalent per GWh (about 35 gCO_2 equivalent per kWh) derived from the U.S.-based reactors in that comparison study. Inherent limitations of applying such broad-based data to license renewal of an existing U.S-based reactor include that it appears to accrue a substantive portion (~18 percent) of reported totals for nuclear from activities associated with new construction; includes cases for GHG contributions from milling and mining processes that assume 40-60 year-out times when the known reserves of uranium are assumed to require much greater mining of low quality ores with a many-fold increase in associated CO_2 emissions; and assumes no production or includes no cases of fuel derived from sources surplus to weapons programs.

Even considering life-cycle emissions, the resulting emissions of GHG (in CO_2 equivalents) would be substantially less (several million tons) overall for SQN operating under a 20-year license renewal than that of a comparable coal- or natural gas-fired plant supplying the equivalent base load power. As such, SQN license renewal would be an effective alternative to help TVA maintain the flexibility to offset those greater amounts of GHG emissions from its generation portfolio. The nuclear option overall leads to substantially lower emissions of GHG than other major sources of new replacement generation in the Tennessee Valley and adjoining service areas in the southeast and central United States. SQN is not expected to be a significant contributor to GHGs or GCC.

Actively reducing carbon emissions through cleaner energy options and energy efficiency initiatives is a central principle in TVA’s Environmental Policy. To accomplish the greatest benefit, TVA's efforts focus upon reducing GHG emissions from its portfolio of generating plants. As noted in the SEIS, increasing the proportion of energy generated by TVA nuclear plants is one of the primary strategies for offsetting GHG emissions, as well as providing the flexibility to increase energy production from other non- or low-emitting sources.

Additionally, in accordance with the requirements of EO 13514, *Federal Leadership in Environmental, Energy and Economic Performance*, TVA developed a Strategic Sustainability Performance Plan (TVA 2010r) that establishes aggressive goals for reductions of GHG, as well as overall pollution prevention. Among TVA’s climate change mitigation initiatives are purchasing energy efficient fleet vehicles, reducing the number of high-fuel-consumption fleet vehicles, and improving the efficiency of fleet vehicle use. TVA is implementing energy-saving improvements in many of its facilities, and new building designs incorporate modern energy efficiency technologies. Additionally, TVA is enhancing its sustainable acquisition program (currently, the Green Procurement Plan initiated in 2007) to ensure the purchase of environmentally preferable materials and services. Finally, in the Sustainability Plan, TVA establishes goals for minimizing and diverting debris from construction sites and decreasing use of chemicals that increase GHG emissions. As additional technological innovations are developed, TVA will consider their application in activities such as construction of new generation facilities.

Table 3-29. Comparison of CO_2 Life-Cycle (Direct and Indirect) Production for Various Sources

Electricity Source	Direct Emissions (grams/kWh)	Indirect Emissions (grams/kWh)
Coal	1,017 max – 790 min range	289 max – 176 min range
Natural Gas	575 max – 362 min range	113 max – 77 min range
Hydroelectric	NA	236 max – 4 min range
Solar Photovoltaic	NA	280 max – 100 min range
Wind	NA	48 max – 10 min range
Nuclear	NA	21 max – 9 min range

(WNA 2009)

Potential for Effects of Climate Change on SQN Operations

Higher air and water temperatures and altered frequency of precipitation that could result from GCC can influence processes for maintaining compliance with environmental and safety standards at nuclear (and fossil) plants, as well as the efficiency of plant operations. SQN would continue to withdraw cooling water from the Tennessee River to operate the plant condenser cooling water system. Regulatory requirements for environmental compliance prescribe the maximum temperature of water that could be released from SQN into the Tennessee River. Additional information concerning the SQN requirements for water temperature and the expected impact of the plant releases on the river are discussed in Section 3.16.1 and Section 3.1.

The impacts from the GCC and GHG emissions upon SQN would be expected to be minor. Because the duration of license renewal is only 20 years, the permanent changes expected would be very minor and for normal fluctuations in temperature of the water and air, SQN would be expected to continue to operate within all thermal limits.

Effects of SQN Operations on Meteorology

The presence and operation of SQN has been shown to have no noticeable effects on the local meteorology, with the exception of a slight increase in frequency, duration, and intensity of steam fogs forming at the river surface due to heated water released through the diffusers. These fogs develop as a result of elevation of the dew point by the addition of moisture to the air from the water surface. Once this shallow fog moves on shore, the moisture source is cut off, and the fog dissipates. Thus, the increased fogging would be confined within the boundaries of the Chickamauga Reservoir and would not affect long-term fog patterns in the surrounding area. This phenomenon is observed frequently over the extended river and reservoir system within the Tennessee Valley region. (TVA 2008a)

SQN's cooling towers are not in operation for the majority of the year (operation averaged 112.7 days of cooling tower operation per year for the years 2006 – 2009), but some minor effects may include increased atmospheric moisture, decreased solar radiation, and increased concentrations of aerosols related to the drift during the brief periods of operation. (TVA 2008a)

Alternative 2 – No Action Alternative

Under Alternative 2, termination of the SQN operating license and shutdown of the plant would have little or no impact on GHG emissions, as the plant emits relatively small quantities of GHG. Because uranium fuel would not be needed to continue SQN operations, the GHG associated with the UFC for SQN would not be emitted. However, the necessary adjustments to TVA's power generation system could result in GHG emissions, as described below.

Alternative 2a – New Nuclear Generation

A new nuclear facility utilizing closed-cycle cooling would typically use less than 5 percent of the volume of water that would be required for a once-through system. The new nuclear plant operation would be less susceptible to climate change influences because it is equipped with a closed-cycle cooling system. Air and water temperature increases would cause a decrease in plant efficiency and plant design, and would include potential changes that would appropriately handle the potential increases in temperatures. Plants can be derated to reduce power and thermal heat loads if needed. Impacts from GCC and GHG emissions would be expected to be minor for new nuclear generation.

Prior to construction of a new generating plant (nuclear or natural gas-fired), local meteorological conditions would be evaluated to model dispersion characteristics as well as the potential impact on the local air quality from the operation of the new facility. Neither a new nuclear nor a new natural gas-fired plant is expected to adversely affect local meteorological conditions.

Alternative 2b – New Natural Gas-Fired Generation

GCC impacts related to a new natural gas-fired generation plant would be similar to Alternative 2a and planned designs would address this issue prior to construction. A new natural gas-fired plant would contribute a substantial amount of GHG emissions for the life of the plant, but substantially less the GHG emissions from a comparably sized coal plant. The impacts are direct and indirect as well as potentially cumulative in the environment. The air emissions would meet all required regulations and would be expected to be minor to moderate.

3.16.3. Affected Environment – Air Quality

Air quality is an important environmental characteristic and this section discusses the federal and state air quality standards, limits, and requirements that are applicable to the continued operation of SQN or potential alternatives. Uniform national ambient air quality standards (NAAQS) established by the EPA under the authority of the CAA restrict ambient levels of criteria pollutants to protect the public health (primary standards) and the public welfare (secondary standards).

NAAQS establish concentration limits in the outside air for six pollutants: PM, SO_2, CO, ozone (O_3), nitrogen dioxide (NO_2), and lead. The primary NAAQS standards are to protect humans, including sensitive individuals such as children, people with asthma, and the elderly, from health risks. The secondary standards protect against impacts to the public welfare, such as unacceptable damage to crops and vegetation, buildings and property, and ecosystems. An area where any air quality standard is violated is designated as a nonattainment area for that pollutant, and emissions of that pollutant from new or expanding sources are carefully controlled. Air quality in the TVA region has steadily improved over the past 30 years.

The EPA promulgated new, more restrictive standards for O_3 and PM in July 1997. In 2008, EPA lowered the 8-hour O_3 standard to 0.075 parts per million (ppm). The original implementation schedule for this standard required that states send their recommended designations to the EPA in March 2009 with the EPA finalizing designations in March 2010. However, the EPA is now reconsidering the ground-level O_3 standards set in 2008. EPA is proposing to strengthen the 8-hour “primary” O_3 standard to a level within the range of 0.060-0.070 ppm and to establish a distinct cumulative, seasonal “secondary” standard within the range of 7-15 ppm-hours. EPA plans to issue final standards by July 2011. These standards and their applicability to continued operation of SQN and potential replacement alternatives are being considered as necessary and would be included in future TVA resource planning. Table 3-30 provides a summary of the NAAQS limits used to evaluate any new alternatives.

Hamilton County, where SQN is located, is a nonattainment area for annual $PM_{2.5}$ (very fine) based on 1997 NAAQS (EPA 2008) and is recommended as a nonattainment area for 8-hour O_3 based on 2008 NAAQS (TDEC 2009). SQN is a very small source of PM_{10} (fine) and $PM_{2.5}$. Only indirect sources of particulates are produced in support of SQN operation. Local air quality is affected by operation of SQN, but that impact is far below the impact that would be expected from replacement generation from fossil-fueled plants depending on the new site location. Personal vehicles of the plant workers, trucks, and equipment used to support routine operations, occasional operation of the emergency diesels, and refueling outage personnel and activities contribute low levels of GHG. It is reported that a 1,300-MW nuclear power plant would avoid annual emissions of about 8.5 million tons of CO_2 when compared to a similar-sized coal plant (NRC 1996); therefore, SQN avoids approximately 16 million tons of CO_2 annually (2,400 MW/1,300 MW X 8.5 million tons = 15.69 million tons) compared to a replacement coal-fired plant. Nuclear plant routine operations are virtually free of all air pollutants and are of trivial impact in the local area.

In addition, the prevention of significant deterioration (PSD) regulations restrict emissions and any significant reduction in ambient air quality. PSD regulations include protection of national parks and wilderness areas designated PSD Class I air quality areas. A new or expanding major air pollutant source must estimate the potential impact of its emissions on the air quality of any nearby Class I area, as specified by the state or local air regulatory agency, with input from the federal land manager(s) having jurisdiction over the given Class I area(s). The closest PSD Class I areas are the Sipsey Wilderness Area in Alabama, the Cohutta Wilderness Area in Georgia, the Great Smoky Mountains National Park, and the Joyce Kilmer-Slickrock Wilderness Area located within both Tennessee and North Carolina (EPA 2009). Extending the operational period of SQN is not a new or expanding major source of air pollutants; therefore, no evaluation of the potential impact to these Class I areas is required. See Figure 3-15 for a map of the nearest Class I areas. Any clean air area not designated as a PSD Class I area is a PSD Class II area with less stringent standards (increments), and extended operation of SQN would not create or modify any air emission source and would not affect any PSD Class II resource.

Table 3-30. National Ambient Air Quality Standards

	Primary Standards		Secondary Standards	
Pollutant	**Level**	**Averaging Time**	**Level**	**Averaging Time**
Carbon Monoxide (CO)	9 ppm (10 mg/m^3)	8-hour (1)	None	
	35 ppm (40 mg/m^3)	1-hour (1)		
Lead	0.15 $\mu g/m^3$ (2)	Rolling 3-Month Average	Same as Primary	
Nitrogen Dioxide (NO_2)	53 ppb (3)	Annual (Arithmetic Average)	Same as Primary	
	100 ppb	1-hour (4)	None	
Particulate Matter (PM_{10})	150 $\mu g/m^3$	24-hour (5)	Same as Primary	
Particulate Matter ($PM_{2.5}$)	15.0 $\mu g/m^3$	Annual (6) (Arithmetic Average)	Same as Primary	
	35 $\mu g/m^3$	24-hour (7)	Same as Primary	
Ozone (O_3)	0.075 ppm (2008 std)	8-hour (8)	Same as Primary	
	0.08 ppm (1997 std)	8-hour (9)	Same as Primary	
	0.12 ppm	1-hour (10)	Same as Primary	
Sulfur Dioxide (SO_2)	0.03 ppm	Annual (Arithmetic Average)	0.5 ppm	3-hour (1)
	0.14 ppm	24-hour (1)		
	75 ppb (11)	1-hour	None	

(1) Not to be exceeded more than once per year.

(2) Final rule signed October 15, 2008. The 1978 lead standard (1.5 $\mu g/m^3$ as a quarterly average) remains in effect until one year after an area is designated for the 2008 standard, except that in areas designated nonattainment for the 1978 standard, the 1978 standard remains in effect until implementation plans to attain or maintain the 2008 standard are approved.

(3) The official level of the annual NO_2 standard is 0.053 ppm, equal to 53 ppb, which is shown here for the purpose of clearer comparison to the 1-hour standard.

(4) To attain this standard, the 3-year average of the 98th percentile of the daily maximum 1-hour average at each monitor within an area must not exceed 100 ppb (effective January 22, 2010).

(5) Not to be exceeded more than once per year on average over three years.

(6) To attain this standard, the three-year average of the weighted annual mean $PM_{2.5}$ concentrations from single or multiple community-oriented monitors must not exceed 15.0 $\mu g/m^3$.

[7] To attain this standard, the three-year average of the 98th percentile of 24-hour concentrations at each population-oriented monitor within an area must not exceed 35 μg/m^3 (effective December 17, 2006).

[8] To attain this standard, the three-year average of the fourth-highest daily maximum 8-hour average ozone concentrations measured at each monitor within an area over each year must not exceed 0.075 ppm (effective May 27, 2008).

[9] (a) To attain this standard, the three-year average of the fourth-highest daily maximum 8-hour average ozone concentrations measured at each monitor within an area over each year must not exceed 0.08 ppm.
(b) The 1997 standard—and the implementation rules for that standard—will remain in place for implementation purposes as EPA undertakes rulemaking to address the transition from the 1997 ozone standard to the 2008 ozone standard.
(c) EPA is in the process of reconsidering these standards (set in March 2008).

[10] (a) EPA revoked the 1-hour ozone standard in all areas, although some areas have continuing obligations under that standard ("anti-backsliding").
(b) The standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above 0.12 ppm is $\leq$ 1.

[11] (a) Final rule signed June 2, 2010. To attain this standard, the three-year average of the 99th percentile of the daily maximum 1-hour average at each monitor within an area must not exceed 75 ppb.

Source: <http://www.epa.gov/air/criteria.html> (accessed April 20, 2011).

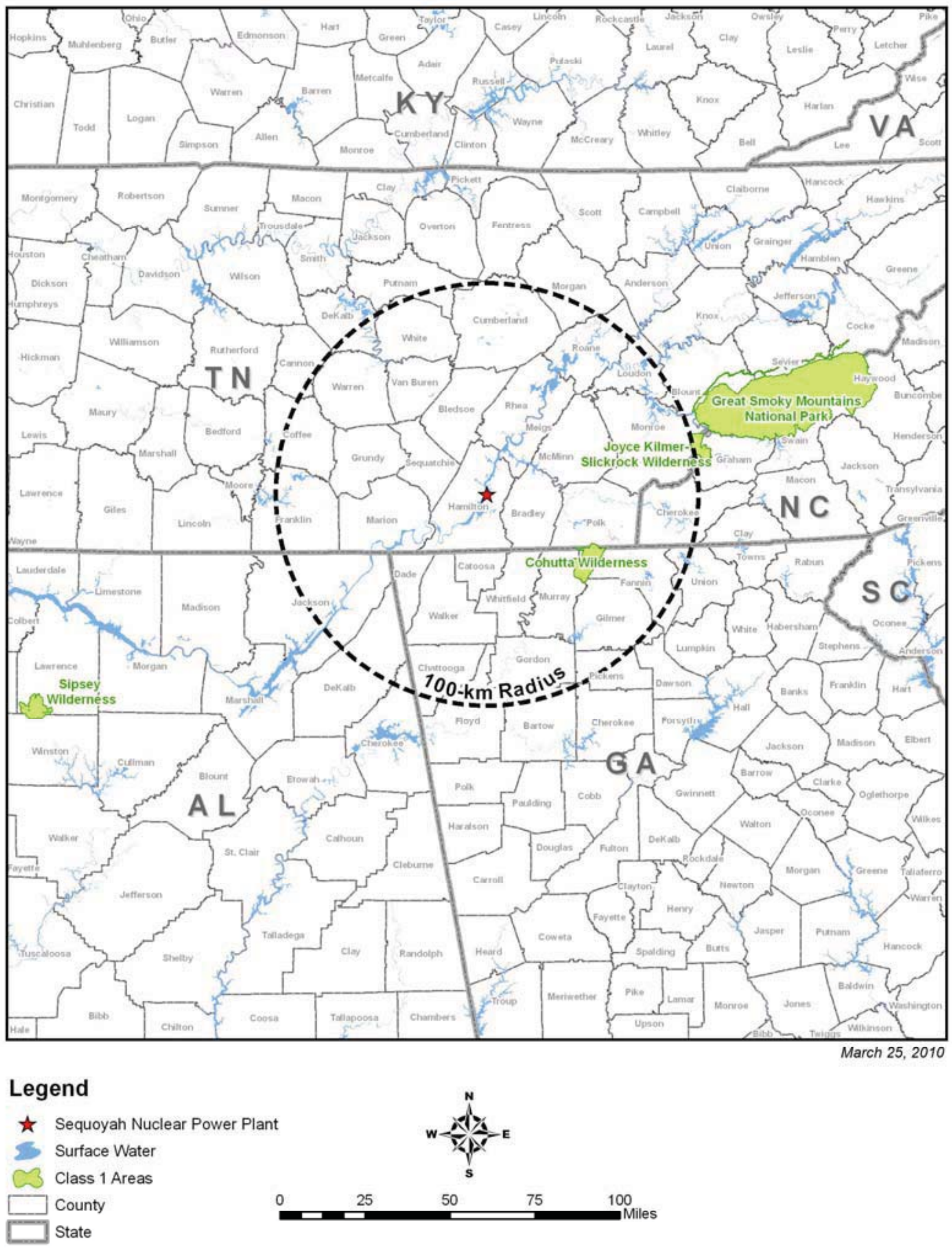

Figure 3-15. PSD Class I Air Quality Areas

Existing Air Emission Sources

There are virtually no air emissions from the nuclear reaction that releases the energy used to generate electricity. Existing sources of air emissions include: minor emissions from vehicular traffic, including both personal and commercial transportation, minor PM_{10} emissions from dust produced from travel over unpaved roads, and small volumes of emissions from auxiliary boilers, cooling towers during operation, testing of stand-by emergency diesel generators, and some heavy machinery used during normal operations and planned refueling outages. Nuclear energy life-cycle emissions include emissions associated with construction of the plant (Alternative 2a only), mining and processing the fuel, routine operation of the plant, waste disposal, and decommissioning. Numerous studies demonstrate that over the life cycle of the fuel, electricity generated from nuclear power results in emissions of about the same amount of GHG per kWh as renewable energy sources and far less than fossil fuel sources (Section 3.16.1). The largest variables in life-cycle GHG emissions of a nuclear plant, aside from the operating lifetime, electrical output, and capacity factor, are the type of uranium enrichment process and the source of power for enrichment facilities. Current enrichment facilities use the energy-intensive gaseous diffusion process largely powered by fossil fuels. New enrichment facilities currently under construction will use much less energy-intensive processes resulting in reduced nuclear plant life-cycle GHG emissions. The relevant emissions would occur over a period of 20 years of the license renewal and would be consistent with the very low level of emissions produced by the currently operating SQN. Nuclear power is an effective alternative to help TVA reduce GHG emissions.

Current air emissions from the operation of SQN are minor amounts of NO_x, CO, SO_x, PM_{10}, and reactive organic gases (ROG). Air emissions from SQN during the time frame of the license renewal, 2020 to 2041, are expected to be similar to current emissions. Air emissions would also be generated in the form of fugitive dust emissions (PM_{10}) and equipment exhaust emissions (NO_x, SO_x, CO, ROG, and PM_{10}). Operation of heavy equipment and vehicles during transportation and routine operations would generate exhaust emissions resulting from fuel combustion, and fugitive dust emissions would be generated by mobile equipment and vehicles traveling on unpaved roads. However, vehicle exhaust emissions and fugitive dust impacts from the operation of SQN on the local air quality are expected to be minor.

Equipment used for activities such as the transport of outage equipment on unpaved surfaces would generate fugitive dust. These dust emissions would consist primarily of large particles that generally settle on nearby surfaces, rather than becoming airborne for any great distance. These types of emissions are not permanent emissions; they occur with short duration and infrequency, and are scattered over different times of the day and throughout the year. Fugitive dust would not cause air quality standards to be exceeded, nor would they delay the attainment of ambient air quality standards in the area. There would be no substantial adverse impacts on air quality.

Air emissions from specific sources at SQN include the following sources that require air permits from the Chattanooga/Hamilton County Air Pollution Control Bureau: the hyperbolic natural draft cooling towers, the auxiliary steam boilers for heating and other uses, the generators and diesel-powered auxiliary (emergency) generators, and other small sources such as insulation saws and abrasives operations (Chapter 4).

Actual operating experience under the thermal regulations in effect, the reservoir conditions, and the plant's cooling requirements have shown that closed-mode operation of the cooling towers has been unnecessary and is not expected to be used in the future. Cooling tower operation is conducted only in the warmer months of the year.

The plant operates under the air quality permit category of a “minor source” of air pollutants as approved by TDEC and the Chattanooga/Hamilton County Air Pollution Control Bureau. All industry with the potential to emit any air pollutant operating in Hamilton County is required to obtain an air pollution permit. The Air Pollution Control Bureau conducts annual inspections, tracks air emissions, and develops special operating conditions to ensure compliance with the applicable rules and regulations. (CHCAPCB 2009) Various air permits are required for operation of SQN and would be maintained during the period of license renewal given their respective renewal schedules (Section 1.5 and Chapter 5).

Hazardous Air Pollutants

Hydrazine and lead are reported annually to the Tennessee Emergency Management Agency (TEMA) as hazardous air pollutants (HAPs) released from SQN, but technically reported as Toxic Release Inventory (TRI) chemicals and submitted as part of the TRI reporting to TEMA. Both of these chemicals are released to the air in very small amounts, and the impacts from these chemicals are considered insignificant HAPs at SQN. Hydrazine is a corrosion inhibitor and provides pH control in the cooling water system. It is controlled in accordance with the NPDES permit and is released in the cooling water returned to the Tennessee River (see Section 3.1.4 and 3.14). A small fraction of the hydrazine used on site is estimated to be released to the air. Lead is present at SQN mainly from the use of ammunition at the on-site security gun range. A small fraction of the lead (0.37 lbs/year) (TVA 2009k) from the ammunition becomes airborne and is released. There is no significant source of HAPs at SQN.

3.16.4. Environmental Consequences – Air Quality

Alternative 1 – License Renewal

Under the Action Alternative, SQN would continue to operate under the current conditions. SQN is not a significant source of pollutants, and the impact of operation for an additional 20-year period would be minor. The nuclear fission process produces substantially less air pollutants when compared to replacement fossil-fueled generation sources. The vehicular traffic of personnel commuting to work would produce small amounts of pollutants, and fugitive dust would occur from vehicles traveling on unpaved roads.

License renewal would help TVA meet the goal of reducing carbon emissions from electrical generation facilities, and provide a potentially positive indirect impact to the air quality. By using nuclear power, the amount of pollutants released into the air would be substantially reduced from what may have been released from alternative fossil fueled sources as described earlier.

Alternative 2 – No Action Alternative

Under the No Action Alternative, the impact on air quality from shutting down SQN would be a slightly positive impact. SQN would start decreasing the work force, which would reduce the emissions from the vehicles. There would be less mobile and stationary equipment in use, which would decrease emissions. Once the destruction and recycling of site structures and facilities began, there would be a brief period of increased particulate emissions from construction-type activities.

Alternative 2a – New Nuclear Generation

Constructing a new nuclear plant is similar to many large construction projects. Construction impacts to air quality come from several sources such as fugitive dust emissions, vehicular traffic emissions, heavy equipment emissions, and concrete batch plant emissions.

BMPs would be used to control the sources of emissions, and the impacts would be minor and of short duration. There would be minor indirect impacts off site and no cumulative impacts due to construction.

Under the No Action Alternative, operation of a new nuclear plant would not create a significant source of pollutants including GHG, because the nuclear fission process produces considerably less air pollutants when compared to fossil-fueled generation sources. The vehicular traffic of personnel commuting to work would produce small amounts of pollutants, and fugitive dust would occur from vehicles traveling on unpaved roads. Therefore, the environmental impact of a new nuclear plant on air quality would be minor. With an operational work force of approximately 650 to 1,000 workers, the traffic due to commuting workers would be a minor impact. Occasional trucks, diesel engines, and small-source engines would be used, but the impacts would be minor. Fugitive dust would be a minor impact.

The quantities of air pollutants released from the nuclear fission process are essentially zero for NO_2, SO_2, CO, and CO_2.

Under Alternative 2a, new nuclear units would not be operational until 2025 – 2027. Between 2020 (when SQN would begin to shut down) and 2027 (when the second new nuclear unit would become operational), a combination of TVA-owned and purchased natural gas-fired capacity, and increased production of existing coal and natural-gas fired units could be used to meet demand. Increased use of fossil fuel plants would increase air emissions during that time period. Between 2020 and 2024, the average annual emissions of SO_2, NO_x, CO_2, and mercury would be less than 2010, but still greater than under Alternative 1. Between 2027 and 2029, when operation of the new nuclear units begin, operation of the fossil fuel plants providing necessary energy during the interim period would decrease and emissions would be similar to those under Alternative 1. Under Alternative 2a, TVA would maintain air emissions in compliance with regulatory limits, but overall quantities of emissions would be greater than under Alternative 1.

Alternative 2b – New Gas Natural Gas-Fired Generation

Activities associated with construction of a new natural gas-fired plant would be similar but on a smaller scale than Alternative 2a. Under Alternative 2b, operation of a new natural gas-fired turbine plant would increase some air pollutants. The amount of pollutants released is determined by the type of control equipment used in the plant design. The typical quantities of air pollutants released from a modern natural gas-fired turbine, such as the JSF gas turbine project, are small enough (for SO_2, NO_2, CO, and CO_2 emissions) that they would be operated with a minor impact to air quality (TVA 2010c). Depending on the chosen location, typical combined-cycle combustion turbine gas-fired generation plants have minor to moderate impacts on air quality, but would be designed and operated to meet all air quality standards. New processes are being developed to continue the decrease in pollutants released or sequestered. With the smallest work force, the vehicular emissions would be minor due to commuting activities.

Table 3-31 presents pollutant air emission estimates for the JSF project operating in the combined-cycle mode to provide base load capacity. The table also provides the SQN equivalent gas-fired plant pollutant air emissions estimates based on the twofold increase in capacity. As a rule of thumb, natural gas combined-cycle generation produces about 1,000 pounds of CO_2 per MWh. (TVA 2010c)

Table 3-31. Air Emissions From JSF Combined-Cycle Base Load and SQN Equivalent Alternative

Pollutant	JSF Combined-Cycle Base Load – Tons per Year	Two JSF Plants Equivalent – Tons per Year (JSF times 2 increase in capacity)
SO_x	109.65	219.30
NO_x	564.00	1128.00
CO	288.00	576.00
Lead	0.0373	0.0746
PM_{10}	137.00	274.00
$PM_{2.5}$	137.00	274.00
VOC	91.60	183.20

SO_x= sulfur oxides, VOC = volatile organic compounds
(TVA 2010c)

Operating new natural gas-fired plants would result in direct and indirect impacts on air quality, but they would be minor in the short term as well as the long term. A PSD analysis may be required to verify the impact to nearby PSD Class I areas.

Under Alternative 2b, new natural gas-fired units would not be operational until 2025 – 2029. Between 2020 and 2029, a combination of TVA-owned and purchased natural gas-fired capacity and increased production of existing coal and natural-gas fired units would be used. Increased use of fossil fuel plants would increase air emissions during that time period. Furthermore, TVA's system-wide generation planning study indicated that under Alternative 2b, although new natural gas-fired plants would be available, the energy needed to replace SQN generation would be obtained primarily by increasing operation of existing coal and natural gas-fired plants. The interim need to provide energy from these alternative generation resources to replace SQN would cease, as would any associated emissions after the new combined-cycle units started operating. Under Alternative 2b, emissions would be greater than under Alternative 1.

Conclusion

Impacts from air emissions would be expected to be minor from the continued operation of SQN during the period of license renewal. Air emissions would be a minor to moderate impact from the construction and operation of either of the alternative new replacement plants. TVA would obtain appropriate permits and maintain air emissions in compliance with regulatory limits.

3.17. Radiological Effects of Normal Operations

This section discusses the potential radiological dose exposure to the public during normal operations of SQN. The impact of SQN is assessed in TVA's 1974 FES and it was concluded that environmental radioactivity levels due to releases to unrestricted areas from SQN will be so low that the radiation doses to man will be less than the variations in the natural background radiation dose (TVA 1974a).

3.17.1. Affected Environment

The estimated total dose to the public within 50 miles of SQN is approximately 95,400 person-rem/year natural background dose. The natural background dose is based on an individual person dose of approximately 90 millirem (mrem)/year and a population of 1,060,000 people within the 50 miles. (TVA 2009i) The estimated dose to the public within 50 miles due to the operation of SQN is about 1.2 person-rem/year, less than the normal fluctuations in the 95,400 person-rem/year natural background radiation dose this population would receive from background sources. Background radiation comes from a variety of sources such as cosmic radiation, soils and rocks, radon, weapons testing, medical X-rays, smoke detectors, and smoking.

Although TVA's 1974 FES for SQN predated the issuance of the federal regulation of the NRC (Appendix I of 10 CFR Part 50), when compared to the federal regulations (Appendix I values), SQN demonstrates full compliance. Recent calculations confirm that earlier assessments and doses to the public resulting from the discharge of radioactive effluents from SQN are a small fraction of the (Appendix I) federal regulation. TVA determined that the doses to the public resulting from the discharge of radioactive effluents from SQN are within applicable limits for dose exposure during normal operations. Alternative 1 – License Renewal would be a continuation of the current SQN operation, and the radiological effects of normal operations during the period of license renewal would be similar to the discussion in this section. Alternative 2a – New Nuclear Generation would result in radiological effects similar to the operation of SQN, with changes based on the nuclear technology chosen and potential improvements based on new reactor designs. Construction and operation of a replacement Alternative 2b – New Natural Gas-Fired Generation plant would have no direct radiological effects. Discussion of the shutdown of SQN at the end of the current license periods or at the end of the license renewal period is presented within this section also.

Exposure Pathways

Evaluation of the potential impacts to the public from normal operational releases is based upon the probable pathways to individuals, populations, and biota near SQN. The exposure pathways, described in federal regulations of the NRC (Regulatory Guides 1.109 and 1.111) (NRC 1977a; NRC 1977b) are shown in Figure 3-16. The critical pathways to humans for routine radiation releases from SQN are direct exposure from radionuclides in the air (submersion), inhalation of contaminated air, ingesting milk from a cow that feeds on open pasture near the site, ingesting vegetables from a garden near the site, ingestion of liquids, immersion in liquid, shoreline direct irradiation, and ingesting fish caught in the Tennessee River (TVA 1974a).

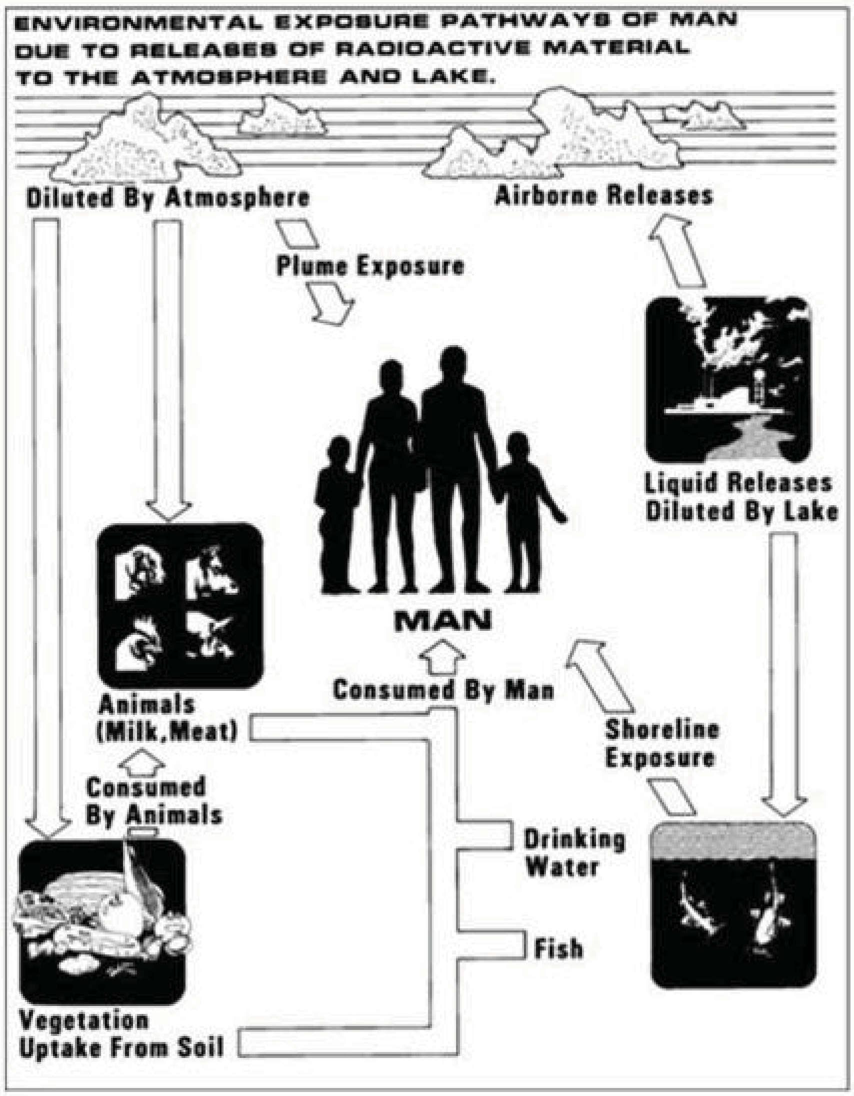

Figure 3-16. Exposure Pathways

The ODCM specifies the requirements for monitoring specific exposure pathways. The ODCM is based on current conditions at the site and in the surrounding community so that monitoring and sampling can be altered as necessary. Dose calculations to members of the public are based on the guidance of the ODCM. The ODCM can be modified to include new pathways if needed or to exclude pathways if the conditions warrant. (SQN 2009)

Radiation exposure pathways to biota other than members of the public were assessed to determine if the pathways could result in radiation doses to biota greater than those predicted for humans. This assessment used surrogate species that provide representative information on the various dose pathways potentially affecting broader classes of living organisms.

Surrogates are used because important attributes are well defined and accepted as a method for judging doses to biota. Surrogate biota used include algae (surrogate for aquatic plants), invertebrates, fish, aquatic animals, muskrat, and duck. (TVA 1974a)

The exposure pathways to humans that were used in the 1974 FES for SQN (TVA 1974a) analyses for liquid effluents remain valid and include:

- External exposure to contaminated water by way of swimming, boating, or walking on the shoreline.
- Ingestion of contaminated water.
- Ingestion of aquatic animals exposed to contaminated water.

Exposure pathways considered include external radiation doses due to noble gases, internal doses from particulates due to inhalation, and the ingestion of milk, meat, and vegetables (including grains) within a 50-mile radius area around SQN.

Exclusion Area Boundary

As defined in federal regulations of the NRC (10 CFR Part 100), the EAB is the area surrounding the reactor in which TVA has the authority to determine all activities, including exclusion or removal of personnel and property from the area. The boundary on which limits for the release of radioactive effluents are based is the EAB as shown in Figure 3-14. There are no residents living in this exclusion area. Access within the EAB is controlled, and no restricted areas within the EAB are accessible to members of the public. Areas outside the EAB are unrestricted in the context of federal regulations of the NRC (10 CFR Part 20) and open to the public. The nearest resident lives 0.5 miles away from the plant in a north-northwesterly direction (TVA 2009i).

Radiation Doses to Members of the Public

This section provides an estimate of doses to the maximally exposed individual (MEI) and the general population during routine operations for both the radioactive liquid and gaseous effluent pathways. The MEI is a hypothetical individual member of the public who would live continuously at the location that would allow him to receive the maximum dose by being exposed to the plant radioactive effluents.

Radiological Doses Due to Liquid Effluents

The release of small amounts of radioactive liquid effluents is permitted for SQN as long as releases comply with the requirements specified in federal regulations of the NRC (10 CFR Part 20) and the ODCM (SQN 2009). The liquid effluent exposure pathways given in Subsection 3.17.1 were considered in the evaluation of radiation doses to the public resulting from radioactive liquid effluent releases. Current analyses of potential radioactive doses to members of the public due to releases of radioactivity in liquid effluents are calculated using the methodology provided in the ODCM.

The resulting calculated doses to an individual due to liquid effluents released from SQN for the years 2004 through 2008 are given in Table 3-32. The dose controls and limits of the ODCM, based on federal regulations of the NRC (10 CFR Part 20, Appendix B, Table 2, Column 2 for concentrations of effluent releases and 10 CFR Part 50 Appendix I for any individual) are annual limits of 3 mrem or less to the total body and 10 mrem or less to any organ while the quarterly limits are 1.5 mrem or less to the total body and 5 mrem or less to any organ (SQN 2009). The annual and quarterly limits are designed to assure that doses due to releases of radioactive material from nuclear power reactors to unrestricted areas are kept as low as practicable during normal conditions.

Table 3-32. Calculated Dose to Individuals From Liquid Effluents, 2004 – 2008

Year	Qtr	Age Group	Total Body Dose	Qtr Limit	% of Limit
2004	1	Adult	9.60e-4 mrem	1.5 mrem	<1
2004	2	Child	3.90e-3 mrem	1.5 mrem	<1
2004	3	Child	2.40e-3 mrem	1.5 mrem	<1
2004	4	Child	2.10e-3 mrem	1.5 mrem	<1
2005	1	Child	1.50e-3 mrem	1.5 mrem	<1
2005	2	Child	4,20e-3 mrem	1.5 mrem	<1
2005	3	Child	2.10e-4 mrem	1.5 mrem	<1
2005	4	Child	1.40e-3 mrem	1.5 mrem	<1
2006	1	Child	8.00e-3 mrem	1.5 mrem	<1
2006	2	Child	3.90e-3 mrem	1.5 mrem	<1
2006	3	Child	3.30e-3 mrem	1.5 mrem	<1
2006	4	Child	2.50e-3 mrem	1.5 mrem	<1
2007	1	Child	8.20e-4 mrem	1.5 mrem	<1
2007	2	Child	1.10e-2 mrem	1.5 mrem	<1
2007	3	Child	1.00e-2 mrem	1.5 mrem	<1
2007	4	Child	6.70e-3 mrem	1.5 mrem	<1
2008	1	Child	3.20e-3 mrem	1.5 mrem	<1
2008	2	Child	4.70e-3 mrem	1.5 mrem	<1
2008	3	Child	1.80e-3 mrem	1.5 mrem	<1
2008	4	Child	5.40 e-3 mrem	1.5 mrem	<1

(TVA 2005c; TVA 2006c; TVA 2007e; TVA 2008c; TVA 2009i)

SQN submits annual reports to the NRC detailing the release of radioactive liquid effluents for the previous year. These annual radioactive effluent release reports (ARERR) include summations of all radioactive liquid releases and the resulting doses for individuals and the total population, as well as the quantities of radioactive nuclides released. It is evident from these reports that the release of radioactive liquid effluents from SQN has a minor impact on the environment and people in the surrounding the area. Based on these reports (TVA 2005c; TVA 2006c; TVA 2007e; TVA 2008c; TVA 2009i), the overall results expected from normal operations of SQN are as follows:

- Each unit meets the dose guidelines given in 10 CFR Part 50, Appendix I.
- The dose estimates to the public are a small fraction of the Appendix I guidelines.
- The analyses of the radiological impact to humans from liquid releases in TVA's 1974 FES for SQN continue to be valid.
- The population doses are low.
- The impact to members of the public resulting from normal liquid effluent releases is minor.

Table 3-33 provides the calculated quarterly total body doses to the total population in the 50-mile radius of SQN for the years 2004 – 2008 from liquid and gaseous effluents released. The natural background radiation causes an estimated dose of 95,400 person-rem/year to the population within the 50-mile radius of SQN. Therefore, SQN is contributing a dose so minor that it cannot be distinguished from the variations in the natural background radiation dose, as was expected in TVA's 1974 FES for SQN.

If Alternative 2a – New Nuclear Generation is pursued, the design would ensure the effluent liquid releases would be within applicable rules and regulations. The new plant would be required to develop a REMP, which would contain adequate sampling and analysis guidance to monitor the environment. Based on design criteria and operational procedures, the normal operation of a new nuclear plant would present minimal risk to the health and safety of the public from radioactive liquid releases. Advanced reactor design would be expected to provide better protection to the workers and the public depending on the technology chosen. All new nuclear plants would be required to meet all applicable liquid release limits and thereby ensure the health and safety of the public, or they would not be allowed to operate.

Table 3-33. Calculated Quarterly Total Population Doses (Liquid and Gaseous) to the Total Population in a 50-Mile Radius of SQN, 2004 – 2008*

Year	Qtr	Total Population Dose by Quarter (person-rem) Liquids	Total Population Dose by Quarter (person-rem) Gases
2004	1	3.80e-2	7.41e-3
2004	2	2.50e-1	2.65e-2
2004	3	1.60e-1	1.58e-2
2004	4	1.30e-1	9.64e-2
2005	1	1.20e-1	2.67e-2
2005	2	3.50e-1	4.26e-2
2005	3	1.90e-2	1.53e-2
2005	4	1.10e-1	2.01e-2
2006	1	5.20e-1	1.58e-2

Year	Qtr	Total Population Dose by Quarter (person-rem) Liquids	Total Population Dose by Quarter (person-rem) Gases
2006	2	2.60e-1	6.16e-2
2006	3	2.30e-1	2.77e-2
2006	4	1.60e-1	6.20e-2
2007	1	5.00e-2	1.79e-1
2007	2	6.80e-1	1.25e-1
2007	3	7.10e-1	1.48e-1
2007	4	4.30e-1	1.60e-1
2008	1	2.00e-1	1.88e-2
2008	2	3.10e-1	5.28e-2
2008	3	1.20e-1	9.09e-2
2008	4	3.60e-1	4.76e-2

*Based on a population of 1,060,000 people within the 50-mile radius.

(TVA 2005c; TVA 2006c; TVA 2007e; TVA 2008c; and TVA 2009i)

Radiological Impact of Gaseous Effluents

Gaseous effluents refers to the release of small quantities of gaseous aerosols and particulates associated with the normal operation of SQN. Gaseous radioactive effluents are released to the atmosphere through vents on the shield building, auxiliary building, turbine building, and service building (TVA 2008a).

The current analyses of potential doses to members of the public due to releases of radioactivity in gaseous effluents are performed using the methodologies described in the SQN ODCM. The methods described are based on NRC guidance for determining the doses for releases of radioactive effluents from nuclear power plants into the atmosphere as provided in Regulatory Guide 1.109, *Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I, Revision 1* (NRC 1977a). The ODCM provides the limits for gaseous effluent doses to members of the public. Those limits are that during any calendar quarter, the dose due to noble gases must be less than or equal to 5 millirad (mrad) for gamma radiation and less than or equal to 10 mrad for beta radiation, and that during any calendar year, the dose must be less than or equal to 10 mrad for gamma radiation and less than or equal to 20 mrad for beta radiation (SQN 2009). Additionally, limits are that during any calendar quarter, the dose due to tritium and radionuclides must be less than or equal to 5 mrad for gamma radiation and less than or equal to 10 mrad for beta radiation, and that during any calendar year, the dose must be less than or equal to 10 mrad for gamma radiation and less than or equal to 20 mrad for beta radiation (SQN 2009). Tables 3-34 through 3-38 provide the gaseous doses calculated from the gaseous releases during the years 2004 – 2008.

Table 3-34. Doses From Gaseous Effluents, 2004

Year	Qtr	Pathway	Dose	QTR Limit	% of Limit
2004	1	Gamma air	2.69e-3 mrad	5 mrad	<1
	1	Beta air	1.22e-3 mrad	10 mrad	<1
	1	Total body	2.00e-3 mrad	10 mrad	<1
	1	Skin	3.03e-3 mrad	10 mrad	<1
	1	Child/thyroid	6.52e-3 mrem	7.5 mrem	<1
	1	Child/total body	6.52e-3 mrem	7.5 mrem	<1
2004	2	Gamma air	4.72e-3 mrad	5 mrad	<1
	2	Beta air	2.01e-3 mrad	10 mrad	<1
	2	Total body	2.67e-3 mrad	10 mrad	<1
	2	Skin	4.01e-3 mrad	10 mrad	<1
	2	Child/thyroid	1.90e-2 mrem	7.5 mrem	<1
	2	Child/total body	1.90e-2 mrem	7.5 mrem	<1
2004	3	Gamma air	3.11e-3 mrad	5 mrad	<1
	3	Beta air	1.37e-3 mrad	10 mrad	<1
	3	Total body	2.38e-3 mrad	10 mrad	<1
	3	Skin	3.58e-3 mrad	10 mrad	<1
	3	Child/thyroid	1.25e-2 mrem	7.5 mrem	<1
	3	Child/total body	1.25e-2 mrem	7.5 mrem	<1
2004	4	Gamma air	6.08e-3 mrad	5 mrad	<1
	4	Beta air	2.79e-3 mrad	10 mrad	<1
	4	Total body	3.50e-3 mrad	10 mrad	<1
	4	Skin	5.30e-3 mrad	10 mrad	<1
	4	Child/thyroid	4.78e-2 mrem	7.5 mrem	<1
	4	Child/total body	4.77e-2 mrem	7.5 mrem	<1

(TVA 2005c)

Table 3-35. Doses From Gaseous Effluents, 2005

Year	Qtr	Pathway	Dose	QTR Limit	% of Limit
2005	1	Gamma air	5.38e-3 mrad	5 mrad	<1
	1	Beta air	2.63e-3 mrad	10 mrad	<1
	1	Total body	3.23e-3 mrad	10 mrad	<1
	1	Skin	4.93e-3 mrad	10 mrad	<1
	1	Child/thyroid	9.75e-3 mrem	7.5 mrem	<1
	1	Child/total body	9.36e-3 mrem	7.5 mrem	<1
2005	2	Gamma air	4.30e-3 mrad	5 mrad	<1
	2	Beta air	2.80e-3 mrad	10 mrad	<1
	2	Total body	2.70e-3 mrad	10 mrad	<1
	2	Skin	4.25e-3 mrad	10 mrad	<1
	2	Child/thyroid	1.61e-2 mrem	7.5 mrem	<1
	2	Child/total body	1.55e-2 mrem	7.5 mrem	<1
2005	3	Gamma air	2.18e-3 mrad	5 mrad	<1
	3	Beta air	1.57e-3 mrad	10 mrad	<1
	3	Total body	1.65e-3 mrad	10 mrad	<1
	3	Skin	2.68e-3 mrad	10 mrad	<1
	3	Child/thyroid	1.08e-2 mrem	7.5 mrem	<1
	3	Child/total body	1.08e-2 mrem	7.5 mrem	<1
2005	4	Gamma air	4.91e-3 mrad	5 mrad	<1
	4	Beta air	1.36e-2 mrad	10 mrad	<1
	4	Total body	3.34e-3 mrad	10 mrad	<1
	4	Skin	7.74e-3 mrad	10 mrad	<1
	4	Child/thyroid	1.01e-2 mrem	7.5 mrem	<1
	4	Child/total body	1.01e-2 mrem	7.5 mrem	<1

(TVA 2006c)

Table 3-36. Doses From Gaseous Effluents, 2006

Year	Qtr	Pathway	Dose	QTR Limit	% of Limit
2006	1	Gamma air	2.62e-3 mrad	5 mrad	<1
	1	Beta air	3.31e-3 mrad	10 mrad	<1
	1	Total body	1.55e-3 mrad	10 mrad	<1
	1	Skin	2.81e-3 mrad	10 mrad	<1
	1	Child/thyroid	7.81e-3 mrem	7.5 mrem	<1
	1	Child/total body	7.79e-3 mrem	7.5 mrem	<1
2006	2	Gamma air	1.67e-2 mrad	5 mrad	<1
	2	Beta air	3.82e-2 mrad	10 mrad	<1
	2	Total body	9.78e-3 mrad	10 mrad	<1
	2	Skin	2.09e-2 mrad	10 mrad	<1
	2	Child/thyroid	5.02e-2 mrem	7.5 mrem	<1
	2	Child/total body	3.88e-2 mrem	7.5 mrem	<1
2006	3	Gamma air	3.20e-3 mrad	5 mrad	<1
	3	Beta air	2.13e-3 mrad	10 mrad	<1
	3	Total body	2.17e-3 mrad	10 mrad	<1
	3	Skin	3.43e-3 mrad	10 mrad	<1
	3	Child/thyroid	2.91e-2 mrem	7.5 mrem	<1
	3	Child/total body	2.91e-2 mrem	7.5 mrem	<1
2006	4	Gamma air	1.90e-2 mrad	5 mrad	<1
	4	Beta air	8.15e-3 mrad	10 mrad	<1
	4	Total body	1.15e-2 mrad	10 mrad	<1
	4	Skin	1.73e-2 mrad	10 mrad	<1
	4	Child/thyroid	3.56e-2 mrem	7.5 mrem	<1
	4	Child/total body	3.56e-2 mrem	7.5 mrem	<1

(TVA 2007e)

Table 3-37. Doses From Gaseous Effluents, 2007

Year	Qtr	Pathway	Dose	QTR Limit	% of Limit
2007	1	Gamma air	4.23e-3 mrad	5 mrad	<1
	1	Beta air	1.98e-3 mrad	10 mrad	<1
	1	Total body	2.42e-3 mrad	10 mrad	<1
	1	Skin	3.66e-3 mrad	10 mrad	<1
	1	Child/thyroid	1.92e-2 mrem	7.5 mrem	<1
	1	Child/total body	1.92e-2 mrem	7.5 mrem	<1
2007	2	Gamma air	3.56e-3 mrad	5 mrad	<1
	2	Beta air	1.69e-3 mrad	10 mrad	<1
	2	Total body	2.13e-3 mrad	10 mrad	<1
	2	Skin	3.19e-3 mrad	10 mrad	<1
	2	Child/thyroid	1.38e-2 mrem	7.5 mrem	<1
	2	Child/total body	1.38e-2 mrem	7.5 mrem	<1
2007	3	Gamma air	5.25e-3 mrad	5 mrad	<1
	3	Beta air	2.95e-3 mrad	10 mrad	<1
	3	Total body	3.37e-3 mrad	10 mrad	<1
	3	Skin	5.24e-3 mrad	10 mrad	<1
	3	Child/thyroid	2.29e-2 mrem	7.5 mrem	<1
	3	Child/total body	2.25e-2 mrem	7.5 mrem	<1
2007	4	Gamma air	8.06e-3 mrad	5 mrad	<1
	4	Beta air	4.24e-3 mrad	10 mrad	<1
	4	Total body	5.95e-3 mrad	10 mrad	<1
	4	Skin	9.10e-3 mrad	10 mrad	<1
	4	Child/thyroid	1.81e-2 mrem	7.5 mrem	<1
	4	Child/total body	1.76e-2 mrem	7.5 mrem	<1

(TVA 2008c)

Table 3-38. Doses From Gaseous Effluents, 2008

Year	Qtr	Pathway	Dose	QTR Limit	% of Limit
2008	1	Gamma air	5.14e-3 mrad	5 mrad	<1
	1	Beta air	1.86e-3 mrad	10 mrad	<1
	1	Total body	2.96e-3 mrad	10 mrad	<1
	1	Skin	4.37e-3 mrad	10 mrad	<1
	1	Child/thyroid	7.12e-2 mrem	7.5 mrem	<1
	1	Child/total body	7.12e-3 mrem	7.5 mrem	<1
2008	2	Gamma air	3.75e-3 mrad	5 mrad	<1
	2	Beta air	1.46e-3 mrad	10 mrad	<1
	2	Total body	2.15e-3 mrad	10 mrad	<1
	2	Skin	3.22e-3 mrad	10 mrad	<1
	2	Child/thyroid	9.01e-3 mrem	7.5 mrem	<1
	2	Child/total body	9.01e-3 mrem	7.5 mrem	<1
2008	3	Gamma air	8.14e-4 mrad	5 mrad	<1
	3	Beta air	3.24e-4 mrad	10 mrad	<1
	3	Total body	6.16e-4 mrad	10 mrad	<1
	3	Skin	9.18e-4 mrad	10 mrad	<1
	3	Child/thyroid	1.62e-2 mrem	7.5 mrem	<1
	3	Child/total body	1.62e-2 mrem	7.5 mrem	<1
2008	4	Gamma air	5.21e-4 mrad	5 mrad	<1
	4	Beta air	2.30e-4 mrad	10 mrad	<1
	4	Total body	3.91e-4 mrad	10 mrad	<1
	4	Skin	5.89e-4 mrad	10 mrad	<1
	4	Child/thyroid	6.63e-3 mrem	7.5 mrem	<1
	4	Child/total body	6.63e-3 mrem	7.5 mrem	<1

(TVA 2009i)

SQN submits annual reports to the NRC detailing the release of radioactive gaseous effluents for the previous year as part of the ARERR. These reports include summations of all radioactive gaseous releases and the resulting doses as well as the quantities of radioactive nuclides released. (TVA 2005c; TVA 2006c; TVA 2007e; TVA 2008c; TVA 2009i)

Federal regulations (10 CFR Part 50, Appendix I) define design objective limits for radioactive material in gaseous effluents for any nuclear power plant. Meeting the limits presented in the federal regulations also conforms to the ALARA criterion for radioactive material in gaseous effluents. If Alternative 2a – New Nuclear Generation is pursued, the design would ensure the effluent releases would be within applicable rules and regulations. Based on these design criteria, normal operation of a new nuclear plant would present minimal risk to the health and safety of the public.

Total Dose (Liquid and Gaseous) From All Sources

Dose limits for individual members of the public are given in the ODCM Control 1.2.3. The annual (calendar year) dose or dose commitment to any member of the public, beyond the site boundary due to releases of radioactivity from UFC sources, shall be limited to less than or equal to 25 mrem to the total body or any organ (except the thyroid, which shall be limited to less than or equal to 75 mrem). Table 3-39 provides results of the calculated cumulative total dose (total body or any other organ) from all sources for the years 2004 – 2008. Table 3-40 provides results of the calculated cumulative total dose (thyroid) from all sources for the years 2004 – 2008. These calculated doses are well within the limits specified in the ODCM. Therefore, it is concluded that normal operation of SQN presents minimal risk to the health and safety of the public.

Individual doses due to normal liquid and gaseous effluent releases from SQN are less than 1 percent of the applicable limits. The doses are well below the federal regulatory guidelines and standards (Appendix I of 10 CFR Part 50 and 10 CFR Part 20).

Table 3-39. Cumulative Annual Total Dose (Total Body or Any Organ) From All Sources, 2004 – 2008

Year	Cumulative Total Dose	Annual Limit	% of Limit
2004	1.16e-1 mrem	25 mrem	0.46
2005	1.35e-1 mrem	25 mrem	0.54
2006	2.29e-1 mrem	25 mrem	0.92
2007	1.50e-1 mrem	25 mrem	0.60
2008	7.56e-2 mrem	25 mrem	0.30

(TVA 2005c; TVA 2006c; TVA 2007e; TVA 2008c; and TVA 2009i)

Table 3-40. Cumulative Annual Total Dose (Thyroid) From All Sources, 2004 – 2008

Year	Cumulative Total Dose	Annual Limit	% of Limit
2004	1.15e-1 mrem	75 mrem	0.15
2005	7.23e-2 mrem	75 mrem	0.10
2006	1.84e-1 mrem	75 mrem	0.25
2007	1.44e-1 mrem	75 mrem	0.19
2008	7.53e-2 mrem	75 mrem	0.10

(TVA 2005c; TVA 2006c; TVA 2007e; TVA 2008c; and TVA 2009i)

If Alternative 2a – New Nuclear Generation is pursued, the design would ensure the effluent gaseous releases would be within applicable rules and regulations. The new plant would be required to develop a REMP, which would contain adequate sampling and analysis guidance to monitor the environment. Based on design criteria and operational procedures, the normal operation of a new nuclear plant would present minimal risk to the health and safety of the public from radioactive gaseous releases. Advanced reactor design would be expected to provide better protection to the workers and to the public depending on the technology chosen. All new nuclear plants would be required to meet all applicable gaseous release limits and thereby ensure the health and safety of the public, or they would not be allowed to operate.

Population Dose

Population dose calculations determined the cumulative dose to the population within 50 miles of SQN. The estimated radiological impact from the normal gaseous releases from SQN is presented in Table 3-34 for comparison with the 50-mile regional population, resulting in 95,400 person-rem/year from natural background radiation. For perspective, the total body dose from normal background radiation to individuals within the United States averages 300 mrem per year (NRC 2004b). The annual total body dose due to normal background radiation for a population of 1,060,000 persons currently within a 50-mile radius of SQN is approximately 95,400 person-rem, assuming 90 mrem/year for each individual. By comparison, the same general population would receive a calculated total body dose of less than 1.2 person-rem/year from both liquid and gaseous effluents released from SQN. (TVA 2009i)

Based on the calculated results, normal operation of SQN presents minimal risk to the health and safety of the public. The annual doses to the public from Alternative 1 – License Renewal continued operation of SQN during the period of license renewal or No Action Alternative 2a – New Nuclear Generation would be well within all regulatory limits, and there would be no observable health impacts on the public from construction and operation of a new nuclear plant.

Radiological Impact on Biota Other Than Man

Radiation exposure pathways to biota other than man (i.e., animals) are examined to determine if the pathways could result in doses to biota greater than those predicted for man. This assessment uses surrogate species that provide representative information on the various dose pathways potentially affecting broader classes of living organisms. Surrogates are used because important attributes are well defined and accepted as a method for judging doses to biota. Surrogate biota used for gaseous effluent exposure from SQN include muskrat, fish, and duck. (TVA 1974a)

Liquid radioactive effluents from SQN are mixed with other wastewater and subsequently discharged into the Tennessee River. Other non-radioactive discharges may be combined with cooling water discharges, but they are small in comparison and are ignored as a source of dilution. Release of radioactive materials in liquid effluents results in minimal radiological exposure to biota. Impacts on aquatic life from radiological releases are minor. Calculated values for doses to plants, invertebrates, and fish were performed for the TVA 1974 FES for SQN and produced results that support the impacts being classified as minor (Table 3-41). (TVA 1974a)

Doses from gaseous effluents contribute to terrestrial total body doses. External doses occur due to immersion in a plume of noble gases and deposition of radionuclides on the ground. The inhalation of radionuclides followed by the subsequent transfer from the lung to the rest of the body contributes to the internal total body doses. Immersion and ground deposition doses are largely independent of organism size, and the total body doses calculated for man can be applied.

Table 3-41. Annual Doses to Biota Living Near SQN

Biota Type	2.0 Curie Mixture	1.0 Curie Mixture
Ducks and Muskrat		
Internal Dose	2.7E+02 mrad	6.1E-05 mrad
External Dose	8.7E-04 mrad	0.0E+00 mrad
Total Dose	2.7E+02 mrad	6.1E-05 mrad
Plants		
Internal Dose	6.2 mrad @ 3-cm	1.3E-05 mrad
External Dose	1.7E-03 mrad	NA
Invertebrates		
Internal Dose	2.9 mrad @ 3-cm	1.3E-05 mrad
External Dose	1.7E-03 mrad	NA
Fish		
Internal Dose	0.3 mrad @ 3-cm	1.3E-05 mrad
External Dose	1.7E-03 mrad	

NA = not applicable

(TVA 1974a)

The NRC conducted a review of all operating nuclear power plants to evaluate the potential impacts of radionuclides on terrestrial biota from continued operations. Site-specific radionuclide concentrations in water, sediment, and soils were obtained from REMP reports for 15 nuclear plants. SQN was not one of the plants selected in the group of 15. These 15 plants were selected to represent sites with a range of radionuclide concentrations in the media, including plants with high annual worker total effective dose equivalent (TEDE) values for both BWR and PWRs. The RESRAD-BIOTA dose evaluation model was used to calculate estimated dose rates for terrestrial biota by using the media concentrations presented in the REMP reports. Results of the RESRAD-BIOTA dose modeling presented in Table 4.6.1.1–1 of the 2009 draft GEIS show the total dose estimates for three different terrestrial ecological receptors: riparian animal (an animal assumed to spend approximately 50 percent of its time in aquatic environments and 50 percent of its time in terrestrial environments), terrestrial animal, and terrestrial plant. The maximum estimated dose rate calculated for any of the nuclear power plants is 35.4 mrad/day, which is below the guideline value of 100 mrad/day for a riparian animal receptor. It is unlikely that the normal operations of these power plants would have adverse effects on terrestrial biota resulting from radionuclide releases, because the calculated doses are below protective guidelines and thus would not significantly affect populations. (NRC 2009b)

Use of federal exposure guidelines (40 CFR Part 190) that apply to members of the public in unrestricted areas is considered very conservative when evaluating calculated doses to biota. The calculated biota doses are well below those specified in the federal guidelines (40 CFR Part 190) and well below any dose expected to have any acute effects.

Radiological Monitoring

The REMP is described in the ODCM and was established to provide preoperational and operational monitoring of the area surrounding SQN, along with any new nuclear alternative. Preoperational monitoring was conducted prior to the start of SQN operations, and monitoring has continued during all the years of current operations. The SQN REMP is designed to provide the environmental monitoring necessary to document compliance with applicable regulations. All results obtained in the performance of the REMP are reported to the NRC on an annual basis in the *Annual Radiological Environmental Operating Report* (AREOR), and the dose results from the release of radioactive effluents are reported each year in the ARERR. The ODCM specifies the requirements of the annual reports. (SQN 2009)

The REMP is designed to monitor the pathways between the plant and the general public in the immediate vicinity of the plant. Sampling locations, sample types, collection frequency, and sample analyses are chosen so that the potential for detection of radioactivity in the environment is maximized. For a new nuclear plant, the REMP would be designed based on federal guidance (NUREG-1301, *Offsite Dose Calculation Manual Guidance: Standard Radiological Effluent Controls for Pressurized Water Reactors*). Quality assurance and quality control procedures and processes would be implemented in accordance with federal requirements (NRC Regulatory Guide 4.15, *Quality Assurance for Radiological Monitoring Programs (Normal Operations) -- Effluent Streams and the Environment*).

New nuclear plants, if built, would meet applicable federal requirements (10 CFR §20.1302, *Compliance with Dose Limits for the Individual Members of the Public* and the requirements established by NRC Regulatory Guide 4.1, *Radiological Environmental Monitoring for Nuclear Power Plants*). A formal REMP would be required for the facility.

Radiological Environmental Monitoring Program for Alternative 1 or 2a

An operating nuclear plant may release liquid and gaseous radioactive effluents into the environment in accordance with all applicable regulations. Exposure pathways to the public from plant effluents consist of direct radiation, immersion, inhalation, and ingestion. The types of samples collected are specified in the SQN ODCM, and the resulting SQN's REMP is designed to monitor these pathways. If the choice of Alternative 1 – License Renewal were approved, the SQN REMP would continue to be used during the 20-year license renewal period. Table 3-42 provides REMP minimum required sampling as per the SQN ODCM. (SQN 2009)

Table 3-42. SQN Minimum Required REMP

Exposure Pathway And/or Sample	Number and Location of Samples*	Sampling and Collection Frequency	Type and Frequency of Analysis
Gaseous			
Radioiodine and Particulates	Minimum of five locations.	W (Weekly) Continuous sampler**	Radioiodine canister: Weekly I-131 Particulate sampler: Analyze for gross beta activity ≥ 24 hours following filter change. Perform gamma isotopic analysis on each sample when gross beta activity is > 10 times the yearly mean of control samples. Q: Perform gamma isotopic analysis on composite (by location) sample.
Direct Radiation			
	35 to 40 locations with ≥ 2 dosimeters for continuously measuring and recording dose rate at each location.	Q (Quarterly)	Q: Gamma Dose
Waterborne			
Surface	Two locations.	M (Monthly) Composite***sample	Gamma Isotopic Each composite sample Tritium analysis

Exposure Pathway And/or Sample	Number and Location of Samples*	Sampling and Collection Frequency	Type and Frequency of Analysis
Ground	Two locations.	Q	Gamma isotopic and tritium Analyses of each sample. Gross beta and gamma Isotopic analysis.
Drinking	Minimum of one location. Two locations.	M Composite*** sample M Grab sample	Q Tritium analysis Gross beta and gamma isotopic analysis.
Shoreline sediment locations	Minimum of two locations.	S (Semi-annually)	Gamma isotopic analysis from each sample.
Ingestion			
Milk	Milk from three locations. Samples of broad leaf vegetation at off-site locations of highest D/Q if no milk samples are available.	B**** (Bi-weekly)	Gamma isotopic and I-131 analysis of each sample.
Fish	Two locations.	One sample in season, or at least once per 184 days if not seasonal. One sample representing a commercially important species and one sample representing a recreationally important species.	Gamma isotopic analysis on edible portions.

Exposure Pathway And/or Sample	Number and Location of Samples*	Sampling and Collection Frequency	Type and Frequency of Analysis
Food Products	Minimum of two locations.	At time of harvest. One sample of each of the following or similar classes of food products, as available. 1. Lettuce and/or cabbage 2. Corn 3. Beans 4. Tomatoes	Gamma isotopic analysis on edible portions.

* Sample locations are given in Table 9.1 (ODCM)
** Continuous sampling with sample collection as required by dust loading, but at least once per seven days.
*** Composite samples shall be collected by collecting an aliquot at intervals not exceeding two hours.
**** When animals are on pasture, at least once per 31 days at other times.

If Alternative 2a – New Nuclear Generation were approved, a new REMP would be developed for the new plant and would include the following minimum monitoring activities.

Direct Radiation Monitoring

Monitoring direct radiation would be performed utilizing a network of environmental monitoring stations. Two or more dosimeters in an inner ring would be placed at monitoring locations near the site boundary in each of the 16 meteorological sectors. A second outer ring of dosimeters would be located in each sector at the 4- to 5-mile range from the site. Environmental dosimeter monitoring stations would be placed at a minimum of eight other special interest locations, including at least two control stations. (NRC 1991)

Gaseous Pathway Monitoring

Sampling for air particulates and radioiodine would be performed at three locations: in different sectors; near the site boundary at one location near area population centers; and one control location greater than 10 miles from the site and in the least prevalent wind direction. The gaseous pathway monitoring would be performed with continuous operating air samplers. (NRC 1991)

Waterborne Pathway Monitoring

Surface water sampling would be performed at a control location upstream of the plant and at one location downstream of the plant discharge, beyond but near the mixing zone. (NRC 1991)

Drinking water sampling would be performed at the first potable water supply downstream from the plant. The sampling method and collection frequency utilized for surface water sampling would also be applied to this first downstream drinking water location. The upstream surface water control location would also serve as the control location for monitoring drinking water. Monthly grab samples would be collected from at least two additional water supply systems downstream of the plant. (NRC 1991)

Groundwater sampling would be conducted at one location on-site down gradient from the plant and at a control location up gradient from plant. If site groundwater hydrology data indicate that leaks or spills at the site might impact off-site groundwater, sampling of private wells could be added to the REMP. (NRC 1991)

Samples of shoreline sediment would be collected from the first downstream shoreline recreational use area and possibly from a control location upstream of the plant. (NRC 1991)

Ingestion Pathway

Monitoring for the ingestion pathway would include milk sampling, sampling of fish from the water source, and sampling of vegetables from local gardens identified in the land-use survey. Samples of milk produced for human consumption would be collected in each of three areas within a 5-mile radius identified by the land-use survey to have the highest potential doses and from at least one control location at 10 to 20 miles from the site in the least prevalent wind direction. Sampling of pasture vegetation would be performed at milk producing locations when milk sampling cannot be performed. (NRC 1991)

Fish sampling would be performed on the plant discharge reservoir or river and at a control location. Sampling would consist of one sample of commercially important species and one sample of recreationally important species. (NRC 1991) Sampling of the principal garden vegetables grown in the area would be performed at private gardens identified by the annual land-use survey. Sampling would be performed once during the normal growing season. (NRC 1991)

Land-Use Survey

A land-use survey would be conducted annually. The purpose of the survey is to identify changes in land use within a 5-mile radius of the plant that would require modifications to the REMP or the ODCM. The survey would identify the nearest resident, nearest animal milked for human consumption, and nearest garden of greater than 500 square feet with broadleaf vegetation in each of the 16 meteorological sectors. The results of the annual land-use survey would be documented in the AREOR. (NRC 1991)

Interlaboratory Comparison Program

The laboratory performing the analyses of the REMP samples would participate in an interlaboratory comparison program providing radiological environmental cross-checks representative of the types of samples and analyses in the REMP. The results of the analysis of the comparison program cross-checks would be included in the AREOR. (NRC 1991)

3.17.2. Environmental Consequences

Alternative 1 – License Renewal

For this alternative, there would be no major construction activity. The future expansion of the spent fuel storage capacity for SQN would result in minor additional radioactive dose to construction workers and no measurable radioactive dose to the public. Therefore, the impacts would be expected to be minor.

Operating SQN for the additional 20-year period of license renewal would not cause an increase in annual radioactive effluent releases. The impact of the additional years of operation would be expected to be minor because the releases would be in compliance with federal regulations. The REMP would continue to monitor levels of radiation in the environment around SQN throughout the license renewal period. The health and safety of the public would be ensured. Indirect and cumulative impacts would be expected to be minor. The impact to the public due to operation of SQN would be considered minor. Based on the postulated biota doses presented above and the new studies performed by the NRC, the impact due to operation of SQN for the period of license renewal would be expected to be minor.

SQN controls the release of radioactive liquids and gases in accordance with applicable regulations, and the resulting impacts on biota other than humans are minor. There are no expected direct, indirect, or cumulative impacts from SQN.

Uranium mining and production in off-site areas is a minor impact, but over the long term can result in potential contamination and destruction of geological resources and pollution of lakes, streams, underground aquifers, and the soil.

Under Alternative 1, the shutdown and decommissioning of SQN would be delayed for an additional 20 years. Regardless of which option is chosen, decommissioning will take place in the future. Once the decommissioning process is started, the radioactive effects would change. The shutdown of SQN would stop the generation of new radioactive effluents being released to the environment. Decommissioning activities associated with the dismantlement of the site structures would produce temporary radioactive air emissions and air emissions from dust, concrete, vehicle exhaust, and equipment. All releases of radioactive effluents would be in accordance with applicable regulations, and the impact from those effluent releases would be minor.

Alternative 2 – No Action Alternative

Under the No Action Alternative, SQN would go into shutdown and begin decommissioning at or before the end of the current license expiration dates. The shutdown of SQN would stop the generation of new radioactive effluents being released to the environment. Decommissioning activities associated with the dismantlement of the site structures would produce temporary radioactive air emissions and air emissions from dust, concrete, vehicle exhaust, and equipment. All releases of radioactive effluents would be in accordance with applicable regulations, and the impact from those effluent releases would be minor.

Alternative 2a – New Nuclear Generation

There would be no radioactive effects during the construction of a new nuclear plant unless the construction takes place at the location of another operating nuclear plant, or there are multiple units being built and one unit becomes operational before the other. The radiological impacts from the construction of a new nuclear plant would be of minor significance to the construction workers. Workers who would be in close proximity to the operating nuclear plant would be tracked and monitored (radiation badge) as necessary to meet NRC requirements.

Depending on the type of nuclear technology chosen, the radioactive effects of a new operating nuclear plant would be expected to be potentially less than the SQN current effects. However, because the current effluent releases are already well below all limits and regulations, the impact would remain minor. There would be no expected observable direct or indirect impacts from radioactive liquid or gaseous releases from a new nuclear facility during normal operations. The REMP would be set up for the new nuclear plant to ensure there are no measurable indirect or cumulative effects to the environment off site of the new location or to the public.

Alternative 2b – New Natural Gas-Fired Generation

There would be no radioactive impacts from the operation of the new natural gas-fired plant. There would be no radioactive impacts from the construction of a new natural gas-fired plant.

3.18. Uranium Fuel Effects

Nuclear power plants fueled by uranium produce radioactive wastes in various forms. This section discusses the management, storage, and transportation of radioactive wastes associated with the operation of SQN, including the handling and storage of spent fuel. The potential production of tritium at SQN is also described in this section.

3.18.1. Radioactive Waste

3.18.1.1. Affected Environment

Radioactive waste (radwaste) sources and treatment systems for SQN were described in TVA's 1974 FES for SQN. Section 2.4 states that TVA's policy is to keep the discharge of all wastes from its facilities, including nuclear plants, at the lowest practicable level by using the best and highest degree of waste treatment available under existing technology within reasonable economic limits (TVA 1974a). While this statement is still true, current practices for managing radioactive waste have evolved since the start of commercial operations of SQN.

This section describes the current radwaste systems and practices at SQN along with data showing current volumes and program results. Operation of SQN radwaste is handled by TVA-approved procedures, and the current methods of handling the waste would be continued during the period of license renewal.

The following information also updates and compares the potential for environmental effects from plant construction and operations regarding radwaste for actions of the viable alternatives; Alternative 1 – License Renewal and No Action Alternative 2a – New Nuclear

Generation. For the No Action Alternative 2b – New Natural Gas-Fired Generation, no radwaste would be generated during construction or operation activities.

Liquid Radioactive Waste Treatment Systems

The liquid waste processing system (LWPS) is designed to receive, segregate, process, recycle for further processing, and discharge liquid wastes. The system design considers potential personnel exposure and assures that quantities of radioactive releases to the environment are as low as practicable. Under normal plant operation, the activity from radionuclides leaving the discharge canal is a small fraction of the federal NRC limits (10 CFR Part 20 and Appendix I to 10 CFR Part 50). (TVA 2008a)

All liquids are now routinely processed as necessary for release to the environment. A separate subsystem is provided for handling laboratory samples that may be tritiated and may contain chemicals. The capability for handling and storage of spent demineralizer resins is also provided. Parts of the LWPS are shared by the two plant units. (TVA 2008a)

The LWPS consists of numerous tanks, pumps, sumps, filters, a demineralizer system, and the associated piping, valves, and instrumentation. All tritiated and nontritiated liquid wastes are processed for discharge to the environment. (TVA 2008a)

The LWPS is also designed to process blowdown liquid from the steam generators if a unit has a primary-to-secondary leak coincident with significant fuel defects. The blowdown from the steam generators is passed through the condensate demineralizer or directly to the cooling tower blowdown line. (TVA 2008a)

The radwaste demineralizer system, located in the railway bay, is a portable vendor-owned system that recycles, reprocesses, discharges or removes soluble and suspended radioactive materials from the waste stream via ion exchange and filtration. After the resin and filter media are expended, they are processed for disposal. Filters are air-dried and placed into containers for disposal. (TVA 2008a)

Spent resin is stored in the spent resin storage tank (SRST). To remove spent resins from the storage tank for packaging, the resin is agitated by bubbling nitrogen through the tank. The resin is slurried from the SRST by nitrogen pressure to the railroad bay, where it is received in liners and dewatered prior to shipment off site or prior to storage in the SQN LLRW on-site storage facility. (TVA 2008a)

Radioactive liquid wastes are released from the plant through the cooling tower blowdown line and through the diffuser pond system. (TVA 2008a)

Table 3-43 provides a summary of radioactive liquid releases for the years 2004 – 2008. The resulting total dose for each year is less than 1 percent of the allowed dose limit.

Table 3-43. Annual Radioactive Liquid Releases, 2004 – 2008

Year	Fission and Activation Products (Curies)	Tritium (Curies)	Dissolved and Entrained Gases (Curies)	Total Volume Released (Liters)	Total Body Dose From Liquids (mrem)
2004	2.39e-01	1.45e+03	2.34e-02	1.75e+08	9.36e-03
2005	2.88e-01	1.48e+03	6.99e-01	2.02e+08	7.31e-03
2006	1.87e-01	2.19e+03	2.54e+00	2.39e+08	1.77e-02
2007	1.23e-01	1.87e+03	1.49e-01	3.83e+08	2.85e-02
2008	8.16e-02	1.27e+03	1.04e-02	2.36e+08	1.51e-02

(TVA 2005c; TVA 2006c; TVA 2007e; TVA 2008c; TVA 2009i)

<u>Gaseous Radioactive Waste Treatment Systems</u>

The gaseous waste processing system (GWPS) is designed to remove fission product gases from the reactor coolant and permit operation with periodic discharges of small quantities of fission gases through the monitored plant vent. This is accomplished by internal recirculation of radioactive gases and holdup in the nine gas decay tanks to reduce the concentration of radioisotopes in the released gases. (TVA 2008a)

The GWPS consists of waste-gas compressor packages, nine gas decay tanks, and the associated piping, valves, and instrumentation. The equipment serves both SQN plant units. (TVA 2008a)

The auxiliary services portion of the GWPS consists of an online waste gas analyzer (WGA) and its instrumentation, valves, tubing, a nitrogen supply, and a hydrogen supply manifold with the necessary instrumentation, valves, and piping (TVA 2008a).

The WGA determines the quantity of oxygen and hydrogen in the waste gas tank that is in service. The volume control tank (VCT), pressurizer relief tank (PRT), holdup tanks, and SRST may be analyzed by grab sample as plant conditions require. (TVA 2008a)

The nitrogen and hydrogen supply packages are designed to provide a supply of gas to the nuclear steam supply system. Nitrogen is supplied to the SRST, reactor coolant drain tank, PRT, VCT, gas decay tanks and the holdup tanks. Hydrogen is supplied to the VCT. (TVA 2008a)

Gaseous wastes consist primarily of hydrogen stripped from the reactor coolant during boron dilution and degassing operations, and nitrogen from the closed cover gas system. The components connected to the vent header are limited to those which contain no air or aerated liquids to prevent formation of a combustible mixture of hydrogen and oxygen. (TVA 2008a)

Waste gases discharged to the vent header are pumped to a waste gas decay tank by one of the two waste gas compressors. The compressors may also be used to transfer gas between gas decay tanks. Normal operation of either compressor is in the manual mode. (TVA 2008a)

The decay tank being filled is normally sampled by the WGA, and an alarm alerts the operator to high oxygen content. On the high oxygen signal, the tank must be isolated and operator action is required to direct flow to the standby tank and select a new standby tank. (TVA 2008a)

Before a gas decay tank is discharged to the atmosphere via the plant vent, a gas sample is taken to determine activity concentration of the gas in the tank. The curie content versus change in tank pressure is used to quantify the activity released along with time to determine the off-site dose for the release. To release the gas, the appropriate local manual stop valve is opened to the plant vent, and the gas discharge modulating valve is opened at the GWPS control panel. If there should be a high radioactivity level in the 2-inch discharge line during release, the modulating valve closes. (TVA 2008a)

Gaseous wastes consist primarily of hydrogen stripped from the coolant. During normal gaseous radwaste processing, the gas holdup tank capacity permits at least 60 days decay for radioactive waste gases before discharge. (TVA 2008a)

Gaseous radioactive wastes are released to the atmosphere through vents on the shield building, auxiliary building, turbine building, and service building (TVA 2008a).

Waste gases from the gas decay tanks are discharged to the environment through a shield building vent. Each shield building has one vent. All gases released from the shield building vent, except for the air that passes through the containment purge air exhaust radiation monitors, are processed through high efficiency particulate air (HEPA) filters and charcoal adsorbers prior to release. (TVA 2008a)

Waste gases in the auxiliary building are discharged through the auxiliary building exhaust vent. Under normal operating conditions, gases are continuously discharged through the vent. Under accident conditions the auxiliary building is isolated, and the auxiliary building gas treatment system discharges at a rate of 9,000 cfm to the reactor building exhaust vent. Ventilation air is exhausted from the turbine building through the turbine building vents. (TVA 2008a)

Gaseous wastes from the condenser are discharged through the condenser vacuum exhaust vent. The vent, which is a 12-inch diameter pipe, is located on the turbine building roof and discharges approximately 96 feet above grade. Under normal operating conditions, the discharge flow rate is less than 20 cfm. (TVA 2008a)

Potentially radioactive waste gases from the radiochemical laboratory, titration room, and radiologically controlled area access control area are exhausted to the service building vent. The service building vent is on the service building roof. The vent discharges to the atmosphere approximately 24 feet above grade. Air from the radiochemical laboratory and titration room is exhausted via fume hoods through HEPA filters. (TVA 2008a)

Excess air inside lower containment is exhausted through the reactor building purge vent valves directly into the annulus, where the annulus vacuum control system would discharge the effluent through the auxiliary building exhaust vent (TVA 2008a).

All releases are assumed to be continuous. Releases known to be periodic, e.g., those during containment purging and waste gas decay tank venting, are treated as continuous releases. Releases from the reactor building, turbine building, and auxiliary building vents are treated as ground level. (TVA 2008a) Individuals are exposed to gaseous effluents via the following pathways:

- External radiation from radioactivity in the air and on the ground.
- Inhalation.
- Ingestion of beef, vegetables, and milk.
- Tritium transpiration.

No other additional exposure pathway has been identified that would contribute 10 percent or more to either individual or population doses. (TVA 2008a) Table 3-44 provides a summary of quarterly gaseous total body dose for the years 2004 – 2008. The resulting quarterly total dose for each year is less than 1 percent of the allowed dose limit.

Table 3-44. Quarterly Gaseous Total Body Dose, 2004 – 2008

Year	Total Body 1st QTR (mrem) (Limit = 7.5 mrem/qtr)	Total Body 2nd QTR (mrem)	Total Body 3rd QTR (mrem)	Total Body 4th QTR (mrem)
2004	6.52e-03	1.90e-02	1.25e-02	4.77e-02
2005	9.36e-03	1.55e-02	1.06e-02	1.01e-02
2006	7.79e-03	3.88e-02	2.91e-02	3.56e-02
2007	1.92e-02	1.38e-02	2.25e-02	1.76e-02
2008	7.12e-03	9.01e-03	1.62e-02	6.63e-03

(TVA 2005c; TVA 2006c; TVA 2007e; TVA 2008c TVA 2009i)

Table 3-45 provides a summary of total (individual) annual dose from all sources (liquids and gases) for the years 2004 – 2008. The resulting total annual dose for each year is less than 1 percent of the allowed dose limit. Therefore, the impact from all radioactive effluent releases released from SQN is minor and would continue to be minor during the period of license renewal.

Table 3-45. Total Dose From All Sources, 2004 – 2008

Year	Total Dose (mrem)	% of Limit (limit = 25 mrem)
2004	1.16e-01	0.46
2005	1.35e-01	0.54
2006	2.29e-01	0.92
2007	1.50e-01	0.60
2008	7.56e-02	0.30

(TVA 2005c; TVA 2006c; TVA 2007e; TVA 2008c; TVA 2009i)

The off-site exposure to individuals from gaseous effluents released during normal operation of SQN is limited by 10 CFR Part 50 Appendix I and 40 CFR Part 190 (TVA 2008a).

Solid Radioactive Wastes

The slurries and solid radwaste, including resin and evaporator concentrates, produced by SQN are prepared for shipment or for temporary on-site storage in compliance with the requirements in 10 CFR Part 61, 10 CFR Part 71, and 49 CFR Parts 170 through 178. Solid wastes would be processed by the solid waste system. (TVA 2008a)

Waste inputs are divided into two categories: DAW and wet active waste (WAW). DAW and WAW inputs are products of the plant operation and maintenance. DAW is further subdivided into compressible and noncompressible wastes. Solid compressible wastes include paper, clothing, rags, mop heads, rubber boots, and plastic. Noncompressible wastes include tools, mop handles, lumber, glassware, pumps, motors, valves, and piping. WAWs are primarily composed of spent resins. The sources for spent resins are the SRST and the radwaste demineralizer. (TVA 2008a)

When sufficient spent resin is accumulated in the SRST, the appropriate valves necessary to transfer spent resin to the liner filling area in the railroad access bay are opened except for the liner fill valves. The SRST is then pressurized with nitrogen. The liner filling valves are then opened, and the resin is forced into the liner. Loading is accomplished with the casks mounted on a truck or trailer bed. The truck or trailer is located in the auxiliary building railroad bay. The cask with a disposable liner is filled from the spent resin tank. The spent resins are dewatered to meet the free-standing water limitations at licensed disposal facilities. Several types of shipping casks may be used. All casks have been licensed pursuant to the general license provisions of paragraph 71.12(b) of 10 CFR Part 71. (TVA 2008a)

Spent resins from the radwaste demineralizer system are sluiced to a transportable liner or high integrity container (HIC) inside a shipping container within the auxiliary building railroad bay area and dewatered to meet the disposal facilities' free-standing water limitations. The dewatered resins and disposable liners are prepared for shipment or temporary on-site storage. (TVA 2008a)

Spent resins from the condensate polishing system are transferred directly to a disposal liner (radwaste) or suitable container (non-radwaste) from the resin storage tank. The disposal liner or container is adjacent to the condensate polishing system building. After transfer of the resins is complete, the liner or container is dewatered and prepared for shipment or temporary on-site storage. (TVA 2008a)

The waste packaging area is provided for receiving, sorting, and compacting DAW. Bagged and/or boxed DAW collected throughout the plant is brought to the waste packaging area for final packaging into 55-gallon drums or metal boxes. Compressible trash like paper, clothing, rags, plastic, etc., is collected and compacted or maybe transported to a contracted broker/processor for processing, packaging, and/or subsequent disposal. Items such as tools, mop handles, valves, motors, piping, lumber, and some compressible materials are packaged, sealed, and stored until shipped for off-site disposal. Collected waste may also be sent to a contracted broker/processor. Active waste filters are packaged when necessary in HICs. If the radiation levels of the containers are high enough to require shielding, the containers are transported in shielded truck trailers or casks similar to those used to transport liners containing bulk quantities of dewatered resins. (TVA 2008a)

The mobile solidification system (MSS) is a portable solidification unit provided under a vendor service contract. The MSS combines and mixes radioactive wastes (concentrates and liquid wastes) with solidification agents and needed additives to solidify the waste. The solidification is done in accordance with a process control program to ensure that each batch of waste is properly solidified. Only solidification agents (such as cement) that have been approved by licensed disposal facilities are used. The waste is solidified in a disposable liner and prepared for shipment or temporary on-site storage. The disposable liners are equipped with internal mixers to provide uniform mixing. The mobile solidification system is in the auxiliary building railroad bay area when the MSS is utilized. Necessary service connections have been provided in the railroad bay to support the MSS. (TVA 2008a)

Radioactive plant filters are usually packaged in HICs or 55-gallon drums. The filter elements are remotely or manually removed from the filter housing. In-plant transportation shielding is provided as required. Radioactive filter elements are drummed and stored in a shielded transportation cask or drum shield prior to shipment for disposal. The low activity level filter elements may be handled as intermediate activity level elements, or they may be stored prior to shipment for disposal. (TVA 2008a)

In order to provide storage for LLRW that cannot be shipped, an on-site storage facility (OSF) has been constructed. This facility is located on a 16-acre site within the SQN site. The grade elevation is approximately 730 feet, which is above the probable maximum flood elevation. The facility is comprised of individual buildings called modules. Each module is designed to contain packaged radwaste generated at SQN and WBN Unit 1, and is segmented into four compartments. All of the modules are above-ground, safety-related structures of reinforced concrete. The modules are designed to resist loads resulting from extreme environmental events, such as high winds, tornadoes, and seismic events. The structural characteristics of the OSF meet or exceed the criteria applicable to SQN. The entire OSF is enclosed within an access-controlled security fence. (TVA 2008a)

Most radwaste is classified as Class A, Class B, or Class C (minor volumes are classified as greater than Class C). Class A includes both DAW and WAW. Classes B and C are normally WAW. The majority of LLRW generated would be Class A waste and can be shipped to Oak Ridge, Tennessee, for reduction, packaging, and shipping to a Class A disposal facility such as Energy Solutions LLC in Clive, Utah. Class B and C wastes constitute a low percentage by volume of the total LLRW and are currently stored in the OSF at SQN. The OSF has sufficient capacity to store the anticipated volume of Class B and C wastes that would be produced at SQN and WBN during the license renewal period. Shipment of solid waste from SQN for the years 2004 – 2008 is tabulated in Table 3-46.

Table 3-46. Total Volume of Shipped Solid Waste, 2004 – 2008

Year	Waste Type	Annual Volume Shipped (m^3)
2004	Spent Resins, Filter Sludges, Evaporator Bottoms	6.19E+01
	DAW, Compressible Waste, Contaminated Equipment	5.56E+01

Year	Waste Type	Annual Volume Shipped (m^3)
	Irradiated Components, Control Rods	None
	Other: Mechanical Filters and Tank Residue	1.70E+01
2005	Spent Resins, Filter Sludges, Evaporator Bottoms	6.81E+00
	DAW, Compressible Waste, Contaminated Equipment	2.87E+01
	Irradiated Components, Control Rods	None
	Other: Mechanical Filters and Tank Residue	3.41E+00
2006	Spent Resins, Filter Sludges, Evaporator Bottoms	2.21E+01
	DAW, Compressible Waste, Contaminated Equipment	1.57E+01
	Irradiated Components, Control Rods	None
	Other: Mechanical Filters and Tank Residue	3.41E+00
2007	Spent Resins, Filter Sludges, Evaporator Bottoms	8.98E+00
	DAW, Compressible Waste, Contaminated Equipment	1.45E+02
	Irradiated Components, Control Rods	None
	Other: Mechanical Filters and Tank Residue	None
2008	Spent Resins, Filter Sludges, Evaporator Bottoms	8.98E+00
	DAW, Compressible Waste, Contaminated Equipment	1.21E+02
	Irradiated Components, Control Rods	None
	Other: Mechanical Filters and Tank Residue	3.41E+00

(TVA 2005c; TVA 2006c; TVA 2007e; TVA 2008c; TVA 2009i)

3.18.1.2. Environmental Consequences

Alternative 1 – License Renewal

Under Alternative 1, during the license renewal period, radwaste would continue to be produced in the manner and annual volumes currently generated at SQN, as described above. There would be no change in the types or rates of liquid, gaseous, or solid wastes generated during the license renewal period. The total volumes of each type of radioactive waste would increase because there would be an additional 20 years of operation. The management, handling, storage, and shipping of radwaste would remain consistent with current practice. All applicable federal regulations would be followed.

SQN would continue to release radioactive liquids and gases to the environment in accordance with, and below the limits of, federal regulation. Impacts to the environment from releases of radioactive liquids and gases are minor and would continue to be minor during the license renewal period.

Solid radwaste would continue to be handled in accordance with TVA-approved procedures, which ensure that all federal regulations and limits pertaining to solid radwaste are met. During the license renewal period, SQN would continue to be available to accept the same types of radwaste currently transported from WBN Unit 1. Additionally, the SQN OSF would have sufficient capacity throughout the license renewal period to accept radwaste from WBN Unit 2, at similar annual volumes as currently generated at WBN 1, should TVA decide to transport WBN Unit 2 radwaste to SQN. Radwaste placed in the SQN OSF from SQN and WBN would be managed to comply with annual and lifetime curie and dose rate limitations. Therefore, impacts to the public and the environment resulting from processing, storage, and transportation of solid radwaste, including cumulative effects of waste storage from WBN are minor, and would continue to be minor during the license renewal period.

The increased volume of radwaste generated during the 20-year period of license renewal would result in a greater volume disposed of in a licensed landfill. The additional volume would remain a minor impact on the available landfill capacity, and would not result in substantial cumulative impacts on licensed landfills.

When SQN finally shuts down at end of the current license or the end of the license renewal period, generation of radwaste would cease. During decommissioning, the plant would ship all stored radioactive material to be processed or to its final disposal. The volume of stored radwaste shipped would be larger at the end of the 20-year license renewal period than it would be should the licenses not be renewed. The radioactive waste from activated components (piping, valves, reactor vessel, etc.) and structures (activated rebar, concrete, etc.) that would be removed during decommissioning would be approximately the same whether it were at the end of the current license or the end of the license renewal period.

Alternative 2a – New Nuclear Generation

Under Alternative 2a, SQN would be shut down at the end of the current license period. The effects of removing stored radwaste would be as described above. However, the volume of radwaste to be removed would be less.

Under Alternative 2a, a new nuclear power plant would produce radwaste in the same basic processes as SQN currently does. Depending upon the specific technology selected for a potential new facility, the radwaste systems would be constructed to the approved design requirements. Those design requirements ensure the system would be able to handle and process all the radwaste in accordance with all applicable federal regulations and would be expected to be similar to the processes described for SQN. Similar to SQN, the environmental impacts of radwaste handling, storage, and transportation are expected to be minor. In fact, those impacts may be less from a new facility than from SQN, if radioactive waste volumes were to decrease due to advanced design, equipment, and programs in the new facility.

Alternative 2b – New Natural Gas-Fired Generation

There are no impacts from radwastes during construction of this type of power generation facility, and there are no impacts from radwastes during operation of this type of power generation facility.

3.18.2. Spent Fuel Storage

3.18.2.1. Affected Environment

SQN has constructed an on-site ISFSI facility at SQN. SQN needed the ISFSI to continue operation of the units because the on-site spent fuel pools were to reach maximum capacity in 2004. The additional on-site storage capacity was needed due to delays in a licensed DOE facility becoming available; DOE is mandated to take possession of spent fuel and provide a permanent disposal facility for all spent fuel. The need to expand on-site spent fuel storage at TVA nuclear plants was addressed when DOE prepared the tritium production FEIS (DOE 1999). That DOE FEIS analyzed spent fuel storage needs at Watts Bar Nuclear Unit 1, SQN, and BLN Units 1 and 2, and included a thorough review of the environmental effects of constructing and operating an on-site ISFSI.

The existing ISFSI was constructed on approximately 4.5 acres of previously graded site (TVA 2000b) within the SQN protected area. SQN uses concrete cask systems for storage. The ISFSI pad site has a maximum capacity of 90 HOLTEC Hi-Storm 100 (S) B casks with an effective capacity of 86 casks (four spaces are left empty to allow for cask shuffling). The HOLTEC-designed MPC-32 is currently used with the HOLTEC casks. (TVA 2000b)

Based on TVA's review of the existing SQN ISFSI, the following environmental issues were identified:

- Radioactive dose to workers.
- Radioactive dose to the public.
- Management and disposal of solid and hazardous waste.
- Transportation.
- Design, siting, and construction of the ISFSI cask storage pads.

TVA determined there were no significant adverse impacts to the environment associated with construction and operation of the existing ISFSI (TVA 2000b).

Industry experience with spent fuel storage, coupled with supplemental studies of the integrity of pool and dry storage systems, indicates that spent fuel can be stored safely on site with minimal environmental impacts (NRC 1996). NRC has made a generic determination that, if necessary, spent fuel generated in any reactor can be stored safely and without significant environmental impact for at least 30 years beyond the licensed life for operation (which may include the term of a revised or renewed license) of that reactor at its spent fuel storage basin or at either on-site or off-site ISFSIs (10 CFR 51.23 (a)).

Alternative 1 – License Renewal

Under Alternative 1, spent fuel assemblies would continue to be produced in the manner and volumes currently generated at SQN and described above. The SQN ISFSI would continue to be operated in accordance with all applicable regulations, which are designed to protect the public and the environment. Operation of the ISFSI results in negligible impacts to the public.

If SQN is approved for license renewal and DOE still is not taking possession of spent fuel, the current capacity for storage of spent fuel is expected to be reached in 2026. Figure 3-17 shows the capacity projections for spent fuel storage and the resulting need for additional storage, based on the approval of the SQN's LRA. At that time, SQN would need to expand the spent fuel storage capacity, and it is likely that TVA would add a separate concrete storage pad. This storage pad construction would be started in approximately 2021 to ensure additional space is available when needed. (Dennis Lundy, TVA, personal communication, March 11, 2010) Dose limits would be maintained in compliance with federal regulations.

Like the construction and operation of the current ISFSI, construction and use of an additional concrete storage pad is expected to have only minor impacts. There would be minor direct impacts from the radiation doses from the ISFSI for the on-site workers and for the people in the surrounding area. The indirect and cumulative dose impacts would be minor.

3.18.2.2. Environmental Consequences

Alternative 2a – New Nuclear Generation

Under Alternative 2, generation of spent fuel at SQN would be stopped. However, the operation of the SQN ISFSI would continue under its separate general license until the DOE takes possession of the spent fuel at the SQN ISFSI facility and it can be decommissioned in a separate project.

For a new nuclear generating facility, spent fuel typically would be stored in a spent fuel pool. It is not expected that an ISFSI would be included in the initial construction.

Once a new nuclear power plant is operating, it would produce spent fuel in the same basic processes as described for SQN. The environmental impacts of a new facility may potentially be less than SQN due to advanced design, equipment, and programs from the new facility. The environmental impacts are expected to be minor for spent fuel storage.

Alternative 2b – New Natural Gas-Fired Generation

No radwaste or spent fuel would be generated during construction or operation of this type of facility. Therefore, there would be no impacts from radwastes or spent fuel.from construction or operation of this type of power generating facility. If SQN is shut down, generation of spent fuel at SQN would be stopped. However, the operation of the SQN ISFSI would continue under its separate general license until the DOE takes possession of the spent fuel at the SQN ISFSI facility and it can be decommissioned in a separate project.

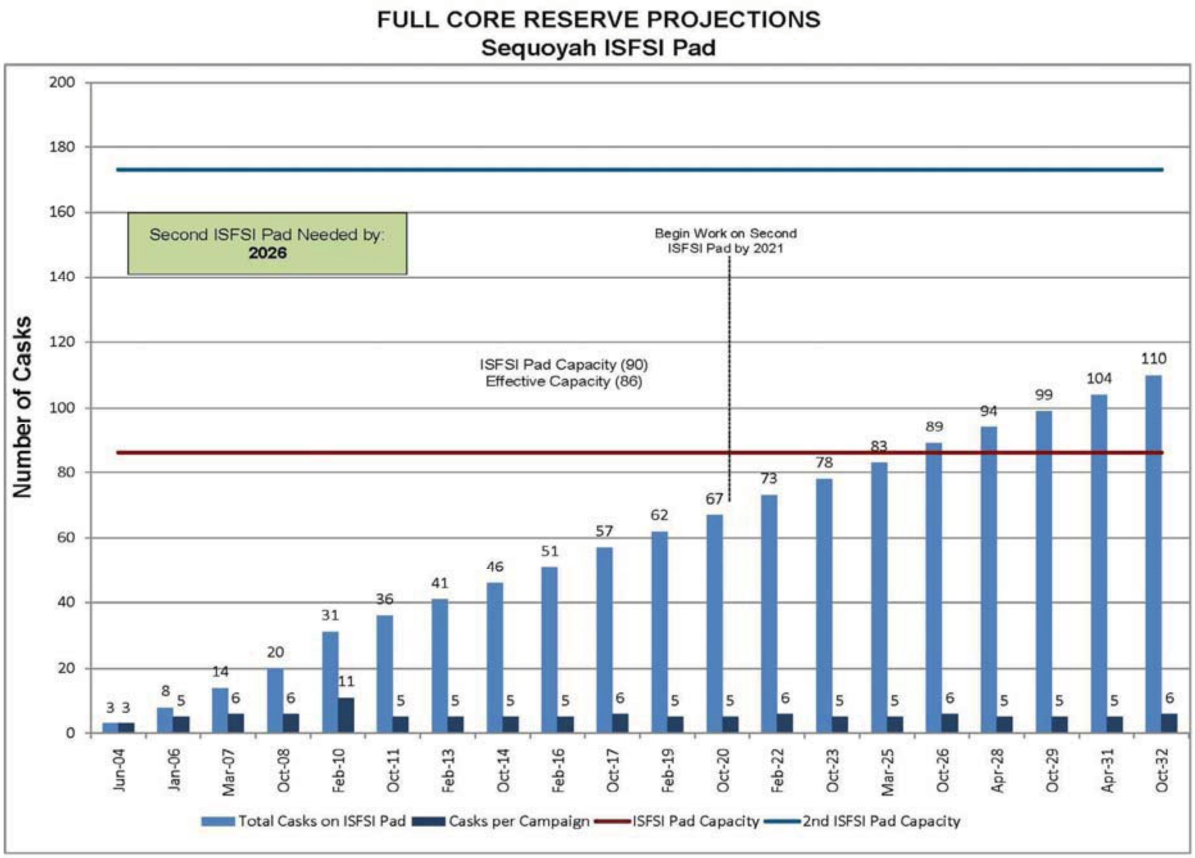

Figure 3-17. Spent Fuel Projections

3.18.3. Transportation of Radioactive Materials

3.18.3.1. Affected Environment

Transportation of radioactive materials is required to operate any nuclear facility. SQN transports radioactive materials currently and would continue to do so during the license renewal period if license renewal is approved by the NRC. This section would also apply to Alternative 2a – New Nuclear Generation (based on the type of nuclear technology chosen) if it were to be constructed and operated. This section is not applicable to the Alternative 2b – New Natural Gas-Fired Generation.

Table S-4 in 10 CFR §51.52 includes the NRC evaluation of the environmental effects of transportation of fuel and waste to and from LWRs. Note "a" of Table S-4 states that data for the table come from the *Environmental Survey of Transportation of Radioactive Materials to and from Nuclear Plants* in WASH-1238, December 1972, and Supplement 1 NUREG-75/038, April 1975, *Environmental Survey of Transportation of Radioactive Materials to and from Nuclear Power Plants*, and the table states that the radiological risk due to effects of accidents in transportation was determined to be minor.

The table addresses two categories of environmental considerations: (1) normal conditions of transport and (2) accidents in transport. (10 CFR Part 51) Subparagraphs 10 CFR §51.52(a) (1) through (5) delineate specific conditions the reactor licensee must meet to use Table S-4 as part of its environmental evaluation to determine impacts. The conditions in paragraph (a) of 10 CFR §51.52 establishing the applicability of Table S-4 relate to:

- Reactor core thermal power.
- Fuel form, fuel enrichment.
- Fuel encapsulation.
- Average fuel irradiation.
- Time after discharge of irradiated fuel before shipment.
- Mode of transport for unirradiated fuel.
- Mode of transport for irradiated fuel.
- Radioactive waste form and packaging.
- Mode of transport for radioactive waste other than irradiated fuel.

Transportation of Unirradiated Fuel

Subparagraph 10 CFR §51.52(a) (5) requires that unirradiated fuel be shipped to the reactor site by truck. Table S-4 includes a condition that the truck shipments not exceed 73,000 pounds as governed by federal or state gross vehicle weight restrictions. New fuel assemblies are transported to the SQN site by truck, in accordance with USDOT and NRC regulations.

The details of the new fuel container designs, shipping procedures, and transportation routes depends on the requirements of the suppliers providing the fuel fabrication and support services. Truck shipments do not exceed the applicable federal or state gross vehicle weight restrictions.

Transportation of Irradiated Fuel

Spent fuel assemblies are removed from the reactor and placed into the spent fuel pool during each refueling outage. It is expected that the spent fuel would remain on site for a minimum of five years between removal from the reactor and shipment off site. Packaging of the fuel for off-site shipment would comply with applicable USDOT and NRC regulations for transportation of radioactive material. If transportation is to a DOE repository, by law, DOE is responsible for the transportation of spent fuel from reactor sites to a repository, as shown in the Nuclear Waste Policy Act of 1982, Section 302, and DOE makes the decision on the transport mode.

The following subsections compare the SQN site with federal requirements (10 CFR §51.52[a]).

Reactor Core Thermal Power

Subparagraph 10 CFR §51.52(a)(1) requires that the reactor have a core thermal power level not exceeding 3,800 MW. SQN has a thermal design reactor core heat output rating of 3,455 MW and meets this condition (TVA 2008a).

Fuel Form

Subparagraph 10 CFR §51.52(a)(2) requires that the reactor fuel be in the form of sintered UO_2 pellets. SQN uses a sintered UO_2 pellet fuel form and would meet this requirement. (TVA 2008a)

Fuel Enrichment

Subparagraph 10 CFR §51.52(a)(2) requires that the reactor fuel have a uranium-235 enrichment not exceeding 4.0 weight percentage. SQN's reactor fuel is assumed to be enriched to 5.0 weight percentage of U-235 for standard fuel (TVA 2008a), which exceeds the 4.0 weight percentage U-235 requirement. The NRC has generically considered the environmental impacts of spent nuclear fuel with U-235 enrichment levels up to 5.0 weight percent and determined that the environmental impacts of spent nuclear fuel transport are bounded by the impacts listed in Table S-4 provided that more than five years has elapsed between removal of the fuel from the reactor and any shipment of the fuel off site. (NRC 1999b)

Five years is the minimum decay time expected before shipment of irradiated fuel assemblies from SQN. In addition, NRC specifies five years as the minimum cooling period when it issues certificates of compliance for casks used for shipment of power reactor fuel as stated in NUREG-1437, Addendum 1 (NRC 1999b). SQN has sufficient land to expand the ISFSI if needed and provide storage capacity to accommodate five-year cooling of irradiated fuel prior to any transport off site even with a 20-year extension of operations. Therefore, SQN meets the requirements of Subparagraph 10 CFR §51.52(a)(2).

Fuel Encapsulation

Subparagraph 10 CFR §51.52(a)(2) requires that the reactor fuel pellets be encapsulated in Zircaloy rods. SQN's reactor fuel is encapsulated in ZIrcaloy fuel rods. Therefore, SQN would meet this requirement. (TVA 2008a)

Average Fuel Irradiation

Subparagraph 10 CFR §51.52(a)(3) requires that the average fuel assembly burnup not exceed 33,000 megawatt-day (MWD)/metric ton uranium (MTU). The average fuel assembly burnup for SQN exceeds this requirement with a design burnup of 48,000 MWD/MTU (TVA 2008a). The NRC has generically considered the environmental impacts of irradiation levels up to 62,000 MWD/MTU and found that the environmental impacts of spent nuclear fuel transport are bounded by the impacts listed in Table S-4 provided that more than five years has elapsed between removal of the fuel from the reactor and any shipment of the fuel off site. SQN would meet this requirement.

Transportation

Subparagraph 10 CFR §51.52(a) (5) allows for truck, rail, or barge transport of irradiated fuel. This requirement can be met for SQN. DOE is responsible for spent fuel transportation from reactor sites to the repository and makes decisions on transport mode as stated in 10 CFR §961.1. Should an off-site repository be established, the heat load of the spent fuel shipping casks and the doses to the general public would be bounded by the conditions of Table S-4. Should a TVA-shared facility or a reprocessing plant be established, transportation would comply with applicable USDOT and NRC regulations for transportation of radioactive material.

3.18.3.2. Environmental Consequences

The risks of transporting radioactive materials are bound by Table S-4. Because SQN meets the requirements of Table S-4, the environmental impact of any transportation of irradiated fuel would be minor.

Transportation impacts of all types of radioactive waste would be expected to be minor for Alternative 1 – License Renewal. No Action Alternative 2a – New Nuclear Generation would be bound by the same transportation criteria for radioactive wastes as SQN. A new nuclear facility would be designed to meet all federal regulations to protect the health and safety of the public and keep potential impacts minor.

3.18.4. Potential Tritium Production by SQN for the DOE

SQN's operating licenses for Units 1 and 2 have provisions for the production of tritium in the reactor units. Tritium production could be performed at just one reactor or at both reactors as needed. SQN has not actually produced tritium for the DOE, but it is possible that the demand for tritium would increase to the point that it would become necessary to begin production in the future. The production of tritium was evaluated in detail by the DOE in its tritium production FEIS. (DOE 1999) TVA was a cooperating agency in development of that FEIS, and adopted it in May 2000.

The production of tritium in a CLWR is technically straightforward and requires no elaborate, complex engineering development and testing program. The entire nation's supply of tritium has been produced in reactors. Most existing commercial PWRs utilize 12-foot-long rods containing an isotope of boron (boron-10) in ceramic form in the reactor fuel assemblies. These rods are sometimes called burnable absorber rods. The rods are inserted into reactor fuel assemblies to absorb excess neutrons produced by the uranium fuel in the fission process for the purpose of controlling power in the core at the beginning of an operating cycle. DOE's tritium program has developed another type of burnable absorber rod in which neutrons are absorbed by a lithium aluminate ceramic rather than boron ceramic. These TPBARs would be placed in the same locations in the fuel assemblies as the standard burnable absorber rods. There is no fissile material (uranium or plutonium) in the TPBARs. (DOE 1999)

When neutrons strike the lithium aluminate ceramic material in a TPBAR, tritium is produced. This tritium is captured almost instantaneously in a solid zirconium material in the rod, called a "getter." The solid material that captures the tritium as it is produced in the rod is so effective that the rod would have to be heated in a vacuum at much higher temperatures than normally occur in the operation of a light water reactor to extract the tritium for eventual use in the nuclear weapons stockpile. The TPBARs containing tritium would be removed and processed off site. (DOE 1999)

Some tritium is expected to permeate through the TPBARs during normal operation, which would increase the quantity of tritium in the reactor's coolant water system. Because tritium is a type, or isotope, of the hydrogen atom, once tritium is in the reactor's coolant water system, it could combine with oxygen to become part of a water molecule and eventually be released to the environment. (DOE 1999) Actual experience at WBN has shown that permeation is greater than that predicted by DOE in its tritium production FEIS. Consequently, TVA has managed the number of TPBARs per reload at WBN to ensure that actual effluent releases and subsequent off-site dose consequences were bounded by the DOE tritium production FEIS for these parameters. Should TVA use TPBARs at SQN, TVA would similarly manage the number of TPBARs to ensure effluents and off-site dose consequences were bounded by the DOE tritium production FEIS.

The following modifications have been implemented or planned at SQN: (1) four rod cluster control assemblies (RCCAs) were relocated from core periphery control rod drive mechanism position to provide improved reactivity control, (2) improved monitoring instrumentation was installed in the waste disposal system, (3) a new sampling system was provided in the auxilary and shield buildings' exhaust vents, (4) additional grab sampling capability, and (5) installed TPBAR consolidation equipment in the spent fuel pool cask loading area. Additional modifications may be needed to support future production, if the decision is made to do so.

In a tritium production mode, SQN would continue to comply with all federal, state, and local requirements. There would be some incremental impacts in the following areas: radiation exposure (worker and public), spent fuel generation, and LLRW generation, but any exposure would remain well below NRC limits. Tritium production could also change the accident and transportation risks associated with these reactors. (DOE 1999) Each of these incremental impacts is discussed below.

Radiation Exposure

Tritium production could increase average annual worker radiation exposure by approximately 0.82 – 1.1 mrem per year. The resultant dose would be well within regulatory limits. Radiation exposure to the public from normal operations could also increase, but would still remain well within regulatory limits. Considering tritium production at either SQN Unit 1 or Unit 2, the total dose to the population within 50 miles could increase by a maximum of 1.9 person-rem per year. Statistically, this equates to one additional fatal cancer approximately every 1,000 years from the operation of SQN Unit 1 or Unit 2. (DOE 1999)

Spent Fuel Generation

The impacts of tritium production on the quantity of spent fuel generated have been addressed in the 1999 DOE FEIS for tritium production. Additional spent fuel would be generated at SQN Unit 1 or Unit 2, or both units. In the average 18-month fuel cycle, spent fuel generation could increase from approximately 80 spent fuel assemblies up to a maximum of 140, a 71 percent increase in spent fuel generation. Spent fuel would continue to be handled and stored at SQN in the spent fuel pool and ISFSI. Storing the additional spent fuel should have minor impacts. The impacts of accidents associated with dry cask spent fuel storage would be small. If fewer than approximately 2,000 TPBARs were irradiated, there would be no change in the amount of spent fuel produced by the reactors. (DOE 1999) Should TVA decide to produce tritium at SQN, the potential increase in spent fuel generation and any necessary adjustment in the timing of the ISFSI expansion would be assessed at that time.

Low-Level Radioactive Waste Generation

Tritium production at SQN Unit 1 or Unit 2 would generate approximately 0.43 additional cubic meters per year of LLRW. This would be a 0.1 percent increase in LLRW generation per reactor unit. Such an increase would amount to less than 1 percent of the LLRW to be disposed of at the Clive, Utah, disposal facility. (DOE 1999)

Accident Risks

Tritium production could change the potential risks associated with accidents at SQN Unit 1 or Unit 2. These changes would be small. Potential impacts from accidents were determined using computer modeling. If a limiting DBA occurred, tritium production at the 3,400 TPBAR level would increase the individual risk of a fatal cancer by 2.1 X 10 -9 to an individual living within 50 miles of SQN Unit 1 or Unit 2. Statistically, this equates to a risk to an individual of one additional fatal cancer approximately every 490 million years from tritium production. For a beyond-DBA (an accident that has a probability of occurring approximately once in a million years or less), tritium production would result in small changes in the consequences of an accident. This is due to the fact that the potential consequences of such an accident would be dominated by radionuclides other than tritium. (DOE 1999)

Transportation

Tritium production at SQN Unit 1 or Unit 2 would necessitate additional transportation to and from the reactor plants. Most of the additional transportation would involve nonradiological materials. Impacts would be limited to toxic vehicle emissions and traffic fatalities. At each of these reactors, the transportation risks would be less than one fatality per year. Radiological materials transportation impacts would include routine and accidental doses of radioactivity. The risks associated with radiological materials transportation would be less than one fatality per 100,000 years. (DOE 1999)

Table S-2 of the DOE FEIS, *Summary of Environmental Consequences for the CLWR Reactor Alternatives*, provided the following analysis. The FEIS concluded that there would be no operational changes and no change in environmental impacts associated with the production of tritium by SQN. Given 1,000 TPBARs, the maximum potential increase in annual gaseous radioactive emissions of tritium would be 100 curies; given 3,400 TPBARs, 340 curies. Given 1,000 TPBARs, the maximum potential increase in annual liquid radioactive effluents of tritium would be 900 curies; given 3,400 TPBARs, 3,060 curies. There would be a less than a 1.0 percent impact on regional economy. Workers annual dose increase (1,000 TPBARs vs. 3,400 TPBARs) ranges from 0.24 mrem to 0.82 mrem, while the maximally exposed individual would increase in the range of 0.017 mrem to 0.057 mrem. The 50-mile population dose would increase in the range of 0.60 person-rem to 1.9 person-rem. (DOE 1999)

Conclusion on Tritium Production

Depending on events, SQN may be used to produce tritium for the DOE although no decision has been made to do so. Plant licenses already have been amended.

Environmental analyses show there would be only minor impacts from the production of tritium.

SQN could produce tritium until the time of license expiration for the current license or until the end of the license renewal period. The impacts would be minor for either option. Tritium production would end with the shutdown of SQN. Tritium production from Alternative 2a – New Nuclear Generation would not normally be considered as part of licensing a new nuclear facility. There would be no expected impact from tritium production at a new nuclear facility. Tritium production from Alternative 2b – New Natural Gas-Fired Generation would not be applicable.

3.19. Nuclear Plant Safety and Security

This section assesses the environmental impacts of postulated accidents involving radioactive materials at SQN and plant security, including protection against intentional destructive acts. It is divided into three subsections that address DBAs, severe accidents, and plant security.

- DBAs (Section 3.19.1)
- Severe accidents (Section 3.19.2)
- Plant security (Section 3.19.3)

3.19.1. Design-Basis Accidents

3.19.1.1. Affected Environment

The potential consequences of postulated accidents are determined based on the use of a set of DBAs that are representative of the reactor designs. The set of DBAs considered for SQN covers the following:

- Postulated loss of A.C. power to the plant auxiliaries (TVA 2008a).
- Postulated waste gas decay tank rupture (TVA 2008a).
- Postulated loss of coolant accident (TVA 2008a).
- Postulated steam line break (TVA 2008a).
- Postulated steam generator tube rupture (TVA 2008a).
- Postulated fuel handling accident (TVA 2008a).
- Postulated rod ejection accident (TVA 2008a).

A high degree of protection against the occurrence of postulated accidents is provided through quality design, manufacture, and construction, which ensure the high integrity of the reactor system and associated safety systems. Deviations from normal operations are handled by protective systems and design features that place and hold the plant in a safe condition. It is conservative to postulate that serious accidents may occur, even though they are extremely unlikely. Engineered safety features are installed to prevent and mitigate the consequences of postulated events that are judged credible. The probability of occurrence of accidents and the spectrum of their consequences to be considered from an environmental impact standpoint have been analyzed using best estimates of probabilities, realistic fission product releases, and realistic transportation assumptions.

Personnel with specific duties and responsibilities in the SQN radiological emergency plan program receive instruction in the performance of their duties and responsibilities during accidents and emergencies. Drills and exercises are conducted regularly to develop and maintain the key skills required for emergency response by these highly trained personnel. Drills are performed regularly for such accident conditions as fire, medical emergencies, radiological protection, and emergency communications.

Selection of Accidents

The evaluations presented in the SQN UFSAR (TVA 2008a) use conservative assumptions for the purpose of comparing calculated site-specific doses resulting from a hypothetical release of fission products. Realistically computed doses that would be received by the population from the postulated accidents would be significantly less than those presented in the SQN UFSAR. The DBAs cover a spectrum of events, including those of relatively greater probability of occurrence and those that are less probable but with greater consequences. DBAs are postulated accidents that a nuclear facility must be designed and built to withstand without loss to the systems, structures, and components necessary to ensure public health and safety.

Evaluation Methodology

The basic scenario for each accident is that radioactivity is released at the accident location inside a building and eventually released to the environment. Chapter 15 of the SQN UFSAR presents conservative radiological consequences for the accidents identified.

Among the conservative assumptions is the use of time-dependent X/Q values and conservative assumptions for the radionuclide activity in the core and coolant, the types of radioactive materials released, and the release paths to the environment in order to calculate conservative dose estimates. Details on the methodologies and assumptions pertaining to each of the accidents, such as activity release pathways and credited mitigation features, are provided in Chapter 15 of the UFSAR. The X/Q values used to calculate conservative design-basis EAB and LPZ doses for SQN are obtained from Chapter 15 of the UFSAR.

3.19.1.2. Environmental Consequences

Alternative 1 – License Renewal

SQN site-specific radiological consequences of DBAs are shown in Tables 3-47 through 3-54. For each accident, the EAB dose shown is for a two-hour period, and the LPZ dose shown is the integrated dose for the duration of the accident. SQN doses are presented as thyroid and whole-body doses (calculated in rem) and as the TEDE as well. The TEDE is the sum of the committed effective dose equivalent (CEDE) and the effective dose equivalent (EDE). (TVA 2008a)

The results presented in Tables 3-46 through 3-53 provide realistically estimated radiological consequences of the postulated accidents for SQN. In all cases, the doses to an assumed individual at the EAB and LPZ are a fraction of the dose limits specified. It is concluded from the results of this realistic analysis that the environmental risks due to postulated radiological accidents are minor. (TVA 2008a) Continued operation of SQN during the period of license renewal does not change the analysis of accidents and the potential impacts of postulated accidents would remain minor. Design analysis of an NRC-approved alternative new nuclear plant would also ensure the health and safety of the public, and if a new nuclear plant were to be built, it would be within the design requirements for all dose limits.

Under Alternative 1, impacts from DBAs would be expected to be as described above. If a DBA occurred, the impacts would be expected to be minor and limited by plant design and the trained emergency actions of SQN personnel.

If SQN were not allowed to extend the licenses for the additional 20-year period, SQN would be shut down and the potential impacts from a DBA would no longer be applicable.

Under Alternative 2a, the new plant design would integrate the requirements to design against and protect from a series of potential DBAs. The new nuclear plant would be designed specifically for the new technology TVA would choose and that technology would meet all DBA criteria and be approved by the NRC.

Under Alternative 2b, there would be no impact applicable for DBAs.

Table 3-47. Loss of A.C. Power With an Accident-Initiated Iodine Spike

	Thyroid	Whole Body	Skin	TEDE
EAB	0.69 rem	0.085 rem	0.18 rem	0.11 rem
LPZ	0.21 rem	0.013 rem	0.026 rem	0.02 rem
Public Limit	300 rem	25 rem	NA	NA

(TVA 2008a)

Table 3-48. Loss of A.C. Power With a Pre-Existing Iodine Spike

	Thyroid	Whole Body	Skin	TEDE
EAB	0.73 rem	0.078 rem	0.17 rem	0.10 rem
LPZ	0.18 rem	0.012 rem	0.024 rem	0.017 rem
Public Limit	300 rem	25 rem	NA	NA

(TVA 2008a)

Table 3-49. Loss-of-Coolant Accident*

	Thyroid	Gamma Dose	Beta Dose	TEDE
Site Boundary 0 – 2 hours	83.1 rem	7.68 rem	4.52 rem	9.80 rem
LPZ 0 – 30 days	16.5 rem	1.50 rem	1.40 rem	1.90 rem
Public Limit	300 rem	25 rem (whole body)	NA	NA

*The loss-of-coolant accident analysis bounds the rod ejection accident.
(TVA 2008a)

Table 3-50. Waste Gas Decay Tank Rupture

	Thyroid	Whole Body	Skin	TEDE
EAB	0.039 rem	1.80 rem	4.7 rem	1.80 rem
LPZ	0.005 rem	0.22 rem	0.56 rem	0.22 rem
Public Limit	300 rem	25 rem	NA	NA

(TVA 2008a)

Table 3-51. Steam Line Break With an Accident-Initiated Iodine Spike*

	Thyroid	Whole Body	Skin	TEDE
EAB	5.40 rem	0.073 rem	0.11 rem	0.25 rem
LPZ	0.69 rem	0.01 rem	0.014 rem	0.053 rem
Control Room	0.22 rem	0.046 rem	0.009 rem	0.053 rem
Public Limit	300 rem	25 rem	NA	NA
Control Room Limit	30 rem	5 rem	30 rem	NA

*The steam line break with accident-initiated iodine spike bounds the steam line break with pre-existing iodine spike. (
TVA 2008a)

Table 3-52. Steam Line Break With Alternate Steam Generator Tube Plugging With an Accident-Initiated Iodine Spike*

	Thyroid	Whole Body	Skin	TEDE
EAB	30.0 rem	0.67 rem	0.97 rem	1.1 rem
LPZ	5.0 rem	0.09 rem	0.14 rem	0.16 rem
Control Room	2.1 rem	0.52 rem	0.064 rem	0.59 rem

	Thyroid	Whole Body	Skin	TEDE
Public Limit	300 rem	25 rem	NA	NA
Control Room Limit	30 rem	5 rem	30 rem	NA

*The steam line break with alternate steam generator tube plugging with accident-initiated iodine spike bounds the steam line break with alternate steam generator tube plugging with pre-existing iodine spike.

(TVA 2008a)

Table 3-53. Steam Generator Tube Rupture With Accident-Initiated Iodine Spike

	Thyroid	Whole Body	Skin	TEDE
EAB	18.50 rem	1.60 rem	2.80 rem	2.20 rem
LPZ	2.30 rem	0.19 rem	0.40 rem	0.26 rem
Public Limit	300 rem	25 rem	NA	NA
Control Room Limit	30 rem	5 rem	30 rem	NA

(TVA 2008a)

Table 3-54. Fuel Handling Accident (FHA)

	FHA in Auxiliary Building	FHA inside Primary Containment
EAB	4.5 rem TEDE	4.5 rem TEDE
LPZ	0.8 rem TEDE	0.8 rem TEDE
Control Room	4.1 rem TEDE	4.2 rem TEDE
Public Limit	6.3 rem TEDE for off-site doses	5.0 rem TEDE for the control room

(TVA 2008a)

3.19.2. Severe Accidents

3.19.2.1. Affected Environment

The term “accident” refers to any unintentional event (i.e., outside the normal or expected plant operation envelope) that results in a release or the potential for a release of radioactive material to the environment. The NRC categorizes accidents as either design basis or severe. DBAs, described in Subsection 3.19.1, are those for which the risk is great enough that the NRC requires plant design features and procedures to prevent unacceptable accident consequences. Severe accidents are defined as accidents with substantial damage to the reactor core and degradation of containment systems. Because the probability of a severe accident is very low, the NRC considers them too unlikely to warrant normal design controls to prevent or mitigate the consequences. Severe accident analyses consider both the frequency of a severe accident and the off-site consequences to determine the public risk.

The risk of nuclear power plant severe accidents is normally determined by a plant-specific probabilistic safety assessment (PSA) that provides a systematic and comprehensive methodology for determining the risks associated with severe accidents due to the operation of the nuclear power plant. Such assessments have been performed on SQN as a response to Generic Letter 88-20. Even though an update of the SQN PSA is currently underway, not all elements of the SQN PSA have been updated sufficiently to provide complete risk information.

Because a complete PSA for SQN was not available, the severe accident risk analysis for SQN is based on the Level 1 and 2 PSA results from the WBN Unit 2 FSEIS. WBN and SQN are very similar in design so the WBN PSA results are representative of SQN. Severe accidents that result in core damage and containment bypass or containment failure are considered. Three modes of containment failure or release categories were evaluated: containment bypass, early containment failure, and late containment failure. The environmental and health consequences of severe accidents that do not result in containment bypass or failure are significantly less and, therefore, would not substantially change the calculated risk of severe accidents at SQN.

The radiological consequences for each release category are from the surplus plutonium disposition (SPD) SEIS (DOE 2011), which used the MELCOR Accident Consequence Code System (MACCS2) computer code (Version 1.13.1) to perform analyses of radiological impacts. The generic MACCS2 input parameters used in the NRC's severe accident analysis (NUREG-1150) (NRC 1990) formed the basis for the analysis. These generic data values were supplemented with parameters specific to SQN and the surrounding area. Site-specific data included population distribution, economic parameters, and agricultural production. Plant-specific release data included nuclide release, release duration, release energy (thermal content), release frequency, and release category (i.e., early release, late release). The behavior of the population during a release (evacuation parameters) was based on declaration of a general emergency and the emergency planning zone (EPZ) evacuation time.

The SQN PSA is currently being upgraded to meet current NRC requirements. The upgraded SQN PSA will provide the basis for the severe accident mitigation alternatives analysis performed in support of the SQN LRA. The overall SQN severe accident environmental consequence conclusions presented in this SEIS will not be impacted by the updated SQN PSA model.

3.19.2.2. Environmental Consequences

Alternative 1 – License Renewal

The consequences of a beyond-DBA (severe) to the maximally exposed off-site individual and the average individual in the population residing within an 80-kilometer (50-mile) radius of the reactor site are summarized in Table 3-55. The SQN analysis assumed that a site emergency would have been declared early in the accident sequence and that all nonessential site personnel would have evacuated the site in accordance with site emergency procedures before any radiological releases to the environment occurred. In addition, the analysis conservatively assumes that 95 percent of the public within 16 kilometers (10 miles) of the plant would participate in the initial evacuation, and the remaining 5 percent of the population would be relocated 12 to 24 hours after passage of the plume.

Table 3-55. Severe Accident Risks

Release Category (frequency per reactor year)	Maximally Exposed Off-Site Individual		Average Individual Member of Population Within 80 Kilometers (50 miles)	
	Dose Risk [a] (rem/year)	Cancer Fatality [b]	Dose Risk [a] (rem/year)	Cancer Fatality [b]
I - Early Containment failure (3.4E-7)	9.5E-03	3.4E-07	5.6E-07	3.4E-10
II - Containment Bypass (1.4E-6)	6.3E-02	1.4E-06	4.4E-06	2.7E-09
III - Late Containment Failure (3.0E-6)	2.5E-03	3.0E-06	3.0E-06	1.7E-09
Cumulative Individual Risk		4.74E-06		4.73E-09

[a] Includes the likelihood of occurrence of each release category.
[b] Likelihood of cancer fatality per year.

The results presented in this table indicate that the risk to the maximally exposed off-site individual is one fatality every 200 thousand years (or 4.74×10^{-6} per year), and the risk to an average individual member of the public is one fatality every 200 million years (or 4.73×10^{-9} per year). These results vary somewhat from those presented in the draft SEIS for SQN license renewal, which was developed based upon the WBN Unit 2 model. Availability of the SPD SEIS data for SQN provided updated risk calculations. Overall, consistent with conclusions presented in the draft SEIS for SQN license renewal, the risk results presented above are small. This conclusion is consistent with previous studies on SQN, such as NUREG/CR-4551, *Evaluation of Severe Accident Risks: Sequoyah, Unit 1 Main Report* (NRC 1990). That study concluded that the consequences of a severe accident at SQN are well within NRC safety goals. The NRC's GEIS (NRC 1996), which was intentionally conservative, concluded that the probability-weighted consequences of severe accidents are of minor significance for all plants, because they represent only a small fraction of the risk to which the public is exposed from other sources. Thus, the probability-weighted consequences and impacts of severe accidents during the period of extended operation would be expected to be a minor impact for SQN. For Alternative 1 – License Renewal, the impacts from potential severe accidents would be expected to be minor. These impacts are within the requirements specified for SQN. Severe accident analyses considered both the risk of a severe accident occurring and the on-site and off-site consequences if the accident did occur to determine the significance. Overall, the risk results presented above for SQN Units 1 and Unit 2 are not significant.

<u>Alternative 2a – New Nuclear Generation</u>

Under Alternative 2a, the new plant would be analyzed for the risk of a severe accident occurring, and the consequences on the on-site and off-site environment if a severe accident did occur. The impacts would necessarily need to be minor and of no significance for the plant to be allowed to be constructed and operated. The new nuclear plant would be analyzed specifically for the selected technology, and that technology would have to be approved by the NRC prior to construction and operation. The impacts would be expected to be minor and of no significance.

<u>Alternative 2b – New Nuclear Generation</u>

Under Alternative 2b, there would be no impact applicable for severe accidents.

3.19.3. Plant Security

Some nongovernmental entities and members of the public have expressed concern about the risks posed by nuclear generating facilities in light of the threat of terrorism. TVA believes that the possibility of a terrorist attack affecting operation of one or more units at SQN is very remote, and postulating potential health and environmental impacts from a terrorist attack involves substantial speculation.

TVA has in place detailed sophisticated security measures to prevent physical intrusion into all its nuclear plant sites, including SQN, by hostile forces seeking to gain access to plant nuclear reactors or other sensitive facilities or materials. TVA security personnel are trained and retrained to react to and repel hostile forces threatening TVA nuclear facilities. TVA's security measures and personnel are inspected and tested by the NRC. It is highly unlikely that a hostile force could successfully overcome these security measures and gain entry into sensitive facilities, and even less likely that they could do this quickly enough to prevent operators from putting plant reactors into safe shutdown mode. However, the security threat that is more frequently identified by members of the public or in the media are not hostile forces invading nuclear plant sites, but attacks using hijacked jet airliners, the method used on September 11, 2001, against the World Trade Center and the Pentagon. The likelihood of this now occurring is equally remote in light of today's heightened security at airports, but this threat has been carefully studied.

The NEI commissioned EPRI to conduct an impact analysis of a large jet airliner being purposefully crashed into sensitive nuclear facilities or containers including nuclear reactor containment buildings, spent fuel storage pools, spent fuel dry storage facilities, and spent fuel transportation containers. Using conservative analyses, EPRI concluded that there would be no release of radionuclides from any of these facilities or containers because they are already designed to withstand potentially destructive events. Nuclear reactor containment buildings, for example, have thick concrete walls with heavy reinforcing steel and are designed to withstand credible earthquakes, overpressures, and hurricane force winds. The EPRI analysis used computer models in which a Boeing 767-400 was crashed into containment structures representative of all U.S. nuclear power containment types. The containment structures suffered some crushing and chipping at the maximum impact point, but were not breached. The results of this analysis are summarized in an NEI paper titled "Deterring Terrorism: Aircraft Crash Impact Analyses Demonstrate Nuclear Power Plant's Structural Strength" (NEI 2002).

The EPRI analysis is fully consistent with research conducted by the NRC. When the NRC considered such threats, Commissioner McGaffigan observed:

> Today the NRC has in place measures to prevent public health and safety impacts of a terrorist attack using aircraft that go beyond any other area of our critical infrastructure. In addition to all the measures the Department of Homeland Security and other agencies have put in place to make such attacks extremely improbable (air marshals, hardened cockpit doors, passenger searches, etc.), NRC has entered into a Memorandum of Understanding with NORAD/NORTHCOM to provide realtime information to potentially impacted sites by any aircraft diversion.

> As NRC has said repeatedly, our research showed that in most (the vast majority of) cases an aircraft attack would not result in anything more than a very expensive industrial accident in which no radiation release would occur. In those few cases where a radiation release might occur, there would be no challenge to the emergency planning basis currently in effect to deal with all beyond-design-basis events, whether generated by mother nature, or equipment failure, or terrorists. (NRC 2007)

Notwithstanding the very remote risk of a terrorist attack affecting operations, TVA increased the level of security readiness, improved physical security measures, and increased its security arrangements with local and federal law enforcement agencies at all of its nuclear generating facilities after the events of September 11, 2001. These additional security measures were taken in response to advisories issued by NRC. TVA continues to enhance security at its plants in response to NRC regulations and guidance. The security measures TVA has taken at its sites are complemented by the measures taken throughout the United States to improve security and reduce the risk of successful terrorist attacks. This includes measures designed to respond to and reduce the threats posed by hijacking large jet airliners.

In the very remote likelihood that a terrorist attack would successfully breach the physical and other safeguards at SQN resulting in the release of radionuclides, the consequences of such a release are reasonably captured by the consideration of the impacts of severe accidents discussed above in this section.

Nuclear plant security is applicable to SQN until it is decommissioned and all spent fuel is removed from the site, regardless of the date of the decommissioning. For Alternative 2a – New Nuclear Generation, any new nuclear plant would be designed and constructed to meet all nuclear security design considerations and regulations. Nuclear security rules and regulations have no relevance to Alternative 2b – New Natural Gas-Fired Generation.

3.20. Decommissioning

Regulatory guidance for the consideration of environmental impacts associated with decommissioning is provided in Section 8.4, Termination of Nuclear Power Plant Operations and Decommissioning, of NUREG-1437 (NRC 1996), and Section 7.3, No Action Alternative, of Draft Regulatory Guide 4015, Proposed Revision 1 of Supplement 1 to Regulatory Guide 4.2 (NRC 2009a). The regulatory options and environmental impacts associated with decommissioning SQN are discussed below.

Regulatory Options for Decommissioning

Under all of the alternatives, TVA is required to begin decommissioning each SQN unit no later than the expiration of its operating license. Decommissioning decisions and actions would have to be made sooner under the No Action Alternatives (New Nuclear Construction and New Natural Gas-Fired Construction to replace power lost when the SQN units are decommissioned) than under the Action Alternative.

The same decommissioning options apply to the Action and No Action Alternatives. When TVA proposes a decommissioning option, appropriate environmental reviews would be conducted. A description of decommissioning options is provided below. TVA currently has no preference among decommissioning options and is not proposing one now.

To decommission a nuclear power plant, radioactive material on the site must be reduced to levels that would permit termination of the NRC license. This involves removing the spent fuel, dismantling any systems or components containing activation products (such as the reactor vessel and primary loop piping), and cleaning up or dismantling contaminated materials. Activated materials generally have to be removed from the facility and shipped to a waste processing, storage, or disposal facility. Contaminated materials may either be cleaned of contamination on site, or the contaminated sections may be detached and removed (leaving most of the component intact in the facility), or the contaminated sections may be completely removed and shipped to a waste processing, storage, or disposal facility. The licensee decides how to decontaminate material, and the decision is usually based on the amount of contamination, the ease with which it can be removed, and the cost to remove the contamination versus the cost to ship the entire structure or component to a waste-disposal site.

The NRC has evaluated the environmental impacts of three methods for decommissioning nuclear power facilities: DECON, SAFSTOR, and ENTOMB (see definitions below) (NRC 1996). TVA would decide how to decommission the SQN site, but NRC regulations state that decommissioning must be completed within 60 years of permanent cessation of operations. The choice of decommissioning options is influenced by potential uncertainties in low-level waste disposal costs. NRC regulations provide for the equipment, structures, and portions of the facility and site that contain radioactive contaminants to be removed or decontaminated to a level that permits termination of the license shortly after cessation of operations.

DECON calls for relatively prompt removal of radioactive material to permit restricted or unrestricted access. All fuel assemblies, nuclear source material, radioactive fission and corrosion products, and all other radioactive and contaminated materials above NRC-restricted release levels are removed from the plant. The reactor pressure vessel and internals would be removed, along with removal and demolition of the remaining systems, structures, and components with contamination control employed as required.

The advantages of DECON include the following (NRC 2000):

- The operating license is terminated and the facility and site become available for other purposes more quickly than with the other options.
- Availability of the operating reactor work force that is knowledgeable of the facility.
- Elimination of the need for long-term security, maintenance, and surveillance of the facility, which would be required for the other decommissioning options.
- Greater certainty about the availability of low-level waste disposal facilities to accept the LLRW.
- Lower estimated costs compared to the SAFSTOR alternative, largely as a result of future price escalation. Most activities that occur during DECON would also occur during the SAFSTOR period, only at a later date. (It is anticipated that the later the date for completion of decommissioning, the greater the cost.) Some of these increases may be offset by technological advances during the SAFSTOR period.

The disadvantages of DECON include the following (NRC 2000):

- Higher worker and public doses (because there is less benefit from radioactive decay that would occur in the SAFSTOR option).
- A larger potential commitment of disposal-site space than the SAFSTOR option.
- The potential for complications if spent fuel must remain on the site until a federal repository becomes available.

SAFSTOR is a deferred decontamination strategy that takes advantage of the natural decay of a significant portion of the radiation. After all fuel assemblies, nuclear source material, radioactive liquid, and solid wastes are removed from the plant, the remaining structure would then be secured and mothballed. Monitoring systems would be used throughout the SAFSTOR period and a full-time security force would be maintained. The facility would be decontaminated to NRC release levels after a period of up to 60 years, and the site would be released. This option makes the site unavailable for alternate uses for an extended period, but there would be a reduced need for radioactive waste disposal. The benefits of SAFSTOR include the following (NRC 2000):

- A substantial reduction in radioactivity as a result of the radioactive decay during the storage period.
- A reduction in worker dose (compared to DECON).
- A reduction in public exposure because of fewer shipments of radioactive material to the low-level waste site (compared to DECON).
- A potential reduction in the amount of waste disposal space required (compared to DECON).
- Lower cost during the years immediately following permanent cessation of operations.
- A storage period compatible with the need to store spent fuel on site.
- More time to benefit from growth in the decommissioning trust fund prescribed by NRC regulations (10 CFR Part 50).

Disadvantages of SAFSTOR include (NRC 2000):

- Shortage of personnel familiar with the facility at the time of deferred dismantlement and decontamination.
- Site unavailable for alternate uses during the extended storage period.
- Uncertainties regarding the availability of sites and cost of disposal of low-level radioactive sites in the future.
- Continuing need for maintenance, security, and surveillance.
- Higher total cost for the subsequent decontamination and dismantlement period (assuming typical price escalation during the time the facility is stored); however,

this will be partially offset by reduced radioactive waste disposal volumes resulting from radioactive decay.

For the ENTOMB option, radioactive structures, systems, and components are encased in a structurally long-lived substance, such as concrete. The entombed structure is appropriately maintained, and continued surveillance is carried out until the radioactivity decays to a level that permits termination of the license. The main benefits of the ENTOMB option are (NRC 2000):

- Reduced amount of work to encase the facility in a structurally long-lived substance.
- Reduced worker dose while decontaminating and dismantling the facility.
- Public exposure from waste transported to the low-level waste site would be minimized.
- The ENTOMB option may have a relatively low cost compared to the DECON and SAFSTOR options.

Disadvantages of ENTOMB include the following (NRC 2000):

- Because most power reactors will have radionuclides in concentrations exceeding the limits for site release even after 100 years, this option may not be feasible under current regulations. This option may be acceptable for reactor facilities that can demonstrate that radionuclide levels will decay to levels that will allow release of the site.
- Although three small demonstration reactors have been entombed, no licensees have proposed the ENTOMB option for any power reactors undergoing decommissioning. Therefore, there is virtually no industry experience to provide a source of lessons learned regarding this option for decommissioning commercial nuclear power plants.

Environmental Impacts Associated with Decommissioning

Discontinuing operation of SQN and the initiation of decommissioning may allow some other commercial or industrial use of part of the site in the future. This would ameliorate to some extent the negative socioeconomic impacts of loss of employment. This may include use of the site for electric power generation. Any such future use would require its own environmental review. New, improved decommissioning technologies and efficiencies may be approved by the NRC by the time TVA considers making a decommissioning decision.

Environmental issues associated with decommissioning that result from continued plant operation during the license renewal period are discussed in the GEIS (NRC 1996). Issues were assigned a Category 1 or a Category 2 designation.

For all Category 1 issues, no additional plant-specific analysis is required by the NRC, unless new and significant information is identified. Category 2 issues are those that do not meet one or more of the criteria of Category 1; therefore, additional plant-specific review for these issues is required. There are no Category 2 issues related to decommissioning at SQN.

Category 1 issues applicable to SQN decommissioning are listed in Table 3-56. For all of those issues, the NRC staff concluded in the GEIS that the impacts are minor, and plant-specific mitigation measures are not likely to be sufficiently beneficial to be warranted.

Table 3-56. Category 1 Issues Applicable to the Decommissioning of SQN Following the Renewal Term

ISSUE – 10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Sections
DECOMMISSIONING	
Radiation Doses	7.3.1; 7.4
Waste Management	7.3.2; 7.4
Air Quality	7.3.3; 7.4
Water Quality	7.3.4; 7.4
Ecological Resources	7.3.5; 7.4
Socioeconomic Impacts	7.3.7; 7.4

A brief description of the NRC staff review and the GEIS conclusions, as codified in 10 CFR Part 51, Subpart A, Appendix B, Table B-1, for each of the issues follows.

- Radiation Doses: Based on information in the GEIS, NRC found doses to the public would be well below applicable regulatory standards regardless of which decommissioning method is used. Occupational doses would increase no more than 1 man-rem [0.01 person-Sv] caused by buildup of long-lived radionuclides during the license renewal term. During its review and evaluation, TVA has not identified any significant new information that would indicate any additional radiation dose would be experienced by either the public or workers. Therefore, TVA concludes there would be no radiation doses associated with decommissioning following license renewal beyond those discussed in the GEIS.

- Waste Management: Based on information in the GEIS, NRC found decommissioning at the end of a 20-year license renewal period would generate no more solid wastes than at the end of the current license term. No increase in the quantities of Class C or greater than Class C wastes would be expected. During its review and evaluation, TVA has not identified any significant new information relevant to environmental concerns that leads to a different conclusion. Therefore, TVA concludes there would be no solid waste impacts from decommissioning following the license renewal term beyond those discussed in the GEIS.

- Air Quality: Based on information in the GEIS, the NRC found air quality impacts of decommissioning are expected to be negligible either at the end of the current operating term or at the end of the license renewal term. During its review and evaluation, TVA has not identified any significant new information relevant to environmental concerns that leads to a different conclusion. Therefore, TVA concludes there would be no air quality impacts from license renewal during decommissioning beyond those discussed in the GEIS.

- Water Quality: Based on information in the GEIS, NRC found the potential for significant water quality impacts from erosion or spills is no greater whether decommissioning occurs after a 20-year license renewal period or after the original 40-year operation period, and measures are readily available to avoid such impacts. During its review and evaluation, TVA has not identified any significant new information relevant to environmental concerns that leads to a different conclusion. Therefore, TVA concludes there would be no water quality impacts from license renewal term during decommissioning beyond those discussed in the GEIS.

- Ecological Resources: Based on information in the GEIS, NRC found decommissioning after either the initial operating period or after a 20-year license renewal period is not expected to have any direct ecological impacts. During its review and evaluation, TVA has not identified any significant new information relevant to environmental concerns that leads to a different conclusion. Therefore, TVA concludes there would be no ecological resources impacts from license renewal during decommissioning beyond those discussed in the GEIS.

- Socioeconomic Impacts: Based on information in the GEIS, NRC found decommissioning would have some short-term socioeconomic impacts. The impacts would not be increased by delaying decommissioning until the end of a 20-year relicense period, but they might be decreased by population and economic growth. During its review and evaluation, TVA has not identified any significant new information relevant to environmental concerns that leads to a different conclusion. Therefore, TVA concludes there would be no socioeconomic impacts from license renewal during decommissioning beyond those discussed in the GEIS.

In summary, none of the alternatives would result in foreclosing any decommissioning options, or result in any environmentally unacceptable conditions. A No Action Alternative would not allow an additional 20-year period for decommissioning technology and the licensing framework to evolve and mature. Similarly, a No Action Alternative would not allow an additional 20-year period to increase the likelihood that a permanent spent fuel repository would be available prior to the completion of decommissioning. The availability of a spent fuel repository would further reduce the potential for adverse environmental effects from decommissioning.

CHAPTER 4

4.0 OTHER EFFECTS

This chapter includes the discussion of potential impacts from the implementation of the proposed project alternatives related to unavoidable adverse environmental impacts, the relationship between short-term uses and long-term productivity, and irreversible and irretrievable commitment of resources.

4.1. Unavoidable Adverse Environmental Impacts

This section describes principal unavoidable adverse environmental impacts for which mitigation measures are either considered impractical, do not exist, or cannot entirely avoid the adverse impact. Specifically, this section considers unavoidable adverse impacts that would occur for any of the potential alternatives:

- Alternative 1 – SQN Units 1 and 2 License Renewal.
- Alternative 2a – SQN Units 1 and 2 Decommissioning and New Nuclear Generation.
- Alternative 2b – SQN Units 1 and 2 Decommissioning and New Natural Gas-Fired Generation.

These unavoidable construction and operational effects are identified in Tables 4-1 and 4-2.

Table 4-1. Construction-Related Unavoidable Adverse Environmental Impacts

Resource, Alternative	Unavoidable Adverse Impact
Land Use Alternative 1	No major construction would occur. Expansion of the ISFSI is on land already designated for SQN and does not represent any change in land use.
Land Use Alternative 2a	Construction of a new nuclear plant and associated structures is expected to potentially require clearing and disturbing of approximately 1,000 acres of land. If it is a greenfield site, all the land may be changed from the "as found" land-use designation while a brownfield site may not change the land-use designation but would require clearing and disturbing activities of the same nature. There would be a long-term commitment of land for the potential new transmission corridors. Some land used as landfills would be dedicated to long-term disposal of construction debris and not available for other uses.
Land Use Alternative 2b	Construction of a natural gas-fired plant and associated structures is expected to potentially require clearing and land disturbing of 110 – 132 acres. If it is a greenfield site all the land may be changed from the "as found" land-use designation while a brownfield site may not change the land-use designation but would require clearing and disturbing activities of the same nature. Plants may be built at multiple sites to allow for the needed generation capacity. There would be a long-term commitment of land for the potential new transmission corridors and natural gas pipelines. Some land used as landfills would be dedicated to long-term disposal of construction debris and not available for other uses.

Resource, Alternative	Unavoidable Adverse Impact
Hydrologic and Water Use Alternative 2a, 2b	A small amount of water is consumed during construction activities. The impact would vary based on the source of the water (groundwater vs. surface water). Ground-disturbing activities along river banks or stream banks, on a short-term basis, introduce minor amounts of sediments and potentially chemicals into water bodies.
Aquatic Ecology Alternative 2a, 2b	Construction at the waterbody's edge or dredging activities may cause direct, short-term, and minor loss of some organisms and temporary degradation of habitat. New transmission lines or natural gas pipelines that cross streams may cause minor disruption of some organisms and degradation of habitat.
Terrestrial Ecology Alternative 2a, 2b	Construction of a new generation plant and transmission corridors would cause minor to major alterations to habitat and the species that inhabit them. Construction, clearing, and grading of a new site could directly harm or displace animals. These impacts are intermittent and would continue throughout the construction phase.
Socioeconomics and Environmental Justice Alternative 2a, 2b	Construction workers and local residents would experience elevated levels of traffic through the course of the construction phase. The location of the new site would determine the level of impact on the surrounding community. Rural areas would potentially experience a greater impact than an urban location. The influx of a construction work force would cause short-term, minor to substantial effects on local housing, infrastructure, land use, and community services such as fire or police protection. In the short term, there may be school crowding. Increased tax revenue would mitigate some of this impact. Construction workers and local residents would be exposed to elevated levels of dust, exhaust emissions, and noise from construction and equipment. These constitute minor unavoidable impacts. No unavoidable adverse construction impacts to minority populations are anticipated.

Table 4-2. Operations-Related Unavoidable Adverse Environmental Impacts

Operation	Unavoidable Adverse Impact
Land Use Alternative 1	The SQN site is approximately 630 acres. The majority of the land use is designated as industrial and would continue to be industrial until the plant is shut down and decommissioned (decommissioning can take up to 60 years after permanent shutdown of SQN). After decommissioning, the site may be used for a different purpose. Approximately 2,400 acres of land would be necessary to supply uranium fuel to support the continued operation of SQN during license renewal. The ISFSI would remain until the DOE takes possession of the spent fuel, and then the ISFSI land would be used for a different purpose. The viewscape of the SQN site and transmission facilities would continue to be impacted over the operational period, but no more so than at the present.
Land Use Alternative 2a, 2b	Approximately 2,400 acres of land would be needed to support uranium fuel production for a new nuclear plant during operation. Operation of a new natural gas-fired plant would be a long-term commitment of thousands of acres of land (approximately 4,320 – 2,400 = 1,920 acres) that would be needed to support the exploration, well development, pipelines and gas processing equipment to allow the delivery of the natural gas to the generation facilities over the life of the plant. The land used at off-site locations for nuclear fuel production and natural gas production would be a long-term commitment. There would be a long-term commitment of land for the required transmission corridors, pipelines, and supporting structures and facilities. Potential for unanticipated disturbances to historic, cultural, or paleontological resources would be mostly or entirely mitigated. Additional land would be used for long-term disposal of general trash and hazardous waste normally associated with large industrial facilities. The UFC of a new nuclear plant would increase radioactive waste and require land dedicated to the long-term disposal of hazardous materials in permitted disposal facilities or permitted landfills. This land would not be available for most other uses. The viewscape of a new plant (large structures, cooling towers, security lights, etc.) and transmission facilities would be adversely affected over the operational period.
Hydrologic and Water Use Alternative 1	Normal plant operations result in discharge of small amounts of chemicals and radioactive effluents to Chickamauga Reservoir throughout the life of SQN. Compliance with the NPDES permit; applicable water quality standards; storm water pollution prevention and SPCC plans; and discharge of radioactive effluents in compliance with applicable regulatory standards would ensure adverse impacts would be minor. Discharge of cooling water results in a thermal plume in Chickamauga Reservoir throughout the operational life of a SQN unit. The differences between plume temperature and ambient water temperature are maintained within limits set in the NPDES permit. When in service, cooling towers release much of the heat to the atmosphere that would otherwise be discharged to the reservoir. Water lost to evaporation represents consumption of water that would not be available for other uses. The consumptive use of surface water, which would continue throughout the operational life of the plant, is less than 0.2 percent of the available surface water. (TVA 2008a)

Operation	Unavoidable Adverse Impact
Hydrologic and Water Use Alternative 2a	Normal operations of a new nuclear plant would be similar to SQN depending on the reactor technology chosen and the type of cooling towers used (closed-cycle cooling is probable technology). Operations would result in discharge of small amounts of chemicals and radioactive effluents to a receiving waterbody throughout the life of the new nuclear plant. Compliance with the new plant's NPDES permit, applicable water quality standards, storm water pollution prevention and SPCC plans, and discharge of radioactive effluents in compliance with applicable regulatory standards would ensure that the result would be minor. Discharge of cooling water would result in a thermal plume in the receiving waterbody throughout the operational life of a new nuclear unit. The differences between plume temperature and ambient water temperature would be maintained within limits set in the NPDES permit. Cooling towers would reduce much of the heat that would otherwise be discharged to the receiving waterbody. Water lost to evaporation represents consumption of water that would not be available for other uses. The consumptive use of surface water, which would continue throughout the operational life of the plant, would be a greater volume with closed-cycle cooling but is expected to be a small percentage of the available surface water.
Hydrologic and Water Use Alternative 2b	Normal plant operations of a new natural gas-fired plant would be similar to Alternative 2a, excluding the radioactive effluents.
Aquatic Ecology Alternative 1	Entrainment or impingement results in a loss of fish and other aquatic organisms. SQN operates in an open mode cooling system configuration most of the year and a helper mode configuration that uses cooling tower operations for the remainder of the year. The impacts of entrainment or impingement on aquatic species would continue to be minor.
Aquatic Ecology Alternative 2a, 2b	The effects of entrainment or impingement result in a loss of fish and other aquatic organisms. The impacts would depend on the source of the water, and the types of aquatic species present. The impacts of entrainment or impingement on aquatic species from a new plant using a closed-cycle cooling system would be minor.

Operation	Unavoidable Adverse Impact
Socioeconomics and Environmental Justice Alternative 2a, 2b	If one of the No Action Alternatives were chosen, and operation of the SQN plant should cease, the loss of operational jobs and potential relocation of employees would have a negligible effect on the permanent population of Hamilton County, but the loss of operational jobs could have a dampening effect on the housing market, specifically in Hamilton County. The loss of operational jobs could result in a loss of population in Hamilton County where a large percentage of SQN operational workers live. The sizeable construction work force needed would likely come from local and regional sources, creating hundreds of new direct and indirect jobs for several years. The impact of an influx of workers on a smaller community or city located near the selected site could result in substantial strain on public services and housing. The impacts on the minority or low-income populations would be proportional to their proximity to the power facility. Acquiring adequate housing would be necessary for workers during the construction phase for either project, and again during the operational phase. Upgrading existing or building new infrastructure, water, and wastewater facilities could be required, particularly with the creation of new housing subdivisions. Minor unavoidable adverse impacts are expected over the life of the operation of any new plant.
Radiological Alternative 1, 2a (Alternative 2b – Not Applicable)	Small radiological doses to workers and members of the public from radioactive liquid and gaseous effluent releases to air and surface water would occur over the operational life of this project. Releases are well below regulatory limits. Effluents are treated according to applicable regulatory standards before being discharged into Chickamauga Reservoir. While employees are potentially exposed over the long term, adherence to applicable regulatory standards, radiological safety procedures, work plans and safety measures reduce this exposure to a minor impact. High-level radioactive spent fuel would be stored and isolated from the biosphere for thousands of years. The potential impacts of high-level radioactive waste and spent fuel are reduced through specific plant design features in conjunction with a waste minimization program. Potential impacts are further reduced through employee safety training programs and work procedures, and by strict adherence to applicable regulations for storage, treatment, transportation, and ultimate disposal of this waste in a geological repository, or reprocessing. The mitigation measures reduce the risk of radioactive impacts, but there is still some small residual risk. Waste disposal constitutes a long-term commitment of land. LLRW would be stored, treated, and disposed. Disposal of these materials represents a long-term commitment of land. The impacts of low-level radioactive and nonradioactive hazardous waste are reduced through waste minimization programs, employee training programs, and strict adherence to work procedures and applicable regulations.

Operation	Unavoidable Adverse Impact
Atmospheric and Meteorological Alternative 1, 2a	Although emissions would be maintained within limits established in permits, air emissions from diesel generators, equipment, and vehicles would have a minor impact on workers and local residents over the operational life of this project. A minor amount of radioactive emissions would occur from nuclear plants during normal operations. Compliance with permit limits and regulations for installing and operating air emission sources and monitoring of those air emissions would result in little or no adverse impacts. Cooling towers would emit a plume of water vapor resulting in a limited obstructed view of the sky, causing a shadowing effect on the ground that has a small effect on vegetation. The plumes present little environmental effect on humans or biota.
Atmospheric and Meteorological Alternative 2b	Burning natural gas produces air pollutants that are potentially harmful to the public if at sufficiently high levels. The plant would be required to meet all air quality standards and the impact would be minor to moderate depending on the location of the site. Existing air quality would be an important factor in the selection of a new natural gas-fired plant location.

4.2. Relationship Between Short-Term Uses and Long-Term Productivity of the Human Environment

This section focuses on and compares the significant short-term benefit (e.g., principally generation of electricity) and uses of environmental resources which have long-term consequences on environmental productivity. Table 4-3 summarizes the proposed action's short-term uses and benefits versus the long-term consequences on environmental productivity. For the purposes of this section, the term “short term” is the period of time during which continued power generation activities would take place for SQN (years of 2020 – 2041), including prompt decommissioning for Alternative 1. This discussion applies to the general ramifications of implementing any of the proposed alternatives.

The principal short-term benefit from the continued operation of SQN through the period of license renewal would be the production of a clean and reliable form of electrical energy. Alternatives 2a and 2b would also supply clean and reliable electrical energy, although natural gas-fired generation would be the least clean (air quality) of all the alternatives. The short-term beneficial impacts of usage outweigh the adverse impacts on long-term environmental productivity.

With respect to long-term benefits, nuclear energy (Alternatives 1 or 2a) avoids carbon dioxide emissions that may have a substantial long-term detrimental effect on global climate. Nuclear energy also reduces the depletion of fossil fuels. Chapter 3 describes effects associated with uranium fuel use as well as natural gas-fired production. Impacts associated with Alternatives 1 and 2a include radioactive waste, spent fuel storage, and transportation of radioactive materials. Subsection 4.2.2 and Section 4.3 describe the effects of mining, conversion, enrichment of uranium, fabrication of nuclear fuel, use of fuel, and disposal of the spent fuel as applicable to Alternatives 1 and 2a. Effects of natural gas-fired production, Alternative 2b, are discussed in the same sections.

There are two key long-term adverse impacts on productivity of importance to the nuclear alternatives. Both of these environmental impacts are governed by the half-lives of the respective radioisotopes. The first involves long-term radioactive contamination of the reactor vessel, equipment, and other material exposed to radioactive isotopes. The second involves irradiated spent fuel (high-level waste) that must be safeguarded and isolated from the biosphere for thousands of years, or reprocessed for use as fuel.

Table 4-3. Summary of SQN – Alternative 1 Principal Short-Term Benefits Versus the Long-Term Impacts on Production

SQN – Alternative 1 Issue	Short-Term Uses and Benefits	Relationships to Maintenance and Enhancement of Long-Term Environmental Productivity
Land Use	Continued commitment of land for industrial use until the plant is shut down and decommissioned.	No permanent loss as the land could be released for other uses or returned to its natural state after decommissioning.
Aquatic Ecology	Entrainment and impingement of aquatic biota will continue, but the impacts will continue to be minor.	No substantial permanent detrimental disturbance to biota or their habitats.
Socioeconomic Growth	For continued operation of SQN, the impacts to local socioeconomic conditions would be expected to remain unchanged and of minor impact. When SQN is required to shut down and go into decommissioning, the short-term impacts to the local economy would be expected to be minor.	Tax revenues, plant expenditures, and employee spending leads to some long-term direct and secondary growth in the local economy, infrastructure, and services that may continue after the plants are decommissioned.
Irradiated Spent Fuel	Provides a short-term supply of clean carbon-free energy.	Managed as a high-level radioactive waste and either reprocessed or isolated from the biosphere for thousands or tens of thousands of years. Long-term commitment of the local ISFSI storage area and the underground geological repository.
Other Radioactive Waste	The radioactively contaminated reactor vessel and equipment are required for the short-term production of nuclear energy.	Contaminated waste would be moved off site and must be managed and isolated from the biosphere for hundreds or thousands of years depending on the level of radiotoxicity and half-life.

SQN – Alternative 1 Issue	Short-Term Uses and Benefits	Relationships to Maintenance and Enhancement of Long-Term Environmental Productivity
Potential for Accident	Potential consequences of a reactor accident could range from minor to substantial. However, the probability or likelihood of a severe accident is calculated to be very remote. Because the probability of such an event is so small, the overall risk of a nuclear accident is, likewise, considered to be so small as not to constitute a potentially significant impact upon the human environment.	In the advent of an accident, the impacts could be long-term and substantial. Affected areas would be remediated, and would eventually be returned to industrial or other purposeful life.
Depletion of Natural Resources	As a reactor fuel, the uranium provides a short-term supply of clean carbon-free energy.	Continued operation of SQN would contribute to the long-term cumulative depletion of the global supply of uranium.
Offset Usage of Finite Fossil Fuel Supplies	During operation, SQN would avoid the consumption of fossil fuels, with some increase in the use of uranium. Consumption of fossil fuels in the UFC is substantively less than would occur for equivalently sized fossil-fuel based generation.	Reduces the cumulative long-term depletion of global fossil fuel supplies.
Materials, Energy, and Water	SQN generates far more electrical power than is used to operate the plant. A small amount of materials are used during plant operation. A relatively small quantity of cooling water is lost through evaporation and drift from cooling systems.	Operation of SQN contributes to the cumulative long-term irretrievable use of materials, energy, and water. However, SQN provides far more energy than is consumed.
Air Pollution	Operation of SQN avoids air pollutants that would likely be produced by fossil-fueled plants if the reactor operation was not extended into the license renewal period.	Operation of SQN results in a long-term cumulative avoidance of greenhouse emissions that would likely be produced by fossil-fueled plants.
Social Changes	Operation of SQN through the period of license renewal would produce little change from the current social characteristics of the local area.	Payments made in lieu of taxes by TVA, and wages spent by the operational staff, would inject substantial revenues into the local economy that have long-lasting economic growth and development effects, which would continue after SQN is decommissioned.

4.2.1. Short-Term Uses and Benefits

There are a number of short-term benefits derived from the continued operation of SQN during the period of license renewal. The license renewal of SQN stands out as the best choice of the three alternatives and is described in greater detail than Alternative 2a or 2b. Table 4-3 presents a summary of SQN's principal short-term benefits versus the long-term impacts on productivity. These short-term uses and benefits, as summarized below include the following:

- Electricity generation.
- Fuel diversity.
- Avoidance of air pollution and greenhouse gas emissions.
- Land use.
- Aquatic biota.
- Socioeconomic changes and growth.

The principal short-term benefit of the license renewal of SQN would be the continued base load generation to meet the demand for electricity in TVA's power service area. Energy diversity is also fundamental to the objective of achieving a reliable and affordable electrical power supply system. Over-reliance on any one fuel source leaves consumers vulnerable to price spikes and supply disruptions. Continued operation of SQN supports the goal of a diversified mix of electrical generating sources. TVA's goal is to reduce the carbon emissions of the TVA generating system, and Alternative 1 or 2a supports that goal while Alternative 2b would not be as effective.

SQN would not require changes to the transmission system in order to maintain the short-term and long-term capacity and reliability of the power supply in TVA's service area. Alternatives 2a and 2b would potentially require extensive new infrastructure for transmission lines and pipelines.

There would be no major construction during the license renewal period. Therefore, no additional impacts to terrestrial resources would occur. Land use would not change at the site until decommissioning has occurred. The land may be released for other uses or returned to its natural state after SQN has been decommissioned. Alternatives 2a and 2b would require extensive land-use changes for the construction of the new plants and infrastructure, resulting in substantial impacts to the terrestrial resources.

SQN would not experience any major construction during the license renewal period, and impacts to flora and fauna have already occurred and would be expected to remain stable at the site. Alternatives 2a and 2b would potentially cause minor to substantial impacts to flora and fauna that could be avoided by pursuing Alternative 1.

Aquatic biota impacts have been determined to be of minor impact due to impingement and entrainment during operation of SQN. Alternatives 2a and 2b would have an even smaller impact due to closed-cycle cooling systems.

The eventual decommissioning of SQN would result in minor short-term impacts to local communities due to the loss of jobs, decreased tax revenue, people moving out of the area, school enrollment decreasing, and impacts on fire, police, and public services. Secondary impacts to local businesses and communities would be expected to be short-term and minor. Decommissioning impacts would occur either at the end of license renewal or at the time the current licenses would expire.

4.2.2. Maintenance and Enhancement of Long-Term Environmental Productivity

Potential long-term effects on the productivity of the human environment are described in this section and summarized in Table 4-3. The assessment of long-term productivity impacts does not include the short-term effects related to the continued operation of SQN or the construction and operation of a new nuclear or natural gas-fired generation plant.

Some of the adverse environmental impacts would remain after practical measures to avoid or mitigate them have been taken.

Land Use

The SQN site land use would continue to be designated as industrial through the period of license renewal. A new nuclear or natural gas-fired plant site land use would have to be designated for construction and operation of the new facilities.

After any of the generating plants considered under Alternatives 1 and 2 are shut down and decommissioned, the land-use designation could be changed as appropriate for the new use of the land. After SQN, or a new nuclear plant, is shut down and decommissioned to NRC standards, the land would be available for other industrial or non-industrial uses. Decommissioned natural gas-fired plants are not subject to NRC standards, but the land would be available for a multitude of potential land uses.

Therefore, land-use impacts are not expected to preclude long-term productivity. Similarly, after decommissioning, there would be no long-term effects related to air emissions, water effluents, and other resources described in Chapter 3.

Exposure to Hazardous and Radioactive Materials and Waste

Under Alternatives 1 and 2a, workers may be exposed to low doses of radiation and trace amounts of hazardous materials and waste. Workplace exposures are carefully monitored to ensure that radioactive exposure is within regulatory limits. Local non-workers also receive a very small incremental dose of radiation. Radiological monitoring and impacts related to the operation of SQN or a new nuclear plant are described in Chapter 3. The persistence of radionuclides depends on the half-life of the radionuclides. The doses are in compliance with applicable regulatory standards and permits and do not substantially affect humans, biota, or air and water resources.

Potential for Nuclear Accident

Under Alternatives 1 and 2a, the risk of a potential accident at SQN or from a new nuclear plant would be the product of the potential consequences, and the probability or likelihood that an event would occur. The potential consequences of an accident could range from minor to substantial. However, the probability or likelihood of a major accident is very remote. Therefore, the overall risk of a nuclear accident is likewise so small as not to constitute a potentially significant impact upon the human environment. The results of analysis in Section 3.19 indicate that the environmental risks due to postulated accidents are minor.

Uranium Fuel Cycle and Depletion of Uranium or Natural Gas

The principal use of uranium is as a fuel for nuclear power plants. With approximately 440 nuclear reactors operating worldwide, these plants currently produce approximately 16 percent of the world's electrical power generation. Global uranium fuel consumption is increasing as nuclear power generation continues to expand worldwide. Continuing to operate SQN through the license renewal period would contribute to a small incremental increase in the depletion of uranium. The World Nuclear Association studies uranium supply and demand issues, and states that there is currently a 50-year supply of relatively low-cost uranium. Higher prices are expected to induce increased uranium exploration and production. A doubling in market price of uranium from the 2003 level might result in as much as a tenfold increase in the supply of this resource. The introduction of fast breeder reactors and other technologies could further reduce the gap between supply and demand. (TVA 2010b)

The operation of a new natural gas-fired plant would contribute to the depletion of the limited global supply of natural gas, although currently natural gas supplies in the United States appear to be increasing as a result of the development of natural gas shale formations.

Offset Usage of Finite Fossil Fuel Supplies

Fossil fuels represent a finite geological deposit, the use of which constitutes a cumulative irreversible commitment of a natural energy resource. The continued operation of SQN or the construction and operation of a new nuclear plant helps offset the cumulative depletion of this limited resource.

Use of Materials, Energy, and Water

Construction and operation of SQN have already resulted in the long-term, irreversible use of materials and energy for the completion of SQN. Construction and operation of a new nuclear or natural gas-fired plant would result in the long-term, irreversible use of materials and energy for the construction and operation of the new generation facilities. However, over the term of operation, SQN and a new nuclear or natural gas-fired plant would provide far more energy than is consumed in their construction. A small amount of water is consumed in the construction of any new electrical generation plant. During operation, a relatively modest quantity of cooling water is also consumed as loss to the atmosphere through evaporation and drift.

4.3. Irreversible and Irretrievable Commitments of Resources

This section describes anticipated irreversible and irretrievable (I&I) commitments of environmental resources that would occur in either the continued operation of SQN or the construction and operation of a new nuclear or natural gas-fired plant. The I&I commitments are summarized in Table 4-4 below.

For the purposes of this analysis, the term "irreversible" applies to the commitment of environmental resources (e.g., permanent use of land) that cannot by practical means be reversed to restore the environmental resources to their former state. In contrast, the term "irretrievable" applies to the commitment of material resources (e.g., irradiated steel, petroleum) that, once used, cannot by practical means be recycled or restored for other uses.

Table 4-4. Summary of Irreversible and Irretrievable Commitments of Environmental Resources

Environmental and Material Resources Issues	Irreversible	Irretrievable
Socioeconomic Changes Alternatives 1, 2a, 2b	Alternative 1 decommissioning would result in both short-term and long-term minor changes in the population, nature and character of the local community, and the local socioeconomic structure. Implementation of Alternatives 2a and 2b would result in both short-term and long-term changes in the population, nature and character of the local community, and the local socioeconomic structure. Some impacts on infrastructure and services are temporary, while other changes represent a permanent and irreversible change in socioeconomic infrastructure.	None
Disposal of Hazardous and Radioactively Contaminated Waste Alternatives 1, 2a, 2b	Alternatives 1 and 2a result in the generation of radioactive, hazardous, and nonhazardous waste that would be disposed of in licensed landfills or disposal repositories. Alternative 2b results in hazardous and nonhazardous waste that would be disposed of in licensed landfills. Land committed to the disposal of radioactive, hazardous, and nonhazardous wastes is an irreversible impact because it is committed to that use, and is largely unavailable for other purposes.	None
Commitment of Underground Geological resources for Disposal of Radioactive Spent Fuel (High-level Waste) Alternatives 1, 2a	Spent nuclear fuel (high level waste) is isolated from the biosphere for thousands or tens of thousands of years in a deep underground geological repository. This long-term commitment makes the surrounding geological resources unusable for thousands of years.	None

Environmental and Material Resources Issues	Irreversible	Irretrievable
Destruction of Geological Resources During Uranium Mining and Fuel Cycle and Natural Gas Production Alternatives 1, 2a, 2b	None	Uranium mining can result in contamination and destruction of geological resources, and pollution of lakes, streams, underground aquifers, and the soil. Natural gas production can result in contamination and destruction of geological resources and pollution of lakes, streams, underground aquifers, and the soil.
Contaminated and Irradiated Materials Alternatives 1, 2a	None	Some of the materials used as components and structures in the operation of SQN or a new nuclear plant are radioactively contaminated or irradiated over the life of the plant. This material cannot be reused or recycled and must be isolated from the biosphere for hundreds or thousands of years.
Land Use Alternatives 1, 2a, 2b	None	The range of available land uses for the SQN site or alternative new generation plants and associated transmission line ROWs will be restricted for the life of the plant and transmission lines, resulting in irretrievable lost production or use of renewable resources such as timber, agricultural land, or wildlife habitat during the period the land is used.

Environmental and Material Resources Issues	Irreversible	Irretrievable
Water Consumption Alternatives 1, 2a, 2b	None	Relatively small amounts of potable water are used during operation of SQN. A small fraction of the cooling water taken from Chickamauga Reservoir is lost through evaporation. Construction and operation of a new power generation facility with only closed-cycle cooling would consume more water than SQN. The impact to surface water is small relative to available resources, but the volume used is a natural resource that is no longer readily available for use.
Consumption of Energy Alternatives 1, 2a, 2b	None	Nonrenewable energy in the form of fuels (gas, oil, and diesel) and electricity is consumed in construction and to a lesser extent, operation of SQN or in the construction and operation of new power generation facilities. Alternative 2b would consume large amounts of natural gas.
Consumption of Uranium Fuel and Natural Gas Alternatives 1, 2a, 2b	None	SQN or a new nuclear plant would contribute a relatively small increase in the depletion of uranium used to fuel the reactors. A new natural gas-fired plant would contribute to the depletion of natural gas used to fuel the plant.

4.3.1. Irreversible Environmental Commitments

Irreversible environmental commitments resulting from the continued operation of SQN or operation of a new nuclear plant would relate primarily to those of the UFC: (1) land disposal of equipment and materials contaminated by hazardous and LLRW, (2) UFC effects that include commitment of underground geological resources for disposal of high-level radioactive waste and spent fuel, and (3) destruction of geological resources during uranium mining.

Implementation of Alternatives 1 (at decommissioning), 2a, or 2b would result in both short-term and long-term minor changes in the population, the nature and character of the local community, and the local socioeconomic infrastructure.

Uranium Fuel Cycle

The UFC is defined as the total of those options and processes associated with the provision, utilization, and ultimate disposition of fuel for nuclear power reactors.

Environmental effects are contributed from uranium mining and milling, the production of uranium hexafluoride, isotopic enrichment, fuel fabrication, use of the fuel, possible future reprocessing of irradiated fuel, transportation of radioactive materials, disposal of used (spent) fuel and management of low-level and high-level wastes.

SQN or a new nuclear plant would generate radioactive, hazardous, and nonhazardous wastes that require disposal. This waste is disposed of in permitted hazardous, mixed, or radioactive landfills or disposal facilities. Land committed to the disposal of radioactive and hazardous wastes represents an irreversible impact because it is committed to that use and can be used for few other purposes.

Emissions for fuel production or storage of spent fuel would be considered irreversible. The analysis of these environmental effects results in the finding that all resource impacts were minor. The UFC effects from either Alternative 1 or 2a impacts would be only minor effects.

In June 2008, the DOE submitted to the NRC a license application to build a deep geologic repository for used nuclear fuel and other high-level radioactive waste at Yucca Mountain, Nevada, a remote desert location. A year later, President Obama announced plans to discontinue the Yucca Mountain project and empanel a blue ribbon commission to provide recommendations for long-term management of high-level radioactive waste. The DOE announced formation of the commission on January 29, 2010. TVA believes that a geologic repository will ultimately be the permanent storage solution.

4.3.2. Irretrievable Environmental Commitments

Irretrievable environmental commitments resulting from the continued operation of SQN or the construction and operation of new power generation plants include the following:

- Construction and irradiated materials.
- Water consumption.
- Consumption of energy.
- Consumption of uranium fuel or natural gas.
- Land use.
- Destruction of geological resources during uranium mining and fuel cycle or natural gas production.

Construction and Irradiated Materials

Common irretrievable commitments of materials comprising the components and structures used either for operation of SQN or construction and operation of a new nuclear plant include such items as concrete, rebar, structural steel, power cable, small bore piping, and large bore piping. A portion of these materials becomes contaminated or irradiated over the life of nuclear operation. This material cannot be reused or recycled and must be isolated from the biosphere for hundreds or thousands of years. However, because some of this material may be reused (if uncontaminated) or decontaminated for future use, the recycled portion does not constitute an irretrievable commitment of resources. As an example, the estimated quantities of materials needed to construct an advanced AP1000 reactor at a suitable location are concrete (77, 200 cubic yards), rebar (10,000 tons), structural steel (6,400 tons), power cable (810,000 linear feet), small bore piping (230,000 linear feet) and large bore piping (68,000 linear feet). (TVA 2010b)

While the amount of construction materials is large, use of such quantities in large-scale construction projects such as nuclear reactors, hydroelectric and coal-fired plants, and many large industrial facilities (e.g., refineries and manufacturing plants) represents a relatively small incremental increase in the overall use of such materials. Even if this material is eventually disposed of, use of construction materials in such quantities has a small impact with respect to the national or global consumption of these materials. An additional irretrievable commitment of resources includes materials used during normal plant operations, some of which are recovered or recycled.

Construction of a natural gas-fired plant would require fewer materials and would not be subject to irradiation or contamination, resulting in almost no irretrievable commitment of resources.

Construction of transmission lines and infrastructure for Alternatives 2a and 2b would require the irretrievable commitment of fossil fuels (diesel and gasoline), oils, lubricants, and other consumables used by construction equipment and workers commuting to the site. Other materials used for construction of the proposed facilities would be committed for the life of the facilities. Some of these materials, such as ceramic insulators and concrete foundations, may be irretrievably committed, while the metals used in conductors, supporting structures, and other equipment could be and would likely be recycled. The useful life of the transmission structures is expected to be at least 60 years. Natural gas pipelines require maintenance that involves irretrievable commitment of fossil fuels as well and have a finite lifetime.

Water Consumption

Relatively small amounts of potable water are used during the operation of SQN and small amounts would be needed for the construction and operation of a new power generation plant.

Some of the cooling water taken from Chickamauga Reservoir for SQN or another surface water body for the new power generation plants would be lost through the cooling towers by way of drift and evaporation. The impact to surface water resources is relatively minor, but represents a natural resource that may no longer be available for use.

Energy Used in Construction or Operation of New Power Generation Plants

Nonrenewable energy in the form of fuels (gas, oil, and diesel) and electricity are consumed in the construction and, to a much smaller extent, operation of all power generation plants. Beyond ancillary (e.g., vehicles, equipment) usage, nuclear reactors do not consume fossil fuels such as petroleum or coal, but a natural gas-fired plant would consume large quantities of natural gas resources.

The total amount of energy consumed during construction or operation of a modern electrical generation plant is very minor in comparison to the total amount consumed within the United States. On net balance, the nuclear reactor produces far more energy (as measured in BTUs) than is consumed in its construction and operation. For this reason, one of the key considerations related to I&I requirements is that operation of SQN (or a new nuclear plant) helps conserve or avoid the consumption of finite fossil fuel supplies.

Uranium Fuel Cycle and the Depletion of Uranium and Natural Gas

As described in Section 4.2.2, global uranium fuel consumption is increasing as nuclear power generation continues to expand worldwide. Continued operation of SQN or operation of a new nuclear plant would contribute a relatively small increase in the depletion of uranium. Sources of uranium include primary mine production as well as secondary sources. Nuclear reactor uranium consumption now exceeds supplies produced through mining. The resulting shortfall has been covered by several secondary sources including excess inventories held by producers, utilities, other fuel cycle participants, reprocessed reactor fuel, and uranium derived from dismantling Russian nuclear weapons. (TVA 2010b)

The limited availability of uranium fuel may affect the future expansion of nuclear power. DOE uranium estimates indicate that sufficient resources exist in the United States to fuel all operating reactors and reactors being planned for the next 10 years at a triuranium octoxide cost (1996 dollars) of $30.00/lb or less. The resource categories designated as reserves and estimated additional resources can supply these quantities of uranium. (TVA 2010b)

The World Nuclear Association studies supply and demand for uranium and states that the world's present measured resources of uranium (in the cost category somewhat above present spot prices and used only in conventional reactors, at current rates of consumption) are sufficient to provide 50 years of low-cost uranium and 70 years of available, but more expensive, uranium. Very little uranium exploration occurred between 1985 and 2005, so the significant increase in exploration currently being witnessed might double the known reserves. On the basis of analogies with other metal minerals, a doubling in price from present levels could be expected to create about a tenfold increase in measured resources over time. The introduction of fast breeder reactors and other technologies may also reduce the supply-demand gap. The addition of a new nuclear unit increases consumption of uranium in the United States by approximately 2 percent and increases worldwide consumption of uranium by about 0.5 percent. Thus, the addition of continued operation of SQN or operation of a new nuclear plant would not create a significant impact on uranium resources. (TVA 2010b)

A new natural gas-fired plant would consume natural gas resources. The known supply of global natural gas reserves is measured in hundreds of years. Burning natural gas at a new plant would deplete a small fraction of the world's known supply of natural gas.

4.4. Energy Resources and Conservation Potential

The total amount of energy consumed during continued operation of SQN or the construction or operation of the Alternatives 2a or 2b is very small in comparison to the total amount consumed within the United States. Considering the resulting net balance of energy, a reactor or combined-cycle gas turbine would produce far more energy (as measured in BTUs) than would be consumed in its construction or operation. Operation of a nuclear plant helps conserve or avoid the consumption of finite fossil fuel supplies. A combined-cycle gas turbine is more efficient than a simple cycle gas turbine and also consumes less fossil fuel than a coal plant.

Nonrenewable energy in the form of fuels (gas, oil, and diesel) and electricity would be consumed in construction of any plant, and to a much smaller extent, in the operation of either SQN or a new nuclear plant.

Processing of nuclear fuel is, however, an energy-intensive activity. Existing uranium enrichment facilities are large and each facility services several nuclear generating plants. For comparative purposes, the energy required to process or enrich uranium (using gaseous diffusion) sufficient to fuel a single 1,000 MW pressurized BWR nuclear plant would approximate that of the output from a 50 MW fossil-fuel (coal-fired) facility operating at 75 percent capacity factor. Newer technologies (e.g., centrifuge or atomic vapor laser isotope separation) currently, or becoming, commercially available for enrichment utilize only 4-15 percent as much power as this gaseous diffusion example. As it is anticipated that these new, less energy intensive technologies will eventually become the norm for production of nuclear fuel, the processing portion of the UFC would likely use even less energy and become even more “carbon-friendly” in the future.

DOE formally announced in a June 29, 2009, *Federal Register* notice (74 FR 31017) that the department had decided to no longer pursue the prior administration's domestic Global Nuclear Energy Partnership (GNEP) program and that the department would focus on long-term research and development of technologies with the potential to produce beneficial changes to the manner in which nuclear waste is managed. This announcement effectively ended DOE efforts to pursue design and construction of spent nuclear fuel recycling facilities, either at a commercial or engineering scale.

CHAPTER 5

5.0 PERMITS AND APPROVALS

This chapter contains detailed descriptions of the permits and approvals TVA would obtain and maintain throughout the SQN license renewal term. The current operating licenses for Units 1 and 2 are set to expire at midnight on September 17, 2020, and September 15, 2021, respectively. If the NRC approves TVA's LRA, each unit's renewed license would permit operation for an additional 20-year period beyond the current expiration dates.

Implementation of Alternatives 2a – New Nuclear Generation or 2b – New Natural Gas-Fired Generation would also require permits and licenses. Many of the permits required to operate new generating plants described in Alternatives 2a or 2b would be similar to the permits discussed below for SQN's continued operation. Additional permits for construction of new plants would also be required. The construction and permitting period for Alternative 2a would be expected to be approximately 10 years or more, while the construction and permitting period for Alternative 2b would be expected to take approximately two – four years for construction after permits are obtained.

As part of the normal operation of SQN, permits are routinely maintained and monitored for applicability, and SQN's staff is committed to compliance with all applicable permits. Therefore, continued operation during the license renewal period would require SQN to maintain, renew, and update current permits (as required). The following permits are needed for operation of SQN:

- Operating license.
- NPDES permit.
- RCRA hazardous waste permit.
- General storm water permit.
- Air pollution control permits (for the emergency generators, generators, auxiliary boilers, insulation saw, cooling towers, and abrasive blasting).
- Annual asbestos permit, as needed.
- Solid waste disposal – construction/demolition waste landfill permit.
- Radioactive waste delivery license for Tennessee.

5.1. Overview of Required Permits/Approval

This section provides a brief background discussion and synopsis of the considerations involved for each type of permit. The permits described focus on the preferred alternative, license renewal, discussed in this SEIS. The equipment, processes, procedures, and programs that support SQN operations are already in place, having been completed under the various applicable permits and licenses, beginning with initial plant construction approximately 30 years ago. Other than the renewal of the operating licenses issued by the NRC, no new permits or approvals are required.

The license renewal program would not require major new construction, alterations, or refurbishment to SQN to maintain consistency with the current licensing basis. An expansion of the ISFSI would be required but is expected to be of no significant impact and therefore, not considered as refurbishment. The actual expansion of the ISFSI would be handled as a separate project. Separate assessments and specific permits and construction activities for this expansion are not discussed in detail in this SEIS.

5.1.1. Operating License Renewal

5.1.1.1. Operating License Renewal Background

U.S. nuclear power plants are originally licensed to operate for 40 years. This term was specified by Congress in the Atomic Energy Act of 1954. The law was fashioned after the Communications Act of 1934, in which radio stations were licensed to operate for several years and allowed to renew their licenses as long as the stations continued to meet their charters. The Atomic Energy Act allowed for nuclear power plants to renew their licenses. Congress selected a 40-year term for nuclear power plant licenses because this period was a typical amortization period for an electric power plant. The 40-year license term was not based on safety, technical, or environmental factors. (NEI 2009) To allow for the license renewal process, the NRC published regulations (10 CFR Part 54) in December 1991 establishing the regulatory requirements governing the renewal of nuclear plant operating licenses. Since issuing the original license renewal rule (hereinafter referred to as the Rule), the NRC, following public involvement, amended the Rule in May 1995.

The NRC requires submission of several documents for license renewal (10 CFR Part 54). These documents identify the SSCs from SQN and their intended functions. Once an integrated plant assessment is done to identify applicable passive, long-lived structures and components or commodity groupings, an aging management review (AMR) is conducted. This review includes time-limited aging analyses (TLAAs). Exemptions to aging effects are also evaluated and their applicability to the analysis is justified.

5.1.1.2. License Renewal Documentation

There are certain regulatory requirements that must be satisfied in order to obtain a renewed operating license, which would allow continued operation of a nuclear power plant beyond its original license term. The license renewal application contains general technical information regarding technical specifications and environmental information, each of which is addressed below. The application must be filed no earlier than 20 years prior to the expiration of the operating license currently in effect.

General information required includes the plant site and the plant owner and operator. This includes administrative information similar to that filed with the original operating license application. The LRA must also include general information about conforming changes to the standard indemnity agreement required by the NRC regulations (10 CFR §140.92, Appendix B) to account for the expiration term of the proposed renewed license.

Technical information in the LRA includes the following:

- The integrated plant assessment (IPA), which demonstrates that the effects of aging on long-lived, passive structures and components are being adequately managed such that the intended functions are maintained consistent with the current licensing basis (CLB) documents (Technical Specification, ODCM, etc.) in the renewal period.

- The listing of structures and components subject to the AMR and the results of the AMR analysis.

- The listing and evaluation of TLAAs and any exemptions in effect based on TLAAs.

- A supplement to the plant's UFSAR that contains a summary description of the programs and activities cited as managing the effects of aging and the evaluation of TLAAs.

- Changes to the CLB of the plant.

Information regarding technical specifications would include any changes or additions to the plant's technical specifications necessary to manage the effects of aging during the period of extended operation. The aging analysis and any potential recommended changes would ensure that SQN is capable of operating safely for the 20-year period beyond the current license expiration dates.

The LRA contains environmental information related to a supplement or a revision to the original environmental report that complies with the NRC requirements (10 CFR Part 51). This document contains environmental information required by the NRC from TVA and is used by the NRC to compose the SQN-specific supplement to the NRC-produced GEIS for license renewal of nuclear plants. The information comprising this document would use information from TVA's NEPA review (i.e., this SEIS). The supplemental SQN environmental report that will be produced for the LRA and this SEIS contain information from the NRC GEIS (NRC 1996). This NUREG-1437 is currently in draft revision and being reviewed by the public and the nuclear industry. Both the original NUREG-1437 and the draft NUREG-1437 are used where applicable in this SEIS.

5.1.2. NPDES Permit

In accordance with the CWA of 1977 and the Tennessee Water Quality Control Act of 1977, a permit was issued to regulate the discharge of various plant effluents into the Tennessee River. The permit specifies discharge limitations and monitoring requirements at each discharge point (DSN). The current permit was issued January 31, 2011 by TDEC; it became effective on March 1, 2011 and will expire on October 31, 2013. (TDEC 2011)

5.1.3. Resource Conservation and Recovery Act

SQN has a RCRA identification number (TN5640020504) that allows the facility to manage, store, and offer for transportation hazardous wastes. When hazardous wastes are produced at SQN, programs and procedures are in place to ensure compliance with RCRA. SQN would continue to retain this RCRA identification number during the period of license renewal. TVA also has a permitted RCRA storage facility at Muscle Shoals, Alabama, (AL2640090005) to handle all hazardous waste shipped from SQN and other TVA facilities. Details of the hazardous waste program are found in Section 3.14. Management of wastes is controlled by an SQN technical instruction (TVA 2008b).

5.1.4. General Storm Water Permit

SQN has a general storm water permit (TNR 050015) for managing storm water runoff collected at the site by various drainage features. This permit would be maintained for the period of license renewal.

5.1.5. Air Pollution Control Permits

SQN has permits to operate its two cooling towers, two insulation saws, two auxiliary boilers, the carpentry shop, one abrasive blaster, and its four emergency diesel generators and two other generators. These permits are issued under the Chattanooga-Hamilton County APCB; permits are for a period of five years and then must be renewed (renewal due July 2012).

5.1.6. Solid Waste Disposal Permit

TVA-SQN has an inert solid waste landfill permit (DML 331050021) for the landfill on the SQN site. The total permitted area of this landfill is approximately 18 acres. The landfill has not been used in the last 10 years, and there are no plans to use the landfill in the future.

This permit allows SQN to dispose of the following materials in its landfill: non-hazardous, non-radioactive solid wastes including scrap lumber, bricks, sandblast grit, crushed metal drums, glass, wiring, non-asbestos insulation, roofing materials, building siding, scrap metal, concrete with reinforcing steel, and similar construction and demolition wastes. Management of the landfill is controlled by an SQN technical instruction that includes an appendix with specific instructions for solid waste disposal. (TVA 2008b)

5.1.7. Tennessee Radioactive Waste Delivery License

The TDEC radioactive waste delivery license for shipment inside the State of Tennessee, T-TN002-L10, allows for the shipment of radioactive material from SQN to facilities within the state. SQN ships LLRW (Class A only) to the Oak Ridge, Tennessee, facility where it is processed, packaged, and shipped to a LLRW disposal facility such as the Energy Solutions facility at Clive, Utah. SQN does not normally ship directly to a disposal facility.

CHAPTER 6

6.0 LIST OF PREPARERS

6.1. NEPA Project Management

Chris Byerman	
Position:	Environmental Project Manager, ENERCON
Education:	B.S., Geological Sciences
Experience:	19 years environmental consulting including nuclear utility industry, NEPA, regulatory compliance, risk reduction, and hydrology
Involvement:	Project management, hydrology, senior technical review
Amy B. Henry	
Position:	NEPA Specialist
Education:	M.S., Zoology and Wildlife; B.S., Biology
Experience:	12 years in biological surveys, natural resources management planning, and environmental reviews
Involvement:	NEPA compliance and document preparation
Deborah A. Luchsinger	
Position:	Principal Consultant/Manager of Special Projects, ENERCON
Education:	Ph.D. Climatology/Atmospheric Sciences; M.S., Environmental and Economic Geology; B.S., Geology
Experience:	6 years in nuclear environment; 30 years in power generation and energy development
Involvement:	Project management, NEPA project management, impacts analysis, hydrogeology, and meteorology
Bruce Yeager	
Position:	NEPA Program Manager
Education:	M.S., Zoology (Ecology); B.S., Zoology (Aquatic Ecology)
Experience:	33 years in environmental compliance for water, air, and land-use planning; environmental business services
Involvement:	NEPA strategy

6.2. Other Contributors

Gary M. Adkins, PE, PMP	
Position:	Senior Project Manager, Nuclear Generation & Development
Education:	B.S., Electrical Engineering; Registered Professional
Experience:	19 years nuclear engineering experience; 6 years license renewal experience
Involvement:	License renewal project manager
Joel L. Armstrong	
Position:	Radiation Protection Support Superintendent
Education:	M.S., Health Physics; B.S., Physics

Experience: 30 years in radiation protection
Involvement: Radiological effects of normal operation

Nolan D. Baier
Position: Senior Specialist
Education: M.B.A.; B.S., Civil Engineering
Experience: 10 years energy industry analytics
Involvement: Need for power

John T. Baxter
Position: Specialist, Aquatic Endangered Species Act Permitting and Compliance
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Experience: 19 years in protected aquatic species monitoring, habitat assessment, and recovery; 11 years in environmental review
Involvement: Aquatic ecology/threatened and endangered species

Francine Beck
Position: Senior Technical Specialist, ENERCON
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Experience: 4 years in nuclear environment, including COLA preparation; 9 years project coordination; 7 years technical editing
Involvement: Technical review and editing, document preparation

Dave Bean
Position: Technical Reviewer, ENERCON
Education: M.S., Zoology; B.A., Biology
Experience: 33 years in nuclear utility industry
Involvement: Supervisor, safety analysis

Mark J. Boggs
Position: Hydrologist
Education: M.S., Hydrology; B.S., Geophysics
Experience: 35 years in hydrologic investigation and analysis for environmental and engineering applications
Involvement: Groundwater

Robert D. Bottoms
Position: Planning Engineer, Specialist
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Experience: 11 years in transmission planning
Involvement: Transmission grid

Gary S. Brinkworth, PE
Position: Senior Manager, New Generation and Portfolio Optimization System Planning (Strategy and Business Planning)
Education: M.S. and B.S., Electrical Engineering
Experience: 14 years electric utility experience (system planning, DSM analysis, forecasting, rate analysis)
Involvement: Need for power, alternative energy sources

Michael G. Browman

Position:	Environmental Engineer – Specialist
Education:	Ph.D., M.S., and B.S., Soil Science; M.S., Environmental Engineering
Experience:	27 years in environmental control technology development and environmental impact analysis
Involvement:	Solid waste

Stacy Burgess

Position:	Environmental Specialist, ENERCON
Education:	B.S., Geology
Experience:	24 years environmental consulting including nuclear utility industry, hydrology, regulatory compliance, and risk reduction
Involvement:	Hydrology, geology

Rick Buckley

Position:	Senior Technical Reviewer, Entergy Nuclear
Education:	B.S., Biology
Experience:	24 years in nuclear utility industry
Involvement:	Environmental protection

Jennifer M. Call

Position:	Meteorologist
Education:	M.S. and B.S., Meteorology/Geosciences, Certified Consulting Meteorologist
Experience:	7 years in meteorological forecasting, air quality monitoring, data analysis, and air quality research
Involvement:	Meteorology

Lorrie A. Carter

Position:	Technical Editor, ENERCON
Education:	M.A., French Language and Literature; B.A., English
Experience:	3 years in nuclear utility industry, 23 years technical editing
Involvement:	Technical editing; documentation specialist

Rodney M. Cook

Position:	Manager, Corporate Nuclear Licensing, SQN
Education:	B.S., Nuclear Engineering
Experience:	38 years licensing and engineering
Involvement:	TVA licensing

Eric J. Davis, CFA

Position:	Program Manager, Investment Trusts
Education:	M.B.A., General Management; B.S., Economics and Finance; A.S., Business Administration
Experience:	10 years in treasury-finance
Involvement:	Decommissioning

James H. Eblen

Position:	Contract Economist
Education:	Ph.D., Economics; B.S., Business Administration

Experience:	40 years in economic analysis and research
Involvement:	Socioeconomics; environmental justice

Edwin T. Floyd

Position:	Technical Reviewer, ENERCON
Education:	B.S., Biology
Experience:	32 years in nuclear utility industry
Involvement:	Health physicist – plant operation and radioactive environmental

Jerry G. Fouse

Position:	Recreation Manager
Education:	M.B.A. and B.S., Forestry and Wildlife
Experience:	35 years in natural resources – recreation planning and economic development
Involvement:	Recreation

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Position:	Planning Engineer
Education:	B.S., Electrical Engineering
Experience:	8 years in transmission planning
Involvement:	Transmission lines

David A. Hankins

Position:	Geographic Analyst
Education:	B.S., Fish and Wildlife Management
Experience:	29 years in geographic information and engineering
Involvement:	GIS

Melinda Harris

Position:	Technical Specialist, ENERCON
Education:	Ph.D., Zoology; M.S., Environmental Science; B.S., Bioenvironmental Science
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Involvement:	Ecology

John M. Higgins, PE

Position:	Water Quality Specialist
Education:	Ph.D., Environmental Engineering; M.S. and B.S., Civil Engineering
Experience:	36 years in environmental engineering and water resources management
Involvement:	Surface water quality/use; wastewater

Paul N. Hopping

Position:	Technical Specialist
Education:	Ph.D., Civil and Environmental Engineering; M.S. and B.S., Civil Engineering
Experience:	26 years in hydrothermal and surface water analysis
Involvement:	Hydrology; hydrothermal effects

Stephanie A. Howard
Position: Environmental Manager, Sequoyah and Watts Bar
Education: M.S. and B.S. in Nuclear Engineering
Experience: 16 years experience Sequoyah environmental compliance
Involvement: Sequoyah plant operations, permits, and technology

Mary E. Jacobs
Position: Atmospheric Analyst
Education: B.S., Mathematics
Experience: 19 years in air quality analysis
Involvement: Air quality

W. Kenneth Kimsey
Position: Supervisor, Sequoyah Chemistry Laboratory
Education: B.A., Chemistry
Experience: 23 years, Sequoyah chemistry
Involvement: Nuclear chemistry

Sandra S. Koss
Position: Program Manager (Radwaste and Meteorological), Nuclear Power
Education: M.S., Chemical Engineering; B.S., Environmental Engineering
Experience: Over 20 years in radwaste and environmental programs and projects
Involvement: Transport of radioactive materials, radioactive waste

Dennis L. Lundy
Position: Engineering Consultant
Education: M.S. and B.S, Civil Engineering; Registered Professional Engineer (Inactive)
Experience: 36 years in nuclear and fossil engineering, management, and design
Involvement: Facility design and operation support

Zita I. Martin
Position: Program Manager, Spent Fuel
Education: B.S., Nuclear Engineering
Experience: 29 years in nuclear fuel; 16 years in spent fuel storage
Involvement: Spent fuel storage

D. Keith McPeters
Position: Industrial Hygienist/Safety Specialist
Education: M.S., Safety Management; B.S., Sociology
Experience: 17 years in occupational/environmental noise assessments; 26 years in industrial hygiene and safety
Involvement: Noise

Roger A. Milstead
Position: Program Manager, Flood Risk
Education: B.S., Civil Engineering; Registered Professional Engineer
Experience: 32 years in floodplain and environmental evaluations

Involvement: Flood plains; flood risk

Steve F. Mueller
Position: Specialist, Atmospheric Science
Education: M.S., Meteorology; Certified Consulting Meteorologist
Experience: 32 years in air quality studies, field research, and atmospheric modeling
Involvement: Climate and climate change

Jeff W. Munsey
Position: Civil Engineer
Education: M.S. and B.S., Geophysics
Experience: 24 years in geophysical and geological studies and investigations, including applications to environmental assessments
Involvement: Seismology

Michael Myers
Position: Technical Specialist, ENERCON
Education: Ph.D., Geography
Experience: 12 years geographic research and teaching (university); 24 years staff, with 10 years principal or co-principal investigator in cultural resource management.
Involvement: Cultural resources

Diedre B. Nida
Position: Senior Environmental Manager, Nuclear Power Group
Education: B.S., Chemistry, certified hazardous materials manager
Experience: 29 years in chemistry/environmental for TVA
Involvement: Sequoyah plant operations, permits, and technology

Mike Payne
Position: Fleet Heat Exchanger Specialist, Nuclear Power Group, Equipment Reliability Group
Education: B.S., Chemistry
Experience: 6 years, chemistry program manager; 4 years, technical services analyst; 10 years, field technical representative to the chemical, metals, and paper industries
Involvement: Chemical additives to raw water (corporate)

W. Chett Peebles
Position: Specialist, Landscape Architect
Education: Bachelor of Landscape Architecture; Registered Landscape Architect; RLA; ASLA
Experience: 20 years in site planning and visual assessment
Involvement: Visual resources

Jerry L. Riggs

Position:	GIS Specialist, ENERCON
Education:	M.A., Geography; B.S., Biochemistry
Experience:	5 years nuclear utility industry
Involvement:	GIS, socioeconomic analysis, and environmental justice

Helen Robertson

Position:	Technical Specialist, ENERCON
Education:	Ph.D., Geography
Experience:	8 years geographic research and teaching (university); 7 years technical writing, editing, and graphic design
Involvement:	Cultural resources, technical editing, document design

Kevin R. Rowe

Position:	Corp. Radiation Protection Manager, TVA
Education:	Health Physics; registered radiation protection technologist; SRO Certification
Experience:	32 years nuclear health physics/radiation protection program management
Involvement:	Radiological effects of normal operation

Kim Stapleton

Position:	Technical Specialist, ENERCON
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Experience:	6 years in GIS and socioeconomics
Involvement:	Socioeconomic analysis

James A. Thomas

Position:	Senior Technical Reviewer, ENERCON
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Experience:	18 years in nuclear utility industry
Involvement:	Environmental protection

Rachel E. Turney-Work

Position:	Senior Technical Specialist, ENERCON
Education:	M.A. and B.A., Geography
Experience:	8 years geography, GIS, socioeconomic and land use analysis
Involvement:	Socioeconomic and land use analysis

Christopher D. Ungate

Position:	Senior Principal Management Consultant, S&L
Education:	M.S. and B.S., Civil Engineering; M.B.A.
Experience:	35 years engineering, planning, and consulting
Involvement:	Need for power, energy alternatives

Michael J. Walker
Position: Manager, Site Probabilistic Risk Analysis
Education: B.S., Chemical Engineering; SRO Certification
Experience: 30 years nuclear plant design, construction, and operation
Involvement: Probabilistic risk analysis

Sean Wallace
Position: Senior Scientist, ENERCON
Education: B.S., Environmental Studies
Experience: 17 years in environmental utility industry
Involvement: Ecology

Ken G. Wastrack
Position: Meteorologist
Education: M.B.A.; B.S., Meteorology
Experience: 34 years in meteorology
Involvement: Meteorology

Louis L. Wheeler
Position: Licensing Review Specialist, ENERCON
Education: B.S., Nuclear Engineering
Experience: 30 plus years in nuclear industry
Involvement: NRC licensing

Richard W. Yarnell
Position: Archaeologist
Education: B.S., Environmental Health
Experience: 38 years, cultural resource management
Involvement: Cultural and historical resources

CHAPTER 7

7.0 LIST OF AGENCIES, ORGANIZATIONS, TRIBES, AND INDIVIDUALS NOTIFIED OF SEIS AVAILABILITY

7.1. Federal Agencies

U.S. Army Corps of Engineers, Nashville District
U.S. Army Corps of Engineers, Nashville Regulatory Branch
U.S. Department of Agriculture, Natural Resource Conservation Service
U.S. Department of Energy, National Nuclear Security Administration
U.S. Department of the Interior
U.S. Environmental Protection Agency, Region 4
U.S. Fish and Wildlife Service, Cookeville, Tennessee
U.S. Forest Service, Cherokee National Forest
National Park Service, Great Smoky Mountains National Park
U.S. Nuclear Regulatory Commission, License Renewal Division

7.2. State Agencies

Greater Nashville Regional Council
Tennessee State Conservationist
Southeast Tennessee Development District, State Conservationist
Tennessee Department of Agriculture
Tennessee Department of Economic and Community Development
Tennessee Department of Environment and Conservation (TDEC)
- TDEC, Air Pollution Control Division
- TDEC, Director
- TDEC, Groundwater Protection Division
- TDEC, Natural Heritage Division
- TDEC, Office of General Council
- TDEC, Radiological Health Division
- TDEC, Water Pollution Control Division
- TDEC, Water Supply Division

Tennessee Department of Transportation (TDOT)
- TDOT, Commissioner
- TDOT, Environmental Planning and Permits Division

Tennessee Division of Archaeology
Tennessee Historical Commission, Director
Tennessee Wildlife Resources Agency

7.3. Local Agencies and Private Organizations

Nuclear Energy Institute, Nuclear Generation Division

7.4. Federally Recognized Tribes

Cherokee Nation
Eastern Band of Cherokee Indians
United Keetoowah Band of Cherokee Indians in Oklahoma
The Chickasaw Nation

Seminole Tribe of Florida
Muscogee (Creek) Nation of Oklahoma
- Alabama-Coushatta Tribe of Texas
- Alabama Quassarte Tribal Town
- Kialegee Tribal Town
- Thlopthlocco Tribal Town
- Absentee Shawnee Tribe of Oklahoma
- Eastern Shawnee Tribe of Oklahoma
- Shawnee Tribe

7.5. Individuals

The following list includes individuals who expressed interest in the SQN SEIS by submitting comments on the scoping document or DSEIS or by signing up for the mailing list. An email announcing availability of the FSEIS was sent to the individuals listed below.

Bob Alexander, Nashville, Tennessee
David Bean, Columbus, Ohio
Mick Mastilovic, Signal Mountain, Tennessee
Vince Richter, Abbeville, Alabama
Virgil E. Vandergriff, Ringgold, Georgia
J.D. Watson, Soddy-Daisy, Tennessee

CHAPTER 8

8.0 LITERATURE CITED

Advanced National Seismic System (ANSS). 2010. "ANSS Catalog Search." Retrieved from <http://www.ncedc.org/anss/catalog-search.html> (accessed March 30, 2010).

Ahlstedt, S. and T. McDonough. 1996. "Summary of Pre-operational Monitoring of the Mussel Fauna in the Upper Chickamauga Reservoir (Tennessee River) in the Vicinity of TVA's Watts Bar Nuclear Plant, 1983-1993." *Walkerana*, 1995-1996, 8(19):107-126.

Alabama Tourism Department (ATD). 2008. *Travel Economic Impact Report 2008*. Retrieved from <http://www.alabama.travel/media/media_room/Report/2008TourismReport.pdf> (accessed February 23, 2010).

"Amended Notice of Intent to Modify the Scope of the Surplus Plutonium Disposition Supplemental Environmental Impact Statement and Conduct Additional Public Scoping." *Federal Register* 75:41850 (19 July 2010).

Association of Tennessee Valley Governments (ATVG). 2009. "TVA In-Lieu-of-Tax Payments, FY 2008." Retrieved from <http://www.atvg.org/forms/inlieu/SoutheastDistrict.pdf> (accessed May 1, 2010).

Balir, N., M. Mehos, W. Short, and D. Heimiller. 2006. *Concentrating Solar Deployment System (CSDS) – A New Model for Estimating U.S. Concentrating Solar Power (CSP) Market Potential*. Conference Paper NREL/CP-620-39682.

"Blending of Surplus Highly Enriched Uranium From the Department of Energy, to Low Enriched Uranium for Subsequent use as Reactor Fuel at the Tennessee Valley Authority's Browns Ferry Nuclear Plant—Record of Decision." *Federal Register* 66:57997 (19 November 2001).

Bohac, Charles E., and M. J. McCall. 2008. *Water Use for the Tennessee River Valley for 2005 and Projected Use in 2030*. Retrieved from <http://www.tva.gov/river/watersupply/watersupply_report_to_2030.pdf> (n.d.).

Buckner. 1936. *Archaeological Site Survey Records for sites 40HA20, 40HA21, 40HA22, 40HA43, and 40HA46*. Tennessee Division of Archaeology, Nashville, Tenn.

Bureau of Economic Analysis (BEA). 2008a. "CA25N – Total Full-time and Part-time Employment by NAICS Industry." Retrieved from <http://www.bea.gov/regional/reis/action.cfm> (accessed April 29, 2010).

———. 2008b. "CA34 – Average Wage per Job." Retrieved from <http://www.bea.gov/regional/reis/drill.cfm> (accessed May 11, 2010).

———. 2008c. "CA04 – Personal Income and Employment Summary." Retrieved from <http://www.bea.gov/regional/reis/action.cfm> (accessed April 29, 2010).

Bureau of Labor Statistics (BLS). 2008. "Metropolitan Area Employment and Unemployment: March 2008." Retrieved from <http://www.bls.gov/news.release/archives/metro_04292008.pdf> (accessed May 11, 2010).

———. 2010. "Metropolitan Area Employment and Unemployment: March 2010." Retrieved from <http://www.bls.gov/news.release/archives/metro_04282010.pdf> (accessed May 11, 2010).

Calabrese, F.A., V. P. Hood, and G. R. Leaf. 1973. *Preliminary Archaeological Survey of the Sequoyah Nuclear Power Plant Area*. July 30, 1973. Unpublished report, on file with Tennessee Valley Authority, Chattanooga, Tenn.

California Environmental Resources Evaluation System (CERES). 2009. "Noise." Retrieved from <http://ceres.ca.gov/planning/genplan/sutter/noise1.html> (accessed April 5, 2010).

Chapman, Jefferson. 1985. "Tellico Archaeology: 12,000 Years of Native American History." Tennessee Valley Authority, *Publications in Anthropology No. 41*. University of Tennessee Press: Knoxville, Tenn.

Chattanooga-Hamilton County Air Pollution Control Bureau (CHCAPCB). 2009. "Company Permitting." Retrieved from <http://www.pollutionsolution.org/company_permitting/home.html.aspx> (accessed January 15, 2009).

Chattanooga-Hamilton County Regional Planning Agency (CHCRPA). 2005a. *Comprehensive Plan 2030*. Retrieved from <http://www.chcrpa.org/Divisions_and_Functions/Comprehensive_Planning/Land_Use_Planning/Land_Use_Planning-CompPlan2030.htm> (accessed November 20, 2009).

———. 2005b. *Recent Trends: Population, Employment, Property Tax Base, Chattanooga MSA & Hamilton County Comprehensive Plan 2030*. Retrieved from <http://www.chcrpa.org/Divisions_and_Functions/Information_and_Research/Analytical_Reports/Recent_Trends-June_2005.pdf> (accessed April 29, 2010).

———. 2009a. *Hamilton County, TN Development Trends in County Commission Districts, 2000-2008*. Retrieved from <http://www.chcrpa.org/Divisions_and_Functions/Information_and_Research/Analytical_Reports/Development_Trends_in_Hamilton_County_2000-2008_July2009.pdf> (accessed November 20, 2009).

———. 2009b. "Hamilton County Zoning Regulations." Recodified February 21, 2001, updated through November 2009. Retrieved from <http://www.chcrpa.org/divisions_and_functions/development_services/Zoning/Zoning_Regulations.htm>

———. 2010. *LRTP 2035 Long-Range Transportation Plan, Volume 1*. Adopted February 16, 2010.

Council on Environmental Quality (CEQ). 2010. “Draft NEPA Guidance on Consideration of the Effects of Climate Change and Greenhouse Gas Emissions.” Memorandum for Heads of Federal Departments and Agencies. February 18, 2010.

Cowardin, L. M., V. Carter, F. C. Golet, and E. T. LaRoe. 1979. *Classification of Wetland and Deepwater Habitats of the United States*. Publication FWS/OBS-79/31. U.S. Fish and Wildlife Service: Washington, D.C.

Dinkins, G. R. 2008. *Survey for Federally Protected Mussels in the Tennessee River Adjacent to Proposed Clifton Fuels Terminal Project, Decatur County, Tennessee.* Prepared for Natural Resource Group, LLC.

Earthquake Center (EC). 2009. “Earthquake Summary Pages for 2003, Fort Payne Earthquake Information Page.” Retrieved from <http://www.eas.slu.edu/Earthquake_Center/NEW/20030429085937/index.html> (accessed November 2, 2009).

Electric Power Research Institute (EPRI). 2002. *Siting Guide: Site Selection and Evaluation Criteria for an Early Site Permit Application Final Report*. Electric Power Research Institute: Palo Alto, Calif.

———. 2007. *Ground Water Protection Guidelines for Nuclear Power Plants.* EPRI Report 1015118. Electric Power Research Institute: Palo Alto, Calif.

———. 2009. *Potential Impact of Climate Change on Natural Resources in the Tennessee Valley Authority Region*. Electric Power Research Institute: Palo Alto, Calif.

Environmental Data Resources (EDR). 2010. “GeoCheck® Report: Sequoyah Nuclear Plant.”

Erlanger Medical Center (Erlanger). 2010. “Fast Facts 2009.” Retrieved from <http://www.erlanger.org/body.cfm?id=187> (accessed April 27, 2010).

Federal Interagency Committee on Noise (FICON). 1992. *Federal Agency Review of Selected Airport Noise Analysis Issues*.

Federal Railroad Administration (FRA). 2010. “Horn Noise Questions and Answers.” Retrieved from <http://www.fra.dot.gov/Pages/1174.shtml> (accessed April 5, 2010).

“Floodplain Management Guidelines for Implementing E.O. 11988.” U. S. Water Resources Council. *Federal Register* 43:6030. (10 February 1978).

Fthenakis, V. M., and H. C. Kim. 2007. “Greenhouse-gas emissions from solar electric- and nuclear power: A life-cycle study.” *Energy Policy* 35 (2007) 2549-25557.

Geological Survey of Alabama (GSA). 2009. “Geological Hazards Program, Geological Survey of Alabama Fort Payne Earthquake, April 29, 2003.” Retrieved from <http://www.gsa.state.al.us/gsa/geologichazards/earthquakes/ftpayne.html> (accessed January 5, 2009).

Georgia Department of Economic Development (GDED). 2006. "Tourism at a Glance—Vital Stats." Retrieved from <http://www.georgia.org/SiteCollectionDocuments/Industries/Tourism/IndustryResearch/Tourism%20at%20a%20glance%2008.doc> (accessed February 25, 2010).

———. 2010. "Georgia Tourism." Retrieved from <http://www.georgia.org/SiteCollectionDocuments/Industries/Tourism/IndustryResearch/State%20Economic%20Report/Tourism%20Economic%20Impact%20Presentation_Jan_10.pdf> (accessed February 25, 2010).

Georgia Office of Planning and Budget (GAOPB). 2005. "Georgia 2015 Population Projections." Retrieved from <http://www.opb.state.ga.us/media/3016/georgia_population_projections_reduced_web_5_25_05.pdf> (accessed December 08, 2009).

Griffith, G. E., J. M. Omernik, and S. H. Azevedo. 1997. *Ecoregions of Tennessee*. EPA/600R-97/022. U.S. Environmental Protection Agency: Corvallis, Ore.

Hamilton County Department of Education (HCDE). 2009. "Hamilton County Schools General Information." Retrieved from <http://www.hcde.org/site/general_info.aspx> (accessed April 27, 2010).

Hamilton County Parks & Recreation (HCPR). 2010. "Chester Frost Park." Retrieved from <http://www.hamiltontn.gov/parkrec/ParkInfo.aspx?ParkID=52> (accessed May 25, 2010).

Hamilton County Sheriff's Office (HCSO). 2010. "Patrol Division 2010." Retrieved from <http://www.hcsheriff.gov/uniform_services/patrol.asp> (accessed April 26, 2010).

"Invasive Species." Executive Order 13112. *Federal Register* 64:6183 (8 February 1999). Retrieved from <http://www.invasivespeciesinfo.gov/laws/execorder.shtml> (accessed May 18, 2010).

Isom, B. G. 1969. "The Mussel Resource of the Tennessee River." *Malacologia* 7(2-3):397-425.

Jones, J. S. and T. Karpynec. 2009. *Phase 1 Cultural Resource Survey of the Proposed Improvements to the TVA Sequoyah Nuclear Power Plant, Hamilton County, Tennessee*. Report prepared for Tennessee Valley Authority, Cultural Resources Division, by TRC Environmental Corporation, Nashville, Tenn. On file with Tennessee Valley Authority, Chattanooga, Tenn.

Karimi, R. 2007. *Watts Bar Nuclear Plant Severe Reactor Accident Analysis*. Science Applications International Corporation: McLean, Va.

Lewis Environmental Consulting (LEC), LLC. 2008. *Baseline Mussel Monitoring Survey at Calvert City Terminal, Tennessee River Mile 14.0 - 14.4 R, 14.2 - 14.5 L, 14.6 - 15.0 R, Livingston and Marshall Counties, Kentucky*. Prepared for Calvert City Terminal, LLC.

Lewis, T. M. N. and M. C. Kneberg Lewis. 1995. "The McGill Site." In *The Prehistory of the Chickamauga Basin in Tennessee*, ed. L. P. Sullivan, pp. 295-300. University of Tennessee Press: Knoxville, Tenn.

Mainstream Commercial Divers (MCD), Inc. 2006. *Mussel Survey of Snake Creek Mile 0.00 - 0.15 and Tennessee River mile 197.0 - 197.7 in Hardin County, Tennessee*. Prepared for Santana Dredging Corporation.

McKee, L., T. Karpynec, and J. Holland. 2010. *Phase 1 Cultural Resources Survey of the TVA Sequoyah Nuclear Plant, Hamilton County, Tennessee*. Report prepared for Tennessee Valley Authority, Cultural Resources Division, by TRC Environmental Corporation, Nashville, Tenn. On file with Tennessee Valley Authority, Chattanooga, Tenn.

Meier, P. J. 2002. *Life-Cycle Assessment of Electricity Generation Systems and Applications for Climate Change Policy Analysis*. Report #UWFTDM-1181. Fusion Technology Institute. University of Wisconsin: Madison, Wisc.

Memorial North Park Hospital (Memorial). 2010. "Memorial Health Care System." Retrieved from <http://www.catholichealthinit.org/body.cfm?id=39317> (accessed April 28, 2010).

Milbrandt, A. 2005. *A Geographic Perspective on Current Biomass Resource Availability in the United States*. National Renewable Energy Laboratory Technical Report NREL/TP 560-39181.

Miller B. A., V. Alavian, M. D. Bender, D. J. Benton, et al. 1993. *Sensitivity of the TVA Reservoir and Power Supply Systems to Extreme Meteorology*. Report No. WR28-1-680-111. Tennessee Valley Authority, Engineering Laboratory: Norris, Tenn.

Mizutani, T. 2009. *Innovative Technological Developments in Electricity Storage*. Presentation at World Energy Dialogue, Hannover, Germany.

Moore, Clarence B. 1915. *Aboriginal Sites on Tennessee River*. Academy of Natural Sciences: Philadelphia, Pa.

National Center for Education Statistics (NCES). 2010a. "Hamilton County School District." Retrieved from <http://nces.ed.gov/ccd/districtsearch/district_detail.asp?start=0&ID2=4701590> (accessed April 27, 2010).

———. 2010b. "Chattanooga Colleges." Retrieved from <http://nces.ed.gov/GLOBALLOCATOR/index.asp?search=1&State=TN&city=Chattanooga&zipcode=&miles=&itemname=&sortby=name&College=1&CS=3BA4C86F> (accessed April 28, 2010).

National Climatic Data Center (NCDC). 2010a. "Thunderstorms and High Winds, Hamilton County, Tennessee, between 01/01/1950 and 10/31/2009." NCDC query output, retrieved from <http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~storms> (accessed February 15, 2010).

———. 2010b. "Tornado(s) Hamilton County, Tennessee, between 01/01/1950 and 10/31/2009." NCDC query output, retrieved from <http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~storms> (accessed February 15, 2010).

National Park Service (NPS). 2010. "Nationwide Rivers Inventory." Retrieved from <http://www.nps.gov/ncrc/programs/rtca/nri/auth.html> (accessed May 18, 2010).

National Renewable Energy Laboratory (NREL). 2010. "Dynamic Maps, GIS Data, and Analysis Tools – Solar Maps." Retrieved from <http://www.nrel.gov/gis/solar.html> (accessed July 23, 2010).

National Weather Service (NWS). 2010. "Chattanooga Climate Normals and Records." Retrieved from <http://www.srh.noaa.gov/mrx/?n=chaclimate> (accessed February 15, 2010).

National Wild & Scenic Rivers System (NWSR). 2010. "National Wild & Scenic Rivers." Retrieved from <http://www.rivers.gov/index.html> (accessed May 18, 2010).

Norfolk Southern Corp. 2010. "Norfolk Southern System Map, 2010." Retrieved from <http://www.nscorp.com/nscportal/nscorp/map.html> (accessed May 20, 2010).

North Carolina Department of Commerce (NCDOC). 2008. "Division of Tourism, Film and Sports Development: 2008 Annual Report." Retrieved from <http://www.nccommerce.com/NR/rdonlyres/7339D19C-AC89-4874-BBD5-4EB9B42D4545/0/2008AnnualReport.pdf> (accessed February 24, 2010).

North Carolina Office of State Budget and Management (NCOSBM). 2009a. "Annual County Population Totals, 2000-2009." Retrieved from <http://www.osbm.state.nc.us/ncosbm/facts_and_figures/socioeconomic> (accessed December 08, 2009).

———. 2009b. "Projected Annual County Population Totals, 2010-2019." Retrieved from <http://www.osbm.state.nc.us/ncosbm/facts_and_figures/socioeconomic> (accessed December 08, 2009).

———. 2009c. "Projected Annual County Population Totals, 2020-2029." Retrieved from <http://www.osbm.state.nc.us/ncosbm/facts_and_figures/socioeconomic> (accessed December 08, 2009).

"Notice of Cancellation of the Global Nuclear Energy Partnership (GNEP) Programmatic Environmental Impact Statement." Office of Nuclear Energy, U.S. Department of Energy. *Federal Register* 74:31017 (June 29, 2009).

Nuclear Energy Institute (NEI). 2002. *Deterring Terrorism: Aircraft Crash Impact Analyses Demonstrate Nuclear Power Plant's Structural Strength*. Nuclear Energy Institute: Washington, D.C.

———. 2007. *Industry Ground Water Protection Initiative – Final Guidance Document*. NEI 07-07. Nuclear Energy Institute: Washington, D.C.

———. 2009. *Fact Sheet: Nuclear Power Plant License Renewal*. Nuclear Energy Institute: Washington, D.C.

Ortmann, A. E. 1918. “The nayades (freshwater mussels) of the Upper Tennessee drainage – With Notes on Synonymy and Distribution.” *Proceedings of the American Philosophical Society* 57:521-626.

Pilot Outlook. 2010. “Sequoyah Nuclear Plant Heliport.” Retrieved from <http://www.pilotoutlook.com/airport/tennessee/tn78> (accessed May 19, 2010).

Scruggs, G. D. 1960. “Status of Fresh-water Mussel Stocks in the Tennessee River.” U.S. Fish and Wildlife Service Special Report. *Fisheries* No. 370:1-41.

“Secretary of the Interior’s Standards and Guidelines for Archaeology and Historic Preservation.” *Federal Register* 48:44716 (29 September 1983). Retrieved from <http://www.nps.gov/history/local-law/Prof_Qual_83.htm> (accessed April 27, 2010).

Sequoyah Nuclear Plant. 2009. *Offsite Dose Calculation Manual*. Revision 55. February 17, 2009.

———. 2010. *Sequoyah Units 1 and 2 License Renewal Project Request for Information*. RFI No. SQN 100803-02. August 3, 2010.

Southeast Development Resource Group (SDRG). 2009. “Southeast Tennessee Development District 2009: Comprehensive Economic Development Strategy (CEDS), Regional Analysis 2009.” Retrieved from <http://www.sedev.org/downloads/CEDS2009.pdf> (accessed April 29, 2010).

Sovacool, B. K. 2008. “Valuing the greenhouse gas emissions from nuclear power: A critical survey.” *Energy Policy* 36 (2008) 29509-2963.

Tennessee Advisory Commission on Intergovernmental Relations (TACIR). 2008. “Hamilton County, Tennessee: Selected Statistical Information.” Retrieved from <http://www.tennessee.gov/tacir/County_Profile/hamilton_profile.htm> (accessed April 28, 2010).

Tennessee Department of Environment and Conservation (TDEC). 2000. “Ground-Water Use by Public Water-Supply Systems in Tennessee, 2000.” Division of Water Supply 2000. Retrieved from <http://pubs.usgs.gov/of/2003/ofr0347/PDF/ank-wuPlate.pdf> (accessed May 1, 2010).

———. 2008. “2008 305(b) Report, The Status of Water Quality in Tennessee.” Retrieved from <http://tn.gov/environment/wpc/publications/pdf/2010_305b.pdf> (accessed March 24, 2011).

———. 2009. “Revised 8-Hour Ozone Standard Nonattainment Area Designations Nine-factor Analysis.” Report to US Environmental Protection Agency. March 10, 2009.

———. 2010a. “Draft Version Year 2010 303(d) List.” Retrieved from <http://www.tn.gov/environment/wpc/publications/pdf/2010draft303dlist.pdf> (accessed March 24, 2011).

———. 2010b. "Natural Heritage Inventory Program." Resource Management Division. Retrieved from <http://tn.gov/environment/na/nhp.shtml> (accessed June 6, 2010).

———. 2010c. "Natural Heritage Inventory Program – Descriptions of Federal and State Ranks and Status Codes." Retrieved from <http://tn.gov/environment/na/pdf/Status&Ranks.pdf> (accessed May 19, 2010).

———. 2010d. "Contamination Case Closed, Sequoyah Nuclear Plant." Letter from TDEC Field Office Manager William Randy Slater to TVA Principal Environmental Engineer Stephanie A. Howard. August 5, 2010.

———. 2011. "Authorization to Discharge under the National Pollutant Discharge Elimination System (NPDES)." No. TN0026450. February 2, 2011. Retrieved from <http://environment-online.state.tn.us:7654/pls/enf_reports/f?p=9034:34001:1192020371490995> (accessed February 14, 2011).

Tennessee Department of Tourist Development (TDTD). 2007. "Tennessee Travel Barometer: Tennessee 2007 Visitor Profile." Retrieved from <http://www.tnvacation.com/media/industry/TennesseeTravelBarometer2008.pdf> (accessed March 4, 2010).

Tennessee Department of Transportation (TDOT). 2008. "Hamilton County Daily Traffic Counts." Retrieved from <http://www.tdot.state.tn.us/projectplanning/adt.asp> (accessed December 31, 2009).

Tennessee State Parks (TNSP). 2010. "Booker T. Washington State Park." Retrieved from <http://www.state.tn.us/environment/parks/BookerTWashington/index.shtml> (accessed May 25, 2010).

Tennessee Valley Authority. 1937. "Chickamauga Reservoir Land Map, 8-4160-20." Tennessee Valley Authority, Real Estate Division: Chattanooga, Tenn.

———. 1938. "McGill Cemetery." Cemetery Relocation Files, Chickamauga Reservoir, RG 142, Records of the Tennessee Valley Authority, National Archives and Records Administration, Southeast Region Branch: Morrow, Ga.

———. 1940. "Igou Cemetery." Cemetery Relocation Files, Chickamauga Reservoir, RG 142, Records of the Tennessee Valley Authority, National Archives and Records Administration, Southeast Region Branch: Morrow, Ga.

———. 1942. *The Chickamauga Project: A Comprehensive Report on the Planning, Design, Construction and Initial Operations of the Chickamauga Project*. Technical Report No. 6.

———. 1974a. *Final Environmental Statement Sequoyah Nuclear Plant Units 1 and 2*. February 13, 1974.

———. 1974b. *Performance Under Specified Design Conditions*.

———. 1974c. *Heat Rejection System*. Engineering and materials design criteria document number SQN-DC-V-14.1. April 19, 1974.

———. 1974d. *Sequoyah Nuclear Plant – Units 1 & 2 Cooling Towers, Plan and Elevation*. TVA Reference No. 53-83659.

———. 1979. *Recent Mollusk Investigations on the Tennessee River*. Prepared by Tennessee Valley Authority, Division of Environmental Planning, Water Quality and Ecology Branch.

———. 1980. *Environmental Assessment for Low-Level Radwaste Management, Sequoyah Nuclear Plant*.

———. 1986. *Aquatic Environmental Conditions In Chickamauga Reservoir During Operation Of Sequoyah Nuclear Plant, Fifth Annual Report, 2005.* TVA/ONRED/WRF-86/5a.

———. 1988. *Environmental Assessment and Finding of No Significant Impact - Change in Expiration Dates of Facility Operating License Nos DPR-77 and DPR-79, Tennessee Valley Authority, Sequoyah Nuclear Plant, Units 1 and 2*.

———. 1989. *Plankton Studies at Sequoyah Nuclear Plant 1988*.

———. 1990a. *Status of the White Crappie Population in Chickamauga Reservoir Final Project Report.*

———. 1990b. *Plankton Studies at Sequoyah Nuclear Plant in 1989.* TVA/WR/AB--90/2.

———. 1991. *Status of the Channel Catfish Population in Chickamauga Reservoir First Year Progress Report*.

———. 1993a. *Sequoyah Nuclear Plant Fuel, Oil, Contamination Investigation and Corrective Action Plan*.

———. 1993b. *The Effects of Aquatic Macrophytes on Fish Populations of Chickamauga Reservoir Coves 1970-1990*. Water Management TVA/WM- -93/24.

———. 1994. *Chickamauga White Bass Study 1990-1992 Final Project Report*.

———. 1995a. *Energy Vision 2020 – Integrated Resource Plan and Programmatic Environmental Impact Statement and Record of Decision*.

———. 1995b. *Sequoyah Nuclear Plant Thermal Variance Monitoring Program: Effects of Thermal Effluent from Sequoyah Nuclear Plant on Fish Populations in Chickamauga Reservoir*. Water Resources Environmental Compliance.

———. 1995c. *Chickamauga Reservoir Sauger Investigation 1993-1995 Final Project Report.*

———. 1999. *Environmental Assessment and Finding of No Significant Impact – Low Level Radioactive Waste Transport and Storage Watts Bar and Sequoyah Nuclear Plants*.

———. 2000a. *Environmental Assessment and Finding of No Significant Impact – Replacement of Steam Generators, Sequoyah Nuclear Plant, Unit 1*.

———. 2000b. *Environmental Assessment and Finding of No Significant Impact – Independent Spent Fuel Storage Installation Sequoyah Nuclear Plant*.

———. 2001. *Environmental Assessment and Finding of No Significant Impact – Leading Edge Flow Measurement System Installation*.

———. 2002a. *Final Supplemental Environmental Impact Statement (SEIS) for Operating License Renewal of the Browns Ferry Nuclear Plant in Athens, Alabama*.

———. 2002b. *Supplemental Environmental Assessment and Finding of No Significant Impact – Independent Spent Fuel Storage Installation, Sequoyah Nuclear Plant, Hamilton County, Tennessee.*

———. 2002c. *Finding of No Significant Impact, Independent Spent Fuel Storage Installation, Sequoyah Nuclear Plant, Hamilton County, Tennessee*. June 3.

———. 2004a. *Reservoir Operations Study Final Programmatic Environmental Impact Statement and Record of Decision*. Prepared in cooperation with the U.S. Army Corps of Engineers and the U.S. Fish and Wildlife Service.

———. 2004b. *Ecological Health Determinations for TVA Reservoirs—2003*. Aquatic Resource Stewardship.

———. 2005a. *Ecological Health Determinations for TVA Reservoirs—2004*. Aquatic Resource Stewardship.

———. 2005b. *Final Environmental Assessment, Bradley 500-KV Substation and Transmission Line – Southeast Area Power Improvement Project*. June 2005.

———. 2005c. *Annual Radioactive Effluent Release Report, Sequoyah Nuclear Plant, 2004*. April 29, 2005.

———. 2006a. *Ecological Health Determinations for TVA Reservoirs—2005*. Aquatic Resource Stewardship.

———. 2006b. *Entrainment Monitoring at Sequoyah Nuclear Plant 2004*.

———. 2006c. *Annual Radioactive Effluent Release Report Sequoyah Nuclear Plant 2005*. April 27, 2006.

———. 2007a. *Strategic Plan 2007*.

———. 2007b. *Final Supplemental Environmental Impact Statement, Completion and Operation of Watts Bar Nuclear Plant Unit 2, Rhea County, Tennessee*.

———. 2007c. *Sequoyah Nuclear Plant Investigation of Tritium Releases to Groundwater*. Authors: Hank E. Julian (Geosyntec Consultants) and Matthew Williams (Tennessee Valley Authority). Knoxville: Tenn.

———. 2007d. *Fish Impingement at Sequoyah Nuclear Plant During 2005 through 2007*. Sequoyah Nuclear Plant NPDES Permit No. TN0026450 316(b) Monitoring Program.

———. 2007e. *Annual Radioactive Effluent Release Report Sequoyah Nuclear Plant 2006*. April 27, 2007.

———. 2008a. *Sequoyah Nuclear Plant Updated Final Safety Analysis Report, Amendment 21*.

———. *2008b. Sequoyah Nuclear Plant Technical Instruction 0-TI-ENV-000-002.0: Solid, Special, Hazardous, and Mixed Waste Management, Revision 2. Environmental Control Division, September 10, 2008.*

———. 2008c. *Annual Radioactive Effluent Release Report Sequoyah Nuclear Plant 2007*. April 28, 2008.

———. 2009a. "Form 10-K: Annual Report Pursuant to Section 13, 15(d), or 37 of the Securities Exchange Act of 1934 for the fiscal year ended September 30, 2009." Report to the U. S. Securities and Exchange Commission. Retrieved from <http://www.sec.gov/Archives/edgar/data/1376986/000137698609000113/tva_10-k2009.htm#taxationandtaxequivalents> (accessed April 14, 2011).

———. 2009b. *Finding of No Significant Impact, Tennessee Valley Authority Sequoyah Nuclear Plant Unit 2 Steam Generator Replacements*, *Hamilton County, Tennessee*. November 13.

———. 2009c. *Sequoyah Nuclear Plan NPDES Permit Renewal Application*. January 27, 2009.

———. 2009d. *Ambient Temperature and Mixing Zone Studies for Sequoyah Nuclear Plant as Required by NPDES Permit No. TN0026450 of September 2005*. WR2009-1-45-151. January 2009.

———. 2009e. *Study to Confirm the Calibration of the Numerical Model for the Thermal Discharge from Sequoyah Nuclear Plant as Required by NPDES Permit No. TN0026450 of September 2005*. WR2009-1-45-150. January 2009.

———. 2009f. *Tritium Analyses: Wells 21, 24, 26-31, 34 and 35-G; GP-7A, 7B, and 13-G*. April and October 2009.

———. 2009g. *Biological Monitoring of the Tennessee River near Sequoyah Nuclear Plant Discharge Autumn 2008*.

———. 2009h. *Environmental Assessment, Sequoyah Nuclear Plant Unit 2 Steam Generator Replacements – Hamilton County, Tennessee*. Retrieved from <http://www.tva.gov/environment/reports/index_archive.htm#power> (accessed February 14, 2011).

———. 2009i. *Sequoyah Nuclear Plant – (SQN) Annual Radiological Environmental Operating Report – 2008*. April 28, 2009.

———. 2009j. *TVA 2009 Tax Equivalent Payments Total More Than $505 Million*. Retrieved from <http://www.tva.gov/news/releases/octdec09/tax_equivalent.htm> (accessed May 4, 2010).

———. 2009k. *SQN 2008 Toxic Release Inventory Forms A and R* (Hydrazine and Lead). Prepared by Stephanie Howard, TVA; certified by Timothy Cleary, SQN. Submitted to Rhonda Paxton, Tennessee Emergency Response Council. June 29.

———. 2010a. *Sequoyah Units 1 and 2 License Renewal Project Request For Information*. RFI No. SQN 100812-01.

———. 2010b. *Final Supplemental Environmental Impact Statement, Single Nuclear Unit at the Bellefonte Plant Site Jackson County, Alabama*. Retrieved from <http://www.tva.com/environment/reports/index.htm> (accessed February 14, 2011).

———. 2010c. *Environmental Assessment, John Sevier Fossil Plant Addition Of Gas-Fired Combustion Turbine/Combined-Cycle Generating Capacity And Associated Gas Pipeline Hawkins County, Tennessee*. Retrieved from < http://www.tva.gov/environment/reports/index_archive.htm#power > (accessed February 2011).

———. 2010d. "IRP Options Environmental Characterization." Excel worksheet.

———. 2010e. "Chickamauga Reservoir." Retrieved from <http://www.tva.gov/sites/chickamauga.htm> (accessed March 16, 2010).

———. 2010f. "Chickamauga Operating Guide." Retrieved from <http://www.tva.com/river/likeinfo/op_guides/chickamauga.htm> (accessed May 10, 2010).

———. 2010g. "Chickamauga Reservoir Ecological Health Rating." Retrieved from <http://www.tva.gov/environment/ecohealth/chickamauga.htm> (accessed March 25, 2010).

———. 2010h. *Water Use Data for Middle Tennessee-Chickamauga Watershed*.

———. 2010i. *Biological Monitoring of the Tennessee River near Sequoyah Nuclear Plant Discharge, Autumn 2009*.

———. 2010j. *2009 Biocide/Corrosion Treatment Plan and Annual Report*. February 2010.

———. 2010k. "Natural Heritage Database Files for SQN." Proprietary information. Queried March 4, 2010.

———. 2010l. *Reservoir Operations Study – Final Programmatic EIS*. Retrieved from <http://www.tva.gov/environment/reports/ros_eis/4-13_species.pdf> (accessed on May 19, 2010).

———. 2010m. "Hixson Utility District, TVA Water Service Invoice 03/09/10 – 04/08/10."

———. 2010n. *Transmission ROW Vegetation Management Guide*.

———. 2010o. *Sequoyah Nuclear Plant Hazardous Waste Minimization Plan, Revision 16*. March 1, 2010.

———. 2010p. *Finding Of No Significant Impact Tennessee Valley Authority John Sevier Fossil Plant Addition of Gas-Fired Combustion Turbine/Combined-Cycle Generating Capacity and Associated Gas Pipeline*. Retrieved from <http://www.tva.gov/environment/reports/index_archive.htm#power> (accessed February 14, 2011).

———. 2010q. *TVA Radiological Emergency Plan, Rev. 91, 03-31-2010*.

———. 2010r. "Strategic Sustainability Performance Plan. Retrieved from <http://www.tva.gov/abouttva/corporatereport.htm> (accessed April 13, 2011).

———. 2011a. *TVA's Environmental & Energy Future: Integrated Resource Plan and Final Programmatic Environmental Impact Statement.*

———. 2011b. *Sequoyah Nuclear Plant Fire Protection Report.* Revision 28, Effective April 4, 2011.

———. 2011c. *Sequoyah Nuclear Plant Hazardous Waste Minimization Plan*, Revision 17. Tennessee Valley Authority.

Third Rock Consultants, LLC. 2010a. *Draft Report: Mollusk and Habitat Survey of the Tennessee River Near Sequoyah Nuclear Power Plant (Hamilton County, TN)*. Prepared for Tennessee Valley Authority.

———. 2010b. *Phase 1A and 1B Mussel Survey Results - Johnsonville Fossil Plant, Humphreys County, Tennessee*. Prepared for Tennessee Valley Authority.

———. 2010c. *Mollusk Survey of the Tennessee River Near Watts Bar Nuclear Plant (Rhea County, Tennessee)*. Prepared for Tennessee Valley Authority.

U. S. Census Bureau (USCB). 1990. "Hamilton County, Tennessee, General Population and Housing Characteristics 1990, 100 Percent Data." Retrieved from <http://factfinder.census.gov/servlet/DatasetMainPageServlet?_program=DEC&_tabId=DEC2&_submenuId=datasets_1&_lang=en&_ts=> (accessed March 12, 2010).

———. 2000a. "Census 2000 Summary File 1 (SF1) Data." Retrieved from <http://www.census.gov/Press-Release/www/2001/sumfile1.html> (accessed March 11, 2010).

———. 2000b. "American Fact Finder: United States." Retrieved from <http://factfinder.census.gov/servlet/SAFFFacts> (accessed February 26, 2010).

———. 2000c. "American Fact Finder: DP-1 Tennessee." Retrieved from <http://factfinder.census.gov/servlet/SAFFPopulation> (accessed March 22, 2010).

———. 2000d. “American Fact Finder: DP-1 Hamilton County, Tennessee.” Retrieved from <http://factfinder.census.gov/servlet/SAFFPopulation> (accessed April 29, 2010).

———. 2000e. “American Fact Finder: DP-3 Tennessee.” Retrieved from <http://factfinder.census.gov/servlet/SAFFPopulation> (accessed March 22, 2010).

———. 2000f. “American Fact Finder: DP-3 Hamilton County, Tennessee.” Retrieved from <http://factfinder.census.gov/servlet/SAFFPopulation> (accessed April 30, 2010).

———. 2000g. “Census 2000 Summary File 3 (SF3) Data.” Retrieved from <http://www.census.gov/Press-Release/www/2001/sumfile1.html> (accessed April 29, 2010).

———. 2000h. “Hamilton County, Tennessee: Census 2000 Summary File 3 (SF3) – Sample Data, Population and Housing.” Retrieved from <http://factfinder.census.gov/servlet/DatasetMainPageServlet?_program=DEC&_tabId=DEC1&_submenuId=datasets_1&_lang=en&_ts=289234982171> (accessed March 12, 2010).

———. 2000i. “American FactFinder Summary File 1 (SF1) Sequoyah Block Group, Race.” Retrieved from <http://factfinder.census.gov/servlet/DatasetMainPageServlet?_program=DEC&_submenuId=datasets_0&_lang=en> (accessed January 7, 2011).

———. 2000j. “American FactFinder Summary File 3 (SF3) Sequoyah Block Group, Low Income.” Retrieved from <http://factfinder.census.gov/servlet/DatasetMainPageServlet?_program=DEC&_submenuId=datasets_0&_lang=en> (accessed February 7, 2011).

———. 2005. “Arts, Recreation & Travel: Travel and Tourism, Table 1226: Characteristics of Domestic Overnight Leisure Trips by U.S. Resident Households, 2000 to 2005.” Retrieved from <https://www.census.gov/compendia/statab/2010/tables/10s1226.pdf> (accessed February 26, 2010).

———. 2008a. “American Community Survey 1-year Estimates: Hamilton County, Tennessee, Selected Housing Characteristics 2008.” Retrieved from <http://factfinder.census.gov/servlet/DatasetMainPageServlet?_program=ACS> (accessed March 12, 2010).

———. 2008b. “American Fact Finder: Chattanooga.” Retrieved from <http://factfinder.census.gov/servlet/SAFFPopulation> (accessed April 28, 2010).

———. 2008c. “American Fact Finder: Cleveland.” Retrieved from <http://factfinder.census.gov/servlet/SAFFPopulation> (accessed April 28, 2010).

———. 2008d. “American Fact Finder: Dalton.” Retrieved from <http://factfinder.census.gov/servlet/SAFFPopulation> (accessed April 28, 2010).

———. 2008e. "American Fact Finder: Soddy-Daisy." Retrieved from <http://factfinder.census.gov/servlet/SAFFPopulation> (accessed April 19, 2010).

———. 2008f. "American Community Survey 1-year Estimates: Hamilton County, Tennessee, Selected Housing Characteristics 2008." Retrieved from <http://factfinder.census.gov/servlet/DatasetMainPageServlet?_program=ACS> (accessed March 12, 2010).

U. S. Department of Agriculture (USDA). 2001. "National Resources Conservation Service."

———. 2009a. "National Agricultural Statistics Service." Retrieved from <http://www.nass.usda.gov/Data_and_Statistics/Quick_Stats/> (accessed April 26, 2010).

———. 2009b. "Farm Service Agency, Conservation Reserve Program Statistics." Retrieved from <http://www.fsa.usda.gov/FSA/webapp?area=home&subject=copr&topic=rns-css> (accessed April 27, 2010).

———. 2009c. "National Agriculture Imagery Program Aerial 2008." Retrieved from <http://datagateway.nrcs.usda.gov/> (accessed November 4, 2009).

U. S. Department of Energy (DOE). 1999. *Final Environmental Impact Statement for the Production of Tritium in a Commercial Light Water Reactor*. Washington, D.C.: DOE EIS – 0288.

———. 2003. *Estimation of Economic Parameters of U.S. Hydropower Resources*. Idaho National Laboratory. INEEL/EXT-03-00662.

———. 2006. *Feasibility Assessment of the Water Energy Resources of the United States for New Low Power and Small Hydro Classes of Hydroelectric Plants*. DOE-ID-11263.

———. 2007. *Electric Power Annual 2006*. DOE/EIA-0348. Energy Information Administration: Washington, D.C.

———. 2010. "Wind Powering America Resource Charts – TVA Region."

———. 2011. *Supplemental Environmental Impact Statement for Surplus Plutonium Disposition at the Savannah River Site*. DOE/EIS-0283-S2. Concurrence Draft. April 15, 2011.

U. S. Department of Transportation (USDOT). 1973. "Special Report: Highway Construction Noise: Measurement, Prediction, and Mitigation – Appendix A." Retrieved from <http://www.fhwa.dot.gov/environment/noise/highway/hcn06.htm> (accessed February 12, 2010).

———. 2008. "National Transportation Atlas Databases." Research and Innovative Technology Administration, Bureau of Transportation Statistics. DVD, 2008.

U. S. Environmental Protection Agency (EPA). 1974. *Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety*. Retrieved from <http://www.nonoise.org/library/levels74/levels 74.htm> (accessed April 5, 2010).

———. 2008. *Area Designations for 1997 Fine Particulate (PM2.5) Standards*.

———. 2009. *List of 156 Mandatory Class I Federal Areas*. Retrieved from <http://www.epa.gov/visibility/class1.html> (accessed January 14, 2010).

U. S. Fire Administration (USFA). 2010. "National Fire Department Census 2010." Retrieved from <http://www.usfa.dhs.gov/applications/census-download/main/download> (accessed April 26, 2010).

U. S. Fish and Wildlife Service (USFWS). 2010a. "Tennessee's Caves." Retrieved from <http://www.fws.gov/asheville/pdfs/TNcaves.pdf> (accessed July 25, 2010).

———. 2010b. *Environmental Conservation Online System, Critical Habitat Portal*. Retrieved from <http://criticalhabitat.fws.gov/> (accessed on May 19, 2010).

U. S. Forest Service (USFS). 2010. "Southern Research Station – Forest Inventory Analysis Timber Product Output (TPO) Reports, 2007." Retrieved from <http://srsfia2.fs.fed.us/php/tpo_2009/tpo_rpa_int1.php> (accessed April 28, 2010).

U. S. Geological Survey (USGS). 2001. *Hydrogeology and Ground-Water Flow Simulation of a Karst Ground-Water Basin in the Valley and Ridge Physiographic Province near Hixson, Tennessee. 2001*.

———. 2009. "Poster of the Fort Payne, Alabama Earthquake of 29 April 2003 – Magnitude 4.6." Retrieved from <http://earthquake.usgs.gov/eqcenter/eqarchives/poster/2003/20030429_image.php> (accessed January 5, 2009).

———. 2010. National Hydrology Dataset.

U. S. Nuclear Regulatory Commission (NRC). 1975. *Environmental Survey of Transportation of Radioactive Materials to and from Nuclear Power Plants, Supplement 1*. NUREG-75/038.

———. 1977a. *Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR PART 50, Appendix I, Revision 1*. Regulatory Guide 1.109. October 1977.

———. 1977b. *Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors, Revision 1*. Regulatory Guide 1.111. July 1977.

———. 1990. *Evaluation of Severe Accident Risks: Sequoyah, Unit 1 Main Report*. NUREG/CR-4551 SAND86-1309 Vol. 5, Rev. 1, Part 1. December 1990.

———. 1991. *Off-site Dose Calculation Manual Guidance: Standard Radiological Effluent Controls for Pressurized Water Reactors.* NUREG-1301, Generic Letter 89-01, Supplement No. 1. April 1991.

———. 1996. *Generic Environmental Statement for License Renewal of Nuclear Power Plants*. NUREG-1437. Washington, D.C.

———. 1998. *Regulatory Guide 4.7 General Site Suitability Criteria for Nuclear Power Stations*.

———. 1999a. *Standard Review Plans for Environmental Reviews for Nuclear Power Plants Supplement 1: Operating License Renewal*. NUREG-1555. October 1999.

———. 1999b. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants.* NUREG-1437 Vol. 1, Addendum 1. Main Report Section 6.3 – Transportation Table 9.1 Summary of findings on NEPA issues for license renewal of nuclear power plants. Final Report. August 1999.

———. 2000. *Staff Responses to Frequently Asked Questions Concerning Decommissioning of Nuclear Power Reactors*. NUREG-1628. Final Report. June 2000.

———. 2004a. *NRR Office Instruction No. LIC-203, Revision 1*. Office of Nuclear Reactor Regulation. May 24, 2004.

———. 2004b. "Fact Sheet: Biological Effects of Radiation." December 2004.

———. 2007. Commission Voting Record. SECY-06-0219 – Final Rulemaking to Revise 10 CFR 73.1, Design Basis Threat (DBT) Requirements. January 29, 2007. Attachment, Commissioner McGaffigan's Additional Comments, at 1.

———. 2009a. *Preparation of Environmental Reports for Nuclear Power Plant License Renewal Applications, Revision 1*. Draft Regulatory Guide 4015. July 2009.

———. 2009b. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*. NUREG-1437, Volume 1, Revision 1. Main report draft for comment. July 2009.

———. 2010. "Staff Requirements Memorandum SECY-09-0090 – Final Update of the Commission's Waste Confidence Decision." Retrieved from <http://www.nrc.gov/reading-rm/doc-collections/commission/srm/meet/2010/m20100915.pdf> (accessed September 30, 2010).

University of Alabama Center for Business and Economic Research (UACB). 2001. "Alabama County Population 2000 and Projections 2005-2025." Retrieved from <http://cber.cba.ua.edu/edata/est_prj/alpop20002025.prn> (accessed December 08, 2009).

University of Miami National Oceanographic Laboratory System (UMNOLS). 2010. "The Tritium Laboratory." Retrieved from <http://www.rsmas.miami.edu/groups/tritium/> (accessed April 2010).

World Health Organization (WHO). 2001. "Fact Sheet No. 250: Occupational and Community Noise." Retrieved from <http://www.who.int/mediacentre/factsheets/fs258/en/> (accessed April 5, 2010).

World Nuclear Association (WNA). 2009. *Comparative Carbon Dioxide Emissions from Power Generation*. Retrieved from <http://www.world-nuclear.org/education> (accessed March 08, 2010).

GLOSSARY

A-weighted decibel (dBA) – A unit of weighted sound pressure level, measured by the use of a metering characteristic and the "A" weighting specified by American National Standard Institute SI.4-1971(R176). (See decibel).

Accident – One or more unplanned events involving materials that have the potential to endanger the health and safety of workers and the public. An accident can involve a combined release of energy and hazardous materials (radiological or chemical) that might cause prompt or latent adverse health effects.

Ambient air – The surrounding atmosphere as it exists around people, plants, and structures. Air quality standards are used to provide a measure of the health-related and visual characteristics of the air.

Archaeological sites (resources) – Any location where humans have altered the terrain or discarded artifacts during prehistoric or historic times.

Area of potential effects (APE) – Geographic area or areas within which an undertaking may directly or indirectly cause changes in the character or use of historic properties, if such properties exist. **Artifact** – An object produced or shaped by human workmanship of archaeological or historical interest.

As Low as Reasonably Achievable (ALARA) – A concept applied to ensure the quantity of radioactivity released to the environment and the radiation exposure of on-site workers in routine operations, including "anticipated operational occurrences," is maintained as low as reasonably achievable. It takes into account the state of technology, economics of improvements in relation to benefits to public health and safety, and other societal and economic considerations in relation to the use of nuclear energy in the public interest.

Background radiation – Ionizing radiation present in the environment from cosmic rays and natural sources in the Earth; background radiation varies considerably with location.

Baseline – A quantitative expression of conditions, costs, schedule, or technical progress to serve as a base or standard for measurement during the performance of an effort; the established plan against which the status of resources and progress of a project can be measured. For this environmental impact statement, the environmental baseline is the site environmental conditions as they exist or have been estimated to exist in the absence of the proposed action.

Base load – The minimum amount of electric power over a given period of time at a steady rate. The minimum continuous load or demand in a power system over a given period of time usually not temperature sensitive.

Base load capacity – The generating equipment normally operated to serve loads on an around-the-clock basis.

Benthic – Plants and animals dwelling at the bottom of oceans, lakes, rivers, and other surface waters.

Benthic macroinvertebrate – Organisms that are large enough to be seen without the aid of magnification and that live in close association with bottom of flowing and nonflowing bodies of water.

Best management practices (BMPs) – A practice or combination or practices that is determined by a state (or other planning agency) after problem assessment, examination of alternative practices, and appropriate public participation to be the most effective, practicable means of preventing or reducing the amount of pollution generated by nonpoint sources to a level compatible with air or water quality goals.

Block groups – U.S. Bureau of the Census term describing a cluster of blocks generally selected to include 250 to 550 housing units.

Blowdown – The wastewater released from cooling tower operations.

Burnup – The total energy released through fission by a given amount of nuclear fuel, generally measured in megawatt-days.

Cancer – The name given to a group of diseases characterized by uncontrolled cellular growth with cells having invasive characteristics such that the disease can transfer from one organ to another.

Capacity factor – The ratio of the annual average power production of a power plant to its rated capacity.

Canister – A stainless-steel container in which nuclear material is sealed.

Closed cycle – form of cooling tower operations that recycles water through cooling towers in order to decrease water withdrawal needs and aid in cooling of the returning wastewater (blowdown) prior to release to the environment.

Combined-cycle – type of gas turbine that uses a simple cycle as well as an additional system for waste heat recovery to increase efficiency of electrical generation.

Combustion turbine – machinery that converts the energy of hot compressed natural gases, produced by burning the natural gas fuel, into mechanical power to turn an electrical generator rotor.

Combustion turbine/combined-cycle – type of gas combustion turbine that uses a simple cycle gas combustion turbine as well as an additional system for waste heat recovery to increase efficiency of electrical generation.

Container – With regard to radioactive wastes, the metal envelope in the waste package that provides the primary containment function of the waste package and is designed to meet the containment requirements of 10 CFR Part 60.

Containment structure – A gas-tight shell or other enclosure around a nuclear reactor to confine fission that otherwise might be released to the atmosphere in the event of an accident. Such enclosures are usually dome-shaped and made of steel-reinforced concrete.

Conductors – A wire or combination of wires not insulated from one another, suitable for carrying electric current.

Cooling water – Water pumped into a nuclear reactor or generator support equipment to cool components and prevent damage from the intense heat generated when the reactor or generator is operating.

Cultural resources – Archaeological sites, historical sites, architectural features, traditional use areas, and Native American sacred sites.

Cumulative impacts/effects – In an environmental impact statement, the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (Federal or nonfederal), private industry, or individual(s) undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time (40 CFR §1508.7).

Current – The movement of electrons in the conductors or transmission lines.

Decay (radioactive) – The decrease in the amount of any radioactive material with the passage of time due to the spontaneous transformation of an unstable nuclide into a different nuclide or into a different energy state of the same nuclide; the emission of nuclear radiation (alpha, beta, neutron, or gamma radiation) is part of the process.

Decibel (dB) – A logarithmic unit of sound measurement that describes the magnitude of a particular quantity of sound pressure power with respect to a standard reference value, in general, a sound doubles in loudness for every increase of 10 decibels.

Decibel, A-weighted (dBA) – A unit of frequency-weighted sound pressure level, measured by the use of a metering characteristic and the "A" weighting specified by the American National Standards Institute (ANSI) Si .4-1983 (RI 594), that accounts for the frequency response of the human ear.

Decommissioning – The removal from service of facilities such as processing plants, waste tanks, and burial grounds, and the reduction or stabilization of radioactive contamination. Decommissioning includes decontamination, dismantling, and return of the area to original condition without restrictions or partial decontamination, isolation of remaining residues, and continuation of surveillance and restrictions. For nuclear power plants, the NRC defines decommissioning as the safe removal of a facility from service and reduction of residual radioactivity to a level that permits termination of the NRC license.

Decontamination – The actions taken to reduce or remove substances that pose a substantial present or potential hazard to human health or the environment, such as radioactive or chemical contamination from facilities, equipment, or soils by washing, heating, chemical or electrochemical action, mechanical cleaning, or other techniques.

Depleted uranium – A mixture of uranium isotopes where uranium-235 represents less than 0.7 percent of the uranium by mass.

Derate – Reduction in operating power production level.

Design-basis accident – Those accidents for which the risk to the public is great enough that the NRC requires plant design features and procedures to prevent unacceptable accident consequences.

Distribution (electrical) – The system of lines, transformers, and switches that connect the transmission network and customer load. The transport of electricity to ultimate use points such as homes and businesses. The portion of an electric system that is dedicated to delivering electric energy to an end user at relatively low voltages.

Dose – The energy imparted to matter by ionizing radiation. The unit of absorbed dose is the rad.

Dose equivalent – The product of absorbed dose in rad (or Gray) and a quality factor, which quantifies the effect of this type of radiation in tissue. Dose equivalent is expressed in units of rem or Sievert, where 1 rem equals 0.01 Sievert.

Drift – Effluent mist or spray carried into the atmosphere from cooling towers.

Drinking water standards – The level of constituents or characteristics in a drinking water supply specified in regulations under the Safe Drinking Water Act as the maximum permissible.

Effective dose equivalent – The sum of the products of the dose equivalent received by specified tissues of the body and a tissue-specific weighting factor. This sum is a risk-equivalent value and can be used to estimate the health effects risk to the exposed individual. The effective dose equivalent includes the committed effective dose equivalent from internal deposition of radionuclides, and the effective dose equivalent due to penetrating radiation from sources external to the body. Effective dose equivalent is expressed in units of rem or Sievert.

Effluent – A gas or liquid discharged into the environment.

Endangered species – Any species that is in danger of extinction throughout all or significant portions of its range. The Endangered Species Act of 1973, as amended, establishes procedures for placing species on the federal lists of endangered or threatened species.

Endangered Species Act (of 1973) – The Act requires Federal agencies, with the consultation and assistance of the Secretaries of the Interior and Commerce, to ensure that their actions likely will not jeopardize the continued existence of any endangered or threatened species, or adversely affect the habitat of such species.

Engineered safety features – For a nuclear facility, features that prevent, limit, or mitigate the release of radioactive material from its primary containment.

Entrainment – The involuntary capture and inclusion of organisms in streams of flowing water; a term often applied to the cooling water systems of power plants/reactors. The organisms involved may include phyto-and zooplankton, fish eggs and larvae (ichthyoplankton), shellfish larvae, and other forms of aquatic life.

Environment – The sum of all external conditions and influences affecting the life, development, and ultimately the survival of an organism.

Environmental justice – The fair treatment of people of all races, cultures, incomes, and educational levels with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment implies that no population of people should be forced to shoulder a disproportionate share of the negative environmental impacts of pollution or environmental hazards due to a lack of political or economic influence.

Exposure to radiation – The incidence of radiation on living or inanimate material by accident or intent. Background exposure is the exposure to natural background ionizing radiation. Occupational exposure is the exposure to ionizing radiation that occurs at a person's workplace. Population exposure is the exposure to a number of persons who inhabit an area.

Exposure pathway – The course a chemical or physical agent takes from the source to the exposed organism. The pathway describes a unique mechanism by which an individual or population is exposed to chemicals or physical agents at or originating from the site. Each exposure pathway includes a source or release from a source, an exposure point, and an exposure route. If the exposure point differs from the source, a transport/exposure medium (e.g., air) is included.

Fission (fissioning) – The splitting of a nucleus into at least two other nuclei and the release of energy.

Fission products – Nuclei formed by the fission of heavy elements (primary fission products); also, the nuclei formed by the decay of the primary fission products, many of which are radioactive.

Floodplain – The lowlands adjoining inland and coastal waters and relatively flat areas.

Fuel assembly – A cluster of fuel rods (or plates), also called a fuel element. Approximately 193 fuel assemblies make up a reactor core.

Fuel rod – Nuclear reactor component that includes the fissile material.

Gigawatt – One gigawatt is 1,000,000,000 (billion) watts. A watt is a standard unit of power that is equal to one joule of energy per second. For electrical power, one watt is equal to one ampere of current per second.

Gigawatt hour – A measure of electrical energy equivalent to a power consumption of 1,000,000,000 (billion) watts for 1 hour.

Habitat – The environment occupied by individuals of a particular species, population, or community.

Hazardous material – A material, including a hazardous substance, as defined by 49 CFR §171.8, which poses a risk to health, safety, and property when transported or handled.

Hazardous waste – Any solid waste (can also be semisolid or liquid, or contain gaseous material) having the characteristics of ignitability, corrosiveness, toxicity, or reactivity, defined by the Resource Conservation and Recovery Act, and identified or listed in 40 CFR Part 261 or by the Toxic Substances Control Act.

Heat exchanger – A device that transfers heat from one fluid (liquid or gas) to another.

High efficiency particulate air filter (HEPA) – A filter used to remove very small particulates from dry gaseous effluent streams.

High(ly) enriched uranium – Uranium that is equal to or greater than 20 percent uranium-235 weight.

High-level radioactive waste – High level for this SEIS is limited to the irradiated spent fuel generated at SQN.

Historic resources – Archaeological sites, architectural structures, and objects produced after the advent of written history dating to the time of the first Euro-American contact in an area.

Impingement – The process by which aquatic organisms too large to pass through the screens of a water intake structure become caught on the screens and are unable to escape.

Ion – An atom that has too many or too few electrons, causing it to be electrically charged; an electron that is not associated (in orbit) with a nucleus.

Ion exchange – A physiochemical process that removes anions and cations, including radionuclides, from liquid streams (usually water) for the purpose of purification or decontamination.

Irradiation – Exposure to radiation.

Isotope – An atom of a chemical element with a specific atomic number and atomic mass. Isotopes of the same element have the same number of protons, but different numbers of neutrons and different atomic masses. Isotopes are identified by the name of the element and the total number of protons and neutrons in the nucleus. For example, plutonium-239 is a plutonium atom with 239 protons and neutrons.

Kilowatt hour (KWh) – A measure of electrical energy equivalent to a power consumption of 1000 watts for 1 hour. The kilowatt-hour of energy is the commercial unit of choice to convey how many kilowatt hours of energy are consumed and the price per kilowatt hour.

License amendment – Changes to an existing reactor's operating license that are approved by the U.S. Nuclear Regulatory Commission.

Light water – The common form of water (a molecule with two hydrogen atoms and one oxygen atom, H_20) in which the hydrogen atom consists completely of the normal hydrogen isotope (one proton).

Light water reactor – A nuclear reactor in which circulating light water is used to cool the reactor core and to moderate (reduce the energy of) the neutrons created in the core by the fission reactions.

Low-level radioactive waste (LLRW) – Waste that contains radioactivity, but is not classified as high-level waste, transuranic waste, spent nuclear fuel, or by-product material as defined by Section lie (2) of the Atomic Energy Act of 1954, as amended. LLRW for this SEIS is any radioactive waste generated at SQN other than spent fuel.

Makeup water – Replacement for water lost through drift, blowdown, or evaporation (as in a cooling tower).

Man-rem – Unit of radiation dose to an individual.

Maximally exposed individual – A hypothetical person who could potentially receive the maximum dose of radiation or hazardous chemicals.

Megawatt (MW) – A unit of power equal to 1 million watts. "Megawatt-thermal" is commonly used to define heat produced, while "megawatt-electric" defines electricity produced.

Millirem – One thousandth of a rem.

Minority population – A population classified by the Bureau of the Census as Black, Hispanic, Asian and Pacific Islander, American Indian, Eskimo, Aleut, and other nonwhite persons, the composition of which is at least equal to or greater than the state minority average of a defined area of jurisdiction.

National Ambient Air Quality Standards (NAAQS) – Uniform, national air quality standards established by the Environmental Protection Agency under the authority of the Clean Air Act that restrict ambient levels of criteria pollutants to protect public health (primary standards) or public welfare (secondary standards), including plant and animal life, visibility, and materials. Standards have been set for ozone, carbon monoxide, particulates, sulfur dioxide, nitrogen dioxide, and lead.

National Historic Preservation Act (NHPA) – This Act provides that property resources with significant national historic value be placed on the National Register of Historic Places. It does not require any permits, but, pursuant to Federal code, if a proposed action might impact an historic property resource, it mandates consultation with the proper agencies.

National pollutant discharge elimination system (NPDES*)* – Federal permitting system required for water pollution effluents under the Clean Water Act, as amended.

National Register of Historic Places (NRHP) – A list maintained by the Secretary of the Interior of districts, sites, buildings, structures, and objects of prehistoric or historic local, state, or national significance under Section 2(b) of the Historic Sites Act of 1935(16 USC 462) and Section IOI(a) (1) (A) of the National Historic Preservation Act of 1966, as amended.

Nuclear reactor – A device that sustains a controlled nuclear fission chain reaction, which releases energy in the form of heat.

Nuclear Regulatory Commission (NRC) – The federal agency that regulates the civilian nuclear power industry in the United States.

Nuclide – A species of atom characterized by the constitution of its nucleus and, hence, by the number of protons, the number of neutrons, and the energy content.

Outfall – The discharge point of a drain, sewer, or pipe as it empties into a body of water.

Peak load – The maximum load consumed or produced by a unit or group of units in a stated period of time.

Person-rem – The unit of collective radiation dose to a given population; the sum of the individual doses received by a population segment.

Plume – A flowing, often somewhat conical, trail of emissions from a continuous point source.

Power service area – Region of the country that TVA is responsible for supplying electrical power and services to its customers.

Pressurized water reactor – A light water reactor in which heat is transferred from the core to an exchanger by water kept under pressure in the primary system. Steam is generated in a secondary circuit. Many reactors producing electric power are PWRs.

Primary system – With regard to nuclear reactors, the system that circulates a coolant (e.g., water) through the reactor core to remove the heat of reaction.

Probabilistic safety assessment – A systematic and comprehensive methodology of determining the risks associated with the operation of a nuclear plant.

Probable maximum flood – The hypothetical flood (peak discharge, volume, and hydrograph shape) that is considered to be the most severe reasonably possible, based on comprehensive hydrometeorological application of Probable Maximum Precipitation, and other hydrologic factors favorable for maximum flood runoff, such as sequential storms and snowmelt.

Probable maximum precipitation – The theoretically greatest depth of precipitation for a given duration that is physically possible over a particular drainage area at a certain time of year. (Reference: American Meteorological Society, 1959).

Radiation – The emitted particles or photons from the nuclei of radioactive atoms. Some elements are naturally radioactive; others are induced to become radioactive by bombardment in a reactor. Naturally occurring radiation is indistinguishable from induced radiation.

Radioactive waste – Materials from nuclear operations that are radioactive or are contaminated with radioactive material and for which use, reuse, or recovery are impractical.

Radioactivity – The spontaneous decay or disintegration of unstable atomic nuclei, accompanied by the emission of radiation.

Radiological – Related to radiology, the science that deals with the use of ionizing radiation to diagnose and treat disease.

Radwaste – Radioactive materials at the end of their useful life or in a product that is no longer useful and requires proper disposal.

Raw water – Untreated water from the plant intake supplied to the circulating water system and the service water system to make up for water which has been consumed and discharged as part of the system operations.

Reactor – A device or apparatus in which a chain reaction of fissionable material is initiated and controlled; a nuclear reactor.

Reactor accident – See "design-basis accident; severe accident."

Reactor coolant system – The system used to transfer energy from the reactor core either directly or indirectly to the heat rejection system.

Reactor core –In a light water reactor: the fuel assemblies including the fuel and target rods, control rods, and coolant/moderator.

Record of decision (ROD) – A document prepared in accordance with the requirements of the Council on Environmental Quality and National Environmental Policy Act regulations 40 CFR §1505.2, that provides a concise public record of the decision on a proposed Federal action for which an environmental impact statement was prepared. A record of decision identifies the alternatives considered in reaching the decision, the environmentally preferable alternative(s), factors balanced in making the decision, whether all practicable means to avoid or minimize environmental harm have been adopted, and if not, why they were not adopted.

Repository – A place for the disposal of immobilized high-level waste and spent nuclear fuel in isolation from the environment.

Resin – An ion-exchange medium; organic polymer used for the preferential removal of certain ions from a solution.

Risk – In accident analysis, the probability-weighted consequence of an accident, defined as the accident frequently per year multiplied by the dose. The term "risk" also is used commonly in other applications to describe the probability of an event occurring.

Risk assessment (chemical or radiological) – The qualitative and quantitative evaluation performed in an effort to define the risk posed to human health and/or the environment by the presence or potential presence and/or use of specific chemical or radiological materials.

Runoff – The portion of rainfall, melted snow, or irrigation water that flows across the ground surface and eventually enters streams.

Safety analysis report (SAR) – A safety document that provides a complete description and safety analysis of a reactor design, normal and emergency operations, hypothetical accidents and their predicted consequences, and the means proposed to prevent such accidents or mitigate their consequences.

Scoping – The solicitation of comments from interested persons, groups, and agencies at public meetings, public workshops, in writing, electronically, or via fax to assist in defining the proposed action, identifying alternatives, and developing preliminary issues to be addressed in an environmental impact statement.

Seismic Category I – Safety-related structures, systems, and components that are designed and built to withstand the maximum potential earthquake stresses for the particular region where a nuclear plant is sited, without loss of capability to perform their safety functions.

Seismicity – The tendency for earthquakes to occur.

Severe accident – Severe accidents are defined as accidents with substantial damage to the reactor core and degradation of containment systems. A reactor accident that would have more severe consequences than a design-basis accident, in terms of damage to the facility, off-site consequences, or both. Also called "beyond-design-basis accidents" for this supplemental environmental impact statement.

Shutdown – That condition in which the reactor has ceased operation and the operator has declared officially that it does not intend to operate it further.

Spent nuclear fuel – Fuel that has been withdrawn from a nuclear reactor following irradiation, the constituent elements of which have not be separated.

Sintered – Formed into a mass by heat and pressure.

Threatened species – Any species designated under the Endangered Species Act as likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

Transient – A change in the reactor coolant system temperature, pressure, or both, attributed to a change in the reactor’s power output. Transients can be caused by (1) adding or removing neutron poisons, (2) increasing or decreasing electrical load on the turbine generator, or (3) accident conditions.

Tritiated (liquid) –Liquid, usually water, that contains tritium.

Tritium – A radioactive isotope of the element hydrogen with two neutrons and one proton. Common symbols for the isotope are "H-3" and "T." Tritium has a half-life of 12.3 years.

Uprate – The process of increasing the maximum power level at which a commercial nuclear power plant may operate.

Uranium – A heavy, silvery-white metallic element (atomic number 92) with several radioactive isotopes that is used as fuel in nuclear reactors.

Wetlands – Land or areas exhibiting the following: hydric soil conditions, saturated or inundated soil during some portion of the year, and plant species tolerant of such conditions; also, areas that are inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.

Whole-body dose – With regard to radiation, the dose resulting from the uniform exposure of all organs and tissues in a human body. (Also see effective dose equivalent.)

χ/Q (Chi/Q) – The relative calculated air concentration due to a specific air release and atmospheric dispersion; units are (seconds per cubic meter). For example (Curies per cubic meter)/(Curies per second)= (seconds per cubic meter) or (grams per cubic meter)/(grams per second) = (seconds per cubic meter).

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APPENDIX A – ANNOUNCEMENTS, NOTICES, AND NEWS RELEASES

TVA

N E W S   R E L E A S E

TVA Examining License Renewal for Sequoyah Nuclear Plant

SODDY DAISY, Tenn. – The Tennessee Valley Authority is preparing a Supplemental Environmental Impact Statement on the potential effect of extending the operating licenses for its two-unit Sequoyah Nuclear Plant.

"Renewing the operating license of the Sequoyah plant will allow us to continue to provide reliable, safe and clean electricity for the consumers in our service area," said Chief Nuclear Officer Preston Swafford. "Using existing non-air-polluting plants like Sequoyah for an additional 20 years helps us keep electricity costs affordable while being a steward of our environment."

Renewing the existing licenses will allow the plant to operate beyond 2020 and 2021, when the current licenses expire for Units 1 and 2, respectively. The Nuclear Regulatory Commission licenses new nuclear plants for 40 years of operation and for an additional 20 years if a renewal application is approved.

"Nuclear plants generate electricity without the release of greenhouse gases, and that helps TVA as it strives to minimize its environmental footprint," Swafford said.

Each of Sequoyah's two reactors is capable of producing more than 1,160 megawatts. Together, they can generate enough electricity to supply about 1.3 million homes.

The TVA Board of Directors is expected to decide if license renewal applications will be submitted after the environmental review is completed and TVA's readiness to prepare the applications is evaluated. The license renewal process is expected to cost about $20 million, including NRC charges to TVA to review the applications.

TVA encourages public participation in the environmental review process. Information about the proposal has been posted at www.tva.com/environment/reports/sqn-renewal/. Comments can be submitted to the Web page or sent to Amy Henry, NEPA Specialist, Tennessee Valley Authority (Mail Stop WT 11D), 400 West Summit Hill Drive, Knoxville, TN 37902 or by e-mail to abhenry@tva.gov. Comments must be postmarked or e-mailed no later than May 10.

The Tennessee Valley Authority, a corporation owned by the U.S. government, provides electricity for utility and business customers in most of Tennessee and parts of Alabama, Mississippi, Kentucky, Georgia, North Carolina and Virginia – an area of 80,000 square miles with a population of 9 million. TVA operates 29 hydroelectric dams, 11 coal-fired power plants, three nuclear plants and 11 natural gas-fired power facilities and supplies up to 36,000 megawatts of electricity, delivered over 16,000 miles of high-voltage power lines. TVA also provides flood control, navigation, land management and recreation for the Tennessee River system and works with local utilities and state and local governments to promote economic development across the region. TVA, which makes no profits and receives no taxpayer money, is funded by sales of electricity to its customers. Electricity prices in TVA's service territory are below the national average.

# # #

Contact: Terry Johnson, Chattanooga, (423) 751-6875
TVA Media Relations, Knoxville (865) 632-6000
www.tva.com/news

For more information about Sequoyah: www.tva.com/power/nuclear/sequoyah.htm

(Distributed: April, 9, 2010)

maintenance, and purchase of services to provide information.

Dated: April 6, 2010.

Michele Meyer,

Assistant Director, Legislative and Regulatory Activities Division, Office of the Comptroller of the Currency.

[FR Doc. 2010–8187 Filed 4–9–10; 8:45 am]

BILLING CODE 4810–33–P

DEPARTMENT OF THE TREASURY

Internal Revenue Service

Facility Control Numbers

AGENCY: Internal Revenue Service (IRS), Treasury.

ACTION: Notice of planned use of Facility Control Numbers.

SUMMARY: The IRS has developed and is publishing in this issue of the **Federal Register**, Facility Control Numbers to communicate to the motor fuel industry, renewable fuel industry and other interested parties such as state excise taxing authorities, the motor fuel terminal facilities that meet the definitions of Internal Revenue Code (Code) section 4081 or renewable fuel production facilities that meet the definitions of Code sections 40A and 6426 and the related regulations.

FOR FURTHER INFORMATION CONTACT: If you have any questions regarding the approved facilities or the listing, you may contact: Facility Control Number Coordinator Naomi Bancroft at (701) 772–9676 ext 234 or Michael Solomon at (302) 286–1557 (not toll-free numbers).

SUPPLEMENTARY INFORMATION: The IRS intends to use the facility numbers in excise fuel information reporting systems and to coordinate dyed fuel compliance activities. The IRS encourages States to adopt and use the numbers for motor fuel information reporting where appropriate. This list is published under the authority of Code section 6103(k)(7).

What is a Facility Control Number (FCN)?

A FCN is a number that identifies the physical location where the IRS has interest in transactions that may be reportable and that designate a location within the motor fuel distribution system, or the bulk transfer/terminal system or renewable fuel production. Facilities include refineries (RCN), approved terminals (TCN), biodiesel production facilities (BCN), or ethanol production facilities (ECN).

A taxable fuel registrant (Letter of Registration for Tax Free Transactions with a suffix code -S-) will be issued a TCN or RCN for each approved terminal or refinery physical location that a registrant in good standing operates. A renewable fuel registrant (Letter of Registration for Tax Free Transactions with a suffix code -AB-, -NB- or -CB-) will be issued a BCN for each biodiesel production physical location that a registrant in good standing operates. A renewable fuel registrant (Letter of Registration for Tax Free Transactions with a suffix code -AF-) will be issued a ECN for each ethanol production physical location that the that a registrant in good standing operates. A taxable fuel registrant in good standing having both an approved terminal and refinery operating at the same physical location will be issued both a TCN and either a RCN, BCN or ECN, depending on the fuel produced.

Each taxable fuel registrant issued a TCN, BCN or ECN will have a monthly ExSTARS filing requirement. The FCN list is available at *http://www.irs.gov/excise.*

What is an approved Terminal?

Approved motor fuel terminals, as defined by Code section 4081 and the related regulations, receive taxable fuel via a pipeline, ship, or barge, deliver taxable fuel across a rack or other non-bulk delivery system and are operated by a terminal operator who is properly registered in good standing with the IRS. Only those taxpayers, who are registered with the IRS on registration for Tax-Free Transactions—Form 637 (637 Registration) with a suffix code of “S” may operate an approved terminal. Each TCN identifies a unique physical location in the bulk transport/delivery system and is independent of the registered operator. The TCN for a physical location will not change even if the owner/operator changes.

What is an approved renewable fuel production facility?

Approved renewable fuel production facilities are facilities that produce methyl esters in the case of biodiesel and denatured alcohol in the case of ethanol and are operated by a 637 registrant in good standing. Renewable fuel registrants (those having Letter of Registration for Tax Free Transactions with a suffix code -AB-, -NB- or -CB-) will be issued a BCN for each biodiesel production physical location. A renewable fuel registrant (Letter of Registration for Tax Free Transactions with a suffix code -AF-) will be issued an ECN for each ethanol production physical location that the registrant operates

When does a Facility Operator need to notify the IRS of Changes?

A facility operator must notify the IRS for any of the following changes:

- Facility ownership change of greater than 50 percent or operator changes; or
- New facility is opened; or
- Facility ceases operation.

How should notification be made?

Notify the IRS ExSTARS Help Desk of the change by faxing the IRS TCN Coordinator, Naomi Bancroft at (701) 772–9207 or calling (701) 772–9676 ext. 234.

Changes to the facility status or other information will be published by the Excise Program Office on the IRS Web site *http://www.irs.gov/businesses/small/article/0,,id=99517,00.html.* Notification is required in order to retain approved status of the facility and 637 Registration. Failure to notify IRS of changes may lead to suspension or revocation of the approved status of the facility or 637 Registration of the facility operator and impose penalties under IRC § 6719. Changes or suspensions of approved status will be published as needed.

John H. Imhoff, Jr.,

National Director, Specialty Taxes.

[FR Doc. 2010–8188 Filed 4–9–10; 8:45 am]

BILLING CODE 4830–01–P

TENNESSEE VALLEY AUTHORITY

Supplemental Environmental Impact Statement for Sequoyah Nuclear Plant Units 1 and 2 License Renewals

AGENCY: Tennessee Valley Authority.

ACTION: Notice of Intent.

SUMMARY: This notice of intent is provided in accordance with the Council on Environmental Quality’s regulations (40 CFR parts 1500–1508) and Tennessee Valley Authority’s (TVA) procedures for implementing the National Environmental Policy Act. TVA will prepare a supplemental environmental impact statement (SEIS) to update information in the 1974 Final Environmental Statement for Sequoyah Nuclear Plant Units 1 and 2 (1974 FES) and other pertinent environmental reviews. This SEIS will address the potential environmental impacts associated with TVA’s proposal to renew operating licenses for the Sequoyah Nuclear Plant (SQN) located in Hamilton County, Tennessee. These license renewals will allow the plant to continue to operate for an additional 20 years beyond the current operating

licenses, which will expire in 2020 (Unit 1) and 2021 (Unit 2). The regulations of the Nuclear Regulatory Commission (NRC) in 10 CFR Part 54 set forth the applicable license extension requirements. Continued operation of SQN Units 1 and 2, which are each capable of producing approximately 1,200 megawatts (MW) of electricity, would help supply baseload power to the TVA power service area through 2041; would support TVA's policy to reduce the carbon emissions of its generating system and take advantage of lower carbon dioxide-emitting energy sources; and would make beneficial use of existing assets at the SQN site.

TVA proposes to pursue renewal of the operating licenses for SQN Units 1 and 2 in accordance with NRC regulations. The No Action Alternative considered is a decision by TVA not to seek renewal of the operating licenses for the SQN units. Under the No Action Alternative, SQN Units 1 and 2 would cease operation in 2020 and 2021, respectively. The SEIS will include examination of a range of supply-side and demand-side management options for supplying power as an alternative to renewing SQN operating licenses. Public comment is invited concerning both the scope of alternatives and environmental issues that should be addressed as part of the SEIS.

DATES: Comments on the scope of the SEIS must be postmarked or e-mailed no later than May 10, 2010, to ensure consideration.

ADDRESSES: Written comments or e-mails on the scope of issues to be addressed in the SEIS should be sent to Amy Henry, NEPA Specialist, Tennessee Valley Authority, 400 West Summit Hill Drive, Mail Stop WT 11D, Knoxville, Tennessee 37902 or e-mailed to *abhenry@tva.gov*. Comments may also be submitted through the TVA Web site at *http://www.tva.gov/environment/reports/sqn-renewal/*.

FOR FURTHER INFORMATION CONTACT: Information about the SEIS may be obtained by contacting Amy Henry, NEPA Specialist, Tennessee Valley Authority, 400 West Summit Hill Drive, Mail Stop WT 11D, Knoxville, Tennessee 37902 (*e-mail: abhenry@tva.gov*), or by visiting the project Web site at *http://www.tva.gov/environment/reports/sqn-renewal*. For information about operation of and license renewals for SQN, contact Gary Adkins, Nuclear Generation Development and Construction, Tennessee Valley Authority, 1101 Market Street, Mail Stop LP 5A, Chattanooga, Tennessee 37402 (*e-mail: gmadkins@tva.gov*).

SUPPLEMENTARY INFORMATION:

TVA Power System

TVA is an agency and instrumentality of the United States, established by an act of Congress in 1933, to foster the social and economic welfare of the people of the Tennessee Valley region and to promote the proper use and conservation of the region's natural resources. One component of this mission is the generation, transmission, and sale of reliable and affordable electric energy. TVA operates the nation's largest public power system, producing 4 percent of all electricity in the nation. TVA provides electricity to most of Tennessee and parts of Virginia, North Carolina, Georgia, Alabama, Mississippi, and Kentucky. It serves about 9 million people in this seven-State region through 155 power distributors and 56 directly served large industries and Federal facilities. The TVA Act requires the TVA power system to be self-supporting and operated on a nonprofit basis, and the TVA Act directs TVA to sell power at rates as low as feasible.

Dependable capacity on the TVA power system is about 37,000 MW of electricity. TVA generates most of this power with three nuclear plants, 11 coal-fired plants, nine combustion-turbine plants, two combined-cycle plants, 29 hydroelectric dams, a pumped-storage facility, and several small renewable generating facilities. A portion of delivered power is obtained through long-term power purchase agreements. Over the past five years, about 60 percent of TVA's annual generation was from fossil fuels, predominantly coal; 30 percent was from nuclear; and the remainder was from hydro and other renewable energy resources. TVA transmits electricity from these facilities over about 16,000 miles of transmission lines. Like other utility systems, TVA has power interchange agreements with utilities surrounding the Tennessee Valley region and purchases and sells power on an economic basis almost daily.

Sequoyah Nuclear Plant

Operation of Sequoyah Nuclear Plant (SQN) provides approximately 2,400 MW of electricity, which is typically used to supply baseload power to the TVA power service area. Baseload power, the minimum amount of power continuously needed in a power system, is usually supplied by generators with low operating costs and dependable availability, such as nuclear plants. SQN is a major component of TVA's generating assets. In fiscal year 2009, SQN met about 11 percent of TVA's total energy need. SQN supplies about one-third of the power generated by TVA's nuclear power plants.

SQN is located in Hamilton County in southeast Tennessee on about 630 acres adjacent to the Tennessee River at Mile 484.5, near the cities of Soddy Daisy, Cleveland, and Chattanooga. The site includes two Westinghouse Electric Corporation pressurized water reactors known as SQN Units 1 and 2, with a power output capacity of approximately 1,200 MW of electricity each. The former Atomic Energy Commission (now called the Nuclear Regulatory Commission or NRC) granted TVA a provisional construction permit in May 1970. Construction at the SQN site was completed in 1980, and operating licenses were approved for Unit 1 in 1980 and Unit 2 in 1981. Unit 1 received its full power license on September 17, 1980, and began commercial operation on July 1, 1981. Unit 2 received its full power license on September 15, 1981 and began commercial operation on June 1, 1982. Both units have performed well with consistently high levels of availability and generating capacity throughout the nearly 30 years of operation.

Proposed Action and Alternatives

TVA proposes to submit applications to the NRC requesting renewal of its SQN operating licenses. Renewal of the current operating licenses would permit operation for an additional 20 years past the current 40-year operating license terms, which expire in 2020 and 2021 for Units 1 and 2, respectively. The proposed action includes provision of an additional on-site storage facility by approximately 2026 to accommodate spent fuel throughout the license renewal term. These proposed license renewals are not anticipated to require other new major construction or modifications beyond normal maintenance and operations.

The SEIS will also consider a "No Action" Alternative under which TVA would not pursue renewal of the SQN operating licenses. Under the No Action Alternative, Units 1 and 2 would cease to produce power in 2020 and 2021, respectively. The SEIS will include an evaluation of a range of supply-side and demand-side management options for supplying power as an alternative to renewing SQN operating licenses. No changes to the existing power transmission system are proposed under any of the alternatives.

No decision to seek license renewals for SQN Units 1 and 2 has been made at this time. TVA is preparing this SEIS to supplement the original 1974 FES to inform decision makers, agencies, tribal representatives, and the public about the potential for environmental impacts associated with a decision to continue operation of SQN Units 1 and 2. The draft SEIS will be made available for public comment. In making its final decision, TVA will consider the assessment in this SEIS, including input provided by reviewing agencies, tribes, and the public.

Preliminary Identification of Environmental Issues

This SEIS will discuss the need to continue to operate SQN and will update the analyses of potential environmental, cultural, recreational, and socioeconomic impacts resulting from plant operation and maintenance of existing facilities. The impact analyses will include, but not necessarily be limited to, the potential impacts on water quality and use; vegetation; wildlife; aquatic ecology; endangered and threatened species; floodplains; wetlands; land use; recreational and managed areas; visual, archaeological, and historic resources; noise; socioeconomics; environmental justice; solid and hazardous waste; geology and seismology; meteorology, air quality, and climate change; uranium fuels cycle effects and radiological impacts; nuclear plant safety and security including design-basis accidents; and severe accidents and intentional destructive acts. These and other important issues identified during the scoping process will be addressed as appropriate in the SEIS.

Additionally, TVA will review and tier from the Generic Environmental Impact Statement for License Renewal of Nuclear Plants (GEIS), NUREG–1437, in which the NRC considered the environmental effects of 20-year renewals of nuclear power plant operating licenses (results are codified in 10 CFR Part 51). The GEIS identifies 92 environmental issues and reaches generic conclusions on environmental impacts for 69 of those issues that apply to all nuclear plants or to plants with specific design or site characteristics. It is expected that the generic assessment in NRC's GEIS would be relevant to the assessment of impacts of the proposed action at SQN.

Information from NRC's GEIS that is related to the current assessment would be incorporated by reference following the procedures described in 40 CFR § 1502.21. Additional plant-specific review will be necessary for most remaining issues, which are encompassed by the above identified range of resources.

Public Participation

This SEIS is being prepared to provide the public an opportunity to comment on TVA's assessment of the potential environmental impacts of pursuing extended licenses to operate SQN Units 1 and 2. The SEIS will also serve to inform the public and the decision makers of the reasonable alternatives that would minimize adverse impacts.

The scoping process will include interagency, tribal, and public scoping. Other federal, state, and local agencies and governmental entities will be asked to comment.

The public is invited to submit comments on the scope of this SEIS no later than the date given under the Dates section of this notice. Any comments received, including names and addresses, will become part of the administrative record and will be available for public inspection. Comments from the scoping process will be used by TVA to identify key Action Alternatives, and the significant environmental issues relating to these alternatives that should be addressed in the draft SEIS. After consideration of the comments received during this scoping period, TVA will identify the issues and alternatives to be addressed in the SEIS.

TVA will prepare a draft SEIS and will invite the review agencies and the public to submit written, verbal, e-mail, or online comments on the draft SEIS. TVA anticipates issuing the draft SEIS for public review later this year. Notice of availability of the draft SEIS will be published in the **Federal Register,** as well as announced in local news media. TVA expects to release the final SEIS in spring 2011.

Dated: April 2, 2010.

Anda A. Ray,

Environmental Executive and Senior Vice President, Environment and Technology, Tennessee Valley Authority.

[FR Doc. 2010–8234 Filed 4–9–10; 8:45 am]

BILLING CODE 8120–08–P

OMB Responses to Agency Clearance Requests

OMB Approvals

EPA ICR Number 1717.07; NESHAP for Off-Site Waste and Recovery Operations; 40 CFR part 63, subparts A and DD; was approved on 10/01/2010; OMB Number 2060–0313; expires on 10/31/2013; Approved without change.

EPA ICR Number 1781.05; NESHAP for Pharmaceutical Production; 40 CFR part 63, subparts A and GGG; was approved on 10/01/2010; OMB Number 2060–0358; expires on 10/31/2013; Approved without change.

EPA ICR Number 1869.06; NESHAP for the Manufacture of Amino/Phenolic Resins; 40 CFR part 63, subparts A and OOO; was approved on 10/01/2010; OMB Number 2060–0434; expires on 10/31/2013; Approved without change.

EPA ICR Number 2079.04; NESHAP for Metal Can Manufacturing Surface Coating; 40 CFR part 63, subparts A and KKKK; was approved on 10/01/2010; OMB Number 2060–0541; expires on 10/31/2013; Approved without change.

EPA ICR Number 1765.06; National Volatile Organic Compound Emission Standards for Automobile Refinish Coatings (Renewal); 40 CFR part 59, subpart B; was approved on 10/01/2010; OMB Number 2060–0353; expires on 10/31/2013; Approved without change.

EPA ICR Number 1611.07; NESHAP for Chromium Emissions from Hard and Decorative Chromium Electroplating and Chromium Anodizing Tanks; 40 CFR part 63, subparts A and N; was approved on 10/01/2010; OMB Number 2060–0327; expires on 10/31/2013; Approved without change.

EPA ICR Number 1966.04; NESHAP for Boat Manufacturing; 40 CFR part 63, subparts A and VVVV; was approved on 10/01/2010; OMB Number 2060–0546; expires on 10/31/2013; Approved without change.

EPA ICR Number 1604.09; NSPS for Secondary Brass/Bronze Production, Primary Copper/Zinc/Lead Smelters, Primary Aluminum Reduction Plants and Ferroalloy Production Facilities; 40 CFR part 60, subparts A, M, P, Q, R, S, and Z, was approved on 10/01/2010; OMB Number 2060–0110; expires on 10/31/2013; Approved without change.

EPA ICR Number 1664.07; National Oil and Hazardous Substances Pollution Contingency Plans (Renewal); 40 CFR 300.900; was approved on 10/01/2010; OMB Number 2050–0141; expires on 10/31/2013; Approved without change.

EPA ICR Number 1984.04; NESHAP for Plywood and Composite Wood Products; 40 CFR part 63, subparts A and DDDD; was approved on 10/01/2010; OMB Number 2060–0552; expires on 10/31/2013; Approved without change.

EPA ICR Number 2387.01; Certification and In-Use Testing of Motor Vehicles: Revisions to Reduce Emissions of Greenhouse Gases (Final Rule); 40 CFR 86.1845 to 86.1848; 40 CFR parts 85 and 86; was approved on 10/04/2010; OMB Number 2060–0644; expires on 10/31/2013; Approved without change.

EPA ICR Number 1801.09; NESHAP for the Portland Cement Manufacturing Industry; 40 CFR part 63, subparts A and LLL; was approved on 10/04/2010; OMB Number 2060–0416; expires on 10/31/2013; Approved without change.

EPA ICR Number 2307.02; NSPS for Portland Cement Plants; 40 CFR part 60, subparts A and F; was approved on 10/04/2010; OMB Number 2060–0614; expires on 10/31/2013; Approved without change.

EPA ICR Number 1361.15; Withdrawing the Comparable Fuels Exclusion under RCRA (Final Rule); 40 CFR 261.38; was approved on 10/04/2010; OMB Number 2050–0073; expires on 10/31/2013; Approved without change.

EPA ICR Number 1774.05; Mobile Air Conditioner Retrofitting Program (Renewal); 40 CFR part 82, subpart G; was approved on 10/13/2010; OMB Number 2060–0350; expires on 10/31/2013; Approved without change.

EPA ICR Number 0282.15; Engine Emission Defect Information Reports and Voluntary Emission Recall Reports (Renewal); 40 CFR parts 85, 89, 90, 91, 92, 94, 1048, 1068 and 1051; was approved on 10/19/2010; OMB Number 2060–0048; expires on 10/31/2013; Approved without change.

EPA ICR Number 2363.01; Exhaust Emissions of Light-duty Vehicles in Metropolitan Detroit (New Collection); was approved on 10/19/2010; OMB Number 2060–0645; expires on 10/31/2013; Approved without change.

Comment Filed

EPA ICR Number 2381.01; Proposed ICR Amendment for Rulemaking entitled "Lead; Clearance and Clearance Testing Requirements for the Renovation, Repair, and Painting Program; Proposed Rule"; in 40 CFR part 745; OMB filed comment on 10/04/2010.

EPA ICR Number 2398.01; Regulation of Fuels and Fuel Additives: 2011 Renewable Fuel Standards—Petition for International Aggregate Compliance Approach; in 40 CFR 80.1457; OMB filed comment on 10/18/2010.

EPA ICR Number 0783.55; Motor Vehicle Emissions: Revisions to Certification of Alternative Fuels Conversions; in 40 CFR 85.1901–85.1908; 40 CFR parts 85, 86 and 600; 40 CFR 86.412 and 86.1845; OMB filed comment on 10/19/2010.

Short Term Extensions of Expiration Date

EPA ICR Number 2147.05; Pesticide Registration Fee Waivers; OMB Number 2070–0167; expires on 01/31/2011; a short term extension was approved on 10/18/2010.

EPA ICR Number 1214.09; Pesticide Product Registration Maintenance Fee; OMB Number 2070–0100; expires on 03/31/2011; a short term extension was approved on 10/18/2010.

Dated: November 1, 2010.

John Moses,

Director, Collections Strategies Division.

[FR Doc. 2010–28016 Filed 11–4–10; 8:45 am]

BILLING CODE 6560–50–P

ENVIRONMENTAL PROTECTION AGENCY

[ER–FRL–8993–5]

Environmental Impacts Statements; Notice of Availability

Responsible Agency: Office of Federal Activities, General Information (202) 564–1399 or *http://www.epa.gov/compliance/nepa/*.

Weekly receipt of Environmental Impact Statements

Filed 10/25/2010 Through 10/29/2010

Pursuant to 40 CFR 1506.9.

Notice

In accordance with Section 309(a) of the Clean Air Act, EPA is required to make its comments on EISs issued by other Federal agencies public. Historically, EPA has met this mandate by publishing weekly notices of availability of EPA comments, which includes a brief summary of EPA's comment letters, in the **Federal Register**. Since February 2008, EPA has been including its comment letters on EISs on its Web site at: *http://www.epa.gov/compliance/nepa/eisdata.html.* Including the entire EIS comment letters on the Web site satisfies the Section 309(a) requirement to make EPA's comments on EISs available to the public. Accordingly, on March 31, 2010, EPA discontinued the publication of the notice of availability of EPA comments in the **Federal Register**.

EIS No. 20100430, Draft EIS, FHWA, AL, Helena Bypass Project, Proposal to Construct a Bypass from County Road 51 in Helena to State Route 261 near Bearden Road, Shelby County, AL, Comment Period Ends: 12/20/2010, Contact: Lynne Urquhart 334–274–6371.

EIS No. 20100431, Final EIS, USFS, WA, Dosewallips Road Washout Project, To Reestablish Road Access to both Forest Service Road (FSR) 2610 and Dosewallips Road, Hood Canal Ranger District Olympic National Forest, Olympic National Park, Jefferson County, WA, Wait Period Ends: 12/06/2010, Contact: Tim Davis 360–965–2375.

EIS No. 20100432, Draft Supplement, TVA, TN, Sequoyah Nuclear Plants Units 1 and 2, Application for License Renewal, Implementation, Hamilton County, TN, Comment Period Ends: 12/20/2010, Contact: Amy Henry 865–632–4045.

EIS No. 20100433, Final EIS, USFS, CA, Plumas National Forest Public Motorized Travel Management, Implementation, Plumas National Forest, Plumas, Lassen, Yuba, Butte and Sierra Counties, CA, Wait Period Ends: 12/06/2010, Contact: Peter Hochrein 530–283–7718.

EIS No. 20100434, Draft EIS, BR, WA, Odessa Subarea Special Study, To Replace Groundwater Currently Used for Irrigation, Grant, Adams, Walla Walla and Franklin Counties, WA, Comment Period Ends: 12/31/2010, Contact: Charles Carnohan 509–575–5848 Ext 370.

EIS No. 20100435, Draft EIS, BR, CA, Suisun Marsh Habitat Management, Preservation, and Restoration Plan, Implementation, CA, Comment Period Ends: 12/20/2010, Contact: Doug Kleinsmith 916–978–5034.

EIS No. 20100436, Draft Supplement, USACE, FL, Martin County, Florida Hurricane and Storm Damage Reduction Project, Beach Nourishment Project Authorizes Construction of a Protective and Recreational Beach Along 4 Miles of Shorefront, Hutchinson Island, Martin County, FL, Comment Period Ends: 01/07/2011, Contact: Paul DeMarco 904–232–1897.

EIS No. 20100437, Draft EIS, FHWA, NM, I–25/Paseo del Norte Interchange Project, To Reduce Congestion and to Improve Safety, Albuquerque, Bernalillo County, NM, Comment Period Ends: 12/20/2010, Contact: Gregory L. Heitmann 505–820–2027.

EIS No. 20100438, Draft EIS, USACE, CO, Programmatic—Growth, Realignment, and Stationing of Army Aviation Assets, To Reduce Congestion and to Improve Safety, Right-of-Way Acquisition, Fort Carson, CO, Comment Period Ends: 12/20/2010, Contact: Mike Ackerman 210–295–2273.

Dated: November 2, 2010.

Ken Mittelholtz,

Deputy Director, NEPA Compliance Division, Office of Federal Activities.

[FR Doc. 2010–28018 Filed 11–4–10; 8:45 am]

BILLING CODE 6560–50–P

FEDERAL COMMUNICATIONS COMMISSION

Notice of Public Information Collection Requirement Submitted to the Office of Management and Budget (OMB) for Emergency Review and Approval, Comments Requested

October 29, 2010.

SUMMARY: The Federal Communications Commission, as part of its continuing effort to reduce paperwork burden, invites the general public and other Federal agencies to take this opportunity to comment on the following information collection, as required by the Paperwork Reduction Act (PRA) of 1995, 44 U.S.C. 3501–3520. Comments are requested concerning (a) whether the proposed collection of information is necessary for the proper performance of the functions of the Commission, including whether the information shall have practical utility; (b) the accuracy of the Commission's burden estimate; (c) ways to enhance the quality, utility, and clarity of the information collected; and (d) ways to minimize the burden of the collection of information on the respondents, including the use of automated collection techniques or other forms of information technology; and (e) ways to further reduce the information collection burden for small business concerns with fewer than 25 employees. The FCC may not conduct or sponsor a collection of information unless it displays a currently valid control number. No person shall be subject to any penalty for failing to comply with a collection of information subject to the Paperwork Reduction Act (PRA) that does not display a valid control number.

DATES: Written Paperwork Reductions (PRA) comments on this information collection should be submitted on or before November 22, 2010. If you anticipate that you will be submitting PRA comments, but find it difficult to do so within the period of time allowed by this notice, you should advise the contacts listed below as soon as possible.

ADDRESSES: Direct all PRA comments to Nicholas A. Fraser, Office of Management and Budget, via e-mail at *Nicholas_A._Fraser@omb.eop.gov* or via fax at (202) 395–5167 and to the Federal Communications Commission via e-mail to *PRA@fcc.gov* and *Cathy.Williams@fcc.gov.*

FOR FURTHER INFORMATION CONTACT: For additional information about the information collection, contact Cathy Williams, Federal Communications Commission via e-mail at *Cathy.Williams@fcc.gov* or by telephone at (202) 418–2918.

To view a copy of this information collection request (ICR) submitted to OMB: (1) Go to the Web page *http://www.reginfo.gov/public/do/PRAMain,* (2) look for the section of the Web page called "Currently Under Review," (3) click on the downward-pointing arrow in the "Select Agency" box below the "Currently Under Review" heading, (4) select "Federal Communications Commission" from the list of agencies presented in the "Select Agency" box, (5) click the "Submit" button to the right of the "Select Agency" box, (6) when the list of FCC ICRs currently under review appears, look for the OMB control number of this ICR and then click on the ICR Reference Number. A copy of the FCC submission to OMB will be displayed.

SUPPLEMENTARY INFORMATION: The Commission is requesting emergency OMB processing of the information collection requirement(s) contained in this notice and has requested OMB approval 17 days after the collection is received at OMB.

OMB Control Number: 3060–XXXX.

Title: Consumer survey.

Form Number: Not applicable.

Type of Review: New Collection.

Respondents: Individuals or households.

Number of Respondents/Responses: 5,000 respondents, 5,000 responses.

Estimated Time per Response: .25 hours (15 minutes).

Frequency of Response: One-time reporting requirement.

Total Annual Burden: 1,250 hours.

Nature of Response: Voluntary. The statutory authority for this collection of information is contained in Section 202(h) of the Telecommunications Act of 1996.

Nature and Extent of Confidentiality: There is no need for confidentiality with this information collection.

Privacy Act Impact Assessment: No personally identifying information will be transmitted to the Commission from the survey contractor as a matter of vendor policy.

Needs and Uses: The Commission is requesting emergency processing under 5 CFR 1320.13 so this information can be available for use to prepare one of the Commission's media ownership studies, TVA

NEWS RELEASE

<u>TVA To Hold Public Meeting on Sequoyah Nuclear Plant License Renewal</u>

CHATTANOOGA, Tenn. – The Tennessee Valley Authority will hold a public meeting on Thursday, Dec. 2, to discuss the environmental evaluation that supports the process for renewal of operating licenses for the two power generating units at Sequoyah Nuclear Plant.

The meeting will be held from 4 p.m. to 8 p.m. EST in the training center at the Sequoyah Nuclear Plant, 2440 Igou Ferry Road, Soddy Daisy, Tenn.

Earlier this year, TVA began preparing a draft Supplemental Environmental Impact Statement on the potential environmental effects of extending the U.S. Nuclear Regulatory Commission (NRC) operating licenses of its nuclear units at Sequoyah. The draft environmental review document identifies potential environmental impacts of extending the original license by 20 years.

“Renewing the existing licenses will allow the units to operate beyond 2020 and 2021, when the current NRC licenses expire for Units 1 and 2,” said Mike Skaggs, site vice president at Sequoyah. “Continuing to safely operate the plant for an additional 20 years supports TVA’s vision to be one of the nation’s leading providers of low-cost and cleaner energy.”

The draft environmental review can be viewed online at www.tva.com/environment/reports/sqn-renewal/. Copies of the Supplemental Environmental Impact Statement can be requested by calling (865) 632-4045 or sending an email to Amy Henry at the address below.

“TVA encourages public participation in the environmental review process,” Skaggs said. “We will have several information stations at the open house where people can talk with knowledgeable staff about the draft environmental review, plant operations, the license renewal process, the environmental review processes and the alternatives considered for license renewals.”

Comments may be submitted via the web or sent to Amy Henry, NEPA Specialist, Tennessee Valley Authority, WT 11D, 400 West Summit Hill Drive, Knoxville, TN 37902. Comments also can be faxed to (865) 632-3451 or e-mailed to abhenry@tva.gov.

Each of Sequoyah's two reactors is capable of producing more than 1,160 megawatts of electricity. Together, they can generate enough power to supply about 1.3 million homes.

The Tennessee Valley Authority, a corporation owned by the U.S. government, provides electricity for utility and business customers in most of Tennessee and parts of Alabama, Mississippi, Kentucky, Georgia, North Carolina and Virginia – an area of 80,000 square miles with a population of 9 million. TVA operates 29 hydroelectric dams, 11 coal-fired power plants, three nuclear plants and 11 natural gas-fired power facilities that can produce nearly 34,000 megawatts of electricity, delivered over 16,000 miles of high-voltage power lines. TVA also provides flood control, navigation, land management and recreation for the Tennessee River system and works with local utilities and state and local governments to promote economic development across the region. TVA, which makes no profits and receives no taxpayer money, is funded by sales of electricity to its customers. Electricity prices in TVA's service territory are below the national average.

# # #

Media Contact: Mike Bradley, Knoxville, (865) 632-8860
TVA Media Relations, Knoxville, (865) 632-6000
www.tva.com/news

(Distributed: Nov. 29, 2010)

TVA Open House

Sequoyah Nuclear Plant Units 1 and 2 License Renewal Draft Supplemental Environmental Impact Statement

TVA will hold an open house in Soddy Daisy, Tennessee, to discuss the draft supplemental environmental impact statement (SEIS) for the proposed renewal of operating licenses for Sequoyah Nuclear Plant Units1 and 2. License renewal would permit operation for an additional 20 years past the terms of the current operating licenses, which expire in 2020 for Unit 1 and 2021 for Unit 2.

The public is invited to stop by anytime during the open house to provide comments or ask questions about the draft SEIS. Copies of the document will be available at the open house and are also available via the Internet as indicated below.

In the draft SEIS, TVA evaluated continued operation of Sequoyah Nuclear Plant as well as alternative methods for supplying electrical power. If TVA decides to pursue license renewal, TVA would submit an application to the U.S. Nuclear Regulatory Commission. The license renewal application would include a technical safety review and an environmental review. The purpose of this SEIS is to help TVA make an informed decision about whether to submit the license renewal application.

Comments about the draft SEIS can be submitted during the open house or anytime before December 22, 2010. These comments will be considered and addressed in the final SEIS. Any comments received, including names and addresses, will become part of the administrative record and will be available for public inspection.

What: TVA Public Open House
Date: Thursday, December 2, 2010
When: 4 - 8 p.m. EST
Where: Sequoyah Training Center (no special access needed)
Address: 2440 Igou Ferry Road, Soddy Daisy, TN 37379

The draft SEIS was prepared and made available for public review on November 5, 2010. Persons with Internet access can review it and submit comments at *http://www.tva.gov/environment/reports/sqn-renewal/index.htm*. Comments can also be submitted by faxing to (865) 632-3451 or mailing to:

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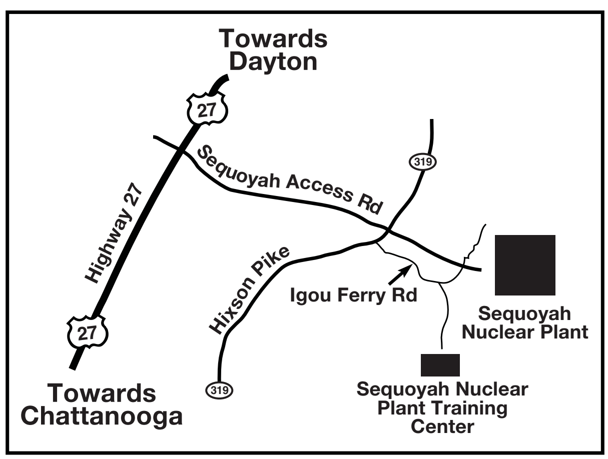
400 Summit Hill Drive (WT-11D)
Knoxville, TN 37902
(865) 632-4045
abhenry@tva.com



If you have special needs, please call Amy Henry prior to the open house meeting. You can also email or call her to request a printed copy of the draft SEIS.

APPENDIX B – SCOPING REPORT

ENVIRONMENTAL IMPACT STATEMENT

SCOPING REPORT

SEQUOYAH NUCLEAR PLANT UNITS 1 AND 2
LICENSE RENEWAL
Hamilton County, Tennessee

PREPARED BY:
TENNESSEE VALLEY AUTHORITY

September 2010

For more information on the supplemental environmental impact statement, contact:

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Introduction

An important mission of the Tennessee Valley Authority (TVA) involves the generation, transmission, and sale of reliable and affordable electric energy. TVA operates the nation's largest public power system, producing four percent of the electricity in the nation. It serves about nine million people in a seven-state power service area. The TVA Act requires the TVA power system to be self-supporting and operated on a nonprofit basis. The TVA Act also directs TVA to sell power at rates as low as feasible. Over the past five years, about 30 percent of TVA's annual generation has been from nuclear power plants.

Operation of Sequoyah Nuclear Plant (SQN) provides a major component of TVA's generating assets. SQN operates under licenses with 40-year terms that would end in 2020 (Unit 1) and 2021 (Unit 2) if the licenses are not renewed. TVA proposes to submit an application to the U.S. Nuclear Regulatory Commission (NRC) requesting renewal of its SQN operating licenses. Renewal of the current operating licenses would permit each unit to operate for an additional 20 years, and would help TVA respond to future demands for power generation within the TVA Power Service Area.

Following the requirements of regulations implementing the National Environmental Policy Act (NEPA), TVA is preparing a supplemental environmental impact statement (SEIS) to evaluate the impacts of renewing SQN operating licenses and alternatives to renewal. See Appendix A for more information about NEPA. Although NEPA regulations do not require that a public scoping process be used for the preparation of an SEIS, TVA decided to employ public scoping for this SEIS. The scoping process involves requesting and using comments from the interested public, organizations, and agencies to help identify the issues and alternatives that should be addressed in a NEPA document. This document summarizes the input that TVA received during the scoping process and defines the scope of the "*Supplemental Environmental Impact Statement for Sequoyah Nuclear Plant Units 1 and 2 License Renewals."*

The final decision to seek license renewals for SQN Units 1 and 2 has not been made at this time. TVA is preparing this SEIS to supplement the original "*Sequoyah Nuclear Plant Units 1 and 2 Final Environmental Statement* " (FES) (TVA 1974) to inform decision makers, agencies, tribal representatives, and the public about the potential for environmental impacts associated with a decision to continue operation of SQN Units 1 and 2 for the extended 20-year license terms. The draft SEIS will be made available for public comment. In making its final decision, TVA will consider the assessment in this SEIS, including input provided by reviewing agencies, tribes, and the public.

The license renewal (LR) process requires an aging management and time-limited analysis review of plant equipment and programs potentially impacting safety and regulated events, accident scenario evaluations, and an environmental review. The reviews must demonstrate that plant systems, structures, and components will be adequately managed during the period of extended operations. In addition to TVA's SEIS, a separate environmental report (ER) will be developed as part of TVA's LR application to NRC. The ER will contain information similar to the SEIS, but will be based upon NRC requirements. The SEIS will support development of the ER. The ER will support the NRC's review of the environmental consequences of granting license extensions. The NRC's environmental review will likewise be conducted in accordance with NEPA, and will also provide opportunities for input from the public, tribes, and other agencies.

Sequoyah Nuclear Plant

SQN is located in Hamilton County in southeast Tennessee on about 630 acres adjacent to the Tennessee River at Mile 484.5, near the cities of Soddy Daisy, Cleveland, and Chattanooga (Figure 1). The site includes two Westinghouse Electric Corporation pressurized water reactors known as SQN Units 1 and 2, with a power output capacity of approximately 1200 MW of electricity each.

The former Atomic Energy Commission (now the NRC) granted TVA a provisional construction permit in May 1970. Construction at the SQN site was completed in 1980. Unit 1 received its full power license on September 17, 1980, and began commercial operation on July 1, 1981. Unit 2 received its full power license on September 15, 1981 and began commercial operation on June 1, 1982. Both units have performed well with consistently high levels of availability and generating capacity throughout their nearly 30 years of operation.

Project Description, Purpose, and Need

TVA is committed to providing reliable, affordable power to meet the needs of TVA customers. Historically, net system requirements grew at an average rate of 2.3 percent (1990–2008) before the recent economic downturn. Consistent with current forecasting and power system planning models, TVA expects peak load and net system power requirements to increase through 2029. As part of TVA's "*Integrated Resource Plan"* (IRP) currently in development, TVA is updating the future load forecast and associated power system planning models.

TVA proposes to submit a license renewal application (LRA) for both units at SQN. On August 5, 2009, TVA informed the NRC of its intention to submit an LRA (TVA 2009).

The purpose of the proposed action is to obtain extended licenses to operate SQN Units 1 and 2 to help meet the identified need for power between 2020 and 2041. SQN provides approximately 2400 MW of electricity, which is typically used to supply base load power in the TVA power service area. SQN is a major component of TVA's generating assets. In fiscal year 2009, SQN met about 11 percent of TVA's total energy need. SQN supplies about one-third of the power generated by TVA's nuclear power plants.

The extended 20-year operational period for both SQN units has the benefit of assuring future base load power generation, avoiding the large capital outlays associated with new construction, and avoiding the environmental impacts that result from siting and construction of a new power generating facility that would be needed to replace the power currently generated by SQN.

Extending the license for SQN Units 1 and 2 through 2040 and 2041 also continues its potential availability to support TVA's interagency agreement with the U.S. Department of Energy (DOE) to produce tritium until 2035. SQN Units 1 and 2, along with Watts Bar Unit 1, are licensed to produce tritium for DOE, although TVA currently does not produce tritium at SQN.

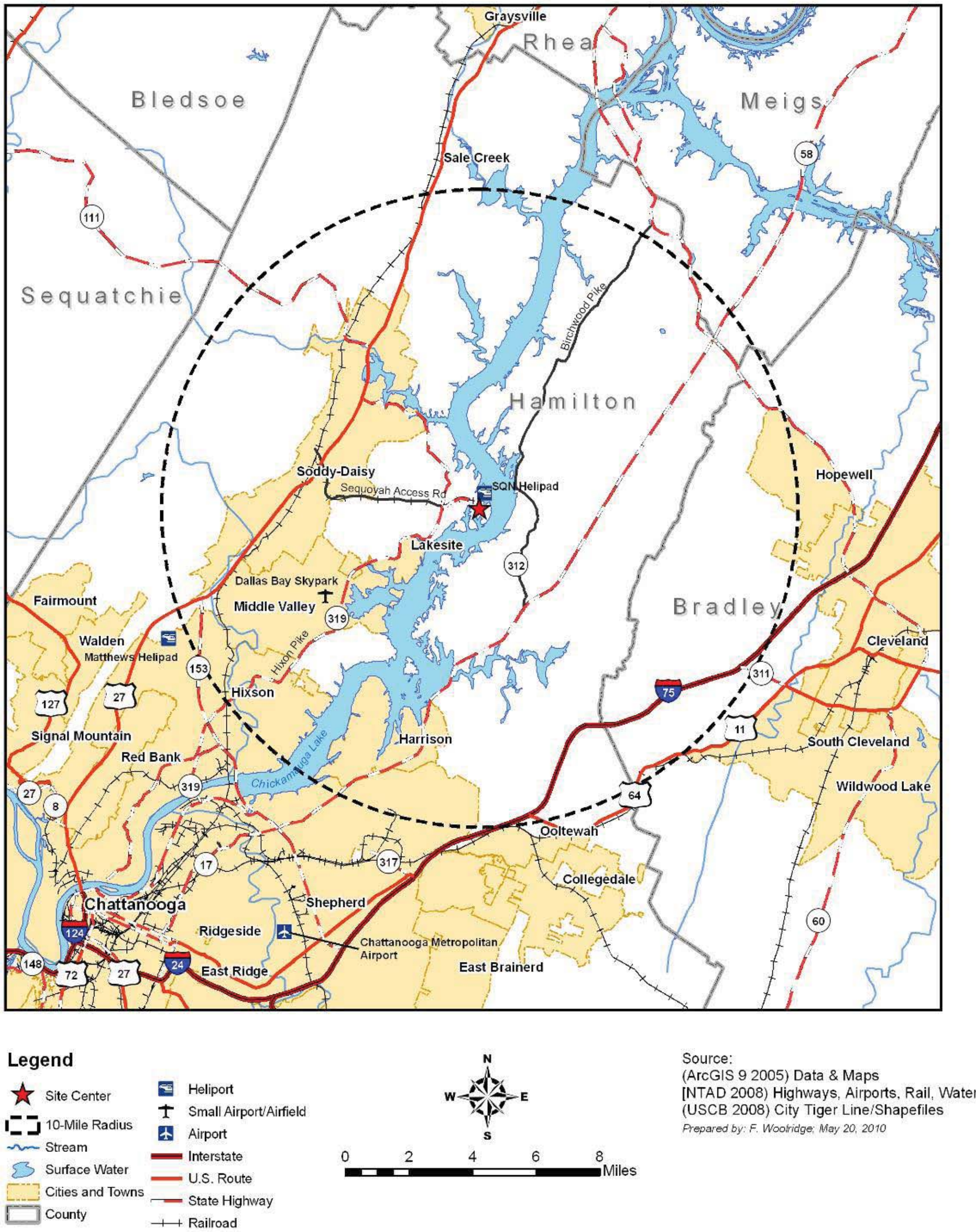

Figure 1. Location of Sequoyah Nuclear Plant

Related Environmental Documents

Previous NEPA reviews contributing to the information and evaluations to be contained in the subject SEIS include the following:

Final Environmental Statement, Sequoyah Nuclear Plant Units 1 and 2 (TVA 1974)

TVA prepared and submitted a comprehensive FES prior to construction activities for SQN Units 1 and 2. This FES included impact analyses for the plant site, surrounding areas, and the proposed transmission corridors. Information from this document was analyzed and updated where needed to develop the SEIS.

In 1978, as requested by the NRC, TVA amended the FES with revised analysis of impacts to the aquatic environment from changes to the plant made prior to its operation. In 1979, the NRC issued an environmental impact appraisal that concluded potential environmental consequences were amenable to acceptable impact control and were appropriately addressed by the EPA in their drafting of the NPDES permit for operation of SQN.

Environmental Assessment and Finding of No Significant Impact for Low-Level Radwaste Management, Sequoyah Nuclear Plant (TVA 1980)

In 1980, TVA revised its plans for treatment and storage of low-level radioactive wastes (LLRW) at SQN. TVA prepared an EA to consider the potential environmental impacts of this revised plan. The proposed management plan was threefold, consisting of (1) establishing a temporary LLRW management plan, including temporary storage, (2) installing equipment for volume reduction and solidification of LLRW, and (3) constructing facilities to safely store LLRW for the operational life of the plant. TVA concluded that construction and operation of the LLRW facility had no significant impact on the environment. Although the facility was constructed, it was not used during the 1980s because LLRW from SQN was transported off-site to a licensed facility. The SEIS contains updated information about the LLRW storage facility at SQN and addresses the environmental impacts of managing LLRW should SQN operating licenses be renewed.

*Environmental Assessment and Finding of No Significant Impact - Change in Expiration Dates of Facility Operating License Numbers DPR-77 and DPR-79, Tennessee Valley Authority, Sequoyah Nuclear Plant, Units 1 and 2 (*TVA 1988*)*

The original operating license terms for SQN, as supported by the 1974 FES, were to end on May 27, 2010. Accounting for the time that was required for plant construction, these terms represented an effective operating license term of approximately 29 years and four months for Unit 1 and 28 years and eight months for Unit 2. TVA submitted an amended application that requested an extension of the operating license expiration dates, so the fixed period of the licenses would be that allowed 40 years from the date of the operating license issuance for both units. Based on TVA's amended application and associated EA, the NRC staff concluded that there were no significant radiological or non-radiological impacts associated with the extension of the licenses.

Energy Vision 2020- Integrated Resource Plan and Final Programmatic Environmental Impact Statement (TVA 1995)

In December 1995, TVA completed this comprehensive environmental review of alternative means of meeting demand for power on the TVA system through the year

2020. The alternative adopted by the TVA Board was a portfolio of various supply-and demand-side energy resources, which included operation of SQN.

Generic Environmental Impact Statement for License Renewal of Nuclear Plants (GEIS) (NRC 1996)

The subject SEIS will incorporate information from the GEIS (NUREG-1437) in which the NRC considered the environmental effects of 20-year renewals of nuclear power plant operating licenses (results are codified in 10 CFR Part 51). The GEIS identifies 92 environmental issues that generally apply to nuclear plants or to plants with specific design or site characteristics. Generic conclusions on environmental impacts are described for 69 of those issues. To date, the NRC has issued 33 supplements to the GEIS for 60 currently-operating nuclear power units.

It is expected that the generic assessment in NRC's GEIS would be relevant to the assessment of impacts of the proposed action at SQN. Information from NRC's GEIS that is related to the current assessment would be incorporated in the subject SEIS by reference. Additional plant-specific review will be necessary for many remaining issues.

*Environmental Assessment and Finding of No Significant Impact – Low Level Radioactive Waste Transport and Storage Watts Bar and Sequoyah Nuclear Plants (*TVA 1999*)*

Due to the anticipated closure of an off-site radioactive waste disposal facility, TVA evaluated the effects of using the existing SQN on-site facility to store low level radioactive waste from SQN, as well as low level radioactive waste transported from Watts Bar Unit 1. TVA concluded there would be no significant impact from implementing the proposed transportation and storage. The SEIS contains updated information about the LLRW storage facility at SQN and addresses the environmental impacts of managing LLRW should SQN operating licenses be renewed.

Final Environmental Impact Statement for the Production of Tritium (DOE 1999)

On December 22, 1998, DOE announced that commercial light water reactors (CLWRs) would be the primary tritium supply technology for the nation's defense needs. The Secretary designated the Watts Bar Unit 1 reactor near Spring City, Tennessee, and SQN Units 1 and 2 as CLWRs available for tritium production. This EIS evaluated environmental effects associated with tritium production at these three units.

Environmental Assessment and Finding of No Significant Impact – Replacement of Steam Generators, Sequoyah Nuclear Plant Unit 1 (TVA 2000a)

TVA prepared an EA prior to replacement of the four steam generators in SQN Unit 1 during the March 2003 scheduled outage. Steam generators, a type of heat exchanger, are large cylindrical pieces of equipment used to produce steam for propelling the turbines that spin the generators to produce electric power. The EA evaluated the effects of replacing the steam generators and concluded there would be no or minimal environmental impact.

Environmental Assessment and Finding of No Significant Impact – Independent Spent Fuel Storage Installation Sequoyah Nuclear Plant (TVA 2000b)

TVA utilizes the NRC's General License to store spent fuel at the SQN onsite independent spent fuel storage installation (ISFSI) outdoor dry storage facility. A general license is an option available to current commercial nuclear power licensees to store spent fuel outside of the spent fuel pool at an ISFSI. The general license requires the use of a fuel storage system that has been previously approved by NRC as demonstrated by the issuance of an NRC Certificate of Compliance.

TVA screened 13 sites for the construction of an ISFSI at SQN and prepared an EA evaluating the effects of a proposed location and alternatives. In April 2000, TVA issued a finding of no significant impact for constructing and operating the ISFSI between the entrance road to SQN and the 500-kV switchyard.

Environmental Assessment and Finding of No Significant Impact –Leading Edge Flow Measurement System Installation (TVA 2001)

TVA prepared an EA to evaluate the effects of installing a leading edge flow measurements (LEFM) system for the feed water supply to the steam generators. Installation of the LEFM system facilitated a power increase of 1.3 percent. TVA concluded there was no significant impact to the environment from installation of the LEFM system.

Supplemental Environmental Assessment and Finding of No Significant Impact – Independent Spent Fuel Storage Installation, Sequoyah Nuclear Plant, Hamilton County, Tennessee (TVA 2002)

TVA prepared this supplemental EA to evaluate a different proposed location for the ISFSI, as well as other changes proposed since the April 2000 EA (TVA 2000b). TVA concluded no significant impact to the environment would occur from constructing and operating the ISFSI on a site southwest of the Dry Active Waste building.

Environmental Assessment for SQN Unit 2 Steam Generator Replacement (TVA 2009a)

TVA prepared an EA prior to replacement of the four steam generators in Unit 2 at SQN during an outage scheduled for October 2012. TVA evaluated the effects of replacing the steam generators and concluded there would be no or very minimal environmental impact.

Environmental Impact Statement for the Integrated Resource Plan (IRP; TVA 2010b)

TVA is currently preparing the IRP, a comprehensive study of alternatives for meeting the future electrical energy needs of the Tennessee Valley. This document updates the *Energy Vision 2020* described above. The purpose of the IRP is to develop a plan that TVA can enact to achieve a sustainable future and meet energy needs of the Tennessee Valley over the next 20 years. The IRP EIS will evaluate the environmental impacts of proposed and alternative strategies with portfolios of supply- and demand-side energy resource options to meet the growing demand for energy in the region. The subject SEIS will use information and analyses from the IRP EIS process, particularly for load forecasting and evaluation of energy generation portfolios designed to meet forecast needs.

Scoping Activities

TVA sought public involvement to help determine the scope of and issues to be addressed in the subject SEIS, and to help identify additional alternatives to the proposed action. The major public involvement steps are listed below:

April 9, 2010	TVA issued a press release and posted project-related scoping information, the notice of intent (NOI), a mailing list sign-up sheet, and an online comment option that was posted on the TVA Web site. The NOI was made available on the Federal Register Public Inspection Desk.
April 12, 2010	The NOI was published in the *Federal Register* and mailed to inform other agencies, tribes, and the public of TVA's intent to prepare the SEIS. The public comment period officially opened.
April 12 to May 11, 2010	TVA held a 30-day scoping comment period that resulted in the receipt of nine comments from seven commenters.

In addition, newspaper articles on the subject were published prior to and during the comment period by the news media, including:

- "TVA seeks 20-year extension of Sequoyah plant license," in the *Chattanooga Times Free Press*, published on Friday, April 9, 2010 http://www.timesfreepress.com/news/2010/apr/09/tva-seeks-20-year-extension-sequoyah-plant-license/

- "TVA seeks Sequoyah license extension," in the *Chattanooga Times Free Press*, published on Saturday, April 10, 2010, http://www.timesfreepress.com/news/2010/apr/10/tva-seeks-sequoyah-license-extension/#comments

- "TVA Plant Assessment," on the WCYB website on Saturday, April 10, 2010, http://www.wcyb.com/pages/6775175.php?contentType=4&contentId=5901767

- "TVA seeking Sequoyah license extension," in the Knoxville News Sentinel published on Sunday, April 11, 2010, http://www.knoxnews.com/news/2010/apr/11/state-local-briefs/

Information about the proposed license renewal NOI to prepare an SEIS, including an interactive comment form and mailing list sign-up, was made available at http://www.tva.gov/environment/reports/sqn-renewal/index.htm. Additionally, the NOI was mailed to 30 federal and state agencies and organizations, as well as 15 federally recognized tribes.

The comments received during public scoping activities are summarized in Appendix B. All of the comments are pertinent to the scope of the SEIS and are being considered in the preparation of the SEIS.

Environmental Issues to be Addressed

The subject SEIS will evaluate the environmental consequences of the proposed action (to operate SQN Units 1 and 2 for an additional 20 years) and alternatives. As a supplement to the 1974 FES (TVA 1974), this SEIS will update the analyses of potential environmental, cultural, recreational, and socioeconomic impacts resulting from plant operation and maintenance of existing facilities. The impact analyses will include, but not necessarily be limited to, the potential impacts on water quality and use; vegetation; wildlife; aquatic ecology; endangered and threatened species; floodplains; wetlands; land use; recreational and managed areas; visual, archaeological, and historic resources; noise; socioeconomics; environmental justice; solid and hazardous waste; geology and seismology; meteorology, air quality, and climate change; uranium fuels cycle effects and radiological impacts; nuclear plant safety and security including design-basis accidents, severe accidents, and intentional destructive acts.

In addition, the SEIS will address cumulative impacts associated with the proposed action and alternatives. Cumulative impacts are defined as “impacts on the environment which result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or nonfederal) or person undertakes such other actions” (40 CFR Part 1508.7). Other actions considered in the analysis of cumulative effects include the operation of Watts Bar Units 1 and 2 (the latter currently under construction), and a single nuclear unit at the Bellefonte Plant Site (TVA 2010a).

Alternatives to be Addressed

TVA projects future power supply needs through ongoing forecasting and the comprehensive integrated resource planning effort currently in progress for the IRP. Information from these processes will be used to identify potential alternatives that meet (completely or partially) the TVA system electrical power needs.

In addition to maximizing use of SQN’s assets, supply-side and demand-side options will be evaluated to identify feasible alternatives for meeting the need for power. Alternatives may or may not require construction of new generating capacity. Options are considered feasible alternatives if they would substantially meet the project purpose and need, are based upon mature and available technology, and would not result in substantially greater air emissions or other environmental impacts.

Based upon information gathered during internal evaluation and public scoping, TVA anticipates analyzing two alternatives in the SEIS as described below. The final set of feasible alternatives will be determined in coordination with the ongoing IRP project.

Alternative 1 – Sequoyah Units 1 and 2 License Renewal, Action Alternative

Under Alternative 1, TVA would submit the LRA and, upon approval from the NRC, would continue to operate SQN Units 1 and 2 for an additional 20-year period beyond the expiration of the current licenses. The current operating license expiration dates are September 17, 2020 for Unit 1 and September 15, 2021 for Unit 2. If this alternative is chosen, SQN would be available as a base load generation plant until 2040 for Unit 1 and 2041 for Unit 2.

Continued operations would not include major construction or ground disturbing activities. SQN would continue to operate under the existing operational limits and permit requirements; no changes would be necessary to comply with current regulations. Other than the continued normal operations, refueling, and maintenance for an additional 20 years, no significant changes would be needed.

It is noted that if the LRA is approved and the DOE does not take responsibility for storing and/or disposal of spent fuel before additional storage space is needed, the existing ISFSI used for the temporary storage of spent fuel at SQN would require expansion. Expansion of the existing ISFSI is expected to be minor in construction scope and will be evaluated in the subject SEIS.

Alternative 2 – Sequoyah Units 1 and 2 Decommissioning, No Action Alternative

Under the No Action Alternative, TVA would not pursue renewal of the SQN operating licenses. Under the No Action Alternative, Units 1 and 2 would cease to produce power in 2020 and 2021, respectively. TVA would eventually have to shut down and decommission the plant at the end of operations.

Decommissioning decisions and actions would have to be made regardless of the alternative chosen. Decommissioning funding assurance is provided through a decommissioning trust fund that is maintained just for the sole purpose of covering decommissioning-related costs for both units. TVA reports on, and NRC reviews the adequacy of the funds to cover such costs on a periodic basis in accordance with NRC requirements (TVA 2009b). NRC's regulations pertaining to decommissioning funding are found in 10 CFR Part 50.75.

This alternative is subdivided into two sub alternatives, necessitated by the need to replace the power otherwise generated by SQN.

Alternative 2a – New Nuclear Generation

Under Alternative 2a, TVA would construct new nuclear powered generators and associated infrastructure to replace power that would no longer be generated by SQN. TVA would construct and operate an advanced reactor design that has been approved by the NRC.

Construction of a new nuclear power plant at SQN is not considered feasible due to the lack of available land on the current site until decommissioning of Units 1 and 2 is complete. The impacts of constructing a new nuclear power plant at an alternate site would be addressed. New plant construction would likely require the need for new transmission lines, new ISFSI and low level radiological waste storage facilities, and new intake and discharge to the Tennessee River or local water body. It is assumed that the new nuclear power plant will have an initial 40-year license term with the opportunity to renew for an additional 20-year license renewal.

Alternative 2b – New Natural Gas-Fired Generation

Under Alternative 2b, TVA would construct new natural gas-fired generators and associated infrastructure to replace power that would no longer be generated by SQN. Construction of a new gas-fired power plant at SQN is not feasible due to the lack of available land on the current site until decommissioning of Units 1 and 2 is complete. Combined-cycle gas turbine (CCGT) technology would likely be chosen, because the technology is mature, economical, and feasible. The impacts of constructing new CCGT unit(s) at an alternate site would be addressed. New plant construction would likely require the need for new transmission lines, new natural gas pipeline(s), new intake and discharge to the Tennessee River or local water body.

Schedule for SEIS Preparation and Review

The following is a tentative schedule for completion of the SEIS.

Publish Notice of Availability (NOA) of the Draft SEIS in the *Federal Register*	November 2010
Draft SEIS Comment Period (45 days)	November – December 2010
Publish NOA of the Final SEIS in the *Federal Register*	April 2011
Consideration by TVA Board of Directors	June 2011
Issue Record of Decision	August 2011

References

(40 CFR Part 1508.7) Code of Federal Regulations. Title 40. Protection of Environment. Cumulative impact. http://ceq.hss.doe.gov/nepa/regs/ceq/1508.htm#1508.7. Accessed June 28, 2010.

(NRC 1996) Generic Environmental Impact Statement for License Renewal of Nuclear Plants (GEIS)

(TVA 1974) Tennessee Valley Authority. Final Environmental Statement Sequoyah Nuclear Plant Units 1 and 2 (FES). February 13, 1974.

(TVA 1980) Tennessee Valley Authority. Environmental Assessment for Low-Level Radwaste Management, Sequoyah Nuclear Plant.

(TVA 1988) Tennessee Valley Authority. Environmental Assessment and Finding of No Significant Impact - Change in Expiration Dates of Facility Operating License Numbers DPR-77 and DPR-79, Tennessee Valley Authority, Sequoyah Nuclear Plant Units 1 and 2.

(TVA 1995). Tennessee Valley Authority. Energy Vision 2020 Integrated Resource Plan Environmental Impact Statement. December 1995.

(TVA 1999). Environmental Assessment and Finding of No Significant Impact – Low Level Radioactive Waste Transport and Storage Watts Bar and Sequoyah Nuclear Plants.

(TVA 2000a) Tennessee Valley Authority. Abbreviated Environmental Assessment and Finding of No Significant Impact – Replacement of Steam Generators at Sequoyah Nuclear Plant Unit 1.

(TVA 2000b) Tennessee Valley Authority. Environmental Assessment and Finding of No Significant Impact – Independent Spent Fuel Storage Installation Sequoyah Nuclear Plant.

TVA (2001) Tennessee Valley Authority. Environmental Assessment and Finding of No Significant Impact – Leading Edge Flow Measurement System Installation.

(TVA 2002) Tennessee Valley Authority. Environmental Assessment and Finding of No Significant Impact – Independent Spent Fuel Storage Installation, Sequoyah Nuclear Plant, Hamilton County, Tennessee . June 2002.

(TVA 2009) Tennessee Valley Authority. Expected Submittal Dates For Sequoyah Nuclear Plant License Renewal Applications. August 5, 2009.

(TVA 2009a) Tennessee Valley Authority. Sequoyah Nuclear Plant Unit 2 Steam Generator Replacements, Hamilton County, Tennessee. Final Environmental Assessment and Finding of No Significant Impact.

(TVA 2009b) Tennessee Valley Authority. Form 10-K (Annual Report). November 25, 2009.

(TVA 2010a) Tennessee Valley Authority. Single Nuclear Unit at the Bellefonte Plant Site, Jackson County, Alabama. Final Supplemental Environmental Impact Statement. Volumes 1 and 2.

(TVA 2010b) Tennessee Valley Authority. Integrated Resource Plan. TVA’s Environmental & Energy Future Draft. September 2010.

Appendix A – The National Environmental Policy Act and Environmental Impact Statement Process

Authority

Wholly owned by the U.S. Government, TVA was established by Congress in 1933 primarily to foster the social welfare of residents in the Tennessee Valley region and promote the wise use of the region's natural resources.

The subject SEIS evaluation will be performed within the framework of the National Environmental Policy Act (NEPA) 42 USC § 4321 et seq., Council on Environmental Quality (CEQ) regulations for implementing the procedural provisions of NEPA, 40 CFR Parts 1500-1508, and TVA's environmental review procedures.

National Environmental Policy Act

NEPA requires federal agencies to consider the impact of their proposed actions on the environment before making decisions that may result in physical impacts. If an action is expected to have a significant impact on the environment, the agency proposing the action must develop a study for public and agency review. This study is an analysis of the potential impacts to the natural and human environment from the proposed action as well as from a range of reasonable alternatives. This study is called an environmental impact statement (EIS). In making a decision on a proposed major action, the agency must consider the full range of alternatives addressed in the EIS. The CEQ regulations require federal agencies to make environmental review documents, comments, and responses a part of their administrative record.

Environmental Impact Statement Process

After the decision to prepare an EIS is made, the federal agency (TVA) prepares and makes available a notice of intent (NOI) to prepare an EIS. This notice briefly describes the proposed action, reasonable alternatives, and probable environmental issues to be addressed in the EIS. The NOI also describes the scoping process for the particular project, and where and when public scoping meetings will be held. Normally there is a public input period of 30 days from the date of publication of the NOI in the *Federal Register.* TVA has prepared this Scoping Document to summarize the public input and comments from interested agencies received on the proposed action, the alternatives to be evaluated, and environmental and other major issues relevant to the project.

Based in part on the information obtained and decisions made during the project scoping process, a Draft EIS is prepared. The completed Draft EIS is distributed to interested individuals, groups, and federal, state, and local agencies. It is transmitted to the U.S. Environmental Protection Agency (EPA), who publishes a notice of its availability in the *Federal Register*.

The Draft EIS public comment period begins with the publication of the notice of availability by EPA in the *Federal Register* and normally lasts at least 45 days. During this public comment period, the agency may hold public meetings as a forum to obtain comments on the Draft EIS. Notice of public meetings is distributed through appropriate media and direct mailings.

At the close of the Draft EIS public comment period, the agency will respond to the comments received and incorporate any required changes in the Final EIS. The completed Final EIS is sent to those who received the Draft EIS or submitted comments on the Draft EIS. It is also transmitted to EPA who publishes a notice of its availability in the *Federal Register*.

The agency makes the decision on the proposed action no sooner than 30 days after the notice of availability of the Final EIS was published in the *Federal Register*. This decision is based on the anticipated environmental impacts, as documented in the EIS, along with cost, schedule, technological and other considerations. The agency then issues a record of decision (ROD). The ROD normally includes: (1) what the decision was; (2) the rationale for the decision; (3) what alternatives were considered; (4) which alternative was considered environmentally preferable; and (5) any associated mitigation measures and monitoring, and enforcement requirements.

Appendix B – Summary of Scoping Comments

A total of seven comment letters were received concerning this SEIS. The comments are summarized below and will be considered during the preparation of the SEIS:

State of Tennessee Department of Environment and Conservation; Water Supply

> The proposed project will be in the Tennessee American and East Side Utility District's Source Water Protection Area. Notification should be given before any work in the area or in the event of any release to the [Tennessee] river. Subsurface discharges from the facility will need to be registered with the Underground Injection Control program.

Tennessee Wildlife Resources Agency

> Requested a comprehensive report on the use of any and all biocides that may be used at the Sequoyah plant for any purpose, including a summary of all toxicity testing, methodology, test media, and test organisms for the period of 1990 – 2010.

Tennessee Historical Commission, State Historical Preservation Office (SHPO)

> A total of three letters were received from this agency. Based on review of the NOI and the report "*TVA, Cultural Resources Assessment, Sequoyah Nuclear Plant Licensing, Unincorporated, Hamilton County, Tennessee,*" the SHPO concluded that the project area contains no historic properties eligible for listing in the National Register of Historic Places.

United Keetoowah Band of Cherokee Indians in Oklahoma

> No objection to the license renewal.

Seminole Tribe of Florida, Tribal Historic Preservation Office (STOF-THPO)

> No objection to findings at this time. Request that the STOF-THPO be informed if cultural resources that are potentially ancestral or historically relevant to the Seminole Tribe of Florida are inadvertently discovered during construction.

Alabama-Coushatta Tribe of Texas, Tribal Historic Preservation Office

> Concurrence that no known impacts (to) religious, cultural, or historical assets of the Alabama-Coushatta Tribe are anticipated at this time by proposed relicensing of SQN. Requested notification in the event of inadvertent discovery of human remains and/or archaeological artifacts during activities at SQN.

Partnership for Affordable Clean Energy (PACE)

> The scope of the SEIS should include the potential negative environmental and economic impacts of having to replace 2,400 MW of base load generation with other options that may be intermittent.

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APPENDIX C – AGENCY CONSULTATION AND OTHER CORRESPONDENCE

Henry, Amy Burke

From:	Ezzell, Patricia Bernard
Sent:	Tuesday, April 13, 2010 2:33 PM
To:	'rallen@cherokee.org'; 'Tyler B. Howe'; 'Lisa Larue'; Kirk Perry; Julie Ray; 'Elliott York'; 'jenniferpietarila@semtribe.com'; aberryhill@muscogeenation-nsn.gov; 'celestine.bryant@actribe.org'; 'Augustine Asbury'; 'hlharjo@yahoo.com'; 'charles coleman'; 'kkaniatobe@astribe.com'; 'Robin Dushane'; 'Kim Jumper'
Cc:	russtown@nc-cherokee.com; 'Gingy Nail'; 'annemullins@semtribe.com'; 'preservation@muscogeenation-nsn.gov'
Subject:	TVA, PREPARATION OF A SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT (SEIS) FOR SEQUOYAH NUCLEAR PLANT UNITS 1 AND 2 LICENSE RENEWALS
Attachments:	SQN LR NOI Federal Register 9Apr10.pdf

Good Afternoon, Everyone,

I am sending this e-mail to provide notification that the Tennessee Valley Authority (TVA) is preparing the subject SEIS for a decision to pursue renewal of operating licenses at the Sequoyah Nuclear Plant in Soddy-Daisy, Hamilton County, Tennessee.

Renewal of the licenses will allow the plant to continue to operate for an additional 20 years beyond the current licenses that will expire in 2020 (Unit 1) and 2021 (Unit 2). Continued operation of Units 1 and 2, which are each capable of producing approximately 1,200 megawatts of electricity, would help address the need for base load power generation in the TVA power service area, support TVA's policy to take advantage of lower carbon-emitting sources, and make beneficial use of existing assets at the Sequoyah Nuclear Plant site.

A copy of the notice of intent to prepare the SEIS is attached for your information and will be published in the *Federal Register* on April 9, 2010. Additional background information on the SEIS process and schedule are available on the TVA Web site at *http://www.tva.gov/environment/reports/sqn-renewal*.

TVA will be initiating Section 106 consultation regarding the Sequoyah Nuclear Plant Relicensing via a separate letter. As always, should you have any questions, please do not hesitate to contact me.

Sincerely,

Pat

Pat Bernard Ezzell
Native American Liaison and Historian
Tennessee Valley Authority
(865) 632-6461

Tennessee Valley Authority, 400 West Summit Hill Drive, Knoxville, Tennessee 37902-1499

April 13, 2010

Mr. E. Patrick McIntyre, Jr.
Executive Director
Tennessee Historical Commission
2941 Lebanon Road
Nashville, Tennessee 37243-0442

Dear Mr. McIntyre:

TVA CULTURAL RESOURCES SURVEY OF THE SEQOUYAH NUCLEAR PLANT

The Tennessee Valley Authority (TVA) proposes to submit an application to the Nuclear Regulatory Commission requesting renewal of Sequoyah Nuclear Plant (SNP) operating licenses. Renewal of the current operating licenses would permit operation for an additional 20 years past the current (original) 40-year operating license terms which expire in 2020 and 2021 for Units 1 and 2, respectively. Continued operation of the plant under extended licenses would involve refurbishment, operation, and maintenance of existing facilities. License renewal would not involve any new major construction or modifications beyond normal maintenance and minor refurbishment. As part of the operating license renewal process, TVA contracted with TRC to conduct a cultural resources survey. TVA considers the area of potential effect (APE) to be the approximately 594 acres making up the SNP in Hamilton County, Tennessee. The architectural APE consists of a 0.5 mile area surrounding the plant facility.

Prior to initiating fieldwork, TRC conducted a preliminary records search at the Tennessee Division of Archaeology and the Tennessee Historical Commission, located in Nashville, Tennessee. The review identified two archaeological sites, 40HA20 and 40HA22, previously recorded within the APE. Both sites were destroyed during plant construction. A third site, 40HA21, was recorded in an area now completely inundated by Chickamauga Reservoir. Two historic period cemeteries, McGill and Igou, also are recorded within the SNP boundaries. A search of TVA records indicated that during the SNP construction in the late 1960s, burials at the McGill Cemetery were disinterred and moved to McGill Cemetery #2, across the river. TRC also visited the Igou Cemetery and found that its boundaries and marked graves are similar to those represented on the original TVA property acquisition documentation.

Following the preliminary records search, TRC conducted a Phase I cultural resources survey. Please find enclosed the draft report titled *Phase I Cultural Resources Survey, Sequoyah Nuclear Plant, Hamilton County, Tennessee.*

The archaeological resources survey was conducted from February 18 to 26, 2010. Much of the APE had been disturbed from the construction of the SNP constructed starting in 1969. The survey focused on examination of the extensive reservoir shoreline making up much of the property boundary and the limited amount of undeveloped land within the APE. The survey identified one archaeological site, 40HA549, and three isolated finds. TVA recommends these archaeological resources ineligible for the National Register of Historic Place (NRHP). The survey also focused on locating possible remains of two apparent residential complexes in the area, shown on the 1930s TVA property acquisition map. TRC's survey found traces of roads and a light scatter of surface debris. Shovel testing across the area found thin soils and limited artifacts, most dating to the 1930s and later. The recovered material did not warrant recording the area as an archaeological site or, given its recent age, as an isolated find.

The architectural resource survey, also conducted on February 23, 2010, resulted in the identification of two previously unrecorded architectural resources (HS-1 and HS-2). TVA recommends HS-1, a circa 1930s front gable house, ineligible for the NRHP due to lack of historic and architectural distinction. HS-2, Igou Cemetery, was discussed above. TVA recommends HS-2 ineligible for the NRHP due to the inability to derive the cemetery's primary significance from graves of persons of particular transcending importance, lack of distinctive design features, and inability to associate the cemetery with a historic event. TVA plans to avoid the cemetery in accordance with Tennessee laws regarding the treatment of human remains.

TVA has reviewed the enclosed report and agrees with the recommendations of the authors. It is TVA's findings that no historic properties will be affected by this undertaking. Pursuant to 36 CFR Part 800, we are seeking your concurrence with TVA's findings and recommendations.

Should you have any questions or comments, please contact Richard Yarnell at 865/632-3463 or wryarnell@tva.gov.

Sincerely,

A. Eric Howard
Historic Preservation Officer
WT 11D-K

MH:IKS
Enclosures
cc: Kimberly Hodges (EDMS), LP 2V-C

Tennessee Valley Authority, 400 West Summit Hill Drive, Knoxville, Tennessee 37902-1499

April 14, 2010

To Those Listed

TVA, CULTURAL RESOURCES SURVEY OF THE SEQUOYAH NUCLEAR PLANT, HAMILTON COUNTY, TENNESSEE

The Tennessee Valley Authority (TVA) proposes to submit an application to the Nuclear Regulatory Commission requesting renewal of Sequoyah Nuclear Plant (SNP) operating licenses. Renewal of the current operating licenses would permit operation for an additional 20 years past the current (original) 40-year operating license terms which expire in 2020 and 2021 for Units 1 and 2, respectively. Continued operation of the plant under extended licenses would involve refurbishment, operation, and maintenance of existing facilities. License renewal would not involve any new major construction or modifications beyond normal maintenance and minor refurbishment. As part of the operating license renewal process, TVA contracted with TRC to conduct a cultural resources survey. TVA considers the area of potential effect (APE) to be the approximately 594 acres making up the SNP in Hamilton County, Tennessee.

Prior to initiating fieldwork, TRC conducted a preliminary records search at the Tennessee Division of Archaeology and the Tennessee Historical Commission, located in Nashville, Tennessee. The review identified two archaeological sites, 40HA20 and 40HA22, previously recorded within the APE. Both sites were destroyed during plant construction. A third site, 40HA21, was recorded in an area now completely inundated by Chickamauga Reservoir. Two historic period cemeteries, McGill and Igou, also are recorded within the SNP boundaries. A search of TVA records indicated that, during the SNP construction in the late 1960s, burials at the McGill Cemetery were disinterred and moved to McGill Cemetery #2, across the river. TRC also visited the Igou Cemetery and found that its boundaries and marked graves are similar to those represented on the original TVA property acquisition documentation.

Following the preliminary records search, TRC conducted a Phase I cultural resources survey. An online version of the draft report titled *Phase I Cultural Resources Survey, Sequoyah Nuclear Plant, Hamilton County, Tennessee* can be downloaded at trcsolutions.com.

The archaeological resources survey was conducted from February 18 to 26, 2010. Much of the APE had been disturbed from the construction of the SNP constructed starting in 1969. The survey focused on examination of the extensive reservoir shoreline making up much of the property boundary and the limited amount of undeveloped land within the APE. The survey identified one archaeological site, 40HA549, and three isolated finds. TVA recommends these archaeological resources ineligible for the National Register of Historic Place (NRHP). The survey also focused on locating possible remnants of two apparent residential complexes in the area, shown on the 1930s TVA property acquisition map. TRC's survey found traces of roads and a light scatter of surface debris. Shovel testing across the area found thin soils and limited artifacts, most dating to the 1930s and later. The recovered material did not warrant recording the area as an archaeological site or, given its recent age, as an isolated find.

Page 2
April 14, 2010

TVA has reviewed the Phase I report and agrees with the recommendations of the authors. It is TVA's findings that no historic properties will be affected by this undertaking.

TVA is consulting with the following federally recognized Indian tribes regarding properties within the proposed project's APE that may be of religious and cultural significance to them and eligible for the NRHP: Cherokee Nation, Eastern Band of Cherokee Indians, United Keetoowah Band of Cherokee Indians in Oklahoma, The Chickasaw Nation, Seminole Tribe of Florida, Muscogee (Creek) Nation of Oklahoma, Alabama-Coushatta Tribe of Texas, Alabama-Quassarte Tribal Town, Kialegee Tribal Town, Thlopthlocco Tribal Town, Absentee Shawnee Tribe of Oklahoma, Eastern Shawnee Tribe of Oklahoma, and Shawnee Tribe of Oklahoma.

By this letter, TVA is providing notification of these findings and is seeking your comments regarding this undertaking and any properties that may be of religious and cultural significance and may be eligible for the NRHP pursuant to 36CFR § 800.2 (c)(2)(ii), 800.3 (f)(2), and 800.4 (a)(4)(b).

Should you have any questions or would like a printed version of this report, please contact me via phone at 865/632-6461 or via e-mail at pbezzell@tva.gov. Please respond within 30 days of receipt of this letter, if you have any comments on the proposed undertaking.

Sincerely,

Pat Bernard Ezzell

Pat Bernard Ezzell
Native American Liaison and Historian

Enclosure

THOSE LISTED:

Dr. Richard Allen
Policy Analyst
Cherokee Nation
Post Office Box 948
Tahlequah, Oklahoma 74465

Governor Bill Anoatubby
The Chickasaw Nation
Post Office Box 1548
Ada, Oklahoma 72821-1548

Ms. Augustine Asbury
Cultural Preservation Coordinator
Alabama Quassarte Tribal Town
Post Office Box 187
Wetumka, Oklahoma 74883

Second Chief Alfred Berryhill
Muscogee (Creek) Nation
Office of the Principal Chief
Post Office Box 580
Okmulgee, Oklahoma 74447

cc: Ms. Joyce Bear (w/Enclosures)
Historic Preservation Officer
Muscogee (Creek) Nation of Oklahoma
Post Office Box 580
Okmulgee, Oklahoma 74447

Mr. Bryant Celestine
Tribal Historic Preservation Officer
Alabama-Coushatta Tribe of Texas
571 State Park Rd. 56
Livingston, Texas 77351

Mr. Charles Coleman
NAGPRA Representative
Thlopthlocco Tribal Town
Route 1, Box 190-A
Weleetka, Oklahoma 74880

Ms. Robin DuShane
Cultural Preservation Director
Eastern Shawnee Tribe of Oklahoma
127 West Oneida
Seneca, Missouri 64865

Mr. Henry Harjo
Environmental Director
Kialegee Tribal Town
Post Office Box 332
Wetumka, Oklahoma 74883

Mr. Tyler Howe
Historic Preservation Specialist
Eastern Band of the Cherokee Indians
Post Office Box 455
Cherokee, North Carolina 28719

cc: Mr. Russ Townsend
Tribal Historic Preservation Officer
Eastern Band of the Cherokee Indians
Post Office Box 455
Cherokee, North Carolina 28719

Ms. Karen Kaniatobe
Tribal Historic Preservation Officer
Absentee Shawnee Tribe of Oklahoma
2025 S. Gordon Cooper
Shawnee, Oklahoma 74801

Ms. Lisa C. LaRue
Director, Language, History and Culture &
Acting Tribal Historic Preservation Officer
United Keetoowah Band
of Cherokee Indians in Oklahoma
Post Office Box 746
Tahlequah, Oklahoma 74464

Mr. Kirk Perry
Administrator
Division of Policy and Standards
The Chickasaw Nation
Post Office Box 1548
Ada, Oklahoma 72821-1548

Ms. Jennifer Pietarila
Archaeological Data Analyst
Seminole Tribe of Florida
Ah-Tah-Thi-Ki Museum
HC-61 Box 21-A
Clewiston, Florida 33440

cc: Ms. Anne Mullins
Project Coordinator
Seminole Tribe of Florida
Ah-Tah-Thi-Ki Museum
HC-61, Box 21-A
Clewiston, Florida 33440

cc: Mr. Willard Steele
Tribal Historic Preservation Officer
Seminole Tribe of Florida
Ah-Tah-Thi-Ki Museum
HC-61, Box 21-A
Clewiston, Florida 33440

Ms. Julie Ray
Preservation & Repatriation Manager
The Chickasaw Nation
Post Office Box 1548
Ada, Oklahoma 72821-1548

cc: Ms. Virginia (Gingy) Nail (w/Enclosure)
Tribal Historic Preservation Officer
The Chickasaw Nation
Post Office Box 1548
Ada, Oklahoma 72821-1548

Mr. Ron Sparkman
Chairman
Shawnee Tribe
Post Office Box 189
Miami, Oklahoma 74355

cc: Ms. Kim Jumper (w/Enclosures)
Tribal Historic Preservation Officer
Shawnee Tribe
Post Office Box 189
Miami, Oklahoma 74355

Chief Glenna J. Wallace
Eastern Shawnee Tribe of Oklahoma
127 West Oneida
Seneca, Missouri 64865

[This page contains sensitive information relating to access to a restricted database. This page is, therefore, redacted.]

Stringfield, I Kathleen

From: Ezzell, Patricia Bernard
Sent: Monday, April 19, 2010 10:32 AM
To: Stringfield, I Kathleen; Harle, Michaelyn S; Yarnell, W Richard
Subject: FW: TVA, CULTURAL RESOURCES SURVEY OF THE SEQUOYAH NUCLEAR PLANT, HAMILTON COUNTY, TENNESSEE

Comments from UKB

From: Lisa Larue [mailto:llarue@unitedkeetoowahband.org]
Sent: Monday, April 19, 2010 10:30 AM
To: Ezzell, Patricia Bernard
Subject: RE: TVA, CULTURAL RESOURCES SURVEY OF THE SEQUOYAH NUCLEAR PLANT, HAMILTON COUNTY, TENNESSEE

Hi Pat, we have no objection to the relicensing.

Lisa C. LaRue

Director, Language, History and Culture

Acting Tribal Historic Preservation Officer

United Keetoowah Band of Cherokee Indians in Oklahoma

From: Ezzell, Patricia Bernard [mailto:pbezzell@tva.gov]
Sent: Wednesday, April 14, 2010 3:35 PM
To: rallen@cherokee.org; Tyler B. Howe; Lisa Larue; Lisa Larue; Kirk Perry; Julie Ray; Elliott York; jenniferpietarila@semtribe.com; aberryhill@muscogeenation-nsn.gov; celestine.bryant@actribe.org; Augustine Asbury; hlharjo@yahoo.com; charles coleman; kkaniatobe@astribe.com; Robin Dushane; Kim Jumper
Cc: russtown@nc-cherokee.com; Gingy Nail; annemullins@semtribe.com; preservation@muscogeenation-nsn.gov
Subject: TVA, CULTURAL RESOURCES SURVEY OF THE SEQUOYAH NUCLEAR PLANT, HAMILTON COUNTY, TENNESSEE

Good Afternoon,
I have another letter for your review. Attached is a letter regarding TVA's proposal to submit an application to the Nuclear Regulatory Commission requesting renewal of Sequoyah Nuclear Plant's operating licenses. Instructions on accessing the referenced report are on the last page of the attached pdf file.

If you are interested in providing comments on this undertaking, it would be great if I could have those by May 17.

As always, should you have any questions, or if you have trouble accessing the report, please do not hesitate to contact me.

Sincerely,

Pat

Pat Bernard Ezzell
Native American Liaison and Historian

Tennessee Valley Authority
(865) 632-6461

TENNESSEE HISTORICAL COMMISSION
DEPARTMENT OF ENVIRONMENT AND CONSERVATION
2941 LEBANON ROAD
NASHVILLE, TN 37243-0442
(615) 532-1550

April 23, 2010

Mr. A. Eric Howard
Tennessee Valley Authority
400 West Summet Hill Dr.
Knoxville, Tennessee, 37902-1499

RE: TVA, SEQUOYAH LICENSE RENEWAL, UNINCORPORATED, HAMILTON COUNTY

Dear Mr. Howard:

In response to your request, received on Monday, April 19, 2010, we have reviewed the documents you submitted regarding your proposed undertaking. Our review of and comment on your proposed undertaking are among the requirements of Section 106 of the National Historic Preservation Act. This Act requires federal agencies or applicant for federal assistance to consult with t he a ppropriate S tate H istoric P reservation O ffice bef ore t hey c arry o ut their p roposed undertakings. The Advisory Council on Historic Preservation has codified procedures for carrying out Section 106 review in 36 CFR 800. You may wish to familiarize yourself with these procedures (Federal Register, December 12, 2000, pages 77698-77739) if you are unsure about the Section 106 process.

Considering available information, we find that the project as currently proposed MAY AFFECT PROPERTIES THAT ARE ELIGIBLE FOR LISTING IN THE NATIONAL REGISTER OF HISTORIC PLACES. You should continue consultation with our office, designated consulting parties and invite them to participate in consultation, and provide us with appropriate survey documentation for review and comment. Please direct questions and comments to Joe Garrison (615) 532-1550-103. We appreciate your cooperation.

Sincerely,

E. Patrick McIntyre
Executive Director and
State Historic Preservation Officer

EPM/jyg

STATE OF TENNESSEE
DEPARTMENT OF ENVIRONMENT AND CONSERVATION
WATER SUPPLY
9th Floor, 401 Church Street
Nashville, Tennessee 37243-1549
Phone: (615) 532-0191; Fax: (615) 532-0503

April 23, 2010

Ms Amy Henry
NEPA Specialist
Tennessee Valley Authority
400 West summit Hill Drive
Mail Stop WT 11D
Knoxville, Tennessee 37902

RE: Request for Comments, Sequoyah Nuclear Plant (Hamilton County), Tennessee Supplemental Environmental Impact Statement (SEIS)

Ms. Henry:

The Division of Water Supply has received and reviewed the SEIS for the Sequoyah Nuclear Plant Project and would like to thank the Tennessee Valley Authority for the opportunity to comment on this plan.

Source Water Protection Program:

A review of the community and non-community water supplies in the area shows that the proposed project will be in the Tennessee American and East Side Utility District's Source Water Protection Area. This system should be notified before any work in the area or in the event of any release to the river.. Any information on the Source Water/Wellhead Protection areas can be directed to Mr. Scotty D. Sorrells Manager Groundwater Management Section. Mr. Sorrells may be reached by e-mail scotty.sorrells@tn.gov or by telephone at (615) 532-9224.

Underground Injection Control:

A file review was conducted of all the registered Underground injection Control (UIC) points within the area of review. No registered UIC sites are within the proposed area. Please be advised that not all old large capacity septic systems that are in existence are on this database. If this facility utilizes subsurface discharges then these will need to be registered with the UIC program. Any information on the UIC programs can be directed to Ms. Carolyn Sullivan UIC Program Groundwater Management Section. Ms. Sullivan may be reached by e-mail carolyn.sullivan@tn.gov or by telephone at (615) 532-0180.

This letter represents a brief review off best available data sources and not a comprehensive field evaluation. Please verify all information contained within this letter in the field.

The issuance of this letter does not convey any property rights in either real or personal property, or any exclusive privileges, nor does it authorize any injury to private property or any invasion of personal rights, nor any infringement of federal, State, or local laws or regulations.

If you have any questions, feel free to call me at (615) 532-9224 or email at scotty.sorrells@tn.gov.

Sincerely,

Scotty D. Sorrells
Manager Ground Water Management Section
Source Water Protection Coordinator
Division of Water Supply

c: Thomas A. Moss Acting Director DWS
William Hench PE Engineering Section
Lyle Bentley Chief SDP
Luke Ewing Manager WWP
Carolyn Sullivan UIC
David Greif GWMS

Date Rec'd.: 5/3/10
Saved: Sequoyah Nuclear
Sent to: [illegible] MH + PBE
File: ✓

SEMINOLE TRIBE OF FLORIDA
TRIBAL HISTORIC PRESERVATION OFFICE

TRIBAL HISTORIC
PRESERVATION OFFICE

SEMINOLE TRIBE OF FLORIDA
AH-TAH-THI-KI MUSEUM

HC-61, BOX 21A
CLEWISTON, FL 33440

PHONE: (863) 983-6549
FAX: (863) 902-1117

TRIBAL HISTORIC PRESERVATION OFFICE

TRIBAL OFFICERS

CHAIRMAN
MITCHELL CYPRESS
VICE CHAIRMAN
RICHARD BOWERS JR.
SECRETARY
PRISCILLA D. SAYEN
TREASURER
MICHAEL D. TIGER

Pat Bernard Ezzell
Native American Liaison and Historian
Tennessee Valley Authority
400 West Summit Hill Drive
Knoxville, TN 37902-1499

THPO: 005707

April 27, 2010

Subject: Assessment of Effects for the Sequoyah Nuclear Power Plant, Hamilton County, Tennessee

Dear Ms. Ezzell,

The Seminole Tribe of Florida's Tribal Historic Preservation Office (STOF-THPO) has received the TVA's correspondence concerning the aforementioned project. The STOF-THPO has no objection to your findings at this time. However, the STOF-THPO would like to be informed if cultural resources that are potentially ancestral or historically relevant to the Seminole Tribe of Florida are inadvertently discovered during the construction process. We thank you for the opportunity to review the information that has been sent to date regarding this project. Please reference ***THPO-005707*** for any related issues.

We look forward to working with you in the future.

Sincerely,

[signature]

Willard Steele,
Tribal Historic Preservation Officer
Seminole Tribe of Florida

Direct routine inquiries to:

Anne Mullins,
Compliance Review Supervisor
annemullins@semtribe.com

Ah- Tah- Thi- Ki Museum, HC-61, Box 21-A, Clewiston, Florida 33440
Phone (863) 902-1113 ♦ Fax (863) 902-1117

TENNESSEE WILDLIFE RESOURCES AGENCY

ELLINGTON AGRICULTURAL CENTER
P. O. BOX 40747
NASHVILLE, TENNESSEE 37204

April 29, 2010

Amy Henry
Tennessee Valley Authority
400 West Summit Hill Drive
Knoxville, TN 37902-1499

Re: Agency Coordination – Preparation of a Supplemental Environmental Impact Statement (SEIS) for Sequoyah Nuclear Plant Units 1 and 2 License Renewals

Dear Ms. Henry:

We have received and reviewed the information that you sent to us regarding the Tennessee Valley Authority's intent to prepare a Supplemental Environmental Impact Statement (SEIS) for Sequoyah Nuclear Plant Units 1 and 2 license renewals. We request a comprehensive report on the use of any and all biocides that may be used at the Sequoyah plant for any purpose, including a summary of all toxicity testing, methodology, test media, and test organisms for the period of 1990-2010. This report should include a review of all fouling agents of interest, including all biotic and abiotic components.

Thank you for the opportunity to comment on this document.

Sincerely,

Robert M. Todd

Robert M. Todd
Fish and Wildlife Environmentalist
NEPA Coordinator

cc: David McKinney, Chief of Environmental Services Division
Bobby Brown, Region III Habitat Biologist
John Mayer, Region III Assistant Manager

The State of Tennessee

TENNESSEE HISTORICAL COMMISSION
DEPARTMENT OF ENVIRONMENT AND CONSERVATION
2941 LEBANON ROAD
NASHVILLE, TN 37243-0442
(615) 532-1550

May 5, 2010

Mr. A. Eric Howard
Tennessee Valley Authority
400 West Summit Hill Drive
Knoxville, Tennessee 37902-1499

RE: TVA, CULTURAL RESOURCES ASSESSMENT, SEQUOYA NUCLEAR PLANT LICENCING, UNINCORPORATED, HAMILTON COUNTY, TN

Dear Mr. Howard:

At your request, our office has reviewed the above-referenced cultural resources survey report in accordance with regulations codified at 36 CFR 800 (Federal Register, December 12, 2000, 77698-77739). Based on the information provided, we concur that the project area contains no historic properties eligible for listing in the National Register of Historic Places.

If project plans are changed or archaeological remains are discovered during construction, please contact this office to determine what further action, if any, will be necessary to comply with Section 106 of the National Historic Preservation Act.

Your cooperation is appreciated.

Sincerely,

E. Patrick McIntyre, Jr.
Executive Director and
State Historic Preservation Officer

EPM/jmb

Lance Brown
Executive Director
P.O Box 70072
Montgomery, AL 36107
May 10, 2010

Amy B. Henry
NEPA Project Manager
Tennessee Valley Authority
400 West Summit Hill Drive, WT 11D
Knoxville, TN 37902
Fax: 865-632-3451

Re: NOI for Sequoyah Nuclear Plant Units 1 and 2 License Renewals

Thank you for the opportunity to comment on the scope of the supplemental environmental impact statement (SEIS) to evaluate the impacts of renewing operating licenses for Sequoyah Nuclear Plant (SQN) Units 1 and 2.

The Partnership for Affordable Clean Energy (PACE) is a coalition of working people, business owners, consumers, and trade organizations who are fighting for fair, responsible energy policies. Headquartered in Montgomery, Alabama, PACE has affiliates and supporters across the Southeast and beyond. The organization is a 501(c)(4) that educates the public about options for our energy future and advocates for sensible policies that balance environmental stewardship with economic reality.

PACE would like for the agency to ensure that the scope of the SEIS include the potential negative environmental and economic impacts of having to replace 2,400 MW of baseload generation with other options that may be intermittent.

Thank you again for the opportunity to comment on this issue. PACE will be looking forward to reviewing the SEIS after your agency completes the analysis.

Sincerely,

Lance Brown
Executive Director
PACE

ALABAMA-COUSHATTA TRIBE OF TEXAS
571 State Park Rd 56 • Livingston, Texas 77351 • (936) 563-1100

May 19, 2010

Tennessee Valley Authority
Attn: Pat Bernard Ezzell
400 West Summit Hill Drive
Knoxville, TN 37902-1499

Dear Mrs. Ezzell:

On behalf of Mikko Oscola Clayton Sylestine and the Alabama-Coushatta Tribe, our appreciation is expressed on your efforts to consult us regarding the Sequoyah Nuclear Plant (SNP) cultural resources survey report in Hamilton County.

Our Tribe maintains ancestral associations within the state of Tennessee despite the absence of written records to completely identify Tribal activities, villages, trails, or grave sites. However, it is our objective to ensure significances of Native American ancestry including the Alabama-Coushatta Tribe are administered with the utmost regard.

Upon review of your April 14, 2010 submission, we concur with the recommendations set forth by your office. No known impacts religious, cultural, or historical assets of the Alabama-Coushatta Tribe are anticipated at this time by the relicensing of SNP, Units 1 and 2, based upon the findings of the cultural resource report.

Hamilton County remains of vital interest to our Tribe as this area was ancestral homelands to the Coushatta Tribe, prior to settlements by other Indian Nations including the Cherokee and Creek Nations and European inundations. Therefore, in the event of inadvertent discovery of human remains and/or archaeological artifacts, activity in proximity to the location must cease and appropriate authorities, including this office, notified without delay.

Should you require additional assistance, please do not hesitate to contact us.

Respectfully submitted,

Bryant J. Celestine
Historic Preservation Officer

Telephone: 936 – 563 – 1181 celestine.bryant@actribe.org Fax: 936 – 563 – 1183

TENNESSEE HISTORICAL COMMISSION
DEPARTMENT OF ENVIRONMENT AND CONSERVATION
2941 LEBANON ROAD
NASHVILLE, TN 37243-0442
(615) 532-1550

May 20, 2010

Mr. A. Eric Howard
Tennessee Valley Authority
400 West Summet Hill Dr.
Knoxville, Tennessee, 37902-1499

RE: TVA, CULTURAL RESOURCES SURVEY REPORT, SEQUPYAH NUCLEAR PLANT, UNINCORPORATED, HAMILTON COUNTY

Dear Mr. Howard:

Pursuant to your request, received on Friday, May 14, 2010, this office has reviewed documentation concerning the above-referenced undertaking. This review is a requirement of Section 106 of the National Historic Preservation Act for compliance by the participating federal agency or applicant for federal assistance. Procedures for implementing Section 106 of the Act are codified at 36 CFR 800 (Federal Register, December 12, 2000, 77698-77739)

Considering the information provided, we find that the area of potential effects for this undertaking contains no historic properties eligible for listing in the National Register of Historic Places. You should notify interested persons and make the documentation associated with this finding available to the public.

If your agency proposes any modifications in current project plans or discovers any archaeological remains during the ground disturbance or construction phase, please contact this office to determine what further action, if any, will be necessary to comply with Section 106 of the National Historic Preservation Act.

This office appreciates your cooperation.

E. Patrick McIntyre
Executive Director and
State Historic Preservation Officer

EPM/jyg

APPENDIX D – RESPONSES TO AGENCY AND PUBLIC COMMENTS

Table of Contents

RESPONSES TO AGENCY AND PUBLIC COMMENTS

The draft supplemental environmental impact statement (DSEIS) was available for public review and comment from November 5, 2010, through December 22, 2010. The document was transmitted to state, federal, and local agencies and federally recognized tribes. It was also available on TVA's website for review. In addition, TVA held a public open house at the SQN Training Center in Soddy-Daisy, Tennessee, on December 2, 2010, where the public had the opportunity to ask questions about the DSEIS and submit comments. This appendix provides TVA's responses to agency and public comments on the DSEIS.

Nine agencies and individuals commented on the DSEIS via mail, email, TVA's web-based comment system, and verbal statements during the 45-day public comment period. TVA received letters from three state and federal agencies. TVA's responses to each agency's comments on the DSEIS follow each agency's letter. Each comment is preceded by a unique identifier that also appears on the copy of the agency's letter. Similar comments expressing a single idea are grouped and addressed with a single response. The order of appearance of these comments is not related to importance. Six individuals provided comments, and the name of an individual may appear in more than one comment, if that individual commented on more than one issue. The actual letters, e-mails, facsimiles, and transcripts of verbal statements have been included in the administrative record.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
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ATLANTA, GEORGIA 30303-8960

December 10, 2010

Ms. Amy Henry
TVA NEPA Compliance
Tennessee Valley Authority
400 West Summit Hill Drive, WT 11D
Knoxville, TN 37902

Subject: EPA NEPA Review Comments on TVA's DSEIS for "Sequoyah Nuclear Plant Units 1 and 2 License Renewal"; Hamilton County, TN; CEQ #20100432; ERP #TVA-A06008-TN

Dear Ms. Henry:

The U.S. Environmental Protection Agency (EPA) has reviewed the subject Tennessee Valley Authority (TVA) Draft Supplemental Environmental Impact Statement (DSEIS) in accordance with our responsibilities under Section 102(2)(C) of the National Environmental Policy Act (NEPA) and Section 309 of the Clean Air Act. In this DSEIS, TVA proposes to renew the operating licenses for Units 1 and 2 of the 2,400-MW Sequoyah Nuclear Plant (SQN) situated on Chickamauga Reservoir in Hamilton County, Tennessee, near the city of Soddy-Daisy. The DSEIS supplements the original 1974 TVA Final EIS (FEIS) for the construction of SQN Units 1 and 2.[1]

We appreciate that TVA visited our Atlanta offices to introduce this proposed license renewal project to us on November 18, 2010. Some observations EPA made at this meeting are incorporated in this letter. In a related matter, by letter dated November 8, 2010, EPA has also recently provided NEPA comments on TVA's Integrated Resource Plan (IRP) Draft EIS (DEIS) for generating electricity over the next 20 years. The IRP incorporates SQN as part of TVA's baseline capacity.

Background

The current 40-year terms for the SQN operating licenses will expire on September 17, 2020 for Unit 1 and on September 15, 2021 for Unit 2. If TVA decides to apply for operating license extensions to the Nuclear Regulatory Commission (NRC) to continue operating Units 1 and 2 for an additional 20 years, NRC NEPA documentation on relicensing will also be needed in addition to the current TVA NEPA document. The purpose of the present TVA supplement is to disclose the environmental impacts of the proposed SQN action and its alternatives to the public and the TVA Board of Directors (Board), and to potentially serve as a baseline for NRC's NEPA documentation should the TVA Board decide to go forward with the license renewal.

[1] We appreciate that not only the current but also the original document are available online as reference.

Alternatives

For a relicensing project, reasonable and feasible alternatives outside continuing the original project – although perhaps in an improved manner – are somewhat limited if the existing facility is still competent and operation can be safely and effectively
657AM continued. Although EPA defers to TVA and NRC regarding the safe operational life expectancy of Units 1 and 2 at SQN, decommissioning may only be necessary if there is a concern regarding safety, outdated reactor and other technology issues, or chronic operational problems at SQN.

In addition to renewing the licenses for SQN Unit 1 and 2 (Alternative 1) or to allow existing licenses to lapse and decommissioning these units (No Action: Alternative 2), the DSEIS offers alternatives for capacity replacement (in lieu of renewals) by new nuclear generation (Alt. 2a) or by new natural gas generation (Alt. 2b). 657AN
Regarding these alternatives, we suggest that new nuclear generation[2] could have the advantage of assuming a more updated reactor design with passive safety features, while new natural gas generation[3] can be expected to produce more emissions than nuclear fuel but less than combusting other fossil fuels. Overall, development of new greenfield or brownfield sites for new nuclear or gas-fired units would have construction environmental impacts, whereas license renewals of the existing SQN units would have no or minimal (expansion or new spent fuel storage building by 2026) construction impacts.

TVA has identified (pg. S-4) Alternative 1 (license renewal) as its action and preferred alternative in the DSEIS.[4] To renew the two licenses appears reasonable unless there is a concern regarding safety, outdated reactor and other technology issues, or chronic operational problems at the existing SQN facility. However, if relicensing for another 20 years is pursued, we recommend that the FSEIS discuss means for improving
657AO the safety, operation, and environmental compliance/monitoring for SQN Units 1 and 2. While there may essentially not be new construction impacts (e.g., to wetlands) associated with the proposed renewal, improvements to ongoing operational protocols at SQN could conceivably result in a reduction of operational environmental impacts over the next 20-year timeframe. While we understand upgrading is an ongoing (annual) process, the proposed license renewal offers an excellent opportunity for TVA to reassess any existing impacts and mitigating them procedurally and structurally (technology components), where appropriate.

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[2] Such as the AP1000 technology being explored for potential use at the Bellefonte nuclear site (BLN) in Alabama. 657AN

[3] Such as recently evaluated at the John Sevier Fossil Plant (JSF) in Tennessee.

[4] EPA appreciates that TVA identified a preferred alternative in the DSEIS as opposed to waiting until
657AO the Final SEIS (FSEIS), since public comments can already be provided on this draft preference at the DSEIS stage.

Environmental Impacts

We offer the following summary comments on the project impacts, with more specific comments provided in the enclosed *Detailed Comments*.

* *Climate Change*: We appreciate TVA's discussion of climate change and GHGs in the DSEIS. As TVA is aware, the Council on Environmental Quality (CEQ) issued draft guidance for public comment on when and how federal agencies must consider GHG 657AW emissions and climate change in their proposed action. While this guidance is not yet final (and thus, not required), EPA recommends that the FSEIS explicitly reference the draft guidance, describe the elements of the draft guidance, and to the relevant extent, provide the assessments suggested by the guidance. We furthermore recommend a discussion of best management practices (BMPs) to reduce greenhouse gases (GHGs) and other air emissions during construction (e.g., at the proposed expanded or new waste storage area) 657BC and operation of the facility (operation of facility buildings, equipment, and vehicles). Finally, we recommend that TVA's NEPA documents related to the various TVA nuclear plants pursue and present a consistent set of information comparing and 657BD contrasting nuclear energy with other energy technologies with regard to lifecycle GHG emissions. Such a consistent presentation should evaluate and make use of all the relevant literature on this subject.

* *Air Quality*: The DSEIS suggests that other than changes to the onsite spent fuel storage and independent spent fuel storage instillation (ISFSI), no major component 657AX updates or refurbishing will be needed to extend the SQN for the 20-year renewal period. If so, we recommend that the FSEIS include a general but more definitive statement (e.g., in the abstract, summary and/or introduction) indicating that TVA believes that no substantive updates or refurbishing is needed for the proposed license renewal. Beyond this general statement, EPA requests that the FSEIS include additional information on climatological and meteorological data, the new SO_2 and NO_2 National Ambient Air Quality Standards (NAAQS), Prevention of Significant Deterioration (PSD) Class II increments, fine particulates (PM2.5) with PM10, potential Hazardous Air 657AP Pollutants (HAPs) from SQN, and fuel oil power generation with Alternative 2b. These and other informational requests are more specifically discussed in the enclosed *Detailed Comments*.

* *Environmental Justice (EJ)*: EPA appreciates – and finds it consistent with Executive Order (EO) 12898 and NEPA perspective – that EJ was considered in the DSEIS. However, results show that SQN apparently is located in a county (Hamilton) that shows 657AQ a higher minority percentage (23.7%) than the State of Tennessee (19.8%), and is also the county with the highest minority percentage in the state. The FSEIS should determine what the percentage level is for the specific block group (BG) incorporating SQN to determine if it is greater or lesser than the county average. It would also be helpful to 657AR include a map depicting the population demographics for the minority clusters that were reported to exist near the SQN facility.

657AS EPA also recommends that any existing EJ impacts – which may have occurred or are ongoing during the 40-year life of the present project licensing – be described in the FSEIS and offset as part of the prospective relicensing. Moreover, even if no existing EJ impacts exist, the proposed renewal offers an opportunity for TVA to outreach with minorities, low-income populations and other demographics living near SQN.

657AT * _Fisheries_: TVA proposes continued use of the existing open-cycle cooling water system at SQN (with helper mode operation using the cooling towers as needed) as opposed to a closed system.[5] However, EPA is concerned that the use of an open system for power plant cooling – which constantly requires new in-take water – would entrain 657AU considerably more fish eggs and larvae (and other plankton) into the system when compared to a closed or helper mode system. The FSEIS therefore should summarize TVA's entrainment and impingement studies or estimates that reportedly show that some 90% of the entrained fish eggs and larvae are American shad. Moreover, the FSEIS should discuss if the U.S. Fish and Wildlife Service (FWS) and their state counterparts concur with TVA's study conclusions. If not, we recommend additional studies designed 657AV or approved by these agencies or consideration of using a closed-cycle system, or at least using the helper mode during spawning or other critical fishery periods. Additionally, an open system would presumably have a greater and steady thermal discharge – even if controlled by the limits of the National Pollutant Discharge Elimination System (NPDES) permit – than the occasional thermal discharge of a closed system which could also have a fisheries impact. Overall, EPA will defer to the FWS and state agencies regarding these fishery-effects and their minimization.

Summary

TVA has identified renewing the operating licenses of SQN Units 1 and 2 as its action and preferred alternative in the DSEIS. Offered alternatives to license renewal are to decommission these units (No Action) or to replace the existing SQN baseload capacity with new TVA nuclear or natural gas units. Environmentally, the decommissioning and license renewal options would offer the least environmental impact, since replacing decommissioned capacity would involve development of a new greenfield or brownfield site with its associated impacts. However, for license renewals, EPA gives deference to TVA and NRC regarding the overall risk of extending the operational life expectancy of Units 1 and 2 at SQN consistent with the operational and safety perspectives of more current designs.

For the FSEIS, EPA has requested additional information on air quality, EJ and fisheries issues, and has provided some recommendations for power plant climate change analyses. As the DSEIS appears to suggest, we recommend that the FSEIS include a 657BE general but more definitive statement indicating that TVA believes that no substantive updates or refurbishing (other than the ISFSI facility) is needed for the proposed license renewal. Moreover, even if no refurbishing may be needed, we recommend that the FSEIS discuss potential ways to improve the existing safety, operation, and 657BF

657AT [5] The FSEIS should further discuss why TVA apparently prefers an open system at SQN from a water consumption, evaporative loss, energy use, thermal discharge, fisheries, NPDES or other perspective.

environmental compliance/monitoring at SQN Units 1 and 2 for the next 20 years beyond the ongoing annual monitoring and upgrades, since the proposed relicensing offers an excellent opportunity to do so. 657BF

EPA DSEIS Rating

We rate this DEIS as an "EC-2" (i.e., Environmental Concern, additional information requested). That is, we have environmental concerns with extending the operational life of this existing facility and are requesting additional information on how this can be achieved in a manner most productive of the environment.

EPA appreciates the opportunity to review this DSEIS. Should you have questions regarding our comments, please contact Chris Hoberg of my staff at 404/562-9619 or hoberg.chris@epa.gov.

Sincerely,

Mueller

Heinz J. Mueller, Chief
NEPA Program Office
Office of Policy and Management

Enclosure: *Detailed Comments*

DETAILED COMMENTS

EPA offers the following specific comments on the DSEIS for TVA's consideration in the development of their FSEIS:

Climate Change

* CEQ Draft Guidance on GHG Analysis within NEPA – We appreciate TVA's discussion of climate change and GHGs in the DSEIS. The DSEIS indicates that the majority of the potential carbon dioxide (CO_2) emissions of the proposed relicensing of SQN would be the lifecycle contributions associated with the uranium fuel cycle (Section 3.16.1.2). The DSEIS notes that such emissions primarily result from energy needed to manufacture the nuclear fuel.

On February 18, 2010, the Council on Environmental Quality (CEQ) proposed four steps to modernize and reinvigorate NEPA. In particular, CEQ issued draft guidance for public comment on, among other issues, when and how federal agencies must consider greenhouse gas emissions and climate change in their proposed action.[6] The draft guidance explains how federal agencies should analyze the environmental impacts of GHG emissions and climate change when they describe the environmental impacts of a proposed action under NEPA. It provides practical tools for agency reporting, including a presumptive threshold of 25,000 metric tons of carbon dioxide equivalent (CO2e) emissions from the proposed action to trigger a quantitative analysis, and instructs federal agencies how to assess the effects of climate change on the proposed action and their design. The draft guidance does not apply to land and resource management actions and does not propose to regulate GHGs.

657A While this guidance is not yet final (and thus, not required), we recommend that the FSEIS explicitly reference the draft guidance, describe the elements of the draft guidance, and to the relevant extent, provide the assessments suggested by the guidance (we acknowledge that the DSEIS provides some of this information; however, we recommend addressing all relevant aspects of the draft CEQ guidance with explicit reference to the Draft CEQ guidance document). Based on your analysis using the draft CEQ guidance, further data collection may be necessary in the future.

EPA also recommends a discussion of BMPs to reduce GHGs and other air emissions during construction (e.g., at the new waste storage area) and operation of the facility (operation of facility buildings, equipment and vehicles). For example, clean energy options such as energy efficiency and renewable energy should be a consideration in the use of construction and maintenance equipment and vehicles. Equipment and vehicles that use conventional petroleum (e.g., diesel) should incorporate clean technologies and fuels to reduce emissions of GHGs and other pollutants, and should adhere to anti-idling policies to the extent possible. Alternate fuel vehicles (e.g., natural gas, electric) are also possibilities. 657B

657A [6] See: http://www.whitehouse.gov/administration/eop/ceq/initiatives/nepa.

* Lifecycle CO_2 Emissions (Sec. 3.16.1.2) – The discussion in Section 3.16.1.2 provides a comparison of CO_2 emissions from different types of energy production approaches. The analysis relies on information from the Department of Energy and the World Nuclear Association. Of particular interest is the value cited for indirect emissions of CO_2 associated with nuclear lifecycle emissions (i.e., 21 max to 9 min grams CO_2/kWh). A recent review by Sovacool[7] of the lifecycle GHG emissions of various energy production technologies reports, for example, a range of 1.4 to 288 g CO_2e/kWh lifecycle emissions for nuclear power, with a mean value of 66 gCO_2/kWh. The range reported in Sovocool is substantially wider and the mean substantially higher than reported in this DSEIS (note that the Sovocool paper is cited in TVA's recent draft Integrated Resource Plan dated September 2010, but not in this DSEIS).

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Sovocool also points out that "...lifecycle analyses for 15 separate distributed generation and renewable energy technologies...found that all but one, solar photovoltaics (PV), emitted much less gCO_2e/kWh than the mean reported for nuclear plants." In contrast, this DSEIS implies that nuclear has lower lifecycle emissions than an array of renewable energy resources (see Table 3-25 of the DSEIS).

We recommend that TVA's NEPA documents related to the various TVA nuclear plants pursue and present a consistent set of information comparing and contrasting nuclear energy with other energy technologies with regard to lifecycle GHG emissions. Such a consistent presentation should evaluate and make use of all the relevant literature on this subject.

* Editorial Comment (Section 3.16.1.2, first paragraph) – We recommend the sentence be modified to read "Climate change refers to any significant change in measures of climate (such as temperature, precipitation, or wind) lasting for an extended period (decades or longer)." 657D

Air Quality

* Stand-Alone SEIS: This document is reported to be a supplement to the 1974 Final Environmental Statement Sequoyah Nuclear Plant Units 1 and 2 (TVA 1974). The DSEIS refers to many other documents as can be seen in the list of references provided at the end of each section. Because the underlying basis for most of the information provided in this supplement are contained in these documents, a complete comprehensive review would have to include the information contained in these documents. The need for the underlying information and analyses is most noticed in the *Affected Environment* and *Environmental Consequences* section (Section 3) of this DSEIS. Therefore, it is suggested that all pertinent information and backup analyses needed to understand and evaluate the provided consequences of the proposed license renewal be included in the FSEIS to the extent feasible. 657E

657C [7] Sovacool, BK. Valuing the Greenhouse Gas Emissions for Nuclear Power: A Critical Survey. Energy Policy 36 (2008) 2940 - 2953.

657F * Electronic References: If a complete stand-alone SEIS can not be developed for this project, the FSEIS should provided the specific document, section, and page where referenced documentation and analyses can be obtained to support the information provided. If appropriate, the specific NRC docket web location should be provided. One option would be to make the supporting reference documents available in electronic format on the TVA website where the DSEIS is currently posted (http://www.tva.com/environment/reports/sqn-renewal/index.htm).

657G * Table S-1 Summary of the Environmental Impacts of the Action and No Action Alternatives (pg. S-13): It is suggested that the negative/positive impacts to socio-economic conditions (e.g., employment, schools, taxes, etc.) to the Sequoyah Nuclear Plant (SQN) area be considered in Alternatives 2a and 2b in this table.

657H * Section 2.1.1.2. Fossil Fuel Energy Sources (pg. 2-4) and Section 2.1.3. Combination of Alternative Sources (pg. 2-13): Only electrical generation using coal and natural gas were considered as reasonable alternatives to the renewal license of SQN. Higher emissions of NO_x, CO_2 and other pollutants were given as the reason fuel-oil-fired power generation was not considered. The basis for this statement (e.g., table providing representative emission rates for these pollutants by type of fuel) was not provided. It is expected that fuel oil power generation would produce emissions that would be less than or equal to those produced by coal. The basis for eliminating fuel oil as an alternative should be provided in the SEIS or this fossil fuel should be considered as an alternative.

657I * Section 2.2.1 Alternate 1 – SQN Units 1 and 2 License Renewal, Action Alternative (pg. 2-14): The preferred alternative of SQN license renewal does not address the possible need for facility component updates and/or refurbishing to extend plant operation for 20 more years. Any needed updates/refurbishing should be identified and their associated environmental consequences and permits/approvals should be addressed in the FSEIS. The DSEIS appears to suggest that other than changes to the onsite spent fuel storage and independent spent fuel storage instillation (ISFSI), no major component updates or refurbishing will be needed to extend the SQN for the 20-year renewal period. If so, we recommend that the FSEIS include a general but more definitive statement indicating that TVA believes that no substantive updates/refurbishing is needed for the proposed license renewal.

657J * Section 3.16. Climatology, Meteorology, and Air Quality (pg. 3-129) – The discussion and information provided in this section rely heavily on the analyses and information in the recent (2008) Sequoyah Nuclear Plant Updated Final Safety Analysis Report (FSAR). As noted above, it is suggested that all pertinent information and backup analyses needed to understand, compare, and evaluate the discussions and conclusions on the proposed license renewal and alternates, be included in the FSEIS.

* Section 3.16.1.1 Regional Climatology (pg. 3-129) – The following comments are associated with the information provided in this section:

657K - *Supplemental Climatologic Data*: The discussion of regional climatology and changes since the initial 1974 FEIS is all text. The text discussion should be supplemented with tables and figures that provide applicable wind roses, frequency distributions, comparisons etc. that would provide the underlying basis for the information provided. The tables and figures will also allow comparisons with previous observations and long-term records, and promote better understanding of the information and conclusions presented.

- *Fuel Oil CO_2 Production*: For consistency and completeness, Table 3-25 should include CO_2 production from fuel oil electric source. 657L

* Section 3.16.1.3 Local Meteorology (pg. 3-133) – The following comments are associated with the information provided in this section:

657M - *Meteorological Data*: The goal of this section is to demonstrate that the initial meteorological conditions of the plant site, and engineering plant features based on these conditions, have not changed and will be appropriate for the 20-year renewal period. The addition of summary tables and figures of onsite meteorological records of comparable lengths obtained during the initial 1970s and current 2000s would be valuable for this demonstration.

- *Atmospheric Temperature*: All the important meteorological parameters for this comparison were identified except atmospheric temperature. 657N

657O - *Supplemental Meteorological Data*: Similar to the previous section on *Regional Climatology*, this discussion should be supplemented with tables and figures that provide applicable wind roses, frequency distributions, comparisons, etc. that would provide the reader with a better understanding of the current meteorological conditions. The tables and figures will also allow comparisons with previous observations and long-term records, and a basis for the evaluation of subsequent dispersion and transport analyses. It is difficult to obtain this understanding from the provided text discussion.

- *Atmospheric Stability Data*: The provided table of atmospheric stability data is only associated with the most recent meteorological measurements (i.e., 2000-2009). These data should be compared to stabilities obtained from initial SQN measurements in the 1970s. Stability class frequency distributions should be used to show agreement and differences between meteorological data records. The data record comparisons of joint frequency distributions of stability, wind direction, and wind speed would be valuable. 657P

657Q - *Supplemental Dispersion Data*: As discussed in previous sections, the *Dispersion* section (pg. 3-137) discussion should be supplemented with tables and figures that would provide the reader with a better understanding of the initial and current dispersion and transport conditions at SQN.

- *Editorial Modifications*: On page 3-137, we suggest: (1) replacing "dilution" in the first sentence of this section with "dispersion" and (2) low atmospheric dispersion and low X/Q values are opposites so the last sentence of the first paragraph should read "Low or small X/Q values…". 657AY

657R - *Routine/Accident Release Records*: The routine release and accident release sections do not compare X/Q calculated values developed using initial plant meteorology with that using the most current onsite record. Only values from the Sequoyah Nuclear Plant Offsite Dose Calculation Manual (ODCM) are provided which are based on 1985-95 meteorological measurements.

657S * Section 3.16.2 Environmental Consequences – Climatology and Meteorology (pg. 3-140) – This section just discusses the consequences of the various alternatives on GHG production and the potential impact of climate change on the operation of SQN and other alternatives during the renewal period. It is suggested that the changes that were noted in the onsite meteorological observations since the 1970s could be used to represent what could be expected during the renewal period.

* Section 3.16.3 Affected Environment – Air Quality (pg. 3-142) – The following comments are associated with the information provided in this section:

657T - *New SO_2 and NO_2 NAAQS*: In addition to new and more restrictive ozone and particulate NAAQS, EPA has promulgated new SO_2 and NO_2 NAAQS in 2010. Since the facility has emissions of NO_x and SO_x, it is recommended that this section be revised to include a brief discussion of the new revised SO_2 and NO_2 NAAQS. These ambient air quality standards will have to be considered for all alternatives. These new NAAQS will be more of a permit challenge for new facilities (i.e., Alternatives 2a and 2b). The new restrictive NAAQS may be most challenging for the fossil fuel Alternative 2b.

- *PSD Class II Increments*: The permitting consequences of the PSD Class I area increments were discussed but not PSD Class II increments applicable for areas in proximity to the plants. PSD Class II increments have been promulgated for PM2.5 and it is anticipated that they will be promulgated for the new SO_2 and NO_2 NAAQS. 657U

657V - *PM10/PM2.5*: PM10 is identified as a pollutant of concern throughout this section. Fine particulates (PM2.5) should be included when citing PM10.

- *Fugitive Emissions*: The discussion of fugitive particulate emissions indicates there are no sensitive receptors adversely affected by temporary generated fugitive dust and equipment exhaust. Because people and animals would qualify as such a receptor, it is suggested that this comment be modified or deleted. 657W

657X - *HAPs*: This section briefly discusses the emissions of criteria air pollutants from the facility and indicates that the plant is classified as a minor source subject to the permitting requirements of the Chattanooga/Hamilton County Air Pollution Control Bureau. However, the DSEIS does not address the potential for HAP emissions from the facility. The Sequoyah Plant is listed in EPA's 2009 Toxic Release Inventory (TRI) database as having air emissions of hydrazine and lead. The emissions of these and any other HAPs should be discussed in the DSEIS.

* Section 3.16.4 Environmental Consequences – Air Quality (pg. 3-146) – The following comments are associated with the information provided in this section:

657Y - *Natural-Gas-Fired Turbine Impacts*: The statement that the air emissions from a modern natural gas-fired turbine would be small enough that they would operate with a minor impact to air quality should be verified. We note that these facilities would have significant impacts considering the new, more restrictive PM2.5 and NO_2 NAAQS and PSD increments.

- *Alternative 2b Impacts*: The representative emissions provided in Table 3-29 for the combined-cycle operation of Alternative 2b reveals major SOx, NOx, CO, PM, and VOC emissions (note: PM2.5 emissions are not provided). It appears that "minor" would not be the appropriate classification for ambient impacts from operation of Alternative 2b natural gas-fired plants. 657Z

Environmental Justice (EJ)

657AA * Scoping – We are pleased to note that the *Socioeconomics* section (3.13) includes EJ information, which was a scoping issue (pg. 1-28). This information is found in section 3.13.3 (*Low-Income and Minority Populations*). For clarity and easier reference, this section could have been entitled *Environmental Justice*.

657AB * Executive Order (EO) 12898 – Page 3-100 states that "...TVA is not subject to this executive order..." The scope of the EO applies to any federal agency on the Working Group, and such other agencies as may be designated by the President, that conducts any federal program or activity that substantially affects human health or the environment. Independent agencies are requested to comply with the provisions of this EO. Therefore, we believe that independent federal agencies like TVA and EPA are subject to EO 12898. If TVA retains the conclusion that they are not subject to the EO in the FSEIS, EPA requests that TVA's rationale for not considering itself an agency subject to the EO be provided in the text or be footnoted. More substantively, however, we appreciate that some EJ information was nevertheless provided for the SQN location regardless of TVA policy.

657AC * U.S. Census Data – Overall, Hamilton County shows a higher minority percentage (23.7%) than the state of Tennessee (19.8%), which is also the highest county in the state. The county's census categories for Blacks represent the greatest minority population difference when compared to the state average, but Asian and American Indian/Alaskan Natives are also present at higher percentages than the state average. The FSEIS should determine what the percentage level is for the specific block group (BG) incorporating SQN to determine if it is greater or lesser than the county average. We also note that minority clusters exist near the SQN facility. It would be helpful to include a map depicting the population demographics in relationship to the project location (i.e., 1, 3, 6 miles from the facility). 657AD

657AE * EJ Impacts – The DSEIS does not provide adequate baseline information regarding potential for existing EJ issues associated with the facility to make an adequate assessment. For example, the DSEIS indicates that for the license renewal alternative (Alt. 1- page 3-101) the "SQN license renewal would result in no changes in operating employment levels at the plant, and there should be no new impacts to minority and low income populations through this action." While this is encouraging from a license renewal standpoint, it is unclear in the DSEIS what the existing SQN employment levels are like for minority and/or low-income populations or what the existing impacts may be to EJ populations. EPA recommends that any existing EJ impacts – which may have occurred or are ongoing during the 40-year life of the present project licensing – be described in the FSEIS and offset as part of the prospective relicensing.

Moreover, even if no existing EJ impacts exist, the proposed renewal offers an opportunity for TVA to do outreach with minorities, low-income populations and other demographics living near SQN. As a part of the proposed license renewal, we recommend that TVA discuss nuclear power impacts with nearby populations relative to 657AF potential benefits such as job opportunities at SQN or educational possibilities. Periodic dialogue with affected residents regarding the plant should also be provided and the 657AF outcome of that dialogue as well as TVA's public involvement process related to specific EJ outreach efforts. Comments and responses to comments should also be summarized in the FSEIS's EJ section.

Fisheries

Page 1-7 states that "SQN operates in a once-through type cooling, normally called the open mode, for the majority of the year, when the cooling tower lift pumps are bypassed" and "[d]uring certain portions of the year, when thermal limit requirements require it, SQN uses a helper mode cooling tower system." Furthermore, page 1-8 states that "[t]he closed-cycle cooling mode is not currently used but can be utilized if needed." We understand that TVA considers Sequoyah an open mode cooling system that uses a helper mode as needed.

While it is clear that portions of the year do not require operation (or only limited operation) of the cooling towers to liberate reactor heat to the atmosphere, we offer that an open or helper mode operation requires much more intake water than a closed system. This could translate into considerably more plankton mortality (e.g., ichthyoplankton (fish eggs and larvae), mollusc and other larvae, and general zooplankton) being entrained within the cooling water system, as well as fish impingement of juvenile and
657AG adult fish on the intake screens.

Based on our discussions with TVA, it is our understanding that some 90% of the ichthyoplankton entrained at SQN consists of American shad and that the size of various fish populations in Chickamauga Reservoir, which is under TVA regulation, have been consistent and are in good health. The FSEIS should summarize these fish entrainment studies or estimates.[8] Moreover, unless federal (FWS) and state fish and wildlife counterpart agencies provide concurrence with TVA's entrainment conclusions, we recommend consideration of using the closed-cycle system or greater use of the helper mode. A fallback approach would be to avoiding use of an open system (or helper mode) during known spawning periods and/or varying water intake depth locations to water column depths where eggs and larvae are less prevalent. Additionally, an open system would presumably have a greater and steady thermal discharge – even if controlled by the limits of the NPDES permit – than the occasional thermal discharge of a closed system which could also have a fisheries impact. EPA will defer to the expertise of federal and state fishery agencies regarding final conclusions and recommendations on this matter.

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[8] For example: 1) were eggs and larvae enumerated and taxonomically identified or estimated and
657AG extrapolated; 2) was there seasonal variation with entrainment and impingement numbers; 3) were rare species included in this study; 4) was the study conducted at a time when the plant operating conditions were representative of today's operating conditions and predicted future operating conditions?

Other Comments

657AH * Reactor Design – The FSEIS (e.g., Sec 1.1) should identify the reactor technology used at SQN, which would not change for the preferred license renewal alternative (Alt. 1), and compare it to the other reactor design(s) available (e.g., AP1000) if the SQN licenses are not renewed and a new nuclear plant alternative (Alt. 2a) was selected and constructed. We understand that a "Westinghouse design" is currently being used at SQN. The FSEIS should clarify.

657AI Similarly, if the existing SQN facility would be relicensed (Alt. 1) and used for power generation for an additional 20 years, would this facility and spent fuel storage area be comparable in its ability to withstanding extreme weather events (tornados, hurricanes, etc.) and terrorist attacks (airplane crash landings, etc.) compared to a new facility with today's design and standards proposed in Alts. 2a and 2b?

657AJ * Current and Extended Operational Period – Page 1-29 suggests that if the current 40-year licenses are renewed for an additional 20 years each, that SQN would have reached the end of its life expectancy and be decommissioned. The FSEIS should verify if this 60-year term is still considered reasonable by the NRC and within the industry, and the potential for yet another license extension at SQN for any term.

657AK * ISFSI – Additional dry cask storage for spent fuel rods (i.e., an independent spent fuel storage installation: ISFSI) will need to be operational by 2026 at Sequoyah if relicensing is selected (pg. 3-180). We understand that impacts of increasing the size of the onsite storage building via a concrete pad should "have only minor impacts" (pg. 3-81) and "to result in minimal disturbance to the environment" (pg. 2-16). In a 2002 Environmental Assessment/Finding of No Significant Impact (EA/FONSI), TVA concluded that construction and operation of the original storage site showed no significant impacts. Page 2-16 also states that: "Previous environmental assessments screened 13 potential sites to locate the current ISFSI storage pad, and a similar evaluation would be performed to choose the new additional storage pad location."

Because the need for this related action would occur within the proposed relicensing timeframe (construction start-up expected in 2021), we appreciate that this action was included in the present DSEIS, with some discussion of onsite expansion impacts.

657AL We agree that additional NEPA documentation, such as a TVA re-evaluation or a supplemental EA[9], would be needed before 2021 since that storage need is over ten years from now and regulations and policies could change. Moreover, we understand that the NRC re-licensing of this facility is separate from the NRC re-licensing of Unit 1 and 2, so that separate NEPA documentation is appropriate. In contrast, if re-licensing of Units 1 and 2 is not selected by TVA in the present SEIS, there would be no need to expand the existing storage building or construct a new onsite facility since Units 1 and 2 would stop operation before 2026.

657AL [9] EPA requests receipt of a copy of such a NEPA document for review and comment.

657AZ In regard to how much additional storage space is needed and within what timeframe, we note that onsite production of tritium for DOE is an option at SQN. Should this be approved and eventuate, a 71% increase in spent fuel would be generated (pg. 3-186). The FSEIS should discuss this in terms of spent fuel storage and possible schedule changes (i.e., would additional storage space already be needed before the projected October 2026 timeframe and 2021 construction startup?).

657BA * Radiological Tritium Monitoring – Page 3-34 states that "An additional groundwater evaluation is planned to further bound tritium concentrations vertically." EPA requests additional discussion on this study in the FSEIS.

657BB * Plant Decommisioning – We appreciate that various methods to decommission SQN and the associated radiological/environmental impacts were considered in Section 3.20 of the DSEIS.

U.S. Environmental Protection Agency Comments and TVA Responses

657AM. For a relicensing project, reasonable and feasible alternatives outside continuing the original project — although perhaps in an improved manner — are somewhat limited if the existing facility is still competent and operation can be safely and effectively continued. Although EPA defers to TVA and NRC regarding the safe operational life expectancy of Units 1 and 2 at SQN, decommissioning may only be necessary if there is a concern regarding safety, outdated reactor and other technology issues, or chronic operational problems at SQN.

657AJ. Current and Extended Operational Period — Page 1-29 suggests that if the current 40-year licenses are renewed for an additional 20 years each, that SQN would have reached the end of its life expectancy and be decommissioned. The FSEIS should verify if this 60-year term is still considered reasonable by the NRC and within the industry, and the potential for yet another license extension at SQN for any term.

> *Response (657AM and 657AJ).* The Atomic Energy Act of 1954 (as amended) allows the U.S. Nuclear Regulatory Commission (NRC) to issue licenses for commercial power reactors to operate for up to 40 years. The NRC regulations allow for the renewal of these licenses for up to an additional 20 years beyond the initial licensing period, depending on the outcome of an assessment to determine whether the reactor can continue to operate safely and whether the protection of the environment can be ensured during the 20-year period of extended operation. At this time, the law allows only 40 years for the initial licensing period, plus 20 years for license extension.

657AN. In addition to renewing the licenses for SQN Unit 1 and 2 (Alternative 1) or to allow existing licenses to lapse and decommissioning these units (No Action: Alternative 2), the DSEIS offers alternatives for capacity replacement (in lieu of renewals) by new nuclear generation (Alt. 2a) or by new natural gas generation (Alt. 2b).

Regarding these alternatives, we suggest that new nuclear generation[2] could have the advantage of assuming a more updated reactor design with passive safety features, while new natural gas generation[3] can be expected to produce more emissions than nuclear fuel but less than combusting other fossil fuels. Overall, development of new greenfield or brownfield sites for new nuclear or gas-fired units would have construction environmental impacts, whereas license renewals of the existing SQN units would have no or minimal (expansion or new spent fuel storage building by 2026) construction impacts.

[2] Such as the AP1000 technology being explored for potential use at the Bellefonte nuclear site (BLN) in Alabama.
[3] Such as recently evaluated at the John Sevier Fossil Plant (JSF) in Tennessee.

> *Response.* The SEIS examines the alternative actions of (1) renewing SQN Unit 1 and 2 operating licenses or (2) not renewing the licenses, in which case SQN would cease operating at the end of the current license terms, and capacity would be replaced. Alternatives 2a and 2b are provided as examples of capacity replacement that would occur under the No Action Alternative.

The construction of any new facility would involve impacts to the environment. Operation of a new nuclear plant design would have some advantages over SQN design, but the overall impacts of a new nuclear plant would still be more significant than the continued operation of SQN. TVA agrees that operation of a new natural gas plant would add more pollutants to the air than would continued operation of SQN, but less than alternative fossil fuel generation such as coal or oil.

657AO. TVA has identified (pg. S-4) Alternative 1 (license renewal) as its action and preferred alternative in the DSEIS.[4] To renew the two licenses appears reasonable unless there is a concern regarding safety, outdated reactor and other technology issues, or chronic operational problems at the existing SQN facility. However, if relicensing for another 20 years is pursued, we recommend that the FSEIS discuss means for improving the safety, operation, and environmental compliance/monitoring for SQN Units 1 and 2. While there may essentially not be new construction impacts (e.g., to wetlands) associated with the proposed renewal, improvements to ongoing operational protocols at SQN could conceivably result in a reduction of operational environmental impacts over the next 20-year timeframe. While we understand upgrading is an ongoing (annual) process, the proposed license renewal offers an excellent opportunity for TVA to reassess any existing impacts and mitigating them procedurally and structurally (technology components), where appropriate.

[4] EPA appreciates that TVA identified a preferred alternative in the DSEIS as opposed to waiting until the Final SEIS (FSEIS), since public comments can already be provided on this draft preference at the DSEIS stage.

657BF. Moreover, even if no refurbishing may be needed, we recommend that the FSEIS discuss potential ways to improve existing safety, operation, and environmental compliance/monitoring at SQN Units 1 and 2 for the next 20 years beyond ongoing annual monitoring and upgrades, since the proposed relicensing offers an excellent opportunity to do so.

Response (657AO and 657BF). As part of the license extension process, TVA is conducting, for NRC review, a more-detailed safety analysis to ensure that the plant continues meet safety, operation, and environmental safeguards during license renewal period without a significant reduction in a margin of safety. The license renewal program would not require major new construction, alterations, or refurbishment to SQN to maintain consistency with the current licensing basis. TVA has procedures in place and that are revised as needed, for monitoring the environment. Training of personnel in these procedures is an ongoing process. The current programs and procedures are adequate to protect the health and safety of the public and the local environment; however, TVA will continue its efforts to refine procedures as needed. Additionally, see responses to comments 657B, 657BC, and 657AI below, which address TVA's continuing efforts to achieve the highest applicable safety standards and further minimize environmental impacts at TVA facilities, including SQN.

657AW. Climate Change: We appreciate TVA's discussion of climate change and GHGs in the DSEIS. As TVA is aware, the Council on Environmental Quality (CEQ) issued draft guidance for public comment on when and how federal agencies must consider GHG emissions and climate change in their proposed action. While this guidance is not yet final (and thus, not required), EPA recommends that the FSEIS explicitly reference the draft guidance, describe the elements of the draft guidance, and to the relevant extent, provide the assessments suggested by the guidance.

657A. While this guidance (Council on Environmental Quality Draft Guidance on GHG Analysis within NEPA [February 18, 2010]) is not yet final (and thus, not required), we recommend that the FSEIS explicitly reference the draft guidance, describe the elements of the draft guidance, and to the relevant extent, provide the assessments suggested by the guidance (we acknowledge that the DSEIS provides some of this information; however, we recommend addressing all relevant aspects of the draft CEQ guidance with explicit reference to the Draft CEQ guidance document). Based on your analysis using the draft CEQ guidance, further data collection may be necessary in the future.

See: http://www.whitehouse.gov/administration/eop/ceq/initiatives/nepa.

> *Response (657AW and 657A).* A discussion of the new Council on Environmental Quality (CEQ) guidance regarding handling of GHGs and GCC in NEPA documents has been added to FSEIS 3.16.2. Under the referenced CEQ guidance, if a proposed action would be reasonably anticipated to cause direct emissions of 25,000 metric tons or more of CO_2-equivalent GHG emissions on an annual basis, agencies should consider this an indicator that a quantitative and qualitative assessment may be meaningful to decision makers and the public. For long-term actions that have annual direct emissions of less than 25,000 metric tons of CO_2-equivalent, CEQ encourages federal agencies to consider whether the action's long-term emissions should receive similar analysis. CEQ does not propose this as an indicator of a threshold of significant effects, but rather as an indicator of a minimum level of GHG emissions that may warrant some description in the appropriate NEPA analysis for agency actions involving direct emissions of GHGs. SQN does not directly generate 25,000 metric tons of CO_2 equivalent on an annual basis.

657BC. We furthermore recommend a discussion of best management practices (BMPs) to reduce greenhouse gases (GHGs) and other air emissions during construction (e.g., at the proposed expanded or new waste storage area) and operation of the facility (operation of facility buildings, equipment, and vehicles).

657B. EPA also recommends a discussion of BMPs to reduce GHGs and other air emissions during construction (e.g., at the new waste storage area) and operation of the facility (operation of facility buildings, equipment and vehicles). For example, clean energy options such as energy efficiency and renewable energy should be a consideration in the use of construction and maintenance equipment and vehicles. Equipment and vehicles that use conventional petroleum (e.g., diesel) should incorporate clean technologies and fuels to reduce emissions of GHGs and other pollutants, and should adhere to anti-idling policies to the extent possible. Alternate fuel vehicles (e.g., natural gas, electric) are also possibilities.

> *Response (657BC and 657B).* Actively reducing carbon emission through cleaner energy options and energy efficiency initiatives is a central principle in TVA's Environmental Policy[1]. To accomplish the greatest benefit, TVA's primary efforts focus upon reducing GHG emissions from its portfolio of generating plants. As noted in the SEIS, increasing the proportion of energy generated by TVA nuclear plants is one of the primary strategies for reducing GHG emissions, as well as increasing the energy produced from non- or low-emitting sources.

Additionally, in accordance with the requirements of Executive Order 13514, TVA developed a Strategic Sustainability Performance Plan[2] that establishes aggressive goals for reductions of GHG, as well as overall pollution prevention. Among TVA's sustainability initiatives are purchasing energy efficient fleet vehicles, reducing the number of high gas consuming fleet vehicles, and improving the efficiency of fleet vehicle use. TVA is implementing energy-saving improvements in many of its facilities, including SQN. TVA's new building designs incorporate modern energy efficiency technologies. Additionally, TVA is enhancing its sustainable acquisition program (currently, the Green Procurement Plan initiated in 2007) to ensure the purchase of environmentally preferable materials and services. Finally, in the Sustainability Plan, TVA establishes goals for minimizing and diverting municipal solid waste and construction/demolition debris from all facilities and decreasing use of chemicals that increase GHG emissions. These efforts are currently being implemented at SQN and other facilities as opportunities arise.

[1] http://www.tva.com/environment/policy.htm
[2.] http://www.tva.gov/abouttva/TVA_Strategic_Sustainability_ Performance_Plan_2011.pdf

657BD. Finally, we recommend that TVA's NEPA documents related to the various TVA nuclear plants pursue and present a consistent set of information comparing and contrasting nuclear energy with other energy technologies with regard to lifecycle GHG emissions. Such a consistent presentation should evaluate and make use of all the relevant literature on this subject.

657C. Lifecycle CO, Emissions (Sec. 3.16.1.2) — The discussion in Section 3.16.1.2 provides a comparison of CO_2 emissions from different types of energy production approaches. The analysis relies on information from the Department of Energy and the World Nuclear Association. Of particular interest is the value cited for indirect emissions of CO_2 associated with nuclear lifecycle emissions (i.e., 21 max to 9 min grams $C0_2$/kWh). A recent review by Sovacool[7] of the lifecycle GHG emissions of various energy production technologies reports, for example, a range of 1.4 to 288 g C02e/kWh lifecycle emissions for nuclear power, with a mean value of 66 gCO_2/kWh. The range reported in Sovocool [sic] is substantially wider and the mean substantially higher than reported in this DSEIS (note that the Sovocool [sic] paper is cited in TVA's recent draft Integrated Resource Plan dated March 2011, but not in this DSEIS). Sovocool [sic] also points out that "...lifecycle analyses for 15 separate distributed generation and renewable energy technologies ... found that all but one, solar photovoltaics (PV), emitted much less gCO_2e/kWh than the mean reported for nuclear plants." In contrast, this DSEIS implies that nuclear has lower lifecycle emissions than an array of renewable energy resources (see Table 3-25 of the DSEIS).

We recommend that TVA's NEPA documents related to the various TVA nuclear plants pursue and present a consistent set of information comparing and contrasting nuclear energy with other energy technologies with regard to lifecycle GHG emissions. Such a consistent presentation should evaluate and make use of all the relevant literature on this subject.

[7] Sovacool, BK. Valuing the Greenhouse Gas Emissions for Nuclear Power: A Critical Survey. *Energy Policy* 36 (2008) 2940 – 2953.

Response (657BD and 657C). Comment noted. TVA strives to present consistent analysis in its NEPA documents. Reference to and a short discussion of the Sovacool paper have been added to FSEIS 3.16.2.

657AX. Air Quality: The DSEIS suggests that other than changes to the onsite spent fuel storage and independent spent fuel storage instillation (ISFSI), no major component updates or refurbishing will be needed to extend the SQN for the 20-year renewal period. If so, we recommend that the FSEIS include a general but more definitive statement (e.g., in the abstract, summary and/or introduction) indicating that TVA believes that no substantive updates or refurbishing is needed for the proposed license renewal.

657BE. As the DSEIS appears to suggest, we recommend that the FSEIS include a general but more definitive statement indicating that TVA believes that no substantive updates or refurbishing (other than the ISFSI facility) is needed for the proposed license renewal.

657I. Section 2.2.1 Alternate 1 — SON Units 1 and 2 License Renewal, Action Alternative 2-14): The preferred alternative of SQN license renewal does not address the possible need for facility component updates and/or refurbishing to extend plant operation for 20 more years. Any needed updates/refurbishing should be identified and their associated environmental consequences and permits/approvals should be addressed in the FSEIS. The DSEIS appears to suggest that other than changes to the onsite spent fuel storage and independent spent fuel storage instillation (ISFSI), no major component updates or refurbishing will be needed to extend the SQN for the 20-year renewal period.

If so, we recommend that the FSEIS include a general but more definitive statement indicating that TVA believes that no substantive updates/refurbishing is needed for the proposed license renewal.

Response (657AX, 657BE, and 657I). The FSEIS abstract and summary sections have been modified to state that the license renewal program would not require major new construction, alterations, or refurbishment to SQN to maintain consistency with the current licensing basis.

657AP. Beyond this general statement, EPA requests that the FSEIS include additional information on climatological and meteorological data, the new SO2 and NO2 National Ambient Air Quality Standards (NAAQS), Prevention of Significant Deterioration (PSD) Class II increments, fine particulates (PM2.5) with PM10, potential Hazardous Air Pollutants (HAPs) from SQN, and fuel oil power generation with Alternative 2b.

657H. Section 2.1.1.2. Fossil Fuel Energy Sources (pg. 2-4) and Section 2.1.3. Combination of Alternative Sources (pg. 2-13): Only electrical generation using coal and natural gas were considered as reasonable alternatives to the renewal license of SQN. Higher emissions of NOx, CO_2 and other pollutants were given as the reason fuel-oil-fired power generation was not considered. The basis for this statement (e.g., table providing representative emission rates for these pollutants by type of fuel) was not provided. It is expected that fuel oil power generation would produce emissions that would be less than or equal to those produced by coal. The basis for eliminating fuel oil as an alternative should be provided in the SEIS or this fossil fuel should be considered as an alternative.

Response (657AP and 657H). Additional information has been added to FSEIS 3.16 to clarify national air quality standards and potential impacts of the Action and

No Action alternatives. Fuel oil power generation is not evaluated in detail in this SEIS. As described in TVA's Integrated Resource Plan, fuel oil-fired generation is not considered an option in TVA's generation plans for the next 20 years, primarily due to emissions of air pollutants. Table 3-25 provides a comparison of emissions from various fuels used to generate electricity, including #6 fuel oil. Additionally, the cost of fuel oil is between 3.5 and 5 times greater (per unit of energy) than natural gas.

657AQ. Environmental Justice (EJ): EPA appreciates — and finds it consistent with Executive Order (EO) 12898 and NEPA perspective — that EJ was considered in the DSEIS. However, results show that SQN apparently is located in a county (Hamilton) that shows a higher minority percentage (23.7%) than the State of Tennessee (19.8%), and is also the county with the highest minority percentage in the state. The FSEIS should determine what the percentage level is for the specific block group (BG) incorporating SQN to determine if it is greater or lesser than the county average.

657AC. U.S. Census Data — Overall, Hamilton County shows a higher minority percentage (23.7%) than the state of Tennessee (19.8%), which is also the highest county in the state. The county's census categories for Blacks represent the greatest minority population difference when compared to the state average, but Asian and American Indian/Alaskan Natives are also present at higher percentages than the state average. The FSEIS should determine what the percentage level is for the specific block group (BG) incorporating SQN to determine if it is greater or lesser than the county average.

Response (657AQ and 657AC). The Sequoyah 2000 Census SF1 Block Group number ID is 470650103012. Within this block group, none of the minority categories had a higher population percentage than the county or state minority percentages. Additionally, according to the 2000 Census SF1 data, Hamilton County (23.7 percent) had a lower minority percentage (Aggregate Category) than nine other Tennessee counties (Davidson – 33.0 percent, Fayette – 37.5 percent, Hardeman – 42.7 percent, Haywood – 53.3 percent, Lake – 33.4 percent, Lauderdale – 36.2 percent, Madison – 34.9 percent, Montgomery – 26.8 percent, and Shelby – 52.7 percent). Therefore, while Hamilton County does have a higher minority percentage compared to the percentage of minorities within the state's population, it is not the county with the highest minority percentage in the state.

Along with revising the SEIS text, the Sequoyah Block Group minority and low-income percentage levels have been added to Table 3-19 U.S. Census Race Category and Low-Income Populations.

657AR. It would also be helpful to include a map depicting the population demographics for the minority clusters that were reported to exist near the SQN facility.

657AD. We also note that minority clusters exist near the SQN facility. It would be helpful to include a map depicting the population demographics in relationship to the project location (i.e., 1, 3, 6 miles from the facility).

Response (657AR and 657AD). FSEIS 3.13.3.1 has been revised to include a map of census block and block groups of interest near SQN. A new figure (Figure 3-13 Minorities Within 6-Mile Radius of SQN) has been added to FSEIS 3.13.3 and is referenced in FSEIS 3.13.3.1.

657AT. Fisheries: TVA proposes continued use of the existing open-cycle cooling water system at SQN (with helper mode operation using the cooling towers as needed) as opposed to a closed system.[5]

[5] The FSEIS should further discuss why TVA apparently prefers an open system at SQN from a water consumption, evaporative loss, energy use, thermal discharge, fisheries, NPDES or other perspective.

> *Response.* As discussed in the SEIS (FSEIS 3.5.2), impacts to Chickamauga Reservoir fisheries caused by the current cooling regime, are negligible. FSEIS 3.1.2.2 discusses current water use for the plant as compared to the alternative closed-loop system.
>
> Using a closed-cycle system substantially increases water consumption through evaporative loss associated with cooling tower operation. As cooling water is recycled through the cooling system several times, impurities in the water source are concentrated, and although the discharge volume of water is decreased, impurities in the effluent would be concentrated. The thermal plume associated with a once-through regime may decrease if the plant were converted to a closed-cycle regime; however, modeling would be necessary to determine the extent of the chemical plume.
>
> Running the plant in its current design in a closed-mode cooling regime using the single on-site cooling tower for each reactor would require SQN to derate and result in negative economic impacts.

657AG. The FSEIS should summarize these fish entrainment studies or estimates. Moreover, unless federal (FWS) and state fish and wildlife counterpart agencies provide concurrence with TVA's entrainment conclusions, we recommend consideration of using the closed-cycle system or greater use of the helper mode. A fallback approach would be to avoiding use of an open system (or helper mode) during known spawning periods and/or varying water intake depth locations to water column depths where eggs and larvae are less prevalent.

Additionally, an open system would presumably have a greater and steady thermal discharge — even if controlled by the limits of the NPDES permit — than the occasional thermal discharge of a closed system which could also have a fisheries impact. EPA will defer to the expertise of federal and state fishery agencies regarding final conclusions and recommendations on this matter.

657AU. However, EPA is concerned that the use of an open system for power plant cooling — which constantly requires new in-take water — would entrain considerably more fish eggs and larvae (and other plankton) into the system when compared to a closed or helper mode system. The FSEIS therefore should summarize TVA's entrainment and impingement studies or estimates that reportedly show that some 90% of the entrained fish eggs and larvae are American shad.

657AV. Moreover, the FSEIS should discuss if the U.S. Fish and Wildlife Service (FWS) and their state counterparts concur with TVA's study conclusions. If not, we recommend additional studies designed or approved by these agencies or consideration of using a closed-cycle system, or at least using the helper mode during spawning or other critical fishery periods. Additionally, open system would presumably have a greater and steady thermal discharge — even if controlled by the limits of the National Pollutant Discharge

Elimination System (NPDES) permit — than the occasional thermal discharge of a closed system which could also have a fisheries impact. Overall, EPA will defer to the FWS and state agencies regarding these fishery-effects and their minimization.

> *Response (657AG, 657AU, and 657AV).* As stated in FSEIS 3.5.2, based on data collected by TVA, entrainment by SQN does not substantially impact the fish community in Chickamauga Reservoir. TVA regularly coordinates with the U.S. Fish and Wildlife Service (USFWS) and Tennessee Wildlife Resources Agency (TWRA) concerning TVA's power generation operations. In 2010, both agencies were among those given the opportunity to comment on the draft NPDES permit for SQN. Both agencies have examined data TVA has collected to demonstrate no significant impact on fisheries resources in the Chickamauga Reservoir near SQN. Neither the USFWS nor the TWRA has recommended TVA take steps to change water intake and discharge regimes at SQN. The Department of the Interior, of which the USFWS is a part, submitted three comments on the DSEIS (see letter in this appendix), but none expressed concerns about the impacts of SQN operations on aquatic biota via impingement, entrainment, or discharge of heated effluent.

657D. 3.16.1.2, first paragraph. We recommend the sentence be modified to read "Climate change refers to any significant change in measures of climate (such as temperature, precipitation, or wind) lasting for an extended period (decades or longer)."

> *Response.* Comment noted. Changes have been made to FSEIS 3.16.1.2.

657E. Stand-Alone SEIS: This document is reported to be a supplement to the 1974 Final Environmental Statement Sequoyah Nuclear Plant Units 1 and 2 (TVA 1974). The DSEIS refers to many other documents as can be seen in the list of references provided at the end of each section. Because the underlying basis for most of the information provided in this supplement is contained in these documents, a complete comprehensive review would have to include the information contained in these documents. The need for the underlying information and analyses is most noticed in the Affected Environment and Environmental Consequences section (Section 3) of this DSEIS. Therefore, it is suggested that all pertinent information and backup analyses needed to understand and evaluate the provided consequences of the proposed license renewal be included in the FSEIS to the extent feasible.

657F. Electronic References: If a complete stand-alone SEIS cannot be developed for this project, the FSEIS should provided the specific document, section, and page where referenced documentation and analyses can be obtained to support the information provided. If appropriate, the specific NRC docket web location should be provided. One option would be to make the supporting reference documents available in electronic format on the TVA website where the DSEIS is currently posted (http://www.tva.com/environment/reports/sgn-renewal/index.htm).

657J. Section 3.16. Climatology, Meteorology, and Air Quality (pg. 3-129) — The discussion and information provided in this section rely heavily on the analyses and information in the recent (2008) Sequoyah Nuclear Plant Updated Final Safety Analysis Report (FSAR). As noted above, it is suggested that all pertinent information and backup analyses needed to understand, compare, and evaluate the discussions and conclusions on the proposed license renewal and alternates, be included in the FSEIS.

Response (657E, 657F, 657J). Relevant data and information from the SQN UFSAR are incorporated into this FSEIS in most instances. Pertinent portions of the SQN UFSAR that provide supplemental background information and are not considered Sensitive Unclassified Non-Safeguards Information will be posted on a webpage for public review.

657G. Table S-1 Summary of the Environmental Impacts of the Action and No Action Alternatives (pg. S-13): It is suggested that the negative/positive impacts to socio-economic conditions (e.g., employment, schools, taxes, etc.) to the Sequoyah Nuclear Plant (SQN) area be considered in Alternatives 2a and 2b in this table.

Response. FSEIS Table S-1 has been revised to clarify potential socioeconomic impacts near SQN under the No Action Alternative.

657K. Section 3.16.1.1 Regional Climatology (pg. 3-129) — Supplemental Climatologic Data: The discussion of regional climatology and changes since the initial 1974 FEIS is all text. The text discussion should be supplemented with tables and figures that provide applicable wind roses, frequency distributions, comparisons etc. that would provide the underlying basis for the information provided. The tables and figures will also allow comparisons with previous observations and long-term records, and promote better understanding of the information and conclusions presented.

657O. Section 3.16.1.3 Local Meteorology (pg. 3-133) — Supplemental Meteorological Data: Similar to the previous section on Regional Climatology, this discussion should be supplemented with tables and figures that provide applicable wind roses, frequency distributions, comparisons, etc. that would provide the reader with a better understanding of the current meteorological conditions. The tables and figures will also allow comparisons with previous observations and long-term records, and a basis for the evaluation of subsequent dispersion and transport analyses. It is difficult to obtain this understanding from the provided text discussion.

Response (657K and 657O). Appendix F — Meteorological Data Summaries has been added to the FSEIS to include data used in making the comparisons discussed in the text. FSEIS 3.16.1.3 has also been revised.

657L. Section 3.16.1.1 Regional Climatology (pg. 3-129) — Fuel Oil CO_2, Production: For consistency and completeness, Table 3-25 should include CO_2 production from fuel oil electric source.

Response. CO_2 production associated with electricity generation powered by fuel oil is presented in Table 3-25. Indirect emissions from fuel oil generation are similar to natural gas indirect emissions due to the exploration, drilling, pipelines, trucking, and processing of fuel oil prior to direct use in a generation facility.

657M. Section 3.16.1.3 Local Meteorology (pg. 3-133) — Meteorological Data: The goal of this section is to demonstrate that the initial meteorological conditions of the plant site, and engineering plant features based on these conditions, have not changed and will be appropriate for the 20-year renewal period. The addition of summary tables and figures of onsite meteorological records of comparable lengths obtained during the initial 1970s and current 2000s would be valuable for this demonstration.

Response. Meteorological data collected at SQN were reviewed to confirm that meteorological patterns measured in the 1970s are consistent with those measured in the 2000s. Comparison between these decades is explained in the text of FSEIS 3.16.1.3. Meteorological data and figures have been added to the SEIS in Appendix F. However, to ensure clarity of the document, care was taken to minimize presentation of extensive datasets in the text.

657N. Section 3.16.1.3 Local Meteorology (pg. 3-133) — Atmospheric Temperature: All the important meteorological parameters for this comparison were identified except atmospheric temperature.

Response. Atmospheric temperature is discussed in the regional climate change subsection of FSEIS 3.16.1.1 and in the severe weather subsection of FSEIS 3.16.1.3. Additional data and information about atmospheric temperature have been added to FSEIS 3.16.1.3, to describe variation in some measures of atmospheric temperature recorded since the construction of SQN.

At a nuclear facility, the water intake and discharge temperatures and the temperature differences for atmospheric dispersion have the greatest impact on the operation of SQN on a daily basis and are of the greatest interest. Atmospheric temperature is monitored continuously but not used on a daily basis to determine operational impacts on SQN, as is other meteorological information.

The temperature extremes of hottest air temperature occurred in 1952 and coldest air temperature occurred in 1985; therefore, temperature data from a single point like the SQN meteorological tower alone cannot accurately provide trends. Regional data were used in FSEIS 3.16.1.1 to address long-term changes in air temperature.

657P. Section 3.16.1.3 Local Meteorology (pg. 3-133) — Atmospheric Stability Data: The provided table of atmospheric stability data is only associated with the most recent meteorological measurements (i.e., 2000-2009). These data should be compared to stabilities obtained from initial SQN measurements in the 1970s. Stability class frequency distributions should be used to show agreement and differences between meteorological data records. The data record comparisons of joint frequency distributions of stability, wind direction, and wind speed would be valuable.

Response. FSEIS 3.16.1.3 has been revised to clarify that historic atmospheric stability measurements were evaluated as part of the analysis in the SEIS. TVA reviewed the maximum X/Q values calculated since 1972. While the maximum X/Q values vary over the years, the current values are consistent with values from 1972. The SEIS provides a summary of the last 10 years as an indication of relative percentages of stability occurrence.

As an operational nuclear facility, SQN is required to provide annual joint frequency distributions to the NRC. The SQN ODCM uses values consistent with all the calculated values and they are conservative. TVA is confident that values used in the current programs are consistent with original values and that all dose information is accurate and conservative.

657Q. Section 3.16.1.3 Local Meteorology (pg. 3-133) — Supplemental Dispersion Data: As discussed in previous sections, the Dispersion section (pg. 3-137) discussion should be supplemented with tables and figures that would provide the reader with a better understanding of the initial and current dispersion and transport conditions at SQN.

> *Response.* Within the section addressing Dispersion, routine and potential accident release dispersions are explained. Tables 3-27 and 3-28 provide the factors used in calculations of routine and potential accident releases. The initial values of X/Q (the principal factor in dispersion calculations) from the 1970s are not used, because they have been updated over the years. The current values from the period 1986 – 1995 are used to represent the operation of SQN as required by the Offsite Dose Calculation Manual (ODCM). While the current values are consistent with the original values from the 1970s, they have been updated with a larger set of meteorological data (1986 – 1995) whose values are more conservative when used in dose calculations. Meteorological data from the period 1996 – 2010 are not as conservative as the data being used in accordance with the ODCM; therefore, the X/Q values have not been further updated for use in dose calculations. Initial and current dispersion and transport characteristics are similar, and the most conservative values are being used as per the ODCM. Further calculations and technical detail were minimized to improve clarity of the section.

657AY. Section 3.16.1.3 Local Meteorology (pg. 3-133) — Editorial Modifications: On page 3-137, we suggest: (1) replacing "dilution" in the first sentence of this section with "dispersion" and (2) low atmospheric dispersion and low X/Q values are opposites so the last sentence of the first paragraph should read "Low or small X/Q values..."

> *Response.* Comment noted. Changes have been made to FSEIS 3.16.1.3.

657R. Section 3.16.1.3 Local Meteorology (pg. 3-133) — Routine/Accident Release Records: The routine release and accident release sections do not compare X/Q calculated values developed using initial plant meteorology with that using the most current onsite record. Only values from the Sequoyah Nuclear Plant Offsite Dose Calculation Manual (ODCM) are provided which are based on 1985-95 meteorological measurements.

> *Response.* All off-site dose calculations use data and requirements from the ODCM. This is the latest information and must be used to determine the dose values. The initial values of X/Q from the 1970s are not used, because they have been updated over the years. The current values from the period 1986 – 1995 are used to represent the operation of SQN as required by the ODCM. While the current values are consistent with the original values from the 1970s, they have been updated with a larger set of meteorological data from (1986–1995), whose values are more conservative when used in dose calculations. Meteorological data from the period 1996 – 2010 are not as conservative as the data being used in accordance with the ODCM; therefore, the values have not been further updated for use in dose calculations. Initial and current dispersion and transport characteristics are similar, and the most conservative values are being used as per the ODCM.

657S. Section 3.16.2 Environmental Consequences - Climatology and Meteorology (pg. 3-140) — This section just discusses the consequences of the various alternatives on GHG production and the potential impact of climate change on the operation of SQN and other alternatives during the renewal period. It is suggested that the changes that were noted in the onsite meteorological observations since the 1970s could be used to represent what could be expected during the renewal period.

Response. The cited regional study, developed by the Electric Power Research Institute (EPRI) at the request of TVA, best represents what might be expected to occur in the future. The text of the FSEIS indicates that the changes in meteorology and climatology for the brief period of just 20 years would not be significant. See FSEIS 3.16 for this discussion.

657T. Section 3.16.3 Affected Environment — Air Quality (pg. 3-142) — New SO_2 and NO_2 NAAQS: In addition to new and more restrictive ozone and particulate NAAQS, EPA has promulgated new SO_2 and NO_2 NAAQS in 2010. Since the facility has emissions of NOx and SOx, it is recommended that this section be revised to include a brief discussion of the new revised SO_2 and NO_2 NAAQS. These ambient air quality standards will have to be considered for all alternatives. These new NAAQS will be more of a permit challenge for new facilities (i.e., Alternatives 2a and 2b). The new restrictive NAAQS may be most challenging for the fossil fuel Alternative 2b.

Response. FSEIS 3.16.3 has been revised to include a table summarizing the current NAAQs standards. TVA agrees that EPA's more stringent national standards will make permitting of new fossil-fueled generating facilities more difficult.

657U. Section 3.16.3 Affected Environment — Air Quality (pg. 3-142) — PSD Class II increments: The permitting consequences of the PSD Class I area increments were discussed but not PSD Class II increments applicable for areas in proximity to the plants. PSD Class II increments have been promulgated for PM2.5 and it is anticipated that they will be promulgated for the new SO2 and NO2 NAAQS.

Response. Comment noted. FSEIS 3.16.3 has been revised.

657V. Section 3.16.3 Affected Environment — Air Quality (pg. 3-142) — PMIO/PM2.5: PM10 is identified as a pollutant of concern throughout this section. Fine particulates (PM2.5) should be included when citing PM 10.

Response. FSEIS 3.16.3 has been revised to address fine particulates (PM2.5) in more detail.

657W. Section 3.16.3 Affected Environment — Air Quality (pg. 3-142) — Fugitive Emissions: The discussion of fugitive particulate emissions indicates there are no sensitive receptors adversely affected by temporary generated fugitive dust and equipment exhaust. Because people and animals would qualify as such a receptor, it is suggested that this comment be modified or deleted.

Response. Comment noted. FSEIS 3.16.3 has been revised.

657X. Section 3.16.3 Affected Environment — Air Quality (pg. 3-142) — HAPs: This section briefly discusses the emissions of criteria air pollutants from the facility and indicates that the plant is classified as a minor source subject to the permitting requirements of the Chattanooga/Hamilton County Air Pollution Control Bureau. However, the DSEIS does not address the potential for HAP emissions from the facility. The Sequoyah Plant is listed in EPA's 2009 Toxic Release Inventory (TRI) database as having air emissions of hydrazine and lead. The emissions of these and any other HAPs should be discussed in the DSEIS.

Response. FSEIS 3.16.2 has been revised to indicate that hydrazine, a corrosion inhibitor used in the cooling water system to control pH and corrosion, is reported to the EPA because a very small fraction is released to the air. Hydrazine is not a significant source of air pollution. Hydrazine is also discussed in the solid waste portion of FSEIS 3.14. Additionally, lead is reported to the EPA as an air pollutant, because a very small fraction of the lead (0.37 pounds/year) used at the SQN practice firing range becomes airborne.

657Y. Section 3.16.4 Environmental Consequences — Air Quality (pg. 3-146) — Natural-Gas-Fired Turbine Impacts: The statement that the air emissions from a modern natural gas-fired turbine would be small enough that they would operate with a minor impact to air quality should be verified. We note that these facilities would have significant impacts considering the new, more restrictive PM2.5 and NO2 NAAQS and PSD increments.

657Z. Section 3.16.4 Environmental Consequences — Air Quality (pg. 3-146) — Alternative 2b Impacts: The representative emissions provided in Table 3-29 for the combined-cycle operation of Alternative 2b reveals major SOx, NOx, CO, PM, and VOC emissions (note: PM2.5 emissions are not provided). It appears that "minor" would not be the appropriate classification for ambient impacts from operation of Alternative 2b natural gas-fired plants.

Response (657Y and 657Z). Emissions from a new gas-fired plant would be required to meet current regulatory requirements. Air emissions limits would be among the criteria considered when siting a new generating facility. Applicable permitting processes would ensure that national ambient air quality standards are protected. Based on this, TVA concludes that any air quality impacts associated with a new gas-fired plant would meet regulatory requirements and would range from relatively minor to moderate, depending upon the location of the new facility.

Furthermore, a new natural gas-fired plant could be constructed with technology such as selective catalytic reduction designed to reduce emissions of some air pollutants. The facility would be operated to comply with air quality regulations.

657AA. Scoping — We are pleased to note that the Socioeconomics section (3.13) includes EJ information, which was a scoping issue (pg. 1-28). This information is found in section 3.13.3 (Low-Income and Minority Populations). For clarity and easier reference, this section could have been entitled Environmental Justice.

Response. The title has been revised to clarify that environmental justice is addressed in FSEIS 3.13.3.

657AB. Executive Order (EO) 12898 — Page 3-100 states that "...TVA is not subject to this executive order..." The scope of the EO applies to any federal agency on the Working Group, and such other agencies as may be designated by the President, that conducts any federal program or activity that substantially affects human health or the environment.

Independent agencies are requested to comply with the provisions of this EO. Therefore, we believe that independent federal agencies like TVA and EPA are subject to EO 12898.

If TVA retains the conclusion that they are not subject to the EO in the FSEIS, EPA requests that TVA's rationale for not considering itself an agency subject to the EO be provided in the text or be footnoted. More substantively, however, we appreciate that some EJ information was nevertheless provided for the SQN location regardless of TVA policy.

> *Response.* TVA is not among the agencies specifically noted in Executive Order (EO) 12898, nor is TVA a member of the Interagency Working Group on Environmental Justice that is identified in EO 12898. As recognized in the comment, independent agencies are requested to comply with the provisions of the EO. Therefore, as noted on FSEIS page 3-98, TVA evaluates potential environmental justice impacts as a matter of policy.

657AE. EJ Impacts — The DSEIS does not provide adequate baseline information regarding potential for existing EJ issues associated with the facility to make an adequate assessment. For example, the DSEIS indicates that for the license renewal alternative (Alt. 1- page 3-101) the "SQN license renewal would result in no changes in operating employment levels at the plant, and there should be no new impacts to minority and low income populations through this action." While this is encouraging from a license renewal standpoint, it is unclear in the DSEIS what the existing SQN employment levels are like for minority and/or low-income populations or what the existing impacts may be to EJ populations. EPA recommends that any existing EJ impacts — which may have occurred or are ongoing during the 40-year life of the present project licensing — be described in the FSEIS and offset as part of the prospective relicensing.

657AS. EPA also recommends that any existing EJ impacts — which may have occurred or are ongoing during the 40-year life of the present project licensing — be described in the FSEIS and offset as part of the prospective relicensing. Moreover, even if no existing EJ impacts exist, the proposed renewal offers an opportunity for TVA to outreach with minorities, low-income populations and other demographics living near SQN.

657AF. Moreover, even if no existing EJ impacts exist, the proposed renewal offers an opportunity for TVA to do outreach with minorities, low-income populations and other demographics living near SQN. As a part of the proposed license renewal, we recommend that TVA discuss nuclear power impacts with nearby populations relative to potential benefits such as job opportunities at SQN or educational possibilities.
Periodic dialogue with affected residents regarding the plant should also be provided and the outcome of that dialogue as well as TVA's public involvement process related to specific EJ outreach efforts. Comments and responses to comments should also be summarized in the FSEIS's EJ section.

> *Response (657AE, 657AS, 657AF).* In its analysis of current conditions, TVA did not identify any location-dependent, disproportionate high and adverse impacts to minority and low-income populations resulting from operation of SQN. There are beneficial impacts realized, such as taxes paid by TVA and SQN workers. These in turn benefit local public services for the general population, including minority/low-income groups in the community.
>
> As described in FSEIS 3.13.1.2, as of 2010, SQN employed a staff of approximately 1144 permanent and contract employees. Of these, 892 employees, or 78 percent, reside in Hamilton County (approximately 0.3 percent of the county population). Because the staff represents a low percentage of the county population, as stated in Section 1-103 of Executive Order 12898, TVA employment policies and current SQN staffing are not relevant or related to identifying the existence of adverse

human health or environmental effects. Subsequently, it would not be appropriate to include any further employment breakdown in the SEIS. TVA is an Equal Opportunity employer and complies with all applicable laws and regulations regarding equal employment opportunities. http://www.tva.com/employment/index.htm.

TVA believes that, relative to the proposed renewal of SQN operating licenses, evaluating existing EJ impacts which may have occurred during the 40-year life of the present project licensing would be a significant and unnecessary extension of what is normally done to evaluate EJ impacts. There are also a number of reasons why this type of historical study would be difficult (and time consuming) to produce, including:

- U.S. Census hierarchical geographic boundaries and minority/low income data categories have changed for each decennial census (1970, 1980, 1990, and 2000; future release 2010). Because these data are the basis for identifying specific populations, a comparison of identified minority populations from one census to another would be difficult.
- It would be necessary to establish what the human health conditions and the environmental setting were like in the past for the regional population and any identified minority/low-income group to evaluate whether any historical environmental justice impacts have occurred. Comprehensive historical data for all socioeconomic and environmental characteristics would likely not be available for the suggested time frame.

TVA has a number of community outreach programs and policies in place for disseminating information to the public near SQN.

With the release of the SEIS document to the public, community leaders, and media, TVA solicited public comments regarding the proposed action via the Internet and posted mail. Copies of the SEIS were made available in public libraries in Chattanooga, Dayton, and Cleveland, Tennessee. Various media outlets posted notices of the proposed action and notification of the scheduled open house public meeting held at the Sequoyah Training Center on December 2, 2010. Experts were made available to meet and discuss the proposed action with those in attendance, and the ability to comment was made available. TVA made additional efforts to reach minority populations near SQN at the time the FSEIS was released. Representatives from SQN visited an African American community center and church in Soddy-Daisy, Tennessee, to inform the community about ongoing operation of SQN and the availability of the FSEIS.

657AH. Reactor Design — The FSEIS (e.g., Sec 1.1) should identify the reactor technology used at SQN, which would not change for the preferred license renewal alternative (Alt. 1), and compare it to the other reactor design(s) available (e.g., AP1000) if the SQN licenses are not renewed and a new nuclear plant alternative (Alt. 2a) was selected and constructed. We understand that a "Westinghouse design" is currently being used at SQN. The FSEIS should clarify.

Response. As stated on FSEIS page S-3, AP1000 is used as an example. Reactor technology for a new nuclear plant has not been determined. Specific examples of AP1000 technology and related impacts are presented throughout the discussion.

FSEIS 1.1.1 provides a general description of the reactor and plant.

FSEIS 2.2.2.1, under Construction and Operation, discusses the new reactor technologies available and provides references for most of the designs. Because there are so many types, and no decision has been made, use of only the AP1000 provides sufficient comparison information to evaluate the project alternatives.

657AI. Similarly, if the existing SQN facility would be relicensed (Alt. 1) and used for power generation for an additional 20 years, would this facility and spent fuel storage area be comparable in its ability to withstanding extreme weather events (tornados, hurricanes, etc.) and terrorist attacks (airplane crash landings, etc.) compared to a new facility with today's design and standards proposed in Alts. 2a and 2b?

Response. The new nuclear facility design basis to withstand extreme weather conditions is essentially the same as SQN's design basis. There has not been much change over the years. SQN was designed to withstand all types of extreme weather. Design basis improvements for terrorist attacks have been addressed in recent years for all nuclear plants, and requirements for new nuclear facilities have been upgraded even further to demonstrate the ability to withstand airplane crashes. However, the U.S. Nuclear Regulatory Commission (NRC) has made numerous statements as to the safety and security of existing nuclear plants. Section 4.3.5 of the cited NRC document explains terrorism and the relationship to license renewal (www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1850/sr1850_faq_lr.pdf). Spent fuel storage at a new nuclear facility will use the same technology currently available unless a better design is approved in the future.

TVA places a high value on protecting public health and safety, the safety of its employees, and protection of the environment through safe operation of its nuclear facilities. TVA's highest-tier policy, entitled "Commitment to Nuclear Safety," states that "TVA's nuclear power activities are carried out with public health and safety, the protection of its employees, and the environment as paramount considerations." Further, TVA's policy states that "TVA will seek continuous improvement, utilizing the best applicable industry standards to achieve operating excellence."

TVA's nuclear plants are regulated by the NRC which, as the safety regulator for the nation's nuclear industry, is tasked by Congress with ensuring adequate protection of public health and safety. As part of its public mandate, the NRC keeps abreast of safety issues worldwide and revises its regulations and guidance to U.S. nuclear power plant operators to increase margins of safety when necessary. In fulfilling its important role, the NRC ensures that U.S. safety standards reflect the highest level of protection appropriate for each nuclear plant site given the conditions that may affect each site and surrounding area.

In addition, TVA is a member of the Institute for Nuclear Power Operations (INPO) and the World Association of Nuclear Operators (WANO). INPO was established in 1979 by the U.S. nuclear power industry to promote excellence and the highest levels of reliability in the operation of commercial nuclear power plants. WANO was created in 1989 to help nuclear plant operators worldwide achieve the highest possible standards of nuclear safety. Among the most important roles carried out by both INPO and WANO is the systematic gathering, review, and analysis of operating experience at all nuclear power plants, coupled with an industry-wide international communications network to facilitate the exchange of this information in order to improve performance at each member facility.

Recognizing its own responsibilities and commitments as an owner and operator of three nuclear plants in Tennessee and Alabama, as an NRC licensee, and an active member of INPO and WANO, TVA remains aware of and is affected by nuclear plant operating events worldwide. This includes recent earthquake-and tsunami-related events in Japan. While many of the extraordinary circumstances that led to this tragedy are not applicable to TVA's nuclear facilities, there nonetheless may be prudent improvements and lessons learned to create an even safer operating environment. Because TVA's nuclear facilities are regulated by the NRC, TVA, of course, will implement applicable new regulatory requirements. However, TVA will not await direction from NRC before taking action to identify and address any safety concerns. TVA plants already have additional safety features that would help to respond to conditions confronting several of Japan's reactors, and we have initiated a re-evaluation of our readiness to deal with severe conditions and serious emergencies, including a systematic review of procedures, training, facilities, and equipment at TVA's operating nuclear plants and planned nuclear units. TVA will implement improvements identified internally or through its participation in INPO and WANO that help to ensure TVA's nuclear generation continues to operate reliably and safely.

657AK. ISFSI — Additional dry cask storage for spent fuel rods (i.e., an independent spent fuel storage installation: ISFSI) will need to be operational by 2026 at Sequoyah if relicensing is selected (pg. 3-180). We understand that impacts of increasing the size of the onsite storage building via a concrete pad should "have only minor impacts" (pg. 3-81) and "to result in minimal disturbance to the environment" (pg. 2-16). In a 2002 Environmental Assessment/ Finding of No Significant Impact (EA/FONSI), TVA concluded that construction and operation of the original storage site showed no significant impacts.

657AL. We agree that additional NEPA documentation, such as a TVA re-evaluation or a supplemental EA[9], would be needed before 2021 since that storage need is over ten years from now and regulations and policies could change. Moreover, we understand that the NRC re-licensing of this facility is separate from the NRC re-licensing of Unit 1 and 2, so that separate NEPA documentation is appropriate.

In contrast, if re-licensing of Units 1 and 2 is not selected by TVA in the present SEIS, there would be no need to expand the existing storage building or construct a new onsite facility since Units 1 and 2 would stop operation before 2026.

[9] EPA requests receipt of a copy of such a NEPA document for review and comment.

Response (657K and 657L). Prior to expanding the SQN ISFSI, TVA will determine the appropriate level of environmental review based upon site-specific conditions and specific project activities. As part of that environmental review, TVA would follow standard practices for coordinating with state and federal agencies, including the EPA.

657AZ. In regard to how much additional storage space is needed and within what timeframe, we note that onsite production of tritium for DOE is an option at SQN. Should this be approved and eventuate, a 71 percent increase in spent fuel would be generated (pg. 3-186). The FSEIS should discuss this in terms of spent fuel storage and possible schedule changes (i.e., would additional storage space already be needed before the projected October 2026 timeframe and 2021 construction startup?).

> *Response.* The impacts of tritium production on the quantity of spent fuel generated have been addressed in the 1999 DOE FEIS for tritium production. The DOE FEIS determined the increase in spent fuel and its impacts to be an issue separate from license renewal. Therefore, although the tritium production option is available to SQN, it has no impact on license renewal decisions. Should TVA decide to produce tritium at SQN, spent fuel would continue to be handled and stored on site at SQN. The increase in spent fuel generated would depend upon the number of TPBARs irradiated. Any necessary adjustment in timing of the ISFSI expansion would be assessed prior to the decision to produce tritium at SQN. The impacts of ISFSI expansion would not differ from those already described in the SQN SEIS.

657BA. Radiological Tritium Monitoring — Page 3-34 states that "An additional groundwater evaluation is planned to further bound tritium concentrations vertically." EPA requests additional discussion on this study in the FSEIS.

> *Response.* FSEIS 3.2.1.3 has been revised with additional information regarding studies to evaluate tritium at SQN.

657BB. Plant Decommissioning — We appreciate that various methods to decommission SQN and the associated radiological/environmental impacts were considered in Section 3.20 of the DSEIS.

> *Response.* Comment noted.

United States Department of the Interior

OFFICE OF THE SECRETARY
Office of Environmental Policy and Compliance
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75 Spring Street, S.W.
Atlanta, Georgia 30303

ER 10/950
9043.1

December 15, 2010

Amy Henry
NEPA Project Manager
Tennessee Valley Authority
400 West Summit Hill Drive, WT 11D
Knoxville, Tennessee 37902

Re: Comments for the Review of the Draft Supplemental Environmental Impact Statement (DSEIS) for the Sequoyah Nuclear Plant Units 1 and 2 License Renewal, Hamilton County, Tennessee

Dear Ms. Henry:

The United States Department of the Interior (Department) has reviewed the DSEIS for the Sequoyah Nuclear Plant Units 1 and 2 License Renewal in Hamilton County, Tennessee. We offer the following comments.

Chapter 3.0 Affected Environment and Environmental Consequences

General

656C

The DEIS identifies several species – aquatic and terrestrial fauna and endangered and threatened species – that inhabit the proposed new construction site and could be adversely impacted from proposed activities. Suggest the Final EIS include a section with proposed mitigation actions for all proposed construction activities and associated transmission lines that could potentially result in significant impacts to terrestrial and aquatic species.

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656A

The DEIS states that the impact to wetlands from proposed construction activities and associated transmission lines would range from minor to substantial, and that a site-specific environmental review would be conducted. Suggest the Final EIS include the site-specific environmental review; an assessment based on the findings; and identify proposed measures to avoid, minimize,

2

656A or mitigate impacts. Suggest the review include scientific studies that describe the methods used and success rates of wetland restorations from other similar construction projects.

Page 3 - 61

656B The DEIS states that there are no expected substantial impacts on the fish community near the plant. Suggest the Final EIS include an assessment of potential offsite impacts, particularly those associated with any trace elements and industrial chemicals that may be present in the cooling water discharged during regular operation and from planned and accidental discharges.

Thank you for the opportunity to review and comment on the DEIS. If you have questions concerning our comments, please contact Gary LeCain at (303) 236-5050 extension 229 or via email at gdlecain@usgs.gov. I can be reached on (404) 331-4524 or at gregory_hogue@ios.doi.gov.

Sincerely,

Gregory Hogue
Regional Environmental Officer

cc: Jerry Ziewitz – FWS
Brenda Johnson – USGS
Dave Vela – NPS
OEPC - Wash

656C. The DEIS identifies several species — aquatic and terrestrial fauna and endangered and threatened species — that inhabit the proposed new construction site and could be adversely impacted from proposed activities. Suggest the Final EIS include a section with proposed mitigation actions for all proposed construction activities and associated transmission lines that could potentially result in significant impacts to terrestrial and aquatic species.

656A. The DEIS states that the impact to wetlands from proposed construction activities and associated transmission lines would range from minor to substantial, and that a site-specific environmental review would be conducted. Suggest the Final EIS include the site-specific environmental review; an assessment based on the findings; and identify proposed measures to avoid, minimize, or mitigate impacts. Suggest the review include scientific studies that describe the methods used and success rates of wetland restorations from other similar construction projects.

> *Response (656C and 656A).* As described in FSEIS 3.6, common aquatic and terrestrial fauna are present on and near SQN. However, while two federally endangered mussels and one federally threatened plant have been recorded within 6 miles of SQN, FSEIS 3.7.1 states that none of the federally listed species, nor the 11 other state-listed species is present on or adjacent to SQN. Habitat for federally listed and state-listed species is not present on or adjacent to SQN.
>
> Under Alternative 1 — License Renewal, proposed activities would have no effect on listed species or wetland habitat (FSEIS 3.7.2 and 3.4.2, respectively). There are currently no proposed construction sites associated with Alternative 1. No changes to the existing transmission infrastructure would be necessary under Alternative 1. As discussed in the SEIS, the ISFSI would eventually be enlarged to accommodate the increased amount of spent fuel. TVA believes that the ISFSI can be modified without affecting protected species or wetlands. As discussed in the SEIS, an environmental review would be performed prior to any new construction activities to ensure no new issues had developed.
>
> A site to accommodate Alternative 2 would be selected based on system needs, applicable guidance such as NRC Regulatory Guide 4.7, *General Site Suitability Criteria for Nuclear Power Stations* (1998), and TVA procedures, which would include a site-specific environmental review. When planning generating facilities and transmission corridors, TVA uses several criteria to screen sites, including the potential for impacts to wetlands and endangered and threatened species. The environmental review would identify potential impacts to biological resources (FSEIS 2.2.2.1). Mitigation measures would be site and species specific and based on the environmental review.

656B. The DEIS states that there are no expected substantial impacts on the fish community near the plant. Suggest the Final EIS include an assessment of potential offsite impacts, particularly those associated with any trace elements and industrial chemicals that may be present in the cooling water discharged during regular operation and from planned and accidental discharges.

Response. Plant effluent is discharged into Chickamauga Reservoir, which is part of the Tennessee River system. Off-site impacts are possible should trace elements and industrial chemicals be present in toxic concentrations. However, SQN is aware of this potential risk and has standard operating procedures in place to prevent routine and accidental toxic releases. Should an accidental release escape immediate detection, scheduled biomonitoring (voluntarily through TVA's Reservoir Ecological Health monitoring program or regulated by the Clean Water Act) would alert SQN to a problem at which point, mitigation efforts would be undertaken.

A list of types of chemicals currently used in operating plant cooling water systems was included in FSEIS 3.1.4.1. Scale inhibitors, corrosion inhibitors, molluscicides, dehalogenation agents, detoxification agents, and biopenetrants have been approved for use within the facility by the appropriate state and federal regulatory agencies and by qualified TVA personnel that determine the best possible chemicals to use based on site-specific needs.

In accordance with SQN's NPDES permit, a biocide/corrosion treatment plan (B/CTP) annual report was submitted on February 9, 2010, to the Tennessee Department of Environmental Conservation Division of Water Pollution Control. This report provides biomonitoring data from tests conducted during treatments, a summary of all analytical results, the approximate duration in hours of each chemical used, the quantity in pounds of each chemical used, and any minor changes that have occurred in the B/CTP. Based on the analytical and toxicity biomonitoring, the facility maintained compliance with the current NPDES permit in 2010 (FSEIS 3.1.4.1).

Operating SQN has little effect on the chemical composition of the water used for cooling. Comparison of preoperational and post-operational levels of alkalinity as calcium chloride (CaCO3), nutrients, minerals, and metal concentrations within the reservoir were similar. However, comparisons of intake and discharge water in 1985 revealed measurable differences in sodium, sulfate, and zinc. Although differences were quantifiable, they were not of a magnitude that would change overall water quality, or affect the plant's ability to meet water quality standards, and would not, therefore, reduce habitat quality for reservoir inhabitants. (FSEIS 3.5.2)

Additional sampling in 1988 and 1989 revealed concentrations of aluminum in the diffuser pond that exceed the chronic toxicity level. Lead concentrations also exceeded the chronic toxicity criterion in the diffuser pond in 1989. Whole effluent toxicity analysis was performed to ensure effluent was not toxic to organisms within the reservoir. Most whole effluent toxicity tests failed to identify toxicity. On the few occasions when toxicity was documented, flows in Chickamauga Reservoir were more than sufficient to avoid toxicity in the receiving water. (FSEIS 3.5.2)

Off-site impacts are possible due to accidental discharges. However, SQN has a spill prevention control and countermeasures (SPCC) program for the prevention, management, and cleanup of accidental spills. Adherence to the plan limits the likelihood that oil or chemicals would reach aquatic habitat (FSEIS 3.5.2).

Tennessee water standards are set to ensure that waters do not contain toxic substances whether alone or in combination with other substances that will produce toxic conditions. The only way to determine the presence of toxic conditions is to monitor effluent with aquatic organisms. SQN follows an NPDES permit that requires routine chronic toxicity assays with *Ceriodaphnia* and fathead minnows to ensure effluent discharged into the reservoir is not toxic.

Because SQN adheres to a rigorous NPDES permit and has programs such as an SPCC and B/CT plans in place, it is unlikely that routine or accidental discharges would measurably degrade water quality in Chickamauga Reservoir.

TENNESSEE HISTORICAL COMMISSION
DEPARTMENT OF ENVIRONMENT AND CONSERVATION
2941 LEBANON ROAD
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(615) 532-1550

November 4, 2010

Mr. A. Eric Howard
Tennessee Valley Authority
400 West Summit Hill Drive
Knoxville, Tennessee 37902-1499

RE: TVA, DRAFT SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT, SEQUOYAH NECLAR PLANT LICENSE,
UNINCORPORATED, HAMILTON COUNTY, TN

Dear Mr. Howard:

At your request, our office has reviewed the above-referenced Draft Supplemental Environmental Impact Statement in accordance with regulations codified at 36 CFR 800 (Federal Register, December 12, 2000, 77698-77739). Based on the information provided, and in accordance with our previous correspondence, we concur that the project area contains no historic properties eligible for listing in the National Register of Historic Places.

If project plans are changed or archaeological remains are discovered during construction, please contact this office to determine what further action, if any, will be necessary to comply with Section 106 of the National Historic Preservation Act.

Your cooperation is appreciated.

Sincerely,

E. Patrick McIntyre, Jr.
Executive Director and
State Historic Preservation Officer

EPM/jmb

Tennessee Historical Commission Comment and TVA Response

653A. At your request, our office has reviewed the above-referenced Draft Supplemental Environmental Impact Statement in accordance with regulations codified at 36 CFR 800 (Federal Register, December 12, 2000, 77698-77739). Based on the information provided, and in accordance with our previous correspondence, we concur that the project area contains no historic properties eligible for listing in the National Register of Historic Places. If project plans are changed or archaeological remains are discovered during construction, please contact this office to determine what further action, if any, will be necessary to comply with Section 106 of the National Historic Preservation Act. Your cooperation is appreciated.

> *Response*. Concurrence is acknowledged. If project plans are changed or archaeological remains are discovered, the Tennessee Historical Commission will be contacted.

Public Comments and TVA Responses

654A. I. Environmental. Global Warming Impact Study, as part of TVA environmental impact.
.......A. Has TVA done such a study as part of their 'environmental impact study'?
.........1. related to drought conditions which will be brought, have been brought to reactor environments on the Tennessee River i.e. Southeast by increasing Global Warming.
...........a. the amount of water needed by nuclear plants for coolant reduced by global warming drought conditions.
................1) last summer one of the plants could not operate due to heat of the river water i.e. global warming.
................2) these conditions, could continue and worsen, thus, disenabling nuclear reactors by either lack of water, or river temperatures too hot to operate the reactors (Frank DePinto).

Response. TVA contracted the Electric Power Research Institute (EPRI) to do a study of the effects of climate change on the Tennessee River Valley. In addition, TVA does river operations studies to determine the effects of changes in the river on all the power generators along the Tennessee River. Drought, precipitation, water temperature, and air temperature are all being monitored and studied to ensure SQN can continue to operate within all limits.

As presented in FSEIS 3.1.2, an assessment of potential climate change in the Tennessee Valley suggests that air temperatures could increase 1.4°F (0.8°C) by 2020 and up to 7.2°F (4°C) by the year 2100 for an increase in air temperatures of approximately 3.6°F (2°C) by the end of the 20-year license renewal period (2041) of SQN, and the potential increase in water temperatures in Chickamauga Reservoir could range from 1.0°F (0.5°C) to 2.0°F (1.1°C). Such a temperature rise could impact the operation of both SQN generating units. The facility would have to utilize the helper mode more frequently, and in extreme cases, implement plant derates to maintain compliance with the NPDES permit.

In the operating history of SQN, there has been no need to derate the plant due to thermal limits; the plant is able to meet thermal limits using the existing cooling towers and normal cooling processes.

The comment states that "last summer one of the plants could not operate due to heat of the river water i.e. global warming." The commenter is probably referring to Browns Ferry Nuclear Plant (BFN), which was derated (i.e., operating at less than maximum levels) for a number of days in summer 2010 (not the entire summer), because of the inability to meet maximum discharge temperature restrictions. This is not indicative of global warming, but is attributable to the design of the plant. The following excerpt from page 1 of the 2010 BFN EA (*Final Environmental Assessment Browns Ferry Nuclear Plant Cooling Towers Addition and Replacements Limestone County, Alabama*) provides further explanation of the situation at BFN:

"BFN currently has six mechanical draft cooling towers. These existing MDCT can only support 69 percent of the heat rejection needs from the three-unit licensed plant. During the hot summer months, this lack of cooling capacity has caused significant reductions in plant operating power production levels (known as derates), resulting in increased operating costs and lost revenue. During the summer of 2010, derates to below 50 percent power were required at BFN for several days in July and about half of August to meet National Pollutant Discharge Elimination System (NPDES) permit requirements involving maximum allowable water temperature."

The subsection within FSEIS 3.16.2 titled "Potential for Effects of Climate Change on SQN Operations" presents the potential effects of lack of cooling water or higher water temperatures on the future operation of SQN. Because the duration of license renewal is 20 years, the permanent changes expected in water and air temperature would be very minor. For normal fluctuations in temperature of the water and air, SQN would be expected to continue to operate within all thermal limits.

651A. As a 35.5 year neighbor of the Sequoyah Nuclear Plant living just 1.1 miles from the reactor, I am delighted with the way Tennessee Valley Authority has managed the construction and operation of SNP. There have been no safety concerns on my part during our family's 35.5 years living literally in the shadow of the SNP. Our firstborn was 11 months old when we moved here; our second child was born 16 months later. Due to food allergies, our children drank milk from our goats who were pastured on our land. TVA employees monitor the radiation levels of the grain on which our goats were pastured. As I anticipated, there was no problem with radioactivity in the grass that ultimately produced the milk our children drank. Our kids were healthy as babies and continue to be healthy adults. For 15 years, our water came from a well on our property and we were pleased to drink it until lightning ran in on the pump. At that point, city water was available to us, so we began using city water. We have appreciated the efforts TVA has made to keep the temperature of Chickamauga Lake downstream of SNP at levels for safe for fish and other marine life. Sequoyah Nuclear Plant has contributed to the economic health of the community, metropolitan area, and region for more than 3 decades. I urge the Nuclear Regulatory Commission to extend the license to operate Sequoyah Nuclear Plant for an additional 20 years. Only positive benefits have come from the operation of SNP. The plant is ecologically extremely clean. The nuclear power is reliable. The SNP has been well maintained. Sequoyah Nuclear Plant by all considerations should be able to operate safely and profitably for at least an additional twenty five years beyond its original license designation. I can say this with confidence because I grew up in Oak Ridge, Tn between 1940 and 1958, obtained a M.S. degree in Radiation Biology, and worked at the Biology Division of Oak Ridge National Laboratory during the latter part of the 1960's. (Diane Goins)

Response. Comment noted.

318A. Instead of dedicating time and energy to nuclear power, TVA should research and implement cleaner, alternative energy sources (Erin Ouzts).

Response. TVA has evaluated and continues to evaluate other clean alternative energy sources. Wind and solar facilities are part of TVA's mix of generating sources.

Additional information on TVA's mix of generating technologies is available in Chapter 5 of TVA's recently published Integrated Resource Plan (Final, March 2011).

TVA uses clean, renewable alternative energy sources such as solar and wind where feasible. Clean and renewable energy sources are expected to play a larger role in the overall TVA strategy for power generation in the future.

318B. I would like to voice my opinion that TVA should not renew it licenses to operate Sequoyah Nuclear Plant. There still is no viable long-term storage plan for nuclear waste. This problem continues to be overlooked, but it is a very serious issue that should no longer be ignored. Can we really guarantee that we can safely store this waste into perpetuity? Sure, it may be better than burning coal in the short-term, but is it really better in the long-term if the earth is covered in radioactive waste? (Erin Ouzts)

Response. Since the 1980s, various entities and scientific communities have invested large amounts of time and money to address the long-term permanent storage need for radioactive waste. On the world scale, there are many options to safely store radioactive waste, and the list continues to grow; for example, new reactor designs to burn-up more of the fuel, encapsulation of waste in ceramics, and options for reprocessing and separation of the radioactive waste. New options are not being overlooked, but implementation is being delayed by such things as diverse political opinions as well as the expensive investment to bring some of the new technology to a larger scale.

Radioactive waste is an important consideration for all of the nuclear fields: power reactors, medical uses, and industry. For the purposes of SQN license renewal, the waste issue has been determined to be important, but manageable. As provided in the FSEIS 2.2.1 subsection titled **Waste**, the issue of radioactive waste for SQN falls within the “Waste Confidence” of the Nuclear Regulatory Commission (NRC), and the radioactive waste from this facility can be safely and properly stored far beyond the lifetime of the plant.

The NRC’s Waste Confidence Rule, found in 10 CFR 51.23, and the NRC’s response to this issue states that

“The Commission has made a generic determination that, if necessary, spent fuel generated in any reactor can be stored safely and without significant environmental impacts for at least 60 years beyond the licensed life for operation (which may include the term of a revised or renewed license) of that reactor at its spent fuel storage basin or at either onsite or offsite independent spent fuel storage installations. Further, the Commission believes there is reasonable assurance that at least one mined geologic repository will be available within the first quarter of the twenty-first century, and sufficient repository capacity will be available within 30 years beyond the licensed life for operation of any reactor to dispose of the commercial high-level waste and spent fuel originating in such reactor and generated up to that time.”

“The staff is confident that there will eventually be a licensed high-level waste repository. If the site near Yucca Mountain is eventually found to be unsuitable, alternative sites will be considered. Until a permanent high-level waste repository is operational, the spent nuclear fuel will be safely stored either onsite or at offsite interim storage facilities.” (NRC 2010) U.S. Nuclear Regulatory Commission. Staff Requirements Memorandum. SECY-09-0090 — Final Update of the Commission's Waste Confidence Decision. September 15, 2010. http://www.nrc.gov/reading-rm/doc-collections/commission/srm/meet/2010/m20100915.pdf. Accessed September 30, 2010.

The DOE is ultimately responsible for the spent fuel and is mandated to find a way to permanently dispose of the spent fuel. Until the DOE can take possession, the spent fuel can be safely stored in the ISFSI facilities at SQN.

655A. Do you know if any public health studies have been done for the area around the plant? If they are referenced in the document, where would I find that? (Don Safer)

Response. Although not referenced in the draft SEIS, the National Cancer Institute (NCI) looked at cancer risks in areas surrounding U.S. nuclear facilities and published the results in 1991. Sequoyah Nuclear Plant was included in that report. A fact sheet concerning the NCI report is incorporated in this appendix following the comment responses. Additionally, the Nuclear Regulatory Commission asked the National Research Council and Institute of Medicine to carry out a state-of-the-art study to enable it to update the NCI information.

FSEIS 3.17 describes the radiological environmental monitoring program (REMP) implemented at the plant. The REMP design is based on the regulatory guidance in NRC Regulatory Guide 4.1 and NUREG-1301 and NUREG-1302.

There have been numerous studies performed in the United States, Canada, and Great Britain that found no correlation between nuclear power plants and cancers. The Nuclear Energy Institute (NEI) has a fact sheet summary of these studies posted on its website. The NEI fact sheet can be accessed at <http://www.nei.org/resourcesandstats/documentlibrary/safetyandsecurity/factsheet/safetystudiespublicworkers/?page=2>.

670A. The summary states that TVA wants to support efforts to reduce the greenhouse gas emissions of its generating system. However, renewing this license will do nothing to further reduce greenhouse gases in the TVA system, as it will simply continue any existing emissions now coming from Sequoyah. Discontinuing operation of a coal-fired power plant will definitely reduce emissions, but not continuing ongoing operation of Sequoyah. This cannot be used as a justification to renew the SQN license. Further, SQN itself may not be a significant source of pollutants, but the mining, enriching and transporting the fuel is. Discontinue the nuclear plant operation and all that pollution in the fuel chain and its associated health problems also ends. This is a reason not to relicense and should be corrected in the report in Table 2-1 under air emissions. (Sandra Kurtz, Bellefonte Environmental Sustainability Team)

Response. Pertinent discussion in FSEIS 3.16.2 has been added and clarified. SQN operations currently directly offset about 16 million tons of GHGs that would otherwise most likely be produced annually from coal-fired sources. In order to supply the required power that TVA customers need, TVA must continue to generate electricity. If SQN does not continue to operate, then additional generation will be required from new facilities and increased generation from existing facilities would occur. Among the alternatives in this SEIS, at a minimum in terms of the life-cycle effects, renewal of the SQN license and continued operation of SQN avoids the greenhouse gas emissions that would be generated by the construction and operation of new generating facilities needed to supply power if SQN was not operating, particularly if those new facilities were fossil fueled. Relative savings in

GHG emissions would likely be less in comparison to the natural gas-fired alternative than that for a new nuclear facility.

670B. Ever increasing maintenance requires shutdowns that eventually translate into unreliability. Sixty years of operation for any plant is too long to guarantee safety without replacement of much of the infrastructure itself. Despite the statements in this report about how reliable nuclear power is, we have already seen leakage from old pipes, inadvertent tritium leaks, breakage of supporting struts, crumbling of concrete, and fires from aging electrical wiring not to mention radiation leaks or risk of malfunction that leads to meltdown. (Sandra Kurtz, Bellefonte Environmental Sustainability Team)

Response. The nuclear fleet of plants in the United States and world-wide has actually seen an increase in plant reliability in the last decade or more. SQN current capacity factor is above 90 percent, which is excellent for any type of power facility.

Aging analysis is an extensive process that all nuclear plants undergo continually. For SQN to get a license renewal, it will submit to the NRC an extensive application that addresses the plant components and structures to verify that they indeed can continue to be operated safely.

While there have been a few instances of pipe leaks, these instances are thoroughly evaluated and corrected. The NRC regulation and oversight helps ensure that nuclear plants, including SQN, operate safely with minimal environmental risks.

SQN submits the application for license renewal to the NRC. NRC evaluates the application to ensure SQN can be operated safely during the license renewal period, and the license renewal is approved or rejected, based on NRC guidelines.

670C. Extending SQN operation means more radioactive waste. As is noted in the report, planning for extended onsite storage space will be required. Other designated places for permanent storage are unlikely leaving us with the liability of monitoring and caring for a waste site where the radiation lasts longer than the life of the casks in which it will be stored. I see no consideration of waste legacy and responsibility to future requirements associated with this waste. After decommissioning, who bears responsibility and who pays the cost? (Sandra Kurtz, Bellefonte Environmental Sustainability Team)

Response. The permanent disposal of spent fuel is the responsibility of the U.S. Department of Energy. Currently, spent fuel is being temporarily stored on site in the spent fuel pools and in the ISFSI. The spent fuel can be safely stored in the ISFSI for at least 60 years after SQN is shut down, even after the license renewal period. (NRC 2010) U.S. Nuclear Regulatory Commission. Staff Requirements Memorandum. SECY-09-0090 – Final Update of the Commission's Waste Confidence Decision. September 15, 2010. http://www.nrc.gov/reading-rm/doc-collections/commission/srm/meet/2010/m20100915.pdf. Accessed September 30, 2010.

This plan for disposal of spent fuel applies if the SQN plant is decommissioned, unless the Department of Energy takes possession of the spent fuel before decommissioning is completed.

As provided in the FSEIS 2.2.1 subsection entitled **Waste**, the issue of radioactive waste for SQN falls within the "Waste Confidence" of the Nuclear Regulatory Commission, and the radioactive waste from this facility can be safely and properly stored far beyond the lifetime of the plant. Also in FSEIS 2.2.1, the subsection entitled **Uranium Usage and Spent Fuel** provides additional information on spent fuel storage. As mentioned in the DSEIS, the Environmental Assessment entitled, "Environmental Assessment and Finding of No Significant Impact – Independent Spent Fuel Storage Installation Sequoyah Nuclear Plant" is available publicly for additional information on the fuel storage issue.

670D. In this report, there was no consideration of solar and wind power as an alternative action dismissing both as requiring too much land. Working through Generation Partners or other programs, electrons could be collected from numerous rooftops and parking lots across the Tennessee Valley eliminating the need for SQN relicensing or the building of any new power plants. This system could be put in place sooner than 2021 as well. This report says indicates that there is not enough solar output in this area, but Germany relies heavily on solar and is phasing out its nuclear program. Before relicensing SQN this alternative should be seriously considered as a way to avoid the dangers and cost of nuclear power while replacing the same amount of power generation. (Sandra Kurtz, Bellefonte Environmental Sustainability Team)

Response. FSEIS 2.1.1.3 and 2.1.1.4 discuss wind and solar. Land requirements were just one of the reasons wind and solar were not considered feasible alternatives (e.g., 103,000 acres required for a photovoltaic solar project that would provide generating capacity similar to SQN). Availability of wind and solar energy is another major factor in the TVA region. Capacity factors in the 20 to 40 percent range for wind and in the 10 percent range for solar make them very inefficient. Individual home-type solar systems have been studied and are very expensive. Power storage is still in need of further development.

In the SQN SEIS, solar and wind were not identified as feasible alternatives to continuing to operate SQN because those technologies did not meet the criteria established in FSEIS 2.1. Solar, wind, and other renewable sources are incorporated in TVA's current and future power generation plans — TVA has recently issued the final 2011 Integrated Resource Plan Environmental Impact Statement (IRP EIS). In this IRP EIS Chapter 5, TVA describes the contribution of solar and wind generation capacity to TVA's overall strategy for meeting the energy needs of the Tennessee Valley.

670E. Table 3-2 shows Ecological Health Indicator measurements for certain parts of the Chickamauga Reservoir, but do not show any direct measurements around SQN itself. Further, we only see averages here when, in fact, it is the extremes that have the most impact on biota. Has there been any measurement of the drift community, its patterns of biodiversity and a comparison of populations in and outside of the thermal plume? Further, are you measuring for radionuclides in fish or benthic macroinvertebrates? This would give us a better picture of direct SQN environmental impacts on aquatic species. (Sandra Kurtz, Bellefonte Environmental Sustainability Team)

Response. In the SEIS, Table 3-2 depicts Ecological Health Indicator measurements for Chickamauga Reservoir. Aquatic biota, including fish, macroinvertebrates, and plankton are discussed in depth in FSEIS 3.5. Both fish and macroinvertebrate communities are sampled at TRM 490.5 (upstream) and 482.0 (downstream) of SQN (Tables 3-11 and 3-12) to detect possible impacts to the biota possibly caused by SQN operation. Plankton studies at the discharge are also included in the section.

Radiological — FSEIS 3.17 provides a discussion of the radiological environmental monitoring program that is being continuously conducted at SQN. All types of organisms and representative plant life are sampled in areas of direct influence from SQN and at control locations. These ongoing program results are reported annually in the Annual Radiological Environmental Operating Reports (AREOR) provided to the NRC, and the program will continue throughout the operational life of the plant. FSEIS Table 3-42 provides the minimum requirements of environmental monitoring such as water, sediments, fish, organisms, garden crops, etc. that are sampled regularly as necessary to cover all potential pathways for people and animals to be impacted by radioactive releases. General results are provided in the FSEIS, and annual reports are available from the NRC.

670F. The report states, “By maintaining radioactive gaseous releases within regulatory limits, the impact to the public would be minor”. However, according to EPA, there is no acceptable dose of radiation. Over the years, the impact of small releases is cumulative. This report has not adequately addressed the health impacts of waste storage and cumulative impacts of radwaste and so-called ‘minor’ impacts. Another 20 years only adds to health concerns for people living nearby. (Sandra Kurtz, Bellefonte Environmental Sustainability Team)

Response. TVA adheres to the as low as reasonably achievable (ALARA) principle. Releases are always within the limits provided in federal regulation and as low as reasonably possible.

The process of radioactivity accumulating over years is an issue that TVA addresses in all procedures and programs. The radiological environmental monitoring program (REMP) assesses for cumulative effects, and none have been detected in the environment surrounding SQN. Radioactive particles are continually undergoing radioactive decay and would be cumulative only over periods within the radioactive half lives and actually would find a maximum value that balances production (deposition) and decay of the particles (known as equilibrium). No radioactive particles have been found in the environment attributable to SQN, and the REMP is in place to find those cumulative impacts if they were to occur. Radioactive particles with extremely long half lives that are highly radiotoxic are not routinely released from SQN.

FSEIS 3.17.1 covers the actual calculated doses from gaseous releases. It discusses the total dose to the entire population within 50 miles of SQN. It also discusses background radiation and the potential exposure pathways for the public.

Doses at the exclusion area boundary as well as doses to hypothetical individual members of the public are also provided.

Discussion of the radiological impact on gaseous influences includes federal regulation and limits under which SQN must operate.

Doses from gaseous releases were provided for the years 2004 – 2008 for gamma air, beta air, total body, skin, child thyroid, and child total body.

Discussion on radiation dose to biota is also provided. The determination has been made that there is no significant impact on the biota surrounding SQN. The REMP monitors for cumulative impacts, and if there is any detection of radioactive materials in the environment, then the programs would be reviewed and release limits changed as directed by NRC or state agencies to protect any biota.

A statement by EPA that there is no acceptable dose of radiation could not be located.

755A. Enjoyed talking with you at the Public Meeting held last evening regarding the Draft Supplemental EIS on Sequoyah Nuclear Plant Units 1 and 2 License Renewal. I appreciate your interest in the concern that I have about whether or not adequate consideration is being given to the potential impact that rail traffic, going to and from the new Volkswagen plant, on the Norfolk Southern line (that bridges the Tennessee River just below Chickamauga Dam and runs through Hixson and Soddy-Daisy) may have on existing emergency evacuation plans for the Hixson and Soddy-Daisy areas. As I mentioned, there are a lot of heavily used “at grade” crossings in those areas: Hamill Road, Old Hixson Pike, Lower Mill Road, Sandswitch Road, West Boy Scout Road, Thrasher Pike, and Harrison Lane at Daisy Dallas Road. The expected super-long length (as much as two miles long) of trains serving the VW plant and perhaps also there being a greater number of trains could cause delays and frustrations on a daily basis for motorists and could potentially create a barrier for residents trying to evacuate in the event of an emergency at Sequoyah or elsewhere in the area. (For example, residents in the D-5 Sector – which includes me - of the Sequoyah evacuation plan are instructed to take “the most direct route from your location to US 27” and the Norfolk Southern railroad is between those residents and US 27.) I hope plans and funding are being put into place by local and state governments to construct overpasses to replace the “at grade” crossings, but I am not aware of any such plans and it seems certain that even if there may be such planning underway, overpasses will not be constructed in time to prevent the traffic problems from occurring, thereby prompting the need to re-examine emergency evacuation plans to take account of the expected change in circumstances.

An article titled “VW rail link chugging along” in the September 17, 2010 edition of the Chattanooga Times Free Press states that 9 of every 10 vehicles assembled at the VW plant (150,000 vehicles, initially and perhaps more later, are expected to be assembled there annually) will leave the plant by rail, using both Norfolk Southern and CSX lines, and that other companies at Enterprise South Industrial Park will also use rail. The article mentions improvements to railroad overpasses and lines in the vicinity of the VW plant, but mentions no such improvements being made or planned on the north side of the river. You can view the article at http://www.timesfreepress.com/news/2010/sep/17/vw-rail-link-chugging-along/. A Norwegian company, Wallenius Wilhelmsen Logistics, will ready the vehicles to be loaded onto trains and provide outbound rail yard management at the VW assembly plant. See article at http://www.timesfreepress.com/news/2010/apr/07/norwegian-firm-to-run-vw-rail-yard/. An article about the City of Chattanooga closing Noah Reid Road at Shallowford Road mentions that trains servicing the Volkswagen plant could be as much as two miles long. That article can be viewed at http://www.timesfreepress.com/news/2010/apr/15/road-closed-for-vw-rail/.

I appreciate your willingness to make some inquiries about this matter and any information that you could pass along to me that would provide some reassurance that the issue has been recognized and is being capably addressed by the proper authorities would be welcome. (Linda Hixon)

Response. TVA has prepared an Emergency Plan that is updated on an annual or biannual basis, taking into account changes in population in the emergency planning zone (EPZ) as well as changes that may have occurred in road construction, new industries, etc. In addition, the Tennessee Emergency Management Agency (TEMA) has responsibility for emergency planning off site of SQN. TVA contacted TEMA concerning this comment and the effect that the new Volkswagen (VW) plant may have on emergency planning for the SQN plant.

TEMA will be performing an update of the SQN Evacuation Time Estimates (ETEs) upon receipt of the 2010 census data. TEMA confirmed that the impact of the VW plant on ETEs for SQN is believed to be minor due to the fact that primary evacuation is the new I-75 exit and the fact that the majority of the VW plant is outside the 10-mile emergency planning zone (EPZ).

Specifically related to any increase in area rail traffic due to the VW plant, TEMA procedurally stops all rail traffic in and around the EPZ upon declaration of a Site Area Emergency classification or above. Rail traffic is cleared prior to the issuance of an evacuation order; therefore, the additional railroad traffic is not an impact on the SQN ETEs.

NATIONAL CANCER INSTITUTE
FactSheet

Reviewed: 04/19/2011

No Excess Mortality Risk Found in Counties with Nuclear Facilities

A National Cancer Institute (NCI) survey published in the *Journal of the American Medical Association*, March 20, 1991, showed no general increased risk of death from cancer for people living in 107 U.S. counties containing or closely adjacent to 62 nuclear facilities. The facilities in the survey had all begun operation before 1982. Included were 52 commercial nuclear power plants, nine Department of Energy research and weapons plants, and one commercial fuel reprocessing plant. The survey examined deaths from 16 types of cancer, including leukemia. In the counties with nuclear facilities, cancer death rates before and after the startup of the facilities were compared with cancer rates in 292 similar counties without nuclear facilities (control counties).

The NCI survey showed that, in comparison with the control counties, some of the study counties had higher rates of certain cancers and some had lower rates, either before or after the facilities came into service. None of the differences that were observed could be linked with the presence of nuclear facilities. "From the data at hand, there was no convincing evidence of any increased risk of death from any of the cancers we surveyed due to living near nuclear facilities," said John Boice, Sc.D., who was chief of NCI's Radiation Epidemiology Branch at the time of the survey.

He cautioned, however, that the counties may be too large to detect risks present only in limited areas around the plants. "No study can prove the absence of an effect," said Dr. Boice, "but if any excess cancer risk due to radiation pollution is present in counties with nuclear facilities, the risk is too small to be detected by the methods used."

The survey, conducted by Seymour Jabon, Zdenek Hrubec, Sc.D., B.J. Stone, Ph.D., and Dr. Boice, was begun in 1987 for scientific purposes in response to American public health concerns, and after a British survey of cancer mortality in areas around nuclear installations in the United Kingdom showed an excess of childhood leukemia deaths near some facilities. [1] No increases in total cancer mortality were found in the British study, and other smaller surveys of cancer deaths around nuclear facilities in the United States and the United Kingdom have yielded conflicting results.

The NCI scientists studied more than 900,000 cancer deaths in the study counties using county mortality records collected from 1950 to 1984. The researchers evaluated changes in mortality rates for 16 types of cancer in these counties from 1950 until each facility began operation and from the start of operation until 1984. For four facilities in two states (Iowa and Connecticut), cancer incidence data were also available. Data on cancer incidence in these counties resembled the county's mortality data patterns.

For each of the 107 study counties, three counties that had populations similar in income, education, and other socioeconomic factors, but did not have or were not near nuclear facilities, were chosen for comparison. The study and control counties were within the same geographic region and usually within the same state. Over 1.8 million cancer deaths were studied in the control counties.

The numbers of cancer deaths in the study counties and in the control counties were analyzed and compared to determine the relative risk (RR) of dying of cancer for persons living near a nuclear facility. A relative risk of 1.00 means that the risk of dying of cancer was the same in the study and control counties; any number below 1.00 indicates that the overall risk was lower in the study county than in the control county; and any number greater than 1.00 indicates a higher risk in the study county. For example, an RR of 1.04 would indicate that there was a 4 percent higher risk of cancer death in the study county. Conversely, an RR of 0.93 would indicate a 7 percent lower risk in the study county.

For childhood leukemia in children from birth through age 9 years, the overall RR comparing study and control counties before the startup of the nuclear facilities was 1.08; after startup the RR was 1.03. These data indicate that the risk of childhood leukemia in the study counties was slightly greater before startup of the nuclear facilities than after. The risk of dying of childhood cancers other than leukemia increased slightly from an RR of 0.94 before the plants began operation to an RR of 0.99 after the plants began operating.

For leukemia at all ages, the RRs were 1.02 before startup and 0.98 after startup. For other cancer at all ages, the RRs were essentially the same: 1.00 before startup and 1.01 after startup. These results provide no evidence that the presence of nuclear facilities influenced cancer death rates in the study counties.

Questions and Answers
National Cancer Institute (NCI) Survey
Cancer Mortality in Populations Living Near Nuclear Facilities

1. **Which nuclear facilities were included in the survey?**

   Only major nuclear facilities that are or once were in operation and went into service before 1982 were included in the survey. All 52 commercial nuclear power facilities in the United States that started before 1982 were included. A facility may include more than one reactor.

   In addition to the commercial nuclear power facilities, nine U.S. Department of Energy (DOE) nuclear installations and one commercial fuel reprocessing plant were included. These facilities do not generate electrical power for commercial use.

   Facilities such as small research reactors at universities were not included. See the Appendix for a complete list of facilities.

2. **Why were the DOE facilities included?**

   In the British study that helped to prompt this survey, an excess of childhood leukemias was found mainly around nuclear installations that were involved in the enrichment, fabrication, and reprocessing of nuclear fuel or research and development of nuclear weapons. The DOE facilities included in the study are similar to these British facilities.

   Also, some DOE installations have been operating since 1943, which is longer than any commercial nuclear power plant in the United States. The first commercial nuclear power plant began operation in 1957.

   The DOE facilities were evaluated both as part of the total group of nuclear facilities and separately.

3. **Which counties were included in the survey?**

   All counties with a major nuclear facility that is or once was in operation and went into service before 1982 were included in the survey as study counties. Other adjacent counties that contain one-fifth of the land that lies within a 10-mile radius of these facilities were also included as study counties. In total, 107 counties were identified as study counties. See the Appendix for a complete list.

   For each study county, three control counties within the same geographic region that do not have or are not near nuclear facilities were identified for comparison. Control counties were chosen that were the most similar to study counties based on population size and socioeconomic characteristics such as race and income.

4. **What were the 16 types of cancer surveyed?**

   The following 16 types of cancer were surveyed: leukemia; all cancers other than leukemia (as a group); Hodgkin lymphoma; lymphomas other than Hodgkin lymphoma; multiple myeloma; cancers of the digestive organs (as a group and separately), including cancer of the stomach, colon and rectum, and liver; cancer of the trachea, bronchus, and lung; female breast cancer; thyroid cancer; cancer of the bone and joints; bladder cancer; brain and other central nervous system cancer; and other benign or unspecified tumors.

5. **Why was childhood leukemia a special focus of the analysis?**

   The excess risk identified in the British study pertained to leukemia deaths among persons under the age of 25. Leukemia is one of the major cancers induced by high doses of radiation and may occur as soon as 2 years after exposure. Other cancers associated with high-dose radiation may not develop until 10 years after exposure.

   Studies have also suggested that children are more sensitive to the cancer-producing effects of radiation than adults. Children may spend more time in and around the home than parents, whose jobs may take them to other areas. They are also more likely to come in close contact with the soil, upon which radioactive releases may have been deposited following discharges from the facilities.

6. **Why were cancer deaths (mortality) compared instead of the number of cancer cases that occurred (incidence)?**

   Although data on cancer incidence (the number of newly diagnosed cases in a given period of time) could provide a more complete evaluation of the possible impact of living near nuclear facilities, cancer incidence data for the entire Nation do not exist. The reporting of county mortality data by state provides nationwide data that can show important geographic and time-related patterns of cancer. In past NCI studies, mortality data have proven useful in developing clues about the causes of cancer and in targeting areas for future research.

   Cancer incidence data were available in two states (Iowa and Connecticut) for four facilities. The cancer registries that provided this information were among those that participate in the NCI Surveillance, Epidemiology, and End Results Program and are of high quality. Survey results using cancer incidence data resembled results using cancer mortality data.

7. **Did any individual county or plant have an excess risk of cancer death?**

   Overall, the risks for childhood leukemia, adult leukemia, and all cancers were about the same in the counties with nuclear installations as in the control counties. The areas around some facilities appeared to have higher risks of leukemia while others had lower risks. Generally, however, the differences are not large and are consistent with the random variations seen when making many comparisons based on geographic data.

   The county surrounding the Millstone Power Plant located in New London, Connecticut, had a significant excess of cases of leukemia in children under 10 years of age (shown in incidence statistics) in comparison to its control counties. The RR was 3.04 after startup of the facility. Upon review, the excess risk shown using incidence data arose partly from comparison with significantly low cancer rates in the control counties rather than from a high rate in the study county.

   No other excesses of childhood leukemia were found that could be linked to any of the nuclear facilities. Further, three facilities—San Onofre in Orange County and San Diego County, California; Quad Cities in Rock Island County and Whiteside County, Illinois; and Vermont Yankee in Windham County, Vermont—were marked by significant deficits in the RR for leukemia death at 10 to 19 years of age. The RRs were 0.75, 0.24, and 0.09, respectively.

8. **Is it possible that "chance" could explain some of the high or low relative risks observed in the survey?**

   Due to the large scope of the study and the many comparisons made, it could be expected that a number of "statistically significant" increased or decreased RRs would be observed due to chance alone. Further, significant variations in rates might also result from underlying differences in other cancer risk factors that have nothing to do with the presence of nuclear facilities. The prevalence of important risk factors, such as cigarette smoking and diet, might be the cause of many of the observed differences in cancer rates between study and control counties. As expected, comparisons of cancer rates in study and control counties showed substantial variation, but there was no general tendency for cancer rates to be higher after nuclear facilities began operating than before operation began.

9. **Did the counties with DOE facilities, individually or as a group, have an increased risk of cancer for the surrounding counties?**

   The findings for the DOE facilities were similar to those for the electricity-generating plants. There was no overall suggestion of cancer excesses that could be attributed to the presence of the DOE nuclear facilities. The lone commercial fuel reprocessing plant was included in the overall evaluation of DOE facilities.

   For these counties, the RRs for childhood leukemia (ages birth to 9 years) were 1.45 before the facilities began operation and 1.06 after opening. For all other childhood cancers, the RRs were 1.06 and 0.95 before and after operation began, respectively. For leukemia at all ages, the RRs were 1.07 before startup and 0.96 after startup. For other cancer at all ages, the RRs were essentially the same, 1.06 before startup and 1.04 after startup.

10. **Why was the study based on the county as the geographic unit?**

    The data for a study based on counties were readily available for the entire United States. NCI and the U.S. Environmental Protection Agency have prepared detailed data on cancer mortality by county since 1950. Population data, which are needed to calculate cancer rates, are also available by county. Thus, the county was the smallest geographic unit for which nationwide data could be quickly evaluated.

11. **Have similar county-based studies been valuable in the past?**

    Yes, surveys using methods that analyze county mortality patterns have been used effectively several times by NCI. Based on findings from NCI "cancer maps" constructed from county mortality statistics, a clustering of lung cancer deaths was seen among residents of counties along the southern Atlantic coast. Across the United States, counties with shipyard industries were found to have elevated rates of lung cancer deaths, particularly in men. Subsequent indepth studies of the high-risk areas linked the excess lung cancer deaths to asbestos and cigarette smoke exposure in shipyards, especially during World War II.

    In another study, mortality rates from lung cancer were found to be elevated among men and women living in counties with smelters and refineries that emitted arsenic. A previous NCI study had shown arsenic to cause lung cancer in smelter workers who were heavily exposed to the substance. Further analytical study of counties with smelters showed an elevated risk of lung cancer associated with residential exposure to arsenic released by smelters into the local environment.

    The county mortality surveys are often considered a first step toward directing future research efforts. These surveys also have their limitations. The county may be too large to detect risks present only in limited areas, death certificates are sometimes not accurate regarding the actual cause of death, and exposures to individuals are unknown.

12. **Would a study based on smaller geographic units be feasible?**

    Mortality and population data are not available on a national basis for areas smaller than counties. The data required for studies of small areas, such as cities or neighborhoods, are collected at the state or local level when they are available.

    Using the existing county mortality data, the survey took 3 years to complete. A national survey using data for areas smaller than counties would take much longer.

13. **Were the study design and results reviewed?**

    In addition to internal review, the design of the study was evaluated by an expert team of scientists from outside the U.S. Government who also reviewed the entire intramural research program of the Radiation Epidemiology Branch in the Division of Cancer Etiology (DCE), NCI.

    Because of the importance of clarifying any potential health hazards associated with living near nuclear facilities, a special advisory group was also established to help evaluate the study results. The advisory group consisted of selected members of DCE's Board of Scientific Counselors as well as other scientists from outside the U.S. Government with expertise in radiation epidemiology.

14. **What levels of radiation might be expected from the normal operation of most of the nuclear facilities studied?**

    Reported radioactive releases from monitored emissions of nuclear facilities in the United States show very low radiation exposure to the surrounding populations. Maximum individual radiation doses from these plants are reported to be less than 5 millirem annually, or less than 5 percent of what is received annually from natural background sources of radiation, such as cosmic rays and radon. Levels this low are believed to be too small to result in detectable harm. However, there have been high releases of radioactive emissions from some facilities, such as the Hanford facility (Benton, Franklin, and Grant Counties, Washington).

    It is important to distinguish between a major release of radioactivity from a reactor accident, such as the accident at Chernobyl in the former Soviet Union, and the small amounts of radiation that are likely to be emitted by nuclear facilities under normal operation.

15. **Will there be more research on the possible hazards of living near nuclear facilities?**

    The NCI county mortality survey is only the initial step in evaluating the possible hazards of living near nuclear facilities. The study provides background information that will complement that from other studies being conducted or planned by the Centers for Disease Control and Prevention, various state health departments, and other groups. Information gained from this survey and other ongoing projects will guide future research efforts.

    In its consensus statement, the ad hoc advisory committee that reviewed and evaluated this study has also recommended areas for further research.

The complete three-volume report titled *Cancer in Populations Living Near Nuclear Facilities* can be ordered from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402-9325. The GPO stock number is 017-042-00276-1.

Appendix
Facilities and Counties Included in the Study

State	County	Study Facility	Year of Startup
Alabama	Houston Lawrence Limestone	Farley Browns Ferry Browns Ferry	1977 1973 1973
Arkansas	Pope	Arkansas	1974
California	Amador Humboldt Orange Sacramento San Diego San Joaquin	Rancho Seco Humboldt Bay San Onofre Rancho Seco San Onofre Rancho Seco	1974 1963 1967 1974 1967 1974
Colorado	Boulder Jefferson Larimer	Fort St. Vrain *Rocky Flats *Rocky Flats Fort St. Vrain	1976 1953 1953 1976

	Weld	Fort St. Vrain	1976
Connecticut	Middlesex New London	Haddam Neck Millstone	1967 1970
Delaware	New Castle	Salem	1976
Florida	Citrus Dade St. Lucie	Crystal River Turkey Point St. Lucie	1977 1972 1976
Georgia	Appling Burke Early Toombs	Hatch *Savannah River Farley Hatch	1974 1950 1977 1974
Idaho	Bingham Butte Jefferson	*Idaho National Engineering Lab. *Idaho National Engineering Lab. *Idaho National Engineering Lab.	1949 1949 1949
Illinois	Grundy Lake Rock Island Whiteside Will	Dresden Zion Quad Cities Quad Cities Dresden	1960 1972 1972 1972 1960
Iowa	Benton Harrison Linn	Duane Arnold Fort Calhoun Duane Arnold	1974 1973 1974
Kentucky	Ballard McCracken	*Paducah Gas. Diff. *Paducah Gas. Diff.	1950 1950
Maine	Lincoln Sagadahoc	Maine Yankee Maine Yankee	1972 1972
Maryland	Calvert	Calvert Cliffs	1974
Massachusetts	Berkshire Franklin Plymouth	Yankee Rowe Vermont Yankee Yankee Rowe Pilgrim	1960 1972 1960 1972
Michigan	Berrien Charlevoix Emmet Monroe Vanburen	Cook Big Rock Point Big Rock Point Fermi Palisades	1975 1962 1962 1963 1971
Minnesota	Goodhue Sherburne Wright	Prairie Island Monticello Monticello	1973 1971 1971
Missouri	Atchinson	Cooper Station	1974
Nebraska	Gage Lancaster Nemaha Richardson Washington	Hallam Hallam Cooper Station Cooper Station Fort Calhoun	1962 1962 1974 1974 1973
New Hampshire	Chesire	Vermont Yankee	1972
New Jersey	Ocean Salem	Oyster Creek Salem	1969 1976
New York	Cattaraugus Oswego Rockland Wayne Westchester	**Nuclear Fuel Services Nine Mile Point/Fitzpatrick Indian Point Ginna Indian Point	1966 1969 1962 1969 1962
North Carolina	Brunswick Gaston Lincoln Mecklenburg	Brunswick McGuire McGuire McGuire	1975 1981 1981 1981
	Butler	*Fernald *Mound	1951 1947

Ohio	Hamilton Montgomery Ottawa Pike Warren	*Fernald *Mound Davis Besse *Portsmouth Gaseous Diffusion *Mound	1951 1947 1977 1952 1947
Oregon	Columbia	Trojan	1975
Pennsylvania	Beaver Dauphin Lancaster York	Shippingport/Beaver Valley Three Mile Island Peach Bottom Three Mile Island Peach Bottom Three Mile Island	1957 1974 1974 1974 1974 1974
South Carolina	Aiken Barnwell Chesterfield Darlington Oconee Pickens	*Savannah River *Savannah River Robinson Robinson Oconee Oconee	1950 1950 1970 1970 1973 1973
South Dakota	Lincoln Minnehaha	Pathfinder Pathfinder	1964 1964
Tennessee	Anderson Hamilton Roane	*Oak Ridge Sequoyah *Oak Ridge	1943 1980 1943
Virginia	Caroline Hanover Isle of Wright Louisa Surry	North Anna North Anna Surry North Anna Surry	1978 1978 1972 1978 1972
Vermont	Windham	Vermont Yankee	1972
Washington	Benton Cowlitz Franklin Grant	*Hanford Trojan *Hanford *Hanford	1943 1975 1943 1943
Wisconsin	Kenosha Kewaunee Manitowoc Pierce Vernon	Zion Kewaunee Point Beach Kewaunee Point Beach Prairie Island La Crosse (Genoa)	1972 1973 1970 1973 1970 1973 1967
West Virginia	Hancock	Shippingport/Beaver Valley	1957

*Department of Energy Facility
**Commercial fuel reprocessing plant

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Related NCI materials and Web pages:

- Radioactive I–131 from Fallout Web Page (http://www.cancer.gov/cancertopics/causes/i131)

How can we help?

We offer comprehensive research-based information for patients and their families, health professionals, cancer researchers, advocates, and the public.

- ***Call*** NCI's Cancer Information Service at 1–800–4–CANCER (1–800–422–6237)
- ***Visit*** us at http://www.cancer.gov or http://www.cancer.gov/espanol
- ***Chat*** using LiveHelp, NCI's instant messaging service, at http://www.cancer.gov/livehelp
- ***E-mail*** us at cancergovstaff@mail.nih.gov
- ***Order*** publications at http://www.cancer.gov/publications or by calling 1–800–4–CANCER
- ***Get help*** with quitting smoking at 1–877–44U–QUIT (1–877–448–7848)

[1]"Cancer Near Nuclear Installations," David Forman, Paula Cook-Mozaffari, Sarah Darby, et al. *Nature,* October 8, 1987.

APPENDIX E – POPULATION PROJECTIONS, HAMILTON COUNTY, TENNESSEE

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POPULATION PROJECTIONS FOR THE STATE OF TENNESSEE, 2010-2030

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and
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Overview

OVERVIEW

This report contains population projections for Tennessee cities and counties in five-year intervals from 2010 to 2030. The purpose of the projections is to aid in local planning efforts, such as those outlined in Public Chapter 1101 (PC1101).

The Center for Business and Economic Research (CBER) previously released population projections for cities, counties and unincorporated areas in 1998 and 2003. Both the 2003 and 2009 projections use the *cohort component* method to determine future population trends. This approach models the components of population change, including births, deaths, and migration, and results in population counts by sex and 5-year age group. Because of space limitations, only population totals for the state, county or place are included in this report. Further details on this model may be found in the Technical Appendix.

Like the previous study, this study uses county-level population projections to control both the state and city-level population counts. In other words, first county population projections are created. The county results are summed together to create the state population projections. In both studies, the city-level projections were weighted so that they were equal to the county totals.

There are some notable differences between the current approach and previous efforts. In the 2003 study, city-level Census data for 2000, 2001 and 2002, were used to assign a share of the county estimates to each city. The current approach uses the cohort component method on the city-level data rather than disaggregating these estimates from county totals. The population projections are generated in four steps. First, a range of fertility and mortality rates are used to predict the number of births and deaths in each county between 2000 and 2004. The fertility/mortality rate that is selected is the one that results in the smallest difference between predicted births/deaths and actual births/deaths over the 2000 to 2004 time period. Second, county-level projections are created using the cohort component method. Third, we apply the cohort component method to the place population as reported in the 2000 Census. Finally, the city-level projections are re-weighted so they are consistent with the county-level population projections.

Population projections rely on using fertility, mortality and migration rates from the past that will likely persist in the future. Unlike fertility and mortality rates, which exhibit largely consistent trends, migration patterns are extremely difficult to predict. While migration is always volatile, the recent changes that both the national and state economy have experienced will no doubt impact migration patterns in the near-term, and perhaps in the long-term as well. In many counties, the fertility rate is not high enough to sustain population growth in the absence of migration, making the number of new migrants especially important in determining future changes in the community. The population projections presented in this report rely on the migration patterns in Tennessee from 1990 to 2005. The more future migration, fertility or mortality diverges from the recent past, the less accurate population projections will be.

Because future migration is so difficult to determine over the long term, migration rates in this study are dampened from 2015 onwards. The Census uses the same process when creating their long-term population projections. The purpose is to lessen the effects of particularly high and low migration rates, both of which are unlikely to persist over a long time period. One of the consequences of reducing migration rates can be population decreases after a period of population growth. Decreasing migration rates are not the sole cause of population decline. In many counties, fertility rates have declined, and deaths exceed or will exceed births. Both changes in migration and changes in a county's age structure – which impacts the number of women of child-bearing age – can impact whether there is population growth or decline.

OVERVIEW

The projections included in this report rely exclusively on population measures – an initial population from the 2000 Census, and historic fertility, mortality and migration rates. Because of this, important factors such as space constraints for new housing, zoning rules, water availability, and road capacity in no way limit population numbers. Just as these factors do not limit growth, neither do they generate growth. The population projections will be most in error in those counties and cities where new industries or housing developments alter the prevailing migration rates of the last 15 years.

In addition to providing projections at the level of cities, CBER also explored creating population projections for individual PC1101 regions, such as municipalities, urban growth boundaries, planned growth areas and rural areas. There were two major obstacles that precluded the creation of population projections in this format. First, there is no straightforward way to ensure that the original PC1101 maps, which were submitted to the Local Government Planning Advisory Committee as paper maps, are drawn so that the Census population captured by the municipalities, urban growth boundaries, planned growth areas and rural areas are the way map-makers intended. Second, it was impossible to make certain that the paper PC1101 maps have been faithfully translated into digital maps. There are good reasons to believe that one or both of these assumptions will not hold true for every county or PC1101 area. More importantly, it is impossible to systematically evaluate areas where these assumptions hold true, and areas where they do not. For this reason, only population projections by municipalities are being released.

Data are available online at:

Center for Business and Economic Research
http://cber.bus.utk.edu/

and

Tennessee Advisory Commission on Intergovernmental Relations
http://www.tennessee.gov/tacir/population.html

Aggregate Projections for Tennessee

AGGREGATE PROJECTIONS FOR TENNESSEE

	Census		Projections				
	2000	2005	2010	2015	2020	2025	2030
Tennessee	5,689,283	5,989,309	6,229,564	6,600,486	6,860,231	7,130,776	7,397,302

Notes: 2005 data are Vintage 2007 Census Bureau intercensal estimates.
The updated projections supplant the state totals reported in the *2009 Economic Report to the Governor*.

Aggregate Projections for Counties

AGGREGATE PROJECTIONS FOR COUNTIES

	Census		Projections				
County	2000	2005	2010	2015	2020	2025	2030
Anderson	71,330	71,801	72,220	73,085	73,382	72,657	71,627
Bedford	37,586	41,963	45,891	52,552	57,529	62,364	67,456
Benton	16,537	16,274	16,098	15,981	15,784	15,938	15,994
Bledsoe	12,367	12,728	13,076	13,664	14,019	14,819	15,624
Blount	105,823	115,261	123,830	140,045	151,018	157,827	164,211
Bradley	87,965	92,288	95,755	100,980	104,536	108,917	113,241
Campbell	39,854	40,436	41,212	42,584	43,379	43,878	44,160
Cannon	12,826	13,156	13,446	13,991	14,317	14,958	15,535
Carroll	29,475	28,731	28,620	28,529	28,398	28,387	28,281
Carter	56,742	58,684	60,732	64,940	67,605	67,878	67,816
Cheatham	35,912	38,053	39,987	42,694	44,609	47,580	50,494
Chester	15,540	15,877	16,093	16,450	16,661	17,694	18,649
Claiborne	29,862	30,845	31,607	33,071	33,924	34,115	34,109
Clay	7,976	7,946	7,969	8,076	8,097	8,162	8,182
Cocke	33,565	34,741	35,858	38,002	39,289	39,699	39,897
Coffee	48,014	50,690	53,078	57,201	60,017	62,288	64,520
Crockett	14,532	14,304	14,160	13,815	13,573	13,945	14,292
Cumberland	46,802	50,912	54,251	61,112	65,343	68,231	71,249
Davidson	569,891	607,413	641,948	697,660	736,606	750,208	764,142
Decatur	11,731	11,415	11,283	11,133	10,975	11,096	11,175
DeKalb	17,423	18,214	19,038	20,551	21,579	22,707	23,770
Dickson	43,156	45,710	48,096	51,681	54,281	57,096	59,765
Dyer	37,279	37,605	37,831	37,777	37,735	38,216	38,555
Fayette	28,806	34,023	38,848	47,925	54,051	54,901	55,301
Fentress	16,625	17,037	17,371	18,003	18,342	18,455	18,477
Franklin	39,270	40,557	41,779	44,103	45,531	46,833	48,035
Gibson	48,152	47,889	48,054	48,455	48,684	48,995	49,210
Giles	29,447	29,097	28,741	28,083	27,515	27,917	28,162
Grainger	20,659	22,109	23,274	25,366	26,761	27,669	28,443
Greene	62,909	64,864	66,414	69,402	71,155	72,185	73,024
Grundy	14,332	14,348	14,382	14,311	14,272	14,363	14,403
Hamblen	58,128	60,017	61,368	62,980	64,053	65,974	67,887
Hamilton	307,896	323,426	326,104	327,665	328,290	329,514	329,365
Hancock	6,786	6,704	6,660	6,605	6,540	6,420	6,276
Hardeman	28,105	27,832	27,719	27,092	26,695	27,778	28,726
Hardin	25,578	25,810	25,953	26,440	26,590	26,578	26,391
Hawkins	53,563	56,014	58,261	62,139	64,667	67,135	69,390
Haywood	19,797	19,399	19,540	19,390	19,350	19,420	19,409
Henderson	25,522	26,173	26,691	27,472	27,999	29,144	30,202
Henry	31,115	31,324	31,516	32,146	32,475	33,113	33,638
Hickman	22,295	23,392	24,673	26,894	28,470	30,999	33,618
Houston	8,088	7,936	7,853	7,654	7,506	7,793	8,055
Humphreys	17,929	17,941	17,952	17,876	17,764	18,186	18,565
Jackson	10,984	10,984	11,100	11,446	11,606	11,954	12,226
Jefferson	44,294	47,913	51,161	57,278	61,411	67,550	74,328

AGGREGATE PROJECTIONS FOR COUNTIES

	Census		Projections				
County	2000	2005	2010	2015	2020	2025	2030
Johnson	17,499	18,058	18,651	19,964	20,747	20,951	21,082
Knox	382,032	409,116	425,233	453,164	471,912	482,461	491,100
Lake	7,954	7,521	7,473	7,390	7,344	7,389	7,421
Lauderdale	27,101	26,576	26,250	24,917	24,078	25,141	26,161
Lawrence	39,926	40,695	41,485	42,215	42,825	44,387	45,916
Lewis	11,367	11,341	11,425	11,463	11,471	12,062	12,620
Lincoln	31,340	32,146	32,753	33,815	34,466	35,024	35,463
Loudon	39,086	43,242	46,760	53,496	57,763	59,643	61,283
McMinn	49,015	51,069	52,729	55,680	57,607	59,300	60,827
McNairy	24,653	25,087	25,434	25,944	26,262	26,850	27,412
Macon	20,386	21,239	22,170	23,750	24,848	26,666	28,460
Madison	91,837	94,927	97,740	101,133	103,784	108,160	112,259
Marion	27,776	27,742	27,827	27,702	27,504	27,591	27,518
Marshall	26,767	28,053	29,231	31,014	32,323	34,590	36,822
Maury	69,498	75,535	81,235	90,865	97,790	103,893	109,908
Meigs	11,086	11,450	11,798	12,337	12,680	13,868	15,126
Monroe	38,961	42,898	46,262	52,194	56,281	60,039	63,870
Montgomery	134,768	147,657	154,663	161,852	167,895	183,707	199,942
Moore	5,740	5,990	6,213	6,589	6,827	7,213	7,596
Morgan	19,757	20,070	20,488	21,071	21,438	21,865	22,172
Obion	32,450	31,855	31,094	29,397	28,034	27,985	27,851
Overton	20,118	20,460	20,813	21,546	21,963	22,513	23,016
Perry	7,631	7,595	7,581	7,536	7,480	7,762	8,026
Pickett	4,945	4,819	4,747	4,647	4,544	4,507	4,454
Polk	16,050	15,771	15,453	14,745	14,199	14,686	15,133
Putnam	62,315	67,102	70,627	77,372	81,792	85,630	89,576
Rhea	28,400	29,724	30,852	32,650	33,862	35,246	36,670
Roane	51,910	52,624	53,550	55,636	56,776	56,832	56,604
Robertson	54,433	59,938	64,972	73,002	78,938	85,690	92,591
Rutherford	182,023	219,839	251,596	307,184	347,974	383,836	420,465
Scott	21,127	21,699	22,173	22,578	22,890	23,605	24,237
Sequatchie	11,370	12,710	13,848	15,857	17,243	18,348	19,454
Sevier	71,170	79,593	86,374	98,578	106,928	115,878	124,788
Shelby	897,472	905,399	910,776	887,968	875,972	892,254	905,818
Smith	17,712	18,473	19,104	20,214	20,968	22,205	23,365
Stewart	12,370	12,887	13,168	13,702	14,032	15,315	16,696
Sullivan	153,048	152,092	150,962	149,343	147,465	145,737	143,378
Sumner	130,449	143,892	155,925	176,163	190,388	201,263	211,946
Tipton	51,271	55,202	58,187	62,837	66,124	71,161	76,138
Trousdale	7,259	7,429	7,472	7,526	7,544	7,932	8,297
Unicoi	17,667	17,581	17,663	18,108	18,252	17,959	17,561
Union	17,808	18,660	19,546	20,906	21,844	23,422	25,026
Van Buren	5,508	5,377	5,228	4,900	4,642	4,657	4,628
Warren	38,276	39,264	40,346	41,663	42,684	44,641	46,584
Washington	107,198	112,724	116,725	124,487	129,326	133,355	137,005

AGGREGATE PROJECTIONS FOR COUNTIES

	Census		Projections				
County	2000	2005	2010	2015	2020	2025	2030
Wayne	16,842	16,718	16,782	16,843	16,820	17,449	18,025
Weakley	34,895	33,541	31,686	28,328	25,974	26,175	26,290
White	23,102	24,260	25,282	27,303	28,620	29,357	30,044
Williamson	126,638	152,062	174,485	213,234	241,933	276,716	318,873
Wilson	88,809	99,771	109,234	125,379	136,792	146,324	155,930

Note: 2005 data are Vintage 2007 Census Bureau intercensal estimates.

Tennessee Advisory Commission on Intergovernmental Relations (TACIR)

Appendix E

Harry A. Green, Executive Director

Population Projections for the State of Tennessee

TACIR, in conjunction with The University of Tennessee Center for Business and Economic Re (CBER), has published new population projections for Tennessee cities and counties in five-ye from 2010 to 2030. The purpose of the projections is to aid in local planning efforts, such as th in Public Chapter 1101 (PC1101). The projections are available below.

- State and County Population Projections by Gender and Age Group EXCEL *(released b March 19, 2010)*

Revisions for aggregate projections for municipalities will be forthcoming from CBER.

- Aggregate Projections for Municipalities* Arrayed by County HTML | EXCEL
- Aggregate Projections for Municipalities* Alphabetically HTML | EXCEL
- Aggregate Projections for Municipalities* by Development District HTML | EXCEL

**Does not include the effects of annexations after 2000.*

Word of Caution

Users of this data should be aware that population projections such as these rely on a number of assu the continuation of past trends into the future. When using population projections such as these, peopl encouraged to use them as a guide illustrating a general possible scenario of future growth patterns. A projections are based on a mathematical model using sound scientific principles, ultimately, the overall these projections will depend on the extent to which future events unfold in a manner that mirrors these observations. Different projections using different assumptions will inevitable yield different results. In a may be people with specific knowledge or understanding of events and factors that may affect their loc that could result in a more complete understanding of the growth dynamic affecting their community. ***Tl caution users not to construe these figures as predicting a specific or inevitable future course*** *Instead, the numbers contained within this report should be read as a likely course of future population on a continuation of past trends. Population projections such as these are simply one of a number of to planners and local community leaders should consider when envisioning the future for their communitie*

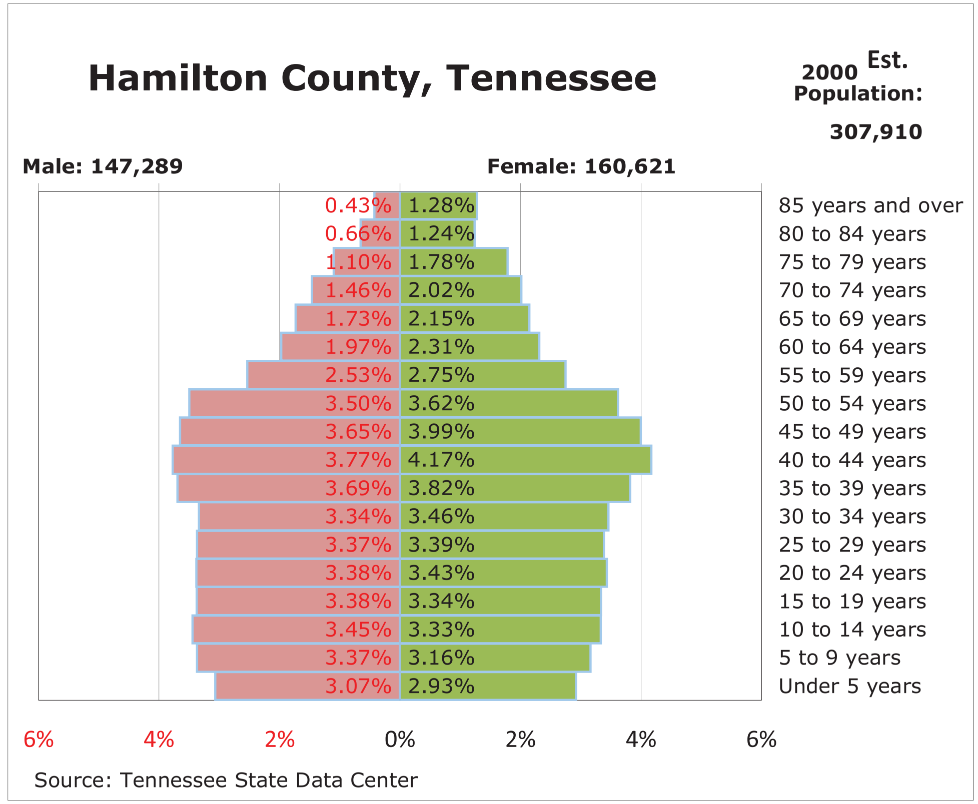
TACIR 226 Capitol Boulevard Building Suite 508 Nashville, TN 37243 (615) 741-3012 ta

Hamilton County, Tennessee **2000**

Total Population: 307,910

Male:	147,289	Female:	160,621
Under 5 years	9,440	Under 5 years	9,007
5 to 9 years	10,369	5 to 9 years	9,733
10 to 14 years	10,610	10 to 14 years	10,268
15 to 19 years	10,396	15 to 19 years	10,272
20 to 24 years	10,404	20 to 24 years	10,571
25 to 29 years	10,378	25 to 29 years	10,430
30 to 34 years	10,277	30 to 34 years	10,647
35 to 39 years	11,368	35 to 39 years	11,773
40 to 44 years	11,613	40 to 44 years	12,844
45 to 49 years	11,236	45 to 49 years	12,299
50 to 54 years	10,767	50 to 54 years	11,147
55 to 59 years	7,805	55 to 59 years	8,453
60 to 64 years	6,076	60 to 64 years	7,118
65 to 69 years	5,334	65 to 69 years	6,613
70 to 74 years	4,495	70 to 74 years	6,210
75 to 79 years	3,393	75 to 79 years	5,495
80 to 84 years	2,018	80 to 84 years	3,811
85 years and over	1,310	85 years and over	3,930

Source: Tennessee State Data Center (http://cber.bus.utk.edu/)

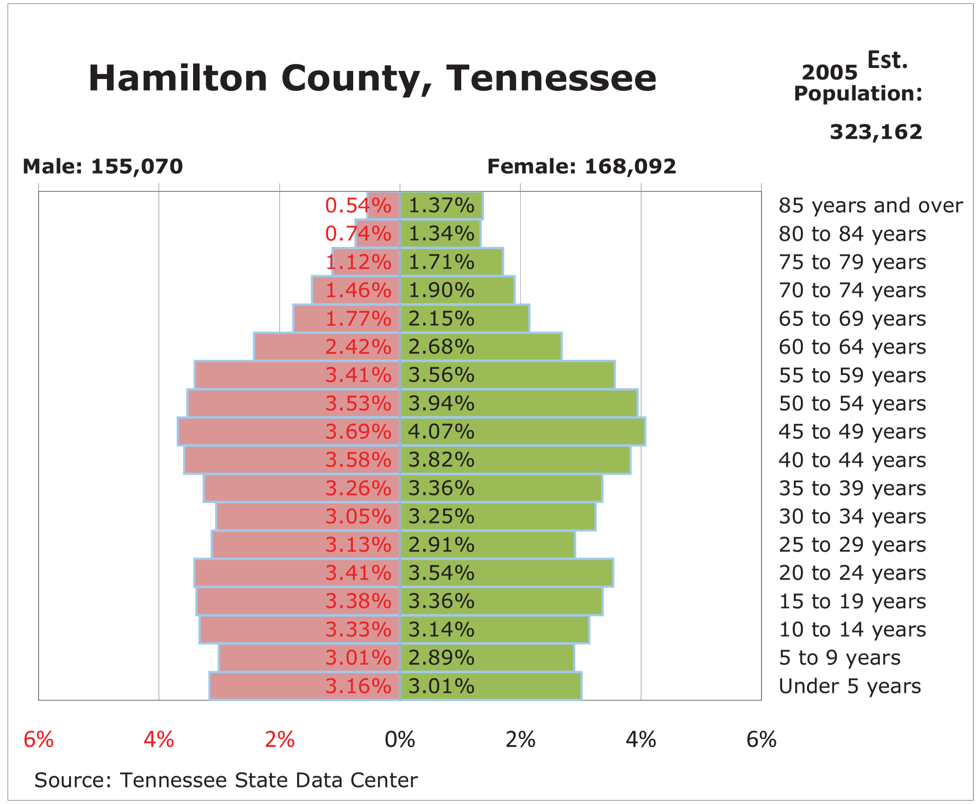


Hamilton County, Tennessee **2005**

Total Population: 323,162

Male:	155,070	Female:	168,092
Under 5 years	10,214	Under 5 years	9,731
5 to 9 years	9,714	5 to 9 years	9,342
10 to 14 years	10,757	10 to 14 years	10,148
15 to 19 years	10,922	15 to 19 years	10,866
20 to 24 years	11,034	20 to 24 years	11,439
25 to 29 years	10,103	25 to 29 years	9,397
30 to 34 years	9,850	30 to 34 years	10,487
35 to 39 years	10,535	35 to 39 years	10,853
40 to 44 years	11,573	40 to 44 years	12,357
45 to 49 years	11,914	45 to 49 years	13,153
50 to 54 years	11,399	50 to 54 years	12,744
55 to 59 years	11,011	55 to 59 years	11,519
60 to 64 years	7,833	60 to 64 years	8,668
65 to 69 years	5,721	65 to 69 years	6,937
70 to 74 years	4,722	70 to 74 years	6,147
75 to 79 years	3,625	75 to 79 years	5,532
80 to 84 years	2,394	80 to 84 years	4,332
85 years and over	1,749	85 years and over	4,440

Source: Tennessee State Data Center (http://cber.bus.utk.edu/)

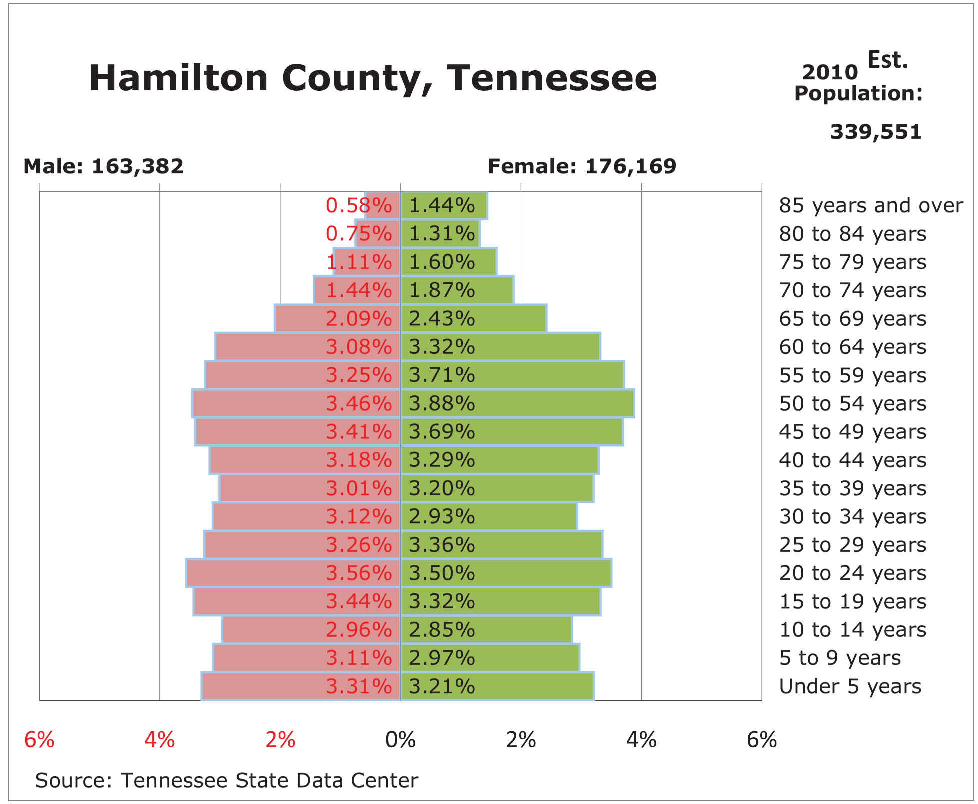


Hamilton County, Tennessee **2010**

Total Population: 339,551

Male:	163,382	Female:	176,169
Under 5 years	11,230	Under 5 years	10,903
5 to 9 years	10,568	5 to 9 years	10,079
10 to 14 years	10,059	10 to 14 years	9,673
15 to 19 years	11,681	15 to 19 years	11,287
20 to 24 years	12,099	20 to 24 years	11,888
25 to 29 years	11,061	25 to 29 years	11,392
30 to 34 years	10,588	30 to 34 years	9,946
35 to 39 years	10,215	35 to 39 years	10,882
40 to 44 years	10,781	40 to 44 years	11,167
45 to 49 years	11,583	45 to 49 years	12,543
50 to 54 years	11,753	50 to 54 years	13,176
55 to 59 years	11,020	55 to 59 years	12,599
60 to 64 years	10,457	60 to 64 years	11,259
65 to 69 years	7,097	65 to 69 years	8,235
70 to 74 years	4,898	70 to 74 years	6,366
75 to 79 years	3,772	75 to 79 years	5,418
80 to 84 years	2,537	80 to 84 years	4,457
85 years and over	1,983	85 years and over	4,899

Source: Tennessee State Data Center (http://cber.bus.utk.edu/)

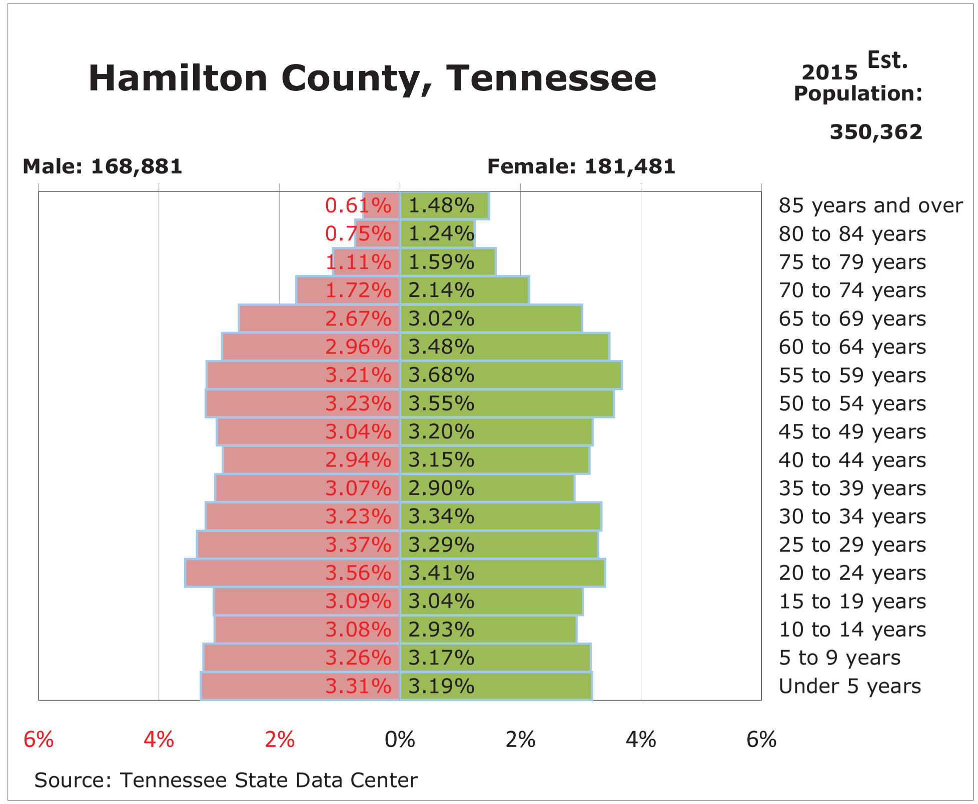


Hamilton County, Tennessee **2015**

Total Population: 350,362

Male:	168,881	Female:	181,481
Under 5 years	11,588	Under 5 years	11,176
5 to 9 years	11,430	5 to 9 years	11,097
10 to 14 years	10,783	10 to 14 years	10,280
15 to 19 years	10,830	15 to 19 years	10,657
20 to 24 years	12,487	20 to 24 years	11,944
25 to 29 years	11,803	25 to 29 years	11,524
30 to 34 years	11,307	30 to 34 years	11,704
35 to 39 years	10,750	35 to 39 years	10,149
40 to 44 years	10,295	40 to 44 years	11,023
45 to 49 years	10,658	45 to 49 years	11,215
50 to 54 years	11,308	50 to 54 years	12,445
55 to 59 years	11,255	55 to 59 years	12,908
60 to 64 years	10,355	60 to 64 years	12,178
65 to 69 years	9,369	65 to 69 years	10,592
70 to 74 years	6,035	70 to 74 years	7,499
75 to 79 years	3,885	75 to 79 years	5,575
80 to 84 years	2,611	80 to 84 years	4,340
85 years and over	2,132	85 years and over	5,175

Source: Tennessee State Data Center (http://cber.bus.utk.edu/)



Hamilton County, Tennessee **2020**

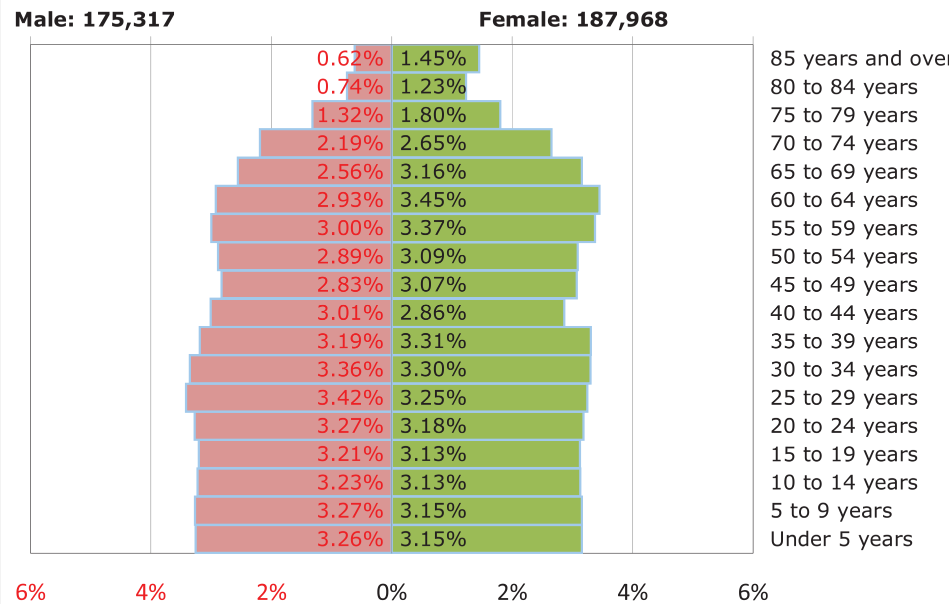
Total Population: 363,285

Male:	175,317	Female:	187,968
Under 5 years	11,834	Under 5 years	11,460
5 to 9 years	11,877	5 to 9 years	11,461
10 to 14 years	11,719	10 to 14 years	11,373
15 to 19 years	11,646	15 to 19 years	11,357
20 to 24 years	11,889	20 to 24 years	11,562
25 to 29 years	12,407	25 to 29 years	11,800
30 to 34 years	12,192	30 to 34 years	11,987
35 to 39 years	11,577	35 to 39 years	12,015
40 to 44 years	10,922	40 to 44 years	10,398
45 to 49 years	10,273	45 to 49 years	11,162
50 to 54 years	10,485	50 to 54 years	11,216
55 to 59 years	10,888	55 to 59 years	12,253
60 to 64 years	10,628	60 to 64 years	12,527
65 to 69 years	9,295	65 to 69 years	11,467
70 to 74 years	7,951	70 to 74 years	9,629
75 to 79 years	4,787	75 to 79 years	6,551
80 to 84 years	2,701	80 to 84 years	4,478
85 years and over	2,246	85 years and over	5,272

Source: Tennessee State Data Center (http://cber.bus.utk.edu/)

Hamilton County, Tennessee

2020 Est. Population: 363,285



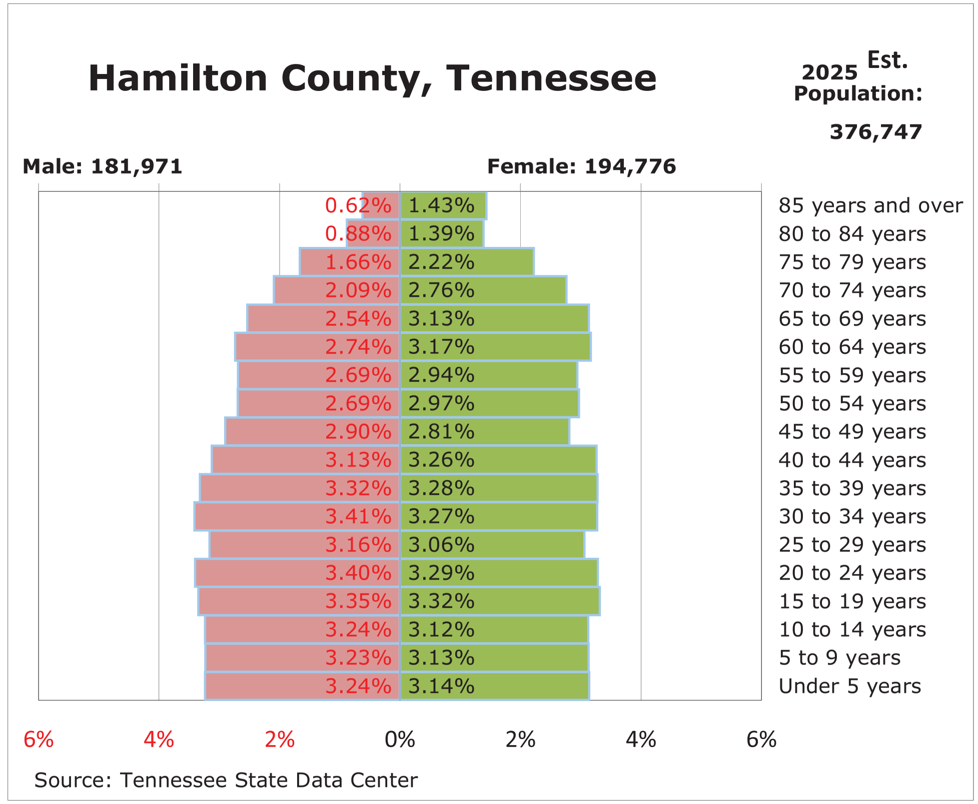
Source: Tennessee State Data Center

Hamilton County, Tennessee **2025**

Total Population: 376,747

Male:	181,971	Female:	194,776
Under 5 years	12,195	Under 5 years	11,828
5 to 9 years	12,167	5 to 9 years	11,788
10 to 14 years	12,202	10 to 14 years	11,772
15 to 19 years	12,623	15 to 19 years	12,493
20 to 24 years	12,816	20 to 24 years	12,378
25 to 29 years	11,923	25 to 29 years	11,526
30 to 34 years	12,861	30 to 34 years	12,334
35 to 39 years	12,506	35 to 39 years	12,352
40 to 44 years	11,781	40 to 44 years	12,297
45 to 49 years	10,926	45 to 49 years	10,588
50 to 54 years	10,147	50 to 54 years	11,196
55 to 59 years	10,133	55 to 59 years	11,086
60 to 64 years	10,317	60 to 64 years	11,926
65 to 69 years	9,553	65 to 69 years	11,804
70 to 74 years	7,887	70 to 74 years	10,412
75 to 79 years	6,271	75 to 79 years	8,362
80 to 84 years	3,317	80 to 84 years	5,232
85 years and over	2,346	85 years and over	5,402

Source: Tennessee State Data Center (http://cber.bus.utk.edu/)

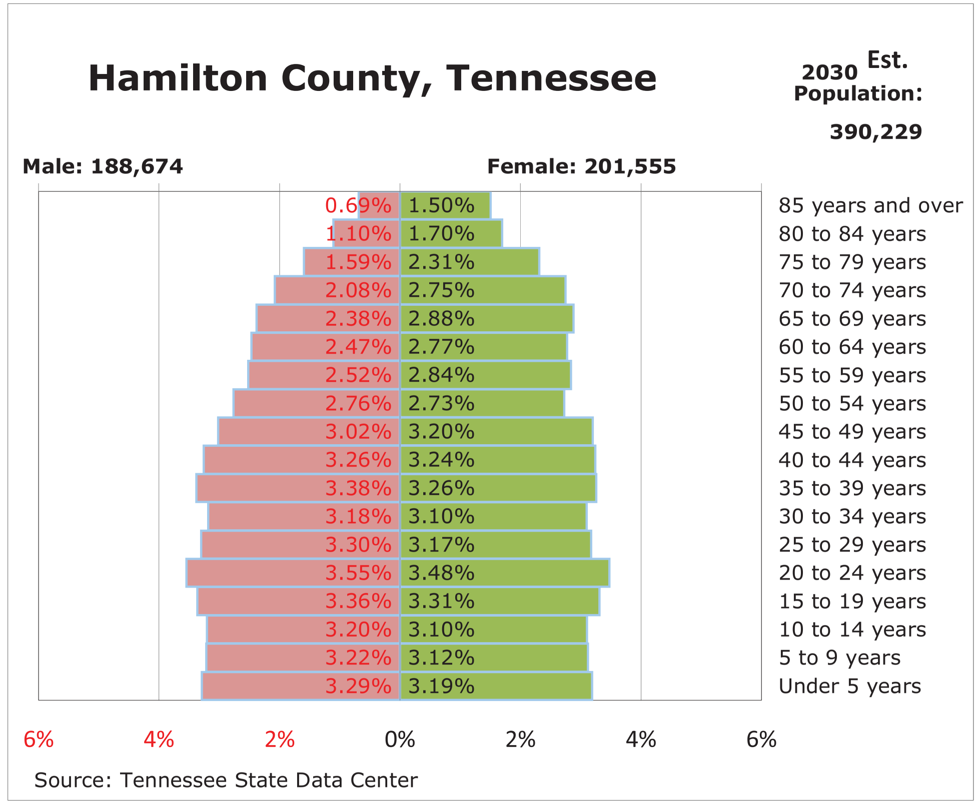


Hamilton County, Tennessee **2030**

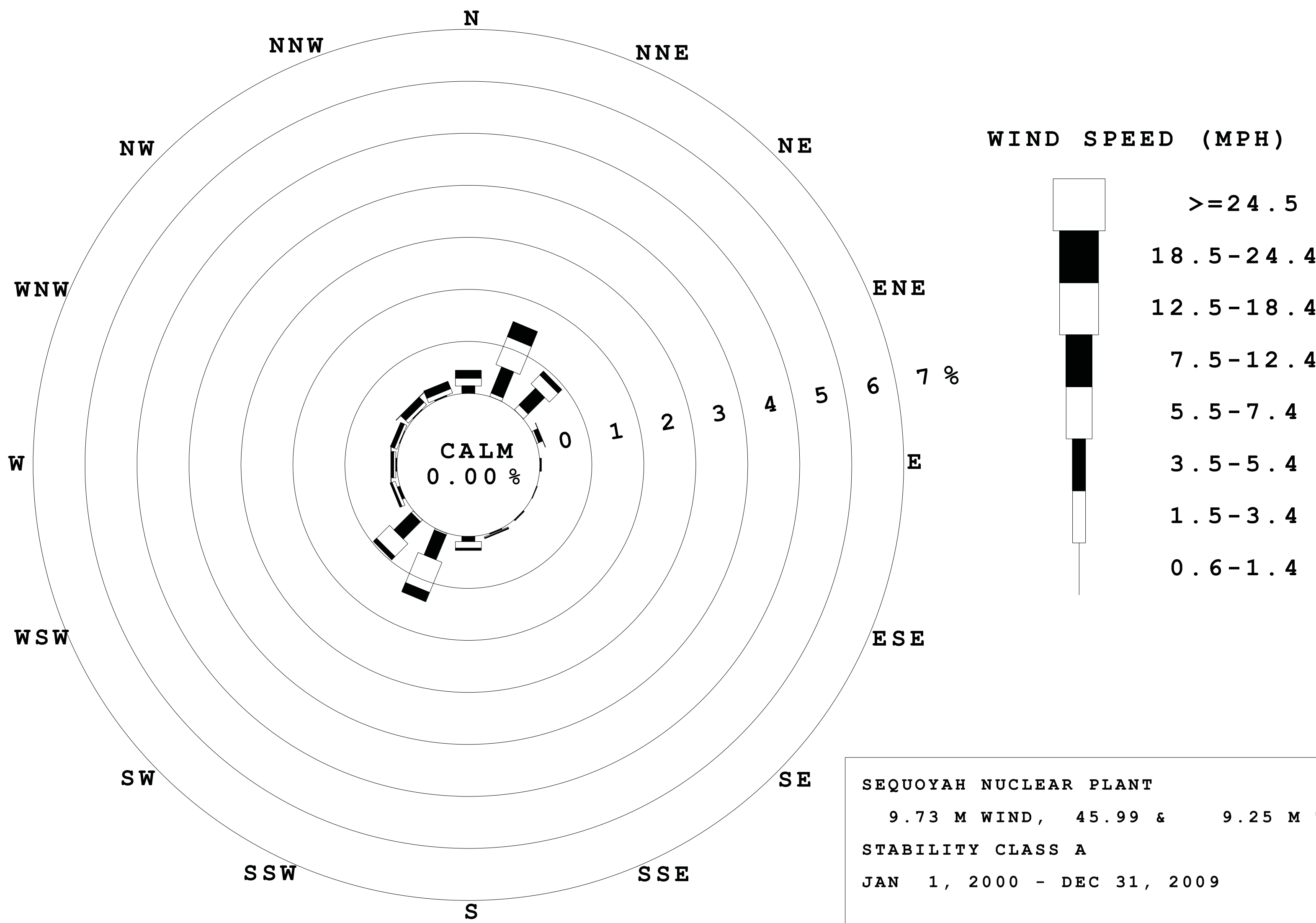
Total Population: 390,229

Male:	188,674	Female:	201,555
Under 5 years	12,836	Under 5 years	12,449
5 to 9 years	12,546	5 to 9 years	12,174
10 to 14 years	12,506	10 to 14 years	12,114
15 to 19 years	13,123	15 to 19 years	12,910
20 to 24 years	13,835	20 to 24 years	13,562
25 to 29 years	12,887	25 to 29 years	12,386
30 to 34 years	12,415	30 to 34 years	12,094
35 to 39 years	13,191	35 to 39 years	12,721
40 to 44 years	12,714	40 to 44 years	12,651
45 to 49 years	11,778	45 to 49 years	12,481
50 to 54 years	10,788	50 to 54 years	10,645
55 to 59 years	9,822	55 to 59 years	11,078
60 to 64 years	9,632	60 to 64 years	10,825
65 to 69 years	9,286	65 to 69 years	11,247
70 to 74 years	8,110	70 to 74 years	10,715
75 to 79 years	6,217	75 to 79 years	9,016
80 to 84 years	4,312	80 to 84 years	6,621
85 years and over	2,676	85 years and over	5,866

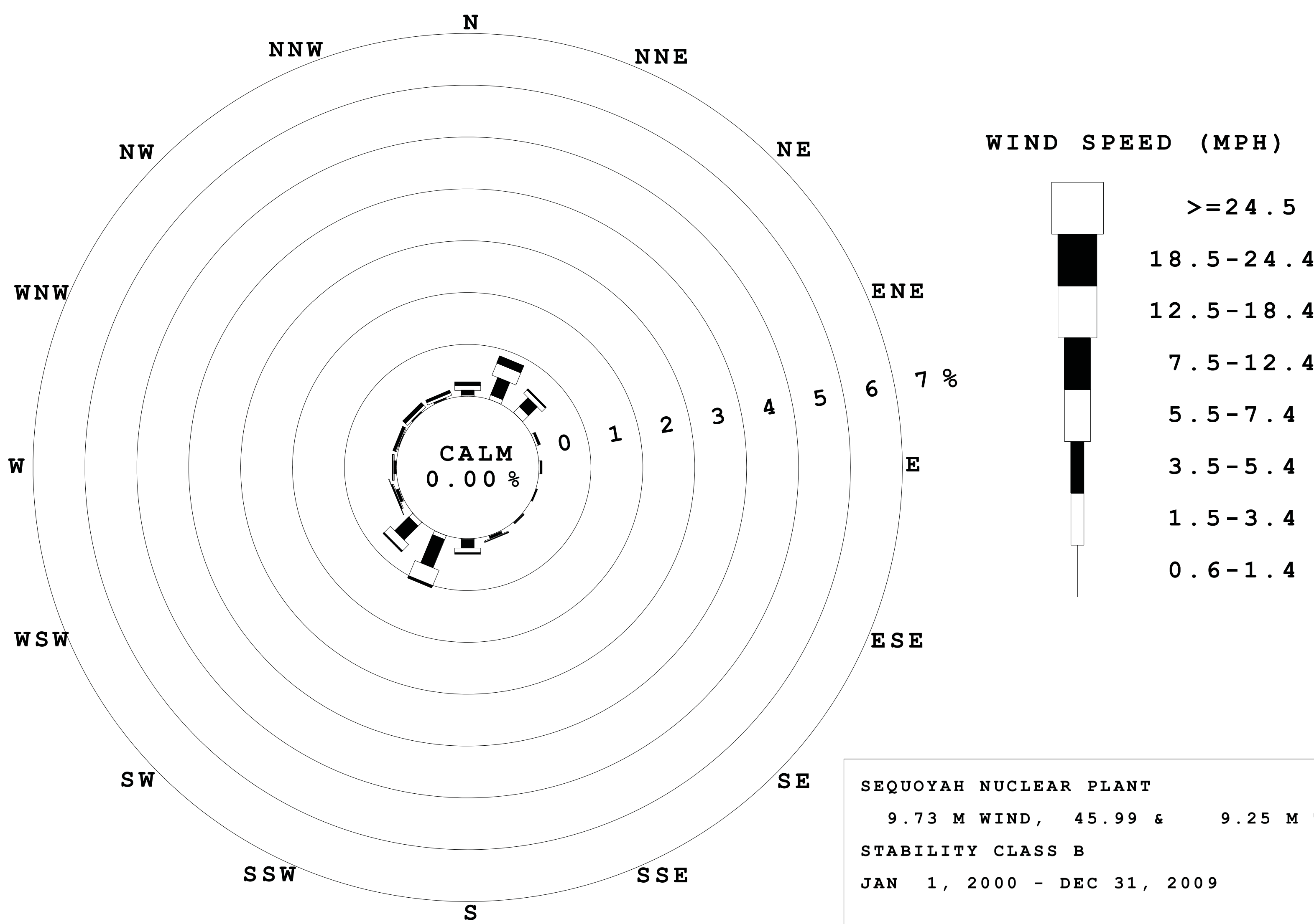
Source: Tennessee State Data Center (http://cber.bus.utk.edu/)



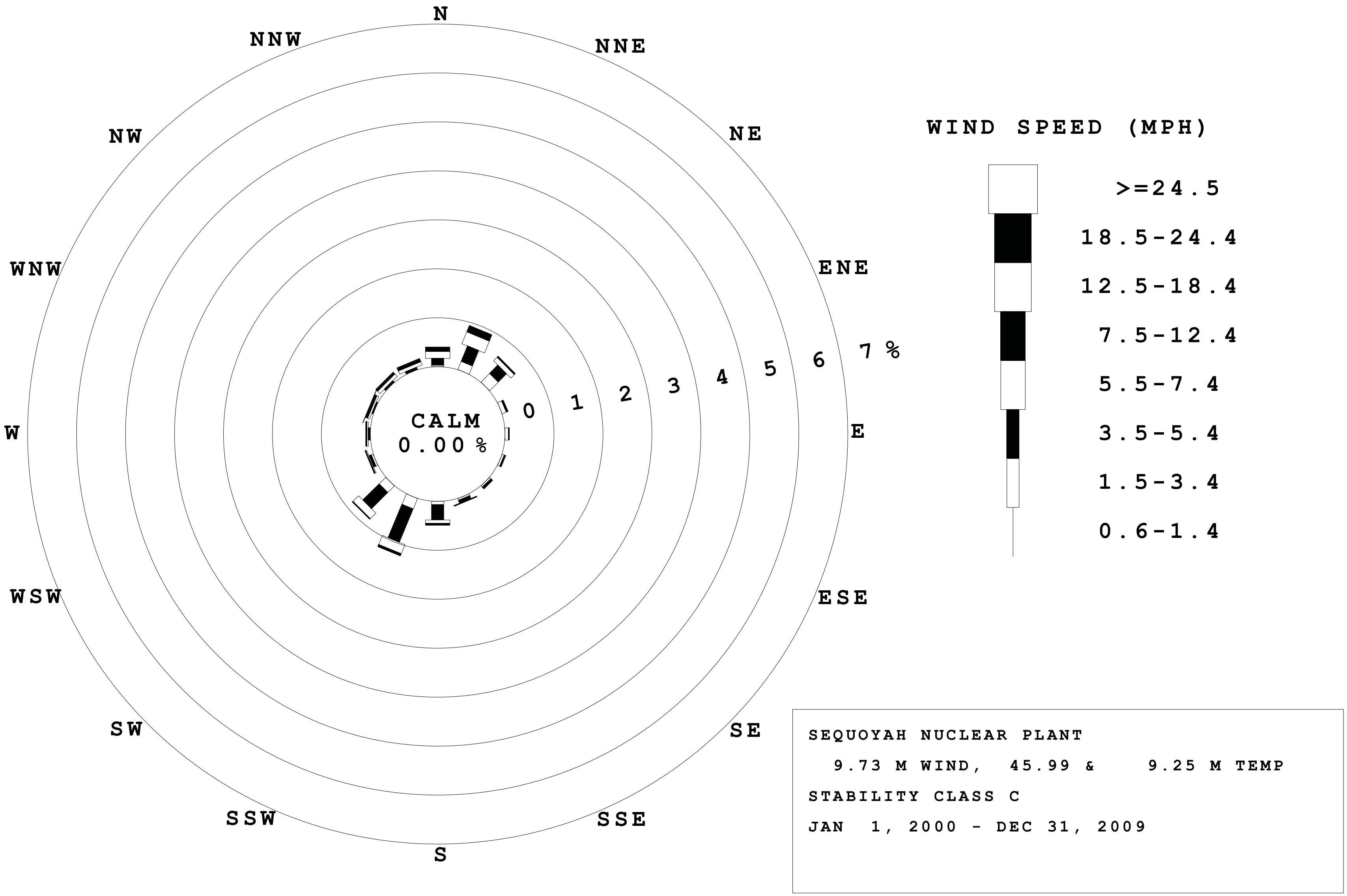
APPENDIX F – METEOROLOGICAL DATA SUMMARIES

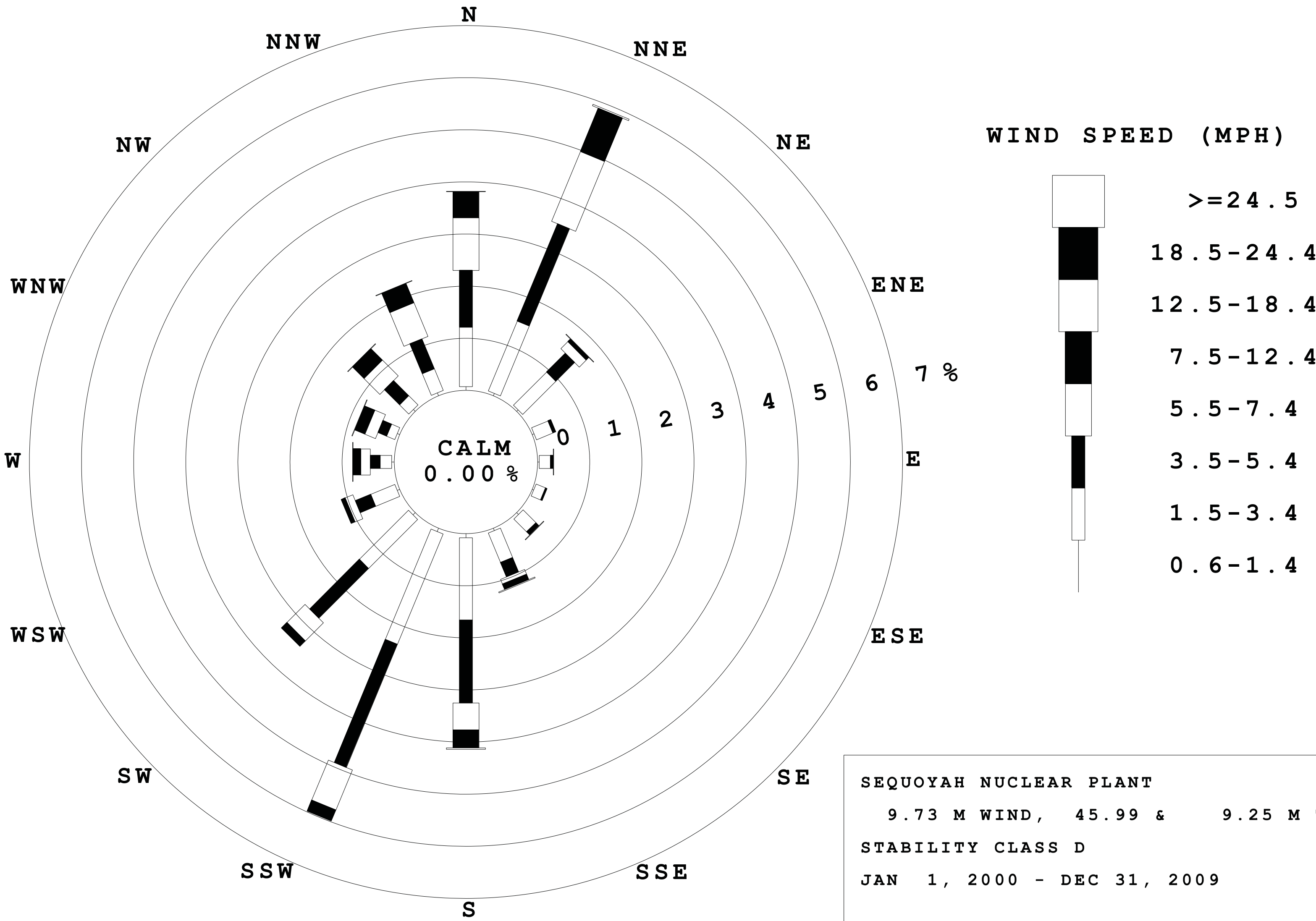


SEQUOYAH NUCLEAR PLANT
9.73 M WIND, 45.99 & 9.25 M TEMP
STABILITY CLASS A
JAN 1, 2000 - DEC 31, 2009

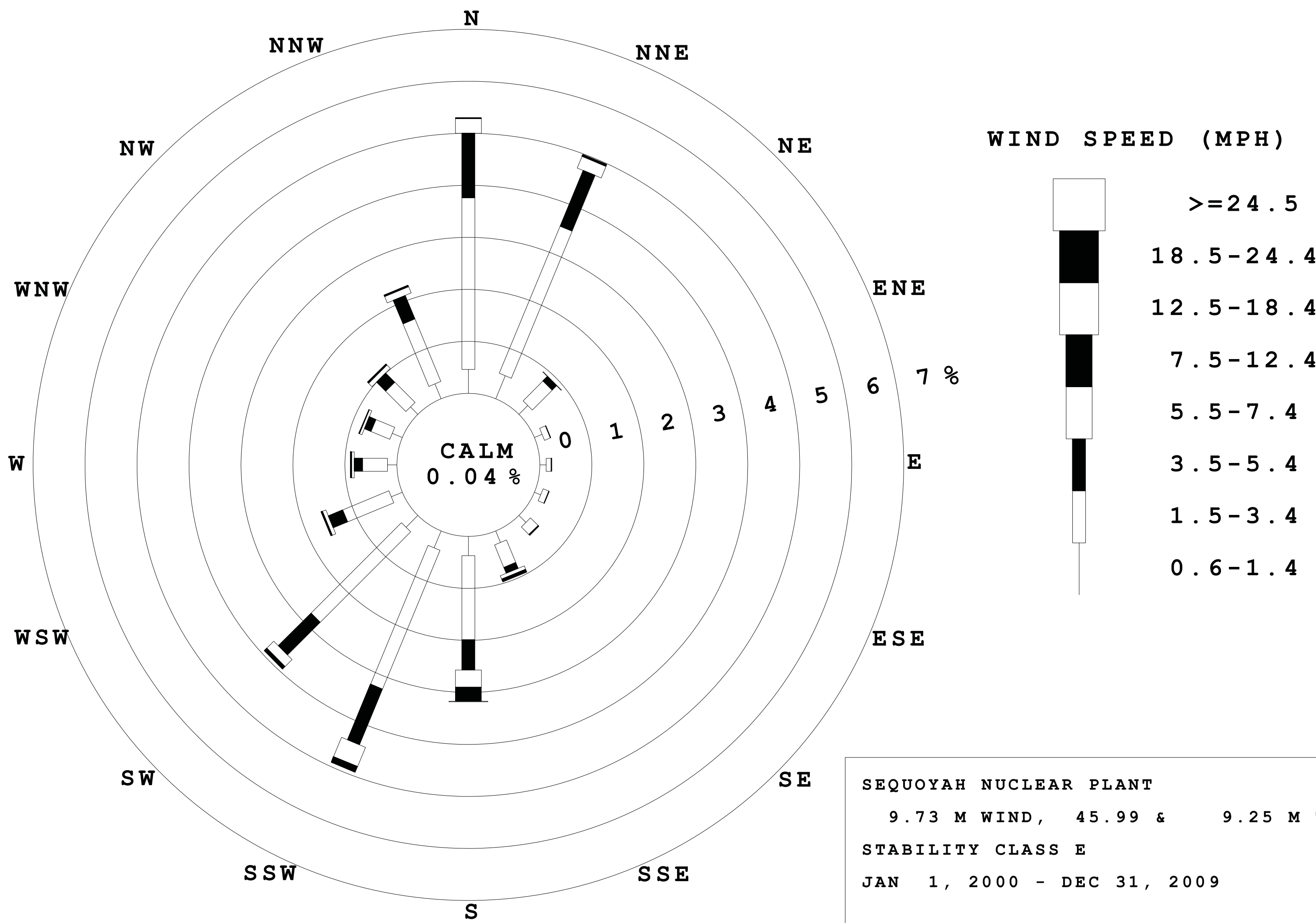


SEQUOYAH NUCLEAR PLANT
9.73 M WIND, 45.99 & 9.25 M TEMP
STABILITY CLASS B
JAN 1, 2000 - DEC 31, 2009

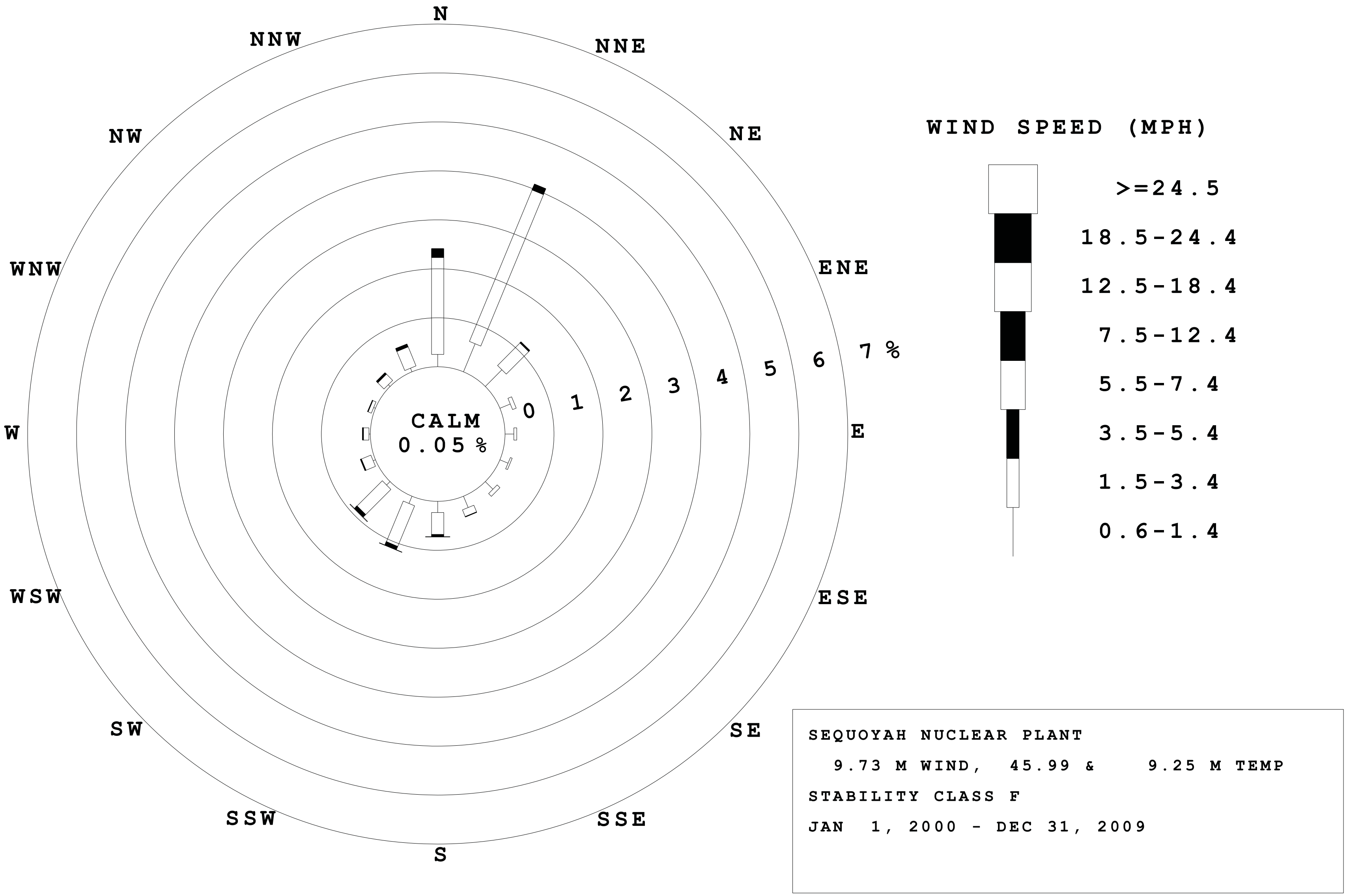

N
NNE
NE
ENE
E
ESE
SE
SSE
S
SSW
SW
WSW
W
WNW
NW
NNW
0
1
2
3
4
5
6
7 %
CALM
0.00 %
WIND SPEED (MPH)
>=24.5
18.5-24.4
12.5-18.4
7.5-12.4
5.5-7.4
3.5-5.4
1.5-3.4
0.6-1.4
SEQUOYAH NUCLEAR PLANT
9.73 M WIND, 45.99 & 9.25 M TEMP
STABILITY CLASS C
JAN 1, 2000 - DEC 31, 2009

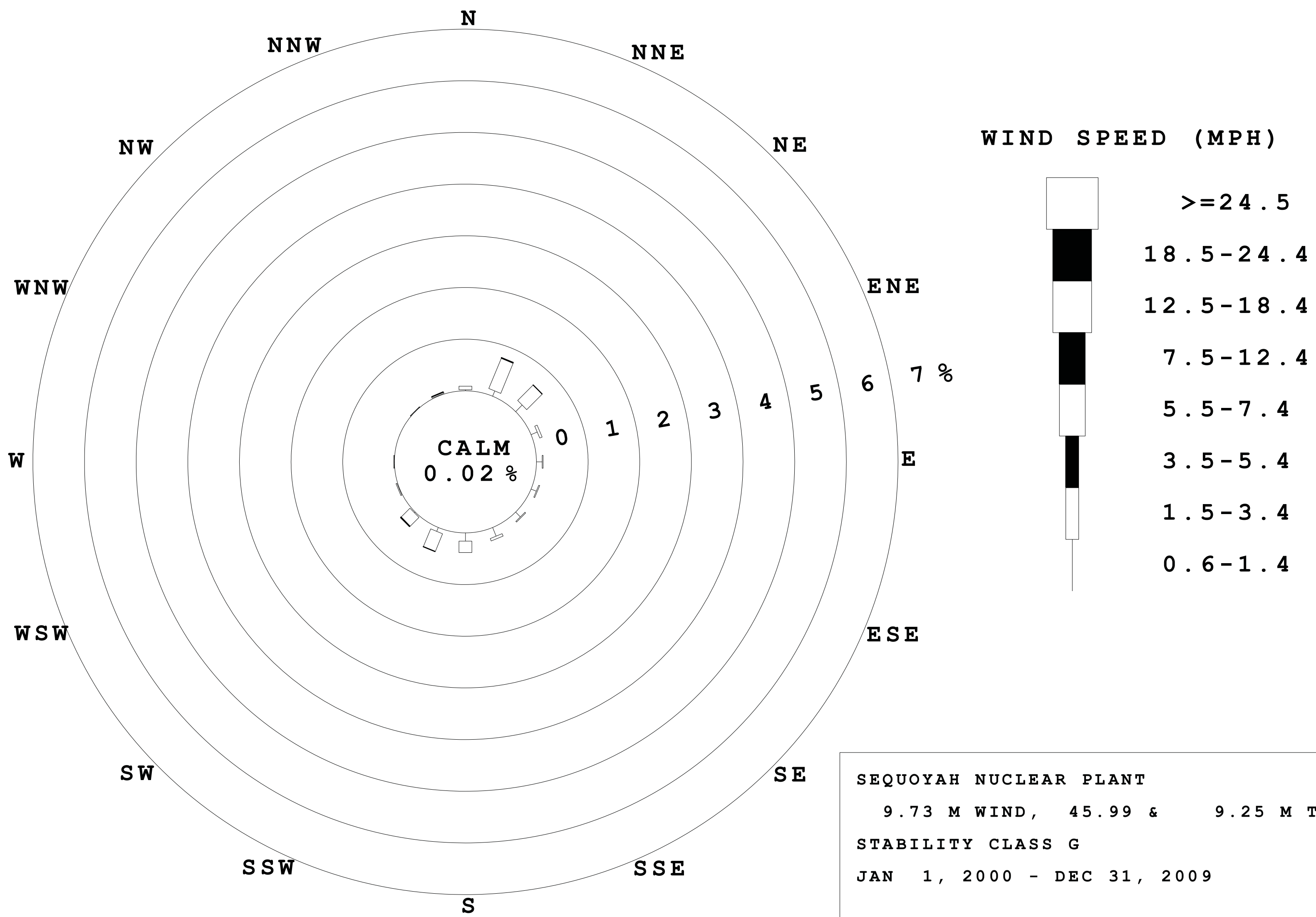


SEQUOYAH NUCLEAR PLANT
9.73 M WIND, 45.99 & 9.25 M TEMP
STABILITY CLASS D
JAN 1, 2000 - DEC 31, 2009

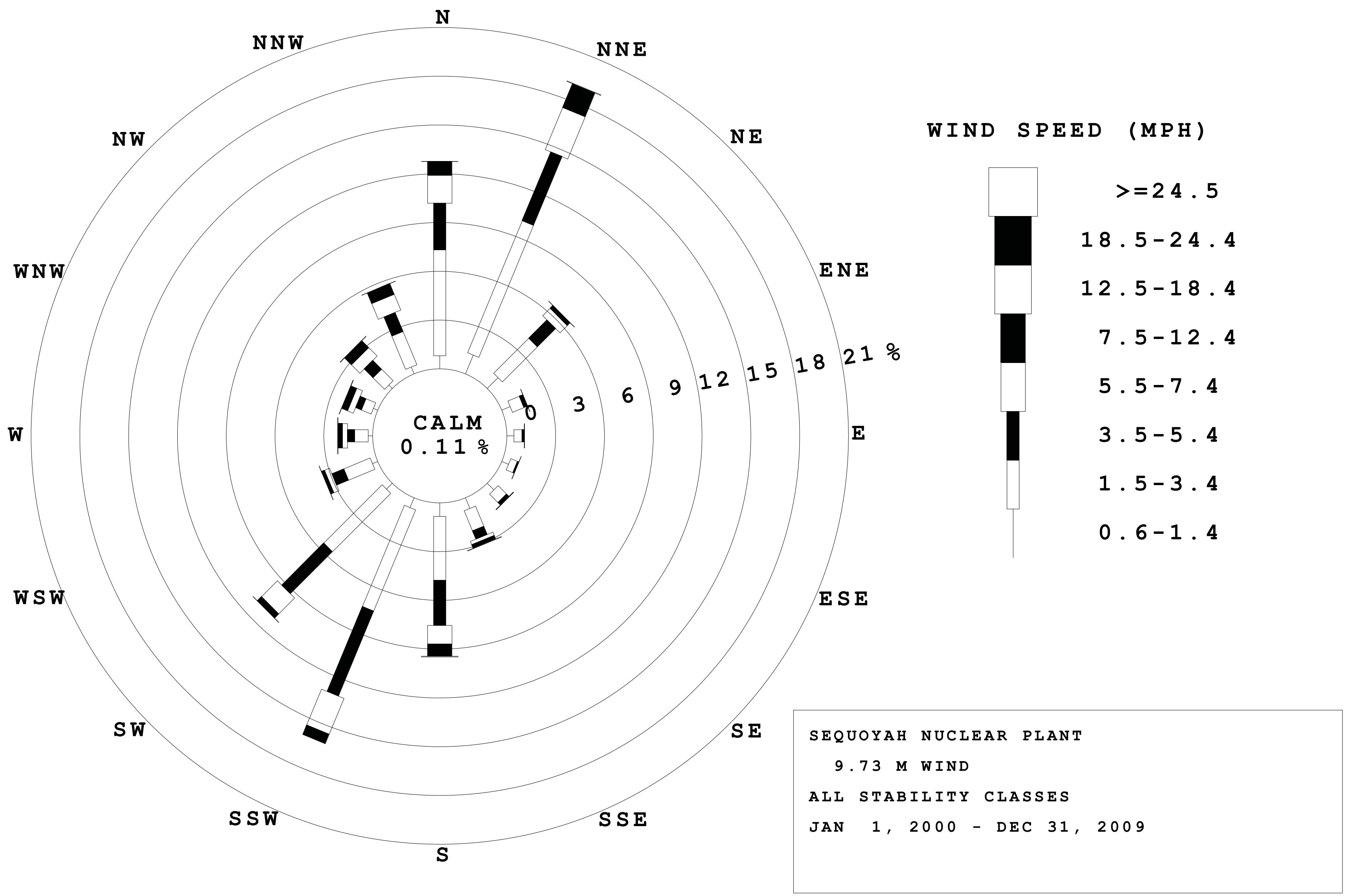


SEQUOYAH NUCLEAR PLANT
9.73 M WIND, 45.99 & 9.25 M TEMP
STABILITY CLASS E
JAN 1, 2000 - DEC 31, 2009

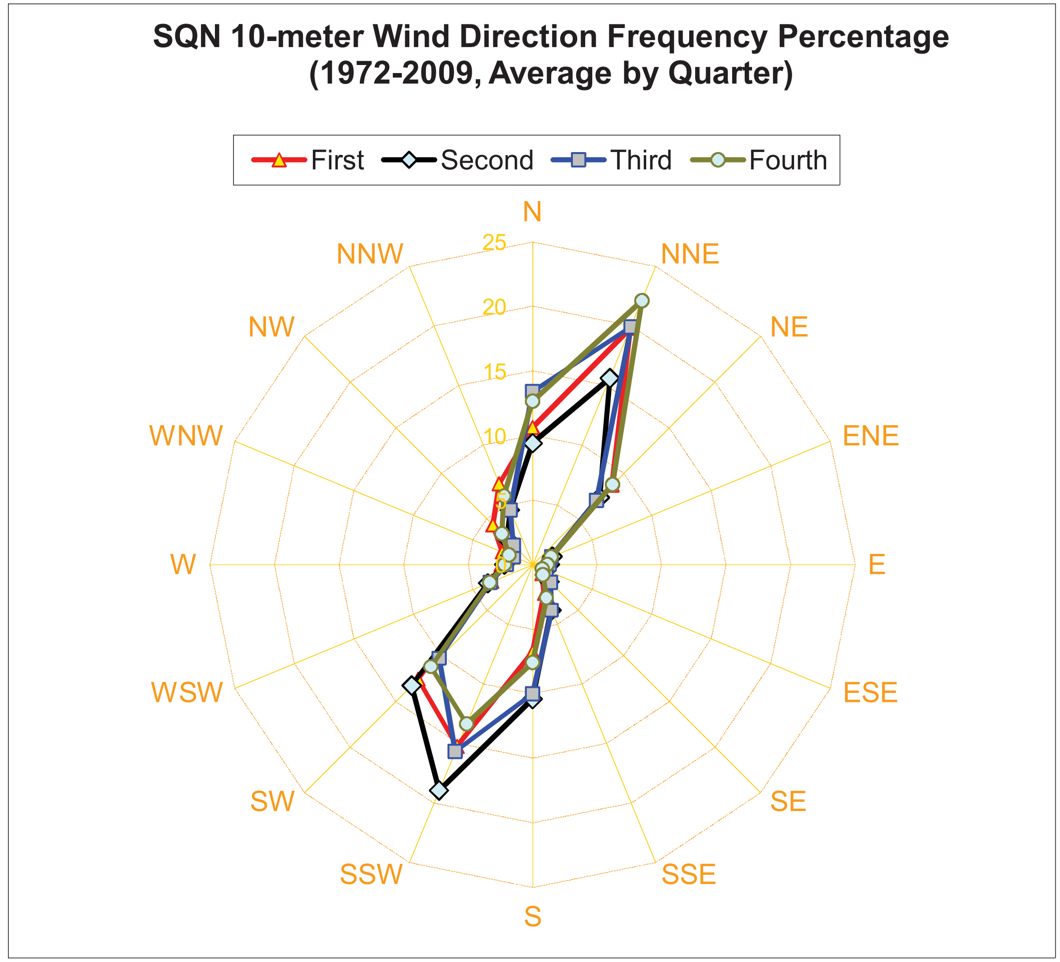

N
NNE
NE
ENE
E
ESE
SE
SSE
S
SSW
SW
WSW
W
WNW
NW
NNW
CALM
0.05%
0 1 2 3 4 5 6 7 %
WIND SPEED (MPH)
>=24.5
18.5-24.4
12.5-18.4
7.5-12.4
5.5-7.4
3.5-5.4
1.5-3.4
0.6-1.4
SEQUOYAH NUCLEAR PLANT
9.73 M WIND, 45.99 & 9.25 M TEMP
STABILITY CLASS F
JAN 1, 2000 - DEC 31, 2009



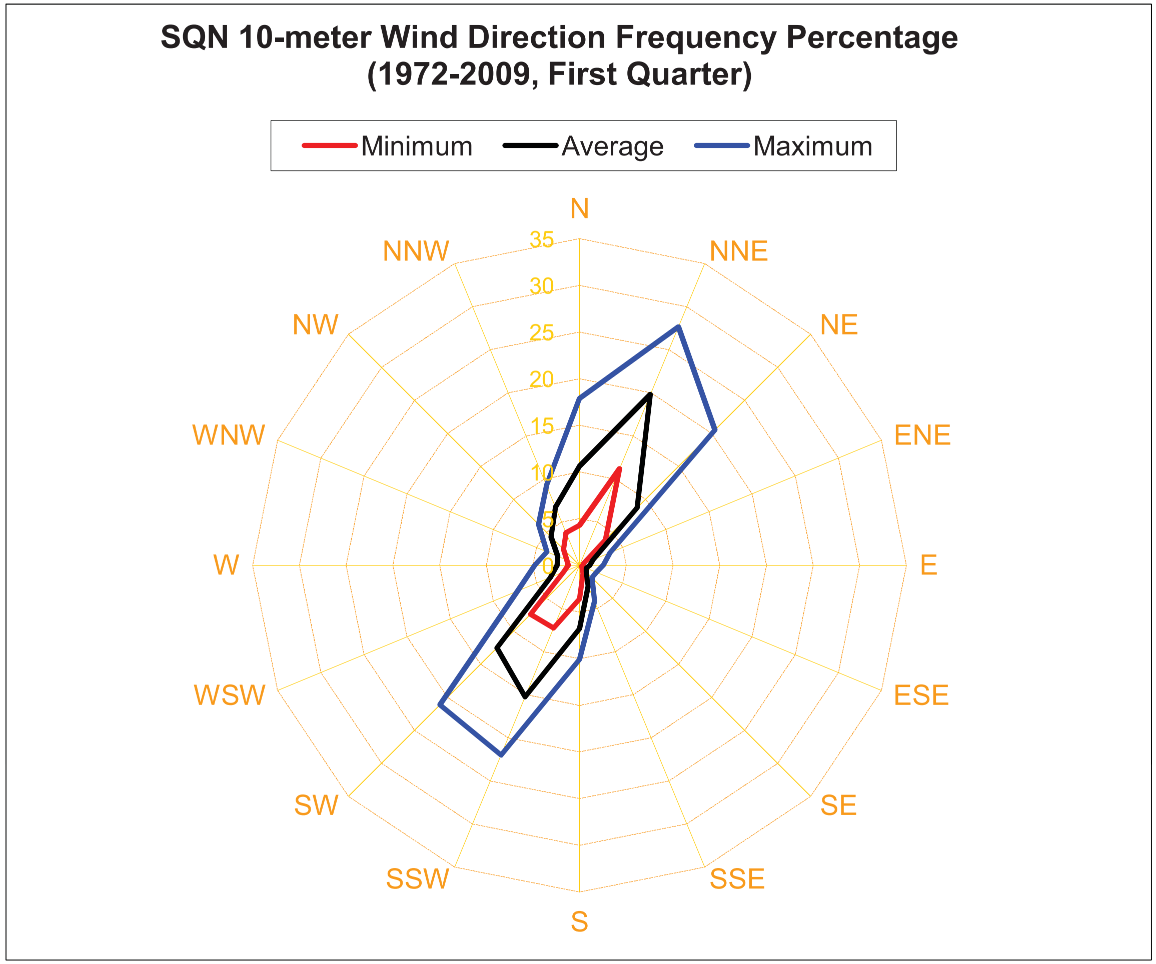
SEQUOYAH NUCLEAR PLANT
9.73 M WIND, 45.99 & 9.25 M TEMP
STABILITY CLASS G
JAN 1, 2000 - DEC 31, 2009


N
NNE
NE
ENE
E
ESE
SE
SSE
S
SSW
SW
WSW
W
WNW
NW
NNW
0 3 6 9 12 15 18 21 %
CALM
0.11 %
WIND SPEED (MPH)
>=24.5
18.5-24.4
12.5-18.4
7.5-12.4
5.5-7.4
3.5-5.4
1.5-3.4
0.6-1.4
SEQUOYAH NUCLEAR PLANT
9.73 M WIND
ALL STABILITY CLASSES
JAN 1, 2000 - DEC 31, 2009

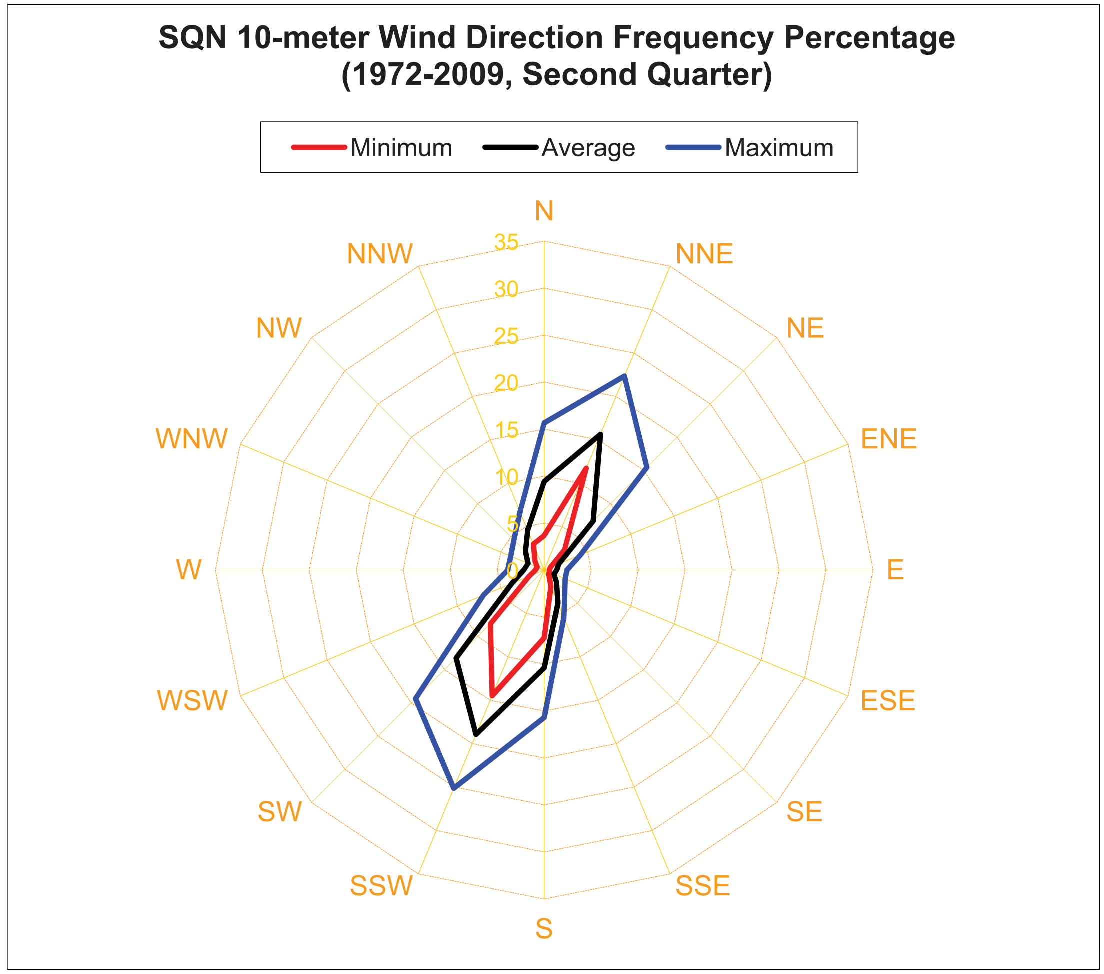
Direction	First	Second	Third	Fourth
N	10.63	9.42	13.40	12.67
NNE	19.81	15.65	19.94	22.13
NE	8.72	7.36	7.01	8.78
ENE	1.56	1.67	1.58	1.55
E	1.09	1.33	1.30	1.13
ESE	0.79	1.13	1.14	0.81
SE	1.01	1.85	1.96	1.13
SSE	2.40	3.82	3.83	2.80
S	6.78	10.41	10.01	7.57
SSW	15.23	18.94	15.65	13.37
SW	12.53	13.24	10.26	11.18
WSW	3.39	3.74	3.55	3.59
W	2.42	2.18	2.04	2.17
WNW	2.54	1.86	1.63	1.99
NW	4.33	2.81	2.12	3.36
NNW	6.77	4.59	4.57	5.77
Range	27.38	24.59	28.06	34.28



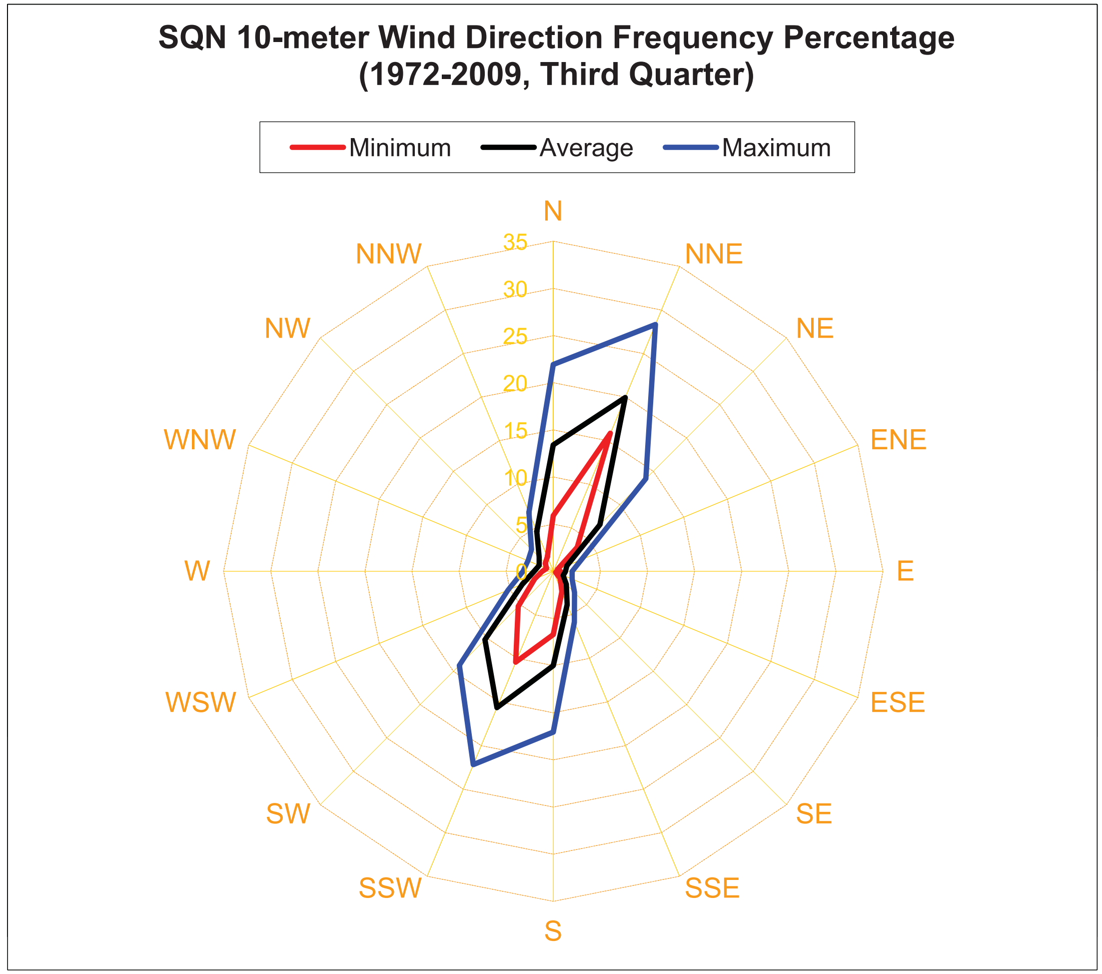
Direction	Minimum	Average	Maximum
N	4.28	10.63	17.86
NNE	11.22	19.81	27.63
NE	3.90	8.72	20.49
ENE	0.45	1.56	3.51
E	0.43	1.09	2.53
ESE	0.25	0.79	1.94
SE	0.37	1.01	1.86
SSE	0.94	2.40	4.17
S	3.61	6.78	10.09
SSW	7.27	15.23	22.02
SW	7.43	12.53	21.15
WSW	1.87	3.39	7.19
W	1.21	2.42	4.81
WNW	1.49	2.54	3.79
NW	2.45	4.33	6.21
NNW	3.79	6.77	9.23



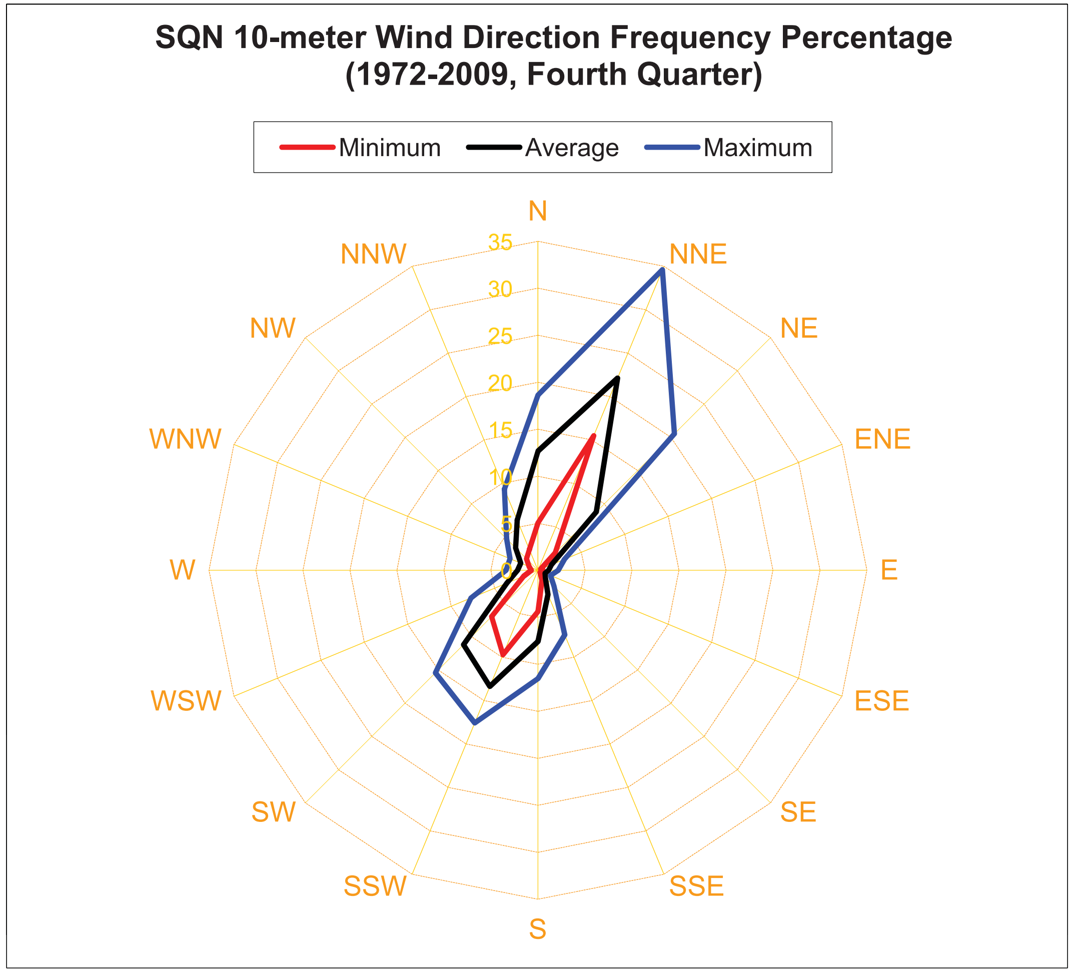
Direction	Minimum	Average	Maximum
N	3.68	9.42	15.65
NNE	11.72	15.65	22.35
NE	3.05	7.36	15.46
ENE	0.70	1.67	4.19
E	0.55	1.33	2.42
ESE	0.59	1.13	2.42
SE	0.70	1.85	3.11
SSE	1.89	3.82	5.46
S	7.22	10.41	15.71
SSW	14.47	18.94	25.14
SW	8.10	13.24	19.35
WSW	1.72	3.74	7.01
W	0.93	2.18	3.89
WNW	0.81	1.86	3.85
NW	1.39	2.81	4.54
NNW	2.99	4.59	6.72



Direction	Minimum	Average	Maximum
N	5.90	13.40	21.93
NNE	15.85	19.94	28.33
NE	3.56	7.01	13.90
ENE	0.47	1.58	3.22
E	0.79	1.30	2.00
ESE	0.27	1.14	2.17
SE	1.02	1.96	3.18
SSE	2.36	3.83	5.83
S	6.71	10.01	17.05
SSW	10.43	15.65	22.19
SW	5.26	10.26	14.11
WSW	2.15	3.55	5.20
W	1.18	2.04	3.22
WNW	0.78	1.63	2.90
NW	1.20	2.12	3.26
NNW	1.65	4.57	6.75



Direction	Minimum	Average	Maximum
N	5.06	12.67	18.65
NNE	15.50	22.13	34.61
NE	2.60	8.78	20.53
ENE	0.32	1.55	3.04
E	0.55	1.13	2.15
ESE	0.36	0.81	1.44
SE	0.33	1.13	2.42
SSE	1.13	2.80	7.43
S	4.39	7.57	11.51
SSW	9.71	13.37	17.58
SW	6.98	11.18	15.42
WSW	1.65	3.59	7.71
W	0.71	2.17	3.40
WNW	1.03	1.99	3.23
NW	1.72	3.36	4.70
NNW	2.38	5.77	9.33



JOINT PERCENTAGE FREQUENCIES OF WIND SPEED BY WIND DIRECTION FOR

STABILITY CLASS A (DELTA T<=-1.9 C/100 M)

SEQUOYAH NUCLEAR PLANT

JAN 1, 2000 - DEC 31, 2009

WIND DIRECTION	WIND SPEED(MPH) CALM	0.6-1.4	1.5-3.4	3.5-5.4	5.5-7.4	7.5-12.4	12.5-18.4	18.5-24.4	>=24.5	TOTAL
N	0.000	0.000	0.009	0.125	0.154	0.151	0.000	0.000	0.000	0.439
NNE	0.000	0.001	0.075	0.540	0.582	0.309	0.001	0.000	0.000	1.508
NE	0.000	0.000	0.126	0.451	0.236	0.103	0.000	0.000	0.000	0.916
ENE	0.000	0.000	0.042	0.081	0.008	0.001	0.000	0.000	0.000	0.132
E	0.000	0.000	0.008	0.022	0.002	0.000	0.000	0.000	0.000	0.033
ESE	0.000	0.000	0.004	0.012	0.004	0.000	0.000	0.000	0.000	0.019
SE	0.000	0.000	0.005	0.023	0.000	0.000	0.000	0.000	0.000	0.028
SSE	0.000	0.000	0.001	0.015	0.020	0.022	0.000	0.000	0.000	0.058
S	0.000	0.000	0.008	0.089	0.132	0.044	0.001	0.000	0.000	0.275
SSW	0.000	0.000	0.026	0.522	0.634	0.188	0.000	0.000	0.000	1.370
SW	0.000	0.000	0.046	0.469	0.354	0.088	0.001	0.000	0.000	0.957
WSW	0.000	0.000	0.006	0.044	0.058	0.035	0.002	0.000	0.000	0.146
W	0.000	0.000	0.004	0.018	0.042	0.055	0.007	0.000	0.000	0.125
WNW	0.000	0.001	0.000	0.014	0.046	0.077	0.002	0.000	0.000	0.140
NW	0.000	0.000	0.001	0.011	0.067	0.130	0.006	0.000	0.000	0.214
NNW	0.000	0.000	0.002	0.021	0.086	0.148	0.005	0.000	0.000	0.263
SUBTOTAL	0.000	0.002	0.362	2.457	2.425	1.351	0.026	0.000	0.000	6.624

TOTAL HOURS OF VALID STABILITY OBSERVATIONS	86366
TOTAL HOURS OF STABILITY CLASS A	5715
TOTAL HOURS OF VALID WIND DIRECTION-WIND SPEED-STABILITY CLASS A	5667
TOTAL HOURS OF VALID WIND DIRECTION-WIND SPEED-STABILITY OBSERVATIONS	85552
TOTAL HOURS CALM	0

METEOROLOGICAL FACILITY: SEQUOYAH NUCLEAR PLANT
STABILITY BASED ON DELTA-T BETWEEN 9.25 AND 45.99 METERS
WIND SPEED AND DIRECTION MEASURED AT 9.73 METER LEVEL

DATE PRINTED: 2011/03/09

MEAN WIND SPEED = 6.03

NOTE: TOTALS AND SUBTOTALS ARE OBTAINED FROM UNROUNDED NUMBERS

JOINT PERCENTAGE FREQUENCIES OF WIND SPEED BY WIND DIRECTION FOR

STABILITY CLASS B (-1.9< DELTA T<=-1.7 C/100 M)

SEQUOYAH NUCLEAR PLANT

JAN 1, 2000 - DEC 31, 2009

WIND DIRECTION	WIND SPEED(MPH) CALM	0.6-1.4	1.5-3.4	3.5-5.4	5.5-7.4	7.5-12.4	12.5-18.4	18.5-24.4	>=24.5	TOTAL
N	0.000	0.000	0.025	0.085	0.092	0.072	0.000	0.000	0.000	0.275
NNE	0.000	0.000	0.088	0.359	0.252	0.152	0.002	0.000	0.000	0.853
NE	0.000	0.000	0.160	0.241	0.094	0.030	0.000	0.000	0.000	0.525
ENE	0.000	0.000	0.051	0.041	0.000	0.000	0.000	0.000	0.000	0.092
E	0.000	0.000	0.026	0.027	0.004	0.000	0.000	0.000	0.000	0.056
ESE	0.000	0.000	0.012	0.018	0.000	0.000	0.000	0.000	0.000	0.029
SE	0.000	0.001	0.020	0.023	0.005	0.001	0.000	0.000	0.000	0.050
SSE	0.000	0.000	0.020	0.041	0.021	0.013	0.000	0.000	0.000	0.095
S	0.000	0.000	0.023	0.162	0.086	0.033	0.002	0.000	0.000	0.307
SSW	0.000	0.000	0.084	0.591	0.316	0.048	0.000	0.000	0.000	1.039
SW	0.000	0.000	0.099	0.375	0.167	0.034	0.002	0.000	0.000	0.678
WSW	0.000	0.000	0.020	0.055	0.020	0.021	0.006	0.000	0.000	0.122
W	0.000	0.000	0.006	0.028	0.018	0.021	0.000	0.000	0.000	0.072
WNW	0.000	0.000	0.000	0.014	0.025	0.048	0.002	0.000	0.000	0.089
NW	0.000	0.000	0.004	0.022	0.048	0.065	0.002	0.000	0.000	0.141
NNW	0.000	0.000	0.011	0.020	0.054	0.054	0.001	0.000	0.000	0.139
SUBTOTAL	0.000	0.001	0.648	2.103	1.200	0.593	0.019	0.000	0.000	4.563

TOTAL HOURS OF VALID STABILITY OBSERVATIONS	86366
TOTAL HOURS OF STABILITY CLASS B	3931
TOTAL HOURS OF VALID WIND DIRECTION-WIND SPEED-STABILITY CLASS B	3904
TOTAL HOURS OF VALID WIND DIRECTION-WIND SPEED-STABILITY OBSERVATIONS	85552
TOTAL HOURS CALM	0

METEOROLOGICAL FACILITY: SEQUOYAH NUCLEAR PLANT
STABILITY BASED ON DELTA-T BETWEEN 9.25 AND 45.99 METERS
WIND SPEED AND DIRECTION MEASURED AT 9.73 METER LEVEL

DATE PRINTED: 2011/03/09

MEAN WIND SPEED = 5.32

NOTE: TOTALS AND SUBTOTALS ARE OBTAINED FROM UNROUNDED NUMBERS

JOINT PERCENTAGE FREQUENCIES OF WIND SPEED BY WIND DIRECTION FOR

STABILITY CLASS C (-1.7< DELTA T<=-1.5 C/100 M)

SEQUOYAH NUCLEAR PLANT

JAN 1, 2000 - DEC 31, 2009

WIND DIRECTION	CALM	WIND SPEED(MPH) 0.6-1.4	1.5-3.4	3.5-5.4	5.5-7.4	7.5-12.4	12.5-18.4	18.5-24.4	>=24.5	TOTAL
N	0.000	0.000	0.034	0.139	0.138	0.086	0.000	0.000	0.000	0.397
NNE	0.000	0.001	0.179	0.341	0.262	0.141	0.004	0.000	0.000	0.928
NE	0.000	0.000	0.250	0.242	0.098	0.030	0.000	0.000	0.000	0.621
ENE	0.000	0.000	0.086	0.039	0.000	0.000	0.000	0.000	0.000	0.125
E	0.000	0.000	0.068	0.015	0.001	0.000	0.000	0.000	0.000	0.084
ESE	0.000	0.000	0.054	0.028	0.000	0.000	0.000	0.000	0.000	0.082
SE	0.000	0.000	0.042	0.048	0.002	0.001	0.000	0.000	0.000	0.094
SSE	0.000	0.000	0.044	0.061	0.012	0.013	0.001	0.000	0.000	0.131
S	0.000	0.000	0.070	0.306	0.071	0.035	0.000	0.000	0.000	0.483
SSW	0.000	0.000	0.226	0.738	0.195	0.048	0.000	0.000	0.000	1.206
SW	0.000	0.000	0.194	0.468	0.164	0.020	0.000	0.000	0.000	0.845
WSW	0.000	0.000	0.039	0.049	0.025	0.025	0.001	0.000	0.000	0.138
W	0.000	0.001	0.013	0.028	0.034	0.020	0.004	0.000	0.000	0.099
WNW	0.000	0.000	0.007	0.025	0.036	0.053	0.006	0.000	0.000	0.126
NW	0.000	0.000	0.006	0.028	0.072	0.054	0.001	0.000	0.000	0.161
NNW	0.000	0.000	0.005	0.049	0.070	0.071	0.000	0.000	0.000	0.195
SUBTOTAL	0.000	0.002	1.316	2.603	1.181	0.597	0.016	0.000	0.000	5.716

TOTAL HOURS OF VALID STABILITY OBSERVATIONS	86366
TOTAL HOURS OF STABILITY CLASS C	4938
TOTAL HOURS OF VALID WIND DIRECTION-WIND SPEED-STABILITY CLASS C	4890
TOTAL HOURS OF VALID WIND DIRECTION-WIND SPEED-STABILITY OBSERVATIONS	85552
TOTAL HOURS CALM	0

METEOROLOGICAL FACILITY: SEQUOYAH NUCLEAR PLANT
STABILITY BASED ON DELTA-T BETWEEN 9.25 AND 45.99 METERS
WIND SPEED AND DIRECTION MEASURED AT 9.73 METER LEVEL

DATE PRINTED: 2011/03/09

MEAN WIND SPEED = 4.92

NOTE: TOTALS AND SUBTOTALS ARE OBTAINED FROM UNROUNDED NUMBERS

JOINT PERCENTAGE FREQUENCIES OF WIND SPEED BY WIND DIRECTION FOR

STABILITY CLASS D (-1.5< DELTA T<=-0.5 C/100 M)

SEQUOYAH NUCLEAR PLANT

JAN 1, 2000 - DEC 31, 2009

WIND DIRECTION	CALM	WIND SPEED(MPH) 0.6-1.4	1.5-3.4	3.5-5.4	5.5-7.4	7.5-12.4	12.5-18.4	18.5-24.4	>=24.5	TOTAL
N	0.000	0.074	1.137	1.093	1.013	0.505	0.008	0.000	0.000	3.830
NNE	0.000	0.055	1.451	2.022	1.447	0.901	0.028	0.002	0.000	5.906
NE	0.000	0.044	0.904	0.506	0.189	0.069	0.006	0.000	0.000	1.718
ENE	0.000	0.040	0.337	0.056	0.001	0.001	0.000	0.000	0.000	0.435
E	0.000	0.029	0.224	0.051	0.008	0.000	0.000	0.000	0.000	0.313
ESE	0.000	0.033	0.205	0.026	0.002	0.001	0.000	0.000	0.000	0.267
SE	0.000	0.046	0.354	0.083	0.011	0.002	0.000	0.000	0.000	0.496
SSE	0.000	0.049	0.608	0.297	0.097	0.108	0.021	0.000	0.000	1.179
S	0.000	0.079	1.576	1.591	0.520	0.342	0.030	0.000	0.000	4.139
SSW	0.000	0.070	2.291	2.555	0.832	0.231	0.000	0.000	0.000	5.980
SW	0.000	0.062	1.334	1.354	0.490	0.146	0.004	0.000	0.000	3.389
WSW	0.000	0.051	0.498	0.320	0.162	0.083	0.001	0.000	0.000	1.116
W	0.000	0.053	0.221	0.186	0.178	0.150	0.013	0.000	0.000	0.800
WNW	0.000	0.046	0.167	0.181	0.222	0.207	0.009	0.000	0.000	0.832
NW	0.000	0.049	0.251	0.407	0.431	0.307	0.008	0.000	0.000	1.454
NNW	0.000	0.064	0.455	0.621	0.704	0.395	0.007	0.000	0.000	2.245
SUBTOTAL	0.000	0.844	12.011	11.349	6.308	3.449	0.136	0.002	0.000	34.100

TOTAL HOURS OF VALID STABILITY OBSERVATIONS	86366
TOTAL HOURS OF STABILITY CLASS D	29518
TOTAL HOURS OF VALID WIND DIRECTION-WIND SPEED-STABILITY CLASS D	29173
TOTAL HOURS OF VALID WIND DIRECTION-WIND SPEED-STABILITY OBSERVATIONS	85552
TOTAL HOURS CALM	0

METEOROLOGICAL FACILITY: SEQUOYAH NUCLEAR PLANT
STABILITY BASED ON DELTA-T BETWEEN 9.25 AND 45.99 METERS
WIND SPEED AND DIRECTION MEASURED AT 9.73 METER LEVEL

DATE PRINTED: 2011/03/09

MEAN WIND SPEED = 4.51

NOTE: TOTALS AND SUBTOTALS ARE OBTAINED FROM UNROUNDED NUMBERS

JOINT PERCENTAGE FREQUENCIES OF WIND SPEED BY WIND DIRECTION FOR

STABILITY CLASS E (-0.5< DELTA T<= 1.5 C/100 M)

SEQUOYAH NUCLEAR PLANT

JAN 1, 2000 - DEC 31, 2009

WIND DIRECTION	CALM	WIND SPEED(MPH) 0.6-1.4	1.5-3.4	3.5-5.4	5.5-7.4	7.5-12.4	12.5-18.4	18.5-24.4	>=24.5	TOTAL
N	0.006	0.456	3.303	1.240	0.282	0.021	0.001	0.000	0.000	5.310
NNE	0.006	0.478	3.061	1.163	0.241	0.041	0.000	0.000	0.000	4.990
NE	0.001	0.241	0.538	0.116	0.013	0.001	0.000	0.000	0.000	0.910
ENE	0.000	0.161	0.120	0.011	0.000	0.000	0.000	0.000	0.000	0.293
E	0.000	0.116	0.102	0.011	0.002	0.000	0.000	0.000	0.000	0.231
ESE	0.000	0.127	0.116	0.006	0.002	0.000	0.000	0.000	0.000	0.252
SE	0.001	0.191	0.213	0.025	0.002	0.004	0.000	0.000	0.000	0.434
SSE	0.001	0.241	0.465	0.120	0.068	0.062	0.002	0.000	0.000	0.960
S	0.003	0.367	1.622	0.580	0.330	0.267	0.012	0.000	0.000	3.180
SSW	0.005	0.347	2.892	1.164	0.401	0.118	0.001	0.000	0.000	4.929
SW	0.005	0.325	2.457	0.892	0.194	0.071	0.004	0.000	0.000	3.947
WSW	0.002	0.229	0.964	0.298	0.070	0.033	0.000	0.000	0.000	1.596
W	0.001	0.182	0.477	0.164	0.047	0.020	0.000	0.000	0.000	0.891
WNW	0.001	0.207	0.393	0.145	0.051	0.011	0.000	0.000	0.000	0.808
NW	0.001	0.198	0.547	0.251	0.094	0.034	0.000	0.000	0.000	1.125
NNW	0.003	0.307	1.295	0.491	0.125	0.034	0.000	0.000	0.000	2.255
SUBTOTAL	0.039	4.173	18.565	6.675	1.922	0.715	0.020	0.000	0.000	32.109

TOTAL HOURS OF VALID STABILITY OBSERVATIONS 86366
TOTAL HOURS OF STABILITY CLASS E 27723
TOTAL HOURS OF VALID WIND DIRECTION-WIND SPEED-STABILITY CLASS E 27470
TOTAL HOURS OF VALID WIND DIRECTION-WIND SPEED-STABILITY OBSERVATIONS 85552
TOTAL HOURS CALM 33

METEOROLOGICAL FACILITY: SEQUOYAH NUCLEAR PLANT
STABILITY BASED ON DELTA-T BETWEEN 9.25 AND 45.99 METERS
WIND SPEED AND DIRECTION MEASURED AT 9.73 METER LEVEL

DATE PRINTED: 2011/03/09

MEAN WIND SPEED = 2.97

NOTE: TOTALS AND SUBTOTALS ARE OBTAINED FROM UNROUNDED NUMBERS

JOINT PERCENTAGE FREQUENCIES OF WIND SPEED BY WIND DIRECTION FOR

STABILITY CLASS F (1.5< DELTA T<= 4.0 C/100 M)

SEQUOYAH NUCLEAR PLANT

JAN 1, 2000 - DEC 31, 2009

WIND DIRECTION	CALM	WIND SPEED(MPH) 0.6-1.4	1.5-3.4	3.5-5.4	5.5-7.4	7.5-12.4	12.5-18.4	18.5-24.4	>=24.5	TOTAL
N	0.008	0.252	1.980	0.179	0.004	0.000	0.000	0.000	0.000	2.423
NNE	0.015	0.621	3.345	0.129	0.000	0.000	0.000	0.000	0.000	4.110
NE	0.004	0.480	0.646	0.027	0.002	0.000	0.000	0.000	0.000	1.160
ENE	0.001	0.231	0.078	0.005	0.000	0.000	0.000	0.000	0.000	0.316
E	0.001	0.179	0.058	0.000	0.000	0.000	0.000	0.000	0.000	0.238
ESE	0.001	0.177	0.036	0.001	0.000	0.000	0.000	0.000	0.000	0.215
SE	0.001	0.215	0.076	0.001	0.000	0.000	0.000	0.000	0.000	0.293
SSE	0.002	0.245	0.152	0.007	0.001	0.001	0.000	0.000	0.000	0.408
S	0.003	0.230	0.445	0.041	0.006	0.000	0.000	0.000	0.000	0.725
SSW	0.004	0.159	0.898	0.065	0.006	0.001	0.000	0.000	0.000	1.133
SW	0.003	0.104	0.732	0.072	0.007	0.000	0.000	0.000	0.000	0.918
WSW	0.001	0.055	0.212	0.016	0.002	0.000	0.000	0.000	0.000	0.286
W	0.001	0.034	0.109	0.016	0.001	0.000	0.000	0.000	0.000	0.161
WNW	0.000	0.040	0.075	0.013	0.004	0.000	0.000	0.000	0.000	0.131
NW	0.001	0.053	0.182	0.039	0.002	0.001	0.000	0.000	0.000	0.278
NNW	0.002	0.084	0.423	0.060	0.002	0.001	0.000	0.000	0.000	0.572
SUBTOTAL	0.048	3.159	9.448	0.671	0.037	0.005	0.000	0.000	0.000	13.368

TOTAL HOURS OF VALID STABILITY OBSERVATIONS	86366
TOTAL HOURS OF STABILITY CLASS F	11499
TOTAL HOURS OF VALID WIND DIRECTION-WIND SPEED-STABILITY CLASS F	11437
TOTAL HOURS OF VALID WIND DIRECTION-WIND SPEED-STABILITY OBSERVATIONS	85552
TOTAL HOURS CALM	41

METEOROLOGICAL FACILITY: SEQUOYAH NUCLEAR PLANT
STABILITY BASED ON DELTA-T BETWEEN 9.25 AND 45.99 METERS
WIND SPEED AND DIRECTION MEASURED AT 9.73 METER LEVEL

DATE PRINTED: 2011/03/09

MEAN WIND SPEED = 2.03

NOTE: TOTALS AND SUBTOTALS ARE OBTAINED FROM UNROUNDED NUMBERS

JOINT PERCENTAGE FREQUENCIES OF WIND SPEED BY WIND DIRECTION FOR

STABILITY CLASS G (DELTA T > 4.0 C/100 M)

SEQUOYAH NUCLEAR PLANT

JAN 1, 2000 - DEC 31, 2009

WIND DIRECTION	CALM	WIND SPEED(MPH) 0.6-1.4	1.5-3.4	3.5-5.4	5.5-7.4	7.5-12.4	12.5-18.4	18.5-24.4	>=24.5	TOTAL
N	0.001	0.019	0.071	0.002	0.000	0.000	0.000	0.000	0.000	0.093
NNE	0.004	0.108	0.625	0.016	0.000	0.000	0.000	0.000	0.000	0.754
NE	0.003	0.179	0.421	0.006	0.000	0.000	0.000	0.000	0.000	0.609
ENE	0.001	0.132	0.053	0.000	0.000	0.000	0.000	0.000	0.000	0.186
E	0.001	0.110	0.022	0.000	0.000	0.000	0.000	0.000	0.000	0.133
ESE	0.001	0.112	0.016	0.000	0.000	0.000	0.000	0.000	0.000	0.129
SE	0.001	0.131	0.023	0.000	0.000	0.000	0.000	0.000	0.000	0.155
SSE	0.001	0.178	0.053	0.000	0.000	0.000	0.000	0.000	0.000	0.232
S	0.002	0.155	0.217	0.005	0.001	0.000	0.000	0.000	0.000	0.381
SSW	0.003	0.079	0.369	0.008	0.000	0.000	0.000	0.000	0.000	0.460
SW	0.002	0.025	0.243	0.023	0.000	0.000	0.000	0.000	0.000	0.293
WSW	0.000	0.012	0.020	0.001	0.000	0.000	0.000	0.000	0.000	0.033
W	0.000	0.002	0.008	0.000	0.000	0.000	0.000	0.000	0.000	0.011
WNW	0.000	0.001	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.005
NW	0.000	0.005	0.008	0.005	0.000	0.000	0.000	0.000	0.000	0.018
NNW	0.000	0.008	0.016	0.006	0.000	0.000	0.000	0.000	0.000	0.031
SUBTOTAL	0.020	1.255	2.171	0.072	0.001	0.000	0.000	0.000	0.000	3.519

TOTAL HOURS OF VALID STABILITY OBSERVATIONS	86366
TOTAL HOURS OF STABILITY CLASS G	3042
TOTAL HOURS OF VALID WIND DIRECTION-WIND SPEED-STABILITY CLASS G	3011
TOTAL HOURS OF VALID WIND DIRECTION-WIND SPEED-STABILITY OBSERVATIONS	85552
TOTAL HOURS CALM	17

METEOROLOGICAL FACILITY: SEQUOYAH NUCLEAR PLANT
STABILITY BASED ON DELTA-T BETWEEN 9.25 AND 45.99 METERS
WIND SPEED AND DIRECTION MEASURED AT 9.73 METER LEVEL

DATE PRINTED: 2011/03/09

MEAN WIND SPEED = 1.79

NOTE: TOTALS AND SUBTOTALS ARE OBTAINED FROM UNROUNDED NUMBERS

JOINT PERCENTAGE FREQUENCIES OF WIND SPEED

BY WIND DIRECTION DISREGARDING STABILITY CLASS

SEQUOYAH NUCLEAR PLANT

JAN 1, 2000 - DEC 31, 2009

WIND DIRECTION	CALM	WIND SPEED(MPH) 0.6-1.4	1.5-3.4	3.5-5.4	5.5-7.4	7.5-12.4	12.5-18.4	18.5-24.4	>=24.5	TOTAL
N	0.014	0.795	6.521	2.869	1.705	0.851	0.009	0.000	0.000	12.765
NNE	0.020	1.254	8.792	4.585	2.810	1.580	0.037	0.002	0.000	19.079
NE	0.008	0.939	3.051	1.588	0.639	0.235	0.006	0.000	0.000	6.466
ENE	0.003	0.561	0.772	0.232	0.009	0.002	0.000	0.000	0.000	1.579
E	0.002	0.430	0.508	0.127	0.017	0.000	0.000	0.000	0.000	1.084
ESE	0.002	0.447	0.441	0.094	0.008	0.002	0.000	0.000	0.000	0.994
SE	0.003	0.579	0.731	0.211	0.021	0.009	0.000	0.000	0.000	1.553
SSE	0.004	0.707	1.338	0.546	0.223	0.230	0.025	0.000	0.000	3.075
S	0.009	0.825	3.939	2.770	1.147	0.739	0.045	0.000	0.000	9.475
SSW	0.015	0.652	6.754	5.646	2.388	0.634	0.001	0.000	0.000	16.091
SW	0.011	0.513	5.074	3.658	1.375	0.359	0.012	0.000	0.000	11.002
WSW	0.004	0.346	1.754	0.790	0.340	0.197	0.010	0.000	0.000	3.441
W	0.002	0.272	0.831	0.438	0.323	0.267	0.023	0.000	0.000	2.157
WNW	0.002	0.293	0.643	0.394	0.384	0.395	0.020	0.000	0.000	2.130
NW	0.003	0.301	0.996	0.765	0.726	0.595	0.017	0.000	0.000	3.403
NNW	0.005	0.460	2.208	1.265	1.049	0.706	0.013	0.000	0.000	5.706
SUBTOTAL	0.105	9.374	44.352	25.978	13.167	6.803	0.219	0.002	0.000	100.000

TOTAL HOURS OF VALID WIND OBSERVATIONS	86377
TOTAL HOURS OF OBSERVATIONS	87672
RECOVERABILITY PERCENTAGE	98.5
TOTAL HOURS CALM	91

METEOROLOGICAL FACILITY: SEQUOYAH NUCLEAR PLANT
WIND SPEED AND DIRECTION MEASURED AT 9.73 METER LEVEL

DATE PRINTED: 2011/03/09

MEAN WIND SPEED = 3.76

NOTE: TOTALS AND SUBTOTALS ARE OBTAINED FROM UNROUNDED NUMBERS

JOINT PERCENTAGE FREQUENCIES OF WIND SPEED BY STABILITY CLASS

SEQUOYAH NUCLEAR PLANT

JAN 1, 2000 - DEC 31, 2009

WIND SPEED (MPH)	STABILITY CLASS A	B	C	D	E	F	G
CALM	0.000	0.000	0.000	0.000	0.039	0.048	0.020
0.6- 1.4	0.002	0.001	0.002	0.844	4.173	3.159	1.255
1.5- 3.4	0.362	0.648	1.316	12.011	18.565	9.448	2.171
3.5- 5.4	2.457	2.103	2.603	11.349	6.675	0.671	0.072
5.5- 7.4	2.425	1.200	1.181	6.308	1.922	0.037	0.001
7.5-12.4	1.351	0.593	0.597	3.449	0.715	0.005	0.000
12.5-18.4	0.026	0.019	0.016	0.136	0.020	0.000	0.000
18.5-24.4	0.000	0.000	0.000	0.002	0.000	0.000	0.000
>=24.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000
TOTAL	6.624	4.563	5.716	34.100	32.109	13.368	3.519

TOTAL HOURS OF VALID STABILITY OBSERVATIONS 86366
TOTAL HOURS OF VALID WIND DIRECTION-WIND SPEED-STABILITY OBSERVATIONS 85552
TOTAL HOURS OF OBSERVATIONS 87672
JOINT RECOVERABILITY PERCENTAGE 97.6

METEOROLOGICAL FACILITY: SEQUOYAH NUCLEAR PLANT
STABILITY BASED ON DELTA-T BETWEEN 9.25 AND 45.99 METERS
WIND SPEED AND DIRECTION MEASURED AT 9.73 METER LEVEL

DATE PRINTED: 2011/03/09

SQN Precipitation Summary - Monthly Statistics
(rainfall data in inches)

1998	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Totals	6.34	6.24	6.58	6.89	1.71	5.88	3.77	2.37	0.71	0.60	2.21	5.77
0.10-0.24/hr.	11	19	17	13	3	8	7	6	1	1	7	17
0.25-0.49/hr.	4	2	5	2	1	3	3	0	1	1	1	4
0.50-0.99/hr.	1	1	1	3	1	1	2	2	0	0	0	1
1.00 or more/hr.	0	0	0	0	0	2	0	0	0	0	0	0

1999	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Totals	9.83	2.84	2.89	3.66	4.21	5.51	2.42	0.08	1.26	3.74	3.25	2.10
0.10-0.24/hr.	31	8	10	10	7	8	4	0	1	14	5	4
0.25-0.49/hr.	3	2	0	1	3	1	2	0	1	1	4	3
0.50-0.99/hr.	1	0	0	1	0	2	0	0	1	1	1	0
1.00 or more/hr.	0	0	0	0	1	1	0	0	0	0	0	0

2000	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Totals	4.54	2.96	4.87	8.20	1.16	3.65	1.22	2.13	2.16	0.00	6.82	2.07
0.10-0.24/hr.	12	6	12	22	5	8	0	3	4	0	12	6
0.25-0.49/hr.	2	3	5	6	0	0	1	2	0	0	6	1
0.50-0.99/hr.	1	0	1	1	0	2	1	1	2	0	1	0
1.00 or more/hr.	0	0	0	0	0	0	0	0	0	0	0	0

2001	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Totals	4.88	5.12	4.62	2.13	4.05	3.95	5.59	2.09	4.53	1.30	3.13	4.95
0.10-0.24/hr.	18	14	19	7	11	9	4	10	5	1	4	10
0.25-0.49/hr.	2	3	1	2	5	6	1	0	3	3	3	4
0.50-0.99/hr.	0	1	0	0	0	0	4	0	1	0	1	1
1.00 or more/hr.	0	0	0	0	0	0	1	0	1	0	0	0

2002	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Totals	6.87	1.54	7.72	1.34	4.68	0.44	1.95	1.70	5.45	2.64	3.62	6.25
0.10-0.24/hr.	10	5	17	2	10	2	1	2	5	2	5	14
0.25-0.49/hr.	4	0	2	0	2	0	1	1	3	0	4	1
0.50-0.99/hr.	3	0	2	0	1	0	2	1	3	2	0	1
1.00 or more/hr.	1	0	1	0	0	0	0	0	0	0	1	1

Monthly

2003	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Totals	0.17	10.61	2.11	5.54	10.80	4.45	6.73	1.74	4.46	0.55	4.97	3.96
0.10-0.24/hr.	0	23	7	8	21	4	18	3	5	3	11	17
0.25-0.49/hr.	0	6	1	8	8	6	4	1	4	0	2	1
0.50-0.99/hr.	0	4	0	1	3	2	2	1	0	0	2	0
1.00 or more/hr.	0	0	0	0	1	0	0	0	1	0	0	0

2004	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Totals	3.58	4.80	4.28	1.49	3.04	5.33	3.01	5.44	9.42	3.29	8.12	6.12
0.10-0.24/hr.	16	11	9	5	7	8	5	5	12	9	21	16
0.25-0.49/hr.	1	4	3	0	3	3	0	2	4	1	5	6
0.50-0.99/hr.	0	1	1	0	1	2	3	0	8	1	2	0
1.00 or more/hr.	0	0	0	0	0	1	0	2	0	0	0	0

2005	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Totals	2.71	4.02	2.79	4.21	2.02	5.48	6.28	5.13	1.87	0.95	4.33	3.33
0.10-0.24/hr.	7	9	3	8	7	13	12	8	4	2	16	9
0.25-0.49/hr.	2	0	2	1	0	3	5	2	0	0	0	1
0.50-0.99/hr.	0	0	0	2	1	2	1	4	1	0	1	0
1.00 or more/hr.	0	0	0	0	0	0	0	0	0	0	0	0

2006	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Totals	5.32	1.83	2.62	5.44	2.68	0.92	2.88	3.72	5.78	5.23	3.77	3.18
0.10-0.24/hr.	13	1	7	16	7	2	5	5	10	17	9	11
0.25-0.49/hr.	5	2	2	2	1	1	2	2	4	3	4	1
0.50-0.99/hr.	0	0	0	2	0	0	1	3	1	0	0	0
1.00 or more/hr.	0	0	0	0	0	0	0	0	1	0	0	0

2007	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Totals	2.87	0.00	1.12	4.27	0.48	2.40	4.40	0.87	1.91	3.63	4.39	3.16
0.10-0.24/hr.	6	0	3	11	2	2	8	2	5	5	12	6
0.25-0.49/hr.	1	0	0	3	0	2	3	1	2	3	3	2
0.50-0.99/hr.	1	0	0	1	0	1	2	0	0	1	2	1
1.00 or more/hr.	0	0	0	0	0	0	0	0	0	0	0	0

Due to sensor outage, some rain events during first quarter 2007 were not recorded.

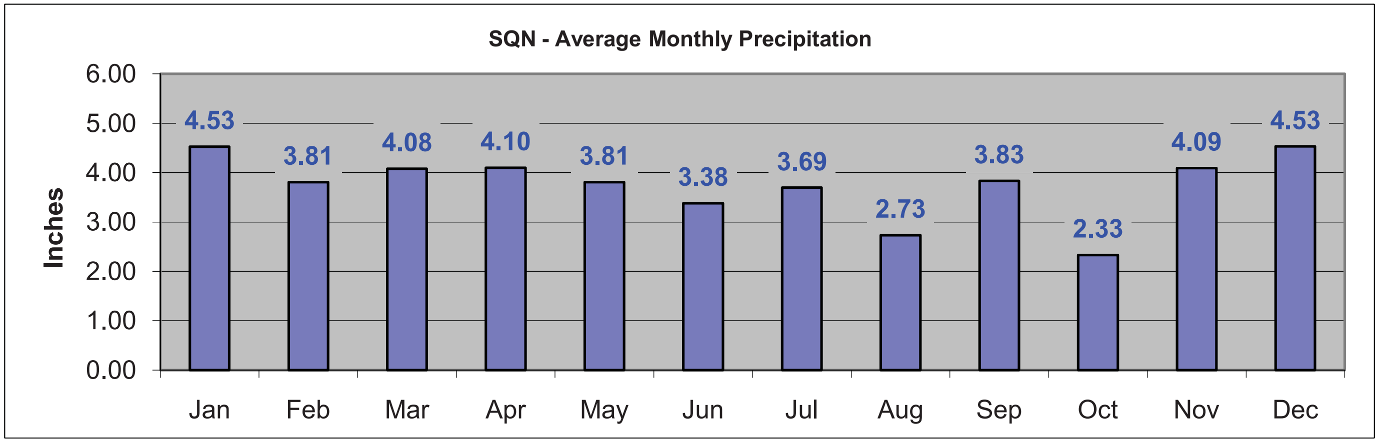
Monthly

2008	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Totals	3.55	3.80	5.53	2.70	2.77	1.31	2.08	5.18	1	1.88	2.30	7.63
0.10-0.24/hr.	4	8	6	8	4	2	4	16	1	5	5	16
0.25-0.49/hr.	7	4	7	1	2	2	2	4	0	1	3	8
0.50-0.99/hr.	0	1	2	0	1	0	0	1	1	0	0	1
1.00 or more/hr.	0	0	0	0	0	0	0	0	0	0	0	0

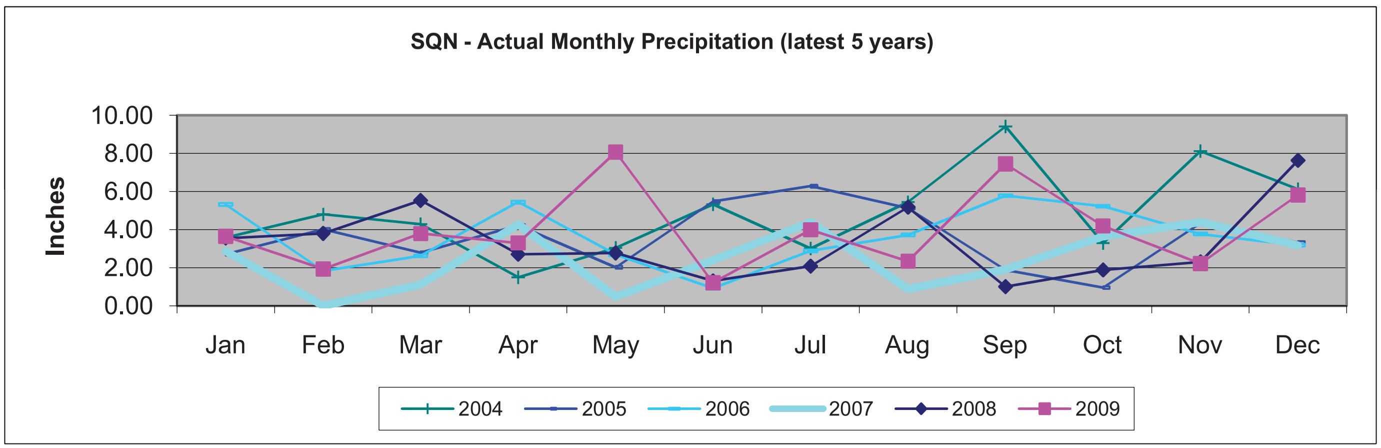
2009	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Totals	3.65	1.93	3.79	3.30	8.07	1.20	3.99	2.34	7.45	4.19	2.21	5.82
0.10-0.24/hr.	10	9	9	6	21	2	4	3	11	9	8	11
0.25-0.49/hr.	2	0	1	1	6	0	2	3	8	3	0	3
0.50-0.99/hr.	0	0	0	2	2	1	1	0	0	0	0	2
1.00 or more/hr.	0	0	0	0	0	0	1	0	1	0	0	0

Average	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Totals	4.53	3.81	4.08	4.10	3.81	3.38	3.69	2.73	3.83	2.33	4.09	4.53
0.10-0.24/hr.	12	9	10	10	9	6	6	5	5	6	10	11
0.25-0.49/hr.	3	2	2	2	3	2	2	2	3	1	3	3
0.50-0.99/hr.	1	1	1	1	1	1	2	1	2	0	1	1
1.00 or more/hr.	0	0	0	0	0	0	0	0	0	0	0	0

Monthly



SQN - Average Monthly Precipitation
Inches
6.00
5.00
4.00
3.00
2.00
1.00
0.00
4.53
3.81
4.08
4.10
3.81
3.38
3.69
2.73
3.83
2.33
4.09
4.53
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec



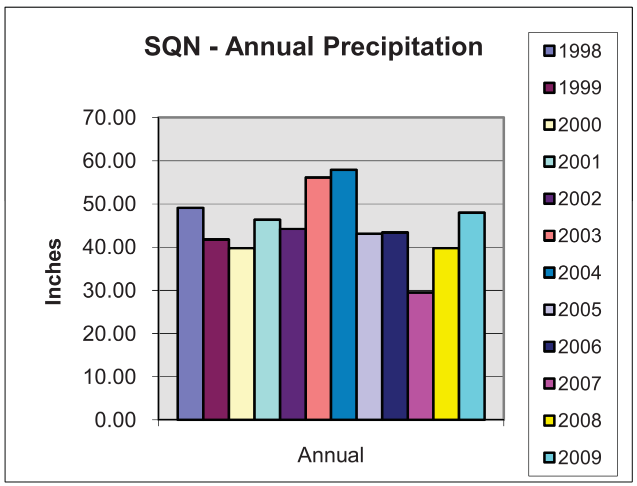
SQN - Actual Monthly Precipitation (latest 5 years)
Inches
10.00
8.00
6.00
4.00
2.00
0.00
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
2004
2005
2006
2007
2008
2009

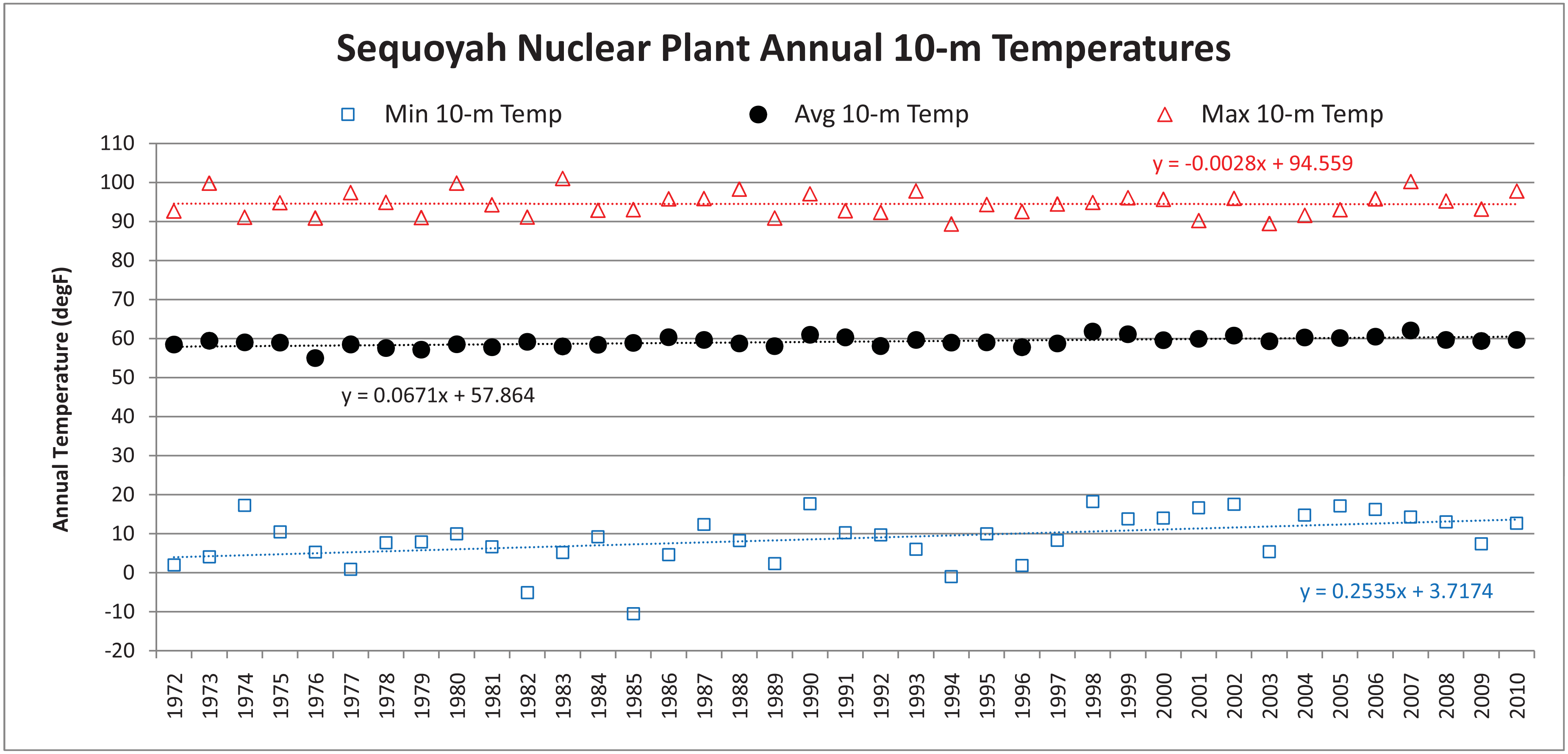
Graphics-Annual

SQN Precipitation Summary
(rainfall data in inches)

	Annual
1998	49.07
1999	41.79
2000	39.78
2001	46.34
2002	44.20
2003	56.09
2004	57.92
2005	43.12
2006	43.37
2007	29.50
2008	39.73
2009	47.94
Average	**44.90**

Due to sensor outage, some rain events during 2007 were not recorded.




Sequoyah Nuclear Plant Annual 10-m Temperatures
Min 10-m Temp
Avg 10-m Temp
Max 10-m Temp
y = -0.0028x + 94.559
y = 0.0671x + 57.864
y = 0.2535x + 3.7174
Annual Temperature (degF)
110
100
90
80
70
60
50
40
30
20
10
0
-10
-20
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
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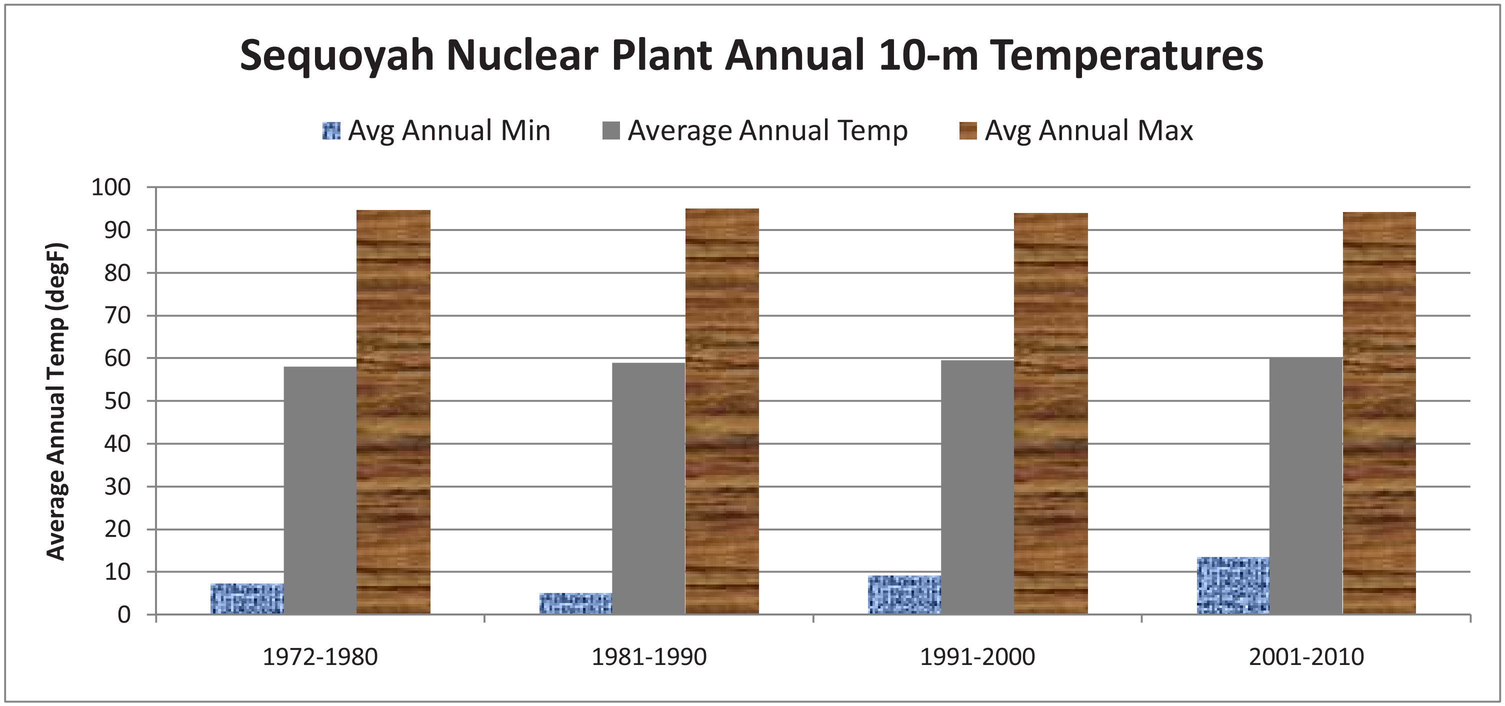
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010


Sequoyah Nuclear Plant Annual 10-m Temperatures
Avg Annual Min
Average Annual Temp
Avg Annual Max
Average Annual Temp (degF)
100
90
80
70
60
50
40
30
20
10
0
1972-1980
1981-1990
1991-2000
2001-2010

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Sequoyah Nuclear Plant - Wind Direction Persistence
Disregarding Stability Class
2000-2009

PERSISTENCE	Wind Direction																	ACC.	ACC.
(HOURS)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	CALM	TOTAL	TOTAL	FREQUENCY
2	781	693	517	92	58	40	100	211	657	821	754	266	161	154	225	457	5	5992	15211	100.00%
3	399	388	209	32	13	13	36	100	309	455	426	100	55	63	85	170	2	2855	9219	60.61%
4	290	315	134	16	4	1	6	48	193	314	277	60	38	33	55	98	1	1883	6364	41.84%
5	174	186	77	1	2	0	5	14	126	269	168	26	24	21	41	65	0	1199	4481	29.46%
6	130	169	61	1	0	0	1	16	74	153	106	14	15	12	32	62	0	846	3282	21.58%
7	79	132	43	0	1	0	0	2	53	138	66	4	6	5	24	52	0	605	2436	16.01%
8	71	107	23	0	0	0	0	4	33	84	46	7	7	6	9	23	0	420	1831	12.04%
9	57	95	8	0	0	0	1	4	26	78	32	5	2	3	13	11	0	335	1411	9.28%
10	37	64	7	0	0	0	0	1	28	78	23	1	2	2	4	5	0	252	1076	7.07%
11	23	53	4	0	0	0	0	1	10	42	16	0	0	1	6	8	0	164	824	5.42%
12	28	49	2	0	0	0	0	0	11	31	15	0	1	0	4	1	0	142	660	4.34%
13	11	44	2	0	0	0	0	0	8	25	9	0	0	2	8	5	0	114	518	3.41%
14	11	41	0	0	0	0	0	0	7	13	1	1	0	0	1	3	0	78	404	2.66%
15	10	29	0	0	0	0	0	0	6	10	2	0	0	0	1	2	0	60	326	2.14%
16	7	30	0	0	0	0	0	0	5	8	2	1	0	0	0	2	0	55	266	1.75%
17	2	15	1	0	0	0	0	1	3	11	1	1	0	0	0	0	0	35	211	1.39%
18	3	13	0	0	0	0	0	0	4	7	1	0	0	0	0	0	0	28	176	1.16%
19	3	16	0	0	0	0	0	0	2	7	2	0	0	0	0	0	0	30	148	0.97%
20	0	10	0	0	0	0	0	0	3	2	1	1	0	1	0	2	0	20	118	0.78%
21	1	5	0	0	0	0	0	0	1	6	0	0	0	0	0	0	0	13	98	0.64%
22	0	4	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0	7	85	0.56%
23	1	6	0	0	0	0	0	0	0	3	0	0	0	0	0	1	0	11	78	0.51%
24	0	5	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	7	67	0.44%
25	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	60	0.39%
26	3	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	57	0.37%
27	0	4	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	5	50	0.33%
28	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	45	0.30%
29	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	43	0.28%
30	0	4	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	6	41	0.27%
31	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	35	0.23%
32	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	32	0.21%
>32	1	27	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	30	30	0.20%
total	2123	2519	1088	142	78	54	149	402	1560	2563	1949	487	311	303	508	967	8	15211		
MAXIMUM PERSISTENCE (HOURS)	40	66	17	6	7	4	9	17	22	34	37	20	12	20	15	23	4			

Sequoyah Nuclear Plant - Wind Direction Persistence
Disregarding Stability Class
2000

PERSISTENCE (HOURS)	Wind Direction N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	CALM	TOTAL
2	82	72	48	5	8	3	6	23	82	82	76	28	24	13	20	50	3	627
3	41	39	19	2	0	1	2	10	26	37	39	9	4	6	4	20	0	262
4	36	33	15	2	0	1	0	3	21	32	17	5	4	7	4	12	0	196
5	20	11	5	0	0	0	0	0	9	37	15	2	1	0	4	5	0	114
6	17	14	6	0	0	0	0	1	4	16	9	1	2	1	2	5	0	84
7	12	14	1	0	0	0	0	0	4	10	4	1	0	1	1	4	0	59
8	6	4	1	0	0	0	0	0	7	7	1	0	0	0	1	1	0	36
9	2	9	2	0	0	0	0	1	2	15	5	0	0	0	2	0	0	47
10	5	10	0	0	0	0	0	0	3	9	3	0	0	0	0	1	0	41
11	0	4	0	0	0	0	0	0	1	6	0	0	0	0	0	1	0	23
12	4	2	0	0	0	0	0	0	0	4	2	0	0	0	0	0	0	24
13	4	4	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	23
14	2	4	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	21
15	1	6	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	24
16	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	18
17	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18
19	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	22
20	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	23
21	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	22
22	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	23
23	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	25
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	24
25	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	27
26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	26
27	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	28
28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	28
29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	29
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30
31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	31
32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	32
>32	0	4	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	5
total	235	240	97	9	8	5	8	38	161	261	171	46	35	28	40	101	3	1486
MAXIMUM PERSISTENCE (HOURS)	25	41	9	4	2	4	3	9	21	34	12	7	6	7	13	23	2	

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Sequoyah Nuclear Plant - Wind Direction Persistance
Disregarding Stability Class
2001

PERSISTENCE	Wind Direction																	
(HOURS)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	CALM	TOTAL
2	68	74	63	8	4	0	13	22	81	80	71	30	14	17	31	30	2	610
3	37	46	21	3	1	2	4	8	35	52	40	7	6	3	7	11	1	287
4	28	31	18	2	0	0	0	8	17	40	21	2	1	2	1	9	1	185
5	11	21	13	1	0	0	0	1	10	28	22	2	1	1	1	7	0	124
6	12	19	6	0	0	0	0	0	6	14	9	2	1	0	1	4	0	80
7	5	15	9	0	0	0	0	0	4	6	8	1	1	0	2	6	0	64
8	8	11	6	0	0	0	0	0	6	13	4	1	0	0	2	2	0	61
9	8	9	0	0	0	0	1	3	3	9	3	0	0	0	1	1	0	47
10	6	8	0	0	0	0	0	0	2	10	1	0	0	0	0	0	0	37
11	5	3	1	0	0	0	0	0	0	6	2	0	0	0	0	0	0	28
12	3	3	0	0	0	0	0	0	1	2	1	0	0	0	0	1	0	23
13	1	4	2	0	0	0	0	0	0	6	0	0	0	0	1	0	0	27
14	2	3	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	21
15	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	17
16	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	19
17	0	1	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	20
18	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	19
19	0	2	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	24
20	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	22
21	0	1	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	24
22	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	24
23	0	2	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	26
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	24
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25
26	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	29
27	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	28
28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	28
29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	29
30	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	31
31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	31
32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	32
>32	1	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
total	197	263	139	14	5	2	18	42	168	277	183	45	24	23	47	72	4	1523
MAXIMUM PERSISTENCE (HOURS)	40	38	13	5	3	3	9	9	19	30	19	8	7	5	13	20	4	

Sequoyah Nuclear Plant - Wind Direction Persistence
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2002

PERSISTENCE (HOURS)	Wind Direction N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	CALM	TOTAL
2	74	76	40	8	8	2	11	19	64	96	60	17	10	15	19	51	0	572
3	42	32	17	1	0	2	5	9	33	52	43	6	4	4	8	26	1	288
4	21	33	11	2	0	0	1	5	24	26	34	5	3	3	8	15	0	195
5	13	16	2	0	0	0	0	1	15	31	17	5	3	1	4	8	0	121
6	18	17	6	0	0	0	0	2	7	21	11	0	1	1	2	6	0	98
7	15	9	2	0	0	0	0	0	6	13	7	0	0	1	2	6	0	68
8	10	11	0	0	0	0	0	0	7	3	3	1	1	0	0	3	0	47
9	3	12	1	0	0	0	0	0	5	7	1	0	0	0	0	1	0	39
10	5	5	1	0	0	0	0	0	3	10	2	0	0	0	0	1	0	37
11	2	6	0	0	0	0	0	1	1	8	1	0	0	0	0	0	0	30
12	4	2	0	0	0	0	0	0	4	4	1	0	0	0	0	0	0	27
13	0	3	0	0	0	0	0	0	1	3	1	0	0	0	0	0	0	21
14	0	6	0	0	0	0	0	0	0	2	0	0	0	0	0	1	0	23
15	2	5	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	23
16	0	5	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0	24
17	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	18
18	0	2	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	22
19	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20
21	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	22
22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	22
23	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25
24	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25
26	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	27
27	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	28
28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	28
29	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30
30	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	31
31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	31
32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	32
>32	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
total	210	250	80	11	8	4	17	37	173	281	181	34	22	25	43	118	1	1495
MAXIMUM PERSISTENCE (HOURS)	19	51	10	4	2	3	4	11	18	30	13	8	8	7	7	14	3	

Sequoyah Nuclear Plant - Wind Direction Persistence
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2003

PERSISTENCE (HOURS)	Wind Direction N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	CALM	TOTAL
2	88	71	36	8	6	5	9	22	60	81	81	19	15	24	25	58	0	610
3	48	39	18	10	2	1	4	13	28	47	52	7	5	2	7	14	0	300
4	29	31	13	0	2	0	2	4	27	35	31	7	2	5	5	11	0	208
5	15	18	7	0	0	0	1	1	10	26	8	1	4	3	5	6	0	110
6	15	14	7	1	0	0	0	5	6	15	11	1	1	0	7	7	0	96
7	6	12	3	0	0	0	0	0	4	20	7	0	0	0	4	6	0	69
8	5	8	2	0	0	0	0	0	3	15	2	0	0	1	2	2	0	48
9	7	5	0	0	0	0	0	0	6	8	8	0	0	0	0	0	0	43
10	5	3	0	0	0	0	0	0	4	3	2	0	0	0	1	2	0	30
11	0	4	0	0	0	0	0	0	1	5	2	0	0	0	0	1	0	24
12	1	10	0	0	0	0	0	0	2	1	0	0	0	0	1	0	0	27
13	1	5	0	0	0	0	0	0	1	4	0	0	0	1	2	3	0	30
14	1	4	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	21
15	1	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19
16	0	5	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	22
17	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	19
18	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	20
19	0	2	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	22
20	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	22
21	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	23
22	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	23
23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	23
24	0	2	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	28
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25
26	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	27
27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	27
28	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30
29	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30
31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	31
32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	32
>32	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
total	224	244	86	19	10	6	16	45	153	270	204	35	27	36	59	111	0	1545
MAXIMUM PERSISTENCE (HOURS)	26	36	8	6	4	3	5	6	20	24	11	6	6	13	13	14	1	

Sequoyah Nuclear Plant - Wind Direction Persistence
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2004

PERSISTENCE	Wind Direction																
(HOURS)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	CALM	TOTAL
2	73	61	36	10	2	8	8	24	72	82	76	27	21	9	17	32	0	560
3	41	34	14	2	0	3	3	8	37	51	37	8	3	5	7	17	0	273
4	29	24	8	1	1	0	0	6	15	40	28	2	7	3	7	9	0	184
5	19	13	5	0	0	0	1	5	18	23	12	3	3	0	6	10	0	123
6	10	9	1	0	0	0	1	0	11	17	6	1	1	4	3	3	0	73
7	10	11	6	0	0	0	0	0	10	17	6	0	1	0	1	5	0	74
8	7	16	0	0	0	0	0	0	3	5	6	1	0	0	2	5	0	53
9	10	8	0	0	0	0	0	0	1	10	1	1	0	1	3	1	0	45
10	1	5	0	0	0	0	0	0	5	5	1	0	0	0	0	1	0	28
11	6	4	0	0	0	0	0	0	2	1	1	0	0	0	0	2	0	27
12	4	5	0	0	0	0	0	0	0	5	1	0	0	0	0	0	0	27
13	1	9	0	0	0	0	0	0	3	4	1	0	0	0	0	1	0	32
14	2	7	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	25
15	1	0	0	0	0	0	0	0	1	1	0	0	0	0	1	0	0	19
16	1	1	0	0	0	0	0	0	3	0	0	1	0	0	0	0	0	22
17	0	1	0	0	0	0	0	0	0	3	0	1	0	0	0	0	0	22
18	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	21
19	2	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	24
20	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	23
21	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	22
22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	22
23	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	24
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	24
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25
26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	26
27	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	29
28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	28
29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	29
30	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	31
31	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	32
32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	32
>32	0	7	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	8
total	219	226	70	13	3	11	13	43	182	267	177	45	36	22	47	86	0	1460
MAXIMUM PERSISTENCE (HOURS)	21	48	7	4	4	3	6	5	18	27	37	17	7	9	15	13	1	

Sequoyah Nuclear Plant - Wind Direction Persistence
Disregarding Stability Class
2005

PERSISTENCE (HOURS)	Wind Direction N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	CALM	TOTAL
2	75	79	60	10	5	8	11	14	46	78	78	24	13	19	17	42	0	581
3	37	35	22	1	2	1	8	10	23	44	47	16	6	11	11	12	0	289
4	31	30	13	3	0	0	0	5	15	32	30	4	1	4	3	8	0	183
5	25	30	10	0	0	0	2	1	12	20	16	2	1	2	5	5	0	136
6	14	22	5	0	0	0	0	0	10	15	9	2	2	1	3	10	0	99
7	9	14	6	0	0	0	0	2	2	17	7	1	1	1	3	1	0	71
8	10	13	1	0	0	0	0	0	3	8	5	0	1	2	1	2	0	54
9	6	14	2	0	0	0	0	0	1	4	2	0	1	1	1	1	0	42
10	3	8	1	0	0	0	0	0	1	6	1	0	0	0	0	0	0	30
11	5	4	0	0	0	0	0	0	1	1	1	0	0	0	2	0	0	25
12	2	5	2	0	0	0	0	0	0	2	2	0	0	0	2	0	0	27
13	2	8	0	0	0	0	0	0	1	1	0	0	0	1	0	0	0	26
14	3	1	0	0	0	0	0	0	3	2	0	0	0	0	0	0	0	23
15	1	3	0	0	0	0	0	0	2	2	0	0	0	0	0	0	0	23
16	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	23
17	0	1	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	21
18	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	20
19	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	21
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20
21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21
22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	22
23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	23
24	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25
26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	26
27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	27
28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	28
29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	29
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30
31	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	33
32	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	33
>32	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
total	223	280	122	14	7	9	21	33	122	235	198	49	26	42	48	82	0	1511
MAXIMUM PERSISTENCE (HOURS)	15	66	12	4	3	3	5	17	18	19	12	7	9	13	12	16	1	

Sequoyah Nuclear Plant - Wind Direction Persistence
Disregarding Stability Class
2006

PERSISTENCE (HOURS)	Wind Direction N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	CALM	TOTAL
2	79	72	64	12	5	2	10	24	72	68	78	37	20	18	30	53	0	646
3	41	28	30	5	1	0	3	9	30	41	45	9	5	11	12	16	0	289
4	27	39	16	1	1	0	0	3	17	19	28	11	5	2	8	7	0	188
5	15	23	8	0	0	0	0	1	10	37	23	1	4	3	6	7	0	143
6	8	19	11	0	0	0	0	2	5	13	11	2	1	2	6	10	0	96
7	4	21	7	0	0	0	0	0	5	15	6	0	3	0	3	7	0	78
8	1	8	2	0	0	0	0	1	0	5	5	1	2	0	1	2	0	36
9	7	7	2	0	0	0	0	0	1	10	5	1	1	0	4	2	0	49
10	6	5	2	0	0	0	0	0	4	7	1	0	0	0	0	0	0	35
11	1	7	1	0	0	0	0	0	2	3	4	0	0	0	0	0	0	29
12	1	5	0	0	0	0	0	0	2	4	1	0	0	0	0	0	0	25
13	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16
14	0	8	0	0	0	0	0	0	2	0	0	0	0	0	0	1	0	25
15	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20
16	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19
17	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19
18	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21
19	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	21
20	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	21
21	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	23
22	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	24
23	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	24
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	24
25	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	26
26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	26
27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	27
28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	28
29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	29
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30
31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	31
32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	32
>32	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
total	196	258	144	18	7	2	13	40	150	226	207	62	41	36	70	105	0	1575
MAXIMUM PERSISTENCE (HOURS)	16	48	17	4	4	2	3	8	14	23	12	9	9	6	9	14	1	

Sequoyah Nuclear Plant - Wind Direction Persistence
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2007

PERSISTENCE (HOURS)	Wind Direction N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	CALM	TOTAL
2	77	61	63	11	9	4	10	27	65	83	77	20	13	11	28	56	0	617
3	31	54	22	2	3	1	3	8	34	52	40	12	7	6	8	16	0	302
4	28	32	11	1	0	0	1	7	18	19	38	8	1	1	9	10	0	188
5	21	14	8	0	0	0	1	3	15	24	22	3	2	3	3	3	0	127
6	9	20	8	0	0	0	0	3	14	18	15	1	1	1	4	7	0	107
7	5	18	5	0	0	0	0	0	2	18	5	0	0	1	2	5	0	68
8	5	11	5	0	0	0	0	2	0	11	4	0	0	0	0	3	0	49
9	3	9	0	0	0	0	0	0	2	6	4	1	0	1	1	1	0	37
10	1	8	2	0	0	0	0	0	2	11	3	1	0	0	0	0	0	38
11	1	11	0	0	0	0	0	0	2	5	2	0	0	1	2	0	0	35
12	2	7	0	0	0	0	0	0	0	3	4	0	0	0	1	0	0	29
13	0	4	0	0	0	0	0	0	1	0	2	0	0	0	1	0	0	21
14	0	3	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	19
15	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	18
16	2	2	0	0	0	0	0	0	0	2	1	0	0	0	0	0	0	23
17	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	19
18	0	4	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	25
19	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20
21	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	22
22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	22
23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	23
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	24
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25
26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	26
27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	27
28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	28
29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	29
30	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	31
31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	31
32	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	33
>32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
total	187	264	124	14	12	5	15	50	156	256	218	47	24	25	59	101	0	1557
MAXIMUM PERSISTENCE (HOURS)	17	32	10	4	3	3	5	8	18	18	18	14	6	11	13	9	1	

Sequoyah Nuclear Plant - Wind Direction Persistence
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2008

PERSISTENCE (HOURS)	Wind Direction N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	CALM	TOTAL
2	84	62	52	8	3	3	8	17	60	83	73	39	14	14	22	46	0	590
3	41	51	23	2	3	1	2	9	27	46	41	17	9	6	13	19	0	313
4	36	26	16	3	0	0	2	4	13	32	31	8	7	2	7	9	0	200
5	15	21	9	0	1	0	0	1	17	20	17	5	3	5	6	7	0	132
6	17	20	3	0	0	0	0	2	6	13	12	2	3	1	2	7	0	94
7	6	6	2	0	1	0	0	0	5	10	7	0	0	0	3	10	0	57
8	11	8	3	0	0	0	0	0	4	6	8	1	1	0	0	2	0	52
9	6	13	0	0	0	0	0	0	3	3	2	0	0	0	1	1	0	38
10	5	6	1	0	0	0	0	1	1	8	5	0	2	1	0	0	0	40
11	1	4	1	0	0	0	0	0	0	4	2	0	0	0	1	3	0	27
12	2	6	0	0	0	0	0	0	2	6	2	0	0	0	0	0	0	30
13	0	2	0	0	0	0	0	0	1	5	2	0	0	0	0	0	0	23
14	1	2	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	20
15	0	3	0	0	0	0	0	0	2	3	2	0	0	0	0	0	0	25
16	0	2	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	20
17	1	3	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	22
18	0	3	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	22
19	0	2	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	22
20	0	1	0	0	0	0	0	0	1	0	1	1	0	1	0	0	0	25
21	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	22
22	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	23
23	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	24
24	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25
26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	26
27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	27
28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	28
29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	29
30	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	31
31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	31
32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	32
>32	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
total	226	245	110	13	8	4	12	34	145	244	206	73	39	30	55	105	0	1549
MAXIMUM PERSISTENCE (HOURS)	17	37	11	4	7	3	4	10	22	21	20	20	10	20	11	16	1	

Sequoyah Nuclear Plant - Wind Direction Persistence
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2009

PERSISTENCE	Wind Direction																
(HOURS)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	CALM	TOTAL
2	81	65	55	12	8	5	14	19	55	88	84	25	17	14	16	39	0	599
3	40	30	23	4	1	1	2	16	36	33	42	9	6	9	8	19	0	282
4	25	36	13	1	0	0	0	3	26	39	19	8	7	4	3	8	0	196
5	20	19	10	0	1	0	0	0	10	23	16	2	2	3	1	7	0	119
6	10	15	8	0	0	0	0	1	5	11	13	2	2	1	2	3	0	79
7	7	12	2	0	0	0	0	0	11	12	9	1	0	1	3	2	0	67
8	8	17	3	0	0	0	0	1	0	11	8	2	2	3	0	1	0	64
9	5	9	1	0	0	0	0	0	2	6	1	2	0	0	0	3	0	38
10	0	6	0	0	0	0	0	0	3	9	4	0	0	1	3	0	0	36
11	2	6	1	0	0	0	0	0	0	3	1	0	0	0	1	1	0	26
12	5	4	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	23
13	1	3	0	0	0	0	0	0	0	2	3	0	0	0	2	1	0	25
14	0	3	0	0	0	0	0	0	1	0	1	0	0	0	1	0	0	20
15	0	5	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	22
16	0	7	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	25
17	0	3	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	24
18	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	20
19	0	2	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	22
20	0	2	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	24
21	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	22
22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	22
23	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	24
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	24
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25
26	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	28
27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	27
28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	28
29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	29
30	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	31
31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	31
32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	32
>32	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
total	206	249	116	17	10	6	16	40	150	246	204	51	37	36	40	86	0	1510
MAXIMUM PERSISTENCE (HOURS)	26	56	11	4	5	3	3	8	20	23	19	9	12	10	14	20	1	