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9.4 Alternative Plant and Transmission Systems

This section discusses alternatives to the heat dissipation, circulating water and transmission systems for the proposed reactors at the VEGP site. Section 9.4.1 evaluates alternative heat dissipation systems, Section 9.4.2 alternative circulating water systems and Section 9.4.3 alternative transmission systems.

9.4.1 Heat Dissipation Systems

9.4.1.1 Screening of Alternative Heat Dissipation Systems

This section discusses alternatives to the proposed heat dissipation system (Section 5.3.3.1) based on the guidance provided in NUREG-1555. Alternatives considered are those generally included in the broad categories of "once through" and "closed cycle" systems. The closed cycle category includes the following types of heat dissipation systems:

- Mechanical draft wet cooling towers
- Natural draft wet cooling towers
- Wet dry cooling towers
- Dry cooling towers
- Cooling ponds
- Spray canals

An initial environmental screening of the above alternative designs was done to eliminate those systems that are obviously unsuitable for use at the VEGP site. The following alternatives were eliminated from further consideration.

Once-through cooling - The water requirements for a once-through cooling system would be 850,000 gpm (1890 cfs) per unit **(Westinghouse 2003)**. This water requirement in combination with the existing water usage for VEGP Units 1 and 2 would withdraw most, if not all, of the flow of the Savannah River. (USGS [2004] estimates the annual mean flow (9,208 cfs) of the Savannah River at the Augusta, Georgia gaging station for the period 1952 - 2003. The average annual mean flow for the same years varies from 4,470 to 16,580 cfs.) Additionally, once through cooling would pose risks of thermal effects and damage to aquatic organisms. EPA regulations (40 CFR Part 125) governing cooling water intake structures under Section 316(b) of the Clean Water Act make it difficult for steam electric generating plants to use one-through cooling systems. For these reasons, once-through cooling was eliminated from further consideration.

Cooling ponds - Studies supporting the construction of VEGP Units 1 and 2 included the potential use of a large (approximately 8,000 acres) cooling reservoir in a closed cycle system. This heat dissipation option was discarded due to serious questions regarding the amount of seepage loss from the reservoir and uncertainty regarding applicability of water quality standards to the impoundment. The proposed new plant footprint is within the 3,169-acre VEGP site. As

described in Section 2.2.1.1, the VEGP plant and auxiliary facilities occupy about 800 acres. A cooling pond system would require more land than is available on the VEGP site. In addition, issues regarding seepage losses and applicability of water quality standards to the reservoir would need to be addressed. These issues, coupled with the land requirements, are sufficient to preclude further consideration of cooling ponds for the new units.

Spray ponds – This alternative is similar to cooling ponds as it involves the creation of new surface water bodies. Spray modules are included to promote evaporative cooling in the ponds, which reduces the land requirements. However, this advantage is offset by higher operating and maintenance costs for the spray modules. This alternative is considered unsuitable for the VEGP site for the same reasons as cooling ponds.

Dry cooling towers – This alternative is not suitable for the reasons discussed in EPA's preamble to the final rule addressing cooling water intake structures for new facilities (66 FR 65256; December 18, 2001). Dry cooling carries high capital and operating and maintenance costs that are sufficient to pose a barrier to entry to the marketplace for some facilities. In addition, dry cooling has a detrimental effect on electricity production by reducing the efficiency of steam turbines. Dry cooling requires the facility to use more energy than would be required with wet cooling towers to produce the same amount of electricity. This energy penalty is most significant in the warmer southern regions during summer months when the demand for electricity is at its peak. The energy penalty would result in an increase in environmental impacts as replacement generating capacity would be needed to offset the loss in efficiency from dry cooling. EPA concluded that dry cooling is appropriate in areas with limited water available for cooling or where the source of cooling water is associated with extremely sensitive biological resources (e.g., endangered species, specially protected areas). The conditions at the VEGP site do not warrant further consideration of dry cooling.

Wet dry cooling towers – These towers are used primarily in areas where plume abatement is necessary for aesthetic reasons or to minimize fogging and icing produced by the tower plume. Wet dry cooling towers use approximately one-third to one-half less water than wet cooling towers **(EPA 2001)**. Due to the rural setting of the site, neither of these advantages is significant. Additionally, somewhat more land is required for the wet dry cooling tower due to the additional equipment (fans and cooling coils) required in the tower assembly. The same disadvantages described above for dry cooling towers would apply to the dry cooling portion of the wet dry cooling tower. The dry cooling process is not as efficient as the wet cooling process because it requires the movement of a large amount of air through the heat exchanger to achieve the necessary cooling. This results in less net electrical power for distribution. Consequently, there would be an increase in environmental impacts as replacement generating capacity would be needed to offset the loss in efficiency from dry cooling. This alternative could be utilized at the VEGP site; however, it is not considered to be environmentally preferable to the proposed wet cooling towers.

Feasible alternatives - Only mechanical draft and natural draft cooling towers are considered suitable heat dissipation systems for the VEGP site and are evaluated in detail. Since natural draft cooling towers were selected as the primary heat dissipation system for the proposed action (see Section 5.3.3.1), mechanical draft cooling towers are considered as an alternative heat dissipation system and evaluated further in Section 9.4.1.2. In accordance with NUREG-1555, the heat dissipation alternatives were evaluated for land use, water use, and other environmental requirements (Table 9.4-1).

9.4.1.2 Analysis of Mechanical Draft Cooling Tower Alternative

SNC modeled the impacts from mechanical draft cooling towers using the SACTI code described in Section 5.3.3.1. Engineering data for the AP1000 was used to develop input to the SACTI model. Four identical cooling towers (two AP1000 units with two cooling towers per unit) were modeled with a heat rejection rate of 7.54×10^9 Btus per hour and circulating water flow of 600,000 gallons per minute for each pair of towers. The tower height was 68 feet. Four cycles of concentration were assumed. The meteorological data was from the VEGP meteorological tower for the year 1999, which had the most complete data set.

Length and Frequency of Elevated Plumes - The SACTI code calculated the expected plume lengths by season and direction for the combined effect of the four mechanical draft cooling towers for the AP1000 units. The longest average plume lengths would occur in the winter months while the shortest would be in the fall. The plumes would occur in all compass directions.

Projected plume lengths, directions, and frequencies are provided in the table below.

	Winter	***Fall***
Median plume length (miles)	0.12	0.12
Predominant direction (median)	NE, ENE, NNE, WSW	SW, WSW, SSW
Longest plume length (miles)	6.2	0.25
Frequency of longest plume (percent)	3.9	7.1

Ground-Level Fogging and Icing - The mechanical draft cooling towers would produce ground-level fogging. Fogging would occur less than 42 hours per year, and most of that fogging would be limited to a 1,000-foot radius of the cooling tower. The most probable direction of fogging would be south to south-southwest and west-southwest to west of the towers. No adverse operational or environmental impact from fogging is expected. No icing would occur.

Solids Deposition - Water droplets drifting from the cooling towers would have the same concentration of dissolved and suspended solids as the water in the cooling tower basin. The water in the cooling tower basin is assumed to have concentrations four times that of the Savannah River, the source of cooling water makeup. As these droplets evaporate, either in the air or on the vegetation or equipment, they would deposit these solids.

The maximum predicted salt deposition rates beyond 0.5 mile would be as follows:

- *Maximum pounds per acre per month:* *13.2*
- *Distance (miles) to maximum deposition:* *0.5*
- *Direction to maximum deposition:* *east*
- *Season of maximum deposition:* *winter*

At distances less than 3,000 feet from the towers, salt deposition would be very large in all directions. Sensitive equipment could not be located within this radius. Approximately 90 percent of the deposition would occur within 2,300 feet of the cooling towers.

Cloud Shadowing and Additional Precipitation - The SACTI code predicted that the precipitation expected from the mechanical draft cooling towers would be a maximum of approximately 1.5 inches of rain per year at 0.19 mile of the towers. In summer, this maximum precipitation would occur north-northeast of the towers. In fall, it would be located southwest to west-southwest and south of the towers. This value is small compared to the precipitation of 33 inches for the year of the meteorological data used for this analysis, which was a year of low rainfall. The 30-year average rainfall at Augusta is 45 inches and at Waynesboro is 47 inches (1971 - 2000) (see Section 5.3.3.1.4).

Other Impacts - The potential for increases in absolute and relative humidity exist where there are visible plumes.

Summary - The potential for fogging and salt deposition would be slightly greater for mechanical draft cooling towers than for natural draft cooling towers. This alternative heat dissipation system would not be environmentally preferable to the proposed natural draft cooling towers.

An economic study conducted to support construction of VEGP Units 1 and 2 concluded that mechanical draft cooling towers were the economic choice over natural draft towers. At that time, a present worth evaluation considering capital cost, power requirements, impact on turbine performance, and maintenance and insurance costs concluded that mechanical draft towers were less costly by more than $1 million per unit. However, natural draft towers were selected for Units 1 and 2 due to environmental considerations. Natural draft cooling towers are proposed for the VEGP units 3 and 4 due to the same considerations.

These differences in impacts are not significant for the VEGP site. These heat dissipation system alternatives are considered environmentally equivalent.

9.4.2 Circulating Water Systems

In accordance with NUREG-1555, this section considers alternatives to the following components of the plant circulating water system:

- intake systems
- discharge systems
- water supply
- water treatment

NUREG-1555 indicates that the applicant should consider only those alternatives that are applicable at the proposed site and are compatible with the proposed heat dissipation system. As discussed in Section 9.4.1, only mechanical draft and natural draft wet cooling towers are considered viable and feasible heat dissipation systems for the VEGP site.

Heat dissipation with wet cooling towers relies on evaporation for heat transfer. The water from the cooling system lost to the atmosphere through evaporation must be replaced. In addition, this evaporation would result in an increase in the concentration of solids in the circulating water. To control solids, a portion of the recirculated water must be removed, or blown down, and replaced with fresh water. In addition to the blowdown and evaporative losses, a small percentage of water in the form of droplets (drift) is lost from the cooling towers. Water pumped from the Savannah River (Section 9.4.2.1) intake structure would be used to replace water lost by evaporation, drift and blowdown from the cooling towers. Blowdown water is returned to the Savannah River via a discharge structure at the river (Section 9.4.2.2).

9.4.2.1 Intake Systems

The makeup water system for VEGP Units 1 and 2 uses a concrete intake structure and a sheet-pile-lined intake canal to draw water from the Savannah River. Makeup water for the circulating water system for the new units would be withdrawn from the Savannah River via a new recessed shoreline intake structure located upstream of the existing VEGP water intake. A conceptual description of the intake design is provided in Section 3.4. Other than differences in dimensions, the design is the same as the intake structure for VEGP Units 1 and 2.

The design of the intake structure for VEGP Units 1 and 2 was modified during the construction phase. The modifications included changing the design for the intake structure canal from slope riprap to vertical sheet pile, adding lateral escape passageways for fish at the intake channel entrance, and providing one independently operating pump per cell (**NRC 1985**). These design modifications were made to reduce the potential impacts on aquatic resources. The design of the intake structure for the new units incorporates these similar features, to reduce impingement and entrainment of aquatic organism (see Sections 3.4.2.1 and 5.3.1) modifications.

Alternative intake systems for the new units include a shoreline or an offshore intake structure. An intake located at the shoreline would result in greater impingement and entrainment of aquatic organisms from the Savannah River. An offshore intake would extend into the channel and interfere with river navigation. No environmentally preferable alternatives to the proposed intake structure were identified.

The location of the existing intake and discharge structures for VEGP Units 1 and 2 and proposed locations for the new intake and discharge structures are shown on Figure 3.1-3. In order to avoid recirculation, the intake structure for the new units must be located upstream of the existing intake structure for VEGP Units 1 and 2, which is directly upstream of the cooling water blowdown discharge point. As described in Section 2.2.1.1, the Savannah River 100-year floodplain ranges from approximately 100 to 800 feet wide at the VEGP site. The floodplain is demarcated from the rest of the VEGP site by steep bluffs along virtually all of the river shoreline. Placement of the new intake structure upstream of the existing intake structure, where the floodplain is at its widest point on the VEGP property would minimize impacts to the marl bluffs, but alter more floodplain habitat. Alternate locations further upstream would increase the amount of undisturbed land impacted by construction of the intake structure. Land that is currently undisturbed would be impacted both to access that portion of the VEGP site and to construct the makeup water pipeline from the intake to the plant. In addition, pumping costs would increase due to the longer distance from the makeup water intake to the cooling towers. The area between the intake structure for Units 1 and 2 and the proposed location for the new intake is characterized by steep bluffs and significant archaeological resources. Construction of an intake structure in that area would incur high costs and result in significant impacts to the bluffs and the archaeological sites. These alternative locations are not environmentally preferable to the proposed site for the river water intake.

9.4.2.2 Discharge Systems

As noted above, the circulating water system for the new units would be a closed loop system utilizing wet cooling towers for heat dissipation. All cooling system discharges, including cooling tower blowdown, would be discharged to the Savannah River via a new discharge structure to be built downstream of the existing VEGP discharge structure. The design is the same as the discharge structure for VEGP Units 1 and 2 (see Section 3.4.2.2).

The original design for the discharge line from VEGP Units 1 and 2 called for a submerged multiport diffuser. The design was changed to a single-port discharge in Amendment 3 to the Vogtle construction permits CPPR-108 and CPPR-109. The predicted benefits of this change were that the thermal plume would be smaller, the plume would not impinge on the Georgia shoreline, and the total width of the river affected by the thermal plume would be less **(NRC 1985)**.

The environmental impact of releasing the effluent through the new discharge line was determined to have minimal impact to aquatic biota in the river. SNC evaluated a single submerged port as the conceptual discharge design for the proposed new units. If the mixing zone resulting from such a design were unreasonably large, a more complex multi-port diffuser would have been considered.

The choice of port diameter is a compromise between (1) mixing zone size (favored by smaller diameter) and (2) pumping costs (to move the necessary flow through the discharge port at

higher velocity) and river bed scour (caused by high jet velocity along the bed). The proposed 2-foot diameter discharge port design represents a compromise between these mixing zone and discharge velocity considerations. No environmentally preferable alternatives to the proposed discharge structure were identified.

Impacts from the combined effects of the discharges from VEGP Units 1 and 2 and the new units are assessed in Section 5.3.2. To avoid recirculation of blowdown into the Units 1 and 2 intake, the new discharge structure must be located downstream of the existing cooling tower blowdown discharge from VEGP Units 1 and 2, which is immediately downstream of the existing intake. The proposed discharge location maximizes the distance between the thermal plume and offsite property owners further downriver. Impacts from the combined effects of the discharges form VEGP Units 1 and 2 and the new units are assessed in Section 5.3.2.

9.4.2.3 Water Supply

As discussed above, there would be a need for continuous makeup water to the closed loop circulating water system. The maximum makeup water flow to the cooling towers in the normal heat sink is estimated at 57,784 gpm (Table 3.0-1, based on two AP1000 units). There are two potential sources of makeup water supply for the VEGP site, the Savannah River and groundwater wells. Other surface water bodies in the Savannah River basin (see Section 2.3.2.1) would not provide sufficient volume to support the makeup requirements of the circulating water system or are located too distant from the site.

The VEGP uses both surface and groundwater sources. The Savannah River is the source of makeup water for the circulating water system natural draft cooling towers for Units 1 and 2, and a backup source of makeup to the nuclear service cooling water towers. VEGP Units 1 and 2 use groundwater for reactor demineralizer makeup, normal makeup to the nuclear service cooling towers, fire protection, and potable water. Two makeup wells producing from the Cretaceous aquifer supply water to storage tanks from which water is withdrawn as needed. These wells designated MU-1 and MU-2A are capable of supplying 2,000 gpm and 1,000 gpm, respectively, of makeup water on a continuous basis. A third well, designated TW-1, is the alternate makeup well and is capable of supplying up to 1,000 gpm on a continuous basis for plant use. SNC has estimated the recoverable water quantity in the Cretaceous aquifer at approximately 21 billion acre-feet, which provides a safe yield of 5 billion gallons per day. However, considering factors such as pumping well interference, water level fluctuations caused by climatic changes, competing groundwater uses, regional concerns about salt-water intrusion, and the need to preclude drawdown from causing subsidence of plant foundations, it is unlikely that a well field could be designed to meet the makeup water requirements for the circulating water system. Therefore, the Savannah River would be used for makeup to the circulating water system cooling towers.

9.4.2.4 Water Treatment

Evaporation of water from cooling towers leads to an increase in chemical and solids concentrations in the circulating water, which in turn increases the scaling tendencies of the water. The circulating water system for the new units would be operated so that the concentration of solids in the circulating water would be approximately four times the concentration in the makeup water (i.e., four cycles of concentration). The concentration ratio would be sustained through blowdown of the circulating water from the cooling towers to the Savannah River and the addition of makeup water.

As described in Section 3.3.2.1, the Savannah River would be the source of makeup water for the new units' circulating water system. This water supply would be treated to prevent biofouling in the intake and makeup pipe to the new units. Additional treatment for biofouling, scaling or suspended matter reduction through the addition of biocides, antiscalants, and dispersants would occur in the cooling tower basin. Sodium hypochlorite and bromine are used to control biological growth in the circulating water system for Units 1 and 2 and would likely be used in the new system for VEGP Units 3 and 4 (see Section 5.2.3). These chemicals replaced a gas chlorination system that originally served the circulating water system for Units 1 and 2. Sodium hypochlorite is as effective a biocide and alleviates some of the safety concerns associated with storing and using gaseous chlorine. Alternative biocides include hydrogen peroxide or ozone. The final choice of chemicals or combination of chemicals would be dictated by makeup water conditions, technical feasibility, economics, and discharge permit requirements. Since the discharges from the system would be subject to NPDES permit limitations that consider aquatic impacts, different water treatment chemicals would be environmentally equivalent.

9.4.3 Transmission Systems

The power transmission system from the proposed VEGP units has not been designed. There are numerous factors that could give rise to changes to the current transmission and distribution system over the life of the ESP. As described in Section 3.7.2, the transmission and distribution system for the two existing units of the VEGP may be different than currently configured at the time of new reactor construction. Therefore, analysis of the transmission and distribution system, including any related environmental impact and alternative design evaluations are not provided in this ESP application.

Table 9.4-1 Screening of Alternative Heat Dissipation Systems

Factors Affecting System Selection	Mechanical Draft Wet Cooling Tower (MDCT)	Natural Draft Wet Cooling Tower (NDCT)
Land Use		
Onsite land requirements	An MDCT system would require more land (25 acres per reactor unit). An MDCT system could be placed within the confines of the VEGP site.	NDCT system would require 2.3 acres (excluding basin) per reactor unit. An NDCT system could be placed within the confines of the VEGP site.
Terrain considerations	Terrain features of the VEGP site are suitable for a MDCT system.	Terrain features of the VEGP site are suitable for a NDCT system.
Water Use	Raw water consumption of 28,900 gpm per reactor unit.	Raw water consumption of 28,900 gpm per reactor unit.
Atmospheric Effects	Impacts would be SMALL (see Section 9.4.1.2). MDCT present greater potential for fogging and salt deposition.	Impacts would be SMALL (see Section 5.3.3) and not warrant mitigation.
Thermal and Physical Effects	Discharges associated with MDCT would meet water quality standards. The volume of water affected by the mixing zone is less than 1% of the volume in the river stretch from the discharge to its furthest downstream extent. Because of the relatively low discharge velocities and rapid plume dilution, only minor scouring of the river bottom is expected. (Section 5.3)	Discharges associated with NDCT would meet water quality standards. The volume of water affected by the mixing zone is less than 1% of the volume in the river stretch from the discharge to its furthest downstream extent. Because of the relatively low discharge velocities and rapid plume dilution, only minor scouring of the river bottom is expected. (section 5.3)
Noise Levels	MDCT would emit broadband noise that is largely indistinguishable from background and unobtrusive (Section 5.3.4.2).	NDCT would emit broadband noise that is largely indistinguishable from background and unobtrusive (Section 5.3.4.2).
Aesthetic and Recreational Benefits	Consumptive water use for a MDCT system would be consistent with minimum stream flow requirements for Savannah River navigation and environmental maintenance, fish and wildlife water demand, and recreation. MDCT plumes resemble clouds and would not disrupt the view scape.	Consumptive water use for a NDCT system would be consistent with minimum stream flow requirements for Savannah River navigation and environmental maintenance, fish and wildlife water demand, and recreation. NDCT plumes resemble clouds and would not disrupt the view scape

Table 9.4-1 (cont.) Screening of Alternative Heat Dissipation Systems

Factors Affecting System Selection	Mechanical Draft Wet Cooling Tower (MDCT)	Natural Draft Wet Cooling Tower (NDCT)
Legislative Restrictions	An intake structure for an MDCT system would meet Section 316(b) of the CWA and the implementing regulations, as applicable. NPDES discharge permit thermal discharge limitation would address the additional thermal load from MDCT blowdown. These regulatory restrictions would have SMALL impacts on this heat dissipation system.	An intake structure for an NDCT system would meet Section 316(b) of the CWA and the implementing regulations, as applicable. NPDES discharge permit thermal discharge limitation would address the additional thermal load from NDCT blowdown. These regulatory restrictions would not negatively impact application of this heat dissipation system.
Is this a suitable alternative for the SNC VEGP site?	Yes	Yes

Source: **Westinghouse 2003**, Table 3.1-1

Section 9.4 References

(EPA 2001) U.S. Environmental Protection Agency, *Technical Development Document for the Final Regulations Addressing Cooling Water Intake Structures for New Facilities* (EPA-821-R-01-036), November, 2001.

(NRC 1985) U.S. Nuclear Regulatory Commission, *Final Environmental Statement Related to the Operation of Vogtle Electric Generating Plant, Units 1 and 2, NUREG-1087*, Office of Nuclear Reactor Regulation, Washington, D.C., March, 1985.

(USGS 2004) United States Geological Survey, *Water Resources Data – Georgia 2003*, Water Data Report GA-03-1, Atlanta, Georgia, 2004.

(Westinghouse 2003) Westinghouse Electric Company, LLC, *AP1000 Siting Guide: Site Information for an Early Site Permit*, APP-0000-X1-001, Revision 3, April 24, 2003.

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10.5 Cumulative Impacts

This section discusses cumulative adverse impacts to the region's environment that could result from the construction and operation of two new units at VEGP. A cumulative impact is defined in Council of Environmental Quality regulations (40 CFR 1508.7) as an "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 non-Federal) or person undertakes such other actions."

To determine if cumulative impacts will be expected the existing environment in the region of VEGP (Chapter 2) was considered in association with the environmental impacts presented in Chapters 4 and 5 for operating two new units at VEGP. The section also contemplates renewal of VEGP Units 1 and 2 operating licenses, and the cumulative impacts of four units on the affected environment.

10.5.1 Cumulative Impacts from Construction

Construction activities will require some groundwater in addition to that used by the existing facilities. The maximum withdrawal rate of the combined existing units and construction will be less than withdrawal rate permitted by the State. No other large groundwater users are in the vicinity of VEGP. Therefore, cumulative impacts to groundwater during construction will be small.

Approximately 310 acres of the VEGP property will be required for the new units. An additional transmission corridor will be constructed and will require a total of approximately 2.0 sq mi of land over a distance of approximately 60 miles. Eastern Georgia is predominantly rural and most land is agricultural or forested. SNC is unaware of any large projects that will change the predominant land use in Burke County or the counties the corridor will cross. The construction of Units 1 and 2 did not spur a great amount of growth in Burke County, and SNC expects the impacts of Units 3 and 4 to be similar. The project will not contribute to cumulative impacts of changing land use.

During construction noise levels will increase above those now experienced at VEGP, however, the noise levels will return to ones expected for a power generation facility after construction ceases. No other large construction activities are planned in the vicinity, and so noise from construction will not be cumulative with other industrial sources.

Construction will result in increased air emissions from commuter traffic and the construction equipment. However, as noted, this is the only large construction project planned for the area and the air quality in the vicinity is in attainment with air quality standards. No adverse cumulative impacts to air quality are expected.

The maximum construction workforce will be approximately 4,400 people and the percent of the workforce that will live in Burke County could have short-term moderate impacts to the Burke County housing market and social services, particularly schools and fire protection infrastructure. However, no other construction projects of this magnitude have been identified in the area, and

so there will be no cumulative impacts due to other large construction workforces. No other cumulative impacts due to construction have been identified.

10.5.2 Cumulative Impacts of Operations

After operations begin, the new units will use groundwater for some operational systems. The groundwater use requirements of the new units and the existing units will be less that the withdrawal rate currently permitted by the State. No other significant current or future users of groundwater in the vicinity of VEGP have been identified. Therefore, cumulative impacts to groundwater during operation will be small and not warrant mitigation.

Noise from the existing units is usually indistinguishable from background, and the new units will generate similar levels of noise. One small power generation facility on the Savannah River Site is within 6 miles of VEGP. No other sources of industrial noise occur in the 6-mile vicinity, and so cumulative noise pollution is expected to be minimal.

Operational activities that could impact surface water such as NPDES-permitted discharges will be small. The maximum mixing zone for the existing units' thermal plume was estimated to be 4,300 cu ft with a downstream distance of about 20 feet and a depth of about 10 feet **(AEC 1974)**. Due to the small size of the plume, field verification of the modeled plume would have been difficult to perform and was not required. SNC has no field measured data on actual plume size. However, there is no basis to believe the model of the existing plume is not accurate. In any event, prior to construction and operation, the only way to assess the cumulative impacts of the existing and new units discharge is clearly through the use of modeling. Based on computer modeling, blowdown from the new units' cooling towers, adjusted by the centerline temperature of the existing thermal plume will result in a new thermal plume with a surface area of approximately 300 sq ft, a cross-sectional area of approximately 115 sq ft, and a volume of approximately 800 cu ft. Neither the existing nor the new plume is large enough to significantly affect the water quality or biota of the river. The new discharge will be downstream of the existing discharge plume and the existing plume will mingle with the new plume. This commingling is reflected in the previously described model, which resulted in an additional 800 cu ft. plume associated with the new discharge. This plume impacts less than 11 percent of the bank-to-bank cross-section area. The cumulative impacts of the plumes from the existing discharge and the proposed discharge on the Savannah River will be SMALL and will not warrant mitigation.

Through the operation of the cooling water intake structures, small numbers of adult and juvenile fish and fish eggs and larvae may become impinged or entrained at VEGP. Based on the results of impingement and entrainment studies performed immediately upstream at SRS and design features of the VEGP cooling water intake structures (discussed in Section 5.3), cumulative impacts from the operation of the existing intake and the proposed intake on the Savannah River are essentially additive. That is, the cumulative impacts are equal to the total of the independent impacts from the existing and the new intake structures. At the average river flow, consumptive

use represents approximately 1.4 percent of river flow. At the low flow 7Q10 flow that occurs approximately once per decade, consumptive use represents approximately 3.4 percent of the 7Q10 flow. The impacts of the combined four units consumptive use of water are SMALL and will not warrant mitigation. Even during the extreme low flow event, the impacts remain SMALL. The impacts to both eggs and larval fish at the extreme low flow event are overstated since most of the spawning takes place in Spring and early Summer when flows are high. 7Q10 flows occur in Fall, when the presence of eggs and larval fish is significantly lower.

The new cooling system will withdraw make up water from the Savannah River, as does the existing system. The existing units have a maximum actual consumptive water use of 30,000 gpm (Table 2.9-1) and the new units have a maximum estimated consumptive use of 28,904 gpm. Between VEGP and the nearest downstream users are several large tributary creeks. The cumulative impacts of VEGP water withdrawal on the Savannah River and downstream users will be SMALL and will not warrant mitigation. In recent years, water withdrawal associated with the Savannah River Site (SRS) has decreased dramatically. The decrease in SRS withdrawals offsets the proposed increase in water withdrawal associated with Vogtle Units 3 and 4 by a factor of 20 or more. The cumulative impact to the aquatic community is improved significantly.

Two natural draft cooling towers will join the two existing towers on the local sky-line. The towers will appear to be clustered together so the visual impact will be only slightly different from what it is now. Two additional towers will increase the size of the plume and its visibility from offsite areas, but will not change the nature of the visual experience. Cumulative impacts on the viewscape will be SMALL and will not warrant mitigation.

The distance between the additional pair of cooling towers and the existing pair of towers will be approximately 4,000 feet. A single cooling tower's plume is estimated to have a maximum salt deposition rate of 3.6 pounds per acre per month, and that maximum deposition will occur 1,600 feet from the tower. Salt deposition was not estimated for Units 1 and 2. Even assuming that all four towers deposited the maximum of 3.6 pounds per acre per month, SNC does not believe that salt deposition from all four units warrants mitigation for several reasons. The deposition rate is a calculated maximum rate, and so the actual rate will likely be less. The maximum salt deposition from all four towers will not overlap and combine since the distance between the two sets of towers (approximately 4,000 feet) is greater than twice the distance to the maximum deposition of 1,600 feet. The salt deposition from the Units 3 and 4 towers would overlap since the towers are only 1,100 feet apart. The maximum estimated cumulative salt deposition rate is 7.2 pounds per acre per month at 1,600 feet north of the towers (3.6 pounds per acre per tower; well within the NUREG-1555 significant level of 8.9 pounds per acre per month) and will not constitute an adverse impact.

Impacts to air quality will not be from the reactors, but from support facilities and equipment and cooling towers, as they are now for the existing units. Emissions of criteria pollutants from the new units will be in pounds per year from the emergency diesel generators or the auxiliary boiler.

The SRS D-Area Powerhouse, SCE&G's Urquhardt Station, and Plant Wilson are all fossil-fueled and are located within about 25 miles of VEGP. The greater Augusta area has several large industrial facilities with permitted releases to the air. The Augusta-Aiken Interstate Air Quality Control Region is in attainment for all criteria pollutants. The contribution of the four VEGP units' support facilities to regional air quality pollutants is small and would not require mitigation. Cumulative atmospheric and meteorological impacts are not expected.

New reactor units will release small quantities of radionuclides to the environment. Each AP1000 unit is predicted to have liquid emissions of approximately 1,000 curies annually and gaseous emissions of approximately 11,000 curies annually. These Westinghouse AP1000 doses were derived for the DCD using the PWR-GALE model to demonstrate that the design would meet the 10 CFR 50, Appendix I limits **(Westinghouse 2005)**. The predicted liquid and gaseous doses from the AP1000 units are identified in Chapter 3 (Tables 3.0-1, 3.5-1 and 3.5-2). Predicted doses for the existing units, contained in the VEGP Units 1 and 2 UFSAR, were based on a previous version of the PWR-GALE model resulting in dose values higher than actual measured doses. Subsequently, the latest version of the PWR-GALE model used in the AP1000 DCD is even more conservative than the previous version used for Units 1 and 2. Therefore, this analysis likely does not represent the doses expected from the new units. The existing units annual measured gaseous and liquid emissions, identified in Table 2.9-1, are 115 curies and 1,400 curies respectively. All releases will be within regulatory limits as indicated in Table 5.4-9. In addition to the two existing VEGP units, other existing sources of radionuclide releases to the environment within the 50-mile region include DOE's Savannah River Site; the disposal facility for commercially-generated low-level radioactive waste, Chem-Nuclear in Barnwell, SC; and area hospitals, with the largest contributors the SRS and VEGP.

Both VEGP and the Savannah River Site (SRS) release radionuclides into the atmosphere and the Savannah River. Tritium accounts for nearly all the radioactivity released to the river. The SRS maintains an extensive monitoring program in the Savannah River. In 2004, the average tritium concentration at the Highway 301 bridge, downstream of VEGP and SRS, from all sources, was 0.061 picocuries per milliliter (**WSRC 2005**). The U.S. Environmental Protection Agency maximum contaminant level for maintaining safe drinking water is 20 picocuries of tritium per milliliter. SNC anticipates that the new units will release tritium in concentrations similar to the existing units. The cumulative impacts of tritium released to the Savannah River from the SRS and four VEGP will be small and will not warrant mitigation.

The potential maximally exposed individual all-pathways dose from all SRS releases was 0.15 millirem in 2004 (**WSRC 2005**). The maximally exposed individual dose from the existing VEGP units in 2004 was 0.091 millirem. The conservative (maximum) estimated dose to the maximally exposed individual from the new units is 0.12 millirem per year. Therefore, if the same hypothetical individual was the maximally exposed individual to both SRS and VEGP releases, the total annual dose will be 0.21 millirem per year. The regulatory limit for exposure to an offsite

member of the public is 25 millirem per year. Cumulative impacts to the maximally exposed individual will be small and will not warrant mitigation.

The fuel cycle specific to new units at VEGP will contribute to the cumulative impacts of fuel production, storage and disposal of all nuclear units in the United States, but the cumulative impacts of the fuel cycle for the existing reactors is small and the addition of the impacts of two new units will not change that conclusion. Fuel and waste transportation impacts from two new units also will be small, and will not increase the cumulative impacts of transportation of all nuclear reactor fuel and wastes.

Non-radioactive solid wastes will be disposed in permitted landfills. The volume of additional wastes will be minimized through waste minimization programs, and therefore, cumulative impacts of waste disposal are expected to be small.

Socioeconomic impacts, including increased tax revenues to Burke County, would be cumulative with socioeconomic changes brought about through the construction and operation of the existing units, and changes due to normal population growth. Taxes from the four units will fund new infrastructure that could attract residents to Burke County. However, the construction and operation of the existing units did not result in large changes to tax-driven land use changes in Burke County, and it is not expected that the new units will either. The infrastructure of Burke, Richmond, and Columbia Counties is adequate to support new operations employees. No other projects that would involve immigration of a large workforce have been identified in the area. Cumulative socioeconomic impacts would be small.

In conclusion, the impacts from the construction and operation of one of more units at the VEGP site will not contribute significantly to existing or future cumulative impacts to the vicinity or the region.

Section 10.5 References

(AEC 1974) U.S. Atomic Energy Commission, Final Environmental Statement related to the proposed Alvin W. Vogtle Nuclear Plant Units 1, 2, 3, and 4, Georgia Power Company, Docket Nos. 50-424, 50-425, 50-426, and 50-427, Directorate of Licensing, Washington, D.C., March.

(WSRC 2005) Westinghouse Savannah River Company, 2005, SRS Environmental Report for 2004, WSRC-TR-2005-00005, Aiken, S.C.

(Westinghouse 2005) Westinghouse Electric Company, LLC, AP1000 Design Control Document, Revision 15, Pittsburgh, PA, November 11.