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United States Nuclear Regulatory Commission
*Protecting People and the Environment*

NUREG-1437
Supplement 34

# Generic Environmental Impact Statement for License Renewal of Nuclear Plants

# Supplement 34

# Regarding Vogtle Electric Generating Plant, Units 1 and 2

# Final Report

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The Category 2 issues related to cooling system operation during the renewal term that are applicable to VEGP are discussed in the sections that follow, and are listed in Table 4-2.

**Table 4-2.** Category 2 Issues Applicable to the Operation of the VEGP Cooling System During the Renewal Term

| ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1 | GEIS Sections | 10 CFR 51.53(c)(3)(ii) Subparagraph | SEIS Section |
|---|---|---|---|
| **SURFACE-WATER QUALITY, HYDROLOGY, AND USE (FOR ALL PLANTS)** | | | |
| Water use conflicts (plants with cooling towers and cooling ponds using makeup water from a small river with low flow) | 4.3.2.1; 4.4.2.1 | A | 4.1.1 |
| **HUMAN HEALTH** | | | |
| Microbiological organisms (public health) (plants using a lake, canal, or cooling towers or cooling ponds that discharge to a small river) | 4.3.6 | G | 4.1.2 |

## 4.1.1 Water Use Conflicts

For plants with cooling tower systems that are supplied with make-up water from a small river with low flow, the potential impact on instream and riparian communities is considered a Category 2 issue, thus requiring a site-specific assessment for license renewal review. Since 1953 (the year of the opening of the J. Strom Thurmond Dam), the mean annual flow volume of the Savannah River at Augusta (22 miles [mi] upstream from VEGP) has ranged from 4,470 to 16,580 cubic feet per second (cfs; USGS 2007a). This volume meets the NRC definition of a small river as flow is less than 100,000 cfs ($3.15 \times 10^{12}$ cubic feet per year [$ft^3$/yr] listed in 10 CFR Part 51.53(c)(3)(ii)(A)), resulting in water use conflicts being a potentially applicable issue for relicensing of VEGP.

In order to evaluate potential impacts related to water withdrawal from the Savannah River, and the potential for impacts to instream and riparian communities associated with the Savannah River, the Staff independently reviewed the VEGP Environmental Report, visited the site, consulted with Federal and State resource agencies, and reviewed the applicant's current NPDES permit and other existing literature.

The GEIS considers surface water use conflicts to be a Category 2 issue for two separate reasons:

1) Consumptive water use can adversely affect riparian vegetation and instream aquatic communities in the stream. Reducing the amount of water available to either the riparian zones or instream communities could result in impacts to threatened and endangered species, wildlife, and recreational uses of the water body. In addition, riparian vegetation performs several important ecological functions, including stabilizing channels and floodplains, influencing water temperature and quality, and providing habitat for aquatic and terrestrial wildlife (NRC 1996).

2) Continuing operation of these facilities depends on the availability of water within the river from which they are withdrawing water. For facilities that are located on small bodies of water, the volume of water available is expected to be susceptible to droughts and to competing water uses within the basin. In cases of extreme drought, these facilities may be required to curtail operations if the volume of water available is not sufficient (NRC 1996).

An additional potential effect of the withdrawal of water from a small river is that the withdrawal may have an impact on groundwater levels and, therefore, result in groundwater use conflicts (NRC 1996). This is considered to be a separate Category 2 issue, and is evaluated in Section 4.5.2 of this SEIS.

The VEGP facility withdraws water from the Savannah River for use as make-up water to the circulating cooling water system. The water is withdrawn under a Georgia Department of Natural Resources (GDNR) surface water permit, Number 017-0191-05, which currently expires in 2010 (SNC 2007a). The permitted volume of water withdrawal under this permit is 131 cfs (85 million gallons per day [mgd] monthly average; GDNR 2007a). The VEGP Environmental Report reports that the actual capacity of the intake system is 89 cfs (SNC 2007a), of which an estimated 66.8 cfs is consumed through evaporative loses and drift (NRC 1985). The actual surface water withdrawal reports provide a different estimate. In 2006, the highest average monthly withdrawal rate was in May, with a daily average of 67.26 mgd (103.8 cfs; SNC 2007c). Using the same consumption ratio reported in the Environmental Report (75 percent), this would translate to an average consumptive use of 77.9 cfs.

The hypothetical minimum flow volume in the river during the most extreme drought is projected to be 957 cfs (SNC 2006a), but this estimate was based on river conditions before the construction of the reservoirs. In reality, the most likely minimum flow volume in the Savannah River would be 3,800 cfs, which is the minimum volume that is to be released from Thurmond Dam, if the water level in the reservoir remains above 312 feet (ft) above mean sea level (msl; USACE 2007). The water level in the reservoir has never dropped that low. There have been days on which the flow volume was less then 3,800 cfs; these have been isolated events (USGS 2007b). Although the state of Georgia is currently considered to be in a period of severe

drought (USGS 2007c), the flow volume at the Waynesboro measuring station has not dropped below 3,900 cfs since measurements began in early 2005 (USGS 2007d).

Based on these values, the highest volume that is expected to be consumed by facility operations (77.9 cfs) represents about 2.05 percent of the lowest expected flow volume (3,800 cfs), and only 8 percent of the hypothetical minimum flow volume. This withdrawal is not expected to represent a volume large enough to adversely affect riparian vegetation and instream aquatic communities in the Savannah River. In addition, it does not appear that flow volumes in the Savannah River, even under the current severe drought conditions, could be reduced to the point where it would affect facility operations. In the unlikely event that drought conditions reduced flow volumes even further, the facility could continue to operate at flow volumes down to 500 cfs (SNC 2006a). At this volume, VEGP consumptive water use would still represent only about 15 percent of the flow volume in the river. Therefore, the Staff has determined that impacts associated with future water use conflicts are SMALL.

The staff identified a variety of measures that could mitigate potential water use impacts resulting from continued operation of VEGP cooling water system. Potential mitigation measures for the effects of the cooling water system on water use impacts include reduction in the use of river water, or additional recycling of cooling water. These mitigation measures could reduce water use impacts by reducing the consumptive use of water within the Savannah River.

The staff did not identify any cost benefit studies applicable to these mitigation measures. The volume of consumptive water use for the facility is authorized under a Permit to Withdraw, Divert, or Impound Surface Water issued by the Georgia Environmental Protection Division (GEPD), and NRC expects that analysis of the costs and benefits of any mitigation measures would be evaluated by GEPD as part of that permitting program.

### 4.1.2 Microbiological Organisms (Public Health)

The effects of thermophilic microbiological organisms on human health are listed in 10 CFR Part 51, Subpart A, Appendix B, Table B-1, as a Category 2 issue and require plant-specific evaluation before license renewal for those plants with closed-cycle cooling on a small river. The average annual flow of the Savannah River at the nearest measuring station to VEGP (Augusta, at river mile [RM] 187.4) is approximately $2.89 \times 10^{11}$ $ft^3/yr$ ($8.2 \times 10^9$ cubic meters per year [$m^3/yr$]) (Gotvald et al. 2005). This is less than the $3.15 \times 10^{12}$ $ft^3/yr$ ($9 \times 10^{10}$ $m^3/yr$) threshold value in 10 CFR 51.53(c)(3)(ii)(G) for thermal discharge to a small river. Nevertheless, recreational uses of the Savannah River in the vicinity of the plant, which include boating, fishing, and canoeing, create the potential for human exposure to thermophilic microbiological organisms. Hence, the effects of the VEGP cooling water discharge on microbiological organisms must be addressed for VEGP license renewal.

## 4.8 Cumulative Impacts

The NRC Staff considered potential cumulative impacts on the environment resulting from the incremental impact of license renewal when added to other past, present, and reasonably foreseeable future actions. For the purposes of this analysis, past actions are those related to the resources when VEGP was licensed and constructed, present actions are related to the resources during current operations, and future actions are those that are reasonably foreseeable through the end of station operations, including the license renewal term. The geographical area over which past, present, and future actions are assessed is dependent on the affected resource.

The impacts of the proposed action, license renewal, as described in previous sections of Chapter 4, are combined with other past, present, and reasonably foreseeable future actions in the potentially affected area regardless of which agency (Federal or non-Federal) or entity is undertaking the actions. The combined impacts are defined as "cumulative" in 40 CFR 1508.7 and include individually minor but collectively significant actions taking place over a period of time (CEQ 1997). It is possible that an impact that may be SMALL by itself could result in a MODERATE or LARGE impact when considered in combination with the impacts of other actions on the affected resource. Likewise, if a resource is regionally declining or imperiled, even a SMALL individual impact could be important if it contributes to or accelerates the overall resource decline.

The NRC staff has identified the principal past, present, and reasonably foreseeable future actions potentially impacting the environment affected by VEGP. These include: the proposed VEGP Units 3 and 4 (future); major SRS facilities, including nuclear reactors (past), the D-Area powerhouse (present), and the Mixed Oxide (MOX) Fuel Fabrication Facility (future); and other users of Savannah River water. VEGP Units 3 and 4 would be located adjacent to Units 1 and 2 and would have similar environmental impacts from operation (NRC 2007).

The principal SRS facilities with a potential to affect the Savannah River due to their water withdrawals and discharges historically were the five production reactors (the C, K, L, P, and R reactors), a coal-fired power plant (the D-Area powerhouse), and a heavy water production facility. During their initial operation, all of these facilities used once-through cooling systems in which water was pumped from the Savannah River, used in secondary cooling, and discharged into the nearest surface stream, which returned the effluent to the river. Numerous changes involving the cooling water systems subsequently occurred, including the construction of two cooling ponds and the shutdowns of the reactors. Use of Savannah River surface water by SRS varied, with estimated withdrawal rates ranging from 8.5 $m^3/s$ to 26.0 $m^3/s$, depending on the number of reactors in operation and the power levels at which they were operating. Generally, the amount of water withdrawn by SRS was approximately 9 percent of the average annual flow in the Savannah River (DuPont 1987). The heavy water production facility was

placed on standby in 1982 (DuPont 1987), and all five nuclear reactors were shut down and placed on standby prior to 1989 (Reed et al. 2002). Of these SRS facilities, only the D-Area powerhouse is currently operational.

The D-Area powerhouse is a coal-fired power plant that has been in operation since 1952 (DOE 1995). In October 1995, the SRS power generation and production facilities were privatized and transferred to South Carolina Electric & Gas (SCE&G). Condenser cooling water for the powerhouse is withdrawn from the Savannah River through one of the SRS intakes located upstream of the VEGP site. Heated water from the condenser is discharged at the origin of Beaver Dam Creek, which flows south for approximately 3 miles and discharges into the Savannah River floodplain swamp, through which the water flows to the river (DOE 1995). The D-Area powerhouse currently is the only major SRS facility with the potential to contribute to cumulative impacts on the Savannah River in conjunction with the effects of continued operation of VEGP Units 1 and 2.

The MOX Fuel Fabrication Facility is currently under construction in the F-Area of SRS. Site preparation began in October 2005, and the facility is scheduled to be in operation by 2016. The 41-acre complex will convert an estimated total of 75,000 lbs of weapons-grade plutonium to nuclear reactor fuel during its 20-year licensing period (NRC 2005). No surface water from the Savannah River or other surface water sources will be used during the construction or operation of the MOX facility (groundwater will be used). Discharges from the component facility that will process liquid wastes will be discharged to the Savannah River through a NPDES-permitted outfall. Constituent concentrations in the river are estimated to remain within their current ranges, and impacts are expected to be small (NRC 2005). Thus, construction and future operation of the MOX facility at SRS would not contribute to cumulative impacts on the Savannah River in conjunction with the effects of continued operation of VEGP Units 1 and 2.

Users of Savannah River water other than VEGP and SRS are identified below.

### 4.8.1 Cumulative Impacts on Water Use and Quality

Cumulative water use impacts may occur with respect to the amount of water available for use from the Savannah River or from local groundwater resources. These impacts may occur if operations of VEGP and other facilities are resulting in consumptive water use from the Savannah River or from groundwater aquifers. Cumulative water quality impact issues in the area near VEGP include thermal stresses within the Savannah River, the release of contaminants to the river and to groundwater, saltwater intrusion within the groundwater aquifers, and the detection of tritium in the unconfined aquifer. The geographic scope of the surface water resources that may be impacted by VEGP include the stretch of the Savannah River from Augusta to Savannah, Georgia. Groundwater resource impacts may exist in the

local area near the VEGP facility, and also include regional drawdown and contamination issues.

#### 4.8.1.1 Water Use Impacts

The other known users of water from the Savannah River, and their permitted volumes of withdrawal, are provided in Table 4-12. A study of water use data near VEGP from 1980 to 2000 indicated that surface water and groundwater withdrawal rates remained constant (Fanning 2003). However, population growth is expected to increase use of the Savannah River as a water resource near Savannah, approximately 150 mi downstream of VEGP (NRC 2007).

**Table 4-12.** Current, Past, and Potential Future Water Withdrawal Permits within Savannah River Basin

| Facility | Location | Maximum Daily Withdrawal (mgd) | Monthly Average Withdrawal (mgd) |
|---|---|---|---|
| **Georgia** | | | |
| Banks County Board of Commissioners | Banks County, GA | 1.00 | 1.00 |
| Southern Nuclear Operating Company (VEGP Units 1 and 2) | Burke County, GA RM 150-152 | 127.00 | 85.00 |
| VEGP Units 3 and 4 | Burke County, GA RM 151.2 | 127.00 | 85.00 |
| City of Waynesboro | Burke County, GA | 1.5 | 1.0 |
| Weyerhaeuser Company | Chatham County, GA | 30.50 | 27.50 |
| Georgia Power Company Port Wentworth | Chatham County, GA | 267.00 | 267.00 |
| International Paper Corporation | Chatham County, GA | 58.00 | 50.00 |
| Kerr-McGee Chemical | Chatham County, GA | 30.00 | 20.00 |
| Columbia County Water System | Columbia County, GA | 8.00 | 8.00 |
| Columbia County Water System | Columbia County, GA | 31.00 | 31.00 |
| Fort James Operating Company | Effingham County, GA RM 44-46 | 35.00 | 35.00 |

**Table 4-12. (**cont'd)

| Facility | Location | Maximum Daily Withdrawal (mgd) | Monthly Average Withdrawal (mgd) |
|---|---|---|---|
| Georgia Power Company Plant McIntosh | Effingham County, GA RM 44-46 | 130.00 | 130.00 |
| Savannah Industrial and Domestic Water | Effingham County, GA | 55.00 | 50.00 |
| City of Elberton | Elbert County, GA | 2.20 | 1.70 |
| City of Elberton | Elbert County, GA | 4.10 | 3.70 |
| City of Lavonia | Franklin County, GA | 1.50 | 1.50 |
| City of Lavonia | Franklin County, GA | 3.00 | 3.00 |
| City of Royston | Franklin County, GA | 1.00 | 1.00 |
| City of Union Point | Greene County, GA | 0.45 | 0.33 |
| City of Hartwell | Hart County, GA | 4.50 | 3.50 |
| City of Commerce | Jackson County, GA | 4.50 | 4.20 |
| JM Huber - Ready Creek | Jefferson County, GA | 5.80 | 4.00 |
| City of Lincolnton | Lincoln County, GA | 0.63 | 0.63 |
| Turner Concrete Company | Madison County, GA | 0.60 | 0.30 |
| Thomson-McDuffie County W/S Commission | McDuffie County | 3.00 | 2.00 |
| Thomson-McDuffie County W/S Commission | McDuffie County | 2.00 | 1.50 |
| City of Crawford | Oglethorpe County, GA | 0.43 | 0.25 |
| Clayton-Rabun Co. Water & Sewer Authority | Rabun County, GA | 2.00 | 2.00 |
| Augusta-Richmond County | Richmond County, GA | 50.00 | 45.00 |
| Augusta-Richmond County | Richmond County, GA | 21.00 | 15.00 |
| Avondale Mills – Augusta Canal | Richmond County, GA | 1.44 | 0.65 |
| DSM Chemicals Augusta Inc. | Richmond County, GA | 8.20 | 6.80 |
| Fort Gordon – Butler Creek | Richmond County, GA | 5.40 | 5.00 |

**Table 4-12. (**cont'd)

| Facility | Location | Maximum Daily Withdrawal (mgd) | Monthly Average Withdrawal (mgd) |
|---|---|---|---|
| Fort Gordon – Cow Branch | Richmond County, GA | 0.70 | 0.60 |
| Fort Gordon – Lietner Lake | Richmond County, GA | 0.50 | 0.40 |
| Fort Gordon – Union Mill Pond | Richmond County, GA | 0.25 | 0.20 |
| General Chemical Corp. Augusta Plant | Richmond County, GA | 5.65 | 5.30 |
| International Paper Augusta Mill | Richmond County, GA | 79.00 | 72.00 |
| PCS Nitrogen Fertilizer, L.P. | Richmond County, GA | 21.60 | 10.80 |
| City of Toccoa | Stephens County, GA | 6.00 | 6.00 |
| City of Toccoa – Lake Toccoa | Stephens County, GA | 9.00 | 9.00 |
| JM Huber Corporation – Brier Creek | Warren County, GA | 5.00 | 2.50 |
| Thiele Kaolin Company | Warren County, GA | 0.75 | 0.50 |
| City of Washington – Clarks Hill | Wilkes County, GA | 2.20 | 2.00 |
| City of Washington – Old Plant | Wilkes County, GA | 2.20 | 1.80 |
| **South Carolina** | | | |
| City of Abbeville | Abbeville County, SC | 10.6 | - |
| Mohawk Industries | Abbeville County, SC | 4.3 | - |
| City of North Augusta | Aiken County, SC | 25.8 | - |
| Graniteville Co. | Aiken County, SC | 2.0 | - |
| SCE&G Urquhart Station | Aiken County, SC | 82.6 | 82.6 |
| Anderson Regional, Six and Twenty Creek | Anderson County, SC | 43.0 | - |
| SCE&G Area Powerhouse | Barnwell County, SC | 44.3 | 44.3 |

**Table 4-12. (**cont'd)

| Facility | Location | Maximum Daily Withdrawal (mgd) | Monthly Average Withdrawal (mgd) |
|---|---|---|---|
| Savannah River Site K Reactor | Barnwell County, SC | 256.00 | 256.00 |
| Savannah River Site L Reactor | Barnwell County, SC | 256.00 | 256.00 |
| Edgefield County Water and Sewer Authority | Edgefield County, SC | 10.0 | - |
| Beaufort-Jasper Water and Sewer Authority | Jasper County, SC | 24.00 | 24.00 |
| McCormick CPW | McCormick County, SC | 2.8 | - |
| McCormick CPW | McCormick County, SC | 0.5 | - |
| Town of Westminster – Ramsey Creek | Oconee County, SC | 3.8 | - |
| Town of Westminster – Chauga River | Oconee County, SC | 8.0 | - |
| City of Seneca | Oconee County, SC | 18.0 | - |
| City of Walhalla – Coneross Creek | Oconee County, SC | 4.3 | - |
| City of Walhalla – Negro Fork | Oconee County, SC | 0.1 | - |
| Greenville Water System, Lake Keowee | Pickens County, SC | 45.0 | - |
| Town of Pickens – City Reservoir/North Fork | Pickens County, SC | 10.6 | - |
| Town of Pickens – Twelvemile Creek | Pickens County, SC | 4.0 | - |
| City of Easley | Pickens County, SC | 4.0 | - |

Sources: GDNR 2007a, NRC 2007, SCDHEC 2003

Surface water use in the vicinity of VEGP during the license renewal period is likely to be dominated by four users: VEGP Units 1 and 2 at a permitted withdrawal rate of 127 cfs; SCE&G's D Area Powerhouse at 44.3 cfs; SCE&G's Urquhart Station at 82.6 cfs; and VEGP proposed Units 3 and 4 at 127 cfs (NRC 2007). These four users are expected to incur a total withdrawal of 380.9 cfs. As discussed in Section 2.2.2, the average flow volume in the Savannah River at Augusta is 9,157 cfs (Gotvald et al. 2005), and the expected low flow volume during drought periods is 3,800 cfs (UGA 2006). Therefore, the total withdrawal from the four

largest users in the vicinity of VEGP is expected to range from 5 percent of the normal volume to 12 percent of the low flow volume. These withdrawals are not expected to impact the volume of surface water available for other downstream users. Although water availability for other users and for aquatic resources could hypothetically be impacted by a more extreme drought (flow rate down to 957 cfs; SNC 2006a), these impacts would be the result of naturally low precipitation rates, and would not be caused by the water withdrawals.

As discussed in Section 4.5, the other large-scale users of groundwater in the area are located many miles from VEGP, and are unlikely to be affected by groundwater withdrawal at VEGP. Domestic groundwater users are located near the facility, but modeling of groundwater withdrawals from current use (Units 1 and 2) and future use (Units 1, 2, 3, and 4) indicates that these withdrawals are not expected to impact the amount of groundwater available to nearby domestic users. The NRC staff concludes that the minimal impacts on surface water and groundwater resources from the continued operation of VEGP Units 1 and 2, as well as from the potential construction and operation of Units 3 and 4, would not contribute to an overall decline in the water resources and would be SMALL Additionally, other past, current, and reasonably foreseeable future actions are estimated to have little impact on water use resources, and therefore, the potential cumulative impact on water resources would be SMALL.

#### 4.8.1.2 Water Quality Impacts

Cumulative impacts may occur with respect to the quality of water within the Savannah River, or within local groundwater resources. These cumulative water quality impacts may occur if operations of other facilities besides VEGP are degrading water quality in the Savannah River or in groundwater aquifers. Water quality degradation may result from changes to water temperatures, or from the release of contaminants into the water sources.

Although it was considered to be a Category 1 issue in the GEIS (NRC 1996), and therefore was concluded to have the potential only for SMALL impacts in Section 4.1, cumulative impacts from heat shock could occur if there were others sources of heated discharge to the Savannah River during the license renewal period. Although several other power plants that may discharge heated water exist on the Savannah River, these are expected to be far enough from VEGP that there is no potential for the thermal plumes to overlap with that from VEGP.

The future operation of VEGP Units 3 and 4 will result in an additional thermal burden on the river at a location near the existing thermal discharge from Units 1 and 2 during the license renewal period. In support of the evaluation of the Early Site Permit (ESP) license for VEGP Units 3 and 4, the NRC Staff performed modeling of the extent of the thermal plume that may result during concurrent operations of all four units. Using a $5^{o}F$ temperature difference as the standard, this analysis concluded that the maximum possible extent of the plume that would be