Prepared for

SCE&G, VC Summer Station
Highway 215 and Bradham Blvd
Jenkinsville, South Carolina 29065

COOLING WATER SYSTEM DATA
V.C. SUMMER NUCLEAR STATION UNIT 1
40 CFR § 122.21(r)(5)

SOUTH CAROLINA ELECTRIC & GAS COMPANY
JENKINSVILLE, SOUTH CAROLINA

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LIST OF ACRONYMS AND ABBREVIATIONS

BTA	best technology available
CFR	Code of Federal Regulations
cfs	cubic feet per second
CWIS	cooling water intake structure
EPA	U.S. Environmental Protection Agency
FPSF	Fairfield Pumped Storage Facility
ft	feet
gpm	gallons per minute
hp	horsepower
MGD	million gallons per day
MW	megawatts
NGVD29	National Geodetic Vertical Datum of 1929
NPDES	National Pollutant Discharge Elimination System
NRC	U.S. Nuclear Regulatory Commission
rpm	revolutions per minute
SCDHEC	South Carolina Department of Health and Environmental Control
SCE&G	South Carolina Electric and Gas Company

1. INTRODUCTION

This report provides cooling water system data for South Carolina Electric & Gas Company's (SCE&G's) Virgil C. Summer Nuclear Station (VCSNS) Unit 1. VCSNS Unit 1 is an existing nuclear-powered generating facility located on Monticello Reservoir in the Broad River basin near Jenkinsville, Fairfield County, South Carolina. SCE&G operates VCSNS Unit 1 under National Pollutant Discharge Elimination System (NPDES) Permit Number SC0030856. The information provided in this report supports the facility's compliance with section 316(b) of the Clean Water Act.

The U.S. Environmental Protection Agency (EPA) published 316(b) regulations for cooling water intake structures (CWISs) at existing power generating and manufacturing facilities that became effective October 14, 2014. The final 316(b) rule requires the submittal of applicable CWIS information under 40 CFR § 122.21(r) to the South Carolina Department of Health and Environmental Control (SCDHEC), the NPDES permitting agency in South Carolina.

As provided in the NPDES permit application requirements at 40 CFR§ 122.21(r)(5), all existing facilities with CWISs must submit cooling water system data to include those applicable provisions of the following:

(i) *A narrative description of the operation of the cooling water system and its relationship to cooling water intake structures; the proportion of the design intake flow that is used in the system; the number of days of the year the cooling water system is in operation and seasonal changes in the operation of the system, if applicable; the proportion of design intake flow for contact cooling, non-contact cooling, and process uses; a distribution of water reuse to include cooling water reused as process water, process water reused for cooling, and the use of gray water for cooling; a description of reductions in total water withdrawals including cooling water intake flow reductions already achieved through minimized process water withdrawals; a description of any cooling water that is used in a manufacturing process either before or after it is used for cooling, including other recycled process water flows; the proportion of the source waterbody withdrawn (on a monthly basis);*

(ii) *Design and engineering calculations prepared by a qualified professional and supporting data to support the description required by paragraph (r)(5)(i) of this section; and*

(iii) *Description of existing impingement and entrainment technologies or operational measures and a summary of their performance, including but not limited to reductions to entrainment mortality due to intake location and reductions in total water withdrawals and usage.*

The following sections describe the VCSNS Unit 1 cooling water system.

2. FACILITY AND COOLING WATER SYSTEM DESCRIPTIONS

VCSNS Unit 1 is a single-unit, 972.7-megawatt (MW), nuclear-fueled, base-load facility located at the southern end of Monticello Reservoir, a freshwater lake (Figure 1). Unit 1 operates using a single CWIS located along the shoreline (Figure 2). It has a design intake capacity of approximately 533,122 gallons per minute (gpm) or 768 million gallons per day (MGD). Because Monticello Reservoir was constructed for the purpose of serving as part of the cooling water system (U.S. Nuclear Regulatory Commission [NRC], 2004), its use as a cooling impoundment for VCSNS Unit 1 has been determined by SCDHEC to be a "closed-cycle recirculating system" under 40 CFR, Part 125, Subpart J, §125.92(c)(2). The U.S. Energy Information Administration (2012) rated VCSNS Unit 1 in 2017 as having 971 MW summer capacity and producing 6,913,294 megawatt-hours of net generation.

Monticello Reservoir is a 6,500-acre freshwater lake with 51 miles of shoreline and a total storage volume of approximately 400,000 acre-feet. The reservoir has an average depth of 59 feet (ft), a maximum depth of 125 ft, and a watershed area of 17.4 square miles in the Frees Creek valley, a tributary to the Broad River. Monticello Reservoir also serves as the upper reservoir for the Fairfield Pumped Storage Facility (FPSF) and exchanges water daily with 4,398-acre Parr Reservoir (the lower reservoir) (Figure 2). FPSF is part of the Parr Hydroelectric Project operated by SCE&G and licensed by the Federal Energy Regulatory Commission. The surface elevation of Monticello Reservoir fluctuates daily within an operating band of 420.5 to 425.0 ft mean sea level (NGVD29).

The VCSNS Unit 1 CWIS has an inlet bay on the south shore of Monticello Reservoir with a depth of 30 to 40 ft. The circulating pump house intake structure located within the inlet bay has six intake bays. Parallel concrete retainer walls on either side of the pump house and a skimmer wall extending 9.5 ft below the full pool elevation direct the withdrawal of cooling water from the deeper, seasonally cooler portion of the reservoir. Six vertical 3/8-inch mesh traveling water screens strain out debris and any impinged organisms. Screen-wash water supplied to each traveling screen collects in a debris trough that conveys debris and any organisms to a trash sump, from which the material is discarded. Three circulating water pumps convey the screened intake flow to the condensers.

After leaving the condensers, the heated cooling water discharges to Monticello Reservoir via a discharge basin and a 1,000-ft-long discharge canal located east of the CWIS beyond the service water pond and jetty (Figure 2).

2.1 Operation of the Cooling Water System

VCSNS Unit 1 operates exclusively in a wet recirculating/closed-loop mode with Lake Monticello. The circulating water system at the facility is designed to remove 6.67×10^9 British thermal units per hour of heat from the main and auxiliary condensers as well as the turbine auxiliaries (NRC, 2004). The cooling water system includes three vertical, wet-pit type circulating water pumps each with an operating design point of 395.94 cubic feet per second (cfs) at 2,095 horsepower (hp) and 294 revolutions per minute (rpm). Three pumps are required when at full power, with an average total flow of 1,187.8 cfs. Flow from the individual pumps combine into a single intake pipe before reaching the condensers.

To limit the heat load rejected to Monticello Reservoir, in 1996 SCE&G installed the turbine building closed-cycle cooling water system to provide cooling for certain station loads that were previously handled by the circulating water system. The closed system does not handle any of the heat load directly associated with reactor cooling. The closed-cycle cooling water system supplies cooling water to equipment associated with the turbine, generator, and other non-nuclear systems in the turbine building. The system uses a forced-draft cooling tower with four fans to reject waste heat to the atmosphere. The cooling tower structure is 86.9 by 41.9 ft with an overall height of 22.4 ft above grade. It is located outside of the protected area fence, approximately 500 ft northwest of the reactor building. Under normal operation, one of the two cooling tower basin pumps circulates treated water, transferring heat removed from the various turbine building components to spray water and then to the atmosphere by evaporation. The turbine building closed-cycle water system is independent of plant emergency cooling facilities and is not required for reactor protection or safe shutdown (NRC, 2004). Due to the fact that this is a wet cooling tower, a small percentage of the total flow usually has to be made up to cover the losses associated with evaporation and blow-down; this is estimated to be about 500 gpm or 1.1 cfs. This make-up flow is derived from the facility's water treatment system, which includes two clarifier raw water pumps that withdraw water from the pump house basin independent of the facility's circulating cooling water system.

Cooling water for the main cooling water circulating system is withdrawn from Monticello Reservoir, passed through the condensers, and ultimately returned to Monticello Reservoir. After leaving the condensers, circulating water moves via a 12-ft-diameter pipe from the plant to a semi-enclosed discharge basin (Figure 2). From the basin, the heated effluent moves through a 1,000-ft long discharge canal to Monticello Reservoir. The discharge canal directs the discharge flow (heated effluent) to the northeast. A 2,600-ft long jetty prevents the recirculation of the heated water (NRC, 2004).

2.1.1 Proportion of the Design Intake Flow Used

The distribution of cooling water flows at VCSNS Unit 1 and associated water balance diagram are presented in Figure 3. Primarily all water withdrawn at the pump house associated with normal operations is used for cooling purposes except that withdrawn by the two 100-percent capacity screen-wash pumps used to provide screen-wash water to the six traveling screens, and the two 100-percent capacity clarifier raw water pumps associated with the facility's water treatment plant. There are also two fire-service pumps, one electric and one diesel-driven, dedicated for fire-fighting activities that when operated in an emergency, withdraw from the CWIS pump basin.

Each screen-wash pump draws from the discharge side of circulating pump number 1C located on the west side of the pump house. Each screen-wash pump is rated at 200 hp at 1,750 rpm and provides approximately 2,000 gpm (4.46 cfs) for screen wash.

Each clarifier raw water pump draws from the circulating pump house basin east of circulating pump number 1A and provides approximately 1,200 gpm (2.67 cfs) for the on-site water treatment cycle, primarily for potable water and other non-cooling water related purposes; however, approximately 500 gpm is used as make-up water for the turbine building closed-cycle water system. Considering screen wash withdrawals and expected nominal losses through the system, the proportion of design intake flow used for cooling water purposes is in excess of 99 percent.

2.1.2 Days of Cooling Water System Operation and Seasonality

The VCSNS Unit 1 cooling water system operates continually throughout the year, with the exception of scheduled maintenance and refueling outages or unexpected maintenance outages. VCSNS Unit 1 is on an 18-month maintenance and refueling outage cycle for the replacement of approximately one-third of the facility's fuel

assemblies (SCE&G, 2015). Refueling outages typically last for 30 to 60 days. During the outage, SCE&G also performs preventive maintenance of circulating water pumps and other components as needed to increase Unit 1's safety, reliability, and efficiency.

2.2 Design and Engineering Calculations

The 316(b) regulations for existing facilities apply to VCSNS Unit 1 based on the applicability criteria at 40 CFR § 125.91(a). The facility is a point source, its design intake flow is greater than 2 MGD, the CWIS withdraws from waters of the U.S., and it uses significantly more than 25 percent of the water withdrawn for cooling purposes under all operational modes. If deemed relevant by SCDHEC for the purposes of compliance with 40 CFR § 122.21(r)(5), SCE&G will provide additional information pertaining to the VCSNS Unit 1 cooling water system upon request.

2.3 Existing Impingement and Entrainment Technologies or Operational Measures

Monticello Reservoir was constructed for the purpose of serving as part of the cooling water system (NRC, 2004). Thus, the use of the reservoir as a cooling impoundment for VCSNS Unit 1 has been determined by SCDHEC and EPA to be a "closed-cycle recirculating system" as defined under 40 CFR §125.92(c)(2). The use of a closed-cycle recirculating system is one of the available alternatives established by EPA for complying with the best technology available (BTA) standards for impingement mortality under 40 CFR §125.94(c)(1).

VCSNS Unit 1 currently does not implement entrainment technologies or operational measures. However, in addition to the use of closed-cycle recirculation, the use of a skimmer wall at the circulating water pump house may further contribute to reduction in entrainment of early life stages of fish by drawing cooling water from mid depths within the reservoir, where ichthyoplankton densities are lower than in shoreline surface waters (Dames & Moore, 1985).

3. SUMMARY AND CONCLUSION

VCSNS Unit 1 is a single-unit, 972.7-MW, nuclear-fueled, base-load power generating facility located at the southern end of Monticello Reservoir in Fairfield County, South Carolina. Monticello Reservoir is a 6,500-acre freshwater impoundment constructed for the purpose of serving as part of the VCSNS cooling water system. The Unit 1 CWIS has a design intake flow of approximately 768 MGD. Monticello Reservoir also serves as the upper reservoir for the FPSF, which is part of SCE&G's Parr Hydroelectric Project.

The VCSNS Unit 1 CWIS has as an inlet bay on the south shoreline of Monticello Reservoir that contains a circulating pump house with six intake bays. Cooling water is withdrawn from depths greater than 9.5 ft below the reservoir full-pool elevation. Six vertical 3/8-inch mesh traveling water screens strain out debris and any impinged organisms, which are conveyed by the screen-wash system to a trash sump for disposal. Three circulating water pumps convey the screened intake flow to the condensers.

The VCSNS Unit 1 cooling water systems operate continually throughout the year with the exception of maintenance and refueling outages scheduled every 18 months. The cooling water system includes three vertical, wet-pit type circulating water pumps each with a design point of 395.94 cfs at 2,095 hp and 295 rpm. Three pumps are required when at full power, with an average total flow of 1,187.8 cfs. Flow from the individual pumps combine into a single intake pipe before reaching the condensers. To limit the heat load rejected to Monticello Reservoir, a closed-cycle cooling water system in the turbine building provides cooling for equipment associated with the turbine, generator, and other non-nuclear systems.

After leaving the condensers, circulating water moves via a 12-ft-diameter pipe to a discharge basin. From the basin, the heated effluent moves through a 1,000-ft-long discharge canal to Monticello Reservoir. A 2,600-ft long jetty prevents the recirculation of the heated water.

The use of Monticello Reservoir as a cooling impoundment for VCSNS Unit 1 has been determined by SCDHEC and EPA to be a closed-cycle recirculating system, which is an option available for complying with the BTA standards for impingement mortality under 40 CFR §125.94(c)(1).

4. REFERENCES CITED

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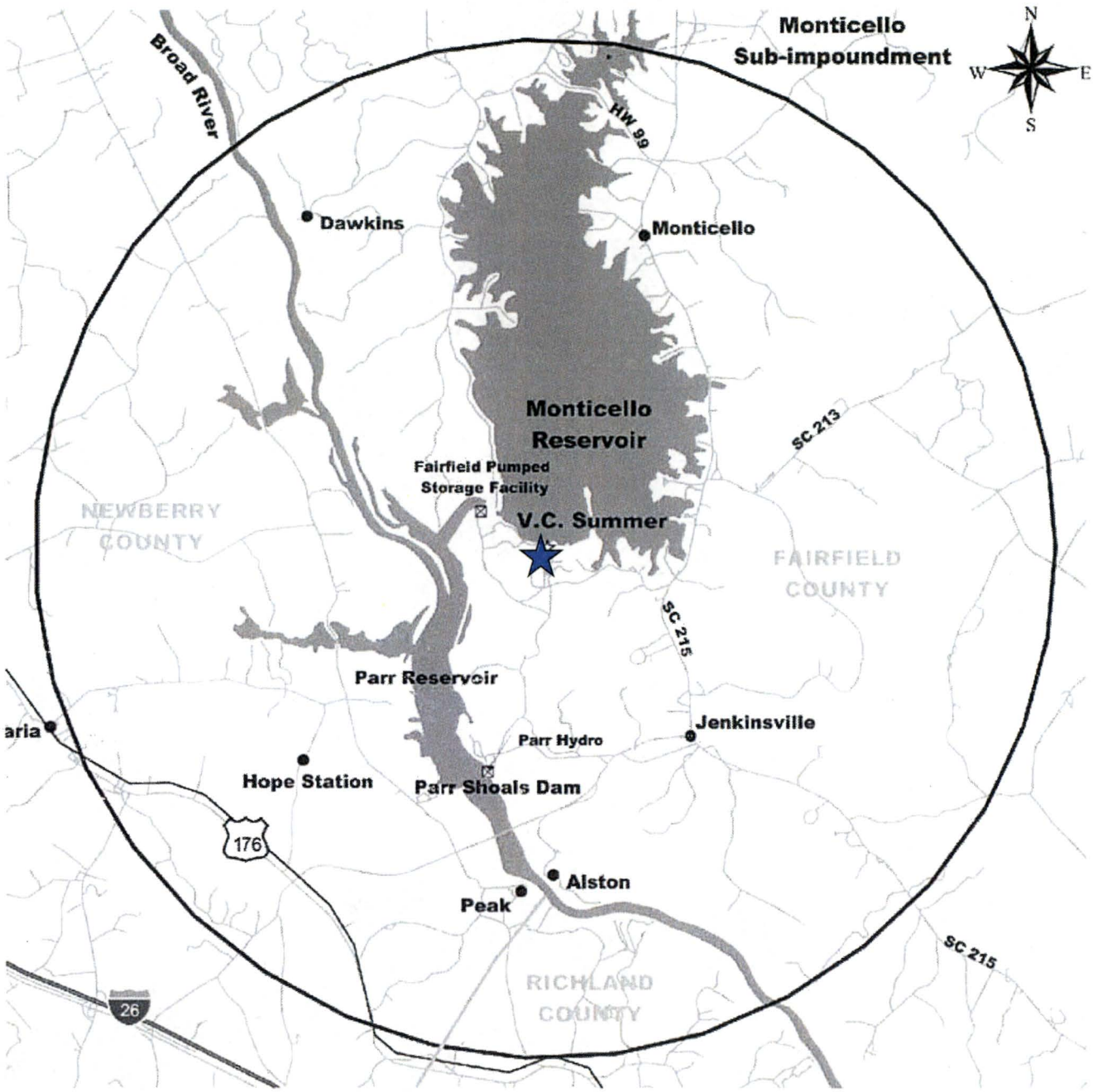
FIGURES



LEGEND

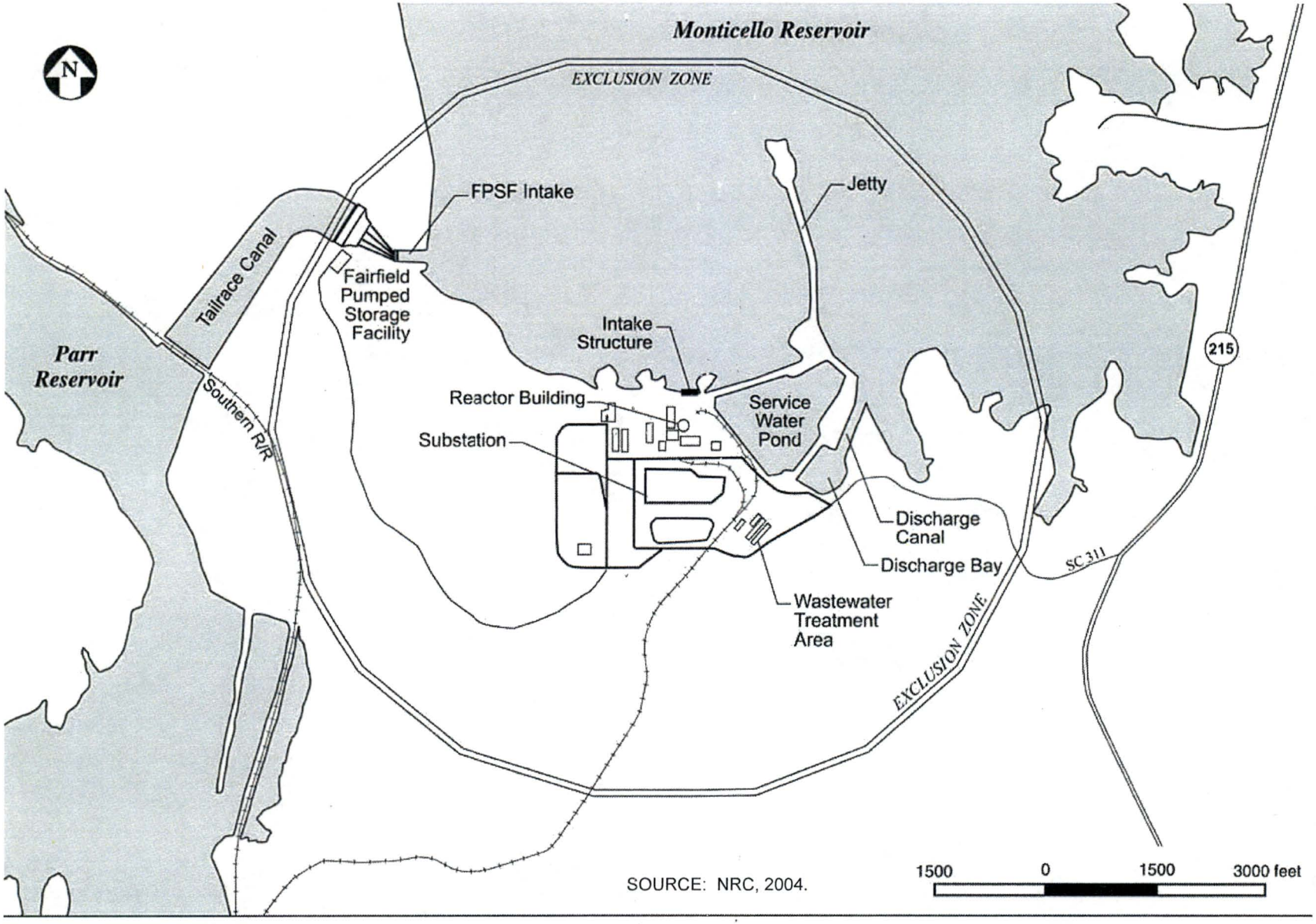
- 10-km (6-mi) radius of V.C. Summer
- Interstates
- Major Roads
- Minor Roads
- County Boundaries
- Lakes and Rivers

1 0 1 2 3 Kilometers

1 0 1 2 3 Miles

Source: NRC, 2004.

Site Vicinity of VCSNS Unit 1 Jenkinsville, South Carolina	Geosyntec consultants Atlanta, Georgia	Figure 1



SOURCE: NRC, 2004.

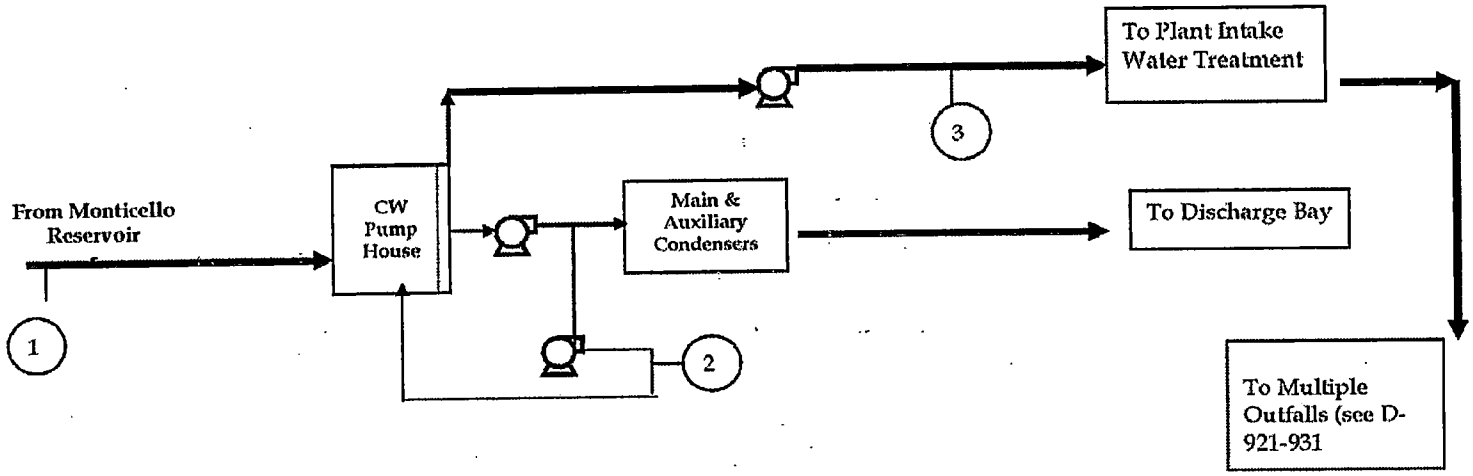
Site Layout of the VCSNS Unit 1 Cooling Water Intake Structure and the Fairfield Pumped Storage Facility

Jenkinsville, South Carolina

Geosyntec consultants
ATLANTA, GEORGIA

Figure 2

V C Summer Nuclear Station Water Balance Diagram



1 = 767.67 MGD = Main and auxiliary condensers.

2 = 2.88 MGD = Screen wash pump flow backwash for the traveling water screens

3 = 1.73 MGD = Clarifier raw water process (non-cooling water flow) to the on-site water treatment plant

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FIGURE NO.: 3
PROJECT NO.: GK3601-04
DOCUMENT NO.: GA050382
FILE: Figure 2-4.ppt

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METHOD OF COMPLIANCE
V.C. SUMMER NUCLEAR STATION UNIT 1
40 CFR § 122.21(r)(6)

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LIST OF FIGURES

LIST OF ACRONYMS AND ABBREVIATIONS

CFR	Code of Federal Regulations
cfs	cubic feet per second
CWA	Clean Water Act
CWIS	cooling water intake structure
FERC	Federal Energy Regulatory Commission
fpm	feet per minute
fps	feet per second
ft	feet
FPSF	Fairfield Pumped Storage Facility
gpm	gallons per minute
hp	horsepower
MSL	mean sea level
MW	megawatts
NGVD29	National Geodetic Vertical Datum of 1929
NPDES	National Pollutant Discharge Elimination System
NRC	Nuclear Regulatory Commission
psi	pounds per square inch
rpm	revolutions per minute
SCDHEC	South Carolina Department of Health and Environmental Control
SCE&G	South Carolina Electric and Gas Company
VCSNS	Virgil C. Summer Nuclear Station

1. INTRODUCTION

This report provides the chosen method of compliance for South Carolina Electric & Gas Company's (SCE&G's) Virgil C. Summer Nuclear Station (VCSNS) Unit 1. VCSNS Unit 1 is an existing nuclear-powered generating facility located on Monticello Reservoir in the Broad River basin near Jenkinsville, Fairfield County, South Carolina. SCE&G operates VCSNS Unit 1 under National Pollutant Discharge Elimination System (NPDES) Permit Number SC0030856. The information provided in this report supports the facility's compliance with section 316(b) of the Clean Water Act.

The U.S. Environmental Protection Agency published 316(b) regulations for cooling water intake structures (CWISs) at existing power generating and manufacturing facilities that became effective October 14, 2014. The final 316(b) rule requires the submittal of applicable CWIS information under 40 CFR § 122.21(r) to the South Carolina Department of Health and Environmental Control (SCDHEC), the NPDES permitting agency in South Carolina.

As provided in the NPDES permit application requirements at 40 CFR § 122.21(r)(6), all existing facilities with CWISs must identify the chosen method of compliance:

> *The owner or operator of the facility must identify the chose method of compliance for the entire facility; alternatively, the applicant must identify the chosen compliance method for each CWIS at its facility. The applicant must identify any intake structure for which a BTA determination for Impingement Mortality under 40 CFR 125.94 (c)(11) or (12) is requested. In addition, the owner or operator that chooses to comply via 40 CFR 125.94 (c)(5) or (6) must also submit an* impingement technology performance optimization study *as described in 40 CFR § 122.21(r)(6)(i) and (ii).*

2. FACILITY DESCRIPTION

VCSNS Unit 1 is a single-unit, 972.7-megawatt (MW), nuclear-fueled, base-load facility located at the southern end of Monticello Reservoir, a freshwater impoundment (Figure 1). Unit 1 operates using a single CWIS located along the shoreline (Figure 2). It has a design intake capacity of approximately 533,122 gallons per minute or 768 million gallons per day (MGD). The actual intake flow of the CWIS is greater than 125 MGD. Although the cooling water system operates in a "once-through" mode, Monticello

Reservoir was constructed for the purpose of serving as part of the cooling water system (U.S. Nuclear Regulatory Commission [NRC], 2004). Thus, the use of Monticello Reservoir as a cooling impoundment for VCSNS Unit 1 has been determined by SCDHEC and EPA to be a closed-cycle recirculating system under 40 CFR, Part 125, Subpart J, §125.92(c)(2).

The VCSNS Unit 1 CWIS consists of an inlet bay created by two embankments and concludes at the circulating pump house structure positioned parallel to the southern shoreline of Monticello Reservoir near the FPSF. Cooling water is drawn in at the pump house, passed through the steam condenser as well as the auxiliary condensers, and discharged back to Monticello Reservoir via a discharge canal located beyond the jetty and east of the CWIS (Figure 2).

3. CHOSEN METHOD OF COMPLIANCE

Existing facilities that withdraw more than 2 MGD have several options to select from to meet the impingement reduction standard as outlined in §125.94(c). VCSNS Unit 1 utilizes the option provided in §125.94(c)(1): a closed-cycle recirculating system; actual intake flows are monitored daily.

VCSNS Unit 1 is designed to operate in one cooling mode: closed-cycle. It utilizes Monticello Reservoir as both the source water body and receiving water body; in a closed-loop, wet recirculating system.

4. SUMMARY AND CONCLUSION

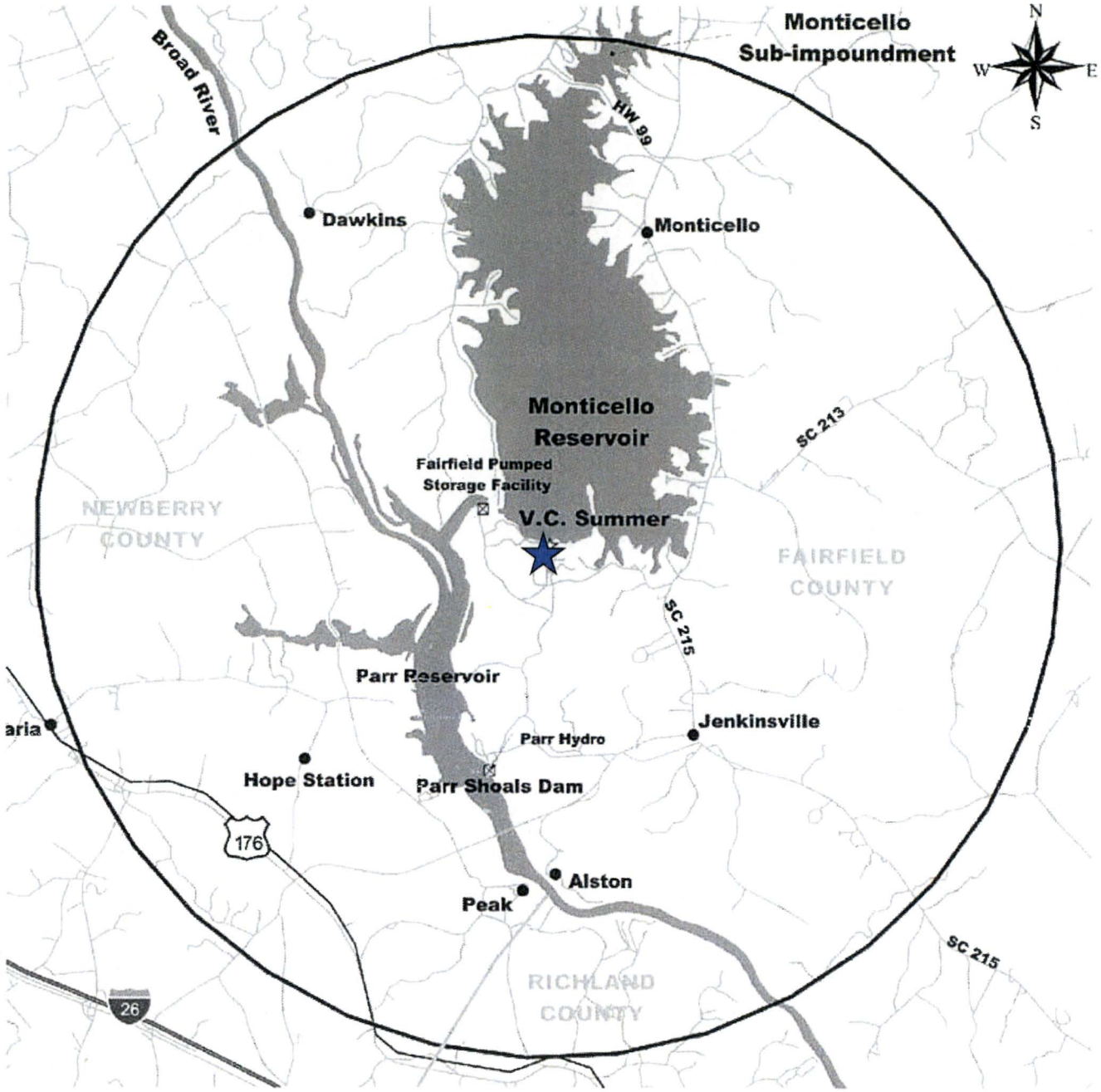
VCSNS Unit 1 is a single-unit, 972.7-MW, nuclear-fueled, base-load power generating facility located at the southern end of Monticello Reservoir in Fairfield County, South Carolina. Monticello Reservoir is a 6,500-acre freshwater impoundment constructed for the purpose of serving as part of the VCSNS cooling water system. The single, shoreline CWIS is part of a cooling water system that has been determined by SCDHEC and EPA to be a closed-cycle recirculating system under the definition at 40 CFR §125.92(c)(2).

VCSNS Unit 1 is designed to operate in one cooling mode: closed-cycle. It utilizes Monticello Reservoir as both the source water body and receiving water body; in a closed-loop, wet recirculating system.

4. REFERENCES CITED

U.S. Nuclear Regulatory Commission (NRC). 2004. Generic Environmental Impact Statement for License Renewal of Nuclear Plants. Supplement 15 Regarding Virgil C. Summer Nuclear Station. Final Report. U.S. Nuclear Regulatory Commission, Washington, DC.

FIGURES



LEGEND

- 10-km (6-mi) radius of V.C. Summer
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1 0 1 2 3 Kilometers

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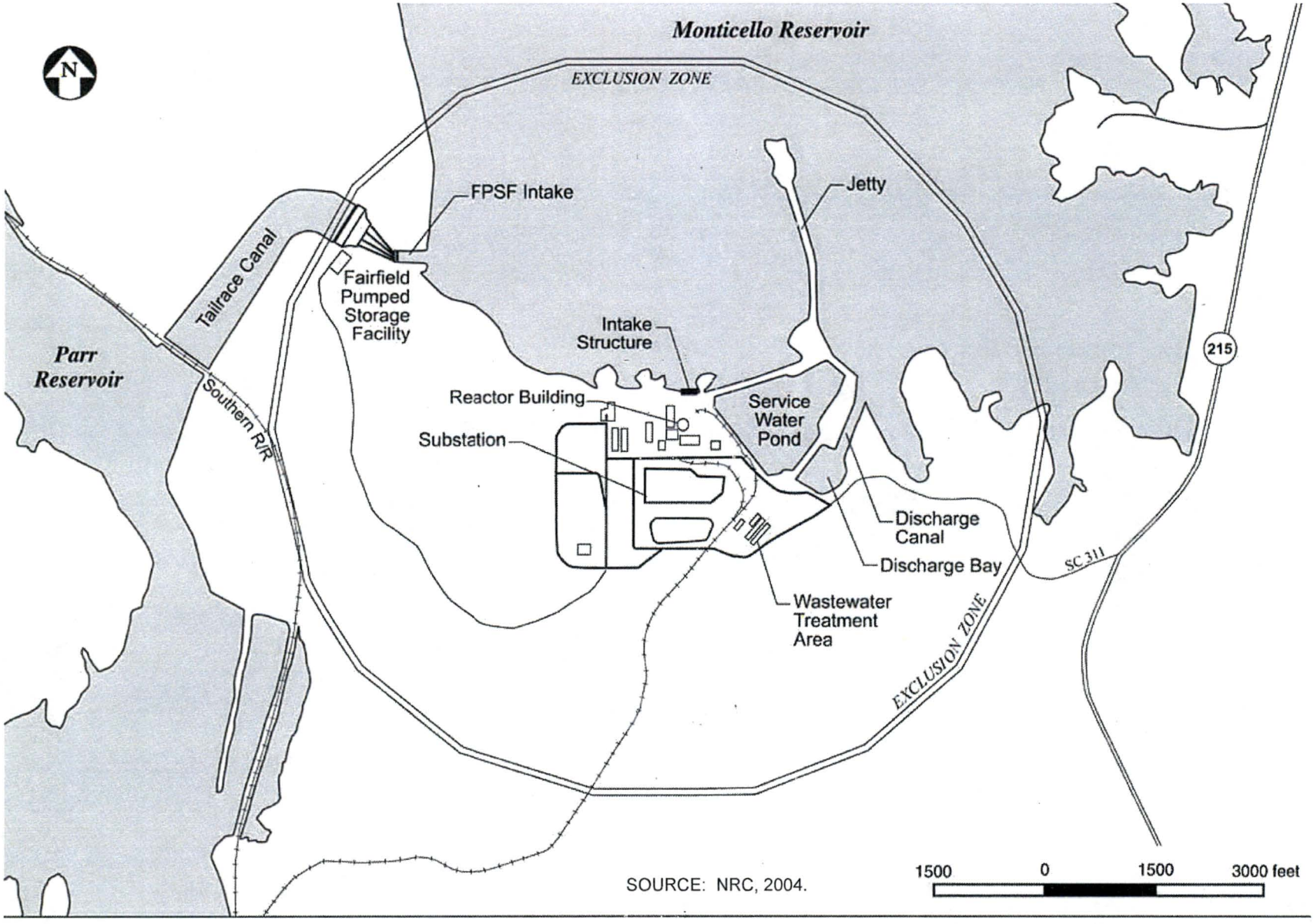
Source: NRC, 2004.

Site Vicinity of VCSNS Unit 1 Jenkinsville, South Carolina	Geosyntec consultants Atlanta, Georgia	Figure 1



SOURCE: NRC, 2004.

Site Layout of the VCSNS Unit 1 Cooling Water Intake Structure and the Fairfield Pumped Storage Facility

Jenkinsville, South Carolina

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ATLANTA, GEORGIA

Figure 2