CHAPTER 6

ENVIRONMENTAL MEASUREMENTS AND MONITORING PROGRAMS

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

LIST OF TABLES

LIST OF FIGURES

CHAPTER 6

ENVIRONMENTAL MEASUREMENTS AND MONITORING PROGRAMS

6.0 ENVIRONMENTAL MEASUREMENTS AND MONITORING PROGRAMS

This chapter describes the environmental measurements (e.g., data collection) and monitoring programs in place or expected to be implemented at the Lee Nuclear Site. These measurements and monitoring programs are addressed, where applicable, within the context of the following four project phases: (1) preapplication, (2) site preparation and construction, (3) preoperational, and (4) operational.

The chapter is divided into the following seven sections:

- Thermal Monitoring (Section 6.1)
- Radiological Monitoring (Section 6.2)
- Hydrological Monitoring (Section 6.3)
- Meteorological Monitoring (Section 6.4)
- Ecological Monitoring (Section 6.5)
- Chemical Monitoring (Section 6.6)
- Summary of Monitoring Activities (Section 6.7)

6.1 THERMAL MONITORING

The following subsections discuss thermal monitoring activities related to the preapplication, site preparation and construction, preoperational, and operational phases of the Lee Nuclear Station. The South Carolina Department of Health and Environmental Control (SCDHEC) administers the National Pollutant Discharge Elimination System (NPDES) permit system for the state (Reference 1) and will issue and enforce the permit that is protective of water quality. The Lee Nuclear Station NPDES permit, once obtained, will establish cooling water discharge sampling locations and monitoring for thermal conditions. The number of NPDES permitted outfalls will be few, because the AP1000 design consolidates process wastewater streams into one discharge. Historical thermal data of the receiving water, and the projected facility discharge volume and temperature, are modeled along with the designated outfall location to establish permit sampling locations and criteria.

Modeling details affecting the Lee Nuclear Station thermal monitoring program, which are described in other sections, include regional hydrology (Subsection 2.3.1); historical, current, and future water use, anticipated water uses (including cooling water) at, and discharges from, the Lee Nuclear Station, and potential pollutant sources (Sections 3.3, 3.6, and 5.5 and Subsections 2.3.2, 2.3.3); and baseline thermal monitoring used to describe the thermal effects (Sections 4.2 and 5.2). Additional thermal data was gathered in 2006 and 2007 to provide information on conditions above, in, and below the Ninety-Nine Islands Dam and reservoir. Information and maps showing features of the nuclear station and the site, including the boundaries and current bathymetry of all water bodies adjacent to the site are provided in Section 2.3 (Figure 2.3-5 and Figure 2.3-6). Information and maps showing the locations of all monitoring stations are provided in Section 2.3 (Figure 2.3-21 and Table 2.3-18). The thermal impacts are described in Subsection 5.2.3 and 5.3.2.1 and in Table 5.2-1.

6.1.1 PREAPPLICATION MONITORING

The results of the first characterization of the Broad River's thermal regime for a nuclear power generating facility license application are documented in NUREG-75/089, "Final Environmental Statement Related to Construction of Cherokee Nuclear Station, Units 1, 2, and 3, Duke Power Company" (Reference 5). The Broad River's thermal regime was re-characterized during the recent 2006-2007 sampling described in Subsection 2.3.3.1, and additional data gathering is currently underway to add to the historical background. These data are comparable and are discussed in Section 2.3.

The results of the quarterly surface water chemical sampling, conducted at 10 points in the vicinity of the Lee Nuclear Station beginning in June 2006, are presented in Section 2.3. These data were used to model the thermal regime of the Broad River above and below the Ninety-Nine Islands Dam. The data are sufficient to support the environmental descriptions provided in Section 2.3 and the analyses detailed in Sections 5.2 and 5.3. Data from this re-characterization were also used to model the thermal regime and thermal effects of the Lee Nuclear Station.

Modeling of the thermal data was performed using the CORMIX model (References 2, 3, and 4). This model is the standard for describing thermal geometries for discharges into a water body. The proposed facility diffuser was modeled with discharge to the Ninety-Nine Islands Dam forebay and the model demonstrated that the 5° F isotherm met requirements of the SCDHEC NPDES regulation.

The anticipated mixing of the Lee Nuclear Station discharge in the Ninety-Nine Islands Dam forebay was modeled by the South Carolina Water Resources Institute at Clemson University using the CORMIX model. The details and results of this evaluation are provided in Sections 5.2 and 5.3 along with the results of the CORMIX modeling in Table 5.2-1.

The SCDHEC is expected to independently review the modeling results associated with discharges from Lee Nuclear Station, as detailed above, when establishing thermal monitoring locations as part of the NPDES permit.

6.1.2 SITE PREPARATION AND CONSTRUCTION MONITORING

Duke Energy established thermal monitoring locations in the vicinity of the Lee Nuclear Station intake, discharge, and downstream of the Ninety-Nine Islands Dam. Thermal data are collected using thermistors and continuous recording data loggers.

Site preparation and construction thermal monitoring is planned to continue at these locations. No additional data collection or modeling is anticipated unless requested by the SCDHEC. Regular communication between Duke Energy and SCDHEC will occur during the permitting process.

6.1.3 PREOPERATIONAL MONITORING

Preoperational thermal monitoring is planned to continue at the locations established in the preapplication phase. No additional modeling is anticipated unless requested by the SCDHEC.

6.1.4 OPERATIONAL MONITORING

The operational monitoring program detects changes in water temperature resulting from plant operation. The site-specific NPDES permit will establish routine thermal monitoring of discharges to the Broad River and their locations. Based on the SCDHEC permit requirements for the Catawba Nuclear Station, which also has a cooling tower discharge, Duke Energy anticipates that SCDHEC will require monitoring of the discharge temperature for the cooling tower blowdown. The daily maximum and monthly average temperature limits for discharges will be established for the cooling water discharge to the Broad River and will be part of the NPDES permit requirements.

Permit requirements will be monitored and maintained by the use of monitoring equipment similar to that currently in use at other Duke Energy nuclear stations such as thermistors, flow meters, and automatic samplers.

Required data analysis methods will be developed in consultation with the SCDHEC, and are expected to be implemented at the time of NPDES permit issue.

6.1.5 REFERENCES

1. South Carolina Department of Health and Environmental Control (SCDHEC); Bureau of Water – Water Quality, Water Pollution Control; South Carolina Code of Laws, Title 48 – Environmental Protection and Conservation.

2. Jirka, G. H., R. L. Doneker, and S. W. Hinton, Cormix *User Manual: A Hydrodynamic Mixing Zone Model and Decision Support System for Pollutant Discharges into Surface Waters*, Office of Science and Technology, U.S. Environmental Protection Agency, Washington, DC, September 1996.

3. CORMIX, CORMIX Mixing Zone Applications, Website, http://www.cormix.info/applications.php, accessed March 13, 2007.

4. CORMIX, Independent CORMIX Validation Studies, Website, http://www.cormix.info/validations.php, accessed March 13, 2007.

5. U.S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation, Final Environmental Statement Related to Construction of Cherokee Nuclear Station, Units 1, 2, and 3, Duke Power Company, Docket Nos. STN 50-491, STN 50-492, and STN 50-493, NUREG-75/089, Washington, DC, October 1975.

6.2 RADIOLOGICAL MONITORING

6.2.1 INTRODUCTION

The Lee Nuclear Station radiological monitoring program characterizes the radiological environment in the vicinity of the Lee Nuclear Site. The program provides sufficient information to detect significant radiological impacts to the environment. It provides data on measurable levels of radiation and radioactive materials in the site environs, and provides baseline data on surveillance of principal pathways of exposure to the public. This program is founded on the guidance provided in NUREG-1301, "Offsite Dose Calculation Manual Guidance: Standard Radiological Effluent Controls for Pressurized Water Reactors" (Reference 2), "Branch Technical Position on An Acceptable Radiological Environmental Monitoring Program," Revision 1 (Reference 3), Regulatory Guide 4.1, Revision 1, "Programs for Monitoring Radioactivity in the Environs of Nuclear Power Plants," and the requirements of Title 10 Code of Federal Regulations (CFR) 20.201. The preoperational monitoring program will be implemented 2 years before plant operation begins. The duration of the preoperational program for specific media is given in Table 6.2-1. Because there are no radiological effluents during the preapplication, site preparation, or construction phase, radiological monitoring to assess the impact of radiological effluent releases is not necessary.

The following description of the Lee Nuclear Station radiological environmental monitoring program includes (1) number and location of sample collection points and measuring devices and the pathway sampled or measured, (2) sample collection frequency, (3) type and frequency of analysis, and (4) general types of sample collection and measuring equipment. The lower limit of detection for each analysis is provided in the Lee Nuclear Station Offsite Dose Calculation Manual (ODCM) (Reference 1).

This program will be utilized to support the preoperational and operational monitoring needs of Lee Nuclear Station Units 1 and 2, and provides adequate baseline information prior to plant operation.

6.2.2 LEE NUCLEAR STATION RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

The Lee Nuclear Station Radiological Environmental Monitoring Program (REMP) monitors the environment by sampling air, water, sediment, fish, and food products, as well as measuring radiation directly. Milk samples are also monitored if milk-producing animals are present within 5 miles (mi.) of the plant.

The REMP includes sampling indicator and control locations within a 20-mi. radius of the plant. The REMP utilizes indicator locations near the site to show any increases or buildup of radioactivity that might occur due to station operation, and control locations farther away from the site to indicate the level of only naturally occurring radioactivity. Indicator results are compared with control and preoperational results to assess any impact Lee Nuclear Station operation might have on the surrounding environment. Radioactive effluent release points are described in final safety analysis report (FSAR) Sections 11.2 and 11.3. Airborne effluents are normally released through the plant vent or the turbine building vent. The plant vent provides the release path for containment venting releases, auxiliary building ventilation releases, annex building releases, radwaste building releases, and gaseous radwaste system discharge. The turbine building vents provide the release path for the condenser air removal system, gland seal condenser exhaust

and the turbine building ventilation releases. Liquid effluents are mixed in and diluted by the cooling tower blowdown before discharge to the Broad River.

6.2.2.1 Pathways Monitored

The airborne, direct radiation, waterborne, vegetation, and ingestion pathways are monitored as required by the ODCM (Reference 1). A description of the Lee Nuclear Station monitoring and sampling locations utilized to monitor the exposure pathways is provided in Table 6.2-2 and shown in Figures 6.2-1 and 6.2-2. Monitoring locations consist of an inner ring of thermoluminescent dosimeters (TLDs) in the general area of the site boundary with a TLD in each compass direction. An outer ring of TLDs is located approximately five miles from the site. In addition, particulate and airborne iodine are monitored close to the site boundary in the direction that has the highest calculated annual average ground level deposition. Monitoring is also provided at special interest locations identified in Table 6.2-2.

The following radiation exposure pathways are monitored:

- Direct (dosimeters)
- Airborne (iodine and particulates)
- Waterborne (surface water, drinking water, groundwater, and river sediment)
- Ingestion (milk, food products, and fish tissue)
- Vegetation (forage)

Sampling results and locations are evaluated to determine effects from seasonal yields and variations. Trending and comparison reviews provide information regarding changes in background levels and determine the adequacy of analytical techniques in light of program results and changes in technology, when compared to baseline measurements. Tritium is monitored at the on-site wells to implement Nuclear Energy Institute guidance on tritium groundwater monitoring. Changes in program implementation (including sampling techniques, frequencies, and locations) may occur as a result of monitoring results.

6.2.2.2 Land-use Census

A land-use census is conducted annually, as required by the ODCM (Reference 1). The purpose of this census is to identify changes in land use within 5 mi. of the Lee Nuclear Site that would require modifications to the REMP or the ODCM. The most important criteria during this census are to determine locations in each sector of the nearest (1) residence, (2) animal milked for human consumption, and (3) garden of greater than 500 square feet (ft^2) producing broadleaf vegetation.

The land-use census is conducted by:

- Performing field surveys in each meteorological sector out to 5 mi. in order to confirm:
  - Nearest permanent residence

- Nearest garden greater than 500 ft^2

- Nearest milking animal, if any

- Identifying locations on a map, measuring distances to Lee Nuclear Station, and recording results on surveillance data sheets.

- Comparing current census results to previous results.

- Contacting the county agent for verification of nearest dairy animals.

6.2.2.3 Quality Assurance Program

The REMP is conducted in accordance with U.S. Nuclear Regulatory Commission (NRC) Regulatory Guide 4.15, Revision 1, “Quality Assurance for Radiological Monitoring Programs (Normal Operations) -- Effluent Streams and the Environment.” Quality assurance is provided through quality training, quality program implementation and administrative and technical procedures. Participation in an approved Inter-laboratory Comparison Program assures that independent checks on the precision and accuracy of the measurements of radioactive material are performed as part of the quality assurance program. This demonstrates that the measurement results are reasonably valid for the purposes of Section IV.B.2, Appendix I of 10 CFR Part 50. These results are reported in the annual radiological environmental monitoring report.

6.2.3 REFERENCES

1. Lee Nuclear Station Offsite Dose Calculation Manual (ODCM).

2. U.S. Nuclear Regulatory Commission, Offsite Dose Calculation Manual Guidance: Standard Radiological Effluent Controls for Pressurized Water Reactors, NUREG-1301, Washington, DC, 1991.

3. U.S. Nuclear Regulatory Commission, Branch Technical Position on An Acceptable Radiological Environmental Monitoring Program, Revision 1, November 1979 (transmitted under Generic Letter GL 79-065, November 27, 1979).

TABLE 6.2-1
DURATION OF PREOPERATIONAL PROGRAM FOR SPECIFIC MEDIA[a]

6 Months	1 Year	2 Years
Airborne iodine	Airborne particulates	Direct radiation
Iodine in milk		
(while animals are in pasture)	Milk (remaining analyses)	Fish and invertebrates
	Surface water	Food products
	Groundwater	Sediment from shoreline
	Drinking water	

a) The duration of the preoperational program and the specific media monitored are from Radiological Assessment Branch Technical Position, “An Acceptable Radiological Environmental Monitoring Program,” Rev. 1, PDR Accession No. 8001040390.

TABLE 6.2-2 (Sheet 1 of 4)
ENVIRONMENTAL SAMPLING LOCATIONS
(LOCATIONS ARE SHOWN IN FIGURES 6.2-1 AND 6.2-2)

Descriptive Location	Direction	Distance mi.	Sample Type	Sampling and Collection Frequency	Type and Frequency of Analysis
Inner ring of stations in the general areas of the SITE BOUNDARY					
River Bank	N	0.6	D	Quarterly	Gamma dose quarterly
River Bank	NNE	0.6	D	Quarterly	Gamma dose quarterly
River Bank	NE	0.6	D	Quarterly	Gamma dose quarterly
Near Property Boundary	ENE	0.6	D	Quarterly	Gamma dose quarterly
River Bank	E	0.8	D	Quarterly	Gamma dose quarterly
River Bank	ESE	0.8	D	Quarterly	Gamma dose quarterly
Ninety-Nine Ferry Rd.	SE	1.0	D	Quarterly	Gamma dose quarterly
Ninety-Nine Ferry Rd.	SSE	1.0	D	Quarterly	Gamma dose quarterly
McKowns Mountain Rd.	S	1.0	D	Quarterly	Gamma dose quarterly
McKowns Mountain Rd.	SSW	1.1	D	Quarterly	Gamma dose quarterly
Near Property Boundary	SW	1.1	D	Quarterly	Gamma dose quarterly
Near Property Boundary	WSW	1.6	D	Quarterly	Gamma dose quarterly
Rolling Mill Rd.	W	1.7	D	Quarterly	Gamma dose quarterly
Rolling Mill Rd.	WNW	1.0	D	Quarterly	Gamma dose quarterly
River Bank	NW	1.2	D	Quarterly	Gamma dose quarterly
River Bank	NNW	0.6	D	Quarterly	Gamma dose quarterly
Outer ring approximately 1 to 5 miles from the site					
South Carolina State Highway 5	N	5.9	D	Quarterly	Gamma dose quarterly
South Carolina 5	NNE	5.0	D	Quarterly	Gamma dose quarterly
South Carolina 5	NE	5.0	D	Quarterly	Gamma dose quarterly
Rock Cut Rd.	ENE	5.0	D	Quarterly	Gamma dose quarterly
S. Main St.	E	5.4	D	Quarterly	Gamma dose quarterly

TABLE 6.2-2 (Sheet 2 of 4)
ENVIRONMENTAL SAMPLING LOCATIONS
(LOCATIONS ARE SHOWN IN FIGURES 6.2-1 AND 6.2-2)

Descriptive Location	Direction	Distance mi.	Sample Type	Sampling and Collection Frequency	Type and Frequency of Analysis
S. Main St.	ESE	6.1	D	Quarterly	Gamma dose quarterly
South Carolina State Highway 211	SE	5.6	D	Quarterly	Gamma dose quarterly
South Carolina State Highway 211	SSE	5.9	D	Quarterly	Gamma dose quarterly
South Carolina State Highway 105	S	5.0	D	Quarterly	Gamma dose quarterly
Lowrys Road	SSW	5.0	D	Quarterly	Gamma dose quarterly
Brick House Road.	SW	5.0	D	Quarterly	Gamma dose quarterly
Pondfield Road	WSW	5.0	D	Quarterly	Gamma dose quarterly
South Carolina State Highway 105	W	5.0	D	Quarterly	Gamma dose quarterly
South Carolina State Highway 329	WNW	4.0	D	Quarterly	Gamma dose quarterly
Wilford Rd.	NW	5.6	D	Quarterly	Gamma dose quarterly
U.S. Highway 29	NNW	5.0	D	Quarterly	Gamma dose quarterly
Sardis Rd.	S	1.6	D	Quarterly	Gamma dose quarterly
McKowns Mountain Rd.	SSE	1.4	D	Quarterly	Gamma dose quarterly
Patrick Rd.	SW	2.2	D	Quarterly	Gamma dose quarterly
Ravis Rd.	NNW	1.5	D	Quarterly	Gamma dose quarterly
Bear Creek Rd.	N	1.4	D	Quarterly	Gamma dose quarterly
Ninety-Nine Islands Rd.	NNE	1.3	D	Quarterly	Gamma dose quarterly
Sample point close to the SITE BOUNDARY having the highest calculated annual average ground level deposition (D/Q)					
Ninety-Nine Ferry Rd.	SE	1.2	P	Weekly	Weekly for I-131
Ninety-Nine Ferry Rd.	SE	1.2	V	Food products collected monthly when available	Gamma isotopic analysis of edible portion. I-131 on green leafy vegetables.

TABLE 6.2-2 (Sheet 3 of 4)
ENVIRONMENTAL SAMPLING LOCATIONS
(LOCATIONS ARE SHOWN IN FIGURES 6.2-1 AND 6.2-2)

Descriptive Location	Direction	Distance mi.	Sample Type	Sampling and Collection Frequency	Type and Frequency of Analysis
Stations in special interest areas					
Ninety-Nine Islands Rd.	NE	1.1	P	Weekly	Weekly for I-131
Ninety-Nine Islands Rd.	NE	1.1	V	Food products collected monthly when available	Gamma isotopic analysis of edible portion. I-131 on green leafy vegetables.
River Bank	NNE	1.0	P	Weekly	Weekly for I-131
River Bank	NNE	1.0	V	Food products collected monthly when available	Gamma isotopic analysis of edible portion. I-131 on green leafy vegetables.
Dairy Farm [a]	SSE	1.1	M	Semiannually	Gamma isotopic and I-131 analysis
Dairy Farm [a]	SSW	1.5	M	Semiannually	Gamma isotopic and I-131 analysis
Dairy Farm [a]	SW	1.2	M	Semiannually	Gamma isotopic and I-131 analysis
West Bank of Broad River [b]	ESE	1.4	W	Monthly	Gamma analysis
East Bank of Broad River [c]	NNW	1.2	W	Monthly	Gamma analysis
West Bank of Broad River[b]	ESE	1.4	S,F	Semiannually	Gamma analysis
East Bank of Broad River[c]	NNW	1.2	S,F	Semiannually	Gamma analysis
Blacksburg	N	6.0	P	Weekly	Weekly for I-131
West Bank of Broad River	SSE	6.0	W	Monthly	Gamma analysis
Union City Drinking Water[d]	S	21.0	W	Monthly	Gamma analysis

TABLE 6.2-2 (Sheet 4 of 4)
ENVIRONMENTAL SAMPLING LOCATIONS
(LOCATIONS ARE SHOWN IN FIGURES 6.2-1 AND 6.2-2)

Descriptive Location	Direction	Distance mi.	Sample Type	Sampling and Collection Frequency	Type and Frequency of Analysis
Sample from control locations 10 – 20 miles distance.					
Control samples[e]	E	10–20	M,D,P,V	See above	See above
Control TLD	WNW	10–20	D	Quarterly	Gamma dose quarterly
Groundwater					
On-site well[f]			G	Quarterly	Gamma isotopic and tritium analysis

D – Direct radiation (TLD)
P – Particulates & Iodine (Airborne)
V – Vegetation
M – Milk
S – Sediment
F – Fish & invertebrates
W – Water
G - Groundwater

NOTES:

a) Sample from milking animals within 5 mi. if milk is available commercially.
b) Surface water, fish and sediment downstream of discharge.
c) Surface water, fish and sediment upstream of discharge.
d) Union City Drinking Water location is not included in Figures 6.2-1 or 6.2-2.
e) Control location with least prevalent wind direction.
f) Tritium monitoring to implement Nuclear Energy Institute guidance on tritium groundwater monitoring (Refer to FSAR Subsection 12AA.5.4.13).

6.3 HYDROLOGICAL MONITORING

This section discusses the hydrological monitoring activities that are implemented to monitor the hydrological setting during preapplication, site preparation and construction, preoperation and operation of the Lee Nuclear Station, including monitoring of flow rates, water levels, sediment loads, and groundwater levels. These activities include the following:

- Preapplication monitoring program of field monitoring and data collection used to support the baseline hydrological descriptions. Details of the program results are in Section 2.3.

- Site preparation and construction monitoring to control anticipated impacts from site preparation and construction and to detect unexpected impacts arising from these activities. This monitoring is needed only in unusual circumstances where specific adverse impacts are predicted.

- Preoperational monitoring to establish a baseline for identifying and assessing hydrological effects resulting from plant operation.

- Operational monitoring programs to establish the impacts of operation of the plant and to detect any unexpected impacts resulting from plant operation.

Effluents discharged to navigable streams are governed by state permit regulations (Reference 2). A NPDES permit to discharge effluents to navigable streams is required for the Lee Nuclear Station to operate. The SCDHEC is the NPDES regulating agency (Reference 3). SCDHEC NPDES regulations incorporate thermal monitoring requirements (discussed in Section 6.1) and chemical monitoring requirements for wastewater discharges to maintain water quality criteria (discussed in Section 6.6). SCDHEC regulations do not require hydrological monitoring for surface waters. SCDHEC regulations do not require hydrologic or chemical monitoring of groundwater unless there is suspected groundwater contamination. Adequate monitoring (baseline and operational) is a prerequisite for obtaining or renewing an NPDES permit.

6.3.1 PREAPPLICATION MONITORING

The preapplication hydrologic monitoring consists of both surface water and groundwater monitoring. Each is discussed separately below.

6.3.1.1 Surface Water Hydrologic Monitoring

The Lee Nuclear Site and surrounding hydrology is described in Section 2.3 and has been compared with the hydrological information presented in the “Cherokee Nuclear Station Environmental Report,” (Reference 1 - Sections 2.2, 2.4, and 2.5). The preapplication surface hydrologic program was performed to verify the existing site hydrologic conditions:

- A bathymetric survey was conducted in September 2006, in the Broad River, Ninety-Nine Islands Reservoir, and on-site impoundments. Results of those studies are provided in Subsections 2.3.1.3.1 and 2.3.1.3.2.

- Temperature and velocity data were collected in the vicinity of the cooling water system intake and discharge structures. These data are discussed in Subsection 2.3.1.2.1. Local

surface water quality in the Broad River and the impoundments is discussed in Subsection 2.3.3.1.

- Seasonal temperature and flows to describe the seasonal variations in hydrology at the site and surroundings.

The data sets were used to determine the following: (1) verify if the surface water hydrology was altered during the intervening years, (2) substantiate the design assumptions, and (3) establish the baseline for the Environmental Report and the NPDES permit.

6.3.1.2 Groundwater Hydrologic Monitoring

Site groundwater hydrologic data were gathered prior to the 1975 construction activities and during the 1975-1982 construction activities. A water table map showing site conditions between 1973 and 1974 is provided in Figure 2.3-12.

In March 2006, a groundwater investigation program was initiated as part of a subsurface study to evaluate current geologic and hydrogeologic conditions at the Lee Nuclear Site. Fifteen borings were drilled and monitoring wells were installed, in accordance with SCDHEC monitoring well permits, with screen intervals in the partially weathered rock. Following review of subsurface data, additional shallow wells were completed in fill material and residuum. A total of 24 monitoring wells, 10 for chemical and water chemistry evaluation and all 24 for groundwater elevation effects, were installed in the surficial hydrogeologic unit to develop a description of conditions across the site. The regional and local hydrogeologic setting is discussed in Subsection 2.3.1.5. Additional groundwater information is provided in Subsection 2.4.12 of the final safety analysis report (FSAR). The site hydrology is discussed in Subsection 2.3.1.5.7. A site hydrograph is provided in Figure 2.3-14. Details regarding monitoring well construction are presented in Table 2.3-5. Groundwater monitoring wells installed at the site and not incorporated into the preapplication monitoring program are expected to be properly abandoned in accordance with SCDHEC regulations, during construction-phase activities to prevent potential effects to subsurface groundwater or improper abandonment due to destruction.

During the 2006 investigation in support of the Lee Nuclear Station combined construction and operating license application (COLA), field and laboratory tests were conducted to characterize soil and rock permeability, and groundwater flow direction and velocity. The results of these investigations are provided in Subsections 2.3.1.5.8 and 2.3.1.5.9, respectively. A summary of the tests is presented in Figure 2.3-17. The projected preferential groundwater flow path is to the north and is shown in Figures 2.3-15, Sheet 8 and 2.3-16, Sheet 3.

Groundwater chemistry samples were collected from 10 monitoring wells located on the Lee Nuclear Site. Samples were collected quarterly for a period of 1 year. Figure 2.3-15 shows the locations of the observation and monitoring wells. Local groundwater quality is discussed in Subsection 2.3.3.2. Results of the analyses are consistent with groundwater samples taken for the Cherokee Nuclear Station project in 1975 (see Table 2.3-21).

As discussed in Section 2.3, no off-site wells are considered capable of reversing groundwater flow beneath the site, or vice versa, based on the geographic positions of these wells (i.e., the distance of the domestic wells from the power block area and their locations outside the slope aquifer system) and their character (i.e., the typical low flowrates and the relatively shallow

completion depths of the domestic wells). Consequently, groundwater hydrologic investigations were limited to the site environs.

6.3.2 SITE PREPARATION AND CONSTRUCTION MONITORING

Hydrological monitoring to observe the effects from site preparation and construction includes preapplication monitoring to establish a baseline for assessing the effects of site preparation and construction activities. Although no adverse effects are expected to occur during construction, a minimal amount of hydrological monitoring is planned during site preparation and construction to confirm the baseline obtained during the preapplication monitoring.

6.3.2.1 Surface Water Hydrologic Monitoring

Construction impacts to surface water are avoided or mitigated by development and implementation of an SCDHEC-required, site-specific construction storm water pollution prevention plan, which includes regular inspections for erosion control measures and visual inspections for discharges, especially after rain events, which may be detrimental to water quality. SCDHEC does not generally require any specific receiving water monitoring as a condition of the storm water permit. Water quality sampling and flow measurements are anticipated to be conducted in the Broad River and onsite impoundments to monitor the effectiveness of erosion control measures implemented as part of the storm water permit.

If necessary, dredging may be performed to remove sediment from the cooling water intake channel prior to start up of the raw water system. During dredging operations, it is anticipated the Broad River will be monitored for turbidity and sediment loads downstream of the dredging site to ensure aquatic systems are minimally affected. The disposal of dredging spoils is discussed in Subsection 4.2.2.

6.3.2.2 Groundwater Hydrologic Monitoring

As construction proceeds the network of monitoring wells will be reconfigured. Some of the closed and properly abandoned monitoring wells surrounding the Lee Nuclear Station Site are expected to be replaced in new locations. Monthly water level gauging of both the current and replacement wells is planned to occur during the construction activities phase to monitor the potential drawdown caused by dewatering or other construction activities, and to substantiate design assumptions related to hydrostatic loading.

Excavation dewatering is expected to continue throughout the construction phase of Lee Nuclear Station. Hydrologic alterations resulting from construction activities are expected to include temporary local changes in groundwater levels from dewatering of foundation excavation areas, or general rising and falling of the groundwater table in localized areas due to topographic alterations. Groundwater level monitoring is designed to record these changes and demonstrate stabilization of the water table once construction is completed. Construction effects on groundwater hydrology are discussed in Section 4.2.1. During the last stages of construction and prior to fuel loading, groundwater level monitoring will be used to re-map groundwater contours and form the basis for establishing wells for the operational groundwater monitoring program.

6.3.3 PREOPERATIONAL MONITORING

6.3.3.1 Surface Water Hydrologic Monitoring

Because no surface water hydrological alterations are expected to occur, there is no projected program to monitor surface hydrological parameters.

6.3.3.2 Groundwater Hydrologic Monitoring

Preoperational hydrological monitoring consists of measuring water levels in the monitoring wells to observe the rebound in groundwater elevations following construction dewatering. Radiological and chemical monitoring of groundwater during the preoperational period is described in Sections 6.2 and 6.6 respectively.

6.3.4 OPERATIONAL MONITORING

This subsection discusses operational monitoring to evaluate the effects of station operation.

6.3.4.1 Surface Water Hydrologic Monitoring

A bathymetric survey of the intake channel and the Make-Up Pond A was conducted initially and will be conducted after the first year of operation to measure sediment build up and determine future dredging intervals. The natural silt load transported by the Broad River may affect the rate of siltation both in the intake and the Make-Up Pond A and reduce the storage capacity of the basin. Monitoring for subsequent sediment removal from the cooling water intake channel and the Make-Up Pond A will be performed periodically to minimize any effect on raw water system operation.

6.3.4.2 Groundwater Hydrologic Monitoring

As noted previously, groundwater contours will be mapped prior to operation. Continued monitoring of groundwater levels, along with the radiological monitoring of groundwater (Subsection 6.2.2), will be used to evaluate the groundwater pathway for potential movement of radionuclides into the environment.

6.3.5 REFERENCES

1. Duke Power Company, "Cherokee Nuclear Station - Environmental Report," Charlotte, NC, revised 1975.

2. South Carolina Department of Health and Environmental Control - Bureau of Water, *"Water Pollution Control Permits,"* Regulation 61-9, December 26, 2003.

3. South Carolina Department of Health and Environmental Control; Bureau of Water - Water Quality, "Water Pollution Control; *South Carolina Code of Laws*, Title 48 - Environmental Protection and Conservation.

6.4 METEOROLOGICAL MONITORING

The meteorological monitoring program is described in this section. This program will provide continuous monitoring from the preapplication through the operational phases. The meteorological monitoring program for the site preparation and construction, preoperational and operational phases will entail relocation of the meteorological tower to a permanent site outside the influence of the permanent plant structures.

6.4.1 ON-SITE METEOROLOGICAL MEASUREMENTS PROGRAM

Two meteorological towers are currently at the site. The meteorological monitoring program for the preapplication phase utilized one meteorological tower (Tower 2), located east of the planned Nuclear Island (see Figure 6.4-1). Either prior to or during the construction phase, Tower 2 is expected to be terminated. Calculations to determine diffusion estimates for both short- and long-term conditions are provided in Section 2.7. These analyses were completed using data from the Tower 2 meteorological instrumentation during the 12-month period of December 2005 through November 2006. A separate tower is expected to be installed as the primary meteorological tower for the site preparation and construction, preoperational, and operational phases.

The Tower 1 meteorological installation encompasses an original 55-meter (m) tower and a 10-m tower from the 1970s, and is the closest of the two tower installations to McKowns Mountain, the highest natural point on the site. Tower 1 is located at roughly the same elevation 588 feet, mean sea level (ft msl) as the future final grade of the Lee Nuclear Station containment structures. Because of its age, Tower 1 does not meet the structural requirements of Regulatory Guide 1.23, Revision 1, "Meteorological Monitoring Programs for Nuclear Power Plants." Consequently, Tower 1 data was not used for data during the Lee Nuclear Station preapplication phase and is not discussed further.

Tower 2 is a newly installed 60-m meteorological tower, located farther away from McKowns Mountain and closer to the Broad River. Tower 2 is more representative of both the wider site area and regional weather conditions. The base elevation for Tower 2 is approximately 611 feet (ft.), or approximately 23 ft. above the 588-ft. base elevation of Tower 1. Data collection from the new meteorological tower began on December 1, 2005.

The locations of meteorological towers relative to other preapplication structures are shown on Figure 6.4-1. The local topography for the Lee Nuclear Site is shown in Figure 1.1-4. These figures illustrate that the location of meteorological Tower 2 is sufficiently removed from any existing structures or significant topographic features. This ensures that the system provides adequate data to represent onsite meteorological conditions and to describe the local and regional atmospheric transport and diffusion characteristics prior to construction.

All instrumentation and measurements associated with Tower 2 meets the guidance provided in Regulatory Guide 1.23, Revision 1 (March 2007). The specifications for the meteorological tower instrumentation are provided in Table 6.4-1.

The permanent meteorological tower installed prior to operations will provide the instrumentation required by Regulatory Guide 1.23, Revision 1 for an operating power plant. As shown in Table 6.4-2, this includes wind speed and direction at two levels, dry-bulb temperature at three levels, dewpoint, and precipitation. Although not required by Regulatory Guide 1.23, station pressure, incoming solar radiation, and outgoing longwave radiation may also be provided.

6.4.1.1 Instrument Description

Tower 2 serves as a representative observation station for the preapplication phase (i.e., meteorological conditions at its location are considered to be representative of the site).

Tower 2 is instrumented at two levels (10 m and 60 m) and measures temperature, wind speed, wind direction, and vertical temperature gradient. Station pressure and temperature are measured at the 2-m level as well as ground-level precipitation, measured at 1-m. See Table 6.4-1 for a complete listing of the instrumentation provided. A system of lightning and surge protection circuitry with proper grounding is included in the facility design.

Trees and vegetation were cleared around Tower 2 to ensure an open exposure. Instrument booms are oriented in the northwest direction on the tower, with a boom length of 8 ft. A general description of the meteorological sensors for Tower 2 and the future permanent tower is provided in Table 6.4-2. Replacement sensors, which may be of a different manufacturer or model, satisfy the requirements of Regulatory Guide 1.23, Revision 1.

Data recovery from the Tower 2 instrumentation, based on evaluation of data from December 2005 to November 2006, was 96.5 percent for wind direction, wind speed, and delta temperature after screening the data using flagging criteria based on NUREG-0917 “Nuclear Regulatory Commission Staff Computer Programs for Use with Meteorological Data, (Reference 1) (see Table 6.4-3). Prior to screening, data recovery for the Tower 2 quality-assured data had initially been 99 percent for the same period.

6.4.2 METEOROLOGICAL DATA PROCESSING

The data management process for Lee Nuclear Site meteorological data involves three basic steps:

- Data acquisition (Subsection 6.4.2.1)
- Data processing (Subsection 6.4.2.2)
- Data validation (Subsection 6.4.2.3)

This subsection includes a summary of the data collection methods and description of the processing and evaluation of the data.

6.4.2.1 Data Acquisition

The meteorological data collection system, with the exception of the vertical temperature difference, is designed and replacement components are chosen to meet or exceed specifications for accuracy identified in Regulatory Guide 1.23, Revision 1.

All wind speeds are recorded in miles per hour. Wind directions are measured on a 0 - 540 analog scale and recorded on a digital 0 - 360-degrees scale. Temperatures are recorded in °C. The precipitation measurement is a digital step trace, each step representing 0.01 inches. One-minute data traces can be generated electronically, eliminating the need for stripcharts.

Electronic signals from individual instrument sensors on the tower, or otherwise placed at the meteorological sites, are sent to the signal conditioning equipment in the co-located instrument shelter/building, and from there to the datalogger. The on-site meteorological data are recorded in digital form in the archive (see Subsection 6.4.2.3). Some additional processing is performed by the datalogger, resulting in the final meteorological data values.

Measured data are stored by the datalogger and available for remote access. The amount of datalogger storage is affected by the number of parameters and averaging intervals. Typical storage is 4 days or longer. The data are sent to the dedicated computer (i.e. "central PC") at the Duke Energy Environmental Center (Huntersville, NC) for validation, reporting, and archiving.

Data quality assurance and archiving occur on a designated "central PC" located in the Duke Environmental Center. The data are remotely polled and downloaded from the on-site datalogger at each tower, via modem, over data lines installed on-site. The on-site meteorological data are recorded in digital form.

6.4.2.2 Data Processing

Data acquisition is under the control of the equipment processors and datalogger at each tower location. The output of each meteorological sensor is scanned periodically, scaled, and the data values are stored as 1-minute averages and 1-hour averages, or totals.

The Tower 2 datalogger sampling rate is the same for all parameters. Channels are sampled at a minimum of every second. From those data points, 1-minute and 1-hour averages are calculated and recorded. The quality of the samples is reflected in the quality of the averages. The time the average was calculated is recorded with each value. Software data processing routines within the dataloggers accumulate output and perform data calculations to generate the data sampling averages listed in Table 6.4-4.

The datalogger checks each piece of data to assure it is between the datalogger analog input limits and assigns a quality flag as needed. This quality indication and the time are recorded with each value.

6.4.2.3 Data Validation

The Duke Energy Ambient Monitoring Group reviews the daily data received from the meteorological systems to detect system problems and perform preliminary data verifications. On-site system checks are performed by the field staff at least monthly to verify proper operation of the systems. After the system checks are completed, site technicians complete a thorough review of all meteorological data collected for the previous month. Data are also reviewed by the ambient monitoring team lead and an in-house meteorologist. Data edits are performed on the central computer database following the data reviews. Both raw (unedited) and edited data files are maintained on the central computer. Backup copies of the data files are maintained.

6.4.3 METEOROLOGICAL INSTRUMENTATION INSPECTION AND MAINTENANCE

The meteorological equipment is kept in proper operating condition by staff that are trained and qualified for the necessary tasks. Meteorological instruments are inspected and serviced at a frequency that assures at least a 90 percent data recovery (Regulatory Guide 1.23 goal) and that minimizes extended periods of instrument outage.

All equipment is calibrated or replaced at least after every 6 months of service. The methods for maintaining a calibrated status for the components of the meteorological data collection system (sensors, recorders, electronics, datalogger, etc.) include field checks, field calibration, and/or replacement by a laboratory-calibrated component. More frequent calibration and/or replacement intervals for individual components may be conducted on the basis of the operational history of the component type. Administrative controls such as appropriate maintenance processes (procedures, work order/work request documents, etc.) are used to calibrate and maintain meteorological and station equipment.

The operational phase of the meteorological program includes those procedures and responsibilities related to activities beginning with the initial fuel loading and continuing through the life of the plant. The meteorological data collection program is continuous without major interruptions during the operational phase. The meteorological program has been developed to be consistent with the guidance given in Regulatory Guide 1.23, Revision 1**.** The basic objective is to maintain data collection performance to assure at least 90 percent joint recoverability and availability of data needed for assessing the relative concentrations and doses resulting from accidental or routine releases.

The restoration of the data collection capability of the meteorological facility in the event of equipment failure or malfunction is accomplished by replacement or repair of affected equipment. A stock of spare parts and equipment is maintained to minimize and shorten the periods of outages. Equipment malfunctions or outages are detected by personnel during routine or special checks. When an outage of one or more of the critical data items occurs, the appropriate maintenance personnel are notified. Records documenting results of calibrations, major causes of instrument outages or drift from calibration, and corrective action taken are maintained.

6.4.4 REFERENCES

1. U.S. Nuclear Regulatory Commission, *Nuclear Regulatory Commission Staff Computer Programs for Use with Meteorological Data*, NUREG-0917, Washington, DC, July 1982.

TABLE 6.4-1 (Sheet 1 of 2)
METEOROLOGICAL INSTRUMENTATION

Tower 2

Meteorological Variable	Instrument Height	Units	Accuracy	Precision
Upper Wind Speed	60 meters	mph	± 0.5	0.1
Upper Wind Direction	60 meters	(degrees from True North)	± 5	1
Upper Sigma-theta (standard deviation of Upper Level Wind Direction)		degrees	(Calculated)	
Lower Wind Speed	10 meters	mph	± 0.5	0.1
Lower Wind Direction	10 meters	(degrees from True North)	± 5	1
Lower Sigma-theta (standard deviation of Lower Level Wind Direction)		degrees	(Calculated)	
Upper Temperature	60 meters	Celsius	± 0.1	0.01
Lower Temperature	10 meters	Celsius	± 0.1	0.01
Upper Delta-T (between 60m and 10m Temperatures)			(Calculated)	
Surface Temperature	2 meters	Celsius	± 0.1	0.01
Lower Delta-T (between 10m and 2 m Temperatures)			(Calculated)	
Dewpoint Temperature	10 meters	Celsius	± 1.5	0.01
Precipitation	1 meter	inches	± 10%	0.01
Station Pressure	2 meters	millibars (mb)	± 0.025% of Reading	0.1
Incoming Solar Radiation	1 meter	(watts/m^2)	± 10 or ± 5% of Reading	0.1

TABLE 6.4-1 (Sheet 2 of 2)
METEOROLOGICAL INSTRUMENTATION

Tower 2

Meteorological Variable	Instrument Height	Units	Accuracy	Precision
Outgoing Longwave Radiation (upwelling from ground)	1 meter	(watts/m2)	± 10 or ± 5% of Reading	0.1

NOTES:

1. Upper delta temperature used in stability class determination.

2. Tower 2 data has been used for air dispersion modeling and site characterization in the ER and FSAR, as most representative of the site.

3. Equipment operational on December 1, 2005.

TABLE 6.4-2
METEOROLOGICAL SENSORS

SENSOR	HEIGHT (meters) Tower 1	Tower 2	Future Permanent Tower	DESCRIPTION
Wind Speed (mph)	10 & 55	10 & 60	10 & 60	Cup anemometer
Wind Direction (degrees from True N)	10 & 55	10 & 60	10 & 60	Vane (resolver phase displacement)
Dry-Bulb Temperature (ºC)	2, 10, 55	2, 10, 60	2, 10 & 60	Platinum wire resistance temperature detector (RTD) with aspirated radiation shield
Dewpoint (ºC)	10	10	10	Chilled mirror
Station Pressure (mb)	2	2	Not Required[a]	Static inlet port
Precipitation (inches)	1	1	1	Tipping-bucket rain gauge
Incoming Solar Radiation (shortwave) (Watts/m^2)	1	1	Not Required[a]	Black & white pyranometer
Outgoing Longwave Radiation (upwelling from ground); (Watts/m^2)	1	1	Not Required[a]	Precision infrared radiometer

a) Not required by Regulatory Guide 1.23, Revision 1, March 2007.

TABLE 6.4-3
MONTHLY DATA RECOVERY RATES

December 2005 – November 2006

	Initial QA Dataset[a]	After additional hours deleted, based on NRC Flagging Criteria[b]
Dec (2005)	95.3%	87.0%
Jan (2006)	98.1%	93.7%
Feb	99.7%	96.6%
Mar	99.3%	98.4%
Apr	99.9%	99.2%
May	99.2%	99.1%
Jun	99.7%	99.0%
Jul	100.0%	99.3%
Aug	99.7%	99.1%
Sep	100.0%	98.8%
Oct	99.7%	96.6%
Nov	99.2%	91.8%
Minimum	95.3%	87.0%
Average	99.2%	96.5%

a) Percentage of valid data, all data points.

b) Percentage of hourly wind speed and direction at 10 m, wind speed and direction at 60 m, and delta-T measurements successfully recorded (6 data points).

TABLE 6.4-4
DATA SAMPLING

1-minute average	1-hour average
wind speed (scalar)	wind speed (scalar)
wind direction (scalar)	wind direction (scalar)
	horizontal wind direction sigma
dry-bulb temperature	dry-bulb temperature
dewpoint temperature	dewpoint temperature
1-minute precipitation (total)	hourly precipitation (total)
solar radiation (total)	solar radiation (total)
station pressure	station pressure
longwave radiation (total)[(a)]	longwave radiation (total)[(a)]

a) Total upwelling from ground.

6.5 ECOLOGICAL MONITORING

Historical information, augmented by site reconnaissance and field surveys in support of the combined license application, provides the basis for the ecological descriptions presented in Subsections 2.4.1 and 2.4.2. This section discusses ecological monitoring for the Lee Nuclear Site.

6.5.1 TERRESTRIAL ECOLOGY AND LAND USE

As described in Subsection 2.4.1, the core area of the Lee Nuclear Site consists of approximately 750 acres of land that were cleared and graded after the U.S. Nuclear Regulatory Commission issued Duke Power Company a construction permit in 1975. Extensive development of the site began in 1977 and continued until 1982 when it was abandoned.

This area now consists mainly of the Open/Field/Meadow and Upland Scrub cover types and contains paved access roads, some construction laydown and parking areas, storage buildings, and warehouses. Approximately 300 acres of the previously disturbed area is dedicated primarily to support the footprint of the proposed reactor units and ancillary facilities. It is in a state of early successional development, devoid of rare plants and other plants of special interest and is a lower quality wildlife habitat than the less disturbed forest stands on the site.

Plant and wildlife species found in less disturbed habitats on the Lee Nuclear Site commonly occur in forests throughout Piedmont province. As reported in Subsection 2.4.1, no protected species, important species, critical habitat, or otherwise important habitat, as defined in NUREG-1555, *Standard Review Plans for Environmental Reviews of Nuclear Power Plants*, occur there. Subsections 4.3.1 and 5.3.3.2 discuss the impacts of construction and operation on terrestrial ecological resources. Also discussed are best management practices (BMPs) that might be implemented as needed to mitigate construction impacts.Thus, all impacts associated with the Lee Nuclear Site are characterized as small. They do not warrant additional monitoring.

As previously discussed in Chapter 4, refurbishing the railroad line requires replacing ballast and rails with only limited disturbance to vegetation that might have encroached onto the previously cleared right-of-way (ROW). Like impacts on plant and wildlife species on the site, this represents a very small impact.

As discussed in Subsection 9.4.3, Duke Energy is in the process of selecting preferred alternate corridors for the proposed transmission lines. Once selected and Duke Energy obtains permission to access the property, the alternative routes will be subjected to further field evaluation designed to detect new information not evident in the data collected to date. As the final step in the process, Duke Energy will select an actual ROW within each corridor and apply for the necessary permits to construct and operate the new transmission lines in accordance with all applicable laws and regulations.

Once Duke Energy secures the right to enter the property, the ROWs will be subjected to site-specific pre-construction investigations, possibly including but not limited to reconnaissance to ascertain the presence or absence of plant species of special concern and other important species and habitats defined in NUREG-1555 or as required by permitting or review agencies at the federal or state level.

With the possible exception of reconnaissance survey along the transmission line ROWs, no additional pre-operational or operational terrestrial ecological monitoring is planned unless the need for monitoring arises as a condition of a permit or other regulatory approval required to construct and operate the Lee Nuclear Station.

6.5.2 AQUATIC ECOLOGY

Duke Energy implemented a preapplication field investigation designed to characterize fishery, macroinvertebrate, and mussel resources in the Broad River above and below the site, in selected impoundments on the site, and in the Ninety-Nine Islands Reservoir at the site. Subsection 2.4.2 describes this investigation, which was implemented to augment historical data, and its results. No protected species or critical habitats, have been located in aquatic habitats on or adjacent to the Lee Nuclear Site (see Subsection 2.4.2).

Dredging and other construction activities are subject to permitting by the U.S. Army Corps of Engineers and other federal and state regulators. Duke Energy will implement BMPs during construction. A stormwater pollution prevention plan and a spill prevention, control, and countermeasure plan, approved in accordance with the SCDHEC NPDES stormwater permit, will cover construction activities at the site, including possible dredging in the existing Make-Up Pond A. These plans also contain BMPs that mitigate impacts to the aquatic environment and emergent wetlands during construction. Wastewater effluent testing, including biological testing, is required as part of the NPDES permit.

Subsections 4.3.2 and 5.3.1.2 discuss the potential impacts on aquatic ecological resources from construction and operation of the Lee Nuclear Station. Construction impacts are characterized as small, local, and temporary. Operational impacts are characterized as small. Thus, no additional pre-operational or operational aquatic ecological monitoring is planned, with the possible exception of specific locations along the transmission line ROWs, unless the need for monitoring arises as a condition of the NPDES permit or another permit or approval required to construct and operate the Lee Nuclear Station.

6.6 CHEMICAL MONITORING

This section describes the chemical monitoring activities for surface and groundwater sources at the proposed Lee Nuclear Station. Chemical monitoring includes the following activities:

- Preapplication monitoring to establish the existing water quality and resulting baselines, as described in Chapters 2 and 3.
- Site Preparation and Construction monitoring to define effects from site preparation and construction activities.
- Preoperational monitoring that establishes a baseline for identifying and assessing environmental effects from operation of the reactor units.
- Operational monitoring that identifies impacts from station operation.

Discussions related to historic, current, and future water use, and discharges from the Lee Nuclear Station, and potential pollutant sources are found in Sections and Subsections 2.3.2, 2.3.3, 3.3, 3.6, and 5.5. Baseline water quality is described in Subsection 2.3.3 and information on anticipated wastewater generation is described in Sections 3.6 and 5.5.

The SCDHEC administers the NPDES permit system for the state. The Lee Nuclear Station NPDES permit will apply to construction and operation activities. The NPDES permit will establish effluent monitoring and sampling requirements. The streams to be sampled, locations of sampling stations (outfalls), constituents to be monitored or target analytes, frequency of sampling, types of samples (e.g., grab or composite), times of day, and time periods of required monitoring will be part of the permit. The Lee Nuclear Station will only have a single combined discharge for cooling tower blowdown, conventional wastewater, and radioactive wastewater. Using the Catawba Nuclear Station, another Duke Energy nuclear station regulated by SCDHEC, Table 6.6-1 provides examples of some expected outfall monitoring requirements for the Lee Nuclear Station NPDES permit.

Quantitative data on chemical constituents in surface water and groundwater at and surrounding the Lee Nuclear Station, including seasonal ranges, averages, and historical extremes, are presented in Section 2.3. For the NPDES monitoring, data quality is assured by applying applicable sample gathering, preservation, chain of custody, and analytical QA/QC procedures. Samples are analyzed by a SCDHEC certified laboratory (Reference 1) and methodology in accordance with 40 CFR 136 (Reference 2). The EPA has established these standard methods in SW-846. The analytical requirements apply to ground and surface waters analyzed for reporting on applicable permits, such as in the SCDHEC NPDES program.

Routine sampling for NPDES outfalls will be performed either by manually collected grab samples or by automated samplers collecting composite samples. It is expected that samples will be submitted to the Duke Energy Analytical Laboratory (SCDHEC Laboratory ID #99005) for analysis. Analytical methods for both groundwater and surface water are presented in Table 2.3-17.

The data obtained will be recorded, analyzed, and reported in accordance with SCDHEC reporting requirements.

6.6.1 PREAPPLICATION MONITORING

The purpose of preapplication water monitoring is to generate a baseline for the assessment of potential effects that may result from construction and operational activities at the Lee Nuclear Station. The preapplication monitoring program may also be used to establish NPDES discharge limits for the site preparation and construction and operational stages.

6.6.1.1 Preapplication Surface Water Monitoring

Quarterly surface water samples were collected at ten sampling locations on the Broad River, upstream and downstream of the dam, and onsite water bodies adjacent to the Lee Nuclear Station, beginning in February 2006. The samples were analyzed for a variety of constituents. The results of the surface water sampling and analysis are presented in Subsection 2.3.3. Figure 2.3-21 shows the surface water sampling locations.

The quarterly surface water sampling data were obtained using generally accepted sampling procedures, and they provide a baseline of water quality on the Broad River in the vicinity of the Lee Nuclear Station. The quarterly sampling activities, coupled with the historical data collected in the vicinity of the Lee Nuclear Site, provide adequate characterization of seasonal variations throughout an annual cycle. The data obtained through this sampling program support the environmental descriptions for hydrology, water use, water quality, aquatic ecology, and water supply discussed in Chapter 2.

6.6.1.2 Preapplication Groundwater Monitoring

In March 2006, a groundwater investigation was initiated as part of a subsurface study to evaluate current geologic and hydrogeologic conditions at the Lee Nuclear Station. Twenty four monitoring wells, some in clusters, were installed from April to July 2006 and water levels were obtained monthly between their installation and April, 2007. Ten of the wells were used to collect groundwater samples for chemical analysis of a variety of constituents. A list of the monitoring wells and relevant installation data is presented in Table 2.3-5 and in Subsection 2.3.3. Figure 2.3-15 shows the well locations and the well locations from which groundwater samples were collected for characterization of groundwater quality.

6.6.2 SITE PREPARATION AND CONSTRUCTION MONITORING

6.6.2.1 Site Preparation and Construction Surface Water Monitoring

Site Preparation and Construction activities at the Lee Nuclear Station will require a NPDES storm water construction permit in accordance with 40 CFR 122.26 and the SCDHEC R.61-9 (References 3 and 4). The Lee Nuclear Station site preparation and construction activities will be performed under an NPDES permit with all requirements implemented in the monitoring program. SCDHEC does not generally require receiving water monitoring as part of the NPDES storm water permit. However, Duke Energy anticipates implementing a limited monitoring program in the vicinity of the storm water discharges to assess the effectiveness of the erosion controls in place during construction.

6.6.2.2 Site Preparation and Construction Groundwater Monitoring

Because construction is expected to have no effects on groundwater, no construction groundwater program is anticipated.

As described in Subsection 6.3.2.2, as construction proceeds, some of the existing monitoring wells are expected to be closed and properly abandoned. These wells will then be replaced with new wells in anticipation of the preoperational and operational monitoring.

6.6.3 PREOPERATIONAL MONITORING

6.6.3.1 Preoperational Surface Water Monitoring

Preoperational surface water chemical monitoring will be focused on establishing the baseline for the NPDES permits. Samples in the vicinity of the intake and discharge structures will be collected and are expected to be analyzed for the pollutant characteristics listed in Table 6.6-1.

6.6.3.2 Preoperational Groundwater Monitoring

The preoperational monitoring program will continue the chemical monitoring program for the monitoring wells on the site to provide a baseline for the operational monitoring program. Samples for chemical analyses will be collected in conjunction with the collection of samples for radiological analyses.

6.6.4 OPERATIONAL MONITORING

6.6.4.1 Operational Surface Water Monitoring

An NPDES permit from SCDHEC is required for the Lee Nuclear Station operational wastewater discharges. The Lee Nuclear Station will have a single combined discharge for cooling tower blowdown, conventional wastewater, and radiological wastes. Process wastewaters and cooling tower blowdown will be discharged into the forebay of the Ninety-Nine Islands Dam through a diffuser to provide effective mixing. The NPDES permit monitoring requirements for the operation of the Lee Nuclear Station will identify items to be monitored for analysis of any changes in water quality that may result from plant operations. Table 6.6-1 lists examples of the systems that may be sampled, constituents to be monitored, frequency of sampling, and types of samples (e.g., grab or composite).

6.6.5 REFERENCES

1. SCDHEC, “A General Guide to Environmental Permitting,” Environmental Laboratory Certification, p.60, 2001

2. 40 CFR 136, “Environmental Protection Agency: Guidelines Establishing Test Procedures For The Analysis Of Pollutants.”

3. United States Environmental Protection Agency (EPA), Title 40 of the Code of Federal Regulations, Part 122.26.

4. South Carolina Department of Health and Environmental Control (SCDHEC); Bureau of Water – Water Quality, Water Pollution Control; South Carolina Code of Laws, Title 48 – Environmental Protection and Conservation.

TABLE 6.6-1
TYPICAL NPDES SURFACE WATER QUALITY MONITORING REQUIREMENTS[a]

MONITORING LOCATION	CONSTITUENTS (UNITS)	MONITORING FREQUENCY	SAMPLE TYPE
Stormwater	pH (units)[e]	1/Discharge[b]	Grab
	Total Suspended Solids (TSS) (mg/L)[d]	1/Discharge	Grab
	Oil and Grease (mg/L)	1/Discharge	Grab
	Total Discharge Volume		Estimate
Cooling Tower Blowdown	Flow (MGD)	Daily	Continuous
	pH (units)	1/Month	Grab
	Copper, total (mg/L)	1/Month	Grab
	Temperature, °F	Daily	Continuous
	Total Residual Chlorine(TRC) (mg/L)	1/Month	Multiple Grabs
	Free Available Chlorine (FAC) (mg/L)	1/Month	Multiple Grabs
Process water consisting of building sumps, floor drains, and other miscellaneous low volume wastewaters	Flow (MGD)	1/Week	Instantaneous
	Total Suspended Solids (TSS) (mg/L)	1/Month	Grab
	Total Residual Chlorine (TRC) (mg/L)	1/Occurrence[c]	Multiple grabs
	BOD 5-Day (mg/L)	1/Quarter	Grab
	Oil & Grease (mg/L)	1/Quarter	Grab
	pH (units)	1/Month	Grab
	Copper, total (mg/L)	1/Month	Grab
	Cadmium, total (mg/L)	1/Month	Grab
	Zinc, total (mg/L)	1/Month	Grab
	Hydrazine (mg/L)	1/Occurrence	Grab

a) Parameters based on the Catawba Nuclear Station NPDES permit which is also in South Carolina and regulated by SCDHEC.

b) 1/Discharge means that a sample must be taken only when discharging.

c) 1/Occurrence means that a sample must be taken when the constituent is being released as part of the discharge stream.

d) mg/L means milligrams per liter

e) units means numbers between 1 and 14.

6.7 SUMMARY OF MONITORING ACTIVITIES

This section summarizes the environmental monitoring activities outlined in earlier sections of Chapter 6 including the following:

- Thermal Monitoring (Section 6.1)
- Radiological Monitoring (Section 6.2)
- Hydrological Monitoring (Section 6.3)
- Meteorological Monitoring (Section 6.4)
- Ecological Monitoring (Section 6.5)
- Chemical Monitoring (Section 6.6)

The summary is divided into four sections: (1) preapplication, (2) site preparation and construction, (3) preoperational, and (4) operational. The site preparation and construction, preoperational and operational monitoring phases are summarized noting applicable sections and subsections in Table 6.7-1: Summary of Monitoring Activities.

6.7.1 PREAPPLICATION MONITORING

Preapplication monitoring requirements for the Lee Nuclear Site are fulfilled by focused monitoring programs:

- Details of the preapplication baseline thermal monitoring are provided in Subsection 6.1.1, and include:
  - The preoperational baseline thermal monitoring program that generated the data used to define the Ninety-Nine Islands Dam forebay mixing dynamics and the discharge to the Broad River.
  - Modeling of the anticipated cooling system discharge thermal effects from operation of the Lee Nuclear Station on the Broad River. The details and results of this modeling are provided in Section 5.3.
- Hydrological preapplication baseline monitoring program to establish background characteristics is detailed in Subsections 6.3.1.1 and 6.3.1.2. This baseline program includes:
  - Seasonal surface water sampling, including thermal measurements, performed at 10 locations on the Broad River and site impoundments.
  - Quarterly measurements of groundwater depth, quality, and flow at monitoring well locations. These data provide input for groundwater modeling.
- Onsite preapplication, site preparation and construction, preoperational and operational meteorological monitoring programs are discussed in Section 6.4. These programs

include continuous meteorological measurement of temperature, wind direction, wind speed, and other parameters necessary to determine atmospheric dispersion at the Lee Nuclear Site.

- Monitoring programs for terrestrial ecology and land use are discussed in Subsection 6.5.1, and for aquatic ecology, in Subsection 6.5.2. These programs include preapplication background studies addressing terrestrial and aquatic resources surrounding the site to establish an ecological baseline for evaluation of impacts from construction and operation activities.

- Details of the preapplication baseline and construction chemical monitoring program are provided in Subsections 6.6.1 and 6.6.2, and include:

  - The preapplication baseline monitoring program composed of surface water and groundwater chemical monitoring provides baseline data to assess effects from construction and operation activities.

  - Seasonal sampling on the Broad River and site impoundments began in February 2006. Quarterly groundwater sampling for comparison was conducted for a period of one year. Both data sets were used for comparison with historical water quality. The 2006-2007 sampling data, combined with historical data, provide a baseline of surface water quality on the Broad River in the Lee Nuclear Site vicinity and in the site groundwater. These data adequately characterize seasonal variations throughout an annual cycle.

6.7.2 SITE PREPARATION AND CONSTRUCTION MONITORING

Monitoring during this period is based on requirements in the NPDES Stormwater permit.

6.7.3 PREOPERATIONAL MONITORING

Monitoring during this period is comprised of the following activities:

- Thermal monitoring in Subsection 6.1.3: Continuous thermal monitoring in the vicinity of the intake, discharge, and downstream of the Ninety-Nine Islands dam

- Radiological Monitoring in Section 6.2: The preoperational monitoring program will commence at least two years prior to operation and continue through the life of the Lee Nuclear Station.

- Hydrological Monitoring, discussed in Subsection 6.3.3 will rebaseline groundwater hydrologic conditions after completion of construction.

- Meteorological Monitoring discussed in Section 6.4 continues through the preoperational phase

- Preoperational surface water chemical monitoring will be focused on establishing the baseline for the NPDES permits. Samples in the vicinity of the intake and discharge are expected to be collected and analyzed for the pollutant characteristics listed in Table 6.6-1.

The preoperational groundwater monitoring program will continue the chemical monitoring program for the monitoring wells on the site to provide a baseline for the operational monitoring program. Samples for chemical analyses will be collected in conjunction with the collection of samples for radiological analyses.

6.7.4 OPERATIONAL MONITORING

While specific operational monitoring requirements and programs for the Lee Nuclear Site have not yet been defined, they are expected to be similar to, and tiered from or added to, the monitoring programs summarized in Subsection 6.7.1. The following sections and subsections provide details of the anticipated operational monitoring programs:

- Thermal Monitoring in Subsection 6.1.4 will be implemented in accordance with the NPDES permit then in effect.
- Radiological Monitoring in Section 6.2:
  - This will include the collection of environmental samples and determination of concentrations of radioactive constituents in the samples. Samples will be taken from stations in the general area of the plant and from areas not directly influenced by plant operations (control locations).
  - Radiological monitoring includes the sampling of air, water, soil, sediment, fish and food products.
- Hydrological Monitoring in Subsection 6.3.4:
  - Monitoring for potential sediment removal from the cooling water system intake channel and Make-Up Pond A will be conducted periodically to evaluate impacts to the raw water system operation.
  - A bathymetric survey of the intake channel and Make-Up Pond A is anticipated following the first year of operation to measure sediment build up and determine future dredging intervals.
  - Surface water and groundwater are expected to be monitored during operation.
- Meteorological monitoring discussed in Section 6.4 continues through the operational phase.
- No Terrestrial or Aquatic monitoring is proposed unless specifically required by permit.
- Chemical monitoring discussed in Subsection 6.6.4 will comply with the NPDES permit; selected water bodies and discharges will be monitored for parameters established in the NPDES permit. Table 6.6-1 lists typical water quality parameters.

Specific procedures for performing the monitoring and sampling programs will be specified in environmental permits. These permits define the required schedules, locations, procedures, and sampling criteria for each program.

TABLE 6.7-1
SUMMARY OF MONITORING ACTIVITIES

MONITORING PERIOD	TYPE OF MONITORING	APPLICABLE SECTION/SUBSECTION FOR ADDITONAL DETAILS
Preapplication	Thermal	6.1.1
	Radiological	6.2
	Hydrological	6.3.1
	Meteorological	6.4
	Ecological	6.5
	Chemical	6.6.1
Site Preparation and Construction	Thermal	6.1.2
	Radiological	6.2
	Hydrological	6.3.2
	Meteorological	6.4
	Ecological	6.5.1 (terrestrial ecology and land use) 6.5.2 (aquatic ecology)
	Chemical	6.6.2
Preoperational	Thermal	6.1.3
	Radiological	6.2
	Hydrological	6.3.3
	Meteorological	6.4
	Ecological	6.5.1 (terrestrial ecology and land use) 6.5.2 (aquatic ecology)
	Chemical	6.6.3
Operational	Thermal	6.1.4
	Radiological	6.2
	Hydrological	6.3.4
	Meteorological	6.4
	Ecological	6.5.1 (terrestrial ecology and land use) 6.5.2 (aquatic ecology)
	Chemical	6.6.4