CHAPTER 6

ENVIRONMENTAL MEASUREMENTS AND MONITORING PROGRAMS

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6.0 ENVIRONMENTAL MEASUREMENTS AND MONITORING PROGRAMS

This chapter presents the details of the environmental monitoring programs that are instituted for the periods prior to application submission (preapplication), during construction, prior to operation (preoperational), and during operation of Bellefonte Nuclear Plant, Units 3 and 4 (BLN). These monitoring programs establish a baseline of information that allows for the evaluation of future information and provide a method of quantifying the environmental effects of BLN operations.

The environmental measurements and monitoring programs are described in the following 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 Programs (Section 6.7).

Monitoring details (e.g., sampling equipment, constituents, parameters, frequency, and locations) for each specific phase of the overall program are described in these sections.

The following provides brief details related to the applicable monitoring periods:

- Preapplication Monitoring. These field monitoring and data collection activities are used to support the baseline discipline-specific descriptions presented in the environmental report.
- Construction Monitoring. These monitoring activities evaluate the impacts from site preparation and construction. These activities also detect any environmental impacts and allow comparison to preconstruction baseline data for assessing the subsequent impacts of site preparation and construction.
- Preoperational Monitoring. These monitoring activities establish a baseline for identifying and assessing environmental impacts resulting from BLN operation.
- Operational Monitoring. These monitoring activities establish the impacts of plant operations and detect any environmental impacts.

Although discussed in additional detail in Section 6.6, standard methods of sample preservation and analytical methods, in conformance with 40 CFR Part 136 (Reference 1), are specified in the current NPDES permit, and are used once the BLN becomes operational and discharge of process wastewaters commences. The same sample procedures are used for the quarterly surface water (Subsection 6.6.1.1) and groundwater (Subsection 6.6.1.2) sampling conducted. Samples are obtained following generally accepted field sampling practices using clean sampling devices, and clean and pre-prepared sample containers. Automated systems used for sample types requiring instantaneous and totalized monitoring, recorder monitoring, and composite monitoring are maintained and calibrated in accordance with equipment manufacturer's requirements to verify and ensure accuracy. Analysis of samples for constituents that are not monitored using instantaneous and totalized automated systems may be performed by TVA or an independent third-party laboratory. Samples submitted to an independent third-party laboratory are submitted in accordance with chain-of-custody protocol. TVA and the independent third-party laboratory comply with the necessary laboratory certification methodologies specific to data quality objectives, quality assurance procedures, quality control methods (including quality procedures/instructions for instrument maintenance and calibration), and statistical methods to interpret analytical results in accordance with 40 CFR Part 136 (Reference 1).

6.0.1 REFERENCES

1. 40 CFR Part 136, "Environmental Protection Agency: Guidelines Establishing Test Procedures for the Analysis of Pollutants."

6.1 THERMAL MONITORING

The following subsections discuss thermal monitoring activities related to the preapplication, preoperational, and operational phases of the BLN. The Alabama Department of Environmental Management (ADEM) incorporates thermal monitoring requirements into wastewater discharge permits issued under the National Pollutant Discharge Elimination System (NPDES). The Tennessee Valley Authority (TVA) has an existing NPDES permit that was issued by ADEM (Permit Number AL0024635) and establishes discharge sampling and monitoring requirements (Reference 3). As TVA proposes to utilize some of the existing systems at BLN, the current BLN permit is used in this section to provide examples of wastestreams that may require monitoring. Specific discharge serial number (DSN) locations may change due to discharge configuration and/or site grading modifications that may alter discharge point locations and/or site stormwater runoff patterns. The two separate discharge points anticipated for the AP1000 design are (1) the nonradioactive circulation water blowdown that is discharged to the Tennessee River through the existing outfall and diffuser system (DSN003) and (2) the nonradioactive turbine building sumps discharge that cascades in sequence through the wastewater retention basin (WWRB), Pond A, and the construction holding pond, finally discharging from the construction holding pond to Town Creek (DSN002).

ADEM reviews historical thermal data on the receiving water, and the facility outfall discharge volume and temperature to independently model the thermal plume geometry and behavior. The results of this modeling effort may require modification of the existing permit limits.

Bellefonte Units 1 and 2 were not completed and never operated. No operating process wastewaters were generated or discharged; therefore, the existing permit limits have not been assessed with anticipated discharges.

Several sections of this environmental report and the final safety analysis report (FSAR) contain details related to regional hydrology (Subsection 2.3.1); historical, current and future water use, anticipated water uses (including cooling water) at, and discharges from, the BLN, and potential pollutant sources (Subsections 2.3.2 and 2.3.3, and Sections 3.3, 3.6, and 5.5); and baseline thermal monitoring programs that can be used to describe the thermal impacts (Sections 4.2 and 5.2).

Information on, and maps showing, bathymetry, water velocity and water temperature of the Guntersville Reservoir adjacent to the site, as well as the watershed boundary of the BLN site are provided in FSAR Section 2.4 (FSAR Figures 2.4.1-203 and 2.4.1-204, and FSAR Table 2.4.1-203) and ER Subsection 2.3.1.2.5 (Figure 2.3-9 and Table 2.3-17). Information on, and maps showing, the location of all thermal, hydrological, or aquatic biological monitoring stations, as well as the predicted extent of the thermal plume are provided in Section 1.1 (Figure 1.1-5), Section 2.3 (Figures 2.3-7, 2.3-22, 2.3-23 and 2.3-28; and Tables 2.3-16, 2.3-17, 2.3-20, 2.3-21, 2.3-35, 2.3-36, 2.3-37, 2.3-38, 2.3-39, and 2.3-41, 2.3-42, 2.3-43, and 2.3-44), Section 2.4 (Figure 2.4-3), Section 4.3 (Figure 4.3-1), Section 5.3 (Figures 5.3-2, 5.3-3, 5.3-4, 5.3-5, 5.3-6, 5.3-7, 5.3-8, 5.3-9, and 5.3-10 and Tables 5.3-2 and 5.3-3), and Section 5.6.

6.1.1 PREAPPLICATION MONITORING

The results of approximately 1 year of quarterly surface water sampling, conducted at 10 points in the vicinity (i.e., 6-mi. band around the BLN site), beginning in June 2006 and ending in March 2007 (samples were taken in June, September, and December 2006, and in March 2007), are presented in Subsection 2.3.3.1.2. Quarterly surface-water samples were analyzed in the field using a Horiba multi-parameter meter to measure pH, temperature, conductivity, turbidity, and dissolved oxygen. Samples were also submitted to a commercial laboratory for additional analysis. The results of the field and laboratory analysis are provided in Subsection 2.3.3.1.2 (Table 2.3-39). The preoperational baseline thermal monitoring data that were input to the CORMIX model reflect actual Guntersville Reservoir conditions in the vicinity of the BLN site, and the data are adequate to support the environmental descriptions provided in Section 2.3 and the impact analyses detailed in Sections 5.2 and 5.3. The following factors were used to determine the location and number of monitoring stations:

- Bathymetric characteristics adjacent to the site (see FSAR Subsection 2.4.1 and ER Section 2.3.1.2.5).
- Cooling system employed and its probable operating modes (see Section 3.4).
- Transient hydrological parameters in the vicinity of the site (see Section 2.3).
- Vertical and horizontal temperature geometry in the vicinity of the site (see Subsection 2.3.1). Results of water samples taken from Guntersville Reservoir in the BLN vicinity for conductivity analysis indicate that the water has a low conductivity, and therefore a low salinity. Salinity is not an issue at the BLN site.

ADEM was consulted to determine if any other parameters should be considered in the preapplication monitoring program. ADEM concurred with the approach used to determine the appropriate parameters that must be considered for the preapplication monitoring program.

6.1.2 PREOPERATIONAL MONITORING

The preoperational monitoring program is intended to supplement the preapplication monitoring in providing a baseline water temperature database. Modeling of the anticipated thermal effects of cooling system discharges from operation of the BLN on the Tennessee River was conducted using CORMIX Version 4.3 (References 1 and 2). The details and results of this modeling are provided in Section 5.3 and considered the following when performed:

- Temporal variations of the Guntersville Reservoir were taken into account. In order to adequately consider temporal variations, CORMIX thermal plume modeling and analysis was conducted under conditions of low river temperature downstream flow, mean river temperature downstream flow, high river temperature downstream flow, low river temperature low downstream flow, mean river temperature low downstream flow, high river temperature low downstream flow, low river temperature maximum reverse river flow, mean river temperature maximum reverse river flow, and high river temperature maximum reverse river flow (see Figures 5.3-2, 5.3-3, 5.3-4, 5.3-5, 5.3-6, 5.3-7, 5.3-8, 5.3-9, and 5.3-10).

- Seasonal temperature variations of the blowdown discharge were considered when conducting CORMIX thermal plume modeling and analysis. The temperature of the blowdown from the cooling towers may vary from below the river temperature in October to above the river temperature in December. The maximum temperature is expected in July and August, when river temperatures are the highest.

- Internal data analysis procedures contained within the CORMIX program use input values to model output results.

- Internal data-quality boundaries contained within the CORMIX program check and limit input values to ensure that the model's capabilities are not exceeded and that accurate outputs are generated. The program rejects and produces error indicators for data input values that are outside the boundaries of the model's limits and warns the user of questionable input parameters.

- Average and extreme extent and enclosed surface area of the limiting excess temperature isotherms, as established by ADEM in comparison with background and baseline data. CORMIX modeling for the maximum temperature differential conditions (i.e., low river temperature downstream flow and low river temperature reverse river flow) determined the surface area within a 37°F temperature isotherm to be approximately 8384 sq. ft.

The results of the CORMIX modeling were used to predict biological impacts of the discharge that include time-temperature relationships. Section 5.3 provides details related to biological impacts of discharge including seasonal and time-temperature variations.

ADEM was consulted to determine if any other parameters should be considered in the pre-operational monitoring program. ADEM concurred with the approach used to determine the appropriate parameters that must be considered for the preoperational monitoring program. Although ADEM previously performed CORMIX modeling on the discharge anticipated from the partially completed Bellefonte Units 1 and 2, TVA expects ADEM to independently conduct and confirm the CORMIX modeling results associated with discharges from Units 3 and 4, as detailed above.

6.1.3 OPERATIONAL MONITORING

The operational monitoring program is designed to detect changes in water temperature resulting from BLN operation. The current TVA NPDES permit (Permit Number AL0024635) establishes routine thermal monitoring of discharges to the Tennessee River and Town Creek embayment. Specifically, discharges through outfall DSN003, for diffuser discharge consisting of cooling tower blowdown and other wastewater resulting from electric power generation, must be monitored for temperature. The current daily maximum and monthly average temperature limits for discharges made through outfall DSN003 are 95°F and 92°F, respectively (Reference 3). The permit requires that discharges made through outfall DSN003 be monitored for temperature via a daily grab sample and on a consistent basis, using a recording temperature monitor or multiple grab samples (consisting of a grab sample taken every 15 min. over a 24-hr. period) (Reference 3).

The DSN outfall locations are expected to remain the same (Figure 2.3-26). Although the thermal monitoring requirements listed in the existing NPDES permit are projected to be adequate for cooling-water discharges made through outfall DSN003 (Reference 3), the BLN site and AP1000 requirements may change the chemicals monitored at the outfalls. Table 3.6-1 lists those chemicals used and residual concentrations within the waste streams discharged from the facility.

With the exception of outlying stormwater and site sanitary outflows, wastewater discharges from the site are directed to settling ponds prior to discharge into the Tennessee River and Town Creek. Cooling tower blowdown effluents are directed to the blowdown diffuser (DSN003). Wastewaters from the partially completed Bellefonte Units 1 and 2 are directed to the desilting ponds, sampled, and then pumped to the cooling tower blowdown line prior to discharge into the Tennessee River at the blowdown diffuser (DSN003). Other nonradioactive effluents from Units 3 and 4 discharge to the WWRB, which then cascades in sequence through Pond A and the construction holding pond, finally discharging from the construction holding pond to Town Creek through a monitored outfall (DSN002). With the exception of outlying, uncontaminated surface runoff discharge points (DSN009 – 015), stormwater from the facility is directed to Pond A and discharged to Town Creek and the Tennessee River as described previously in Subsection 2.3.1.1.4.

The existing NPDES permit requires amendment to (1) indicate that discharges through outfalls DSN002 and DSN003 are to be made as a result of operating Units 3 and 4. These changes constitute a permit modification and, therefore, need to be requested at least 180 days prior to initiating process-water discharges.

The monitoring equipment to be used is determined and selected at the time of permit modification. It is expected that the monitoring equipment selected and used at the BLN would be identical or similar to equipment currently used at other TVA nuclear facilities sited on the Tennessee River.

Required data analysis procedures are developed through consultation with the ADEM and implemented at the time of permit modification.

6.1.4 REFERENCES

1. G. H. Jirka, Doneker, R. L., 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.

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

3. Alabama Department of Environmental Management, “National Pollutant Discharge Elimination System Permit, Tennessee Valley Authority, Bellefonte Nuclear Plant, Permit Number AL 0024635,” November 2004.

6.2 RADIOLOGICAL MONITORING

The Radiological Environmental Monitoring Program (REMP) will be utilized to support the preoperational and operational monitoring needs of Bellefonte Nuclear Plant Units 3 and 4, and provide adequate baseline information prior to plant operation.

6.2.1 INTRODUCTION

The BLN REMP adequately characterizes the radiological environment of the biosphere in the vicinity of the BLN site. 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 Regulatory Guide 4.1, “Programs for Monitoring Radioactivity in the Environs of Nuclear Power Plants,” April 1975, and the requirements of 10 CFR 20.1301. The preoperational monitoring program is implemented 2 years before scheduled fuel load. 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 BLN REMP 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 BLN Off-Site Dose Calculation Manual (ODCM).

This REMP is utilized to support the preoperational and operational monitoring needs of the BLN and provides adequate baseline information prior to BLN operation.

6.2.2 BLN RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

The BLN 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 mi. of the BLN. The sampling of vegetation (forage) is used in place of milk sampling if milk-producing animals are not present within 5 mi. of the site.

The REMP includes sampling indicator and control locations within a 20-mi. radius of the BLN and utilizes indicator locations near the site to show any increases or buildup of radioactivity that might occur due to BLN 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 BLN operation might have had on the surrounding environment. The lower limit of detection is provided in the ODCM. 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 Tennessee River (DSN003).

6.2.2.1 Pathways Monitored

The airborne, direct radiation, waterborne, and ingestion pathways are monitored as required by the ODCM. A description of the BLN 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 5 mi. from the site. In addition, particulate and airborne iodine are monitored close to the site boundary in the direction (NNE) that has the highest calculated annual average ground level deposition. Monitoring is also provided at 13 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 and river sediment)
- Aquatic (fish tissue analysis)
- Ingestion (milk and drinking water)
- 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. Changes in program implementation (including sampling techniques, frequencies and locations) may occur as a result of monitoring results.

An inter-laboratory comparison program verifies the accuracy and precision of radioactive analyses of environmental samples. These results are reported in the Annual Radiological Environmental Operating Report.

6.2.2.2 Land Use Census

A land use census is conducted annually, as required by the ODCM. The purpose of this census is to identify changes in land use within 5 mi. of the BLN site that would require modifications to the REMP or the ODCM. The purpose of this census is to determine the location in each sector of the nearest 1) residence, 2) animal milked for human consumption, and 3) garden of greater than 500 sq. ft. producing broadleaf vegetation.

The land use census is conducted by:

- Field surveys in each meteorological sector out to 5 mi. in order to confirm:

- Nearest permanent residence
- Nearest garden and approximate size
- Nearest milking animal, if any

• Identifying locations on a map, measuring distances to BLN 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 NRC Regulatory Guide 4.15, “Quality Assurance for Radiological Monitoring Programs (Normal Operations) -- Effluent Streams and the Environment.” Quality assurance is provided in the REMP through quality training, program implementation by periodic tests, the inter-laboratory comparison program, and administrative and technical procedures.

TABLE 6.2-1
DURATION OF PREOPERATIONAL PROGRAM FOR SPECIFIC MEDIA

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	

TABLE 6.2-2 (Sheet 1 of 6)
ENVIRONMENTAL SAMPLING LOCATIONS

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					
Town Creek River Bank	N	0.7	D	Quarterly	Gamma Dose Quarterly
Town Creek River Bank	NNE	1.1	D	Quarterly	Gamma Dose Quarterly
Town Creek River Bank	NE	2.0	D	Quarterly	Gamma Dose Quarterly
Town Creek River Bank	ENE	1.7	D	Quarterly	Gamma Dose Quarterly
Tennessee River Bank	E	1.7	D	Quarterly	Gamma Dose Quarterly
Tennessee River Bank	ESE	1.5	D	Quarterly	Gamma Dose Quarterly
Tennessee River Bank	SE	1.4	D	Quarterly	Gamma Dose Quarterly
Tennessee River Bank	SSE	1.4	D	Quarterly	Gamma Dose Quarterly
Tennessee River Bank	S	2.1	D	Quarterly	Gamma Dose Quarterly
RTE 588	SSW	1.3	D	Quarterly	Gamma Dose Quarterly
RTE 588	SW	1.1	D	Quarterly	Gamma Dose Quarterly
Bellefonte Rd & RTE 588	WSW	1.2	D	Quarterly	Gamma Dose Quarterly
Town Creek River Bank	W	0.9	D	Quarterly	Gamma Dose Quarterly
Town Creek River Bank	WNW	0.7	D	Quarterly	Gamma Dose Quarterly
Town Creek River Bank	NW	0.6	D	Quarterly	Gamma Dose Quarterly
Town Creek River Bank	NNW	0.6	D	Quarterly	Gamma Dose Quarterly

TABLE 6.2-2 (Sheet 2 of 6)
ENVIRONMENTAL SAMPLING LOCATIONS

Descriptive Location	Direction	Distance (mi.)	Sample Type	Sampling and Collection Frequency	Type and Frequency of Analysis
Outer ring approximately 5 mi. from the site					
Mud Creek River Bank	N	5.0	D	Quarterly	Gamma Dose Quarterly
Mud Creek River Bank	NNE	4.6	D	Quarterly	Gamma Dose Quarterly
RTE 116	NE	4.6	D	Quarterly	Gamma Dose Quarterly
Tennessee River Bank	ENE	4.6	D	Quarterly	Gamma Dose Quarterly
RTE 369 & 462	E	4.6	D	Quarterly	Gamma Dose Quarterly
RTE 432 & 88	ESE	4.6	D	Quarterly	Gamma Dose Quarterly
RTE 378	SE	4.6	D	Quarterly	Gamma Dose Quarterly
RTE 124	SSE	4.8	D	Quarterly	Gamma Dose Quarterly
RTE 380	S	4.6	D	Quarterly	Gamma Dose Quarterly
RTE 390	SSW	4.6	D	Quarterly	Gamma Dose Quarterly
Hunter Rd	SW	4.6	D	Quarterly	Gamma Dose Quarterly
Snodgrass Rd & US72	WSW	4.6	D	Quarterly	Gamma Dose Quarterly
Staples Lane	W	4.6	D	Quarterly	Gamma Dose Quarterly
RTE 102	WNW	4.6	D	Quarterly	Gamma Dose Quarterly
RTE 107	NW	4.6	D	Quarterly	Gamma Dose Quarterly
RTE 33	NNW	4.6	D	Quarterly	Gamma Dose Quarterly

TABLE 6.2-2 (Sheet 3 of 6)
ENVIRONMENTAL SAMPLING LOCATIONS

Descriptive Location	Direction	Distance (mi.)	Sample Type	Sampling and Collection Frequency	Type and Frequency of Analysis
Sample point close to the SITE BOUNDARY having the highest calculated annual average ground level deposition (D/Q) (NNE)					
Garden	NNE	1.3	P	Continuous sampler operation with sample collection per 7 days or as required by dust loading, whichever is more frequent.	Weekly for I-131 Radioiodine Canister – I-131; 7 days Particulate Sampler – Gross beta radioactivity following filter change, composite (by location) for gamma isotopic; 92 days
Garden	NNE	1.3	V	Food products collected monthly when available	Gamma isotopic analysis of edible portion. I-131 on green leafy vegetables.
Stations in special interest areas					
Hollywood School	WNW	2.6	D	Quarterly	Gamma Dose Quarterly
Main St, Dutton	S	6.8	D	Quarterly	Gamma Dose Quarterly
Section High School	SSW	7.5	D	Quarterly	Gamma Dose Quarterly
Post Office, Section, AL	SW	9.6	D	Quarterly	Gamma Dose Quarterly
Post Office, Scottsboro, AL	WSW	6.1	D	Quarterly	Gamma Dose Quarterly
Cedar Grove, AL	NNE	7.9	D	Quarterly	Gamma Dose Quarterly

TABLE 6.2-2 (Sheet 4 of 6)
ENVIRONMENTAL SAMPLING LOCATIONS

Descriptive Location	Direction	Distance (mi.)	Sample Type	Sampling and Collection Frequency	Type and Frequency of Analysis
Garden	WNW	0.7	V	Food products collected monthly when available	Gamma isotopic analysis of edible portion. I-131 on green leafy vegetables.
Garden	NW	0.8	V	Food products collected monthly when available	Gamma isotopic analysis of edible portion. I-131 on green leafy vegetables.
Dairy[(a)]	WNW	0.8	M	Semiannually	Gamma isotopic and I-131 analysis
Dairy[(a)]	NW	1.0	M	Semiannually	Gamma isotopic and I-131 analysis
Dairy[(a)]	NNE	2.2	M	Semiannually	Gamma isotopic and I-131 analysis
Tennessee River[(b)]	S	1.7	F	Semiannually	Gamma analysis
RTE 588	SW	1.1	P	Continuous sampler operation with sample collection per 7 days or as required by dust loading, whichever is more frequent.	Weekly for I-131 Radioiodine Canister – I-131; 7 days Particulate Sampler – Gross beta radioactivity following filter change, composite (by location) for gamma isotopic; 92 days

TABLE 6.2-2 (Sheet 5 of 6)
ENVIRONMENTAL SAMPLING LOCATIONS

Descriptive Location	Direction	Distance (mi.)	Sample Type	Sampling and Collection Frequency	Type and Frequency of Analysis
Fort Payne Water (Tennessee River East Bank) [(b)]	SSW	3.4	W	Semiannually	Gamma analysis
Scottsboro Waterboard (Tennessee River West Bank)	SW	5.0	W	Semiannually	Gamma analysis
Section Waterworks (Tennessee River West Bank)	SW	8.0	W	Semiannually	Gamma analysis
Tennessee River West Bank	SSW	4.1	S	Semiannually	Gamma analysis
Bridgeport Utilities Board	NE	21.1	W	Semiannually	Gamma analysis
Samples from control locations					
Town Creek River Bank	NE	2.0	P	Continuous sampler operation with sample collection per 7 days or as required by dust loading, whichever is more frequent.	Weekly for I-131 Radioiodine Canister – I-131; 7 days Particulate Sampler – Gross beta radioactivity following filter change, composite (by location) for gamma isotopic; 92 days
Tennessee River	NE	(c)	W,F,S	Semiannually	Gamma analysis
Sulphur Springs	E	10-20	D,P,V	Semiannually	Gamma analysis
US11[(d)]	ESE	10-20	D	Quarterly	Gamma Dose Quarterly

TABLE 6.2-2 (Sheet 6 of 6)
ENVIRONMENTAL SAMPLING LOCATIONS

Descriptive Location	Direction	Distance (mi.)	Sample Type	Sampling and Collection Frequency	Type and Frequency of Analysis
Groundwater					
On-site well			G	Quarterly	Gamma isotopic and tritium analysis 365 days

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

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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 and fish from reservoir above the BLN (Nickajack).

d) Control location with least prevalent wind direction.

e) Sample size and sampling duration are given in the REMP.

f) Vegetation sampled during growing season.

6.3 HYDROLOGICAL MONITORING

This section discusses the hydrological monitoring programs:

- Preapplication monitoring to verify existing hydrologic conditions, substantiate design assumptions related to site hydrology, and support the baseline hydrologic descriptions in Subsection 2.3.1.
- Site preparation and construction monitoring to control anticipated impacts from site preparation and construction, and detect unexpected impacts arising from these activities.
- Preoperational monitoring to establish a baseline for identifying and assessing environmental impacts resulting from BLN operation.
- Operational monitoring programs to establish the impacts of BLN operation and detect unexpected impacts arising from BLN operation.

Effluents discharged to navigable streams are governed by the Clean Water Act (CWA) (Reference 3), 40 CFR Part 122 (Reference 4), 40 CFR Part 423 (Reference 5), and state water quality standards. A National Pollutant Discharge Elimination System (NPDES) permit to discharge effluents to navigable streams pursuant to Section 402 of the CWA would be required for the reactors to operate in compliance with the CWA, but it is not a prerequisite to obtaining an NRC license. Adequate monitoring (baseline and operational) is a prerequisite for obtaining or amending an NPDES permit. A Section 401 Water Quality certification is required prior to application for a new, or amendment of an existing, NPDES permit. The 401 certfication is also required prior to issuance of the COL.

6.3.1 PREAPPLICATION MONITORING

This subsection primarily addresses the data from ongoing BLN monitoring programs, baseline data collected prior to the initiation of construction of Bellefonte Units 1 and 2, and data from ongoing monitoring programs conducted by the Tennessee Valley Authority (TVA). The monitoring was used as a baseline to verify existing hydrologic conditions, substantiate design assumptions related to site hydrology, assess site suitability, and support the hydrologic descriptions in Subsection 2.3.1. New data obtained during the 2006/2007 combined license (COL) application investigation was compared with the baseline data collected prior to the initiation of construction of Bellefonte Units 1 and 2, as addressed in Section 2.3.

The BLN is required to conduct surface water sampling and flow measurements in accordance with NPDES permit AL0024635 (Reference 1). Sampling data for a recent 2-year period are shown in Table 6.3-1, indicating the discharge flow and water quality entering Town Creek and the Tennessee River. Due to the partial completion of Bellefonte Units 1 and 2, minimal discharges were recorded. Each monitoring point is identified by a discharge serial number (DSN). Flow rate monitoring is conducted as follows:

- Monitoring point DSN002 discharges into Town Creek from Pond A and construction holding ponds. Flow rate is not directly monitored at the construction holding pond overflow weir.
- Monitoring point DSN003 includes diffuser discharges from cooling tower blowdown, desilting pond effluent, sump collection ponds consisting of building sumps and floor drains, all liquid wastewaters from Bellefonte Units 1 and 2, and other miscellaneous low-volume wastewaters discharged into the Tennessee River. Flow rate is measured during discharge events.
- Monitoring point DSN007 includes the Simulator Training Facility treated sanitary, equipment room floor drains, and laboratory wastewaters discharged into the site sanitary system. Flow rate is measured during operation.

Monitoring for the BLN is conducted in accordance with updated NPDES permit requirements for construction and operation; however, the permit application is not submitted until the construction is ready to commence. Discharge monitoring points are identified and included in the permit at that time. The NPDES permit currently in place for monitoring discharge from existing infrastructure requires amendment or replacement to accommodate the BLN project plans.

The TVA initiated a valley-wide Vital Signs (VS) monitoring program in 1990 to evaluate ecological conditions in major reservoirs. The VS program includes long-term monitoring of water quality parameters and health evaluations of fish and benthic macroinvertebrates within TVA-controlled reservoirs. The TVA currently monitors water quality within the Guntersville Reservoir under the VS monitoring program. Temperature, dissolved oxygen concentrations, and general surface water quality parameters are monitored monthly from April to September at Tennessee River miles 350 and 375.2 to assess the quality of water within the reservoir.

A bathymetric survey was conducted September 25-27, 2006, in the Tennessee River in the vicinity of the cooling water system intake and discharge structures. Figure 2.3-9 (Sheets 1 – 3) shows the locations of waypoints used for temperature and velocity measurements, and Table 2.3-17 provides measurement data. Figure 2.3-9 (Sheet 4) depicts water depth obtained from the bathymetric survey within the adjacent portions of the Tennessee Rive and in the cooling water system intake channel. Water temperatures were taken at the surface, then at 10-ft. increments to a depth of 20 ft. where allowable, due to the total depth of the water at that location. Water velocity measurements were taken at the surface, then at 5-ft. increments to a depth of 15 ft. where allowable, due to the total depth of the water at that location. The data reveal that the temperature did not vary substantially with increased depth.

A total of 24 groundwater monitoring wells were installed at the BLN site between 1973 and 1990 (Figure 6.3-1. Bedrock monitoring wells WT1 through WT6 were installed in 1973 for hydrology investigations related to construction of Bellefonte Units 1 and 2. Two additional bedrock monitoring wells were installed in 1981 to monitor groundwater near the trisodium phosphate ponds (metal cleaning waste ponds). These wells were initially labeled as B1 and B2; however, they are now referred to as wells B7 and B8, respectively. Overburden monitoring wells W9, W10, and W11 were installed in 1984 to monitor groundwater in the vicinity of the trisodium phosphate land application areas (areas containing material removed from the trisodium phosphate ponds). Monitoring wells W12 through W19 were installed in May 1990 to provide background groundwater quality and water level data for a study performed to evaluate the feasibility of conversion to a fossil fuel plant. The wells are both bedrock wells (W12, W13, W16, and W19) and overburden wells (W14, W15, W17 and W18). Four bedrock monitoring wells (P-1 through P-4) were installed in conjunction with a geotechnical, geologic, and seismological evaluation conducted in the area southwest of the BLN cooling towers in 2005.

Because the programs under which the historic groundwater monitoring wells were installed at the BLN site have been completed, none of these wells are currently monitored. Monitoring wells likely to be damaged or destroyed during construction are properly abandoned to prevent potential impacts to subsurface groundwater or improper abandonment due to destruction.

During the 2006 investigation in support of the COL application, 122 soil borings were drilled to characterize subsurface geologic conditions and obtain laboratory geotechnical test samples. Details of these borings are presented in FSAR Section 2.5. Clustered groundwater monitoring wells were installed in 17 of these boring locations and screened to examine three subsurface zones: regolith (designated as MW-12XXa), weathered (epikarst) bedrock (designated as MW-12XXb), and deeper bedrock (designated as MW-12XXc).

Figure 2.3-22 (Sheets 1 – 4) shows the monitoring well locations and quarterly groundwater potentiometric elevations of the monitoring wells that were installed and monitored in support of the COL application investigation. A 1-year program of monthly well gauging began in June 2006, and Table 2.3-21 provides a summary of the monthly water level data collected between June 2006 and May 2007. Depth to water at each of the 17 clustered monitoring wells was measured with a direct-reading water level meter. The water level meter was equipped with an audible alarm that sounded when the probe tip encountered the water surface. Groundwater level below the top of casing was read directly from the measuring tape. Groundwater depth measurements were then subtracted from a surveyed top-of-casing elevation to determine the groundwater surface elevation.

Based on evaluation of the groundwater elevation data obtained during the current groundwater monitoring program, several bedrock wells exhibited very slow recharge or equalization characteristics, or were found to have no producible groundwater. These wells were not used to determine the groundwater gradient and subsurface flow characteristics. Transient variations in groundwater velocity and quality parameters are discussed in Section 2.3.1.5.6 and 2.3.3.1.2.

The groundwater gradient for wells screened as bedrock wells (MW-12XXb and MW-12XXc) is generally to the north toward the Town Creek embayment. This gradient is consistent with the historical gradient reported from previous investigations conducted at the BLN site, as presented in Section 2.3.1.5.5. Based on the current groundwater measurements (taken in 2006 and 2007), some groundwater flow is apparent from the northeast corner of the site in a northeast direction towards the cooling water system intake channel during wet weather periods.

Groundwater wells completed in the regolith show sporadic and isolated groundwater availability, except in areas of deeper bedrock weathering; therefore, potentiometric elevation maps for the regolith wells were not developed.

Site soil properties are discussed in Section 2.3.1.5.7. The majority of the soils on the BLN property consist of mixtures of sandy loam and clay. These types of soils tend to have low soil erodibility, especially in areas of low relief and surface gradient (Reference 6). Portions of the property located along the slopes of River Ridge exhibit higher soil erodibility due to the steeper topographic gradient; however, this is limited by the vegetative cover observed throughout the higher elevations on the site.

Cooling system and nonradiological waste retention impacts are discussed in Sections 4.2 and 5.2. Surface water flow rates and sediment transport are discussed in Subsection 2.3.1.2.4 and Section 5.2. Groundwater flow velocities are discussed in Section 2.3.1.5.6.

6.3.2 CONSTRUCTION MONITORING

Hydrological monitoring to control anticipated impacts from site preparation and construction, and to detect unexpected impacts arising from these activities, includes pre-construction monitoring to establish a baseline for assessing subsequent impacts of site preparation and construction. This monitoring is needed in circumstances where specific adverse impacts are anticipated.

6.3.2.1 Groundwater

Preconstruction groundwater monitoring has been conducted, as described in Subsection 2.3.3.3. Background groundwater quality sampling, conducted quarterly from June 2006 to March 2007, was used to establish seasonal baseline water quality data prior to initial construction. This monitoring also included monthly water level gauging of all wells installed as part of the pre-COL application investigation. No additional preconstruction groundwater monitoring is anticipated in conjunction with the pre-COL application investigation.

Groundwater samples were collected and analyzed quarterly within a 1-year period (June 2006, September 2006, December 2006, and March 2007) from 10 monitoring wells at the BLN site as part of this baseline water quality study. Groundwater sampling results are presented in Table 2.3-44, with locations presented in Figure 2.3-22.

The groundwater samples were obtained in accordance with a site-specific groundwater sampling plan developed for data collection during the pre-COL application investigation. Laboratory analytical methods are listed in Table 6.3-2. Field measurements were obtained using a multi-parameter water quality meter. Industry standard data quality procedures were used in the acquisition of the groundwater and surface water quality samples.

Most of the existing monitoring wells require abandonment or are expected to be destroyed during the construction process as excavation for the power block and other structures proceeds. The wells at cluster MW-1208 are expected to remain intact throughout construction. As construction proceeds, replacement of the abandoned or destroyed monitoring wells surrounding Units 3 and 4 is expected to verify no dewatering requirements during construction and substantiate design assumptions related to hydrostatic loading. Monthly water level gauging of these replacement wells are conducted for the duration of the construction activities.

Due to low water production from the formation, extensive excavation dewatering is not expected. Hydrologic alterations resulting from construction activities might include temporary changes in groundwater levels from minor dewatering of foundation excavation areas, or general rising or lowering of the groundwater table in localized areas due to topographic alterations. Once the dewatering and foundation construction activities are terminated, groundwater levels are expected to return to their previous levels.

6.3.2.2 Surface Water

Preconstruction surface water monitoring was conducted and is described in Subsection 2.3.3.1.2. Background surface water quality sampling, conducted quarterly from June 2006 to March 2007 of the Tennessee River, Town Creek, Town Creek embayment, and the existing construction holding pond, is used to establish baseline water quality data prior to initial construction. No additional preconstruction surface water monitoring is planned in conjunction with the pre-COL application investigation.

Surface water samples were collected and analyzed quarterly within a 1-year period (June 2006, September 2006, December 2006, and March 2007) from 10 surface water sampling locations at the BLN site as part of this baseline water quality study. Surface water sampling results are presented in Table 2.3-39 with locations presented in Figure 2.3-27.

The surface water samples were obtained in accordance with a site-specific surface water sampling plan developed for obtaining data for the pre-COL application investigation. Laboratory analytical methods are listed in Table 6.3-3. Field measurements were obtained using a multi-parameter water quality meter. Industry standard data quality procedures were used in the acquisition of the groundwater and surface water quality samples.

Monthly water level gauging of the Tennessee River, Town Creek, Town Creek embayment, the existing construction holding pond, and the yard drainage pond were included in the pre-COL application investigation. The results of the water level gauging are presented in Table 2.3-21. Depth to water at each COL application surface gauging location was measured with a direct-reading water level meter. Surface water level below the reference point was then read directly from the measuring tape. Surface water depth measurements were then subtracted from a surveyed reference elevation to determine the surface elevation.

Construction impacts are expected to be reduced by development and implementation of a site-specific construction stormwater pollution prevention plan, which typically includes regular inspections for erosion-control measures and visual inspections for discharges that may be detrimental to water quality. Water quality sampling and flow measurements are expected to be conducted during construction, as required, to meet the BLN NPDES Permit Number AL0024635 discharge criteria (Reference 1).

Dredging for sediment removal from the existing cooling water system intake channel is planned prior to startup of the raw water system. Any dredging required is performed as maintenance on the existing intake channel and is not new dredging. Monitoring of the Tennessee River for increased turbidity downstream of the dredging operations is conducted during dredging operations to minimize impacts to aquatic systems.

6.3.3 PREOPERATIONAL MONITORING

Preoperational hydrological monitoring is conducted to establish a baseline for identifying and assessing environmental impacts resulting from BLN operation. The monitoring is used to verify existing hydrologic conditions and substantiate design assumptions related to site hydrology.

Field measurements are anticipated to consist of reconnaissance, field sampling, laboratory analysis, data reduction, and evaluation. This monitoring includes approximately 1 year of data collection for most parameters to ensure that temporal variations, such as seasonal changes, have been adequately monitored. Monitoring focuses on physical, chemical, and microbial components of the hydrologic systems on, and adjacent to, the BLN site. The monitoring is used to evaluate the following:

- Alteration of surface water flow.
- Alteration of groundwater flow.
- Impact of sanitary and chemical waste retention methods on water quality.
- Alteration of sediment transport.
- Alteration of floodplain or wetlands.

Data from ongoing monitoring programs for the BLN site are evaluated and used as appropriate. Based on results of the construction-phase monitoring, this 1-year requirement may be reduced if it is determined that the construction-phase sampling and monitoring results are adequate to establish the preoperational baseline parameters. Monitoring is performed using industry standard equipment and analysis procedures. The program may be modified as improved equipment and analysis methods are developed, or as needed to meet updated regulatory program requirements.

6.3.4 OPERATIONAL MONITORING

This section discusses operational monitoring to establish the impacts of BLN operation and detect unexpected impacts arising from BLN operation. Operational monitoring is used to evaluate the following:

- Alteration of surface water flow.
- Alteration of groundwater flow.
- Impact of sanitary and chemical waste retention methods on water quality.
- Alteration of sediment transport.
- Alteration of floodplain or wetlands.

Monitoring and subsequent sediment removal for maintenance of the existing cooling water system intake channel is anticipated periodically to minimize any impact to the raw water system operation. The interval between channel soundings is expected to be modified to correspond to the rate of sedimentation incurred during BLN operation. A bathymetric survey of the intake channel is expected following the first year of operation to measure sediment build up and determine future dredging intervals.

Data from ongoing monitoring programs for the BLN site are evaluated and used as appropriate. Surface water and groundwater parameters are monitored quarterly for the first year of operation, then yearly afterwards. Monitoring is performed using industry standard equipment and analytical procedures. The program may be modified as improved equipment and analysis methods are developed, or as needed to meet updated regulatory program requirements. Operational monitoring for groundwater and surface water satisfies the applicable requirements of other state and federal agencies, as appropriate.

6.3.5 REFERENCES

1. Alabama Department of Environmental Management, “National Pollutant Discharge Elimination System Permit, Permit Number AL 0024635,” November 2004.

2. U.S. Environmental Protection Agency, PCS Detailed Report, NPDES AL 0024635, Website, http://oaspub.epa.gov/enviro/pcs_det_reports.detail_report?npdesid=AL0024635, accessed August 13, 2006.

3. Federal Water Pollution Control Act, as amended, 33 USC 1251 et seq. (also known as Clean Water Act).

4. 40 CFR Part 122, “EPA Administered Permit Programs: The National Pollutant Discharge Elimination System.”

5. 40 CFR Part 423, “Steam Electric Power Generating Point Source Category.”

6. Ontario Ministry of Agriculture, Food, and Rural Affairs, Soil Erosion, Cause and Effect, Website, http://www.omafra.gov.on.ca/english/engineer/facts/87-040.htm#Soil%20Erodibility, accessed April 18, 2007.

TABLE 6.3-1 (Sheet 1 of 2)
BLN SURFACE WATER DISCHARGES AND WATER QUALITY DATA

Monitoring Period End Date	Monitoring Point	Flow (Mgd)		Water Temperature (°F)		pH		Total Suspended Solids (ppm)		Oil and Grease (ppm)		Total Residual Chlorine (ppm)		Biochemical Oxygen Demand		Fecal Coliform
		Max	Ave	Max	Ave	Max	Min	Max	Ave	Max	Ave	Max	Ave	Max	Ave	Max
12/31/2004	DSN002	0.864	0.607	NR	NR	8.9	7.6	4.8	2.9	<5	<5	NR	NR	NR	NR	NR
6/30/2005	DSN002	1.00	1.00	NR	NR	8.7	8.7	3.0	3.0	<5	<5	NR	NR	NR	NR	NR
12/31/2004	DSN003	0.970	0.970	NR	NR	8.3	8.3	NR	NR	NR	NR	0.06	0.06	NR	NR	NR
2/28/2005	DSN003	0.420	0.420	NR	NR	8.1	8.1	NR	NR	NR	NR	0.05	0.05	NR	NR	NR
3/31/2005	DSN003	0.480	0.480	NR	NR	8.3	8.3	NR	NR	NR	NR	0.03	0.03	NR	NR	NR
4/30/2005	DSN003	0.470	0.470	NR	NR	8.4	8.4	NR	NR	NR	NR	0.05	0.05	NR	NR	NR
5/31/2005	DSN003	0.420	0.420	NR	NR	8.6	8.6	NR	NR	NR	NR	0.05	0.05	NR	NR	NR
6/30/2005	DSN003	0.420	0.420	NR	NR	8.5	8.5	NR	NR	NR	NR	0.04	0.04	NR	NR	NR
8/31/2005	DSN003	0.370	0.370	NR	NR	8.6	8.6	NR	NR	NR	NR	0.05	0.05	NR	NR	NR
1/31/2006	DSN003	NR	NR	51.8	51.8	7.78	7.77	NR	NR	NR	NR	NR	NR	NR	NR	NR
2/28/2006	DSN003	0.970	0.970	NR	NR	NR	NR	NR	NR	NR	NR	0.00	0.00	NR	NR	NR
12/31/2004	DSN003c	0.970	0.685	NR	NR	8.3	8.3	6.0	4.3	<5	<5	NR	NR	NR	NR	NR
3/31/2005	DSN003c	0.040	0.450	NR	NR	8.3	8.3	14.8	9.8	<5	<5	NR	NR	NR	NR	NR
6/30/2005	DSN003c	0.470	0.436	NR	NR	8.6	8.6	15.8	14.2	<5	<5	NR	NR	NR	NR	NR
9/30/2005	DSN003c	0.370	0.370	NR	NR	8.6	8.6	14.2	14.2	<5	<5	NR	NR	NR	NR	NR
3/31/2006	DSN003c	0.70	0.70	NR	NR	8.07	8.07	4.0	3.0	<5.0	<5.0	NR	NR	NR	NR	NR
12/31/2006	DSN003c	0.70	0.70	NR	NR	8.3	8.3	16.0	16.0	0	0	NR	NR	NR	NR	NR
2/28/2006	DSN003d	0.97	0.97	NR	NR	NR	NR	NR	NR	NR	NR	0.00	0.00	NR	NR	NR
12/31/2004	DSN007	0.027	0.013	NR	NR	7.6	7.2	<1	<1	NR	NR	NR	NR	<2	<2	NR
1/31/2005	DSN007	0.004	0.002	NR	NR	7.6	7.2	<1	<1	NR	NR	NR	NR	<2	<2	NR
2/28/2005	DSN007	0.008	0.003	NR	NR	7.9	7.5	<1	<1	NR	NR	NR	NR	<2	<2	NR
3/31/2005	DSN007	0.004	0.002	NR	NR	7.5	7.3	<1	<1	NR	NR	NR	NR	<2	<2	NR
4/30/2005	DSN007	0.004	0.002	NR	NR	7.3	7.1	0.0	0.0	NR	NR	NR	NR	5.0	5.0	NR

TABLE 6.3-1 (Sheet 2 of 2)
BLN SURFACE WATER DISCHARGES AND WATER QUALITY DATA

Monitoring Period End Date	Monitoring Point	Flow (Mgd)		Water Temperature (°F)		pH		Total Suspended Solids (ppm)		Oil and Grease (ppm)		Total Residual Chlorine (ppm)		Biochemical Oxygen Demand		Fecal Coliform
		Max	Ave	Max	Ave	Max	Min	Max	Ave	Max	Ave	Max	Ave	Max	Ave	Max
5/31/2005	DSN007	0.001	0.001	NR	NR	7.2	7.0	<1	<1	NR	NR	NR	NR	<2	<2	340
6/30/2005	DSN007	0.001	0.001	NR	NR	7.3	7.1	<1	<1	NR	NR	NR	NR	<2	<2	2
7/31/2005	DSN007	0.001	0.001	NR	NR	7.0	6.7	<1	<1	NR	NR	NR	NR	<2	<2	138
8/31/2005	DSN007	0.001	0.001	NR	NR	7.3	9.7	<1	<1	NR	NR	NR	NR	<2	<2	410
9/30/2005	DSN007	0.001	0.001	NR	NR	7.7	7.1	<1	<1	NR	NR	NR	NR	<2	<2	52
11/30/2005	DSN007	0.001	0.001	NR	NR	7.7	7.6	1.0	1.0	NR	NR	NR	NR	<2	<2	<1
12/31/2005	DSN007	0.002	0.001	NR	NR	7.6	7.4	1.0	1.0	NR	NR	NR	NR	<2	<2	<1
1/31/2006	DSN007	0.009	0.003	NR	NR	7.6	7.5	0.0	0.0	NR	NR	NR	NR	<2	<2	<1
2/28/2006	DSN007	0.006	0.004	NR	NR	7.8	7.5	<1	<1	NR	NR	NR	NR	<2	<2	<1
3/31/2006	DSN007	0.003	0.0028	NR	NR	7.6	7.4	2.0	2.0	NR	NR	NR	NR	<2	<2	<1
4/30/2006	DSN007	0.001	0.001	NR	NR	7.5	7.2	2.0	2.0	NR	NR	NR	NR	0.0	0.0	0
5/31/2006	DSN007	0.002	0.001	NR	NR	7.3	7.1	1.0	1.0	NR	NR	NR	NR	4.0	4.0	90
6/30/2006	DSN007	0.003	0.003	NR	NR	7.5	6.6	2.0	2.0	NR	NR	NR	NR	0.0	0.0	0
7/31/2006	DSN007	0.001	0.001	NR	NR	6.7	6.5	1.0	1.0	NR	NR	NR	NR	6.0	6.0	0
8/31/2006	DSN007	0.001	0.001	NR	NR	6.9	6.4	2.0	2.0	NR	NR	NR	NR	11.0	11.0	52
9/30/2006	DSN007	0.002	0.002	NR	NR	7.5	7.1	4.0	4.0	NR	NR	NR	NR	7.0	7.0	0
10/31/2006	DSN007	0.001	0.001	NR	NR	7.6	7.4	2.0	2.0	NR	NR	NR	NR	4.0	4.0	8
10/31/2006	DSN007	0.001	0.001	NR	NR	8.0	7.6	<1	<1	NR	NR	NR	NR	<2	<2	7
11/30/2006	DSN007	0.004	0.004	NR	NR	7.6	7.2	0.0	0.0	NR	NR	NR	NR	5.0	5.0	210

Notes:
NR - Not required
Mgd - Million gallons per day

(Reference 2)

TABLE 6.3-2 (Sheet 1 of 2)
GROUNDWATER ANALYTICAL METHODS

Parameter	EPA Method	Volume	Bottle Type	Preservative
Suspended Solids	160.2	500 ml	Plastic	< 4°C
Total Dissolved Solids	160.1	250 ml	Plastic	< 4°C
Hardness	130.1	250 ml	Plastic	Nitric Acid (HNO_3)
Turbidity	180.1	250 ml	Plastic	< 4°C
Biochemical Oxygen Demand (BOD)	405.1	1L	Plastic	< 4°C
Chemical Oxygen Demand (COD)	410.4	250 ml	Plastic	Sulfuric Acid (H_2SO_4)
Total Phosphorous	365.1	250 ml	Plastic	Sulfuric Acid (H_2SO_4)
Orthophosphate	365.1	250 ml	Plastic	< 4°C
Ammonia Nitrogen	350.1	250 ml	Plastic	Sulfuric Acid (H_2SO_4)
Nitrite + Nitrate Nitrogen	353.2	125 ml	Plastic	Sulfuric Acid (H_2SO_4)
Nitrate Nitrogen	353.2	125 ml	Plastic	Sulfuric Acid (H_2SO_4)
Organic Nitrogen - Kjeldahl Nitrogen (TKN)	351.2	250 ml	Plastic	Sulfuric Acid (H_2SO_4)
Carbon Dioxide (CO_2)	406B	250 ml	Plastic	< 4°C
Bicarbonate/Alkalinity	310.1	250 ml	Plastic	< 4°C
Chlorides	300	125 ml	Plastic	< 4°C
Sulfate	300	125 ml	Plastic	< 4°C
Mercury (Total)	245.1	500 ml	Plastic	Nitric Acid (HNO_3)
Mercury (Dissolved)	245.1	500 ml	Plastic	< 4°C
pH	150.1	125 ml	Plastic	< 4°C
Total Coliform	9221B	125 ml	Plastic	Sodium Thiosulfate
Fecal Coliform	9221E	125 ml	Plastic	Sodium Thiosulfate

TABLE 6.3-2 (Sheet 2 of 2)
GROUNDWATER ANALYTICAL METHODS

Parameter	EPA Method	Volume	Bottle Type	Preservative
Fecal Streptococci	9230	125 ml	Plastic	< 4°C
Silica, Sodium, Potassium, Calcium, Magnesium	200.7	500 ml	Plastic	Nitric Acid (HNO_3)
Total Metals (arsenic, barium, cadmium, chromium, lead, selenium, silver, nickel, zinc, copper, boron, iron, and manganese)	200.8	500 ml	Plastic	Nitric Acid (HNO_3)

TABLE 6.3-3 (Sheet 1 of 2)
SURFACE WATER ANALYTICAL METHODS

Parameter	EPA Method	Volume	Bottle Type	Preservative
Suspended Solids	160.2	500 ml	Plastic	< 4°C
Total Dissolved Solids	160.1	250 ml	Plastic	< 4°C
Hardness	130.1	250 ml	Plastic	Nitric Acid (HNO_3)
Turbidity	180.1	250 ml	Plastic	< 4°C
Biochemical Oxygen Demand (BOD)	405.1	1L	Plastic	< 4°C
Chemical Oxygen Demand (COD)	410.4	250 ml	Plastic	Sulfuric Acid (H_2SO_4)
Phytoplankton (Chlorophyll a)	10,200H	1L	Plastic	< 4°C
Total Phosphorous	365.1	250 ml	Plastic	Sulfuric Acid (H_2SO_4)
Orthophosphate	365.1	250 ml	Plastic	< 4°C
Ammonia Nitrogen	350.1	250 ml	Plastic	Sulfuric Acid (H_2SO_4)
Nitrite + Nitrate Nitrogen	353.2	125 ml	Plastic	Sulfuric Acid (H_2SO_4)
Nitrate Nitrogen	353.2	125 ml	Plastic	Sulfuric Acid (H_2SO_4)
Organic Nitrogen - Kjeldahl Nitrogen (TKN)	351.2	250 ml	Plastic	Sulfuric Acid (H_2SO_4)
Carbon Dioxide (CO_2)	406B	250 ml	Plastic	< 4°C
Bicarbonate/Alkalinity	310.1	250 ml	Plastic	< 4°C
Chlorides	300	125 ml	Plastic	< 4°C
Sulfate	300	125 ml	Plastic	< 4°C
Mercury (Total)	245.1	500 ml	Plastic	Nitric Acid (HNO_3)
Mercury (Dissolved)	245.1	500 ml	Plastic	< 4°C
pH	150.1	125 ml	Plastic	< 4°C
Total Coliform	9221B	125 ml	Plastic	Sodium Thiosulfate

TABLE 6.3-3 (Sheet 2 of 2)
SURFACE WATER ANALYTICAL METHODS

Parameter	EPA Method	Volume	Bottle Type	Preservative
Fecal Coliform	9221E	125 ml	Plastic	Sodium Thiosulfate
Fecal Streptococci	9230	125 ml	Plastic	< 4°C
Silica, Sodium, Potassium, Calcium, Magnesium	200.7	500 ml	Plastic	Nitric Acid (HNO_3)
Total Metals (arsenic, barium, cadmium, chromium, lead, selenium, silver, nickel, zinc, copper, boron, iron, and manganese)	200.8	500 ml	Plastic	Nitric Acid (HNO_3)

6.4 METEOROLOGICAL MONITORING

The meteorological monitoring program is the same throughout the pre-construction, construction, and operational phases of the project. The monitoring program is a continuation of the ongoing meteorological monitoring program for the Bellefonte facility.

The on-site meteorological measurement program has evolved over the years from the temporary meteorological towers installed in 1972 to a more modern system installed in 2006.

6.4.1 ON-SITE METEOROLOGICAL MEASUREMENTS PROGRAM 1975 – 1983

The original tower at the permanent monitoring site was installed approximately 5000 ft. northeast of the original Unit 1 Reactor Building at 615 ft. msl. The tower was 113 m above ground level, and supported instrumentation for wind speed and direction, and temperature at 10, 60, and 110 m. Meteorological monitoring began on October 29, 1975 and was terminated on November 1, 1983. The system was designed to meet or exceed the design and accuracy requirements of Regulatory Guide 1.23, Revision 0.

The following data were collected:

Meteorological Variable(s)	Elevation (m – above ground level)	Start Date	End Date
Wind Speed & Direction	110	10-29-75	11-01-83
	60	11-01-78	11-01-83
	46	08-19-76	11-01-78
	10	10-29-75	11-01-83
Dry-bulb Temperature	110	10-29-75	11-01-83
	60	11-01-78	11-01-83
	46	10-29-75	11-01-78
	10	10-29-75	11-01-83
	1	10-29-75	12-19-78
Dewpoint Temperature	10	08-19-76	11-01-83
	1	10-29-75	12-19-78
Rainfall	0	10-29-75	11-01-83

Table 6.4-1 provides the specifications of the meteorological equipment originally installed at Bellefonte.

The information recorded by the meteorological instruments was stored in digital form. Operational checks of the system were made twice weekly or more frequently, as necessary, to achieve the required 90 percent annual data recovery. Data recovery for the time period of 1979 through 1983 is provided in Table 6.4-2. The original meteorological data collected at the Bellefonte Nuclear Site are compared to current data in Section 2.7.

6.4.1.1 Data Collection

The on-site meteorological data were recorded in both analog and digital form. Hourly values of measured meteorological variables were recorded and displayed on teletype. Wind data from the three tower levels (10, 60, and 110 m), along with the 10-m dewpoint data, were continuously recorded and displayed on analog strip chart recorders. Hourly values of measured meteorological variables were recorded on punched paper tape. Periodically, these data were removed and sent off-site for data validation, conversion to full digital format, and transfer to electronic form for permanent storage. Teletype displays, analog strip charts, and punched paper tapes were retained for 5 years after data were collected.

6.4.1.2 Meteorological Instrumentation Inspection and Maintenance

Instrument servicing, maintenance, and calibration were performed in accordance with procedures established by TVA in accordance with manufacturer requirements. Routine inspections were made to verify proper operation of equipment and that no damage to the tower, environmental data station, or any other structure or equipment had occurred. The recording media were also checked for proper operation.

Semi-annual checks for proper instrumentation readings were made at various points. Each component of the meteorological facility was checked and/or field calibrated, and/or removed and replaced with a laboratory-calibrated component at least semi-annually.

6.4.2 ON-SITE METEOROLOGICAL MEASUREMENTS PROGRAM 2006 – 2007

A new meteorological tower began operation at the permanent monitoring site on April 1, 2006. The permanent meteorological facility consists of a 55-m instrumented tower for wind and temperature measurements, a separate 10-m tower for dewpoint measurements, a ground-based instrument for rainfall measurements, and a data collection system in an instrument building (Environmental Data Station or EDS). The EDS, which is located west of the tower base, has been determined to have no adverse influence on the measurements taken at the tower. The data collected include: wind speeds, wind directions, and temperatures at the 10-m and 55-m levels; and dewpoint temperatures at the 10-m level. Data collection began on April 1, 2006.

Rainfall is monitored from a rain gauge located approximately 45 ft. from the tower. The meteorological sensors are connected to the data collection and recording equipment in the EDS. A system of lightning and surge protection circuitry with proper grounding is included in the facility design.

The instrumentation and measurements associated with the new meteorological facility meet ANSI/ANS-3.11-2005 requirements. The specifications for the new instrumentation are provided in Table 6.4-3. The new meteorological facility location relative to other BLN structures is shown on Figure 2.1-1. The local topography for the BLN site is shown on Figure 1.1-4. These figures illustrate that the location of the meteorological tower is sufficiently removed from any BLN structures or significant topographic features. There are no buildings, vegetation, or obstructions closer to the tower location than 10 times the height of the object above the tower base (1:10 ratio). The area within 984 ft. of the tower base is covered by natural ground surface and vegetation. There are no land heights or obstructions that might affect meteorological measurements. Based on these considerations, the measurements at the meteorological tower are representative of actual conditions. This system provides adequate data to represent on-site meteorological conditions and to describe the local and regional atmospheric transport and diffusion characteristics.

Instrument Description

A description of the meteorological sensors is provided in Table 6.4-3. Replacement sensors, which may be of a different manufacturer or model, satisfy ANSI/ANS-3.11-2005 specifications (Reference 1).

The main tower serves as a representative observation station (i.e., meteorological conditions at its location are considered to be representative of the site).

Data recovery from the new meteorological tower instrumentation, based on evaluation of data from April 2006 to April 2007, is given in Table 6.4-2.

6.4.3 METEOROLOGICAL DATA PROCESSING

The data processing procedure for Bellefonte meteorological data involves three basic steps:

a. Data acquisition (Subsection 6.4.3.1).

b. Data processing (Subsection 6.4.3.2).

c. Data analysis (Subsection 6.4.3.3).

The data acquisition system is located at the EDS and consists of a personal computer (with peripherals) and various interface devices. These devices send meteorological data to an off-site computer to enable callup for data validation and archiving off-site. The on-site meteorological data are recorded in digital form.

The current meteorological data collection system is designed and replacement components are chosen to meet or exceed specifications for accuracy identified in ANSI/ANS-3.11-2005. The meteorological data collection system satisfies the ANSI/ANS-3.11-2005 accuracy requirements.

6.4.3.1 Data Acquisition

Data acquisition for the current system is under control of the EDS computer program. The output of each meteorological sensor is scanned periodically, scaled, and the data values are stored.

Meteorological sensor outputs are measured at the following rates: horizontal wind direction and wind speed, every 5 sec. (720 per hour); temperature and dewpoint, every minute (60 per hour); rainfall, every 15 min. (4 per hour). Each piece of data is checked to verify that it is between the minimum and maximum instrument limits. Data outside of specified limits are considered invalid and treated as missing.

Wind speeds are recorded in miles per hour. Wind directions are recorded on a 0 to 360 degree scale. Temperatures are recorded in degrees Fahrenheit. Precipitation is recorded in inches. The temperature differential used in stability class evaluations is based on the upper (55-m) and lower (10-m) temperature instrumentation.

6.4.3.2 Data Processing

Software data processing routines within the EDS computer accumulate output and perform data calculations to generate the following data:

Every 15 Minutes	Hourly
Average wind speed	Average wind speed
Vector wind speed	Vector wind speed
Vector wind direction	Vector wind direction
Horizontal wind direction sigma	Horizontal wind direction sigma
Dry-bulb temperature	Dry-bulb temperature
15-min. precipitation	Dewpoint temperature
	Hourly precipitation

An average is calculated every 15 min. and each hour from the individual readings. If there are insufficient individual samples to calculate an average (generally 25 percent for most variables, 50 percent for temperatures, and 75 percent for wind direction sigmas), an average is not calculated and the value for the hour (or 15 min.) is classified as missing.

6.4.3.3 Data Analysis

The EDS computer sends the data to an off-site computer for validation, reporting, and archiving. These data are stored for remote access.

Meteorological data are generally reviewed every workday to identify possible data problems and notify appropriate personnel. Meteorological data are validated before they are placed into permanent archival storage to verify that the amount of valid data in the master record meets regulatory requirements for minimum data collection. Validation includes running data validation software as an aid to reviewing raw data, identifying and editing questionable or invalid data, recovering data from backup sources, and adjusting data to reflect calibration results. After validation is completed, data are permanently stored in electronic form.

Meteorological data are provided to specific users either routinely or on request. Data summaries are provided for both routine and non-routine applications.

6.4.4 METEOROLOGICAL INSTRUMENTATION INSPECTION AND MAINTENANCE

The meteorological equipment at the EDS is kept in proper operating condition by staff that are trained and qualified for the necessary tasks.

Most equipment is calibrated or replaced at least every 6 months of service. The methods for maintaining a calibrated status for the components of the meteorological data collection system (sensors, recorders, electronics, data logger, 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. Procedures and processes, such as appropriate maintenance processes (procedures, work order/work request documents, etc.), are used to calibrate and maintain meteorological and station equipment. Records documenting results of calibrations, major causes of instrument outages or drift from calibration, and corrective action taken are maintained.

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 BLN. The meteorological data collection program is continuous without major interruptions. The meteorological program has been developed to be consistent with the guidance given in ANSI/ANS-3.11-2005 and the reporting procedures in Regulatory Guide 1.21, Revision 1. The basic objective is to maintain data collection performance to provide at least 90 percent annual 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.

Short and long-term diffusion estimates are provided in Section 2.7.

6.4.5 REFERENCES

1. ANSI/ANS-3.11-2005, *Determining Meteorological Information at Nuclear Facilities*, American Nuclear Society, La Grange Park, Illinois, December 22, 2005.

TABLE 6.4-1
BELLEFONTE UNITS 1 AND 2 METEOROLOGICAL INSTRUMENTATION
OCTOBER 29, 1975 – NOVEMBER 1, 1983

Sensor	Height (m)	Description
Wind Direction	10, 60, and 110	Climet Instruments, Inc., Model 012-10; threshold, 0.75 mph; accuracy ±3°.
Wind Speed	10, 60, and 110	Climet Instruments, Inc., Model 011-1; threshold, 0.6 mph; accuracy ±1% or 0.15 mph, whichever is greater.
Temperature	10, 60, and 110	Weed Instrument Co., Model 101; accuracy ±0.06°F; Climet Instruments, Inc., Model 016-1 aspirated radiation shield; error, 0°F to 0.2°F.
Dewpoint	10	EG & G, Inc. Model 440; accuracy ±0.7°F.
Rainfall	1	Belfort Instrument Co., Model 5915-12; accuracy ±0.06 inch.

TABLE 6.4-2
MONTHLY DATA RECOVERY RATE

	1979	1980	1981	1982	2006	2007
Jan	97%	95%	94%	99%	n/a	98.25%
Feb	99%	95%	99%	100%	n/a	98.36%
Mar	100%	30%	99%	99%	n/a	95.97%
Apr	99%	32%	98%	83%	56%	n/a
May	84%	98%	100%	87%	100%	n/a
Jun	94%	82%	99%	81%	99%	n/a
Jul	97%	95%	99%	97%	99.46%	n/a
Aug	94%	86%	99%	99%	99.87%	n/a
Sep	100%	99%	70%	99%	99.31%	n/a
Oct	97%	99%	92%	93%	96.64%	n/a
Nov	90%	90%	91%	97%	99.31%	n/a
Dec	99%	95%	94%	97%	98.79%	n/a
Avg.	96%	83%	95%	94%	94%	97.53%

NOTES

1. This is the fraction of hourly wind speed and direction at the lower level, wind speed and direction at the upper level, and delta-T measurements successfully recorded (6 data points).

2. Mid-level wind and temperature sensor elevations were changed from 46 m to 60 m on November 1, 1978. Consequently, only data from 1979 to 1982 provide full-year databases that are consistent for use in modeling and other data applications.

3. Overall data recovery for current year (April 1, 2006 - March 31, 2007) is 95.16%.

TABLE 6.4-3
BLN METEOROLOGICAL INSTRUMENTATION
2006 – 2007

Sensor	Level, (m)	Sensor Specifications
Wind Direction (WD) and Wind Speed (WS)	10, 55	Ultrasonic wind sensor; starting threshold, 0 mph WD: resolution, 1°; range, 0 to 360°; accuracy ±2°. WS: resolution, 0.1 mph; range, 0 to 144 mph; accuracy ±0.3 mph or 3% of reading, whichever is greater.
Ambient Air Temperature	10, 55	RTD Temperature (platinum wire resistance temperature detector) mounted in motor-fan aspirated solar radiation shield. Sensor: Data recording range -30.0 to 120.0°F; RTD stability, ±0.25°F/year; RTD repeatability, ±0.25°F; time response, 5 seconds. Aspirated Shield: Maximum radiation error, 0 to +0.4°F; delta-T error, 0.1°F with like shields; aspiration flow rate, 3.5 to 7.6 m/s.
Dewpoint Temperature	10	Humidity and Temperature Transmitter for High Humidity Applications; capacitive humidity sensor with warmed probe head. Temperature range, -70 to +180°C; measurement range, 0 to 100% RH, factory calibration uncertainty, ±0.6 % RH for 0...40% RH and ± 1.0 % for 40...97% RH.
Rainfall	1	Heated tipping bucket rain gauge. Accuracy ±0.5% at 0.5 inch/hour and ±2.0% at 2 inches/hour; sensitivity, ±0.01 inches; resolution 0.01 inch.

6.5 ECOLOGICAL MONITORING

Ecological monitoring conducted in support of construction of the Bellefonte facility, augmented by recent site reconnaissance and field survey in support of this combined license application, serve as the basis for the ecological descriptions provided in Subsections 2.4.1 and 2.4.2. Historical information from studies conducted for Bellefonte Units 1 and 2 (Reference 2) and more current information from the Final Environmental Impact Statement for the Bellefonte Conversion Project (Reference 1), as well as Tennessee Valley Authority (TVA) current monitoring programs provided information for this phase of the ecological monitoring program. The U.S. Fish and Wildlife Service, state agencies, and Native American tribal agencies have been contacted. Ecological concerns expressed by contacted agencies are outlined in Section 2.4.

The TVA is responsible for all monitoring programs associated with TVA power plants or performed on TVA land. Aquatic and terrestrial ecosystems surrounding the BLN site were considered prior to submission of this combined license application. Preconstruction studies, predominantly from the initiation of construction of Bellefonte Units 1 and 2, addressed water quality and aquatic resources surrounding the site to establish an aquatic baseline for subsequent operational evaluation of aquatic impacts. Prior to reinitiation of maintenance activities along the existing transmission lines, TVA conducts a Sensitive Area Review, as described in Subsections 5.6.1 and 5.6.2.

6.5.1 TERRESTRIAL ECOLOGY AND LAND USE

Most of the terrestrial acreage associated with the BLN remains unaffected by activities related to additional development and operation of the BLN (Section 4.3). Because no new transmission corridors or modifications to existing transmission corridors are planned, the construction area is relegated to a very small portion of land within the BLN boundary. Although the bald eagle and two endangered bat species sometimes utilize portions of the site for foraging and perching, ample habitat suitable for these uses remains intact.

6.5.1.1 Preapplication Monitoring

As reported in Section 2.4, no protected species, important species, or critical habitats lie within the footprint of the BLN. An endangered plant habitat survey performed in January 2007 determined the acreage to be affected (Figure 4.3-1) is devoid of rare plant habitat. Because habitat is not conducive to harboring endangered plants, at this time subsequent surveys are not planned. Wildlife species presently found in areas that are expected to be disturbed by construction and operation of the BLN facility are also known to commonly occur in the surrounding forests.

6.5.1.2 Ongoing Monitoring

On an as-needed basis to support environmental reviews of proposed projects, the TVA conducts ecological monitoring of terrestrial resources.

Area nests of important avian species are identified and locations noted by the TVA. Along Guntersville Reservoir, several eagle nests and the largest heronry in northern Alabama have been identified. Nests are monitored annually for activity. However, numbers of large birds are expectedly small and calculating descriptive statistics would not divulge any more information than nest quantification and determination of activity on an annual basis.

TVA's efforts include bringing the existing, but de-energized, transmission lines into the maintenance cycle. Maintenance procedures for transmission corridors have also been established by the TVA. The rights-of-way for energized transmission corridors are maintained by the use of mowing or herbicides on a 3- to 5-year maintenance cycle. As part of the maintenance cycle, the TVA conducts a desktop review which consists of analyzing aerial photographs, U.S. Geological Survey (USGS) topographical maps, and video taken during low-altitude flyovers of transmission corridors for habitat changes that would encourage residence by endangered species. If potential for endangered species habitation exists, site reconnaissance follows the desktop review. (Section 5.6) Because information is qualitative rather than quantitative, descriptive statistics are not calculated.

Chapter Subsections 4.3.1 and 5.3.1.2 discuss impacts of construction and operation to terrestrial ecology resources. Ecological impacts associated with the addition of Units 3 and 4 have been characterized as SMALL, with the exception of wetland impacts which are characterized as MODERATE. The TVA has been monitoring terrestrial habitats for several years and, structurally, little has changed. Therefore, with the exception of ongoing monitoring programs discussed above, no additional terrestrial ecological monitoring at the BLN site in support of this combined license application is planned.

6.5.2 AQUATIC ECOLOGY

No protected species or critical habitats have been located in aquatic habitats adjacent to the BLN site (Figure 2.4-4). However, Guntersville Reservoir does sustain a multimillion dollar fishery (Section 5.3) that if poorly maintained would constitute an economic loss. Guntersville Reservoir is 76 mi. in length, and wildlife species found in aquatic habitat adjacent to the BLN site commonly occur throughout the reservoir. Figure 4.3-1 illustrates that acreage affected by construction of the BLN is not tangent to aquatic habitat. Therefore, other than from possible re-dredging of the intake channel, direct impacts to aquatic habitat from physical disturbance are not anticipated.

6.5.2.1 Preapplication Monitoring

A survey performed in April 2007 determined mussels along 22 transects adjacent to the BLN site were common mussels and in low densities (Subsection 2.4.2). Although six mussels are federally listed in Jackson County, the USFWS listed only the pink mucket mussel as a concern adjacent to the BLN site.

Adult freshwater mussels reside on or in the substrate and siphon water which provides both food and oxygen. When reservoirs are formed by damming rivers, siltation is common. Oftentimes, riverine mussels cannot survive in increasingly silty habitat and the community structure changes from sensitive to more tolerant species. In 1991, two relic pink mucket mussels were located within Guntersville Reservoir at TRM 417. Subsequent surveys in 1995 and 2007 revealed no pink mucket mussels adjacent to the BLN site.

6.5.2.2 Ongoing Monitoring

Aquatic monitoring currently performed within Guntersville Reservoir is performed by the TVA as part of the reservoir Vital Signs monitoring program designed to determine community structure as a measure of overall reservoir condition (Section 2.4). The Vital Signs monitoring program is robust and long-term, and has demonstrated value for detecting changes in the reservoir and in addressing concerns of regulators. Guntersville Reservoir was sampled annually from 1991 to 1994 to gather baseline information, and then every other year until present to determine reservoir health and degree of change based on five key indicators. Dissolved oxygen, chlorophyll concentration, fish assemblage, benthic macroinvertebrate community, and sediment quality are sampled in the forebay (Tennessee River mile [TRM] 350.0), transition (TRM 375.2), and inflow (TRM 424.0). At each site, fish are collected by both electro-fishing and gill netting techniques to reduce bias from using a single method. Endpoints utilized to determine species richness and composition include:

- Number of species.
- Number of centrarchid species.
- Numbers of intolerant species.
- Percentage of tolerant individuals.
- Percent dominance by one species.
- Number of non-native species.

Percent top carnivores and percent omnivores determine trophic composition in the three sample sites. Fish abundance and health is determined according to the average number of fish collected per run, taking into account percent anomalies. Data collected by the TVA are incorporated into internal reports, which are stored in the Natural Heritage Program database. Summaries of past monitoring events are located in Subsection 2.4.2.

Benthic macroinvertebrates are also monitored by the TVA at identical reservoir locations that are monitored for fish communities. Ponar grab or Peterson dredge samples are taken at 10 equally spaced locations along each transect at the specified location. Samples are washed, counted, and identified before being fixed in a formalin solution.

To evaluate macroinvertebrate communities in Guntersville Reservoir, seven measurements associated with point values are analyzed:

- Taxa richness.
- Ephemeroptera, Plecoptera, or Trichoptera (EPT) taxa.
- Long-lived taxa.
- Non-Chironomid and Oligocheate density.

- Percent Oligochaete.
- Dominance.
- Zero samples.

Taxa richness determines the number of different species found while sampling. EPT taxa refer to the number of collected invertebrates in families Ephemeroptera, Plecoptera, or Trichoptera, all of which are considered relatively pollution sensitive and also contribute to long-lived taxa, which is another biological measure of ambient pollution. Non-Chironomid and Oligochaete density and percent Oligochaetes are useful because Chironomids and Oligochaetes are very tolerant invertebrates, with Oligochaetes being perhaps the hardiest invertebrate. High numbers of hardy individuals indicates poor habitat quality. Dominance by a single class and Zero Samples are fairly straightforward and are also indications of poor living conditions.

Once measurements are taken, endpoints analyzed, and number scores for each location tallied, the sample location is characterized as excellent, good, fair, or poor. Data collected by the TVA are then incorporated into internal reports, which are stored in the Natural Heritage Program database. Summaries of collected data are located in Subsection 2.4.2.

The Alabama Department of Environmental Management issued National Pollutant Discharge Elimination System (NPDES) Permit Number AL0024635, specific to the BLN, in November 2004. Receiving waters include Guntersville Reservoir and Town Creek. This NPDES permit specifies that visible oil, foam discharge with sheen, or concentrations of polychlorinated biphenyl compounds are permitted. The permit also stipulates that flow, pH, total residual chlorine, and temperature in blowdown and other wastewater resulting from electric power generation are monitored and maintained either under a maximum, or in the case of pH, between a range of 6.0 to 9.0.

Flow, chlorine, and temperature are measured daily, and pH is measured weekly. Also specified by the NPDES permit is the need to conduct an annual 7-day chronic toxicity assay in which mortality is expected to fall below the LC25 level. In the event the BLN would exceed limits or fail requirements determined by the NPDES permit, the TVA would be required to report such occurrences to the Alabama Department of Environmental Management. Penalties for permit violation range from temporary permit suspensions to civil and criminal liability suits depending on the extent and frequency of the violation.

Site preparation and construction monitoring is used when specific adverse impacts from site preparation and construction are predicted. Aquatic ecological impacts associated with construction and operation were identified in Subsection 4.3.2 and Section 5.3, respectively and categorized as SMALL. Intake, discharge, and transmission structures built for Bellefonte Units 1 and 2 are planned to be used for Units 3 and 4, negating the need for construction near aquatic environments. As part of its Vital Signs monitoring program, the TVA has been monitoring aquatic communities for several years and the community structure has remained stable. TVA plans to continue Vital Signs monitoring of Guntersville Reservoir. Small impacts are not expected to change the current environment to such a degree that community is expected to be affected. Therefore, there are no plans to conduct additional on-site aquatic ecological monitoring in support of this combined license application.

6.5.3 REFERENCES

1. Tennessee Valley Authority, *Final Environmental Impact Statement for the Bellefonte Conversion Project*, October 1997.

2. Tennessee Valley Authority, *Environmental Review - Desktop Review (SAR) - Bellefonte Nuclear Plant,* April 12, 2006.

6.6 CHEMICAL MONITORING

This section describes the chemical monitoring programs for surface water and groundwater sources. Although application and permit issuance for wastewater discharges is not required until a time period closer to when construction of BLN begins, this section describes anticipated water quality monitoring activities including the following:

- Preapplication monitoring that establishes the water quality and baselines described in Chapters 2 and 3.
- Construction monitoring that determines potential impacts from site preparation and unit construction activities.
- Preoperational monitoring that establishes a baseline for identifying and assessing environmental impacts from operation of the units.
- Operational monitoring that identifies impacts from operation of the units.

Several sections of this environmental report contain details related to historical, current, and future water use, anticipated water uses (including cooling water) at, and discharges from, the BLN, and potential pollutant sources (Subsections 2.3.2 and 2.3.3, and Sections 3.3, 3.6, and 5.5); baseline water quality (Subsection 2.3.3); information on anticipated wastewater generation (Sections 3.6 and 5.5); ecosystem impact monitoring (Sections 4.3 and 5.3); and baseline thermal monitoring programs that can be used to describe the thermal impacts (Sections 4.2, 5.2, and 6.5).

The Alabama Department of Environmental Management (ADEM), through authorization to implement the National Pollutant Discharge Elimination System (NPDES) regulations, incorporates chemical monitoring requirements into wastewater discharge permits. The Tennessee Valley Authority (TVA) has a current NPDES permit (Permit Number AL0024635) issued by ADEM. The discharge sampling and monitoring requirements established in the NPDES permit are discussed in detail as applicable to the various chemical monitoring phases. The discharge streams (systems) to be sampled, monitoring sampling stations (outfalls), constituents to be monitored or sampled, frequency of sampling, type (method) of sample collection (e.g., grab or composite), and time period of required monitoring (monitoring frequency) under the current NPDES permit are listed in Table 6.6-1 (Reference 1). Monitoring sampling stations (outfalls) for discharge streams are identified by their individual discharge serial number (DSN). The current permit is used in this section to provide examples of wastestreams that may require monitoring. Specific DSN locations may change due to discharge configuration and/or site grading modifications that may alter discharge point locations and/or site stormwater runoff patterns. Cooling tower blowdown effluents are directed to the blowdown diffuser. Liquid effluents from Bellefonte Units 1 and 2 infrastructure are directed to the desilting ponds. From there, the effluents are sampled and then discharged to the Tennessee River through the cooling tower blowdown line and diffuser system (DSN003). Other nonradioactive effluents from the BLN discharge to the wastewater retention basin (WWRB) which then cascades in sequence through Pond A and the construction holding pond, finally discharging from the construction holding pond to Town Creek through a monitored outfall (DSN002).

Bellefonte Units 1 and 2 were not completed and never operated, and no operating process wastewaters were generated or discharged; therefore, the existing permit limits have not been assessed with anticipated discharges. No process waters have been generated, sampled, or analyzed; however, standard methods of sample preservation and analytical methods, in conformance with 40 CFR Part 136 (Reference 2), are specified in the current NPDES permit, and are used once the BLN becomes operational and discharge of process wastewaters commences. Although automated monitoring systems have not been identified as of yet, this equipment may include, but is not limited to, flow meters, constituent concentration monitoring and recording equipment, temperature monitors, and composite samplers. Automated systems use for sample types requiring instantaneous and totalized monitoring (for flow), recorder monitoring (for free available chlorine, total residual chlorine, and temperature), and composite monitoring (for 7-day chronic toxicity) are maintained and calibrated in accordance with equipment manufacturer's requirements to verify and ensure accuracy.

Analysis of samples for constituents that are not monitored using instantaneous and totalized automated systems may be performed by TVA or an independent third-party laboratory. Constituents that may be analyzed by TVA or the independent third-party laboratory include pH, total suspended solids, oil and grease, free available and total residual chlorine, total chromium, total zinc, priority pollutants, total copper, total iron, hydrazine, 7-day chronic toxicity, biological oxygen demand, and fecal coliform. TVA and the independent third-party laboratory comply with the necessary laboratory certification methodologies specific to data quality objectives, quality assurance procedures, quality control methods (including quality procedures/instructions for instrument maintenance and calibration), and statistical methods to interpret analytical results in accordance with 40 CFR Part 136 (Reference 2).

Quantitative data on chemical characteristics of surface water and groundwater at and within the vicinity of the BLN site, including seasonal ranges, averages and historical extremes, are presented in Subsection 2.3.3.

6.6.1 PREAPPLICATION MONITORING

The purpose of the preapplication monitoring program is to generate a baseline to support the assessment of potential impacts that may result from the construction and operation of the BLN. The preapplication monitoring program is composed of NPDES permit-required, surface water monitoring programs (as indicated in the existing NPDES permit) and groundwater monitoring programs. Because Bellefonte Units 1 and 2 were not completed, no process wastewaters were generated or discharged under the NPDES permit through inactive outfalls DSN003d, 003e, 003f, and 004 (see Section 6.6). Due to these circumstances, no sampling or analysis has been conducted on discharges from these outfall DSNs. The stormwater discharge outfalls are designated as DSN009 – 015. No discharge monitoring requirements apply for DSN009 – 015.

6.6.1.1 Chemical Surface Water Monitoring

The DSN outfalls are shown in Figure 2.3-26 and Table 6.6-1 lists the surface water quality parameters that are included in the current NPDES permit; however, the current NPDES permit requires amendment to indicate that discharges through outfall DSN002 and DSN003 are to be made as a result of operating Units 3 and 4. Although the current NPDES permit does not specify required methods of sample collection or the time of day required for sampling, samples are obtained following generally accepted field sampling practices (see Subsection 6.6.1.2) and at approximately the same time of day that the previous sample was taken. Samples are analyzed in accordance with 40 CFR Part 136 (Reference 2) by TVA or by an independent third-party laboratory that complies with the necessary laboratory certification methodologies (see Section 6.6). Additional details on permit revisions and reactivating the required process-water discharge monitoring program is provided in Subsection 6.6.4.

Quarterly surface water samples were taken at 10 sample points on Guntersville Reservoir, beginning in June 2006. The samples were analyzed for a variety of constituents, the results of which are presented in Subsection 2.3.3.1.2 (Table 2.3-39). In addition, the sampling locations are presented in Figure 2.3-27 and FSAR Subsection 2.4.12 (FSAR Figure 2.4.12-213).

The quarterly surface water samples were obtained following generally accepted field-sampling practices, including the use of clean sampling devices, and clean and pre-prepared sample containers supplied by the laboratory that performs the analysis. The samples were taken at a depth of 1 ft. and at approximately 90-day intervals. Following sample collection, surface water samples were submitted in accordance with chain-of-custody protocol to an independent third-party commercial laboratory in Huntsville, Alabama. Sample vessels were obtained from the independent third-party commercial laboratory, and where required, the sample containers were prepared with proper sample preservation chemicals before being shipped to the BLN site. The independent third-party commercial laboratory is ADEM-certified for conducting drinking water analysis. ADEM does not require laboratory certifications for water sample analyses other than drinking water. However, the analytical procedures that are applied to the BLN surface water samples for total chromium, total copper, and many of the priority pollutants are identical to the procedures used by the independent third-party commercial laboratory when analyzing drinking water samples and are in accordance with 40 CFR Part 136 (Reference 2). To acquire and maintain ADEM drinking water analysis laboratory certification, the independent third-party commercial laboratory was required to develop and maintain instrument calibration procedures, data analysis methods (including statistical methods to interpret results in accordance with 40 CFR Part 136) (Reference 2), and quality assurance/quality control methods, and therefore, complies with the necessary laboratory certification methodologies (see Section 6.6).

The quarterly surface water sampling data provide a baseline of water quality on Guntersville Reservoir in the vicinity of the BLN site and adequately characterize seasonal variations throughout an annual cycle. The data obtained through this sampling program support the environmental descriptions of hydrology, water use, water quality, aquatic ecology, and plant water supply detailed in Chapters 2 and 3.

6.6.1.2 Chemical Groundwater Monitoring

In April 2006, a groundwater investigation program was initiated as part of a subsurface study to evaluate current geologic and hydrogeologic conditions at the BLN site. Seventeen monitoring well clusters (45 wells total) and six aquifer test observation wells were installed from April to June 2006. These wells were developed, and water levels were measured monthly from June 2006 to May 2007. A list of the monitoring wells and relevant installation data are presented in Subsection 2.3.1.5.5 (Table 2.3-20) and FSAR Subsection 2.4.12 (FSAR Table 2.4.12-203). The locations of the groundwater monitoring wells are presented in Figure 2.3-22 and FSAR Figure 2.4.12-212. In addition to the water level measurements, quarterly samples were taken from 10 of the wells and analyzed for a variety of constituents, and the results of the groundwater sampling are presented in Subsection 2.3.1.5.5 (Table 2.3-44).

The groundwater samples were obtained following generally accepted field sampling practices, including the use of clean sampling devices, and clean and pre-prepared sample containers supplied by the laboratory that performs the analysis. The samples were taken on approximately 90-day intervals. Sample preservation and analysis followed the procedures for surface water sampling and analysis. Groundwater samples were submitted in accordance with chain-of-custody protocol to the independent third-party commercial laboratory in Huntsville, Alabama.

6.6.2 CONSTRUCTION MONITORING

A construction monitoring program may be required by ADEM to provide data necessary to assess water quality changes resulting from construction of Units 3 and 4, especially in relation to construction-area stormwater runoff. The land area disturbed by construction of Units 3 and 4 is expected to exceed the 1-ac. limit, requiring a stormwater construction permit in accordance with 40 CFR 122.26 and the ADEM Administrative Code 335-6-12 (References 3 and 4).

If construction monitoring is required by ADEM, the results are compared with the preapplication quarterly surface water and groundwater sampling program discussed in Subsections 6.6.1.1 and 6.6.1.2 and used to detect any deviations from the baseline.

6.6.3 PREOPERATIONAL MONITORING

Because preapplication monitoring was conducted (see Subsection 6.6.1), a preoperational monitoring program is not required. The preapplication monitoring conducted, as detailed in Section 6.6.1, provides (1) a logical extension of both the preapplication/site preparation and construction monitoring programs, (2) an adequate baseline to compare against the operational monitoring program (see Subsection 6.6.4), and (3) the means to measure and quantify any water quality changes resulting from BLN operation.

Wastewaters are generated from preoperational activities, including pressurized hydrotesting, flushing, and cleaning of piping and other BLN equipment. System integrity testing conducted using pressurized water and flushing of piping and other BLN equipment generates various volumes of relatively clean wastewater. The volumes generated depend on the quantity and volume of the piping and other BLN equipment requiring pressure testing and flushing. The wastewaters generated from these activities must meet the limits of the existing NPDES permit.

In some cases, prefabricated piping and other plant equipment is treated with oils and/or protective sealants to prevent damage and rusting during shipping to and handling at the site. Solvent solutions may be used to dissolve protective sealants. The solvents and dissolved sealants are flushed from the piping and other BLN equipment using water. This process generates wastewaters that are captured and retained in designated temporary holding tanks or the lined retention pond for analysis. If the analysis determines that the wastewaters generated are nonhazardous and can be discharged in accordance with the current NPDES permit, they are discharged. Conversely, if the analysis determines that the wastewaters are hazardous or cannot be discharged in compliance with the current NPDES permit, they are retained and sent off-site for treatment at an appropriately permitted treatment facility.

6.6.4 OPERATIONAL MONITORING

The current NPDES permit monitoring requirements provide an operational monitoring program that would have adequately identified the changes in water quality that were expected to result from the operation of Bellefonte Units 1 and 2, and assessed the effectiveness of the related effluent treatment systems. The specific elements of the operational monitoring program were developed in consultation with ADEM and are reflected in the current NPDES permit. Notification of discharges is submitted to ADEM for approval 180 days prior to initiation of discharge and monitoring. The current NPDES permit requires amendment to indicate that discharges through outfall DSN002 and DSN003 are anticipated as a result of operating Units 3 and 4.

Subsection 3.3.1 discusses plant water use and includes details related to water consumption by the various cooling and other water use systems and the discharges from these systems. Subsection 3.3.2 discusses methods of treatment of water used in the plant and discharged back to the Guntersville Reservoir. Subsections 3.3.2.1, 3.3.2.2, and 3.3.2.4, respectively, discuss the chemicals that are injected into the circulating water system, the service water system, and the demineralized water system by the turbine island chemical feed system for treatment. The chemicals added to the circulating water and service water systems maintain a noncorrosive, nonscale-forming condition, and limit biological film formation. Raw water supplied to the demineralized water system is treated by filtration, reverse osmosis units, and an electrodeionization system. These systems use a pH adjustment chemical to adjust the pH of the reverse osmosis influent and a dilute antiscalant to increase the solubility of salts and decrease scale formation on the membranes. Table 3.6-1 lists those chemicals used and residual concentrations within the waste streams discharged from the facility.

Figure 3.3-1 is a water balance summary for BLN, and Table 3.3-1 provides estimates of water use and blowdown discharged to the Guntersville Reservoir from the circulating water system, the service water system, and the demineralized water system. Detailed water use by operating mode (power operation, start up, hot standby, safe shutdown, cold shutdown and refueling) is provided in Table 3.4-2.

Subsection 3.5.1 discusses the liquid radioactive waste management system. Subsection 3.5.1.1 discusses steam generator blowdown. Under normal operating conditions the blowdown is returned to the condensate system. However, if steam generator tube leakage results in significant levels of radioactivity in the steam generator blowdown stream, this stream is first passed through electrodeionization units and then redirected to the liquid radwaste system for treatment before release. In this event, the blowdown stream is directed to one of the waste holdup tanks for processing. From the waste holdup tanks, the blowdown stream is pumped and processed through waste ion exchangers continuously or in batches. The blowdown is then collected in a monitor tank and sampled. The liquid waste is discharged from the monitor tank in a batch operation with the discharge flow rate restricted as necessary to maintain an acceptable concentration when diluted by the cooling tower blowdown discharge flow. The liquid waste is discharged into the Guntersville Reservoir.

Section 3.6 addresses nonradioactive waste systems. Subsection 3.6.1 identifies and quantifies each chemical and biocide added to the receiving water by the discharge stream. Table 3.6-1 shows the chemicals used in each system (for the circulating water, service water, and demineralized water systems), the amount used per year, the frequency of use and the concentration anticipated in the waste stream discharged from two units.

Section 3.6.1.2 further details the system for processing and discharging the steam generator blowdown. The chemicals that are needed to maintain proper operation of the system are injected by the turbine island chemical feed system on an as-needed basis and are not dependent on the modes of operation of the BLN. The chemicals injected into the steam generator blowdown, the amount used per year, the frequency of use, and the concentration in the waste stream are shown in Table 3.6-1.

Subsection 3.6.1.3 discusses the wastewater treatment system. For each unit, the wastewater system (1) collects wastes from system flushing during startup prior to treatment and discharge, (2) collects processes fluids drained from equipment or systems during maintenance or inspection activities, and (3) directs nonradioactive equipment and floor drains wastes to the building sumps and transfers their contents for proper waste disposal. The wastewater system removes oil and/or suspended solids from miscellaneous waste streams generated from the BLN.

6.6.5 REFERENCES

1. Alabama Department of Environmental Management, "National Pollutant Discharge Elimination System Permit, Tennessee Valley Authority, Bellefonte Nuclear Plant, Permit Number AL0024635," November 2004.

2. 40 CFR Part 136, "Environmental Protection Agency: Guidelines Establishing Test Procedures for the Analysis of Pollutants."

3. 40 CFR 122.26, "EPA Administered Permit Programs: The National Pollutant Discharge Elimination System, Stormwater Discharges."

4. Alabama Department of Environmental Management (ADEM), Water Division – Water Quality Program, Volume I, Division 6, Administrative Code 335-6-12, September 19, 2006.

TABLE 6.6-1 (Sheet 1 of 3)
SURFACE WATER QUALITY MONITORING PROGRAM
(EXAMPLE INFORMATION FROM CURRENT NPDES PERMIT)

MONITORING DSN AND DISCHARGES	CONSTITUENTS (units)	MONITORING FREQUENCY	SAMPLE TYPE
DSN002: Impoundment pond discharge consisting of main plant area stormwater runoff, and fire and supply test water, associated with electric power generation[(a)]	Flow (Mgd)	1/Discharge[(b)]	Instantaneous or Estimate
	pH (s.u.)	1/Discharge[(b)]	Grab
	Total Suspended Solids (mg/l)	1/Discharge[(b)]	Grab
	Oil and Grease (mg/l)	1/Discharge[(b)]	Grab
DSN003c: Cooling tower desilting pond effluent, sump collection ponds consisting of building sumps and floor drains, and other miscellaneous low-volume wastewaters	Flow (Mgd)	1/Discharge[(c)]	Instantaneous[(d)]
	pH (s.u.)	1/Discharge[(c)]	Grab
	Total Suspended Solids (mg/l)	1/Discharge[(c)]	Grab
	Oil and Grease (mg/l)	1/Discharge[(c)]	Grab
DSN003d: Cooling tower blowdown	Flow (Mgd)	Daily	Totalized
	Free Available Chlorine (FAC)[(e)] (mg/l)	1/week	Multiple Grabs[(f)] or Recorder
	Total Residual Chlorine (TRC) (mg/l)	1/week	Multiple Grabs[(f)] or Recorder
	Total Chromium (mg/l)	1/6 months	Grab
	Total Zinc (mg/l)	1/6 months	Grab
	Priority Pollutants[(g)] (ug/l)	1/year	Grab
	Time of Chlorine Addition (min/day/unit)	1/week	Logs
DSN003e: Liquid radiation waste[(h)] DSN003f: Condensate demineralizer regeneration wastes[(i)]	Flow (Mgd)	2/week	Calculated[(j)]
	pH (s.u.)	2/week	Grab
	Total Suspended Solids (mg/l)	2/week	Grab[(k)]
	Oil and Grease (mg/l)	2/week	Grab[(k)]
	Total Copper[(l)] (mg/l)	2/week	Grab[(k)]
	Total Iron[(l)] (mg/l)	2/week	Grab[(k)]

(Reference 1)

TABLE 6.6-1 (Sheet 2 of 3)
SURFACE WATER QUALITY MONITORING PROGRAM
(EXAMPLE INFORMATION FROM CURRENT NPDES PERMIT)

MONITORING DSN AND DISCHARGES	CONSTITUENTS (units)	MONITORING FREQUENCY	SAMPLE TYPE
DSN003g: Sump collection ponds discharge consisting of building sumps and floor drains, and other miscellaneous low-volume wastewaters[m]	Flow (Mgd)	1/discharge	Instantaneous or Estimated
	pH (s.u.)	1/discharge[n]	Grab
	Total Suspended Solids (mg/l)	1/discharge[n]	Grab
	Oil and Grease (mg/l)	1/discharge[n]	Grab
	Hydrazine (mg/l)	1/discharge[n]	Grab
DSN003: Diffuser discharge consisting of cooling tower blowdown and other wastewater resulting from electric power generation[o]	Flow (Mgd)	Daily	Instantaneous
	pH (s.u.)	1/week	Grab
	Total Residual Chlorine (mg/l)	Daily	Grab
	Temperature (°F)	Daily	Grab
DSN003: Diffuser discharge consisting of cooling tower blowdown and other wastewater resulting from electric power generation	Flow (Mgd)	Continuous	Totalized or Recorder
	pH (s.u.)	1/week	Grab
	Total Residual Chlorine (mg/l)	Continuous	Recorder or Multiple Grabs[p]
	Temperature (°F)	Continuous	Recorder or Multiple Grabs[p]
	7-Day Chronic Toxicity (%)	1/year	Composite
DSN004: East culvert impoundment discharge consisting of stormwater runoff	Flow (Mgd)	1/discharge[b]	Instantaneous
	pH (s.u.)	1/discharge[b]	Grab
	Total Suspended Solids (mg/l)	1/discharge[b]	Grab
	Oil and Grease (mg/l)	1/discharge[b]	Grab
DSN005: Plant intake trash sluicing consisting of intake screen and strainer backwash, and intake pumping station sumps/ drains	Flow (Mgd)	Daily[q]	Pump logs
	pH (s.u.)	Daily[q]	Grab
	Total Residual Chlorine (mg/l)	Daily[q]	Grab
DSN007: Simulator Training Facility treated sanitary, equipment room floor drains, and laboratory wastewaters	Flow (Mgd)	1/week	Instantaneous
	pH (s.u.)	1/week	Grab
	Total Suspended Solids (mg/l)	1/Month	Grab
	Biochemical Oxygen Demand, 5 day (mg/l)	1/Month	Grab
	Fecal Coliform (col/100 ml)	1/Month	Grab

(Reference 1)

TABLE 6.6-1 (Sheet 3 of 3)
SURFACE WATER QUALITY MONITORING PROGRAM
(EXAMPLE INFORMATION FROM CURRENT NPDES PERMIT)

MONITORING DSN AND DISCHARGES	CONSTITUENTS (units)	MONITORING FREQUENCY	SAMPLE TYPE
DSN008: Simulator Training Facility once-through cooling water, HVAC and atomic adsorption unit condensate, and fire protection system flush water	No Discharge Monitoring Requirements Apply	No Discharge Monitoring Requirements Apply	No Discharge Monitoring Requirements Apply
DSN009-015: Uncontaminated stormwater runoff	No Discharge Monitoring Requirements Apply	No Discharge Monitoring Requirements Apply	No Discharge Monitoring Requirements Apply

(Reference 1)

a) Wastewater from the diluted and concentrated chemical treatment ponds are not authorized for discharge under this outfall. Stormwater from the chemical treatment ponds which has not come in contact with process wastewaters may be discharged in accordance with the requirements of this outfall.
b) Constituents are to be monitored once per discharge, not to exceed once per quarter.
c) Constituents are to be monitored once per discharge, not to exceed once per month.
d) Pump logs are acceptable for flow measurements.
e) Free available chlorine limitations apply at the outlet to the individual unit being chlorinated, if applicable, prior to combining with any other waste stream. Simultaneous multi-unit chlorination is permitted.
f) Total residual chlorine may not be added from any single generating unit for more than 2 hrs. per day unless the discharger demonstrates to ADEM that the discharge for more than 2 hrs. is required for macroinvertebrate control. Total residual chlorine limitations apply at the outlet of the individual unit being chlorinated, prior to combining with any other waste stream or entering the receiving water. When chlorination is occurring, grab samples shall be taken at least every 30 min. to verify compliance with total residual chlorine limitations. Simultaneous multi-unit chlorination is permitted. Sampling is required only during chlorination.
g) Priority pollutants are defined by 40 CFR Part 423 (Reference 6) and are listed in Appendix A, Part IV.C.
h) Radioactive component of this discharge is regulated by the U.S. Nuclear Regulatory Commission.
i) Monitoring requirements and limitations for DSN003f are not applicable when this discharge is directed to DSN003e.
j) Flow may be obtained by summing batch volumes released during a 24-hr. period.
k) Grab samples shall be taken during the discharge of each batch during a 24-hr. period. These grab samples shall be of equal volume and shall be composited and analyzed as one sample.
l) Monitoring requirements and limitations apply during the discharge of metal cleaning wastewaters.
m) Low-volume wastewaters are defined by 40 CFR Part 423.
n) Constituents are to be monitored once per discharge, not to exceed once per week.
o) Due to accessibility restrictions, monitoring for compliance may be conducted at outfall DSN003(d).
p) Multiple grab samples shall be defined as a grab sample taken every 15 min. beginning with the start up of chlorination and ending when TRC is no longer detectable over a 24-hr. period.
q) Effluent limitations and monitoring requirements apply during periods of biocide addition to the intake pump pit.

6.7 SUMMARY OF MONITORING PROGRAMS

This section summarizes the environmental monitoring programs 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 three sections: (1) site preparation and construction monitoring, (2) preoperational monitoring, and (3) operational monitoring. The site preparation and construction, preoperational, and operational monitoring programs, along with sections and subsections where related details can be found, are listed in Table 6.7-1, Summary of Monitoring Programs.

6.7.1 SITE PREPARATION AND CONSTRUCTION MONITORING

Site preparation and construction monitoring requirements for the BLN are fulfilled by the principal ongoing monitoring programs:

- Preapplication thermal monitoring and modeling programs are detailed in Subsection 6.1.1, and include:
  - Anticipated thermal effects of cooling system discharges from operation of the BLN on the Tennessee River were modeled using CORMIX Version 4.3. The details and results of this modeling are provided in Section 5.3.
  - Preoperational baseline thermal monitoring data that were input to the CORMIX model reflect actual Guntersville Reservoir conditions in the vicinity of the BLN site.
- Radiological monitoring during the site preparation and construction phases is detailed in Section 6.2, and includes:
  - Execution of a program that adequately characterizes the radiological environment of the biosphere in the vicinity of the BLN site.
  - Data on measurable levels of radiation and radioactive materials in the site environs providing baseline data on surveillance of principal pathways of exposure to the public.

- Hydrological preapplication and construction monitoring programs are detailed in Subsections 6.3.1 and 6.3.2, respectively. These programs include:
  - Four quarters of surface water sampling, including thermal measurements, have been performed on the Tennessee River.
  - Quarterly measurements of groundwater depth, quality, and flow data have been collected from wells.
  - Groundwater quality, depth, and flow conditions are also monitored to determine the suitability of locating the two units at the site. These data provide input for groundwater models.
  - New observation wells were installed in and around the BLN site to better characterize the site hydrology as discussed in Subsection 6.3.2.
- On-site preapplication and site preparation and construction meteorological monitoring programs for the periods 1975 to 1983 and 2006 to 2007 are detailed in Subsections 6.4.1 and 6.4.2, respectively. These programs include the following:
  - Details and results of a meteorological monitoring program that began October 29, 1975 and terminated on November 1, 1983 are provided in Subsection 6.4.1.
  - Recent meteorological monitoring commenced at the site on April 1, 2006.
  - Meteorological conditions are being monitored to determine the suitability of locating Units 3 and 4 at the site. The observation of temperature, wind, and other parameters provides input for developing statistical meteorological models.
- Monitoring programs for terrestrial ecology and land use are discussed in Subsection 6.5.1 and aquatic ecology is discussed in Subsection 6.5.2. These programs include the following:
  - Responsibility of the Tennessee Valley Authority (TVA) for the ecological monitoring programs associated with TVA power plants or performed on TVA land.
  - Preconstruction studies addressed water quality and aquatic resources surrounding the site to establish an aquatic baseline for subsequent operational evaluation of aquatic impacts.
  - Data on terrestrial resources has been collected and studied by the TVA. An endangered plant habitat survey was performed in January 2007 and determined the acreage to be affected is devoid of rare plant habitat (Section 6.5.1).
  - Survey to determine if endangered pink mucket mussels were residing in Guntersville Reservoir adjacent to the BLN site was conducted in April 2007. No

pink mucket mussels or other listed species were found during the survey (Section 2.4).

- Details in Subsections 4.3.1 and 5.3.1.2 conclude that the impacts of construction and operation of the BLN on terrestrial resources are characterized as SMALL.

- Impacts associated with construction and operation on aquatic resources are identified in Sections 4.3.2 and 5.3, respectively, and are categorized as SMALL.

- Aquatic monitoring currently performed by the TVA within Guntersville Reservoir as part of the reservoir Vital Signs monitoring program is designed to determine community structure as a measure of overall reservoir condition (Section 2.4).

- Four seasons of ecological and fish monitoring were performed by TVA biological staff as a part of other environmental reviews. Ongoing TVA ecological monitoring continues into the foreseeable future.

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

    - Preapplication monitoring program composed of surface water and groundwater monitoring programs that are required under the National Pollutant Discharge Elimination System (NPDES) permit.

    - Surface-water-quality parameters that are included in the current NPDES permit are listed in Table 6.6-1.

    - Quarterly (1 year) surface water samples taken at 10 sample points on Guntersville Reservoir, beginning in June 2006. The quarterly surface water sampling data provide a baseline of water quality on Guntersville Reservoir in the vicinity of the BLN site and adequately characterize seasonal variations throughout an annual cycle.

The site preparation and construction hydrological, meteorological, ecological, and other applicable monitoring programs continue through the construction and preoperational phases of the project.

6.7.2 PREOPERATIONAL MONITORING

The preoperational monitoring programs continue through the preoperational phases of the project. Details of these programs are located in the following sections and subsections:

- Thermal monitoring is addressed in Subsection 6.1.2:

    - The preapplication CORMIX modeling conducted and detailed in Subsection 6.1.1 is also valid and applicable for preoperational monitoring (Section 5.3).

  - Cooling tower blowdown effluents are discharged through the blowdown diffusers. Effluents from Bellefonte Units 1 and 2 infrastructure are directed to the desilting ponds. From there the effluents are discharged to the Tennessee River through the existing outfall and diffuser system (DSN003). Other nonradioactive effluents from the BLN discharge to the WWRB, which then cascades in sequence through Pond A and the construction holding pond, finally discharging from the construction holding pond to Town Creek through a monitored outfall (DSN002).

- Radiological monitoring is addressed in Section 6.2:
  - The preoperational monitoring program is implemented before the BLN begins operation.
  - The duration of the preoperational program for specific media is given in Table 6.2-1.
- Hydrological monitoring is addressed in Subsection 6.3.3:
  - The monitoring is expected to be conducted to establish a baseline for identifying and assessing environmental impacts resulting from BLN operation.
  - The monitoring is used to verify existing hydrologic conditions and substantiate design assumptions related to site hydrology.
  - The construction-phase monitoring may be reduced if it is determined that the construction-phase sampling and monitoring results are adequate to establish the preoperational baseline parameters.
- Meteorological monitoring is addressed in Section 6.4.
- Terrestrial ecology and land use monitoring is detailed in Subsection 6.5.1, and Subsection 6.5.2.1 contains details on monitoring aquatic ecology:
  - To determine whether or not endangered pink mucket mussels were residing in Guntersville Reservoir adjacent to the BLN site, a dive crew surveyed the area in April 2007. The mussels discovered along 22 transects were identified by an on-site malacologist. Only common mussels in low densities were located (Section 2.4).
  - To predict biological impacts of the discharge that include time-temperature relationships, CORMIX modeling results were used (see Section 5.3).
- Chemical monitoring is addressed in Subsection 6.6.3:
  - Because preapplication monitoring was conducted (Subsection 6.6.1), a pre-operational monitoring program is not required.

6.7.3 OPERATIONAL MONITORING

While specific operational monitoring requirements and programs for the BLN 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 is addressed in Subsection 6.1.3:
  - Current NPDES permit establishes routine thermal monitoring of discharges to the Tennessee River and Town Creek.
  - Requirements, limits, and conditions similar or identical to those found in the existing NPDES permit for thermal monitoring are anticipated to also apply for operation of the BLN.
- Radiological monitoring is addressed in Section 6.2 and includes:
  - Collection of environmental samples and determination of concentrations of radioactive constituents in the samples. Samples are taken from stations in the general area of the BLN and from areas not directly influenced by BLN operations.
  - Sampling of air, water, sediment, fish and food products, as well as direct radiation levels.
  - Monitoring of annual total dose contributions to the maximum exposed individual from radioactive emissions and other nearby radioactive sources to determine compliance with 40 CFR Part 190 (Reference 1), annual total dose.
  - Monitoring of on-site worker and off-site populations on a regular basis to ensure that exposures comply with applicable regulations and permit requirements.
  - Reporting of monitoring results in the Annual Radiological Environmental Monitoring Report.
- Hydrological monitoring is addressed in Subsection 6.3.4:
  - Monitoring and subsequent sediment removal from the cooling water system intake channel is anticipated periodically to minimize any impact to the raw water system operation.
  - Commencement of a bathymetric survey of the intake channel is expected following the first year of operation to measure sediment build up and determine future dredging intervals.
  - Monitoring of surface water and groundwater parameters are expected quarterly for the first year of operation, then annually afterwards.

- Modification of the program may occur as improved equipment and analysis methods are developed, or as needed to meet updated regulatory program requirements.

- Meteorological monitoring is addressed in Section 6.4.

- Terrestrial ecology and land use are addressed in Subsection 6.5.1, and 6.5.2 addresses aquatic ecology including:

  - Terrestrial species and habitats that could be adversely affected by BLN operations are monitored according to established procedures.

  - Fish and aquatic species, and habitats that could be affected by the intake or discharge of cooling water or other operational impacts, are sampled and monitored according to established procedures.

- Chemical monitoring is addressed in Subsection 6.6.4, and includes:

  - Discharges made through outfalls that have been assigned discharge serial numbers are monitored for consistency with the NPDES permit. The DSN outfalls are shown in Figure 2.3-26, and Table 6.6-1 lists the surface-water-quality parameters that are included in the current NPDES permit.

  - Monitoring of physical, biological, and chemical attributes may occur as part of the future stormwater pollution prevention plan.

  - Monitoring consistent with requirements specified in the Resource Conservation and Recovery Act (RCRA) (Reference 2) is conducted. New and existing tanks containing oil or hazardous substances are monitored during tank filling operations. Continuous leak detection systems are also monitored according to procedures set forth in the permit. Inspections are performed to verify that hazardous waste is treated, stored, and disposed of in accordance with state and federal regulations (RCRA).

Specific procedures for performing the monitoring and sampling programs are provided in various environmental permits. The permits define the required schedules, locations, procedures, and sampling criteria for each monitoring program. The principal monitoring programs include collecting data on:

- Site meteorological conditions.

- Groundwater flow, depth, and quality.

- Stormwater runoff and water quality monitoring of any applicable water bodies (wetlands and streams), including the Tennessee River.

- Soil monitoring for chemical constituents.

- Ecological surveys of wetlands, and aquatic species and habitats.
- Ecological surveys of terrestrial species and habitats.
- Radiological monitoring.
- Material holding tanks and waste.
- Employee radiological and health monitoring.

A program designed to monitor, identify, and report accidents and employee safety issues is also expected to be implemented. The program data are used to modify work procedures and practices so as to promote a safe working environment.

6.7.4 REFERENCES

1. 40 CFR Part 190, "Environmental Radiation Protection Standards for Nuclear Power Operations."

2. Resource Conservation and Recovery Act, 42 USC 6901 et seq.

TABLE 6.7-1
SUMMARY OF MONITORING PROGRAMS

MONITORING PERIOD	TYPE OF MONITORING	APPLICABLE SECTION/ SUBSECTION FOR ADDITIONAL DETAILS
General	Thermal	6.1
	Radiological	6.2
	Hydrological	6.3
	Meteorological	6.4
	Ecological	6.5
	Chemical	6.6
Site Preparation and Construction	Thermal	6.1.1 (preapplication)
	Radiological	6.2
	Hydrological	6.3.1 (preapplication) 6.3.2 (construction)
	Meteorological	6.4.1 (for the period 1975 to 1983) 6.4.2 (for the period 2006 to 2007)
	Ecological	6.5.1 (terrestrial ecology and land use) 6.5.2 (aquatic ecology)
	Chemical	6.6.1 (pre-application) 6.6.2 (construction)
Preoperational	Thermal	6.1.2
	Radiological	6.2
	Hydrological	6.3.3
	Meteorological	6.4
	Ecological	6.5.1 (terrestrial ecology and land use) 6.5.2.1 (aquatic ecology)
	Chemical	6.6.3
Operational	Thermal	6.1.3
	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