DUKE ENERGY®

J. Ed Burchfield, Jr.
Vice President
Oconee Nuclear Station

Duke Energy
ON01VP | 7800 Rochester Hwy
Seneca, SC 29672

o: 864.873.3478
f: 864.873.5791
Ed.Burchfield@duke-energy.com

RA-18-0112 10 CFR 50.90

August 8, 2018

ATTN: Document Control Desk
U. S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Duke Energy Carolinas, LLC
Oconee Nuclear Station (ONS), Units 1, 2, and 3
Docket Numbers 50-269, 50-270, and 50-287
Renewed Facility Operating License Nos. DPR-38, DPR-47, and DPR-55

Subject: Response to Request for Additional Information Related to Proposed Revisions to the Duke Energy Physical Security Plan
License Amendment Request No. 2018-01, Supplement 1

Duke Energy Carolinas, LLC (Duke Energy) submitted a License Amendment Request (LAR), which proposes to revise the Duke Energy Physical Security Plan for Oconee Nuclear Station, on February 12, 2018. On July 6, 2018, NRC requested Duke Energy to respond to a Request for Additional Information associated with the LAR. The enclosure provides the requested information. The attachments provide supporting documents as needed.

Inquiries on this proposed amendment request should be directed to Sam Adams, ONS Regulatory Affairs Group, at (864) 873-3348.

I declare under penalty of perjury that the foregoing is true and correct. Executed on August 8, 2018.

Sincerely,

J Ed Burchfield

J. Ed Burchfield, Jr.
Vice President
Oconee Nuclear Station

S001A
NRR

Enclosure: Duke Energy Response to NRC Request for Additional Information

Attachments:

1. RAI-9 Response Documents
2. RAI-12 Response Documents
3. RAI-13 Response Documents

cc w/enclosure and attachments:

Ms. Catherine Haney, Administrator, Region II
U.S. Nuclear Regulatory Commission
Marquis One Tower
245 Peachtree Center Ave., NE, Suite 1200
Atlanta, GA 30303-1257

Ms. Audrey Klett, Project Manager
(by electronic mail only)
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Mail Stop O-8G9A
11555 Rockville Pike
Rockville, Maryland 20852

Mr. Eddy Crowe
NRC Senior Resident Inspector
Oconee Nuclear Station

Ms. Lynne Garner, Manager,
(by electronic mail only: garnerld@dhec.sc.gov)
Radioactive and Infectious Waste Management,
Bureau of Land and Waste Management
Department of Health & Environmental Control
2600 Bull Street
Columbia, SC 29201

ENCLOSURE

DUKE ENERGY RESPONSE TO NRC REQUEST FOR ADDITIONAL INFORMATION

Duke Energy Response to NRC Request for Additional Information

NRC RAI Summary Introduction

By letter ONS-2018-014 dated February 12, 2018 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML18046A080), Duke Energy Carolinas, LLC (the licensee) submitted License Amendment Request (LAR) No. 2018-01 for the Oconee Nuclear Station (Oconee). The licensee applied for changes to the Duke Energy Physical Security Plan (PSP) under the provisions of Title 10 of the Code of Federal Regulations (10 CFR) Part 50, "Domestic Licensing of Production and Utilization Facilities," Section 50.90, "Application for amendment of license, construction permit, or early site permit." In its application, the licensee stated that it is voluntarily proposing these changes to further increase the margin of protection for certain associated components and equipment whenever the Standby Shutdown Facility (SSF) is declared inoperable.

The U.S. Nuclear Regulatory Commission (NRC) staff determined that the following requests for additional information (RAIs) are necessary to complete processing of LAR No. 2018-01. The NRC staff emailed a draft of the RAIs to the licensee on May 23, 2018, and had a clarification call with the licensee on June 13, 2018. Based on that call, the NRC clarified draft RAI-14 to explain what it meant by a noise-sensitive receptor. As discussed with you on July 5, 2018, the NRC staff has also since determined that it would send draft RAIs 1 through 9 in a final version (and renumbered) at a later date because the staff identified another potentially related draft RAI for that set. Therefore, draft RAIs 10-26 are renumbered and reordered below. Their content has not changed other than the clarification noted above in RAI-6. As previously discussed with you on July 5, 2018, the NRC staff requests the licensee to respond to the RAIs in this email within 30 days of this email.

RAI-1

The NRC staff requests the licensee to provide an unredacted revision of its no significance hazards consideration and environmental analysis that were provided in the application that can be made publicly available.

Duke Energy Response

No Significant Hazards Consideration

Duke Energy Carolinas, LLC (Duke Energy) has evaluated whether or not a significant hazards consideration is involved with the proposed amendment to Oconee Nuclear Station (ONS) Facility Operating Licenses DPR-38, DPR-47, and DPR-55 by focusing on the three standards set forth in 10 CFR 50.92, "Issuance of Amendment," as discussed below.

1) Does the proposed amendment involve a significant increase in the probability or consequences of an accident previously evaluated?

   Response: No.

The proposed amendment makes changes to the Duke Energy Physical Security Plan (PSP) for Oconee Nuclear Station that include additional protective measures during a specific infrequent short-term operating state as well as a modification that provides additional access restriction. The proposed changes do not modify the reactor coolant system pressure boundary, nor make any physical changes to the facility design, material, or construction standards. The proposed changes do not adversely affect the operation of any safety-related System, Structure, or Component (SSC) or the ability of any safety-related SSC to perform its designed safety function. The probability of a credited design basis accident (DBA) is not affected by this change, nor are the consequences of any credited DBA affected by this change.

2) Does the proposed amendment create the possibility of a new or different kind of accident from any accident previously evaluated?

   Response: No.

   The proposed amendment makes changes to the Duke Energy PSP for Oconee Nuclear Station that include additional protective measures during a specific infrequent short-term operating state as well as a modification that provides additional access restriction. These proposed changes do not alter the plant configuration (no new or different type of equipment will be installed) or make changes in methods governing normal plant operation. The proposed changes do not adversely affect the operation of any safety-related SSC or the ability of any safety-related SSC to perform its designed safety function. The physical change being proposed does not introduce a new failure mode that would inhibit any safety-related SSC from performing its safety function. Therefore, the possibility of a new or different kind of accident from any kind of accident previously evaluated is not created.

3) Does the proposed amendment involve a significant reduction in a margin of safety?

   Response: No.

   The proposed amendment makes changes to the Duke Energy PSP for Oconee Nuclear Station that include additional protective measures during a specific infrequent short-term operating state as well as a modification that provides additional access restriction. These proposed PSP changes do not involve: 1) a physical alteration of the Oconee Units; 2) the installation of new or different equipment associated with plant operations; or 3) any impact on the fission product barriers or safety limits. Therefore, the proposed changes do not involve a significant reduction in a margin of safety.

Based on the above, Duke Energy concludes that the proposed amendment presents no significant hazards consideration under the standards set forth in 10 CFR 50.92(c), and, accordingly, a finding of "no significant hazards consideration" is justified.

Environmental Analysis

Duke Energy Carolinas, LLC, has evaluated this license amendment request against the criteria for identification of licensing and regulatory actions requiring environmental assessment in accordance with 10 CFR 51.21. Duke Energy Carolinas, LLC, has determined that this license

amendment request meets the criteria for a categorical exclusion as set forth in 10 CFR 51.22(c)(9). This determination is based on the fact that the amendment meets the following specific criteria:

- The amendment involves no significant hazards consideration.
- There is no significant change in the types or significant increase in the amounts of any effluent that may be released offsite. The principal barriers to the release of radioactive materials are not modified or affected by this change and no significant increases in the amounts of any effluent that could be released offsite will occur as a result of this change.
- There is no significant increase in individual or cumulative occupational radiation exposure. Because the principal barriers to the release of radioactive materials are not modified or affected by this change, there will be no significant increase in individual or cumulative occupational radiation exposure resulting from this change.

RAIs 2 through 17

In its application, the licensee proposed changes to its PSP, including modifications to physical security structures that may affect the human and natural environment. In accordance with the National Environmental Policy Act of 1969, as amended (NEPA) and NRC's regulations implementing NEPA (i.e., 10 CFR 51), the NRC staff is required to prepare an Environmental Assessment to evaluate the impacts to the human and natural environment from the proposed action. Section 51.41 of 10 CFR states that the NRC staff may require environmental information from an applicant for an amendment to an operating license to aid the NRC staff in complying with NEPA. Sections 5 and 6 of the licensee's application includes an environmental considerations analysis. However, the analysis did not describe details regarding construction activities, the affected environment where construction would occur, and additional information to evaluate the extent and intensity of the impacts from the proposed modifications. In order to comply with NEPA and 10 CFR 51 and to prepare an environmental assessment, the NRC staff requests the following additional information. The NRC staff requests that the licensee provide a publicly available version of the responses.

The following RAIs (2-7) pertain to the type and extent of proposed construction activities.

NOTE: Formal design work and planning has not yet begun for the proposed construction activities. RAI Responses provided are based on conceptual design work and planning.

RAI-2

The NRC staff requests the licensee to provide an overview of the proposed construction activities, including any ground disturbing activities, such as excavation, clearing, and grading, and to describe both the spatial and temporal extent of any ground disturbing activities.

Duke Energy Response

The initial conceptual plan is to provide a floating barrier consisting of multiple segments connected by cabling and anchored by abutments. The abutments, as planned, would be cast in place concrete. The concrete abutments, as planned, would either sit on the ground or be placed in the ground. If the abutments sit on the ground, minor clearing and grubbing would occur before formwork is set. If the abutments are placed in the ground, the area necessary to contain the abutment would be excavated and the earth would act as the formwork. For the abutment on the east side of the river, a temporary construction access would be needed to allow construction vehicles to access the area where the abutment would be built. The time frame for all construction activities is expected to be less than twelve weeks. The total area of ground disturbance is expected to be less than one-tenth of an acre for the permanent installation of the abutments and less than one-half of an acre for the temporary disturbances associated with construction activities.

RAI-3

The NRC staff requests the licensee to describe the construction laydown areas, construction equipment (including the maximum height of equipment), and the duration of construction activities.

Duke Energy Response

Depending on the results of the design, the laydown area would hold formwork and rebar for above ground concrete abutments or rebar and spoil from excavation for an in-ground concrete abutment. It is expected that the laydown area would be less than one-third of an acre and that it would be located on the elevated grassy area to the East of the river. Equipment needed for this type of construction is expected to consist of a rubber tire crane that is less than 100 feet tall when fully extended, one rubber tire front end loader, one excavator, two 10-yard dump trucks and delivery vehicles. Delivery vehicles are expected to be flatbed trucks for delivery of steel and formwork and concrete trucks for the delivery and placement of concrete. The duration of construction activities is expected to be less than twelve weeks.

RAI-4

The NRC staff requests the licensee to discuss whether any chemicals or other contaminants may be used during construction activities.

Duke Energy Response

Based on the conceptual plan and the expected construction equipment to be used, the list of chemicals to be used is expected to include form oils, diesel fuel, fuel oil, gasoline and hydraulic fluid. Duke Energy nuclear fleet procedures which govern the control of chemicals to include labeling, storage, etc. would be utilized for the labeling and control of all chemicals used on the project.

RAI-5

The NRC staff requests the licensee to describe whether any tree cutting would occur.

Duke Energy Response

Based on the conceptual plan, there is no tree cutting expected. If the continued design and planning work should identify a need for tree cutting, Duke Energy nuclear fleet procedures would be followed. These procedures require that a natural resource evaluation be conducted prior to tree cutting. This evaluation ensures compliance with the Duke Energy Special Utility Permit issued by the United States Fish and Wildlife Service (USFWS), the Migratory Bird Treaty Act of 1918, and the Endangered Species Act of 1973.

RAI-6

The NRC staff requests the licensee to provide an estimation of air emissions and noise levels from construction equipment, identify the distance from the construction site to the nearest noise-sensitive receptors (e.g., nearby sensitive receptors such as residences, schools, or nursing homes), and include estimated noise levels at the nearest noise-sensitive receptor.

Duke Energy Response

Based on the equipment expected to be used, as discussed in the response to RAI-3 above, and applying the methodology from the site air permit, it is estimated that air emissions would not exceed 3.5 tons of Nitrogen Oxides (NOx) or 0.75 tons Carbon Monoxide (CO) per month during construction. Similarly, based again on the expected equipment to be used, it is estimated that noise levels from construction equipment would be less than 85dBA. The nearest sensitive noise receptor is a private residence located approximately four-tenths of a mile to the northeast of the construction site. At the aforementioned residence, the noise level contribution from the construction is estimated to be less than 38dBA which is below the normal conversational level of 50dBA.

RAI-7

The NRC staff requests the licensee to describe the extent and composition of any permanent structures that would remain within any waterbodies or on land.

Duke Energy Response

The conceptual plan is to provide floating barriers connected by cable and anchored by abutments. The floating barriers would be permanent and would float on top of the water's surface. When the water is low, some of the floating barriers would rest on each bank of the river. The abutments, as planned, would be cast in place concrete. The abutments, as planned, would either sit on the ground or be placed in the ground. In either case the abutments would be permanent structures that would remain.

The following RAIs (8-13) pertain to the baseline environmental resources that exist in the area where the construction activities may impact the natural and human environment.

RAI-8

The NRC staff requests the licensee to provide an overview of the human and natural environment in the area where the proposed modifications would occur.

Duke Energy Response

The area where the proposed modifications would occur is located within the owner controlled area of the Oconee Nuclear Station (ONS) site along the Keowee river. The land consists of an elevated grassy area with low brush on the east side of the river and rip-rap on the west side of the river. There is no current activity at the proposed location, such as parking lot or office area. There are no known habitats within the area. There are no identified wetlands or environmentally sensitive areas in the proposed location.

RAI-9

The NRC staff requests the licensee to provide a copy of any natural resource studies that have been conducted to characterize the environmental resources on the Oconee Nuclear Station site since publication of the NRC's Generic Environmental Impact Statement for License Renewal of Nuclear Plants: Oconee Nuclear Station, Units 1, 2 & 3 - Final Report (NUREG-1437, Supplement 2) (December 1999).

Duke Energy Response

The following natural resource studies are being provided in Attachment 1:

1. Oconee Nuclear Station SWPPP Spoil Project Ecological Assessment Summary February 5, 2013;
2. Oconee Nuclear Station Fukushima FLEX Building Project Ecological Assessment Summary Report April 25, 2014; and
3. Listed Species Assessment ISFSI Phase IX Expansion July 20, 2015.

RAI-10

The NRC staff requests the licensee to describe the occurrence of any known State- or Federally-listed species within or near the Oconee Nuclear Station site.

Duke Energy Response

There are no known State or Federal listed species within the Owner Controlled Area. The April 25, 2014, Ecological Assessment provided in response to RAI-9 identifies four Rare, Threatened, and Endangered (RTE) species known to exist near the site. The RTE species identified are: 1) Loose-flowered Sedge, 2) Dropping Sedge, 3) Indian Olive, and 4) Three-parted Violet.

RAI-11

The NRC staff requests the licensee to describe any known cultural resources located within the proposed construction area and on the Oconee Nuclear Station site.

Duke Energy Response

There are no known cultural resources located within the proposed construction area. There is a cemetery located within the ONS Owner Controlled Area near the entrance to the site. As noted in the Oconee Environmental Report submitted as part of the License Renewal Application, Volume IV, Exhibit D, Section 4.12, there are no historic properties on the ONS site. There is one historic property, the Old Pickens Church (and cemetery), located within the 1-mile radius of the ONS site.

RAI-12

The NRC staff requests the licensee to clarify whether there have been any updates to the "Keowee-Toxaway Fishery Resources Ten-Year Work Plan: January 1996-December 2005," that was established between South Carolina Department of Natural Resources and Duke Power Company.

Duke Energy Response

There have been two new versions of the Ten-Year Work Plan issued. One is a January 2006-December 2015 Keowee-Toxaway Fishery Resources Work Plan. The other version is a January 1, 2017-July 31, 2027 Bad Creek Fishery Resources Work Plan. Both are included in Attachment 2 of this response.

RAI-13

The NRC staff requests the licensee to provide a copy of the following documents, if available: (a) South Carolina Department of Natural Resources and Duke Power Company. 1996. Keowee Toxaway Fishery Resources, Ten Year Work Plan, January 1996-December 2005 (20pp); and (b) the biological survey conducted in June 1998 by Dr. L.L. Gaddy in support of the License Renewal Application for Oconee Nuclear Station.

Duke Energy Response

The January 1996-December 2005 Ten Year Work Plan and the June 1998 survey completed by Dr. Gaddy are included in Attachment 3 to this response.

RAI-14

The NRC staff requests the licensee to describe the minimum distance between the construction laydown areas to nearby wetlands or other "natural areas" that were surveyed in 1998 in connection with the Environmental Report for the License Renewal Application for Oconee Nuclear Station.

Duke Energy Response

The 1998 natural areas shown in the Environmental Report are provided in Figure 4.6-1 Location of State Listed Rare, Threatened or Endangered Species at Oconee Nuclear Station (see page 4-35). Based on this drawing, Natural Area 1 and 4 are approximately half of a mile from the proposed construction laydown area. These natural areas would not be impacted by the construction.

RAI-15

The NRC staff requests the licensee to describe any measures that will be taken to reduce erosion or run off into aquatic habitats.

Duke Energy Response

Per Duke Energy nuclear fleet procedures, the project design would include a detailed erosion and sedimentation control plan. This plan will be prepared in accordance with South Carolina Department of Health and Environmental Control (SCDHEC) permitting requirements. These plans typically will include locations of silt fencing, locations of spoils areas, construction entrances and sequence of construction. Other details can include minimum inspection frequency, seeding and vegetation plans, and protection of any catch basins in the work zone. The plan will also include other details required to reduce erosion. The erosion control plan will be based on the size of the project.

RAI-16

The NRC staff requests the licensee to provide a summary description of administrative controls and environmental procedures in place for management of cultural resources ahead of future ground-disturbing activities. The NRC staff also requests the licensee to describe how inadvertent cultural resource discoveries will be treated

Duke Energy Response

The Duke Energy nuclear fleet procedure for land disturbing activities requires work to halt upon the discovery of any archeological material. This includes pottery, arrowheads, and bones. Anytime these items are identified, the work is required to stop and the group performing the land disturbing activities is required to immediately notify the site Environmental Field Services group. Environmental personnel are then required to engage the appropriate State agencies to determine the appropriate actions to be taken prior to resuming work activities.

RAI-17

The NRC staff requests the licensee to describe any mitigation measures that the licensee may implement to reduce the environmental impacts from the proposed modifications.

Duke Energy Response

The project will be constructed in a manner to minimize the environmental impact. These measures will include the appropriate erosion control methods to prevent silt and sediment from reaching the water during construction. Chemicals and oil filled equipment will be stored in temporary berms to collect any spillage that may occur. One measure that will be taken to reduce the environmental impact will be the fueling of equipment and vehicles by personnel from the site garage rather than the contractor. This ensures that the fueling will be conducted by trained individuals that will ensure that spills are minimized while equipment fueling occurs.

ATTACHMENT 1

RAI-9 RESPONSE DOCUMENTS

1. Oconee Nuclear Station SWPPP Spoil Project Ecological Assessment Summary February 5, 2013
2. Oconee Nuclear Station Fukushima FLEX Building Project Ecological Assessment Summary Report April 25, 2014
3. Listed Species Assessment ISFSI Phase IX Expansion July 20, 2015

ATTACHMENT 1 DOCUMENT 1

OCONEE NUCLEAR STATION SWPPP SPOIL PROJECT ECOLOGICAL ASSESSMENT SUMMARY FEBRUARY 5, 2013

ATTACHMENT 2 DOCUMENT 1

KEOWEE-TOXAWAY FISHERY RESOURCES WORK PLAN: JANUARY 2006 - DECEMBER 2015

Bad Creek Hydroelectric Project

FERC No. 2740

Article 32(b)(1)

KEOWEE-TOXAWAY FISHERY RESOURCES WORK PLAN
JANUARY 2006 - DECEMBER 2015
SOUTH CAROLINA DEPARTMENT OF NATURAL RESOURCES
AND
DUKE POWER, A DIVISION OF DUKE ENERGY CORPORATION

SOUTH CAROLINA DEPARTMENT OF NATURAL RESOURCES

John E. Frampton, Director

Date: 12-16-05

DUKE POWER

William F. Hall, III
Vice-President – Fossil / Hydro Generation

Date: 12-21-05

KEOWEE-TOXAWAY FISHERIES RESOURCES

W0RK PLAN (JANUARY 2006 - DECEMBER 2015)

INTRODUCTION

The following studies, habitat protection/enhancements, and other activities are considered important to the successful management of the Keowee-Toxaway fishery resources. Many of the activities (e.g., trout habitat monitoring, gill-net surveys, electrofishing surveys, hydroacoustic surveys and creel surveys) have been ongoing for years and are the basis of establishing high quality and unique fisheries in South Carolina. Other activities will provide new types of information that will help manage these fisheries.

This work plan is the second to be developed under the Keowee-Toxaway Fishery Resources Memorandum of Understanding. The studies and other activities in this plan will all be jointly planned by the South Carolina Department of Natural Resources ("SCDNR") and Duke Power ("DP") team that have worked cooperatively over the years on the Keowee-Toxaway fishery resources. This team will coordinate and carry out these activities, involve third parties as needed, plan activities, and schedule and carry out an annual review of the status of activities.

All monetary values included in this MOU are based upon 2006 dollars. These amounts will be adjusted annually based upon the consumer price index.

Item 1: Agreement on Fish Entrainment at the Jocassee Pumped Storage Station

Lakes Jocassee and Keowee support robust fish populations. These populations were monitored by Duke Power and the SCDNR during the first ten-year work plan. While the extent of fish entrainment at the Jocassee Station is not currently documented, results of the monitoring have not identified any population level problems. The monitoring will continue in this work plan.

Work Plan

- DP and the SCDNR will continue to cooperatively monitor the fishery in lakes Jocassee and Keowee as described in Items 3, 5, 6 and 7.
- DP and SCDNR will annually review the results of the monitoring. If any significant changes are observed in fish populations in Lake Keowee or Lake Jocassee, DP and the SCDNR will meet to determine the cause of the changes and any necessary measures to correct them.

Function

DP and the SCDNR agree that these provisions should adequately protect the fisheries. A more thorough study of entrainment impacts may be conducted concurrent with relicensing of the Jocassee Pumped Storage Station.

Item 2: Agreement on Minimizing Fish Entrainment via Bad Creek Pumped Storage Project

DP and the SCDNR have worked cooperatively to evaluate fish entrainment at the Bad Creek Station. Site-specific studies provided information that identified operational periods associated with low and high entrainment rates, and this information was used to develop the operational guidelines presented in the work plan.

Work Plan

- During this work plan period, DP will operate its facilities to minimize, to the extent possible, the period during which Lake Jocassee pool elevations are below 335 m (1099 ft) MSL.
- When pool elevations in Lake Jocassee fall below 335 m (1099 ft) MSL [3.4 m (11) ft below full pool], DP will implement operational changes, based upon unit availability and other operational considerations, to minimize fish entrainment. These operational protocols were developed during the previous work plan and include turning off lights near the intake so as not to attract fish to the area and utilizing a unit startup and shutdown sequence that minimizes fish entrainment. These operational protocols may continue to evolve as additional information is gathered.
- If the pool elevation in Lake Jocassee falls below 335 m (1099 ft) MSL and is projected to remain below this level for 30 consecutive days, DP will notify the SCDNR. After such notification, DP will notify the SCDNR when the pool elevation rises above 335 m (1099 ft) for 7 consecutive days. No additional notifications to the SCDNR will be necessary if pool elevations fluctuate above and below 335 m (1099 ft) unless DP has previously notified the SCDNR the lake elevation rose above 335 m (1099 ft) for 7 consecutive days. If pool elevations are projected to remain below 335 m (1099 ft) MSL for 60 consecutive days, DP will initiate consultation with the SCDNR and the US Fish and Wildlife Service to determine if additional measures to minimize impacts are appropriate.

Function

- Minimize entrainment related to the operation of Bad Creek Hydroelectric Station during pump back operations.
- Establish communications protocols between DP and the SCDNR during low water periods.

Item 3: Cost Share for Fishery Enhancements and Studies

Both Lake Jocassee and Lake Keowee are recognized as important fisheries in the Upstate region. In addition, the SCDNR has established and manages a trout fishery in Lake Jocassee that is unique in South Carolina.

Work Plan

Depending on the specific activities proposed in the work schedule, DP will provide at least $190,000 and no more than $224,000/year to the SCDNR for use in enhancing fishery resources and conducting fishery studies in Lake Keowee, Lake Jocassee and tributaries to Lake Jocassee. This funding will provide for the following activities to be implemented by the SCDNR:

- Jocassee Creel Survey once every three years beginning in 2006 (i.e., 2006, 2009, 2012, and 2015);
- Keowee Creel Survey once every three years beginning in 2008 (i.e., 2008, 2011, and 2014);
- Annual trout stocking; and,
- At least two applied fishery research or monitoring studies or special management projects to be determined by the SCDNR in consultation with DP. Possible studies include but are not limited to the following:
  - Research study modeling historic water quality (habitat), environmental factors, hydro operations, etc. and relationships with fish population and fishery indices in Lake Jocassee;
  - Mortality studies of trout in Lake Jocassee and modeling of regulation scenarios;
  - Mortality studies of black bass in Lake Jocassee and Lake Keowee.

This funding may also be utilized for the purchase of supplies and equipment, special fishery research efforts and other activities identified by the SCDNR as beneficial to the fishery resources of Lake Jocassee and Lake Keowee. Funding for aforementioned work may be reallocated to address more pertinent or unforeseen fishery monitoring or management needs if mutually agreed upon by DP and the SCDNR. This funding may be used to hire SCDNR personnel to conduct or manage projects and for administrative support.

The creel survey schedule outlined above may be modified with the agreement of both the SCDNR and DP.

The SCDNR will provide DP copies of study reports prepared in conjunction with the annual funding.

Function

- Help ensure trout are available for maintaining the quality fishery in Lake Jocassee.
- Provide vital information on fishing effort, catch and harvest of sportfish as well as socioeconomic data.
- Use study data to formulate stocking strategies, size and creel limits, and to monitor potential impacts of commercial uses of the reservoir (i.e., power production) on the fishery.

Item 4: Agreement on Maintaining Adequate Pelagic Habitat in Lake Jocassee

DP and the SCDNR have worked cooperatively since 1973 to obtain a continuous and systematic database on trout habitat in Lake Jocassee and the factors that influence its horizontal and vertical distribution. A detailed understanding of habitat factors, including the roles of pumped storage operations and winter stored oxygen, has been gained. This understanding has led to the development of a model ("the Jocassee model") that can be used to predict late summer trout habitat thickness in the main body of the reservoir.

Work Plan

- During this work plan period, DP will continue to work in cooperation with the SCDNR to help ensure the presence of trout habitat in Lake Jocassee.
- DP will continue to carry out appropriate field studies on the vertical and horizontal distribution of trout habitat in Lake Jocassee. The program will include monthly measurements of temperature and dissolved oxygen profiles at 10 locations throughout the reservoir. If different or additional data are needed to refine the Jocassee model, these study details will be determined jointly with the SCDNR.
- Projections of late summer trout habitat thickness, defined as water ≤ 20 °C containing ≥ 5 mg/l DO, based on the Jocassee model will be reviewed with the SCDNR during the preceding May. Actual late summer data will be reported to the SCDNR in October of each year.
- Based on field data and the Jocassee model, DP and the SCDNR will work to protect trout habitat in Lake Jocassee. To help prevent operations from causing excessive habitat degradation, DP will do the following:
    - Employ the Jocassee trout habitat model and provide the September habitat prediction for the current year to the SCDNR and DP managers by 15 May.
    - If the model indicates a September habitat thickness of ≤ 10 m, DP will initiate bimonthly measurements of temperature and DO to monitor habitat conditions and update the actual rate of habitat depletion. These data will be shared with the SCDNR and DP managers in a timely manner.

The Jocassee model and additional monitoring will allow DP early notification and management flexibility, during rare critical habitat years, to ensure that hydro operations will not decrease trout habitat less than a 5-meter minimum thickness (habitat defined by temperatures $\leq 20°$ C and dissolved oxygen ≥ 5 mg/l criteria).

Function

This effort will provide an active and cooperative system that will help ensure the successful continuance of the trophy trout fishery in Lake Jocassee. Lake Jocassee provides the only trophy trout fishing and reservoir trout fishing opportunity in SC. These opportunities are also extremely limited across the southeast region. Monitoring and implementation of the DP habitat model will help ensure the continued compatibility of hydroelectric operations and maintenance of important fishery resources.

Item 5: Keowee and Jocassee Creel Surveys following Jocassee Runner Upgrade

Creel surveys have been conducted on Lake Jocasee and Lake Keowee since the development of the lakes. This long-term monitoring effort provided the means to assess angler fishing success, fishing pressure and socioeconomic effects of fishing on the region over a 20-year time period.

Work Plan

- DP will provide $54,000/year for additional creel surveys not identified in the schedule for Item 3 following completion of an upgrade of all four turbine runners at the Jocassee Station. Creel surveys on both lakes will be conducted for three consecutive years beginning the second full year after completion of the upgrade of all four runners. The creel survey methodology will be consistent with the other creel surveys conducted as part of this work plan.

  Following the three consecutive years of surveys, no creel surveys will be conducted for two years. Creel surveys will then be conducted on each lake once every three years with the first survey taking place on Lake Keowee.

- The SCDNR and DP will provide copies of study reports prepared in conjunction with this effort to one another.

- The SCDNR will administer the creel surveys if it chooses.

Function

- Provides vital information on angler success along with information on fishing effort, catch and harvest of sportfish as well as socioeconomic data.

- Will provide effective monitoring of the fishery to assess major impacts to the Lake Keowee and Lake Jocassee fisheries following runner upgrades.

Item 6: Hydroacoustic Monitoring of Small Pelagic Fish (Jocassee, Keowee)

During the first work plan period, hydroacoustic monitoring of fish populations was initiated to assess pelagic prey fish abundance and distribution in these reservoirs. As these fish provide prey for sportfish, understanding their relative abundance is important to assessing the overall quality of the fisheries in both lakes.

Work Plan

DP will provide funding and conduct this monitoring work. DP will provide the SCDNR copies of study reports prepared in conjunction with this activity.

This monitoring is scheduled annually (spring and fall) throughout the planning period.

Function

Based on the results of the Bad Creek entrainment study, entrainment impacts mostly small pelagic prey fish in these reservoirs. The collection of these data will allow effective on-going monitoring of these populations which are the primary food of trout and other predatory sport fish in Lake Jocassee and Lake Keowee.

Item 7: Electrofishing of Littoral Fish Populations (Jocassee and Keowee)

Electrofishing to assess the status of littoral fish populations in these reservoirs was conducted once every three years during the previous work plan period. Since littoral fish contribute significantly to the fisheries of these reservoirs, it is important to monitor their abundance, growth, and relative weight at regular intervals.

Work Plan

- DP will conduct this work.
- This monitoring is scheduled to occur once every three years (2008, 2011, and 2014) of the work plan period.
- DP will provide the SCDNR copies of study reports prepared in conjunction with this activity.

Function

Even though littoral fish are impacted less than pelagic fish, they are entrained and their spawning can be impacted by weekly water level fluctuations associated with pumped storage operations. These data allow effective monitoring of littoral sportfish populations (e.g., largemouth bass, spotted bass, smallmouth bass, redeye bass and bluegills) in these reservoirs.

Item 8: Stream Surveys

Streams flowing into Lake Jocassee and Lake Keowee provide critical habitat for a number of important fish species. DP and the SCDNR conducted stream surveys jointly during the previous work plan period.

Work Plan:

- One or more streams may be surveyed each year, as determined by the SCDNR.
- DP will assist the SCDNR in their ongoing efforts to survey fish populations in tributaries of lakes Jocassee and Keowee as staff availability allows.
- SCDNR will coordinate this effort.

Function

Maintain a database on tributary fish populations (e.g., Whitewater River) for use in developing future fish management strategies.

Item 9: Erosion Control Work

There are numerous unpaved roads within the Jocassee Gorges. Erosion from these roads can negatively impact the fishery.

During the first work plan period, many of these roads were owned by Duke Power. As a result of the Jocassee Gorges initiative, most of these roads are now owned by South Carolina and managed by the SCDNR. DP still needs to access portions of some of these roads in order to maintain the transmission lines and the Foothills Trail. The SCDNR maintains other roads for public access and property management activities. On-going maintenance of such roads is necessary to ensure that they meet the requirements of the South Carolina Department of Health and Environmental Control (SCDHEC).

Work Plan

- DP and the SCDNR will work together to develop an agreement regarding the management of roads in the Jocassee Gorges.
- This agreement will address management of roads such that they are in compliance with SCDHEC requirements.
- DP and the SCDNR will also work together to involve other property owners in cooperating on the management of roads within the Gorges.

Function

Protect/enhance water quality and habitat factors in headwater trout streams at Keowee-Toxaway.

Item 10: Lower Eastatoe Creek Management and Angler Access

The Lower Eastatoe Creek provides excellent fishing opportunities. The initial work plan called for DP and the SCDNR to work cooperatively to provide for angler access to the area and access for the hatchery trucks for stocking. The focus of this work plan period will be on enhancing the access facilities currently provided by DP. These areas are known as the "Upper Powerline Parking Area" and the "Dug Mountain Access Area."

Work Plan

- DP will provide and maintain access for the hatchery trucks at the Upper Powerline Parking Area and Dug Mountain Access Area.
- DP will ensure that the Upper Powerline Parking Area and the trail to the Eastatoe Creek are maintained.
- DP will enhance the existing parking lot at the Dug Mountain Access Area and construct a Handicapped Accessible Fishing Platform at the site by December 31, 2006.
- DP and the SCDNR will work cooperatively to involve additional partners in the planning and on-going management of the angler access areas. Potential partners include Trout Unlimited, homeowners groups and adjacent property owners.

Function

These activities will provide additional angler access to the Eastatoe Creek. Additionally, the development of partnerships to manage the sites will ensure that the sites have frequent on-site management activities.

Item 11: Agreement to Manage Property around Lake Jocassee

DP's Keowee-Toxaway Land Use Plan developed in 1983, prohibited development of company lands around Lake Jocassee. In keeping with that plan, DP and the SCDNR have worked cooperatively on the management of lands around Lake Jocassee. This cooperation led to the Jocassee Gorges Project which resulted in the transfer of more than 50,000 acres of property to the public. DP, consistent with its FERC license to operation the Keowee-Toxaway Project, which includes Lake Jocassee, is required to protect and enhance the scenic, recreational and environmental values of the project. Shoreline management planning addresses the management of lands within the FERC project boundary.

Work Plan

- Duke Power will develop a Shoreline Management Plan (SMP) for Lake Jocassee. Development of the SMP is targeted to be completed by the end of 2006.

- Duke Power will consult with the SCDNR, the USFWS and others during the development of the SMP to ensure that the plan is consistent with protecting and enhancing the scenic, recreational and environmental values of the project.

Function

Shoreline management planning at Lake Jocassee will provide for the protection of scenic, recreational and environmental values.

ATTACHMENT 2 DOCUMENT 2

BAD CREEK FISHERY RESOURCES WORK PLAN: JANUARY 1, 2017 - JULY 31, 2027

Bad Creek Pumped Storage Project
FERC No. 2740
License Article 32(b)(l)

FISHERY RESOURCES WORK PLAN

JANUARY 1, 2017 - JULY 31, 2027

SOUTH CAROLINA DEPARTMENT OF NATURAL RESOURCES

AND

DUKE ENERGY CAROLINAS, LLC

South Carolina Department of Natural Resources

Date: 12-8-2016

Alvin A. Taylor
Director, South Carolina Department of Natural Resources

Duke Energy Carolinas, LLC

Date: 12/5/2016

Steven D. Jester
Vice President, Water Strategy, Hydro Licensing and Lake Services

Revised: December 2, 2016

BAD CREEK FISHERY RESOURCES
WORK PLAN (JANUARY 1, 2017 – JULY 31, 2027)

INTRODUCTION

A license to operate the Bad Creek Pumped Storage Project (Project) for 50 years was issued by the Federal Energy Regulatory Commission (FERC) to Duke Power Company (now Duke Energy Carolinas, LLC; Duke Energy) on August 1, 1977. License Article 32 required Duke Energy to file a revised Exhibit S within one year of license issuance. Exhibit S of the license application addressed fish and wildlife protection, mitigation and enhancement (PM&E) measures. Revised Exhibit S was to include a) a detailed wildlife mitigation plan; b) an outline of studies to be conducted to assess project effects on 1) fish entrainment and resultant mortality, 2) coldwater fish habitat in Lake Jocassee, and 3) trout migration, spawning and rearing; and c) a detailed mitigation plan with proposed measures to be taken by Duke Energy to mitigate the adverse impacts of Project operations on Lake Jocassee and stream fisheries. Studies to address Article 32(b)(1) were to be conducted at the beginning of Project operations and results filed within three years of the commencement of project operation. Duke Energy developed the revised Exhibit S in consultation with the South Carolina Wildlife and Marine Resources Department (now South Carolina Department of Natural Resources; SCDNR), and on August 15, 1979, FERC issued an Order approving the revised Exhibit S.

As a result of the fish entrainment and mortality studies conducted under Article 32(b)(1), a Memorandum of Understanding (MOU) for the Keowee-Toxaway Fishery Resources (now known as the Bad Creek MOU) was developed between Duke Energy and SCDNR. This agreement, signed in 1996, describes a cooperative framework and directs planning and management efforts towards fisheries management in lakes Keowee and Jocassee and their tributaries for the term of the Project license and recognizes the commitment that both SCDNR and Duke Energy have made to maintain the high quality fisheries found in these reservoirs and streams. The Bad Creek MOU identified a number of eligible activities that included fisheries surveys and inventories, water quality and other habitat evaluations, stocking, angler access improvements, youth fishing rodeos, and impact assessments.

Under the Bad Creek MOU, 10-year work plans were developed and implemented during 1996-2005 and 2006-2015, and a wide variety of studies and management activities were conducted. Several activities conducted under previous work plans of the Bad Creek MOU were identified as PM&E measures appropriate for transfer to the Keowee-Toxaway Hydroelectric Project (FERC No. 2503) and are now addressed under the Keowee-Toxaway Relicensing Agreement associated with the FERC license issued in 2016. These included an agreement on measures to reduce fish entrainment at the Jocassee Pumped Storage Station, an agreement to maintain pelagic trout habitat in Lake Jocassee and an agreement to maintain the lower Eastatoe Creek angler access area. The work conducted by both Duke Energy and SCDNR during the past 20 years under the Bad Creek MOU has contributed directly to the enhancement of the resources, through activities such as annual trout stocking and access improvements, and provided additional information with which to better understand the aquatic resources in lakes Keowee and Jocassee.

Per the Bad Creek MOU, activities may include a wide variety of actions including, but not limited to, trout stocking, population monitoring, habitat monitoring, habitat protection and enhancement, fisheries studies, and other activities considered important to the successful management of the Keowee-Toxaway area fishery resources. All studies and other activities identified in this plan will be jointly planned by Duke Energy and the SCDNR team that has worked cooperatively over the years on the Keowee-Toxaway fishery resources.

Item 1: Agreement on Minimizing Fish Entrainment via Bad Creek Pumped Storage Project

Duke Energy and the SCDNR have worked cooperatively to evaluate fish entrainment at the Bad Creek Pumped Storage Station. Site-specific studies provided information that identified operational periods associated with low and high entrainment rates, and this information was used to develop the operational guidelines presented in the work plan.

Work Plan

During this work plan period, Duke Energy will operate its facilities to minimize, to the extent practicable, the period during which Lake Jocassee pool elevations are below 335 m (1099 ft) above mean sea level (AMSL) (i.e., 89 ft local datum with the full pond elevation of 1110 ft AMSL referenced as 100.0 ft local datum). When pool elevations in Lake Jocassee fall below 335 m (1099 ft) AMSL [89 ft local datum], Duke Energy will implement operational changes, based upon hydro unit availability and other operational considerations, to minimize fish entrainment[1]. These operational protocols were developed during the original work plan and include turning off lights near the intake so as not to attract fish to the area and utilizing a unit startup and shutdown sequence that minimizes fish entrainment. These operational protocols may continue to evolve as additional information is gathered.

If the pool elevation in Lake Jocassee falls below 335 m (1099 ft) AMSL [89 ft local datum] and is projected to remain below this level for 30 consecutive days, Duke Energy will notify the SCDNR. After such notification, Duke Energy will notify the SCDNR when the Jocassee pool elevation rises above 335 m (1099 ft) AMSL [89 ft local datum] for seven (7) consecutive days. No additional notifications to the SCDNR will be necessary if Jocassee pool elevations fluctuate above and below 335 m (1099 ft) AMSL [89 ft local datum] unless Duke Energy has previously notified the SCDNR the lake elevation rose above 335 m (1099 ft) AMSL [89 ft local datum] for seven (7) consecutive days. If Jocassee pool elevations are projected to remain below 335 m (1099 ft) AMSL [89 ft local datum] for 60 consecutive days, Duke Energy will initiate consultation with the SCDNR and the US Fish and Wildlife Service to determine if additional measures to minimize impacts are appropriate.

Function

[1] Protocols include turning lights off and implementing a start-up and shut-down pumping sequence at Bad Creek Pumped Storage Station. The pumping protocol includes bringing Unit 4 on first and then Units 2, 3 and 1 sequentially. Unit order is reversed during the shutdown sequence.

Minimize entrainment related to the operation of Bad Creek Pumped Storage Station during pump back operations.

Establish communications protocols between Duke Energy and the SCDNR during low water periods.

Item 2: Hydroacoustic Monitoring of Small Pelagic Fish in Jocassee and Keowee

Hydroacoustic monitoring of fish populations began in 1997 in Lake Jocassee and in 1999 in Lake Keowee by Duke Energy to assess pelagic prey fish abundance and distribution in the reservoirs. Pelagic fish (threadfin shad and blueback herring) comprise the primary prey for trout and other sportfish and understanding their relative abundance is important to assessing the overall quality of the fisheries in both lakes.

The extensive database developed under this work item will be very helpful in monitoring Project impacts to pelagic prey species associated with entrainment mortality resulting from Bad Creek operations, including the new runner upgrades planned for installation, and this sampling program should be continued through this work plan.

Work Plan

- Duke Energy will provide resources and conduct this monitoring work.
- This monitoring is scheduled annually, and sampling will be conducted in the fall on both lakes Jocassee and Keowee through 2027.
- Duke Energy will provide the SCDNR copies of study reports prepared in conjunction with this activity.

Function

The collection of these data will allow effective on-going monitoring of forage populations which are the primary food of trout and other predatory sportfish in Lake Jocassee and Lake Keowee. These data will also be used to detect any noticeable changes in pelagic species as a result of runner upgrades at Bad Creek Pumped Storage Station.

Item 3: Electrofishing of Littoral Fish Populations in Jocassee and Keowee

Duke Energy has monitored littoral fish populations in Lake Keowee since 1972 and Lake Jocassee since 1974 to provide a fish community assessment. Electrofishing is used to assess the status of littoral fish populations in these reservoirs. Littoral fish populations include important sportfish such as largemouth, spotted and smallmouth bass, and other sunfish; and other species that are important prey, such as sunfish, cyprinids, clupeids, and others. Catch-per-unit-effort (numbers of individuals/3,000 m and weight (kg)/3,000 m), numbers of species, and condition for largemouth and spotted bass was determined for each sampling area. Sampling was conducted in the spring once every three years in the previous work plans.

It is important to continue this monitoring effort because the results can be used to 1) determine species composition and to detect changes; 2) obtain catch per unit effort data (i.e. numbers per hour) that may be used to detect increasing or decreasing population trends; and 3) evaluate the relative condition of largemouth and spotted bass. For these reasons, this work should be continued through this work plan.

Work Plan

- Duke Energy will conduct this work.
- Duke Energy will provide the SCDNR copies of study reports prepared in conjunction with this activity.
- This monitoring will continue every three years (2017, 2020, 2023 and 2026) of the work plan period.
- No changes in the sampling design will be made for Lake Jocassee.
- Sampling on Lake Keowee will follow the current Oconee Nuclear Station sampling design with data provided to SCDNR.

Function

This survey provides data to describe and characterize the littoral fish populations (e.g., sunfish, minnows, suckers, catfish, etc.) in lakes Keowee and Jocassee. The data includes species composition and estimates of standing stocks, age and growth, and condition (largemouth and spotted bass), which is information needed to monitor fish populations and establish harvest regulations to maintain a sustainable fishery.

Item 4: Cost Share for Trout Stocking

Lake Jocassee is recognized as a regional trout fishery, and maintaining this fishery is an important interest of SCDNR. In partnership with Duke Energy, the SCDNR has established and manages a trout fishery in Lake Jocassee which is unique in South Carolina. This fishery is supported by annual stocking of trout produced at the SCDNR Walhalla Fish Hatchery.

Work Plan

- Duke Energy will provide $80,000 (in 2017 dollars) per year to the SCDNR for use in growing and stocking trout in Lake Jocassee and tributaries to Lake Jocassee. This funding will begin in 2017 and continue through 2027 and will be adjusted annually based on the Consumer Price Index.

- This funding may be utilized for all activities involved with rearing and stocking trout and hatchery maintenance.

- The SCDNR will provide Duke Energy with a written summary of stocking activities at the annual coordination meeting.

Function

Help ensure trout are available for maintaining the quality fishery in Lake Jocassee.

Item 5: Cost Share for Fisheries Research and Enhancements

The Bad Creek MOU lists a number of activities eligible for cost-sharing, including fisheries research, water quality studies, trout habitat studies, stream surveys, creel surveys, fish and habitat management, development of bank and stream-side access, and stream protection and enhancement.

In previous work plan periods, SCDNR has elected to conduct sportfish creel surveys on lakes Jocassee and Keowee. Creel surveys provide unique information to describe the fishery from an angler perspective, including estimates of fishing effort, harvest and success. These data provide information useful in tracking angling trends, developing fishing regulations, and measuring angler satisfaction. SCDNR will continue creel surveys on a six-year interval rather than the three-year interval as conducted previously. Funding for four creel surveys, two per lake, would not exceed $390,000 total over the 2017-2027 period of this work plan.

The Bad Creek MOU has provided funding for a number of other fisheries studies conducted during the past 20 years. These studies have addressed a number of resource issues, including seasonal trout habitat use, the strength of the forage base, an evaluation of predator (trout) /prey balance (bio-energetics) which has been used to determine stocking rates, stream assessment, and brook trout restoration. All of these studies have provided the science needed to improve management of aquatic resources.

These studies previously funded under the Bad Creek MOU include:

- Trout telemetry in Lake Jocassee (helped better understand critical summer habitat for trout).
- Gill net monitoring – this is a long-term monitoring program to assess littoral and pelagic populations (abundance, length and age distributions, species composition, stocking assessments of smallmouth bass), with emphasis on trout and imperiled redeye bass, among other sportfish populations.
- Redeye bass genetics studies – two studies to date (one genetics study on reservoir populations), more recently a genetics and habitat study on stream populations. Both studies focused on impact of hybridization with non-native Alabama Bass. (Multiple peer-reviewed publications from this work.)
- Whitewater River – study of exploitation on wild trout – included both creel and population dynamics components.
- Bio-energetics study of trout in Lake Jocassee (guided trout stocking program).
- Assessment of streams on Jocassee Gorges to identify and prioritize potential native brook trout restoration. In-stream habitat was documented on all headwater streams

using the Basin Visual Estimation Technique method. In-stream habitat deficiencies were documented. In-depth water chemistry was assessed at 40 sites across the Keowee-Toxaway headwater streams, and longitudinal fish population sampling was conducted in all streams.

- Brook trout habitat and populations were restored in three streams including nine miles of brook trout habitat (Carrick Creek, Emory Creek, and Laurel Fork Creek).
- Comparison of growth and survival of diploid vs. triploid brown trout in Lake Jocassee – in progress.
- Brook trout genetics study – in progress. A contemporary genetics study of brook trout populations was conducted to identify source populations for restoration of additional Jocassee Gorges streams. Additional studies may be indicated to evaluate genetic diversity, assortative mating, and other potential concerns in restored populations.
- Southeast Aquatic Resource Partnership (SARP) brook trout restoration project – in progress. Bad Creek MOU funding was used to leverage funds from SARP, Trout Unlimited, other non-profits, and Clemson University. This project includes restoration of brook trout habitat (and fish) in Howard Creek, Big Laurel Creek, Little Laurel Creek, Side-of-Mountain Creek, and Reedy Cove Creek. This includes an additional nine+ miles of brook trout restoration.
- Population dynamics assessment of black bass species in Lake Jocassee and Lake Keowee to monitor: length and age distributions, total annual mortality, relative condition, recruitment, and yield-per-recruit modelling of populations to determine most effective regulation scenarios. This monitoring is important in evaluating the success of spring spawning lake level stabilization regimes to maintain largemouth bass populations and fisheries in both lakes.

As in previous work plans, SCDNR requests funding be provided to continue at least three applied fishery research or monitoring studies or special management projects over the next 11 years (2017-2027). These activities will be determined by the SCDNR in consultation with Duke Energy. Possible studies include but are not limited to the following:

- Redeye bass studies and management
- Additional trout stream restoration
- Black bass exploitation studies (levels of natural mortality in bass populations are known, but the proportion of annual mortality due to angling exploitation is not known)
- Jocassee trout survival/mortality/exploitation studies (Major knowledge gaps exist regarding survival rates of stocked trout from the time of planting until fish recruit to the fishery. This limits the ability to apply the previously developed bio-energetics model for determining stocking rates, etc.)
- Habitat protection/ access improvement/erosion control
- Evaluation of habitat enhancement projects conducted under Keowee-Toxaway Habitat Enhancement Program[2] or other funding initiatives in the Keowee-Toxaway Lakes.

[2] The Keowee-Toxaway Habitat Enhancement Program (HEP) is a program funded through Duke Energy's Lake Use Permitting Program. The HEP supports projects designed to protect, enhance and create fish and wildlife species in the Keowee-Toxaway watershed (including the Bad Creek Project).

Work Plan

- SCDNR will submit study/management activity requests to Duke Energy for review and concurrence.

- Funding for approved projects may be utilized for the purchase of supplies, equipment and personnel needed to conduct this work.

- Other funding sources, such as the Keowee-Toxaway Habitat Enhancement Program, may also be utilized for cost-sharing these activities.

- Duke Energy will provide a one-time payment of $120,000 in 2017 to support Bad Creek MOU research and monitoring activities by SCDNR as described above.

- Duke Energy will provide funding ($390,000 total with no applied escalation) for the four creel surveys. Unless changed with the consent of Duke Energy, funding will be provided according to the following schedule:
    - 2019 Lake Jocassee $ 90,000
    - 2020 Lake Keowee $ 105,000
    - 2025 Lake Jocassee $ 90,000
    - 2026 Lake Keowee $ 105,000

- Duke Energy will provide any relevant data from routine water quality monitoring in Howard Creek at the annual coordination meeting.

- The SCDNR will provide Duke Energy with a written summary of activities conducted under this item at the annual coordination meeting of Duke Energy and SCDNR staff.

Function

Collect data to better manage the aquatic resources in Lake Jocassee and Lake Keowee. Provide vital information on fishing effort, harvest, and success of sportfish as well as socioeconomic data. Use study data to formulate stocking strategies, size and creel limits, and to monitor potential impacts of commercial uses of the reservoirs (i.e., power production) on the fishery. Share the results of these studies and routine environmental monitoring work as requested.

ATTACHMENT 3

RAI-13 RESPONSE DOCUMENTS

1. Keowee-Toxaway Fishery Resources Ten Year Work Plan January 1996 - December 2005
2. Endangered, Threatened, and Otherwise Noteworthy Plant and Animal Species of the Oconee Nuclear Station, Oconee and Pickens Counties, South Carolina, Dr. L.L. Gaddy, June 1998

ATTACHMENT 3 DOCUMENT 1

KEOWEE-TOXAWAY FISHERY RESOURCES
TEN YEAR WORK PLAN
JANUARY 1996 - DECEMBER 2005

KEOWEE-TOXAWAY FISHERY RESOURCES

TEN YEAR WORK PLAN
JANUARY 1996 - DECEMBER 2005

SOUTH CAROLINA DEPARTMENT OF NATURAL RESOURCES
AND
DUKE POWER COMPANY

Dr. J. A. Timmerman, Jr.
Director
SC Dept. Natural Resources

12/2/96
Date

M. D. McIntosh
Vice President
Fossil/Hydro Generation

Mar 18, 1996
Date

J. R. Hendricks
General Manager
Environmental Division
Duke Power Company

12/2/96
Date

KEOWEE-TOXAWAY FISHERIES RESOURCES
TEN-YEAR WORK PLAN (JANUARY 1996 - DECEMBER 2005)
SCDNR/DPC

INTRODUCTION

The following studies, habitat protection/enhancements, and other activities are considered important to the long-term effective management of the Keowee-Toxaway Fishery Resources. Many of the activities (monitoring trout habitat, creel surveys) have been ongoing for years and have been the basis of establishing high quality and unique fisheries for the state of South Carolina. Other activities (telemetry and bass habitat studies) will provide new types of information that will help sustain these fisheries as they are subjected to increased angler pressure.

The studies and other activities in this plan will all be jointly planned by the SCDNR/DPC team that has worked cooperatively over the years on the Keowee-Toxaway fishery resources. This team will coordinate and carry out the needed activities, involve third parties as needed (i.e., Clemson University, others), plan activities, and schedule and carry out an annual review meeting on the status of activities.

KEOWEE-TOXAWAY FISHERY RESOURCES
TEN-YEAR WORK PLAN (JANUARY 1996 - DECEMBER 2005)
SCDNR/DPC

Item: Agreement on Fish Entrainment at Jocassee Pumped Storage Station

- The complete extent of fish entrainment at Jocassee is not currently documented. However, observations and experience at this project indicate that entrainment damages are not in excess of that which would be mitigated by this agreement. It is not anticipated that the proposed upgrade of Jocassee units will result in any significant change in fish entrainment.

- Duke and SCDNR will continue to cooperatively monitor the lake fishery at Jocassee and pumped storage operations.

- Following unit upgrades, if any significant changes are observed in fish entrainment, Duke will consult with SCDNR to determine if any additional measures should be initiated.

KEOWEE-TOXAWAY FISHERY RESOURCES
TEN-YEAR WORK PLAN (JANUARY 1996 - DECEMBER 2005)
SCDNR/DPC

Item: Agreement on Minimizing Fish Entrainment via Bad Creek Pumped Storage Project

- DPC and SCDNR have worked cooperatively on a three-year study to evaluate fish entrainment at the Bad Creek hydro. Results indicate that fish entrainment was relatively low when Lake Jocassee was near full pool [338.3 m (1110 ft) MSL]. However, entrainment of thread-fin shad and blue-back herring increased substantially on days when Lake Jocassee water surface elevations were below 334 m (1096 ft) MSL [4.3 m (14 ft) below full pool].

- During this ten-year plan period, Duke will operate its facilities so as to minimize, to the extent possible, the period during which Lake Jocassee pool elevation is below 335 m (1099 ft) MSL.

- If the pool elevation in Lake Jocassee falls below 335 m (1099 ft) MSL and is projected to remain below this level for 30 consecutive days, Duke will notify the SCDNR. If the pool elevation is projected to remain below 335 m (1099 ft) MSL for a total of 60 consecutive days, Duke will initiate consultation with the SCDNR to determine if further monitoring of entrainment impacts and/or measures to minimize these impacts are appropriate.

KEOWEE-TOXAWAY FISHERY RESOURCES
TEN-YEAR WORK PLAN (JANUARY 1996 - DECEMBER 2005)
SCDNR/DPC

Item: Cost Share Agreement for Stocking of Trout in Lake Jocassee

- Duke Power and SCDNR will equally cost share the providing of trout for stocking in Lake Jocassee. The total annual cost is $102,250. Thus, the annual cost to DPC will be $51,125 (plus any inflation adjusted annually based on the consumer price index), or the actual cost of their share of the fish, whichever is less.

- Ten-Year Plan: Trout are currently produced at the Walhalla State Hatchery for stocking in Lake Jocassee.

- Function: Help ensure trout are available for maintaining the quality, and high demand, fishery in Lake Jocassee.

KEOWEE-TOXAWAY FISHERY RESOURCES
TEN-YEAR WORK PLAN (JANUARY 1996 - DECEMBER 2005)
SCDNR/DPC

Item: Agreement on Maintaining Adequate Pelagic Trout Habitat in Lake Jocassee.

- DPC and SCDNR have worked cooperatively since 1973 to obtain a continuous and systematic database on trout habitat in Lake Jocassee and the factors that influence its horizontal and vertical distribution. A detailed understanding of habitat factors, including the roles of pumped storage operations and winter stored oxygen, have been gained.

- During this 10-year plan period, Duke will continue to work actively and in cooperation with SCDNR to help ensure the presence of trout habitat in Lake Jocassee.

- Duke will continue to carry out appropriate field studies on the vertical and horizontal distribution of trout habitat in Lake Jocassee. Study details will be determined jointly with SCDNR.

- Based on field data, and the Jocassee model, Duke and SCDNR will work to protect trout habitat in Lake Jocassee. Activities will include:

  A) To help prevent operations from causing degradation, efforts will focus on precluding depletion of water cooler than 20° C (68° F) at elevations lower than 305 m (1000.7 ft) MSL (this is the lower level reached in past years). These efforts may include switching "Jocassee operations" to other available peaking facilities, when needed to meet the non-depletion goal.

  B) To help prevent an unusual DO depletion from causing degradation by resulting in too narrow a band of trout habitat, Duke will use the Jocassee model to help ensure a 10 m (32.8 ft) band of adequate habitat exists at all times. These efforts may include switching "Jocassee operations" to other available peaking facilities, when needed to meet the "minimum band" goal.

  C) The general goal of these efforts will therefore be to maintain, at a minimum, a layer of adequate trout habitat at least 10 m (32.8 ft) in thickness, and with its upper layer no lower than elevation 305 m (1000.7 ft) MSL. However, in no event will any operations occur if the habitat thickness decreases to 5 m (16.4 ft), unless mutually agreed by both parties.

- Ten-Year Plan: Data will be obtained routinely throughout the 10-year period through a jointly planned sampling program. The data, and any operational

modifications, will be reviewed annually with the SCDNR Regional Office fisheries personnel.

- Function: This effort will provide an active and cooperative system that will help ensure that adequate habitat is maintained for this highly popular Lake Jocassee fishery.

KEOWEE-TOXAWAY FISHERY RESOURCES
TEN-YEAR WORK PLAN (JANUARY 1996 - DECEMBER 2005)
SCDNR/DPC

Item: Jocassee Creel Survey

- Duke will provide funding up to $30,000/yr.

- SCDNR will administer and implement the study and data presentation.

- Ten-Year Plan: Survey is scheduled to be done annually throughout the period.

- Function:
  - ⇒ Provides vital information on fishing effort, catch and harvest of sportfish as well as socioeconomic data.

  - ⇒ This is the most important sampling tool available to monitor the sport fishery. The Jocassee fishery is impossible to manage effectively without this monitoring tool because most traditional fishery sampling tools (i.e., electrofishing) are not effective on Jocassee.

  - ⇒ Used to formulate stocking strategies, size and creel limits, and to monitor the impacts of commercial uses of the reservoir (i.e., power production) on the fishery.

KEOWEE-TOXAWAY FISHERY RESOURCES
TEN-YEAR WORK PLAN (JANUARY 1996 - DECEMBER 2005)
SCDNR/DPC

Item: Keowee Creel Survey

- Duke will provide funding up to $30,000/yr.
- SCDNR will administer.
- Clemson University fisheries scientists will implement and summarize data.
- Ten-Year Plan: This survey is scheduled for every third year, except it will occur for three consecutive years following installation of upgraded runners at the Jocassee Station.
- Function:
  - ⇒ Provides vital information on fishing effort, catch and harvest of sportfish as well as socioeconomic data.
  - ⇒ Will provide effective monitoring of the fishery to assure there are no major impacts immediately after a runner upgrade takes place, hence the three year annual creel following upgrade.
  - ⇒ Long term monitoring also needs to be conducted. Creel survey on every third year thereafter should be sufficient.

KEOWEE-TOXAWAY FISHERY RESOURCES
TEN-YEAR WORK PLAN (JANUARY 1996 - DECEMBER 2005)
SCDNR/DPC

Item: Gill-Netting Studies (Jocassee)

- Duke will furnish the nets at a cost up to $1,200/yr.
- SCDNR will conduct the sampling.
- Ten-Year Plan: Sampling is scheduled annually throughout the period.
- Function:
  - ⇒ Provides the longest database on the Jocassee fishery. Gill net data has been collected since 1975 (prior to development of the creel survey or hydroacoustic technique).
  - ⇒ Provides vital "hands on" data on the trout fishery to assess trout stocking practices and population monitoring.
  - ⇒ Data on trout densities, species and strain performance, year class strength, growth, "carry-over," survival, etc. are collected. This data is used to formulate stocking and management decisions such as creel and size limits.

KEOWEE-TOXAWAY FISHERY RESOURCES
TEN-YEAR WORK PLAN (JANUARY 1996 - DECEMBER 2005)
SCDNR/DPC

Item: Jocassee Water Quality Monitoring for Trout Habitat

- Duke will provide funding and implement.

- Projections for late summer habitat will be reviewed with SCDNR Regional Office fisheries personnel in May, based on the Jocassee model. Actual late summer data will be reported by October of each year.

- Ten-Year Plan: Data will be obtained routinely over the study period.

- Function:
  - ⇒ Provides information on a critical element in the Jocassee coldwater fishery.
  - ⇒ Allows biologist to factor in the impacts of environmental and operational events into the management of the fishery.
  - ⇒ Lake Jocassee maintains a very low narrow band of coldwater habitat in late summer and this is the only way to assess the quantity of, and future maintenance of, this critical habitat.

KEOWEE-TOXAWAY FISHERY RESOURCES
TEN-YEAR WORK PLAN (JANUARY 1996 - DECEMBER 2005)
SCDNR/DPC

Item: Hydroacoustic Monitoring of Small Pelagic Fish (Jocassee, Keowee)

- Duke will provide funding and conduct this monitoring work.

- Ten-Year Plan: This monitoring is scheduled to occur annually (spring and fall) throughout the planning period.

- Function:
  - ⇒ This data allows effective monitoring of the status of shad populations in the reservoirs. Shad are the most important food source of trout and other game fish in Lake Jocassee and Lake Keowee.

  - ⇒ This is "cutting edge" technology that will be extremely important in the future as more traditional sampling procedures that require mortality of fish are more closely scrutinized by the public (i.e., cove rotenones).

KEOWEE-TOXAWAY FISHERY RESOURCES
TEN-YEAR WORK PLAN (JANUARY 1996 - DECEMBER 2005)
SCDNR/DPC

Item: Telemetry Study of Trout (Jocassee)

- Duke will provide funding for this study (up to $18,000) which will be conducted during 1997.

- SCDNR will administer the project.

- Clemson University fisheries personnel will conduct the study.

- Ten-Year Plan: During the remainder of this 10-year agreement, if there is a period of minimal trout habitat, a 1-year follow-up study may be necessary. Duke will provide funding (up to $18,000) if an additional 1-year study is deemed necessary by Duke and SCDNR.

- Function:
  - ⇒ Provide important back-up information, and "ground truth" data, for hydroacoustic plots of vertical distribution of trout in Lake Jocassee.

  - ⇒ Develop habitat criteria (Temp., D.O.) that is based on the fish and their ecology in this specific system.

  - ⇒ This study will also help validate and or calibrate hydroacoustic estimation techniques with which SCDNR and Duke Power have been experimenting.

KEOWEE-TOXAWAY FISHERY RESOURCES
TEN-YEAR WORK PLAN (JANUARY 1996 - DECEMBER 2005)
SCDNR/DPC

Item: Study of Black Bass Populations Electrofishing (Keowee, Jocassee)

- Duke will provide support (as in previous years) for electrofishing studies and collection of black bass for population analysis and age-and-growth studies.

- SCDNR will provide overall coordination of the work.

- Ten-Year Plan: These electrofishing efforts are scheduled to occur every third year during this planning period.

- Function:
  - ⇒ Black bass (largemouth, spotted, smallmouth bass) are the most sought after species in both lakes.

  - ⇒ Electrofishing and other sampling techniques allows the biologist to collect "hands on" data such as condition factors, health assessments, size structures, age and growth, etc.

  - ⇒ This sampling is necessary to make proper recommendations for creel and size limits for the long-term maintenance of the bass fishery given increasing public use.

KEOWEE-TOXAWAY FISHERY RESOURCES
TEN-YEAR WORK PLAN (JANUARY 1996 - DECEMBER 2005)
SCDNR/DPC

Item: Black Bass Habitat Study (Keowee)

- Duke will provide funding for this study up to $18,000/yr.
- SCDNR will administer the project.
- Clemson University fisheries personnel will conduct the study.
- Ten-Year Plan: This effort will be scheduled for a 3-year period during the planning period.
- Function: Provide important data for bass management in Lake Keowee. Black bass (largemouth and spotted bass) are the two most sought after gamefish in Lake Keowee. The recent development of the spotted bass fishery makes the obtaining of this data an important management need.

KEOWEE-TOXAWAY FISHERY RESOURCES
TEN-YEAR WORK PLAN (JANUARY 1996 - DECEMBER 2005)
SCDNR/DPC

Item: Stream Surveys

- Duke will assist SCDNR in their ongoing efforts to survey fish populations in tributaries of Lakes Jocassee and Keowee.

- SCDNR will coordinate the effort.

- Ten-Year Plan: One or more streams will be surveyed each year, as determined by SCDNR.

- Function: Maintain a database on headwater stream fish populations (such as Whitewater River), and document any impacts or management efforts that need attention.

KEOWEE-TOXAWAY FISHERY RESOURCES
TEN-YEAR WORK PLAN (JANUARY 1996 - DECEMBER 2005)
SCDNR/DPC

Item: Erosion Control Work

- Duke and Crescent Resources, Inc. will develop a team to review erosion control needs in pertinent road areas related to forestry work on DPC and CRI lands.
- Plans will be developed and implemented to take needed corrective erosion control actions in a timely manner.
- SCDNR will participate in this team effort.
- Ten-Year Plan: The review will begin in 1996.
- Function: Protect/enhance water quality and habitat factors in headwater trout streams at Keowee-Toxaway.

KEOWEE-TOXAWAY FISHERY RESOURCES
TEN-YEAR WORK PLAN (JANUARY 1996 - DECEMBER 2005)
SCDNR/DPC

Item: Lower Eastatoe Creek Management and Angler Access

- Duke will provide and maintain adequate access for the hatchery truck on DPC lands along Eastatoe.

- Duke will provide and maintain an angler parking area on its Eastatoe property, including needed signage, trails, etc.

- SCDNR will coordinate the overall plan.

- Ten-Year Plan: The access area will be developed in 1996 and maintained throughout the planning period.

- Function: Cooperatively provide access for anglers to a major SC stream, in a manner compatible with the resources.

KEOWEE-TOXAWAY FISHERY RESOURCES
TEN-YEAR WORK PLAN (JANUARY 1996 - DECEMBER 2005)
SCDNR/DPC

Item: Agreement to Prohibit Development Around Lake Jocassee

- Duke's Land Use Plan, in effect since 1983, prohibits development of company lands around Lake Jocassee.

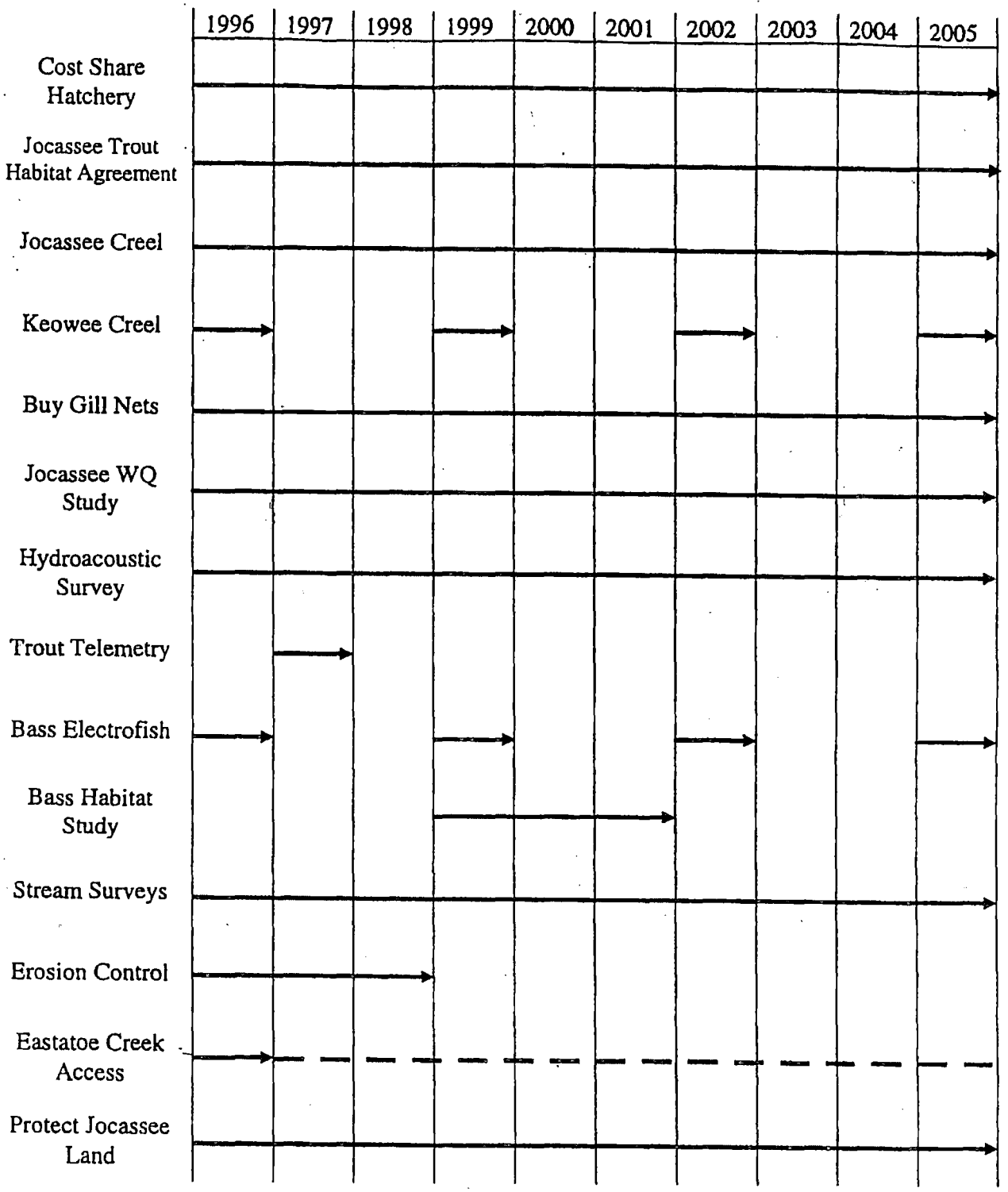
- Duke has reviewed this plan closely with the SCDNR and made the commitment that Duke will not change this "non-development" aspect of the Land Use Plan without SCDNR review.

- In recent years, and months, Duke has maintained (and is maintaining) a close dialogue with SCDNR on this subject, and will continue to do so.

- Ten-Year Plan: Duke will maintain close contact with SCDNR on its Jocassee lands throughout the planning period.

- Function: To ensure protection of significant resources related to biodiversity, aesthetics, and water quality.

KEOWEE-TOXAWAY FISHERY RESOURCES
TEN-YEAR WORK PLAN (JANUARY 1996 - DECEMBER 2005)
SCDNR/DPC



ATTACHMENT 3 DOCUMENT 2

ENDANGERED, THREATENED, AND OTHERWISE NOTEWORTHY PLANT AND ANIMAL SPECIES OF THE OCONEE NUCLEAR STATION, OCONEE AND PICKENS COUNTIES, SOUTH CAROLINA, DR. L.L. GADDY, JUNE 1998

ENDANGERED, THREATENED, AND OTHERWISE NOTEWORTHY PLANT AND ANIMAL SPECIES OF THE OCONEE NUCLEAR STATION, OCONEE AND PICKENS COUNTIES, SOUTH CAROLINA

prepared by

L. L. Gaddy, Ph. D.
245 The Wild Wood Way
Walhalla, South Carolina 29691

for

Duke Energy Corporation
Charlotte, North Carolina

June 1998

INTRODUCTION

This report presents the results of an inventory of endangered, threatened, and otherwise noteworthy plant and animal species of Duke Energy's Oconee Nuclear Station. The study area for this investigation was a one mile-radius circle centered on the Number Two Reactor inside the Oconee Nuclear Station. The study area included all lands at Oconee Nuclear Station and additional lands along the Keowee River and along Lake Keowee (see Map 1).

Field work was conducted in May and June of 1998. A habitat analysis of the study area was conducted using false color infrared photography, black and white photography, and topographic maps of the site. Habitats that appeared to be potential areas of occurrences for the species listed in Table 1 were completely surveyed on foot in the field. More cursory inventories were done of successional forests and highly-disturbed areas.

RESULTS

Three state-listed plants species and one species not previously known in South Carolina were found in the course of the inventory (Table 1). Additionally, four significant natural areas which harbored state-listed plants, old-growth trees, or other noteworthy natural features were located (Map 1).

Table 1. Endangered, threatened, and otherwise noteworthy plant and animal species occurring or historically-occurring in the vicinity of the Oconee Nuclear Station.

SCIENTIFIC NAME	COMMON NAME	STATUS [1]	OCCURRENCE [2]
PLANTS			
Carex laxiflora	loose-flowered sedge	SR	PRESENT
Carex prasina	drooping sedge	SL	PRESENT
Echinacea laevigata	smooth coneflower	FE	HISTORICAL
Nestronia umbellula	Indian olive	SL	PRESENT
Orobanche uniflora	one-flowered broomrape	SL	HISTORICAL
Pachysandra procumbens	Allegheny spurge	SL	HISTORICAL
Viola tripartita	three-parted violet	SL	PRESENT
ANIMALS			
Sigmora robusta	a millipede	SL	HISTORICAL

[1] SR-new state record for species found during this inventory; SL-listed as "rare, threatened, or endangered" by the State of South Carolina (see Appendix); FE-federally-listed as endangered by the Fish and Wildlife Service.

[2] PRESENT indicates that species was found on Oconee Nuclear Station property or within a one-mile radius of Oconee Nuclear Station during the course of this inventory or has recently been reported from the area by biologists; HISTORICAL indicates that species has been reported from the general area in the past but was not located within a one-mile radius of Oconee Nuclear Station during this inventory.

Populations of the state-listed three-parted violet (Viola tripartita) were found in three different areas in rich deciduous woods. This yellow violet is uncommon in the Blue Ridge and upper Piedmont of South Carolina. The populations located within the study area ranged from five to 25 plants (Map 1).

A population of Indian olive (Nestronia umbellula), also state-listed in South Carolina, was found along the nature trail in Natural Area 1 (see Map 1 and discussion of Natural Area 1 below). About 50 plants of Indian olive were found in a blueberry (Vaccinium spp.) thicket at this site. (Robert Siler, a Duke Engineering & Services biologist, brought this population to my attention).

Drooping sedge (Carex prasina), uncommon in the Blue Ridge and Piedmont of South Carolina, is also listed and monitored by the South Carolina Department of Natural Resources. One population of about 10 plants was found in small seepage bogs east of SC 183 in Natural Area 3 (see Map 1 and discussion of natural areas below).

Finally, the first substantiated South Carolina record for loose-flowered sedge (Carex laxiflora) was found in the southern portion of the study area in Natural Area 4 (see Map 1 and discussion of natural areas below). About 25 plants of Carex laxiflora were located during this inventory on a rich, north-facing slope. Carex laxiflora is reported from South Carolina in Radford et al., 1968, the authoritative guide to the flora of Carolinas; however, over the last decade, field research has revealed that several other species of sedges were probably incor-

rectly identified as this species, which heretofore was unknown from South Carolina (see Gaddy, 1995). Only two records of the sedge were known from the southern Blue Ridge, both in North Carolina (the closest record to South Carolina for the species was Windy Falls on the Horsepasture River--a site also within the Keowee-Toxaway River drainage). Because this is the first record for the species in South Carolina, a specimen was collected for deposit in the Clemson University Herbarium.

Four significant natural areas were also encountered during the survey of the study area. They have been included on Map 1 to facilitate their location. Natural Area 1 is the nature trail area north of the World of Energy. Here, relatively undisturbed deciduous woods dominated by white oak (Quercus alba), red oak (Quercus rubra), southern red oak (Quercus falcata), and hickories (Carya spp.). Dogwood (Cornus florida), mountain laurel (Kalmia latifolia), and the uncommon buckthorn (Rhamnus caroliniana) are found in the understory. This site harbors a rich herbaceous flora which includes good populations of uncommon wildflower species such as Indian pink (Spigelia marilandica), American liverleaf (Hepatica americana), Indian olive (Nestronia umbellula) (see above), and three-parted violet (Viola triparti-ta). Smaller populations of many other showy spring herbs are also found here.

Natural Area 2 is an area of old-growth Piedmont mixed hardwoods on a north-facing slope and ridge east of SC 183 (Map 1). Here, a forest of mixed oak and tulip poplar appears not to

have been disturbed in recent history. Black oak (Quercus velutina) up to 40 inches in diameter at breast height (4.5 feet) (dbh), southern red oak (Quercus falcata) to 36 inches in dbh, white oak (Quercus alba) up to 30 inches in dbh, and tulip poplar (Liriodendron tulipifera) over 24 inches in dbh all were seen here. The area of old-growth is not extensive but is significant considering the fact that old-growth Piedmont forests are rare. Buckthorn (Rhamnus carolinana) and three-parted violet (Viola tripartita) were also found in the natural area.

Natural Area 3 is a small, north-facing ravine in the southwestern portion of the study area. A stand of 100-year old white oak (Quercus alba), some of which have recently been cut, is found here on slopes overlooking several interesting bogs. Good populations of cinnamon fern (Osmunda cinnamomea), southern lady fern (Athyrium asplenoides), and New York fern (Thelypteris noveboracensis) surround several small bogs which harbor a small population of the rare drooping sedge (Carex prasina). The northern end of this ravine harbors a small beaver pond/marsh complex with bur-reed (Sparganium americanum), sedges (Carex spp.), tag alders (Alnus serrulata), and black willows (Salix nigra) (see Map 1).

Finally, Natural Area 4 is an extensive north-facing bluff with mature white oak (Quercus alba), red oak (Quercus rubra), beech (Fagus grandifolia), and tulip poplar (Liriodendron tulipifera) (largest trees over 30 inches in dbh). Found in the southern portion of the study area south of SC 183, this site also harbors mountain laurel (Kalmia latifolia), dogwood (Cornus

florida), redbud (Cercis candadensis) (one tree eight inches in dbh), and chalk maple (Acer leucoderme) in the understory. The herbaceous flora is rich with three-parted violet (Viola tripartita), loose-flowered sedge (Carex laxiflora) (discussed above), black cohosh (Cimicifuga racemosa), maidenhair fern (Adiantum pedatum), and American liverleaf (Hepatica americana).

LITERATURE CITED

Gaddy, L. L. 1995. Carex radfordii (Sect. Laxiflorae: Cyperaceae), a new species from the southern Appalachians. Novon 5:259-261.

Radford, A. E., H. E. Ahles, and C. R. Bell. 1968. Manual of the vascular flora of the Carolinas. University of North Carolina Press. Chapel Hill. 1183 p.

APPENDIX

United States Department of the Interior

FISH AND WILDLIFE SERVICE
P.O. Box 12559
217 Fort Johnson Road
Charleston, South Carolina 29422-2559

April 17, 1998

Ms. Jennifer Huff
Duke Power
Mail Code EC124
P.O. Box 1006
Charlotte, North Carolina 28201-1006

Re: Oconee Nuclear Station - FERC Relicense
FWS Log No. 4-6-98-227

Dear Ms. Huff:

As per your request, we are providing a list of the federally endangered (E) and threatened (T) species which potentially occur in Oconee County, South Carolina to aid you in determining the impacts your project may have on protected species. In-house surveys should be conducted by comparing the habitat requirements for the attached listed species with available habitat types at the project site. Field surveys for the species should be performed if habitat requirements overlap with that available at the project site. Surveys for protected plant species must be conducted by a qualified biologist during the flowering or fruiting period(s) of the species. Please notify this office with the results of any surveys for the below list of species and an analysis of the "effects of the action," as defined by 50 CFR 402.02 on any listed species including consideration of direct, indirect, and cumulative effects.

We also recommend you contact the S.C. Department of Natural Resources (SCDNR), Data Manager, Wildlife Diversity Section, Columbia, SC 29202, concerning known populations of federal and/or state endangered or threatened species, and other sensitive species in the project area.

These lists should be used only as a guideline, not as the final authority. The lists include known occurrences and areas where the species has a high possibility of occurring. Records are updated continually and may be different from the following.

SOUTH CAROLINA COUNTY DISTRIBUTION RECORDS OF
ENDANGERED and THREATENED SPECIES

E - Endangered
T - Threatened

Oconee County	Status	Certainty of occurrence
Indiana bat (Myotis sodalis)	E	Known
American peregrine falcon (Falco peregrinus anatum)	E	Possible
Bald eagle (Haliaeetus leucocephalus)	T	Known
Smooth coneflower (Echinacea laevigata)	E	Known
Small whorled pogonia (Isotria medeoloides)	T	Known
Persistent trillium (Trillium persistens)	E	Known

Your interest in ensuring the protection of endangered and threatened species is appreciated. If you have any questions please contact Ms. Lori Duncan of my staff at (803) 727-4707 ext. 21. In future correspondence concerning the project, please reference FWS Log No. 4-6-98-227.

Sincerely yours,

Roger L. Banks
Field Supervisor

RLB/LWD

cc: Federal Energy Regulatory Commission, Washington, DC

Pickens County		
American peregrine falcon (Falco peregrinus anatum)	E	Known
Bald eagle (Haliaeetus leucocephalus)	T	Possible
Bog turtle (Clemmys muhlenbergii)	PT(S/A)	Known
Smooth coneflower (Echinacea laevigata)	E	Known
Dwarf-flowered heartleaf (Hexastylis naniflora)	T	Possible
Black-spored quillwort (Isoetes melanospora)	E	Known
Mountain sweet pitcher-plant (Sarracenia rubra ssp. jonesii)	E	Known

KEY

ELCODE - element code, indicating taxonomic class in cols 1 and 2:

AA - Animals, Amphibians
AB - Animals, Birds
AF - Animals, Fish
AM - Animals, Mammals
AR - Animals, Reptiles
I - Invertebrate Animals
PD - Plants, Dicots
PG - Plants, Gymnosperms
PM - Plants, Monocots
PP - Plants, Pteridophytes (ferns)
N - Non-vascular Plants

GRANK/SRANK - the Nature Conservancy rating of degree of endangerment:

G1 - Critically imperiled globally because of extreme rarity or because of some factor(s) making it especially vulnerable to extinction
G2 - Imperiled globally because of rarity or factor(s) making it vulnerable
G3 - Either very rare throughout its range or found locally in a restricted range, or having factors making it vulnerable
G4 - Apparently secure globally, though it may be rare in parts of its range
G5 - Demonstrably secure globally, though it may be rare in parts of its range
GH - Of historical occurrence throughout its range, with possibility of rediscovery
GX - Extinct throughout its range
G? - Status unknown

S1 - Critically imperiled state-wide because of extreme rarity or because of some factor(s) making it especially vulnerable to extirpation
S2 - Imperiled state-wide because of rarity or factor(s) making it vulnerable
S3 - Rare or uncommon in state
S4 - Apparently secure in state
S5 - Demonstrably secure in state
SA - Accidental in state (usually birds or butterflies that are far outside normal range)
SE - Exotic established in state
SH - Of historical occurrence in state, with possibility of rediscovery
SN - Regularly occurring in state, but in a migratory, non-breeding form
SR - Reported in state, but without good documentation
SX - Extirpated from state
S? - Status unknown

STATUS - legal status:

FE - Federal Endangered
FT - Federal Threatened
NC - Of Concern, National (unofficial - plants only)
RC - Of Concern, Regional (unofficial - plants only)
SE - State Endangerd (official state list - animals only)
ST - State Threatened (official state list - animals only)
SC - Of Concern, State
SX - State Extirpated
PE/PT/C - Proposed or candidate for federal listing

All information is based on the existing S.C. Heritage Trust database, and we do not assume that it is complete. Areas not yet inventoried by our biologists may contain significant species or communities. Also, our data are always in need of updating because as natural populations change over time, species must be added, dropped, or reclassified.

RARE, THREATENED, AND ENDANGERED SPECIES OF OCONEE COUNTY

STATUS	GRANK	SRANK	SCIENTIFIC NAME	COMMON NAME
ANIMALS:				
SC	G5	S?	ACCIPITER COOPERII	COOPER'S HAWK
SC	G3	S?	ALASMIDONTA VARICOSA	BROOK FLOATER
SC	G3G4	S1	ANEIDES AENEUS	GREEN SALAMANDER
SC	G5	S2S3	CLETHRIONOMYS GAPPERI	SOUTHERN RED-BACKED VOLE
SC	G5T4	S2S3	CLETHRIONOMYS GAPPERI CAROLINENSIS	CAROLINA RED-BACKED VOLE
SE	G4	S2?	CORYNORHINUS RAFINESQUII	RAFINESQUE'S BIG-EARED BAT
SC	G4	S?	CRYPTOBRANCHUS ALLEGANIENSIS	HELLBENDER
SC	G3G4	S?	DESMOGNATHUS AENEUS	SEEPAGE SALAMANDER
SC	G2G3	S?	ELLIPTIO LANCEOLATA	YELLOW LANCE
SC	G5	S1?	ETHEOSTOMA ZONALE	BANDED DARTER
ST	G3	S1	MYOTIS LEIBII	EASTERN SMALL-FOOTED MYOTIS
SC	G5	S3?	MYOTIS LUCIFUGUS	LITTLE BROWN MYOTIS
SC	G4	S3S4	MYOTIS SEPTENTRIONALIS	NORTHERN MYOTIS
FE/SE	G2	S1	MYOTIS SODALIS	INDIANA MYOTIS
SC	G5	S3S4	NEOTOMA FLORIDANA	EASTERN WOODRAT
SC	G5T4	S3S4	NEOTOMA FLORIDANA HAEMATOREIA	SOUTHERN APPALACHIAN WOODRAT
SC	G5	S?	PARASCALOPS BREWERI	HAIRY-TAILED MOLE
SC	G5	S?	RANA PALUSTRIS	PICKEREL FROG
SC	G5	S3	RANA SYLVATICA	WOOD FROG
SC	G5	S1	RHINICHTHYS ATRATULUS	BLACKNOSE DACE
SC	G?	S?	SIGMORIA ARCUATA	A MILLIPEDE
SC	G?	S?	SIGMORIA ROBUSTA	A MILLIPEDE
SC	G5	S3S4	SOREX HOYI	PYGMY SHREW
SC	G5	S4	SPILOGALE PUTORIUS	EASTERN SPOTTED SKUNK
SC	G5	S3	SYLVILAGUS AQUATICUS	SWAMP RABBIT
SC	G4	S2?	SYLVILAGUS OBSCURUS	APPALACHIAN COTTONTAIL
SC	G5	S3?	TAMIASCIURUS HUDSONICUS	RED SQUIRREL
SC	G5	S4	TYTO ALBA	BARN-OWL
SC	G5	S?	ZAPUS HUDSONIUS	MEADOW JUMPING MOUSE
PLANTS:				
SC	G5	S1S2	ACER PENSYLVANICUM	STRIPED MAPLE
SC	G4	S2	ACONITUM UNCINATUM	BLUE MONKSHOOD
SC	G5	S?	ALLIUM CERNUUM	NODDING ONION
SC	G4?	S?	AMORPHA GLABRA	SMOOTH INDIGOBUSH
SC	G5	S2	ARISTOLOCHIA MACROPHYLLA	PIPEVINE
RC	G4	S1	ASPLENIUM MONANTHES	SINGLE-SORUS SPLEENWORT
SC	G5	S1S2	ASPLENIUM RESILIENS	BLACK-STEM SPLEENWORT
SC	G5	S2	ASPLENIUM RHIZOPHYLLUM	WALKING-FERN SPLEENWORT
SC	G5	S?	ASPLENIUM TRICHOMANES	MAIDENHAIR SPLEENWORT
SC	G2G3	S?	ASTER GEORGIANUS	GEORGIA ASTER
SC	G5	S?	ASTER NOVAE-ANGLIAE	NEW ENGLAND ASTER
SC	G5	S1	BETULA ALLEGHANIENSIS	YELLOW BIRCH
SC	G4	S1	BOYKINIA ACONITIFOLIA	BROOK SAXIFRAGE
SC	G2	S?	CARDAMINE CLEMATITIS	MOUNTAIN BITTER CRESS
SC	G4?	S?	CARDAMINE DISSECTA	DIVIDED TOOTHWORT
SC	G3	S?	CARDAMINE FLAGELLIFERA	BITTER CRESS
SC	G5	S?	CAREX AMPHIBOLA	NARROWLEAF SEDGE
SC	G3	S?	CAREX AMPLISQUAMA	FORT MOUNTAIN SEDGE
SC	G4	S?	CAREX APPALACHICA	APPALACHIAN SEDGE
SC	G4	S?	CAREX AUSTROCAROLINIANA	A SEDGE
NC	G3	S1	CAREX BILTMOREANA	BILTMORE SEDGE
SC	G5	S?	CAREX GRACILLIMA	GRACEFUL SEDGE
SC	G3	S?	CAREX MANHARTII	MANHART SEDGE
SC	G4	S?	CAREX OLIGOCARPA	EASTERN FEW-FRUIT SEDGE
SC	G5	S1	CAREX PEDUNCULATA	LONGSTALK SEDGE
SC	G5	S?	CAREX PLANTAGINEA	PLANTAIN-LEAVED SEDGE
SC	G4	S?	CAREX PRASINA	DROOPING SEDGE

SC	G5	S?	CAREX SCABRATA	ROUGH SEDGE
SC	G5	S?	CAREX STRICTA	TUSSOCK SEDGE
SC	G4Q	S?	CAREX WOODII	PRETTY SEDGE
RC	G5	S2	CASTILLEJA COCCINEA	SCARLET INDIAN-PAINTBRUSH
SC	G5	S2	CAULOPHYLLUM THALICTROIDES	BLUE COHOSH
SC	G4	S?	CHELONE LYONII	PINK TURTLEHEAD
SC	G5	S?	CIRCAEA LUTETIANA	SOUTHERN BROADLEAF ENCHANTER'S NIGHTSHAD
SC	G5T5	S1	CIRCAEA LUTETIANA SSP CANADENSIS	ENCHANTER'S NIGHTSHADE
SC	G3	S?	COLLINSONIA VERTICILLATA	WHORLED HORSE-BALM
SC	G5	S?	COMPTONIA PEREGRINA	SWEET FERN
SC	G5	S?	CYPRIPEDIUM PUBESCENS	LARGE YELLOW LADY'S-SLIPPER
SC	G5	S?	CYSTOPTERIS BULBIFERA	BULBLET FERN
SC	G5	S?	CYSTOPTERIS PROTRUSA	LOWLAND BRITTLE FERN
SC	G4	S?	DICENTRA EXIMIA	WILD BLEEDING-HEART
RC	G4	S1	DIPHYLLEIA CYMOSA	UMBRELLA-LEAF
SC	G5	S1	DIPLAZIUM PYCNOCARPON	GLADE FERN
SC	G4	S1	DRYOPTERIS GOLDIANA	GOLDIE'S WOODFERN
SC	G5	S?	DRYOPTERIS INTERMEDIA	EVERGREEN WOODFERN
FE	G2	S1	ECHINACEA LAEVIGATA	SMOOTH CONEFLOWER
SC	G5	S1	EUONYMUS ATROPURPUREUS	WAHOO
SC	G5?	S?	EUPATORIUM FISTULOSUM	HOLLOW JOE-PYE WEED
RC	G3	S1	FOTHERGILLA MAJOR	MOUNTAIN WITCH-ALDER
SC	G5	S?	GALEARIS SPECTABILIS	SHOWY ORCHIS
SC	G5	S1	GAULTHERIA PROCUMBENS	TEABERRY
SC	G5	S?	GAYLUSSACIA BACCATA	BLACK HUCKLEBERRY
SC	G5	S?	HACKELIA VIRGINIANA	VIRGINIA STICKSEED
SC	G5	S?	HEPATICA ACUTILOBA	LIVERLEAF
SC	G4	S?	HEUCHERA PARVIFLORA	LITTLE-LEAVED ALUMROOT
SC	G5	S?	HYDROCOTYLE AMERICANA	AMERICAN WATER-PENNYWORT
FT	G2G3	S1	ISOTRIA MEDEOLOIDES	SMALL WHORLED POGONIA
SC	G4	S?	JUGLANS CINEREA	BUTTERNUT
SC	G4	S?	JUNCUS GYMNOCARPUS	NAKED-FRUITED RUSH
SC	G5	S?	JUNCUS SUBCAUDATUS	WOODS-RUSH
SC	G5	S?	JUNIPERUS COMMUNIS	GROUND JUNIPER
SC	G3	S?	KRIGIA MONTANA	FALSE DANDELION
SC	G5	S?	LIPARIS LILIIFOLIA	LARGE TWAYBLADE
SC	G4	S?	LISTERA SMALLII	KIDNEY-LEAF TWAYBLADE
SC	G5?	S2	LONICERA FLAVA	YELLOW HONEYSUCKLE
SC	G4	S1S2	LYGODIUM PALMATUM	CLIMBING FERN
RC	G2	S1	LYSIMACHIA FRASERI	FRASER LOOSESTRIFE
SC	G5	S?	MENISPERMUM CANADENSE	CANADA MOONSEED
SC	G5	S?	MITELLA DIPHYLLA	TWO-LEAF BISHOP'S-CAP
SC	G5	S?	MONARDA DIDYMA	OSWEGO TEA
RC	G3	S1	MONOTROPSIS ODORATA	SWEET PINESAP
SC	G4	S2	NESTRONIA UMBELLULA	NESTRONIA
SC	G5	S?	OROBANCHE UNIFLORA	ONE-FLOWERED BROOMRAPE
SC	G5	S?	OSMORHIZA CLAYTONII	HAIRY SWEET-CICELY
RC	G4G5	S1	PACHYSANDRA PROCUMBENS	ALLEGHENY-SPURGE
RC	G4	S2S3	PANAX QUINQUEFOLIUS	AMERICAN GINSENG
RC	G4	S1	PARNASSIA ASARIFOLIA	KIDNEYLEAF GRASS-OF-PARNASSUS
SC	G5	S1	PELLAEA ATROPURPUREA	PURPLE-STEM CLIFF-BRAKE
SC	G5	S1	PHACELIA BIPINNATIFIDA	FERNLEAF PHACELIA
SC	G5	S1	PHILADELPHUS HIRSUTUS	STREAMBANK MOCK-ORANGE
SC	G2	S?	PLAGIOCHILA CADUCILOBA	GORGE LEAFY LIVERWORT
SC	G2G3	S?	PLAGIOMNIUM CAROLINIANUM	MOUNTAIN WAVY-LEAF MOSS
SC	G5	S1	POLYGALA PAUCIFOLIA	GAY-WING MILKWORT
RC	G3G5	S1	PYCNANTHEMUM MONTANUM	SINGLE-HAIRED MOUNTAIN-MINT
SC	G5	S?	RHIZOMNIUM APPALACHIANUM	LARGE-LEAVED MNIUM
SC	G5	S?	RHODODENDRON CATAWBIENSE	CATAWBA RHODODENDRON
NC	G2	S1	RUDBECKIA HELIOPSIDIS	SUN-FACING CONEFLOWER
SC	G4	S1	SANICULA TRIFOLIATA	LARGE-FRUITED SANICLE
SC	G5	S?	SAXIFRAGA MICRANTHIDIFOLIA	LETTUCE-LEAF SAXIFRAGE
NC	G2	S2	SHORTIA GALACIFOLIA	OCONEE-BELLS
SC	G5	S1	SOLIDAGO BICOLOR	WHITE GOLDENROD

SC	G3	S1	STACHYS CLINGMANII	CLINGMAN'S HEDGE-NETTLE
SC	G5TU	S1	STACHYS TENUIFOLIA VAR LATIDENS	BROAD-TOOTHED HEDGE-NETTLE
RC	G4	S2	STEWARTIA OVATA	MOUNTAIN CAMELLIA
SC	G4?	S?	THERMOPSIS MOLLIS	SOFT-HAIRED THERMOPSIS
SC	G5T5	S?	TIARELLA CORDIFOLIA VAR CORDIFOLIA	HEART-LEAVED FOAM FLOWER
SC	G5	S?	TRAUTVETTERIA CAROLINIENSIS	CAROLINA TASSEL-RUE
RC	G4	S1	TRICHOMANES BOSCHIANUM	BRISTLE-FERN
RC	G4G5	S2	TRICHOMANES PETERSII	DWARF FILMY-FERN
SC	G3	S?	TRILLIUM DISCOLOR	FADED TRILLIUM
SC	G5	S?	TRILLIUM GRANDIFLORUM	LARGE-FLOWER TRILLIUM
FE	G1	S1	TRILLIUM PERSISTENS	PERSISTENT TRILLIUM
SC	G3	S?	TRILLIUM RUGELII	SOUTHERN NODDING TRILLIUM
SC	G3	S?	TRILLIUM SIMILE	A TRILLIUM
SC	G5	S?	TRILLIUM UNDULATUM	PAINTED TRILLIUM
SC	G4	S2	TRIPHORA TRIANTHOPHORA	NODDING POGONIA
SC	G5	S?	VIOLA CONSPERSA	AMERICAN BOG VIOLET
SC	G5TU	S?	VIOLA PUBESCENS VAR LEIOCARPON	YELLOW VIOLET
SC	G5	S?	VIOLA TRIPARTITA	THREE-PARTED VIOLET
SC	G5T?	S?	VIOLA TRIPARTITA VAR GLABERRIMA	THREE-PARTED VIOLET
SC	G5T3?	S?	VIOLA TRIPARTITA VAR TRIPARTITA	THREE-PARTED VIOLET
RC	G2?	S2	WALDSTEINIA LOBATA	PIEDMONT STRAWBERRY
SC	G4	S1	XEROPHYLLUM ASPHODELOIDES	EASTERN TURKEYBEARD

RARE, THREATENED, AND ENDANGERED SPECIES OF PICKENS COUNTY

STATUS	GRANK	SRANK	SCIENTIFIC NAME	COMMON NAME
ANIMALS:				
SC	G5T5	S5	ACRIS CREPITANS CREPITANS	NORTHERN CRICKET FROG
SC	G3G4	S1	ANEIDES AENEUS	GREEN SALAMANDER
FT	G3	S1	CLEMMYS MUHLENBERGII	BOG TURTLE
SE	G4	S2?	CORYNORHINUS RAFINESQUII	RAFINESQUE'S BIG-EARED BAT
SC	G5	S?	CROTALUS HORRIDUS	TIMBER RATTLESNAKE
SC	G5	S1	ETHEOSTOMA FLABELLARE	FANTAIL DARTER
ST	G5T5	S?	EUMECES ANTHRACINUS PLUVIALIS	SOUTHERN COAL SKINK
SC	G5	SH	FELIS CONCOLOR	MOUNTAIN LION
FE	G5TH	S1	FELIS CONCOLOR COUGUAR	EASTERN COUGAR
SC	G5	S2	LAMPROPELTIS TRIANGULUM	MILK SNAKE
SC	G5	S?	LASIURUS CINEREUS	HOARY BAT
SC	G2G3	S?	MACROMIA MARGARITA	MARGARET'S RIVER CRUISER
SC	G5	S4	MICROTUS PENNSYLVANICUS	MEADOW VOLE
ST	G3	S1	MYOTIS LEIBII	EASTERN SMALL-FOOTED MYOTIS
SC	G5	S3?	MYOTIS LUCIFUGUS	LITTLE BROWN MYOTIS
SC	G4	S3S4	MYOTIS SEPTENTRIONALIS	NORTHERN MYOTIS
SC	G5	S3S4	NEOTOMA FLORIDANA	EASTERN WOODRAT
SC	G5T4	S3S4	NEOTOMA FLORIDANA HAEMATOREIA	SOUTHERN APPALACHIAN WOODRAT
SC	G1G3	S1S3	POLYCENTROPUS CARLSONI	CARLSON'S POLYCENTROPUS CADDISFLY
SC	G5	S?	RANA PALUSTRIS	PICKEREL FROG
SC	G5	S3	RANA SYLVATICA	WOOD FROG
SC	G?	S?	SIGMORIA ARCUATA	A MILLIPEDE
SC	G5	S3S4	SOREX HOYI	PYGMY SHREW
SC	G5	S4	SPILOGALE PUTORIUS	EASTERN SPOTTED SKUNK
SC	G5	S3	SYLVILAGUS AQUATICUS	SWAMP RABBIT
SC	G4	S2?	SYLVILAGUS OBSCURUS	APPALACHIAN COTTONTAIL
SC	G5	S3?	TAMIASCIURUS HUDSONICUS	RED SQUIRREL
SC	G5	S4	TYTO ALBA	BARN-OWL
SC	G5	S3?	URSUS AMERICANUS	BLACK BEAR
SC	G5	S?	ZAPUS HUDSONIUS	MEADOW JUMPING MOUSE
PLANTS:				
SC	G4	S2	ACONITUM UNCINATUM	BLUE MONKSHOOD
SC	G5	S1	AGRIMONIA PUBESCENS	SOFT GROOVEBUR
SC	G5	S?	ALLIUM CERNUUM	NODDING ONION
SC	G4?	S?	AMORPHA GLABRA	SMOOTH INDIGOBUSH
SC	G?	S?	ANEURA MAXIMA	
SC	G5	S2	ARISTOLOCHIA MACROPHYLLA	PIPEVINE
RC	G4	S1	ASPLENIUM MONANTHES	SINGLE-SORUS SPLEENWORT
SC	G4	S1	ASPLENIUM PINNATIFIDUM	LOBED SPLEENWORT
SC	G5	S2	ASPLENIUM RHIZOPHYLLUM	WALKING-FERN SPLEENWORT
SC	G5	S?	ASPLENIUM TRICHOMANES	MAIDENHAIR SPLEENWORT
NC	G3	S1	ASTER AVITUS	ALEXANDER'S ROCK ASTER
SC	G2G3	S?	ASTER GEORGIANUS	GEORGIA ASTER
SC	G5	S?	ASTER LAEVIS	SMOOTH BLUE ASTER
SC	G5	S?	ASTER NOVAE-ANGLIAE	NEW ENGLAND ASTER
SC	G5	S?	ASTER SPECTABILIS	SHOWY ASTER
SC	G5	S1	BETULA ALLEGHANIENSIS	YELLOW BIRCH
SC	G4	S?	CAREX APPALACHICA	APPALACHIAN SEDGE
SC	G4	S?	CAREX AUSTROCAROLINIANA	A SEDGE
SC	G5	S?	CAREX EBURNEA	EBONY SEDGE
SC	G5	S1	CAREX PEDUNCULATA	LONGSTALK SEDGE
SC	G5	S?	CAREX PLANTAGINEA	PLANTAIN-LEAVED SEDGE
SC	G4	S?	CAREX PRASINA	DROOPING SEDGE
SC	G5	S?	CAREX SCABRATA	ROUGH SEDGE
RC	G5	S2	CASTILLEJA COCCINEA	SCARLET INDIAN-PAINTBRUSH
SC	G5	S2	CAULOPHYLLUM THALICTROIDES	BLUE COHOSH
SC	G1	S?	CHEILOLEJEUNEA EVANSII	

SC	G4	S?	CHELONE LYONII	PINK TURTLEHEAD
SC	G5	S?	CIMICIFUGA AMERICANA	MOUNTAIN BUGBANE
SC	G5T5	S1	CIRCAEA LUTETIANA SSP CANADENSIS	ENCHANTER'S NIGHTSHADE
RC	G4	S1	CLADRASTIS KENTUKEA	YELLOWWOOD
SC	G3	S?	COLLINSONIA VERTICILLATA	WHORLED HORSE-BALM
NC	G3	S1	COREOPSIS LATIFOLIA	BROAD-LEAVED TICKSEED
SC	G5	S?	CYPRIPEDIUM PUBESCENS	LARGE YELLOW LADY'S-SLIPPER
SC	G5	S?	CYSTOPTERIS PROTRUSA	LOWLAND BRITTLE FERN
SC	G3?	S?	DANTHONIA EPILIS	BOG OAT-GRASS
SC	G5	S?	DESCHAMPSIA FLEXUOSA	CRINKLED HAIRGRASS
NC	G3	S1	DRABA APRICA	OPEN-GROUND WHITLOW-GRASS
SC	G5	S?	DRYOPTERIS INTERMEDIA	EVERGREEN WOODFERN
FE	G2	S1	ECHINACEA LAEVIGATA	SMOOTH CONEFLOWER
SC	G5	S1	EUONYMUS ATROPURPUREUS	WAHOO
SC	G5?	S?	EUPATORIUM FISTULOSUM	HOLLOW JOE-PYE WEED
RC	G3	S1	FOTHERGILLA MAJOR	MOUNTAIN WITCH-ALDER
SC	G5	S?	GALEARIS SPECTABILIS	SHOWY ORCHIS
SC	G5	S1	GAULTHERIA PROCUMBENS	TEABERRY
SC	G5	S?	GAYLUSSACIA BACCATA	BLACK HUCKLEBERRY
SC	G4	S1	HELIANTHUS PORTERI	PORTER'S GOLDENEYE
SC	G5	S?	HEPATICA ACUTILOBA	LIVERLEAF
SC	G4	S?	HEUCHERA PARVIFLORA	LITTLE-LEAVED ALUMROOT
SC	G5	S?	HYDROCOTYLE AMERICANA	AMERICAN WATER-PENNYWORT
SC	G1G2	S?	HYMENOPHYLLUM TAYLORIAE	TUNBRIDGE FERN
NC	G4G5	S1	HYMENOPHYLLUM TUNBRIGENSE	TUNBRIDGE FERN
SC	G4G5	S?	IPOMOPSIS RUBRA	RED STANDING-CYPRESS
SC	G4?	S?	ISOETES CAROLINIANA	ENGELMANN'S QUILLWORT
FE	G1	S1	ISOETES MELANOSPORA	BLACK-SPORED QUILLWORT
SC	G3	S2	ISOETES PIEDMONTANA	PIEDMONT QUILLWORT
SC	G4	S?	JUGLANS CINEREA	BUTTERNUT
SC	G4	S?	JUNCUS GEORGIANUS	GEORGIA RUSH
SC	G4	S?	JUNCUS GYMNOCARPUS	NAKED-FRUITED RUSH
SC	G4	S?	JUNGERMANNIA FOSSOMBRONIOIDES	
SC	G3	S?	KRIGIA MONTANA	FALSE DANDELION
SC	G5	S1?	LILIUM CANADENSE	CANADA LILY
SC	G5?	S2	LONICERA FLAVA	YELLOW HONEYSUCKLE
SC	G1	S?	LOPHOCOLEA APPALACHIANA	
SC	G4	S1S2	LYGODIUM PALMATUM	CLIMBING FERN
RC	G2	S1	LYSIMACHIA FRASERI	FRASER LOOSESTRIFE
SC	G5	S?	MENISPERMUM CANADENSE	CANADA MOONSEED
SC	G4	S?	MINUARTIA UNIFLORA	ONE-FLOWER STITCHWORT
SC	G5	S?	MONARDA DIDYMA	OSWEGO TEA
RC	G3	S1	MONOTROPSIS ODORATA	SWEET PINESAP
SC	G4	S2	NESTRONIA UMBELLULA	NESTRONIA
SC	G5	S?	OENOTHERA PERENNIS	SMALL SUNDROPS
SC	G5	S?	OROBANCHE UNIFLORA	ONE-FLOWERED BROOMRAPE
RC	G4G5	S1	PACHYSANDRA PROCUMBENS	ALLEGHENY-SPURGE
RC	G4	S2S3	PANAX QUINQUEFOLIUS	AMERICAN GINSENG
RC	G3G4	S2	PARNASSIA GRANDIFOLIA	LARGE-LEAVED GRASS-OF-PARNASSUS
SC	G5	S1	PELLAEA ATROPURPUREA	PURPLE-STEM CLIFF-BRAKE
SC	G5	S?	PELLAEA WRIGHTIANA	CLIFF-BRAKE FERN
SC	G1Q	S?	PELLIA APPALACHIANA	
SC	G5	S1	PHILADELPHUS HIRSUTUS	STREAMBANK MOCK-ORANGE
SC	G2	S?	PLAGIOCHILA CADUCILOBA	GORGE LEAFY LIVERWORT
SC	G5	S1	PLATANTHERA LACERA	GREEN-FRINGE ORCHIS
SC	G5	S1	POLYGALA PAUCIFOLIA	GAY-WING MILKWORT
SC	G1Q	S?	PORELLA JAPONICA SSP APPALACHIANA	
RC	G3G5	S1	PYCNANTHEMUM MONTANUM	SINGLE-HAIRED MOUNTAIN-MINT
SC	G5	S?	RHODODENDRON CATAWBIENSE	CATAWBA RHODODENDRON
SC	G5T?	S?	RUELLIA CAROLINIENSIS SSP CILIOSA	A PETUNIA
SC	G5	S?	SANGUISORBA CANADENSIS	CANADA BURNET
FE	G3T1	S?	SARRACENIA RUBRA SSP JONESII	MOUNTAIN SWEET PITCHER-PLANT
SC	G3	S1	SAXIFRAGA CAREYANA	CAREY SAXIFRAGE
SC	G5	S?	SAXIFRAGA MICRANTHIDIFOLIA	LETTUCE-LEAF SAXIFRAGE

SC	G5T?	S?	SCIRPUS CESPITOSUS VAR CALLOSUS	TUSSOCK BULRUSH
RC	G2	S2	SENECIO MILLEFOLIUM	PIEDMONT RAGWORT
NC	G2	S2	SHORTIA GALACIFOLIA	OCONEE-BELLS
SC	G5TU	S1	STACHYS TENUIFOLIA VAR LATIDENS	BROAD-TOOTHED HEDGE-NETTLE
RC	G4	S2	STEWARTIA OVATA	MOUNTAIN CAMELLIA
SC	G5T5	S?	TIARELLA CORDIFOLIA VAR CORDIFOLIA	HEART-LEAVED FOAM FLOWER
SC	G5	S?	TRAUTVETTERIA CAROLINIENSIS	CAROLINA TASSEL-RUE
RC	G4	S1	TRICHOMANES BOSCHIANUM	BRISTLE-FERN
RC	G4G5	S2	TRICHOMANES PETERSII	DWARF FILMY-FERN
SC	G3	S?	TRILLIUM DISCOLOR	FADED TRILLIUM
SC	G3	S?	TRILLIUM RUGELII	SOUTHERN NODDING TRILLIUM
SC	G4	S2	TRIPHORA TRIANTHOPHORA	NODDING POGONIA
SC	G5TU	S?	VIOLA PUBESCENS VAR LEIOCARPON	YELLOW VIOLET
SC	G5	S?	VIOLA TRIPARTITA	THREE-PARTED VIOLET
SC	G5T3?	S?	VIOLA TRIPARTITA VAR TRIPARTITA	THREE-PARTED VIOLET
SC	G4	S1	XEROPHYLLUM ASPHODELOIDES	EASTERN TURKEYBEARD
SC	G5	S?	XYRIS TORTA	TWISTED YELLOW-EYED-GRASS