DRAFT LICENSE APPLICATION

Volume I of V

Bad Creek Pumped Storage Project
(FERC No. 2740)

February 2025

Prepared by:

HDR

Prepared for:

Duke Energy Carolinas, LLC

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Bad Creek Pumped Storage Project
FERC Project No. 2740
DRAFT LICENSE APPLICATION

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Acronyms and Abbreviations

AIP	Agreement in Principle
Bad Creek Project or Project	Bad Creek Pumped Storage Project (existing project)
Bad Creek II	Bad Creek II Power Complex (proposed project)
BCRA	Bad Creek Relicensing Agreement
CFR	Code of Federal Regulations
cfs	cubic feet per second
CUI/CEII	Controlled Unclassified Information//Critical Energy Infrastructure Information
CUI/PRIV	Controlled Unclassified Information//Privileged
Duke Energy or Licensee	Duke Energy Carolinas, LLC
Resource Plan	Duke Energy’s 2023 Carolinas Resource Plan
FERC or Commission	Federal Energy Regulatory Commission
FLA	Final License Application
FPA	Federal Power Act
FPC	Federal Power Commission
ft	feet/foot
ft msl	feet mean sea level
ILP	Integrated Licensing Process
KT Project	Keowee-Toxaway Hydroelectric Project (FERC No. 2503)
kV	kilovolt
kW	kilowatt
m	meter
mi^2	square miles
MW	megawatt
MWh	megawatt hour
PM&E	protection, mitigation, and enhancement
rpm	revolutions per minute
RROC	Regulated Renewables Operations Center
SEPA	Southeastern Power Administration
SCDNR	South Carolina Department of Natural Resources
USEPA	U.S. Environmental Protection Agency

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DRAFT LICENSE APPLICATION

BAD CREEK PUMPED STORAGE PROJECT

(FERC NO. 2740)

Executive Summary

Introduction

Duke Energy Carolinas, LLC (Duke Energy or Licensee), is the Licensee, owner, and operator of the Bad Creek Pumped Storage Project (Bad Creek Project or Project) (Federal Energy Regulatory Commission [FERC or Commission] Project No. 2740), located eight miles north of Salem in Oconee County, South Carolina. The Project is an existing, licensed, major hydroelectric project and is situated directly adjacent to Lake Jocassee. Lake Jocassee, which is part of the Keowee-Toxaway Hydroelectric Project (KT Project; FERC No. 2503), serves as the lower reservoir for pumped-storage operations and Bad Creek Reservoir serves as the upper reservoir. The Project consists of two earthen dams and a dike, an upper reservoir, inlet/outlet structures in the upper and lower reservoirs, a water conveyance system, an underground powerhouse, transmission facilities, an equipment building and switchyard, and an approximately 9.25-mile-long transmission line corridor extending from the Project to the KT Project's Jocassee switchyard. The construction of the Project took roughly 10 years, and the Project began operating in 1991. There are no federal lands associated with the Project.

An original license was issued for the Project on August 1, 1977, by the Federal Power Commission (FPC) as Project No. 2740 (59 FPC 1266). The license has been amended numerous times[1] with the most recent amendment allowing for the upgrade and rehabilitation of the four pump-turbines in the powerhouse, thereby increasing the authorized installed capacities and maximum hydraulic capacities of the pump-generator turbines.[2] As a result of this upgrade, the Project is estimated to produce about as much power as some nuclear plants, enough to power more than 1 million homes (Wells 2018). The runner upgrade program was completed in March 2024.

The current operating license for the Project expires on July 31, 2027. Accordingly, Duke Energy is pursuing a new 50-year license[3] for the Project pursuant to the Commission's Integrated Licensing Process (ILP), as described at 18 Code of Federal Regulations (CFR) Part 5. In accordance with

1 See amendments on May 2, 1978; December 27, 1989; January 25, 1993; August 11, 1997; March 23, 2007; and August 6, 2018.

2 The upgraded Project is estimated to have a rated and maximum installed capacity of approximately 1,400 MW and 1,690 MW, respectively.

3 On October 19, 2017, the Commission issued its "Policy Statement on Establishing License Terms for Hydroelectric Projects" (Policy Statement). The Policy Statement established a 40-year default license term policy for new licenses but provides for exceptions to the 40-year default license term under certain circumstances including deferring to the license term explicitly agreed to in a generally-supported comprehensive settlement agreement. As discussed in this application, Duke Energy has entered into a comprehensive settlement agreement whereby the parties to the agreement are supportive of a 50-year license term. (See Exhibit E, Appendix B.)

FERC's regulations at 18 Code of Federal Regulations (CFR) §16.9(b), Duke Energy must file its application for a new license with FERC no later than July 31, 2025.

Given the need for additional significant energy storage and renewable energy generation across Duke Energy's service territories over the Project's new license term, Duke Energy is requesting approval to construct a second powerhouse with four additional pump-generator turbines (Bad Creek II Power Complex [Bad Creek II]) at the existing site in concert with its application for continued operation of the Project. As with the existing Project, Bad Creek II would use the Bad Creek Reservoir as its upper reservoir and Lake Jocassee as its lower reservoir for pumped storage operations, and no modifications to the existing upper and lower reservoir licensed operating conditions would be required.

Duke Energy Portfolio Growth and Project Expansion

The construction of the Project took roughly 10 years and cost $1 billion – it was finished one year ahead of schedule and $90 million under budget when it opened in 1991 (Moore 2016). At the time Bad Creek was constructed, Duke Energy operated 3 nuclear stations, 8 coal-fired stations and 26 hydroelectric stations in the Carolinas, with a combined capacity of 15,500 MW. Today, the Project is one of the most powerful and flexible energy generation and storage assets in Duke Energy's system. Originally built primarily to store surplus energy from baseload nuclear and fossil fuel power plants during times of low energy demand, today the Project is used to balance an increasingly complex energy grid by storing energy from surplus baseload generation and other non-dispatchable renewables generation and providing 1,400 MW of renewable capacity and average annual energy generation of 1,884,685 megawatt hours (MWh) of power back to the grid when energy demand is higher or renewable generation is not available.

Duke Energy has worked collaboratively with customers and other stakeholders to invest in a diverse portfolio of generation resources to respond to the region's growing energy needs. The nuclear, coal, natural gas, renewables, and hydroelectric generation facilities owned by Duke Energy provide about 35,000 MW of owned electricity capacity to 4.5 million customers within its service area across North Carolina and South Carolina (Duke Energy 2023). Even with the expansion of energy efficiency and demand reduction programs, cumulative annual energy consumption in the Carolinas is expected to grow by approximately 35,000 gigawatt-hours between 2024 and 2038 (Duke Energy 2023).

The combination of growing demand and the planned retirement of older, less efficient generation resources has created an additional need for generation, much of which will be met with the addition of renewable resources. Expansion and accelerated development of Duke Energy's energy storage portfolio is a necessary complement to this renewables growth. Duke Energy presently projects procuring more than 4,400 MW of energy storage including 2,700 MW of battery storage by 2031 (Duke Energy 2023); however, the existing Project and the downstream Jocassee Pumped Storage Station have provided and will continue to provide most of the energy storage within Duke Energy's system.

Longer-duration storage from additional pumped storage capacity would provide essential system flexibility and balancing capabilities required for efficient and reliable day-to-day operations of the grid with the increase in renewable generation. The addition of a second powerhouse (Bad Creek II) is a key component of meeting this system need. The four variable-speed Bad Creek II pump-turbine units would double the installed capacity, filling a significant portion of Duke Energy's need for longer-duration storage.

Stakeholder Consultation and Relicensing Process

Duke Energy consulted federal, state, and local resource agencies; Native American tribes; local government; non-governmental organizations; and local residents throughout the relicensing process. While the ILP includes opportunities for interested stakeholders to participate in the relicensing process, Duke Energy devoted significant resources to enhancing stakeholder involvement by convening Resource Committees to oversee and participate in resource-specific relicensing studies, and the Bad Creek Relicensing Agreement (BCRA) Team to negotiate the Relicensing Agreement, a comprehensive agreement addressing the substantial aspects of the licensing proceeding. The following agencies and organizations participated in Bad Creek relicensing in this manner:

- Advocates for Quality Development, Inc.
- Catawba Indian Nation
- Fisher Knob Homeowners Association
- Foothills Trail Conservancy
- Friends of Lake Keowee Society
- Greenville Water
- Naturaland Trust
- Oconee County, SC
- SC Department of Archives and History
- SC Department of Environmental Services
- SC Department of Natural Resources
- SC Department of Parks, Recreation, and Tourism
- SC Wildlife Federation
- U.S. Fish and Wildlife Service
- Upstate Forever

The BCRA Team began its efforts in April 2024 with the development of a team charter and met monthly through signing of the BCRA, which took place on January 23, 2025. The BCRA was developed in two stages: the Agreement in Principle (AIP) followed by the BCRA. The AIP is a non-binding document with key items from cumulative negotiations of the BCRA Team, including items of agreement as well as potential items of reservation and/or dissent. The AIP served as the basis for developing the BCRA, a contract that is binding on the signatories and comprehensively addresses relicensing issues. The BCRA contains elements recommended to FERC for the "proposed action" for National Environmental Policy Act required documents (Environmental Assessment or Environmental Impact Statement) including license conditions proposed by the signatories. It includes provisions that signatories recommend FERC include in the new license, as well as resource enhancements and other stipulations that are recommended, but not intended for inclusion in the new license. Resource enhancements and other stipulations that are not included in the new license will be enforceable under state contract law.

The following agencies and organizations are signatory parties to the BCRA:

- Advocates for Quality Development, Inc.
- Catawba Indian Nation
- Duke Energy Carolinas, LLC
- Foothills Trail Conservancy
- Friends of Lake Keowee Society
- Naturaland Trust
- Oconee County, SC
- SC Department of Archives and History
- SC Department of Environmental Services
- SC Department of Natural Resources
- SC Department of Parks, Recreation, and Tourism
- SC Wildlife Federation
- Upstate Forever

The AIP, BCRA, and documentation of BCRA Team consultation are included in Exhibit E.

Summary of Proposed Action and Protection, Mitigation, and Enhancement Measures

Duke Energy is proposing continued operation of existing Project facilities, construction and operation of Bad Creek II, and a suite of protection, mitigation, and enhancement (PM&E) measures that reflect Duke Energy's long-term commitment to protecting the environment and local communities. Throughout the initial license period, Duke Energy has operated the Project consistent with FERC license requirements and worked collaboratively with stakeholders to protect resources in the Project area. That legacy was maintained during the relicensing of the KT Project and is continuing with PM&E measures proposed with this license application for the Bad Creek Project.

Existing PM&E measures for the Project include current license requirements; KT Project FERC license requirements; and contractual obligations included in the KT Relicensing Agreement and 2014 Operating Agreement between Duke Energy, the U.S. Army Corps of Engineers, and Southeastern Power Administration. Duke Energy is proposing to continue the existing measures that appropriately balance Project and non-Project purposes. Additional PM&E measures related to continued operation of the Project as well as Bad Creek II construction have been identified in consultation with relicensing stakeholders through implementation of the relicensing studies and negotiation of the BCRA. Proposed PM&E measures are summarized below; see Exhibit E for additional information as well as an evaluation of these measures.

- **Water Quality**

Duke Energy is proposing to implement a Water Quality Monitoring Plan (WQMP) in conjunction with construction of Bad Creek II. The WQMP identifies water quality and monitoring methods in the Whitewater River cove of Lake Jocassee as well as tributary streams that will potentially be affected by Bad Creek II construction activities. Site-specific monitoring prior to, during, and following Bad Creek II construction is included. The WQMP has been developed in consultation with relicensing stakeholders to ensure meaningful protective measures are in place throughout construction.

- **Reservoir Elevations**

Duke Energy is proposing to maintain the current Bad Creek Reservoir operating range of 160 feet (ft) with a Normal Maximum Elevation of 2,310 ft above mean sea level (msl) and a Normal Minimum Elevation of 2,150 ft msl. Duke Energy also proposes to incorporate the KT Low Inflow Protocol (LIP) into the new license to ensure Project pumping operations will not cause Lake Jocassee to fall below the LIP stage minimum reservoir elevation. These measures ensure pumped storage generation and storage are leveraged in a method that benefits the electrical grid while also appropriately managing lake levels during both normal and low inflow conditions.

- **Fish Protection Measures**

Duke Energy, working closely with the South Carolina Department of Natural Resources (SCDNR), has demonstrated throughout the current license its dedication to the protection of the fishery in Lake Jocassee and its tributaries. This focus will continue under the new license and BCRA with the implementation of operational measures with Lake Jocassee at normal and low elevations and changes in lower reservoir inlet/outlet structure lighting. As set forth in the BCRA, Duke Energy will also provide more than $10.5 million in funding support for fishery enhancement and management activities over the new license term.

- **Public Recreation**

The Project vicinity is known for its recreational value and Duke Energy's proposed PM&E measures will continue to support and enhance this important resource.

Duke Energy maintains 43 miles of the 77-mile-long Foothills Trail, a regionally significant long-distance National Recreation Trail. This support began during initial Project development and will continue under the new license term. Duke Energy will continue maintaining this portion of the trail in partnership with the Foothills Trail Conservancy, provide additional enhancements to ensure the continued well-being and longevity of the trail, and, through the BCRA, provide significant funding for management of back-country roads within the Jocassee Gorges area and land conservation efforts. Duke Energy is also offering to lease, at no cost, approximately 1,900 acres to the South Carolina Department of Natural Resources for hunting, wildlife viewing, and public recreation.

- **Cultural Resources**

Duke Energy is proposing to implement a Project Historic Properties Management Plan. The Historic Properties Management Plan includes measures to protect the only identified archaeological site at the Project eligible for inclusion in the National Register of Historic Places (Historic Properties), develop an interpretative exhibit highlighting the history and development of the Project, and consult with the South Carolina State Historic Preservation Office and tribes regarding actions that could affect Historic Properties.

- **Visual Resources**

The Upstate of South Carolina is renowned for its scenic beauty. Duke Energy is proposing measures to reduce the visual effects associated with existing Project facilities as well as measures to minimize the visual effects associated with Bad Creek II. These measures include the selection of paint colors and materials for structures that reduce visual contrast with the surrounding environment, reducing external lighting as practicable and safe, and other measures to reduce the effect of the existing Project and Bad Creek I on the aesthetics of the area.

- **Species Protection**

The Project is in an area renowned for its biodiversity. Duke Energy's proposed PM&E measures provide for the protection and enhancement of wildlife and botanical species including species protected under the Endangered Species Act, bald eagle, migratory birds, bats, botanical species, reptiles and amphibians, and habitat for these species. These measures will help ensure the Project area continues to host a large and diverse assemblage of plants, animals, and insects.

Application Road Map

The application consists of the following volumes. [Note: The Licensee has noted throughout this document sections that will be provided in the Final License Application.]

Volume I of V (Public)

- **Executive Summary**
- **Initial Statement and Additional Information Required by 18 CFR §4.32**

- **Exhibit A – Project Description**
- **Exhibit B – Project Operations and Resource Utilization**
- **Exhibit C – Construction History and Proposed Construction Schedule**
- **Exhibit D – Costs and Financing**

Volume II of V (Public)

- **Exhibit E – Environmental Report:** Includes study reports, the BCRA, management plans, and the consultation record.

Volume III of V (Public)

- **Exhibit F – List of General Design Drawings:** Includes the list of design drawings filed as Critical Energy Infrastructure Information (CUI//CEII) in accordance with 18 CFR §388.112 in Volume IV.
- **Exhibit G – Project Boundary Maps:** Includes map showing the Project Boundary for the Bad Creek Pumped Storage Project (*Electronic project boundary files to be included with the FLA*.)
- **Exhibit H – Ability to Operate:** Describes the commitment and responsibility of Duke Energy as a Licensee to continue to operate and maintain the Project and the needs and costs for power from the Project or alternate sources.

Volume IV of V (Controlled Unclassified Information [CUI]/Critical Energy Infrastructure Information [CEII])

- **Exhibit F – General Design Drawings, Supporting Design Report**
- **Exhibit H – Single Line Drawing**

Volume V of V (CUI/Privileged [PRIV])

- **Cultural Resources Study Report**

DRAFT LICENSE APPLICATION

BAD CREEK PUMPED STORAGE PROJECT

(FERC NO. 2740)

Initial Statement (18 CFR §4.41(a))

BEFORE THE UNITED STATES OF AMERICA FEDERAL ENERGY REGULATORY COMMISSION

BAD CREEK PUMPED STORAGE PROJECT (FERC NO. 2740)

APPLICATION FOR A NEW LICENSE FOR A MAJOR MODIFIED PROJECT

(1) Duke Energy Carolinas, LLC (Duke Energy or Licensee or Applicant) applies to the Federal Energy Regulatory Commission (FERC or Commission) for a new license for the Bad Creek Pumped Storage Project (Bad Creek or Project) (FERC Project No. 2740), as described in the attached exhibits. The current license for the Project was issued on August 1, 1977, and expires on July 31, 2027.

(2) The location of the Project is:

State or territory:	South Carolina
County:	Oconee
Township or nearby town:	Town of Salem
Stream or other body of water:	Bad Creek and West Bad Creek

(3) The exact name, address and telephone number of the Applicant are:

Duke Energy Carolinas, LLC
Jeffrey G. Lineberger, P.E.
General Manager of Water Strategy, Hydro Licensing & Lake Services
Mail Code DEP-35B
525 South Tryon Street
Charlotte, NC 28202
(704) 382-5942

(4) The exact name, address and telephone number of each person authorized to act as agent for the Applicant in this application are:

Alan Stuart
Hydro Licensing Project Manager
Duke Energy Carolinas, LLC
Mail Code DEP-35B
525 South Tryon Street
Charlotte, NC 28202
(980) 373-2079
Alan.Stuart@duke-energy.com

Garry S. Rice Esq.
Deputy General Counsel
Duke Energy Carolinas, LLC
525 South Tryon Street
Charlotte, NC 28202
(704) 382-8111
Garry.Rice@duke-energy.com

(5) The Applicant is a domestic corporation and is not claiming preference under Section 7(a) of the Federal Power Act. See 16 U.S.C. 796.

(6) The statutory or regulatory requirements of the state in which the Project is located that affect the Project as proposed with respect to bed and banks and the appropriation, diversion, and use of water for power purposes, and with respect to the right to engage in the business of developing, transmitting, and distributing power and in any other business necessary to accomplish the purposes of the license under the Federal Power Act are: the 401 Water Quality Certification.

Pursuant to Section 401 of the Clean Water Act, 33 U.S.C. § 1341(a), Duke Energy must obtain a Water Quality Certification from the state in which the applicable release occurs, unless the state authority waives this requirement. Any applicable release resulting from the operation of the Project occurs wholly within the State of South Carolina. The South Carolina Department of Environmental Services (SCDES) administers Water Quality Certifications pursuant to S.C. Code Ann. § 48-1-10, et seq.

The steps which the Applicant has taken, or plans to take, to comply with each of the laws cited above are: The applicant will apply for the Section 401 Water Quality Certification per 18 Code of Federal Regulations (CFR) § 5.23(b). Under Section 401 of the Clean Water Act (CWA) (33 USC § 1251 et seq.), a federal agency may not issue a license or permit to conduct activities that may result in any discharge into waters of the United States unless the state or authorized tribe where the discharge would originate either issues a Section 401 Water Quality Certification finding compliance with existing water quality requirements or waives the certification requirement.

Duke Energy will prepare an application seeking Water Quality Certification for the Project, including the addition of the Bad Creek II Power Complex (Bad Creek II), in parallel with the FERC licensing process and intends, to the greatest extent possible, to use licensing documents including but not limited to study reports and the license application exhibits to satisfy this parallel regulatory process.

(7) Brief Project Description: Duke Energy is the owner and operator of the Bad Creek Pumped Storage Project located on Bad Creek and West Bad Creek in Oconee County, South Carolina. The Project is located about 8 miles north of the Town of Salem. The Project was constructed over approximately 10 years (completed in 1991) and has been

operated by Duke Energy for hydroelectric power generation since 1991. The Project provides up to 1,400 megawatts (MW) of renewable capacity.

Existing Project works are as follows:

(1) a 363-acre upper reservoir with a storage capacity of 35,513 acre-feet, of which 31,808 acre-feet is usable storage capacity between minimum elevation 2,150 feet mean sea level (ft msl) and full pond elevation of 2,310 ft msl; (2) a rockfill impervious core dam with crest elevation at 2,315 ft msl about 2,600 feet long and 360 feet high across Bad Creek; (3) a rockfill impervious core dam with crest elevation at 2,315 ft msl about 900 feet long and 170 feet across West Bad Creek; (4) a saddle dike with crest elevation at 2,313 ft msl about 960 feet long and 90 feet high across a natural depression on the eastern rim of the reservoir; (5) an ungated water intake structure in the upper reservoir; (6) a concrete-lined main shaft, power tunnel, and manifold, totaling 5,026 feet long and 29.53 feet in diameter, connecting to 4 concrete, steel-lined penstocks about 386 feet long and varying from 13.78 to 8.43 feet in diameter; (7) an underground powerhouse containing four reversible pump-generating units, with a nameplate rating of 350,000 kilowatts each for a total generating capacity of 1,400 megawatts; (8) four concrete-lined draft tube tunnels about 316 feet long and 16.4 feet diameter, connecting by means of a manifold structure to two concrete-lined tailrace tunnels about 875 feet long and 24.61 feet diameter; (9) a discharge (inlet/outlet) structure equipped with four 20-foot by 30-foot, steel lift gates located in the existing Lake Jocassee which serves as the lower reservoir; (10) transmission facilities consisting of (a) the generator leads, (b) the electrical bus housed in a vertical shaft about 528 feet high and 29.5 feet in diameter leading from the underground powerhouse to (c) four above ground 19/525-kilovolt (kV) step-up transformers, (d) a 100-kV transmission line extending about 9.25 miles from the Bad Creek switchyard to the Jocassee switchyard, (e) a 525-kV transmission line extending about 9.25 miles from the Bad Creek II switchyard to the Jocassee switchyard; and (11) appurtenant facilities.

The Bad Creek II proposed Project works are as follows:

(1) a submerged horizontal water intake structure in the upper reservoir; (2) two low-pressure headrace tunnels averaging approximately 1,130 ft long with isolation gates; (3) two vertical shafts approximately 787 ft long and 30 ft in diameter; (4) two high-pressure headrace tunnels approximately 2,124 ft long and 30 ft in diameter; (5) four concrete steel-lined penstocks approximately 346 ft long varying from 10 to 15 ft in diameter; (6) an underground powerhouse containing four variable-speed reversible pump-generating units with a nameplate rating of 350,000 kilowatts each for a total generating capacity of 1,400 megawatts; (7) four draft tube tunnels about 295 ft long and 18 ft in diameter, connecting by means of a manifold structure to two concrete-lined tailrace tunnels about 1,820 ft long and 31 ft in diameter; (8) a lower reservoir inlet/outlet structure equipped with four steel lift gates located in the existing Lake Jocassee which serves as the lower reservoir; (9) transmission facilities consisting of (a) the generator leads, (b) the electrical bus housed in a vertical shaft about 960 ft high and approximately 18 ft in diameter leading from the underground powerhouse to (c) four above ground 19/525-kV step-up

transformers, (d) a 525-kV transmission line extending about 9.25 miles from the Bad Creek II switchyard to the Jocassee switchyard; and (10) appurtenant facilities. All tunnels would be fully lined with concrete for stability and to reduce hydraulic losses.

(8) The Project does not occupy any lands of the United States.

(9) The Project is an existing constructed project. Duke Energy is proposing to construct a second powerhouse with four variable speed, reversible pump-turbine units.

Additional Information Required by 18 CFR § 4.32(a)

(1) Identify every person, citizen, association of citizens, domestic corporation, municipality, or state Identify every person, citizen, association of citizens, domestic corporation, municipality, or state that has or intends to obtain and will maintain any proprietary right necessary to construct, operate, or maintain the project:

Duke Energy presently holds and will continue to hold the proprietary rights necessary to operate and maintain the Project.

(2) Identify (providing names and addresses):

i. Every county in which any part of the project, and any Federal facilities that would be used by the project would be located:

Name	Address
Oconee County, South Carolina	Amanda Brock Oconee County 415 S. Pine Street Walhalla, SC 29691

ii. The names and addresses of every city, town or similar local political subdivision in which any part of the Project, and any Federal facilities that would be used by the Project, are located or that has a population of 5,000 or more people and is located within fifteen (15) miles of the project dam are as follows:

Name	Address
Town of Salem, SC	Honorable Mayor Lynn Towe 5A Park Ave Salem, SC 29676-3304

There are no Federal lands or facilities associated with the Project.

iii. Every irrigation district, drainage district, or similar special purpose political subdivision:

A. In which any part of the project, and any Federal facilities that would be used by the project, would be located, or (B) That owns, operates, maintains, or uses any project facilities or any Federal facilities that would be used by the project:

There are no irrigation or drainage districts, or similar special purpose political subdivisions associated with or in the general area of the Project. There are no federal lands or facilities within the existing or proposed expanded Project.

iv. Every other political subdivision in the general area of the Project that there is reason to believe would likely be interested in, or affected by, the application.

There are no other political subdivisions in the general area of the Project that there is reason to believe would likely be interested in, or affected by, the application.

v. All Indian tribes that may be affected by the Project:

Tribe	Address
Catawba Indian Nation	1536 Tom Steven Rd Rock Hill, SC 29730
Cherokee Nation	22361 Bald Hill Road Tahlequah, OK 74464
Eastern Band of Cherokee Indians	Qualla Boundary P.O. Box 455 Cherokee, NC 28719
Muscogee (Creek) Nation	P.O. Box 580 Okmulgee, OK 74447
United Keetoowah Band of Cherokee Indians	18263 W. Keetoowah Circle Tahlequah, OK 74465

VERIFICATION

(To be included in Final License Application)

This application is executed in the

State of: South Carolina

County of: Oconee

[Name]
[Title]
Duke Energy Carolinas, LLC
[Address]
[Address]

The undersigned being duly sworn, deposes and says that the contents of this application are true to the best of his knowledge or belief. The undersigned applicant has signed this application this ___ day of [Month], 2025.

____
[Name]

Subscribed and sworn to before me, a Notary Public of the State of South Carolina, this ___ day of [Month], 2025.

____
Notary Public

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DRAFT LICENSE APPLICATION

BAD CREEK PUMPED STORAGE PROJECT

(FERC NO. 2740)

EXHIBIT A

PROJECT DESCRIPTION

Exhibit A - Project Description (18 CFR §4.41(b))

A.1 Project Overview and Location

Duke Energy Carolinas, LLC (Duke Energy or Licensee), is the Licensee, owner, and operator of the Bad Creek Pumped Storage Project (Bad Creek Project or Project) (Federal Energy Regulatory Commission [FERC or Commission] Project No. 2740), located on Bad Creek and West Bad Creek in Oconee County, eight miles north of Salem, South Carolina.

The Project is an existing, licensed, major hydroelectric project that is situated directly adjacent to Lake Jocassee, which is part of the Keowee-Toxaway Hydroelectric Project (KT Project; FERC No. 2503). Lake Jocassee serves as the lower reservoir for Project pumped-storage operations and Bad Creek Reservoir serves as the upper reservoir. The Project consists of two dams, an upper reservoir, an intake structure, penstocks, a powerhouse, a transmission line, a substation, and appurtenances.

An original license was issued for the Project on August 1, 1977, by the Federal Power Commission as Project No. 2740 (59 FPC 1266). The license was subsequently amended on May 2, 1978; December 27, 1989; January 25, 1993; August 11, 1997; March 23, 2007; and August 6, 2018.

Duke Energy is proposing to construct the Bad Creek II Power Complex (Bad Creek II) a second powerhouse and associated facilities as described in this Exhibit A.

Figure A-1 provides an overview of the Project setting and the proposed FERC Project Boundary[1].

[1] Duke Energy is proposing an expanded Project Boundary to encompass the proposed Bad Creek II. Refer to Exhibit G for a comparison of the proposed Project Boundary to the existing one provided in original license Exhibits J and K and described in the original license order.

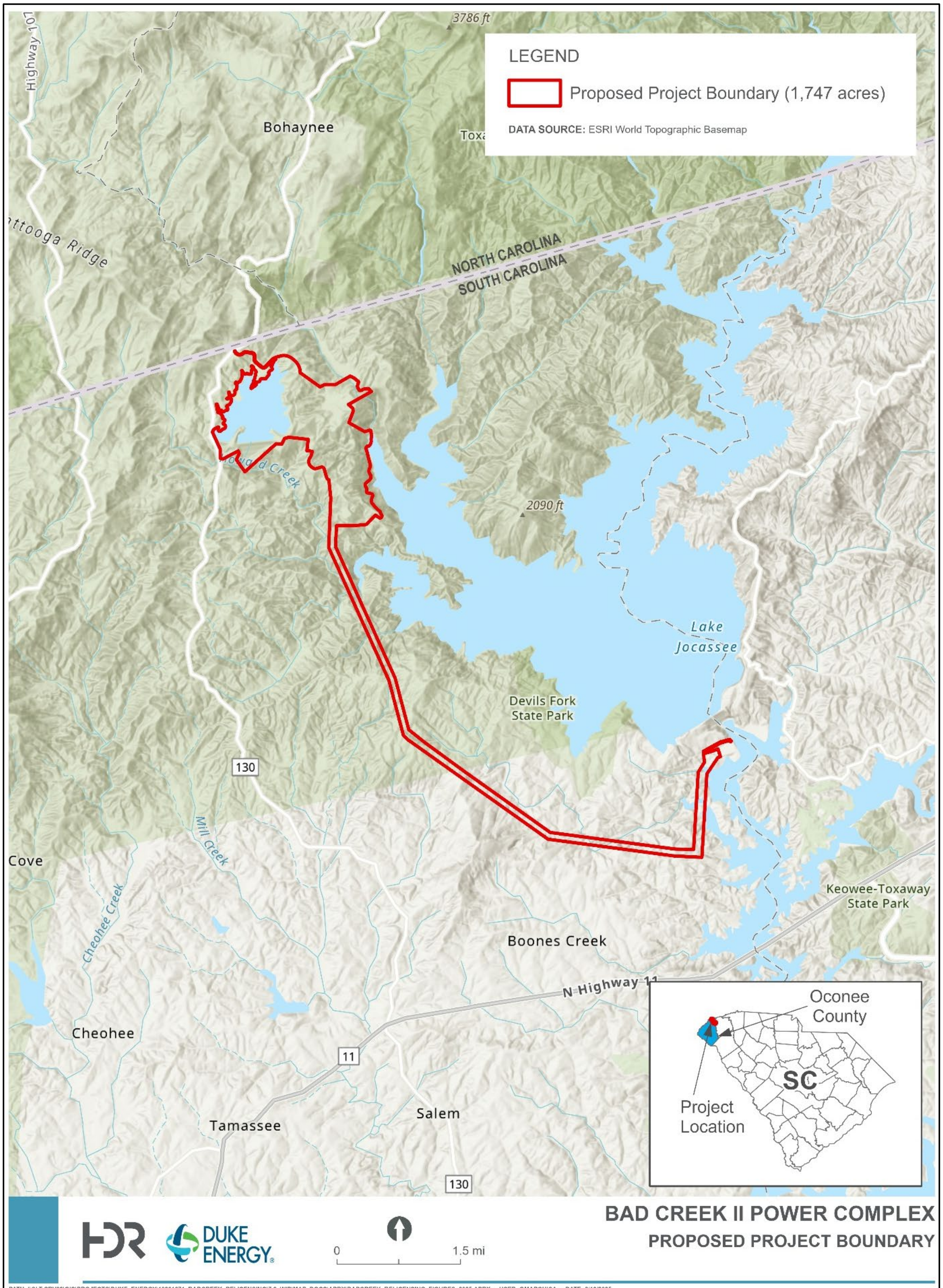


Figure A-1. Project Location Map and Proposed Project Boundary

A.2 Project Description

The Project is an existing, licensed, major hydroelectric project and is situated directly adjacent to Lake Jocassee. Lake Jocassee, which is part of the Keowee-Toxaway Hydroelectric Project (KT Project; FERC No. 2503), serves as the lower reservoir for pumped-storage operations and Bad Creek Reservoir serves as the upper reservoir. Construction of the Project took approximately ten years and the Project became operational in 1991. Per 18CFR§11.1(i), it has an authorized installed capacity of 1,400 megawatts (MW) and a maximum installed capacity of 1,690 MW.

The Project consists of two earthen dams and a dike, an upper reservoir, inlet/outlet structures in the upper and lower reservoirs, a water conveyance system, an underground powerhouse, transmission facilities, an equipment building and switch yard, and an approximately 9.25-mile-long transmission line corridor extending from the Project to the KT Project's Jocassee switchyard. The facility is currently operated as a daily cycling facility with the upper reservoir typically operating between the elevations of 2,310 and 2,250 ft msl. Lake Jocassee is operated between 1,110 and 1,080 ft msl; the lower reservoir inlet/outlet structure is located on the west shore of the Whitewater River arm of Lake Jocassee. The Project site is located entirely on Duke Energy-owned property. A portion of the transmission line corridor associated with the Project is owned in fee simple and a portion is in easement. There are no federal lands associated with the Project.

The existing facilities and structures described in Sections A.3 and A.5 below are also shown on the Project drawings included in Exhibit F (filed as Critical Energy/Electric Infrastructure Information [CEII] in accordance with 18 CFR §388.112) of this application.

A.3 Existing Project Facilities

Project works consist of: (1) a 363-acre upper reservoir (based on 2018 LiDAR data) with a storage capacity of 35,513 acre-feet, of which 31,808 acre-feet is usable storage capacity between minimum elevation 2,150 feet mean sea level (ft msl) and full pond elevation of 2,310 ft msl; (2) a rockfill impervious core dam with crest elevation at 2,315 ft msl about 2,600 feet long and 360 feet high across Bad Creek; (3) a rockfill impervious core dam with crest elevation at 2,315 ft msl about 900 feet long and 170 feet across West Bad Creek; (4) a saddle dike with crest elevation at 2,313 ft msl about 900 feet long and 90 feet high across a natural depression on the eastern rim of the reservoir; (5) an ungated water intake structure in the upper reservoir; (6) a concrete-lined main shaft, power tunnel, and manifold, totaling 5,026 feet long and is 29.53 feet in diameter, connecting to four concrete, steel-lined penstocks about 386 feet long and varying from 13.78 to 8.43 feet in diameter; (7) an underground powerhouse containing four reversible pump-generating units, with a nameplate rating of 350,000 kilowatts each for a total generating capacity of 1,400 MW; (8) four concrete-lined draft tube tunnels about 316 feet long and 16.4 feet diameter, connecting by means of a manifold structure to two concrete-lined tailrace tunnels about 875 feet long and 24.61 feet diameter; (9) an inlet/outlet structure equipped with four 20-foot by 30-foot, steel lift gates located in the existing Lake Jocassee which serves as the lower reservoir; (10) transmission facilities consisting of (a) the generator leads, (b) the electrical bus housed in a vertical shaft about 528 feet high and 29.5 feet in diameter leading from the underground powerhouse to (c) four above ground 19/525-kV step-up transformers, (d) a 100-kV transmission line extending about 9.25 miles from the Bad Creek switchyard to the Jocassee switchyard, (e) a 525-kV transmission line extending about 9.25 miles from the Bad Creek switchyard to the Jocassee switchyard; and (11) appurtenant facilities.

These facilities are further described below and are shown on Figure A-2.

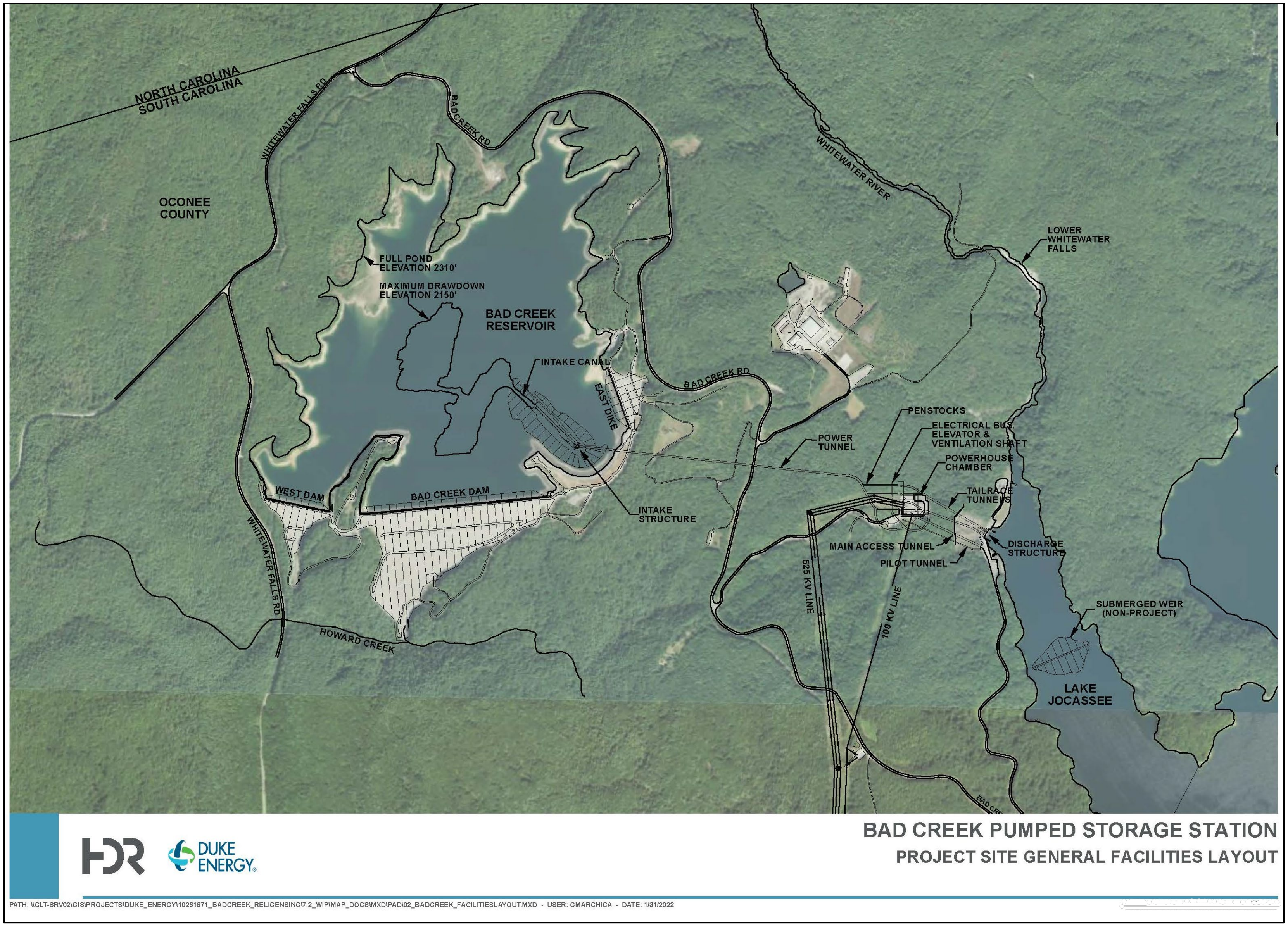


Figure A-2. Bad Creek Project Existing Facilities Layout

A.3.1 Reservoirs

A.3.1.1 Bad Creek Reservoir (Upper Reservoir)

The Project was originally planned to be utilized as a weekly cycling facility with approximately 6 hours of generation per day, 5 days per week, with additional unit operations to support load-following needs coupled with pumping during low nighttime load. The facility is currently operated as more of a daily cycling facility with the upper reservoir typically operating between the elevations of 2,310 and 2,250 ft msl. Such an operating mode permits Duke Energy to maximize head, energy density, and plant/unit efficiency. The upper reservoir (Figure A-3) is impounded by two large dams (main dam and west dam) and a saddle dike (east dike). The maximum reservoir drawdown is 160 feet with a power storage of 31,392 acre-feet.

Table A-1 contains Bad Creek upper reservoir data. Reservoir storage capacity curves are included in Exhibit B.

Table A-1. Bad Creek Upper Reservoir Data

Drainage area	1.36 square miles
Shoreline length at normal full pond elevation	5.1 miles
Surface area at normal full pond elevation	363 acres
Maximum depth	310 feet
Permanent crest of dam elevation	Main and west dams = 2,315 feet msl Saddle dike = 2,313 feet msl
Normal full pond elevation	2,310 feet msl
Gross storage capacity	35,513 acre-feet

Figure A-3. Aerial View of the Bad Creek Upper Reservoir

A.3.1.2 Lake Jocassee (Non-Project Lower Reservoir)

Lake Jocassee, licensed as part of the KT Project (FERC Project No. 2503), serves as the lower reservoir. At full pond (1,110 ft msl), the lower reservoir, Lake Jocassee (Figure A-4.), has a water surface area of approximately 7,980 acres and a storage capacity of approximately 1,206,798 acre-ft with 92.4 miles of shoreline. The usable storage (1,110 – 1,080 ft msl) is 225,447 acre-ft. At full pond, the Lake Jocassee water surface is approximately 40 ft above the top of the Bad Creek Project inlet/outlet structure openings. At the maximum drawdown elevation of 1,080 ft msl, the Lake Jocassee water surface is approximately 10 ft above the top of the Bad Creek Project lower inlet/outlet structure openings.

Figure A-4. Lower Reservoir (Whitewater River Arm of Lake Jocassee), Lower Inlet/Outlet Structure, and Powerhouse Portal Area

A.3.2 Submerged Weir in Lower Reservoir

While not part of the licensed project works, the submerged weir in Lake Jocassee is a notable feature associated with construction of the Project. The weir is located approximately 1,800 ft downstream of the Project discharge and crest of the submerged weir is between 1,060 and 1,070 ft msl. The function of the constructed weir is to help minimize the effects of Bad Creek Project operations on the natural stratification of Lake Jocassee. The weir prevents the mixing of warmer water from the pumped storage discharge with the cooler water in the lower layer of the lake, for the protection of cold-water fish habitat. The weir also serves to dissipate the energy of the discharging water. It was originally built out of nearly half a million cubic yards of rock excavated during initial Project construction (excavation of underground powerhouse and tunnels).

A.3.3 Dams

The dams (National Inventory Dam ID SC83011), from right (west) to left (east), consist of the West Dam, Main Dam, and East Dike. The dams were constructed of a silty sand central core supported by rockfill shells with granular filters that provide material transition and seepage control to prevent internal erosion. Table A-2 contains information about the Project dams and saddle dike (Duke Power 1991).

Table A-2. Bad Creek Reservoir Dam Data

Description	Main Dam	West Dam	Saddle/East Dike
Type	Rockfill impervious core	Rockfill impervious core	Rockfill impervious core
Length along Base Line	2,581 feet	908 feet	960 feet
Maximum Height	360 feet	170 feet	90 feet
Maximum Width at Base	1,850 feet	1,080 feet	580 feet
Crest Elevation	2,315 feet msl	2,315 feet msl	2,313 feet msl
Crest Width	30 feet	30 feet	30 feet
Foundation Material	Soil	Soil	Soil

A.3.4 Inlet/Outlet Structures

A.3.4.1 Upper Reservoir Inlet/Outlet Structure

The existing upper reservoir inlet/outlet system consists of an intake channel, a dewatering dam, and a bellmouth inlet located in the southeast portion of Bad Creek Reservoir. The intake channel (Figure A-5) is a rectangular basin excavated into rock with a width of 75 ft at the shaft increasing to 140 ft at the channel entrance. When tunnel dewatering is performed, a dewatering dam is used to keep the intake channel dry without fully dewatering the upper reservoir. Located midway in the intake channel, this dewatering dam is a concrete gravity structure with a height of 30 ft. The structure includes two 42-inch sluice gates, equipped with operators accessible from a steel walkway affixed to the top of the concrete structure. The bellmouth inlet has a 50.9-ft diameter opening tapering to 29.5 ft. The tapered inlet serves as a means of transition from the slower velocities of the intake channel to the higher velocities of the power tunnel.

Figure A-5. Upper Reservoir Intake Channel; (left) Prior to Initial Reservoir Fill and (right) Under Full Reservoir Drawdown Condition

A.3.4.2 Lower Reservoir Inlet/Outlet Structure

The lower reservoir inlet/outlet structure (Figure A-6) is located on the west shore of the Whitewater River arm of Lake Jocassee. The structure, which is primarily of reinforced concrete construction, measures 118 ft long, 15 ft wide, and 95 ft tall. The structure is supported by tiebacks extending into bedrock. The tailrace tunnels penetrate the structure near the invert (1,050 ft msl), which is below the Lake Jocassee maximum drawdown elevation (1,080 ft msl). The inlet/outlet structure is equipped with four (4), 20-foot by 30-foot, steel lift gates and is equipped with structural steel trashracks. A gantry crane is provided to lift the gates.

Figure A-6. Lower Reservoir Inlet/Outlet Structure

A.3.5 Water Conveyance System

In the turbine mode, water is conveyed from the upper reservoir to Lake Jocassee via the submerged inlet/outlet structure transitioning to a 29.5-ft-diameter shaft. This shaft extends vertically 856 ft and then elbows into the power tunnel, which is sloped toward the powerhouse at approximately a 7.0 percent grade. Near the powerhouse, the power tunnel transitions into a manifold tunnel branching into four penstock tunnels with diameters from 13.8 ft to 8.4 ft. The total length of the water conveyance system from the main shaft to the manifold is 5,026 ft. From the penstock tunnels, the flow passes through a reducer cone into 8.43-ft-diameter penstocks, then through the turbines, and exiting the powerhouse via four approximately 316-ft-long and 16.4-ft-diameter draft tube tunnels. The draft tube tunnels merge into two approximately 875-ft-long and 24.6-ft-diameter tailrace tunnels discharging into Lake Jocassee through the lower reservoir inlet/outlet control structure. Draft tube gates are provided in each draft tube tunnel to allow individual unit isolation of the draft tube from the tailwater.

The water conveyance tunnels and shafts are lined with cast-in-place concrete. The four penstock tunnels are steel lined with cast-in-place concrete. The steel lining extends approximately 213 ft upstream from the powerhouse. Four hydraulically operated spherical valves, each with a 9-ft inside diameter, are provided, one for each unit, to isolate the pump-turbine from headwater during inspection or maintenance work.

A.3.6 Underground Powerhouse

A.3.6.1 Powerhouse Access Tunnel and Vertical Shaft

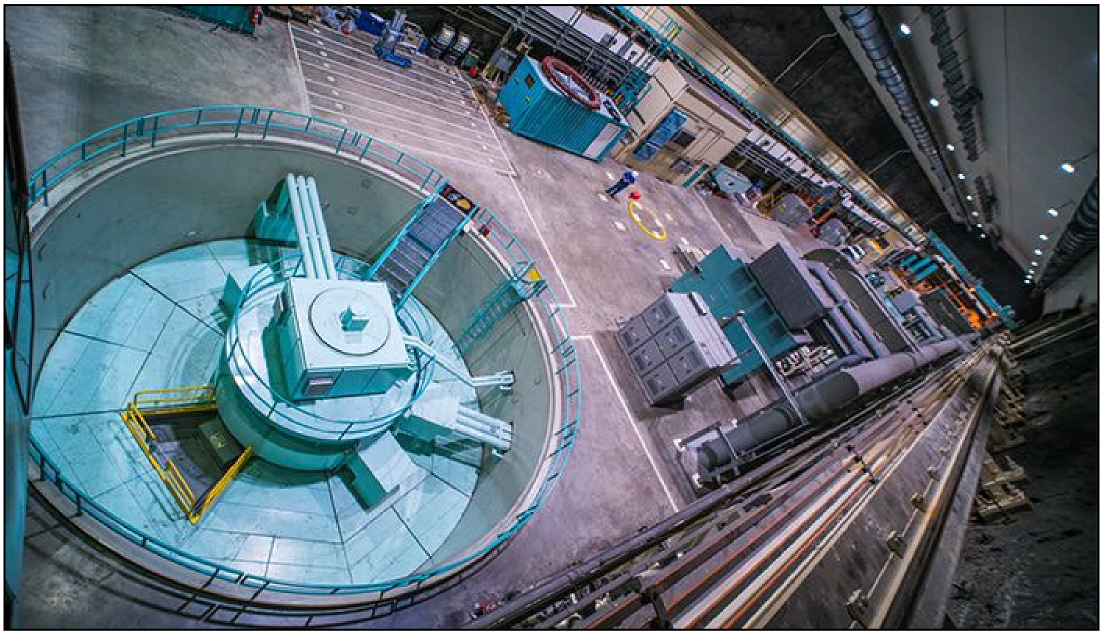
Access to the powerhouse is provided by a 29.5-ft-wide by 26.2-ft-high access tunnel (Figure A-7). The tunnel is approximately 1,186 ft long and enters the powerhouse at an elevation of 1,005.9 ft msl. The tunnel invert accommodates a two-lane paved road. Access to the powerhouse is also provided by a stairwell and elevator in the vertical access shaft at the equipment building. The vertical shaft is recessed in the downstream face of the powerhouse chamber. The shaft also houses the isolated phase bus lines from the generators and major heating, ventilation, and air conditioning equipment ducts for bus cooling.

Source: Moore 2016

Figure A-7. Bad Creek Project Entrance Tunnel

A.3.6.2 Powerhouse

The powerhouse (Figure A-8 and Figure A-9) is a three-level structure located in a mined rock cavern about 600 ft underground below the equipment control building and 1,186 ft upstream of the main access tunnel portal. The cavern is approximately 75 ft wide, 164 ft high, and about 433 feet long. It contains a service bay and four pump-turbine motor-generators. The powerhouse is constructed of reinforced concrete up to and including the operating floor at 1,015 ft msl. There are intermediate floors housing mechanical and electrical equipment. The four single-speed pump/turbine-motor/generator units are supported on mass concrete foundations transferring the operating loads to the surrounding rock. Major equipment is serviced by one 475-ton overhead bridge crane.



Source: Moore 2016

Figure A-8. View of the Inside of the Bad Creek Project Powerhouse

Figure A-9. Bad Creek Project Operating Deck

A.3.6.3 Equipment Building

A 43.5-ft-high, steel construction, above-ground equipment building at the Bad Creek Project is located approximately 469.2 ft above the underground powerhouse and contains the original control complex (it should be noted the control room was subsequently relocated to the underground powerhouse) and diesel generators as well as other major electrical and heating, ventilation, and air conditioning equipment. A vertical access shaft connects the powerhouse to the equipment building and contains an elevator, stairwell, and the isolated phase bus conveying current from the generators to the step-up transformers.

A.3.7 Access Roads

Access to the Bad Creek Project is provided by a 4.8-mile-long paved road leading from the Project entrance at SC Highway 130 to the powerhouse portal area at Lake Jocassee. The road alignment is based on a maximum 10 percent grade and a minimum 100-ft radius of curvature.

A.3.8 Transmission Facilities

Project transmission facilities consist of the following:

- Generator leads and the electrical bus housed in a vertical shaft about 528-ft-high and 29.5 ft in diameter leading from the underground powerhouse to four above-ground 19/525-kV step-up transformers.
- A 100-kV transmission line extending about 9.25 miles from the Bad Creek switchyard to the Jocassee switchyard. The 100-kV line is supported by standard steel lattice towers along the common right-of-way it shares with the 525-kV line and by wooden H-frame structures from Jocassee to the common right-of-way.
- A 525-kV transmission line (Figure A-10) extending about 9.25 miles from the Bad Creek switchyard to a grid intertie at the Jocassee switchyard. The 525-kV line is supported by standard single circuit steel lattice structures spaced between 1,000 ft and 1,500 ft apart.

The two lines share a common 254-ft-wide right-of-way corridor for 7.4 miles, at which point they diverge toward their respective destinations. The total length of the transmission corridor from the Bad Creek Project into the Jocassee Tie Station is approximately 9.25 miles.

The Project's existing facilities layout is shown on Figure A-11 and the single-line electrical diagram is being filed as CEII.

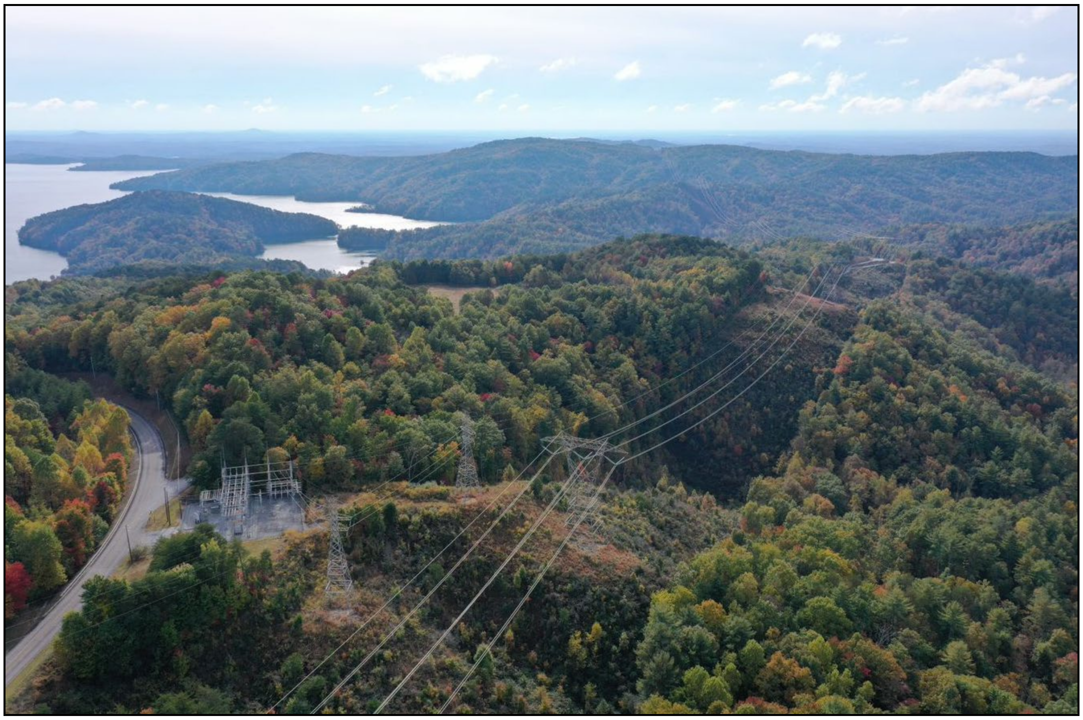


Figure A-10. 525-kV Transmission Line and Corridor

A.4 Bad Creek II

Bad Creek II would utilize the existing Project upper and lower reservoirs (Bad Creek Reservoir and Lake Jocassee, respectively). Bad Creek II would consist of a new upper reservoir inlet/outlet structure in Bad Creek Reservoir, water conveyance system, underground powerhouse, and lower reservoir inlet/outlet structure in Lake Jocassee. No modifications to the existing upper and lower reservoirs would be required for Bad Creek II other than construction of the inlet/outlet structures (Figure A-11). The construction of Bad Creek II would require an expansion of the existing FERC Project Boundary to encompass facilities required for the operation and maintenance of the Project (see Figure A-1).

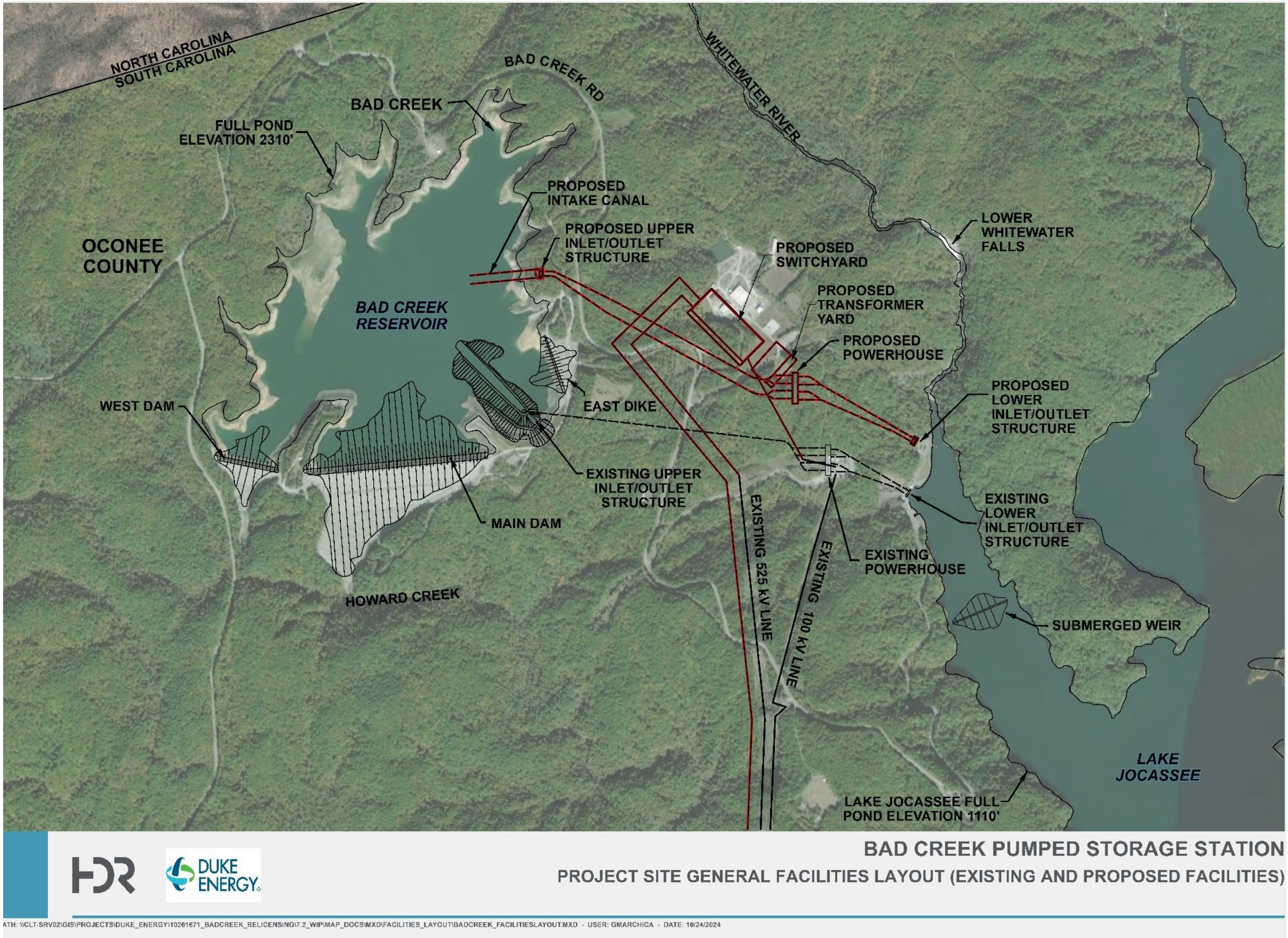


Figure A-11. Proposed Bad Creek II Facilities Layout (Major Existing Bad Creek Project Facilities also Shown)

A.4.1 Submerged Weir in Lower Reservoir

Excavation required for construction of Bad Creek II will result in a significant quantity of earth and rock (or "spoil") material. According to preliminary studies and estimates for proposed material removed from underground excavations, approximately 4.4 million cubic yards of spoil material for the Project infrastructure will need to be deposited into potential spoil area locations. Similar to the construction of the original Project, rock material removed from the underground excavations will be added to the existing submerged weir in Lake Jocassee, expanding the downstream slope of the existing structure. Approximately one million cubic yards of material will be added to the existing submerged weir. Flow modeling studies have been performed in the Whitewater River cove as part of the relicensing (see Exhibit E) and results indicate adding material to the weir does not result in a change in vertical mixing or velocities.

A.4.2 Inlet/Outlet Structures

A.4.2.1 Upper Reservoir Inlet/Outlet Configuration

The upper reservoir inlet/outlet will be a submerged, reinforced concrete structure located along the shore of Bad Creek Reservoir measuring approximately 150 ft wide, 30 ft deep, and 40 ft tall. Four tunnels will penetrate the structure at approximate invert elevation of 2,083 ft msl. Each tunnel inlet will be fitted with a coarse opening trashrack to protect against entraining large stones and/or debris into the water conveyance tunnels. Isolation gates and access shafts will be provided downstream of the inlet/outlet to permit dewatering of either or both of the headrace tunnels without impact to the upper reservoir operations. The intake channel will have a maximum invert elevation of 2,130 ft msl (at the reservoir interface), measure approximately 150 ft wide at the base, and extend approximately 700 ft from the structure into Bad Creek Reservoir.

A.4.2.2 Lower Reservoir Inlet/Outlet Configuration

The Bad Creek II lower reservoir inlet/outlet will be a reinforced concrete structure similar to the existing Bad Creek Project inlet/outlet. The structure will be located in the portal area adjacent to the existing Bad Creek Project inlet/outlet, requiring the relocation of minor facilities in the area including but not limited to a grounding mat, septic facilities, water treatment ponds, and stormwater drainage. The new structure will be constructed a sufficient distance from the existing inlet/outlet and Lake Jocassee to permit a "sinking cut" (to construct the inlet/outlet) to be installed behind a natural earthen cofferdam and with sufficient access to avoid the existing inlet/outlet structure and channel.

The inlet/outlet structure will be approximately 150 ft wide, 20 ft deep, and 95 ft tall. Four tunnels will penetrate the structure at invert elevation of 1,009 ft msl. Each tunnel opening will be fitted with a steel bulkhead to permit dewatering of either or both of the headrace tunnels. The channel invert will be approximately 150 ft wide with near vertical side slopes in rock and 2:25H:1V side slopes in soil. Permanent tieback retaining walls will extend from the inlet/outlet structure similar to the existing Bad Creek Project inlet/outlet structure.

A.4.3 Water Conveyance System

Bad Creek II will maximize installed capacity while maintaining approximately 11.5 hours of usable storage in the upper reservoir. The water conveyance profile will consist of an upper reservoir horizontal intake, two low-pressure headrace tunnels approximately 1,130 ft long with isolation gates, two vertical shafts approximately 787 ft long and 30 ft in diameter, two high-pressure headrace tunnels approximately 2,124 feet long and 30 ft in diameter, and four concrete steel-lined penstocks approximately 346 ft long and varying from 10 to 15 ft in diameter. In turbine mode, flow passes from the penstocks through the turbines to four draft tube tunnels about 295 feet long and 18 feet diameter, connecting by means of a manifold structure to two concrete-lined tailrace tunnels about 1,820 feet long and 31 feet in diameter, to a lower reservoir inlet/outlet structure equipped with steel lift gates. Turbine maximum discharge (station total) at the station will be 19,840 cubic feet per second (cfs).

A.4.4 Underground Powerhouse

A.4.4.1 Powerhouse Access Tunnels and Shafts

Permanent underground powerhouse access will be provided by a modified horseshoe (D-shape) access tunnel extending from the portal area to the powerhouse. Secondary access will be provided by the vertical access shaft also housing the low voltage isolated phase bus extending to the new transformer yard. The access tunnel will have a bottom width and height of approximately 30 ft and 26 ft, respectively, a maximum grade of 10 percent, and an approximate length of 1,800 ft. The invert of these tunnels will be lined with concrete, and the walls and crown rock bolted and lined with shotcrete as needed. The tunnels will include ventilation and lighting.

Construction adits will be installed around the powerhouse to facilitate construction of the headrace and tailrace tunnels. These adits will be permanently plugged where they intersect the water conveyance tunnels after construction is complete.

In addition to the access tunnels and adits discussed above, a permanent drainage tunnel will be constructed upstream of the powerhouse cavern with drilled drains to intercept seepage in the rock mass and prevent hydrostatic pressure against the upstream wall of the powerhouse. In addition, drain holes will be aligned to relieve hydrostatic pressure along the exterior of the penstocks during an unwatering event.

A.4.4.2 Powerhouse Main Cavern

The main cavern of the Bad Creek II underground powerhouse will be arranged and sized similarly to that of the Bad Creek Project powerhouse and contain the pump-turbine/generator-motor units, and electrical and mechanical balance of plant and station services. The overall size of the underground powerhouse will be approximately 433 ft long by 75 ft wide by 170 ft high. The underground powerhouse will be connected by two equipment tunnels to the draft tube gate gallery, which will be approximately 400 ft long by 20 ft wide by 26 ft high.

A.4.5 Transmission Facilities

The Bad Creek II transformer yard will be located aboveground with convenient access via the Lower Whitewater Falls access road. The transformer yard is sized to provide an area similar to the existing 525-kV transformer yard for the Bad Creek Project and will be located southeast of the existing operations area directly above the vertical shaft. The transformer yard will contain all necessary transformation equipment and an equipment building. The Bad Creek II switchyard will adjoin the Bad Creek II transformer yard.

Bad Creek II transmission facilities will consist of the following:

- Generator leads and the electrical bus housed in a vertical shaft about 960-ft-high and approximately 18 ft in diameter leading from the underground powerhouse to four above-ground 19/525-kV step-up transformers.
- A 525-kV transmission line comparable to the existing Project 525-kV line (Figure A-10) extending about 10 miles from the Bad Creek II switchyard to a grid intertie at the Jocassee switchyard. The 525-kV line will be supported by standard single circuit steel lattice structures spaced between 1,000 ft and 1,500 ft apart and shared a right-of-way corridor with the existing Project 525-kVline.

In conjunction with the construction of Bad Creek II, the existing Project 525-kV transmission line will be rerouted to the Bad Creek II transformer yard and switchyard, extending the length of the line by approximately 0.7 mi.

Bad Creek II facilities layout is shown on Figure A-11 and the single-line electrical diagram is being filed as CEII.

A.5 Existing and Proposed Turbines and Generators

The Project's authorized installed capacity is presently 1,400 MW based on the installed nameplate ratings and FERC's method to calculate authorized installed capacity (18 CFR §11.1(i)). Following construction of Bad Creek II, the installed capacity for the Project will be 2,800 MW.

Pertinent turbine and generator data for the Project is included in Table A-3.

Table A-3. Project Turbine and Generator Data

	Existing Turbine-Generators	Bad Creek II Turbine-Generators
Number of Units	4	4
Turbine Type	Francis pump-turbine	Francis pump-turbine
Design Head (net ft)	1,150	1,150
Rated Capacity (horsepower)	467,667	467,667
Minimum Hydraulic Capacity (cfs)	3,070 (per unit)	0 (per unit)
Maximum Hydraulic Capacity (cfs)	4,940 cfs (per unit)	4,940 cfs (per unit)
Operating Speed revolutions per minute (rpm)	300	+/- 300
Generator-Motor Type	Vertical	Vertical
Rated Capacity (kW)	420,000 (per unit)	459,000 (per unit)*
Power Factor	0.9	0.9
Phase	3-phase	3-phase
Voltage (V)	19,000 V (per unit)	18,000 V (per unit)
Frequency (Hertz)	60 (per unit)	60 (per unit)
Synchronous Speed (rpm)	300	N/A
Range of Speed (rpm)	N/A	270.0-324.5

*Rated capacity increase for Bad Creek II results from variable speed ability, which enables higher efficiency and greater output at maximum power.

A.6 Lands of the United States

There are no lands of the United States within the existing or proposed Project Boundary.

A.7 References Cited

Duke Power Company (Duke Power). 1991. Bad Creek Pumped Storage Project, Final Report. September 11, 1991.

Wells, J. 2018. Upgrades underway at Duke Energy's most intriguing plant. Duke Energy Illumination. August 8, 2018. [URL]: https://illumination.duke-energy.com/articles/upgrades-underway-at-duke-energy-s-most-intriguing-plant. Accessed August 26, 2021.

DRAFT LICENSE APPLICATION

BAD CREEK PUMPED STORAGE PROJECT

(FERC NO. 2740)

EXHIBIT B

PROJECT OPERATION AND RESOURCE UTILIZATION

Exhibit B - Project Operation and Resource Utilization (18 CFR §4.41(c))

B.1 Evaluation of Alternative Sites

Bad Creek Pumped Storage Project (Project) is one of the most powerful and flexible energy generation and storage assets in Duke Energy's system. Originally built primarily to store surplus energy from baseload nuclear and fossil fuel power plants during times of low energy demand, today the Project is used to balance an increasingly complex energy grid by storing energy from surplus baseload generation and other non-dispatchable renewables generation and providing power back to the grid when energy demand is higher or renewable generation is not available.

Duke Energy has worked collaboratively with customers and other stakeholders to invest in a diverse portfolio of generation resources to respond to the region's growing energy needs. The diverse nuclear, coal, natural gas, renewables, and hydroelectric generation facilities owned by Duke Energy provide about 35,000 megawatts (MW) of owned electricity capacity to 4.5 million customers within its service area across North Carolina and South Carolina. Even with the expansion of energy efficiency and demand reduction programs, cumulative annual energy consumption in the Carolinas is expected to grow by approximately 35,000 gigawatt-hours between 2024 and 2038.

The combination of growing demand and the planned retirement of older, less efficient generation resources has created an additional need of approximately 15,000 MW (including required reserve margin) over the 15-year planning horizon per Duke Energy's 2023 Carolinas Resource Plan (Resource Plan).[5] As of 2023, Duke Energy had more than 8,500 MW of renewable energy contracted, owned, or operated. By 2026, Duke Energy plans to procure 2,700 to 3,150 MW of additional renewable capacity for its regulated utilities.

Expansion and accelerated development of Duke Energy's energy storage portfolio is a necessary complement to this renewables growth and Duke Energy presently projects procuring more than 4,400 megawatts of energy storage including 2,700 MW of battery storage by 2031 per the Resource Plan. However, the Project and the downstream Jocassee Pumped Storage Station have provided and will continue to provide most of the energy storage within Duke Energy's system.

[5] Duke Energy Carolinas 2023 Resource Plan available is from https://www.duke-energy.com/our-company/about-us/irp-carolinas.

Longer-duration storage from additional pumped storage capacity would provide essential system flexibility and balancing capabilities required for efficient and reliable day-to-day operations of the grid. To confirm pumped storage generation, a proven resource that provides critical net dependable capacity during peak periods and diversifies reliance on constrained dispatchable resources such as natural gas and battery energy storage, was cost-effective when compared to other energy storage options, Duke Energy evaluated two alternative cases when developing the Resource Plan. One case modeled the system without additional pumped storage while the second case allowed the model to economically select pumped storage. In the first case, including additional pumped storage was found to be a more economical solution than not including it. In the second case where pumped storage was allowed to be selected or not selected by the model, pumped storage was selected. As a result, all three portfolios presented in the Resource Plan rely upon additional pumped storage generation.

Duke Energy evaluated four sites for developing the additional pumped storage capacity included in the Resource Plan: the expansion of the Project, the expansion of Jocassee Pumped Storage Station, and two greenfield sites. Based on those evaluations, additional pumped storage capacity at the Project, the Bad Creek II, was the most economic option of the four sites based on a cost per MW perspective.

B.2 Evaluation of Alternative Designs, Processes, and Operations

During the Bad Creek II design process, various alternatives and options were evaluated related to equipment design details, spoil disposal sites, siting of the Bad Creek II 525-kV transmission line, construction access routes, and other Project features. Design evaluations included:

- **Pump Turbine Alternatives:** Reversible hydroelectric pump-turbine/generator-motors have traditionally been designed, manufactured, and operated as single-speed synchronous machines. (Bad Creek Units 1 through 4 are single-speed units.) Beginning in the 1990s, variable speed units were introduced. Variable speed technology has an advantage over single speed technology because of its unique ability to provide load following and frequency regulation capability in both the generation and pump mode. Single speed pump-turbines provide the same grid flexibility benefits in the generate mode as a conventional hydropower unit. In the pump mode, single speed units are unable to provide frequency regulation because they lack the ability to adjust the input power. Variable speed power electronics enable the power consumed in the pumping mode to be varied, which allows the pump-turbine/generator-motor to provide battery-like performance over a wide range of pumping power input.

After a lengthy study of both single and variable speed technology, the Licensee elected to propose variable speed pumped storage technology for Bad Creek II Units 5 through 8.

- **Transmission Line Alternatives:** The Licensee evaluated two possible routes, a northern and a southern alternative, for connecting Bad Creek II to the Jocassee substation. The southern route is shorter, aligned with the existing 525-kV transmission line corridor, and crosses Lake Jocassee fewer times than the northern route. Therefore, the Licensee is proposing the southern route.

Potential Project operations are constrained by use of Lake Jocassee as the lower reservoir and the requirements of the KT Project license including the KT Low Inflow Protocol and 2014 Operating Agreement.

The final design and proposed action reflect the Licensee's efforts to balance constructability with environmental protections and cost. Potential effects are evaluated in Exhibit E.

B.3 Project Operations

B.3.1 Manual versus Automatic Operations

The existing Project is an automated station operated from Duke Energy's Regulated Renewables Operations Center (RROC) in Charlotte, North Carolina. Operation and maintenance personnel staff the powerhouse 7 days a week, 24 hours a day to perform maintenance and respond to alarms at the request of the RROC. The Project is operated in accordance with the Owner's Dam Safety Program and FERC's regulations and engineering guidelines. Safety-related operations at the Project involve routine inspections and maintenance as required. The Licensee will continue these practices under the new license including after construction of Bad Creek II.

B.3.2 Estimated Annual Plant Factor

The annual plant factor is the ratio of estimated average annual generation from the plant (in MWh per year) to the energy that the plant might produce if it operated at full capacity for one year. However, since the Project operates as a pumped storage facility, plant utilization factor is used in lieu of annual plant factor which is more appropriately applied to the operation of conventional hydroelectric facilities. Plant utilization factor is defined as the actual unit usage divided by the maximum potential unit usage multiplied by 100, or the combined number of hours the units were on-line (generating and pumping modes), divided by the number of units at the Project (four units), and multiplied by the number of hours per year (8,760 hours). The plant utilization factor for the Project during the period 2015 through 2020 was approximately 54 percent including both pumping and generating run time.

The estimated average plant utilization factor including both pumping and generating for a ten-year period following construction of Bad Creek II would be approximately 35 percent for Bad Creek and 83 percent for Bad Creek II. This reflects a shift in utilization to take advantage of the variable speed units at Bad Creek II that can vary pumping to integrate renewable energy more effectively as well as a wider generating range for enhanced stability of the power grid. Bad Creek Units 1-4 will be used for base load pumping, at set values as a function of head, and limited load following up to maximum power for peak demand periods.

B.3.3 Operations During Adverse, Mean, and High Water Years

The Project utilizes the Bad Creek Reservoir as the upper reservoir and Lake Jocassee as the lower reservoir. The Project currently operates on a “daily cycle” mode, commonly alternating between generating and pumping on a daily basis, with the reservoir typically maintained in the upper 50 to 60 ft at elevations of 2,310 and 2,250 ft msl (compared to a maximum drawdown of 160 ft). This operating mode permits the Licensee to maximize head, energy density, and plant/unit efficiency and utilize the Project like a massive battery to help balance the regional transmission system, including rapid consumption or generation of power due to variable solar energy production.

Following Bad Creek II construction, the Licensee would continue operating the upper reservoir within the current licensed operating band[6]; however, because of the increased hydraulic capacity with the addition of Bad Creek II, generation run times (at best efficiency) would decrease from approximately 23 hours to approximately 12 hours, but the energy density would increase by a factor of approximately two. This means that twice as many MW-hours could be brought to the grid during times of increased demand. Pump run times would also decrease but the rate of storage would double. In addition, the Bad Creek II variable speed units could be used during pumping to capture more renewable energy with integration load following, since pump load can be varied, as well as help stabilize the power grid during pumping. The total pumping capacity would be increased so that the entire useable volume of the upper reservoir could be filled in approximately 11.5 hours. This added capability in both modes of operation would allow utilization of the entire upper reservoir usable volume on a daily basis for generation and recovery via pumping, should system needs require it.

The drainage basin is very small (about 1.36 square miles), and flooding is generally not a concern at the Project. There are no spillway gates at the Project and flood inflow is passed via the generating units. During low flow conditions, pumping at the Project could be constrained if Lake Jocassee is near its FERC license minimum elevation. As noted above, existing and potential Project operations are

[6] The Licensee will maintain Bad Creek Reservoir within a 160 ft operating range between a Normal Maximum Elevation of 2,310 ft msl (100 ft local datum) and a Normal Minimum Elevation of 2,150 ft msl (-60 ft local datum).

constrained by use of Lake Jocassee as the lower reservoir and the requirements of the KT Project license, including the KT Low Inflow Protocol and 2014 Operating Agreement.

B.4 Estimated Energy Production and Dependable Capacity of the Project

B.4.1 Dependable Generating Capacity

For a pumped storage facility, the "dependable generating capacity" may be defined as the total output in MWs from the station with all units at maximum power while operating at the median upper reservoir storage limit. Using this definition, the dependable generating capacity of Bad Creek Units 1-4 is 410 MW each for a total of 1,640 MW. The dependable generating capacity of Bad Creek II Units 5-8 will be 440 MW each for a total of 1,760 MW. The combined dependable generating capacity for the Project will be 3,400 MW.

The Net Dependable Capacities for Bad Creek and Bad Creek II (Table B-1) are based upon the available energy storage within the upper 30 feet of the Bad Creek upper reservoir which corresponds to an approximate gross head of 1,170 feet. The volume at this elevation is approximately 9,710 acre-feet. Based on the estimated hydraulic output of the pump-turbines at each facility, the capacities in generation mode can be achieved for a minimum duration for 3 hours while both facilities are in operation. The duration approximately doubles when either facility is not dispatched.

Table B-1. Net Dependable Capacities

Existing Facility		Bad Creek II	
Unit 1	410 MW	Unit 5	440 MW
Unit 2	410 MW	Unit 6	440 MW
Unit 3	410 MW	Unit 7	440 MW
Unit 4	410 MW	Unit 8	440 MW
Total	**1,640 MW**	**Total**	**1,760 MW**

B.4.2 Average Annual Energy Production

The Project operates in a pumped storage mode which is characterized by the regular movement of water from the upper reservoir to the lower reservoir (generation) and from the lower reservoir back to the upper reservoir (pumping). The Project is considered a true pumped storage facility, in that essentially all the water utilized for generation originates from the lower reservoir.

The Project had an average annual gross generation of 1,884,685 MWh for the period 2015 through 2020. Average annual pumping energy required for this same period was 2,398,114 MWh. This results in a net consumption of 513,429 MWh and a net cycle efficiency of 78.9 percent. Table B-2 provides a summary of monthly and annual Project generation in gross MWh for the years 2015-2020 and Table

B-4 provides a summary of monthly and annual average pumping in MWh, depicted as a negative value representing energy used for pumping.

Beginning in 2021, all four units at Bad Creek were upgraded with higher power and more efficient runners / impellers with the last outage ending in 2024. For the period of 2025 through 2033, the total annual generation[7] is projected to increase on average to 2,068,143 MWh. The total annual pumping power consumed is projected to increase as well on average to 2,548,437 MWh. The maximum cycle efficiency (i.e., assuming operation of all units at peak efficiency) was determined by the energy model to be 81.1 percent. Comparing the historic net cycle efficiency of 78.9 percent to the modeled net cycle efficiency of 79.4 percent demonstrates that historically, the units were not always dispatched at peak efficiency but were instead used for power system regulation to some extent.

Following construction of Bad Creek II, the average annual generation for the total Project over a ten-year period is projected to be 4,815,496 MWh and average annual pumping power consumed is estimated to be 5,979,366 MWh. Using the same energy model, the maximum net cycle efficiency for the total Project would increase from 79.4 percent to 81.3 percent. Use of the units for power system regulation, however, will decrease net cycle efficiency to an extent. Nonetheless, net cycle efficiency is expected to increase with the addition of Bad Creek II.

[7] Projected average annual generation and pumping power values are based on the output of an integrated resource plan model that simulates how the Project will be integrated into Duke Energy's mix of generation resources in the future. The model forecasts the Project to be heavily utilized to maximize energy storage of renewable energy resources and regulation of the Licensee's power system.

Table B-2. Monthly and Annual Generation (MWh) (2015-2020)

Year	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Gross
2015	100,655	130,038	126,013	27,316	165,939	242,494	243,170	228,911	204,897	131,591	92,562	186,530	1,880,116
2016	141,791	140,095	166,621	120,740	192,213	250,548	280,666	275,966	236,956	75,581	130,096	150,084	2,161,355
2017	143,280	126,845	170,104	179,434	192,119	228,127	244,174	250,919	210,675	166,714	145,293	152,845	2,210,528
2018	147,120	99,841	0[a]	0[a]	0[a]	41,286	230,212	218,657	193,770	199,986	154,368	143,307	1,424,863
2019	167,955	169,037	141,052	162,458	225,670	182,404	216,698	176,367	197,223	154,139	128,876	127,905	2,049,783
2020	131,602	124,319	36,211	91,282	141,764	153,911	188,147	169,694	131,768	136,253	125,562	150,954	1,581,467
Average	138,734	131,696	106,453	96,668	152,754	183,128	233,845	220,086	195,882	144,044	129,460	151,938	1,884,685

[a] Station outage for full upper reservoir drawdown and commencement of upgrade activities.

Table B-3. Monthly and Annual Pumping (MWh) (2015-2020)

Year	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Gross
2015	-147,689	-162,229	-152,260	-39,336	-210,528	-313,033	-304,618	-301,852	-239,795	-170,417	-129,292	-239,268	-2,410,317
2016	-169,019	-192,667	-201,499	-154,861	-243,238	-317,078	-355,179	-344,490	-301,423	-102,546	-161,742	-186,067	-2,729,808
2017	-193,154	-152,621	-217,424	-225,426	-258,191	-290,042	-310,980	-310,182	-264,283	-217,133	-175,150	-213,946	-2,828,533
2018	-172,901	-105,277	0[a]	0[a]	0[a]	-79,437	-296,959	-269,142	-254,421	-247,004	-197,500	-193,777	-1,816,418
2019	-203,317	-223,769	-193,895	-189,820	-287,878	-244,389	-266,870	-220,898	-248,400	-187,130	-189,855	-164,474	-2,620,696
2020	-148,590	-169,737	-45,791	-122,102	-164,750	-200,074	-226,254	-230,111	-155,228	-174,421	-161,591	-184,259	-1,982,909
Average	-172,445	-167,717	-162,174	-146,309	-232,917	-240,676	-293,477	-279,446	-243,925	-183,109	-169,188	-196,965	-2,398,114

[a] Station outage for full upper reservoir drawdown and commencement of upgrade activities.

B.4.3 Flows

The total contributing drainage area for the Bad Creek Reservoir is 1.36 square miles (mi^2) and the average annual flow of Bad Creek and West Bad Creek, combined, is approximately 5 cfs. Annual evaporation from Bad Creek Reservoir is estimated to be 42 inches. Leakage through the Project embankments is approximately 5 cfs. Combined, water losses due to evaporation, leakage through embankments, and turbine leakage are considered insignificant when compared to the total volume of water cycled at the Project annually. The construction of Bad Creek II would not significantly affect leakage. As such, these variables are not considered when estimating the Project's dependable capacity.

The Project exchanges water between Bad Creek Reservoir and Lake Jocassee and has no significant contributing inflows; therefore, neither monthly flow duration curves nor critical streamflow are applicable.

B.4.4 Reservoir Storage Capacity

The gross storage capacity for the Bad Creek Reservoir is approximately 35,513 acre-ft with a total surface area of 363 acres (based on 2018 LiDAR data). Storage-volume (storage capacity) curves are included in Figure B-1 and Figure B-2.

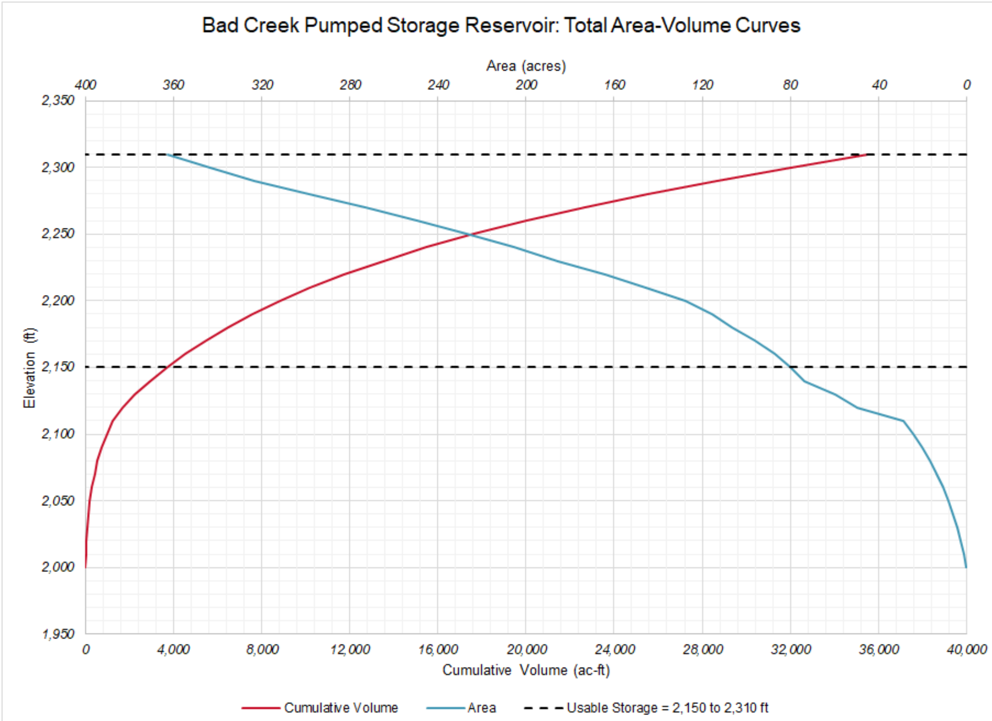


Figure B-1. Bad Creek Reservoir Total Area-Volume Curves

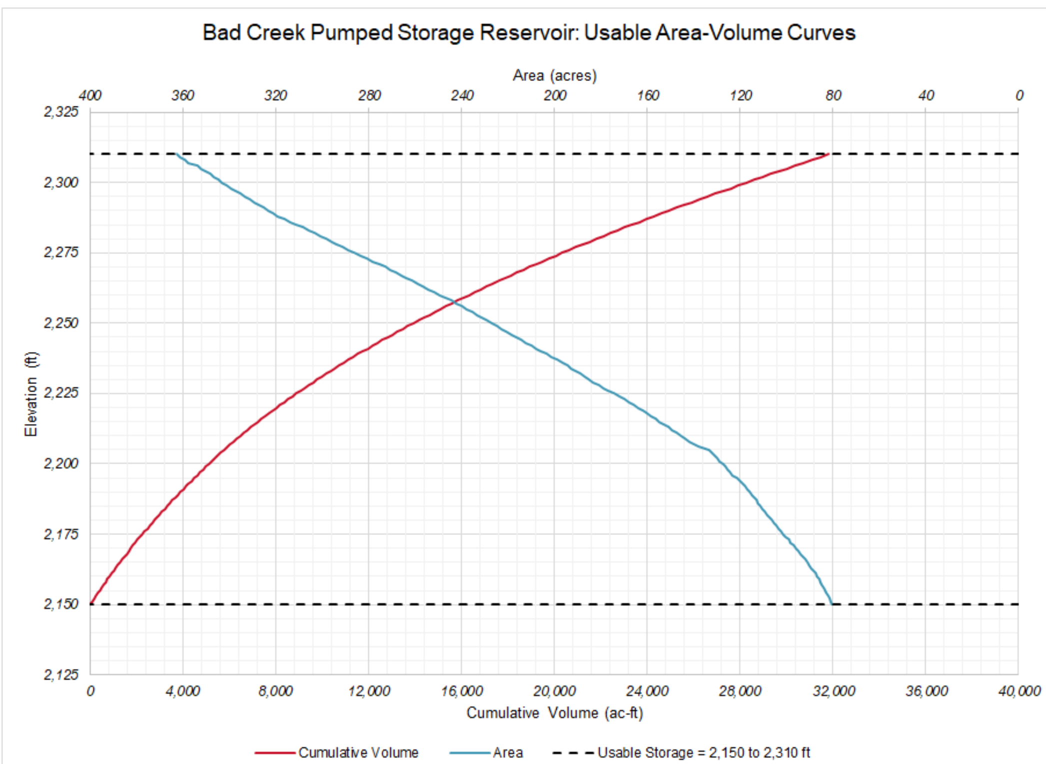


Figure B-2. Bad Creek Reservoir Usable Area-Volume Curves

B.4.5 Hydraulic Capacity

The estimated combined maximum hydraulic capacity for all four existing turbine units (i.e., Units 1-4) at the Project is 19,380 cfs (Table B-4). This estimate is based on manufacturer's turbine mode discharge information for all four units operating at full wicket gate opening and at the maximum Net Head.

Table B-4. Estimated Combined Hydraulic Capacities and Generator-Motor Output at Different Gate Openings for 4 Unit Operation (Existing Units 1-4 and Proposed Units 5-8)

Gate Opening	Existing (Units 1-4)			Proposed (Units 5-8)		
	Estimated Minimum Hydraulic Capacity (cfs)	Estimated Maximum Hydraulic Capacity (cfs)	Maximum Generator-Motor Output (kw)	Estimated Minimum Hydraulic Capacity (cfs)	Estimated Maximum Hydraulic Capacity (cfs)	Maximum Generator-Motor Output (kw)
Operating Limit	7,622	10,600	800	0	0	0
Full	16,656	19,380	1,690	19,840	19,840	1,784
Best	15,520	15,520	1,400	14,400	15,600	1,400

The estimated combined maximum hydraulic capacity for proposed Units 5 through 8 at the Project would be 19,840 cfs (Table B-4). This estimate is based on the manufacturer's turbine discharge information for all four units operating at full wicket gate opening and at the maximum Net Head.

B.4.6 Tailwater Rating Curve

There is no tailrace associated with the Project; therefore, there is no tailwater rating curve.

B.4.7 Head vs. Capability

Pump power and generation power varies based on the gross head (i.e., Bad Creek Reservoir level – Lake Jocassee level) and friction losses as flow varies in the water conveyance system. For the existing Project, the generating power range is from 800 MW to 1,690 MW (Figure B-3). The pumping power range is 1,360 MW to 1,604 MW (Figure B-4). These values are based on the manufacturer’s guarantees of the upgraded units.

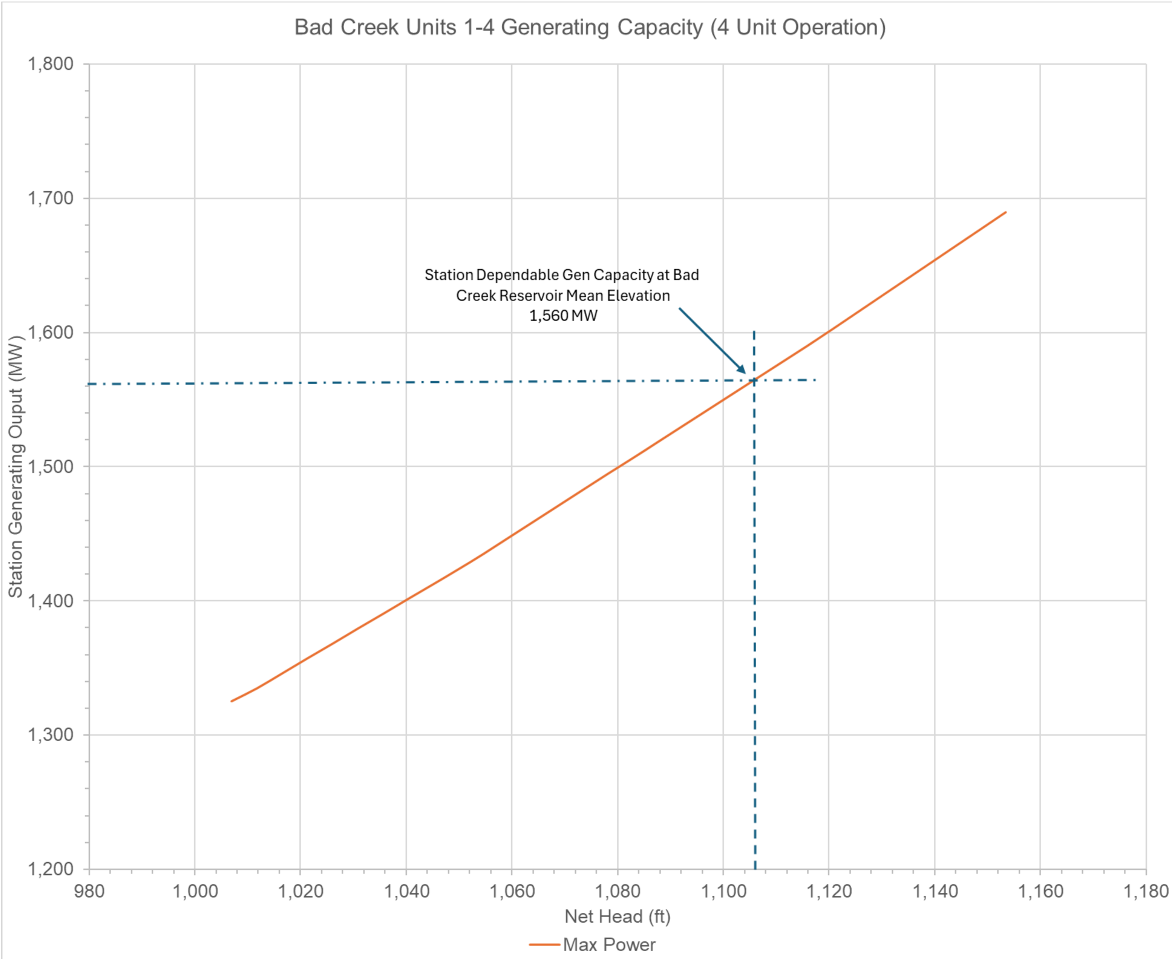


Figure B-3. Units 1-4 Combined Generating Power versus Net Head

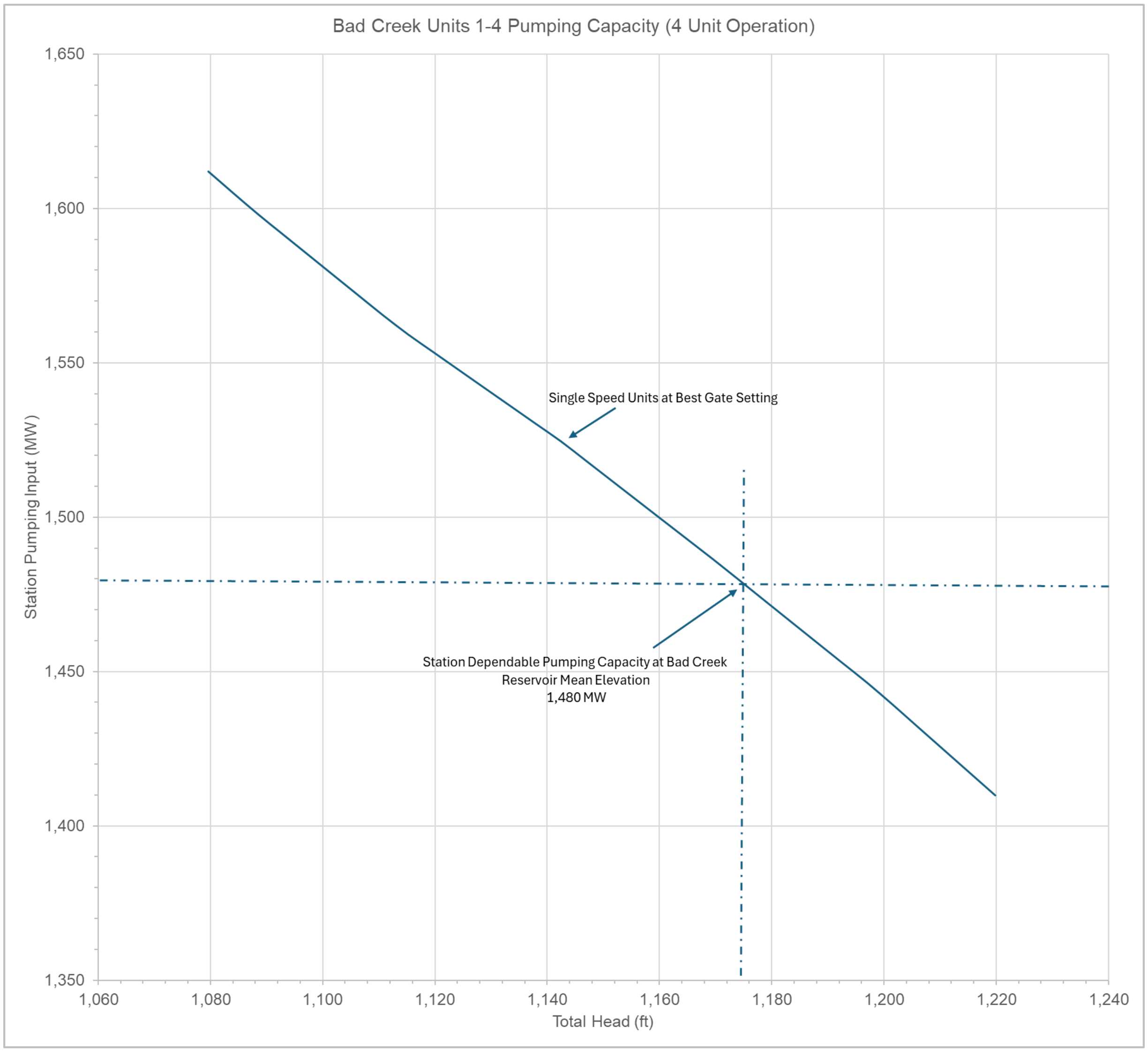


Figure B-4. Units 1-4 Combined Pumping Power versus Total Head

The combined generating power for the Bad Creek II variable speed units would range from 0 MW – 1,770 MW (Figure B-5). The combined pumping power would range from approximately 920 MW – 1,888 MW at a gross head of 1,150 ft msl (Figure B-6). These values are based on the manufacturer's guarantees of the upgraded units.

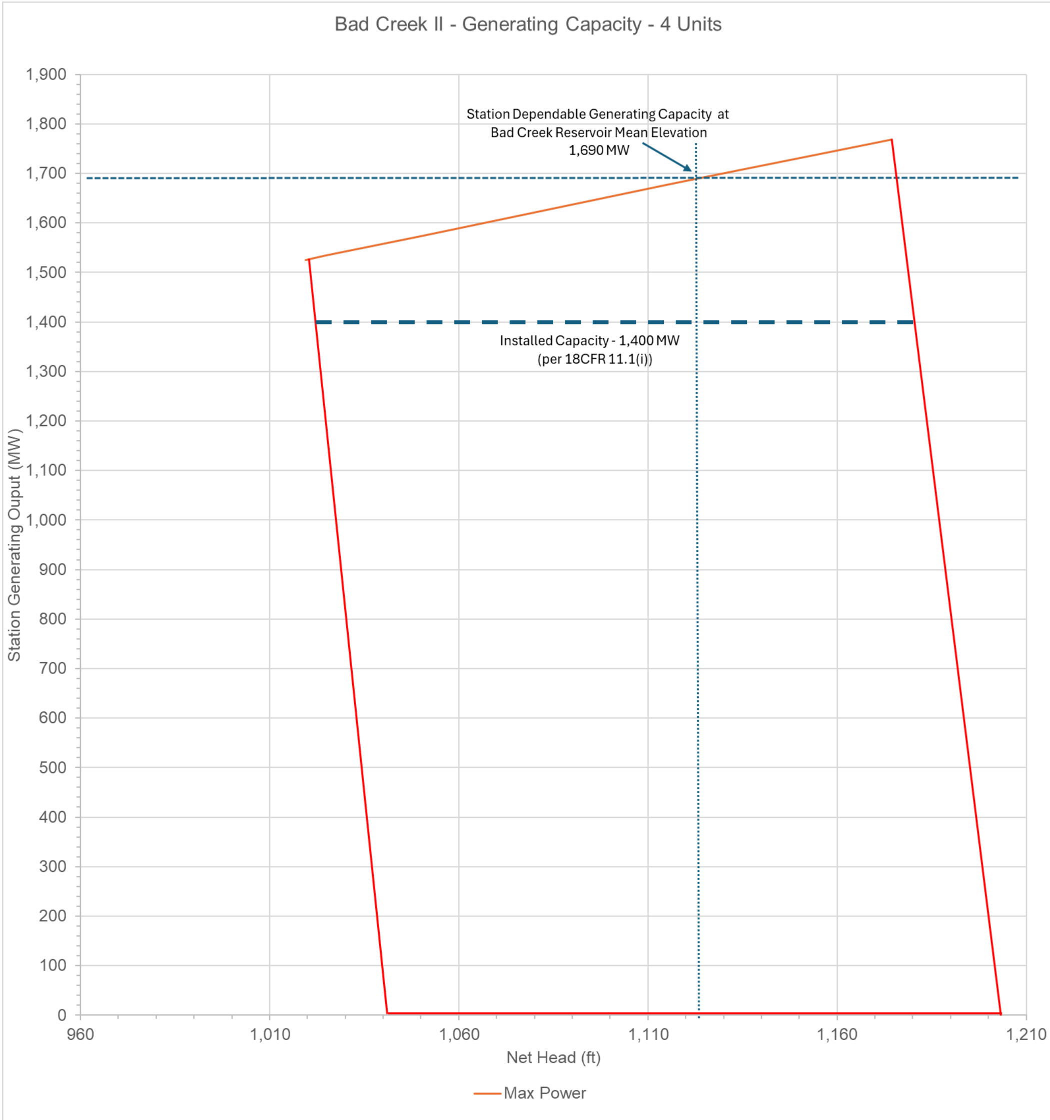


Figure B-5. Units 5-8 Range of Generating Power Regulation versus Net Head

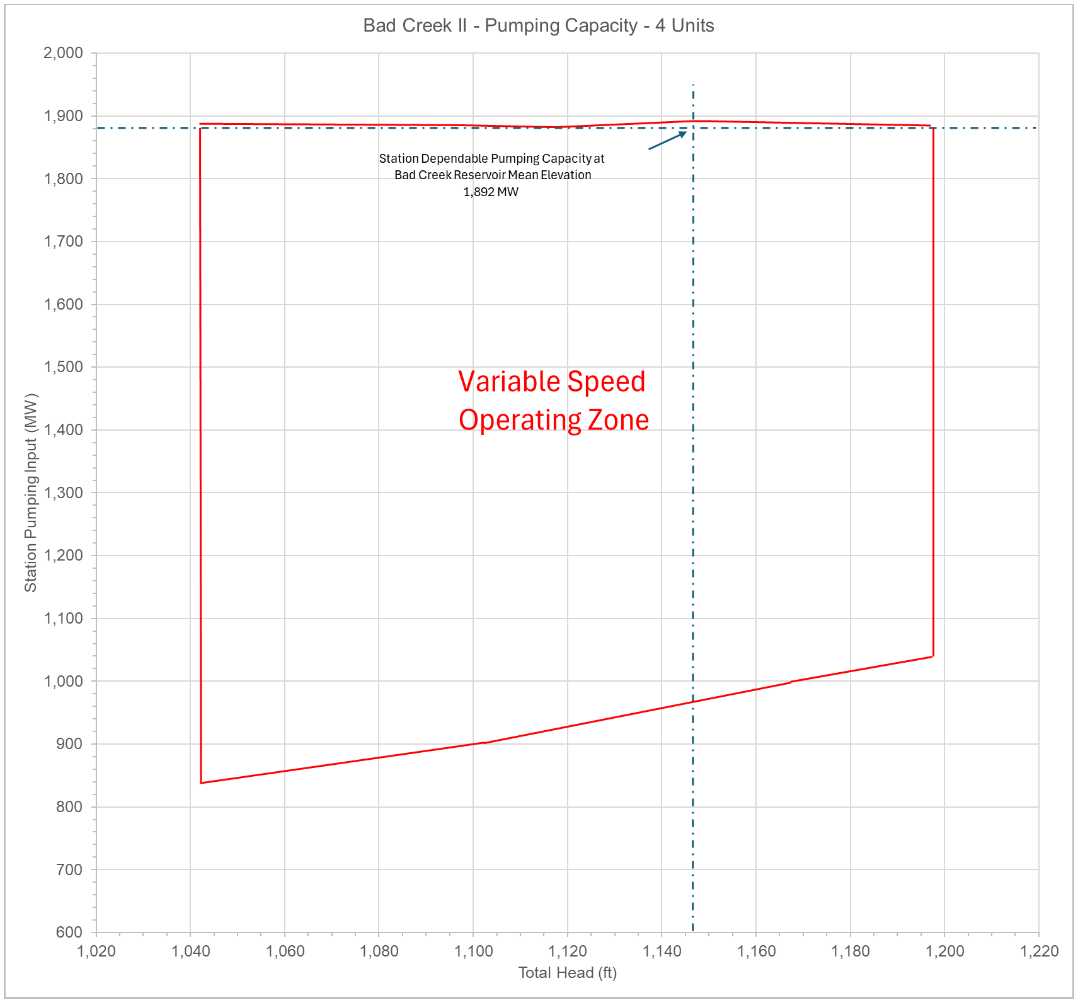


Figure B-6. Units 5-8 Range of Power Regulation in Pumping Mode versus Total Head

B.5 Power Utilization

Power generated by the existing Project is used to meet the demands of the Duke Energy transmission and distribution system. Duke Energy estimates 2% or less of the energy generated by the Project is currently utilized on-site as auxiliary power; this percentage is not anticipated to change significantly following Bad Creek II construction.

For additional information about Duke Energy's electric operations and energy conservation programs, see Exhibit H.

B.6 Future Development

The Licensee is proposing to expand the Project with the addition of Bad Creek II but is not proposing additional water power projects that would affect waters in the upper Savannah River basin.

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Draft License Application

Bad Creek Pumped Storage Project

(FERC No. 2740)

Exhibit C

Construction History and Proposed Construction Schedule

Exhibit C - Construction History and Proposed Construction Schedule (18 CFR §4.41(d))

C.1 Construction of Existing Facilities

18 CFR §4.41(d)(1) requires a proposed construction schedule for license applications including new construction, modification, or repair of major project works. However, to provide general and background information, a brief summary of the construction history of the existing Project works is included below.

Planning and licensing activities for the Bad Creek Project began in the early 1970s, but the Project was not originally licensed by FERC until August 1, 1977. Construction activities began in 1984 with development of the access road into the project site. The Project became operational in 1991. Table C-1 includes significant construction activities that have occurred since the Project began operation.

Table C-1. Project Construction History

Date	Construction Activity
March 2001	A grouting program was implemented to eliminate seepage around the penstock bypass plug
2006	Added two cameras with view of staff gage and one camera with view of reservoir with capability for local and remote monitoring
2018	Penstock spherical valves were replaced
August 2019 - March 2023	Upgrades of Units 1, 2, and 3
April 2023 - March 2024	Upgrade of Unit 4

C.2 Construction of Proposed Facilities

As currently planned, construction of Bad Creek II would occur over an approximately seven-year period summarized on Figure C-1 and further discussed in Exhibit E, Section E.6.2.2.

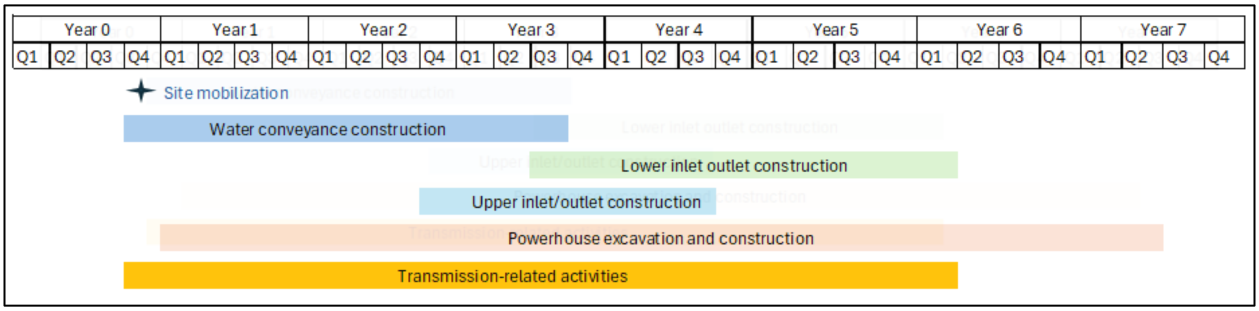

Figure C-1. Bad Creek II Construction Timeline

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DRAFT LICENSE APPLICATION

BAD CREEK PUMPED STORAGE PROJECT

(FERC NO. 2740)

EXHIBIT D

COSTS AND FINANCING

Exhibit D - Costs and Financing (18 CFR §4.41(e))

D.1 Cost of Proposed Project Modifications

Note: Yellow highlighted text denotes placeholders that will be updated or provided in the Final License Application.

The Bad Creek Pumped Storage Project (Project) was originally licensed in 1977 for a license term of 50 years. Construction was completed in 1991. Consistent with the requirements of 18 CFR §4.41(e), construction costs for the existing licensed facilities are not required.

Duke Energy is proposing to construct a second powerhouse with four pump-turbine generators as well as associated facilities (Bad Creek II). The estimated costs for the proposed project are included in Table D-1.

Table D-1. Estimated Costs for Bad Creek II Construction

Bad Creek II Component	Estimated Cost (2023 $)
Land acquisition	xx
Major Project works	xx
Indirect construction costs	xx
Interest during construction	xx
Overhead, construction, legal expenses, and contingencies	xx

D.2 Project Takeover Cost Pursuant to Section 14 of the FPA

Under Section 14(a) of the Federal Power Act (FPA), the federal government may take over any project licensed by the Commission upon the expiration of the original license. The Commission may also issue a new license in accordance with Section 15(a) of the FPA. If such a takeover were to occur upon expiration of the current license, the Licensee would have to be reimbursed for the net investment, not to exceed fair value, of the property taken, plus severance damages. To date, no agency or interested party has recommended a federal takeover of the Project pursuant to Section 14 of the FPA.

D.2.1 Fair Value

Fair value is not defined in the FPA or its implementing regulations. The fair value of the Project depends on prevailing power values and license conditions, both of which are currently subject to change. The best approximation of fair value is likely to be the cost to construct and operate a comparable power generating facility. Because of the high capital costs involved with constructing new facilities and the increase in fuel costs associated with operating such new facilities (assuming a fossil-fueled replacement), the fair value would be considerably higher than the net investment amount. The fair value is assumed at this time to be represented by the current net investment plus severance damages. Duke Energy reserves the right to revise its statement of fair value should administrative, legislative, or judicial decisions clarify the principles and definitions of takeover compensation. If a takeover were to be proposed, the Licensee would calculate fair value based on then-current conditions, but the fair value of the Project is currently estimated to be $X.

D.2.2 Net Investment

The FPA defines "net investment" as the original cost, plus additions, minus the sum of the following items (to the extent that such items have been accumulated during the period of the license from earnings in excess of a fair return on such investment): (a) unappropriated surplus; (b) aggregate credit balances of current depreciated accounts; and (c) aggregate appropriations of surplus or income held in amortization, sinking fund, or similar reserves. As of the end of 2023, the net investment in the Project was $XX. This amount is in alignment with the asset value listed in the Uniform System of Accounts for the Project. This amount should not be interpreted as the fair value or fair market value of the Project.

D.2.3 Severance Damages

Project takeover would impact Duke Energy, its customers, and its investors in many ways. Because the Project is a component of a diverse power system that consists of multiple types of generation with various fuel sources, impacts extend beyond the value of the firm capacity and energy contribution from the Project itself. The full extent of actual severance damages would be dependent upon the details of the system separation, the characteristics of the replacement power source, and the compensation mechanism used to reimburse Duke Energy for the system value lost due to removing the power and reliability provided by the Project. These values would need to be calculated based on power values and license conditions at the time of Project takeover.

D.3 Estimated Average Annual Cost of Project

Average annual costs associated with the Project include labor, materials, expenses, and overhead associated with routine operation and maintenance (O&M); the annualized cost of capital charges; and annual insurance, fees, taxes, depreciation, and administration. Summaries of estimated annual costs for three recent years for the Project are provided in Table D-2. The annual average costs assume an inflation rate of 2.5 percent to obtain an average of $XX in 2023 dollars.

Table D-2. Project Average Annual Cost Estimate

Expense	2021	2022	2023	2021-2023 Average (2023 $)
O&M Expenses				
Operation Supervision & Engineering				
Water for Power				
Pumped Storage Expenses				
Electric Expenses				
Miscellaneous Pumped Storage Power Generation Expenses				
Maintenance Supervision & Engineering				
Maintenance of Structures				
Maintenance of Reservoirs, Dams, and Waterways				
Maintenance of Electric Plant				
Maintenance of Miscellaneous Pumped Storage Plant				
Taxes and Fringes Cost on Labor				
Property Taxes				
Estimate of Depreciation Expense				
Average Incremental PM&E O&M Cost				
Average Incremental PM&E Capital Cost				
Cost of Capital				
Current Plant Balance				
Accumulated Depreciation Estimate				
Net Plant Investment				
Annual Capital Cost				
Annual Cost of Capital Charge				
Bad Creek Total Annual Cost				

D.3.1 Cost of Capital (Equity and Debt)

Duke Energy's average cost of capital in 2023 was xx percent. Actual capital costs are based on a combination of funding mechanisms that include stock issues, debt issues, revolving credit lines, and cash from operations.

D.3.2 Local, State, and Federal Taxes

Property taxes for the 2023 year were $xx. Income taxes for the Project are incorporated into costs of the Licensee's consolidated business and are not separated out for the Project.

D.3.3 Depreciation and Amortization

The annualized composite rate of depreciation for the Project is xx percent.

D.3.4 Operation and Maintenance Expenses

The annual O&M expense for the Project in 2023 including corporate support costs but excluding property and real estate taxes and pumping costs was $xx.

D.3.5 Estimated Capital and O&M Costs of Proposed PM&E Measures

The estimated capital and O&M costs for proposed PM&E measures for the new license term are provided in Table D-3.

Table D-3. Proposed PM&E Measures Cost Estimate

Description of Proposed PM&E Measures	Average Annual Capital Cost (2024$)	Average Annual O&M Cost (2024$)
Bad Creek (Existing Project) Measures		
Bad Creek Reservoir Normal Operating Range: Maintain reservoir between 2,310.00 ft msl and 2,150.0 ft msl.		
Implement the Low Inflow Protocol.		
Implement the Maintenance and Emergency Protocol.		
Water Quality Certification: Implement the Water Quality Certification.		
Fish Entrainment Mitigation Measures: • Modify lower reservoir inlet/outlet lighting and public safety devices to reduce light shining on Lake Jocassee.		
• Pumping start-up sequence.		
• Coordinate with SCDNR regarding fish entrainment measures when Lake Jocassee falls below 1099 ft msl.		
Species Protection Plans: Implement up to 10 Species Protection Plans, including a Special Status Bat Protection Plan		
Eagle and Raptor Protection: Install eagle and raptor protection measures (i.e., pole retrofits, substation caps and covers, flight diverters) at strategic locations.		
Integrated Vegetation Management Plan: Implement measures to protect sensitive native plant and wildlife species and habitats and review it every ten years.		
Pollinator Enhancement Program:		

Description of Proposed PM&E Measures	Average Annual Capital Cost (2024$)	Average Annual O&M Cost (2024$)
• Plant milkweed and other native wildflowers in strategic locations.		
• Add up to two Monarch CCAA monitoring sites.		
Recreation Management Plan:		
• Maintain 43 miles of the Foothills Trail.		
• Extend Foothills Trail easements for 43 miles of the Foothills Trail.		
• Privy Pilot Study: Install 2 primitive privies / outhouses along the Foothills Trail and study for 2 years.		
• Depending on the findings of the pilot privy study, install up to 8 additional privies along the Foothills Trail.		
Bad Creek Visitors Overlook Improvements: New viewing telescopes, interpretative signage, picnic area.		
Signage: enhance signage at the main ramp at Devils Fork State Park (DFSP) and the Musterground Road entrance.		
Improved public information signage at DFSP.		
Visual Resources Management Plan:		
• Select exterior colors and lighting to reduce visual effects as normal maintenance and repair occurs.		
• Review and update plan as needed every ten years.		
Implement the Historic Properties Management Plan:		
• Nominate Site 38OC249 for inclusion in the NRHP.		
• Monitor Site 38OC249 annually.		
• Develop an interpretative exhibit regarding the cultural history of the Project area.		
Bad Creek II Construction Measures		
Erosion and Sediment Control Plan: Implement non-structural and structural Best Management Practices during construction.		
Spoil Disposal: Install French drains to minimize impacts to streams.		
Revegetation Plan: Minimize ground disturbance and revegetate with native plant seed mixes to enhance pollinator and wildlife habitat.		
Water Quality Monitoring Plan: Implement the proposed monitoring.		
Fish Entrainment Measures: • Conduct ADCP-based flow study.		
• Hydroacoustic fish monitoring for 10 years.		
Public Recreation: • Revise the Public Safety Plan to install additional public safety measures in Whitewater River cove to educate boaters about the hazards of Bad Creek II operations.		

Description of Proposed PM&E Measures	Average Annual Capital Cost (2024$)	Average Annual O&M Cost (2024$)
• Repair damage to Musterground Road and Foothills Trailhead Road intersection caused by construction activities prior to reopening it.		
• Provide FTC access to Musterground Road for trail maintenance during construction.		
• Highway 281 Lot Security Monitoring.		
• Brewer Road: Reopen Brewer Road to provide access to Musterground Road during construction.		
• DFSP Improvements: Courtesy dock at the Villa Ramp with 2 slips (one with a lift for emergency responders).		
Visual Resources Management Plan: Select lighting and exterior finishes that minimize visual effects.		
Non-License Measures		
Lake Keowee Source Water Protection Program: Provide $500,000 within two years following the new license and $500,000 within one year following the start of commercial operation of Bad Creek II.		
Fisheries Enhancement and Management: Provide $10,500,000 to SCDNR. Provide an additional $1,000,000 within one year following the start of commercial operation of Bad Creek II.		
Public Recreation		
• Construct a storage building on Project lands for the Foothills Trail Conference to support trail maintenance activities.		
• Provide rights of first refusals to NC and SC for the Foothills Trail and spur trails.		
• Consult with the FTC on spur trail expansion at the Foothills Trail.		
• Develop a Pumped Storage Operations interpretative display for Devils Fork State Park.		
• Jocassee Gorges Road Maintenance: Provide SCDNR $1,500,000.		
• No-Cost Leases: Lease approximately 1,900 acres of land to SCDNR for the license term.		
• Extend the Laurel Preserve Tract lease for the term of the new license.		
• Sponsor an annual wildlife viewing and environmental education event at the Project.		
• Pumped Storage Operations Interpretative Exhibit		
• Brewer Road game carcass disposal area and game processing / cleaning station.		
• Foothills Trail Interpretative Exhibit: Develop exhibit for display at the Bad Creek Visitors Center.		
Terrestrial Resources		
• Oconee County Conservation Bank: Provide $500,000 within two years of the new license and $500,000 within one year following the start of commercial operation of Bad Creek II.		

Description of Proposed PM&E Measures	Average Annual Capital Cost (2024$)	Average Annual O&M Cost (2024$)
• Keowee-Toxaway Habitat Enhancement Program: Provide $500,000 within two years following the new license and $500,000 within one year following the start of commercial operation of Bad Creek II.		
• Wildlife Enhancement Program: Provide $2,500,000 within one year following the start of Bad Creek II construction.		
Total Bad Creek (Existing Project) Measures		
Total Bad Creek II Construction PM&E Measures		
Total Non-License Costs		
Total Costs		

D.4 Annual Value of Project Power

The Licensee sells the electricity generated at the Project into the regional grid at market rates and uses excess generation to pump water off peak. The Licensee estimates average annual Project generation to be about 2,068,143 MWh. This would increase to about 4,237,300 MWh with Project expansion. Based on a 2023 average price of electricity of $xx/MWh, this equates to a value of $xx for existing Project generation and $xx for expanded Project generation[8].

D.5 Electric Energy Alternatives

If the Licensee is not granted a new license to continue operating the Project, it would immediately need to acquire replacement power from market purchases, construction of alternate power plants, or some combination thereof. The planned retirement of existing coal-fired generating facilities would need to be delayed until viable replacement generation sources were identified and additional battery storage would be needed.

Duke Energy's generation resources include gas, coal, and nuclear-fueled generating facilities as well as conventional hydroelectric, pumped storage hydroelectric, solar, and wind resources. However, Duke Energy's system planning demonstrates these resources would not be able to compensate for the loss of Project generation. Further, existing generation resources would not be capable of replacing the unique values provided by the Project as discussed in Exhibit H, Section H.1.2.

[8] Pumped storage hydroelectric facilities are net consumers of electricity. Therefore, the estimate value reflects only the value associated with generation and does not reflect offsets associated with pumping. The value also does not reflect the ancillary values of pumped storage hydroelectric generation discussed throughout this application.

D.6 Consequences of Application Denial and Future Use of the Project Site

The consequences of denying the Licensee's application for expansion of the Project are described in Exhibit H, Section H.1.2. If the proposed Project (i.e., Bad Creek II) was not constructed, the Licensee anticipates it would retain the land within the proposed Project boundary and continue managing said areas in concert with the existing Project.

D.7 Sources and Extent of Financial and Annual Revenues

The Licensee's financial resources are described in Exhibit H, Section H.1.9.

D.8 Cost to Develop the License Application

The approximate cost to prepare the application for new license for the Project through July 31, 2025, is $XX.

D.9 On-Peak and Off-Peak Values of the Project

Average energy rates compiled from the Southeastern Power Administration (SEPA) purchase records from 2019 through 2023 were employed to price energy (Table D-4). This mechanism is considered to be satisfactory for the calculation of on-peak and off-peak energy value since the values used represent energy values in the region.

Table D-4. Average Monthly On-Peak and Off-Peak Energy Values, 2019 through 2023

Month	Average Monthly Energy Value ($/kW)					
	2019	2020	2021	2022	2023	Average
On-Peak						
January						
February						
March						
April						
May						
June						
July						
August						
September						
October						
November						
December						

Month	Average Monthly Energy Value ($/kW)					
	2019	2020	2021	2022	2023	Average
Off-Peak						
January						
February						
March						
April						
May						
June						
July						
August						
September						
October						
November						
December						

Using the SEPA rates from Table D-4 and modeled generation under proposed operations, the net energy compensation for the Project would be calculated as the generation energy value less the pumping energy value. Using the SEPA rates and modeled generation and pumping under proposed operations for the existing Project, these values are $xx for generation and $xx for pumping for a net annual compensation of $xx in 2023 dollars. These values for the expanded Project are $xx for generation and $xx for pumping for a net annual compensation of $xx in 2023 dollars.