BROOKSIDE SOLAR, LLC

Matter No. 21-00917

900-2.22 Exhibit 21

Electric System Effects and Interconnection

Contents

Tables

Appendices

Acronym List

AC	alternating current
ACI	American Concrete Institute
ACSR	aluminum conductor steel reinforced
AEIC	Association of Edison Illuminating Companies
AES	The AES Corporation, Inc.
ANSI	American National Standards Institute
ASCE	American Society of Civil Engineers
ASTM	American Society for Testing and Materials
bgs	below ground surface
DC	direct current
EHS	extra high strength
EPR	Ethylene-Propylene Rubber
FERC	Federal Energy Regulatory Commission
ICEA	Insulated Cable Engineers Association
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
KCMIL	kilo-circular mil
kV	kilovolt
NEC	National Electrical Code
NERC	North American Electric Reliability Corporation
NESC	National Electric Safety Code
NFPA	National Fire Protection Association
NPCC	Northeast Power Coordinating Council, Inc.
NYCRR	New York Codes, Rules and Regulations
NYISO	New York Independent System Operator, Inc.
NYSDEC	New York State Department of Environmental Conservation
NYSEG	New York State Electric and Gas Corporation
NYSRC	New York State Reliability Council, L.L.C.
OATT	Open Access Transmission Tariff
OPGW	Optic Ground Wire
ORES	Office of Renewable Energy Siting

OSHA	Occupational Safety and Health Administration
POI	point of interconnection
PV	photovoltaic
RUS	Rural Utilities Service
SRIS	System Reliability Impact Study
TR-XLPE	tree-retardant cross-linked polyethylene
UL	Underwriters Laboratories
USCs	Uniform Standards and Conditions

Glossary Terms

Applicant	Brookside Solar, LLC, a subsidiary of The AES Corporation, Inc. (AES), the entity seeking a siting permit for the Facility from the Office of Renewable Energy Siting (ORES) under Section 94-c of the New York State Executive Law.
Facility	The proposed components to be constructed for the collection and distribution of energy for the Brookside Solar Project, which includes solar arrays, inverters, electric collection lines, and the collection substation.
Facility Site	The parcels encompassing Facility components which totals 1,471 acres in the Towns of Burke and Chateaugay, Franklin County, New York (Figure 2-1).

Exhibit 21: Electric System Effects and Interconnection

This Exhibit provides information required in accordance with the requirements of Section 900-2.22 of the Section 94-c Regulations.

21(a) Electric Interconnection

(1) Voltage

The collection lines will have a nominal voltage of 34.5 kilovolts (kV) from line-to-line and a maximum design level voltage of 115 kV. Power from the inverters will be collected and transported by the 34.5-kV collection lines within the Facility Site. The collection lines will be located underground and will connect to the collection substation, where a transformer will step up the voltage to 115 kV. The power will then be transferred to the transmission system via the point of interconnection (POI) 115-kV three breaker ring station that will be connected to the transmission system by tapping the existing New York State Electric and Gas (NYSEG) Line 911 Willis Road to Chateaugay 115-kV transmission line.

(2) Conductors

The proposed conductors to be used on the 115-kV transmission line will be non-specular 795 kilo-circular mil (KCMIL) aluminum conductor steel reinforced (ACSR) 26/7 “Drake.” The Facility proposes to use three 795 KCMIL conductor lines with grey porcelain disc insulators. Shield wire to be used at the Facility will be either 3/8” Extra High Strength (EHS) Steel or Optic Ground Wire (OPGW). The cable conductor size and type will be determined by the required load while maintaining the conductor below 105 degrees Celsius during normal operations.

Conductors to be used on the 34.5-kV cable systems a maximum of 750 KCMIL aluminum conductors. The conductor insulation for the 34.5 kV-lines will either be tree-retardant cross-linked polyethylene (TR-XLPE) or Ethylene-Propylene Rubber (EPR), as required.

(3) Insulator Design

Typical utility-grade ceramic/porcelain insulators, designed and constructed in accordance with the American National Standards Institute (ANSI) C29 will be used. The load of the insulator shall not exceed the corresponding insulator strength published in ANSI C29.9, Tables 1 and 2.

(4) Length of Transmission Line

The transmission line for the Facility consists of two, three-wire 115-kilovolt (kV) interconnection transmission lines, approximately 173-feet and 210-feet in length, single circuit overhead 115-kV parallel transmission lines between the POI switchyard and the existing NYSEG Line 911 Willis Road to Chateaugay 115-kV transmission line.

(5) Tower Dimensions & Construction Materials

The Facility proposes to use steel pole towers, approximately 65 feet and 70 feet above ground level, using a three-pole configuration (see Appendix 5-1, Facility Design Drawings).

(6) Tower Design Standards

The design standards for the Facility interconnection towers and tower foundations are provided in Table 21-1 below, and on Sheets HV-C.09.01 through HV-E.15.01 of Appendix 5-1.

Table 21-1. Tower Design Standards

Standard	Name
ANSI C2	National Electric Safety Code (NESC), 2017
ANSI Z535	2011 Product Safety Signs and Labels
ACI 318	Building Code Requirements for Structure Concrete
ASCE 48	Design of Steel Transmission Pole Structures
ASCE 72	Design of Steel Transmission Pole Structures Second Edition
ASCE 74	Guidelines for Electrical Transmission Line Structural Loading
ASCE 91	Design of Guyed Electrical Transmission Structures
ICEA S-93-639	5-46 kV Shielded Power Cable for Use in the Transmission and Distribution of Electric Energy
IEC 60287	Electric Cables – Calculation of the Current Rating – Part 2-1: Thermal Resistance – Calculation of Thermal Resistance.
IEC 60383-2	Ceramic or Glass Insulators Units for Alternating Current (AC) Systems - Part 1
IEEE 524	Guide to Installation of Overhead Transmission Line Conductors
IEEE 738	Standard for Calculating the Current-Temperature of Bare Overhead Conductors
IEEE 48	IEEE Standard for Test Procedures and Requirements for AC Cable Terminations Used on Shielded Cables Having Laminated Insulation Rated 2.5 kV through 765 kV or Extruded Insulation Rated 2.5 kV through 500 kV, 2009
IEEE 404	IEEE Standard for Extruded and Laminated Dielectric Shielded Cable Joints Rated 2.5 kV to 500 kV, 2012

Table 21-1. Tower Design Standards

Standard	Name
RUS BULLETIN 1724E-200	Design Manual for High Voltage Transmission Lines
RUS BULLETIN 1728F-806	Specifications and Drawings for Underground Electric Distribution
UL 1072	Standard for Medium-Voltage Power Cables
ACI: American Concrete Institute ASCE: American Society of Civil Engineers ANSI: American National Standards Institute ICEA: Insulated Cable Engineers Association IEC: International Electrotechnical Commission IEEE: Institute of Electrical and Electronics Engineers RUS: Rural Utilities Service UL: Underwriters Laboratories	

(7) Underground Cable System & Design Standards

The underground collector system will collect the power produced by the solar array as described in Sections 21(a) and 21(b), above. Collection cables will be designed in accordance with the following standards:

- Insulated Cable Engineers Association (ICEA) S-93-639, and
- Association of Edison Illuminating Companies (AEIC) CS8.

(8) Underground Lines Profile & Oil Pumping Stations/Manhole Locations

The underground collection lines and associated material are depicted on the Facility Design Drawings provided in Appendix 5-1. The underground collection lines will be buried at various depths, depending on the location and environmental conditions (as discussed within Exhibit 10). Generally, this will be no less than 36 inches (3 feet) below ground surface (bgs) outside of agricultural lands, and 48 inches (4 feet) bgs within agricultural lands. For areas where the depth to bedrock is encountered less than 48 inches bgs, the collection lines will be buried below the surface of the bedrock if the bedrock is friable/rippable. If the bedrock is not friable/rippable, the collection line shall be installed as close as possible to the surface of the bedrock.

Oil pumping stations and manhole locations are not used as part of the 34.5-kV collection system. This is typical of pipe-type cable installation.

(9) Equipment to be Installed in Substations or Switching Stations

The collector substation will include 34.5-kV and 115-kV busses, main power transformer, 34.5-kV and 115-kV circuit breakers, a coupling capacitor voltage transformer, an instrument transformer and revenue metering, air-break disconnect switches, 115-kV motor operated disconnect switch, a capacitor back, station service transformer, a generator, surge arrestors, a ground switch, steel structures, and a control house, as depicted on the Design Drawings provided in Appendix 5-1. The control house is a non-habitable equipment structure to be used for operation and maintenance of the Facility. These Facility components allow for the delivery of the energy produced by the Facility to the existing electric power grid.

The equipment and structures required for the Facility will be designed in accordance with the requirements of NYSEG, the transmission operator and owner of the existing Line 911 Willis Road to Chateaugay 115-kV transmission line.

(10) Any Terminal Facility

The Facility terminal facilities will consist of the collection substation as described above.

(11) Cathodic Protection Measures

The underground collection system and steel poles for the 115-kV overhead interconnection line are not expected to require cathodic protection measures, as no third-party metallic pipelines are known to be located in the Facility Site.

21(b) System Reliability Impact Study

The New York Independent System Operator, Inc. (NYISO) commissioned Burns & McDonnell to perform a System Reliability Impact Study (SRIS) for the Facility, which is included as Appendix 21-1. The SRIS was performed in accordance with the Applicable Reliability Standards set forth under the Federal Energy Regulatory Commission (FERC)-approved Attachment X of the NYISO Open Access Transmission Tariff (OATT). The SRIS was also conducted in accordance with the applicable North American Electric Reliability Corporation (NERC), Northeast Power Coordinating Council, Inc. (NPCC), New York State Reliability Council, L.L.C. (NYSRC), and Affected System(s) reliability and design standards; and in accordance with applicable NYISO, NYSEG study guidelines, procedures, and practices. The

Study assessed the impact of the Facility in the NYISO Zone D (North) and NYISO Zone E (Mohawk Valley).

The SRIS was performed using the updated NYISO Class Year 2019 ATBA base cases that were developed from the 2019 FERC 715 filing cases which had the 2024 system representation. The SRIS evaluated the impact of the Facility for the summer peak and light load system conditions. The impact of the Facility was evaluated by comparing the study results for the models without the Facility with the study results for the models with the Facility included at full output. The impact of the Facility on the flows and voltages were analyzed under normal and emergency system conditions. The effects of the Facility on the stability of the interconnected system were evaluated for NYISO design emergency events and local emergency events system conditions. The short circuit impact of the Facility on the interconnected system was evaluated using the NYISO's short circuit cases.

There are no elective system upgrades proposed with the Facility; therefore, no other system upgrades were modeled in the SRIS.

21(c) Impact on Transmission System Reliability

The SRIS evaluated the potential significant impacts of the interconnection of the Facility to the transmission system reliability by performing thermal, voltage, stability, and short circuit analyses. During summer peak and light load system conditions, the SRIS determined that the Facility does not cause any significant thermal and voltage impacts under normal and emergency system conditions.

The short circuit analysis results determined that the Facility does not cause any significant short circuit impacts to the New York State transmission system.

During summer peak and light load system conditions, the SRIS determined that the Facility does not cause any significant system stability impacts when the system is under NYISO design emergency events and under local emergency events system conditions.

21(d) Impact on Ancillary Services

The SRIS did not evaluate the impact of the Facility on the ancillary services. However, the Facility as proposed is capable of providing reactive power support to the interconnected

system and is able to maintain NYISO's power factor requirements at the POI over its full range of operation.

21(e) Impact on Total Transfer Capacity

The Facility location is far from any NYISO major interfaces and therefore, the Facility is unlikely to cause any significant impacts to the system Total Transfer Capacity. The impact on the Total Transfer Capacity was not evaluated as it was not recommended by NYISO in the Facility SRIS Study Scope.

21(f) Criteria, Plans, and Protocols

(1) Engineering Codes, Standards, Guidelines, and Practices

The Facility will be designed in accordance with applicable standards, codes, guidelines, and will use best industry practices.

Electricity from the Facility will be generated using photovoltaic (PV) solar panels. The panels produce electricity at a low voltage, which is converted from direct current (DC) to AC at the Facility's inverters. The collection system for the Facility will be composed of 10.28 miles of underground 34.5-kV lines, which will be installed using direct bury methods. The collection lines will feed into the onsite collection substation, which will step up the power to 115 kV.

The collection substation will connect to the POI facilities, which will be composed of an onsite 115-kV three breaker ring bus switchyard and two approximately 173-foot and 210-foot-long tie-in lines. The tie-in lines will be transferred to NYSEG to own and operate and will connect to the adjacent Line 911 Willis Road to Chateaugay 115-kV transmission line.

Facility components will be designed, constructed, and operated in accordance with but not limited to the following codes, guidelines, and references, as applicable:

- RUS – Rural Utilities Service Bulletin 1724E-200,
- ANSI,
- ASCE – American Society of Civil Engineers,
- ASTM – American Society for Testing and Materials,
- Building Code of New York,

- IEEE – Institute of Electrical and Electronic Engineers,
- NEC – National Electric Code,
- NERC,
- NESC – National Electric Safety Code,
- NFPA – National Fire Protection Association,
- NPCC,
- NYSRC,
- OSHA – Occupational Safety and Health Administration, and
- UL – Underwriters Laboratories.

The Applicant will adhere to all applicable NYSEG requirements in relation to the proposed POI facilities, collection lines, and collection substation. The collection substation will not be built to NYSEG standards, except where specific requirements as previously stated are applicable. Refer to Exhibit 5 for additional information on applicable engineering codes, standards, guidelines, and practices, and Appendix 21-2 of this Exhibit, Transmission and Collection Design Criteria, for additional information.

(2) Facility Type Certification

Materials and equipment will be new and will meet applicable requirements and standards listed above to facilitate the long-term, reliable operation of the Facility. Specification sheets for the proposed solar modules and racking systems are provided in Appendix 2-1 of Exhibit 2. The equipment under consideration has been certified by the UL. The final selection of major Facility components will be completed prior to construction and will depend on factors such as market conditions and availability. The equipment ultimately selected for use at the Facility shall comply with the applicable standards and requirements listed above.

(3) Inspection, Testing, and Commissioning Procedures and Controls

Inspection, testing, and commissioning is conducted to validate the electrical connections, panel operation, and to perform the appropriate field tests to ensure the integrity of the Facility components. Commissioning activities include the testing and inspection of the electrical, mechanical, and communication systems associated with the Facility after the completion of construction and shall be completed in accordance with all applicable engineering, design, and

manufacturer standards. A detailed report shall be prepared upon completion of the applicable commissioning processes ensuring that the commissioning processes were completed in accordance with all appropriate engineering and manufacturer standards. Commissioning of the solar panels will occur once the panels and collection substation are fully constructed and the NYISO is ready to accept the transport of power to the New York State electrical grid.

Post-construction inspection, testing, and commissioning of the Facility's solar panels includes but is not limited to:

- Adhering to all employee safety requirements;
- Confirming that the panels have been de-energized to ensure no current is flowing through the electrical components;
- Verifying all protective equipment has been properly installed;
- Confirming that all wires and cable have been routed properly without sharp bends;
- Checking that all fuses, connections, safety switches, breakers, inverters, and all other systems/components are appropriately installed and securely fastened;
- Ensuring that there are no short circuits or short protections, and confirming the components are ready to receive power; and
- Testing panels and inverters.

Collection System

The Applicant and its contractor(s) shall visually inspect all collection system materials for defects prior to and during construction and installation and should confirm the associated design specifications have been met. The collection substation system commissioning process includes, but is not limited to:

- Visual, mechanical, and electrical testing of power transformers and high-voltage breakers;
- Testing of all metering units, circuit breakers, transformers, switches, relays, computer systems, and other instruments;
- Inspections and testing of switchgear and switchboards;

- Testing and diagnostics of all cables;
- Testing of the grounding systems; and
- Integration of the substation into the data collection system.

(4) Maintenance and Management

Maintenance of the Facility during operation will include vegetation management, solar array inspections and cleanings, electrical equipment inspections and maintenance, and overall safety assessments.

A vegetation management plan will be provided as part of the pre-construction compliance filings. Vegetation management will include but is not limited to mowing and herbicide application. The Facility within the fence shall be mowed at least twice per year. Vegetation shall not exceed the height of the lowest panel between mowing. Vegetation outside the fenced area shall be mowed, maintained, or brush-hogged periodically to allow for maintenance access and prevent shading on the panels. Vegetation maintenance outside the fenced area is anticipated to be required every 2 to 3 years.

Herbicides may be applied as a secondary vegetation control, where necessary; however, herbicides will be applied only as spot treatments to target specific, discrete locations. Herbicides may be used to treat invasive species, as needed. An Invasive Species Management and Control Plan is attached as Appendix 11-2. Herbicides used at the Facility shall comply with the regulations and requirements of the New York State Department of Environmental Conservation (NYSDEC) Pesticide Control Regulations.

21(g) Transfer of Transmission Ownership

(1) Facilities to be Transferred

The Applicant will be transferring the transmission structure, conductors, and disconnect switches for the line tap to NYSEG following construction.

(2) Transmission Owner Design Requirements

The interconnection will be designed in accordance with NYSEG’s requirements.

(3) Operational and Maintenance Responsibilities and Standards

NYSEG will be responsible for the operational and maintenance obligations associated with the interconnection facilities from the take-off structure to the main line.

21(h) Multi-use Options for Utilities

The Applicant is not proposing that the Facility share any aboveground facilities with other utilities (i.e., communications, cable, phone, cell phone relays, etc.).

21(i) Equipment Availability and Delivery Schedule

The Applicant is not aware of equipment availability restrictions in relation to the Facility at this time and currently plans for the Facility to be operational in Q4 of 2023. Based on this timeframe, major Facility components are expected to arrive onsite from Q4 of 2022 through the commercial operation date.

Conclusions

The Facility components will use industry best practices, and will be installed in accordance with applicable standards, codes, guidelines, and requirements. The SRIS determined that the Facility and its interconnection will not cause adverse thermal, voltage, short circuit and stability impacts on the New York State Transmission System. Although the SRIS did not evaluate the impact of the Facility to the ancillary services, the Facility is capable of providing required reactive power to the electric transmission system and maintaining required voltage level at the POI over its full range of operation. Inspection, testing, and commissioning will be conducted to validate the electrical connections, panel operation, and to perform the appropriate field tests to ensure the integrity of the Facility components. The Facility has been designed to comply with 19 New York Codes, Rules and Regulations (NYCRR) Section 900-2.22 and the Uniform Standards and Conditions (USCs) and impacts related to the electric system and interconnection have been avoided and minimized to the maximum extent practicable.