North Seneca Solar Project

ORES Permit Application No. 23-00036

1100-2.22 Exhibit 21

Electric System Effects and Interconnection
Revision 1

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EXHIBIT 21 ELECTRIC SYSTEM EFFECTS AND INTERCONNECTION

(a) Proposed Electric Interconnection

Interconnection of the Facility to the electrical grid will be achieved using multiple systems. The photovoltaic (PV) panels produce power at a low voltage, which is converted from direct current (DC) at a voltage of approximately 1,500 volts (V) to alternating current (AC) at a voltage of approximately 630 V at the inverters. Co-located with the inverters are medium voltage transformers that increase the AC voltage output from approximately 630 V to 34.5 kilovolts (kV) (i.e., the collection system voltage). A medium voltage collection system comprised of underground cables transmits the power to a proposed collection substation. The proposed collection substation then increases the voltage from 34.5 kV to 115 kV with the use of at least one main power transformer, which allows the energy to be delivered to the adjacent point of interconnection (POI) switchyard, which will be owned and operated by National Grid (NG). A short length of overhead transmission voltage line (i.e., 800 feet) will connect the POI switchyard to the existing 115kV National Grid transmission line.

(1) Design Voltage and Voltage of Initial Operation

The Facility is grouped into four different three-phase collection circuits, each with their own photovoltaic (PV) array and 34.5 kV cable network which will terminate at the proposed collection substation feeder circuit breakers. The PV array strings will be connected to combiner boxes or load break disconnects and transmitted using insulated aluminum cables to inverters which will convert electrical output from approximately 1,500 V DC to 630 V AC. The Facility will contain 24 inverters with over 90-megawatt (MW) capability such that the Facility's electrical output is delivered to the POI while meeting local and national reliability standards. All inverters are rated as 3.89 MW with a native 630 VAC output. The voltages listed are nominal and typically operate within a margin of +/- 5%.

(2) Type, Size, Number, and Materials of Conductors

The underground collection system will be comprised of four three-phase circuits in parallel, connecting each of the MV transformers to the proposed collection substation. Each section of underground cables will be comprised of aluminum conductors, each surrounded by electrical insulation and an overall jacket. The size of each conductor will depend on the distance from between the MV Transformers and to collection substation, and the power flowing through conductors but will typically range from 4/0 to 1250 kcmil American Wire Gauge (AWG). Detailed description of underground collection system conductor types, sizes, numbers and material can be found on wiring schedule on drawing 204-01.

The proposed collection substation will contain rigid aluminum tubular bus conductors. Although specific design details of the transmission, or gen-tie, lines are not final at this time, it is anticipated that the overhead gen-tie lines between substations and the transmission line between the POI switchyard and existing National Grid transmission line will be approximately 93 feet and 800ft in length respectively; the conductor is assumed to be 795 kcmil aluminum conductor steel-reinforced (ACSR) "Drake" with a single conductor per phase.. Final equipment selection will be performed with National Grid approval upon the completion of detailed engineering.

(3) Insulator Design

Typical utility-grade ceramic/porcelain or composite/polymer insulators, designed and constructed in accordance with ANSI C29, will be used. Insulators in the proposed collection substation and the POI switchyard will generally be porcelain.

(4) Length of the Transmission Line

As indicated previously, a short length of overhead transmission voltage line (approximately 800 feet) will connect the designated POI switchyard to existing National Grid transmission line. Also, a short length of overhead transmission line voltage line (approximately 93 feet) will connect the collection substation to the POI switchyard.

(5) Typical Dimensions and Construction Materials of the Towers

Typical details of the proposed transmission line can be found in the 900 Series Electrical Drawings (Appendix 5-B).

It is proposed that all collection lines will be buried. As such, towers are not currently anticipated for these Facility components. However, if further investigations determine burial to be impractical (e.g., if shallow bedrock is encountered), the lines may need to be carried on overhead support structures. The precise dimensions and construction materials of these structures will be determined once the need for such structures has been identified.

(6) Design Standards for Each Type of Tower and Tower Foundation

Overhead collection lines are not anticipated. However, if it is determined that overhead collection lines are needed, support structures for these lines would be designed in accordance with the following applicable standards:

- NESC – National Electric Safety Code standards
- American Society of Civil Engineers (ACSE) Manual 72, “Design of Steel Transmission Pole Structures,” and Standard 48, “Design of Steel Transmission Pole Structures”
- Rural Utilities Service Bulletin 1724E-200 “Design Manual for High Voltage Transmission Lines.”
- ANSI – American National Standards Institute
- ASTM – American Society for Testing and Materials
- OSHA – Occupational Safety and Health Administration
- IEEE – Institute of Electrical and Electronic Engineers
- NEC – National Electric Code

(7) Type of Cable System and Design Standards for Underground Construction

The underground collection cable systems will collect converted and transformed AC electricity from the PV array inverters. Installation of the cable system will include direct burial methods such as trenching and plowing. Common equipment used in this process includes a cable plow, rock saw, and rock wheel trencher. Direct burial will involve the installation of bundled cable (electrical and fiber optic bundles) directly into an approximately 12-inch-wide trench created by the plow, saw blade or rock wheel. The bundled cable will be installed to a minimum depth of 36 inches in non-agricultural areas to 48 inches in agricultural areas. After the cable is installed, the trench will be filled with compacted native soil, if suitable. All areas will be returned to approximate pre-construction grades and restored.

Alternative methods will be necessary for collection line routing across public roads and in order to avoid environmentally sensitive resources. Typically, these methods involve pushing or drilling a subsurface carrier pipe through the ground underneath obstructions. Pits are required at either end of the bore to stage boring equipment and materials and receive the subsurface carrier pipe. The cable is then pulled through the installed carrier pipe and transitioned back to direct burial. Typical details of the trenchless installation methods proposed for the Facility are included in Appendix 5-B.

Design of the system will comply with:

- ANSI – American National Standards Institute
- ASTM – American Society for Testing and Materials
- OSHA – Occupational Safety and Health Administration
- IEEE – Institute of Electrical and Electronic Engineers
- NEC – National Electric Code
- NFPA- National Fire Protection Association

A number of splicing points/junction boxes are required for the underground cable splicing. If more splicing is required, an area of sufficient size will be excavated. Additional splicing activities will comply with manufacturer instruction and training.

The underground collection lines can be typically spliced using cold shrink or heat shrink splicing kits. Each splice kit contains a bolted or compression conductor connector, insulation shield, ground strap and connectors, insulating tape, splice body, jacket material, etc. The ends of the cables to be spliced together will be cut and prepared according to splice manufacturer instructions. This generally includes cutting the jacket, peeling back the neutral wires/tape and semi-con layer and smoothing the cable insulation. A connector is installed to join and secure the conductors. The splice point is covered with the insulating splice body and secured depending on the type of splice. A cold shrink splice will contract around the splice point when a core holding the splice open is removed/unwound, which allows the splice to contract to its natural position tightly around the splice. A heat shrink splice requires the use of a heat source (heat gun, torch, etc.) to shrink the material around the splice point. Installation will be conducted in accordance with manufacturer's specifications.

(8) Profile of Underground Lines

Refer to the typical trench details on drawing 501 of design drawings in Appendix 5-B for depth of the underground collection cable and associated material. As stated previously, the depth may increase in certain areas based on land use (e.g., agricultural/pasture lands). Underground collection cables will be buried at a minimum depth of 36 inches in non-agricultural areas and 48 inches in agricultural land areas or, in areas where the depth of bedrock is less than 48 inches, the greater of the depth of bedrock or the minimum permissible by code. There is no insulation/cooling system required, such as pumped oil or water. There are no below-grade manholes required.

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

The proposed collection substation will include one 34.5-115 kV main power transformer, a 34.5 kV bus, high-voltage and medium-voltage breakers, metering/relaying transformers, disconnect switches, an equipment enclosure containing power control electronics, and lightning masts. The equipment for the proposed collection substation will be constructed on concrete foundations. The proposed POI switchyard will include high-voltage breakers, metering/relaying transformers, disconnect switches, an equipment enclosure containing power control electronics, and lightning masts. The equipment for the proposed POI switchyard will be constructed on concrete foundations. The POI switchyard will be owned by National Grid. Refer to preliminary drawings in Appendix 5-B for a plan/overview of the collection substation and the POI switchyard.

(10) Any Terminal Facility

The only terminal facilities expected are the POI switchyard and proposed collection substation, no other terminal facility or substations are expected to be impacted. These components are described in Section (a)(9).

(11) Need for Cathodic Protection Measures

There are no cathodic protection measures expected to be required for installation of the underground collection systems, as no metallic pipelines will be installed as part of this Facility. Also, no Facility underground collection system cables are planned in parallel with or in vicinity of existing underground pipelines rights-of-way. All overhead/underground crossings will be perpendicular over/under existing underground pipelines, which will mitigate the need for any kind of cathodic protection. Facility will coordinate and consult with pipeline owner/operators regarding crossing methods and any need for cathodic protection measures, if any. Therefore, cathodic protection measures are not discussed further in this Application.

(b) System Reliability Impact Study

A System Reliability Impact Study (SRIS) for the Facility was performed by Qualus Power Services on behalf of the New York Independent System Operator (NYISO) in March 2023. The Project has entered the NYISO 2023 Class Year Facilities Study which is expected to be completed in 2025. Results of this study are summarized below:

- **N-0 and N-1 Steady State Analysis**
  Thermal and voltage steady state analyses, were conducted for summer peak and light load conditions, pre-contingency and for relevant Design Criteria Contingencies conditions. Under both summer peak and light load conditions, results of the N-0 and N-1 thermal analysis show that the Project does not have any adverse thermal impacts on the system due to its interconnection. Under both summer peak and light load conditions, results of the N-0 and N-1 voltage analysis show that the Project does not have any adverse impacts on system voltages due to its interconnection.

- **N-1-1 – Steady State Analysis**
  Thermal and voltage steady state analyses, were conducted for summer peak conditions.

It is observed that a Farmington transformer is overloaded under N-1-1 condition. This overload is observed pre-contingency, but the Project increases the overload by at least 1%. System adjustments after the first-level contingency reduces the loadings on the transformer to pre-Project levels. Results of the voltage analyses therefore show that the Project does not have any adverse voltage impacts on the NYSTS.

- **Stability**
  The conclusion of the stability analysis, based on the responses obtained from the dynamic simulations, is that the Project does not degrade the dynamic response of the New York State Transmission System for the tested design and local contingencies under the summer peak and light load conditions. The analysis did not identify any adverse impact due to the addition of the Project.

- **Short Circuit**
  Under both summer peak and light load conditions, results of the N-0 and N-1 analysis show that the Project does not have any adverse thermal or voltage impacts on the system due to its interconnection.

(c) Potential Reliability Impacts

The SRIS evaluated several power flow base cases, as provided by the NYISO, including 2022 Summer Peak, Winter Peak, and Light Load system conditions. The SRIS concludes that the Facility does not cause any adverse impacts to the reliability of the New York State transmission system.

(d) Benefits and Detriments of the Facility on Ancillary Services

The SRIS did not identify any benefits or detriments to the Facility on Ancillary Services. The only system upgrades required are directly related to the connection of the Facility to the system. The upgrades are limited to the construction of a new POI switchyard, and remote substations.

(e) Estimated Change in Total Transfer Capacity

Thermal, voltage and stability transfer analyses were performed for summer peak conditions, and it was observed that the interconnection of the Project does not have any adverse impacts on the Hook Road-Elbridge Line #7 and Elbridge interfaces (opened and closed) transfer limits.

(f) Criteria, Plans, and Protocols

The following sections provide the applicable engineering codes, facility inspection controls and procedures, and maintenance and management plans. The Applicant will require that all contractors and sub-contractors to comply with all applicable federal, state, and local codes, standards, and requirements through the design, construction, and commissioning of the Facility. The Facility will be constructed based on design drawings stamped by a New York State Professional Engineer.

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

The Facility will be designed in accordance with applicable standards, codes, and guidelines. For portions owned by the Applicant (collection system, collector substation and PV plant), best industry practices will be used, along with any standards/preferences set by the companies designing the Facility. For the POI, the facility will be designed to be in conformation with all National Grid, New York State Reliability Council (NYSRC), Northeast Power Coordinating Council (NPCC), and North American Electric Reliability Corporation (NERC) reliability criteria.

115 kV Overhead Transmission System

An approximately 800-foot span of 115 kV overhead transmission line will be constructed between the POI switchyard and the existing National Grid transmission line (see Appendix 5-B, 900 series drawings for a conceptual layout). Also, a short span of 93 feet overhead transmission line will be installed between the collection substation and POI switchyard. This overhead transmission line is anticipated to be designed and operated in accordance with the Interconnection Agreement, approved tariffs and applicable rules and protocols of National Grid, NYISO, NYSRC, NPCC, NERC, and successor organizations. In addition, the Facility is anticipated to be designed in accordance with (but not limited to) the following standards:

- RUS Bulletin 1724E-200
- NESC – National Electric Safety Code Standards
- ANSI – American National Standards Institute
- ASTM – American Society of Testing and Materials
- OSHA – Occupational Safety and Health Administration
- IEEE – Institute of Electrical and Electronic Engineers
- ASCE – American Society of Civil Engineers
- NEC – National Electric Code

The vertical clearance requirements for the transmission line will follow all applicable standards and requirements. All dead-end structures and tangent structures will be designed to meet or exceed various applicable loadings outlined in the NESC.

Proposed Collection Substation

The proposed collection substation design will incorporate, but is not limited to, the following standards and codes where applicable:

- NESC - National Electric Safety Code.
- NFPA 70 - National Fire Protection Association - National Electric Code
- NFPA 850 - National Fire Protection Association – Recommended Practice for Fire Protection for Electric Generating Plants and High Voltage Direct Current Converter Stations
- ACI - American Concrete Institute
- ANSI - American National Standard Institute
- ASCE - American Society of Civil Engineers
- ASTM - American Society for Testing and Materials
- IBC - International Building Code

- IEEE 80 - IEEE Guide for Safety in AC Substation Grounding
- IEEE C37.2 - IEEE Standard Electrical Power System Device Function Numbers and Contact Designation
- IEEE C37.90 - IEEE Standard for Relays and Relay Systems Associated with Electrical Power Apparatus
- IEEE C37.110 - Guide for the Application of Current Transformers Used for Protective Relaying Purposes
- IEEE C57.13 - IEEE Standard Requirements for Instrument Transformers
- IEEE 485 - IEEE Recommended Practice for Sizing Lead-Acid Batteries for Stationary Applications
- IEEE C57.12.10 - IEEE Standard Requirements for Liquid-Immersed Power Transformers
- IEEE 998 - IEEE Guide for Direct Lightning Stroke Shielding of Substations
- IEEE C37.119 - IEEE Guide for Breaker Failure Protection of Power Circuit Breakers
- IEEE 605 - IEEE Guide for Design of Substation Rigid-Bus Structures
- IEEE 693 - IEEE Recommended Practices for Seismic Design of Substations
- IEEE 980 - IEEE Guide for Containment and Control of Oil Spills in Substations

The collection substation grading will be done in the most economical and efficient manner and will be slightly elevated in relation to the surrounding ground levels to give it positive drainage and ensure that water does not pond at or inside the substation. Grading slopes inside the substation fence will preferably be between 0 and 1% but under no conditions will the slope be more than 2%. The graded area will extend approximately 5 to 20 feet beyond the substation fence to allow for yard stone and the perimeter loop of the ground grid and tie into existing topographical contours (see Appendix 5-B). All clearing, grubbing, excavation, and cut/fill will conform to geotechnical report recommendations and the Stormwater Pollution Prevention Plan (SWPPP) (Appendix 13-C).

Design of the proposed collection substation will consider various environmental data such as the following:

- Altitude
- Maximum wind speed
- Normal ambient temperatures
- Extreme ambient temperatures
- Precipitation
- Humidity
- Seismic hazard (acceleration as percent of gravity)

The foundation design will be based on the maximum load (both static and dynamic) that will be applied to the steel structures and/or the equipment. Either drilled piers or spread footing will be used to support steel structures as per geotechnical report recommendations (Appendix 10-A). Cast-in-place headed anchor rods with leveling nuts will be used/designed to connect substation structures/equipment to their foundations.

Oil containment will be designed/installed for the main transformer as required by federal, state, and local regulations. The oil containment will have an oil capacity of no less than 110% of equipment total oil capacity.

The steel structure design will conform to the provisions and requirements of the American Institute of Steel Construction and ASCE "Substation Structure Design Guide, Manual of Practice 113." Materials for structural steel and miscellaneous steel will conform to the following requirements of the ASTM:

- Wide Flange (WF) Shapes and Tees cut from WF: ASTM A992, Grade 50 or multi-certification A36/A572, Grade 50
- Tubular – a structure composed of closed sections (tubes) of circular, multi-sided, or elliptical cross section and tapered or untapered: ASTM A595 or A500 Grade B
- Pipe: A53, Grade B
- M shapes, S shapes, HP, Channels, and Angles: ASTM A36
- Structural Plates and Bars: ASTM A36

All structures will be galvanized conforming to the requirements of ASTM A123, ASTM A143, and ASTM A153 as applicable. All structural welding design will conform to the requirements of AWS D1.1. All high strength bolts, nuts, and washers will conform to ASTM A325, A394 or A490, ASTM A563, and ASTM F436, respectively, and will be galvanized in accordance with ASTM A153.

The proposed collection substation will maintain voltage-dependent electrical clearances per ANSI/IEEE requirements.

All necessary associated overhead bus, conductors, supports, insulators, terminations etc. will comply with IEEE 605 and all other relevant standards. All connections from the tubular bus to equipment will be made using flexible connector.

Buses will be designed to carry the maximum expected load, including full load capability (highest name plate rating) of all the transformers feeding off, or supplying, the bus.

Design will incorporate Schedule 40, 6063-T6 seamless aluminum bus tube and stranded All Aluminum Conductor flexible conductor. Bus tube will include internal damping cable to reduce Aeolian vibration in accordance with methods given in IEEE 605. Bus calculations considering bus diameter, span length and short circuit forces will be provided in accordance with the methods given in IEEE 605.

A grounding design study will be performed in accordance with IEEE 80. The study will ensure that the ground grid is designed to maintain safe touch and step voltages within IEEE tolerable limits. The ground grid analysis will have the following basis: Fault Current, 50 kg body weight, a fault current split factor, soil resistivity and fault duration of 0.5 second.

The lightning protection will be designed by using the rolling sphere method per IEEE 998, which will reduce the probability of a direct lightning strike to the station. A constant radius sphere will be used in conjunction with flashover probability calculations to design an efficient and economical shielding system. The shielding calculations will provide shielding for the substation bus and equipment using statistical methods and will not exclude all strikes from the protected area.

The proposed collection substation will be designed with adequate, secure, reliable, and redundant protective and control schemes. The protection zones will be overlapped to maintain redundancy while ensuring that the major equipment will be protected. The applicable utility protection practices will be incorporated into the protection and control settings as necessary in the design.

A protective device coordination study will be performed to develop the necessary calculations to select protective relay characteristics and settings, ratio and characteristic of associated current transformers. The coordination study will include time current curves, which will show the various protective devices settings and the time margin between settings. Relay settings will be set to protect equipment and detect abnormal conditions. The settings will be chosen according to the IEEE standards to protect equipment, detect the minimum fault current flows, and coordinate with adjacent protective relay devices.

<u>34.5 kV Collection System</u>

The underground collection line design shall incorporate, but is not limited to, the following standards and codes where applicable:

- ANSI - American National Standards Institute
- ASTM - American Society for Testing and Materials
- IEEE 48 - Standard Test Procedures and Requirements for Alternating-Current Cable Terminations 2.5 kV through 765 kV
- IEEE 80 - Guide for safety in AC substation grounding
- IEEE 400 - Guide for Field Testing and Evaluation of the Insulation of Shielded Power Cable Systems
- IEEE 400.1 - Guide for Field Testing of Laminated Dielectric, Shielded Power Cable Systems Rated 5kV and Above with High Direct Current Voltage
- IEEE 400.3 - Guide for Partial Discharge Testing of Shielded Power Cable Systems in a Field Environment
- IEEE C2 - NESC
- IEEE C57.12.10 - American National Standards for Transformers
- NFPA 70 - National Electric Code (NEC)
- TIA/EIA - Telecommunications Industry Association/Electric Industry Alliance
- NEMA - National Electrical Manufacturer's Association

Solar energy projects commonly employ medium voltage AC cables to connect dispersed PV arrays and their inverters to the proposed collection substation. Determining the configuration and sizing of the cable runs requires balancing a variety of considerations, including land use restrictions, cable characteristics, soil conditions, equipment and construction constraints, cost, reliability, maintainability, and efficiency. The design process incorporates these considerations to provide the client with the most robust, flexible, and cost-effective design possible.

The standard installation configuration is for the cables to be bundled and directly buried in the native soil, approximately 3 feet below grade (4 feet in agricultural areas). Unique installation configurations may be required where the cables cross public roads, utility easements, etc.

The ampacity of all cable configurations (standard single circuit, or unique configurations such as multiple circuits in parallel, circuits crossing each other, etc.) will be determined based on Neher- McGrath methods. The analysis will include the effects of various parameters, including soil thermal resistivity, shield grounding connections, mutual heating from parallel cables, and special thermal backfill resistivity (if used). The calculations will ensure that all cables can carry the expected loads without overheating and damaging components of the cables.

Estimated electrical losses will be calculated as a percentage of the expected energy production of the Facility. Losses will be determined for all cables and transformers.

(2) Generation Facility Type Certification

A comprehensive list of product certifications and certificates can be found in the equipment specifications in the Manufacturer Data Sheets in Appendix 5-B.

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

The various aspects of the Facility will have a written inspection, testing and commissioning plan, as summarized below, that is adhered to during all stages of construction as well as a post-construction inspection and testing phase. When completed, all documentation will be provided to ORES and stored at the Facility Site for easy review/access in the future.

115 kV Overhead Transmission Line

The overhead lines will be inspected, tested, and commissioned in accordance with American National Standards Institute (ANSI), Institute of Electrical and Electronics Engineers (IEEE), National Fire Protection Association (NFPA), American Society for Testing Materials (ASTM), and other relevant requirements, as necessary.

34.5 kV Underground Collection System

The collection system will be inspected, tested, and commissioned in accordance with various ANSI, IEEE, NFPA, IETA, ASTM, and other relevant requirements, as necessary. All tests shall be performed with the equipment de-energized, except where specifically required for it to be energized for functional testing.

Underground cable systems have comparatively fewer components than the substation described above. All material received for construction of the underground lines will be visually inspected for defects and compatibility with the design/specifications.

During installation, materials used for cable trench installation will be tested for conformance with the design, including backfill material (gradation, compaction, thermal resistivity, etc.), as necessary. The cables will be installed in the proper configuration, at the proper depth and with proper spacing (see Appendix 5-B for additional details). Care must be taken to ensure that the required/minimum/maximum bending radius or pulling tension (if installed in conduit/duct) of the cable is observed to avoid damage.

Hardware/terminations at the ends of the cables will be installed in accordance with manufacturer requirements to ensure adequate mechanical strength and electrical continuity. Cable shields/neutrals will be installed per the design and solidly connected to the grounding system or surge arresters, or taped/insulated, where applicable. Phasing of the conductors will be checked to ensure that the end- to-end connection of each conductor is correct per the design of the station/equipment at each end of the cable.

Very Low Frequency, at a minimum, or Partial Discharge testing will be performed on cables, in accordance with IEEE recommendations, in order to identify deficiencies or damage in the cable system that could result in outages or failure. Testing of transformers will be performed in accordance with applicable ANSI/IEEE standards.

Proposed Collection Substation

The substation will be inspected, tested, and commissioned in accordance with various ANSI, IEEE, NFPA, ASTM, and other relevant requirements, as necessary. All tests shall be performed with the equipment de-energized, except where specifically required for it to be energized for functional testing.

All material received for construction of the proposed collection substation will be visually inspected for defects and compatibility with the design/specifications. Various industry standard electrical and mechanical tests are performed on equipment before leaving the manufacturers' facilities. Some tests are performed on a "class" of equipment, such that the passing tests results apply to all specific equipment produced. Other tests are required to be performed on each individual piece of equipment.

Additional tests will be performed on specific equipment after installation at the Facility site to ensure that there was no damage during handling including, but not limited to the following:

- Main power transformer
- High/medium voltage circuit breakers
- Disconnect switches
- Instrument transformers (current transformer, voltage transformer)
- Surge arresters
- Station service transformer
- High/medium voltage cables
- Capacitor bank and/or reactor banks
- DC battery bank and charger

Other standard tests will be performed to ensure that the components of a design were constructed/installed at the Facility Site in the correct manner. These include, but are not limited to the following:

- Medium voltage bus connections and hardware
- Grounding grid (including ground grid testing)
- Low voltage protection, control, and instrumentation wiring
- Protective relaying systems
- System Control and Data Acquisition (SCADA)/communication systems

Concrete foundations will be utilized for the proposed collection substation. Visual/dimensional inspections will be performed on reinforcing steel/rebar (for bar size, configuration, tie/welds, etc.), anchor bolts (size, location, elevation, etc.), formwork (size, dimensions, location, height/reveal, etc.) prior to pouring the concrete. Excavations, subgrade and compacted backfill will be verified to be in accordance with design requirements. The mix design of the concrete will be reviewed for conformance with the design requirements. During pouring of concrete, samples will be taken to ensure that the proper slump, air content, temperature and any additives are in accordance with design requirements. Numerous test cylinders will be obtained for future strength/compression testing at periodic points after pouring (7 days, 28 days, etc.). The cylinders will be tested to determine if the concrete is curing at the proper rate and will meet design strength prior to being loaded.

Any imported yard subbase, surface stone, etc. will be tested for proper sieve gradation, compaction, etc., as necessary. Adequate quantities/dimensions of imported material will be verified. A final survey of station benchmarks, elevations (overall pad and concrete foundations, etc.) will be performed.

<u>PV Array</u>

PV Array commissioning will occur once the PV modules, proposed collection substation and POI switchyard are fully installed and the National Grid and NYISO are ready to accept transport of power to the New York electrical grid. Commissioning and operation of the Facility relies on consistent systems monitoring and testing. Systems monitoring includes the following considerations:

- DC array inspection through manual electrical testing and/or aerial thermal imaging. Manual electrical testing is used to detect faults in the DC system that the monitoring system was unable to identify. This type of monitoring provides the defects currently causing module failures. Manual inspection requires that, should system testing suggest incorrect operation of some of the Facilities, wiring enclosures, combiner boxes, and module junction boxes be accessible for more detailed inspection. Aerial thermal imaging inspection strives to detect string, module, and sub-module faults as well as the racking and balancing of the system (e.g. racking shifts, systemic shading, major erosion) in arrays by monitoring thermal variations between modules (NREL, 2016).
- Equipment required: Support trucks will be driven to the construction site for manual inspections. Aerial thermal imaging is typically conducted by manned survey aircraft or unmanned aerial vehicles (NREL, 2016).
- Timing: Commissioning will preferentially be completed in late spring or summer to take advantage of typically drier weather with more stable irradiance. If necessary, this activity can be completed in the spring, fall, or winter depending on weather conditions (NREL, 2016).

(4) Maintenance and Management Plans, Procedures, and Criteria

The Applicant will prepare a Facility Maintenance and Management Plan prior to construction of the Facility, based on the Applicant's experience and typical operations and maintenance requirements for solar projects. The objective of the Facility Maintenance and Management Plan is to optimize the Facility's operational capacity and availability through best-in-class maintenance guidelines and inspections that are designed to pro-actively detect any significant safety or maintenance issues.

Solar energy projects typically consist of multiple inverters that are electrically connected to produce the desired energy output. Each inverter requires periodic, preventative maintenance as well as corrective maintenance in the event of a malfunction within the individual inverter. Typically, solar energy facility maintenance cycles occur semi-annually or annually, and on an as-needed basis. These maintenance cycles can last from days to weeks (NREL, 2016). During maintenance activities, PV arrays will remain in-service to the greatest extent practicable.

115 kV Overhead Transmission System

The overhead 115 kV lines are monitored by the protective relay system that protects them. Any serious issues with the line will likely manifest themselves as an electrical fault, in which case the relay system would open the breakers in the National Grid owned Substation and disconnect from the Facility.

The 115 kV transmission line is anticipated to be visually inspected at regular intervals (annually), as well as after any significant weather events such as extremely high winds, severe snow and ice, etc. Additional details regarding the operation and maintenance of the 115 kV transmission line will be provided available in the Operation and Maintenance Plan filing prior to construction of the Facility.

34.5 kV Collection System

The underground collection system generally does not have the ability to notify or alarm operators of a problem unless an electrical fault is experienced that would trip the relay operation in the collection substation. Depending on design, there could be some equipment that could provide remote indication or control which includes, but is not limited to, the following:

- Transformers – there is generally a transformer associated with each inverter and, if desired, it could be designed/installed with high/low temperature or oil level alarms.
- Fault locators – the devices are installed at certain intervals through the collection system to assist in locating faults on underground cables (that cannot be verified visually); and
- Metal-enclosed switchgear.

Switchgear with remote control capabilities will be used. However, if manual operation of the collection system is required, such work will be completed by personnel familiar with and trained in the operation and safety hazards of high-voltage electrical equipment. Personal protective equipment appropriate for the activities being performed will always be worn/used. Hazards such as arc flash will be present but are mitigated to the extent practical during detailed design. In accordance with industry standards, hazard labels will be installed on electrical equipment that can be operated/accessed to provide guidance for additional personal protective equipment required for operational activities.

Most of the underground collection system cannot be inspected visually. There will be access points that will allow for a limited amount of visual verification such as riser poles that transition to the proposed collection substation, and, as applicable, junction boxes that combine multiple cable sections or splices. While terminations and cable ends can be inspected at these points, they are more valuable as a point to connect electrical testing equipment.

Some equipment provided by manufacturers will have operations and maintenance (O&M) manuals specific to that product, similar to the substation equipment described herein. These maintenance intervals and procedures will be used where applicable and can apply to equipment such as transformers or metal-enclosed switchgear.

Proposed Collection Substation

The proposed collection substation will have a SCADA system that will send status and alarm signals to the overall Facility SCADA system. These signals will notify the operators of items such as breaker trips, transformer high/low temperature or oil level, battery charger trouble, etc. The SCADA system will also allow for remote operation of electrically operated equipment. The operations team will be able to open and close circuit breakers, motor-operated disconnect switches, the transformer tap changer, and switch on or off the PV.

Because many items in the substation are large pieces of equipment supplied by major manufacturers, these items will be inspected and maintained in accordance with the manufacturers' O&M manual, which will be stored at the substation. The requirements will differ depending on which manufacturer is used. These items may include, but are not limited to, the following:

- Main power transformer
- High and medium voltage circuit breakers
- Instrument transformers
- Disconnect switches
- Capacitor/reactor banks
- Metal-clad switchgear
- Station service transformers
- Stationary battery and charger

Many of these items will be designed to send preventative alarm signals to the SCADA system to notify operators of problems before they become more significant or costly.
The proposed collection substation will be visually inspected at regular intervals, as well as after significant weather events such as extremely high winds, severe snow, and ice. The proposed collection substation will be monitored during the operations period of the Facility to ensure changes in environmental circumstances, utility changes, or equipment changes are evaluated for impact to the Facility.

(g) POI Switchyard Transfer Information

A description of the substation facilities, transmission owner's requirements, and operational and maintenance responsibilities is provided below.

(1) Description of Substation Facilities to be Transferred and Timetable for Transfer

National Grid is the interconnecting transmission owner for this Facility. It is anticipated that the interconnection of the Facility will be accomplished via a new 3-ring breaker switchyard tapping the National Grid North Seneca 115 kV transmission line on property under contract with the Applicant. However final POI design and specification will be completed during the ongoing Class Year Facilities Study.

It is anticipated that POI substation facility construction would take place starting in early 2025 with completion in late 2025 prior to project commissioning. Given the facilities are anticipated to be located on Applicant property, the Applicant will be responsible for transferring ownership of the land to National Grid along with the management and ownership of the switchyard equipment prior to Facility operation (late 2025). See Appendix 5-B for preliminary general arrangement and plan views of the POI switchyard.

(2) Operational and Maintenance Responsibilities for the POI Switchyard

National Grid, as the transmission owner, will define and perform the operational and maintenance responsibilities for the POI switchyard.

(h) Criteria and Procedures for Sharing Facilities with Other Utilities

The Applicant does not anticipate sharing facilities with other utilities at this time.

(i) Availability and Expected Delivery Dates for Major Components

Availability and delivery times for major Facility components may vary depending on selected equipment, inventory, manufacturer, and market conditions. The Applicant is not aware of any equipment availability restrictions but will monitor availability to guide the final selection of equipment. The delivery of major Facility components is expected to be generally within the ranges identified as follows:

- PV Modules: 173,376 modules
- Module Trackers: 2,687 trackers
- Inverters and medium voltage transformer: 24
- High voltage transformers: 1

The Applicant expects racking to begin delivery early in the fourth quarter of 2026, with panel delivery beginning winter of 2026 and continuing intermittently over a few months. The transformer should arrive at the end of Q1 2027. Note that the equipment procurement strategy will be decided during the final engineering and planning stage of the Facility, prior to construction. As needed, adjustments to equipment procurement may be made after starting Facility construction.

REFERENCES

National Renewable Energy Laboratory (NREL). 2016. Best Practices in Photovoltaic System Operations and Maintenance: 2nd Edition. NREL/Sandia/Suspec Alliance SuNLaMP PV O&M Working Group. Technical Report NREL/TP-7A40-67553.