# Mohawk Solar

## Case No. 17-F-0182

# 1001.34 Exhibit 34

# Electric Interconnection

# EXHIBIT 34 ELECTRIC INTERCONNECTION

Interconnection of the Facility to the electrical grid will be achieved using multiple systems. The PV panels themselves produce power at a low voltage, which is converted from direct current (DC) to alternating current (AC) at the inverters. A medium voltage collection system comprised of underground cables transmits the power to a collection substation. The collection substation then increases the voltage to 115 kV and delivers the power to the adjacent POI switchyard. The POI switchyard will either be constructed by the Applicant, which would meet design specifications offered by National Grid, or by National Grid themselves. The POI switchyard will ultimately connect the Facility to the National Grid transmission system.

## (a) Design Voltage and Voltage of Initial Operation

The Facility is grouped into 4 different 3-phase collection circuits, each with their own PV array and 34.5kV cable network which will terminate at the collection substation feeder circuit breakers. The array strings will be connected to combiner boxes and transmitted via 1500VDC cables to inverters which will convert electrical output from DC to AC. The Facility will contain a total of 710 SMA Sunny Highpower Peak3 150-US inverters rated at 150kVA each with 600V AC output. The 600V AC power will be collected at switchboard panels and connected to 600V-34.5kV pad mounted step-up transformers for transmission on the 34.5kV collection circuits into the substation. The 34.5kV collector bus is connected to a 34.5kV-115kV main power transformer for transmission into the NYISO 115KV transmission system. The voltages listed are nominal and typically operate within a margin of +/- 5%. The electrical collection system will total approximately 217, 430 linear feet in length and will be installed along Facility access roads and public roads to the maximum extent practicable.

## (b) Type, Size, Number, and Materials of Conductors

The collection system will be comprised of underground cables, with the potential of overhead lines if necessary. The underground cable system, totaling approximately 40 miles, will be comprised of four circuit sections in parallel, connecting each of the PV arrays to the collection substation. Each section will be comprised of aluminum conductors, each surrounded by electrical insulation and an overall jacket. The size of each conductor will depend on the number of PV arrays producing power into a given conductor but will typically range from 500 to 1250 kcmil American Wire Gauge (AWG).

The collection substation will contain rigid tubular bus conductors made of 6063-T6 aluminum. In total the substation system will have approximately 90 feet of 3 phase tubular bus conductor, 4 inches in size.

The transmission, or gen-tie, line will be approximately 200 feet in length and contains 795 aluminum conductor steel reinforced (ACSR) 26/7 strand 'drake' conductor.

(c) 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 collection substation and the POI switchyard will generally be porcelain.

(d) Length of the Transmission Line

Given the short distance between the proposed collection substation and POI switchyard, the proposed transmission, or gen-tie line will span approximately 200 feet, connecting the Facility to the electric grid. The collection substation and the POI switchyard will be located immediately adjacent to each other and will utilize the existing St. Johnsville-Marshville 115KV transmission line owned by National Grid. Minor construction or modification to the existing St Johnsville-Marshville transmission line may be required to meet the infrastructure needs of the Facility.

(e) Typical Dimensions and Construction Materials of the Towers

Overhead collection lines are not anticipated; however, a short segment of overhead transmission, or gen-tie line will be constructed to connect the Facility to the electrical grid. Typical details of the overhead transmission, or gen-tie, line can be found in Appendix 5-B.

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

Overhead collection lines are not anticipated; however, a short transmission, or gen-tie line will be constructed. Supporting structures will be designed in accordance with:

- National Electric Safety Code (NESC) standards for heavy loading and high wind
- 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

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

The underground cable systems described in section (b) will collect converted, 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 include 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 a trench created by the plow, saw blade or rock wheel. All trenches will be a minimum of 12 inches wide and may be as deep as 48 inches. After cable is installed, the trench will be filled with compacted soil; native soil if suitable. All areas will be returned to approximate pre-construction grades and restored.

Due to specific collection line routing constraints, alternative methods may be necessary for construction. Where direct rips/trenches are not allowed, installation of the underground cables will be accomplished using subsurface bores/horizontal drilling. Typically, this method involves having a subsurface carrier pipe that is pushed/drilled through the ground underneath obstructions. Pits are required at either end of the bore to drill and receive the drill head, as well as to hold drilling fluid. The cable is then pulled through the installed carrier pipe and transitioned back to direct burial using the "rip" method. Typical details of the trenchless installation methods proposed for the Facility are included in Appendix 11-E.

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

If splicing is required for underground cables, an area of sufficient size will be excavated. Once the cut is made, a water-tight protective seal will be applied to prevent damage from water and dirt. A protective tarp with seals will be applied around the splicing location as an additional measure of preventing damage from water, dust, or dirt. Splicing locations will remain above 45 degrees Fahrenheit, in accordance with industry standards. Additional splicing activities will comply with manufacturer instruction and training.

The underground collection lines can be 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 are 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 differently 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. While no splices are planned for initial installation, if any circumstances arise that require the installation of one or more splices, they will be directly buried and will not require any additional splicing structures.

(h) Profile of Underground Lines

Refer to drawings in Appendix 5-D for depth of the underground collection cable and associated material. As stated above, 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 4 feet in agricultural areas. There is no additional insulation/cooling system required, such as pumped oil or water. There are no below-grade manholes required.

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

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

(j) Any Terminal Facility

The only terminal facilities expected are the POI switching station and collection substation and are described/shown above in section (i).

(k) Need for Cathodic Protection Measures

There are no cathodic protection measures expected to be required for installation of the underground systems, as no metallic pipelines will be used. Therefore, cathodic protection measures are not discussed further in this Application.