Marcy to New Scotland Upgrade Project

Exhibit E-1

Description of Proposed Transmission Line

TABLE OF CONTENTS

LIST OF TABLES

EXHIBIT E-1: DESCRIPTION OF PROPOSED TRANSMISSION LINE

§ 88.1 Exhibit E-l: description of proposed transmission line

The applicant shall submit a detailed description of the proposed transmission line. Such description shall include:

(a) the design voltage and voltage of initial operation;

(b) the type, size, number and materials of conductors;

(c) insulator design;

(d) the length of the transmission line;

(e) the construction materials of the towers; and

(f) the design standards for each type of tower and tower foundation.

E-1.1 Introduction

LS Power Grid New York, LLC and LS Power Grid New York Corporation I (together, "LS Power Grid New York") and the Power Authority of the State of New York, doing business as the New York Power Authority (NYPA) (LS Power Grid New York and NYPA, collectively, the "Applicant") are seeking a Certificate of Environmental Compatibility and Public Need for the Marcy to New Scotland Upgrade Project (the "Project"). The Project, which is anticipated to be constructed predominantly within approximately 93 miles of existing utility-owned transmission line corridor, includes the following components:

(1) upgrades to the Marcy and Edic substations;

(2) reconductoring, involving the replacement of two circuits of 230 kV transmission line with two circuits of 345 kV transmission line on existing structures, extending for approximately 13 miles from the Edic substation;

(3) removal of two existing single circuit 230 kV transmission lines on H-frame structures, and replacement with a new 345 kV double circuit transmission line on steel monopoles, extending for approximately 55 miles (with the exception of up to two segments where the double circuit lines may split into single circuits);

(4) construction of a new 345 kV substation in the Town of Princetown;

(5) removal of two existing single circuit 230 kV transmission lines on H-frame structures, and replacement with two new single circuit 345 kV transmission lines on steel monopoles between the new Princetown substation and Rotterdam substation, extending for approximately 5 miles, one of which will connect to the new Princetown substation and the other will loop in the Edic portion of the existing Edic to New Scotland 345 kV line;

(6) construction of a new 345/230/115 kV substation adjacent to the existing Rotterdam substation yard and upgrades at the existing Rotterdam substation;

(7) construction of a new double circuit 345 kV transmission line on steel monopoles between the new Princetown substation and the New Scotland substation, extending for approximately 20 miles, rebuild of an existing single circuit 345 kV transmission line on new steel monopoles starting at the new Princetown substation and extending approximately 6 miles southward in that same corridor, and partial removal and/or removal from service of the existing Rotterdam to New Scotland 115 kV line in a portion of that same corridor; and

(8) upgrades to the existing New Scotland substation.

Approximately 1,250 existing H-frame structures will be removed, and approximately 675 new structures, predominantly monopole, will be installed as part of the Project.

The Project's route will extend from the Edic substation in Marcy, New York through the Towns of Deerfield and Marcy in Oneida County; the Towns of Schuyler, Frankfort, German Flatts, Little Falls, Stark, Danube, and the Village of Ilion in Herkimer County; the Towns of Minden, Canajoharie, Root, Charleston, Glen, and Florida in Montgomery County; the Towns of Duanesburg, Princetown, and Rotterdam in Schenectady County; and the Towns of Guilderland and New Scotland in Albany County.

E-1.2 Design Voltage and Voltage of Initial Operation (16 NYCRR § 88.1(a))

16 NYCRR § 88.1: The applicant shall submit a detailed description of the proposed transmission line. Such description shall include: (a) the design voltage and voltage of initial operation;

As described in the Introduction above, the Project involves reconductoring of some existing structures as well as the replacement of other existing structures with new structures as is described in greater detail in Section 4.2 of Exhibit 4. The entire Project (reconductored sections and new sections) will be designed and operated at a voltage of 345 kV.

E-1.3 Type, Size, Number and Materials of Conductors (16 NYCRR § 88.1(b))

16 NYCRR § 88.1: The applicant shall submit a detailed description of the proposed transmission line. Such description shall include: (b) the type, size, number, and materials of conductors;

The proposed conductor type will be the same for the entire project (reconductored sections and new sections), with the exception of the rebuild portion, where the Applicant will rebuild approximately 6 miles of the existing 345 kV #14 line south from Princetown substation. The conductor type proposed for the majority of the project is 954 kcmil 54/7 "Cardinal" Aluminum Conductor Steel Supported (ACSS) with a high-strength steel core and non-specular finish. Each have an outside diameter of approximately 1.196 inches and a rated breaking strength of 32,300 pounds.

For the rebuild portion of the existing 345kV circuit south of Princetown substation, the proposed conductor type is 795 kcmil 26/7 "Drake" Aluminum Conductor Steel Reinforced (ACSR), which matches the conductor type currently installed. Each phase consists of 2 subconductors separated 18 inches apart. Each subconductor will have an outside diameter of approximately 1.107 inches and a rated breaking strength of 31,500 pounds.

The proposed shield wires will be either 1) an Optical Ground Wire (OPGW) consisting of aluminum clad steel strands surrounding an aluminum tube containing optical fibers, 2) an Alumoweld shield wire consisting of stranded aluminum clad steel wires or 3) an extra high strength galvanized steel stranded cable. There will be up to one OPGW per circuit, which will be gray in color regardless of the type of shield wire chosen.

Vibration dampers will be installed on all conductors and shield wires (including OPGW) to mitigate the effect of aeolian vibration.

E-1.4 Insulator Design (16 NYCRR § 88.1(c))

16 NYCRR § 88.1: The applicant shall submit a detailed description of the proposed transmission line. Such description shall include: (c) insulator design;

The proposed insulators for the Project will be suspension-type insulators consisting of toughened glass bells supported by galvanized steel hardware fittings. Suspension applications will use single I-string assemblies in the reconductor portion and V-String assemblies in the new build portion. The V-String assemblies will consist of two suspension insulators in the shape of a "V" to provide enhanced reliability. The assemblies will be configured with hot-line fittings to facilitate future maintenance of the assemblies. Preliminary design details for the proposed insulators are provided in Table E-1-1 below.

Table E-1-1. Typical Insulator Characteristics

ANSI Class	52-5-H
Insulator Material	Toughened Glass
Shed Profile	Standard
Connection Type	Ball & Socket (Type J)
M&E Strength	30,000 lb
Proof Test Load	15,000 lb
Shed Diameter	10"
Shed Color	Blue/Green Tint

E-1.5 Length of the Transmission Line (16 NYCRR § 88.1(d))

16 NYCRR § 88.1: The applicant shall submit a detailed description of the proposed transmission line. Such description shall include: (d) the length of the transmission line;

E-1.5 Length of the Transmission Line (16 NYCRR § 88.1(d))

16 NYCRR § 88.1: The applicant shall submit a detailed description of the proposed transmission line. Such description shall include: (d) the length of the transmission line;

The Project will be implemented within approximately 93 miles of existing transmission corridor. Within this corridor, the Project consists of approximately 24 circuit miles of 345kV transmission line reconductor, 35 miles of new single-circuit 345kV transmission line and 66 miles of new double-circuit 345kV transmission line.

E-1.6 Construction Materials of the Towers (16 NYCRR § 88.1(e))

16 NYCRR § 88.1: The applicant shall submit a detailed description of the proposed transmission line. Such description shall include: (e) the construction materials of the towers;

All proposed new transmission structures will be tubular steel with a galvanized finish.

E-1.7 Design Standards for Each Type of Tower and Tower Foundation (16 NYCRR § 88.1(f))

16 NYCRR § 88.1: The applicant shall submit a detailed description of the proposed transmission line. Such description shall include: (f) the design standards for each type of tower and tower foundation.

E-1.7.1 Design Standards for Transmission Structures

The proposed new transmission structures will be self-supporting tubular steel transmission structures and may include monopole single circuit tangent/running angle, monopole double circuit tangent/running angle, monopole single circuit dead-end, two-pole double circuit dead-end, and three-pole single circuit dead-end designs. Drawings of the proposed transmission line structures are provided in Exhibit 5.

Design and construction of the proposed transmission line and the proposed structure loads will conform to the National Electrical Safety Code (NESC), ASCE Standard 48, ANSI Standards, and other codes and standards applicable to such installations. The design standards for the new transmission line structures are described further below.

E-1.7.1.1 Monopole Single Circuit and Double Circuit Tangent/Running Angle Structures

The proposed monopole single circuit and double circuit tangent/running angle structures will be steel monopole structures with tubular davit arms supporting the conductors and shield wires. Structure pole shafts will consist of multiple 12-sided sections which will be jacked or bolted together. Structure designs will follow the latest version of the American Society of Civil Engineers (ASCE) Standard 48 “Design of Steel Transmission Pole Structures”.

E-1.7.1.2 Monopole Single Circuit Dead-End Structures

The proposed monopole single-circuit dead-end structures will be steel monopole structures which support the conductors and shield wires directly from the pole shaft or on a tubular steel davit arm. Structure pole shafts will consist of multiple 12-sided sections which will be jacked or bolted together. Structure designs will follow the latest version of the American Society of Civil Engineers (ASCE) Standard 48 "Design of Steel Transmission Pole Structures".

E-1.7.1.3 Two-Pole Double Circuit Dead-End Structures

The proposed two-pole double-circuit dead-end structures will each consist of two steel monopole structures which support the conductors and shield wires directly from the pole shaft or on a tubular steel davit arm. Structure pole shafts will consist of multiple 12-sided sections which will be jacked or bolted together. Structure designs will follow the latest version of the American Society of Civil Engineers (ASCE) Standard 48 "Design of Steel Transmission Pole Structures".

E-1.7.1.4 Three-Pole Single Circuit Dead-End Structures

The proposed three-pole single circuit dead-end structures will consist of three steel monopole structures which support the conductors and shield wires directly from the pole shaft. Structure pole shafts will consist of multiple 12-sided sections which will be jacked or bolted together. Structure designs will follow the latest version of the American Society of Civil Engineers (ASCE) Standard 48 "Design of Steel Transmission Pole Structures".

E-1.7.2 Design Standards for Transmission Line Foundations

The proposed transmission line foundations may include direct embedded, drilled pier, helical pier, or micropile/rock anchor. Drawings of the proposed transmission line foundations are provided in Exhibit 5. Descriptions of the construction process for the proposed transmission line foundations are described in Section 4.2 in Exhibit 4. Design and construction of the proposed foundations will conform to all applicable codes and standards. Design standards for the proposed transmission line foundations are described below.

E-1.7.2.1 Direct Embedded Foundations

Direct embedded foundations may be utilized for any structure type in any soil conditions. Direct embedded foundations consist of a drilled foundation hole and a pole base backfilled with grout, concrete, or aggregate. The foundation reveal will be approximately 0 to 2 feet above ground level and formed into a cylindrical shape. Pole bases of direct embedded structures will have a ground sleeve to provide added protection against corrosion near the ground level. A ground sleeve is typically a 3/16" steel collar that is welded around the outside of the steel pole shaft. If during drilling, the excavation becomes unstable, the hole will be kept open by either inserting a permanent or temporary steel casing or filling the hole with a polymer slurry. Design of direct embed structures/foundations will follow the latest version of the American Society of Civil

Engineers (ASCE) Standard 48 "Design of Steel Transmission Pole Structures" and IEEE 691 "Guide for Transmission Structure Foundation Design and Testing".

E-1.7.2.2 Drilled Pier Foundations

Drilled pier foundations may be utilized for any structure type in any soil conditions. Drilled pier foundations consist of a drilled foundation hole, a reinforced steel cage, and an anchor bolt cage backfilled with concrete. Concrete forms are placed at the surface to allow for the final desired pier height above ground level. The concrete reveal will be approximately 1 to 3 feet above ground level and formed into a cylindrical shape. After the concrete cures, the transmission structure is then secured to the anchor bolts embedded into the finished foundation. If during drilling, the excavation becomes unstable, the hole will be kept open by either inserting a permanent or temporary steel casing or filling the hole with a polymer slurry. Design of drilled pier foundations will follow the latest version of IEEE 691 "Guide for Transmission Structure Foundation Design and Testing".

E-1.7.2.3 Helical Pile Foundations

Helical pile foundations may be utilized for any structure type in soil profiles where rock is not present. A helical pile foundation for a transmission structure consists of multiple piles rotated into the soil supporting a steel grillage or concrete cap attachment point. The piles are equipped with helix-shaped plates attached along the length of the pile that allow the pile to function as a screw as it is rotated into the soil during installation. Grout may be injected around the helical pier shaft if needed for additional shear strength and corrosion protection. After the piers are rotated into the soil to a prescribed torque or depth, a steel grillage is welded or bolted to the piers. The transmission structure is then bolted to the steel grillage. Alternatively, the piers may be attached to a reinforced concrete cap with an anchor bolt cage for securing the above ground structure. Design of helical pile foundations will follow the latest version of IEEE 691 "Guide for Transmission Structure Foundation Design and Testing"; "Design of Helical Piles for Heavily Loaded Structures" (John S. Pack, 2000); and/or "Helical Pile Acceptance Criteria, Design Guidelines, and Load Test Verification" (Mishael Perlow Jr, 2011) as applicable.

E-1.7.2.4 Micropile/Rock Anchor Foundations

Micropile and/or Rock Anchor foundations may be utilized for any structure type in any soil conditions. A micropile foundation consists of multiple micropiles, typically five to twelve inches in diameter, drilled into the soil supporting a base plate or concrete cap attachment point. A base plate is welded or bolted to the steel rods to allow the transmission structure to be bolted to the base plate. Alternatively, the rods may be attached to a reinforced concrete cap or concrete pedestal with an anchor bolt cage for securing the above ground structure. Design of micropile/rock anchor foundations will follow the latest versions of FHWA NHI-05-039 "Micropile Design and Construction" and PTI "Recommendations for Prestressed Rock and Soil Anchors".

Rock anchor foundations are substantially similar to micropile foundations in configuration and installation; however, rock anchors are typically smaller diameter relative to micropiles, and rock anchors are typically loaded under tension instead of tension and compression. This system is most effective in rock soil profiles.

E-1.7.3 Grounding Systems

Structure and external grounding systems, materials, and details will be determined during final design and based upon results of field investigation of ground resistivity and consideration of site conditions. Grounding systems may include bonding structure to foundation system, installing ground rods, installing localized buried wire grounding systems (i.e., “counterpoise”), drilling ground wells, or any combination thereof.

All structures, anchor bolt assemblies, rebar cages, and permanent exterior steel foundation casing (where used) may be bonded together and to the external grounding system where necessary to achieve the desired grounding performance. The footing resistance at each structure will be verified during construction to meet the required footing resistance values in accordance with a qualified lightning performance study to be completed during the EM&CP development.