national**grid**

Lockport-Batavia Line 112
Rebuild Project

Exhibit E-1

Description of Proposed Transmission Line

TABLE OF CONTENTS

LIST OF TABLES

EXHIBIT E-1: DESCRIPTION OF PROPOSED TRANSMISSION LINE

E-1.1 INTRODUCTION

The Project[1] proposed by National Grid involves the selective relocation and reconstruction of the approximately 21.7-mile portion of National Grid's 115kV T1510 Lockport-Batavia Line 112 between Structure 1-2 (the line's first transmission line structure outside the Lockport Substation) and Structure 211. The Project is located in the Town of Lockport and Town of Royalton in Niagara County and the Town of Alabama in Genesee County (Frontier and Genesee Regions of National Grid's Western New York Service Territory).

As described in Exhibit 2, the Project consists of six (6) distinct Segments[2], Segments 1 to 5 and Segment 7. Rebuilt Line 112 will be located substantially along the same centerline as Existing Line 112 in all project Segments except for Segment 4. The portion of Line 112 between Segments 5 and 7 that extends from Structure 173 ½ to new Structure 184 ½ (identified as Segment 6) is not part of the Project.

In the portion of Segment 1 between Structures 1-2 and 4, Rebuilt Line 112 will be reconstructed on vertically configured, galvanized steel pole double circuit structures set on the same centerline as Existing Line 112, except Structure 1-2 will not be replaced. The rebuilt double circuit structures in this Segment will continue to support the 115kV T1530 Lockport – Mortimer Line 111 (Existing Line 111), and its existing conductor will not be replaced. Rebuilt Line 112 will be supported for the remainder of Segment 1 between Structures 5 and 6 by single circuit galvanized tubular steel pole braced-post insulator structures.

In Segment 2, Rebuilt Line 112 will continue to be reconstructed on the same centerline as Existing Line 112 and will be supported by single circuit galvanized tubular steel pole braced-post insulator suspension structures and single circuit galvanized tubular steel single pole dead-end structures, with the exception of Structures 15 and 92. In this Segment, Structures 15 and 92 will

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[1] In this exhibit, the term "Project" and numerous other capitalized terms are defined in the Glossary included in this Application.

[2] Another segment of Existing Line 112, designated as Segment 6, extends approximately 1.9 miles on the site of the Western New York Science and Technology Advanced Manufacturing Park being developed by the Genesee County Economic Development Center, from new Structure 173 ½ to new Structure 184 ½. Segment 6 is not part of the Project. It was the subject of a report to the Commission under 16 NYCCR Part 102 (Case 22-T-0502). The Applicant intends to include as-built drawings of Segment 6 in the EM&CP.

be vertically configured, galvanized steel pole double circuit structures supporting Rebuilt Line 112 along with Existing Line 111.

In Segment 3, Rebuilt Line 112 will be supported by single circuit galvanized tubular steel pole delta davit arm suspension structures and single circuit galvanized tubular steel single pole dead-end structures. In this Segment, Rebuilt Line 112 will be reconstructed on the same centerline as Existing Line 112. Additional permanent easement rights will be secured to ensure conformance with the Applicant's Transmission Right-of-Way Maintenance Plan ("TROWMP"), to ensure that the energized conductor remains within the operational easement under all applicable design conditions and to ensure that operation of all circuits in the corridor is in conformance with the Commission's electric and magnetic field guidelines. Between Structure 120 and Structure 124, an additional 40 feet of permanent easement will be required to expand the Existing Right-of-Way ("ROW") to the northeast and another five feet of easement will be required on the southwest edge of ROW. Between Structure 124 and 141, permanent rights will be expanded to a total of 100 feet, requiring acquisition of 20 feet of permanent easement on the southwestern edge of ROW and an additional 40 feet of permanent easement on the northeastern edge of ROW.

In Segment 4, the Applicant will relocate Rebuilt Line 112 to new 100-foot wide right-of-way (Segment 4 Relocated). This will be done for the following reasons: to avoid the need to expand the ROW in Segment 4 Existing, to ensure conformance with the Applicant's TROWMP in the Tonawanda Wildlife Management Area ("TWMA"), to ensure that the energized conductor remains within the operational easement under all applicable design conditions, to ensure that operation of Rebuild Line 112 in conformance with the New York State Public Service Commission's ("Commission") electric and magnetic field guidelines, and to reduce future maintenance impacts to this sensitive area. Structure placement for Rebuilt Line 112 in Segment 4 Relocated will optimize span lengths while mitigating impacts to sensitive resources. Rebuilt Line 112 will be supported by single circuit galvanized tubular steel pole delta davit arm suspension structures, single circuit galvanized tubular steel pole delta davit arm dead-end structures, and single circuit galvanized tubular steel single pole dead-end structures in Segment 4 Relocated.

In Segment 5 of the Project, Rebuilt Line 112 will be supported by single circuit galvanized tubular steel pole delta davit arm suspension structures, single circuit galvanized steel pole H-Frame suspension structures, and single circuit galvanized tubular steel single pole dead-end structures. In this Segment, Rebuilt Line 112 will be reconstructed on the same centerline as Existing Line 112. Additional permanent easement rights will be secured to ensure conformance with the Applicant's TROWMP, to ensure that the energized conductor remains within the operational easement under all applicable design conditions, and to ensure that operation of all circuits in the corridor is in conformance with the Commission's electric and magnetic field guidelines. Permanent rights will be expanded to a total of 100 feet, requiring acquisition of 20 feet of permanent easement on the southwestern edge of the Existing ROW and an additional 40 feet of permanent easement on the northeastern edge of the Existing ROW.

The scope for Segment 7 of the Project is generally consistent with the scope associated with Segment 5. In this Segment, Rebuilt Line 112 will be supported by galvanized tubular steel pole delta davit arm suspension structures, galvanized tubular steel pole delta davit arm dead-end structures, and single circuit galvanized tubular steel single pole dead-end structures. Rebuilt Line 112 will be reconstructed in Segment 7 on the same centerline as Existing Line 112 with the small exception between Structures 195 and 200 as outlined in Exhibit 2. Additional permanent easement rights will be secured to ensure conformance with the Applicant's TROWMP, to ensure that the energized conductor remains within the operational easement under all applicable design conditions, and to ensure that operation of all circuits in the corridor is in conformance with the Commission's electric and magnetic field guidelines. Permanent rights will be expanded to a total of 100 feet, requiring acquisition of 20 feet of permanent easement on the southwestern edge of ROW and an additional 40 feet of permanent easement on the northeastern edge of ROW.

E-1.2 TRANSMISSION LINE DESIGN

The structure designs for the Project have been developed in accordance with the latest edition of the National Electric Safety Code ("NESC"), National Grid Transmission Line Design and Structure Loading criteria, and ROW considerations such as ROW width, the location of existing facilities, terrain and environmental conditions.

E-1.2.1 **Design Voltage, Conductor, Grounding, and Insulators**

The Rebuilt Line 112 is designed to operate at a nominal system voltage of 115 kV alternating current. The voltage of initial operation will also be 115 kV.

The proposed conductor type for Rebuilt Line 112 is a single 795 kcmil 26/7 Aluminum Conductor Steel Reinforced ("ACSR") "Drake" conductor per phase for three phases over the full length of the Project. The winter STE rating for Rebuilt Line 112 will be 1,629 amps. All conductor proposed to be installed as part of the Project would have a non-specular finish. The existing 795 kcmil ACSR "Coot" conductor presently in service between the Lockport Substation and Structure 1-2 will remain in service. Similarly, the existing conductors presently in service between Structure 211 and the Batavia Substation will remain in service.

The aerial ground wire type proposed to be utilized on Rebuilt Line 112 will be a 48 count fiber optic ground wire ("OPGW") for the full length of the Project. In locations where the Rebuilt Line 112 crosses under existing overhead electric transmission lines, the aerial ground wire may be terminated at the structures on either side of the crossing to ensure that proper clearances to the crossing circuits are maintained. In these instances, the Applicant may elect to install either an underslung span of OPGW or All-Dielectric Self-Supporting ("ADSS") cable or buried ADSS cable (in conduit) to ensure continuity of the fiber optic cable. This will be detailed in the Environmental Management and Construction Plan ("EM&CP").

Grounding on the Rebuilt Line 112 will be provided in one of two ways. In instances where structures are set on reinforced concrete foundations, the grounding will be accomplished using driven ground rods set a minimum of three feet from the exterior face of the foundation and bonded to a grounding plate located near the base of the structure. Steel pole direct embed structures will be placed in corrugated metal pipe that is bonded to the structure grounding plate located near the ground line of the structure. In instances where aerial ground wire and OPGW cannot be continuous (primarily where the line must cross under another line) the use of buried wire grounding systems (continuous counterpoise) and an underhung ADSS cable will be considered. This will be detailed in the EM&CP.

Insulator design for the Rebuilt Line 112 will vary based on structure type utilized. On Segments 1 and 2, the Applicant proposes to utilize suspension structures featuring braced line post insulators. The use of this insulator assembly type is to minimize the width of the structures associated with the Rebuilt Line 112, which in turn, affords the appropriate circuit-to-circuit clearances between Rebuilt Line 112 and the adjacent 115kV facilities in the Project ROW. The remainder of Rebuilt Line 112, from Structure 119 to Structure 211, will feature ten ball-and-socket toughened glass insulators. Where necessary, restrained porcelain strut insulator assemblies will be utilized to mitigate the effects of conductor blow-out and to maintain the appropriate clearance between the conductor and the grounded surfaces of the structure. Structures located at critical crossings such as highways, railroads, and navigable water crossings will utilize double insulator string assemblies.

E-1.2.2 **Structure Type, Size, and Material**

Several different structure types will be used for the Project (see Figures 5-1 through 5-4, Exhibit 5).

The primary structure type for the Rebuilt Line 112 will be single circuit galvanized tubular steel single poles. The single circuit galvanized tubular steel pole structures in Segments 1 and 2 will be predominately braced-post insulator structures for tangent structures with self-supporting single pole dead-end structures. In Segment 1 and in two locations in Segment 2, Rebuilt Line 112 will be supported by double circuit tubular steel pole structures that also support Existing Line 111. In Segments 3, 4, 5, and 7, Rebuilt Line 112 will be supported by delta configured galvanized tubular steel pole suspension structures with dead-ends and line angles supported by either self-supporting single circuit galvanized steel pole delta davit arm dead-end structures or self-supporting single circuit galvanized steel single pole dead-end structures. Single circuit galvanized steel pole H-Frame suspension structures are proposed for Rebuilt Line 112 on either side of the location where Existing Line 112 crosses under two New York Power Authority ("NYPA") 345kV Lines in Segment 5 at Structures 171 and 172.

Placement of the structures associated with Rebuilt Line 112 (except for Segment 4 Relocated) will be generally within 10 to 15 feet ahead or back of the existing structure replacements along the existing centerline. The resulting average span length will be approximately 550 feet. Table E-1-1 details the approximate quantities of transmission structures by structure type to be installed as part of the Project and provides the proposed height range associated with each structure type.

Table E-1.2-1 Quantities of 115kV Structures to be Replaced as Part of the Project

Structure Type	Quantity (208 Total Structures)	*Proposed Height Range (ft)
No Work	1 (Str 1-2)	N/A
Double Circuit Single Pole Dead-end w/ Davit Arms	5	80 – 90
Single Circuit Single Pole Dead-end w/ Davit Arms	3	65 – 80
Single Circuit Single Pole Dead-end	14	75 – 90
Single Circuit H-Frame Dead-end	2	40 & 65
Single Circuit 3-Pole Dead-end	2	50 – 60
Single Circuit Single Pole Braced Line Post Suspension	106	56 – 68
Single Circuit Single Pole Davit Arm Suspension	73	52 – 80
Single Circuit H-Frame Suspension	2	60 & 65

*Proposed height ranges listed are above grade.

Figures accompanying Exhibit 5 provide typical cross-sections of the proposed structures within the Project ROW.

E-1.2.3 **Structural Loading and Foundations**

Structure design will be done in accordance with applicable national and state codes, including the most current edition of the NESC, as well as more stringent criteria imposed by National Grid. The NESC specifies both the minimum structural load criteria to determine the required structural capacity and clearances for energized hardware and wires. Typical clearance requirements defined by the NESC include clearances to ground, adjacent transmission lines, railroads, buildings, and other facilities. The minimum structure load required by NESC or National Grid is as follows:

- NESC Heavy Loading (250B): ½-inch radial ice at 0° F with a 40 mph wind;
- NESC Extreme Wind Loading (250C): 90 mph wind at 60° F;
- NESC Extreme Ice with Concurrent Wind Loading (250D): 1 inch radial ice at 15°F with a 40 mph wind; and
- National Grid Heavy Ice: 1½ inch radial ice at 30°F with a 28 mph wind

In addition to the NESC, there are several published standards that will be followed, depending on the type of structure and material used. Some of the common standards include:

- Steel Lattice Structures – American Society of Civil Engineers Manual 10-97 “Design of Latticed Steel Transmission Structures”
- Tubular Steel Poles – American Society of Civil Engineers Manual 72 “Design of Steel Transmission Pole Structures”
- Rural Utilities Service Bulletin 1724E-200 “Design Manual for High Voltage Transmission Lines”
- American Concrete Institute ACI 336.3R-14 – Report on Design and Construction of Drilled Piers
- American Concrete Institute ACI 318-19 – Building Code Requirements for Structural Concrete

E-1.2.4 **Structure Foundation Design**

The Applicant proposes to employ two types of foundations for the Project’s transmission line structures. Typical tangent, single circuit steel pole suspension structures are proposed to have direct embed foundations. The direct embedded foundation consists of placing a steel pole directly into a 12 gauge corrugated metal pipe (commonly referred to as a culvert), to a specified depth determined in final design. Upon setting the pole within the culvert, crushed stone backfill will be placed in the space remaining between the pole and the inside surface of the culvert and tamped at no greater than twelve inch intervals. The purpose of the culvert is to provide a grounding system for the structure as well as to provide a foundation of suitable character to support the structure loadings. Diameters of these culverts will range from 3 to 4 feet depending upon the diameter of the steel pole. Steel pole structures designed for line angles and dead-end structures will be self-supporting and will typically be set on reinforced concrete caisson foundations. These concrete foundations will range from 6 to 10 feet in diameter and set to a depth of 15 to 40 feet depending upon structure loading and soil conditions. However, should existing soil conditions, structure loading, and costs dictate the need, alternate foundation types, such as micropiles, helical piles, rock anchors, will be used. This will be detailed in the EM&CP.