Empire Offshore Wind LLC

Empire Wind 2 Project
Article VII Application

Exhibit E-1
Description of Proposed Transmission Line

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ACRONYMS AND ABBREVIATIONS

Empire or the Applicant	Empire Offshore Wind LLC
EW 2	Empire Wind 2
ft	foot
HVAC	high-voltage alternating-current
in	inch
in^2	square-inch
km	kilometer
kV	kilovolt
LIPA	Long Island Power Authority
LIRR	Long Island Rail Road
m	meter
mi	mile
mm	millimeter
mm^2	square millimeter
nm	nautical mile
NY Project	EW 2 Project transmission facilities in New York
POI	Point of Interconnection at an expansion of the Barrett 138-kV Substation
XLPE	cross-linked polyethylene

EXHIBIT E-1: DESCRIPTION OF PROPOSED TRANSMISSION LINE

E-1.1 Introduction

Empire Offshore Wind LLC (Empire or the Applicant) proposes to construct and operate the Empire Wind 2 (EW 2) Project as one of two separate offshore wind projects to be located within the Bureau of Ocean Energy Management-designated Renewable Energy Lease Area OCS-A 0512. The EW 2 Project will require an electric transmission system to connect the offshore wind farm to the point of interconnection (POI) to the New York State Transmission System. An electric transmission line with a design capacity of 125 kilovolts (kV) or more, extending a distance of one mile or more, is subject to review and approval by the New York State Public Service Commission as a major electric transmission facility pursuant to Article VII of the New York Public Service Law. The EW 2 Project transmission system will extend a total of approximately 12.1 miles (mi) (19.5 kilometers [km]) within the State of New York and includes 230-kV export cable circuits and 345-kV interconnection cable circuits. As such, this application is being submitted to the New York State Public Service Commission pursuant to Article VII of the New York Public Service Law for the portions of the EW 2 Project transmission system that are located within the State of New York (collectively, the NY Project).

The NY Project will interconnect to the New York State Transmission System operated by the New York Independent System Operator, Inc. at the Oceanside POI, located at an expansion of the Barrett 138-kV Substation. The Barrett 138-kV Substation is owned by the Long Island Power Authority (LIPA) and operated by PSEG Long Island and is located in Oceanside in the Town of Hempstead, New York. The NY Project will enter LIPA's substation at 345 kV, where the voltage will be converted to 138-kV within the POI. The onshore portion of the NY Project will be located entirely within Nassau County, New York.

The NY Project includes:

- Three three-core 230-kV high-voltage alternating-current (HVAC) submarine export cables located within an approximately 7.7-nautical mile (nm, 14.2-km)-long submarine export cable corridor from the boundary of New York State waters 3 nm (5.6 km) offshore to the cable landfall;
- A cable landfall in the City of Long Beach, New York;
- Three 230-kV onshore export cable circuits, each with three single-core HVAC onshore export cables within an approximately 1.5-mi (2.4-km)-long onshore export cable corridor from the cable landfall to the onshore substation;
- An onshore substation in the Village of Island Park, within the Town of Hempstead, New York, which will step up the voltage to 345 kV for the onshore interconnection cables; and
- Up to three 345-kV interconnection cable circuits, each with three single-core HVAC interconnection cables within an approximately 1.7-mi (2.8-km)-long interconnection cable corridor from the onshore substation to the POI.

This Exhibit addresses the requirements of 16 New York Codes, Rules and Regulations § 88.1 and provides a description of the Project's proposed transmission lines, including the submarine export cables, onshore export cables, and interconnection cables. All proposed transmission lines for the Project are submarine or underground, as described in **Exhibit E-3: Underground Construction**, with the exception of a short segment of the transmission line that will cross Barnums Channel via a cable bridge, parallel to the Long Island

Rail Road (LIRR) bridge trestle, aboveground transmission facilities that are part of the onshore substation, and structures that may be associated with the POI (see **Exhibit E-2: Other Facilities**). There are no towers associated with the proposed transmission lines.

E-1.2 Description of the Proposed Transmission Line

Table E-1.2-1 summarizes the characteristics of the proposed transmission lines, including the submarine export cables and the onshore export and interconnection cables.

Table E-1.2-1Characteristics of Proposed Transmission Lines

Characteristics	Submarine Export Cables a/	Onshore Export Cables	Interconnection Cables
Number of circuits	3	3	3 b/
Number of cables per circuit	1	3	3
Number of cables (total)	3	9 + 6 fiber optic	9 + 6 fiber optic
Design voltage c/	245 kV	245 kV	362 kV
Voltage of initial operation	230 kV	230 kV	345 kV
Length of each cable route	8.8 mi (14.2 km)	1.5 mi (2.4 km)	1.7 mi (2.8 km)
Cable diameter	11.8 in (300 mm)	5.2 in (133 mm)	5.9 in (150 mm)
Cable cross-sectional area	109 in^2 (707 cm^2)	21 in^2 (139 cm^2)	27.4 in^2 (177 cm^2)
Number of conductors per cable	3	1	1
Conductor characteristics			
Diameter	2 in (50.5 mm)	2.5 in (64.3 mm)	2.5 in (64.3 mm)
Cross-section	3.1 in^2 (2,000 mm^2)	3.9 in^2 (2,535 mm^2)	3.9 in^2 (2,535 mm^2)
Material	copper	copper	copper
Insulator design	XLPE	XLPE	XLPE

Notes:
a/ Fiber optic elements are bundled within each submarine export cable.
b/ The Applicant is evaluating the potential to reduce to two 345-kV interconnection cable circuits.
c/ Design voltage is based on the highest voltage that can be sustained under normal operating conditions at any time and at any point in a system.

E-1.2.1 Submarine Export Cables

From the southeastern portion of Renewable Energy Lease Area OCS-A 0512, three 230-kV submarine export cables will be installed within a single cable corridor that runs northwest traversing the New York Bight toward Long Island. The submarine export cable corridor crosses the state boundary 3 nm (3.5 mi, 5.6 km) offshore, directly south of Jones Beach in western Long Island. After crossing the New York State boundary, the submarine cable route continues approximately northwest and turns north to the landfall at Riverside Boulevard in the City of Long Beach, New York.

The submarine export cable corridor in New York is approximately 7.7 nm (8.8 miles, 14.2 km) long from the state boundary offshore to the cable landfall. The submarine export cables will be HVAC. Each of the three HVAC submarine export cables will consist of a three-core cable with copper or aluminum conductors enclosed in a cross-linked polyethylene (XLPE) insulation system, and up to two integrated optical fibers for communication and monitoring. The cable insulation is rated for voltage levels up to 245 kV.

Each of the three, 3.1-square-inch (in²) (2,000 square-millimeter [mm²]) bundled copper power conductors will be within insulated power cores. Each conductor will be made of stranded copper or aluminum wires and will be protected against longitudinal water ingress by means of a water-blocking compound, yarns, and/or tapes. Each power cores within the bundled submarine export cable will incorporate a single conductor with a semi-conductive lead alloy inner sheath together with a polymeric sheathing, which will prevent radial water ingress into the power core. A semi-conductive water swellable tape will be applied over the insulation screen to prevent longitudinal water ingress.

The three insulated power cores within each submarine export cable will be laid together in a trefoil formation together with fiber optic elements and extruded polymeric-shaped fillers. The extruded fillers are placed in the interstices between the power cores to give a substantially round shape to the power core bundle. The fiber optic elements will be placed within the extruded fillers that provide mechanical protection. An armoring package made of an armoring bedding and a layer of either steel, or steel and polymeric armor wires flushed with bitumen, will be applied over the bundle. Finally, an outer serving (defined as a layer of protective covering over the exterior) made of black polypropylene yarns will be applied over the armoring package.

Colored polypropylene yarns will be applied helically over the outer serving; the cable will be marked at specified lengths every 0.62 mi (1 km), as well as every 328 feet (ft) (100 meters [m]) of the first and last kilometer. The entire three-core submarine export cable will be up to approximately 11.8 inches (in) (300 millimeters [mm]) in outer diameter. A cross-section of the submarine export cable is provided in **Exhibit E-3.**

E-1.2.2 Onshore Export Cables

The submarine export cables will transition to the onshore export cables at a jointing location at the cable landfall at Riverside Boulevard in the City of Long Beach, New York. The jointing location is expected to be a buried jointing chamber/pull-in pit, with manholes at ground level; however, final design is ongoing. A link box chamber may be required at the surface level. All components will be underground. A representative example of export cable transition components is provided in **Exhibit 5: Design Drawings.**

From the jointing location at the cable landfall in the City of Long Beach, the approximately 1.5-mi (2.4-km)-long onshore export cable route will go traverse east along E Broadway, north on Lincoln Boulevard, and then west on E Harrison Street. At the western end of E Harrison Street, the route turns north on Long Beach Road, and briefly west on Park Place before turning north to cross Reynolds Channel to the onshore substation, which is located on the north side of Reynolds Channel. The onshore export cable corridor will contain three circuits of three single-core HVAC cables with copper or aluminum conductors enclosed in XLPE insulation, for a total of nine cables, with a voltage of 230 kV. The conductor within each single-core cable will have a cross-sectional area of approximately 3.9 in² (2,535 mm²). Semi-conductive swelling tape will be applied over the insulation screen, and each dielectric cable will be sheathed in polyethylene, with a metallic laminated or lead sheath as a longitudinal water barrier. The onshore export cables will each be approximately 5.2 in (133 mm) in outer diameter. A cross-section of a typical onshore export cable is provided in **Exhibit E-3**. Up to two separate fiber optic cables per circuit, each approximately 1.1 in (30 mm) in outer diameter, will also be installed alongside the onshore export cables for communications and monitoring.

The onshore export cables and associated fiber optic cables will be housed in duct banks and will be buried to a minimum target depth of 3 ft (0.9 m) beneath the surface. The configuration of the nine export cables and fiber optic cables within the duct banks may vary along the installation corridor. Each of the concrete duct banks will be approximately 3 ft (0.9 m) high by 7 ft (2.1 m) wide. In certain areas, there may be a separation between duct banks due to site conditions and spacing constraints. Joint pits/pull-in pits (manholes) will be located approximately every 1,500 to 5,000 ft (457 to 1,524 m) along the onshore export cable corridor to

provide access to the cables. The actual length between joint pits/pull-in pits will vary due to site-specific and cable installation constraints. Duct bank and joint pit layouts, and preliminary locations of vaults, are provided in **Exhibit 5**.

E-1.2.3 Interconnection Cables

The proposed onshore substation will increase the voltage to 345 kV for the interconnection cable route to the POI in Oceanside, New York. Details on the proposed onshore substation are provided in **Exhibit E-2**. From the onshore substation, the approximately 1.7-mi (2.8-km)-long interconnection cable route will traverse north through Island Park and Barnum Island approximately parallel to the LIRR railroad, traversing existing parking lots in the vicinity of the Island Park Station. It will continue along the west side of the LIRR corridor north of Island Park Station until Parente Lane, where the interconnection cable route will follow Parente Lane, then continue north onto D'Amato Drive and cross Long Beach Road. The route will then immediately turn north on North Nassau Lane. At the end of North Nassau Lane, the interconnection cables will continue north across private property and continue along or adjacent to the west side of the LIRR corridor. From there, the route will continue north under Daly Boulevard until reaching the POI. The interconnection cables will enter LIPA's Barrett 138-kV Substation at 345 kV; the voltage will be converted to 138 kV within the interconnection substation.

The interconnection cable corridor will contain up to three circuits of three single-core HVAC cables with copper conductors enclosed in XLPE insulation, for a total of nine cables, with a voltage of 345 kV. The conductor within each single-core cable will have a cross-sectional area of approximately 3.9 in^2 (2,535 mm^2). Semi-conductive swelling tape will be applied over the insulation screen, and each dielectric cable will be sheathed in polyethylene, with a metallic laminated or lead sheath as a longitudinal water barrier. The interconnection cables will each be approximately 5.9 in (150 mm) in outer diameter. A cross-section of a typical onshore interconnection cable is found in **Exhibit E-3**. Up to two separate fiber optic cables per circuit, each approximately 1.1 in (30 mm) in outer diameter, will also be installed alongside the interconnection cables for communications.

The interconnection cables and fiber optic cables will be housed in duct banks and will be buried to a minimum target depth of 3 ft (0.9 m) beneath the surface. The configuration of the nine interconnection cables and the fiber optic cables within the duct banks or culverts may vary along the installation corridor. Each of the concrete duct banks will be approximately 3 ft (0.9 m) high by 7 ft (2.1 m) wide. In certain areas, there may be a separation between duct banks within the interconnection cable corridor, due to site conditions and spacing constraints. Joint pits/pull-in pits (manholes) will be located approximately every 1,500 to 5,000 ft (457 to 1,524 m) along the interconnection cable corridor to provide access to the cables. The actual length between joint pits/pull-in pits will vary due to site-specific and cable installation constraints. Duct bank and joint pit layouts and preliminary location of vaults are provided in **Exhibit 5**.