

Empire Offshore Wind LLC  
and  
EW Offshore Wind Transport Corporation

Empire Wind 2 Project  
Article VII Application

**Exhibit E-4**  
**Engineering Justification**

August 2023

**REDACTED FOR PUBLIC DISCLOSURE**

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**ACRONYMS AND ABBREVIATIONS**

BOEM	Bureau of Ocean Energy Management
CLCPA	Climate Leadership and Community Protection Act
Empire or the Applicant	Empire Offshore Wind LLC and EW Offshore Wind Transport Corporation
EW 2	Empire Wind 2
ft	foot
HVAC	high-voltage alternating-current
km	kilometer
kV	kilovolt
Lease Area	BOEM-designated Renewable Energy Lease Area OCS-A 0512
LIPA	Long Island Power Authority
m	meter
mi	mile
MW	megawatt
nm	nautical mile
NYISO	New York Independent System Operator, Inc.
NY Project	EW 2 Project transmission facilities in New York
NYSERDA	New York State Energy Research and Development Authority
NYSPSC or Commission	New York State Public Service Commission
O&M	Operations and Maintenance
OREC	offshore wind renewable energy credit
POI	Point of Interconnection at the Hampton Road substation
PSEG-LI	PSEG Long Island
PSL	New York Public Service Law
SRIS	System Reliability Impact Study

## EXHIBIT E-4: ENGINEERING JUSTIFICATION

### E-4.1 Introduction

Empire Offshore Wind LLC and EW Offshore Wind Transport Corporation (collectively, 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 (BOEM) designated Renewable Energy Lease Area OCS-A 0512 (Lease Area). 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-kilovolt (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 (Commission or NYSPSC) as a major electric transmission facility pursuant to Article VII of the New York Public Service Law (PSL). The EW 2 Project transmission system will extend a total of approximately 12.2 miles (mi) (19.6 kilometers [km]) within the State of New York and includes two 345-kV cable circuits.

The POI will be located on a parcel located along Hampton Road in Oceanside, within the Town of Hempstead, New York. The POI facilities (referred to herein collectively as the Hampton Road substation) will include both 345-kV and 138-kV substation facilities. The Applicant is proposing to permit all of these facilities, as well as the 138-kV “loop-in / loop-out” lines that will connect the substation facilities to two existing 138-kV cable circuits located under Lawson Boulevard owned by the Long Island Power Authority (LIPA) and operated by PSEG Long Island (PSEG-LI). LIPA will own and PSEG-LI will operate these loop-in / loop-out lines and the 138-kV facilities at the Hampton Road substation site. The ownership and/or operation of the 345-kV facilities at the Hampton Road substation will be determined through a mutually acceptable Interconnection Agreement between the Applicant and LIPA, as developed through the New York Independent System Operator, Inc. (NYISO) interconnection process. This application is being submitted to the Commission pursuant to Article VII of the PSL for the portions of the EW 2 Project transmission system that are located within the State of New York (the NY Project). The onshore portion of the NY Project will be located entirely within Nassau County, New York.

The NY Project includes:

- Two three-core 345-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;
- Two 345-kV onshore export cable circuits, each with three single-core HVAC onshore export cables within an approximately 1.6-mi (2.5-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 house major control components for the electrical system and perform functions such as voltage regulation, reactive power compensation, and harmonic filtering;

- Two 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 Hampton Road substation;
- The new Hampton Road substation in Oceanside in the Town in Hempstead, New York, which will include substation facilities that will provide the necessary breaker arrays and 345-kV/138-kV transformers; and
- Four 138-kV loop-in / loop-out lines cable circuits, located within an approximately 0.1-mi (0.2-km) long cable corridor from the Hampton Road substation to existing LIPA transmission lines located under Lawson Boulevard in Oceanside, New York.

This Exhibit addresses the requirements of 16 New York Codes, Rules and Regulations § 88.4 by providing the engineering justification for the proposed transmission line, its relation to existing facilities and the interconnected network, benefits with respect to reliability and economy, proposed completion date, and the effect of a schedule delay. This Exhibit also provides a description of the system studies that have been conducted for the NY Project.

#### **E-4.2 Relation to Existing Networks**

The purpose of the EW 2 Project is to meet the Applicant's contractual obligation to the New York State Energy Research and Development Authority (NYSERDA) to supply a maximum potential capacity of at least 1,260 megawatts (MW) of renewable electricity from an offshore wind farm located in the Lease Area. The EW 2 Project addresses the need identified by New York for renewable energy and will help the State achieve its Climate Leadership and Community Protection Act (CLCPA) mandate and other renewable energy goals (see **Exhibit 3: Alternatives**).

Two 345-kV HVAC submarine export cables will transport power from the offshore substation for the wind farm in the Lease Area to the cable landfall. At the cable landfall, the submarine export cables will transition to 345-kV HVAC onshore export cables to the proposed onshore substation in the Village of Island Park, New York, which will provide voltage regulation, reactive power compensation, and harmonic filtering. Leaving the onshore substation, two 345-kV HVAC interconnection cable circuits will transport the power to the Hampton Road substation and POI. As described in Section E-4.1, the Hampton Road substation will convert the voltage to 138 kV for delivery into a 138-kV breaker array. This 138-kV breaker array will be connected to LIPA's existing 138-kV transmission lines under Lawson Boulevard in Oceanside, New York, by the 138-kV loop-in / loop-out lines running under the Long Island Rail Road right of way. The onshore portion of the NY Project will be located entirely within Nassau County, New York. A description of the onshore substation is provided in **Exhibit E-2: Other Facilities**, and detail on the transmission system is provided in **Exhibit E-3: Underground Construction**. Final interconnection design will be determined as part of the NYISO interconnection process.

The POI at the Hampton Road substation is located in the Long Island Load Zone (NYISO Load Zone K, **Figure E.4.2-1**). Zone K interfaces with New York City (Zone J). A figure showing the POI in relation to the existing New York State Transmission System is provided confidentially in **Appendix N System Reliability Impact Studies**. The NY Project configuration shown in the System Reliability Impact Study (SRIS) was updated in the Final Part 1 Facilities Study for the Project dates September 19, 2022. Among other things, the Final Part 1 Facilities Study moved the POI from the Barrett 138-kV Substation to the Hampton Road substation site as described above. In a Material Modification Assessment presented to its Transmission Planning Advisory Subcommittee on April 3, 2023, NYISO approved further modifications to the NY Project,

including a change in the incoming lines from the Applicant’s offshore wind farm from three 230 kV cable circuits to two 345 kV cable circuits.

The Applicant submitted an interconnection request on December 11, 2019, which was assigned queue position #959 in the Interconnection Queue maintained by NYISO as part of its Transmission Interconnection Process. A SRIS was completed for the EW 2 Project associated with this queue position, as detailed in Section E-4.5 and provided confidentially in **Appendix N**. Conceptual single-line diagrams of the system from the wind turbines to the POI is provided in **Figure E.4.2-2**.

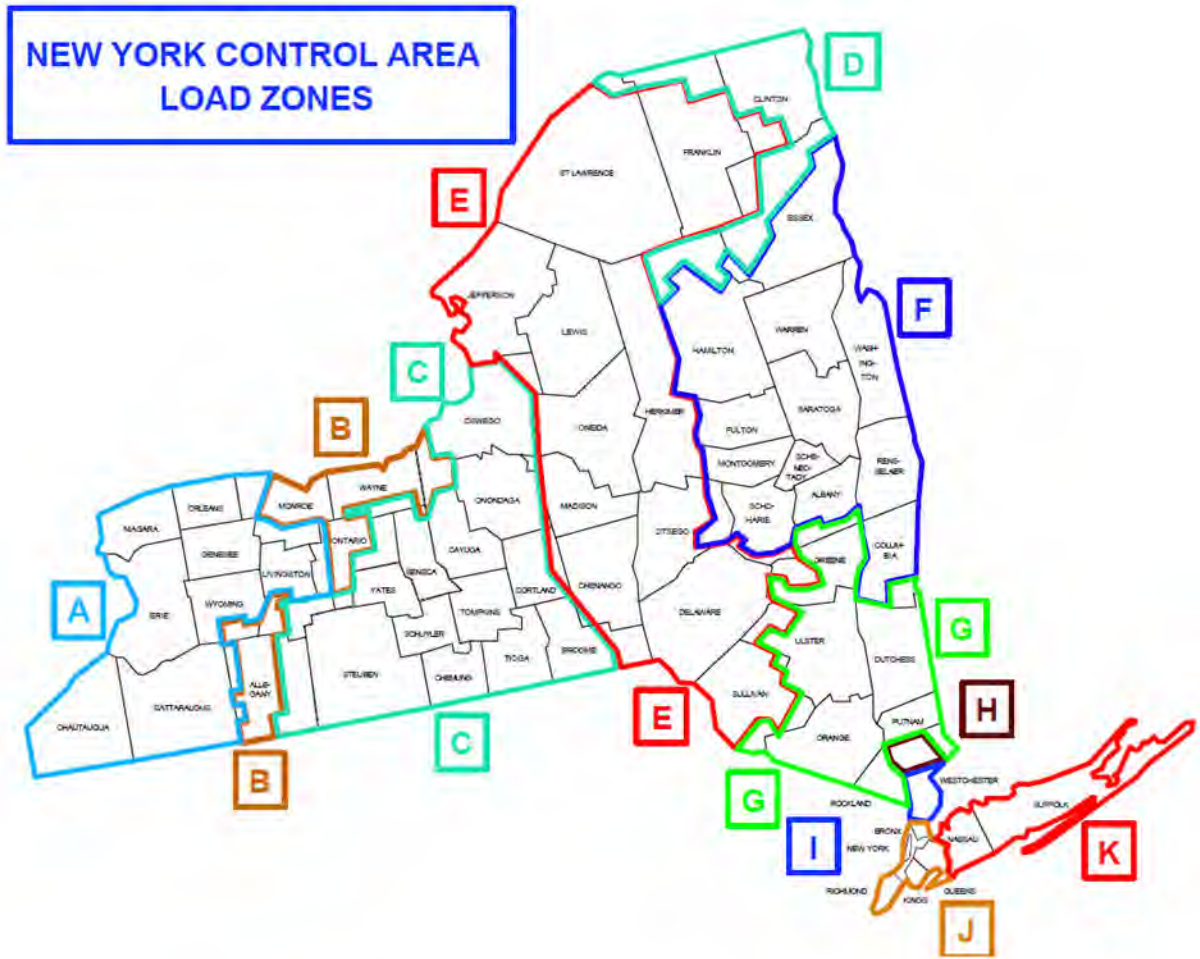


Figure E.4.2-1 New York Load Zones (NYISO 2021)

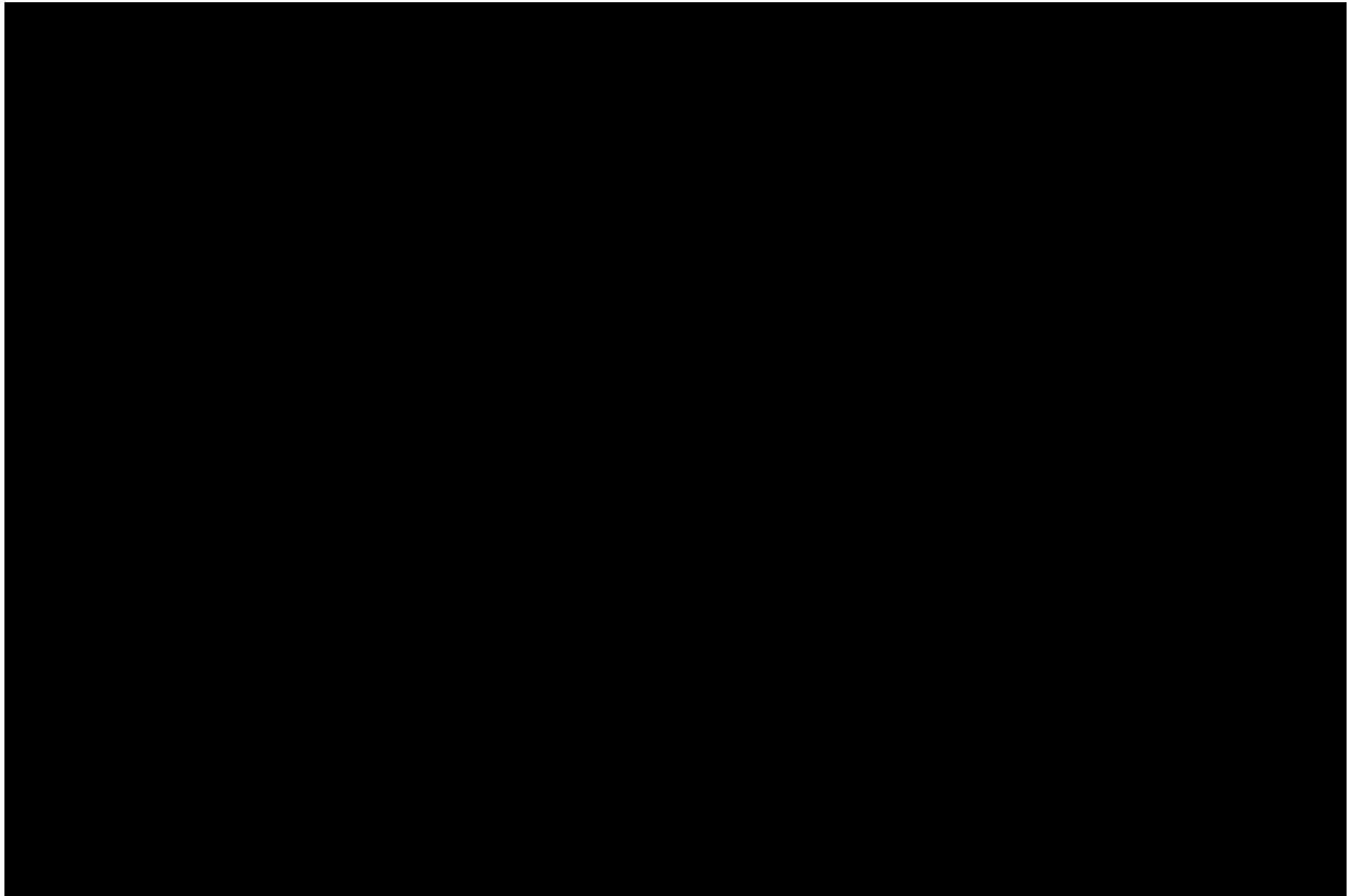


Figure E.4.2-2 Conceptual Single-Line Diagram of the EW 2 Project

### E-4.3 Reliability and Economy Benefits

Reliability of the NY Project transmission, interconnection, and substation facilities will be ensured through the use of designed control measures, monitoring (supervisory control and data acquisition), protection systems, and system redundancy. The submarine export cables, onshore substation, onshore export and interconnection cables, Hampton Road substation and loop-in / loop-out lines will be designed, installed, and tested to meet or exceed applicable industry standards and electrical codes as described in **Exhibit E-3**.

The NY Project will be maintained in accordance with these standards and the requirements of the interconnection agreement. The submarine export cables will be installed to a minimum target burial depth of 6 feet (ft) (1.8 meters [m]). The onshore export and interconnection cable system will be housed in duct banks and will be buried to a target depth of 3 ft (0.9 m) to minimize risk from external factors such as weather events and third-party damage. It is similarly anticipated that the loop-in / loop out lines will be housed in duct banks and will be buried to a minimum target depth of 4 ft (1.2 m).

Prior to being placed into service, the electrical components of the NY Project will be measured and tested. Testing will be conducted in accordance with vendor recommendations, rules, and regulations. Commissioning tests will include assessment of baseline performance metrics, testing of the grounding and bonding systems, non-destructive impedance and leakage tests, continuity tests of the cable and conductor system, and grounding measurement.

As part of the EW 2 Project operations, the Applicant will maintain a staffed Operations and Maintenance (O&M) Base that will remotely monitor and control EW 2 Project operations at all times. The O&M Base will be located at the South Brooklyn Marine Terminal, in Brooklyn, New York, and will include offices, control rooms, warehouses, and wharves for crew transfer vessels and service operations vessels for the offshore wind farm. The O&M Base will also be responsible for monitoring the Applicant's facilities, including the submarine export, onshore export and interconnection cables, onshore substation and the Applicant's facilities at the Hampton Road substation. The Applicant's O&M staff will ensure that all components are maintained and operated in a safe and reliable manner, compliant with regulatory conditions, and in accordance with commercial objectives.

The onshore substation will contain monitoring equipment that will notify the Applicant of any equipment faults, unexpected shutdowns, and/or any other issues that could occur within the onshore substation or along the transmission cables associated with the NY Project. NY Project infrastructure and equipment will be designed to be able to withstand extreme conditions and will be protected both externally and internally by a lightning protection system. The onshore substation and Hampton Road substation will be equipped with an emergency generator as a back-up system in the event that station power is lost. Additional information on protection systems is provided in **Exhibits E-2** and **E-3**.

The Applicant will account for the topographical and geological conditions identified in the NY Project area during operation of the NY Project. The submarine export, onshore export and interconnection cables will be monitored through Distributed Temperature Sensing equipment. The Distributed Temperature Sensing system will be able to provide real-time monitoring of temperature, alerting the Applicant should the temperature change, which often is the result of a change in cable burial depth, caused by, for example, scouring of cable covering material. The Applicant will also conduct surveys of the submarine export cables to confirm the cables have not become exposed or that the cable protection measures have not worn away. A Distributed Vibration Sensing system will be integrated within the submarine export cables to provide real-time vibration monitoring close to the cables, which may indicate potential dredging activities or anchor drag occurring close to the cables. Upon receiving any such alert, the Applicant will warn vessels in the area (for the submarine export cable route), assess the cable condition, and identify any needed corrective actions.



In the event of mechanical damage, fault or failure, the Applicant will repair or replace the NY Project component in a timely manner. Should the submarine export, onshore export, or interconnection cables fault, the damaged portion of the cable will be spliced and replaced with a new, working segment. Mechanical repairs to the submarine export cable would be completed using a barge and jetting tools to expose and replace or splice the submarine export cable at the repair site. For onshore repairs, as necessary, the entire segment of the onshore export or interconnection cable that has failed would be pulled out of the duct and will be replaced by a new segment or trenching or excavation equipment would be brought in to excavate the location for a local replacement and/or repair. Additional detail on monitoring and repairs during operations will be provided in the Applicant's O&M Plan.

The use of a submarine and underground cable system minimizes reliability concerns by reducing the opportunity for potential damage. With remote monitoring and relatively infrequent maintenance and repair requirements, underground and submarine cables will provide reliable energy transmission and interconnection over the lifespan of the NY Project. The EW 2 Project will provide economic benefits to New York and the local Nassau County area through job creation, infrastructure investment, supply chain development, benefits to ratepayers, and cost savings through emissions reductions (see **Exhibit 6: Economic Effects of Proposed Facility**).

Monitoring and maintenance of the Hampton Road substation facilities will be determined through a mutually acceptable Interconnection Agreement between the Applicant and LIPA, as developed through the NYISO interconnection process.

Emergency Response Plans or similar types of documents for the Applicant's facilities will be developed to address the possibility of non-routine events (such as extreme weather, fire, or terrorist events). Relevant personnel will be provided training on the details of the Emergency Response Plans, including the site-specific emergency evacuation routes, warning signals, locations of fire extinguishers and first aid kits, as well as the chain of command.

#### **E-4.4 Schedule and Impact of Delay**

The NY Project schedule anticipates receipt of all permits and authorizations for the start of onshore construction in 2024. The Applicant currently expects the system will be ready for energization in 2027.<sup>1</sup> Construction schedules are subject to multiple factors, including but not limited to state and federal permitting, financial investment decisions, power purchase contracts, and supply chain considerations.

The Applicant was awarded a contract to supply at least 1,260 MW of offshore wind renewable energy credits (ORECs) from its EW 2 Project in NYSERDA's second competitive OREC solicitation. The EW 2 Project will contribute to New York's achievement of the renewable energy and offshore wind mandates in the CLCPA and will provide significant economic benefits to New York State. Through the CLCPA, New York set forth an ambitious renewable energy plan of achieving 100 percent carbon-free electricity by 2040 and 70 percent of electricity from renewable sources by 2030, including a requirement of reaching 9,000 MW of offshore wind by 2035. A schedule delay would impact delivery of the contracted power generation from the offshore wind farm, would delay the attainment of the economic and environmental benefits of the EW 2 Project, and

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<sup>1</sup> The System Reliability Impact Studies provided in **Appendix N** are based on a proposed In-Service Date of June 2023, an Initial Synchronization Date of August, 2024 and a Commercial Operation Date of December, 2024. A revised project schedule will be established in the Large Facility Interconnection Agreement to be negotiated after the completion of the Class Year 2021 Facilities Study.

ultimately, could jeopardize New York State's ability to meet its CLCPA mandate. Economic benefits of the EW 2 Project are further described in **Exhibit 6**.

#### **E-4.5 System Reliability Impact Study**

The NYISO completed an SRIS on the effects of the EW 2 Project in queue position #959. These SRIS evaluated the impacts of the EW 2 Project outputting 1,500 MW<sup>2</sup>, for injection into the New York transmission system. At the May 3, 2021, Transmission Planning Advisory Subcommittee Meeting, NYISO informed market participants that it had approved Empire Wind's request to reduce queue position #959 from 1,500 MW to 1,260 MW.

The main purpose of the SRIS is to: (a) analyze the impacts of the EW 2 Project on power flows, stability, and short-circuit conditions on New York State Transmission System; (b) determine any System Upgrade Facilities that would be required to eliminate any adverse impacts of the EW 2 Project on the reliability of the New York State Transmission System; and (c) determine any System Deliverability Upgrade Facilities required for the EW 2 Project to serve as a capacity resource in the New York Control Area.

The SRIS was conducted in accordance with the applicable North American Electric Reliability Corporation, Northeast Power Coordinating Council, New York State Reliability Council, and LIPA and affected system(s) reliability and design standards. The SRIS was also conducted in accordance with applicable NYISO, connecting transmission owner, and affected system(s) study guidelines, procedures, and practices.

In order to evaluate the potential system reliability impacts, the SRIS included the following analyses for scenarios both with and without the proposed EW 2 Project:

- Steady-state voltage and thermal N-0 and N-1 contingency analysis;
- Steady-state N-1-1 analysis;
- Stability analysis;
- Critical clearing time assessment;
- Short-circuit analysis;
- Minimum short circuit ratio testing;
- Sub-synchronous torsional interaction;
- Reactive power capability testing;
- Bus voltage deviation testing;
- Extreme contingency analysis;
- NPCC A-10 bulk power system testing;
- Bus flow analysis;
- Cost estimate and time to construct;
- Power quality harmonics analysis;
- Preliminary non-binding deliverability analysis; and
- Elective system upgrade evaluation.

The SRIS was evaluated by the NYISO's Transmission Planning Advisory Subcommittee, which recommended the study for approval by NYISO's Operating Committee on March 1, 2021. The NYISO Operating Committee approved the SRIS on March 11, 2021. A copy of the redacted SRIS is provided in **Appendix N**.

The Project accepted its allocation of interconnection costs in NYISO's 2021 Class Year Facilities Study and posted security for those upgrades. In that Facilities Study, the POI was shifted from the existing Barrett 138-kV Substation to a new substation to be constructed at the Hampton Road substation site. In a subsequent Material Modification Assessment, NYISO concluded that the Applicant's proposed change from three 230-kV cable circuits to two 345-kV cable circuits connecting into the Hampton Road substation did not constitute a material change. The Applicant subsequently incorporated this change into the NY Project.

#### **E-4.6 References**

NYISO. 2021. Real-time Dashboard, Printable Zone Maps. Accessed online January 18, 2021 at: [https://www.nyiso.com/documents/20142/1397960/nyca\\_zonemaps.pdf/8c3807e1-5bab-ab44-3c71-2c8e61b5748b](https://www.nyiso.com/documents/20142/1397960/nyca_zonemaps.pdf/8c3807e1-5bab-ab44-3c71-2c8e61b5748b).