Empire Offshore Wind LLC

Empire Wind 1 Project

Article VII Application

# Exhibit E-4

# Engineering Justification

June 2021

**REDACTED FOR PUBLIC DISCLOSURE**

# TABLE OF CONTENTS



# FIGURES

# ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| Astoria | Astoria Generating Company, L.P. |
| BOEM | Bureau of Ocean Energy Management |
| ConEdison | Consolidated Edison Company of New York, Inc. |
| CLCPA | Climate Leadership and Community Protection Act |
| Empire, the Applicant | Empire Offshore Wind LLC |
| EW 1 | Empire Wind 1 |
| ft | foot |
| HVAC | high-voltage alternating-current |
| km | kilometer |
| kV | kilovolt |
| Lease Area | BOEM-designated Renewable Energy Lease Area OCS-A 0512 |
| m | meter |
| mi | mile |
| MW | megawatt |
| nm | nautical mile |
| NYISO | New York Independent System Operator, Inc. |
| NYSPSC or Commission | New York State Public Service Commission |
| O&M | Operations and Maintenance |
| POI | Point of Interconnection at the Gowanus 345-kV Substation |
| Project | EW 1 Project transmission facilities in New York |
| PSL | New York Public Service Law |
| SBMT | South Brooklyn Marine Terminal |
| SRIS | System Reliability Impact Study |

# EXHIBIT E-4: ENGINEERING JUSTIFICATION

## E-4.1 Introduction

Empire Offshore Wind LLC (Empire, or the Applicant) proposes to construct and operate the Empire Wind 1 (EW 1) 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 proposed transmission system for the EW 1 Project will connect the offshore wind farm to the point of interconnection (POI), and will include 230-kilovolt (kV) export and 345-kV interconnection lines traversing a total of approximately 17.5 miles (mi) (15.2 nautical miles [nm], 28.2 kilometers [km]) within the State of New York. An electric transmission line with a design capacity of 125 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. This application is being submitted to the Commission pursuant to Article VII of the New York Public Service Law (PSL) for the portions of the EW 1 Project transmission system that are located within the State of New York (collectively, the Project).

The Project will interconnect to the New York State Transmission System operated by the New York Independent System Operator, Inc. (NYISO) at the Gowanus 345-kV Substation (the point of interconnection, or POI). The Gowanus 345-kV Substation is owned by the Consolidated Edison Company of New York, Inc. (ConEdison). The Project's onshore facilities, including the onshore cable route, onshore substation, and the POI, are located entirely within Brooklyn, Kings County, New York.

The Article VII components of the EW 1 Project include:

- Two three-core 230-kV high-voltage alternating-current (HVAC) submarine export cables located within an approximately 15.1-nm (27.9-km)-long, submarine export cable corridor from the boundary of New York State waters 3 nm (5.6 km) offshore to the cable landfall in Brooklyn, New York;
- A 0.2-mi (0.3-km)-long onshore cable route and substation including:
    - Two three-core 230-kV HVAC EW 1 onshore export cables buried underground from the cable landfall either directly to the cable terminations or to a vault within the onshore substation;
    - An onshore substation located at the South Brooklyn Marine Terminal (SBMT), which will increase the voltage to 345 kV for the onshore interconnection cables; and
    - Two 345-kV cable circuits, each with three single-core HVAC onshore interconnection cables, buried underground from the onshore substation to the POI.

## E-4.2 Relation to Existing Networks

The purpose of the Project is to meet the Applicant's contractual obligation to the New York State Energy Research and Development Authority and generate a maximum potential capacity of 816 megawatts (MW) of renewable electricity from an offshore wind farm located in the Lease Area. The 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**). The Applicant submitted a request on June 12, 2018 to the NYISO for interconnection to inject 800 MW of this offshore wind energy at ConEdison's existing Gowanus 345-kV Substation.

Two 230-kV HVAC submarine export cables will transport power from the offshore substation for the wind farm in the Lease Area to the onshore substation in New York, where it will be converted to 345-kV HVAC for transport and delivery to the POI. 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 point of interconnection at the Gowanus 345-kV Substation is located in New York City Load Zone J (see **Figure E.4.2-1**), which is in ConEdison's service territory. The ConEdison system in New York is divided into 17 transmission load areas (ConEdison 2019). **Figure E.4.2-2** shows the Gowanus 345-kV Substation POI in relation to existing NYISO transmission facilities above 115 kV. A System Reliability Impact Study (SRIS) was completed, as detailed in Section E-4.5 and provided confidentially in **Appendix L System Reliability Impact Study**.

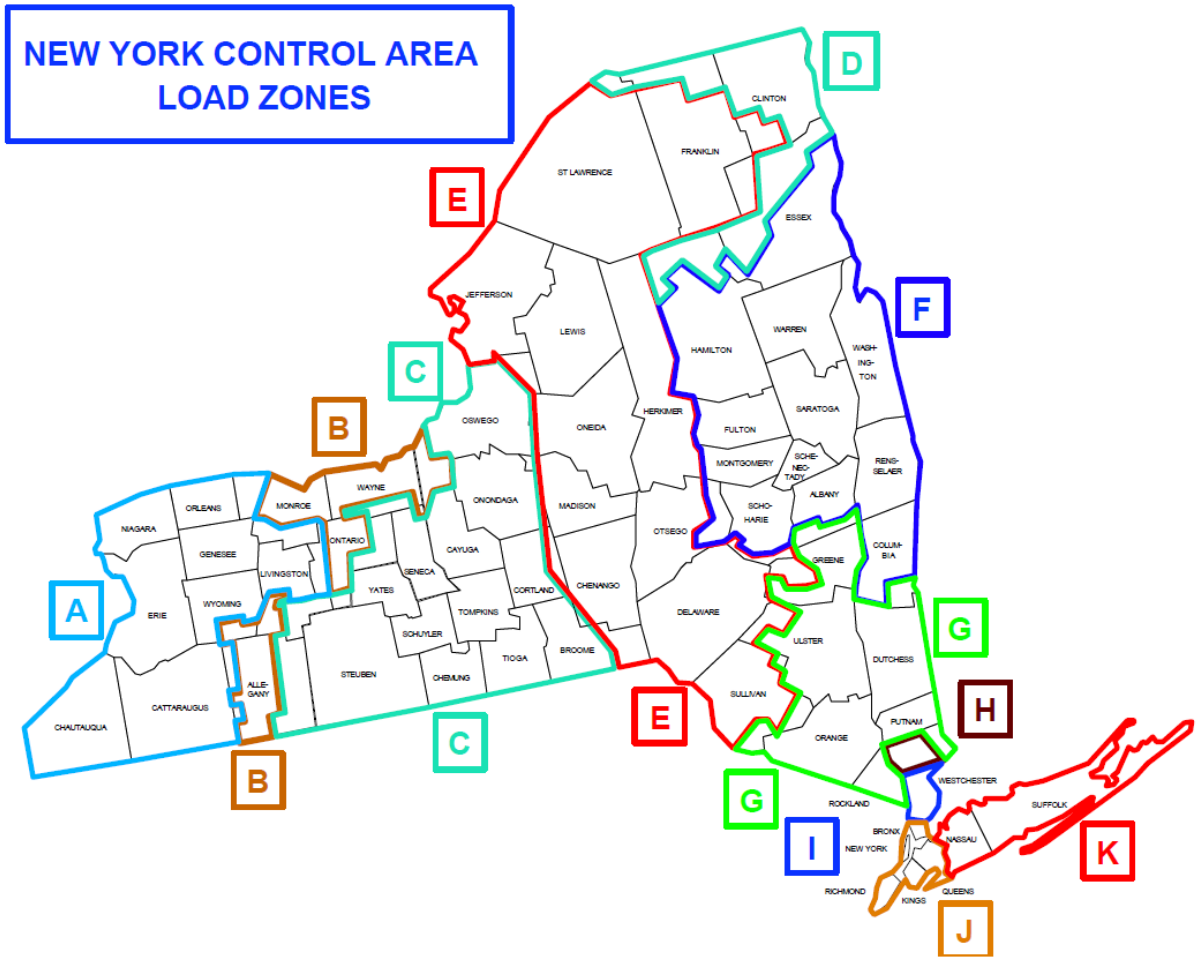


**Figure E.4.2-1 New York Load Zones (NYISO 2021)**

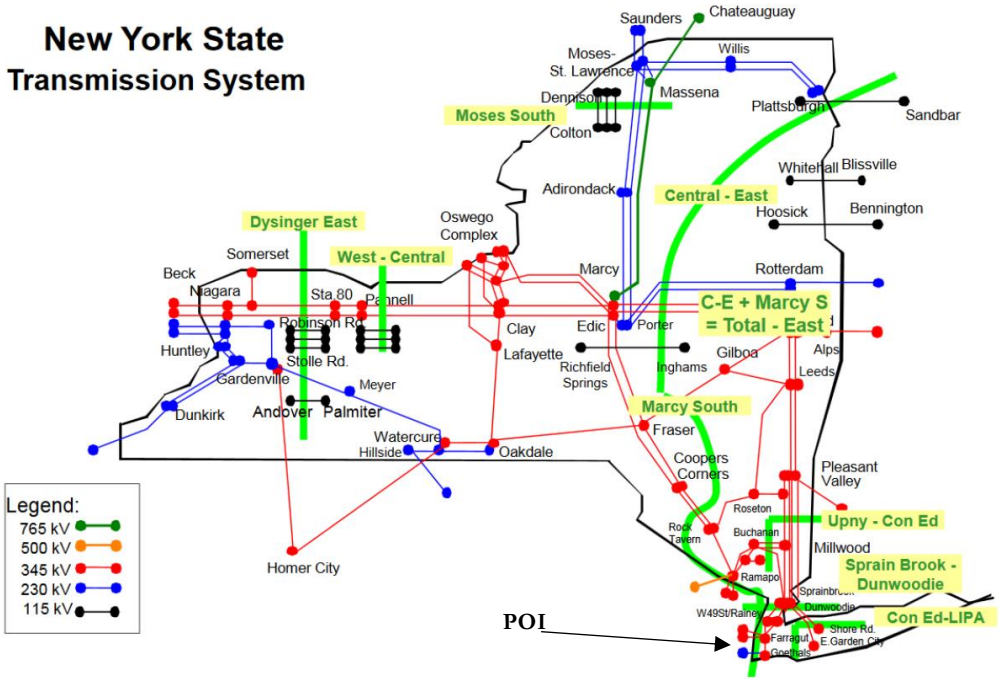


**Figure E.4.2-2 New York Electric System Map (NYISO 2018)**

New York Zone J interfaces with the Dunwoodie (Zone I), Millwood (Zone H) and Long Island (Zone K). The existing Gowanus 345-kV Substation is located along the 345-kV transmission system between ConEdison's Goethal Substation, which receives power from the Arthur Kill Power Plant and includes a 230-kV connection to New Jersey, and the Farragut Substation. Astoria Generating Company, L.P. (Astoria)'s existing Gowanus Generating Station (640 MW) in Brooklyn is also interconnected at the Gowanus Substation. Astoria's Narrows Generating Station (320 MW) in Brooklyn is interconnected into ConEdison's existing Greenwood Substation. Both the Gowanus Generating and Narrows Generation Stations serve NYISO Zone J and are connected within the Gowanus/Greenwood sub-load pocket at 138-kV (Astoria 2019).

The bus scheme of the onshore substation at SBMT will include single or double 230-kV buses and a single 345-kV bus. A conceptual single-line diagram of the system from the wind turbines to the POI is provided in **Figure E.4.2-3**.

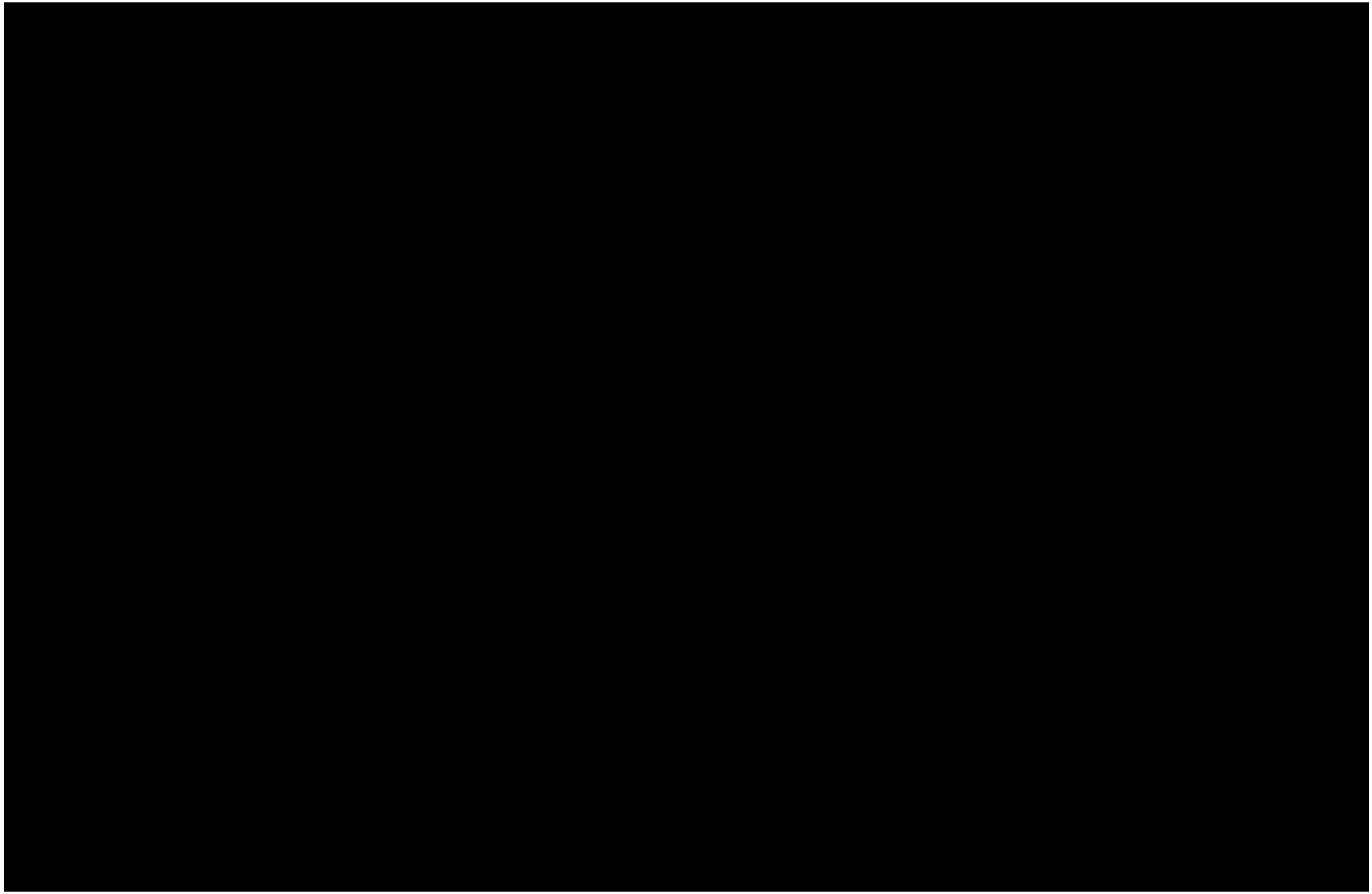

**Figure E.4.2-3 Conceptual Single-Line Diagram of the EW 1 Project**

## E-4.3 Reliability and Economy Benefits

Reliability of the 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, and onshore cables will be designed, installed and tested to meet or exceed applicable industry standards and electrical codes as described in **Exhibit E-3.**

The 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 depth of 6 feet (ft) (1.8 meters [m]). The onshore interconnection cable system will be housed in duct banks and will be buried to a target depth of 2.6 ft (0.8 m) to minimize risk from external factors such as weather events and third-party damage. Prior to being placed into service, the electrical components of the 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 1 Project operations, the Applicant will maintain a staffed Operations and Maintenance (O&M) Facility that will monitor Project operations at all times. The O&M Facility will be located adjacent to the onshore substation within SBMT and will include offices, control rooms, warehouses, shop space, and pier space for crew transfer vessels and service operations vessels for the offshore wind farm. The O&M Facility will also be responsible for monitoring the Project's transmission lines and onshore 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 Project. 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 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 submarine export cables will be monitored during operations through Distributed Temperature and Distributed Vibration Sensing equipment. The Distributed Temperature Sensing system will be able to provide real time monitoring of temperature along the submarine export cable route, alerting the Applicant should the temperature change, which often is the result of scouring of material and cable exposure. The Distributed Vibration Sensing system will provide real time vibration monitoring close to the cables indicating potential dredging activities or anchor drag occurring close to the cables. Upon receiving any such alert, the Applicant will investigate the cable condition and identify and take corrective actions, if necessary.

In the event of a mechanical damage, fault, or failure, the Applicant will repair or replace the Project component in a timely manner. Should the submarine export or onshore cables fault, the 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 or jet to expose and replace or splice the submarine export cable at the repair site. For onshore repairs, as necessary, trenching or excavation equipment would be brought in to excavate the location of the replacement and/or repair. Additional detail on monitoring and repairs during operations will be provided in the Project's O&M Plan.

The use of a submarine and underground cable system minimizes reliability concerns relative to overhead transmission, by reducing the opportunity for potential damage. As compared to overhead transmission lines, remote monitoring and relatively infrequent maintenance and repair of underground and submarine cables result in cost savings and reliability benefits for the Project over its lifespan.

Emergency Response Plans or similar types of documents 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 Project schedule anticipates receipt of all permits and authorizations for the start of onshore construction by 2023. The Applicant currently expects the system will be ready for energization in 2025.[1] 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 for 816 MW for its EW 1 Project, as a result of the New York State Energy Research and Development Authority's first competitive solicitation for offshore renewable energy certificates. The EW 1 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 Project, and ultimately, could jeopardize New York State's ability to meet its CLCPA mandate. Economic benefits of the Project are further described in **Exhibit 6: Economic Effects of Proposed Facility**.

## E-4.5 System Reliability Impact Study

The Project was assigned queue position #737 in the NYISO Transmission Interconnection Process. The NYSIO completed its SRIS on the effects of the EW 1 Project. The main purpose of the SRIS was to: i) assess the impact of the Project on reliability of the existing system and ii) evaluate alternatives to eliminate adverse reliability impacts, if any, resulting from the proposed interconnection.

The SRIS was conducted in accordance with the applicable North America Electric Reliability Corporation, Northeast Power Coordinating Council, New York State Reliability Council, and affected system(s) reliability and design standards. It also was 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 both with and without the proposed Project:

- Steady-state evaluation of the study system under system intact conditions, single-element contingencies, multiple-element contingencies, and extreme contingencies;
- Power flow analysis N-1 and for selected prior-outages, N-1-1;

[1] The System Reliability Impact Study provided in **Appendix L** is based on a proposed In-Service Date of June 1, 2023, Initial Synchronization Date of February 1, 2024 and a Commercial Operation Date of December 1, 2024. A revised schedule will be part of the final Large Facility Interconnection Agreement.

- Short-circuit analysis;
- Stability analysis under local faults, design criteria contingencies, and extreme contingencies;
- Transfer limit analysis, including assessment of incremental impacts on the normal and emergency transfer limits;
- Northeast Power Coordinating Council A-10 testing to identify whether new or existing stations in the project vicinity should be classified as Bulk Power Systems due to the addition of the Project; and
- Assessment of phase angle regulator impacts.

The SRIS was evaluated by the NYISO Transmission Planning Advisory Subcommittee, which recommended the study for approval on August 1, 2019. The NYSIO Operating Committee approved the SRIS on August 7, 2019. A copy of the redacted SRIS and approval documentation is provided in **Appendix L**. The Applicant accepted and posted security for its interconnection costs in the 2019 Class Year Facilities Study on June 14, 2021, and will begin negotiation of its interconnection agreement with NYISO and ConEdison in the near future.

## E-4.6 References

Astoria (Astoria Generating Company, L.P.). 2019. Gowanus Generating Station, Gowanus Repowering Project, Preliminary Scoping Statement. New York State Siting Board on Electric Generation and Siting and the Environment Case Number 18-F-0758. Accessed online January 18, 2021 at: http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId=%7B50EEA8CD-58A9-40FC-87B5-3DC6E1CE3D4E%7D

ConEdison (Consolidated Edison Company of New York, Inc.). 2019. 2019 Local Transmission Plan (LTP), Draft Report. Accessed online January 18, 2021 at: https://www.coned.com/-/media/files/coned/documents/business-partners/transmission-planning/local-transmission-plan-2019.pdf?la=en

NYISO (New York Independent System Operator, Inc.). 2018. 2017 Congestion Assessment and Resource Integration Study. Comprehensive System Planning Process. Accessed online January 18, 2021 at: https://www.nyiso.com/documents/20142/2226108/2017-Report-CARIS2017-Appendix-B-J-FINAL.pdf/861e807c-9d9a-3d3b-43d1-43f8833f09e3

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