Generation Interconnection Facilities Study Report

For

PJM Transmission Interconnection Request Queue Position AE1-020

“Oyster Creek 230 kV”

April 2022

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Preface

The intent of the Facility Study is to determine a plan, with approximate cost and construction time estimates, to connect the subject generation interconnection project to the PJM network at a location specified by the Interconnection Customer. As a requirement for interconnection, the Interconnection Customer may be responsible for the cost of constructing: Network Upgrades, which are facility additions, or upgrades to existing facilities, that are needed to maintain the reliability of the PJM system. All facilities required for interconnection of a generation interconnection project must be designed to meet the technical specifications (on PJM web site) for the appropriate transmission owner.

In some instances, an Interconnection Customer may not be responsible for 100% of the identified network upgrade cost because other transmission network uses, e.g. another generation interconnection or merchant transmission upgrade, may also contribute to the need for the same network reinforcement.

The Facility Study estimates attempt to identify the estimated time required to obtain property rights and permits for construction of the required facilities. The project developer is responsible for the right-of-way, real estate, and construction permit issues. For properties currently owned by Transmission Owners, the costs may be included in the study.

A. Transmission Owner Facilities Study Summary

1. Description of Project

Ocean Wind, LLC, (hereinafter referred to as "IC") has proposed a new offshore wind generating facility located in Lacey Township, Ocean County, New Jersey. The installed facilities will have a total Maximum Facility Output (MFO) of 816 MW with 229.3 MW of this output being recognized by PJM as Capacity. The generation facility will interconnect with Jersey Central Power and Light Company (JCPL) a FirstEnergy Company (FE), hereinafter referred to as "Transmission Owner" (TO), by constructing a new connection to the Oyster Creek 230 kV substation located in Ocean County, New Jersey, via a single interconnection point.

2. Amendments to the System Impact Study or System Impact Study Results

There were no notable amendments since the System Impact Study.

3. Interconnection Customer's Milestone Schedule

IC's requested Commercial Operation Date (COD) for the generation facility is **December 31, 2024.**

Milestone Schedule:

July 1, 2024 Initial Back-feed through Project Substation Date
December 31, 2024 Project Commercial Operation Date

4. Customer's Scope of Work

IC is responsible for all design and construction related to activities on their side of the Point of Interconnection (POI). This includes, but is not limited to, the generation step-up (GSU) transformer, 230 kV (AE1-020) generator lead line and connection to the tap point at the existing Oyster Creek 230 kV substation.

Point of Interconnection (POI): The interconnection of the project to the JCPL system will be accomplished by constructing a new connection to the Oyster Creek 230 kV Substation, located in Ocean County, New Jersey, via a single interconnection point.

IC is required to own, install, and maintain a fully-rated, fault-interrupting circuit breaker on the high-side of the GSU transformer. The revenue metering current and voltage transformers shall be installed on the high voltage side of the GSU, on the generation side of the fault-interrupting device, and within the local zone of fault protection for the facility. The protective relaying and metering design must comply with FirstEnergy's applicable standards as well as with PJM requirements.

The easements and associated rights of way for the TO owned substation along with the 230 kV line taps to the substation will be acquired by the IC and transferred to the TO at no cost. Site preparation for the TO owned substation, including clearing, grading and an access road, as necessary, is assumed to be by the IC. The access road design must be approved by FirstEnergy to ensure it provides adequate access to the substation to support construction and maintenance activities. Route selection, line design, and right-of-way acquisition for the IC's facilities are not included in this report and are the responsibility of the IC.

Assumptions / Notes:

- IC will coordinate design and alignment of proposed 230 kV generator lead line with the Transmission Owner for review of any clearance, right-of-way or right-of-way encroachment issues with TO owned facilities.
- IC will coordinate design and construction of proposed 230 kV lead line. For these areas, the IC shall provide TO with proposed drawings prior to construction and as-built drawings, confirmed by as-built survey data post-construction.
- Transmission Owner's preference would be to limit interference and avoid transmission line crossings with new 230 kV terminal positions. As a minimum, IC facilities should not encroach within 100 feet of TO centerline at blowout conditions. If IC's line design does not comply with this requirement TO would need to review this area as a special exception.
- Additional costs will be incurred by the IC, if final alignment of the 230 kV generator lead line causes encroachments, changes, or modifications to any existing or relocated TO

facilities.

- Additional cost will be incurred by the IC, if the engineering, permitting assumptions and corresponding constructions means and methods used to develop the cost for the direct connection and non-direct connection are changed during the detailed design phase of the project
- The IC has requested a non-standard GSU transformer winding configuration. This transformer is in violation of section 14.2.6 of FE's "Requirements for Transmission Connected Facilities". The installation of an upstream transformer that has a delta winding provides the necessary configuration to be acceptable.
- All new generator only and new generator plus load facilities must be isolated from the FE Transmission System by a Power Transformer. The winding configurations of the transformer connecting to a non-effectively grounded portion of the FE Transmission system shall be determined by FE on a case-by-case basis.

5. Description of Facilities Included in the Facilities Study

Attachment Facilities

- AE1-020 (AE2-000) Generator Lead Termination
    - Terminate the generator lead line

Direct Connection

- None

Non-Direct Connection

- Manitou Substation
    - Relay settings changes

- Oyster Creek Substation
    - Install (2) new 230kV breakers at Oyster Creek 230 kV substation for (1) new POI connection to AE1-020 (AE2-000)

Other

- AE1-020 (AE2-000) Customer Substation
    - Customer Sub Review

New System Upgrades

PJM Network Upgrade # n6587

- Oyster Creek Substation
    - Terminate new 1351.5 kcmil 54/19 ACSS/MA5 "Martin" line conductor at the substation switch including a tap to the arresters.
- S2045 (Cedar Street – Oyster Creek 230 kV Line Reconductor)
    - Reconductor approximately 0.08 miles, one span, between Cedar St deadend structure (customer) and Oyster Creek substation with 1351.5 kcmil 54/19 ACSS/MA5.

6. Total Cost of Transmission Owner Facilities Included in the Facilities Study

Description	Total (w/o Tax)
Attachment Facilities:	**$603,223.53**
Total Direct Connection (DC) Costs:	**$0**
Total Non-Direct Connection (NDC) Costs:	**$5,546,084.16**
Other Costs:	**$45,851.85**
New System Upgrades	**$645,190.07**

TOTAL Costs (ALL Categories)	**$6,840,349.61**

7. Summary of the Schedule for Completion of Work for the Facilities Study

Attachment Facility	*Duration*
AE1-020: Engineering, Procurement, and Construction	22 months
PJM n6587: Engineering, Procurement, and Construction	16 months

B. Transmission Owner Facilities Study Results

This section describes facilities identified to be installed (attachment facilities), replaced, and/or upgraded (upgrade facilities) by FirstEnergy to accommodate the project. During detailed design and analysis other components may be identified for installation or replacement due to this interconnection.

1. Transmission Lines –New

None.

2. Transmission Lines – Upgrade

(PJM Network Upgrade # n6587)

Line S2045, Cedar St. – Oyster Creek

- Reconductor approximately 0.08 miles, one span, between Cedar St deadend structure (customer) and Oyster Creek substation with 1351.5 kcmil 54/19 ACSS/MA5 "Martin".
- The minimum required rating to mitigate is 1148 MVA. The proposed conductor, 1351.5 kcmil 54/19 ACSS/MA5 "Martin" has a STE rating of 1176 MVA.
- The existing span is approximately 418' in length, and the existing conductor is 795 26/7 ACSR.
- The existing shield wire is ½" EHS 7 STR steel and will remain if condition allows. Since new conductor is heavier, coordination with customer will need to occur to make sure design loading on their structure is still sufficient. Tensions are remaining the same.
- Conductor insulator assemblies to be replaced along with compression hardware for the ACSS wire on both the customer structure and Oyster Creek substation.
- Siting/Licensing
  - Assume no local opposition to the project.
  - Assume minimal social and ecological impacts.
  - Assume existing rights predate any Green Acres restricted areas.
  - Assume local permits will be secured to support construction in lieu of filing with the BPU.
- Assumptions
- Existing shield wire is sufficient and will be reused. An engineering analysis will be required to confirm.
  - No OPGW is required.
  - The existing aerial LiDAR is sufficient for this design.

ANCILLARY ESTIMATES (LINE)

IT/Network

- Fiber (Relaying and Communications)

        - None
    - SCADA/Other
        - None

Distribution
    - None

Real Estate
    - Assume all work will be performed on substation property or within the existing ROW, meaning no new ROW will be required.

Environmental
    - An environmental review will be required to identify any construction constraints and additional permitting requirements.

Access Roads
    - Access road will be required to stabilize the access road, install work pads and pull pads

Forestry
    - Some clearing may be required.

3. New Substation/Switchyard Facilities

- AE1-020 (AE2-000) Customer Substation
    - Below Grade
        - None
    - Above Grade
        - Review drawings, nameplates, and relay settings.
    - R&C
        - None
    - Additional Equipment to be Removed
        - None
    - Assumptions
        - None

ANCILLARY ESTIMATES (SUBSTATION)

- IT/Network
    - Fiber (Relaying and Communications)
        - Support as required for new fiber comms to AE2-000
    - SCADA/Other

- Support as required for point changes associated with new equipment.

- Distribution
  - None

- Real Estate
  - None

- Environmental
  - None

- Revenue Metering
  - Located at customer substation.

4. Substation/Switchyard Facility Upgrades

- Oyster Creek Substation
  - Below Grade
    - Install (1) lot of foundations, conduit, and grounding for new equipment.
  - Above Grade
    - Install (1) 230kV H-frame
    - Install (1) 230kV, 3000A motor operated line disconnect switch
    - Install (3) 230kV surge arresters
    - Install (3) 230kV CVTs
    - Install (2) 230kV, 4000A circuit breakers
    - Install (5) 230kV, 3000A GOAB disconnect switches
    - Install (1) lot of rigid bus, support structures, and cable as shown on the proposed layout
      - Conductor loadability to be at least 1418/1739/1610/2062MVA SN/SSTE/WN/WSTE
  - R&C
    - Install (1) line relay & control panel(s) consisting of dual SEL-411L with (2) SEL-501 & (2) SEL-451 for BFT
      - Rewire existing schemes to free up space in relay house. See removal below and attached site visit email & photos.
    - Incorporate new breakers into bus protection schemes
  - Additional Equipment to be Removed.
    - Unused panels and/or components in relay house to create space for new relay & control panel(s)
  - Assumptions
    - AC and DC services are adequate for new equipment
    - SCADA RTU has adequate flexibility for new equipment
    - Control house has adequate space for new relaying
    - 230kV C-Bus & D-Bus conductor has sufficient loadability

- Manitou Substation
    - Below Grade
        - None
    - Above Grade
        - None
    - R&C
        - Relay setting changes on (4) 230kV lines.
    - Additional Equipment to be Removed.
        - None
    - Assumptions
        - None

(PJM Network Upgrade # n6587)

- Oyster Creek Substation
    - Below Grade
        - None
    - Above Grade
        - Terminate new 1351.5 kcmil 54/19 ACSS/MA5 “Martin” line conductor at the substation switch including a tap to the arresters.
    - R&C
        - Revise relay settings for line conductor change
    - Additional Equipment to be Removed.
        - None
    - Assumptions
        - None

ANCILLARY ESTIMATES (SUBSTATION)

- IT/Network
    - Fiber (Relaying and Communications)
        - None
    - SCADA/Other
        - None
- Distribution
    - None
- Real Estate
    - None
- Environmental
    - None

- Revenue Metering
    - None

5. Telecommunications Facilities – Upgrades

IC will design, provide, install, own and maintain a fiber-optic communications cable between the Oyster Creek 230 kV substation and IC's **generation** (collector) substation. Two (2) fiber-optic channels are required for each generator protection scheme to obtain high- speed tripping capability for any fault within the zone of protection. Should subsequent/additional PJM studies indicate that stability issues exist, the primary and backup relay fiber-optic communication channels must be in separately-routed cable paths and additional fiber-optic connection costs would apply (not included herein).

The IC will make the fiber-optic cable termination connections for its cable(s) at the Oyster Creek substation control house.

IC is responsible for obtaining and maintaining all associated Rights-of-Way (ROW), Easements, and Permits for its fiber cable.

6. Metering & Communications

The revenue metering system (particularly the revenue metering current transformers) shall be designed to accurately meter the light loads that will occur when the facility is not generating power and only back-feeding station service from the Transmission Owner. This may require the use of high accuracy extended range current transformers.

Transmission Owner's Revenue Metering Requirements may be found in the FirstEnergy Corporation Requirements for Transmission Connected Facilities document which can be found on the PJM website at:

https://pjm.com/planning/design-engineering/to-tech-standards/private-firstenergy

These requirements are in addition to any metering required by PJM.

Transmission Owner shall provide, own, operate, test, and maintain the revenue metering at the Interconnection Customer's expense as specified in Requirements for Transmission Connected Facilities section 12.3.2 and Attachment F.

The meter and associated equipment shall be located on the source side of the customer's fault interrupting device, as close to the POI as possible. Preferably outside of IC station fence.

Transmission Owner will obtain real-time, site-specific, generation data from PJM, via the required communication link from IC to PJM. Transmission Owner will work with PJM and IC to ensure the generation data provided to PJM meets Transmission Owner's requirements.

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7. Environmental, Real Estate and Permitting

The following are possible environmental, real estate and permitting issues:

- Environmental permitting, Real Estate acquisition, and New Jersey Board of Public Utilities notifications vary, some up to twelve (12) months after preliminary engineering is completed to secure the required approvals.
- Prior to agreement by Developer to purchase the property, a Phase 1 Environmental Assessment should be conducted for the entire site to avoid assumption of environmental liabilities by Developer or Transmission Owner.
- The Transmission Owner interconnection substation may involve environmental surveys, permits, approvals and plans with federal, state, and/or local agencies.
- Assumed Developer is to provide all access rights, easements, ROW and permits necessary to complete the Project to the satisfaction of Transmission Owner. Environmental permitting shall encompass all federal, state and local requirements, consultations and agency coordination. Confirmation of meeting all permitting requirements shall be provided to Transmission Owner, prior to start of construction. Following construction and energization, confirmation of permit closeout shall be provided to the satisfaction of Transmission Owner, prior to transfer of ownership. If any of these elements are not included in the final agreement between Transmission Owner and Developer, twelve (12)-to-eighteen (18) months should be added to the Project Schedule to secure necessary permits, and additional costs would apply.
- Developer will provide copies of all of the relative environmental permits and other necessary approvals to Transmission Owner before Transmission Owner accepts the interconnection facilities.
- Developer is required to install an access road from the new interconnection substation to the nearest public road (must be approved by Transmission Owner) and obtain access rights for Transmission Owner. Developer is responsible to maintain access road and ensure unimpeded access for Transmission Owner at all times.
- Developer is responsible for all property acquisition (including easements/rights-of-way (ROW)) for transmission, distribution and communication facilities needed for the generator interconnection.
- If Developer owns the project property, in fee title, Transmission Owner will require a fee property transfer for the interconnection substation site which may require subdivision approval, together with permanent access rights to and from the substation, as well as a perpetual easement for any transmission lines to the substation. Developer is responsible for all costs, including but not limited to subdivision, associated with the property transfer.
- If Developer leases the project property, the Developer will be required to obtain fee property from the underlying fee property owner, on behalf of Transmission Owner, for the interconnection substation site, together with permanent access rights to and from the substation, as well as a perpetual easement for any transmission lines to the substation.
- All property rights must be surveyed and metes and bounds descriptions prepared for incorporation into Transmission Owner's document forms, for transfer of title.
- The Transmission Owner interconnection substation and transmission line loop will involve New Jersey Board of Public Utilities notification/approval.
- All work occurs within an existing transmission line right-of-way or on Developer's property with access to all existing structures possible via that property and the right-of- way following established access routes that do not cross wetlands or streams.

- Developer will develop, and secure regulatory approval for, all necessary Erosion and Sediment Control (E&SC) plans and National Pollutant Discharge Elimination System (NPDES) permits.
- Developer will obtain all necessary permits.
- Developer will conduct all necessary wetlands and waterways studies and permits.
- Developer will conduct all necessary historical and archaeological studies.
- If the Developer plans to cross the transmission line right of way with facilities or access roads, please refer to the Transmission Rights-of-Way Restrictions information located at:

  https://www.firstenergycorp.com/help/safety/real-estate-power-lines/transmission-right-of-way.html#ROWform

8. Interconnection Cost Details

The following table provides a breakdown of the costs according to the description of work required to accommodate the requested interconnection. The estimated costs are in 2020 dollars. This cost excludes a Federal Income Tax Gross Up charge (CIAC (Contribution in Aid of Construction)). This tax may or may not be charged based on whether this project meets all qualifications and requirements as set forth in Section 118(a) and 118(b) of the Internal Revenue Code of 1986, as amended and interpreted

by Notice 2016-36, 2016-25 I.R.B. (6/20/2016) (the "IRS Notice"). If at a future date it is determined that the Federal Income Tax Gross charge is required, the Transmission Owner shall be reimbursed by the Interconnection Customer for such taxes.

[Note: Project Management, Environmental, Forestry, Real Estate and ROW costs should be embedded in each individual work activity as applicable.]

Work Description	Direct		Indirect		Total Cost
	Labor	Material	Labor	Material	
AE1-020 (AE2-000) Generator Lead Termination: Terminate the generator lead line	$331,486.83	$112,872.61	$118,274.50	$40,589.58	$603,223.53
Total Attachment Facilities Cost	**$331,486.83**	**$112,872.61**	**$118,274.50**	**$40,589.58**	**$603,223.53**
Total Direct Connection Cost	**$0**	**$0**	**$0**	**$0**	**$0**
Manitou Substation: Relay settings changes (PJM Network Upgrade Number n8043.2)	$86,285.70	$0	$30,786.74	$0	$117,072.43
Oyster Creek Substation: Install (2) new 230kV breakers at Oyster	$2,983,381.50	$1,015,853.50	$1,064,470.52	$365,306.21	$5,429,011.73

Creek 230 kV substation for (1) new POI connection to AE1-020 (AE2-000) (PJM Network Upgrade Number n8043.1)					
Total Non-Direct Connection Cost	**$3,069,667.20**	**$1,015,853.50**	**$1,095,257.26**	**$365,306.21**	**$5,546,084.16**
AE1-020 (AE2-000) Customer Substation: Customer Sub Review	$33,794.11	$0	$12,057.74	$0	$45,851.85
Total Other Costs	**$33,794.11**	**$0**	**$12,057.74**	**$0**	**$45,851.85**
Total Project Costs	**$3,434,948.14**	**$1,128,726.11**	**$1,225,589.50**	**$405,895.79**	**$6,195,159.54**

Network Upgrades:
(PJM Network Upgrade # n6587)

Work Description	Direct		Indirect		Total Cost
	Labor	Material	Labor	Material	
Total Attachment Facilities Cost	**$ 0**	**$ 0**	**$ 0**	**$ 0**	**$ 0**
Total Direct Connection Cost	**$0**	**$0**	**$0**	**$0**	**$0**
Oyster Creek Substation: Terminate new 1351.5 kcmil 54/19 ACSS/MA5 "Martin" line conductor at the substation switch including a tap to the arresters.	$158,510.08	$999.95	$56,556.40	$97.80	$216,164.22
S2045 (Cedar Street – Oyster Creek 230 kV Line Reconductor): Reconductor approximately 0.08 miles, one span, between Cedar St deadend structure (customer) and Oyster Creek substation with 1351.5 kcmil 54/19 ACSS/MA5 "Martin".	$309,827.34	$5,728.86	$110,546.39	$2,923.25	$429,025.84
Total Non-Direct Connection Cost	**$468,337.42**	**$6,728.81**	**$167,102.79**	**$3,021.04**	**$645,190.07**
Total Project Costs	**$468,337.42**	**$6,728.81**	**$167,102.79**	**$3,021.04**	**$645,190.07**

Generation projects meeting IRS "Safe Harbor" provisions generally do not incur "CIAC" (Contribution in Aid to Construction), a tax collected by the utility for the state or federal government. First Energy does not

expect to collect CIAC for this project. If for any reason, "CIAC" would be required for this project, it would be the responsibility of the party owning the generator to pay this cost.

First Energy reserves the right to charge the Interconnection Customer operation and maintenance expenses to maintain the Interconnection Customer attachment facilities, including metering facilities, owned by First Energy.

9. Schedules and Assumptions

A proposed **22 month Direct Connection** schedule is estimated to complete the engineering, construction and the associated activities, from the date of a fully executed Interconnection Construction Service Agreement and Construction Kick-Off Meeting. This schedule assumes that all issues covered by the "Environmental, Real Estate and Permitting Issues" section of this document are resolved, and outages (typically not granted from June through September) will occur as planned. Construction cannot begin until after all applicable permits and/or easements have been obtained.

22 month Schedule

Activity	Start Month	End Month
Preliminary Engineering	1	4
Siting, Permits & Real Estate	4	12
Detailed Engineering	5	12
Equipment Delivery	15	15
Below Grade Construction – Substation	15	18
Above Grade Construction – Substation	17	22
Testing & Commissioning	21	22

n6587 Network Upgrades Schedule

Activity	Start Month	End Month
Preliminary Engineering	1	2
Detailed Engineering	2	6
Siting, Permits & Real Estate	6	12
Equipment Delivery	12	12
Above Grade Construction – Substation	13	15
Above Grade Construction – T-Lines	13	15
Testing & Commissioning	16	16

Attachment #1: Protection Study

PROTECTION & RELAY AND COMMUNICATION EQUIPMENT SCOPE

SHORT CIRCUIT ANALYSIS

Short circuit data for a fault at the proposed interconnection location of the AE1-020 Wind generator interconnection on the Oyster Creek substation 230kV bus (symmetrical values only):

Initial conditions (percent on 100MVA base)

230kV
Z1 = 0.74958 + j8.82808 Ohms
Z0 = 2.34086 + j12.6854 Ohms

Three phase fault – 14,988 Amps
Single line to ground fault – 13,031 Amps 3I0

Note: These fault values do not include the AE1-020 generator, or the GSU transformer, or the 230kV transmission line to Oyster Creek substation as being modeled in the calculations.

Impedances are given on a 100 MVA and 230kV bases. The faults provided are bolted, symmetrical values for normal system conditions. Future increases in fault currents are possible and it is the customer's responsibility to upgrade their equipment and/or protective equipment for coordination when necessary.

All proposed generation interconnection points and load-serving delivery points must comply with the technical requirements detailed in FirstEnergy's "Requirements for Transmission Connected Facilities" document.

Relay and Communication Equipment Scope:

Relay Communication Channels

Two independent fiber optic communication channels are required between FirstEnergy's Oyster Creek substation and the AE1-020 Generation substation to be used for relay communication and direct transfer trip.

AE1-020 Generator 230kV Substation General Connection Requirements

The 230kV AE1-020 line exit breaker shall have two sets of C800 current transformers with a thermal factor of at least 2.0 available on the 230kV Bus side of the breaker(s) to be used for protection of the 230kV intertie line between Oyster Creek and AE1-020 substations. Additional CTs required for the protection of plant equipment are to be determined by developer. The 230kV breakers shall have two independent trip coils. A 230kV three phase potential source (CCVT or equivalent) is required for line exit relaying.

Faults within any 230kV piece of equipment must be detected by two (primary and backup) independent high-speed zones of protection. 230kV Bus protection shall consist of primary and backup current differential or a high-impedance voltage differential scheme. 230kV Transformer protection shall consist of a primary current differential scheme and a backup current scheme, preferably differential, utilizing separate current transformers, and an independent transformer neutral overcurrent relay.

Backup protection shall be completely independent from the primary protection, including separate current transformers, potential transformer windings (where applicable) and DC control circuits. A separate tripping path energizing separate breaker trip coils is required for primary and backup relaying.

A breaker failure relay (such as SEL-501 or SEL-352 or SEL-451 or equivalent) shall be utilized on all 230kV circuit breakers. Any protective relay trip of a 230kV breaker shall initiate the failure to trip scheme for that breaker. The re-trip feature for the BFT scheme shall be utilized and trip the 230kV circuit breaker. The 230kV breaker failure scheme shall operate a hand reset lockout relay which shall trip and block close all electrically adjacent circuit breakers. Tripping of remote adjacent breakers shall be accomplished via the fiber optic cables and the tie line protective relays by direct transfer trip (DTT).

All primary relaying CTs are required to be connected on the inner bushing looking through the breaker into the protected equipment. All backup relaying CTs are required to be connected on the outer bushing looking through the breaker into the protected equipment. The protection should trip the associated breakers, initiate breaker failure-to-trip schemes, and reclosing schemes where applicable.

The relaying system shall have a reliable source of DC power independent from the AC system or immune to AC system disturbance or loss (for example - DC battery and charger) to assure proper operation of the protection scheme.

All relays, relay schemes, and relay settings that include 230kV voltages or currents, or trip any 230kV circuit breakers shall require the review and approval of FirstEnergy.

FirstEnergy will complete detailed relay coordination studies to identify off-site relay setting changes required due to this generation interconnection. This may result in additional individual relay replacements being required. These relay replacements will be done at the cost of the developer.

The customer is solely responsible for protecting its own equipment in such a manner that electrical faults or other disturbances on the FE system do not damage its equipment.

Metering Requirements

A revenue metering installation is required for this installation. Requirements are outlined in FirstEnergy's "Requirements for Transmission Connected Facilities" document.

Operational metering is also required for this generation connection. These requirements are also outlined in FirstEnergy's "Requirements for Transmission Connected Facilities" document.

These requirements are in addition to any metering required by PJM.

230kV Transformer Requirements

As per section 14.2.6 of the FirstEnergy Requirements for Transmission Connected Facilities document, because this area of the system is effectively grounded, the transformer shall have a wye grounded winding on the high (230kV Transmission System) Side and have a Delta connected winding on the low side of the generator side of the step up transformer. This is required to maintain proper ground relay coordination on the FirstEnergy system. No exceptions to this standard shall be granted.

At AE1-020 Generator 230kV Substation:

Line exit to Oyster Creek Substation:

- One set of three-phase, 230kV, dual-winding potential devices 2000/1200:1 ratio required on the 230kV Bus.
- Two Independent fiber-optic cables are required to Oyster Creek SS to be used for the primary and backup line protection and Direct Transfer Trip between the terminals.

The protection for the 230kV line to Oceanview shall consist of:

- SEL-411L Primary line relay to use a Line Differential scheme via fiber-optic
- SEL-411L Backup line relay to use a Line Differential scheme via fiber-optic
- SEL-501 Breaker failure relay
- LOR For use with SEL-501, the LOR shall trip local adjacent breaker(s) and send DTT through primary & backup line relays
- Satec Line meter

Faults within any 230kV piece of equipment must be detected by two (primary and backup) independent high-speed zones of protection.

At Oyster Creek Substation:

Line exit to AE1-020 generator substation:

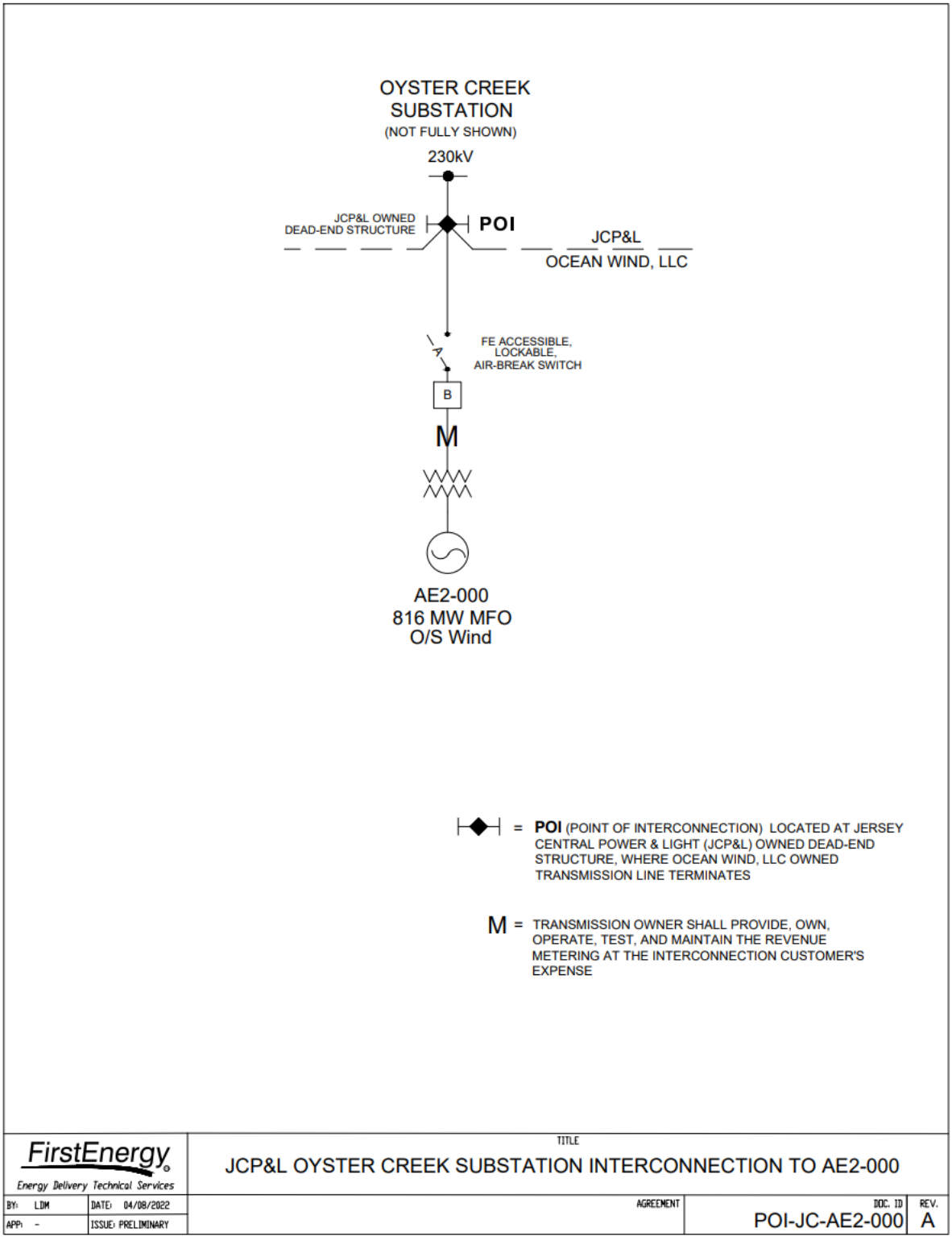
- One set of three-phase, 230kV, dual-winding potential devices 2000/1200:1 ratio required on the line exit.
- Two Independent fiber-optic cables are required to the AE1-020 generator SS to be used for the primary and backup line protection and DTT between the terminals.

The protection for the 230kV line to AE1-020 generator substation shall consist of:

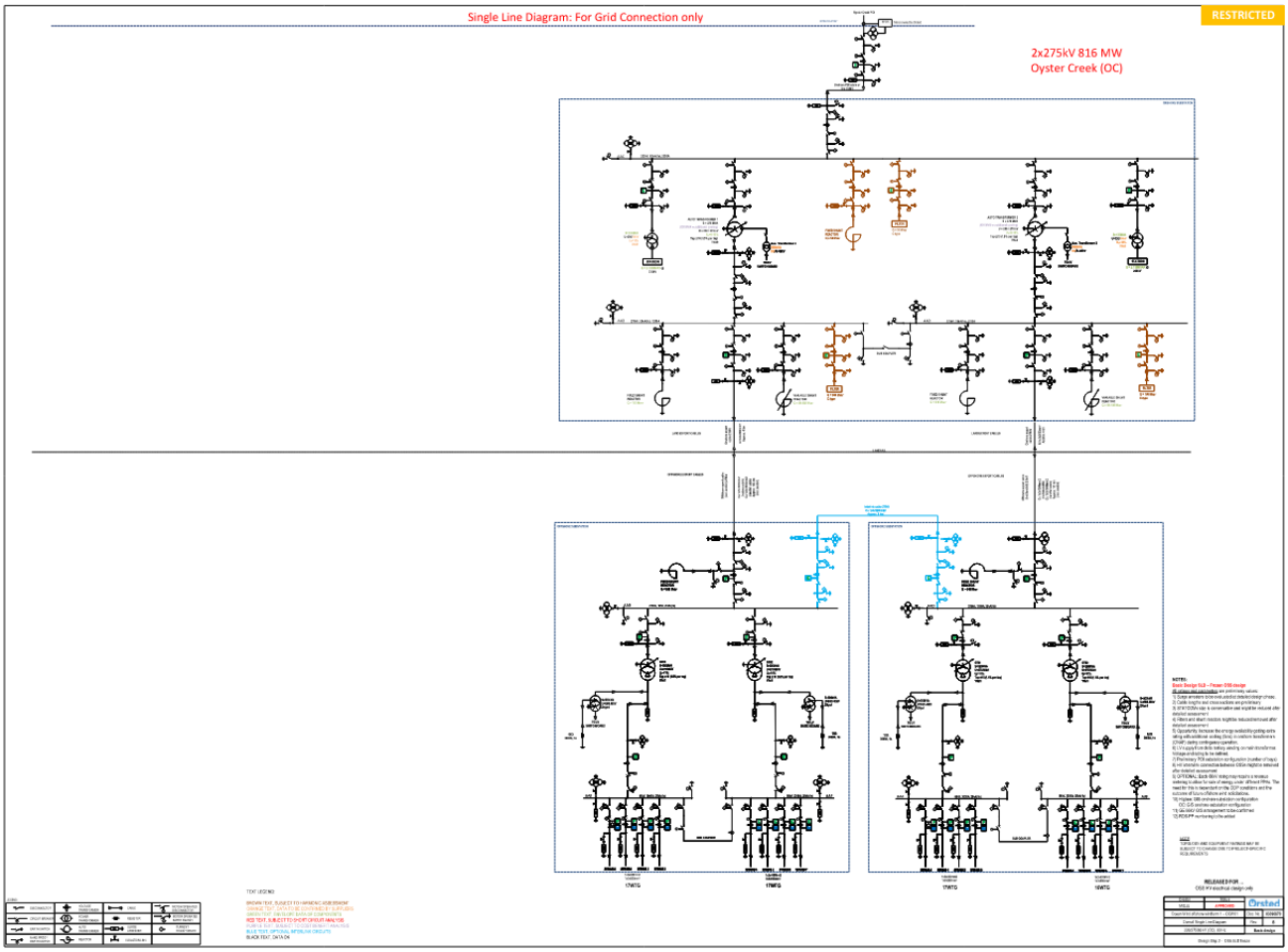
- SEL-411L Primary line relay to use a Line Differential scheme via fiber-optic
- SEL-411L Backup line relay to use a Line Differential scheme via fiber-optic and SEL-451
- SEL-501 For Breaker Failure and Sync Check
- LOR For use with SEL-501, the LOR shall trip local adjacent breaker(s) and send DTT through primary & backup line relays
- Satec Line meter

Attachment #2: One-Line Diagrams

FirstEnergy Facilities One-Line

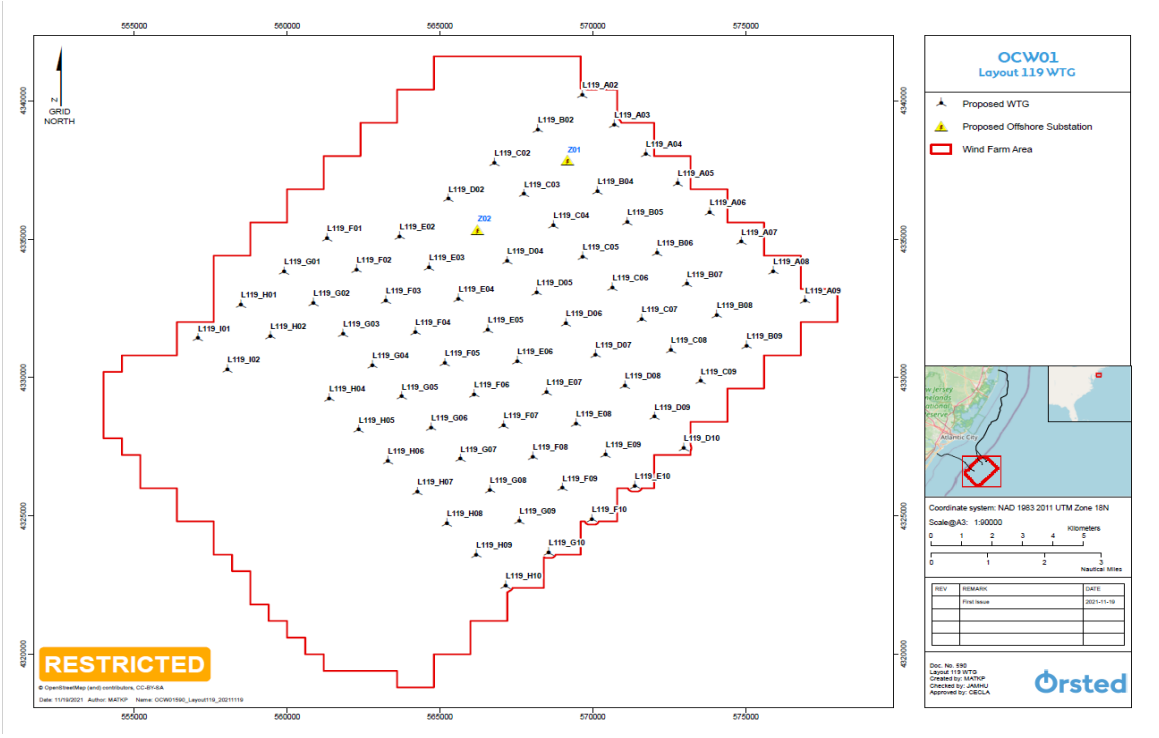


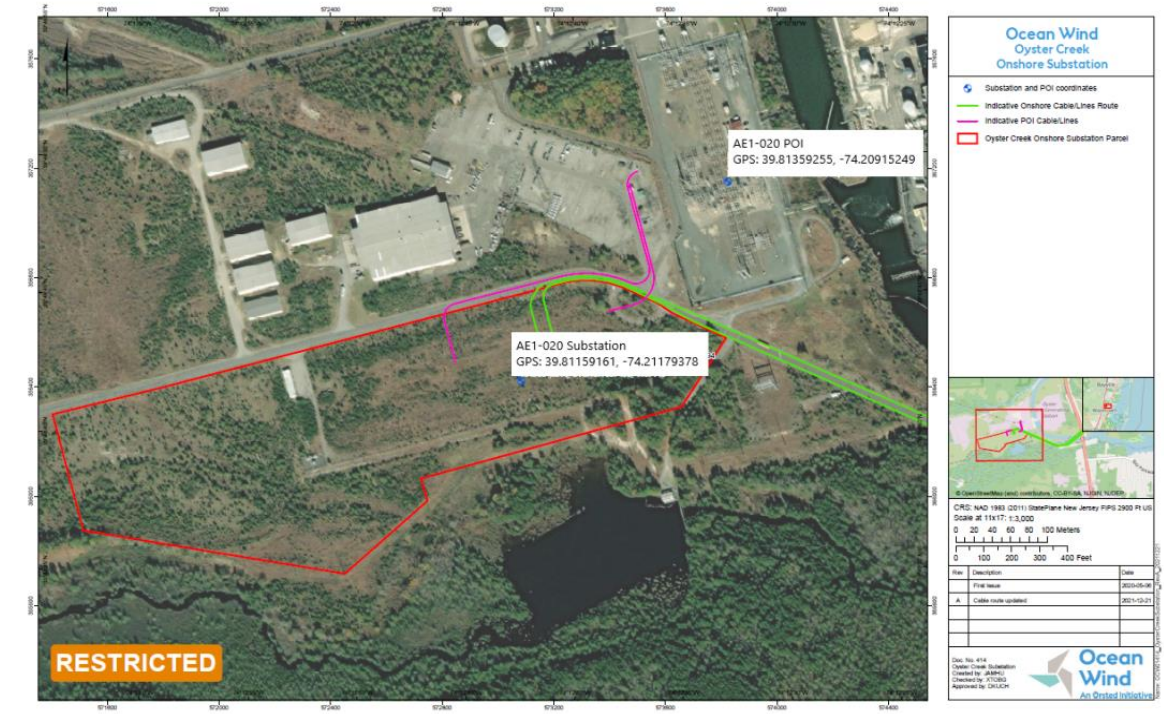
IC Facilities One-Line



Attachment #3: Project Site Plan

IC Site Plan, IC Substation Location and Point of Interconnection to FE





Attachment #4: Generation Connection Requirements

Generation Connection Requirements

The proposed interconnection facilities must be designed in accordance with the Transmission Owner's *Requirements for Transmission Connected Facilities* documents located at either of the following links:

www.firstenergycorp.com/feconnect

www.pjm.com/planning/design-engineering/to-tech-standards.aspx

The following is an excerpt taken from Transmission Owner's *Requirements for Transmission Connected Facilities* document:

For all generation facilities, other than wind-powered and other non-synchronous generating facilities, the minimum requirement shall be the provision of a reactive power capability sufficient to maintain a composite power delivery at continuous rated power output at a power factor as defined in the table below. This requirement will be measured at either the POI or generator terminals as specified in the table below. These reactive requirements apply to both the initial installation as well as to any incremental change in unit MW capability. FE will coordinate with the Connecting Party to identify the optimal generator step-up transformer tap to make such a capability available when demanded.

For all wind-powered or other non-synchronous generating facilities the minimum requirement shall be the provision of a reactive power capability sufficient to maintain a composite power delivery at a power factor as defined in the table. This requirement will be measured at either the POI or generator's terminals as specified in the table below. These reactive requirements apply to both the initial installation as well as to any incremental change in unit MW capability. FE will coordinate with the Connecting Party to identify the optimal generator step-up transformer tap to make such a capability available when needed.

Generation Type	New / Increase	Size	Power Factor Requirement	Measurement Location
Synchronous	New	> 20 MW	0.95 leading to 0.90 lagging	Generator's Terminals
Synchronous	New	<= 20 MW	0.95 leading to 0.90 lagging	Point of Interconnection
Wind or Non-Synchronous	New	All	0.95 leading to 0.95 lagging	Point of Interconnection
Synchronous	Increase	> 20 MW	1.0 (unity) to 0.90 lagging	Generator's Terminals
Synchronous	Increase	<= 20 MW	1.0 (unity) to 0.90 lagging	Point of Interconnection
Wind or Non-Synchronous	Increase	All	0.95 leading to 0.95 lagging	Generator's Terminals

Any different reactive power requirements that FE and/or PJM determines to be appropriate for wind-powered or other non-synchronous generation facilities will be stated in the applicable interconnection agreement(s).

Induction generators and other generators with no inherent VAR (reactive power) control capability, or those that have a restricted VAR capability less than the defined requirements, must provide dynamic supplementary reactive support located at the generation facility with electrical characteristics equivalent to that provided by a similar-sized synchronous generator.

Design Requirements

Developer is responsible for specifying appropriate equipment and facilities such that the parallel generation is compatible with Transmission Owner's Transmission System. Developer is also responsible for meeting any applicable federal, state, and local codes.

Design Criteria

Facilities owned and operated by Transmission Owner shall comply with the applicable Transmission Owner technical requirements and standards posted on the PJM website per the PJM Tariff, and the following criteria. Where there are different requirements for the same criterion, the more restrictive shall apply. Developer must abide by any PJM, RFC or NERC criteria imposed that is more restrictive than those of Transmission Owner.

General Design Requirements

• System phasing (counter clockwise)	1-2-3
• System frequency:	60 hertz
• Elevation, AMSL:	Less than 1000 meters
• ***Isokeraunic level:***	40
• Maximum ambient temperature:	40 degrees C
• Minimum ambient temperature:	-40 degrees C
• Maximum conductor operating temperature:	Contact Transmission Owner
• Wind Loading (round shapes):	Per ASCE 10, per Fig. 250-2B depending on location Per ASCE 7-98, per Fig. 6-1 depending on location
• Ice loading – Substations (no wind):	25 mm
• Seismic zone:	Per ASCE Manual 113 Substation Structure Design Manual. Equipment qualification per IEEE 693-2005 and IEE 1527-2006 Per ASCE 7-98, per Fig. 9.4.1.1(a) and (b). Equipment qualification per IEEE 693-97

Voltage and Current Ratings

• Nominal phase-to-phase:	230 kV
• Maximum phase-to-phase:	242 kV
• Basic impulse level (BIL):	900 kV
• Maximum continuous current carrying capacity:	2000 A

- Design fault current: 61 kA

Clearances and Spacing

- Recommended rigid bus center-to-center phase spacing: 132”
- Minimum phase-to-phase, metal-to-metal distance: 89”
- Recommended phase-to-ground: 80”
- Minimum phase-to-ground: 71”
- Minimum vertical clearance from live parts to grade: 13’-9”
- Minimum horizontal clearance from live parts: 8’-3”
- Minimum bottom of insulator to top of foundation: 8’-6”