Generation Interconnection Facilities Study Report

For

PJM Transmission Interconnection Request Queue Position AE2-030

“Frostburg 138 kV”

December 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

Dan's Mountain Solar, LLC, (hereinafter referred to as "IC") has proposed a new solar generating facility to be located in Frostburg Township, Allegany County, Maryland. The installed facilities for AE2-030 will have a total Maximum Facility Output (MFO) of 18 MW with 7.56 MW of this output being recognized by PJM as Capacity. The generation facility will interconnect with Allegheny Power Systems (APS), a FirstEnergy Company (FE), hereinafter referred to as "Transmission Owner" (TO), by installing a new 138 kV three breaker at the new Substation.

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

The Commercial Operation Date (COD) for the transmission interconnection facility is December 1, 2024.

Milestone Schedule:

10/1/2024	Initial Back-feed through Project Substation Date
12/1/2024	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, 138 kV (AE2-030) generator lead line and connection to the tap point on the new 138 kV line terminal at the new 138 kV Substation.

Point of Interconnection (POI): The interconnection of the project at the Primary POI will be accomplished by constructing a new 138 kV three (3) breaker ring bus substation and looping the Frostburg-Ridgeley 138 kV line into the new station. The new substation will be approximately four miles from Frostburg substation.

IC is required to own, install, and maintain a fully-rated, fault-interrupting circuit breaker on the high-side of the GSU transformer, as well as the necessary revenue metering equipment. 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 138 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 138 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 138 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 138 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 138 kV generator lead line causes encroachments, changes, or modifications to any existing or relocated TO facilities.
- IC is responsible to make all arrangements for electric distribution service (if required) for its generation station. No costs or schedule are included herein.
- 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

- **AE2- 030 Old McDonald Substation**
  - Energize and integrate attachment facilities to the FirstEnergy transmission system.

Direct Connection

- AE2- 030 Old McDonald Substation
  - Design, install, and test/commission MPLS and MW Equipment for SCADA transport.
- AE2-030 Old McDonald Substation (OTB):
  - Installation of a Security Camera System.

Non-Direct Connection

- Dans Rock Substation:
  - Design, install, and test/commission MW Equipment for SCADA transport.
- Finzel-Ridgeley 138kV Line Loop
  - Loop the Finzel – Ridgeley 138kV line into the new Old McDonald substation.
- Frostburg Substation
  - Replace relay panel, wave trap, and tuner; install carrier panel at Frostburg No.1 substation.
- Ridgely Substation

  - Install UPLC, retune wavetrap/tuner, update relay settings, replace nameplates, and install conduit.
- Finzel Substation
  - Replace wave trap, line relay panel, and nameplates at Finzel Substation.

Other

- Revenue Metering
  - Engineering oversight of specification, design, and commissioning of metering provided and owned by interconnection customer.
  - Support FE MV90 and Power Billing setup of systems to obtain data from customer meter.
- AE2-030 Old McDonald Substation (OTB):
  - FE Oversight Engineering.

New System Upgrades

None.

6. Summary of Cost for Transmission Owner Facilities Included in the Facilities Study

The following table summarizes the total estimated costs according to FERC criteria. The estimated costs are in 2020 dollars. This cost excludes a Federal Income Tax Gross Up charges on Contributions in Aid of Construction (CIAC). This tax may or may not be charged based on whether this project meets the eligibility requirements of IRS Notice 88-129. 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.

Description	Total (w/o Tax)
Attachment Facilities:	**$86,946**
Total Direct Connection (DC) Costs:	**$1,585,075.29**
Total Non-Direct Connection (NDC) Costs:	**$3,557,113.59**
Other Costs:	**$1,801,140.85**
New System Upgrades	**$ 0**
TOTAL Costs (ALL Categories)	**$6,943,330**

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

Attachment Facility	*Duration*
AE2-030: Engineering, Procurement, and Construction	37 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

Finzel – Ridgeley 138kV Line

- Description of Work
  - Loop the Finzel-Ridgeley 138kV line into the new Old McDonald substation.
- Existing Conditions
  - The existing line is constructed on double circuit lattice towers, shared with the Garret-Ridgeley 138kV line from Ridgeley substation to structure 341 and on the in/out loop to Frostburg substation, and on single circuit lattice towers on the remainder of the line. On the single circuit segment, existing conductor is 954 kcmil 45/7 ACSR and existing shield wire is (1) 7#9 Alumoweld on the single circuit segment. On the double circuit segment, existing conductor is 954 kcmil 45/7 ACSR and existing shield wire is two (2) 7#9 Alumoweld.
  - Per the RPA documents, conductor on the loop will match the existing 954 kcmil 45/7 ACSR. New shield wire on the loop is assumed to be 7#8 Alumoweld.
- Structures Installed
  - The line will be cut between existing structures 321 and 322.
    - Two (2) single circuit wood 3-pole deadend structures (321A and 321B) similar to FE standard TR-138075 will be installed for the loop to Old McDonald substation.
    - Two (2) single circuit wood monopole tangent structures (321C and 321D) similar to FE standard TR-138010 will be installed on the span to the station.
  - Approximately 800’ of new conductor and shield wire will be installed on each leg of the loop.
  - Existing conductor and shield wire will be transferred to the west side of structure 321A and the east side of structure 321B
- Structures Removed
  - Existing conductor and shield wire between new structures 321A and 321B will be removed.
- Construction Considerations
  - None
- Siting/Licensing

- A Full Application will be required.

- Assumptions
  - Assume existing structures 321 and 322 are in good condition and have adequate capacity for any new loading arrangement. An engineering analysis will be required to confirm.
  - See the attached .kmz file for the assumed loop configuration.
  - An aerial LiDAR survey of the project area will be required.

ANCILLARY ESTIMATES (Line)

Project Management (PM)
- Project management will be required for this asset.

Forestry
- Some clearing may be required.

Real Estate
- New ROW will be required for the line loop.
- A rights and restrictions review by Real Estate will be required.
  - Georeferenced ROW extents will be required to be provided to Engineering.

Environmental
- An environmental review will be required to identify any construction constraints or permitting requirements.
- Assume the site will be accessed from the substation property and only minor additional access improvements will be required.

Revenue Metering
- None

IT/Network
- Fiber (Relaying and Communications)
  - OPGW fiber shall be installed on the 4.7 mile line to Ridgeley.
- SCADA
  - None

ACCESS ROAD CONSTRUCTION
- Assume the site will be accessed from the substation property and only minor additional access improvements will be required.

Distribution
- None

3. New Substation/Switchyard Facilities

AE2-030 Old McDonald Substation (OTB)
- Below Grade
  - Rough graded substation and access road supplied by AE2-030 Developer
  - Install foundations, raceway, conduits, ground grid, and grounding connections to as required for new 138kV equipment and relay house.
  - Install fencing, stone, and drainage for new substation. (180'x180')

- Install conduits for fiber.
- Perform site survey, soil resistivity testing, ground grid study, and soil boring.

- Above Grade
  - Install (3) 138kV, 3000A Circuit Breakers.
  - Install (9) 138kV CVTs.
  - Install (1) prefabricated control house building with HVAC, lighting, and receptables.
  - Install (9) 138kV, 84kV MCOV Surge Arresters.
  - Install (1) 100kVA SSVT.
  - Install (1) physical security camera system.
  - Install (6) 138kV, 2000A Manual Disconnect Switches.
  - Install (3) 138kV, 2000A MOABs.
  - Install (1) lightning mast with shield wire.
  - Install (2) 138kV, 2000A wide band line traps, line tuners, and coax for the Frostburg-Finzel line terminal and Ridgeley line terminal.
  - Install (1) lot of steel structures and insulators for bus supports as indicated in the attached proposed layout.
  - Install (1) lot of steel and insulators for (3) H-Frame dead-ends as indicated in the attached proposed layout.
  - Install (1) lot of steel for (6) switch stands, (1) SSVT stand, (2) wave trap stands, and (9) CVT stands as indicated in the attached proposed layout.
  - Install (1) lot of rigid bus, wire, fittings, above grade grounding, above grade conduits, and lighting as indicated in the attached proposed layout.
  - Perform AC study, DC study, lighting study, and lightning protection study.

- R&C (Relaying & Communications)
  - Install (1) lot of control cables, SEL cables, and fiber.
  - Install (1) fiber patch panel.
  - Install (1) ATS.
  - Install relaying for Frostburg, Ridgely, and AE2-030 138kV lines in the prefabricated control building with the following equipment:
    - (1) pre-wired panel to include dual SEL-411L line current differential relaying over fiber to AE2-030 generation collector substation. Install SEL-2506 Fiber I/O module for transfer trip send and receive for anti-islanding.
    - (1) pre-wired panel to include PR SEL-421 and BU SEL-411L to Frostburg substation. Install RX for anti-islanding purposes.
    - (1) pre-wired panel to include PR SEL-421 and BU SEL-411L to Ridgeley substation.
    - (1) carrier panel for Ridgeley line terminal consisting of (1) Powercomm PCM 5350, (1) RFL Hybrid chassis with one skewed hybrid, (1) RFL 9780 RX, (1) Ametek UPLC
    - (1) carrier panel for Finzel-Frostburg line terminal consisting of (1) Powercomm PCM 5350, (1) RFL Hybrid chassis with one skewed hybrid, (1) RFL 9780 TX/RX, (2) Ametek UPLC

- (3) breaker control panels consisting of (1) SEL-451 and (1) SATEC meter.
- Install (1) SCADA RTU and HMI, including RTAC and GPS clock, and other standard communication equipment.

- Additional Equipment to be Removed.
  - None
- Siting/Licensing
  - Siting as required for new substation.
- Assumptions
  - FE Sub Located at GPS coordinates provided by AE2-030.
  - Direction of AE2-030 Generation Sub and that it will be remote requiring a line dead-end structure.

ANCILLARY ESTIMATES (Substation)

Project Management (PM)
- Project management will be required for this asset.

Forestry
- Clearing and grubbing of trees and brush for the new substation is required.

Real Estate
- Real estate required for new interconnect.

Environmental
- Environmental required for new interconnect.

Revenue Metering
- 138kV revenue metering is required.

IT/Network
- FIBER (RELAYING AND COMMUNICATION)
  - Fiber run inside AE2-030 substation for relaying to new generating station
    - Fiber from generator to AE2-030 is the responsibility of the developer
  - Support for fiber between AE2-030 substation and Old McDonald Substation.
  - Support for the incoming OPGW fiber from Ridgeley.
- SCADA
  - New SCADA RTU at AE2-030 interconnection

TESTING & COMMISSIONING (TSCS)
- Testing and commissioning services as required for new equipment and relays

AE2-030 Generation
- Below Grade
  - None
- Above Grade
  - Integrate customer protection and controls to the FirstEnergy transmission system.
- R&C
  - None
- Additional Equipment to be Removed.

- None
- Assumptions
  - None

ANCILLARY ESTIMATES (Substation)

Project Management (PM)
- Project management will be required for this asset.

Forestry
- None

Real Estate
- None

Environmental
- None

Revenue Metering
- None

IT/Network
- FIBER (RELAYING AND COMMUNICATION)
  - None
- SCADA
  - None

TESTING & COMMISSIONING (TSCS)
- Testing and commissioning services as required.

4. Substation/Switchyard Facility Upgrades

Frostburg Substation
- Below Grade
  - Install conduits and grounding for new equipment.
- Above Grade
  - Modify drawings and nameplates for new line name.
  - Replace (1) 138kV wave trap, (1) line tuner, and coax with (1) 138kV, 2000A wideband wave trap, line tuner, and coax.
  - Install (1) lot cables, connectors, above grade conduits, and above grade grounding for new equipment.
- Relay & Control
  - Replace (1) panel Ridgeley/Finzel Panel 7 with (1) standard relaying panel containing (1) SEL-421, (1) SEL-411L, and (1) SEL-451 BFT.
  - Install (1) carrier panel containing (1) Powercomm PCM 5350, (1) RFL Hybrid chassis with one skewed hybrid, (1) RFL 9780 TX/RX, (2) Ametek UPLC.
  - Install (1) lot of control cables and SEL cables.
  - Update drawings to account for new generation interconnect
- Additional Equipment to be Removed
  - None

- Assumptions
  - Existing DC system and SCADA RTU are adequate.
  - There is adequate space in the control building for the new panel.
  - Existing steel structures are adequate.
  - Carrier equipment need to be replaced.

ANCILLARY ESTIMATES (SUBSTATION)

PROJECT MANAGEMENT (PM)
- Project management will be required for this asset.

FORESTRY
- None

Real Estate
- None

ENVIRONMENTAL
- None

REVENUE METERING
- None

IT/NETWORK
- FIBER (RELAYING AND COMMUNICATION)
  - None
- SCADA
  - Modify existing RTU.

TESTING & COMMISSIONING (TSCS)
- Testing and commissioning services as required for new equipment and relays.

Ridgeley Substation
- Below Grade
  - Install conduit for the fiber run into the control house.
- Above Grade
  - Modify drawings and nameplates for new line name
  - Retune traps and tuners as necessary.
- Relay & Control
  - Update drawings and relay settings to account for new generation interconnect
  - Replace (1) RFL6785P with (1) Ametek UPLC
  - Install (1) lot of control cables and SEL cables.
- Additional Equipment to be Removed
  - None
- Assumptions
  - Existing DC system and SCADA RTU are adequate.
  - There is adequate space in an existing panel for the new UPLC.
  - Relay replacement associated with AE2-289 RPA PE-21-191205-094949 has been completed.
  - There may be a need for lead abatement and asbestos removal, but neither are included in this estimate. Please review at substation site visit and make

determination.

ANCILLARY ESTIMATES (SUBSTATION)

PROJECT MANAGEMENT (PM)
- Project management will be required for this asset.

FORESTRY
- None

Real Estate
- None

ENVIRONMENTAL
- None

REVENUE METERING
- None

IT/NETWORK
- FIBER (RELAYING AND COMMUNICATION)
  - Support for the incoming OPGW from Old McDonald.
- SCADA
  - Modify existing RTU.

TESTING & COMMISSIONING (TSCS)
- Testing and commissioning services as required for revised relay settings and new relay.

Finzel Substation
- Below Grade
  - None
- Above Grade
  - Replace yard and relay panel nameplates to account for new generation interconnect
  - Replace (1) 138kV, 1200A wave trap, (1) line tuner, and coax with (1) 138kV, 2000A wide band wave trap, line tuner and coax.
  - Install (1) lot of cables, connectors, above grade conduits, and above grade grounding for new equipment.
- Relay & Control
  - Update drawings to account for new generation interconnect
  - Replace (1) Ridgeley line & Breaker B1 panel 2 with (1) standard relay panel containing (1) SEL-421, (1) SEL-411L, and (1) SEL-451 BFT.
  - Replace breaker B2 BFT relay in panel 3 with (1) SEL-451 BFT.
  - Install (1) lot of control cables and SEL cables.
- Additional Equipment to be Removed
  - None
- Assumptions
  - Existing DC system and SCADA RTU are adequate.
  - There is adequate space in the control building for new panel.
  - Existing steel structures are adequate.
  - There is adequate space in an existing panel for the new SEL-451.

ANCILLARY ESTIMATES (SUBSTATION)

PROJECT MANAGEMENT (PM)
- Project management will be required for this asset.

FORESTRY
- None

Real Estate
- None

ENVIRONMENTAL
- None

REVENUE METERING
- None

IT/NETWORK
- FIBER (RELAYING AND COMMUNICATION)
  - None
- SCADA
  - Modify existing RTU.

TESTING & COMMISSIONING (TSCS)
- Testing and commissioning services as required for new equipment and relays.

5. Telecommunications Facilities – Upgrades

IC will design, provide, install, own and maintain a fiber-optic communications cable between the Frostburg 138 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 Frostburg 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

IC shall install, own, operate, test and maintain the necessary revenue metering equipment.

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.

The revenue metering CTs and VTs shall be installed on the transmission voltage side of the Connecting Party's step-up transformer, on the generation side of the fault-interrupting device, and within the local zone of fault protection for the facility.

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.

Communications for transmission line protection between the new interconnection substation, and IC's generation (collector) substation, will be via fiber optics (see "Telecommunication Facilities" section above).

7. Environmental, Real Estate and Permitting

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

- Environmental permitting, Real Estate acquisition, and Pennsylvania Public Utility Commission (PaPUC) 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 Pennsylvania Public Utility Commission (PaPUC) 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 charges (CIAC (Contribution in Aid of Construction)). This tax may or may not be charged based on whether this project meets the eligibility requirements of IRS Notice 88-129. 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	
AE2-030 Customer Substation: Integrate customer protection and controls to the FirstEnergy transmission system.	$74,749.04	$0	$12,196.71	$0	$86,945.75
Total Attachment Facilities Cost	$74,749.04	$0	$12,196.71	$0	$86,945.75
AE2- 030 Old McDonald Substation: Design, install, and test/commission MPLS and MW Equipment for SCADA transport. (PJM Network Upgrade Number n8216.3)	$321,114.00	$246,885.00	$52,395.81	$83,548.65	$703,943.45
AE2-030 Old McDonald Substation: Installation of a Security Camara System (PJM Network Upgrade Number n8216.1)	$351,654.81	$352,730.10	$57,379.11	$119,367.82	$881,131.84
Total Direct Connection Cost	$672,768.81	$599,615.10	$109,774.92	$202,916.47	$1,585,075.29
Dans Rock Substation: Design, install, and test/commission MW Equipment for SCADA transport. (PJM Network Upgrade Number n8216.2)	$112,052.00	$56,462.00	$18,283.40	$19,107.37	$205,904.77
Finzel-Ridgeley 138kV Line Loop: Loop the Finzel – Ridgeley 138kV line into the new Old McDonald substation (PJM	$973,428.29	$92,785.14	$158,833.18	$31,399.53	$1,256,446.13

Network Upgrade Number n7913)					
Frostburg Substation: Replace relay panel, wave trap, and tuner; install carrier panel at Frostburg No.1 substation (PJM Network Upgrade Number n7914)	$604,282.96	$150,779.38	$98,600.16	$51,025.43	$904,687.93
Ridgely Substation: Install UPLC, retune wavetrap/tuner, update relay settings, replace nameplates, and install conduit (PJM Network Upgrade Number n7915)	$353,587.28	$33,292.92	$57,694.43	$11,266.70	$455,841.33
Finzel Substation: Replace wave trap, line relay panel, and nameplates at Finzel Substation. (PJM Network Upgrade Number n7916)	$507,317.38	$107,693.11	$82,778.40	$36,444.55	$734,233.43
Total Non-Direct Connection Cost	$2,550,667.91	$441,012.55	$416,189.57	$149,243.58	$3,557,113.59
Revenue Metering: Engineering oversight of specification, design, and commissioning of metering provided and owned by interconnection customer. Support FE MV90 and Power Billing setup of systems to obtain data from customer meter.	$3,989.48	$0	$650.96	$0	$4,640.44
AE2-030 Old McDonald Substation (OTB): FE Oversight Engineering	$1,469,739.02	$0	$239,815.64	$0	$1,709,554.66
Other Cost	$1,473,728.50	$0.00	$240,466.60	$0.00	$1,714,195.10
Total Project Costs	**$4,771,914.24**	**$1,040,627.65**	**$778,627.81**	**$352,160.05**	**$6,943,329.75**

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

For this project which the Interconnection Customer has elected Option to Build the Transmission Owner Attachment and Direct Connection facilities, a proposed **thirty-seven (37) month** schedule is

estimated to complete the engineering, construction and the associated **Non-direct Connection activities**, from the later of the date of a fully executed Interconnection Construction Service Agreement and Construction Kick-Off Meeting or upon TO's receipt of IC's locational data for the dead end structure(s) for final tie-in connections. 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.

37 month Schedule

Activity	Start Month	End Month
[redacted]		
Preliminary Engineering	1	4
Siting, Permits & Real Estate	2	14
Detailed Engineering	2	16
Equipment Delivery	17	23
Below Grade Construction – Substation	21	25
Below Grade Construction – T-Lines	26	29
Above Grade Construction – Substation	29	32
Above Grade Construction – T-Lines	30	35
Testing & Commissioning	35	37

Attachment #1: Protection Study

PROTECTION & COMMUNICATION AND EQUIPMENT SCOPE

SHORT CIRCUIT DATA for a fault at the proposed location of the connection of Old McDonald SS on the existing Ridgeley - Finzel-Frostburg 138kV line (Symmetrical Values Only)
Initial conditions (percent on 100 MVA base)

138kV

Z1 = 0.603 + j 4.879%
Z0 = 1.755 + j 6.547%

3 phase fault – 8728A
Single line to ground fault – 8047A 3I0

Note: These fault values do not include the AE2-030 Generator or GSU step up transformer as being modeled in the calculations.

Impedances are given on a 100 MVA and 138kV 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 coordination when necessary.

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

The attached relay sketch provides details of relay requirements for AE2-030 Generation interconnection substation (Old McDonald Substation) and is considered part of the Facilities Study Report.

AE2-030 Interconnection Substation
(henceforth to be known as Old McDonald Substation)

RELAY AND COMMUNICATION EQUIPMENT SCOPE

At Old McDonald SS:

138kV Line Exit to Ridgeley

- Install the following:
- Three single-phase dual winding capacitor voltage transformers, dual ratio = 1200/700/1 (carrier facilities are only required on phase X, but may be included with all three CVTs)
- 2000A wide band line trap (phase X only)
- Wide band line tuner (phase X only)

- The protective relaying for the 138kV line to Ridgeley shall contain the following:
- SEL-421 relay for the primary line protection, which shall utilize a DCB scheme
- SEL-411L relay for the backup line protection, which shall utilize a line differential scheme, and also reclose the B-1 breaker for faults on the Ridgeley 138kV line
- SEL-451 relay for Bkr B-3 breaker failure
- LOR relay for Bkr B-3 breaker failure tripping
- Ametek UPLC for DCB blocking carrier
- RFL-9780 Rx, for anti-islanding receive from Ridgeley
- SATEC digital multimeter
- RFL Hybrid chassis with one skewed hybrid
- PowerComm PCM5350

OPGW fiber shall be installed on the 4.7 mile line to Ridgeley

138kV Line Exit to Finzel-Frostburg

Install the following:
Three single-phase dual winding capacitor voltage transformers, dual ratio = 1200/700/1 (carrier facilities are only required on phase X, but may be included with all three CVTs)
2000A wide band line trap (phases X and Y)
Wide band line tuner (phases X and Y)

The protective relaying for the 138kV line to Finzel-Frostburg shall contain the following:
- SEL-421 relay for the primary line protection, which shall utilize a DCB scheme
- SEL-411L relay for the backup line protection, which shall utilize a DCB or POTT scheme, and also reclose the B-1 breaker for faults on the Finzel-Frostburg 138kV line
- SEL-451 relay for Bkr B-1 breaker failure
- LOR relay for Bkr B-1 breaker failure tripping
- Ametek UPLC for primary relay scheme carrier
- Ametek UPLC for backup relay scheme carrier
- UPLC Tx/Rx, for anti-islanding transmit and receive from Finzel-Frostburg
- SATEC digital multimeter
- RFL Hybrid chassis with one skewed and one balanced hybrid
- PowerComm PCM5350

138kV Line Exit to Generator – Customer SS

Install the following:
- Three single-phase dual winding capacitor voltage transformer, dual ratio = 1200/700/1 (carrier facilities are not required)
- OPGW fiber optic cable to customer substation for relaying digital communication channel

The protective relaying for the 138kV line to the generator shall contain the following:

- SEL-411L relay for the primary line protection, which shall utilize a line differential scheme with step distance backup
- SEL-411L relay for the backup line protection, which shall utilize a line differential scheme with step distance backup
- SEL-451 relay for Bkr B-2 breaker failure
- LOR relay for Bkr B-2 breaker failure tripping
- LOR relay for generation station breaker failure tripping (operate from transfer trip receive)
- SATEC digital multimeter
- SD relay ("27L") for line potential monitoring (blocks all closing of Bkrs B-2 and B-3 if line from generator is hot)

AE2-030 will only close into this line of it is dead. All synchronizing is to be performed at the Generator Substation. No automatic reclosing will be applied.

Additional items

- GPS Clock, Arbiter 1094B, with antenna, 50 feet of cable, and antenna mounting kit
- SCADA and annunciator, details to be determined by Real Time Operations
- SEL RATC for remote access to SEL protective relays
- Test switches, fuses, and terminal blocks as deemed necessary

At Ridgeley SS:

(This assumes the relay replacement associated with AE2-289 PE-21-191205-094949 has been completed)

- Change frequencies for existing DCB and anti-islanding transfer trip schemes
- Re-tune traps and tuners as necessary
- Add fiber equipment to connect the SEL-411L to the OPGW fiber, including splice box, non-metallic fiber for run from the splice box to a patch panel in the control building and jumpers to connect the relay to the patch panel

At Frostburg SS:

- Replace existing SEL-321 / SEL-311 line protection panel with standard first energy SEL-421 / SEL-411L panel equipped for dual pilot relaying including an SEL-451 relay with LOR lockout aux relay for 138kV breaker failure
- 2000A wide band line trap (phase Y)
- Wide band line tuner (phase Y)
- Add carrier equipment to Y phase CCVT if necessary

At Frostburg SS:

- Replace existing SEL-321 / SEL-311 line protection panel with standard first energy SEL-421 / SEL-411L panel equipped for dual pilot relaying
- Replace breaker B1 and B2 SEL-501 relays with SEL-451 relays for breaker failure
- 2000A wide band line trap (phase Y)
- Wide band line tuner (phase Y)
- Add carrier equipment to Y phase CCVT if necessary

Generation Substation Protection Requirements for 138kV line to Old McDonald SS

It is the responsibility of the Generator Owner (GO) to assure protection, coordination and equipment adequacy within their facility for conditions including but not limited to:

- Single phasing of supply
- System faults
- Equipment failures
- Deviations from nominal voltage or frequency
- Lightning and switching surges
- Harmonic voltages
- Negative sequence voltages
- Separation from FE supply
- Synchronizing generation
- Synchronizing facilities between independent transmission system and FE
- Transmission System

The generator owner (GO) is to design their protective system to clear any faults within their zones of protection with one or more of their local breakers. Each zone of protection covering the 138kV portion of the GO system (including the GSU(s)) is to be protected by two fully independent relay schemes that each provides high speed fault protection. The terminal breaker at the GO end of the direct connection line is to be included in one of these zones of protection. Two SEL-411L relays shall be used for protection of the interconnect line, to match the companion relays at AE2-030 Substation.

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.

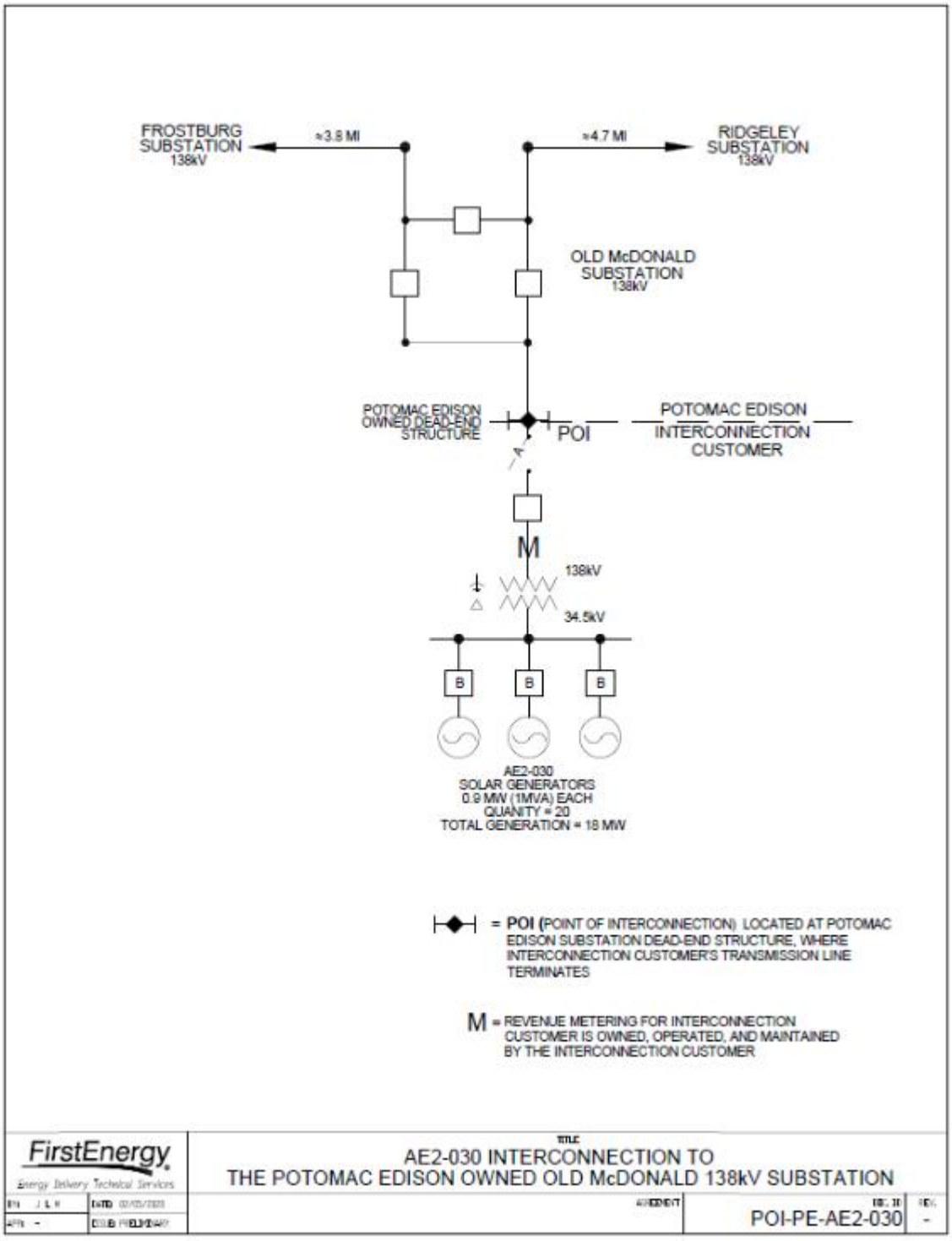
Operational metering is also required for this generation connection. These requirements are also outlined in FirstEnergy's "Requirements for Transmission Connected Facilities" document. These requirements are in addition to any metering required by PJM.

Generator Step-Up Transformer Requirements

As per section 3.2.3 under Connecting Transformer Requirements of the First Energy TPP-REF-004 Requirements for Transmission Connected Facilities document dated 08-06-2021, because this area of the system is effectively grounded, the transformer shall have a wye grounded winding on the high (transmission system) side and have a delta connected winding on the low side. This is required to maintain proper ground relay coordination on the First Energy system. No exceptions to this standard shall be granted.

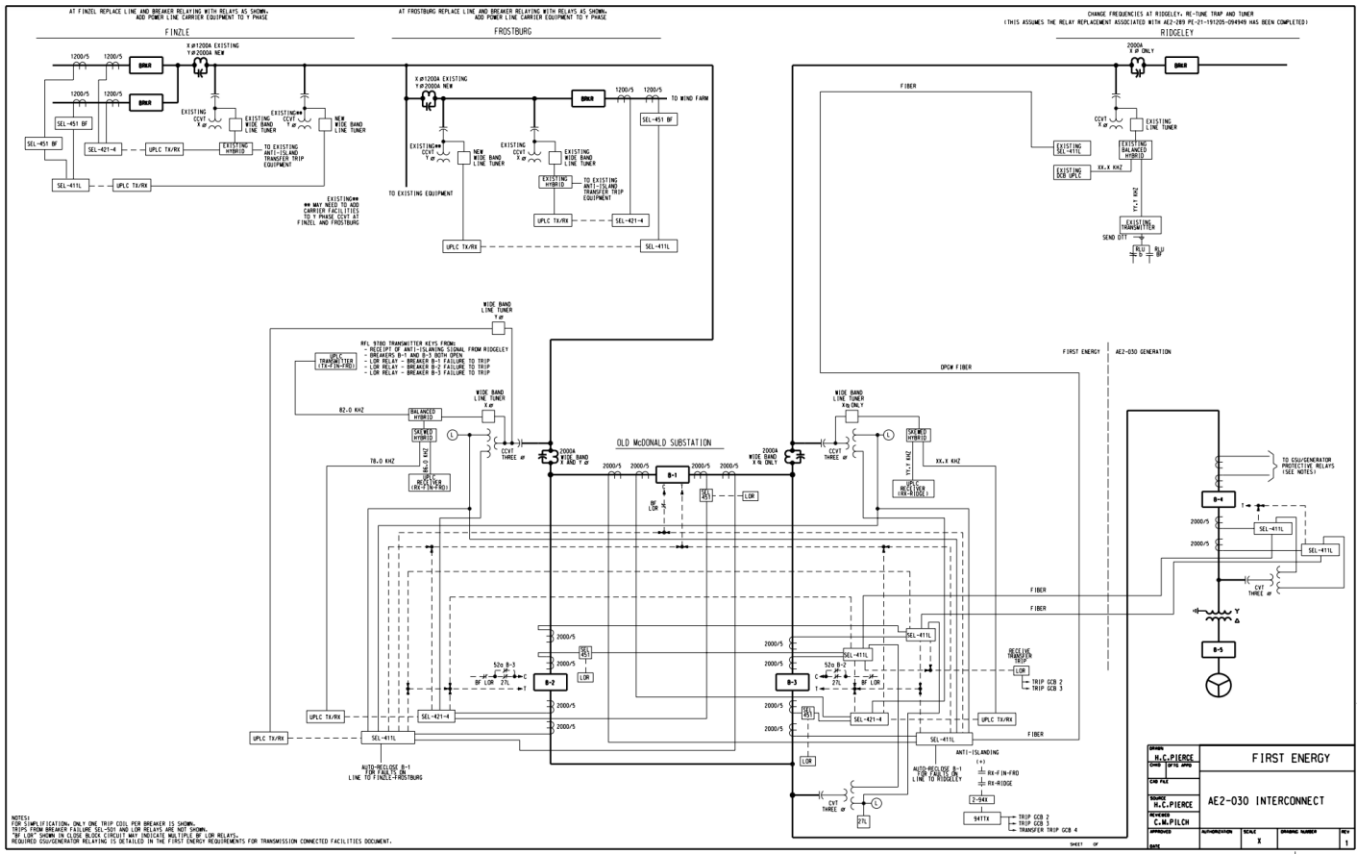
Attachment #2: One-Line Diagrams

FirstEnergy Facilities One-Line



IC Facilities One-Line

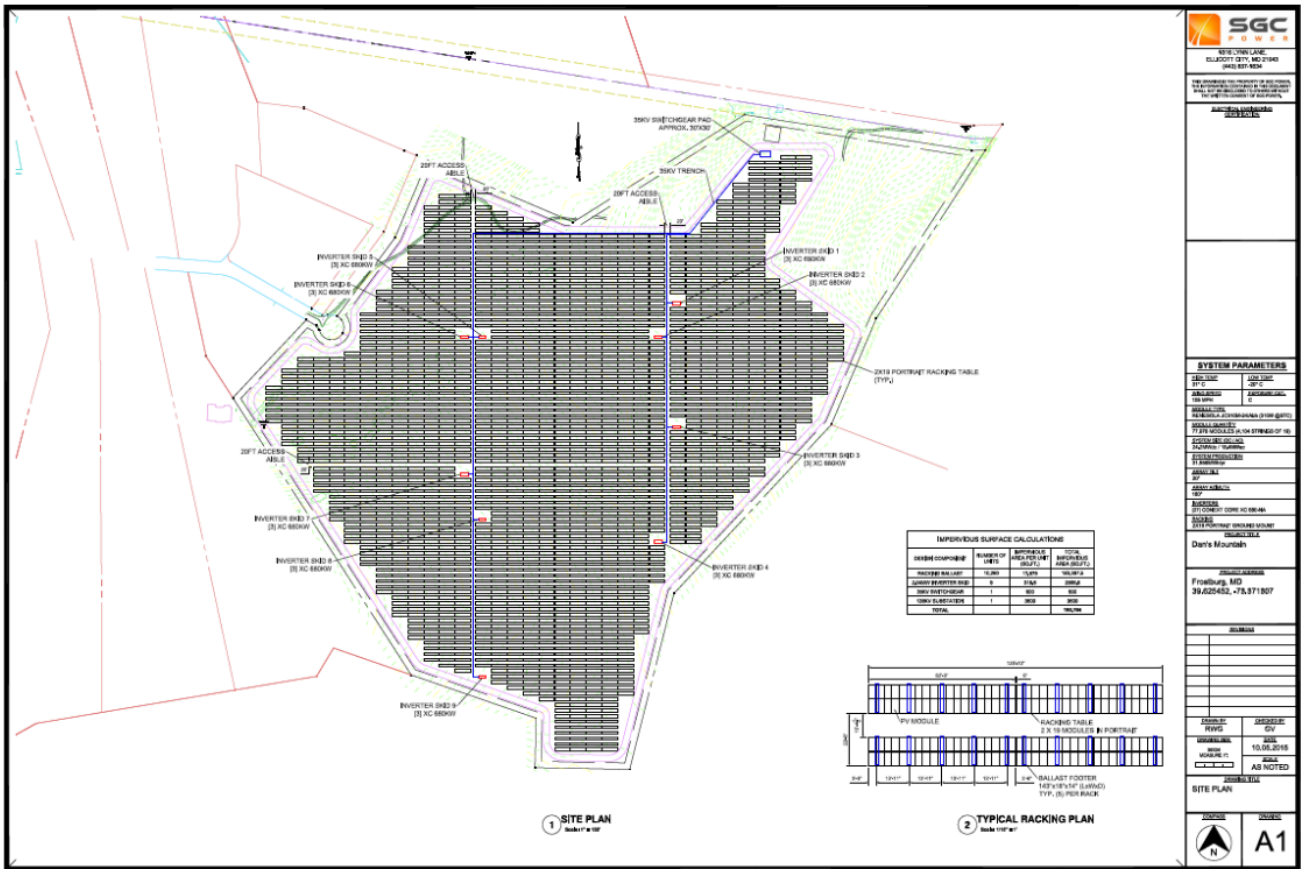
Not Approved for Construction



Attachment #3: Project Site Plan

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

Not Approved for Construction



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:	138 kV
• Maximum phase-to-phase:	145 kV
• Basic impulse level (BIL):	550 kV
• Maximum continuous current carrying capacity:	2000 A

- Design fault current: 40 kA
- Single Contingency (breaker failure) clearing time: 60 cycles

Clearances and Spacing

- Recommended rigid bus center-to-center phase spacing: 96”
- Minimum phase-to-phase, metal-to-metal distance: 63”
- Recommended phase-to-ground: 52.5”
- Minimum phase-to-ground: 50”
- Minimum vertical clearance from live parts to grade: 12’-2”
- Minimum horizontal clearance from live parts: 6’-8”
- Minimum conductor clearance above roads in switchyard: 25’-0”
- Minimum bottom of insulator to top of foundation: 8’-6”