Generation Interconnection Facilities Study Report

For

PJM Interconnection Request Queue Position AF2-356

“Albright-Mt. Zion 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

CPV Backbone Solar, LLC, (hereinafter referred to as "IC") has proposed a new solar generating facility to be located in Oakland Township, Garrett County, Maryland. The installed facilities for AF2-356 will have a total Maximum Facility Output (MFO) of 175 MW with 105 MW of this output being recognized by PJM as Capacity. The generation facility will interconnect with APS-Potomac Edison, a FirstEnergy Company (FE), hereinafter referred to as "Transmission Owner" (TO), by constructing a new 138 kV three (3) breaker ring bus substation and looping the Albright – Mt. Zion 138 kV Line into 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

IC's requested Commercial Operation Date (COD) for the generation facility is **August 31, 2025**.

Milestone Schedule:

June 30, 2025	Initial Back-feed through Project Substation Date
August 31, 2025	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 (AF2-356) 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 Albright – Mt. Zion 138 kV Line into the new station.

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

- AF2-356 Interconnection Substation (OTB)
    - Energize and integrate attachment facilities to the FirstEnergy transmission system.

Direct Connection

- AF2-356 Interconnection Substation (OTB)
    - Install physical security camera system.
- Design, install, and test/commission MPLS Equipment for SCADA transport.

Non-Direct Connection

- Albright – Cross School 138kV Line
    - Loop in and out the Albright-Cross School AFA 138kV line to new 3-breaker ring bus at Swanton 138kV substation.
- Westvaco 138kV Substation
    - Modify drawings for line name change
- Beryl 138kV Substation
    - Modify drawings for line name change

- Mt Zion 138kV Substation
    - Modify drawings for line name change
- Cross School 138kV Substation
    - Replace (1) 138kV, 2000A, wave trap, line tuner, and coax on Albright line exit with (1) 138kV, 2000A wideband wave trap, line tuner, and coax.
    - Replace line relaying panel for the Swanton line terminal.
- Albright 138kV Substation
    - Replace (1) 138kV, 2000A, wave trap, line tuner, and coax on Cross School line exit with (1) 138kV, 2000A wideband wave trap, line tuner, and coax.
    - Replace line relaying panel for the Swanton line terminal.
- Dan's Rock Substation
    - Design, install, and test/commission new licensed microwave link at Dan's Rock MW.

Other

- AF2-356 Interconnection Substation (OTB)
    - Support as required for backup station service.
    - FE Oversight Engineering.

New System Upgrades

None.

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

Description	Total (w/o Tax)
Attachment Facilities:	**$93,714.09**
Total Direct Connection (DC) Costs:	**$2,455,264.12**
Total Non-Direct Connection (NDC) Costs:	**$4,871,870.48**
Other Costs	**$115,506.77**
New System Upgrades	**$0**
TOTAL Costs (ALL Categories)	**$7,536,355.46**

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

Attachment Facility	*Duration*
AF2-356: Engineering, Procurement, and Construction	29 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

Albright-Cross School AFA 138kV

- Description of Work
  - Loop in and out the Albright- Cross school AFA 138kV line to new 3-breaker ring bus at Swanton 138kV substation.
- Existing Conditions
  - The existing line is constructed on wood H-frame and 3-pole structures.
  - Per TAMI, the existing conductor is 556.5 kcmil 26/7 ACSR shielded by (2) 1/2" 7 strand EHS.
- Structures Installed
  - (2) 138kV single circuit wood 3-pole deadend structure (TR-138075)
  - (6) 138kV substation deadend assemblies (TR-020270)
  - Approximately (0.1) circuit miles of 556.5 kcmil 26/7 ACSR shielded by (2) 7#8 Alumoweld.
  - Transfer existing conductor and shield wire to (2) new deadend structures.
- Structures Removed
  - (1) 138kV single circuit wood H-frame tangent structure (similar to TR-138045)
  - Approximately (0.1) circuit miles of 556.5 kcmil 26/7 ACSR shielded by (2) 1/2" 7 strand EHS.
- Construction Considerations
  - Install required insulators, fittings, grounding, guying, and anchors for each new structure.
- Siting/Licensing
  - Assume a Full Application is required. Cost to be split with PE-T-729
- Assumptions
  - Assume a ground survey will be required. Cost to be split with PE-T-729
  - Assume adjacent structures are in adequate condition and can handle different loading. An analysis during project development will be required.
  - It is assumed that the existing conductor is in good condition and can be transferred to new structures.

ANCILLARY ESTIMATES (LINE)

- PROJECT MANAGEMENT (PM)
  - Project management will be required for this asset.
- Forestry
  - Clearing of ROW for span to Swanton substation.
- Real Estate/ROW
  - RE/ROW required for new span to Swanton substation. 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 and additional permitting requirements.
- REVENUE METERING
  - None
- IT/Network
  - Fiber (Relaying and Communication)
    - None
  - SCADA/Other
    - None
- ACCESS ROAD CONSTRUCTION
  - It is assumed that the location of the new structures can be accessed from the substation site.
- Distribution
  - None

3. New Substation/Switchyard Facilities

AF2-356 Interconnection Substation (OTB)

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

ANCILLARY SUBSTATION ESTIMATES

- PROJECT MANAGEMENT (PM)

- Project management will be required for this asset.
- FORESTRY
  - None
- RE/ROW
  - None
- ENVIRONMENTAL
  - None
- REVENUE METERING
  - Located at customer substation
- IT/NETWORK
  - FIBER (RELAYING AND COMMUNICATION)
    - None
  - SCADA
    - Modify EMS screen
- TESTING & COMMISSIONING (TSCS)
  - Support as required for customer substation.

4. Substation/Switchyard Facility Upgrades

Swanton (***Customer has selected the Option-To-Build***)

- Below Grade
  - None
- Above Grade
  - Install physical security camera system
- R&C
  - None
- Additional Equipment to be Removed
  - None
- Assumptions
  - None

ANCILLARY SUBSTATION ESTIMATES

- PROJECT MANAGEMENT (PM)
  - Project management will be required for this asset.
- DISTRIBUTION (DX)
  - Support as required for backup station service.
- FORESTRY
  - None
- RE/ROW
  - None (Assumed site is provided by developer)
- ENVIRONMENTAL
  - None

- REVENUE METERING
  - None (Assumed meters will be at collector station)
- IT/NETWORK
  - FIBER (RELAYING AND COMMUNICATION)
    - Fiber from the customer substation. Support required for customer interconnect communications
  - SCADA
    - Support for new SCADA RTU and comm equipment
- TESTING & COMMISSIONING (TSCS)
  - Required for new equipment and relaying.

Albright

- Below Grade
  - Install foundations, conduits, and grounding for new equipment.
  - Disposal of oil from B7 OCB.
  - Remove (1) circuit breaker foundation.
- Above Grade
  - Replace (1) 138kV, 1200A wave trap, line tuner, and coax on Cross School line exit with (1) 138kV, 2000A wideband wave trap, line tuner, and coax.
  - Install (1) 138kV, 2000A wideband wave trap, line tuner, coax, and support structure.
  - Install (2) 138kV CVT and steel support stands.
  - Replace (1) 138kV, 1600A circuit breaker (B7) with (1) 138kV, 3000A circuit breaker.
  - Install (1) lot of conductors, fittings, conduits, grounding, and insulators.
- R&C
  - Replace (1) line relaying panel for the Swanton line terminal.
  - Install (1) breaker failure relaying panel.
  - Replace (1) existing carrier panel.
- Additional Equipment to be Removed
  - None
- Assumptions
  - Assumed existing 138kV line CVT does not require replacement.
  - Existing structure & foundation are adequate for re-use
  - See attached protection specs for specific relays
  - Engineering to determine if more than one carrier relaying panel is required. Existing control building layout indicates there is sufficient space.
  - 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 SUBSTATION ESTIMATES

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

- FORESTRY
  - None
- RE/ROW
  - None
- ENVIRONMENTAL
  - None
- REVENUE METERING
  - None
- IT/NETWORK
  - FIBER (RELAYING AND COMMUNICATION)
    - None
  - SCADA
    - Modify existing SCADA RTU
- TESTING & COMMISSIONING (TSCS)
  - Required

Mt Zion

- Below Grade
  - None
- Above Grade
  - Modify nameplates for line name change
- R&C
  - Modify drawings for line name change
- Additional Equipment to be Removed
  - None
- Assumptions
  - None

ANCILLARY SUBSTATION ESTIMATES

- PROJECT MANAGEMENT (PM)
  - Project management will be required for this asset.
- FORESTRY
  - None
- RE/ROW
  - None
- ENVIRONMENTAL
  - None
- REVENUE METERING
  - None
- IT/NETWORK
  - FIBER (RELAYING AND COMMUNICATION)
    - None
  - SCADA

- None
- TESTING & COMMISSIONING (TSCS)
  - None

Cross School

- Below Grade
  - Foundations, conduits, and grounding for new equipment.
- Above Grade
  - Replace (1) 138kV, 2000A, wave trap, line tuner, and coax on Albright line exit with (1) 138kV, 2000A wideband wave trap, line tuner, and coax.
  - Install (1) 138kV, 2000A, wideband wave trap, line tuner, coax, and support structure.
  - Install (2) 138kV CVTs and steel support stands.
  - Install (3) slip over CTs to CS1 (Black Oak line side).
  - Install (3) slip over CTs to CS2 (wind farm line side). Install (1) lot of conductors, fittings, insulators, conduits, and grounding.
  - Install (2) junction boxes.
- R&C
  - Replace (1) line relaying panel for the Swanton line terminal.
  - Replace (1) existing carrier panel.
  - Relocate existing CS-51 transfer trip transmitter from panel 3 to panel 2.
- Additional Equipment to be Removed
  - None
- Assumptions
  - Assumed existing 138kV line CVT does not require replacement
  - Existing structure & foundation are adequate for re-use
  - See attached detailed protection spec for specific relays
  - Existing BF relaying can be retained as it is not in the relaying panel
  - 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 SUBSTATION ESTIMATES

- PROJECT MANAGEMENT (PM)
  - Project management will be required for this asset.
- FORESTRY
  - None
- RE/ROW
  - None
- ENVIRONMENTAL
  - None
- REVENUE METERING
  - None
- IT/NETWORK

        - FIBER (RELAYING AND COMMUNICATION)
            - None
        - SCADA
            - Modify existing SCADA RTU
    - TESTING & COMMISSIONING (TSCS)
        - Required

Beryl

- Below Grade
    - None
- Above Grade
    - Modify nameplates for line name change
- R&C
    - Modify drawings for line name change
- Additional Equipment to be Removed
    - None
- Assumptions
    - None
    - 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 SUBSTATION ESTIMATES

- PROJECT MANAGEMENT (PM)
    - Project management will be required for this asset.
- FORESTRY
    - None
- RE/ROW
    - None
- ENVIRONMENTAL
    - None
- REVENUE METERING
    - None
- IT/NETWORK
    - FIBER (RELAYING AND COMMUNICATION)
        - None
    - SCADA
        - None
- TESTING & COMMISSIONING (TSCS)
    - None

Westvaco

- Below Grade
    - None

- Above Grade
  - Modify nameplates for line name change
- R&C
  - Modify drawings for line name change
- Additional Equipment to be Removed
  - None
- Assumptions
  - None

ANCILLARY SUBSTATION ESTIMATES

- PROJECT MANAGEMENT (PM)
  - Project management will be required for this asset.
- FORESTRY
  - None
- RE/ROW
  - None
- ENVIRONMENTAL
  - None
- REVENUE METERING
  - None
- IT/NETWORK
  - FIBER (RELAYING AND COMMUNICATION)
    - None
  - SCADA
    - None
- TESTING & COMMISSIONING (TSCS)
  - None

5. Telecommunications Facilities – Upgrades

IC will design, provide, install, own and maintain a fiber-optic communications cable between the Swanton 138 kV new Interconnection 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 new Swanton 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 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	
AF2-356 Interconnection Substation (OTB): Energize and integrate attachment facilities to the FirstEnergy transmission system.	$75,834.94	$4,113.27	$12,373.90	$1,391.98	$93,714.09
Total Attachment Facilities Cost	**$75,834.94**	**$4,113.27**	**$12,373.90**	**$1,391.98**	**$93,714.09**
AF2-356 Interconnection Substation (OTB): Install physical security camera system.	$1,181,136.65	$315,422.12	$192,724.72	$106,742.38	$1,796,025.87
Design, install, and test/commission MPLS Equipment for SCADA transport.	$300,934.00	$298,284.00	$49,103.06	$10,917.19	$659,238.25
Total Direct Connection Cost	**$1,482,070.65**	**$613,706.12**	**$241,827.78**	**$117,659.57**	**$2,455,264.12**
Albright – Cross School 138kV Line: Loop in and out the Albright-Cross School AFA 138kV line to new 3-breaker ring bus at Swanton 138kV substation.	$1,078,673.30	$75,174.27	$176,005.89	$25,439.81	$1,355,293.28
Westvaco 138kV Substation: Modify drawings for line name change	$37,410.65	$589.97	$6,104.25	$199.65	$44,304.53

Beryl 138kV Substation: Modify drawings for line name change	$37,022.00	$590.66	$6,040.84	$199.89	$43,853.38
Mount Zion 138kV Substation: Modify drawings for line name change	$39,061.02	$587.23	$6,373.54	$198.72	$46,220.51
Cross School 138kV Substation: Replace (1) 138kV, 2000A, wave trap, line tuner, and coax on Albright line exit with (1) 138kV, 2000A wideband wave trap, line tuner, and coax. Replace line relaying panel for the Swanton line terminal.	$800,370.09	$332,608.37	$130,595.48	$112,558.40	$1,376,132.34
Albright 138kV Substation: Replace (1) 138kV, 2000A, wave trap, line tuner, and coax on Cross School line exit with (1) 138kV, 2000A wideband wave trap, line tuner, and coax. Replace line relaying panel for the Swanton line terminal.	$1,119,547.51	$394,287.24	$182,675.29	$116,134.90	$1,812,644.95
Dan's Rock Substation: Design, install, and test/commission new licensed microwave link at Dan's Rock MW.	$112,254.00	$60,632.00	$18,316.36	$2,219.13	$193,421.49
Total Non-Direct Connection Cost	**$3,224,338.57**	**$864,469.75**	**$526,111.65**	**$256,950.51**	**$4,871,870.48**
AF2-356 Interconnection Substation (OTB): Support as required for backup station service.	$8,000.00	$0.00	$1,305.35	$0.00	$9,305.35
AF2-356 Interconnection Substation (OTB): FE Oversight Engineering.	$91,179.69	$107.62	$14,877.69	$36.42	$106,201.42
Other Cost	**$99,179.69**	**$107.62**	**$16,183.04**	**$36.42**	**$115,506.77**
Total Project Costs	**$4,881,423.86**	**$1,482,396.76**	**$796,496.37**	**$376,038.48**	**$7,536,355.46**

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 29 **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.

29 month Schedule

Activity	Start Month	End Month
[redacted]		
Preliminary Engineering	1	2
Siting, Permits & Real Estate	2	3
Detailed Engineering	3	4
Equipment Delivery	4	5
Below Grade Construction – Substation	5	10
Below Grade Construction – T-Lines	11	13
Above Grade Construction – Substation	14	24
Above Grade Construction – T-Lines	24	27
Testing & Commissioning	27	29

Attachment #1: Protection Study

PROTECTION & COMMUNICATION AND EQUIPMENT SCOPE

SHORT CIRCUIT DATA for a fault at the proposed location of the connection of Swanton SS on the existing Albright - Cross School 138kV line (Symmetrical Values Only)
Initial conditions (percent on 100 MVA base)

138kV
Z1 = 1.021 + j 5.849%
Z0 = 3.191 + j 11.392%

3 phase fault – 7486A
Single line to ground fault – 5455A 3I0

Note: These fault values do not include the AF2-356 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 AF2-356 Generation interconnection substation (Swanton Substation) and is considered part of the Facilities Study Report.

AF2-356 Interconnection Substation
(henceforth to be known as Swanton Substation)

RELAY AND COMMUNICATION EQUIPMENT SCOPE

At Swanton SS:

138kV Line Exit to Albright

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

The protective relaying for the 138kV line to Albright 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 scheme
• SEL-451 relay for Bkr B-2 breaker failure, and also reclose the B-1 breaker for faults on the Albright 138kV line
• LOR relay for Bkr B-2 breaker failure tripping
• UPLC for primary DCB blocking carrier
• UPLC for backup DCB blocking carrier
• UPLC Tx/Rx, for anti-islanding receive from Albright
• SATEC digital multimeter
• RFL Hybrid chassis with one skewed hybrid
• Two PowerComm PCM5350 units

138kV Line Exit to Cross School

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

The protective relaying for the 138kV line to Cross School 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 step distance scheme
• SEL-451 relay for Bkr B-1 breaker failure, and also reclose the B-1 breaker
• LOR relay for Bkr B-1 breaker failure tripping
• UPLC for primary DCB blocking carrier
• UPLC for backup DCB blocking carrier
• UPLC, for anti-islanding transmit to and receive from Cross School
• UPLC to transmit transfer trip to Westvaco
• SATEC digital multimeter
• RFL Hybrid chassis with two balanced hybrids
• Four PowerComm PCM5350 units

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-3 breaker failure
• LOR relay for Bkr B-3 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)

AF2-356 will only close into this line if 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 Albright SS:

• Replace existing 1200A single frequency line trap with new 2000A wide band trap
• Replace existing single frequency line tuner with new wide band tuner
• Add new 2000A wide band line trap and wide band line tuner on B phase
• Add carrier facilities to Y phase CCVT if not already present
• Replace McGraw Edison ALP-60 oil breaker with an SF6 breaker with two relay CTs per bushing, 2000/5 C-800 with a thermal rating of 2. Line side bushings shall also contain 1 metering CT per bushing, 800/5 SR

Replace line relays to properly operate with new relays at Swanton SS as follows:
• 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 scheme
• SEL-451 relay for line terminal breaker failure, and also reclose the line terminal breaker
• LOR relay for line terminal breaker failure tripping
• UPLC for primary DCB blocking carrier
• UPLC for backup DCB blocking carrier
• UPLC Tx, for anti-islanding transmit to Swanton (may be existing)
• SATEC digital multimeter
• RFL Hybrid chassis with one balanced hybrid (may be existing)
• Two PowerComm PCM5350 units

At Cross School SS:

• Add wide band line trap and tuner to Y phase
• Add carrier facilities to Y phase CCVT if not already present
• Add slip over CTs to CS1 (Black Oak line side) and CS2 (wind farm line side) 138kV breakers, one per bushing, C800, 2000/5MR, thermal factor 2.

Replace panel 3 line relays to properly operate with new relays at Swanton SS as follows:
• 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 scheme
• UPLC for primary DCB blocking carrier
• UPLC for backup DCB blocking carrier
• UPLC TX/RX Tx, for anti-islanding transmit to and receive from Swanton
• PM174 SATEC digital multimeter
• RFL Hybrid chassis with one balanced hybrid
• Four PowerComm PCM5350 units
• Change frequencies for existing DCB scheme if/as necessary

Relocate existing CS-51 transfer trip transmitter from panel 3 to panel 2 Existing breaker failure and reclosing schemes will be maintained as they are not on the line relay panel.

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 AF2-356 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.

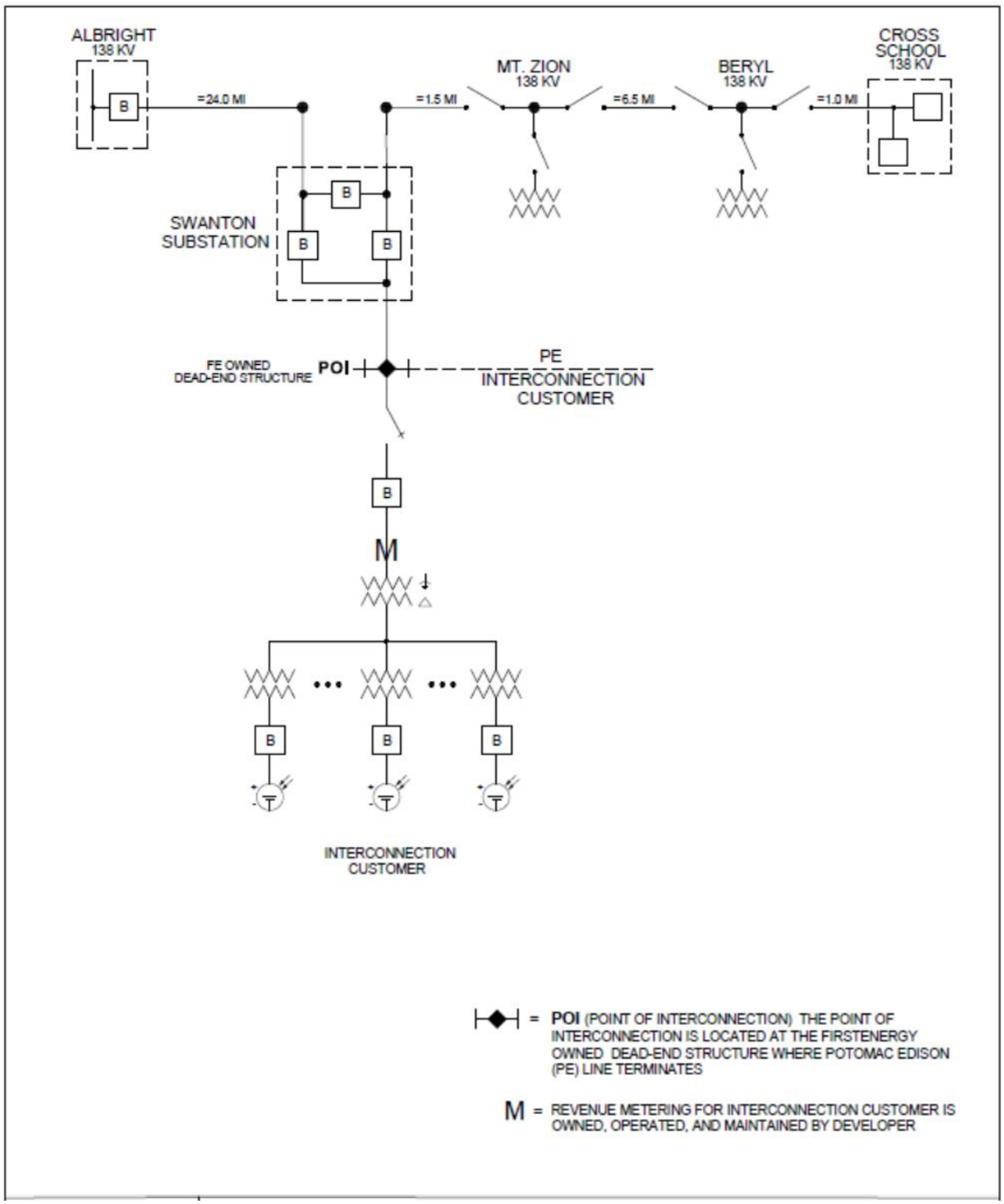
Operational metering is also required for this generation connection. These requirements are also outlined in FirstEnergy's "Requirements for Transmission Connected Facilities" document. These requirements are in addition to any metering required by PJM.

Generator Step-Up Transformer Requirements

As per section 3.2.3 of the First Energy Requirements for Transmission Connected Facilities document TPP-REF-004, 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

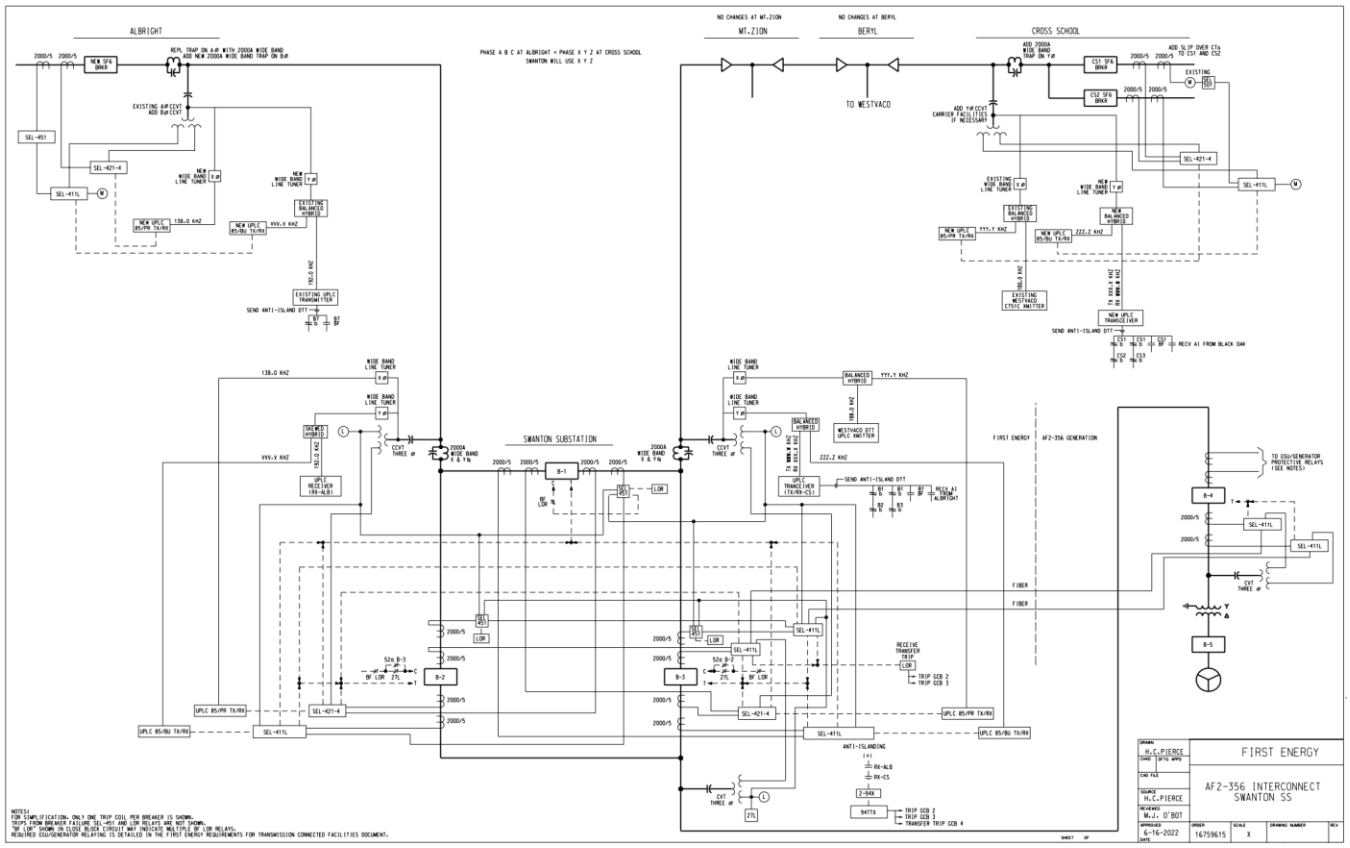
Attachment #2: One-Line Diagrams

FirstEnergy Facilities One-Line



IC Facilities One-Line

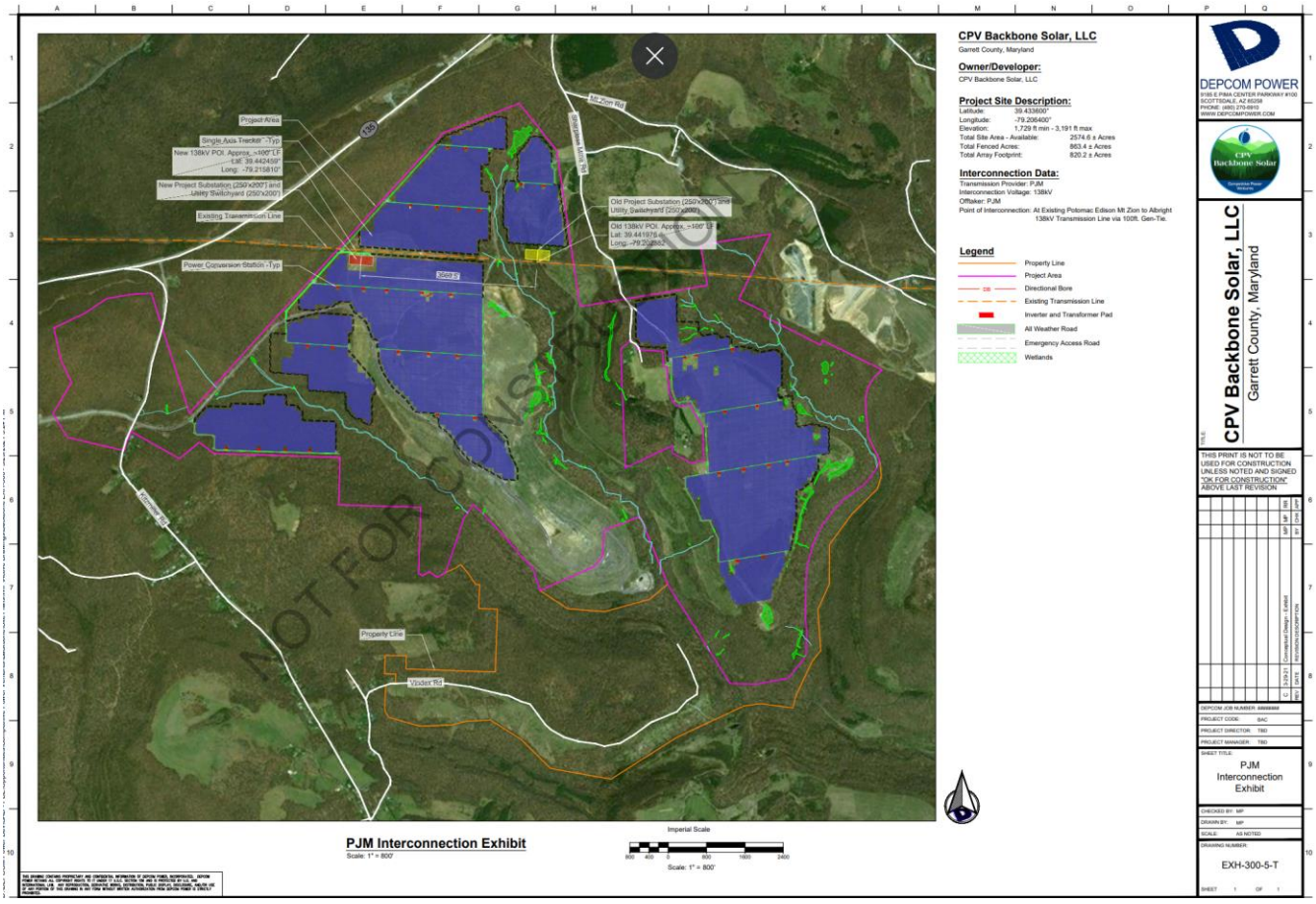
Not Approved for Construction



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”