

Facilities Study Report
For
Physical Interconnection of
PJM Generation Interconnection Request
Project ID AG1-548

“Erie South-Union City 115 kV”

Introduction

This Facilities Study has been prepared in accordance with the PJM Open Access Transmission Tariff, as well as the Application and Studies Agreement between the Project Developer and PJM Interconnection, LLC (PJM or Transmission Provider (TP)). The Transmission Owner (TO) is Mid-Atlantic Interstate Transmission, LLC (MAIT), a FirstEnergy company.

A. Transmission Owner Facilities Study Summary

1. PROJECT DESCRIPTION

The Project Developer has proposed a solar/storage Generating Facility located in Erie County, Pennsylvania. The installed facilities for AG1-548 will have a total Maximum Facility Output (MFO) of 150 MW with 45 MW of this output being recognized by PJM as Capacity.

2. POINT OF INTERCONNECTION (POI)

The Generating Facility will interconnect with the MAIT transmission system via a newly constructed 115 kV three (3) breaker ring bus substation, tapping the Erie South – Union City 115 kV line, PNT-115-RC, approximately 2.8 miles from Union City substation.

The construction of the new interconnection substation will result in the splitting of the existing Erie South – Union City 115 kV line, PNT-115-RC, into two lines on the transmission system. New line designations are to be determined.

The proposed generation interconnection is shown on the single line diagram in Attachment #1.

3. POINT OF CHANGE IN OWNERSHIP (PCO)

The Point of Change in Ownership (PCO) will be located at the first dead-end structure outside the new three (3) breaker ring bus interconnection substation fence line.

4. SCOPE OF PROJECT DEVELOPER FACILITIES

Project Developer will design, build, own, operate and maintain the Project Developer Interconnection Facilities on Project Developer's side of the Point of Change in Ownership (PCO). This includes, but is not limited to:

- Generation step-up (GSU) transformer(s) or final transformation, as applicable.
- Circuit breakers and associated equipment located between the high side of the GSU and the Point of Change in Ownership.
- Generator lead line from the Generating Facility to the Point of Change in Ownership.
- Relay and protective equipment, and Supervisory Control and Data Acquisition (SCADA) and telecommunications equipment to comply with the TO's Applicable Technical Requirements and Standards.
- Revenue metering equipment. 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 easements and associated rights of way for the TO owned substation along with the 115 kV line taps to the substation will be acquired by the Project Developer 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 Project Developer. 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 Project Developer's facilities are not included in this report and are the responsibility of the Project Developer.

B. Transmission Owner Facilities Study Results

The following is a description of Transmission Owner facilities for physical interconnection of the proposed AG1-548 project to MAIT transmission system. These facilities shall be designed according to FirstEnergy Applicable Technical Requirements and Standards. Once built, MAIT will own, operate, and maintain these Facilities.

1. TRANSMISSION OWNER INTERCONNECTION FACILITIES (TOIF)

1.1 New Interconnection Substation Line Terminal

A 115 kV dead-end structure and foundation within the fence of the Interconnection Substation, to terminate the Project Developer's generator lead line.

Line conductor from the dead-end structure to the bus position in the switchyard of the interconnection substation.

- Scope of work described as part of section 2.1.

1.2 Energize and integrate generator interconnection facilities to the transmission system.

- Relay and Controls Scope of Work
 - Integrate interconnection facilities protection and controls to the transmission system.
- Ancillary Scope of Work
 - Project Management
 - Project management will be required for this asset.
 - Revenue Metering
 - Provide support for Project Developer installed revenue metering.
 - Testing and Commissioning
 - Test and commission all power assets.

2. STAND ALONE NETWORK UPGRADES

2.1 New Interconnection Substation (Nxxxx)

A new three (3) breaker ring bus substation will be constructed along the Erie South – Union City 115 kV transmission line to interconnect AG1-548 with the MAIT transmission system.

The new substation will be located approximately 2.8 miles from Union City Substation. The Project Developer will be responsible for acquiring all easements, properties, and permits that may be required to construct both the new interconnection switching station and the associated facilities. The Project Developer will also be responsible for the rough grade of the property and an access road to the proposed three-breaker ring bus site.

- Below Grade Scope of Work:
 - Install (1 lot) foundations, trench, conduit and grounding for new equipment.
 - Install fence, ground grid, grading, and stone for new substation.
 - Conduit from fence to control house for fiber.
 - Detention pond as required.
- Above Grade Scope of Work:
 - Install (3) 115kV H-frame structures.
 - Install (1) prefabricated control house.
 - Install (3) 115kV, 3000A, 40kAIC circuit breakers.
 - Install (6) 115kV, 2000A, GOAB circuit breaker disconnect switches.
 - Install (3) 115kV, 1200A, motor operated line disconnect switches.
 - Install (2) 115kV wide band line traps, (2) wide band line tuners, and coax.
 - Install (9) 115kV CVTs.
 - Install (9) 115kV surge arresters.
 - Install (1) 115kV station service transformer with (2) 240/120V fused disconnect switches.
 - Install (1 lot) rigid bus, cable, and support structures.
 - Install (1 lot) grounding for new equipment.
 - Substation lighting.
 - Security camera system.
- Relay & Control Scope of Work
 - Install (3) breaker control panels with:
 - (1) SEL451 and (1) SATEC meter
 - Install (3) transmission line relay panels:
 - (1) panel containing (2) SEL-411Ls
 - (2) panels containing (1) SEL-411L and (1) SEL-421

- Install (1) carrier panel with:
 - (3) UPLCs and (2) PCM-5350s
- Install (1) SEL-2411
- Install (1) SCADA RTU
- Install (1) HMI panel
- Install (1) FDP
- Install (1) communications panel with (1) RTAC and (1) GPS clock
- Install (1) ATS
- Install (1) Qualitrol FL-8 Traveling Wave Fault Location system
- Install (1 lot) control cables, SEL cables, and fiber
- Scope of work Assumptions
 - Emergency AC source will be off site distribution transformer.
 - Developer to provide rough graded site and access road.
 - Execution engineer to perform AC/DC, lightning, and grounding studies.
 - No site-specific plan was provided. Location and overall arrangement were assumed.
 - An allowance cost is included for retention pond.
 - It is assumed security camera system is required.
- Transmission Owner Permits Required:
 - PAPUC LON required for Transmission Line Tie-in.
- Ancillary Scope of Work
 - Project Management
 - Project management will be required for this asset.
 - Forestry
 - None
 - Real Estate & Right-Of-Way
 - Support for transfer of developer-owned property to FirstEnergy.
 - Real estate estimate has been included for:
 - Internal support including document review, project planning meetings, subcontractor oversight and assistance with transfer of assets if required.
 - External support for general project support, easement digitization and other GIS support, acquisition (assuming voluntary, no condemnation); assuming NO field construction support will be required.
 - Since developer is providing site and access road, Assumed general internal consultive support, and general external support for meeting attendance.

- There will be no acquisition or field support.
- Environmental
 - Support as required to build approximately 32,400sq. ft. substation.
- Revenue Metering
 - None
- Information Technology
 - Network equipment and scopes described in section 2.2 and 2.3.
- Testing and Commissioning
 - Testing and commissioning services as required for new substation.
- Standard Design References:
 - FirstEnergy's *Requirements for Transmission Connected Facilities*:
www.pjm.com/planning/design-engineering/to-tech-standards.aspx.
 - PJM Protection Standard (PJM Manual 7):
<https://pjm.com/-/media/documents/manuals/m07.ashx>
- MAIT Protection Specification:
 - Refer to *Attachment 4* of this document.
- Material List and Equipment Ratings:
 - Refer to *Attachment 3*.

2.2 ADSS Fiber Installation

- Install/Test approximately 3.12 miles of new 48 count ADSS fiber (estimated 15,546 feet aerial and 980 feet underground) from the AG1-548 substation control house to the nearest splice point on the Zayo-owned fiber backbone (near 41.9036, -79.8614).
- Utilize the Union City to Backbone ADSS fiber cable to create a full fiber path between AG1-548 and Union City.

2.3 MPLS Equipment

- Estimated design, installation, and testing/commissioning for MPLS equipment for SCADA transport at AG1-548 Substation. Assumed SCADA work is included in this cost.
- Estimated cost associated with Crossbow engineering and materials at AG1548 Substation.
- Estimated cost associated with new ADSS Fiber installation for SCADA transport at AG1-548 Substation.
- Estimated (1) in-sub fiber run from AG1-548 Substation control house to developer-built fiber run to support communications and control to generator site.

2.4 New Interconnection Substation – FE Option to Build Scope

FirstEnergy work at new Interconnection Substation

- Above Grade
 - Install (1) security system and camera system.
 - Install (1) indoor security AC cabinet.
- Relay and Control Scope of Work
 - Install (1) network fiber termination rack.
 - Programming of SCADA RTU.
- Scope of Work Assumptions
 - Assumed developer will install camera foundations and conduits to FirstEnergy standards.
 - Assumed 2 weeks of testing and commissioning for testing to Transmission Control Centers.
 - Assumed Project Developer will install fiber from generator station to OTB station and bring fiber into control house.
 - FirstEnergy will be responsible for network fiber.
- Ancillary Scope of Work
 - Project Management
 - Project management will be required for this asset.
 - Information Technology
 - Refer to section 2.2 & 2.3 for SCADA backhaul connection and MPLS installation
 - Testing and Commissioning
 - Testing of new site to Transmission Control Center; perform functional testing as required

3. NETWORK UPGRADES

3.1 Erie South – Union City 115 kV, PNT-115-RC Line

The Erie South – Union City 115 kV, PNT-115-RC line will be cut and looped into the new interconnection substation at a point approximately 2.8 miles from Union City substation, between structures 116 and 117.

- Existing Conditions
 - The existing line is constructed on single circuit 115kV wood H-frame structures.
 - Per TAMI, the existing conductor is 795 kcmil 26/7 ACSR shielded with (2) 3/8"-7 Strand EHS Steel
- Structures Installed

- (2) 115 kV single circuit steel mono-pole deadend structures on concrete foundations (TR-138325).
- 0.1 miles spans of 795 kcmil 26/7 ACSR conductor, shielded with (2) 7#8 Alumoweld.
- (6) substation deadend assemblies (TR-020270).
- Transfer of the existing conductor and shieldwire onto the new deadend structures. A total of (6) conductor transfers and (4) shieldwire transfers.
- Structures Removed
 - Approximately (0.1) circuit miles of 795 kcmil 26/7 ACSR conductor and (0.2) miles of 3/8"-7 Strand EHS Steel.
- Permitting
 - A PAPUC LON will be required
- Scope of Work Assumptions
 - It is assumed the adjacent structures are adequate to support the new loading. An engineering analysis is required to confirm.
 - It is assumed that the existing conductor and shield wire is in adequate condition and can be transferred to the new structures.
 - Conductor will match existing and shield wire is assumed to be 7#8 Alumoweld.
 - Assume that a ground survey is required.
 - Assume that outage requirements can be met.
- Ancillary Scope of Work
 - Project Management
 - Provide project management, coordination, administration, scheduling, material management and project development if required
 - Forestry
 - Clearing may be required. Priority tree rights may be expanded.
 - Real Estate & Right-Of-Way
 - Additional guying rights may be required for the two new deadend structures.
 - A rights and restrictions review by Real Estate will be required.
 - Assume all work will be performed within the existing ROW or on substation property with no additional ROW required.
 - Real estate estimate has been included for:
 - Internal support including document review, project planning meetings, subcontractor oversight and assistance with transfer of assets if required.
 - External support for acquisition of access roads and laydown yards, rights & restrictions reviews, easement digitization and other GIS support, general project support, and minimal construction support and damage

settlements/releases.

- Acquisition of 1 yard.
- Modified/new guying rights; assuming of 2 locations.
- We have not included acquisition labor or cost of potential priority tree rights unless specified as needed in the scope and assumptions.
- Direct damage payments not included in estimate.
- Environmental
 - An environmental survey will be required to identify any additional construction constraints or additional permitting requirements.
- Revenue Metering
 - None
- Information Technology
 - None
- Access Road Construction
 - Access roads will be required, terrain is flat (approximately 0.1 miles).
- Distribution
 - None

3.2 Erie South Substation

Install new relaying and carrier equipment

- Below Grade Scope of Work:
 - Install (1 lot) foundations, trench, conduit and grounding for new equipment.
- Above Grade Scope of Work:
 - Install (1) 115 kV wide band line trap, line tuner, and coax.
- Relay & Control Scope of Work
 - Install (1) standard line relaying panel with (1) SEL-421 and (1) SEL-411L
 - Install (1) carrier panel with (3) UPLCs and (1) PCM-5350
 - Update relay settings
 - Modify drawings for line name change
- Scope of Work Assumptions:
 - Control house has adequate space for new panels
 - Station AC and DC systems are adequate
 - The communications processor has adequate amount of ports available

- The SCADA RTU has an adequate amount of spare points available
- 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 Scope of Work
 - Project Management
 - Provide project management, coordination, administration, scheduling, material management and project development if required.
 - Information Technology
 - Estimated SCADA work at Erie South Substation to support relay, meter, UPLC, wave trap, and PCM installation, as well as the installation of a SAS-K12 Switch with drawing updates.
 - Testing and Commissioning
 - To test and commission all power assets.

3.3 Union City Substation

Install new relaying

- Relay & Control Scope of Work
 - Install (1) standard line relaying panel with (1) SEL-421 and (1) SEL-411L
 - Install (1) SEL-2411
 - Install (1) lot SEL and control cables
 - Update relay settings
 - Modify drawings for line name change
- Additional Equipment to be Removed
 - (1) wave trap and line tuner
 - (1) PCM-5350
- Scope of Work Assumptions
 - Control house has adequate space for new panels
 - Station AC and DC systems are adequate
 - The communications processor has adequate amount of ports available
 - The SCADA RTU has an adequate amount of spare points available
 - 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 Scope of Work
 - Project Management

- Provide project management, coordination, administration, scheduling, material management and project development if required
- Information Technology
 - Estimated SCADA work at Union City Substation to support relay and SATEC meter and wave trap installation.
- Testing and Commissioning
 - Test and commission all power assets.

3.4 Union City Substation (Shared with AF2-010)

Install equipment for anti-islanding scheme.

- Below Grade
 - Foundation for the new wave trap
- Above Grade
 - Install a wide band wave trap and tuner
- Relay & Control Scope of Work
 - Install (1) SEL-2411 automation controller to transmit breaker status over fiber for the interconnection substation.
 - Install (1) UPLC-II FSK Tx/Rx to receive breaker open status from Erie South.
 - Install (1) skewed hybrid, and PCM-5350 PLC monitor for Erie South Line exit.
 - Revise relay settings.
- Scope of Work Assumptions
 - It is assumed the new UPLC-II and PCM-5350 will be installed inside existing panel
 - Existing DC system and SCADA RTU are adequate.
 - There is an existing FTP and it is adequate.
 - 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 Scope of Work
 - Project Management
 - Project management will be required for this asset.
 - Testing and Commissioning
 - Testing and commissioning services as required for revised relay settings, frequency changes, and end to end testing.

3.5 Titusville Substation (Shared with AF2-010)

Install equipment for anti-islanding scheme.

- Relay & Control Scope of Work
 - Install (2) UPLC-II FSK Tx/Rx to receive breaker open status for the interconnection substation and Grandview substation.
 - Install (1) balanced hybrid, and (2) PCM-5350 PLC monitors for the new interconnection substation.
 - Install (1) skewed hybrid, and (2) PCM-5350 PLC monitors at Grandview line exit.
 - Revise relay settings and adjust PLC frequencies.
- Scope of Work Assumptions
 - It is assumed the new UPLC-II and PCM-5350 will be installed inside existing panel
 - Existing DC system and SCADA RTU are adequate.
 - There is an existing FTP and it is adequate.
 - 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 Scope of Work
 - Project Management
 - Project management will be required for this asset.
 - Testing and Commissioning
 - Testing and commissioning services as required for revised relay settings, frequency changes, and end to end testing.

3.6 Erie South Substation (Shared with AF2-010)

Install equipment for anti-islanding scheme.

- Relay & Control Scope of Work
 - Install (1) UPLC-II FSK Tx/Rx to receive breaker open status.
 - Install (1) balanced hybrid, and (1) PCM-5350 PLC monitor.
- Scope of Work Assumptions
 - It is assumed the new UPLC-II and PCM-5350 will be installed inside existing panel
 - Existing DC system and SCADA RTU are adequate.
 - 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 Scope of Work
 - Project Management
 - Project management will be required for this asset.

- Information Technology
 - Estimated SCADA work at Union City Substation to support relay and SATEC installation.
- Testing and Commissioning
 - Testing and commissioning as required for revised relay settings, frequency changes, and end to end testing.

3.7 Grandview Substation (Shared with AF2-010)

Install equipment for anti-islanding scheme.

- Relay & Control Scope of Work
 - Install (1) UPLC-II FSK Tx/Rx to receive breaker open status.
 - Install (1) balanced hybrid, and (1) PCM-5350 PLC monitor.
- Scope of Work Assumptions
 - It is assumed the new UPLC-II and PCM-5350 will be installed inside existing panel
 - Existing DC system and SCADA RTU are adequate.
 - 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 Scope of Work
 - Project Management
 - Project management will be required for this asset.
 - Information Technology
 - Estimated SCADA work at Union City Substation to support relay and SATEC installation.
 - Testing and Commissioning
 - To test and commission all power assets.

4. Other Scope of Work

4.1 Support for Project Developer owned revenue metering.

4.2 Option to Build Oversight

FirstEnergy oversight of developer design and construction of new interconnection substation

- Below Grade

- Must meet FirstEnergy standards - Option to Build.
- Above Grade
 - Must meet FirstEnergy standards - Option to Build.
- Relay and Controls Scope of Work
 - Must meet FirstEnergy standards - Option to Build.
- Scope of Work Assumptions
 - Engineering oversight for review/comment of OTB site design for meeting FirstEnergy Standards.
 - Geotechnical/site/civil oversight for review/comment of OTB site grading design for meeting FirstEnergy standards.
 - Construction Oversight assumed for 6 months (note: potential for additional oversight for Geotech/site/civil site construction for challenging projects).
 - Developer responsible for apparatus testing of devices and supplying results to FirstEnergy
 - FirstEnergy commissioning oversight is assumed for duration of construction
- Ancillary Scope of Work
 - Project Management
 - Coordinate with developer and provide project management, coordination, administration, scheduling, material management and project development for FirstEnergy scope of work.
 - Provide construction oversight for project construction duration.
 - Forestry
 - Completed by Developer.
 - Real Estate and Right-of-Way
 - Support as required for transfer of property to FirstEnergy upon construction completion
 - Internal support including document review, project planning meetings, assistance with transfer of assets as required.
 - Environmental
 - Environmental review of proposed site.
 - Testing and Commissioning
 - Commissioning review of developer supplied information and witness of critical testing

5. MILESTONE SCHEDULE FOR COMPLETION OF MAIT WORK

Facilities outlined in this report are estimated to take 41 months to construct, from the time the Generation Interconnection Agreement is fully executed. This schedule may be impacted by the timeline for procurement and installation of long lead items, the ability to obtain outages to construct and test the proposed facilities.

Description	Start Month	Finish Month
Preliminary Engineering	1	2
Detailed Engineering	5	28
Siting, Permitting & Real Estate	3	28
Equipment Delivery	30	30
Construction	31	39
Testing and Commissioning	37	41

6. ASSUMPTIONS IN DEVELOPING SCOPE/COST/SCHEDULE

6.1 Scope Assumptions:

- Project Developer will coordinate design and alignment of proposed 115 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.
- Project Developer will coordinate design and construction of proposed 115 kV lead line. For these areas, the Project Developer 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 115 kV terminal positions. As a minimum, Project Developer facilities should not encroach within 100 feet of TO centerline at blowout conditions. If Project Developer'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 Project Developer, if final alignment of the 115 kV generator lead line causes encroachments, changes, or modifications to any existing or relocated TO facilities.
- Project Developer is responsible for making 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 MAIT Transmission System by a Power Transformer with a winding configuration meeting the requirements in FirstEnergy's "Requirements for Transmission Connected Facilities" document.

6.2 Cost Estimate Assumptions:

- The cost estimates provided in this report were developed as of August 15, 2024, based upon current

market conditions. Hence, they are subject to significant changes in the event that project implementation is delayed. Notwithstanding the cost estimates from this report being used in the Generator Interconnection Agreement for the related project, MAIT reserves the right to re-evaluate and provide a more accurate cost estimate during the implementation phase of the project. In accordance with section 217 of the Open Access Transmission Tariff, the Project Developer will be responsible for 100 percent of the actual costs of the facilities required to accommodate its Interconnection Request.

- MAIT reserves the right to charge the Project Developer operation and maintenance expenses to maintain the Project Developer attachment facilities, including metering facilities, owned by MAIT. These costs will be specified in the Generator Interconnection Agreement.

6.3 Schedule Assumptions:

- This schedule assumes that all issues covered by the “Environmental, Real Estate and Permitting Issues” section of this document are resolved. Construction cannot begin until after all applicable permits and/or easements have been obtained.
- MAIT’s ability to support this schedule also depends on the feasibility of taking the required outages to support construction. Outages that are determined to negatively impact system reliability or cause congestion may be delayed or denied, at any time, even if they are submitted on time based on the Outage Submittal Rules in section 4.2.1 of PJM Manual 03. This includes, but is not limited to, outages requested between the months of June and September, as well as January and March, which typically get denied due to summer and winter peak conditions. Therefore, the construction schedule will be adjusted as needed to accommodate any outage restrictions that have been identified by MAIT or the Transmission Provider.

7. REVENUE METERING REQUIREMENTS

All revenue metering needed for this interconnection project must meet the metering requirements stated in Appendix 2, section 8 of the AG1-548 GIA, and in PJM Manuals M01 and M14D. The details of applicable revenue metering requirements are given in the “[Requirements for Transmission Connected Facilities](#)” posted on PJM website.

The revenue metering will be installed on the Project Developer side of the Point of Change in Ownership, and will be installed, owned, and maintained by Project Developer.

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:

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

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 Project Developer to PJM. Transmission Owner will work with PJM and Project Developer to ensure the generation data provided to PJM meets Transmission Owner's requirements.

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

8. LAND REQUIREMENTS FOR INTERCONNECTION SUBSTATION

Land requirements for the Interconnection Substation needed for this interconnection project must meet the requirements in the following documents posted on PJM website.

- Requirements for Transmission Connected Facilities
- Geotechnical Design Requirements

The appropriate land requirements for a new Interconnection Substation are dependent on several electrical and physical factors/attributes. FirstEnergy will ultimately have to evaluate every property individually to assess the feasibility of construction, as well as any additional requirements that may be needed to support geotechnical and environmental concerns.

As a preliminary guide for site selection, FirstEnergy has provided a list of specifications for the substation size, Siting and Geotechnical standards, and Environmental requirements. It is important to note that these specifications are general, and as such, no construction activities should be performed on a selected site without prior approval from FirstEnergy.

8.1 Site Dimensions and Layout:

The typical new interconnection substation is a three-breaker-ring bus tapping an existing transmission line. The standard layout and dimensions of the substation are based on the voltage level of the interconnection system.

Below is a table summary of the typical substation dimensions for AG1-548. The standard requirement for a parking area has been included. However, Environmental, Geotechnical, and other factors may significantly increase the area required. For example, sites that require stormwater detention facilities will require area in addition to the typical dimensions provided in the table.

3 breaker Ring Bus Voltage	Dimension Size (ft)	Dimension Acres	Dimension size w/ 100ft buffer (ft)	Acre size w/ 100ft buffer	Parking (15 cars) 230ftx60ft	Total Acres (Buffer + Parking)
115	228x228	1.35	328x328	2.7	0.5	3.2

8.2 Real Estate Transfer

The preferred method for conveying a property to the TO is by "fee simple" transfer. If there are subdivisions or other conditions that hinder the ability for the Project Developer to convey the property by "fee simple" transfer, the TO may allow the use of an exclusive easement. These conditions should be discussed with the TO, and the accepted method of transfer should be confirmed early in the Interconnection process.

The Project Developer is required to obtain the following documents in the sequence listed below:

- Acquire the Interconnection Facilities property in fee from the property owner.
- Acquire an easement from the property owner for the Interconnection Facilities to the TO's T-Line (using the TO's template), if the size of property acquired doesn't sufficiently bi-sect the TO's existing right of way. If the property acquired by the Project Developer sufficiently overlaps the TO's existing right of way, this Interconnection Facilities easement is not needed.
- Provide access agreements to the TO from the property owners and Project Developer (this may be required if an exclusive easement is being used instead of conveying property to the TO in "fee simple").
- Provide an assignment of appropriate easement rights to the TO upon project completion. (Note: assignment must include all of TO's language in order to safely, operate and maintain facilities. It's critical that TO's easement templates are used when Project Developer is acquiring easements intended to be assigned to the TO.
- Provide deed conveyance of "fee simple" property for the Interconnection Facilities to the TO upon project completion and prior to transfer of title to personal property.

Document Exhibits:

Project Developer shall provide a survey and legal description detailing the location of the substation (preferably located adjacent to an existing transmission line right of way), ingress-egress to the substation from a dedicated public roadway, and easement for distribution and communication facilities and/or transmission facilities if necessary. This drawing shall be prepared by a licensed and registered surveyor and include at a minimum (ingress-egress, distribution and communication facilities locations may not need to be shown on the survey if property being conveyed is by "fee simple"):

- Legal description and survey of fee property being conveyed, including all lot split requirements
 - When property is conveyed to the TO by fee simple, the Project Developer is required to submit a completed Phase I Environmental Site Assessment (ESA) to the TO in accordance with all the requirements outlined in ASTM E 1527-05 prior to the start of construction of a substation property that will be transferred to the TO. Furthermore, if the Phase I ESA completed for the property documents the presence of any recognized environmental conditions (RECs), the Project Developer shall bear the cost and responsibility to complete a Phase II ESA in accordance with ASTM Standard E 1903-97 (Guide for Environmental Site Assessments: Phase II Environmental Site Assessment Process), however, final approval and property conveyance shall be at the sole discretion of the TO.
- Legal description for new transmission right of way (if "fee simple" conveyance is not used)
- Legal description for new distribution right of way (if "fee simple" conveyance is not used)
- Legal description for any other energy-related facilities that may be required (if "fee simple" conveyance is not used)
- Legal description for ingress-egress to a dedicated public roadway (if fee simple conveyance is not used)
- Survey drawing that shows:
 - New right of way along with the location of existing easements

- Other existing facilities on the property
- Names of adjoining property owners
- Basic drawing features: title block, north arrow, legend, graphic scale

8.3 Geotechnical and Siting Requirements:

Project Developer shall refer to [Geotechnical Design Requirements](#) provided on PJM's website. In addition, below are a list of standard siting guideline to account for when selecting a property for the interconnection substation:

- Slopes steeper than 2:1 and/or taller than 10' shall have slope stability performed.
- Factor of Safety (FS) shall be 1.5 for permanent condition.
- Minimum road width shall be 16'. AutoTurn Analysis shall be performed to accommodate the design vehicle needed inside the substation curve widening to be provided as necessary.
- Longitudinal slope for main access road to substation shall be 0.5%-10%. This is a mandatory design specification.
- Slope across the substation pad shall be 0.5%-2%.
- Every 20' vertical slope shall require a bench.

Site Grading and Preparation Responsibility:

It is the responsibility of the Project Developer to properly vet a proposed substation location. The proposed location should be reviewed by a Civil Engineer to determine the site's suitability for construction and operation as a substation (refer to Attachment 5 to FE's preliminary Geotechnical summary report). This should include a review of available information regarding the specific site location that should be considered when estimating constructability, risk, cost, and schedule. The substation is considered the substation and all associated FirstEnergy Facilities needed to operate and maintain the site such as, access roads, stormwater management facilities, walls/structures, and utilities. This review should include, but is not limited to:

- Geologic Hazards
 - Karst
 - Geologic formation/group
 - Hard bedrock (shallow bedrock difficult to excavate)
 - Weak bedrock
 - Landslide susceptibility and topography
 - Surficial soils survey
 - Coal resource mapping
- Environmental Hazards
 - Flood mapping
 - Wetland Mapping
 - Any pollution information that could affect construction.
 - Corrosivity
- Past development
 - Mining activity
 - Previously reclaimed site

9. ENVIRONMENTAL AND PERMITTING

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

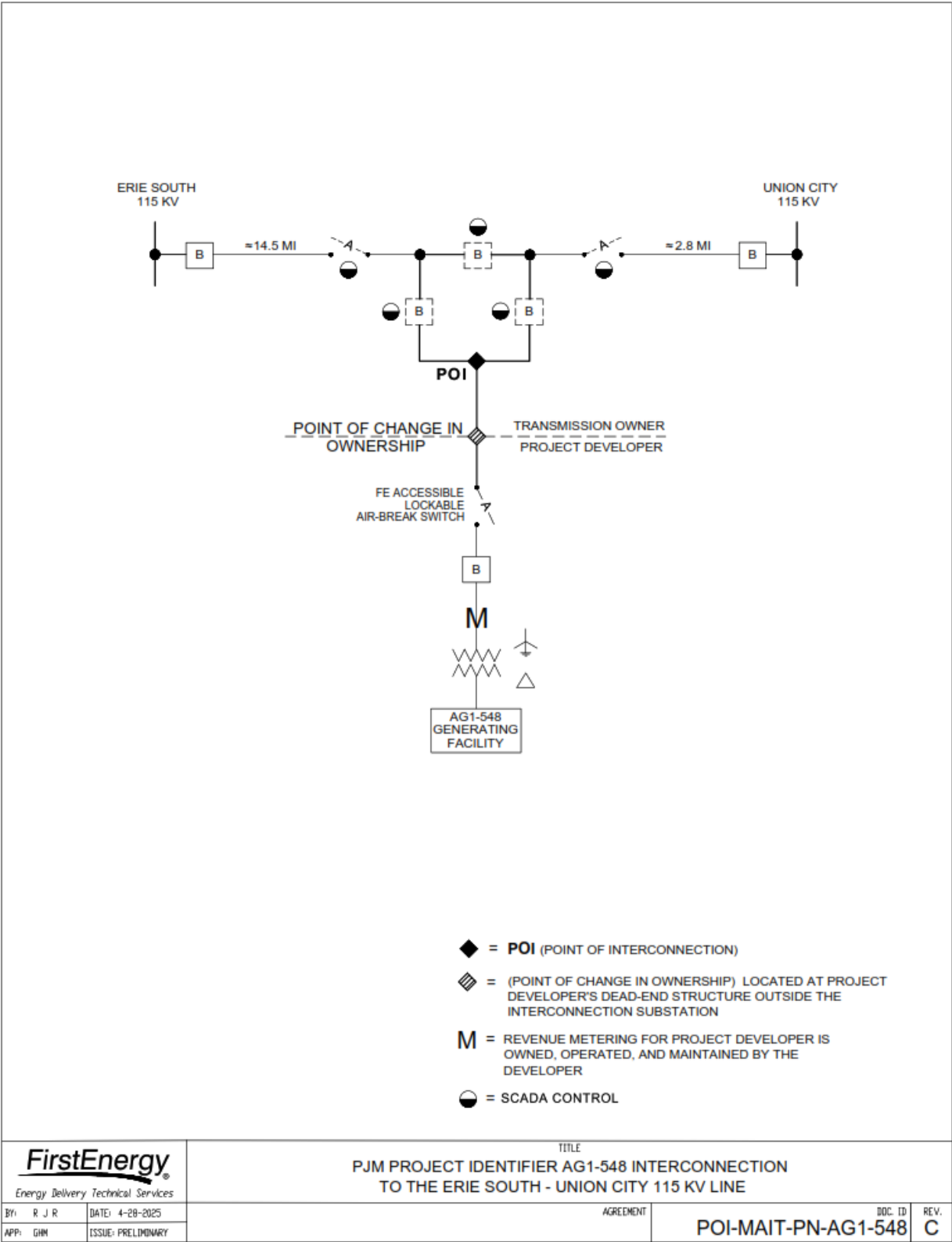
- Environmental permitting, Real Estate acquisition, and Pennsylvania Public Utility Commission (PaPUC) notifications vary, some up to twelve (12) months after preliminary engineering is completed to secure the required approvals.
- Prior to agreement by Project Developer to purchase the property, a Phase 1 Environmental Assessment should be conducted for the entire site to avoid assumption of environmental liabilities by Project 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 Project 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 Project Developer, twelve (12)-to-eighteen (18) months should be added to the Project Schedule to secure necessary permits, and additional costs would apply.
- Project Developer will provide copies of all the relative environmental permits and other necessary approvals to Transmission Owner before Transmission Owner accepts the interconnection facilities.
- Project 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. Project Developer is responsible to maintain access road and ensure unimpeded access for Transmission Owner at all times.
- Project 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 Project 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. Project Developer is responsible for all costs, including but not limited to subdivision, associated with the property transfer.
- If Project Developer leases the project property, the Project 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 PUC notification/approval.
- All work occurs within an existing transmission line right-of-way or on Project 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.

- Project 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.
- Project Developer will obtain all necessary permits.
- Project Developer will conduct all necessary wetlands and waterways studies and permits.
- Project Developer will conduct all necessary historical and archaeological studies.
- If the Project 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>

C. APPENDICES

ATTACHMENT #1: SINGLE LINE DIAGRAM FOR THE PHYSICAL INTERCONNECTION





ATTACHMENT #3: MATERIAL LIST AND EQUIPMENT RATINGS

Material/Equipment	Quantity
Cable Trench (lf)	200
Battery Charger (ea)	1
Remote Terminal Unit (RTU) (ea)	1
Insulator - Line - Polymer (ea)	6
Insulator - Line - Porcelain/Glass (ea)	174
Engineered Steel Poles (ea)	2
Steel Support Structure (ea)	56
Hard Bus - 1.5 inch (ft)	120
Hard Bus - 3 inch (ft)	880
Battery Monitor (ea)	1
Package Control Enclosure - Prefabricated (ea)	1
Relay - Individual (ea)	17
Relay Panel (ea)	11
Circuit Breaker - 138 kV (ea)	3
Anchor Bolt - Substation (ea)	376
Insulator - Substation - 138 kV (ea)	84
Line Trap - 138 kV (ea)	3
Surge Arrester - 138 kV (ea)	9
Capacitor Coupled Voltage Transformer (CCVT) - 138 kV (ea)	9
Station Service Voltage Transformer (SSVT) - 138 kV (ea)	1
Security - Camera (ea)	16
Security - Physical Access Control (Badge Reader) (ea)	3
Battery - 125V (ea)	1
AC/DC Panelboard (ea)	2
Disconnect Switch - Substation - 115 kV (ea)	6
Disconnect Switch - Substation - 138 kV (ea)	3
Switch - Motor Operator - Substation (ea)	3
Cable - Control/Communication (lf)	36660
Conductor - AAC (ft)	1240
Conductor - ACSR (ft)	1742.4
Conduit - Rigid (lf)	1093
Wire - Fiber - ADSS (ft)	16570.61
Wire - Shield - OHGW (lf)	580.8

ATTACHMENT #4: PROTECTION SCOPE

Description:

- AG1-548 115kV: Interconnection on Erie South – Union City 115kV Line.

Relevant future projects for reference:

This scope assumes that the following projects will be completed prior to, or concurrently with AG1-548 (See AF2-010 Protection document for Common Use scope requirements):

- PN-22-200302-165741 – AF2-010 Interconnection on Titusville – Union City 115kV

New 3-breaker ring bus

- Dual SEL-411L Standard BES line protection for primary and backup line differential schemes communicating over fiber channels for interconnection tie line to generator collector substation, and (3) line-side CCVTs.
- SEL-421/SEL-411L Standard BES line protection for primary DCB and backup DCUB line protection for Erie South 115kV line, and carrier equipment, including (2) UPLC-II carrier transmitter receivers and (2) PCM-5350 power line carrier monitors, (2) wide band line tuners, (2) wide band line traps, and (3) line-side CCVTs.
- SEL-421/SEL-411L Standard BES line protection for primary POTT and backup line differential protection for Union City 115kV line communicating over dedicated fiber, and (3) line-side CCVTs.
- Fiber shall be installed for dual pilot line protection communications between Union City and the new AG1-548 Interconnection Substation 3-breaker ring bus.
- (3) SEL-451 for breaker failure protection
- (1) UPLC-II FSK unit to receive breaker status from Erie South for anti-islanding
- (1) SEL-2411 to transmit and receive breaker status to and from Union City over dedicated fiber for anti-islanding
- SEL-3530 RTAC data concentrator for relay distance to fault information to SCADA, and remote access to relays if a network connection is available
- Qualitrol FL-8 Traveling Wave Fault Location system

Erie South Substation

- For the AG1-548 terminal, install SEL-421/SEL-411L Standard BES line protection for primary DCB and backup DCUB line protection and carrier equipment, including (2) UPLC-II carrier transmitter receivers. Reuse existing PCM-5350 power line carrier monitor, wide band line tuner, and wide band line trap for the DCB scheme. Install new PCM-5350 power line carrier monitor, wide band line tuner, and wide band line trap for the DCUB scheme. Install new or reuse existing UPLC-II FSK Transmitter/Receiver to transmit breaker status to the new 3 breaker ring bus for anti-islanding.

Union City Substation

- For the AG1-548 terminal, install SEL-421/SEL-411L Standard BES line protection for primary POTT and backup line differential protection communicating over new dedicated fiber. Remove existing power line carrier equipment including PCM-5350 power line carrier monitor, wide band line tuner, and wide band line trap. Install a new SEL-2411 to transmit and receive breaker status over dedicated fiber to and from the new 3 breaker ring bus for anti-islanding.

ATTACHMENT #5: PRELIMINARY GEOTECHNICAL SUMMARY**Observation & Concern Table:**

Category	Source	Risk	Comment
Surficial Soil Survey	USDA Soil Survey	Low to Moderate	Fair drainage in surficial soils but potential for deep weaker soils.
Geologic Formation/Group	PA Geologic Survey	Low	Formation consists of light-gray siltstone, gray sandstone, and bluish-gray shale
Karst	USGS/PA Geologic Survey	Moderate	Sinkholes and Karst formations in the area.
Landslide Susceptibility	GIS/Google Earth/FEMA Risk Map	Low	Located in low-risk area
Coal Resource	PA Geologic Survey	Low	No coal mining activity in this area
Environmental Hazard	US Wetland Maps/FEMA	Low	Low environmental impact
Past Development	TAMI/GIS MAP	Low	Undeveloped Farmland/Fields

Geologic Hazards

This review was conducted to determine potential geologic hazards and risk at the proposed generator developer location. The reviewed location is in Erie County, Pennsylvania. This included a proposed substation and pole structure dead ends. This location was reviewed for surficial soils survey, geologic formation/group, karst, landslide susceptibility, coal resource mapping, environmental hazards, and past development. The review was performed to identify if any geologic risks could affect the project's budget, constructability, or schedule.

Surficial Soil Survey

The proposed site is located within the Venango silt loam soil type. Which contain fine grained clays (CL) and gravels (GC). Both soil types provide fair drainage with proper construction and environmental controls. Glacial till soils like this one have potential for weaker soils and greater depth.

Geologic Formation/Group

This area is part of the Venango Formation. Which is a complex unit consisting of light-gray siltstone, gray sandstone, and bluish-gray shale. The Panama Conglomerate and Woodcock Sandstone are upper and lower key horizons (not always present). Bedding is well developed in most places, and bed thickness ranges from less than 1 foot to 4 feet.

Karst

There are no labeled karst or sinkhole formations on this site. A determination of this should be discussed in the sites geotechnical report to best understand the risk.

Landslide Susceptibility

Based on the PA DCNR map Erie County, Pennsylvania is considered low risk of landslides. The topography of the site varies approximately 1 foot north to south and 1 foot east to west.

Coal Resource mapping

There are significant coal resources or mining activity in this region.

Environmental Hazards

Based on FEMA and U.S. Fish and Wildlife Service maps there is no mapped wetlands or flood zones in this development area. An environmental study should still be performed to confirm this prior to construction.

Past Development

The past development assessment of the site was based on aerial photography. Based on aerial photography dating back to 1985 this site has not been previously developed or mined. It appears to have remained a field.

Recommendations & Geotechnical Opinion

List of Observations/Concerns Interconnection Facilities – Erie South-Union City 115kV AG1-548:

1. Soils are well drained with proper construction controls. Weaker deep glacial till soils.
2. 2. No risk of karst based on available data.
3. 3. Low to risk for landslide.
4. 4. Low environmental impact risk.

Preliminary Geotechnical Opinion

The geotechnical conditions of this site seem to conclude that it is a low-risk location for substation development. There is some potential for weak deep glacial till soils. The developer should plan a subsurface investigation and geotechnical report commenting on risk before development begins. All these findings should be confirmed with field data.