# Facilities Study Report

# For

# Physical Interconnection of

# PJM Generation Interconnection Request Project ID AF2-010

# "Union City-Titusville 115 kV"

Revision 1: August 2025

## Introduction

This Facilities Study has been prepared in accordance with the PJM Open Access Transmission Tariff. 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 Generating Facility located in Union City, Erie County, Pennsylvania. The installed facilities for AF2-010 will have a total Maximum Facility Output (MFO) of 77 MW with 46 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 Titusville – Union City 115 kV line, PNT-115-DU, approximately 1.27 miles from Union City substation.

The construction of the new interconnection substation will result in the splitting of the existing Titusville – Union City 115 kV line, PNT-115-DU, 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 AF2-010 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.
    - Information Technology
        - SCADA: Add Generator Substation to EMS Screens

## 2. STAND ALONE NETWORK UPGRADES

2.1 New Interconnection Substation

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

The new substation will be located approximately 1.27 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:
    - Grading, drainage, fence, grounding, and stoning of new substation.
    - Foundations, conduit, trench, and grounding for new equipment.
    - Install stormwater detention basin.
    - Install conduit for fiber.
- Above Grade Scope of Work:
    - Install (1) lot fence.
    - Install (1) prefabricated control house.
    - Install (3) 115kV, 3000A, 40kAIC circuit breakers.
    - Install (6) 115kV, 2000A disconnect switches.
    - Install (3) 115kV, 2000A MOAB line switches.
    - Install (9) 115kV CVTs.
    - Install (1) 115kV line trap, line tuner, and coax for Titusville line exit.
    - Install (9) 115kV class surge arresters.
    - Install (3) 115kV dead end structures.
    - Install (2) SSVTs.
    - Install (1) lot of rigid bus, strain bus, support structures, insulators, grounding, lighting, and connectors.
    - Security System.
- Relay & Control Scope of Work
    - Install (1) standard line relaying panel (for the Titusville line) with: (1) SEL-421 and (1) SEL-411L.
    - Install (1) carrier panel (for the Titusville line) with: (2) UPLCs and (1) PCM-5350.
    - Install (2) standard line relaying panels each with: (2) SEL-411L.
    - Install (3) standard breaker control panels each with: (1) SEL-451 BFT and (1) SATEC meter.

- Install (1) HMI panel, including GPS clock and RTAC.
- Install (1) communication panel
- Install (1) SCADA RTU.
- Install (1) fiber termination rack.
- Install (1) ATS.
- Install (1) lot of control cables, SEL cables, and fiber.

- Scope of work Assumptions
  - Rough graded site/ property with access road will be provided by developer.
  - Execution engineering to conductor AC/DC, lightning, and grounding studies.
  - Backup station service will not be from local distribution.
  - There has not been a Facility Study kickoff meeting yet with PJM & the Developer, so there are no site drawings available.
- Transmission Owner Permits Required:
  - 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 FE.
      - Internal support including document review, project planning meetings, and assistance with transfer of assets.
      - External support for general project support, acquisition (assuming voluntary, no condemnation); assuming NO field construction support will be required.
      - Cost of purchasing new land rights and associated fees such as recording costs or permits (estimated--actual cost will depend on current market values, land type, location and negotiations).
      - Recording fees: do not include taxes that may be required by specific counties via a "Real Estate Transfer Tax Statement of Value."
  - Environmental
    - Required for new ring bus.
  - Revenue Metering
    - None
  - Information Technology

        - Estimated SCADA work at AF2-010 Interconnection Substation to support breaker, relay, RTU, RTAC, SATEC, wavetrap, MOAB, battery charger, battery monitor, and PCM installation, as well as the installation of a SAS-K12 Switch with drawing updates.
    - Testing and Commissioning
        - Testing and commissioning services as required for new equipment and relays.
- 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

- New ADSS Fiber installation between Titusville Substation and Union City Substation.

2.3 MPLS Equipment

- Design, Installation, and testing/commissioning for MPLS equipment for SCADA transport at AF2-010 Substation.
- Estimated cost associated with Crossbow engineering and materials at AF2-010 Substation.

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 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 Titusville – Union City 115 kV, PNT-115-DU line

The Titusville – Union City 115 kV, PNT-115-DU line will be cut and looped into the new interconnection substation at a point approximately 1.27 miles from Union City substation, between structures 208 and 209.

- Existing Conditions
  - The existing line is constructed on single circuit wood H-frame structures.
  - Per TAMI, the existing conductor is 636 kcmil 24/7 ACSR shielded by (2) 3#6 Copperweld.
- Structures Installed
  - (2) 115kV single circuit steel mono-pole deadend structures on concrete foundations (TR-138325).
  - (6) 115kV substation deadend insulator assemblies (TR-020270).
  - Approximately (0.1) circuit miles of 795 kcmil 26/7 ACSR shielded by (2) 7#8 Alumoweld.
  - Transfer existing conductor and shield wire to new deadend structures.
- Structures Removed
  - Approximately (0.1) miles of 636 kcmil 24/7 ACSR shielded by (2) 3#6 Copperweld.
- Permitting
  - A Letter of Notification (LON) will be required.
- Scope of Work Assumptions
  - A ground survey will be required.
  - It is assumed that the existing conductor and shield wire are in adequate condition and can be

transferred to the new structures. An engineering analysis during project development will be required.

- It is assumed that the adjacent structures are in adequate condition and can handle new loading. An engineering analysis during project development will be required.
- Exact location of the interconnection or substation are unknown at this time.
- For estimating purposes, a location was selected. A final location will be required, and a detailed engineering analysis will be required to confirm feasibility.
- No conductor or MVA requirements were provided. For estimating purposes 795 kcmil 26/7 ACSR was selected. Final requirements will need to be determined.

- Ancillary Scope of Work
  - Project Management
    - Project management will be required for this asset.
  - Forestry
    - None
  - Real Estate & Right-Of-Way
    - Assume all work will be completed within the existing ROW.
    - Guying rights may need to be modified around the new loop structures.
    - A rights and restrictions review by Real Estate will be required.
    - Georeferenced ROW extents will be required to be provided to engineering.
    - Real estate estimate have 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 and 1 access roads.
      - 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 review will be required to identify any additional construction constraints or additional permitting requirements.
  - Revenue Metering
    - None

- Information Technology
  - None
- Access Road Construction
  - It is assumed access roads will be required along line route, approximately 0.1 miles. Terrain is flat.
- Distribution
  - None

3.2 Titusville Substation

Replace line relaying.

- Relay & Control Scope of Work
  - Replace the existing primary SEL-421.
  - Replace the existing RFL-9785 with a UPLC-II carrier set for the DCB carrier scheme.
  - Revise relay setting.
- Scope of Work Assumptions
  - It is assumed the new equipment 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.

3.3 Union City Substation

Replace line relaying.

- Relay & Control Scope of Work
  - Install a new standard BES line protection panel with dual SEL-411L relays for primary and backup line protection.
  - Revise relay settings.
- Scope of Work Assumptions

- New panel will fit in existing building.
- 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.
  - Information Technology
    - Estimated SCADA work at Union City Substation to support relay and SATEC installation.
  - Testing and Commissioning
    - Testing and commissioning services as required for new relays.

3.4 Union City Substation (Shared with AG1-548)

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 AG1-548)

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 AG1-548)

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 AG1-548)

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 57 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 | 3 | 46 |
| Siting, Permitting & Real Estate | 5 | 46 |
| Equipment Delivery | 48 | 48 |
| Construction | 49 | 55 |
| Testing and Commissioning | 53 | 57 |

## 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 July 31, 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 AF2-010 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 AF2-010. 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 PERMITING

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

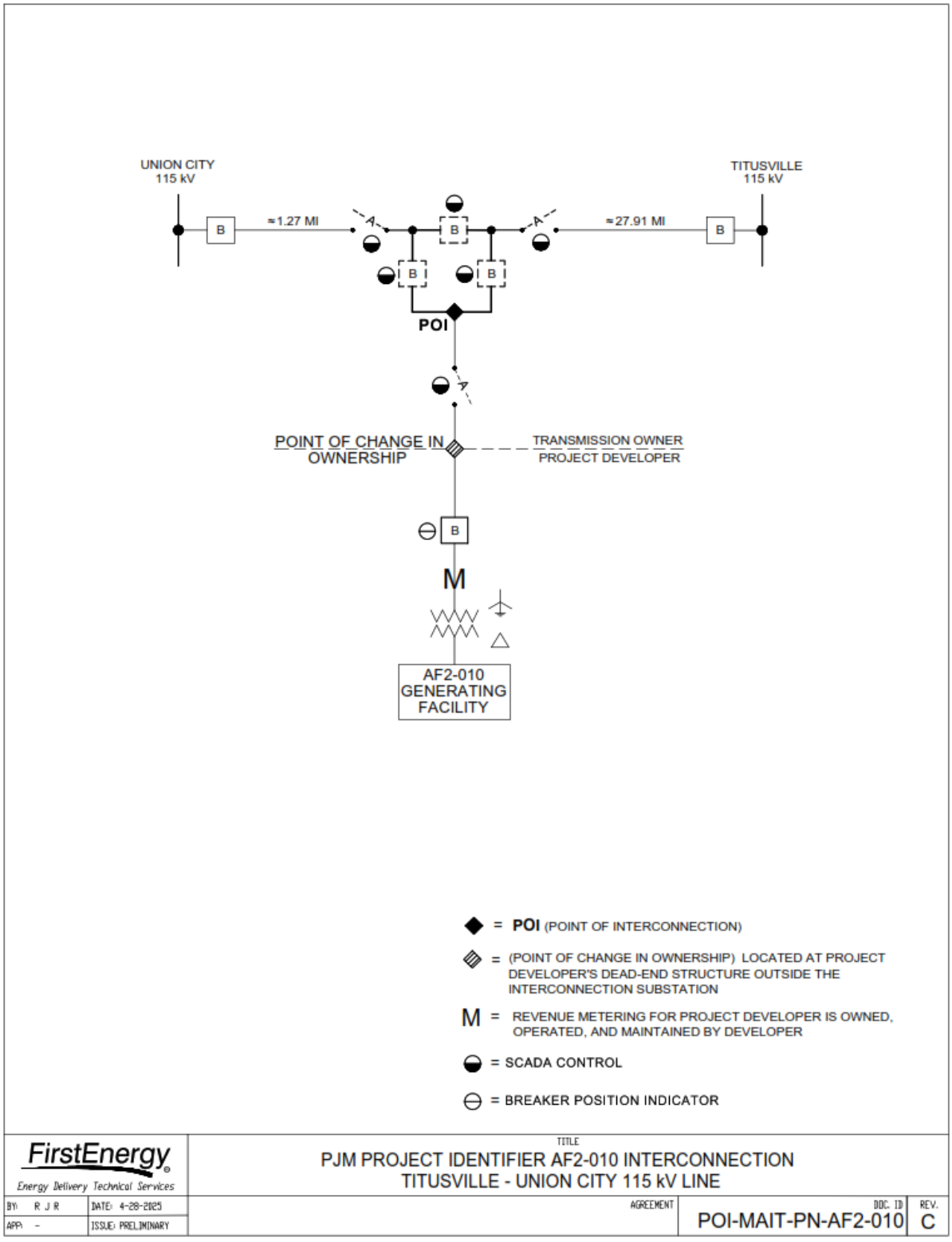
- Environmental permitting, Real Estate acquisition, and Pennsylvania Public Utility Commission (PaPUC) notifications vary, some up to twelve (12) months after preliminary engineering is completed to secure the required approvals.
- Prior to agreement by Project Developer to purchase the property, a 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:

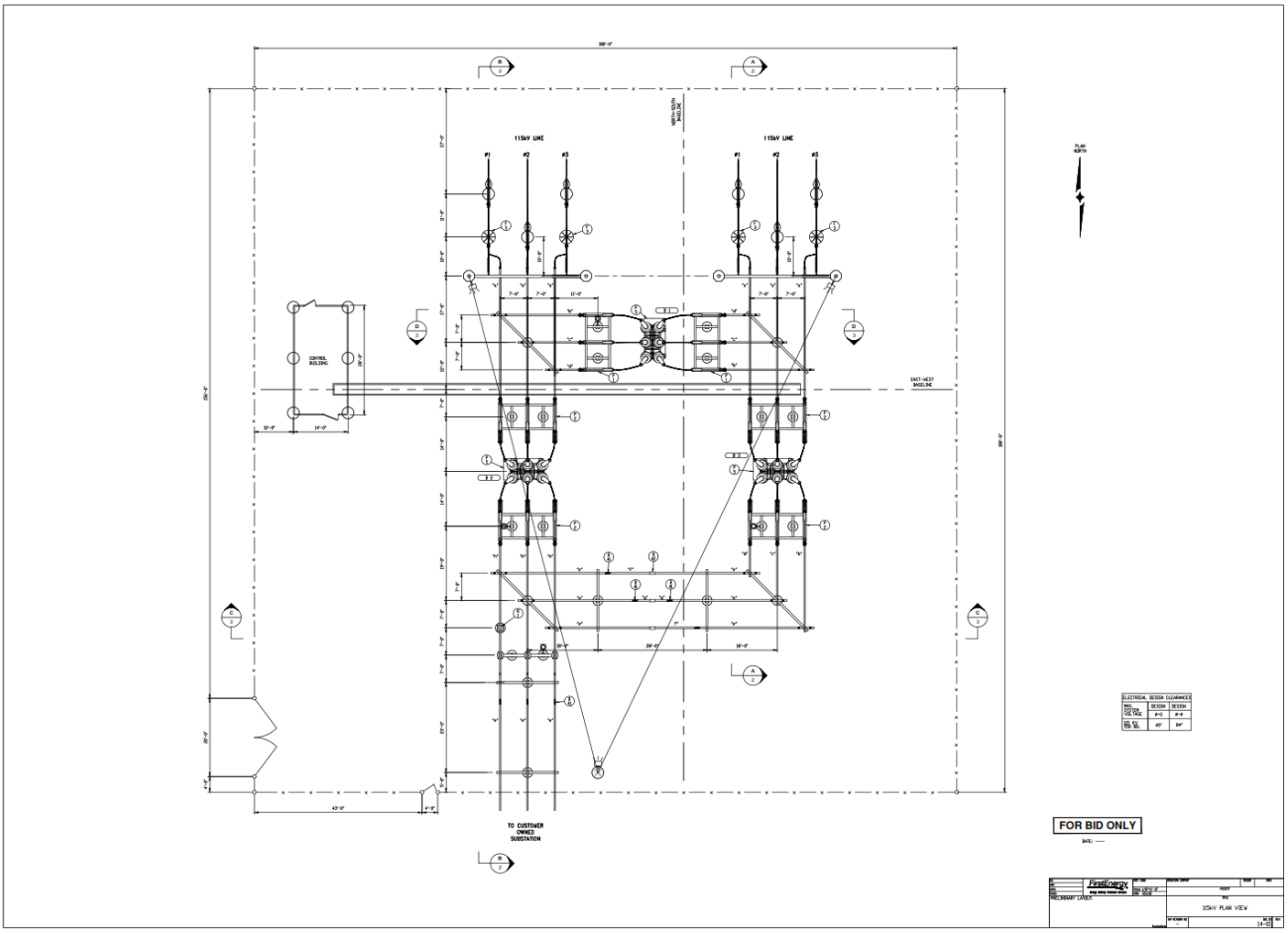
https://www.firstenergycorp.com/help/safety/real-estate-power-lines/transmission-right-of-way.html#ROWform

# C. APPENDICES

## ATTACHMENT #1: SINGLE LINE DIAGRAM FOR THE PHYSICAL INTERCONNECTION



## ATTACHMENT #2: SUBSTATION GENERAL ARRANGEMENT



**ATTACHMENT #3: MATERIAL LIST AND EQUIPMENT RATINGS**

| Material/Equipment | Quantity |
|---|---|
| Cable Trench (lf) | 150 |
| 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) | 3 |
| Steel Support Structure (ea) | 35 |
| Hard Bus - 1.5 inch (ft) | 240 |
| Hard Bus - 4 inch (ft) | 340 |
| Battery Monitor (ea) | 1 |
| Package Control Enclosure - Prefabricated (ea) | 1 |
| Relay - Individual (ea) | 23 |
| Relay Panel (ea) | 9 |
| Circuit Breaker - 138 kV (ea) | 3 |
| Anchor Bolt - Substation (ea) | 288 |
| Insulator - Substation - 138 kV (ea) | 18 |
| Line Trap - 138 kV (ea) | 2 |
| Surge Arrester - 138 kV (ea) | 9 |
| Capacitor Coupled Voltage Transformer (CCVT) - 138 kV (ea) | 9 |
| Station Service Voltage Transformer (SSVT) - 138 kV (ea) | 2 |
| Security - Camera (ea) | 22 |
| Security - Physical Access Control (Badge Reader) (ea) | 2 |
| Battery - 125V (ea) | 1 |
| AC/DC Panelboard (ea) | 2 |
| Switch - Motor Operator - Substation (ea) | 3 |
| Cable - Control/Communication (lf) | 30965 |
| Conductor - AAC (ft) | 1050 |
| Conductor - ACSR (ft) | 1742.4 |
| Conduit - Rigid (lf) | 1113 |
| Wire - Fiber - ADSS (ft) | 10560 |
| Wire - Shield - OHGW (lf) | 780.8 |

**ATTACHMENT #4: PROTECTION REQUIREMENTS**

The following facilities study protection requirements are for the AF2-010 solar interconnection to the Titusville – Union City 115kV Line.

**Short Circuit Analysis (Existing Conditions without AF2-010)**

Three phase = *5,200* A

Single line to ground = 3,400 A

Z1= 0.01628 + j 0.09521 p.u.

Z0= 0.07446 + j 0.24194 p.u.

Impedances are given on a 100 MVA and 115kV base. The fault currents provided are bolted, symmetrical values for normal system conditions. Future increases in fault currents are possible and it is the Developer's responsibility to upgrade its equipment and/or protective equipment coordination when necessary.

**AF2-010 Interconnection Substation**

Construct a new three breaker 115kV ring bus. Install three SEL-451 relays, one per breaker, for failure to trip protection. Install three sets of three-phase CCVTs, one for each line exit. Install three SATEC meters, one per line exit. Install a GPS Clock and SEL RTAC for remote relay access and SCADA distance to fault. Install one Qualitrol FL-8 TWS unit for traveling wave fault location.

Fiber shall be installed between Union City Substation and the AF2-010 Interconnection Substation, with at least 3 fiber pairs dedicated for protection communications. Fiber shall also be installed between the AF2-010 Interconnection & Collector Substations, with at least 2 fiber pairs dedicated for protection communications.

*Titusville 115kV line exit* – Install a new standard BES line protection panel with SEL-421 primary for Directional Comparison Blocking (DCB) over Power Line Carrier (PLC) and SEL-411L backup for step distance protection. Install one UPLC-II On-Off Tx/Rx unit for the primary DCB line protection scheme. Install one UPLC-II FSK Tx/Rx unit to receive breaker status from Titusville for the anti-islanding scheme. The primary DCB line protection and anti-islanding carrier schemes shall couple to Z-phase. Install a wide band line tuner, wide band wave trap, a skewed hybrid, and two PCM5350 power line carrier monitors

*Union City 115kV line exit* – Install a new standard BES line protection panel with dual SEL-411L relays for primary and backup line protection, utilizing a current differential protection scheme over dedicated fiber. These relays shall also provide step distance and directional overcurrent protection. Install a SEL-2411 automation controller to receive breaker status over fiber from Union City for the anti-islanding scheme at the AF2-010 Interconnection SS.

*AF2-010 Collector Sub 115kV line exit* – Install SEL-411L primary and SEL-411L backup relays for line protection, each utilizing a current differential protection scheme over dedicated fiber, with backup overcurrent and step distance protection. In addition to providing line protection, the SEL-411L relays will send and receive direct transfer trip to and from the AF2-010 Collector Substation for anti-islanding and breaker failure to trip protection. Install an anti-islanding scheme to trip AF2-010 generation should the AF2-010 generation become islanded with load on the FirstEnergy transmission system. The anti-islanding scheme will utilize the AF2-010 Interconnection Substation breaker 'b' contacts and breaker status from the remote substations as communicated via Frequency Shift Keyed power line carrier and mirrored bits over direct fiber.

**Titusville Substation**

*AF2-010 115kV line exit* – Replace the existing primary SEL-421-4 relay with an SEL-421-5 relay. Revise relay settings, adjust power line carrier frequencies as needed, and perform end-to-end testing. Replace the existing RFL-9785 On-Off Tx/Rx with a UPLC-II On-Off Tx/Rx carrier set for the DCB carrier scheme. Install one UPLC-II FSK Tx/Rx to transmit breaker open status to the AF2-010 interconnection substation for the anti-islanding scheme. Install a balanced hybrid and two PCM-5350 power line carrier monitors.

*Grandview 115kV line exit* – Revise relay settings and adjust power line carrier frequencies as needed. Install one UPLCII FSK Tx/Rx to receive breaker open status from Grandview. A handoff scheme shall transmit the breaker status to the AF2-010 interconnection substation for the anti-islanding scheme. Install a skewed hybrid and two PCM-5350 power line carrier monitors.

**Union City Substation**

AF2-010 115kV line exit – Install a new standard BES line protection panel with dual SEL-411L relays for primary and backup line protection, utilizing a current differential protection scheme over dedicated fiber. These relays shall also provide step distance and directional overcurrent protection, reclosing, and sync check. Install a SEL-2411 automation controller to transmit/receive breaker status over fiber for the anti-islanding scheme at the AF2-010 Interconnection SS.

*Erie South 115kV line exit* – Install one UPLC-II FSK Tx/Rx to receive breaker open status from Erie South. A handoff scheme shall transmit the breaker status to the AF2-010 interconnection substation for the anti-islanding scheme. Install a wide band wave trap and tuner, a skewed hybrid, and PCM-5350 power line carrier monitor.

**Erie South Substation**

*Union City 115kV line exit* – Install one UPLC-II FSK Tx/Rx to transmit breaker open status to Union City for the AF2-010 anti-islanding scheme. A handoff scheme at Union City shall forward this signal to the AF2-010 interconnection substation. Install a balanced hybrid and PCM-5350 power line carrier monitor.

**Grandview Substation**

*Titusville 115kV line exit* – Install one UPLC-II FSK Tx/Rx to transmit breaker open status to Titusville for the AF2-010 anti-islanding scheme. A handoff scheme at Titusville shall forward this signal to the AF2-010 interconnection substation. Install a balanced hybrid and one PCM-5350 power line carrier monitor.

**AF2-010 Collector Substation Protection Requirements**

*AF2-010 115kV Interconnection SS exit* – Install SEL-411L primary and SEL-411L backup line protection relays, each utilizing a current differential protection scheme over dedicated fiber, with backup overcurrent and step distance protection. The SEL-411L relays will also be used for sending and receiving breaker failure transfer trip, with the transfer trip I/O configured in the same manner as at the interconnection station. A dedicated breaker failure to trip relay is required for the 115kV breaker. A protection scheme containing generator intertie functions is required. Voltages and currents for the intertie relaying must come from the 115kV system. The fault interrupting device on the 115kV interconnection line shall be a fully rated circuit breaker.

It is the responsibility of the Developer to assure protection, coordination, and equipment adequacy within its 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

The Developer is to design its protective system to clear any faults within their zones of protection with one or more of their local circuit breakers. Each zone of protection covering the 115kV portion of the Developer's system, including the GSU transformers, is to be protected by two independent relay schemes that each provide high speed fault clearing and meet the following redundancy requirements. Primary and backup relaying shall use independent CTs, and independent CVTs or independent windings from the same CVTs. Primary and backup relaying shall not have any common wiring, isolating switches, or auxiliary tripping relays. Redundancy of a protection system can be achieved by ensuring that there is no single point of failure between two locally independent primary and backup protection schemes for a given element. Relays from the same manufacturer are acceptable for both the primary and backup schemes. The terminal breaker at the generation end of the direct connect tie line is to be included in the 115kV over-lapping zones of protection. The CTs used for the zones of protection covering the 115kV portion of the system shall use C800 relay accuracy CTs and the CTs should not saturate for the maximum through-fault current that can be experienced by the relay system for the tap ratio in use. Each 115kV breaker is to have a dedicated failure to trip relay. The GSU Transformer winding configuration shall be Grounded-Wye on the high side (FE side), and Delta on the low side (generator side).

The AF2-010 Collector Substation shall not close into the direct connect tie line if it is dead, so that all synchronizing is performed at the AF2-010 Collector Substation. All protection communications between the AF2-010 Interconnection Substation and the AF2-010 Collector Substation shall utilize fiber optic communications paths. No automatic reclosing will be applied at AF2-010 Interconnection Substation for faults on the 115kV direct connect tie line.

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

## 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 | Low | No Karst formation near site. |
| 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 risk of flooding |
| Past Development | TAMI/GIS MAP | Low | Undeveloped Farmland/Fields |

### Geologic Hazards

This 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 340-feet X 250-foot substation and 2 dead-end structures connecting to the Titusville - Union City 115kV line. 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 any geologic risks that could affect the project's budget, constructability, or schedule.

### Surficial Soil Survey

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

### Geologic Formation/Group

This site is part of the Venango Formation. The formation primarily consists of light-gray siltstone, gray sandstone, and bluish-gray shale. The Panama Conglomerate and Woodcock Sandstone are upper and lower key horizons. Bedding well developed and bed thickness is 1-4 feet.

### Karst

A determination of karst risk should be discussed in the sites geotechnical report to better understand the risk. Based on available mapping there is no risk of karst.

**Landslide Susceptibility**

Based on the PA DCNR map Erie County, Pennsylvania is considered low risk of landslides. The topography of the site varies approximately 1-6 feet north to south and 1-4 feet 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 a riverine or riverbank is within the proximity of this site. So, environmental investigations should be performed and submitted with the final design.

**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 – Titusville-Union 115kV AF2-010:

1. Glacial till soils like these have potential for weaker soils and greater depth.
2. This site is part of the Venango Formation. The formation primarily consists of light-gray siltstone, gray sandstone, and bluish-gray shale. The Panama Conglomerate and Woodcock Sandstone are upper and lower key horizons. Bedding well developed and bed thickness is 1-4 feet.
3. Low potential for Karst.
4. Low risk for landslide.
5. Low environmental impact risk.

**Preliminary Geotechnical Opinion**

This opinion assumes this is a generator developer, option to build project. The geotechnical conditions of this site seem to conclude that it is a low-risk location for a substation. There is potential for deep weak soils due to the glacial till soil types, as well as some environmental disturbance. The developer should plan a subsurface investigation and geotechnical report commenting risks before development begins. All these findings should be confirmed with field data.