# Facilities Study Report
# For
# Physical Interconnection of
# PJM Generation Interconnection
# Request Project ID AG2-448

# "Cross School – Westvaco 138 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 Potomac Edison Company (PE), a FirstEnergy company.

This Facilities Study was performed to satisfy the Phase 2 Facilities Study requirement of the PJM Tariff. The Facilities Study is intended to provide scope, cost and schedule estimates for the project as currently defined and approved for Phase 2 study. In the event project changes are made during DP2 that impact this report, updates will be provided as part of the Phase 3 report. Following execution of the project's final agreement, this report will not be updated to account for other changes made as part of the agreement's modification clause and instead the scope change process will be followed.

## A. Transmission Owner Facilities Study Summary

### 1. PROJECT DESCRIPTION

The Project Developer has proposed a solar Generating Facility located in Mineral County, West Virginia. The installed facilities for AG2-448 will have a total Maximum Facility Output (MFO) of 50 MW with 30 MW of this output being recognized by PJM as Capacity.

### 2. POINT OF INTERCONNECTION (POI)

The Generating Facility will interconnect with the PE transmission system via a newly constructed 138 kV four (4) breaker ring bus substation, tapping the Cross School - Westvaco - Kitzmiller 138 kV line, approximately 1.36 miles from Westvaco substation.

The construction of the new interconnection substation will result in the splitting of the existing Cross School - Westvaco - Kitzmiller 138 kV line into three 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, owned by the Project Developer, outside the new four (4) 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:

- 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.

The easements and associated rights of way for the TO owned substation along with the 138 kV line taps to the substation will be acquired by the 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 AG2-448 project to PE transmission system. These facilities shall be designed according to FirstEnergy Applicable Technical Requirements and Standards. Once built, PE will own, operate, and maintain these Facilities.

### 1. TRANSMISSION OWNER INTERCONNECTION FACILITIES (TOIF)

1.1 New Interconnection Substation Line Terminal

Install line terminal equipment within the AG2-448 interconnection substation. Install one span from AG2-448 interconnection substation to the Project Developer-owned dead-end structure outside of FE substation fence.

- Installations
  - 0.1 miles of conductor 795 kcmil 26/7 ACSR shielded by (1) 7#8 alumoweld
  - Disconnect switch and line exit facilities described in the New Interconnection Substation scope.
- Siting & Licensing
  - Full application will be required.
- Scope of work Assumptions
  - Location of PCO assumed
  - Location of generator substation assumed
  - A ground survey will be required for design and as-built.
  - Cost of mobilization/demobilization shared with line Loop scope of work.
  - Assume minimal social and ecological impacts.

- Assume no local opposition to the project.

- Ancillary Scope of Work
  - Project Management
    - Provide project management, coordination, administration, scheduling, material management and project development if required.

1.2 Energize and integrate generator Interconnection Facilities to the transmission system.

- Installations
  - Below Grade:
    - None.
  - Above Grade:
    - None.
- Relaying & Control:
    - Revise Relay Settings
- General Notes/Assumptions:
    - None
- Support Estimates
  - Project Management

    PM Scope:
    - Provide project management, coordination, administration, scheduling, material management and project development as required PM

    Assumptions:
    - None
  - Testing and Commissioning
    - T&C Scope:
      - Test and commission of new relay settings and metering equipment.
    - T&C Assumptions:
      - None

**2. STAND ALONE NETWORK UPGRADES**

2.1 New Interconnection Substation

Construct a new interconnection substation with 4-138kV breakers in a ring bus configuration including (1) medium control house including relaying, (4) 138kV circuit breakers, (8) 138kV disconnect switches,

(4) 138kV MOAB disconnect switches, (4) Sets of 138kV CVTs, (12) 138kV surge arresters, (4) 138kV dead end structures, (1) SSVTs, (2) Wave Traps, and new relay panels.

The new substation will be located approximately 1.36 miles from Westvaco 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 four-breaker ring bus site.

- Installations
  - Below Grade:
    - Install ground grid
    - Install cable trench, conduit, and control cables to equipment
    - Install foundations for all equipment, control house, fences posts, and structures
  - Above Grade:
    - prefabricated medium control house with (1) RTU and the relay panels noted below
    - lot battery, battery rack, and battery charger.
    - physical security camera system
    - high security fence with (2) sliding gates
    - (4) 138kV circuit breakers
    - (8) 138kV disconnect switches
    - (4) 138kV MOAB disconnect switches
    - (4) Sets of 138kV CVTs
    - (12) 138kV surge arresters
    - (4) 138kV dead end structures
    - (1) SSVTs
    - (2) Wave Traps (assumed foundations and stands needed)
    - Install (1) lot of rigid buses, insulators, conductors, and fittings

  - Relaying & Control:
    - For the Project Developer 138 kV line:
      - (2) SEL-411L relays for primary and backup line protection over dedicated fiber.
    - For the Cross School 138 kV line:
      - (2) SEL-411L relays for primary and backup line protection over dedicated fiber.
      - (1) SEL-2411 for AI to and from Cross School

- For the Kitzmiller 138 kV line:
  - (1) SEL-421 relay for primary line protection over PLC
  - (1) SEL-411L relay for backup line protection over PLC
  - (1) UPLC to be used with the primary protection
  - (1) UPLC to be used with the backup protection
  - (1) UPLC to be used with the anti-islanding
- For the Westvaco 138 kV line:
  - (1) SEL-421 for primary line protection via a step distance scheme
  - (1) SEL-411L for backup line protection via a step distance scheme
- For each of the (4) 138 kV breaker positions:
  - (1) SEL-451 relay with dedicated lockout
- For general relaying support:
  - (1) lot of SEL-3350 or similar data concentrator RTACs for relay remote access
  - (1) lot of Arbiter 1094b or similar GPS Clocks for timing
  - (1) lot of Qualitrol TWS systems for traveling wave monitoring, for networked lines > 100kV
  - (1) lot of SEL-3555 or similar data concentrator RTACs for use as PMU data concentration
  - (1) DFR to support event analysis

- Additional Equipment to be Removed:
  - None

- General Notes/Assumptions:
  - Rough graded site and access road provided by Project Developer
  - Assume will need (11) relay panels

- Project Developer/ 3rd Party Impacted Sites:
  - Project Developer will follow FE transmission protection requirements for collector substation
  - Developer is solely responsible for protecting its own equipment in such a manner that electrical faults or other disturbances on the FE transmission system do not damage its equipment.

- Ancillary Scope of Work
  - Project Management

    PM Scope:

    - Provide project management, coordination, administration, scheduling, material management and project development as required

  - Environmental

    Environmental Scope:

    - Environmental will be needed for new substation Environmental Assumptions:
    - Road Bonds are required
    - Environmental Filming (Documentation of Existing roads are required)
    - Environmental Access and Road Crossing Permit Fees are required
    - Environmental Development of Permit Binder is required
    - Environmental Cultural Resource Consultation is required
    - Environmental Construction walk down is required
    - RTE consultation letters are required Wetland delineations and WDR are required
    - Stormwater permits and local approvals are assumed
    - Internal environmental engineering and external project management costs are included
    - A phase 1-A site assessment is included

  - Information Technology Assumptions:
    - SCADA work at AG2-448 Substation to support HMI, security cameras, breakers, relays, RTU, meters, traveling wave monitor, wave trap, MOABs, GOABs, battery charger, data concentrator, DFR, PCMs, and disconnect switches installation.

  - RE/ROW

    RE/ROW Scope:

    - RE/ROW will be needed for new substation. Developer to provide leased land to FE to build new substation
    - RE/ROW Assumptions:
      - ~0.92 acres needed for this new substation.
      - Assuming a $0 easement has already been signed.
      - Assuming only internal consultive support is needed with 1 access road

and 1 laydown yard.

- Real estate $s 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 general project support, and minimal construction support and damage settlements/releases.
  - Direct damage payments not included in estimate
  - Kept GIS

- Testing & Commissioning
  - Testing and commissioning of all new substation equipment

- Information Technology
  - SCADA work at AG2-448 Interconnection substation to support HMI, security cameras, breaker, relays, RTU, meters, wave trap, MOAB, GOAB, battery charger, data concentrator, DFR, PCM, battery monitor, and disconnect switch installation.

- Distribution
  - Distribution allowance to bring in back-up station service power.
  - Existing Facilities
    - Wood Poles installed 1948 35' height 2 Dead End Included
      - Circuit #: 302760076
      - Circuit Name: ELK GARDEN NO 6 - 7.2/12.5 kV
  - Installations
    - 1 Tap Structure
      - Single Conductor Tap near 666-MP44 (Lat/Long 39.44534265, -79.05281679)
    - 15 Tangent Structures
    - 0.66 Mile Tap line
    - Approximately 200' Span Lengths
  - Distribution Assumptions:
    - New Poles are wood direct embed No guying needed
    - Conductor for new line to match existing
    - 5% Forestry needed, assumed minor clearing/grubbing everywhere else.

- Roughly 0.66 miles of Access Roads in ROW corridor
- 0.66 mile of existing ROW can be used for new 12.47 kV circuit. Assumed Environmental Permitting needed
- No wetlands.

- 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
  - PE Protection Specification:
    - Refer to Attachment 4 of this document.
  - Material List and Equipment Ratings:
    - Refer to Attachment 3 of this document.

2.2 ADSS Fiber Installation

- IT Scope:
  - Install/Test 0.06 miles of new 96F/SM ADSS cable from the AG2-448 substation control house to the Eastern OPGW dead-end outside of AG 2-448. Underground ADSS will be used for this entire run of fiber.
  - Install/Test 0.06 miles of new 96F/SM ADSS cable from the AG2-448 substation control house to the Western OPGW dead-end outside of AG 2-448. Underground ADSS will be used for this entire run of fiber.
  - Test approximately 1.4 miles of new 96F/SM OPGW cable to be installed between Beryl Switching Station and AG2-448 on the Eastern shield wire position. Aerial OPGW fiber will be utilized for this entire run of fiber.
  - The Eastern and Western OPGW cables will end where the current Beryl Switching Station is located.
  - Test approximately 1.4 miles of new 96F/SM OPGW cable to be installed between Beryl Switching Station and AG2-448 on the Western shield wire position. The Eastern and Western OPGW cables will end where the current Beryl Switching Station is located.
  - Aerial OPGW fiber will be utilized for this entire run of fiber.
  - Install ADSS tie cables from the OPGW dead-ends to the existing FirstEnergy owned fiber cable (installed under the Cross School WF Fiber Expansion project under FPID 35207). Install/Test approximately 0.4 miles of new 96F/SM ADSS cable from the Eastern OPGW dead-end STR located near the existing Beryl Switching Station to the existing FirstEnergy owned Cross School WF fiber

cable.). Underground ADSS will be used for this entire run of fiber.

- Install/Test approximately 0.4 miles of new 96F/SM ADSS cable from the Western OPGW dead-end STR located near the existing Beryl Switching Station to the existing FirstEnergy owned Cross School WF fiber cable. Underground ADSS will be used for this entire run of fiber.
- Install/Test approximately 2.18 miles of new 96F/SM ADSS cable from Cross School WF control house to the existing FirstEnergy owned fiber cable (installed under the Cross School WF Fiber Expansion project FPID 35207). Aerial ADSS will be from the existing fiber expansion splice point alongside existing distribution structures.
- New poles are to be installed along the transmission line just outside of Cross School substation to attach aerial ADSS fiber and connect to existing distribution infrastructure. Install/Test approximately 0.06 miles of 48F/SM from the AG2-448 Control House to the AG2-448 PCO.
- Install/Test approximately 0.06-mile run of 48F/SM from the AG2-448 Control House to the AG2-448 PCO. Underground ADSS will be utilized from the substation control building to the PCO just north of the AG 2-448 substation yard. Underground ADSS will be utilized from the substation control building to the PCO just north of the AG 2-448 substation yard.
- Install/Test another approximately 0.06-mile run of 48F/SM from the AG2-448 Control House to the AG2-448 PCO. Underground ADSS will be utilized from the substation control building to the PCO just north of the AG 2-448 substation yard. Underground ADSS will be utilized from the substation control building to the PCO just north of the AG 2-448 substation yard.

- IT Assumptions:
  - The physical material and installation costs for the OPGW are included in the transmission estimate.
  - It is assumed that the new substation build will include conduit builds for necessary Project Developer connections.
  - Assumed that two fiber cables are required to the PCO, but they will not need to be independently routed. FDCM to provide oversight on OPGW installation and is responsible for the splicing and testing of the new OPGW cable.

2.3 In – Sub Fibers Run

- IT Scope:
  - (2) in-sub fiber run from AG2-448 Substation control house to Project Developer-built fiber run to support communications and control to generator site.
- IT Assumptions:
  - Scoping documentation provided to BMcD as estimate input included in SAGE Estimating Software. Assumed ISD of 09/05/2030 based on documentation included in SAGE Estimating Software.
  - Estimate is built using the transport decision assigned under SCoReS #205501.

- Fiber estimate is conceptual and for budgetary purposes only, not intended for release. Cost estimates from Fiber Contractor for this RPA should supersede this cost estimate once provided. Assumed physically diverse fiber routes are not required.
- Assumed that the new substation build will include conduit builds for necessary Project Developer connections.
- Assumed developer is responsible for building fiber communications from generator site to AG 2-448 interconnection substation.

2.4 MPLS Installation

Design, install, and test/commission MPLS equipment for SCADA transport at AG2-448 Substation

- Design, install, and test/commission MPLS equipment for SCADA transport at AG2-448 Substation. Assumed SCADA work is included in this cost.
- Crossbow engineering and materials at AG2-448 Substation.

2.5 New Interconnection Substation – FE Option to Build Scope

FirstEnergy work at new interconnection substation

o Installations:
  - Below Grade:
    - None

o Above Grade:
  - Install (1) security system and camera system
  - Install (1) indoor security AC cabinet

o Relaying & Control:
  - Install (1) network fiber termination rack
  - Programming of SCADA RTU

o General Notes/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

o Project Developer/ 3rd Party Impacted Sites:
  - N/A

o Ancillary Scope of Work

- Project Management
  - Provide project management, coordination, administration, scheduling, material management and project development as required.
- Forestry
  - N/A
- RE/ROW
  - N/A
- Environmental
  - N/A
- Testing & Commissioning

  Testing and Commissioning Scope:
  - Testing of new site to Transmission Control Center; perform functional testing as required

## 3. NETWORK UPGRADES

3.1 Cross School – Westvaco – Kitzmiller 138 kV Line

- General Description:
  - Cut the Kitzmiller - Cross School 138kV Line between structures 13 and 14. The line coming from Westvaco to enter the new AG2-448 4-breaker ring bus Interconnection Substation as a new line exit and will become the Westvaco - AG2-448 138kV Line.
  - Cut the Kitzmiller - Cross School 138kV Line at the Beryl switchyard. After Beryl is decommissioned, the Transmission group will cut and loop the existing Kitzmiller - Cross School 138kV Line between structures 270 and 271 to create two new circuits: Kitzmiller - AG2-448 138kV Line and the AG2-448 - Cross School 138kV Line.
  - Rebuild the two new circuits (Kitzmiller - AG2-448 138kV Line and the AG2-448 - Cross School 138kV Line) in the existing Beryl-Westvaco 138kV Line corridor and replace structures 1 through 12 with new double circuit structures. Both the new Kitzmiller - AG2-448 138kV Line and the new AG2-448 - Cross School 138kV Line to have their own line exit terminals in the new AG2-448 4-breaker ring bus Interconnection Substation. The approximate distance of the new rebuild is 1.4 miles.

- Existing Conditions:
  - Per TAMI the existing line is constructed on single circuit, multi-pole wood and H-frame structures. Existing conductor is 556.5 kcmil 26/7 ACSR shielded by (2) 7#9 Alumoweld.
  - Per GIS View, there is an existing distribution line crossing between existing Strs. 7 & 8 along the existing Kitzmiller - Cross School 138kV Line.
- Installations

- (6) single circuit, steel, monopole, dead-end structures on concrete foundations
- (2) double circuit, steel, monopole, dead-end structures on concrete foundations
- (10) double circuit, light duty steel, monopole, direct embedded, tangent structures
- 1.4 miles of DC conductor 795 kcmil 26/7 ACSR shielded by (2) OPGW
- AG2-448-Cross School 138 kV Line
    - Transfer existing conductor and shield wire to new dead-end structure
- Kitzmiller - AG2-448 138 kV Line
    - Transfer existing conductor and shield wire to new dead-end structure
- Westvaco - AG2-448 138kV Line
    - New deadend insulators on Strs. 270 and 271.

o Removal:

- (2) single circuit, wood 3-pole structures
- (11) single circuit, wood H-frame structures
- Approximately 1.4 miles of 556.5 kcmil 26/7 ACSR conductor and (2) 7#9 Alumoweld shield wire.

o Siting/Licensing Assumptions:

- Assumed Full Application will be required.
- Assume minimal social and ecological impacts.
- Assume no local opposition to the project.

o General Notes/Assumptions:

- Substation group will remove the disconnect switches, PTs, relays, fence, and decommission the Beryl asset
- Outage can be obtained to perform line construction.
- A LiDAR survey will be required for design, and a ground survey will be required for as-built. Cost of mobilization/demobilization shared with Line Terminal scope of work.
- It is assumed the existing conductor and shield wire are in adequate condition and can be transferred. An engineering analysis during project development will be required.
- Assume the existing conductor and shield wire to be reused and transferred for the Westvaco - AG 2-448 138kV Line.
- It is assumed the adjacent structures are in adequate condition and can handle the new loading. An engineering analysis during project development will be required.
- The loop cut-in and substation location were not provided in detail. A general area was provided. Specific substation location and layout will be required during project development and execution. Scope of project may change.
- Assume new conductor and insulators from existing Strs. 270 and 271 leading to the new

double circuit. Distribution coordination required for (1) crossing between existing Strs. 7 and 8.

- Per the design criteria, the new AG2-448 - Cross School 138kV Line will cross the new Westvaco - AG2-448 138kV Line near the new AG2-448 Interconnection Station. An engineering analysis during project development will be required.

- Ancillary Scope of Work
  - Project Management Scope:
    - Provide project management, coordination, administration, scheduling, material management and project development if required.
  - Access Roads Scope:
    - Access roads will be required, terrain is flat, approximately 1.7 miles.
  - Forestry Scope:
    - Approximately 2.0 acres of forestry clearing required along with other clearing within the existing ROW
  - Environmental Scope:
    - No wetland/stream crossings
  - Assumptions:
    - Road Bonds are required
    - Environmental Filming
    - Documentation of Existing roads are required
    - Environmental Access and Road Crossing Permit Fees is required
    - Environmental Development of Permit Binder is required
    - Environmental Cultural Resource Consultation is required
    - Environmental Construction walk down is required
    - RTE consultation letters are required Wetland delineations and WDR are required
    - Stormwater permits and local approvals are assumed
    - Internal environmental engineering and external project management costs are included A phase 1-A site assessment is included
  - RE/ROW

    Scope:
    - Rights & restrictions review on existing line
    - New ROW will be required

    Assumptions:
    - 2.9 T-line miles needed for this T-Line. 2 estimate requests

- Assuming only internal consultive support is needed.

Real estate estimates 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 general project support, and minimal construction support and damage settlements/releases.
- Direct damage payments not included in estimate
- Kept GIS / R&R for installation of structures.
- Access roads (direct cost); assumption of 2 off-ROW roads.
- Laydown yard; assumption of 2 yards (per interview) for duration of construction (per interview).
- Modified easements; assuming 2.
- Agent per diem.

3.2 Westvaco Substation

- Description of Work
  - Revise relay settings at Westvaco.
- Below Grade
  - None
- Above Grade
  - None
- Relay & Control
  - Revise relay settings.
- Additional Equipment to be Removed
  - None
- Assumptions
  - None.
- Support Estimates
  - Project Management
    - Provide project management, coordination, administration, scheduling, material management and project development if required.
  - Testing and Commissioning
    - Testing and Commissioning to support revision of relay settings.

3.3 Cross School Substation

- Description of Work
  - Install new relays and revise relay settings at Cross School Substation.
- Below Grade
  - None.
- Above Grade
  - Installation of relay and control equipment as noted below
- Relay & Control
  - (1) New Relay panel to accommodate:
  - (2) SEL-411L relays for primary and backup line protection over dedicated fiber.
  - (1) SEL-2411 for Anti Island communications between the new Ring Bus and Cross School
  - Control cables for new relays
- Additional Equipment to be Removed
  - (2) wave traps, (2) line tuners, carrier equipment, line relays, and associated accessories
- Assumptions
  - Assumed new relay panel, for new relays however, new relays may fit in existing Panel #9 per print Cross School Front View Panel 9 PE-24-11-02.pdf. During detailed design, FE and engineer to confirm space in Relay Panel #9 or if new relay panel will be required.
  - Assume there is room in the control house.
- Ancillary Scope of Work
  - Project Management
    - Provide project management, coordination, administration, scheduling, material management and project development if required.
  - Information Technology
    - IT support for new relay installation
    - Assumptions:
      - Existing SCADA transport at Cross School Substation is sufficient for additional SCADA telemetry.
  - Testing and Commissioning
    - Testing and Commissioning to support new relays and revision of relay settings.

3.4 Kitzmiller Substation

- Description of Work
  - Revise relay settings at Kitzmiller.

- Below Grade
  - None
- Above Grade None
  - Relay & Control Revise relay settings.
- Additional Equipment to be Removed
  - None
- Assumptions
  - None.
- Ancillary Scope of Work
  - Project Management
    - Provide project management, coordination, administration, scheduling, material management and project development if required.
  - Testing and Commissioning
    - Testing and Commissioning to support revision of relay settings.

3.5 Mt. Zion Substation

- Description of Work
  - Revise relay settings at Mt. Zion.
- Below Grade
  - None
- Above Grade None
  - Relay & Control Revise relay settings.
- Additional Equipment to be Removed
  - None
- Assumptions
  - None.
- Ancillary Scope of Work
  - Project Management
    - Provide project management, coordination, administration, scheduling, material management and project development if required.
  - Testing and Commissioning
    - Testing and Commissioning to support revision of relay settings.

3.6 Beryl

- Description of Work
  - Decommission Beryl asset by removing disconnect switches, PTs, relays, structures, foundations, and fence to facilitate new cut/loop of the Kitzmiller-Cross School 138 kV Line. Transmission group will cut and loop the existing Kitzmiller-Cross School 138kV Line between structures 270 and 271 to create two new circuits: Kitzmiller-AG2-448 138 kV Line and the AG2-448-Cross School 138 kV Line. Transmission costs will be allocate on separate estimate request.
- Below Grade
  - Remove and backfill all foundations, conduit, and cable trench. Remove all control cables
- Above Grade
  - Remove the equipment and stands for (3) 138kv MOAB line switches, (3) ground switches, (2) single phase 138kv PTs, and (2) single phase arresters.
  - Remove the bus, (1) bus support, conductor and fittings.
  - Remove the fence, posts, and gates
  - Remove (1) battery and cabinet, (1) charger and cabinet and associated cables and junction boxes
- Relay & Control
  - Remove (3) relay cabinets and associated relays, junction boxes, and control cables.
- Additional Equipment to be Removed
  - None
- Assumptions
  - No equipment and stands will be reused.
  - No part of the battery or relay systems will be reused.
  - No ground grid removal.
- Ancillary Scope of Work
  - Project Management
    - Provide project management, coordination, administration, scheduling, material management and project development if required.
  - Environmental
    - Provide environmental support and permit coordination for the removal of the existing equipment in Beryl Switchyard Substation to support decommissioning of asset.
    - Assumptions:
      - Minimal to no permitting will be needed and the only costs captured in this estimate are for internal environmental engineering and external project management and consultation.

- Information Technology
  - SCADA work at Beryl Substation to support equipment decommissioning.
- RE / ROW
  - Provide RE/ROW support to decommission Beryl asset. Beryl Switchyard to be replaced with T-line Cut/loop asset as part of the new rebuild.
  - Assumptions:
    - No new ROW or laydown yards needed. Single estimate request.
  - Real estate estimates 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 general project support, and damage settlements/releases.
    - 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 are not included in estimate.
- TESTING AND COMMISSIONING
  - Testing and decommissioning to support new Cut/Loop.

**4. Other Scope of Work**

4.1 Revenue metering.

- Description of Work
  - Provide revenue metering panel within new AG2-448 Control House. Integrate revenue metering to Interconnection Substation.
  - Provide new 3-phase 138kV Free-standing CT/VT Combo Units.
- Below Grade
  - (1) Lot of excavation, conduit, backfill, grounding, and wiring between Free Standing CT/VT Combo units to revenue metering.
  - (1) Lot of foundations for Free-standing CT/VT 138 kV Combo Unit.
- Above Grade
  - (1) set of 3-phase Free Standing CT/VT Combo Unit 138 kV.
- Relay & Control
  - (1) New Revenue Metering Panel with test switches.
- Additional Equipment to be Removed

- None

- Assumptions
  - It is assumed current and voltage signals will be pulled from new 3-phase free standing CT/VT Combo Units.
  - Assumes enough room in AG2-448 Control house to support a new revenue metering panel.
  - Assumes enough room in AG2-448 substation to add in free standing CT/VT Combo Units.
  - Assumes the same crew that is constructing the OTB FE Work scope will be adding the revenue metering panel and freestanding CT/VT combo units. Temp const facilities and construction general conditions (Scope Capture) are included in separate estimate request PE-S-00023168.
- Ancillary Scope of Work
  - Project Management
    - Provide project management, coordination, administration, scheduling, material management and project development if required.
  - Revenue Metering
    - Provide high end revenue meter and engineering support for revenue metering at FE Substation AG 2-448
  - Testing and Commissioning
    - Testing and commissioning services as required

4.2 Option to Build Oversight

- Description of Work:
  - FirstEnergy oversight of Project Developer design and construction of new interconnection substation on a relatively high-risk location from preliminary civil desktop study review.
- Below Grade:
  - Must Meet FirstEnergy Standards - Option to Build
- Above Grade:
  - Must Meet FirstEnergy Standards - Option to Build
- Relaying & Control:
  - Must Meet FirstEnergy Standards - Option to Build
- Additional Equipment to be Removed:
  - N/A
- General Notes/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) Project 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 Estimates
  - Project Management

    Scope:
    - Coordinate with Project 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
  - RE/ROW
    - 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 if required.
  - Environmental
    - Environmental review of Proposed Site
  - Testing & Commissioning
    - Commissioning Review of Project Developer Supplied Information and Witness of Critical Testing

## 5. MILESTONE SCHEDULE FOR COMPLETION OF PE WORK

Facilities outlined in this report are estimated to take 38 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.

| Activity | Start Month | End Month |
|---|---|---|
| Preliminary Engineering | 1 | 2 |
| Siting, Permits & Real Estate | 5 | 27 |
| Detailed Engineering | 3 | 27 |
| Equipment Delivery | 29 | 29 |
| Construction | 30 | 36 |
| Testing & Commissioning | 34 | 38 |

## 6. ASSUMPTIONS IN DEVELOPING SCOPE/COST/SCHEDULE

6.1 Scope Assumptions:

- Project Developer will coordinate design and alignment of proposed 138 kV generator lead line with the Transmission Owner for review of any clearance, right-of-way or right-of-way encroachment issues with TO owned facilities.
- Project Developer will coordinate design and construction of proposed 138 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 138 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 138 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 PE 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 April 14, 2026, 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, PE 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.

- PE reserves the right to charge the Project Developer operation and maintenance expenses to maintain the Project Developer attachment facilities, including metering facilities, owned by PE. 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.
- PE'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 PE 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 AG2-448 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 Transmission Owner side of the Point of Change in Ownership, and will be installed, owned, and maintained by Transmission Owner.

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 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.

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

## 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 AG2-448. 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.

| 4 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) |
|---|---|---|---|---|---|---|
| 138kV | 301x261 | 2 | 401x361 | 3.6 | 0.5 | 4.1 |

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 guidelines 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. APPLICABLE TECHNICAL REQUIREMENTS AND STANDARDS

The Requirements for Transmission Connected Facilities, Revision 7, dated January 27, 2026, shall apply.

The GeoTechnical Design Requirements, dated July 20, 2022, shall apply.

The FirstEnergy Approved Vendor List, dated February 6, 2026, shall apply.

The TPP-REF-003 Transmission Planning Criteria, Revision 10, dated December 19, 2023, shall apply.

## 10. ENVIRONMENTAL AND PERMITTING

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

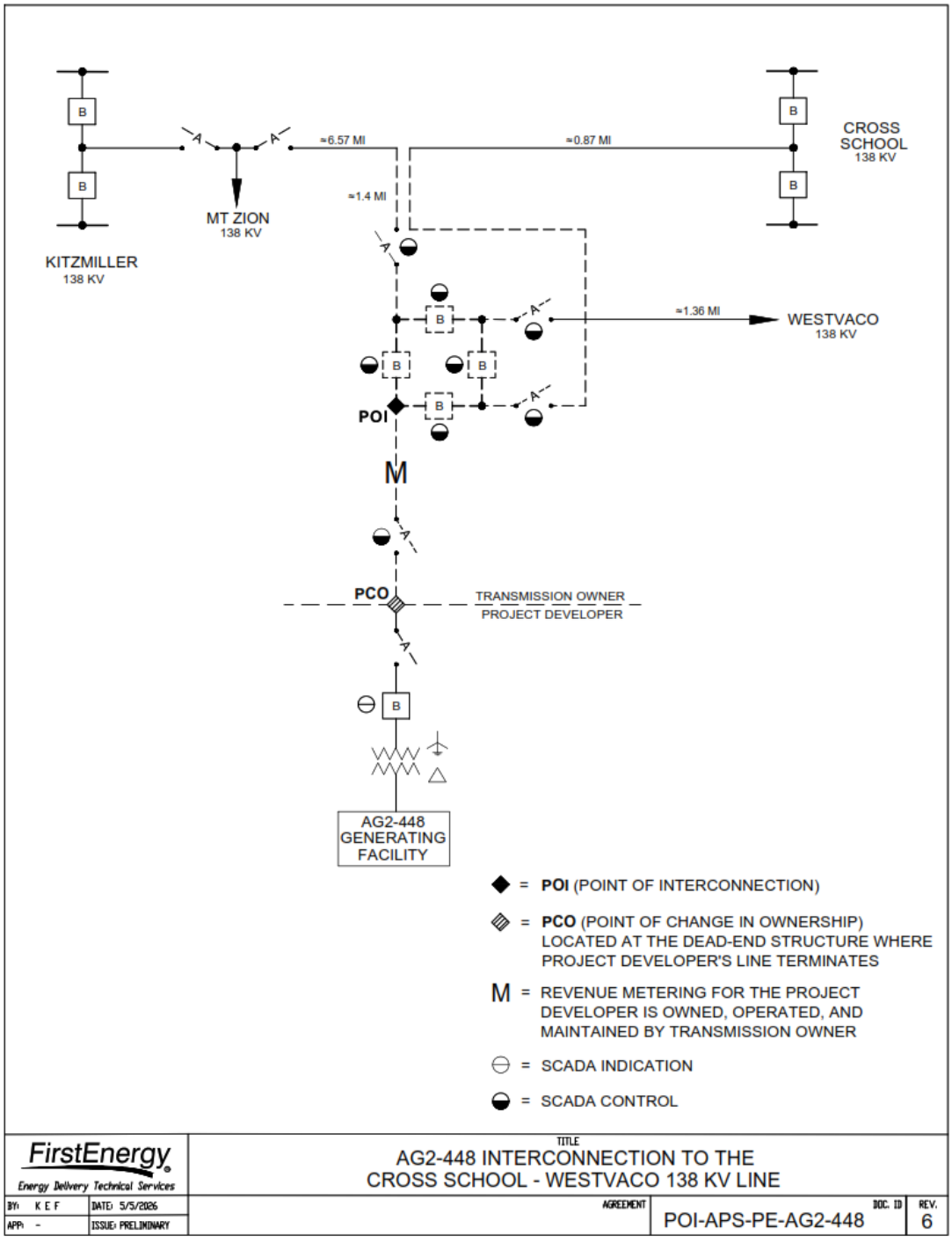
- Environmental permitting, Real Estate acquisition, and notifications to the state's Public Utilities Commission (PUC) vary, some up to twelve (12) months after preliminary engineering is completed to secure the required approvals.
- Prior to agreement by Project Developer to purchase the property,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

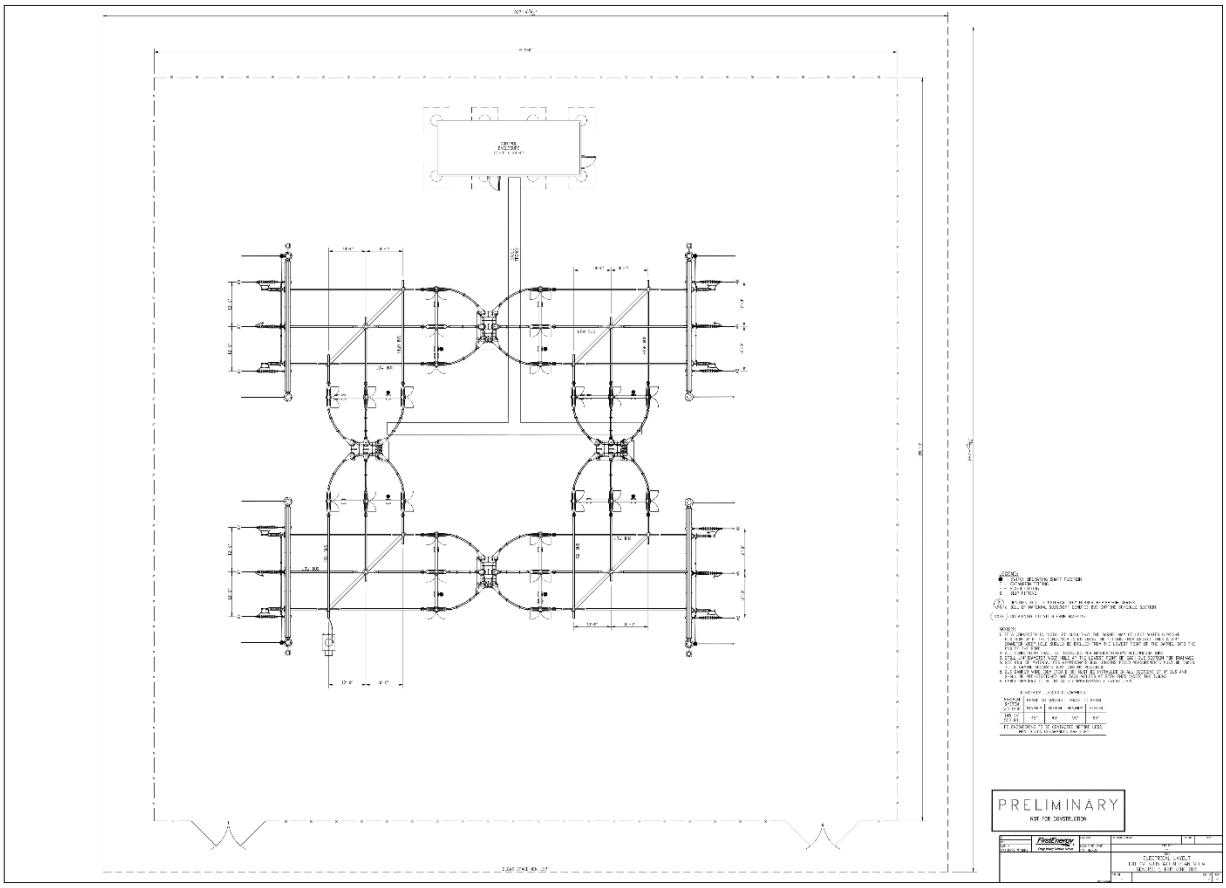
  https://www.firstenergycorp.com/help/safety/real-estate-power-lines/transmission-right-of-way.html#ROWform

## 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) | 125 |
| Battery Charger (ea) | 1 |
| Digital Fault Recorder (DFR) (ea) | 1 |
| Remote Terminal Unit (RTU) (ea) | 4 |
| Insulator - Line - Polymer (ea) | 51 |
| Insulator - Line - Porcelain/Glass (ea) | 864 |
| Wood Pole - Class H4 (ea) | 10 |
| Engineered Steel Poles (ea) | 8 |
| Light Duty Steel Pole - Class H4 (ea) | 10 |
| Steel Support Structure (ea) | 34 |
| Hard Bus - 1.5 inch (ft) | 240 |
| Hard Bus - 4 inch (ft) | 880 |
| Package Control Enclosure - Prefabricated (ea) | 1 |
| Relay - Individual (ea) | 18 |
| Relay Panel (ea) | 13 |
| Circuit Breaker - 145 kV 40 kA (ea) | 4 |
| Anchor Bolt - Substation (ea) | 396 |
| Insulator - Substation - 138 kV (ea) | 12 |
| Line Trap - 138 kV (ea) | 2 |
| Surge Arrester - 138 kV (ea) | 12 |
| Capacitor Coupled Voltage Transformer (CCVT) - 138 kV (ea) | 12 |
| Current Transformer - Freestanding (CT) - 138 kV (ea) | 3 |
| Potential Transformer (PT) - 138 kV (ea) | 3 |
| Station Service Voltage Transformer (SSVT) - 138 kV (ea) | 1 |
| Security - Camera (ea) | 26 |
| Security - Physical Access Control (Badge Reader) (ea) | 2 |
| Battery - 125V (ea) | 1 |
| AC/DC Panelboard (ea) | 2 |
| Disconnect Switch - Substation - 138 kV (ea) | 12 |
| Switch - Motor Operator - Substation (ea) | 12 |
| Cable - Control/Communication (lf) | 40820 |
| Conductor - AAC (ft) | 1670 |
| Conductor - ACSR (ft) | 52272 |
| Conduit - Rigid (lf) | 2184 |
| Wire - Fiber - ADSS (ft) | 38327 |
| Wire - Fiber - Underground (ft) | 6740.25 |
| Wire - Shield - OHGW (lf) | 1161.6 |
| Wire - Shield - OPGW (lf) | 17183.2 |

**ATTACHMENT #4: PROTECTION SCOPE**

**Project Developer Protection Requirements**

- The generation delivery points must comply with the technical requirements detailed in the FirstEnergy "Requirements for Transmission Connected Facilities" document.
- The Generator Step-Up (GSU) transformer(s) connecting to the FE system shall have a grounded-wye winding configuration on the high side and a delta configuration on the low side. This establishes an effective ground on the transmission system and mitigates overvoltage conditions during ground faults. A delta connected winding on the low side provides isolation of zero-sequence currents such that the FE system will not be exposed to ground faults on the generator system.
- One and up to two fully rated circuit breakers are required at the point of interconnection (POI).
- (2) SEL-411L's for primary and backup current differential protection are required for the transmission line connecting the FE interconnection substation to the POI. These relays will use direct fiber that is routed redundantly to the FE interconnection substation for primary and backup protection communications. Part number and firmware shall be sent to FE for approval to confirm communications compatibility. The 87L channel shall also be used to communicate anti-islanding DTT to Project Developer facility. The 87L channel shall also be used for breaker failure DTT communications.
- Redundant high speed protection schemes are required to protect the Project Developer owned equipment at POI voltage. Each zone of protection covering the POI voltage portion of the Project Developer's system, the GSU Transformer(s), and the POI voltage interconnection breaker, shall be protected by two independent relay schemes meeting the following redundancy requirements. Primary and backup relaying shall use independent CTs, and independent PTs or independent windings from the same PTs. 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.
- A protection scheme containing generator Intertie functions is required and must be able to provide tripping for the following functions: overfrequency, underfrequency, phase and zero-sequence overvoltage, phase undervoltage, directional overcurrent, and directional power. The current source and voltage source are to be at the Transmission POI voltage. The current source for the intertie relaying is preferred to be from CTs on the POI voltage interconnection breaker.
- C800 CTs must be used on the POI voltage portion of the Project Developer's system, and the CTs should not saturate for the maximum expected through-fault current at the tap ratio in use.
- 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.

- If there are multiple existing utility feeds, they shall not be paralleled. Either a mechanical or electrical interlock shall be in place to prevent paralleling of service points.

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

**FE Protection Requirements**

Fiber shall be installed between the new FE interconnection ring bus (hereto forth referred to as FERingBus) and Cross School for protection communication. Fiber used for primary and backup protection relaying shall be redundant, such that failure of a single cable does not simultaneously disable primary and backup relaying communications.

To coordinate with proposed Project Developer substation, the relay settings at the following stations will need adjusted (note that in some cases due to limitations of the existing relays, relays may need to be replaced):

At Beryl Substation:

- Remove existing line switches and associated controls and accessories.

At Cross School Substation:

- Review/revise relay settings as needed.
- Install a standard line protection relay panel with Primary and Backup SEL-411L. The primary and backup line protection schemes will provide current differential protection over dedicated fiber.
- Install (1) SEL-2411 for anti-islanding between FERingBus and Cross School.
- Remove existing power line carrier equipment including wave trap(s), line tuner(s), and associated wiring and accessories.

At Kitzmiller Substation:

- Review/revise relay settings as needed.

At FERingBus Substation:

- Project Developer 138 kV line – Install a standard line protection relay panel with Primary and Backup SEL-411L. The primary and backup line protection schemes will provide current differential protection over dedicated fiber.
- Install (1) set of (3) 138 kV CCVTs on each Project Developer line terminal.

- Cross School 138 kV line – Install a standard line protection relay panel with Primary and Backup SEL-411L. The primary and backup line protection schemes will provide current differential protection over dedicated fiber.
- Install (1) set of (3) 138 kV CCVTs on the Cross School line terminal.
- Install (1) SEL-2411 for AI to Cross School.
- Kitzmiller 138 kV line – Install a standard line protection relay panel with Primary SEL-421 and Backup SEL-411L. The primary and backup line protection schemes will provide protection over PLC.
- Install one (1) set of (3) 138 kV CCVTs on the Kitzmiller line terminal.
- Install one (1) wave trap, (1) line tuner, and (1) UPLC to support the primary protection.
- Install (1) wave trap, (1) line tuner, and (1) UPLC to support the backup protection.
- Install (1) UPLC to support anti-islanding communications with Cross School.
- Westvaco 138 kV line – Install a standard line protection relay panel with Primary SEL-421 and Backup SEL-411L. The primary and backup line protection schemes will provide protection via a step distance scheme.
- Install (1) set of (3) 138 kV CCVTs on the Westvaco line terminal.
- Install (4) appropriately rated circuit breakers for 138 kV application, (2) CTs per bushing.
- Install (4) SEL-451 relays for 138 kV breaker failure and controls including additional lockouts and auxiliaries as necessary.
- (1) lot of SEL-3350 or similar data concentrator RTACs for relay remote access.
- (1) lot of Arbiter 1094b or similar GPS Clocks for timing.
- (1) lot of Qualitrol TWS systems for traveling wave monitoring, for networked lines > 100 kV
- (1) lot of SEL-3555 or similar data concentrator RTACs for use as PMU data concentration
- (1) DFR to support event analysis

**Short Circuit Data**

The short circuit levels at the line tap to the new 138 kV ring bus are the following:

Short Circuit values at 138 kV

Three phase faults = 8.1 kA

Single line to ground fault = 7.0 kA

Transmission System Impedances at 138 kV, 100 MVA base

Positive sequence Z1 = (0.0088 + j0.0532) (per unit)

Zero sequence Z0 = (0.0166 + j0.0740) (per unit)

The fault current and system impedance values are for the proposed tap location on the existing 138 kV line, for the normal system configuration connecting to Kitzmiller and Cross School substations. The fault currents provided are bolted, symmetrical values for present, normal transmission system conditions. Future increases in fault currents are possible, and it is the Project Developer's responsibility to upgrade their equipment and/or protective equipment coordination when necessary.

**ATTACHMENT #5: PRELIMINARY GEOTECHNICAL SUMMARY**

**Observation and Concern Table**

| Category | Source | Risk | Comment |
|---|---|---|---|
| Surficial Soil Survey | USDA Soil Survey | Moderate | Clayey soils, potential for uncontrolled fill materials. |
| Geologic Formation/Group | WV/USGS Geologic Survey | Moderate | This site is part of the Conemaugh. Shallow bedrock anticipated. |
| Karst | USGS | Low to Moderate | Located within mapped carbonate rock formation. Karst features nearby but not directly at site. |
| Landslide Susceptibility | GIS/Google Earth/FEMA Risk Map/WVGES | Moderate | Moderate slopes. Potential uncontrolled fills present. |
| Coal Mining and Oil and Gas Wells | WV Geologic Survey, TAMI 2 | High | Coal mining activity in this area. No oil or gas wells in this area. |
| Environmental Hazard | US Wetland Maps/FEMA | Low | Low risk of flooding. |
| Past Development | TAMI/GIS MAP/Historic Aerials | Moderate | Mining at the site. Site used as access road. Potential for uncontrolled fill. |

**Site Background/ Geologic Hazards Potential:**

FE conducted this review to determine potential geologic hazards and risks at the proposed generator Project Developer location (AG2-448). The reviewed location is in Piedmont, Mineral County, West Virginia. This includes a proposed substation located along the Kitzmiller – Cross School 138kV transmission line. The substation would be located between existing tower structures 15 and 14. The existing transmission line operated by Potomac Edison was installed in 2014. The proposed substation would consist of (3) breaker 138kV ring bus with SCADA control. This location was reviewed for surficial soils survey, geologic formation/group, karst, landslide susceptibility, coal mining and oil and gas well resource mapping, environmental hazards, and past development. The review was performed to identify any geologic risks that could affect the project's budget, constructability, and/or schedule.

**Surficial Soil Survey**

The United States Department of Agriculture Web Soil Survey indicates that the site is currently mapped as the Gilpin channery silt loam (GmF). The Gilpin series generally consists of fine-grained soils with varying

amounts of sand and gravel within the soil matrix (MH, ML, CL, and GC). The Gilpin is further underlain by bedrock at relatively shallow depths at the site (25 to 40 inches). The formation is mapped as Hydrologic Soil Group (HSG) C classification, indicating the soils have a slow infiltration rate. The depth to the water table is listed as greater than 80 inches of the ground surface.

In review of historic aerial photographs, mining is evident at the site and prominently north of the site. An access road traverses the proposed substation site from the southeast to the clearing north of the proposed substation site. Fill materials should be anticipated to be present among the native soils. The native clayey soils and potential for uncontrolled fill materials would present a moderate risk for development.

**Geologic Formation/Group**

The site is located in the Valley and Ridge Physiographic Province which is described as containing folded and faulted mountain ridges and low-lying valleys from the Precambrian to early Mississippian age. The Geologic Map of West Virginia maps the site to be underlain by the Conemaugh Formation. The Conemaugh is known for its cyclothemic sequences of primarily shale and sandstone, but also consisting of minor amounts of limestone, clay, siltstone, and thin, non-persistent coal beds. As previously mentioned, the bedrock is anticipated to be relatively shallow based on soil survey mapping. The potential shallow bedrock combined with the formation containing coal presents a moderate geologic risk for development.

**Karst**

The site is underlain by the Conemaugh formation which does contain minor amounts of limestone bedrock which can be prone to karst conditions. The West Virginia Tax Districts Containing Karst Terrain exhibit indicates that there are known karst areas within the site vicinity, but not directly at the site. Transmission Asset Mapping Interface 2 was also reviewed and also shows karst related features nearby but not directly in the site vicinity. A determination of karst risk should be discussed in the sites geotechnical report to better understand the risk. Based on available mapping there is low to moderate risk of karst.

**Landslide Susceptibility**

Based on the FEMA national risk index, the site is located in a relatively low risk to landslides area. The West Virigina Geological and Economic Survey was also reviewed and indicates the potential for some landslides in the steeper terrain near the site, however the site itself is located in a low potential zone for landslide susceptibility. TAMI was utilized to generate elevation profiles for the potential site area. The ground surface slopes upward from the north to south, from approximately 30 feet in a 500 foot span north of the station and 10 feet in a 200 foot span to the south of the station location, then the ground begins sloping downward again. The ground also slopes upward from west to east, approximately 100 feet in a 1,000 foot span (centered at the substation). However, given the unknown uncontrolled fill conditions, and moderate slopes at the site, there is a moderate risk for landslides at the site.

**Resource mapping**

There was significant coal mining activity in this region and in the immediate site location as shown on the West Virigina Geological and Economic Survey Underground and Surface Mining tool. TAMI 2 also shows area to be underlain by mining activities however does not show the full extent of mining as shown on the

West Virginia mining tool. The TAMI 2 maps show that a shaft to the mine located to the north traverses very close to the prospective site. The mining that has occurred at the site would present a high risk for development.

The West Virigina Geological and Economic Survey indicates some gas wells within Mineral County, but none within the vicinity of the prospective site.

**Environmental Hazards:**

Based on FEMA and U.S. Fish and Wildlife Service maps there are no wetlands or features that would cause an increased risk of flooding. 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 1946 this site was developed for the transmission line around 2014. At the same time, significant earthwork appears to have taken place to the north near the former site location with the possibly of surface mining or some restoration work in the immediate area of the proposed station. The site appears to have been used as a part of the access road to the clearing to the north.

**Recommendations, Geotechnical Opinion, and Estimating**

List of Observations / Cross School– Westvaco 138kV

1. This site is part of the Conemaugh formation, containing coal and limestone at shallow depths. Moderate geologic risk.
2. Low to moderate potential for karst
3. Moderate risk for landslide
4. Low environmental impact risk
5. Mining occurred at the site including the immediate area
6. Possible mining and site potentially used as access road.

The geotechnical conditions of this site seem to conclude that it is relatively moderate to high-risk location to develop a substation due to the coal mining that has occurred at the site. Additional due diligence will be required to determine the extent of the coal mining and additional costs might be expected to determine the extent and any potential interference with the prospective substation site. This would include additional borings. If mining is encountered higher foundation costs would be expected to mitigate mining. The above estimate does not necessarily reflect the below ground extent of the mining, and it should be noted that the mining could potentially extend below the site.