

Facilities Study Report
For
Physical Interconnection of
PJM Generation Interconnection Request
Project ID AG2-621

“Hoytdale 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 American Transmission Systems, Inc. (ATSI), a FirstEnergy company.

This Facility Study was performed to satisfy the Phase 2 Facility Study requirement of the PJM Tariff. The Facility 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 Decision Point 2 (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 agreements 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 Storage Generating Facility located in Beaver County, Pennsylvania. The installed facilities for AG2-621 will have a total Maximum Facility Output (MFO) of 150 MW with 150 MW of this output being recognized by PJM as Capacity.

2. POINT OF INTERCONNECTION (POI)

The Generating Facility will interconnect with MAIT as a direct connect at the existing Hoytdale 138 kV Substation.

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

3. POINT OF CHANGE IN OWNERSHIP (PCO)

The PCO will be located at the first dead-end structure outside the existing Hoytdale 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 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.

B. Transmission Owner Facilities Study Results

The following is a description of Transmission Owner facilities for physical interconnection of the proposed AG2-621 project to ATSI transmission system. These facilities shall be designed according to FirstEnergy Applicable Technical Requirements and Standards. Once built, ATSI will own, operate, and maintain these Facilities.

1. TRANSMISSION OWNER INTERCONNECTION FACILITIES (TOIF)

1.1 Hoytdale Substation Line Terminal

- Description of Work
 - Add new A-frame line exit structure within FE substation extending off existing backbone. Add (1) 138kV Circuit Breaker 63 kaic, (2) install new bus disconnect switches, (1) line disconnect switch, (1) 3-phase Surge Arrestor, and (1) 3-phase CCVT.
 - Upgrade existing Hoytdale substation with new line protection relays, breaker failure relays, and transformer protection relays per protection requirements.
 - Retire existing PVD lead relay, primary differential relay, and overall differential relay.
- Below Grade
 - Install cable conduit, and control cables for new equipment.
 - Install foundations for new equipment.
- Above Grade
 - Install substation equipment:
 - (1) A-Frame Line Exit/Takeoff structure
 - (1) 138kv, 63kaic CB
 - (2) 2 CB/Bus Disconnect Switches with foundations and high stands
 - (1) 1 Line Disconnect Switches
 - (1) 3-phase Surge Arrrester
 - (1) 3-phase CCVT with foundations and stands
 - Install rigid bus from A-frame to disconnect switch and from disconnect switch to 138kv substation bus (estimated 190' of 4" AL and 210' of shield wire).
 - Install new Relay and Controls inside control house as noted below.
 - Install control cables for new equipment in control house.
- Relay & Control
 - Add (1) line relay and breaker failure panel which includes:
 - 1 - Schweitzer SEL-411L-1X4X-5B8CDXH52424XX relay to be used for primary line

- protection
 - 1 - Schweitzer SEL-411L-1X4X-5B8CDXH52424XX relay to be used for backup line protection
 - 1 - Schweitzer SEL-04515415XB0X4H224XXXX relay to be used for breaker failure protection
 - Hand-reset lockout (86BFR) and electrically-reset lockout (86BFRX) for associated breaker failure functions
 - Replace existing TR#2 protection panel #16R with (1) Transformer protection panel which includes:
 - 1 – Schweitzer SEL-0487E3X411XXB4X4H60XXXX relay to be used for TR#2 low-side overall differential protection
 - Hand-reset lockout (86OAL) and electrically-reset lockout (86OALX)
 - 1 – Schweitzer SEL-0487E3X411XXB4X4H60XXXX relay to be used for TR#2 high-side overall differential protection
 - Hand-reset lockout (86OAH) and electrically-reset lockout (86OAHX)
 - 1 – Schweitzer SEL-0487B1X4X52XB4XEH7PPXXX relay to be used for TR#2 low-side lead/138kV North bus protection
 - Hand-reset lockout (86B) and electrically-reset lockout (86BX)
 - Add/modify lockouts and aux relays as needed for TR#2 protection.
 - Incorporate new North bus breaker into existing breaker failure schemes (including breakers B26, B14, B2, B102, and B114).
- Additional Equipment to be Removed
 - Retire the following relays
 - PVD low-side lead relays (87B-NB)
 - TR#2 SEL-587 primary diff relay (87T-2)
 - BDD20 overall diff relays (87OA-2)
- Scope of Work Assumption
 - All disconnects are motor-operated
 - Replacing the entire TR#2 protection panel #16R (P-83-12-58.pdf) and removing North Bus PVD relays from bus protection panel #17R (P-83-12-59.pdf)
 - Line Disconnect and Surge arresters will be mounted on A-Frame and CCVTs will need foundations and stands (similar to New Castle #1 line print P-83-13-02.pdf)
 - There is enough space in existing control house for new panels (P-83-31-10.pdf)
 - The DC system can support the added equipment
 - Will need SATEC meter on Line Panel so did not remove
 - The Project Developer shall be responsible for acquiring all necessary land rights and rights of

way required for the full length of the 138 kV generator lead line, including the portion on the TO side of the PCO (approximately one span from the POI). This report does not grant approval to the Project Developer to use the TO's existing right of way or line structures for any portions of the generator lead line or interconnection facilities.

- Ancillary Scope of Work
 - Project Management
 - Provide project management, coordination, administration, scheduling, material management and project development if required.
 - Environmental
 - Support as required for substation reconfiguration
 - Review drawings and support work related to new equipment and new foundations. Provide any necessary support for permitting, if required.
 - Information Technology
 - Estimate SCADA work at Hoytdale Substation to support breaker, relays, MOAB, GOAB, and disconnect switch installation.
 - Fiber:
 - In-sub fiber run from Hoytdale control house to developer-run fiber build at developer AG2-621 PCO (First Project Developer DE structure outside of Hoytdale). Fiber only to the first DE structure outside of FE substation fence for communications and control to AG2-621 generation interconnection.
 - Network:
 - update points list as required.
 - Install/Test approximately 0.09 miles of 48F/SM from the Hoytdale substation Control House to the AG2-621 PCO.
 - Underground ADSS will be utilized from the substation control building to the PCO just north of the Hoytdale substation yard.
 - Install/Test another approximate 0.07-mile fiber build of 48F/SM from the Hoytdale Control House to the AG2-621 PCO.
 - Underground ADSS will be utilized from the substation control building to the PCO just north of the Hoytdale substation yard.
 - Testing and Commissioning
 - Testing and commissioning services as required for new equipment and relays.

1.2 AG2-621 Generator Lead Line

Install one span from the existing Hoytdale substation to Project Developer-Owned dead-end structure at the PCO.

- Installations

- 0.1 miles of 795 kcmil 26/7 ACSR conductor, shielded by (1) 7#8 Alumoweld
- Siting & Licensing
 - Full Application will be required.
 - Assume minimal social and ecological impacts.
 - Assume no local opposition to the project.
- Scope of Work Assumptions:
 - Location of PCO assumed
 - Location of generator substation assumed
 - A ground survey will be required for design and as-built.
- Ancillary Scope of Work
 - Project Management
 - Provide project management, coordination, administration, scheduling, material management and project development if required.

1.3 AG2-621 Generator Substation

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
 - Provide project management, coordination, administration, scheduling, material management and project development if required.
 - Revenue Metering
 - Revenue Metering to be installed by ATSI.
 - Testing and Commissioning
 - Testing and commissioning services as required.

2. STAND ALONE NETWORK UPGRADES

None

3. NETWORK UPGRADES

3.1 Maple Substation

Review and update relay settings.

- Below Grade Scope of Work:
 - N/A
- Above Grade Scope of Work:
 - N/A
- Relay & Control Scope of Work
 - Review and update relay settings.
- Scope of Work Assumptions:
 - Existing relays will be used.
- Ancillary Scope of Work
 - Project Management
 - Provide project management, coordination, administration, scheduling, material management and project development if required.
 - Information Technology
 - N/A
 - Testing and Commissioning
 - Testing and commissioning services as required for revised relay settings.

3.2 New Castle Substation

Review and update relay settings.

- Below Grade Scope of Work:
 - N/A
- Above Grade Scope of Work:
 - N/A
- Relay & Control Scope of Work
 - Review and update relay settings.
- Scope of Work Assumptions:
 - Existing relays will be used.
- Ancillary Scope of Work
 - Project Management
 - Provide project management, coordination, administration, scheduling, material management and project development if required.

- Information Technology
 - N/A
- Testing and Commissioning
 - Testing and commissioning services as required for revised relay settings.

3.3 McClelland Substation

Review and update relay settings.

- Below Grade Scope of Work:
 - N/A
- Above Grade Scope of Work:
 - N/A
- Relay & Control Scope of Work
 - Review and update relay settings.
- Scope of Work Assumptions:
 - Existing relays will be used.
- Ancillary Scope of Work
 - Project Management
 - Provide project management, coordination, administration, scheduling, material management and project development if required.
 - Information Technology
 - N/A
 - Testing and Commissioning
 - Testing and commissioning services as required for revised relay settings.

3.4 Cranberry Substation

Review and update relay settings.

- Below Grade Scope of Work:
 - N/A
- Above Grade Scope of Work:
 - N/A
- Relay & Control Scope of Work
 - Review and update relay settings.
- Scope of Work Assumptions:

- Existing relays will be used.
- Ancillary Scope of Work
 - Project Management
 - Provide project management, coordination, administration, scheduling, material management and project development if required.
 - Information Technology
 - N/A
 - Testing and Commissioning
 - Testing and commissioning services as required for revised relay settings.

3.5 Mansfield Substation

Review and update relay settings.

- Below Grade Scope of Work:
 - N/A
- Above Grade Scope of Work:
 - N/A
- Relay & Control Scope of Work
 - Review and update relay settings.
- Scope of Work Assumptions:
 - Existing relays will be used.
- Ancillary Scope of Work
 - Project Management
 - Provide project management, coordination, administration, scheduling, material management and project development if required.
 - Information Technology
 - N/A
 - Testing and Commissioning
 - Testing and commissioning services as required for revised relay settings.

4. Other Scope of Work

4.1 Revenue metering.

- Description of Work

- Install (1) one new 3-phase free standing CT/PT Combo Unit, metering panel, and revenue metering for new lead generation line in new Interconnection Substation for AG2-621. FE to install revenue metering at Hoytdale substation for AG2-621 interconnection.
- Below Grade Scope of Work:
 - (1) Lot of excavation, conduit, backfill, grounding, and wiring, between free standing CT/VT combo units and revenue metering.
 - (1) Lot of foundations for free-standing 138kV CT/VT Combo Unit.
- Above Grade Scope of Work:
 - (1) set of 3-phase Free Standing 138kV CT/VT Combo Unit.
- Relay & Control Scope of Work
 - (1) New Revenue Metering Panel with test switches. The material for the revenue meter to be included in revenue metering support estimate.
- Scope of Work Assumptions:
 - It is assumed current and voltage signals will be pulled from new 3-phase free standing CT/VT Combo Units. Costs for these combo units are included in the estimate for Hoytdale substation.
 - Assumes enough room in Hoytdale Control house to support a new revenue metering panel.
 - Assumes enough room in Hoytdale substation to add in free standing CT/VT Combo Units.
 - Assumes the same crew that is constructing the Hoytdale substation expansion 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 the estimate for Hoytdale substation.
- Ancillary Scope of Work
 - Project Management
 - Provide project management, coordination, administration, scheduling, material management and project development if required.
 - Revenue Metering
 - Provide high end meter and engineering support for metering at existing Hoytdale substation.
 - Information Technology
 - Scope is covered in Hoytdale substation estimate.
 - Testing and Commissioning
 - Testing and commissioning services as required.

5. MILESTONE SCHEDULE FOR COMPLETION OF ATSI WORK

Facilities outlined in this report are estimated to take 46 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
Siting, Permitting & Real Estate	5	38
Detailed Engineering	3	38
Equipment Delivery	40	40
Construction	41	44
Testing and Commissioning	44	46

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 ATSI Transmission System by a Power Transformer with a winding configuration meeting the requirements in FirstEnergy's "Requirements for Transmission Connected Facilities" document.
- 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.

6.2 Cost Estimate Assumptions:

- The cost estimates provided in this report were developed as of March 12, 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, ATSI 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.
- ATSI reserves the right to charge the Project Developer operation and maintenance expenses to maintain the Project Developer attachment facilities, including metering facilities, owned by ATSI. 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.
- ATSI’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 ATSI 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 AG2-621 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

Not Applicable.

9. APPLICABLE TECHNICAL REQUIREMENTS AND STANDARDS

The [Requirements for Transmission Connected Facilities](#), Revision 7, dated January 27, 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

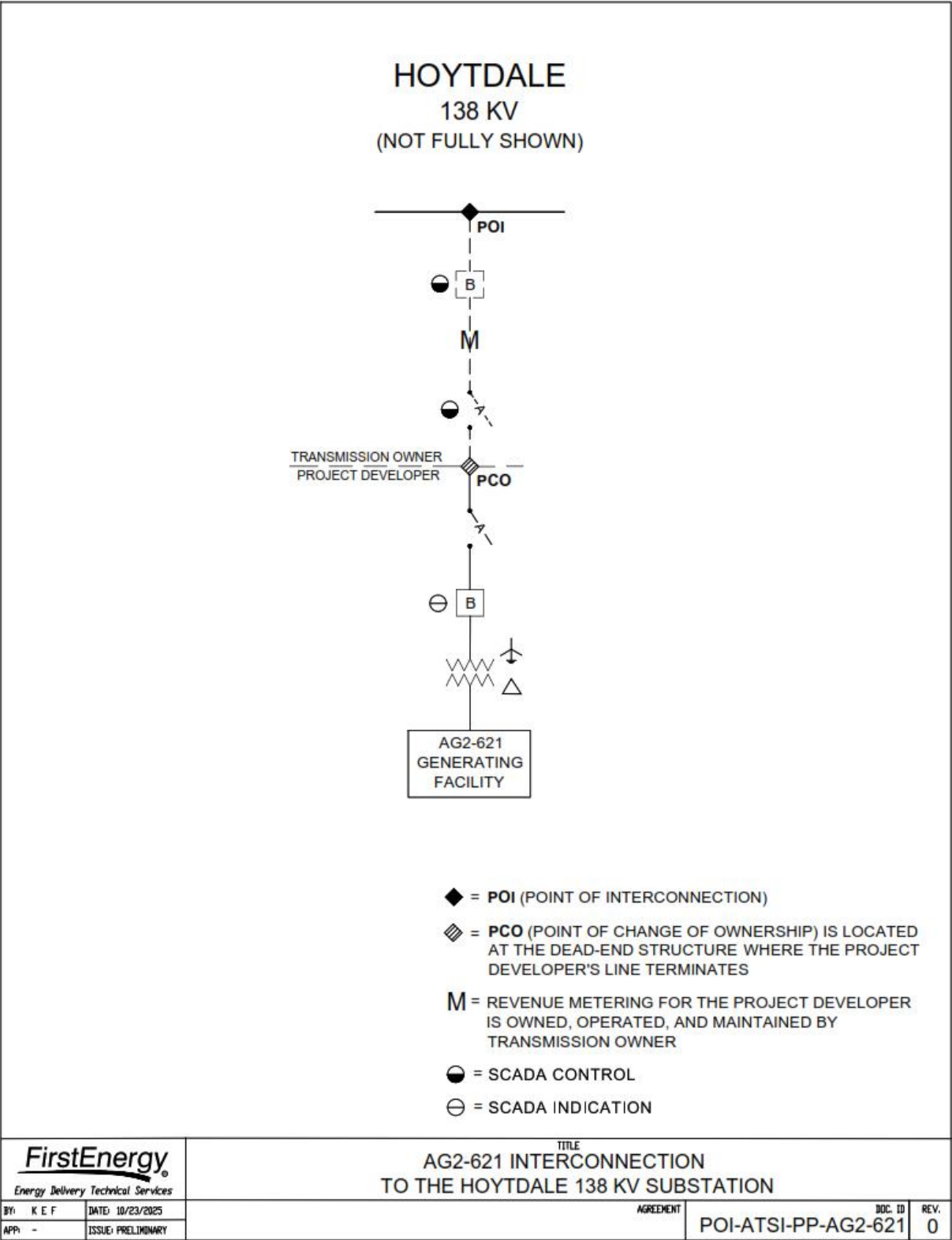
interconnection substation site, together with permanent access rights to and from the substation, as well as a perpetual easement for any transmission lines to the substation.

- 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:

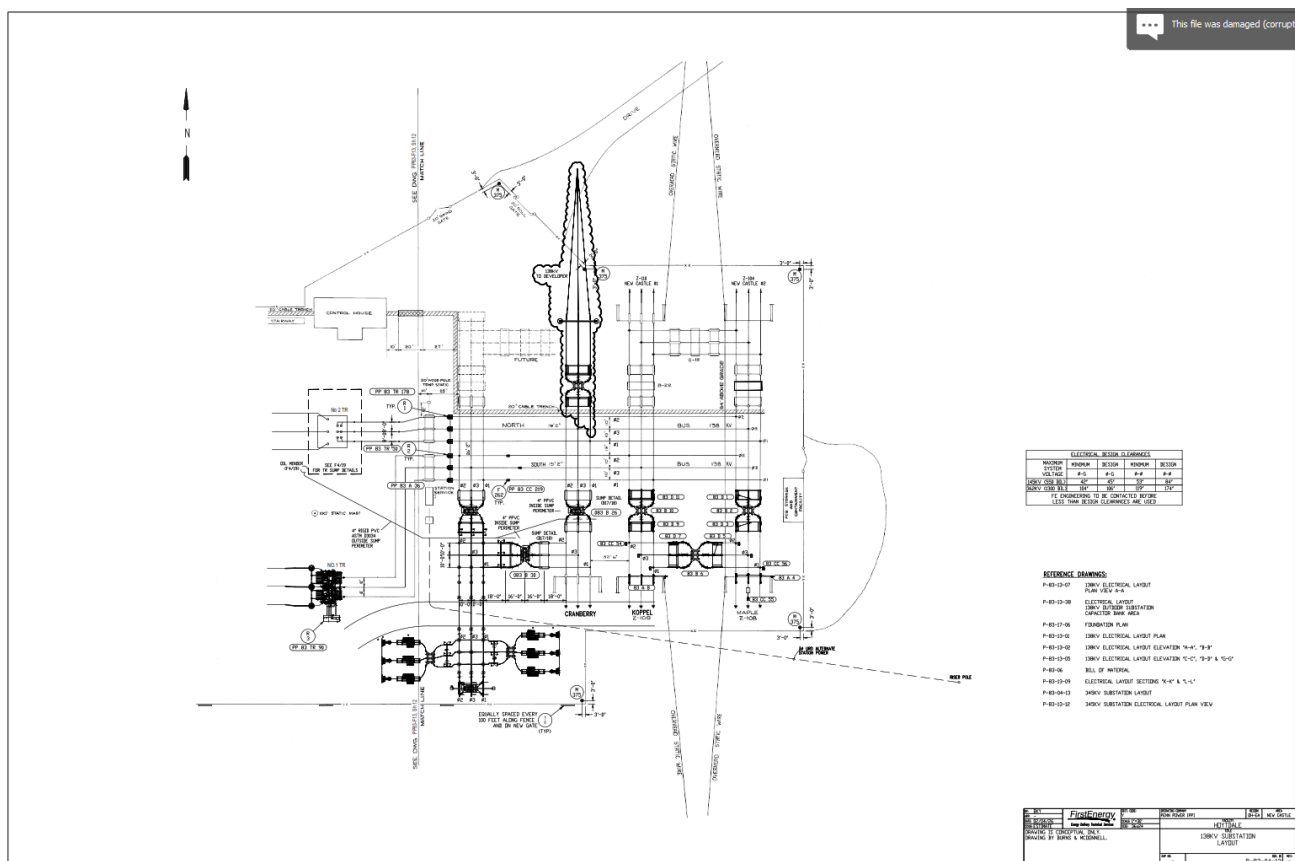
<https://www.firstenergycorp.com/help/safety/real-estate-power-lines/transmission-right-of-way.html#ROWform>

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
Insulator - Line - Porcelain/Glass (ea)	36
Steel Support Structure (ea)	9
Hard Bus - 4 inch (ft)	220
Relay - Individual (ea)	6
Relay Panel (ea)	3
Circuit Breaker - 145 kV 63 kA (ea)	1
Anchor Bolt - Substation (ea)	60
Surge Arrester - 138 kV (ea)	3
Capacitor Coupled Voltage Transformer (CCVT) - 138 kV (ea)	3
Current Transformer - Freestanding (CT) - 138 kV (ea)	3
Potential Transformer (PT) - 138 kV (ea)	3
Disconnect Switch - Substation - 138 kV (ea)	3
Switch - Motor Operator - Substation (ea)	3
Cable - Control/Communication (lf)	7620
Conductor - AAC (ft)	450
Conductor - ACSR (ft)	1742.4
Conduit - Rigid (lf)	651
Wire - Fiber - ADSS (ft)	1831.749
Wire - Fiber - Underground (ft)	2386
Wire - Shield - OHGW (lf)	580.8
Wire - Shield - OPGW (lf)	200

ATTACHMENT #4: PROTECTION SCOPE**Short Circuit Analysis****Short Circuit Values**

The existing 138kV fault values at the AG2-621 interconnection location (Hoytdale 138kV) are:

Three phase = 34.2kA

Single line to ground = 33.8kA

$Z1 = (0.1 + j 1.2)\%$

$Z0 = (0.2 + j 1.3)\%$

These values are provided for bolted, symmetrical faults under present normal system conditions and are provided on a 138kV, 100MVA base. 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.

Protection Requirements:**Main 138/34.5kV Transformer**

- The interconnecting 138-34.5kV transformer shall have a wye-grounded configuration on the transmission (138kV) side of the transformer and a delta-connected configuration on the generator (34.5kV) side.
 - Transformer is required to be two-winding (i.e. no tertiary winding)
- One 138kV, three-phase circuit breaker will be required on the FE side of the customer's main 138/34.5kV transformer.
- One 34.5kV, three-phase circuit breaker will be required on the low-side lead of the customer's main 138/34.5kV transformer.
 - Bus protection shall be required for the customer's 34.5kV bus
- The circuit breaker shall be fully rated to interrupt available fault current when calculated according to the latest ANSI standard.
 - Bypass switches shall NOT be installed across the breaker. If the customer desired the added reliability benefit of being able to keep the substation energized while performing breaker maintenance, a ring bus or dedicated sparing circuit breaker is required.
 - If the circuit breaker uses gas as an interrupting medium, the device shall be equipped with a low gas pressure alarming/tripping/lockout scheme (as appropriate for the particular device) in order to minimize the possibility of a transmission fault resulting from a loss of insulating gas.
- The interconnecting transformer and all 138kV facilities at the customer substation shall have redundant, high-speed protection inclusive of the 138kV breaker and high-side metering and shall trip, at minimum, this breaker. Separate CTs and tripping paths are required between the primary and backup relaying.
 - Primary Overall Transformer Differential Protection Relay – minimum functions: 87OA. (FE standard device is SEL-487E)
 - The 138kV source for overall transformer differential protection shall be CTs on the utility source side of the transformer breaker. The low side source for primary

- differential protection shall be CTs on the bus side of the low side transformer breaker
- Backup Overall Transformer Differential Protective Relay - minimum functions: 87T. (FE standard device is SEL-487E)
 - The 138kV source for primary transformer differential protection shall be CTs on the utility source side of the transformer breaker separate from the overall differential relay. The low side source for primary differential protection shall be CTs on the bus side of the low side transformer breaker separate from the overall differential relay.
- System Backup Protective Relay - minimum functions: High-side - 51G. (FE standard device is SEL-451)
 - The source for 51G system backup shall be from a CT on the transformer high-side neutral.
- Breaker Failure (BF) Relay – Dedicated breaker failure relay with associated hand-reset lock out relay (LOR). Will be wired to trip the transformer low-side as well as issue DTT to Hoytdale to isolate from the transmission system if there is a failure to trip operation. (FE standard device is SEL-451).
 - Direct transfer trip for breaker failure, anti-islanding, and other functions as needed shall be communicated via fiber using the associated SEL-411L primary and backup relays. Trip on loss of channel to both the primary and backup schemes.
- CTs used for the zones of protection covering the high voltage portion of the customer's system shall use C800 relay accuracy CTs. These CTs should not saturate for the maximum through-fault current that can be experienced by the relay for the tap ratio in use.
- The relaying system shall have a reliable source of power independent from or immune to disturbances/loss of the AC system (e.g. DC battery and charger) to ensure proper operation of the protection schemes and tripping of the circuit breakers.
- The customer will be required to coordinate with upstream protection. It is solely the customer's responsibility to install and design their relaying to ensure adequate protection of their equipment.
- Detailed one-line diagrams with proposed protection should be provided well in advance of design and engineering to allow for approval of the protection scheme and preliminarily validate coordination with FE system.
- Customer metering should be within their transformer zone of protection.

138kV Line and Intertie Relaying

- The line between Hoytdale and AG2-621 station will require redundant and independent fiber optic based communications channels to be installed and maintained by the interconnecting customer between the facilities for use with high-speed line current differential protection.
 - Separate primary and backup SEL-411L relays at the AG2-621 station will be required. Separate primary and backup SEL-411L relays will also be required at Hoytdale.
 - Any identified Intertie relay functionality (e.g. overfrequency, underfrequency, phase and ground overvoltage, directional overcurrent, and directional power) will be incorporated into the SEL-411L line relaying at AG2-621
 - The source CTs for the line current differential relays at the customer station shall be separate sets of 2000:5 CTs (C800 or better). These shall be located in the transformer-side bushings of the customer's high-side breaker
 - Line and transformer zones of protection overlap through the breaker.
 - The primary SEL-411L relays shall be sourced from an inner set of CTs and the backup SEL-411L relays sourced from an outer set of CTs on the transformer side of the customer's high-side breaker such that the backup SEL-411L scheme encompasses the primary.

- The 138kV PTs/CCVTs for the SEL-411L relays shall be on the line-side of the 138kV breaker. PTs/CCVTs shall have, at minimum, two secondary windings and SEL-411L relays shall use separate secondary windings.

Generator Owner's System Protection

- The generator owner (GO) is to design their protective system to clear any fault within their zones of protection with one or more of their local breakers.

Settings for the protection on the 138kV transformer and intertie relaying shall be provided to FE for review and approval well in advance of energization.

The Connecting Party shall provide utility-grade relays for protection of the FE Transmission System. FE shall approve all relays specified for the protection of the FE Transmission System, including time delay and auxiliary relays. Relay operation for any of the listed functions that are required shall initiate immediate separation of the parallel generation from the FE Transmission System:

Relay	Function
Frequency	To detect underfrequency and overfrequency operation.
Overvoltage	To detect overvoltage operation.
Undervoltage	To detect undervoltage operation.
Ground Fault Detector	To detect a circuit ground on the FE Transmission System.
Phase Fault Detector	To detect phase to phase faults on the FE Transmission System.
Transfer Trip Receiver	To provide tripping logic to the generation owner for isolation of the generation upon opening of the FE supply circuits.
Directional Power	To detect, under all system conditions, a loss of FE primary source. The relay shall be sensitive enough to detect transformer magnetizing current supplied by the generation.

The Interconnection Customer will be required to comply with all FE Generation Protection Requirements for Generation Interconnection Customers. The Generation Protection Requirements may be found within the "FirstEnergy Requirements for Transmission Connected Facilities" document located at the following links:

www.firstenergycorp.com/feconnect

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

FE System Modifications

System modifications may be required to make settings changes and/or replace existing relays at FirstEnergy remote substation. Customer relaying will be required to coordinate with upstream transmission system protection.

Hoytdale Substation

- Install one new breaker on the 138kV North bus/TR#2 low-side lead
- Install one set of 138kV CCVTs
- Install new line protection for 138kV exit to AG1-621 facility
- Install breaker failure relaying on new 138kV breaker
- Install new bus/transformer protection incorporating the 138kV North bus due to limitations with existing relaying
- Settings changes may be necessary on other, existing relaying to support system coordination

Settings Changes

Settings changes are possible at, but not limited to, the following stations:

- Cranberry
- Mansfield
- Maple
- McClelland
- New Castle

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

Category	Source	Risk	Comment
Surficial Soil Survey	USDA Soil Survey	Moderate	Urban land Arents or Udorthents strip mine – Possible fill
Geologic Formation/Group	PA/USGS Geologic Survey	Moderate	Coal present
Karst	USGS/ TAMI 2	Low	Bedrock mapped with minor limestone, TAMI indicates no karst features
Landslide Susceptibility	GIS/Google Earth/FEMA Risk Map	Moderate	Moderately sloped, prior retaining walls constructed
Coal Mining and Oil and Gas Wells	PA Geologic Survey/TAMI 2	Low	No mining mapped within the site vicinity
Environmental Hazard	US Wetland Maps/FEMA	Low	Low risk of flooding
Past Development	TAMI/GIS MAP/Historic Aerials	Low	Undeveloped except for existing substation(s) and T-Lines

Site Background / Geologic Hazards

This review was conducted to determine potential geologic hazards and risk at the existing Hoytdale 138kV substation generator developer location (AG2-621). The existing substation is located in Wampum, Beaver County, Pennsylvania. This includes improvements to the existing Hoytdale substation. The existing substation is operated by Penn Power. The proposed improvements to the substation would consist of the installation of one breaker 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 Udorthents strip mine steep (UAE), or Urban Land-Arents complex. The urban land complex are generally undefined fill soils, while the Udorthents are generally highly variable and generally consist of gravelly clays and silts. The Udorthents soil series is well drained and currently mapped with a Hydrologic Soil Group (HSG) C classification, indicating the soils have a moderately slow infiltration rate. The depth to the water table is listed as greater than 80 inches below the ground surface.

Geologic Formation/Group

The site is located in the Pittsburgh Low Plateau Section of the Appalachian Plateaus Physiographic province. The Appalachian Plateaus Physiographic province features relatively flat-lying sedimentary rocks deeply cut by rivers, creating rugged, dissected landscapes with high ridges and deep valleys, known for coal and natural gas reserves. The Geologic Map of Pennsylvania maps the Allegheny Formation which is composed primarily of cyclic sequences of clay shale, claystone, siltstone, sandstone, limestone, and coal. Freshwater limestone beds (commonly less than 5 feet thick) or calcareous claystone with limestone nodules commonly underlie the coal beds in the upper third of the formation. The Allegheny is characterized by the presence of economically significant coal beds (the Upper and Lower Freeport coals, the Upper, Middle, and Lower Kittanning coals, the Clarion coal, and the Brookville coal).

Karst

The site is mapped to be within the Allegheny Formation, which does contain limestone beds. The Transmission Asset Mapping Interface (TAMI 2) was reviewed and the site is not mapped within an area prone to karst features. Based on the bedrock geology and karst mapping, there appears to be a low risk of karst related concerns for the site. 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

The Allegheny Mountain Section is listed as a generally low, but includes local areas of high to moderate risk of landslide susceptibility by the Pennsylvania Geological Survey titled "Landslides in Pennsylvania". FEMA national risk index for the area in which the site is located as a relatively low risk to landslides. Transmission Asset Mapping Interface (TAMI) was utilized to generate elevation profiles for the potential site area. The ground surface slopes downward from south to north approximately 80 feet south of the Hoytdale SVC station to the north side of the Hoytdale Substation. Retaining walls were constructed during the construction of the Hoytdale SVC station. The site also slopes downward from west to east outside of the station, including an approximate 20 foot slope midway through the station. Given the mapped risks by FEMA, the Pennsylvania Geological Survey, and substation profiles, there appears to be a moderate risk of landslide susceptibility.

Resource mapping

There are occasional coal resources and mining activity in this region. Based on the Pennsylvania Department of Environmental Protection Mining map tool, the maps indicate that underground mining has not occurred at the site or immediate surrounding area. TAMI 2 was also reviewed but does not show mining to have occurred at the site. The potential for mining at the site is a low risk concern for the proposed improvements.

Several unconventional and conventional natural gas wells are located within Beaver County. Available mapping indicates that no gas or oil wells have been located in the site vicinity.

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 to the immediate site location. An environmental study should still be conducted 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 1952, this site was generally open farm field prior to the construction of the substation sometime between 1958 and 1969. Expansions to the substation have occurred since the original construction, including the construction of the Hoytdale SVC station to the south which was constructed between 2015 and 2017. The site is listed as primarily Urban land-Arents complex which is mapped as fill indicating that prior to available aerial images some of the areas within the site were filled.

Recommendations & Geotechnical Opinion

List of Observations/Concerns Interconnection Facilities – Hoytdale 138 kV AG2-621:

1. The site is mapped to be within Udorthents strip mine and Urban land Arents. Fill materials are likely present.
2. This site is part of the Allegheny Formation and contains both thin limestone and coal.
3. Low potential for karst.
4. Moderate risk for landslide occurrence.
5. Low environmental impact risk.
6. Mining activity not present within the site area. No gas wells within the area.

Preliminary Geotechnical Opinion

The geotechnical conditions of this site seem to conclude that it is relatively moderate risk location due to the geologic formation that includes limestone and coal (although not in a high concern), moderate slope of the site that could be prone to landslides and mapped as primarily a fill site that could contain uncontrolled fills. Geotechnical information was not readily available for review, however, to the extent possible, any background from the substation construction should be reviewed further.