

**AEP Portion of
Facilities Study Report
For
Physical Interconnection of
PJM Generation Interconnection Request
Project ID AG1-125
Madison County, Ohio

"Marysville - Flatlick 765 kV"**

Revision 0: October 2024

Introduction

This Facilities Study has been prepared in accordance with the PJM Open Access Transmission Tariff Part VII, and if applicable, the Application and Studies Agreement between the Project Developer and PJM Interconnection, LLC (PJM or Transmission Provider (TP)). The Transmission Owner (TO) is AEP Ohio Transmission Company, Inc. to be abbreviated in the remainder of this report as OHTCo. Additional scope will be required by Ohio Power Company to be abbreviated as OHPCo. OHTCo is an affiliate company of American Electric Power Service Corporation (AEP). All references to AEP include OHTCo unless otherwise specified.

A. Transmission Owner Facilities Study Summary

1. PROJECT DESCRIPTION

The Project Developer (PD) has proposed a Solar Generating Facility located in Madison County, Ohio with a designated PJM Project ID of AG1-125. The installed facilities for AG1-125 will have a total Maximum Facility Output (MFO) of 400 MW with 234.9 MW of this output being recognized by PJM as Capacity.

2. POINTS OF INTERCONNECTION AND CHANGE IN OWNERSHIP

The Generating Facility will interconnect with the American Electric Power (AEP) transmission system via a newly constructed OHTCo owned 765 kV station referred to as “New AG1-125 765 kV Switching Station” tapping the Marysville - Flatlick 765 kV line, approximately 23.2 miles from the Marysville 765 kV Substation and 85.9 miles from the Flatlick 765 kV Substation.

This project will require a station service electrical feed from the PD’s Main Power Transformer. As such, there is a need to identify two Points of Change in Ownership, one for the high voltage connection, and one for the low voltage station service connection.

The Point of Interconnection (POI) is the point where the risers connect the generator lead circuit to the OHTCo New AG1-125 765 kV Switching station line termination point. The high voltage Point of Change in Ownership (PCO) will be located at the first structure in the generation lead circuit outside the OHTCo New AG1-125 765 kV Switching Station fence. OHTCo will own the span from the OHTCo New AG1-125 765 kV Switching Station to the constructed and owned dead end PCO structure, including the jumpers. The Project Developer will own the other span connecting to the PCO structure along with the remainder of the 765 kV generator lead transmission line and associated structures back to the AG1-125 generation collector substation. The low voltage PCO will be located at a riser structure inside of the PD’s collector station. The PD will own the PCO riser structure and the conductor from the riser structure back to the tertiary winding of the generation Main Power Transformer. OHTCo will own the conductor and any required conduit between the PCO riser structure, extending underground, to a riser structure in the OHTCo New AG1-125 765 kV Switching Station.

The construction of the new interconnection substation will split the existing Marysville - Flatlick 765 kV circuit into two lines on the transmission system.

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

3. AMENDMENTS TO THE IMPACT STUDY DATA OR IMPACT STUDY RESULTS

No amendments to the impact study data or impact study results are required by AEP.

4. PROJECT DEVELOPER SCHEDULE

The Project Developer's requested in-service date for the generation facility is January 17, 2028. This report does not imply a Transmission Owner commitment to any previously proposed date.

5. SCOPE OF PROJECT DEVELOPER INTERCONNECTION FACILITIES

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

- Two (2) 230 kV circuit breakers and associated equipment located between the high side of the GSU and the Point of Change in Ownership
- One (1) Main Power Transformer(s) (MPT(s))
- Station service electrical connection from the MPT facility to the low voltage Point of Change in Ownership
- One (1) Circuit breakers and associated equipment located between the high side of the MPT(s) and the high voltage Point of Change in Ownership
- Generator lead line conductors from the Generating Facility to the Point of Change in Ownership
- Protective relays and associated equipment for the generator lead
- Telecommunications Equipment including Supervisory Control and Data Acquisition (SCADA) to comply with the TO's Applicable Technical Requirements and Standards

B. Transmission Owner Facilities Study Results

The following is a description of the planned Transmission Owner facilities required for physical interconnection of the proposed AG1-125 project to the AEP transmission system. These facilities shall be designed according to AEP Applicable Technical Requirements and Standards. Once built, AEP will own, operate, and maintain these Facilities.

1. INTERCONNECTION SUBSTATION (NEW) (Stand Alone Network Upgrade) (PJM Network Upgrade n8918)

OHTCo will construct a New AG1-125 765 kV Switching Station, initially populated with four (4) circuit breakers, expandable to five (5) circuit breakers. This arrangement is planned to be designed to accommodate 4000 A of continuous current. The station will be constructed on the west side of the Marysville - Flatlick 765 kV circuit to interconnect the project with the AEP Transmission system.

Major equipment is expected to include:

- Four (4) 63 kA circuit breakers with associated control relaying (one (1) for the extension to the shunt reactors).
- One (1) 16' x 48' dual battery Drop-In Control Module (DICM).
- Eight (8) motorized breaker disconnect switches.

- Two (2) additional motorized disconnect switches.
- Two (2) 3-phase coupling capacitor voltage transformers (CCVT), one (1) each on the line exits to the Marysville and Flatlick 765 kV Stations.
- Six (6) single phase line traps, three (3) each for the line exits to the Marysville and Flatlick 765 kV Stations.
- Two (2) A-Frame line exit structures, one (1) each for the line exits to the Marysville and Flatlick 765 kV Stations.
- Four (4) single-phase (three primary, one spare) 100 MVAR shunt reactors.
- Associated conductors (buswork, ground grid, jumpers), telecom terminal equipment, insulators, arresters, foundations, and structures.
- A dual Directional Comparison Blocking (DCB) line protection relay scheme for the line to the Marysville 765 kV Station.
- A dual Directional Comparison Blocking (DCB) line protection relay scheme for the line to the Flatlick 765 kV Station.
- Installation of two (2) station service arrangements, including metering, with independent power sources as follows:
 - One (1) station service source is planned to come from the new AG1-125 765 kV Switching Station generator Main Power Transformer tertiary winding. The PD will be required to provide a connection point inside of their generation step up facilities to accommodate the station service requirement.
 - One (1) station service source is planned to come from the local Load Service Entity (LSE), Ohio Edison. An agreement will be required for the local distribution facilities to be routed into the new AG1-125 765 kV Switching Station. The estimate in this report includes installation of approximately 1200' of two-phase underground station service conductor by directional boring from the nearest available three-phase facilities.

The civil work required to develop a site that accommodates the installation of the above station includes grading of a 1210' x 1015' pad and approximately 2640' x 20' of access road.

2. TRANSMISSION LINE TIE-IN

The below transmission line facility configuration will cut the New AG1-125 765 kV Switching Station into the existing Marysville - Flatlick 765 kV Circuit in an in-and-out arrangement (**PJM Network Upgrade n8920**):

- OHPCo will remove three (3) existing 120 ft. lattice tower structures in the Marysville - Flatlick 765 kV Circuit ROW (str. # 402, 403, & 404).
- OHPCo will install two (2) new 765 kV lattice dead end towers on concrete pier foundations with anchor bolt cages in the existing Marysville - Flatlick 765 kV Circuit Right of Way, one (1) to the northeast of the new AG1-125 765 kV Switching Station site, and one to the southeast of the new AG1-125 765 kV Switching Station site.
- OHPCo will install one (1) additional 765 kV lattice dead end tower with on a concrete pier foundation with an anchor bolt cage between the new northeast structure and the new AG1-125 765 kV Switching Station site.

- OHPCo will install two (2) additional 765 kV lattice dead end towers with on concrete pier foundations with anchor bolt cages between the new southeast structure and the new AG1-125 765 kV Switching Station site.
- OHPCo will extend two (2) spans of 4-bundle ACSR (Aluminum Conductor Steel Reinforced) 1351 45/7 (Dipper) transmission line conductor with ACSR 159 12/7 GUINEA shield wire from the new northeast ROW structure to the new station.
- OHPCo will extend three (3) spans of 4-bundle ACSR 1351 45/7 (Dipper) transmission line conductor with ACSR 159 12/7 GUINEA shield wire from the new southeast ROW structure to the new station.

3. TRANSMISSION OWNER INTERCONNECTION FACILITIES:

The OHTCo Interconnection Facilities are expected to include the following:

Please see Section 8.1, bullet #4 and Section 9 for submetering requirements.

- OHTCo install one (1) new steel, 120', single circuit, single pole dead end structure on a concrete pier foundation with an anchor bolt cage and one span of 4-bundle ACSR 1351 (Dipper) transmission line conductor with shield wire for the generation lead circuit extending from the New AG1-125 765 kV Switching Station.
- OHTCo will install 765 kV revenue metering for the generation lead at the new AG1-125 765 kV Switching Station. Installation will include three (3) 1-phase meter quality CCVTs on the generator lead line entering the new station. Meter current inputs will be provided by the circuit breaker bushing CTs for the line to the AG1-125 collector station. Metering installation will also include one (1) DICM-installed metering panel with Primary and Backup meters and associated telecommunications connectivity.
- OHTCo will extend two (2) underground 48 count ADLT (all dielectric loose tube) fiber optic cables with ADSS (All-Dielectric Self Supporting) Entrances via diverse paths from the new AG1-125 765 kV Switching Station control house to fiber demarcation splice boxes to support direct fiber relaying between the new AG1-125 765 kV Switching Station and Project Developer's collector station. The Project Developer will be responsible for the fiber extension from the splice boxes to the collector station.
- OHTCo will install one (1) A-Frame line exit structure for the line exits to the new AG1-125 765 kV Switching Station.
- OHTCo will install a dual direct-fiber current differential relay protection scheme for the generation lead to the proposed AG1-125 collector station.

4. UPGRADE TO NEIGHBORING STATIONS

The Neighboring Station Upgrade Scopes will include the following:

4.1 Marysville 765 kV (PJM Network Upgrade n8921)

- OHPCo will replace the tuning equipment associated with the three (3) 1-phase line traps on the 765 kV line to the new AG1-125 765 kV Switching Station (Flatlick line) at the Marysville 765 kV Station.

- OHPCo will replace the existing breaker control cable for Circuit Breaker “B1” at the Marysville 765 kV Station.
- OHPCo will replace the breaker failure and control relays for Circuit Breakers “B” and “B1” at the Marysville 765 kV Station.
- OHPCo will replace the existing line relaying for the line to the new AG1-125 765 kV Switching Station (Flatlick line) at the Marysville 765 kV Station. The new relays will employ a dual Directional Comparison Blocking (DCB) protection scheme. Installation will include an Ethernet Switch.

4.2 Flatlick 765 kV (PJM Network Upgrade n8922)

- OHPCo will replace the breaker failure and control relays for Circuit Breakers “B” and “C” at the Flatlick 765 kV Station.
- OHPCo will replace the existing line relaying for the line to the new AG1-125 765 kV Switching Station (Marysville line) at the Flatlick 765 kV Station. The new relays will employ a dual Directional Comparison Blocking (DCB) protection scheme.

5. INSTALLATION OF FIBER-OPTIC CABLE CIRCUITS (PJM Network Upgrade n8919)

The required Fiber-optic Cable Upgrades are expected to include the following:

- OHTCo will extend two (2) new fiber-optic cable paths consisting of a total of 1.4 miles of 144 count ADLT cable with ADSS entrances installed in new underground ROW. This installation is required to accommodate supervisory control and data acquisition (SCADA) at the new 765 kV station. The new fiber-optic cables will extend from the new 765 kV station control house to demarcation points with third (3rd) party leased lines.

6. COST ESTIMATE OF AEP FACILITIES FOR PHYSICAL INTERCONNECTION

The following tables summarize the total estimated costs according to FERC criteria. The estimated costs are in 2024 dollars. **This cost excludes Federal Income Tax Gross Up charges on Contributions in Aid of Construction (CIAC).** This tax may or may not be charged based on whether this project meets the eligibility requirements of IRS Notice 88-129. If at a future date it is determined that the Federal Income Tax Gross Up charges are required, the Transmission Owner shall be reimbursed by the Project Developer for such taxes. The estimated reimbursement amount is noted in the table below.

6.1 COST ESTIMATE FOR TRANSMISSION OWNER-BUILD OPTION

Work Description	Type of Upgrade	Direct		Indirect		Total	Tax
		Labor	Material	Labor	Material		
Transmission Owner Interconnection Facilities	TOIF	\$1,833,235	\$762,108	\$192,878	\$83,333	\$2,871,554	\$0
New Interconnection Substation (OHTCo)	Stand Alone Network Upgrade n8918.0	\$37,209,644	\$35,754,135	\$2,769,999	\$2,661,646	\$78,395,424	\$0
Expansion of existing substation	Network Upgrade	\$0	\$0	\$0	\$0	\$0	\$0
Interconnection Substation tie-in (OHPCo)	Network Upgrade n8920.0	\$5,253,253	\$2,077,906	\$773,986	\$305,388	\$8,410,533	\$0
Remote relay and associated equipment at Marysville 765 kV (OHPCo)	Network Upgrade n8921.0	\$830,566	\$467,472	\$261,737	\$106,816	\$1,666,591	\$0
Remote relay and associated equipment at Flatlick 765 kV (OHPCo)	Network Upgrade n8922.0	\$514,704	\$381,001	\$112,776	\$83,480	\$1,091,961	\$0
Fiber Installation in Existing ROW	Network Upgrade	\$0	\$0	\$0	\$0	\$0	\$0
Fiber Installation in New ROW	Stand Alone Network Upgrade	\$0	\$0	\$0	\$0	\$0	\$0
Final Tie in for Fiber installation in New ROW (OHTCo)	Network Upgrade n8919.0	\$502,756	\$130,934	\$45,376	\$11,817	\$690,883	\$0
Total Project Costs		\$46,144,158	\$39,573,556	\$4,156,752	\$3,252,480	\$93,126,946	\$0

6.2 COST ESTIMATE FOR DEVELOPER-BUILD OPTION

Work Description	Type of Upgrade	Direct		Indirect		Total	Tax
		Labor	Material	Labor	Material		
Transmission Owner Interconnection Facilities (Oversight)	TOIF	\$0	\$0	\$0	\$0	\$0	\$0
New Interconnection Substation (Oversight)(OHTCo)	Stand Alone Network Upgrade n8918.0	\$224,288	\$55,462	\$108,244	\$26,767	\$414,761	\$0
Expansion of existing substation	Network Upgrade	\$0	\$0	\$0	\$0	\$0	\$0
Interconnection Substation tie-in (OHPCo)	Network Upgrade n8920.0	\$5,253,253	\$2,077,906	\$773,986	\$305,388	\$8,410,533	\$0
Remote relay and associated equipment at Marysville 765 kV(OHPCo)	Network Upgrade n8921.0	\$830,566	\$467,472	\$261,737	\$106,816	\$1,666,591	\$0
Remote relay and associated equipment at Flatlick 765 kV (OHPCo)	Network Upgrade n8922.0	\$514,704	\$381,001	\$112,776	\$83,480	\$1,091,961	\$0
Fiber Installation in Existing ROW	Network Upgrade	\$0	\$0	\$0	\$0	\$0	\$0
Fiber Installation in New ROW (Oversight)	Stand Alone Network Upgrade	\$0	\$0	\$0	\$0	\$0	\$0
Final Tie in for Fiber installation in New ROW (OHTCo)	Network Upgrade n8919.0	\$502,756	\$130,934	\$45,376	\$11,817	\$690,883	\$0
Total Project Costs		\$7,325,567	\$3,112,775	\$1,302,119	\$534,268	\$12,274,729	\$0

7. MILESTONE SCHEDULES FOR COMPLETION OF AEP WORK

7.1 STANDARD OPTION:

<u>Activity</u>	<u>Number of Days (See Notes)</u>
Project Engagement*	1
Engineering Start	70
Material Ordering	112
Construction (Grading & Below Grade)	517
Construction (Above Grade)	607
Outage Requests Made By	400
Outage (Structure Foundations)**	892
Outage (Cut-in & Testing)**	942
Ready For Back Feed (ITO In-Service Date)	962

***Day 1 will be determined at the PJM construction project kick off meeting.**

****Scheduled Outages are contingent upon outage availability. Longer duration outages are not available during peak load periods.**

The above schedule is based on typical AEP construction timelines, long lead material availability, and common outage constraints. The facilities outlined in this report, as constructed by AEP, are estimated to take 32 months to complete. Given this construction timeline and a typical period for agreement processing, AEP can support a backfeed date of October 15, 2027, subject to change during the tariff defined Final Agreement Negotiation Phase. The Project Developer is expected to have the Interconnection Facilities constructed and ready to accept backfeed by the business day prior to the final negotiated backfeed date.

7.2 OPTION TO BUILD:

<u>Activity</u>	<u>Dates (See Notes)</u>
Project Engagement*	1
Engineering Start	70
Material Ordering	170
Construction (Grading & Below Grade)	630
Construction (Above Grade)	690
Outage Requests Made By	335
Outage (Structure Foundations)**	710
Outage (Cut-in & Testing)**	760
Ready For Back Feed (ITO In-Service Date)	790

***Day 1 will be determined at the PJM construction project kick off meeting. Scheduled Outages are contingent upon outage availability. Longer duration outages are not available during peak load periods.**

****Coordination with the Project Developer will be required 90 days prior to the start of this task.**

The above schedule is based on typical AEP construction timelines, long lead material availability, and common outage constraints. The facilities related to the cut-in and remote end stations outlined in this report, as constructed by AEP, are estimated to take 26 months to complete. Given this construction timeline and a typical period for agreement processing, AEP can support a backfeed date of February 8, 2027, subject to change during the tariff defined Final Agreement Negotiation Phase. The Project Developer is expected to have the Interconnection Facilities, including the interconnection station, ready to accept backfeed by the business day prior.

8. ASSUMPTIONS IN DEVELOPING SCOPE/COST/SCHEDULE

Note - Any materials purchased, or design decisions made by the Project Developer (relative to any facilities to be owned by AEP) prior to coordination with and approval by the executing AEP team (pursuant to an Engineering and Procurement or Generation Interconnection Agreement) are at the developer's risk and may not meet the specifications required for interconnection with the AEP transmission system.

8.1 SCOPE ASSUMPTIONS:

- Facility specifications (Breaker ratings, conductor size, etc.) and configurations are a result of the desktop functional scoping process observed while conducting this facilities study and are subject to change based on the results of the detailed scoping efforts that will take place post-interconnection or engineering and procurement agreements.
- Protection and Control (P&C) coordination with the Project Developer will be needed throughout the project. The Project Developer will be required to install an AEP-compatible line relaying protection panel at the collector substation using AEP standards to ensure relay coordination and adequate line protection. The AEP design team will ensure that the firmware at the collector station terminal matches the approved firmware at the AEP terminal. Failure to accept the cost of a matching line relay protection panel may change scoping.
- Scopes provided are based on a table-top process without the benefit of the results of site-specific engineering studies (e.g., soil borings, environmental survey, ground grid, etc.), unless otherwise provided by the Project Developer.
- The Project Developer will obtain, at its cost, all necessary provisions for the AEP direct connection facilities.
- The Project Developer will provide a site acceptable to AEP (for transfer in Fee Simple) and any required easements for the new AG1-125 765 kV Switching Station and associated line work to enable access to all facilities and structures.
- The new AG1-125 765 kV Switching Station interconnecting the proposed AG1-125 generator will be located in close proximity to the existing Marysville - Flatlick Transmission Line Right of Way.
- The Project Developer will have their construction and required checkout completed prior to the start of the interconnection to the new AG1-125 765 kV Switching Station and any required testing outages.
- Further reinforcements to other existing structures in the Marysville - Flatlick 765 kV Circuit ROW may or may not be necessary to account for change in longitudinal loads. This will be evaluated during detailed scoping.
- The existing structures intended to support the installation of new fiber optic ADSS cable are assumed to be capable of the additional burden. As such, this scope is subject to change as result of the detailed engineering processes that take place after execution of a Generation Interconnection Agreement.
- Ohio Edison will provide a station service electrical connection to their local distribution system.
- The PD will provide a station service electrical connection to their MPT tertiary windings.

8.2 SCHEDULE ASSUMPTIONS:

- All transmission outages are subject to PJM and AEP Operations outage scheduling requirements.
- Significant scope of work changes will impact the schedule.
- The above schedule reflects only the work required to interconnect the AG1-125 project. The schedules regarding network upgrades associated with this project, if any, are detailed in the documentation related to the specific network upgrade.
- Slippage by the Project Developer in executing the Generation Interconnection Agreement (GIA) does not equate to a "day for day" slippage in the scheduled back feed and in service dates. Depending on the time of year, planned outages, neighboring projects and maintenance of the grid, outage availability has the potential to shift by weeks or months depending on conditions at the time of the fully executed agreement.

8.3 ESTIMATE ASSUMPTIONS:

- Estimates provided are based on a table-top process without the benefit of the results of site-specific engineering studies (e.g., soil borings, environmental survey, ground grid, etc.), unless otherwise provided by the Project Developer.

8.4 OPTION TO BUILD ASSUMPTIONS:

- The Project Developer will use firms from the AEP approved list that have experience in the transmission region where the POI is located.
- The Project Developer follows the requirements specified in "Independent Power Producers Option to Build Guidelines" (Rev. 4, dated December 11, 2023), available at:

<https://www.aep.com/requiredpostings/AEPTransmissionStudies>

9. METERING REQUIREMENTS

All metering needed for this interconnection project must meet the metering requirements stated in Appendix 2, section 8 of the AG1-125 GIA, and in PJM Manuals M01 and M14D. The details of applicable metering requirements are provided in the "Connection Requirements for the AEP Transmission System" (Rev. 5, dated December 31, 2023) document, found at:

<https://www.aep.com/requiredpostings/AEPTransmissionStudies>

The primary and backup metering will be installed on the Transmission Owner side of the Point of Change in Ownership and will be owned and maintained by the Transmission Owner.

Any additional generation proposed behind an originating project's PCO that differs in either fuel type or corporate entity from the originating project will require the installation of additional submetering for both the originating project and the uprate for the purpose of settlement. Submetering will require additional space within the originating project's facilities. The meters, routers, Ethernet to fiber converters, and telecom switch will be procured and owned by AEP. The revenue quality instrument transformers, fiber-optic cable connecting the submeters, and any other additional hardware for the required submetering will be procured, installed, owned, and maintained by the Project Developer.

10. LAND REQUIREMENTS FOR INTERCONNECTION SUBSTATION

Land requirements for the Interconnection Substation needed for this interconnection project must meet the requirements set forth in “Standards and Expectations for Siting, Real Estate, Right-of-Way, and Environmental Permitting for Transmission Interconnection Projects,” Version 3 dated October 31, 2022 at <https://www.aep.com/requiredpostings/AEPTransmissionStudies> posted on AEP website.

The land footprint required for a typical 765 kV interconnection station is 1210' x 1015', not accounting for additional retention/detention ponds that may be required. This area is subject to change as result of the detailed engineering processes that take place after interconnection agreement execution.

11. ENVIRONMENTAL AND PERMITTING

The Project Developer is expected to obtain, at its cost, all necessary permits and provisions for the facilities to be constructed for this interconnection. AEP requires that the standards provided in the "Standards and Expectations for Siting, Real Estate, Right-Of-Way, and Environmental Permitting for Transmission Interconnection Projects", Version 3 dated October 31, 2022 found at: <https://www.aep.com/requiredpostings/AEPTransmissionStudies> be adhered to for all facilities interconnecting with the AEP transmission system.

C APPENDICES

Attachment #1: Single line Diagram for the Physical Interconnection

AG1-125 Point of Interconnection Marysville – Flatlick 765 kV Circuit (Remote Stations Not Completely Shown)



