Generation Interconnection

Facilities Study Report

for

Queue Project AD1-015

150 MW (57 MW Capacity) Solar

Frazeysburg 138 kV

Muskingum County, Ohio

August 2021

1 Facilities Study Summary

1.1 Project Description

Muskingum Solar, LLC proposes to install PJM Project AD1-015, a 150 MW (57.0 MW Capacity) solar generating facility in Muskingum County, Ohio (Figure 2). The point of interconnection for the generating facility will be a direct connection to AEP's Frazeysburg 138 kV substation (Figure 1).

1.2 Amendments/Changes to the Impact Study Report

No significant amendments/changes noted.

1.3 Interconnection Customer Schedule

PJM and AEP understand that the Interconnection Customer has established the following schedule dates:

Receive back feed power from AEP: 10/01/2023

Generation Commercial Operation Date: 12/15/2023

1.4 AEP's Scope of Work to Facilitate Interconnection

- To accommodate the interconnection at AEP's existing Frazeysburg 138 kV substation, the station will be expanded by adding four (4) 138 kV circuit breakers. Relay upgrades will also be required at the Ohio Central 138 kV and North Newark 138 kV stations.

- Installation of associated protection and control equipment, line risers, switches, jumpers, SCADA, and 138 kV revenue metering will be required at the Frazeysburg 138 kV substation. AEP reserves the right to specify the final acceptable configuration considering design practices, future expansion, and compliance requirements.

- AEP will extend one span of 138 kV transmission line for the generation lead going to the AD1-015 site. This span extends directly from within the AEP station to the adjacent IC collector station structure at the Point of Interconnection (POI, the point of change of ownership).

- It is understood that the Interconnection Customer is responsible for all of the connection costs associated with interconnecting the PJM project AD1-015 to the AEP transmission system. The cost of the customer's generating facility and the costs for the line connecting the generating facility to AEP's transmission system (Beyond the first span exiting the Frazeysburg station) are not included in this report; these are assumed to be the Customer's responsibility.

- The customer will be responsible for the cost of constructing a fiber-optic connection from their telecom equipment to the Frazeysburg station control house.

- AEP will remove 2 structures, 39A and 39B, on the Ohio Central-North Newark 138kV line, and install 3 new transmission structures and associated conductors to accommodate the Frazeysburg 138 kV substation expansion.

1.5 Description of Transmission Owner Facilities Included in the Facilities Study

1.5.1 Direct Connection Work

- AEP will install four (4) additional 138 kV circuit breakers and one line connection for the IPP at the Frazeysburg 138 kV substation. The Frazeysburg 138 kV bus will be configured as a four breaker ring. (Figure 1).

- AEP will install associated line protection and control equipment, line risers, switches, jumpers and SCADA at the Frazeysburg 138 kV substation.

- AEP will expand the Frazeysburg 138 kV substation boundary fence, ground grid, and gravel ~300 feet to the West.

- AEP will install a new control house due to insufficient space in the existing Frazeysburg control house to accommodate the required communications and relaying equipment.

1.5.2 Non-Direct Connection Work

- AEP will review and update the protection & control relays and settings (as needed) at the North Newark substation

- AEP will review and update the protection & control relays and settings (as needed) at the Ohio Central 138 kV substation.

1.5.3 Attachment Facilities Work

- AEP will Install 138 kV revenue metering at the Frazeysburg 138 kV substation.

- AEP will extend one span of 138 kV transmission line for the generation lead going to the AD1-015 site. This span extends directly from within the AEP station to the IC collector station structure at the POI.

- AEP will need to remove 2 structures, 39A and 39B, on the Ohio Central-North Newark 138kV line, and install 3 new transmission structures and associated conductors to accommodate the Frazeysburg 138 kV substation expansion.

- Two fiber connections are required. AEP will extend the fiber-optic cables from the points of transition into the Frazeysburg 138 kV control house. The customer will be responsible for the fiber work on the IPP side of the points of transition.

1.5.4 Network Upgrade Work

- No AEP facility upgrades will be needed.

1.6 Total Cost of Transmission Owner Facilities Included in the Facilities Study:

Attachment Facilities	$488,893.99
Direct Connection Facilities	$0
Non-Direct Connection Facilities	$8,248,085.02
Network Upgrade Facilities	$0
Total Cost	$8,736,979.01

The estimates do not include the impact that delays in obtaining ROW, permits, or other approvals may have.

1.7 Summary of Schedule Milestones for Completion of Transmission Owner Work Included in Facilities Study:

Standard Process

Task	Dates
Engineering Start	Q1, 2022
Material Ordered	Q2, 2022
Construction Start (Grading & Below Grade)	Q3, 2022
Construction Start (Above Grade)	Q4, 2022
Outage Requests Made By	TBD
Outage (Structure Foundations)	TBD
Outage (Retermination & Testing)	TBD
Ready For Back Feed (AEP's ISD)	10/01/2023
In-Service Date (COD)	12/15/2023

Assumptions (Standard Process)

- ISA and ICSA executed by 7/30/2021
- System conditions must allow scheduled outages to occur to support the proposed in service and backfeed date. Additional clearance outages may be needed for surrounding infrastructure.
- The customer will obtain, at its cost, all necessary provisions for the AEP direct connection facilities.
- The customer will perform site development and road construction as needed in accordance with AEP specifications.

- The customer will provide site acceptable to AEP (for transfer to AEP in Fee Simple) and any additional easements for 138 kV station expansion and line work and include access to all facilities and structures.
- The customer will have their construction and required checkout completed prior to the start of the interconnection and testing outage.
- Assumed 5 months for engineering design
- Assumed the last 30 days leading to ISD is primarily spent doing fiber, relay, and communications checks.
- Protective relay settings are approximately 4 months of coordination with the developer's engineer.
- Assumptions were made based on relay coordination and length of fiber path.
- Assumed collector station would be located adjacent to the expanded AEP substation.
- OPSB filings will need to be coordinated to ensure accuracy between parties.
- Field verification and environmental studies have not been completed. The findings of any of these studies may result in changes to the estimate.
- Assumed the existing ground grid is sufficient and will not need to be replaced.
- At the time of this report site surveys were not complete to confirm the need for any potential environmental permits or considerations during construction.
- Note that all outages are subject to PJM and AEP Operations outage scheduling requirements

2 Transmission Owner Facilities Study Results

2.1 Transmission Lines – New

- AEP will remove existing structures 39A and 39B and associated conductors and replace with 3 new structures and associated conductors on the Ohio Central-North Newark 138kV line to accommodate the Frazeysburg 138 kV substation expansion.

2.2 Transmission Line – Upgrades

- No transmission line upgrades will be required for this project.

2.3 Substation Facilities – New

- No new substation facilities will be required for this project.

2.4 Substation Facilities – Upgrades

- AEP will expand the existing Frazeysburg 138 kV substation to facilitate the connection of the generation lead going to the PJM project AD1-015. To accomplish this, four additional circuit breakers will be installed. The Frazeysburg 138 kV bus will be extended to the West. Installation of associated protection and control equipment, line risers, switches, jumpers, SCADA, and 138 kV revenue metering will also be required (Figure 1).

- Protective relay settings at AEP's North Newark and Ohio Central 138 kV remote-end substations will need to be reviewed and updated to coordinate with the Frazeysburg 138 kV substation.

- Protective relay settings for the remainder of the Frazeysburg 138 kV substation will be reviewed and updated (as needed) to account for the addition of the AD1-015 generation source.

2.5 Metering & Communications

Standard 138 kV metering will be installed at the Frazeysburg 138 kV substation. A standard station communication scheme will be used. All metering equipment shall meet the requirements as specified by AEP in the "AEP Metering and Telemetering Requirements for AEP Transmission Customers" document (SS-490011). Communication requirements are published in the "AEP SCADA RTU Requirements at Transmission Interconnection Facilities" (SS-500000).

AEP will also update the telecom equipment at the Frazeysburg 138 kV substation for SCADA/EMS functionality. Fiber-optic cable will be extended to the AEP/AD1-015 point of transition.

The Generation Interconnection Agreement does not in or by itself establish a requirement for American Electric Power to provide power for consumption at the developer's facilities. A separate agreement must be reached with the local utility that provides service in the area to ensure that infrastructure is in place to meet this demand, and proper metering equipment in installed. The metering work above and cost indicated below does not include any potential work or cost to address metering requirements of the local service provider. It is the responsibility of the developer to contact the local service provider to obtain a local service agreement prior to energization.

2.6 Environmental, Real Estate, and Permitting issues

- The Interconnection customer is expected to obtain, at its cost, all necessary permits and provisions for the IPP station adjacent to the Frazeysburg 138 kV substation.

2.7 System Modeling & Operating Requirements

- None

2.8 Summary of Results of Study

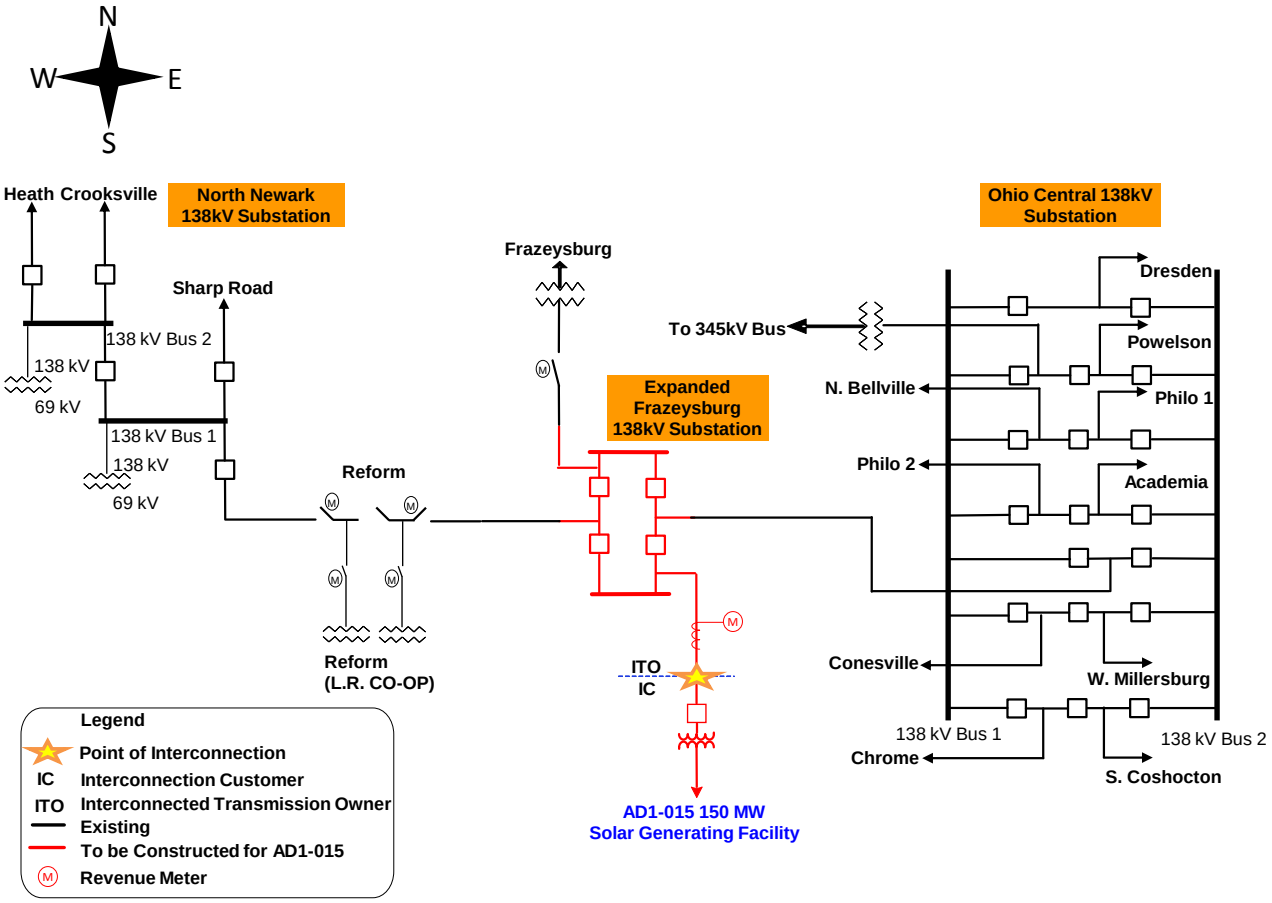
Cost Estimates for AEP

Task	Network Upgrade Number	Engineering	Material	Construction	Other	TOTAL
Expand Frazeysburg substation	N7426	**$858,301.85**	**$2,121,814.45**	**$2,437,403.00**	**$1,109,601.71**	**$6,527,121.01**
North Newark-Ohio Central 138 kV T-Line Retermination	N7427	$236,124.67	$67,828.67	$388,603.67	$183,328.00	$875,885.01
Install line protection and controls at Frazeysburg substation	N7428	$16,495.00	$28,152.00	$106,918.00	$39,379.00	$190,944.00
138 kV Revenue Metering at Frazeysburg	N7425	$55,232.67	$117,839.67	$70,338.67	$54,538.00	$297,949.01
Extend span from POI station toward Collector Station (incl. fiber)	N7425	$35,396.48	$75,518.88	$45,077.33	$34,951.29	$190,943.98
Upgrade protection and controls at the Ohio Central substation	N7429	$42,640.33	$79,062.33	$89,445.33	$95,329.00	$306,476.99
Upgrade protection and controls at the North Newark substation	N7430	$42,618.00	$78,170.00	$89,437.00	$95,190.00	$305,415.00
Telecom fiber interconnection with existing AEP infrastructure	N7431	$12,446.67	$9,078.67	$2,456.67	$18,261.00	$42,243.01
TOTAL		$1,299,255.67	$2,577,464.67	$3,229,679.67	$1,630,578.00	$8,736,978.01

2.9 Information Required for Interconnection Service Agreement

Description	DCF Facility	NUF Facility	Attachment Facility	TOTAL
Direct Material	$0.00	$2,384,106.12	$193,358.55	$2,577,464.67
Direct Labor	$0.00	$4,322,890.19	$206,045.15	$4,528,935.34
Indirect Material	$0.00	$376,846.87	$32,127.58	$408,974.44
Indirect Labor	$0.00	$1,164,241.84	$57,361.71	$1,221,603.56
TOTAL	$0.00	$8,248,085.02	$488,892.99	$8,736,978.01

Figure 1: Point of Interconnection One-Line Diagram



The Point of Interconnection is the first structure outside of AEP's Frazeysburg Switchyard (such structure being located in Interconnection Customer's 34.5-138 kV Collector Substation) with the Interconnected Transmission Owner owning the first span of conductors out of its station, and the Interconnection Customer owning the first structure.

Figure 2: Point of Interconnection Map