



**Generation Interconnection
Facilities Study Report
For
Queue Project AD2-071
Strawton - Deer Creek 138 kV
Madison County, Indiana
100 MW Energy / 67 MW Capacity**

August 2022

1 Facilities Study Summary

1.1 Project Description

The Interconnection Customer, Madison County Solar Project, LLC, proposes to install PJM project AD2-071, a 100 MW (67 MW Capacity) Solar generating facility in Madison County, Indiana (Figure 2). The Point of Interconnection (POI) for the generating facility will be a new station, Snowhill 138 kV Station, cut into the Strawton - Pipe Creek section of the Strawton - Deer Creek 138 kV circuit.

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 requested the following schedule dates:

Receive back feed power from AEP: May 2023

Generation Commercial Operation Date: October 2023

Acknowledgment of the Interconnection Customer's requested back feed and commercial operation dates does not imply AEP's commitment to or guarantee of these dates.

1.4 AEP's Scope of Work to Facilitate Interconnection

- The Strawton - Pipe Creek section of the Strawton - Deer Creek 138 kV circuit will be tapped by constructing a new three (3) circuit breaker 138 kV station, Snowhill 138 kV Station, physically configured as a breaker and a half station but operated as a ring-bus (Figure 1).
- Associated protection and control equipment, line risers, switches, jumpers, SCADA, and 138 kV revenue metering will also be installed at the proposed Snowhill 138 kV Station. AEP reserves the right to specify the final acceptable configuration considering design practices, future expansion, and compliance requirements.
- AEP will install two (2) new dead end structures in the existing Strawton - Pipe Creek section of the Strawton - Deer Creek 138 kV Right of Way. One (1) span of transmission line will be extended from each of two (2) existing structures in the Strawton - Pipe Creek section of the Strawton - Deer Creek 138 kV Right of Way to the new dead end structures. One (1) span of transmission line will be extended from each dead end structure to the proposed Snowhill 138 kV Station in an in-and-out arrangement.
- AEP will extend one (1) span of 138 kV transmission line for the generation lead going to the AD2-071 site. AEP will build and own the first transmission line dead end structure outside of the proposed Snowhill 138 kV Station fence to which the AEP and AD2-071 transmission line conductors will attach.
- AEP will replace the remote end line protection relays and review the protection schemes and settings at the Strawton 138 kV Station.
- AEP will review and revise (as needed) the Deer Creek 138 kV Station remote end line protection relay settings.

- Two (2) diverse fiber-optic paths to the AD2-071 collector station are required. AEP will extend two (2) fiber-optic cables from the proposed Snowhill 138 kV Station control house to the POI. The Interconnection Customer will be responsible for the fiber work on the IPP side of the POI.
- AEP will extend two (2) new fiber-optic connections from the AD2-071 proposed Snowhill 138 kV Station into AEP's existing fiber-optic network on the Strawton - Pipe Creek section of the Strawton - Deer Creek 138 kV transmission through path to facilitate relaying with the Snowhill, Deer Creek, and Strawton 138 kV Stations.
- AEP will replace three (3) structures and four (4) spans of conductor along the Strawton – Deer Creek 138 kV Circuit to mitigate the overload identified in network upgrades N6329/N6330 (covered by supplemental project S2092.1).
- It is understood that the Interconnection Customer is responsible for all of the connection costs associated with interconnecting the PJM project AD2-071 to the AEP transmission system. The cost of the Interconnection Customer's generating facility is not included in this report. Those costs are assumed to be the Interconnection Customer's responsibility.

1.5 Description of Transmission Owner Facilities Included in the Facilities Study

1.5.1 Direct Connection Work

- The Strawton - Pipe Creek section of the Strawton - Deer Creek 138 kV circuit will be tapped by constructing a new three (3) circuit breaker 138 kV station, Snowhill, physically configured in a breaker and half bus arrangement but operated as a ring-bus (Figure 1).
- AEP will install associated line protection and control equipment, line risers, switches, jumpers, and SCADA at the proposed Snowhill 138 kV Station. AEP reserves the right to specify the final acceptable configuration considering design practices, future expansion, and compliance requirements.

1.5.2 Non-Direct Connection Work

- AEP will install two (2) new dead end structures in the existing Strawton - Pipe Creek section of the Strawton - Deer Creek 138 kV Right of Way. One (1) span of transmission line will be extended from each of two (2) existing structures in the Strawton - Pipe Creek section of the Strawton - Deer Creek 138 kV Right of Way to the new dead end structures. One (1) span of transmission line will be extended from each dead end structure to the proposed Snowhill 138 kV Station in an in-and-out arrangement.
- AEP will replace the remote end line protection relays and review the protection schemes and settings at the Strawton 138 kV Station.
- AEP will review and revise (as needed) the Deer Creek 138 kV Station remote end line protection relay settings.
- AEP will extend two (2) new fiber-optic connections from the AD2-071 proposed Snowhill 138 kV Station into AEP's existing fiber-optic network on the Strawton - Pipe Creek section of the Strawton - Deer Creek 138 kV transmission through path to facilitate relaying with the Snowhill, Deer Creek, and Strawton 138 kV Stations.
- AEP will replace three (3) structures and four (4) spans of conductor along the Deer Creek - Strawton 138 kV Circuit to mitigate the overload identified in network upgrades N6329/N6330 (covered by supplemental project S2092.1).

1.5.3 Attachment Facilities Work

- AEP will install 138 kV revenue metering at the proposed Snowhill 138 kV station.
- AEP will extend one (1) span of 138 kV transmission line for the generation lead going to the AD2-071 site. AEP will build and own the first dead end transmission line structure outside of the proposed Snowhill 138 kV Station fence to which the AEP and AD2-071 transmission line conductors will attach.
- Two (2) diverse fiber-optic paths to the AD2-071 collector station are required. AEP will extend two (2) fiber-optic cables from the proposed Snowhill 138 kV Station control house to the POI. The Interconnection Customer will be responsible for the fiber work on the IPP side of the POI.

1.5.4 Network Upgrade Work

Due to system overloads found during the PJM studies, the following network reinforcements are required:

- **N6329/N6330 – Pipe Creek – Grant tap 138 kV sag study:**

#	Overloaded Facility	Upgrade Description	Estimated Cost
#1	05PIPECK-05GRNTTA 138 kV line	A Sag Study will be required on the 1.9 miles of ACSR ~ 556.5 ~ 26/7 ~ DOVE - Conductor Section 1 to determine any mitigations required for the overload. The cost for this upgrade is expected to be between \$20,000 (no remediations required, just sag study) and \$2.85 million (complete line reconductor/rebuild required). An approximate time for the sag study is 6 to 12 months after signing an interconnection agreement. New expected SE rating to be 284 MVA. PJM Network Upgrade N6329. Depending on the results of the sag study, an alternate upgrade to consider would be to resolve the stuck breaker contingency at Strawton which is causing the overload. This can be evaluated in the Facilities Study at the completion of the sag study.	\$2,850,000
#2	AD2-071 TAP-05PIPECK 138 kV line	A Sag Study will be required on the 8.2 miles of ACSR ~ 556.5 ~ 26/7 ~ DOVE - Conductor Section 1 to determine any mitigations required for the overload. The cost of this upgrade is expected to be 32,800 (No remediations required, just sag study) and \$ 12.3M (complete Line Reconductor/rebuild). New ratings after the sag study: S/N: 205 MVA S/E: 284 MVA. An approximate time for the sag study is 6 to 12 months after signing an interconnection agreement. PJM Network Upgrade N6330. Depending on the results of the sag study, an alternate upgrade to consider would be to resolve the stuck breaker contingency at Strawton which is causing the overload. This can be evaluated in the Facilities Study at the completion of the sag study.	\$12,300,000
Total Cost			\$15,150,000

- The sections of transmission line associated with the clearance violations identified in network upgrade projects N6329 and N6330 will be rebuilt by AEP under subsequent supplemental project s2092.1 and are projected to be in service by 12/15/2022.

- **Hogan – Delaware 138 kV risers:**

Violation #	Overloaded Facility	Upgrade Description	Estimated Cost
#1	05HOGAN-05DELAWR 138 kV line	PJM Supplemental projects S0738 (Upgrade the Delaware - Hogan 138 kV risers) and S1498 - projected in-service date is December 2021. New SE rating to be 284 MVA SE with S0738 and S1498 complete. The new expected SE rating should be confirmed in the Facilities Study. An interim study will be required if AD2-071 comes into service prior to completion of PJM supplemental projects S0738 and S1498.	\$0
Total Cost			\$0

- Supplemental projects S0738 and S1498 replace the risers of concern at both the Hogan and Delaware 138 kV Stations. The new expected SE rating for this overloaded facility will be 337 MVA.

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

Attachment Facilities	\$1,070,798.00
Direct Connection Facilities	\$6,535,310.00
Network Upgrade Facilities	\$1,251,626.00
Total Cost	\$8,857,734.00

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:

Typical Schedule for Scope Indicated (Actual schedule to be determined at PJM Project kick off meeting)

<u>Activity</u>	<u>Dates (See Notes)</u>
Engineering Start	Day 1*
Material Ordering	Starts Day 145
Construction (Grading & Below Grade)	Starts Day 365
Construction (Above Grade)	Starts Day 395
Outage Requests Made By	Day 110
Outage (Structure Foundations)**	Starts Day 375
Outage (Cut-in & Testing)**	Starts Day 570
Ready For Back Feed (Interconnected Transmission Owner In-Service Date)	Day 585

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

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

Notes Regarding the Schedule

- All transmission outages are subject to PJM and AEP Operations outage scheduling requirements.
- Significant scope of work changes will impact the schedule.

Scope 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 Interconnection Customer.
- P&C coordination with the Interconnection Customer will be needed throughout the project. The Interconnection customer will be required to install an AEP-compatible line relaying protection panel at the collector substation using AEP standards to ensure relaying 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 panel may change scoping.
- Slippage by the Interconnection Customer in executing the ISA and ICSA agreements 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.
- The Interconnection Customer will obtain, at its cost, all necessary provisions for the AEP direct connection facilities.
- The Interconnection Customer will perform site development and road construction in accordance with AEP specifications as required for this interconnection.
- The Interconnection Customer will provide a site acceptable to AEP (for transfer in Fee Simple) and any required easements for the Snowhill 138 kV Station and line work to enable access to all facilities and structures.
- The proposed Snowhill 138 kV Station interconnecting AD2-071 will be located in close proximity to the existing Strawton - Pipe Creek section of the Strawton - Deer Creek 138 kV Right of Way.
- The Interconnection Customer will have their construction and required checkout completed prior to the start of the interconnection to the proposed Snowhill 138 kV Station and any required testing outages.
- Supplemental project s2092.1 will be in service prior to AD2-071.

2 Transmission Owner Facilities Study Results

2.1 Transmission Lines - New

- AEP will extend one (1) span of 138 kV transmission line for the generation lead going to the AD2-071 site. AEP will build and own the first transmission line dead end structure outside of the proposed Snowhill 138 kV Station fence to which the AEP and AD2-071 transmission line conductors will attach.
- AEP will install two (2) new dead end structures in the existing Strawton - Pipe Creek section of the Strawton - Deer Creek 138 kV Right of Way. One (1) span of transmission line will be extended from each of two (2) existing structures in the Strawton - Pipe Creek section of the Strawton - Deer Creek 138 kV Right of Way to the new dead end structures. One (1) span of transmission line will be extended from each dead end structure to the proposed Snowhill 138 kV Station in an in-and-out arrangement.

2.2 Transmission Line - Upgrades

- AEP will replace three (3) structures and four (4) spans of conductor along the Deer Creek – Strawton 138 kV Circuit to mitigate the overload identified in network upgrades N6329/N6330 (covered by supplemental project S2092.1).

2.3 Station Facilities - New

- A new 138 kV station, Snowhill 138 kV Station, will be constructed consisting of a breaker and a half station design, but operated as a 3-breaker ring bus loop fed by tapping AEP's Strawton - Pipe Creek section of the Strawton - Deer Creek 138 kV circuit.
- Associated protection and control equipment, line risers, switches, jumpers, SCADA, and 138 kV revenue metering will also be installed at the proposed Snowhill 138 kV Station. AEP reserves the right to specify the final acceptable configuration considering design practices, future expansion, and compliance requirements.

2.4 Station Facilities - Upgrades

- AEP will replace the remote end line protection relays and review the protection schemes and settings at the Strawton 138 kV Station.
- AEP will review and revise (as needed) the Deer Creek 138 kV Station remote end line protection relay settings.

2.5 Metering & Communications

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

Two (2) diverse fiber-optic paths to the AD2-071 collector station are required. AEP will extend two (2) fiber-optic cables from the proposed Snowhill 138 kV Station control house to the POI. The Interconnection Customer will be responsible for the fiber work on the IPP side of the POI.

AEP will extend two (2) new fiber-optic connections from the AD2-071 proposed Snowhill 138 kV Station into AEP's existing fiber-optic network on the Strawton - Pipe Creek section of the Strawton - Deer Creek 138 kV transmission through path to facilitate relaying with the Snowhill, Deer Creek, and Strawton 138 kV Stations.

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 is installed. The metering work described above and the cost estimates indicated below do 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. This is required 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 connecting to the proposed Snowhill 138 kV Station.

2.7 System Modeling and Operating Requirements

In addition to the IPP modeling requirements imposed by PJM as part of the Generation Interconnection process, the following system modeling parameters are required to be supplied by the Interconnection Customer to AEP:

- Modeling parameters are required as outlined in the 'Connection Requirements for the AEP Transmission System.' These requirements can be accessed at: <https://aep.com/requiredpostings/AEPTransmissionStudies>

2.8 Summary of Results of Study (Refer to Section 1.4)

<u>Task</u>	<u>Network Upgrade Number</u>	<u>Engineering</u>	<u>Material</u>	<u>Construction</u>	<u>Other</u>	<u>TOTAL</u>
Construct Snowhill 138 kV Station	n8104.1	\$880,125.33	\$2,179,618.33	\$2,574,078.34	\$901,488.00	\$6,535,310
Install 138 kV Revenue Metering	N/A	\$62,448.67	\$139,725.67	\$107,055.66	\$27,674.00	\$336,904.00
Install Two (2) Structures, Four (4) Spans of Conductor, Connect Snowhill 138 kV Station to Existing Transmission Circuit, Update Remote End Protective Relay Settings	n8104.2	\$106,116.67	\$221,316.67	\$352,417.66	\$132,724.00	\$812,575.00
Install One (1) Dead End Structure, One (1) Span of Conductor from the Snowhill 138 kV Station to the Point of Interconnection	N/A	\$89,034.67	\$117,270.67	\$198,256.66	\$111,150.00	\$515,712.00
Install Two Diverse (2) Fiber-Optic Paths from the Snowhill 138 kV Station to the Point of Interconnection	N/A	\$26,941.00	\$34,664.00	\$110,003.00	\$46,574.00	\$218,182.00
Replace Protective Relays at Strawton 138 kV Station	n8104.3.	\$47,840.33	\$74,668.33	\$42,428.34	\$33,794.00	\$198,731
Install Two (2) Fiber-Optic Paths to facilitate relaying between Snowhill, Deer Creek, and Strawton 138 kV Stations	n8104.4.	\$60,777.33	\$33,568.33	\$103,975.34	\$41,999.00	\$240,320
<u>TOTAL</u>		\$1,273,284.00	\$2,800,832.00	\$3,488,215.00	\$1,295,403.00	<u>\$8,857,734.00</u>

2.9 Information Required for Interconnection Service Agreement

<u>Description</u>	<u>DCF Facility</u>	<u>NUF Facility</u>	<u>ATF Facility</u>	<u>TOTAL</u>
<u>Direct Material</u>	\$2,179,618.33	\$329,553.33	\$291,660.33	\$2,800,832.00
<u>Direct Labor</u>	\$3,454,203.67	\$713,555.67	\$593,739.67	\$4,761,499.00
<u>Indirect Material</u>	\$348,768.52	\$65,614.26	\$54,124.31	\$468,507.08
<u>Indirect Labor</u>	\$552,719.48	\$142,902.74	\$131,273.69	\$826,895.92
<u>TOTAL</u>	\$6,535,310.00	\$1,251,626.00	\$1,070,798.00	<u>\$8,857,734.00</u>

Figure 1: Point of Interconnection One-Line Diagram

The Point of Interconnection is the first structure in the generation lead circuit outside of the proposed Snowhill 138 kV Station fence. AEP will own the span from the proposed Snowhill 138 kV Station to the first AEP constructed and owned dead end structure, including the jumpers. The Interconnection Customer, Madison County Solar Project, LLC, will own the other span connecting to the Point of Interconnection structure, along with the remainder of the 138 kV generator lead, transmission line, and associated structures back to the AD2-071 generation collector substation.

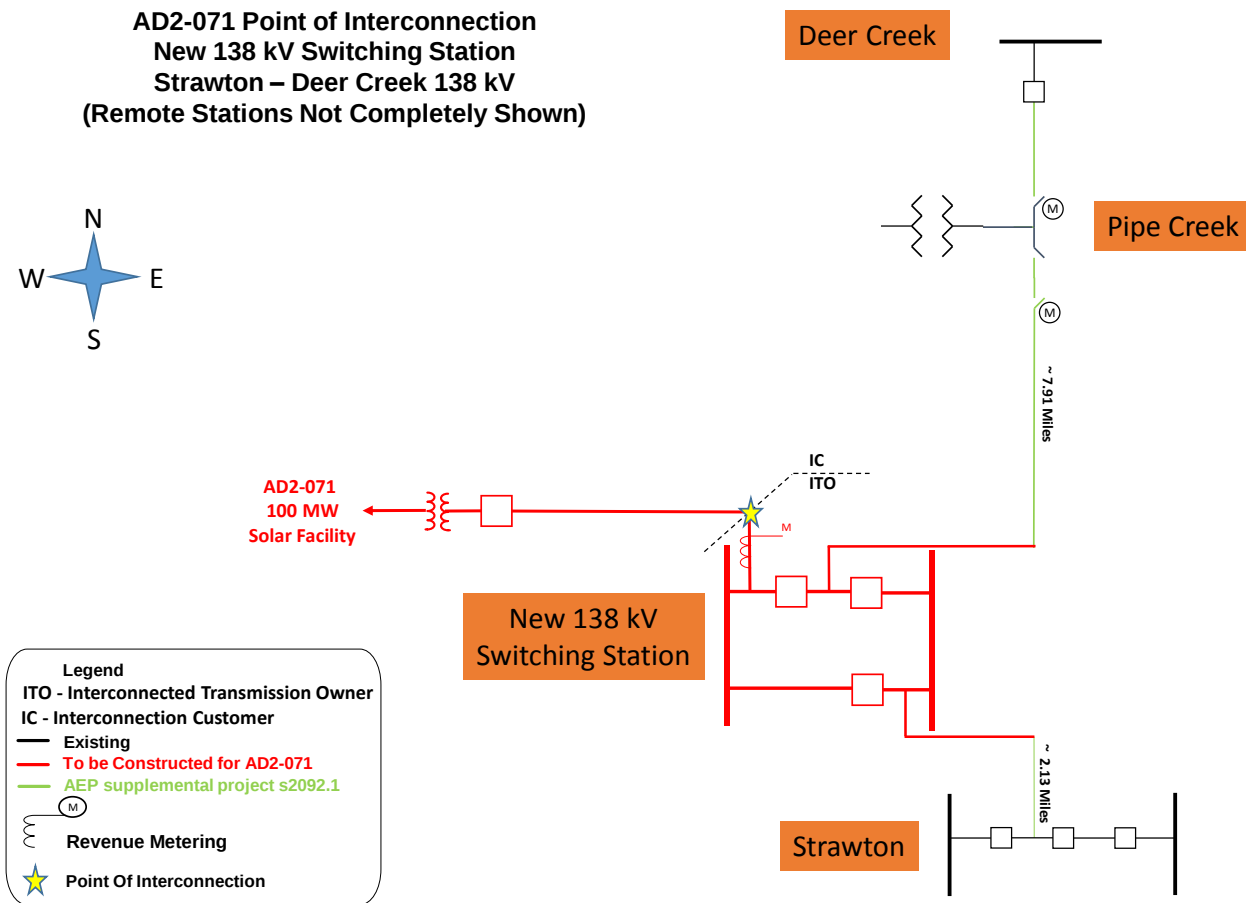


Figure 2: Point of Interconnection Map

