Generation Interconnection Feasibility Study Report

For

PJM Generation Interconnection Request Queue Position AD2-162 Biers Run – Circleville 138 kV

July 2018

Preface

The intent of the feasibility study is to determine a plan, with ballpark cost and construction time estimates, to connect the subject generation to the PJM network at a location specified by the Interconnection Customer. The Interconnection Customer may request the interconnection of generation as a capacity resource or as an energy-only resource. As a requirement for interconnection, the Interconnection Customer may be responsible for the cost of constructing: (1) Direct Connections, which are new facilities and/or facilities upgrades needed to connect the generator to the PJM network, and (2) Network Upgrades, which are facility additions, or upgrades to existing facilities, that are needed to maintain the reliability of the PJM system.

In some instances a generator interconnection may not be responsible for 100% of the identified network upgrade cost because other transmission network uses, e.g. another generation interconnection, may also contribute to the need for the same network reinforcement. The possibility of sharing the reinforcement costs with other projects may be identified in the feasibility study, but the actual allocation will be deferred until the impact study is performed.

The Feasibility Study estimates do not include the feasibility, cost, or time required to obtain property rights and permits for construction of the required facilities. The project developer is responsible for the right of way, real estate, and construction permit issues. For properties currently owned by Transmission Owners, the costs may be included in the study.

General

The Interconnection Customer (IC) proposes to install PJM Project #AD2-162, a 110.0 MW (73.8 MW Capacity) solar generating facility in Pickaway County, Ohio (see Figure 2). The point of interconnection is to AEP's Biers Run – Circleville 138 kV circuit (see Figure 1).

The requested in service date is December 1, 2021.

The objective of this Feasibility Study is to determine budgetary cost estimates and approximate construction timelines for identified transmission facilities required to connect the proposed generating facilities to the AEP transmission system. These reinforcements include the Attachment Facilities, Local Upgrades, and Network Upgrades required maintaining the reliability of the AEP transmission system. Stability analysis is not included as part of this study.

Attachment Facilities

Point of Interconnection (Biers Run – Circleville 138 kV)

To accommodate the interconnection on the Biers Run – Circleville 138 kV circuit, a new three (3) circuit breaker 138 kV switching station physically configured in a breaker and half bus arrangement but operated as a ring-bus will be constructed (see Figure 1). Installation of associated protection and control equipment, 138 kV line risers, SCADA, and 138 kV revenue metering will also be required. AEP reserves the right to specify the final acceptable configuration considering design practices, future expansion, and compliance requirements.

New Switching Station Work and Cost:

- Construct a new three (3) circuit breaker 138 kV switching station physically configured in a breaker and half bus arrangement but operated as a ring-bus. Installation of associated protection and control equipment, 138 kV line risers and SCADA will also be required (see Figure 1).
    - **Estimated Station Cost: $6,000,000**

Direct Connection Cost Estimate

The total preliminary cost estimate for Direct Connection work is given in the following table below.

For AEP building Direct Connection cost estimates:

Description	Total Cost
Biers Run – Circleville 138 kV T-Line Cut In	$1,000,000
Total	**$1,000,000**

Table 1

Non-Direct Connection Cost Estimate

The total preliminary cost estimate for Non-Direct Connection work is given in the following table below:

For AEP building Non-Direct Connection cost estimates:

Description	Estimated Cost
138 kV Revenue Metering	$250,000
Upgrade line protection and controls at the Biers Run 138 kV station	$250,000
Upgrade line protection and controls at the Circleville 138 kV substation	$250,000
Total	**$750,000**

Table 2

Interconnection Customer Requirements

It is understood that the IC is responsible for all costs associated with this interconnection. The cost of IC's generating plant and the costs for the line connecting the generating plant to the new switching station are not included in this report; these are assumed to be the IC's responsibility.

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 may 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. It is the responsibility of the developer to contact the local service provider to determine if a local service agreement is required.

Requirement from the PJM Open Access Transmission Tariff:

1. An Interconnection Customer entering the New Services Queue on or after October 1, 2012 with a proposed new Customer Facility that has a Maximum Facility Output equal to or greater than 100 MW shall install and maintain, at its expense, phasor measurement units (PMUs). See Section 8.5.3 of Appendix 2 to the Interconnection Service Agreement as well as section 4.3 of PJM Manual 14D for additional information.

2. The Interconnection Customer may be required to install and/or pay for metering as necessary to properly track real time output of the facility as well as installing metering which shall be used for billing purposes. See Section 8 of Appendix 2 to the Interconnection Service Agreement as well as Section 4 of PJM Manual 14D for additional information.

Revenue Metering and SCADA Requirements

PJM Requirements

The Interconnection Customer will be required to install equipment necessary to provide Revenue Metering (KWH, KVARH) and real time data (KW, KVAR) for IC's generating Resource. See PJM Manuals M-01 and M-14D, and PJM Tariff Sections 24.1 and 24.2.

AEP Requirements

The Interconnection Customer will be required to comply with all AEP Revenue Metering Requirements for Generation Interconnection Customers. The Revenue Metering Requirements may be found within the "Requirements for Connection of New Facilities or Changes to Existing Facilities Connected to the AEP Transmission System" document located at the following link:

http://www.pjm.com/~/media/planning/plan-standards/private-aep/aep-interconnection-requirements.ashx

Network Impacts

The Queue Project AD2-162 was evaluated as a 110.0 MW (Capacity 73.8 MW) injection tapping the Biers Run to Circleville 138kV line in the AEP area. Project AD2-162 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AD2-162 was studied with a commercial probability of 53%. Potential network impacts were as follows:

Base Case Used

Summer Peak Analysis – 2021 Case

Contingency Descriptions

The following contingencies resulted in overloads:

AD2-162 Contingency Descriptions	
Contingency Name	**Description**
AEP_P7-1_#8126_B_B	AEP_P7-1_#8126_B_B OPEN BRANCH FROM BUS 937230 TO BUS 243483 CKT 1 / 937230 AD2-162 TAP 138 243483 05CRCLVS 138 1 OPEN BRANCH FROM BUS 246889 TO BUS 246890 CKT 1 / 246889 05BIERSR 138 246890 05HOPETN 138 1 END
AEP_P4_#8125_05BIERSR 138	AEP_P4_#8125_05BIERSR 138 OPEN BRANCH FROM BUS 246888 TO BUS 246889 CKT 1 / 246888 05BIERSR 345 246889 05BIERSR 138 1 OPEN BRANCH FROM BUS 246889 TO BUS 246890 CKT 1 / 246889 05BIERSR 138 246890 05HOPETN 138 1 END
AEP_P1-2_#5808	AEP_P1-2_#5808 OPEN BRANCH FROM BUS 243522 TO BUS 243593 CKT 1 / 243522 05HARRIS 138 243593 05ZUBER 138 1 END
AEP_P1-2_#5764	AEP_P1-2_#5764 OPEN BRANCH FROM BUS 243522 TO BUS 243550 CKT 1 / 243522 05HARRIS 138 243550 05OBETZ 138 1 OPEN BRANCH FROM BUS 243539 TO BUS 243550 CKT 1 / 243539 05MARION 138 243550 05OBETZ 138 1 END

Table 3

Generator Deliverability

(Single or N-1 contingencies for the Capacity portion only of the interconnection)

None

Multiple Facility Contingency

(Double Circuit Tower Line, Fault with a Stuck Breaker, and Bus Fault contingencies for the full energy output)

None

Contribution to Previously Identified Overloads

(This project contributes to the following contingency overloads, i.e. "Network Impacts", identified for earlier generation or transmission interconnection projects in the PJM Queue)

AD2-162 Contribution to Previously Identified Overloads															
#	Type	Contingency Name	Affected Area	Facility Description	Bus From	Bus To	Cir.	PF	Loading Initial	Loading Final	Rating Type	Rating MVA	MW Con.	FG App.
1	DCTL	AEP_P7-1_#8126_B_B	AEP - AEP	05ADENA-05ROSS 69 kV line	243839	243615	1	DC	100.12	106.03	ER	54	7.09	
2	DCTL	AEP_P7-1_#8126_B_B	AEP - AEP	05BIERSR 138/69 kV transformer	246889	246893	1	DC	102.86	111.34	ER	130	11.03	
3	DCTL	AEP_P7-1_#8126_B_B	AEP - AEP	05BIERSRUN-05SLATE 69 kV line	246893	243617	1	DC	152.13	158.52	ER	50	7.09	
4	LFFB	'AEP_P4_#8125_05BIERSR 138	AEP - AEP	05BIERSRUN-05SLATE 69 kV line	246893	243617	1	DC	105.01	113.85	ER	50	9.81	

Table 4

Steady-State Voltage Requirements

None

Short Circuit

(Summary of impacted circuit breakers)

New circuit breakers found to be over-duty:

None

Delivery of Energy Portion of Interconnection Request

PJM also studied the delivery of the energy portion of this interconnection request. Any problems identified below are likely to result in operational restrictions to the project under study. The developer can proceed with network upgrades to eliminate the operational restriction at their discretion by submitting a Merchant Transmission Interconnection request.
Only the most severely overloaded conditions are listed. There is no guarantee of full delivery of energy for this project by fixing only the conditions listed in this section. With a Transmission Interconnection Request, a subsequent analysis will be performed, which will study all overload conditions associated with the overloaded element(s) identified.

AD2-162 Delivery of Energy Portion of Interconnection Request														
#	Type	Contingency Name	Affected Area	Facility Description	Bus From	Bus To	Cir.	PF	Loading Initial	Loading Final	Rating Type	Rating MVA	MW Con.	FG App.
1	N-1	AEP_P1-2_#5808	AEP - AEP	05HARRIS-05OBETZ 138 kV line	243522	243550	1	DC	118.7	135.59	ER	173	29.22	
2	Non	-	AEP - AEP	05HARRIS-05OBETZ 138 kV line	243522	243550	1	DC	101.73	113.36	NR	138	16.04	
3	N-1	AEP_P1-2_#5764	AEP - AEP	05HARRIS-05ZUBER 138 kV line	243522	243593	1	DC	116.37	136.09	ER	173	34.12	

AD2-162 Delivery of Energy Portion of Interconnection Request															
		Contingency	Affected		Bus				Loading		Rating		MW	FG
#	Type	Name	Area	Facility Description	From	To	Cir.	PF	Initial	Final	Type	MVA	Con.	App.
4	N-1	AEP_P1-2_#5808	AEP - AEP	05OBETZ-05MARION 138 kV line	243550	243539	1	DC	86.98	100.26	ER	220	29.22	
5	N-1	AEP_P1-2_#5764	AEP - AEP	05ZUBER-05BEATTY 138 kV line	243593	243469	1	DC	86.04	102.14	ER	212	34.12	

Table 5

New System Reinforcements

(Upgrades required to mitigate reliability criteria violations, i.e. Network Impacts, initially caused by the addition of this project generation)

None

Contribution to Previously Identified System Reinforcements

(Overloads initially caused by prior Queue positions with additional contribution to overloading by this project. This project may have a % allocation cost responsibility which will be calculated and reported for the Impact Study)
(Summary form of Cost allocation for transmission lines and transformers will be inserted here if any)

The System Reinforcements listed below are not part of the Bulk Electric System (BES), but was identified by AEP and will be required for the interconnection of AD2-162.

#	Overloaded Facility	Upgrade Description	Schedule	Estimated Cost
1	05BIERSR 138/69 kV transformer	Replace 138kV/69kV transformer.	An approximate construction time would be 24 to 36 months after signing an interconnection agreement	$1,500,000
2	05BIERSRUN-05SLATE 69 kV line	Rebuild the 0.67 mile of the ACSR ~ 211.6 ~ 6/1 ~ PENGUIN (4/0) conductor to mitigate the overload.	An approximate construction time would be 24 to 36 months after signing an interconnection agreement	$800,000
			Total Network Upgrades	**$2,300,000**

Table 6

Schedule

It is anticipated that the time between receipt of executed agreements and Commercial Operation may range from 12 to 18 months if no line work is required. If line work is required, construction time would be between 24 to 36 months after signing an interconnection agreement.

Conclusion

Based upon the results of this Feasibility Study, the construction of the IC's 110.0 MW (73.8 MW Capacity) solar generating facility (PJM Project #AD2-162) will require the following additional interconnection charges. This plan of service will interconnect the proposed solar generating facility in a manner that will provide operational reliability and flexibility to both the AEP system and the IC's generating facility.

Cost Breakdown for Point of Interconnection (Biers Run – Circleville 138 kV)		
Attachment Cost	New 138 kV Switching Station and installation of associated protection and controls equipment.	$6,000,000
Direct Connection Cost Estimate	Biers Run – Circleville 138 kV T-Line Cut In	$1,000,000
Non-Direct Connection Cost Estimate	138 kV Revenue Metering	$250,000
	Upgrade line protection and controls at Biers Run 138 kV substation	$250,000
	Upgrade line protection and controls at Circleville 138 kV substation.	$250,000
	Contribution to Previously Identified System Reinforcements-Not part of the BES	$2,300,000
	Total Estimated Cost for Project AD2-162	**$10,050,000**

Table 7

The estimates are preliminary in nature, as they were determined without the benefit of detailed engineering studies. Final estimates will require an on-site review and coordination to determine final construction requirements.

Figure 1: Point of Interconnection (Biers Run – Circleville 138 kV)

One-Line Diagram

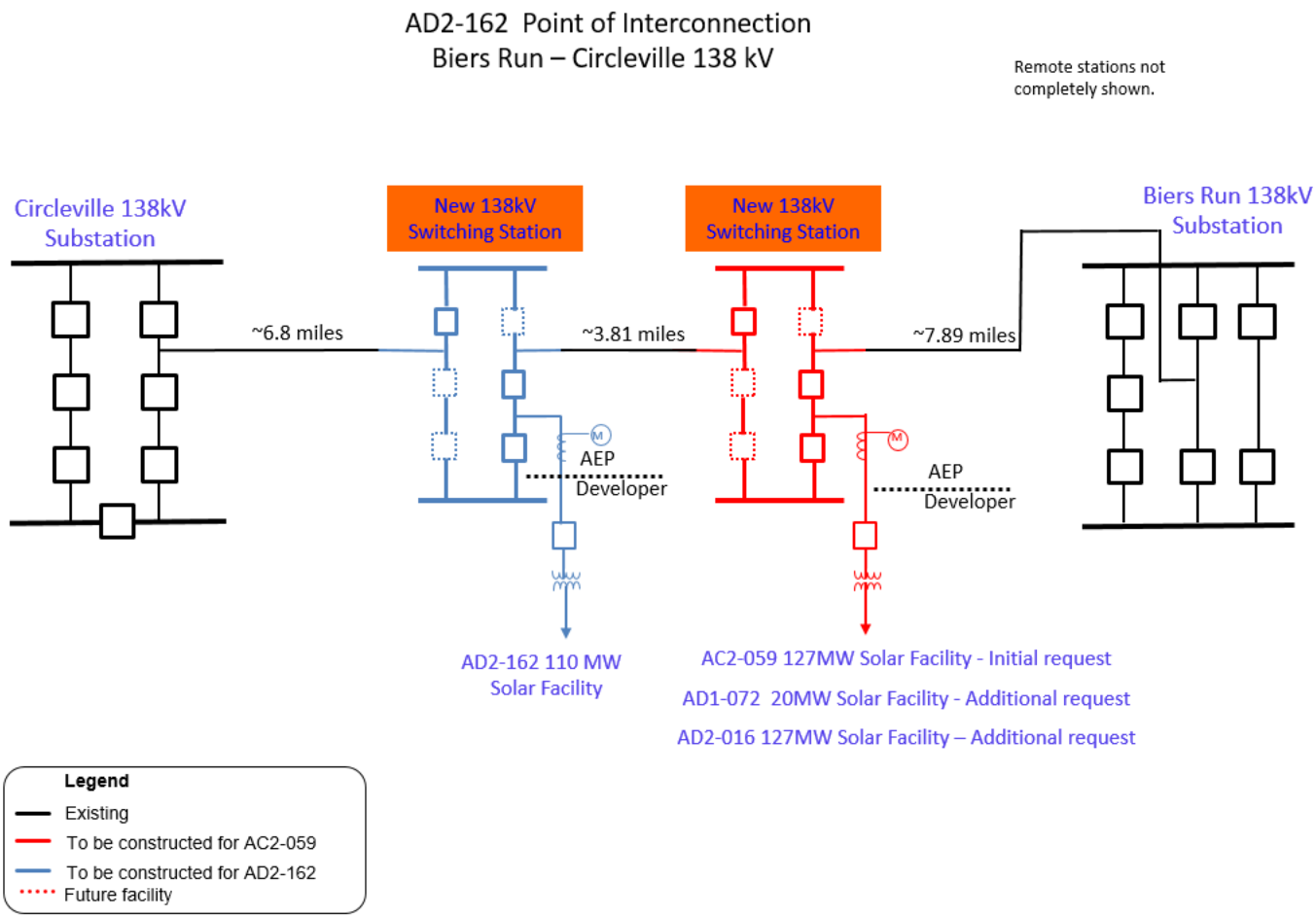

Figure 2: Point of Interconnection (Biers Run – Circleville 138 kV)