



Generation Interconnection

Feasibility Study Report

for

Queue Project AG1-540

BERRY HILL 138 KV

21.35 MW Capacity / 55 MW Energy

January 2021

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1 Introduction

This Feasibility Study has been prepared in accordance with the PJM Open Access Transmission Tariff, 36.2, as well as the Feasibility Study Agreement between the Interconnection Customer (IC), and PJM Interconnection, LLC (PJM), Transmission Provider (TP). The Interconnected Transmission Owner (ITO) is AEP.

2 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. Cost allocation rules for network upgrades can be found in PJM Manual 14A, Attachment B. 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.

3 General

The Interconnection Customer (IC), has proposed a Storage generating facility located in Pittsylvania County, Virginia. The installed facilities will have a total capability of 55 MW with 21.35 MW of this output being recognized by PJM as Capacity. The proposed in-service date for this project is October 01, 2024. This study does not imply a TO commitment to this in-service date.

Queue Number	AG1-540
Project Name	BERRY HILL 138 KV
State	Virginia
County	Pittsylvania
Transmission Owner	AEP
MFO	55
MWE	55
MWC	21.35
Fuel	Storage
Basecase Study Year	2024

Any new service customers who can feasibly be commercially operable prior to June 1st of the basecase study year are required to request interim deliverability analysis.

4 Point of Interconnection

AG1-540 will interconnect with the AEP transmission system via a direct connection to the proposed Berry Hill 138 kV station. See <https://www.aeptransmission.com/virginia/BerryHill/> and Attachment 1.

To accommodate the interconnection at the Berry Hill 138 kV substation, the substation will have to be expanded requiring the installation of one (1) 138 kV circuit breaker (Attachment 1). Installation of associated protection and control equipment, 138 kV line risers, SCADA and 138 kV revenue metering will also be required.

Installation of the generator lead first span exiting the POI station, including the first structure outside the AEP fence, will also be included in AEP’s scope. In the case where the generator lead is a single span, the structure in the customer station will be the customer’s responsibility.

The Berry Hill station does not presently exist, but is part of a potential Supplemental project presently under development by AEP for other purposes. The potential project is still subject to PJM review, including Do No Harm Analysis. In addition, Supplemental projects are driven by other factors and the in-service date for the Berry Hill station has not been established. If the potential Supplemental project doesn’t materialize, on a schedule compatible with the AG1-540 development, the proposed POI at Berry Hill would not exist. In the absence of the Berry Hill station, subject to Material Modification review by PJM, the project could connect to the existing Axton-Danville 138 kV circuit #2 at a point near where it would be cut to loop in and out of Berry Hill. In this instance, AF1-049 would be responsible for the full cost of a new greenfield 3-CB ring-bus station, as well as the generator lead from the project site to the new POI station site and AG1-540 would interconnect at this new greenfield station.

5 Cost Summary

The AG1-540 project will be responsible for the following costs:

Description	Total Cost
Total Physical Interconnection Costs	\$1,509,000
Total System Network Upgrade Costs	\$0
Total Costs	\$1,509,000

This cost excludes a Federal Income Tax Gross Up charges. This tax may or may not be charged based on whether this project meets the eligibility requirements of IRS Notice 2016-36, 2016-25 I.R.B. (6/20/2016). If at a future date it is determined that the Federal Income Tax Gross charge is required, the Transmission Owner shall be reimbursed by the Interconnection Customer for such taxes.

Cost allocations for any System Upgrades will be provided in the System Impact Study Report.

The estimates provided in this report 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. In addition, Stability analysis will be completed during the Facilities Study stage. It is possible that a need for additional upgrades could be identified by these studies.

6 Transmission Owner Scope of Work

The total physical interconnection costs is given in the table below:

6.1 Attachment Facilities

The total preliminary cost estimate for the Attachment work is given in the table below. These costs do not include CIAC Tax Gross-up.

Description	Total Cost
138 kV Revenue Metering	\$376,000
Generator lead first span exiting the POI station, including the first structure outside the fence	\$400,000
Total Attachment Facility Costs	\$776,000

6.2 Direct Connection Cost Estimate

The total preliminary cost estimate for the Direct Connection work is given in the table below. These costs do not include CIAC Tax Gross-up.

Description	Total Cost
Install one (1) additional 138 kV circuit breaker. Installation of associated protection and control equipment, 138 kV line risers, and SCADA will also be required.	\$643,000
Total Direct Connection Facility Costs	\$643,000

6.3 Non-Direct Connection Cost Estimate

The total preliminary cost estimate for the Non-Direct Connection work is given in the table below. These costs do not include CIAC Tax Gross-up.

Description	Total Cost
Review line protection and control settings at the Axton 138 kV substation	\$45,000
Review line protection and control settings at the Danville #2 138 kV substation	\$45,000
Total Non-Direct Connection Facility Costs	\$90,000

7 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 generally be between 24 to 36 months after Agreement execution.

8 Interconnection Customer Requirements

It is understood that the Interconnection Customer (IC) is responsible for all costs associated with this interconnection. The costs above are reimbursable to the Transmission Owner. The cost of the IC's generating plant and the costs for the line connecting the generating plant to the Point of Interconnection 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 the Transmission Owner 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.

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.

9 Revenue Metering and SCADA Requirements

9.1 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 Section 8 of Attachment O.

9.2 Meteorological Data Reporting Requirements

9.3 Interconnected Transmission Owner Requirements

The IC will be required to comply with all Interconnected Transmission Owner's revenue metering requirements for generation interconnection customers located at the following link:

<http://www.pjm.com/planning/design-engineering/to-tech-standards/>

10 Summer Peak - Load Flow Analysis

The Queue Project AG1-540 was evaluated as a 55.0 MW (Capacity 21.35 MW) injection tapping the Axton to Danville 138 kV line in the AEP area. Project AG1-540 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AG1-540 was studied with a commercial probability of 53.0 %. Potential network impacts were as follows:

10.1 Generation Deliverability

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

None

10.2 Multiple Facility Contingency

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

None

10.3 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)

None

10.4 Potential Congestion due to Local Energy Deliverability

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.

Note: Only the most severely overloaded conditions are listed below. 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 shall study all overload conditions associated with the overloaded element(s) identified.

ID	FROM BUS#	FROM BUS	kV	FROM BUS AREA	TO BUS#	TO BUS	kV	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJE CT LOADIN G %	POST PROJE CT LOADIN G %	AC/D C	MW IMPAC T
168046379	242549	05BANSTR	138.0	AEP	242632	05EDAN2	138.0	AEP	1	AEP_P2-1_242720 05MONETA 138242775 05ROCKCASS 1381	operati on	296.0	149.54	150.19	DC	3.57
168046381	242549	05BANSTR	138.0	AEP	242632	05EDAN2	138.0	AEP	1	Base Case	operati on	296.0	118.64	119.37	DC	4.07
168282642	242620	05DANVL2	138.0	AEP	242631	05EDAN1	138.0	AEP	1	AEP_P1-2_#1370_7	operati on	402.0	109.93	118.75	DC	35.47
168282644	242620	05DANVL2	138.0	AEP	242631	05EDAN1	138.0	AEP	1	Base Case	operati on	275.0	108.56	116.99	DC	23.17
168282440	242631	05EDAN1	138.0	AEP	242620	05DANV L2	138.0	AEP	1	AEP_P1-3_#1377_05J.FERR 765_1	operati on	402.0	163.75	169.47	DC	22.99
168282441	242631	05EDAN1	138.0	AEP	242620	05DANV L2	138.0	AEP	1	AEP_P2-1_242520 05J.FERR 500 242514 05J.FERR 765 1	operati on	402.0	163.75	169.47	DC	22.99
168282442	242631	05EDAN1	138.0	AEP	242620	05DANV L2	138.0	AEP	1	Base Case	operati on	275.0	142.56	150.99	DC	23.17

ID	FROM BUS#	FROM BUS	kV	FROM BUS AREA	TO BUS#	TO BUS	kV	TO BUS AREA	CK T ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADIN G %	POST PROJECT LOADIN G %	AC/D C	MW IMPACT
168282633	242631	05EDAN 1	138.0	AEP	242632	05EDAN 2	138.0	AEP	Z1	AEP_P1-3_#8675_05EDANV1 230_5-B	operation	296.0	111.99	119.15	DC	21.19
168282657	242632	05EDAN 2	138.0	AEP	242631	05EDAN 1	138.0	AEP	Z1	AEP_P2-1_24260705CLOVRD 13824389205MEADS8 138 1	operation	296.0	109.56	114.02	DC	13.16
168282575	242802	05SMITHM TN	138.0	AEP	926050	AC1-083 TAP	138.0	AEP	1	AEP_P2-1_24260705CLOVRD 13824389205MEADS8 138 1	operation	296.0	124.76	125.4	DC	3.57
168046406	926050	AC1-083 TAP	138.0	AEP	242550	05BEARSK	138.0	AEP	1	AEP_P2-1_24260705CLOVRD 13824389205MEADS8 138 1	operation	296.0	145.1	145.74	DC	3.57
168046408	926050	AC1-083 TAP	138.0	AEP	242550	05BEARSK	138.0	AEP	1	Base Case	operation	296.0	111.54	112.28	DC	4.07
169810023	940080	AE1-250 TAP	138.0	AEP	242549	05BANSTR	138.0	AEP	1	Base Case	operation	335.0	107.28	107.92	DC	4.07
169810140	941430	AE2-140 TAP	138.0	AEP	242544	05AXTON	138.0	AEP	1	AEP_P1-2_#5463_158-A	operation	388.0	97.85	102.02	DC	16.2

10.5 System Reinforcements

None

10.6 Flow Gate Details

The following indices contain additional information about each facility presented in the body of the report. For each index, a description of the flowgate and its contingency was included for convenience. The intent of the indices is to provide more details on which projects/generators have contributions to the flowgate in question. All New Service Queue Requests, through the end of the Queue under study, that are contributors to a flowgate will be listed in the indices. Please note that there may be contributors that are subsequently queued after the queue under study that are not listed in the indices. Although this information is not used "as is" for cost allocation purposes, it can be used to gage the impact of other projects/generators. It should be noted the project/generator MW contributions presented in the body of the report are Full MW Impact contributions which are also noted in the indices column named "Full MW Impact", whereas the loading percentages reported in the body of the report, take into consideration the PJM Generator Deliverability Test rules such as commercial probability of each project as well as the ramping impact of "Adder" contributions. The MW Impact found and used in the analysis is shown in the indices column named "Gendeliv MW Impact".

10.7 Queue Dependencies

The Queue Projects below are listed in one or more indices for the overloads identified in your report. These projects contribute to the loading of the overloaded facilities identified in your report. The percent overload of a facility and cost allocation you may have towards a particular reinforcement could vary depending on the action of these earlier projects. The status of each project at the time of the analysis is presented in the table. This list may change as earlier projects withdraw or modify their requests.

None

10.8 Contingency Descriptions

Contingency Name	Contingency Definition
AEP_P2-1_242520 05J.FERR 500 242514 05J.FERR 765 1	CONTINGENCY 'AEP_P2-1_242520 05J.FERR 500 242514 05J.FERR 765 1' OPEN BRANCH FROM BUS 242520 TO BUS 242514 CKT 1 END
AEP_P1-2_#5463_158-A	CONTINGENCY 'AEP_P1-2_#5463_158-A' OPEN BRANCH FROM BUS 242544 TO BUS 943810 CKT 2 / 242544 05AXTON 138 943810 AF1-049 TAP 138 2 END
AEP_P1-3_#8675_05EDANV1 230_5-B	CONTINGENCY 'AEP_P1-3_#8675_05EDANV1 230_5-B' OPEN BRANCH FROM BUS 936160 TO BUS 304024 CKT 1 / 936160 AD2-022 TAP 230 304024 6ROXSEP230 T 230 1 END
AEP_P2-1_242720 05MONETA 138 242775 05ROCKCAS SS 138 1	CONTINGENCY 'AEP_P2-1_242720 05MONETA 138 242775 05ROCKCAS SS 138 1' OPEN BRANCH FROM BUS 242720 TO BUS 242775 CKT 1 END
AEP_P1-2_#1370_7	CONTINGENCY 'AEP_P1-2_#1370_7' OPEN BRANCH FROM BUS 242509 TO BUS 242514 CKT 1 / 242509 05AXTON 765 242514 05J.FERR 765 1 OPEN BRANCH FROM BUS 242509 TO BUS 242545 CKT 1 / 242509 05AXTON 765 242545 05AXTONX 138 1 OPEN BRANCH FROM BUS 242544 TO BUS 242545 CKT SR / 242544 05AXTON 138 242545 05AXTONX 138 SR OPEN BRANCH FROM BUS 242544 TO BUS 242545 CKT ZB / 242544 05AXTON 138 242545 05AXTONX 138 ZB END
Base Case	
AEP_P1-3_#1377_05J.FERR 765_1	CONTINGENCY 'AEP_P1-3_#1377_05J.FERR 765_1' OPEN BRANCH FROM BUS 242514 TO BUS 242520 CKT 1 / 242514 05J.FERR 765 242520 05J.FERR 500 1 OPEN BRANCH FROM BUS 242520 TO BUS 306719 CKT 1 / 242520 05J.FERR 500 306719 8ANTIOCH 500 1 END
AEP_P2-1_242607 05CLOVRD 138 243892 05MEADS8 138 1	CONTINGENCY 'AEP_P2-1_242607 05CLOVRD 138 243892 05MEADS8 138 1' OPEN BRANCH FROM BUS 242607 TO BUS 243892 CKT 1 END

11 Short Circuit Analysis

The following Breakers are overdutied

None

12 Affected Systems

12.1 TVA

TVA Impacts to be determined during later study phases (as applicable).

12.2 Duke Energy Progress

Duke Energy Progress Impacts to be determined during later study phases (as applicable).

12.3 MISO

MISO Impacts to be determined during later study phases (as applicable).

12.4 LG&E

LG&E Impacts to be determined during later study phases (as applicable).