Generation Interconnection

Feasibility Study Report

for

Queue Project AF2-175

STRABAN 13.2 KV

1.8 MW Capacity / 3 MW Energy

July 2020

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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 Mid-Atlantic Interstate Transmission, LLC (MAIT) (Meted zone).

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 Interconnection Customer seeking to interconnect a wind or solar generation facility shall maintain meteorological data facilities as well as provide that meteorological data which is required per Schedule H to the Interconnection Service Agreement and Section 8 of Manual 14D.

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 Solar generating facility located in Adams County, Pennsylvania. The installed facilities will have a total capability of 3 MW with 1.8 MW of this output being recognized by PJM as Capacity. The proposed in-service date for this project is December 31, 2021. This study does not imply a TO commitment to this in-service date.

Queue Number	AF2-175
Project Name	STRABAN 13.2 KV
State	Pennsylvania
County	Adams
Transmission Owner	ME
MFO	3
MWE	3
MWC	1.8
Fuel	Solar
Basecase Study Year	2023

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

AF2-175 will interconnect with the Met-Ed distribution system.

The interconnection of the project at the Primary POI will be accomplished by tapping the 00674-4 13.2kV line from the Straban Substation, near pole 16517-17640 and constructing a one span tap. The distribution line tap will be located approximately 1.6 miles from Straban substation. The IC will be responsible for acquiring all easements, properties, and permits that may be required to construct both the new interconnection line tap and the associated attachment facilities. The project will also require non-direct connection upgrades at Straban substation.

Attachment 1 shows a one-line diagram of the proposed primary direct connection facilities for the AF2-175 generation project to connect to the FirstEnergy ("FE") transmission system. IC will be responsible for constructing the facilities on its side of the POI, including the attachment facilities which connect the generator to the Met-Ed distribution system's direct connection facilities.

5 Cost Summary

The AF2-175 project will be responsible for the following costs:

Description	Total Cost
Total Physical Interconnection Costs	$323,900
Total System Network Upgrade Costs[1]	$0
Total Costs	$323,900

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 88-129. 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.

[1] This project currently contributes to an overload of the AD1-020- Hunterstown 115 kV line segment of the Hunterstown-Lincoln 115 kV line. There is a PJM RTEP Market Efficiency project b3145 to reconductor this line and upgrade terminal equipment with a projected in-service date of 6/1/2023. This overload will be re-evaluated in the System Impact phase. AF2-102 does not have cost contribution but may need to wait until this reinforcement is completed before going into Commercial Operation.

6 Transmission Owner Scope of Work

The interconnection of the project at the Primary POI will be accomplished by tapping the 00674-4 13.2kV line from the Straban Substation, near pole 16517-17640 and constructing a one span tap. The distribution line tap will be located approximately 1.6 miles from Straban substation. The IC will be responsible for acquiring all easements, properties, and permits that may be required to construct both the new interconnection line tap and the associated attachment facilities. The project will also require non-direct connection upgrades at Richmond substation.

Attachment 1 shows a one-line diagram of the proposed primary direct connection facilities for the AF2-175 generation project to connect to the FirstEnergy ("FE") transmission system. IC will be responsible for constructing the facilities on its side of the POI, including the attachment facilities which connect the generator to the Met-Ed distribution system's direct connection facilities.

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

Description	**Total Cost**
Tap 13.2 kV distribution circuit.	$ 10,000
Fuse	$ 5,000
Direct transfer trip scheme to prevent reverse power flow on the substation transformer.	$ 308,900
Total Physical Interconnection Costs	$ 323,900

7 Schedule[1]

Based on the scope of work for the interconnection facilities, it is expected to take a minimum of **9 months** after the signing of an Interconnection Agreement and construction kickoff call to complete the installation. This assumes that there will be no environmental issues with any of the new properties associated with this project, that there will be no delays in acquiring the necessary permits for implementing the defined direct connection and network upgrades, and that all transmission system outages will be allowed when requested.

8 Transmission Owner Analysis

Met-Ed performed an analysis of the 13.2 kV distribution system.

Under normal circuit configurations, when fed from the Straban substation, the AF2-175 project did not contribute to any overloads or voltage flicker violations on the Met-Ed distribution system

Under abnormal circuit configurations, when fed from the North Hanover substation, the AF2-175 project results in reasonable cause for concern for voltage flicker violations on the Met-Ed distribution system. FirstEnergy may require the installation of a PQ monitoring system to permit ongoing assessment of compliance with these criteria.

9 Interconnection Customer Requirements

9.1 System Protection

The IC must design its Customer Facilities in accordance with all applicable standards, including the standards in FE's "Requirements for Distribution Connected Facilities" document located at: http://www.pjm.com/planning/design-engineering/to-tech-standards/private-firstenergy.aspx.

Preliminary Protection requirements will be provided as part of the Facilities Study. Detailed Protection Requirements will be provided once the project enters the construction phase.

9.2 Compliance Issues and Interconnection Customer Requirements

The proposed Customer Facilities must be designed in accordance with FE's "Requirements for Distribution Connected Facilities" document located at: http://www.pjm.com/planning/design-engineering/to-tech-standards/private-firstenergy.aspx. In particular, the IC is responsible for the following:

The purchase and installation of a fully rated 13.2 kV circuit breaker to protect the AF2-175 generator lead line. A single circuit breaker must be used to protect this line; if the project has several GSU transformers, the individual GSU transformer breakers cannot be used to protect this line.

The purchase and installation of the minimum required FE generation interconnection relaying and control facilities. This includes over/under voltage protection, over/under frequency protection, and zero sequence voltage protection relays.

The purchase and installation of supervisory control and data acquisition ("SCADA") equipment to provide information in a compatible format to the FE Transmission System Control Center.

Compliance with the FE and PJM generator power factor and voltage control requirements.

The execution of a back-up service agreement to serve the customer load supplied from the AF2-175 generation project metering point when the units are out-of-service. This assumes the intent of the IC is to net the generation with the load.

The IC will also be required to meet all PJM, ReliabilityFirst, and NERC reliability criteria and operating procedures for standards compliance. For example, the IC will need to properly locate and report the over and under voltage and over and under frequency system protection elements for its units as well as the submission of the generator model and protection data required to satisfy the PJM and ReliabilityFirst audits. Failure to comply with these requirements may result in a disconnection of service if the violation is found to compromise the reliability of the FE system.

9.3 Power Factor Requirements

The IC shall design its solar-powered, non-synchronous Customer Facility with the ability to maintain a power factor of at least 0.95 leading (absorbing VARs) to 0.95 lagging (supplying VARs) measured at the high-side of the facility substation transformer(s) connected to the Met-Ed distribution system.

If high voltage, low voltage, or objectionable voltage flicker arises due to the operation, frequent tripping, and/or frequent starting and stopping of the generator, the generator owner may be required to disconnect its generation equipment from the FirstEnergy system until the problem has been fully investigated and resolved.

10 Revenue Metering and SCADA Requirements

10.1 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.

10.2 Meteorological Data Reporting Requirements

The solar generation facility shall provide the Transmission Provider with site-specific meteorological data including:

- Back Panel temperature (Fahrenheit)
- Irradiance (Watts/meter2)
- Ambient air temperature (Fahrenheit) – (Accepted, not required)

- Wind speed (meters/second) – (Accepted, not required)

Wind direction (decimal degrees from true north) – (Accepted, not required)

10.3 ME Requirements

The IC will be required to comply with all FE revenue metering requirements for generation interconnection customers which can be found in FE's "Generation Interconnection Technical Requirements for Distribution Connected Facilities" document located at:

http://www.pjm.com/planning/design-engineering/to-tech-standards/private-firstenergy.aspx

11 Summer Peak - Load Flow Analysis

The Queue Project AF2-175 was evaluated as a 3.0 MW (Capacity 1.8 MW) injection at the Straban 115 kV substation in the ME area. Project AF2-175 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AF2-175 was studied with a commercial probability of 53.0 %. Potential network impacts were as follows:

11.1 Generation Deliverability

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

None

11.2 Multiple Facility Contingency

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

None

11.3 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)

ID	FROM BUS#	FROM BUS	kV	FROM BUS AREA	TO BUS#	TO BUS	kV	TO BUS AREA	CKT ID	CONTNAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
10111308 5	93397 0	AD1-020 TAP	115. 0	METE D	20453 9	27HUNTRST N	115. 0	METE D	1	ME-P2-3-ME-115-019-B	breake r	160.0	116.87	118.29	DC	2.26

11.4 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	CONTNAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
10111348 8	93397 0	AD1-020 TAP	115. 0	METE D	20453 9	27HUNTRST N	115. 0	METE D	1	ME-P1-2-ME-115-061	operatio n	160.0	112.37	113.79	DC	2.26

11.5 System Reinforcements - Summer Peak Load Flow - Primary POI

ID	Idx	Facility	Upgrade Description	Cost
101113085	1	**AD1-020 TAP 115.0 kV - 27HUNTRSTN 115.0 kV Ckt 1**	**METED** **b3145 (1611) : PJM RTEP Market Efficiency Project. Reconductor the Hunterstown to Lincoln 115 kV line with larger conductor (2.6 miles) with 795 ACSR. Upgrade limiting terminal equipment at Hunterstown and Lincoln.** **Project Type : FAC** **Cost : $0** **Time Estimate : Projected in-service date: 06/01/2023**	$0[1]
			TOTAL COST	**$0**

11.6 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".

11.6.1 Index 1

ID	FROM BUS#	FROM BUS	FROM BUS AREA	TO BUS#	TO BUS	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
101113085	933970	AD1-020 TAP	METED	204539	27HUNTRSTN	METED	1	ME-P2-3-ME-115-019-B	breaker	160.0	116.87	118.29	DC	2.26

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
204649	27ORTAN CT	2.6875	50/50	2.6875
235002	**AC1-039 C (Suspended)**	**0.8691**	**Adder**	**1.02**
237778	01MSM_W1-116	0.1050	50/50	0.1050
901952	W1-116E	0.9952	50/50	0.9952
918902	AA1-109 E	0.3761	Adder	0.44
923202	**AB1-124 C (Suspended)**	**1.1975**	**50/50**	**1.1975**
923203	**AB1-124 E (Suspended)**	**1.9537**	**50/50**	**1.9537**
923212	**AB1-125 C OP (Suspended)**	**0.8981**	**50/50**	**0.8981**
923213	**AB1-125 E OP (Suspended)**	**1.4653**	**50/50**	**1.4653**
925642	**AC1-039 E (Suspended)**	**0.8023**	**Adder**	**0.94**
925721	**AC1-048 C (Suspended)**	**8.1330**	**50/50**	**8.1330**
925722	**AC1-048 E (Suspended)**	**13.2696**	**50/50**	**13.2696**
930521	AB1-096 C	0.4873	50/50	0.4873
930522	AB1-096 E	0.8017	50/50	0.8017
932371	**AC2-053 C (Suspended)**	**4.6474**	**50/50**	**4.6474**
932372	**AC2-053 E (Suspended)**	**7.5826**	**50/50**	**7.5826**
933971	AD1-020 C	44.5148	50/50	44.5148
933972	AD1-020 E	38.5352	50/50	38.5352
938041	**AE1-006 C (Suspended)**	**4.6474**	**50/50**	**4.6474**
938042	**AE1-006 E (Suspended)**	**7.5826**	**50/50**	**7.5826**
939101	AE1-139 C O1	31.1618	50/50	31.1618
939102	AE1-139 E O1	20.7745	50/50	20.7745
941871	AE2-192 C	31.1610	50/50	31.1610
941872	AE2-192 E	20.7740	50/50	20.7740
945231	AF1-188	0.7990	50/50	0.7990
958081	AF2-102 C	1.1007	50/50	1.1007
958082	AF2-102 E	0.7338	50/50	0.7338
958841	AF2-175 C	1.3578	50/50	1.3578
958842	AF2-175 E	0.9052	50/50	0.9052
959772	AF2-268 E	1.5980	50/50	1.5980
WEC	WEC	0.1660	Confirmed LTF	0.1660
LGEE	LGEE	0.3081	Confirmed LTF	0.3081
CPLE	CPLE	0.4974	Confirmed LTF	0.4974
CBM-W2	CBM-W2	4.6765	Confirmed LTF	4.6765
NY	NY	0.6100	Confirmed LTF	0.6100
CBM-W1	CBM-W1	6.4176	Confirmed LTF	6.4176
TVA	TVA	0.8400	Confirmed LTF	0.8400
O-066	O-066	9.1459	Confirmed LTF	9.1459
CBM-S2	CBM-S2	4.0749	Confirmed LTF	4.0749

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
CBM-S1	CBM-S1	5.0183	Confirmed LTF	5.0183
G-007	G-007	1.3998	Confirmed LTF	1.3998
MADISON	MADISON	0.0444	Confirmed LTF	0.0444
MEC	MEC	0.8628	Confirmed LTF	0.8628

11.7 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.

Queue Number	Project Name	Status
AA1-109	Cotoctin-Troutville Junction 34.5kV	In Service
AB1-096	Carroll-Mt. Airy 34.5kV	Engineering and Procurement
AB1-124	Carroll-Monocacy 34.5kV	Suspended
AB1-125	Carroll-Monocacy 34.5kV	Suspended
AC1-039	Catoctin 34kV	Suspended
AC1-048	Germantown 115kV	Suspended
AC2-053	Germantown 115kV	Suspended
AD1-020	Hunterstown-Lincoln 115 kV	Engineering and Procurement
AE1-006	Germantown 115 kV	Suspended
AE1-139	Hunterstown 115 kV	Active
AE2-192	Orrtanna 115 kV	Active
AF1-188	Orrtanna 115 kV	Partially in Service - Under Construction
AF2-102	Germantown 13.2 kV	Active
AF2-175	Straban 13.2 kV	Active
AF2-268	Orrtanna 13.2 kV	Active
W1-116	Emmitsburg 34kV	In Service

11.8 Contingency Descriptions

Contingency Name	Contingency Definition
ME-P1-2-ME-115-061	CONTINGENCY 'ME-P1-2-ME-115-061' /* HUNTRSTOWN-ORRTANNA 115 KV LINE DISCONNECT BRANCH FROM BUS 204539 TO BUS 204550 CKT 1 /* 27HUNTRSTN 115 27ORRTANNA 115 END
ME-P2-3-ME-115-019-B	CONTINGENCY 'ME-P2-3-ME-115-019-B' /* ORRTANNA BKR NEW2 - HUNTERTOWN & AEC DISCONNECT BRANCH FROM BUS 204550 TO BUS 204539 CKT 1 /* 27ORRTANNA 115 27HUNTRSTN 115 REMOVE LOAD R FROM BUS 204550 END

12 Short Circuit Analysis

Short circuit analysis to be performed in the System Impact phase.

12.1 System Reinforcements - Short Circuit

Short circuit analysis to be performed in the System Impact phase.

13 Affected Systems

None

14 Attachment 1: One Line Diagram