



**Generation Interconnection
Feasibility Study Report
for
Queue Project AF2-170
ERIE WEST-SPRINGBORO 34.5 KV
12 MW Capacity / 20 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, Inc. (MAIT, PENELEC 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 Erie County, Pennsylvania. The installed facilities will have a total capability of 20 MW with 12 MW of this output being recognized by PJM as Capacity. The proposed in-service date for this project is September 15, 2022. This study does not imply a TO commitment to this in-service date.

Queue Number	AF2-170
Project Name	ERIE WEST-SPRINGBORO 34.5 KV
State	Pennsylvania
County	Erie
Transmission Owner	MAIT (PENELEC Zone)
MFO	20
MWE	20
MWC	12
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

AF2-170 will interconnect with the PENELEC distribution system at POI pole FV-662A34, which is located on the 34.5kV Springboro ckt#00264-34 @ Erie West.

Attachment 1 shows a one-line diagram of the proposed primary direct connection facilities for the AF2-170 generation project to connect to the Penelec distribution system. Attachment 2 provides the proposed location for the point of interconnection. IC will be responsible for constructing all of the facilities on its side of the POI, including the attachment facilities which connect the generator to the Penelec distribution system's direct connection facilities.

Customer did not request a secondary point of interconnection.

5 Cost Summary

The AF2-170 project will be responsible for the following costs:

Description	Total Cost
Total Physical Interconnection Costs	\$ 143,900
Total Local System Upgrade Costs	\$ 3,477,600
Total System Network Upgrade Costs	\$ 6,541,980

Description	Total Cost
Total Costs	\$ 10,163,480

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.

6 Transmission Owner Scope of Work

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

Description	Total Cost
Tap the existing 34.5kV Springboro ckt#00264-34 @ Erie West at POI pole FV-662A34 and install a SCADA controlled 34.5kV recloser to interconnect queue project AF2-170. Install 34.5kV metering in customer's facilities. The customer is responsible to build their own line from their site to Penelec's existing facilities.	\$ 100,000
Review customer drawings, create nameplates and update CD drawing @ AF2-170 Customer Substation	\$ 15,800
Modify line relay settings @ Springboro circuit breaker at Erie West	\$ 28,100
Total Physical Interconnection Costs	\$ 143,900

7 Schedule

Based on the scope of work for the Attachment Facilities and the Direct and/or Non-Direct Connection facilities, it is expected to take a minimum of 15 months after the signing of an Interconnection Construction Service Agreement to complete the installation. This includes the requirement for the IC to make a preliminary payment that compensates FE for the engineering design work that is related to the construction. 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.

The schedule for the required Network Impact Reinforcements will be more clearly identified in future study phases.

8 Transmission Owner Analysis

Penelec performed an analysis of its distribution system. The AF2-170 project did contribute overloads on the distribution system requiring the replacement of the existing #2 transformer (15/20/25MVA-OA/FA/FA) @ Erie West substation with a larger MVA capacity unit.

Description	Total Cost
115-34.5kV Transformer Replacement & Relay Settings @ Erie West	\$ 3,477,600
Total Local System Upgrades	\$ 3,477,600

9 Interconnection Customer Requirements

9.1 System Protection

An analysis was conducted to assess the impact of the Erie West - Springboro 34.5kV (AF2-170) Project on the system protection requirements in the area. The results of this review show that the following relay additions will be required:

Proposed single line diagrams show the IC constructing a generation facility they call "Erie West - Springboro 34.5kV" that will connect to Penelec's 34.5kV Erie West substation ckt#00264-34 via a customer owned tap to pole FV-662A34.

The 34.5kV interconnection proposal will require Developer to meet applicable "Technical Requirements" as outlined in First Energy's document titled "Technical Requirements for the Interconnection of Customer-Owned Generation to the FirstEnergy Distribution System".

Protection requirements are included in the "Technical Requirements" document.

9.2 General Concerns

It is to be understood, for abnormal operation of the Penelec system, which could cause Developer's generation facility to be electrically isolated from the Penelec system synchronous source via the tripping of a interconnecting primary voltage line or device, Developer will, via Penelec's direction, be required to disconnect the generation from Penelec's system and remain disconnected (units are required to be OFF LINE), until the Penelec system normal circuitry is restored. These abnormal conditions will be reviewed by Penelec system operators as to the need for the generation facility to be disconnected.

9.3 Requirements for Owner's/Developer's generation IPP Facility

The proposed interconnection Owner's/Developer's facilities must be designed in accordance with the document titled FirstEnergy Distribution Engineering Practices Interconnection of Customer-Owned Generation to the FirstEnergy Distribution System dated 11/17/14 located at the following link:

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

The document is referred to as engineering practice EP(# 02-280) with section 4 part C specifically referencing the “interconnection technical requirements”. Certain protection requirements are shown.

Additionally, Owner/Developer is responsible to provide adequate protection (for their equipment) under any distribution system operating condition' - which includes 'Separation from supply' (i.e. tripping of F.E. circuit breakers) and 'Re-synchronizing the generation after electric restoration of the supply' (i.e. reclosing of F.E. circuit breakers).

Owner’s/Developer’s protection must be designed to coordinate with the reclosing practices of FirstEnergy line protective devices. The generator must cease to energize the FirstEnergy circuit to which it is connected prior to reclosing of any (FE) automatic reclosing devices.

Owners/Developer’s electrical protection and control schematics shall be provided to FE for consideration. FE may request modifications, if required, to meet the technical requirements.

9.4 Power Factor

IC will be responsible for meeting a power factor between 0.95 lagging (producing MVARs) to 0.95 leading (absorbing MVARs) and assure that voltage deviation will be less than 1.0 volt as measured at the POI under all Solar Gen operating conditions due to the inherent dynamic reactive power capability of this solar/storage facility.

Generators with no inherent VAR (reactive power) control capability, or those that have a restricted VAR capability less than the defined requirements, must provide dynamic supplementary reactive support located at the generation facility with electrical characteristics equivalent to that provided by a similar sized synchronous generator. A Dynamic Reactive Compensation (either Static VAR Compensator (SVC) or STATCOM) or other method be applied in order to maintain the required specifications at the POI. IC is responsible for the installation of equipment on its side of the POI in order to adhere to the criteria stated above by FirstEnergy.

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 Interconnected Transmission Owner Requirements

IC will be required to comply with all FE Revenue Metering Requirements for Generation Interconnection Customers. These FE requirements are the following:

The FE operating company (Penelec) shall provide, own, operate, test, and maintain the revenue metering equipment at the Interconnection Customer's (IC) expense. The revenue metering equipment includes, but is not limited to, current transformers, voltage transformers, secondary wires, meter socket, bidirectional revenue meter, and associated devices. The IC shall mount the instrument transformers unless otherwise agreed to by Penelec. The instrument transformers and meter socket shall be installed in a location that is readily accessible to authorized Penelec representatives. Penelec will provide the IC access to bidirectional kWh and kVARh pulses from the Penelec meter at the IC's expense if requested. The IC shall, at its expense, install, own, operate, test, and maintain any metering and telemetry equipment that may be required to provide real-time meter data to FE or PJM.

11 Summer Peak - Load Flow Analysis

The Queue Project AF2-170 was evaluated as a 20.0 MW (Capacity 12.0 MW) injection at the Erie West 34.5 kV substation in the PENELEC area. Project AF2-170 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AF2-170 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	CK T ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADIN G %	POST PROJECT LOADIN G %	AC D C	MW IMPAC T
101105608	943150	AE2-344 TAP	115.0	PENELEC	200572	26EDIN B.S.	115.0	PENELEC	1	ATSI-P2-3-CEI-345-004D	breaker	179.0	124.86	125.31	DC	1.8

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	FRO M BUS AREA	TO BUS#	TO BUS	kV	TO BUS AREA	CK T ID	CONT NAME	Type	Ratin g MVA	PRE PROJEC T LOADIN G%	POST PROJEC T LOADIN G%	AC D C	MW IMPAC T
100592166	235197	01KARNSC	138.0	AP	235152	01BUTLER	138.0	AP	1	ATSI-P1-2-CEI-345-700T	operatio n	179.0	238.09	238.55	DC	1.83
100592167	235197	01KARNSC	138.0	AP	235152	01BUTLER	138.0	AP	1	PN-P1-2-PN-345-107T	operatio n	179.0	238.09	238.55	DC	1.83
100592210	235240	01COLMBGP N	138.0	AP	235202	01KISKIV	138.0	AP	1	ATSI-P1-2-CEI-345-700T	operatio n	151.0	189.48	189.96	DC	1.58
100592211	235240	01COLMBGP N	138.0	AP	235202	01KISKIV	138.0	AP	1	PN-P1-2-PN-345-107T	operatio n	151.0	189.48	189.96	DC	1.58
100592195	235282	01GAR RN	138.0	AP	235240	01COLMBGP N	138.0	AP	1	PN-P1-2-PN-345-107T	operatio n	151.0	197.96	198.43	DC	1.58
100592196	235282	01GAR RN	138.0	AP	235240	01COLMBGP N	138.0	AP	1	ATSI-P1-2-CEI-345-700T	operatio n	151.0	197.96	198.43	DC	1.58

11.5 System Reinforcements - Summer Peak Load Flow - Primary POI

ID	Idx	Facility	Upgrade Description	Cost
101105608	1	AE2-344 TAP 115.0 kV - 26EDINB S. 115.0 kV Ckt 1	<p>PENELEC</p> <p>PN-AF2-F-0049A (1815) : Replace relays at Edinboro South Project Type : FAC Cost : \$427,980 Time Estimate : 12.0 Months</p> <p>PN-AF2-F-0049B (1816) : Reconductor 2 miles of transmission line Project Type : FAC Cost : \$6,114,000 Time Estimate : 30.0 Months</p>	\$6,541,980
			TOTAL COST	\$6,541,980

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
101105608	943150	AE2-344 TAP	PENELEC	200572	26EDINBS	PENELEC	1	ATSI-P2-3-CEI-345-004D	breaker	179.0	124.86	125.31	DC	1.8

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
915951	Y3-092 FTIR	77.2200	Merchant Transmission	77.2200
942813	AE2-299 BAT	18.6240	50/50	18.6240
943151	AE2-344 C	34.8193	50/50	34.8193
943152	AE2-344 E	23.2129	50/50	23.2129
944382	AF1-103 BAT	1.4446	Merchant Transmission	1.4446
944391	AF1-104 O1	1.5292	Adder	1.8
945051	AF1-170 C	10.9968	50/50	10.9968
945052	AF1-170 E	7.3312	50/50	7.3312
957571	AF2-051 C O1	6.5208	50/50	6.5208
957572	AF2-051 E O1	3.3592	50/50	3.3592
958731	AF2-164 C O1	1.0996	Adder	2.44
958732	AF2-164 E O1	0.7331	Adder	1.63
958791	AF2-170 C	0.4863	Adder	1.08
958792	AF2-170 E	0.3242	Adder	0.72
960321	AF2-323 C O1	5.0295	50/50	5.0295
960322	AF2-323 E O1	3.3530	50/50	3.3530
WEC	WEC	0.0220	Confirmed LTF	0.0220
LGEE	LGEE	0.0399	Confirmed LTF	0.0399
CPL	CPL	0.0370	Confirmed LTF	0.0370
CBM-W2	CBM-W2	0.5569	Confirmed LTF	0.5569
NY	NY	0.4302	Confirmed LTF	0.4302
CBM-W1	CBM-W1	0.8632	Confirmed LTF	0.8632
TVA	TVA	0.0924	Confirmed LTF	0.0924
O-066	O-066	0.9072	Confirmed LTF	0.9072
CBM-S2	CBM-S2	0.3410	Confirmed LTF	0.3410
CBM-S1	CBM-S1	0.5708	Confirmed LTF	0.5708
G-007	G-007	0.1310	Confirmed LTF	0.1310
MEC	MEC	0.1096	Confirmed LTF	0.1096

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
AE2-299	Erie East 230 kV	Active
AE2-344	Edinboro South-Venango Junction 115 kV	Active
AF1-103	Warren 34.5 kV	Active
AF1-104	Erie West 34.5 kV	Active
AF1-170	Springboro-Venango Junction 115 kV	Active
AF2-051	Geneva 115 kV	Active
AF2-164	Handsome Lake 345 kV	Active
AF2-170	Erie West-Springboro 34.5 kV	Active
AF2-323	Geneva-Franklin Tap 115 kV	Active
Y3-092	Erie West 345kV	Engineering and Procurement

11.8 Contingency Descriptions

Contingency Name	Contingency Definition
ATSI-P2-3-CEI-345-004D	CONTINGENCY 'ATSI-P2-3-CEI-345-004D' /* ERIE WEST 345KV BKR 8 DISCONNECT BRANCH FROM BUS 200599 TO BUS 200600 CKT 1 /* 26ERIE W 345 26ERIE SO 345 DISCONNECT BRANCH FROM BUS 200599 TO BUS 238547 CKT 1 /* 26ERIE W 345 02AT 345 DISCONNECT BRANCH FROM BUS 238547 TO BUS 239036 CKT 1 /* 02AT 345 02PERRY 345 DISCONNECT BRANCH FROM BUS 238547 TO BUS 239082 CKT 1 /* 02AT 345 02S8-ATT 345 DISCONNECT BUS 200600 /* 26ERIE SO 345 DISCONNECT BUS 238547 /* 02AT 345 END

Contingency Name	Contingency Definition
PN-P1-2-PN-345-107T	CONTINGENCY 'PN-P1-2-PN-345-107T' /* ERIE WEST - ASHTABULA - PERRY 345KV DISCONNECT BRANCH FROM BUS 200599 TO BUS 238547 CKT 1 /* 26ERIE W 345 02AT 345 DISCONNECT BRANCH FROM BUS 238547 TO BUS 239082 CKT 1 /* 02AT 345 02S8-ATT 345 DISCONNECT BRANCH FROM BUS 238547 TO BUS 239036 CKT 1 /* 02AT 345 02PERRY 345 DISCONNECT BUS 238547 /* 02AT 345 END
ATSI-P1-2-CEI-345-700T	CONTINGENCY 'ATSI-P1-2-CEI-345-700T' /* PN/ATSI ERIE WEST - ASHTABULA - PERRY 345KV DISCONNECT BRANCH FROM BUS 239036 TO BUS 238547 CKT 1 /* 02PERRY 345 02AT 345 DISCONNECT BRANCH FROM BUS 238547 TO BUS 239082 CKT 1 /* 02AT 345 02S8-ATT 345 DISCONNECT BRANCH FROM BUS 239082 TO BUS 238544 CKT 8 /* 02S8-ATT 345 02ASH_3 138 DISCONNECT BRANCH FROM BUS 238547 TO BUS 200599 CKT 1 /* 02AT 345 26ERIE W 345 END

12 Short Circuit Analysis

Short circuit analysis will be provided in the System Impact Study report.

13 Affected Systems

13.1 NYISO

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

14 Attachment 1: One Line Diagram