Generation Interconnection

Feasibility Study Report

for

Queue Project AF2-383

TOLNA 115 KV

20 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, LLC (MAI) (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; Storage generating facility located in York County, Pennsylvania. The installed facilities will have a total capability of 20 MW with 20 MW of this output being recognized by PJM as Capacity. The proposed in-service date for this project is December 01, 2023. This study does not imply a TO commitment to this in-service date.

Queue Number	AF2-383
Project Name	TOLNA 115 KV
State	Pennsylvania
County	York
Transmission Owner	MAIT (ME zone)
MFO	20
MWE	20
MWC	20
Fuel	Solar; Storage
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

The interconnection of the project at the Primary POI will be accomplished by constructing a new 115 kV line terminal and dead-end structure at the existing Tolna 115 kV substation.

Attachment 1 shows a one-line diagram of the proposed primary Direct Connection facilities for the AF2-383 generation project to connect to the FirstEnergy ("FE") Transmission System. The IC will be responsible for constructing the facilities on its side of the POI, including the Attachment Facilities which connect the generator to the FE Transmission System's Direct Connection facilities.

5 Cost Summary

The AF2-383 project will be responsible for the following costs:

Description	Total Cost
Total Physical Interconnection Costs	$2,430,000
Total System Network Upgrade Costs	$7,250,000[1]
Total Costs	**$9,680,000**

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

6 Transmission Owner Scope of Work

The interconnection of the project at the Primary POI will be accomplished by constructing a new 115 kV line terminal and dead-end structure at the existing Tolna 115 kV substation.

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

Description	Total Cost
Install 115 kV breaker, relocate bus PT's, install disconnect switch, dead-end structure, and associated facilities for generator lead line exit at interconnection substation.	$2,430,000
Total Physical Interconnection Costs	$2,430,000

7 Schedule[1]

Based on the scope of work for the interconnection facilities, it is expected to take a minimum of **24 months** after the signing of an Interconnection Construction Service Agreement and construction kickoff call to complete the installation. This includes the requirement for the IC to make a preliminary payment that compensates FE for the first three months of the engineering design work that is related to the construction of the interconnection substation. 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 of work for any required System Reinforcement will be further defined in future studies. The estimated time to complete the system upgrades is shown in the "System Reinforcements" section below.

8 Transmission Owner Analysis

8.1 Power Flow Analysis

FE performed an analysis of its underlying transmission <100 kV system. The AF2-383 project did not contribute to any overloads on the <100 kV FE transmission system.

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 Transmission 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 Transmission 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:

1. The purchase and installation of a fully rated 115 kV circuit breaker to protect the AF2-383 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.

2. 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.

3. 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.

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

5. The execution of a back-up service agreement to serve the customer load supplied from the AF2-383 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 Transmission System.

9.3 Power Factor Requirements

The IC shall design its 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 FE Transmission System.

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

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/

11 Summer Peak - Load Flow Analysis

The Queue Project AF2-383 was evaluated as a 20.0 MW (Capacity 20.0 MW) injection at the Tolna 115 kV substation in the ME area. Project AF2-383 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AF2-383 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	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
101404865	204557	27SMITH ST	115.0	METED	204558	27SMITH TP	115.0	METED	1	ME-P2-3-ME-115-032AT	breaker	152.0	112.6	114.34	DC	2.65
101404730	939000	AE1-129 TAP	115.0	METED	204571	27ZIONS VW	115.0	METED	1	ME-P2-3-ME-230-019CT	breaker	156.0	128.85	129.41	DC	1.65

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	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
101405155	204524	27CLY 978	115.0	METED	204682	27ES3	115.0	METED	1	204571 27ZIONS VW 115 939000 AE1-129 TAP 115 1	operation	130.0	128.36	129.0	DC	1.56

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 PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
101405260	204558	27SMITH TP	115.0	METED	204557	27SMITH ST	115.0	METED	1	204668 27TEX E TP 115 939020 AE1-131 TAP 115 1	operation	152.0	107.75	108.32	DC	1.93
101405232	204572	27RAINTREE	115.0	METED	204557	27SMITH ST	115.0	METED	1	204571 27ZION S VW 115 939000 AE1-129 TAP 115 1	operation	129.0	110.13	110.77	DC	1.56
101405163	204682	27ES3	115.0	METED	204572	27RAINTREE	115.0	METED	1	204571 27ZION S VW 115 939000 AE1-129 TAP 115 1	operation	130.0	125.44	126.08	DC	1.56

11.5 System Reinforcements - Summer Peak Load Flow - Primary POI

ID	Idx	Facility	Upgrade Description	Cost
101404730	2	**AE1-129 TAP 115.0 kV - 27ZIONS VW 115.0 kV Ckt 1**	**METED** **ME-0007a (1615) : Reconductor line with larger conductor (2.9 miles).** **Project Type : FAC** **Cost : $7,100,000** **Time Estimate : 30.0 Months**	$7,100,000
101404865	1	**27SMITH ST 115.0 kV - 27SMITH TP 115.0 kV Ckt 1**	**METED** **b3136 (1610) : Replace bus conductor at Smith 115 kV substation** **Project Type : FAC** **Cost : $150,000** **Time Estimate : Projected in-service date: 06/01/2024**	$150,000
			TOTAL COST	**$7,250,000[1]**

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
101404865	204557	27SMITH ST	METED	204558	27SMITH TP	METED	1	ME-P2-3-ME-115-032AT	breaker	152.0	112.6	114.34	DC	2.65

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
204660	27YK H STA	0.7178	50/50	0.7178
939001	AE1-129 C	17.7660	50/50	17.7660
939002	AE1-129 E	12.3228	50/50	12.3228
945271	AF1-192	0.0797	Adder	0.09
958071	AF2-101 C	0.2248	50/50	0.2248
958072	AF2-101 E	0.1498	50/50	0.1498
958601	AF2-151 C	0.2322	50/50	0.2322
958602	AF2-151 E	0.1548	50/50	0.1548
959043	AF2-195 BAT	54.1662	50/50	54.1662
959221	AF2-213 C O1	13.8579	50/50	13.8579
959222	AF2-213 E O1	20.7869	50/50	20.7869
959371	AF2-228 C O1	13.8348	50/50	13.8348
959372	AF2-228 E O1	9.2232	50/50	9.2232
960922	AF2-383 BAT	2.6488	50/50	2.6488
NEWTON	NEWTON	0.0484	Confirmed LTF	0.0484
FARMERCITY	FARMERCITY	0.0026	Confirmed LTF	0.0026
G-007A	G-007A	0.4987	Confirmed LTF	0.4987
VFT	VFT	1.4061	Confirmed LTF	1.4061
CALDERWOOD	CALDERWOOD	0.0283	Confirmed LTF	0.0283
PRAIRIE	PRAIRIE	0.1214	Confirmed LTF	0.1214
CHEOAH	CHEOAH	0.0285	Confirmed LTF	0.0285
EDWARDS	EDWARDS	0.0150	Confirmed LTF	0.0150
TILTON	TILTON	0.0277	Confirmed LTF	0.0277
GIBSON	GIBSON	0.0246	Confirmed LTF	0.0246
BLUEG	BLUEG	0.0781	Confirmed LTF	0.0781
TRIMBLE	TRIMBLE	0.0250	Confirmed LTF	0.0250
CATAWBA	CATAWBA	0.0234	Confirmed LTF	0.0234

11.6.2 Index 2

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
101404730	939000	AE1-129 TAP	METED	204571	27ZIONS VW	METED	1	ME-P2-3-ME-230-019CT	breaker	156.0	128.85	129.41	DC	1.65

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
939001	AE1-129 C	19.2545	50/50	19.2545
939002	AE1-129 E	13.3552	50/50	13.3552
959043	AF2-195 BAT	19.2287	50/50	19.2287
959223	AF2-213 BAT	37.4389	50/50	37.4389
959371	AF2-228 C O1	14.9939	50/50	14.9939
959372	AF2-228 E O1	9.9959	50/50	9.9959
960922	AF2-383 BAT	0.8749	Merchant Transmission	0.8749
NEWTON	NEWTON	0.0537	Confirmed LTF	0.0537
FARMERCITY	FARMERCITY	0.0028	Confirmed LTF	0.0028
G-007A	G-007A	0.3932	Confirmed LTF	0.3932
VFT	VFT	1.0900	Confirmed LTF	1.0900
CALDERWOOD	CALDERWOOD	0.0273	Confirmed LTF	0.0273
PRAIRIE	PRAIRIE	0.1292	Confirmed LTF	0.1292
CHEOAH	CHEOAH	0.0280	Confirmed LTF	0.0280
EDWARDS	EDWARDS	0.0172	Confirmed LTF	0.0172
TILTON	TILTON	0.0309	Confirmed LTF	0.0309
GIBSON	GIBSON	0.0268	Confirmed LTF	0.0268
BLUEG	BLUEG	0.0851	Confirmed LTF	0.0851
TRIMBLE	TRIMBLE	0.0273	Confirmed LTF	0.0273
CATAWBA	CATAWBA	0.0210	Confirmed LTF	0.0210

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
AE1-129	Zion View - Middletown 115 kV	Active
AF1-192	Mountain 2 115 kV	Partially in Service - Under Construction
AF2-101	Allen 13.2 kV	Active
AF2-151	Dillsburg 13.2 kV	Active
AF2-195	Queen Street 115 kV	Active
AF2-213	Zions View-Smith Street 115 kV	Active
AF2-228	Zions View-Middletown 115 kV	Active
AF2-383	Tolna 115 kV	Active

11.8 Contingency Descriptions

Contingency Name	Contingency Definition
ME-P2-3-ME-230-019CT	CONTINGENCY 'ME-P2-3-ME-230-019CT' /* YORKANA-B11 DISCONNECT BRANCH FROM BUS 204515 TO BUS 208048 CKT 1 /* 27YORKANA 230 OTCR 230 DISCONNECT BRANCH FROM BUS 204515 TO BUS 207922 CKT 1 /* 27YORKANA 230 BRIS 230 DISCONNECT BRANCH FROM BUS 204515 TO BUS 204570 CKT 1 /* 27YORKANA 230 27YORKANA 115 END
204571 27ZIONS VW 115 939000 AE1-129 TAP 115 1	CONTINGENCY '204571 27ZIONS VW 115 939000 AE1-129 TAP 115 1' OPEN BRANCH FROM BUS 204571 TO BUS 939000 CKT 1 END
204668 27TEX E TP 115 939020 AE1-131 TAP 115 1	CONTINGENCY '204668 27TEX E TP 115 939020 AE1-131 TAP 115 1' OPEN BRANCH FROM BUS 204668 TO BUS 939020 CKT 1 END
ME-P2-3-ME-115-032AT	CONTINGENCY 'ME-P2-3-ME-115-032AT' /* YORKANA-1B45 (TIE BREAKER) DISCONNECT BRANCH FROM BUS 204570 TO BUS 204687 CKT 1 /* 27YORKANA 115 27PROSPECT 115 DISCONNECT BRANCH FROM BUS 204701 TO BUS 208720 CKT 1 /* 27YORKANAB 115 RED FRONT 115 DISCONNECT BRANCH FROM BUS 204570 TO BUS 204568 CKT 1 /* 27YORKANA 115 27YOE TAP 115 DISCONNECT BRANCH FROM BUS 204570 TO BUS 204701 CKT ZB /* 27YORKANA 115 27YORKANAB 115 DISCONNECT BRANCH FROM BUS 204701 TO BUS 204574 CKT 1 /* 27YORKANAB 115 27MODRN LF 13 DISCONNECT BRANCH FROM BUS 204515 TO BUS 204570 CKT 1 /* 27YORKANA 230 27YORKANA 115 DISCONNECT BRANCH FROM BUS 204515 TO BUS 204701 CKT 3 /* 27YORKANA 230 27YORKANAB 115 REMOVE LOAD 2 FROM BUS 204701 /* 27YORKANAB 115 DISCONNECT BUS 204701 /* 27YORKANAB 115 DISCONNECT BUS 204574 /* 27MODRN LF 13 DISCONNECT BUS 204570 /* 27YORKANA 115 END

12 Short Circuit Analysis

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

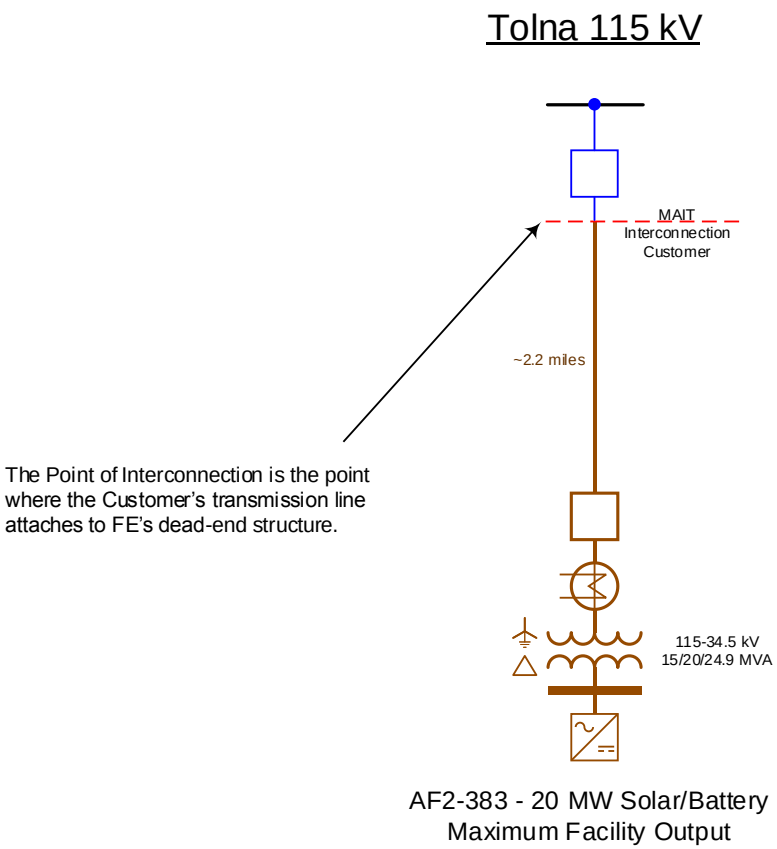
12.1 System Reinforcements - Short Circuit

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

13 Affected Systems

None

14 Attachment 1: One Line Diagram



Customer facilities are shown for informational purposes only. The Customer is responsible for designing its facilities to comply with applicable FirstEnergy connection standards, including FE's "Requirements for Transmission Connected Facilities" document.

MAIT	
Interconnection Customer	