Generation Interconnection

Feasibility Study Report

for

Queue Project AF2-176

MASURY-MAYSVILLE 138 KV

42 MW Capacity / 70 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 ATSI.

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.

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3 General

The Interconnection Customer (IC), has proposed a Solar generating facility located in Mercer County, Pennsylvania. The installed facilities will have a total capability of 70 MW with 42 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	AF2-176
Project Name	MASURY-MAYSVILLE 138 KV
State	Pennsylvania
County	Mercer
Transmission Owner	ATSI
MFO	70
MWE	70
MWC	42
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.

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4 Point of Interconnection

The interconnection of the project at the Primary POI will be accomplished by constructing a new 138 kV three (3) breaker ring bus substation and looping the Masury-Maysville 138 kV Line into the new station. The new substation will be located approximately 14.5 miles from Masury Substation. The IC will be responsible for acquiring all easements, properties, and permits that may be required to construct both the new interconnection switching station and the associated facilities. The IC will also be responsible for the rough grade of the property and an access road to the proposed three-breaker ring bus site. The project will also require Non-Direct Connection upgrades at Masury Substation and Maysville Substation.

Attachment 1 shows a one-line diagram of the proposed primary Direct Connection facilities for the AF2-176 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 AF2-176 project will be responsible for the following costs:

Description	Total Cost
Total Physical Interconnection Costs	$ 23,630,000
Total Transmission Owner Network Upgrades Costs (<100 kV/Non-BES)	$117,243,654[1]
Total System Reinforcement Costs	$0
Total Costs	$140,873,654

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] These transmission owner identified overloads will be reviewed by PJM and FirstEnergy in the Impact Study phase to determine whether the queue customer has a cost responsibility to these overloads.

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6 Transmission Owner Scope of Work

The interconnection of the project at the Primary POI will be accomplished by constructing a new 138 kV three (3) breaker ring bus substation and looping the Masury-Maysville 138 kV Line into the new station. The new substation will be located approximately 14.5 miles from Masury Substation. The IC will be responsible for acquiring all easements, properties, and permits that may be required to construct both the new interconnection switching station and the associated facilities. The total physical interconnection costs is given in the table below:

Description	Total Cost
Install disconnect switch, dead-end structure, and associated facilities for generator lead line exit at interconnection substation.	$ 285,000
Construct 138 kV three breaker ring bus interconnection substation.	$ 5,375,000
Loop the Masury-Maysville 138 kV line into the new substation.	$ 820,000
Upgrade relaying at Masury.	$ 440,000
Install ~14.5 miles of OPGW for fiber relaying from Masury to FE owned 3-breaker ring for AF2-176	$ 12,750,000
Install ~4 miles of OPGW for fiber relaying from Maysville to FE owned 3-breaker ring for AF2-176	$ 3,520,000
Upgrade relaying at Maysville.	$ 440,000
Total Physical Interconnection Costs	$23,630,000

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7 Schedule

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 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 work and that all system outages will be allowed when requested.

The schedule for the required Network Impact Reinforcements will be more clearly identified in future study phases. The estimated time to complete each of the required reinforcements is identified in the "System Reinforcements" section of the report.

8 Transmission Owner Analysis

At the Primary POI, the AF2-176 project contributes to overloads on the FE Transmission <100 kV System as shown below. The estimated cost of system reinforcements necessary to mitigate these overloads is shown below.

These transmission owner identified overloads will be reviewed by PJM and First Energy in the Impact Study phase to determine whether the queue customer has a cost responsibility to these overloads.

Contingency Description	Overloaded Element	Rating (MVA)	AF2-176 MW Contrib.	FE Comments /Reinforcements
ATSI-P1-2-OEE-138-012-A	AE1-079 Tap-Camp Reynolds 69 kV Line	43	28.68	OEE-011B
ATSI-P1-2-OEE-138-012-A	Maysville-AE1-079 Tap 69 kV Line	43	28.68	OEE-012B
ATSI-P1-2-OEE-138-012-A	Maysville-Y299 Tap 69 kV Line	53	28.52	OEE-014A
Base Case	AE1-079 Tap-Camp Reynolds 69 kV Line	27	5.66	OEE-011B
Base Case	Maysville-AE1-079 Tap 69 kV Line	27	5.66	OEE-012B
ATSI-P1-2-OEE-69-024	AE1-079 Tap-Camp Reynolds 69 kV Line	43	9.60	OEE-011A
ATSI-P1-2-OEE-138-012-A	Camp Reynolds-Sharon 69 kV Line	72	28.68	OEE-013B
ATSI-P1-2-OEE-69-024	Maysville-AE1-079 Tap 69 kV Line	43	9.60	OEE-012A
ATSI-P1-2-OEE-138-012-A	Y299 Tap-Sharon 69 kV Line	76	28.52	OEE-015A
ATSI-P1-2-OEE-138-012-A	AE1-183 Tap-Henderson 69 kV Line	46	12.81	OEE-016A
ATSI-P1-2-OEE-138-012-A	Greenville-Hempfield 69 kV Line	46	12.81	OEE-017A
Base Case	Maysville-Y299 Tap 69 kV Line	32	5.63	OEE-014A

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Contingency Description	Overloaded Element	Rating (MVA)	AF2-176 MW Contrib.	FE Comments /Reinforcements
ATSI-P1-2-OEE-138-012-A	Henderson-McDowell 69 kV Line	46	12.81	OEE-018B
Camp Reynolds-AE1-079 Tap 69 kV Line	Maysville-Y299 Tap 69 kV Line	53	9.57	OEE-014A
ATSI-P1-2-OEE-138-012-A	Hempfield-Werner Tap 69 kV Line	46	12.81	OEE-019A

Project ID	Facility Description	Reinforcement Description	Cost
OEE-011A	938580 AE1-079 TAP - 239681 02CP.REYN+ 69.0 kV Ckt Id 1	Reconductor the portion of the AE1-079 Tap-Camp Reynolds 69 kV Line segment that is 336.4 ACSR built with a design temperature of 120º F with 336 ACSR built with a design temperature of 212º F. The AE1-079 generator is roughly 1.25 miles from Maysville and 2.35 from Camp Raynolds (near structure 62 of the Maysville-Sharon Y-301 69 kV Line) .	$5,997,519
OEE-011B	938580 AE1-079 TAP - 239681 02CP.REYN+ 69.0 kV Ckt Id 1	Reconductor the AE1-079 Tap-Camp Reynolds 69 kV Line segment (2.35 miles) using 556 ACSR 26/7. The AE1-079 generator is roughly 1.25 miles from Maysville and 2.35 from Camp Raynolds (near structure 62 of the Maysville-Sharon Y-301 69 kV Line) .	$5,903,318
OEE-012A	238949 02MAYSVL - 938580 AE1-079 TAP 69.0 kV Ckt 1	Reconductor the portion of the Maysville-AE1-079 Tap 69 kV Line segment that is 336.4 ACSR built with a design temperature of 120º F with 336 ACSR built with a design temperature of 212º F. The AE1-079 generator is roughly 1.25 miles from Maysville and 2.35 from Camp Raynolds (near structure 62 of the Maysville-Sharon Y-301 69 kV Line) .	$3,234,264
OEE-012B	238949 02MAYSVL - 938580 AE1-079 TAP 69.0 kV Ckt 1	Reconductor the Maysville-AE1-079 Tap 69 kV Line segment (1.25 miles) using 556 ACSR 26/7. The AE1-079 generator is roughly 1.25 miles from Maysville and 2.35 from Camp Raynolds (near structure 62 of the Maysville-Sharon Y-301 69 kV Line) .	$3,140,063
OEE-013B	239861 02CP.REYN+ - 239104 02SHARON 69.0 kV Ckt Id 1	Reconductor the Camp Reynolds-Sharon 69 kV Line segment (9.1 miles) using 556 ACSR 26/7. Upgrade remote ends so that the TL is the most limiting element of the circuit.	$23,644,671
OEE-014A	238949 02MAYSVL - 239893 02Y299+ 69.0 kV Ckt Id 1	Reconductor the Maysville-Sharon Tap 69 kV Line segment (9.4 miles) using 556 ACSR 26/7. Upgrade remote ends so that the TL is the most limiting element of the circuit.	$23,707,472
OEE-015A	239893 02Y299+ - 239104 02SHARON 69.0 kV Ckt Id 1	Reconductor the Sharon-Sharon Tap 69 kV Line segment (3.3 miles) using 556 ACSR 26/7. Upgrade remote ends so that the TL is the most limiting element of the circuit.	$9,074,781
OEE-016A	939540 AE1-183 TAP - 239941 02HNDERSN 69.0 kV Ckt Id 1	Reconductor the portion of the AE1-183 Tap-Henderson Tap 69 kV Line segment that is currently 3/0 ACSR using 336 ACSR 26/7. The AE1-183 generator is roughly 8.1 miles from McDowell (near structure 108 of the Maysville-McDowell 69 kV Line) .	$5,024,100

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Project ID	Facility Description	Reinforcement Description	Cost
OEE-017A	239869 02GRNVLY80 - 239870 02HEMPFIEL 69.0 kV Ckt Id 1	Reconductor the Greenville-Hempfield 69 kV Line segment (2.1 miles) using 336 ACSR 26/7. Upgrade remote ends so that the TL is the most limiting element of the circuit.	$5,997,519
OEE-018B	239941 02HNDERSN - 238955 02MCDOWL 69.0 kV Ckt Id 1	Reconductor the portion of the Hempfield-McDowell 69 kV Line segment that is currently 3/0 ACSR using 336 ACSR 26/7. Upgrade remote ends so that the TL is the most limiting element of the circuit.	$29,007,897
OEE-019A	239870 02HEMPFIEL - 239871 02HART.TAP 69.0 kV Ckt Id 1	Reconductor the Hempfield-Werner Tap 69 kV Line segment (1 mile) using 336 ACSR 26/7.	$2,512,050

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.

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 138 kV circuit breaker to protect the AF2-176 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 AF2-176 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.

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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.

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/meter^2)
- 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/

The IC will be required to comply with all FE revenue metering requirements for generation interconnection customers which can be found in FE's "Requirements for Transmission Connected Facilities" document located at: http://www.pjm.com/planning/design-engineering/to-tech-standards/private-firstenergy.aspx

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11 Summer Peak - Load Flow Analysis

The Queue Project AF2-176 was evaluated as a 70.0 MW (Capacity 42.0 MW) injection tapping the Maysville to Masury 138 kV line in the ATSI area. Project AF2-176 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AF2-176 was studied with a commercial probability of 53.0 %. Potential network impacts were as follows:

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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)

None

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
10059856 8	946410	AF1-305 TAP	138.0	ATSI	238944	02MASURY	138.0	ATSI	1	ATSI-P1-2-OEE-69-022-B	operation	110.0	66.78	117.91	DC	56.25
10059857 3	946410	AF1-305 TAP	138.0	ATSI	238944	02MASURY	138.0	ATSI	1	Base Case	operation	110.0	53.05	101.56	DC	53.36

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11.5 System Reinforcements - Summer Peak Load Flow - Primary POI

ID	Idx	Facility	Upgrade Description	Cost
			TOTAL COST	**$0**

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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".

None

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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.

None

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11.8 Contingency Descriptions

Contingency Name	Contingency Definition
Base Case	
ATSI-P1-2-OEE-69-022-B	CONTINGENCY 'ATSI-P1-2-OEE-69-022-B' /* MAYSVILLE - SHARON 69 [Y-301] DISCONNECT BRANCH FROM BUS 938580 TO BUS 239861 CKT 1 /* AE1-079 TAP 69 02CP.REYN+ 69 DISCONNECT BRANCH FROM BUS 239104 TO BUS 239861 CKT 1 /* 02SHARON 69 02CP.REYN+ 69 DISCONNECT BUS 239894 /* 02CP.REYNL 69 DISCONNECT BUS 239890 /* 02GRNV MTL 69 END

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12 Short Circuit Analysis

The Short Circuit Analysis will be completed in the System Impact Study phase.

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13 Affected Systems

13.1 NYISO

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

13.2 MISO

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

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14 Attachment 1: One Line Diagram

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