Generation Interconnection Feasibility Study Report

For

PJM Generation Interconnection Request Queue Position AD2-163

East Springfield-Mill Creek 138kV

July 2018

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. 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.

General

The Interconnection Customer (IC), has proposed a Solar generating facility located in Madison County, Ohio. The installed facilities will have a total capability of 180 MW with 120.7 MW of this output being recognized by PJM as capacity. The proposed in-service date for this project is December 1, 2021. **This study does not imply a ATSI commitment to this in-service date.**

Point of Interconnection

AD2-163 will interconnect with the ATSI transmission system along the East Springfield - Tangy 138 kV Line.

Cost Summary

The AD2-163 project will be responsible for the following costs:

Description	Total Cost
Attachment Facilities	$ 0
Direct Connection Network Upgrades	$ 8,166,200
Non Direct Connection Network Upgrades	$ 31,067,900
Total Costs	**$ 39,234,100**

In addition, the AD2-163 project may be responsible for a contribution to the following costs:

Description	Total Cost
New System Upgrades	$ 1,150,000
Previously Identified Upgrades	$ 0
Total Costs	**$ 1,150,000**

Cost allocations for these upgrades will be provided in the System Impact Study Report.

General Information

Queue Position: AD2-163

Interconnected Transmission Owner ("TO"): American Transmission Systems, Incorporated ("ATSI")

Affected TO(s) (if applicable): American Transmission Systems, Incorporated ("ATSI")

PJM Zone: ATSI

FE Operating Company or Planning Region: Ohio Edison - Southern

Customer Connection Request

Requested Backfeed Date: 08/01/2021

Requested Commercial Operation Date: 12/01/2021

This study does not imply a FirstEnergy commitment to these dates.

New Facilities		Existing Facilities	
Capacity:	120.7 MW	Capacity:	N/A
Energy:	180 MW	Energy:	N/A
MFO[1]:	180 MW	MFO:	N/A
Fuel:	Solar	Prior Queue Position(s):	N/A

[1] Maximum Facility Output

Attachment Facilities

No Attachment Facilities are required to support this interconnection request.

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	Activity Cost	Tax (if applicable)	Total Cost
138kV Three Breaker Ring Bus Generation Interconnection at AD2-163 Interconnection	$ 8,166,200	$ 1,106,200	$ 9,272,400
Total Direct Connection Facility Costs	**$ 8,166,200**	**$ 1,106,200**	**$ 9,272,400**

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	Activity Cost	Tax (if applicable)	Total Cost
Loop in existing East Springfield-Tangy 138kV Line to create AD2-163-Tangy 138kV Line. Install approximately 25.5 miles of OPGW from AD2-163 to Tangy substation.	$ 16,980,100	$ 2,250,500	$ 19,230,600
Loop in existing East Springfield-Tangy 138kV Line to create AD2-163-Tangy 138kV Line. Install approximately 19.7 miles of OPGW from AD2-163 to East Springfield substation.	$ 13,312,700	$ 1,764,400	$ 15,077,100
East Springfield 138kV line exit at Tangy SS: Replace line relaying with 411Ls. Add fiber termination rack and conduit for fiber.	$ 160,900	$ 21,700	$ 182,600
Tangy 138kV line exit at East Springfield SS: Replace circuit breaker & line relaying, add arresters, fiber termination rack and conduit for fiber.	$ 614,200	$ 83,500	$ 697,700
Total Non-Direct Connection Facility Costs	**$ 31,067,900**	**$ 4,120,100**	**$ 35,188,000**

Connection Facility Requirements

The interconnection of the project at the Primary POI will be accomplished by constructing a new 138 kV three (3) breaker ring bus and looping the East Springfield - Tangy 138 kV Line into the new station. The new substation will be located approximately 19.7 miles from East Springfield substation and will be owned and operated by FE upon completion. 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 attachment 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 East Springfield and Tangy substations.

A summary of the connection facilities that will be required for the Primary POI and their estimated costs are shown in the following table. Based on this scope of work, it is expected to take a minimum of 29 months after the signing of an Interconnection Construction Service Agreement. This includes preliminary payment that compensates FE for the first three months of the engineering design work that is related to the construction of the AD2-163 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 that PJM will allow all transmission system outages when requested. Due to the scope of work and estimated time to design and build, FE may not be able to meet the customer's requested commercial operation date.

Interconnection Customer Requirements

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.

3. The purchase and installation of a fully rated 138 kV circuit breaker to protect the AD2-163 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.

4. 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.

5. 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.

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

7. The execution of a back-up service agreement to serve the customer load supplied from the AD2-163 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.

8. 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.

Revenue Metering, SCADA, & Protection Requirements

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 Sections 24.1 and 24.2.

Metering

The IC will be require 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.

FE Requirements

The Interconnection Customer will be required to comply with all FE Revenue Metering Requirements for Generation Interconnection Customers. The Revenue Metering Requirements may be found within the "FirstEnergy Requirements for Transmission Connected Facilities" document located at the following links:

http://www.firstenergycorp.com/feconnect
http://www.pjm.com/planning/design-engineering/to-tech-standards.aspx

System Protection

The IC must design it's 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.

Network Impacts

The Queue Project AD2-163 was evaluated as a 180.0 MW (Capacity 120.7 MW) injection tapping the East Springfield to Tangy 138kV line in the ATSI area. Project AD2-163 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AD2-163 was studied with a commercial probability of 53%. Potential network impacts were as follows:

Summer Peak Analysis – 2021

Generator Deliverability

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

None.

Multiple Facility Contingency

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

None.

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.

Short Circuit

(Summary of impacted circuit breakers)

New circuit breakers found to be over-duty:

#	Area	Bus No.	Bus	Breaker	Rating Type	Duty Percent Without AD2-163	Duty Percent With AD2-163	Duty Percent Difference
1	AEP	243485	05CLINTO 138.kV	101	S	99.95%	100.01%	0.05%
2	AEP	243485	05CLINTO 138.kV	102	S	99.95%	100.01%	0.05%
3	AEP	243529	05KENNY 138.kV	102	S	99.95%	100.00%	0.05%
4	AEP	243529	05KENNY 138.kV	106	S	99.95%	100.00%	0.05%

Contributions to previously identified circuit breakers found to be over-duty:

None.

Steady-State Voltage Requirements

(Summary of the VAR requirements based upon the results of the steady-state voltage studies)

Steady State Voltage Studies to be conducted during later study phases

Stability and Reactive Power Requirement for Low Voltage Ride Through

(Summary of the VAR requirements based upon the results of the dynamic studies)

Stability Studies to be conducted during later study phases

Affected System Analysis & Mitigation

MISO Impacts:

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

Winter Analysis - 2021

Winter Studies to be conducted during later study phases

Light Load Analysis - 2021

Light Load Studies to be conducted during later study phases

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.

None.

New System Reinforcements

(Upgrades required to mitigate reliability criteria violations, i.e. Network Impacts, initially caused by the addition of this project generation)

Violation #	Overloaded Facility	Upgrade Description	Network Upgrade Number	Upgrade Cost
#1, 2	Clinton 101 and 102 circuit breakers	In order to mitigate the overloads of facilities above, the following reinforcements are required: • Replace two 138kV circuit breakers at the Kenny 138kV switchyard. This reinforcement was identified as a supplemental project (#S1334); Therefore the AD2-163 project does not have cost responsibility for this upgrade, however it may be responsible for acceleration costs. AD2-163 would be subject to interim deliverability Studies until this project this project is completed.	S1334	**$ 0**
#3, 4	Kenny 102 and 106 circuit breakers	In order to mitigate the overloads of facilities above, the following reinforcements are required: • Replace two 138kV circuit breakers at the Kenny 138kV switchyard The estimated schedule duration is 12 months.		**$ 1,150,000**
			Total New Network Upgrades	**$ 1,150,000**

Contribution to Previously Identified System Reinforcements

(Overloads initially caused by prior Queue positions with additional contribution to overloading by this project. This project may have a % allocation cost responsibility which will be calculated and reported for the Impact Study)

None.