Generation Interconnection Feasibility Study Report

For

PJM Generation Interconnection Request Queue Position AC2-195

Galion-Roberts South 138kV

July 2017

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 Marion, OH. The installed facilities will have a total capability of 99.96 MW with 62.1MW of this output being recognized by PJM as capacity. The proposed in-service date for this project is December 31, 2020. **This study does not imply a American Transmission Systems Inc. (or "ATSI") commitment to this in-service date.**

Point of Interconnection

AC2-195 will interconnect with the American Transmission Systems Inc. (or "ATSI") transmission system using one of the following options:

Primary: Along the Galion-Roberts South 138kV line

Secondary: Along the Galion-Roberts North 138kV line

Cost Summary

The AC2-195 project will be responsible for the following costs:

Description	Total Cost
Attachment Facilities	$ 0
Direct Connection Network Upgrades	$ 6,289,600
Non Direct Connection Network Upgrades	$ 468,200
Total Costs	**$ 6,757,800**

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
Construct a 138kV three breaker ring bus interconnect substation between Galion and Roberts. @ AC2-195 Interconnect	5,471,000	732,400	6,203,400
Loop the Galion-Roberts South 138kV circuit into the AC2-195 ring bus. The proposed location of the ring bus is near structure #3825 (Primary POI). @ Galion-Roberts South 138kV Loop to AC2-195 Ring Bus (Primary POI)	818,600	106,700	925,300
Total Direct Connection Facility Costs	**$6,289,600**	**$839,100**	**$7,128,700**

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
Upgrade line relaying to AC2-195 Interconnect @ Galion SS	234,100	30,600	264,700
Upgrade line relaying to AC2-195 Interconnect @ Roberts SS	234,100	30,600	264,700
Total Non-Direct Connection Facility Costs	**$468,200**	**$61,200**	**$529,400**

Transmission Owner Scope of Work

The primary Point of Interconnection (POI) for the AC2-195 generation project is located one span outside of the proposed ATSI ring bus switch station which will be located on the Galion-Roberts South 138kV line. The direct connection of AC2-195 generation project will be accomplished by utilizing a three (3) breaker ring bus to connect to the Galion-Roberts South 138 kV line. The Interconnection Customer will be responsible for constructing all of the facilities on its side of the POI, including the 138 kV line extension to its generation facilities. Interconnection Customer may not install above ground equipment within any FirstEnergy right-of-way unless permission to do so is expressly granted by FirstEnergy. The ATSI facilities required for the Direct Connection of the generation project and the associated cost estimate are shown in Attachment 3.

Transmission Owner Schedule

Based on the extent of the ATSI primary direct connection required to support the AC2-195 generation project, it is expected to take a minimum of twenty-six (26) months from the date of a fully executed Interconnection Construction Service Agreement to complete the installation. This assumes that Interconnection Customer will provide all rights-of-way, permits, easements, etc. that will be needed. A further assumption is 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 facility upgrades, and that all system outages will be allowed when requested.

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 fully rated 138 kV circuit breakers on the high side of the AC2-195 step-up transformer.

4. The purchase and installation of the minimum required ATSI 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. The establishment of dedicated communication circuits for SCADA to the FE Transmission System Control Center.

7. A compliance with the FE and PJM generator power factor and voltage control requirements.

8. The execution of a back-up service agreement to serve the customer load supplied from the AC2-195 generation project metering point when the units are out-of-service. This assumes the intent of Interconnection Customer is to net the generation with the load.

Revenue Metering and SCADA 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.

ATSI 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

Network Impacts : Primary POI

The Queue Project AC2-195 was evaluated as a 99.96 MW (Capacity 62.1 MW) injection tapping the Hamilton – Dual Rail 138 kV line in the ATSI area. Project AC2-195 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AC2-195 was studied with a commercial probability of 53%. Potential network impacts were as follows:

Summer Peak Analysis - 2020

Contingency Descriptions

The following contingencies resulted in overloads:

Contingency Name	Description
B2-OES-138-009_A	CONTINGENCY 'B2-OES-138-009_A' /* GALION - ROBERTS SOUTH 138KV LINE FAULT DISCONNECT BRANCH FROM BUS 238746 TO BUS 924790 CKT 1 /* 02GALION 138 AB2-131 TAP 138 END
B2-OES-138-009_C	CONTINGENCY 'B2-OES-138-009_C' /* GALION - ROBERTS SOUTH 138KV LINE FAULT DISCONNECT BRANCH FROM BUS 238667 TO BUS 239073 CKT 1 /* 02DUALR+ 138 02ROBERT 138 DISCONNECT BRANCH FROM BUS 238667 TO BUS 932720 CKT 1 /* 02DUALR+ 138 AC2-195 TAP 138 REMOVE LOAD O FROM BUS 238668 /* 02DUALRL 138 REMOVE LOAD C FROM BUS 238668 /* 02DUALRL 138 DISCONNECT BUS 238668 /* 02DUALRL 138 DISCONNECT BUS 238667 /* 02DUALR+ 138 END

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)

None.

Light Load Analysis - 2020

Light Load Studies to be conducted during later study phases (as required by PJM Manual 14B).

Stability and Reactive Power Requirement

Stability and Reactive study to be completed during later study phases

Steady-State Voltage Requirements

Steady-State Voltage study to be completed during later study phases

Affected System Analysis & Mitigation

MISO Impacts:

MISO Impacts to be determined 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.

	Contingency		Affected		Bus			Power	Loading %		Rating		MW	
#	Type	Name	Area	Facility Description	From	To	Circuit	Flow	Initial	Final	Type	MVA	Contribution	Ref
1	N-1	B2-OES-138-009_A	FE - FE	02DUALR+-02ROBERT 138 kV line	####	##	1	DC	61.6	110	ER	208	99.96	
2	N-1	B2-OES-138-009_C	FE - FE	AB2-131 TAP-02GALION 138 kV line	####	##	1	DC	63.6	107	ER	228	99.96	
3	N-1	B2-OES-138-009_A	FE - FE	AC2-195 TAP-02DUALR+ 138 kV line	####	##	1	DC	59.9	101	ER	242	99.96	

New System Reinforcements

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

None.

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.

Network Impacts : Secondary POI

The Queue Project AC2-195 was evaluated as a 100.0 MW (Capacity 62.1 MW) injection at the Marion Ethanol 138 kV substation in the ATSI area. Project AC2-195 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AC2-195 was studied with a commercial probability of 53%. Potential network impacts were as follows:

Summer Peak Analysis - 2020

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)

None.

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)

None.

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.

Light Load Analysis - 2020

Light Load Studies to be conducted during later study phases (as required by PJM Manual 14B).

Stability and Reactive Power Requirement

Stability and Reactive study to be completed during later study phases

Steady-State Voltage Requirements

Steady-State Voltage study to be completed during later study phases

Affected System Analysis & Mitigation

MISO Impacts:

MISO Impacts to be determined during later study phases