Revised

Generation Interconnection

Impact Study Report

for

Queue Project AE2-309

CARLOS JUNCTION-LONACONING 34.5 KV

16.66 MW Capacity / 19.84 MW Energy

August 2021

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1 Introduction

This System Impact Study has been prepared in accordance with the PJM Open Access Transmission Tariff, 205, as well as the System Impact Study Agreement between Jade Meadow LLC, the Interconnection Customer (IC), and PJM Interconnection, LLC (PJM), Transmission Provider (TP). The Interconnected Transmission Owner (ITO) is The Potomac Edison Company (APS).

2 Preface

The intent of the System Impact Study is to determine a plan, with approximate cost and construction time estimates, to connect the subject generation interconnection project to the PJM network at a location specified by the Interconnection Customer. As a requirement for interconnection, the Interconnection Customer may be responsible for the cost of constructing: Network Upgrades, which are facility additions, or upgrades to existing facilities, that are needed to maintain the reliability of the PJM system. All facilities required for interconnection of a generation interconnection project must be designed to meet the technical specifications (on PJM web site) for the appropriate transmission owner.

In some instances an Interconnection Customer may not be responsible for 100% of the identified network upgrade cost because other transmission network uses, e.g. another generation interconnection or merchant transmission upgrade, 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 System Impact Study is performed.

The System Impact 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.

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.

3 Revisions since February 2020 System Impact Study

The AE2-309 System Impact Study has been revised to reflect the results from a recent retool analysis. No other changes were made. Updates to the physical interconnection scope and cost will be reflected in the state-level Facilities Study Report (if required by FirstEnergy) or in the Interconnection Agreement.

- Retooled analysis results show that the AE2-309 customer no longer has a contribution to the need for n6170 (Rockwood-Somerset 115 kV line rebuild). (See Network Impacts Section of the report.)

4 General

The Interconnection Customer (IC), has proposed a Solar; Storage generating facility located in Allegany County, Maryland. The installed facilities will have a total capability of 19.84 MW with 16.66 MW of this output being recognized by PJM as Capacity. The proposed in-service date for this project is October 30, 2020. This study does not imply a TO commitment to this in-service date.

Final attachment facilities and local upgrades (if required) along with terms and conditions to interconnect AE2-309 will be specified in a separate two party Interconnection Agreement (IA) between APS and the Interconnection Customer as this project is considered FERC non-jurisdictional per the PJM Open Access Transmission Tariff (OATT).

Queue Number	**AE2-309**
Project Name	CARLOS JUNCTION-LONACONING 34.5 KV
Interconnection Customer	Jade Meadow LLC
State	Maryland
County	Allegany
Transmission Owner	APS
MFO	19.84
MWE	19.84
MWC	16.66
Fuel	Solar; Storage
Basecase Study Year	2022

5 Point of Interconnection

The interconnection of the project at the Point of Interconnection (POI) will be accomplished by tapping Carlos Junction Lonaconing 34.5 kV line and constructing a one span tap. The transmission line tap will be located 0.4 miles from Carlos Junction substation and approximately four miles from Lonaconing substation. The IC will be responsible for acquiring all easements, properties, and permits that may be required to construct both the new interconnection line tap and the associated Attachment Facilities. The project will also require Non-Direct Connection upgrades at Carlos Junction and Westernport substations.

Attachment 1 shows a one-line diagram of the proposed primary Direct Connection facilities for the AE2-309 generation project to connect to the FirstEnergy ("FE") transmission system. **Attachment 2** provides the proposed location for the point of interconnection. IC will be responsible for constructing all 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.

6 Cost Summary

Total estimated cost for the required Interconnection Facilities is **$221,100**. 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

7 Transmission Owner Scope of Work

The interconnection of the project at the POI will be accomplished by tapping the Carlos Junction Lonaconing 34.5 kV line and constructing a one span tap. The transmission line tap will be located 0.4 miles from Carlos Junction substation and approximately four miles from Lonaconing substation. The IC will be responsible for acquiring all easements, properties, and permits that may be required to construct both the new interconnection line tap and the associated Attachment Facilities. The project will also require Non-Direct Connection upgrades at Carlos Junction and Westernport substations.

Attachment 1 shows a one-line diagram of the proposed primary Direct Connection facilities for the AE2-309 generation project to connect to the FirstEnergy ("FE") transmission system. **Attachment 2** provides the proposed location for the point of interconnection. IC will be responsible for constructing all 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.

Description	Total Cost
Tap the Carlos Junction-Lonaconing 34.5 kV line to interconnect AE2-309 with a three-switch tap configuration. Install new 34.5 kV meter and all necessary equipment.	$123,700
Project Management	$15,400
Relay settings updates at Carlos Junction	$12,600
Relay settings updates at Westernport	$12,600
Cust dwgs, NPs, and rly settings at AE2-309 Cust	$56,800
Total Estimated Connection Facility Costs	**$221,100**

8 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 **six months** after the signing of an Interconnection 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 interconnection work, and that all transmission system outages will be allowed when requested.

9 Transmission Owner Analysis

9.1 Power Flow Analysis

FE performed an analysis of its underlying transmission <100 kV system. The AE2-309 project did not contribute to any overloads on the FE transmission <100 kV system.

9.2 Stability Analysis

Per PJM, not required for this project.

10 Interconnection Customer Requirements

10.1 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.

The IC has requested a non-standard GSU transformer winding configuration. This transformer is in violation of section 14.2.6 of FE's "Requirements for Transmission Connected Facilities" document and will not be accepted. The GSU transformer must have a grounded wye connection on the high (utility) side and a delta connection on the low (generator) side. Notification to the developer of the transformer winding configuration requirement has been previously communicated, however an updated project single line has not been received.

10.2 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 rated34.5 kV circuit breaker to protect the AE2-309 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 AE2-309 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 system.

10.3 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.

11 Revenue Metering and SCADA Requirements

11.1 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.

11.1.1 Meteorological Data Reporting Requirement

The solar generation facility shall provide the Transmission Provider with site-specific meteorological data including:

- Temperature (degrees Fahrenheit)
- Atmospheric pressure (hectopascals)
- Irradiance
- Forced outage data

11.2 APS Requirements

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.

12 Network Impacts

The Queue Project AE2-309 was evaluated as a 19.84 MW (Capacity 16.66 MW) injection at the Carlos Junction – Lonaconing 34.5 kV line in the APS area. Project AE2-309 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AE2-309 was studied with a commercial probability of 100%. Potential network impacts were as follows:

Summer Peak Load Flow

12.1 Generation Deliverability

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

None

12.2 Multiple Facility Contingency

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

None

12.3 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

12.4 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.

Overload Number	Type	Contingency Name	Affected Area	Facility Description	Bus From	Bus To	Circuit	Power Flow	Loading % Initial	Loading % Final	Rating Type	Rating MVA	MW Contribution
1	N-1	PN-P1-2-PN-115-068	AP - AP	01GARRET-AD1-068 TAP 138 kV line	235469	934440	1	AC	101	103	ER	191	4.18
2	N-1	AP-P1-2-MP-138-160-A	AP - AP	01DANSMTN-01RIDGLY 138 kV line	237310	235504	1	AC	99.9	102	ER	182	3.4
3	N-1	PN-P1-2-PN-115-068	AP - AP	AD1-068 TAP-01ALBRIG 138 kV line	934440	235120	1	AC	132	134	ER	191	4.18
4	Non	Non	AP - AP	AD1-068 TAP-01ALBRIG 138 kV line	934440	235120	1	AC	120	122	NR	164	3.14
5	Non	Non	AP - AP	AD1-068 TAP-01ALBRIG 138 kV line	934440	235120	1	AC	120	122	NR	164	3.14

14 System Reinforcements

None

15 Flow Gate Details

The following indices contain additional information about each flowgate presented in the body of the report. For each appendix, a description of the flowgate and its contingency was included for convenience. However, the intent of the appendix section is to provide more information on which projects/generators have contributions to the flowgate in question. Although this information is not used "as is" for cost allocation purposes, it can be used to gage other generators impact. It should be noted the generator contributions presented in the appendices sections are full contributions, whereas in the body of the report, those contributions take into consideration the commercial probability of each project.

Appendix 1							
Bus Number	Bus Name	Full Contribution	Project Status	Bus Number	Bus Name	Full Contribution	Project Status
237312	01DANS_S-014	11.11		LTF	CHILHOWEE	0.04	
200890	26BF_G21_K23	0.17		LTF	COFFEEN	0.11	
200891	26CSLMN_L13	0.27		LTF	COTTONWOOD	0.45	
200840	26DEEPCRK1	0.79		LTF	DUCKCREEK	0.22	
200841	26DEEPCRK2	0.79		LTF	EDWARDS	0.1	
200835	26DSGENWIN	2.24		LTF	FARMERCITY	0.07	
200892	26LOOKOUT	0.25		LTF	G-007A	0.68	
202225	26SCI_S29B	0.06		LTF	GIBSON	0.04	
200889	26STNY CRK	0.17		LTF	HAMLET	0.14	
200834	26SW_E13_K22	0.47		200864	K-013 E	1.62	IS
200813	26YOUGH	0.34		292340	K-022	0.02	IS
933951	AD1-018 C	1.3	Suspended	292350	K-023	6.88	IS
933952	AD1-018 E	2.12	Suspended	292542	L-013_1	6.88	IS
934441	AD1-068 C	6.98	W	LTF	NEWTON	0.28	
934442	AD1-068 E	40.49	W	LTF	NYISO	1.85	
938351	AE1-053	2.15	Active	293902	O-048 E	6.19	IS
938831	AE1-109 C	-0.65	EP	294903	P-060 E	4.36	IS
938832	AE1-109 E	-0.85	EP	LTF	PRAIRIE	0.53	
938991	AE1-128 C	5.1	Active	293432	R-040 E	0.39	IS
938992	AE1-128 E	3.4	Active	290229	S-014 E	44.44	EP
942361	AE2-249 C	0.57	Suspended	LTF	SANTEETLA	0.03	
942362	AE2-249 E	0.38	Suspended	LTF	SMITHLAND	0.04	
942902	AE2-309 B C	0.8	Active	LTF	TILTON	0.12	
942901	AE2-309 S C	1.97	Active	LTF	TRIMBLE	0.11	
942903	AE2-309 S E	0.52	Active	LTF	TVA	0.38	
LTF	BLUEG	1.02		LTF	UNIONPOWER	0.17	
LTF	CALDERWOOD	0.12		LTF	VFT	1.89	

LTF	CANNELTON	0.06		913141	Y1-033 C OP1	0.25	IS
LTF	CATAWBA	0.08		913142	Y1-033 E OP1	10.89	IS
LTF	CBM-N	0.43		917672	Z2-108 E	4.3	IS
LTF	CHEOAH	0.11		918812	AA1-100 E	1.46	IS

16 Contingency Details

Contingency Name	Description
AP-P1-2-MP-138-160-A	CONTINGENCY 'AP-P1-2-MP-138-160-A' /* 1518A DISCONNECT BRANCH FROM BUS 235120 TO BUS 934440 CKT 1 /* 01ALBRIG 138 AD1-068 TAP 138 END
PN-P1-2-PN-115-068	CONTINGENCY 'PN-P1-2-PN-115-068' /* ROCKWOOD - SOMERSET 115KV DISCONNECT BRANCH FROM BUS 200744 TO BUS 200746 CKT 1 /* 26SOMERST 115 26ROCKWOOD 115 DISCONNECT BRANCH FROM BUS 200746 TO BUS 200773 CKT 1 /* 26ROCKWOOD 115 26ROCKWOOD 23 END

Affected Systems

17 Affected Systems

17.1 NYISO

None.

Short Circuit

18 Short Circuit

The following Breakers are overdutied:

None.

Stability

19 Stability Analysis and Reactive Power Assessment

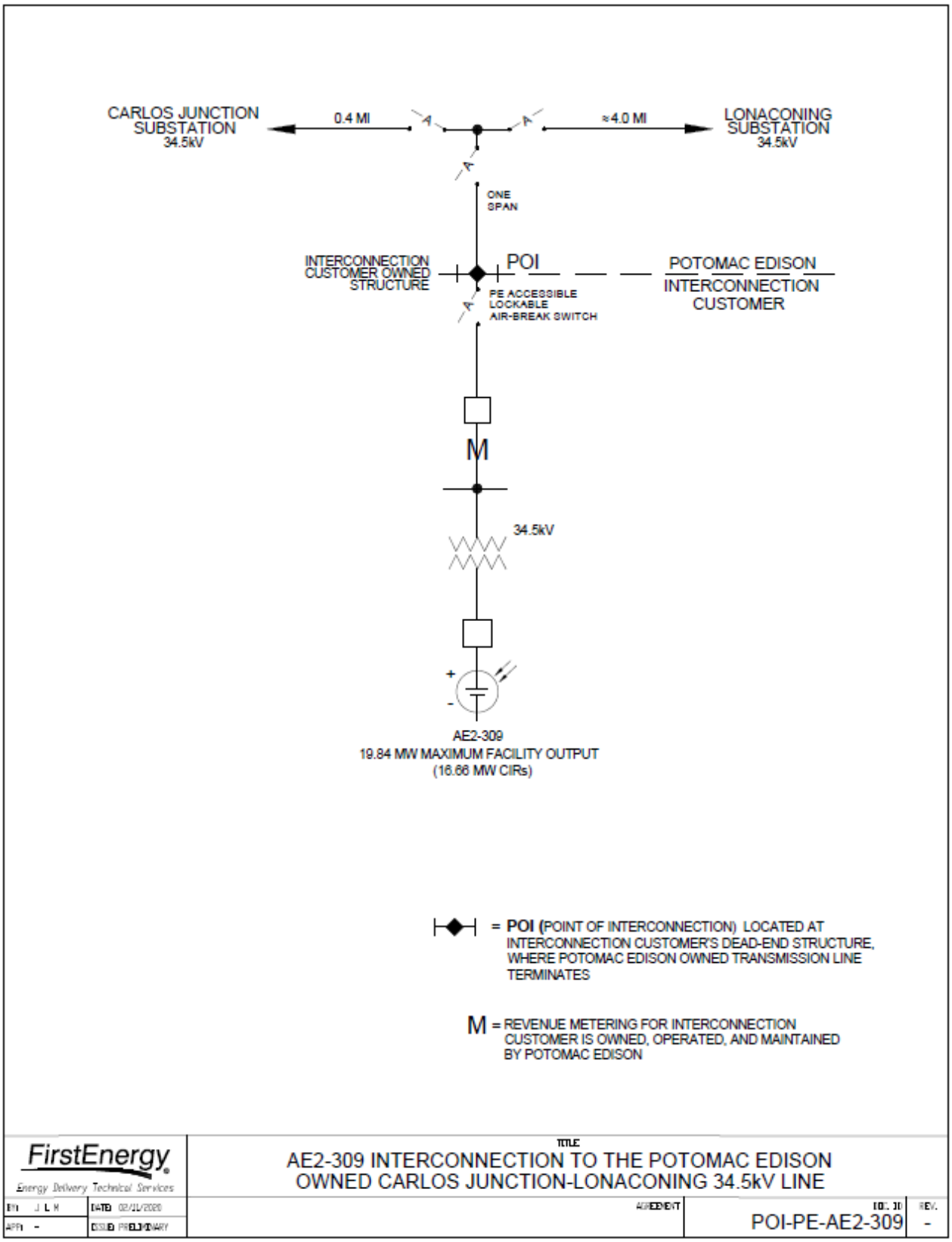
Not required for this project.

Light Load

20 Light Load Analysis

No impacts from light load analysis.

21 Attachment 1 – One Line



22 Attachment 2 – Project Location