Generation Interconnection Combined Feasibility and System Impact Study Report

For

PJM Generation Interconnection Request Queue Position AC1-039

Catoctin 34.5 kV

(Revised)

March 2017

Preface

The intent of the Combined Feasibility and 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, if any, is included in the System Impact Study.

The Study estimates do not include the feasibility, cost, or time required to obtain property rights and permits for construction of the required facilities. Interconnection Customer is responsible for the right of way, real estate, and construction permit issues. For properties currently owned by Transmission Owners, the costs associated with them will be addressed when seeking an Interconnection Agreement as outlined below. Interconnection Customer will also be responsible for providing and installing metering equipment in compliance with applicable PJM and Transmission Owner standards.

General

Community Energy Solar Development, LLC ("Interconnection Customer") has proposed a new solar photovoltaic generation facility located approximately 3.5 miles south from Catoctin substation, on the east side of Catoctin Furnace Road, in Frederick County, Maryland. AC1-039 requested 20.0 MW Energy (MFO) and 10.4 MW Capacity Interconnection Rights (CIR). The proposed in-service date for the AC1-039 project is 10-31-2018. **This study does not imply a Potomac Edison ("Transmission Owner") commitment to this in-service date.**

Point of Interconnection

AC1-039 will interconnect with the Potomac Edison distribution system by tapping the Catoctin – Yellow Springs 34.5 kV line at about 3.5 miles distance from Catoctin substation, as shown in the single-line diagram in Appendix 2.

Costs Summary and Transmission Owner Scope of Work

Potomac Edison facilities and network upgrades required to support AC1-039 project are:

(a) Attachment Facilities: $ 0.0

(b) Direct Connection Network Upgrades:

(b1) Install a line tap from the Catoctin - Monocacy 34.5 kV line to the Point of Interconnection including the installation of two (2) fully rated load-break air switches at the tap point and metering equipment inside Interconnection Customer facilities; Network Upgrade Number: n5250; estimated cost: **$ 116,200**.

(c) Non-Direct Connection Network Upgrades:

(c1) Modify relay settings for AC1-039 interconnection at Catoctin substation; Network Upgrade Number: n5216; estimated cost: **$6,800**.

(c2) Modify relay settings for AC1-039 interconnection at Monocacy substation; Network Upgrade Number: n5217; estimated cost: **$6,800**.

(d) Direct Connection Local Upgrades: $ 0.0

(e) Non-Direct Connection Local Upgrades: $ 0.0

(f) Option to Build Upgrades: $ 0.0

Estimated Total Costs (a) to (f): ..... $ 129,800

NOTE: Above net amounts are in 2017 Dollars. Contribution in Aid of Construction (CIAC) Federal Income Tax Gross Up charge may be added to above amounts if this project does not meet the eligibility requirements of IRS Notice 88-129.

Interconnection Customer Requirements

In addition to the Potomac Edison facilities, Interconnection Customer will also be responsible for meeting all criteria as specified in the applicable sections of the FirstEnergy "Requirements for Transmission Connected Facilities" document, effective 10-3-2016, which can be found under this link: http://www.pjm.com/~/media/planning/plan-standards/private-fe/fcr-facilities-connection-requirements.ashx, including:

1. The purchase and installation of a fully rated 34.5 kV circuit breaker on the high side of the AC1-039 step-up transformer.
2. The purchase and installation of the minimum required FirstEnergy 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 FirstEnergy Transmission System Control Center.
4. The establishment of dedicated communication circuits for SCADA report to the FirstEnergy Transmission System Control Center.
5. A compliance with the FirstEnergy and PJM generator power factor and voltage control requirements.
6. The execution of a back-up retail service agreement to serve the customer load supplied from the (AC1-039) generation project interconnection point when the units are out-of-service. This assumes the intent of Community Energy Solar Development, LLC is to net the generation with the load.
7. Compliance Issues: The Interconnection Customer must also meet all PJM, ReliabilityFirst and NERC reliability criteria and operating procedures required for standards compliance. For example, the Interconnection Customer 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 FirstEnergy system.
8. Reactive Power Requirements: AC1-039 project shall be designed have a range of dynamic reactive capability that supports its operation from a 0.95 leading to 0.95 lagging power factor at the generator's terminals. Solar projects can cause voltage swings as their output oscillates with moving clouds without continuous regulation, and system voltages can exceed the established limits. Should Interconnection Customer fail to provide dynamic reactive capability from the AC1-039 generation project for any reason once interconnected, FirstEnergy and/or PJM dispatchers may need to take action to curtail both the energy and capacity portions of its output to prevent non-compliance with voltage criteria.
9. Any proposed interconnection facilities by Interconnection Customer must be designed in accordance with the "FirstEnergy Requirements for Transmission Connected Facilities" document; link is provided above.

The above requirements are in addition to any metering required by PJM.

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 Interconnection Customers's generating Resource. See PJM Manuals M-01 and M-14D, and PJM Tariff Sections 24.1 and 24.2.

FirstEnergy Requirements

The Interconnection Customer will be required to comply with all FirstEnergy 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/private-firstenergy.aspx

Schedule

Based on the scope of the attachment facilities, direct and non-direct system upgrades, it is expected to take twelve (12) months from the date of a fully executed Interconnection Construction Service Agreement to complete the installation. This includes a full payment for the work that is related to this interconnection project. It also assumes that the Interconnection Customer will provide the property for the Project direct connection facilities and all right-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 facilities and that transmission system outages will be possible when requested.

Network Impacts

The Queue Project AC1-039 was evaluated as a 20.0 MW (Capacity 10.4 MW) injection at the Catoctin 34.5kV substation in the APS area. Project AC1-039 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AC1-039 was studied with a commercial probability of 100%. 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.

Steady-State Voltage Requirements:

None.

Short Circuit:

The X/R ratio and the fault currents on the Catoctin - Monocacy 34.5 kV line are shown below.

	Three-Phase	Single-Line
X/R Ratio	4.6605	4.3445
Fault Current (Amps)	7610	4950

These values are for the current system configuration. Any system changes in the area could have a significant impact on these values. It will be the responsibility of the Community Energy Solar Development, LLC to make any protection upgrades required should this occur.

Affected System Analysis & Mitigation

NYISO Impacts:

None.

Delivery of Energy Portion of Interconnection Request
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.
Only the most severely overloaded conditions are listed. 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 will study all overload conditions associated with the overloaded element(s) identified.

Not Applicable.

Light Load Analysis – 2020:

Not required.

System Reinforcements

Short Circuit:

None.

Stability and Reactive Power Requirement:

None.

Summer Peak Load Flow Analysis Reinforcements:

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 Load Flow Analysis Reinforcements:

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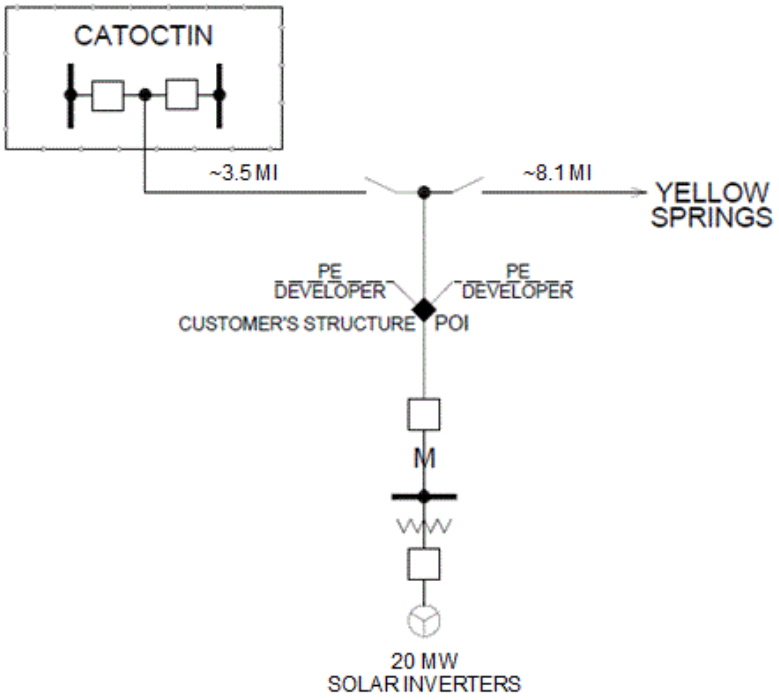
None.

Appendix 1

Facility Location
PJM Queue Position: AC1-039

Appendix 2

Interconnection One-Line Diagram
PJM Queue Position: AC1-039



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(a) Attachment Facilities:

Catoctin - Monocacy 34.5 kV Line Tap & Metering. Region Line Tap on Catoctin - Monocacy 34.5 kV line AC1-039 Point of Interconnection including costs associated with 34.5 kV Meter Package; estimated cost: **$ 116,200**.

(b) Direct Connection Network Upgrades: $ 0.0

(c) Non-Direct Connection Network Upgrades:

(c1) Modify relay settings for AC1-039 interconnection at Catoctin substation; Network Upgrade Number: n5216; estimated cost: **$6,800**.

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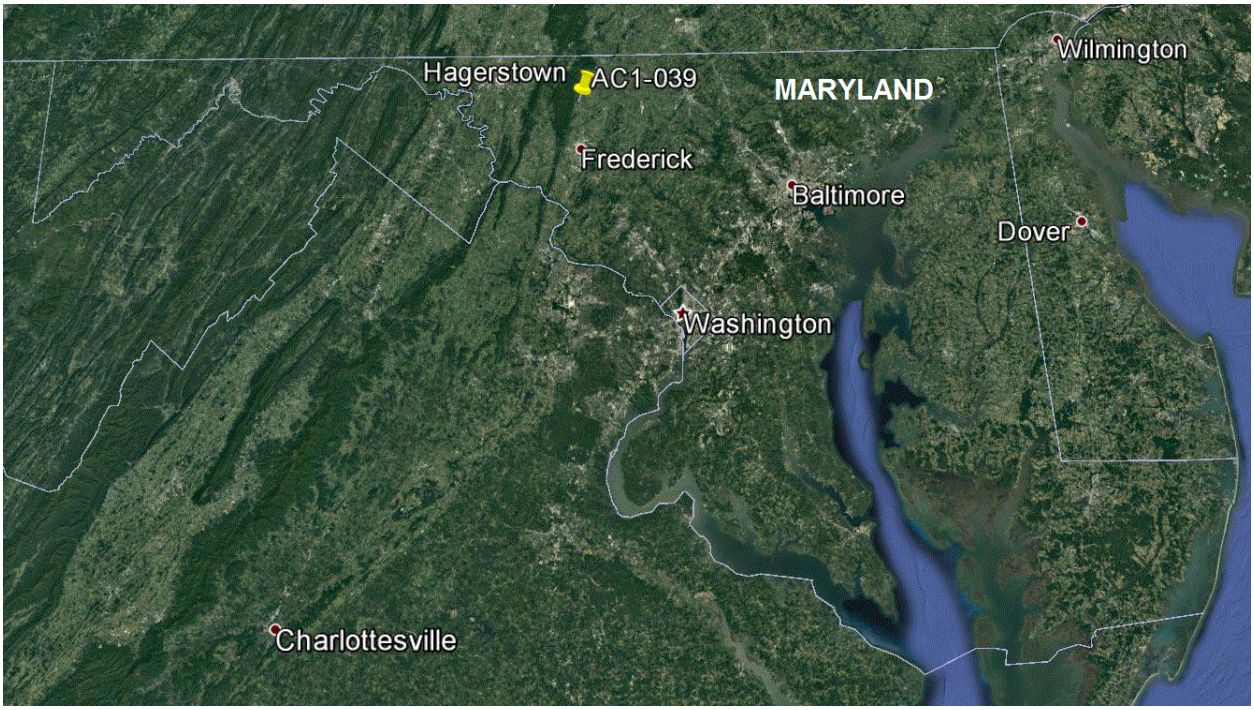

Appendix 2

Interconnection One-Line Diagram
PJM Queue Position: AC1-039