Generation Interconnection System Impact Study Report

For

PJM Generation Interconnection Request Queue Position AA2-060

Branchville-Sussex #1 34.5kV

April 2016

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.

General

Renewable Energy Associates, LLC, the Interconnection Customer (IC), has proposed a storage facility located in Sussex County, NJ. The installed facilities will have a total capability of 6 MW with 0 MW of this output being recognized by PJM as capacity. The proposed in-service date for this project is December 2015. **This study does not imply a Jersey Central Power & Light (JCPL) commitment to this in-service date.**

Point of Interconnection

AA2-060 will interconnect with the JCPL system along the Branchville-Sussex 34kV line (#1).

Cost Summary

The AA2-060 project will be responsible for the following costs:

Description	Cost	Tax (if applicable)	Total Cost
Attachment Facilities	$ 440,900	$ 143,100	$ 584,000
Direct Connection Network Upgrades	$ 0	$ 0	$ 0
Non Direct Connection Network Upgrades	$ 0	$ 0	$ 0
Total Costs	**$ 440,900**	**$ 143,100**	**$ 584,000**

© PJM Interconnection 2016. All rights reserved.

Attachment Facilities

The total preliminary cost estimate for the Attachment work is given in the table below. These costs do not include CIAC Tax Gross-up.

Description	Activity Cost	Tax (if applicable)	Total Cost
Branchville - Sussex #1 34.5 kV Line Tap. Tap Q745-3 line and extend to proposed battery storage site off Roy Road & County Route 565 in Wantage Township, Sussex County, NJ. Project includes replacing one existing pole (the proposed tap pole) & installing 3 new poles for SCADA controlled MOAB switches, installation of supervisory-controlled, load-break switches on those 3 poles, to the customer fuse/POI pole, and any necessary distribution work, guying etc. (n4876)	$ 440,900	$ 143,100	$ 584,000
Total Attachment Facility Costs	**$ 440,900**	**$ 143,100**	**$ 584,000**

Direct Connection Cost Estimate

No Direct Connection facilities are required to support this interconnection.

Non-Direct Connection Cost Estimate

No Non-Direct Connection facilities are required to support this interconnection.

Tap Line Scope of Work

The proposed POI for the AA2-060 generation project will be located on the Branchville-Sussex 34.5 kV line. Attachment 1 provides the proposed location for the POI. The direct connection of AA2-060 will be accomplished by tapping the Branchville-Sussex 34.5 kV line 4 miles west of Sussex Substation, and installing one (1) span of overhead 34.5 kV line, three (3) 34.5 kV SCADA controlled gang-operated load-break air switches, and the necessary poles. Attachment 2 shows a conceptual one-line diagram of the proposed connection of AA2-060 to the JCP&L transmission system. The Interconnection Customer will be responsible for constructing all of the facilities on its side of the POI including the attachment line. The Interconnection Customer may not install above ground equipment within any JCP&L right-of-way unless permission to do so is expressly granted by JCP&L.

© PJM Interconnection 2016. All rights reserved.

Schedule

Based on the extent of the FE primary Direct Connection and system upgrades required to support the AA2-060 generation project, it is expected to take a minimum of 12 months from the date of a fully executed Interconnection Construction Service Agreement to complete the installation. This includes the requirement that the 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 network 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 Interconnection Customer seeking to interconnect a wind generation facility shall maintain meteorological data facilities as well as provide that meteorological data which is required per item 5.iv. of Schedule H to the Interconnection Service Agreement.

4. The purchase and installation of fully rated interrupting device on the high side of the AA2-060 step-up transformer.

5. 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.

6. The purchase and installation of a 34.5 KV interconnection metering package. FE will provide the ratio and accuracy specifications.

7. 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.

8. The establishment of dedicated communication circuits for SCADA to the FE Transmission System Control Center.

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

10. It will be mandatory for this generation project to have a range of dynamic reactive

© PJM Interconnection 2016. All rights reserved.

capability that supports its operation from a 0.95 leading (absorbing vars) to 0.95 lagging (producing vars) power factor measured at the POI. Should the IC fail to provide dynamic reactive capability from the generation project for any reason once interconnected, the FE and/or PJM Dispatchers may need to take action to curtail both the energy and capacity portion of its output to prevent non-compliance with voltage criteria.

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.

JCPL 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

© PJM Interconnection 2016. All rights reserved.

Network Impacts

The Queue Project AA2-060 was studied as a 6.0 MW (Capacity 0.0 MW) injection/withdrawal tapping the Branchville Q-Sussex B 34.5kV line in JCPL. Project AA2-060 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AA2-060 was studied with a commercial probability of 100%. Potential network impacts were as follows:

Generator Deliverability

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

None.

Light Load Analysis

Light Load Studies to be conducted during later study phases (applicable to wind, coal, nuclear, and pumped storage projects).

None.

Multiple Facility Contingency

(Double Circuit Tower Line contingencies were studied for the full energy output. The contingencies of Line with Failed Breaker and Bus Fault will be performed for the Impact Study.)

None.

Short Circuit

(Summary of impacted circuit breakers)

None.

FirstEnergy System Protection Analysis

In accordance with the RTEP process, a short circuit analysis was not conducted by PJM since the AA2-060 Project connection is to the Jersey Central Power & Light less than 100 kV transmission system. Therefore, the FE Protection staff conducted a short circuit review of the project connection.

Section 14.2.6 of the FE "Requirements for Transmission Connected Facilities" document states that the winding configurations for the transformer connecting to a non-effectively grounded portion of the FE Transmission System shall be determined by FE on a case by case basis.

© PJM Interconnection 2016. All rights reserved.

This project, modeled per Attachment N as grounded wye on the 34.5 kV side, has a significant impact on the ground currents (nearly doubling the fault current) for faults on the tapped line. To avoid creating possible miscoordination, which could trigger the need for a substation ring bus connection rather than a tap connection, this project should have the 34.5 kV connection ungrounded (either ungrounded wye or delta on the step up transformers).

Evaluating the connection of the AA2-060 generation project to the 34.5 kV system as an ungrounded connection indicated there were no overdutied breakers.

The X/R ratio and the fault currents on the Branchville-Sussex 34.5 kV line 4 miles West of Sussex Substation are shown below.

	Three-Phase	Single-Line
X/R Ratio	3.0168	4.0370
Fault Current (Amps)	3,797	1,897

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 Interconnection Customer to make any protection upgrades required should this occur. The proposed interconnection facilities must be designed in accordance with the FE "Requirements for Transmission Connected Facilities."

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

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

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.

© PJM Interconnection 2016. All rights reserved.

Potential Congestion due to Local Energy Deliverability

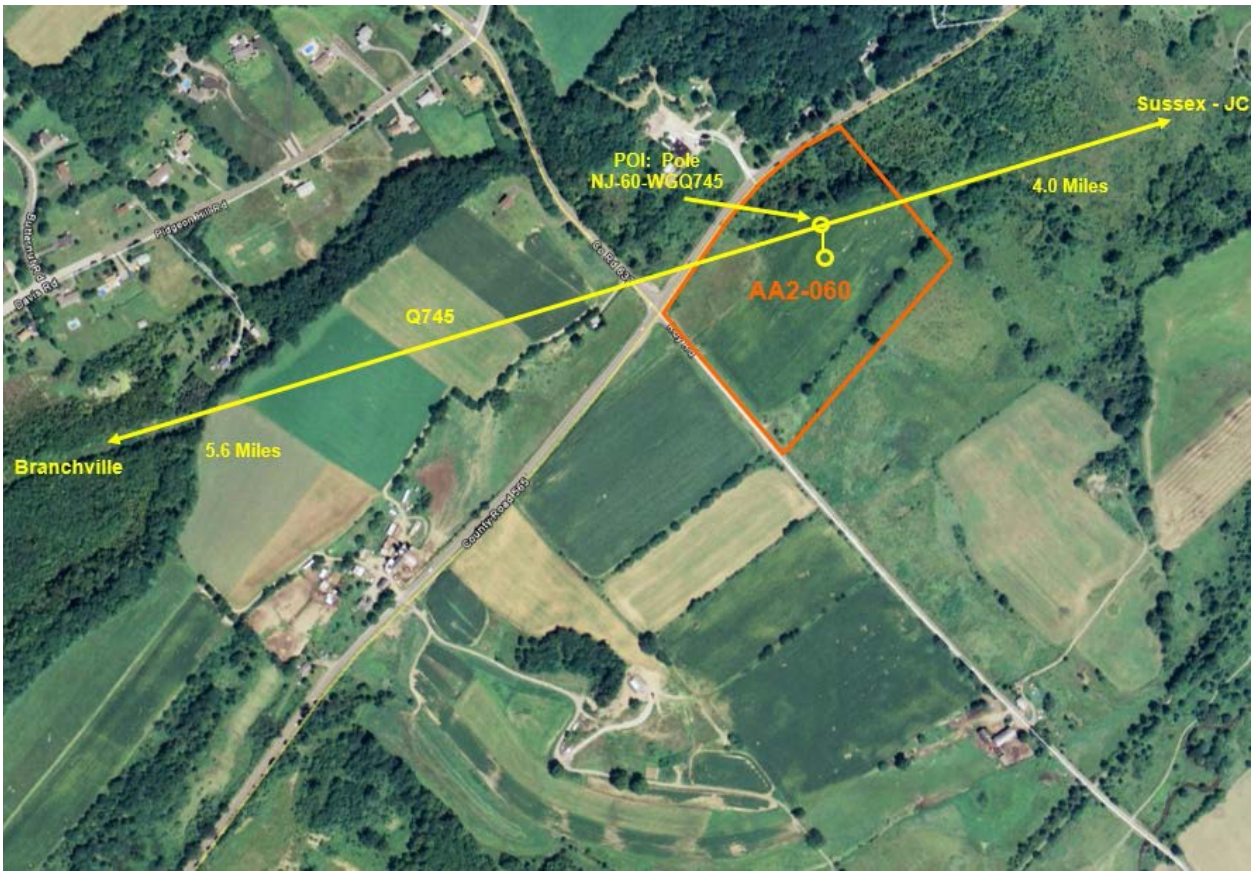
PJM also studied the delivery of the energy portion of this interconnection request. Any problems identified below are likely to result in operational restrictions to the project under study. The developer can proceed with network upgrades to eliminate the operational restriction at their discretion 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

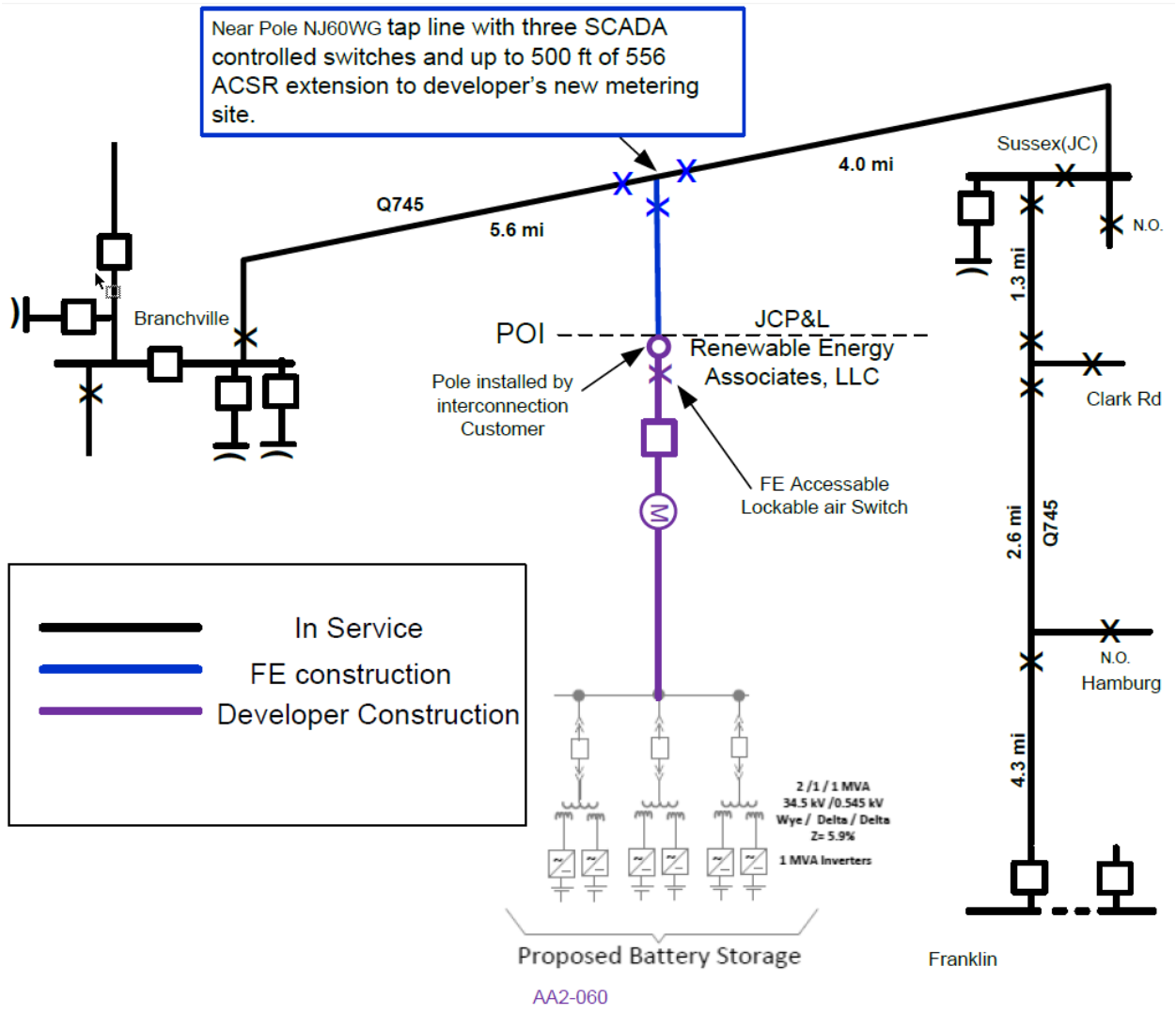
None.

© PJM Interconnection 2016. All rights reserved.

Attachment 1. Project Location



Attachment 2. Single Line Diagram



© PJM Interconnection 2016. All rights reserved.