Generation Interconnection

System Impact Study Report

for

Queue Project AE1-244

GILBERT STORAGE 34.5 KV

0 MW Capacity / 19.8 MW Energy

August, 2019

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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 **Smart Energy Development, Inc.**, the Interconnection Customer (IC), and PJM Interconnection, LLC (PJM), Transmission Provider (TP). The Interconnected Transmission Owner (ITO) is Jersey Central Power & Light Company (JCPL).

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.

3 General

Smart Energy Development, Inc., the Interconnection Customer (IC), has proposed a new battery storage generating facility in Holland Township, NJ 08848. The installed facilities will have a total capability of **19.8 MW** with **0 MW** 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 Jersey Central Power & Light (JCPL) commitment to this in-service date.**

Queue Number	**AE1-244**
Project Name	GILBERT STORAGE 34.5 KV
Interconnection Customer	Smart Energy Development, Inc.
State	New Jersey
County	Hunterdon
Transmission Owner	JCPL
MFO	19.8
MWE	19.8
MWC	0
Fuel	Storage
Basecase Study Year	2022

3.1 Point of Interconnection

The **AE1-244 "Gilbert Storage 34.5 kV**" generation project will interconnect with the Gilbert-Morris Park (A27) 34.5 kV line near Gilberts switching station. The line tap will be located approximately 0.1 miles from Gilbert Substation and 10.7 miles from Morris Park. The primary direct connection of this project will be accomplished by tapping the Gilbert-Morris Park (A27) 34.5 kV line, and installing one span of overhead 34.5 kV line to the Point of Interconnection (POI) including three (3)-34.5 kV load-break air switches with SCADA control at the tap location, and 34.5 kV interconnection metering. This is the primary Point of Interconnection (POI) chosen by the IC. 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 Gilbert and Morris Park substations.

Attachment 1 shows a one-line diagram of the proposed primary direct connection of the (AE1-244) generation project to the Jersey Central Power & Light transmission systems. **Attachment 2** provides the proposed location for the point of interconnection. IC will be responsible for constructing all of the facilities on its side of the POI including the attachment line. IC may not install above ground equipment within any JCPL right-of-way unless permission to do so is expressly granted by JCPL. The IC will also be responsible for the rough grade of the property and an access road to the proposed site.

3.2 Cost Summary

The AE1-244 project will be responsible for the following costs:

Description	Total Cost
Attachment Facilities	$74,967
Direct Connection Network Upgrade	$0
Non Direct Connection Network Upgrades	$180,333
New System Upgrades	$0
Contribution to Previously Identified System Upgrades	$0
Total Costs	$255,300

The transmission and substation costs given above exclude the Contribution in Aid of Construction ("CIAC") Federal Income Tax Gross up charge. If at a future date Federal CIAC taxes are deemed necessary by the IRS for this project, JPCL shall be reimbursed by the Interconnection Customer for such taxes.

The required Attachment Facilities, Direct Connection and Non-Direct Connection work for the interconnection of the AE1-244 generation project to the JCPL Transmission System is detailed in the following sections. The associated one-line with the generation project attachment facilities and primary direct and non-direct connection are shown in Attachment 1.

Note that the FE findings were made from a conceptual review of this project. Further note that the cost estimate data contained in this document should be considered high level estimates since it was produced without a detailed engineering review. The applicant will be responsible for the actual cost of construction. FE herein reserves the right to return to any issues in this document and, upon appropriate justification, request additional monies to complete any reinforcements to the transmission systems.

4 Transmission Owner Scope of Work

The AE1-244 "Gilbert Storage 34.5 kV" generation project will interconnect with the Gilbert-Morris Park (A27) 34.5 kV line near Gilbert substation. The line tap will be located approximately 0.1 miles from Gilbert Substation and 10.7 miles from Morris Park. The primary direct connection of this project will be accomplished by tapping the Gilbert-Morris Park (A27) 34.5 kV line, and installing one span of overhead 34.5 kV line to the Point of Interconnection (POI) including three (3)-34.5 kV load-break air switches with SCADA control at the tap location, and 34.5 kV interconnection metering. 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 Gilbert and Morris Park substations.

4.1 Attachment Facilities

To accommodate the proposed AE1-244 Project, JCPL will tap the Gilbert-Morris Park (A27) 34.5 kV line and install one span of overhead 34.5 kV line to the point of interconnection ("POI"), 3-34.5 kV load-break air switches with SCADA control at the tap location, and 34.5 kV interconnection metering. The one (1) SCADA-controlled MOAB switch covering the generator lead line and the one span of 34.5 kV will be considered Attachment Facilities. The IC will be responsible for acquiring all easements, properties and permits that may be required to construct the associated 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	Total Cost
Construct a 34.5 line tap/connection and 3-34.5kV load-break switches with SCADA control at tap location, including 1 span of 34.5kV line to the point of interconnection at Gilbert-Morris Park (A27) 34.5kV Generation Interconnection. (One (1) 34.5 kV switch on the generator lead line and the span of 34.5 kV circuit are considered Attachment Facilities)	$74,967
Total Attachment Facility Costs	$74,967

4.2 Direct Connection Cost Estimate

There is no Direct Connection scope of work required for this project.

4.3 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	Total Cost
Construct a 34.5 line tap/connection and 3-34.5kV load-break air switches with SCADA control at tap location, including 1 span of 34.5kV line to the point of interconnection at Gilbert-Morris Park (A27) 34.5kV Generation Interconnection. (The two (2) switches on the main circuit on either side of the tap are considered Non-Direct Connection costs)	$ 149,933
Gilbert Substation- revise remote relay and metering settings on the Morris Park 34.5 kV terminal	$ 15,200
Morris Park Substation- revise remote relay and metering settings on the Gilbert 34.5 kV terminal	$ 15,200
Total Non-Direct Connection Facility Costs	$180,333

5 Schedule

Based on the extent of the JCPL primary Attachment Facilities and Non-Direct Connection work required to support the AE1-244 generation project, it is expected to take a minimum of **six (6) months** from the date of a fully executed Interconnection Construction Service Agreement to complete the installation. This includes the requirement for the IC to make a preliminary payment to FE which funds the Non-Direct Connection work and the first three months of engineering design that is related to the construction of the Attachment Facilities. It further assumes that the IC 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 Attachment Facilities and Non-Direct Connection work, and that all system outages will be allowed when requested.

6 Transmission Owner Analysis

6.1 Power Flow Analysis

PJM performed a power flow analysis of the transmission system using a 2022 summer peak load flow model and the results were verified by FE. Additionally, FE performed an analysis of its underlying transmission <100 kV system. The AE1-244 project did not contribute to any overloads on the FE transmission system.

6.2 Short Circuit Analysis

PJM performed a short circuit analysis and the results were verified by FE. The connection of AE1-244 project to the system does not result in any newly overdutied circuit breakers on the FE transmission system and does not have a significant fault current contribution to existing overdutied circuit breakers.

6.3 Stability Analysis

A stability analysis will not be conducted by PJM as the AE1-244 generation project is less than or equal to 20 MW and is inverter based. FE will evaluate the need for a dynamic analysis on its lower voltage system in the System Impact Study phase of this project.

7 Interconnection Customer Requirements

7.1 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.

All new generator only and new generator plus load facilities must be isolated from the FE transmission System by a Power Transformer. Section 14.2.6 of FE's "Requirements for Transmission Connected Facilities" document specifies the winding configurations of 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. The IC has requested a GSU transformer winding configuration that will not be accepted. The GSU transformer must have a delta or ungrounded wye connection on the high (utility) side.

7.2 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 rated 34.5 kVkV circuit breaker to protect the AE1-244 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 AE1-244 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.

7.3 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 generator's terminals.

8 Revenue Metering and SCADA Requirements

8.1 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.

8.2 JCPL 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.

9 Network Impacts

The Queue Project AE1-244 was evaluated as a 19.9 MW (Capacity 0.0 MW) injection at the Gilbert 34.5kV substation in the JCPL area. Project AE1-244 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AE1-244 was studied with a commercial probability of 100%. Potential network impacts were as follows:

Summer Peak Load Flow

10 Generation Deliverability

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

None

11 Multiple Facility Contingency

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

None

12 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

13 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

14 System Reinforcements

None

Affected Systems

15 Affected Systems

None

Short Circuit

16 Short Circuit

The following Breakers are overduty:

None

Stability

17 Stability Analysis

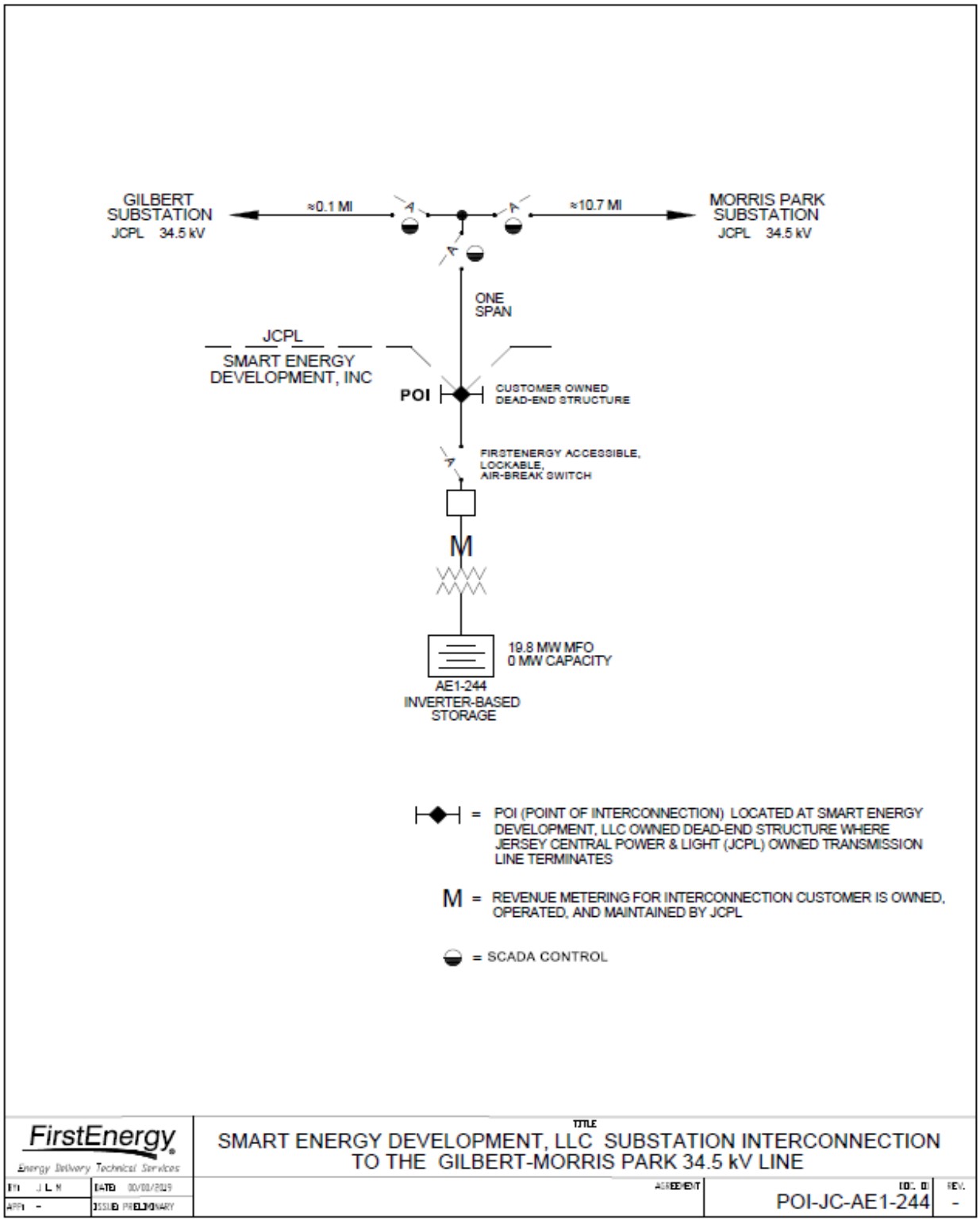
Not required.

Light Load

18 Light Load Analysis

No violations.

19 Attachment 1: One Line



20 Attachment 2: Site Plan