

***Generation Interconnection  
Combined Feasibility/System  
Impact Study Report***

***For***

***PJM Generation Interconnection Request  
Queue Position AC2-144***

***“Newburgh 12.47 kV”***

***August 2017***

## Preface

The intent of the Combined Feasibility/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. 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 associated with them will be addressed when seeking an Interconnection Agreement as outlined below. Developer will also be responsible for providing and installing metering equipment in compliance with applicable PJM and Transmission Owner standards.

## General

**Advanced Solar Products, Inc.**, the Interconnection Customer (IC), has proposed **battery storage** generating facilities located at 59 Newburgh Road, in Hackettstown, New Jersey. The installed facilities for the **AC2-144 “Newburgh 12.47 kV”** request will have a total capability of **250 kW** with **0 kW** of this output being recognized by PJM as capacity.

The proposed in-service date for this project is **February 1, 2018**. **This study does not imply a Jersey Central Power & Light (JCP&L) commitment to this in-service date.**

## Point of Interconnection:

The IC requested the study of a primary Point of Interconnection (POI) only for this project. This report contains detailed connection requirements, costs and schedule, power flow analysis, short circuit analysis, and a cost and schedule for any associated system reinforcements for the Primary POI.

The proposed POI for the **AC2-144 “Newburgh 12.47 kV”** generation project will be located 300 ft. from the JCP&L Newburgh Substation. The generator will be connected to Newburgh 17778 line at 12.47 Y through an IC-owned 300 kVA 12.47 kV-277/480 V pad mount transformer. JCP&L will interspace a new distribution pole on the Newburgh 12.47 kV line to feed a new customer owned pad mount transformer for the battery storage facility. The POI for the AC2-144 Project will be at the high side of the new pad mount transformer. The IC will be

responsible for acquiring all easements, properties and permits that may be required to construct both the associated attachment facilities. A conceptual one-line diagram of the proposed interconnection of AC2-144 is shown in **Attachment 1**. An aerial view of the proposed location of the facility is shown in **Attachment 2**.

## Cost Summary

The AC2-144 “Newburgh 12.47 kV” project will be responsible for the following costs. These costs do not include Federal Income Tax Gross-up:

Description	Total Cost
Attachment Facilities	\$ 31,000
Direct Connection Network Upgrades	\$ 0
Non Direct Connection Network Upgrades	\$ 0
<b>Total Costs</b>	<b>\$ 31,000</b>

In addition, the AC2-144 project may be responsible for a contribution to the following costs:

Description	Total Cost
New System Upgrades	\$ 0
Previously Identified Upgrades	\$ 0
<b>Total Costs</b>	<b>\$ 0</b>

The transmission and substation costs given above exclude any applicable state or federal taxes. If at a future date Federal CIAC (contribution in aid of construction) taxes are deemed necessary by the IRS for this project, JPCL shall be reimbursed by the Interconnection Customer for such taxes. JPCL estimates the tax, if applicable, would be approximately **\$4,721**.

The required Attachment Facilities, Direct Connection, and Non-Direct Connection work for the interconnection of the AC2-144 generation project to the JCPL system is detailed in the following sections. The associated one-line with the generation project is shown in **Attachment 1**.

All JCP&L costs are not subject to refundable provisions of the NJ-BPU Tariff for Electric service. Full payment of the estimated cost of the project will be required upon execution of the necessary agreement(s). A true up of the actual cost versus estimated cost of the project will be performed by FE at the end of the project.

Note - This is an estimate based on similar work orders previously worked by JCP&L for the types of work described in the analysis above. It is accurate to within plus or minus 30% percent. Should the customer want to proceed with the connection of this facility, a contract with JCP&L will be developed based on these costs and a true-up of actual charges will be made at the completion of the project.

## Attachment Facilities

To accommodate the proposed AC2-144 Project, JCP&L will interspace a new pole on Newburgh Rd, install a set of fuses and then extend three phase 12.47 kV primary line one span to an IC-owned riser pole. The IC will be responsible for acquiring all easements, properties and permits that may be required to construct the associated facilities.

JCP&L will not require any upgrade at the Newburgh substation.

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

Description	Total Cost
Engineering, Review and Commissioning	\$ 2,000
Interspace new pole, install disconnect switch and extend one span of primary to IC owned riser pole	\$ 9,000
Primary Meter Installation:	\$ 20,000
<b>Total Attachment Facility Costs</b>	<b>\$ 31,000</b>

The Attachment Facility cost estimate for the AC2-144 “Newburgh 12.47 kV” project is approximately **\$31,000**.

## Direct Connection Cost Estimate

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

## Non-Direct Connection Cost Estimate

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

## Schedule

Based on the extent of the JCP&L primary direct connection required to support the AC2-144 generation project, it is expected to take a minimum of **3 months** from the date of fully executed applicable agreements to complete the installation required for the project. The schedule above is based on the assumption 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 any necessary permits, and that PJM will allow all transmission system outages when requested.

# **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.

## **JPCL Requirements**

Revenue metering will be owned, operated, and maintained by the Interconnection Customer. Operational metering will be owned, operated, and maintained by the party owning the metering and will be provided to PJM via ICCP.

The AC2-144 Project is to be metered separately and the IC shall provide the communication link required for the meter data directly to PJM. All costs associated with the meter upgrades shall be the responsibility of the IC. The IC must meet the requirements of PJM.

## **Compliance Issues**

IC must meet all PJM, ReliabilityFirst, and NERC reliability criteria and operating procedures required for standards compliance. For example, 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.

## **JCPL Analysis:**

The study scope is to identify any facility modifications needed to accommodate the installation of 250 KW of the AC2-144 Project at the POI described above.

## **Control Systems**

Due to the relatively low output capacity of the proposed facility versus minimum loading on the circuit, Direct Transfer Trip will NOT be required for the proposed AC2-144 Project. The proposed 250 KW of battery energy storage generation will be injected to the circuit at the POI. The power that is injected is not expected to cause a reverse power flow condition on Newburgh Bank 2.

## **Short Circuit Study**

The available fault current on the existing 12.47KV distribution system at the primary terminals of the pad mounted transformer, without the AC2-144 Project proposed battery energy storage generation is 4850 Amperes – 3 phase and 5300 Amperes single line to ground.

## **Voltage Study**

Distribution circuit analysis shows no adverse impact on JCP&L circuit voltage profile as a result of the AC2-144 Project interconnection.

The AC2-144 Project must not interfere or degrade the quality of service to any other JCP&L / FE customers (service voltage, voltage flicker, harmonics, service reliability etc.)

## **At Battery Storage Facility:**

The AC2-144 Project must not interfere with the proper operation of the distribution system, including causing power quality problems, the detection and clearing of faults on the First Energy system.

## **Power Quality**

The connected facility shall comply with harmonic voltage and current limits specified in IEEE Standards as they now exist. These IEEE standards include, but not limited to: 141-19921, 519-19922, and 1453-20043. To provide continuous monitoring of Power Quality performance, JCP&L will require the installation of a Power Quality Meter (SEL-735 with intermediate PQ option) to monitor and capture power quality information, and the provision of a communications circuit, to permit ongoing assessment of compliance. This unit will be installed at the circuit breaker dedicated to the Battery Energy Storage System.

## **Anti-Island Protection**

The AC2-144 Project must be equipped with adequate protection to detect an island condition and disconnect from the FirstEnergy distribution system within two seconds of the formation of an island (per IEEE 1547).

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<sup>1</sup> IEEE Standard 141-1993, IEEE Recommended Practice for Electric Power Distribution for Industrial Plants, The Institute of Electrical and Electronics Engineers, Inc. 345 East 47th Street, New York, NY 10017-2394, USA

<sup>2</sup> IEEE Standard 519-1992, IEEE Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems, The Institute of Electrical and Electronics Engineers, Inc. 345 East 47th Street, New York, NY 10017-2394, USA

<sup>3</sup> IEEE Standard 1453-2004, IEEE Recommended Practices for Measurement and Limits of Voltage Fluctuations Associated with Light Flicker on AC Power Systems, The Institute of Electrical and Electronics Engineers, Inc. 345 East 47th Street, New York, NY 10017-2394, USA

## Interconnection Customer Requirements

- IC must meet all applicable JCP&L/FirstEnergy standards and requirements which are included in the current Tariff for Electric Service.
- IC's main breaker shall have a SEL 351 Multi-function relay (or equivalent) which is required for interconnection protection. This relay must have the capability to measure Reverse Power.
- All breakers, lightning protection etc. should meet JCP&L/FE's minimum BIL Ratings.
- The AC2-144 Project must not interfere with operation of FE voltage line regulating equipment including voltage regulators, line capacitors and substation LTC.
- IC must meet applicable FE Technical Standards and Requirements for Distribution Connected Facilities which can be found under:

<http://www.pjm.com/~media/planning/plan-standards/private-fe/generation-interconnection-technical-requirements-for-distribution-connected-facilities.ashx>

- Frequency response systems participating in the PJM Ancillary Services Market respond to an automatic signal from PJM in order to correct for short-term changes in electricity use that might affect the stability of the power system by matching generation and load to maintain system frequency. Consequently, because of the magnitude and frequency of load changes, additional analysis is required during the review process.
- Presence of frequency response may significantly increase costs to reconfigure system to accommodate future load growth or inhibit / prevent system reconfiguration. Additional costs to reconfigure system because of frequency response may be passed on to IC or Frequency Response may be required to cease interconnection operations.
- The AC2-144 Project shall be capable of maintaining Power Factor between .95 leading to .95 lagging measured at Generator's terminals. JCP&L may require IC's AC2-144 Project to absorb vars after the AC2-144 Project is operational.
- The AC2-144 Project generation must not interfere or degrade the quality of service to any other JCP&L customers (service voltage, voltage flicker, harmonics, service reliability etc.)

- The IC's AC2-144 Project to be operated in PJM's frequency regulation market and settled via PJM's ancillary market shall provide, own, operate, test and maintain the revenue metering at the IC's expense. The IC shall provide the revenue metering data to PJM and JCP&L unless otherwise mutually agreed upon by JCP&L.
- The IC's transformer must be grounded Wye to grounded Wye.
- All Rights of Way (ROW) are the responsibility of the IC to obtain.
- The execution of a back-up retail service agreement with the electric distribution company to serve the customer load supplied from the (AC2-144) generation project interconnection point when the units are out-of-service.

The above requirements are in addition to any metering or other requirements imposed by PJM.

## **Network Impacts**

The Queue Project AC2-144 was evaluated as a 0.3 MW (Capacity 0.0 MW) injection/withdraw at the Newburgh 34.5 kV substation in the JCPL area. Project AC2-144 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AC2-144 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**

*(Results of the steady-state voltage studies should be inserted here)*

None

#### **Short Circuit**

*(Summary of impacted circuit breakers)*

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.

None

### **Light Load Analysis - 2020**

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

None

### **System Reinforcements**

#### **Short Circuit**

*(Summary form of Cost allocation for breakers will be inserted here if any)*

None

#### **Stability and Reactive Power Requirement**

*(Results of the dynamic studies should be inserted here)*

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)*

*(Summary form of Cost allocation for transmission lines and transformers will be inserted here if any)*

None

### **Light Load 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**

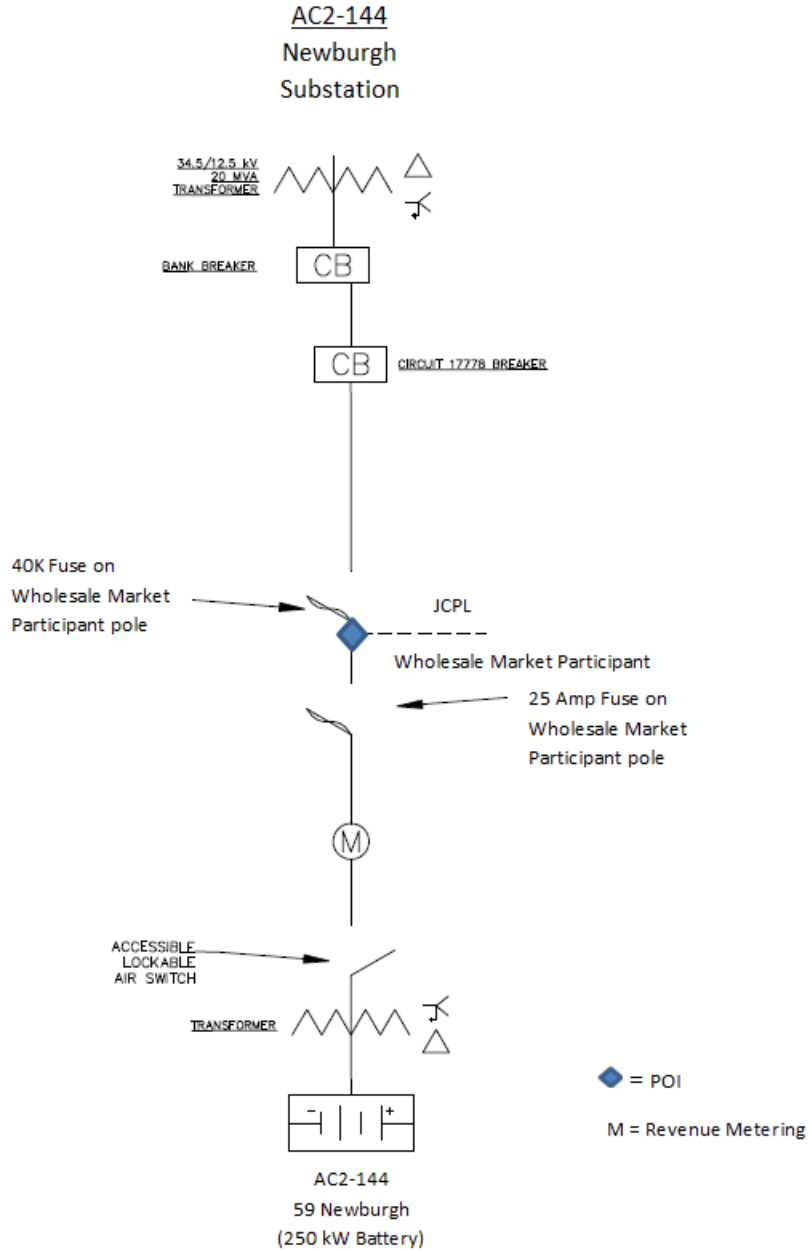
*(Overloads initially caused by prior Queue positions with additional contribution to overloading by this project. This project may have a % allocation cost responsibility which will be calculated and reported for the Impact Study)*

*(Summary form of Cost allocation for transmission lines and transformers will be inserted here if any)*

None

# Attachment 1. One Line Diagram

## Newburgh 12.47 kV (AC2-144) Generation Project



## Attachment 2. Project Location Newburgh 12.47 kV (AC2-144) Generation Project

