

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

***For***

***PJM Generation Interconnection Request  
Queue Position W2-081***

***Port Carbon 12kV***

**October 2010**

## 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

Queue W2-081 is a Blythe Township Solar 1, LLC request to interconnect a 3.0 MW (1.14 MW Capacity) Resource solar photovoltaic generation. The solar facility will be located in Port Carbon, Schuylkill County, PA approximately 0.2 miles north of PPL Electric Utilities' (PPL EU's) Port Carbon 69-12 kV Substation. This facility is located on the same site as the W1-114 Port Carbon project, but will have a separate Point of Interconnection. This study assumes that all distribution reinforcements required by W1-114 will be completed before the interconnection of W2-081. Queue W2-081 has requested an in-service date of December, 2010. **This study does not imply a PPL EU commitment to this in-service date.**

## Point of Interconnection

Queue W2-081 generation can be connected to the Port Carbon line #86-1 as shown on the single line diagram on Attachment 1.

The total estimated cost for PPL EU to construct the Queue W2-081 Direct Connection facilities is \$260,000.

## **Scope of Work by Interconnection Customer:**

Queue W2-081 Interconnection Customer is responsible for design, construction and costs for all facilities associated with W2-081 on the Interconnection Customer side of the POI (Point of Interconnection) shown on the single line diagram on page 3.

### **Protection equipment**

The Interconnection Customer will need to install suitable protection and control equipment based on PPL EU parallel generation requirements. This includes both Intertie Protective Relaying (IPR) and Point of Contact (POC) relaying. Please refer to the PPL EU web site for the IPR and POC requirements. The website addresses are shown below:

IPR Requirements:

<http://www.pplelectric.com/Business+Partners/Tools+and+Reference+Center/Customer-Owned+Generation/>

POC Requirements:

[http://www.pplelectric.com/NR/rdonlyres/B0937C7E-B6E9-40AD-AE8C-ED3C9558E528/0/point\\_of\\_contact.pdf](http://www.pplelectric.com/NR/rdonlyres/B0937C7E-B6E9-40AD-AE8C-ED3C9558E528/0/point_of_contact.pdf)

### **DTT Relaying Requirements**

Radio based DTT (Direct Transfer Trip) equipment is required at both W2-081 and W1-114 facilities. PPL EU has determined that radio is a viable communication path between W2-081 Interconnection and PPL EU's Port Carbon 69/12 kV Substation. PPL EU determined that a radio based communication scheme will be the most cost effective and therefore preferred DTT communication technology.

The DTT scheme will provide a trip signal to the Interconnection Customer for any line fault, or any other condition that will cause the source Port Carbon 12 kV line breaker to trip. The DTT scheme provides a block-closing signal to the breakers at PPL EU source switchyard/substation from the IPP. Automatic reclosing of the PPL EU line breaker will be blocked whenever the Interconnection Customer's 12kV breaker is closed and the generation is on-line. This signal from the Interconnection Customer will indicate:

- The isolation breaker is open (a breaker 'b' switch) OR
- A contact that will indicate when ANY inverter is operating in parallel with the PPL system (contact is OPEN when any inverter is in parallel) - this contact will close when ALL inverters are OFF line (disconnected from the PPL system).

If the need arises to transfer W2-081 to an alternate source, for maintenance, restoration of service, or any other reason, W2-081 will be required to isolate from PPL's system temporarily. This is required since only the Port Carbon 86-1 12 kV breaker is being modified to accept W2-

081 generation. Under certain operating conditions, W2-081 may be required to reduce generation or disconnect from PPL EU distribution.

### **SCADA Requirements**

PPL EU published requirements state that a PPL EU SCADA RTU is required for generation installation of 2.5 MW and above. PPL EU will require the installation of PPL EU approved SCADA equipment that will connect to its existing SCADA system. This connection will be a 4-wire dedicated FDDA-type phone line. PPL EU will provide detailed specifications and design drawings for this equipment.

### **Telephone Circuit Requirements**

PPL EU will require a communication path for SCADA and voice. PPL EU anticipates that telephone circuits will be required to establish these paths.

The Interconnection Customer will be responsible to procure the following:

- a) A 4-wire dedicated FDDA-type phone line for SCADA.
- b) A normal dialup telephone line for voice communication. This may be an extension telephone.

Phone lines tend to be long lead-time items and must be in place and operational for equipment testing. The Interconnection Customer should investigate with the local phone company the possibility of obtaining this type of service at their facility.

All installation, maintenance, and monthly lease or billing charges for communications facilities are the responsibility of the Interconnection Customer.

### **Metering Equipment Installation at the Point of Interconnection**

Installation of revenue grade Metering Equipment will be required at two locations, the Queue W2-081 Point of Interconnection (POI) and at the Queue W2-081 Station Service. The revenue grade metering equipment will be provided by PPL EU at no cost to the interconnection customer. All metering equipment must meet applicable PPL EU tariff requirements as well as being compliant with all applicable requirements of the PJM agreements.

### **Metering / Telemetry for PJM**

Interconnection Customer is also required to provide revenue metering and real-time telemetry data to PJM in compliance with the requirements listed in PJM Manuals M-01 and M-14.

## **Isolation Breaker and Disconnect Switch Requirement**

Blythe Township Solar 1, LLC will have its own electrically controlled Fault Interrupting Device (FID) that is capable of separating the IPP generation from the PPL EU system. This FID will be operated by the PPL EU Controlled POC and/or IPR relaying. The IPP may also operate this FID by IPP owned protection and control equipment. As per PPL EU design requirements, sharing of IPR/POC equipment within the IPR cabinet with the IPP is not allowed.

# Transmission Owner (PPL EU) Scope of Direct Connection Work

## Direct Connection Requirements

The proposed Queue W2-081 solar park facility is located approximately 0.2 miles from PPL EU owned Port Carbon 69/12kV substation and will be connected to the Port Carbon 86-1 feeder – 12 kV line (primary feed) as shown on the one line diagram below and described in the text that follows.

This study assumes that all distribution modifications required by W1-114 interconnection, as described by the PJM Generator Interconnection W1-114 Feasibility/Impact Study, will be completed prior to the interconnection of W2-081. All reinforcements described below are in addition to reinforcements required for the interconnection of W1-114.

Breakdown of estimated costs for the 12 kV connection:

\$	0	Distribution modifications
\$	260,000	Relay and Control Upgrades

## Distribution Direct Connection Work (\$0)

The following distribution modifications will be required on PPL EU's Port Carbon area distribution system in order to accommodate Blythe Township Solar 1, LLC generation:

1. Construct a 12 kV line from a tap point on #86-1 line, to the W2-081 Point of Interconnection, at Blythe Township Solar 1, LLC Customer facility. (Cost to be Determined)
  - W2-081 must submit a request for electric service for the service extension. W2-081 can contact PPL's ICS department at 1-888-220-9991 or: <http://www.pplelectric.com/Commercial+and+Industrial/Service+Center/Building+or+Renovating/>
  - The cost for the extension will be engineered and direct billed separate from this feasibility/impact study and is not included in the PPL scope of work.

This study assumes that all distribution modifications required by W1-114 interconnection will be completed prior to the interconnection of W2-081.

## **Relay and Control Modifications (\$260,000)**

The following relay and control upgrades will be required at Port Carbon 69/12 kV substation in order to accommodate Blythe Township Solar 1, LLC generation:

1. Installation of radio-based DTT (Direct Transfer Trip) equipment as described in *DTT Relaying Requirements* (Estimated \$260,000).

This study assumes that all relay and control upgrades required by W1-114 interconnection will be completed prior to the interconnection of W2-081.

## **PJM Analysis and Network Impacts**

Queue project W2-081 was studied as a(n) 3.0MW (1.14MW of which was Capacity) injection into PPL's system at the Port Carbon 69kV substation. The project was studied on a combined feasibility-impact basis which utilizes an AC analysis, and incorporates all contingency types. Project W2-081 was evaluated for compliance with reliability criteria for summer peak conditions in 2014. Potential network impacts were as follows:

### **Generator Deliverability**

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

No problems identified.

### **Multiple Facility Contingency**

*(Double Circuit Tower Line, Stuck breaker and Bus Fault contingencies for the full energy output)*

No problems identified.

### **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)*

No problems identified.

### **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.

### **Short Circuit**

Not required.

## **Energy Portion of Interconnection Request**

*PJM also studied the delivery of the energy portion of the surrounding generation. Any potential 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 Transmission Interconnection Request. Note: Only the most severely overloaded conditions are listed below. There is no guarantee of full deliverability for this project by fixing only the conditions listed in this section. With a Transmission Interconnection Request, a subsequent analysis will be performed which analyzes all overload conditions associated with the identified overloaded element(s). As a result of the aggregate energy resources in the area, the following violations were identified:*

No problems identified.

# Attachment 1 Single Line Diagram

