Generation Interconnection Combined Feasibility/System Impact Study Report

For

PJM Generation Interconnection Request Queue Position W1-114

Port Carbon

July 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. The Developer will also be responsible for providing and installing metering equipment in compliance with applicable PJM and Transmission Owner standards.

General

Queue W1-114 is a Flexera, Inc. 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. The Interconnection Customer has requested an in-service date of September 30, 2010. This study does not imply a PPL EU commitment to this in-service date.

The total cost estimate for this connection is:

Attachment Facilities	$ 261,200
Direct Connection Local Upgrades	0
Non Direct Connection Local Upgrades	0
Total Costs	**$ 261,200**

The estimated completion date for construction is September 30, 2011.

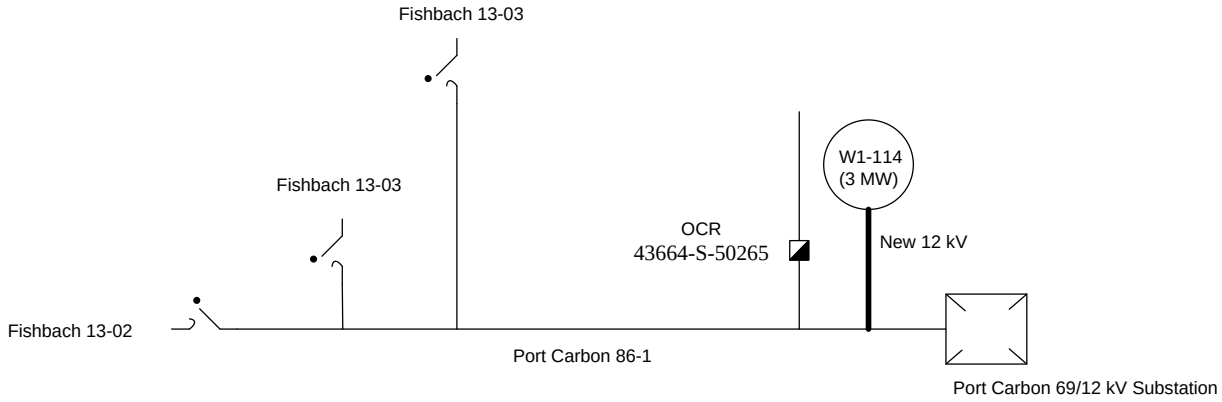
Point of Interconnection

W1-114 generation can be connected to the Port Carbon #86-1 line as shown on the single line diagram on Attachment 1.

Transmission Owner (PPL EU) Scope of Direct Connection Work

Attachment Facilities Requirements

The proposed Queue W1-114 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.



The total attachment cost estimate is $261,200 to accommodate the interconnection of W1-114.

Breakdown of estimated costs for the 12 kV connection:

$162,380	Distribution modifications
$98,820	Relay and Control Upgrades

Distribution Modifications ($162,380)

The following distribution modifications will be required on PPL EU's Port Carbon area distribution system in order to accommodate the W1-114 generation:

Construct a 12 kV line from a tap point on #86-1 line, to the W1-114 Point of Interconnection, at the Interconnection Customer facility (Approximately 1,200 feet new 3-phase 477 Al). PPL EU requires that the customer connect to the # 86-1 line upstream from OCR 43664-S-50265. PPL EU's estimate is based on the assumption that the Point of Interconnection will be located in grid 436-S-503.

Relay and Control Modifications ($98,820)

The following relay and control upgrades will be required at Port Carbon 69/12 kV substation in order to accommodate the generation from W1-114:

1) Modification to the Port Carbon bus sectionalizing breaker and transformer breakers' relay logic.

2) Voltage check relay functions

A three-phase voltage check relay will be installed at Port Carbon Substation to supervise the closing of the 12 kV breaker which supplies this customer facility. This additional protection scheme will check to ensure that the 12 kV line is de-energized prior to closing the 12 kV breaker. Three 12 kV potential devices must be added to the Port Carbon Substation 86-01 12 kV line to provide potential for this check. The cost for the relay and control modifications at the Port Carbon Substation is estimated to be $98,820.

Scope of Work by Interconnection Customer:

Queue W1-114 Interconnection Customer is responsible for design, construction and costs for all facilities associated with W1-114 on the Interconnection Customer side of the POI (Point of Interconnection) shown on the single line diagram on page 4.

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

Direct Transfer Trip

PPL EU has reviewed the requirement for Direct Transfer Trip (DTT) on this installation. Normally DTT is required if there are other PPL EU customers involved that could be islanded with the generation. Normally with other customers on the line, inverter-based installations are required to have anti-islanding capability built in as part of the IEEE 1547 and UL 1741 requirements. This customer's inverter is not IEEE 1547 compliant because of the size of the generator; however, it has all the anti-islanding functionality of IEEE 1547. It was determined by PPL EU that the inverter's anti-islanding functionality, in addition to the intertie protective relaying, would be sufficient and therefore would not require DTT. If adjustable, the anti-islanding of the customer's inverter should be set at 1 second or less. If not adjustable, the under/over voltage trip levels and time delay settings must be reviewed further by PPL.

If the need arises to transfer W1-114 to an alternate source, for maintenance, restoration of service, or any other reason, W1-114 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 W1-114 generation.

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:

1) A 4-wire dedicated FDDA-type phone line for SCADA.

2) 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 W1-114 Point of Interconnection (POI) and at the Queue W1-114 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

W1-114 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.

Network Impacts

The queue W1-114 project was studied as a 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 W1-114 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 Contingencies only with full energy output. Stuck Breaker and Bus Fault contingencies will be applied during the Impact Study)

No problems identified.

Contribution to Previously Identified Overloads

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

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.

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. 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 analyzes all overload conditions associated with the overloaded element(s) identified. As a result of the aggregate energy resources in the area, the following violations were identified.

No problems identified.

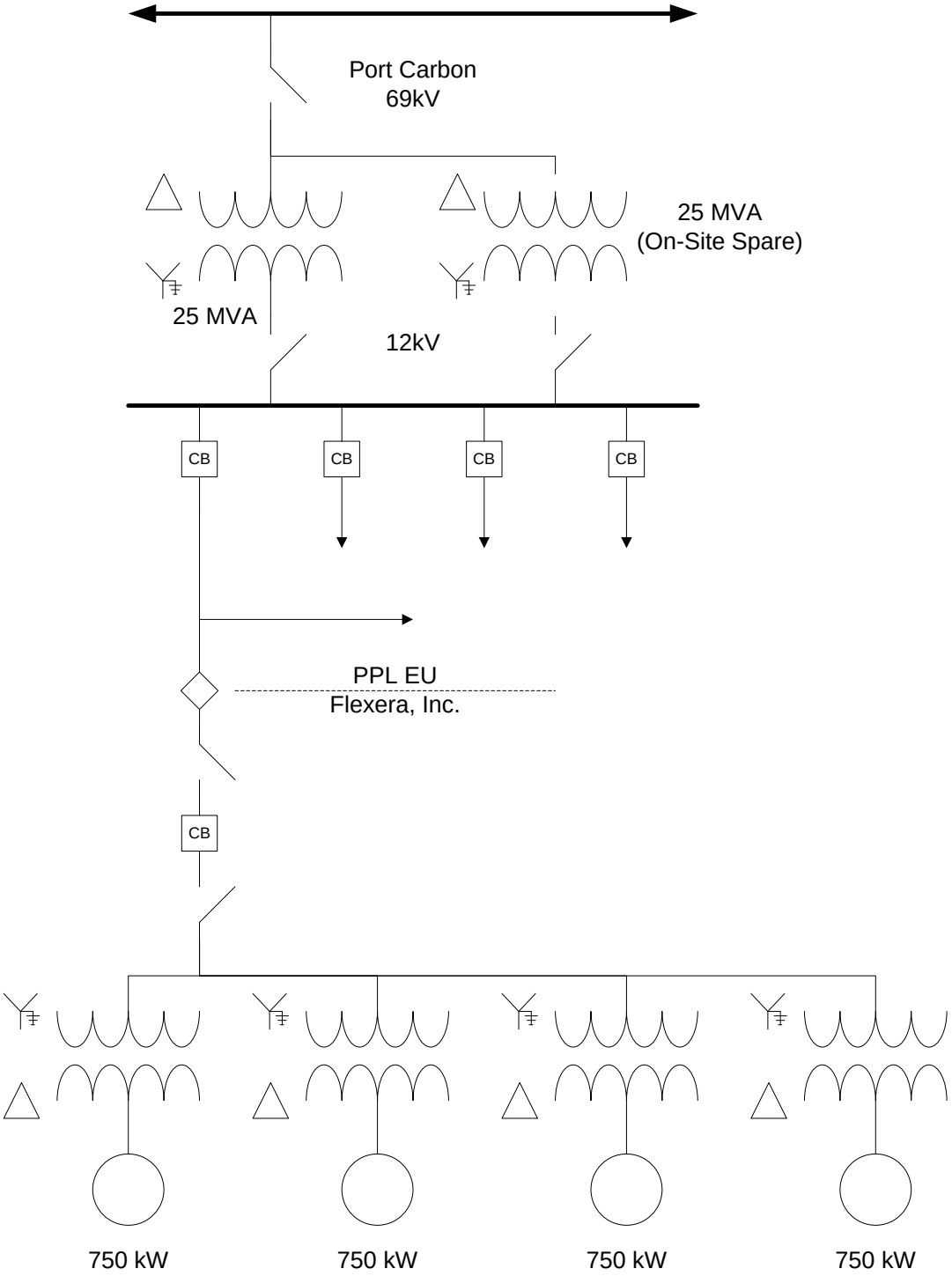
Short Circuit

Not required.

Stability Analysis

Not required.

Attachment 1
Single Line Diagram



Attachment 2
Site Location