PJM Generator Interconnection V2-027 South Milton 1.62 MW Feasibility / Impact Study

October 2009

Docs # 562314

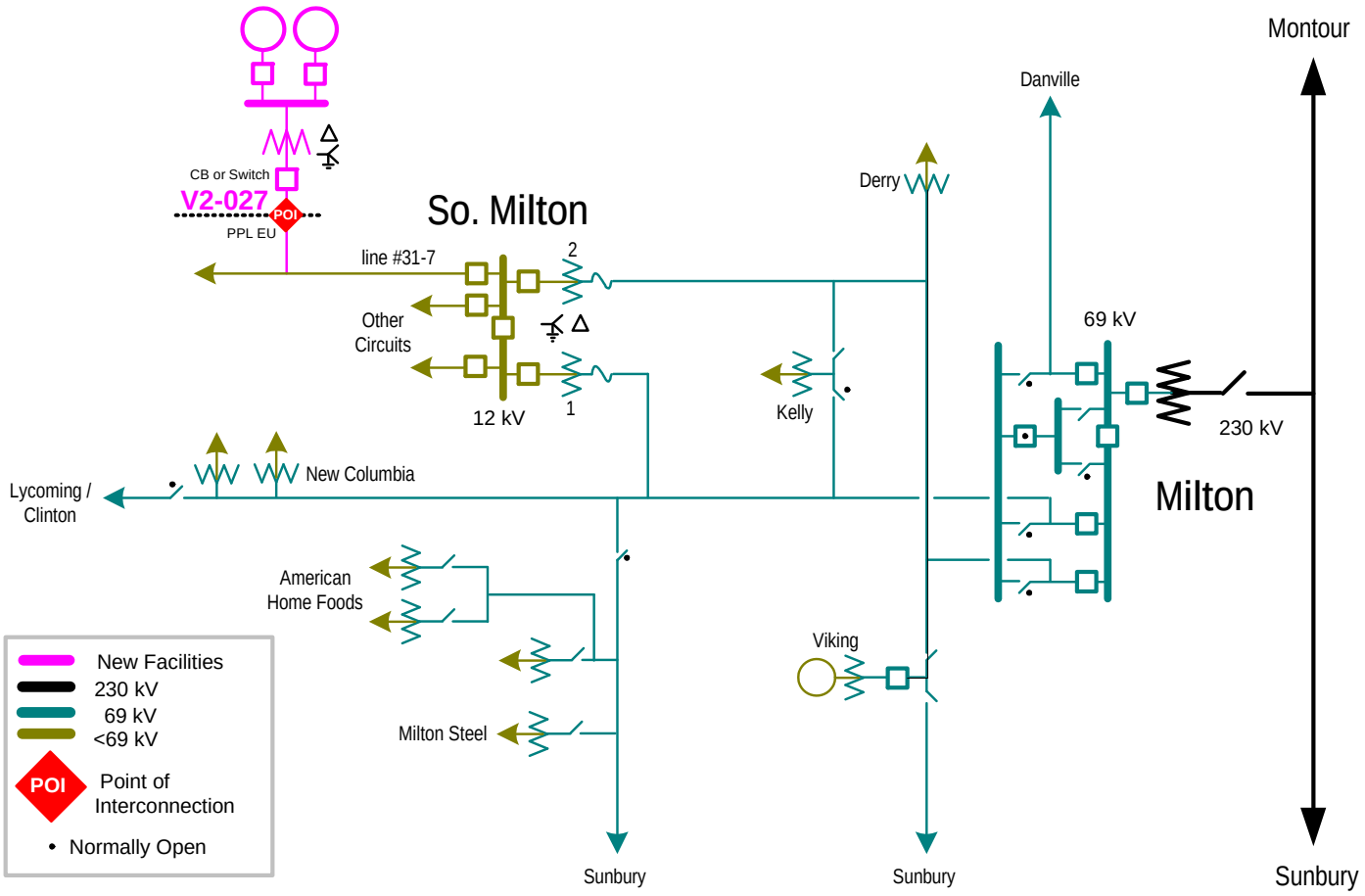
Confidential

General

Queue V2-027 is a Milton Regional Sewer Authority (MRSA) request to interconnect a 1.62 MW Capacity Resource consisting of two 815 KW methane biogas synchronous generator sets. The new generation will be located at 5585 State Route #405, Milton, Northumberland County, Pennsylvania. Queue V2-027 has requested a February 1, 2011 in-service date. **This study does not imply a PPL EU commitment to this in-service date.**

Direct Connection

Queue V2-027 generation can be connected to the South Milton 12 kV line #31-7 as shown on the single line diagrams below and Attachment 1.



The total estimated cost for PPL EU to construct the Queue V2-027 Direct Connection facilities is **$341,000** and the estimated construction time is **9 months**.

V2-027 Interconnection Customer (MRSA) Scope of Work

1. Queue V2-027 Interconnection Customer is responsible for design, construction and costs for all facilities associated with V2-027 on the Interconnection Customer side of the POI (Point of Interconnection) shown on the single line diagram of the previous page and ATTACHMENT 1.

2. Metering and telemetering requirements for PJM:

   The Interconnection Customer will be required to install the equipment necessary to provide revenue metering (KWH and KVARH hourly data sent once per day) and real time data (telemetry) for the Interconnection Customer's generating resource in compliance with PJM Manuals M-01 and M-14B, and the PJM Tariff. **Real time data (telemetry) is only required if Queue V2-027 is a Capacity Resource.**

   For additional information regarding PJM metering requirements and the PJM internet-based telemetry alternative (Arcom Director) contact Ryan Nice at 610-666-4777 or nicer@pjm.com

   Metering and telemetering requirements for PPL EU:

   The existing metering equipment at the Milton Regional Sewer Authority facility will need to be reviewed. If any new metering equipment is required, it will be provided by PPL EU at no cost to the Interconnection Customer (MRSA).

3. Protection Equipment:

   The Interconnection Customer is required to install suitable protection and control equipment based on PPL EU's Applicable Standards for interconnection of parallel generation. This includes both Intertie Protective Relaying (IPR) and Point of Contact (POC) relaying. The PPL EU web site links for the IPR and POC requirements 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_r1.pdf

   The Interconnection Customer is also required to install DTT (Direct Transfer Trip) communication, relay and control equipment at the V2-027 Customer Facility. See item 2 under the Interconnected Transmission Owner (PPL EU) Direct Connection Scope of Work on the following pages for related work.

4. Isolation Breaker Requirement:

   V2-027 Interconnection Customer will have its own isolation breaker that is capable of separating the V2-027 generation from the PPL EU system. This breaker will be operated by the PPL EU Controlled POC and/or IPR relaying. The Interconnection Customer may also operate this breaker by its own protection and control equipment. As per PPL EU design requirements, sharing of IPR/POC equipment within the IPR cabinet with the Interconnection Customer is not allowed.

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

The following distribution modifications will be required on the South Milton #31-7 12 kV line in order to accommodate the generation:

1. 12 kV line tap (Estimated cost = $63,000)

   Construct a 12 kV line (approx 220 ft.) from the tap point on #31-7 line to the V2-027 Point of Interconnection at the MRSA Interconnection Customer facility using 477 kcmil Aluminum conductor or equivalent. The distance of 220 ft. was based on the approximate intertie point proposed by the V2-027 Interconnection Customer which is south of MRSA's present point of contact. If this proposed intertie point is to be changed, PPL EU will need to be informed and the cost may change accordingly.Queue V2-027 generation will be interconnected to the PPL EU 12 kV distribution system as shown in Figures 1 and 2. No reinforcement of the 12 kV distribution system is required for Queue V2-027.

2. Direct transfer trip will be required between the 12kV line #31-7 circuit breaker at South Milton substation and the generator to avoid islanding the generation on PPL load. The following communication, relay and control upgrades will be required. (Estimated cost = $209,000)

   - Furnish and install approximately 900' of 36 strand ADSS fiber cable from South Milton substation to the closest PPL EU pole near the customer's facility. This includes all mounting hardware and associated materials required for the installation. It is assumed that no "make-ready" work will be required to install this fiber cable in the existing electric space on the 12 kV distribution pole line. All work will be completed according to PPL EU specifications and is expected to be completed during normal business work hours, Mon-Fri 7am to 3pm.

   - Perform bi-directional testing of the installed fiber cable from terminal to terminal.

     Also at South Milton 69/12 kV substation

- Substation fiber hand-off hardware including: cable, mast, conduit, enclosure, splice trays and relays.

- Direct Transfer Trip (Fiber Optic Communication Device).

- 3-Phase Voltage check relay function.

3. In addition, the PPL EU SCADA is designed on the premise that power flow is always OUT of the substation. The installation of generation will cause this to reverse during lighter load periods. SCADA programming will be required to obtain correct indication for reverse power flow. Modification to the South Milton SCADA will be required for alarm points. (Estimated cost = $69,000)

Direct Connection Discussion

Fiber Optic based bidirectional, direct transfer trip (DTT) facilities between the customer's substation, and PPL EU's South Milton Substation will be required for V2-027. The communications path will be via two SEL 2505 Communications Processors and ADSS fiber. This equipment will provide a primary trip signal from PPL EU to Milton Regional Sewer Authority, to clear the customer's generation from the PPL line whenever the PPL South Milton Substation 12 kV #31-7 line breaker is tripped. The same DTT equipment will be used to permit reclosing of the South Milton #31-7 line breaker after the generation at Milton Regional Sewer Authority is isolated from the PPL system. Based on preliminary information, we assume a suitable location can be found for a pole for the fiber hand-off point including a splice enclosure furnished by PPL EU. The customer will be responsible to install suitable fiber cable from this splice enclosure to their facilities. Splicing and end connector installation costs at the customer's facility are the customer's responsibility.

The following data is currently on record as being provided by Milton Regional Sewer Authority (MRSA):

Generator Impedances	Xd = 1.4861 PU (28.5754 ohms), X'd = .2069 PU (3.978 ohms), X"d = .1306 PU (2.5117 ohms)
Generator Rating and Base	2 x 900KVA at .9 power factor (815 KW) @ 480 V
Low-side impedance to Gen terminals	Z = .00137+j00168 ohms (900 KVA base)
GSU Transformer Impedance and Base	Z = 9.8%, X/R = 5.92 (1670 KVA base)
GSU Transformer rating	1670 KVA at 65 degrees C with fans
Transformer connections	12.47 KV Wye primary and 480 V Delta secondary

If the above data is incorrect or incomplete, Milton Regional Sewer Authority is asked to provide updated information for this equipment.

Network Impacts

Queue V2-027 was studied as a 1.62 MW Capacity injection into the South Milton 12 kV line #31-7. Project V2-027 was evaluated for compliance with reliability criteria for summer peak conditions in 2013. Potential network impacts were as follows:

NETWORK IMPACTS

Local System Impacts

(Impacts to PPL EU's lower voltage distribution system based on reliability criteria commonly applied to these facilities)

There are no overloads expected as a result of the V2-027 connection. PPL EU studies found that voltage remained within acceptable limits for the operation of V2-027's generators. However, if customers on the South Milton #31-7 12 kV line begin to experience unacceptable voltage fluctuations due to the MRSA's operations, MRSA will be required to take all necessary corrective action to mitigate the problem. An instantaneous voltage variation of greater than 5% at the Point of Interconnection is generally not acceptable. In addition, the frequency and severity of voltage variations are also considered when determining compliance with PPL EU's flicker guidelines. These guidelines are based upon the General Electric flicker-irritation curve and will be used to determine if the system is operating within acceptable limits.

Queue V2-027 should also be aware of PPL EU's harmonic distortion guidelines. PPL EU allows up to a 3% total harmonic voltage distortion level. In addition, no single harmonic is allowed to exceed 1.7% of the system fundamental voltage. If PPL EU discovers that objectionable harmonics in excess of the stated limits are being injected into the system from V2-027's equipment, Queue V2-027 Interconnection Customer will be responsible for taking corrective measures to mitigate harmonic currents and may be required to curtail operation until such corrective measures are implemented.

Preliminary studies indicate that operating the V2-027 synchronous machines at unity power factor over all output conditions will not adversely affect system voltage. PPL EU reserves the right to change the power factor requirement for V2-027 as system conditions change.

Generator Deliverability

(Normal System with all facilities in-service and Single, or N-1, contingencies for the Capacity portion only of the interconnection)

No problems identified.

Multiple Facility Contingency
(Double Circuit Tower Line, Line with Failed Breaker and Bus Fault contingencies for the full energy output)

No problems identified.

Short Circuit Analysis

No problems identified.

Stability Analysis

Not required because of generator size and location of POI (Point of Interconnection).

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.

NETWORK UPGRADE REQUIREMENTS

New System Reinforcements
(Upgrades required to mitigate reliability criteria violations, i.e. "Network Impacts", initially caused by the addition of this project generation)

None required.

Contribution to Previously Identified System Reinforcements
(This project contributes to the Network Impact causing the need for these Network Upgrades. This project will be allocated a portion of the upgrade cost)

None required.

ATTACHMENT 1

V2-027 Interconnection Single Line Diagram