PJM Generator Interconnection Request
Queue # Q36
Philipsburg-Tyrone North 115 kV
Feasibility Study Report

September 2006

DOCS #388174, v1

Preface

The intent of the feasibility study is to determine a plan, with ballpark cost and construction time estimates, to connect the subject generation to the PJM network at a location specified by the Interconnection Customer. The Interconnection Customer may request the interconnection of generation as a capacity resource or as an energy-only resource. As a requirement for interconnection, the Interconnection Customer may be responsible for the cost of constructing: **(1) Direct Connections**, which are new facilities and/or facilities upgrades that are needed to connect the generator to the PJM network, and **(2) Network Upgrades**, which are facility additions or upgrades to existing facilities that are needed to maintain the reliability of the PJM system.

In some instances a generator interconnection may not be responsible for 100% of the identified network upgrade cost because other transmission network uses, e.g. another generation interconnection, 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 impact study is performed.

The Feasibility 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.

Q36 Philipsburg-Tyrone North 115 KV Feasibility Study Report

General

The Interconnection Customer (IC) has proposed to install 80 MW of wind turbine generation in Penelec along the Philipsburg-Tyrone North 115 kV line in Pennsylvania. The project is proposed to be in service by 12/31/2008. Because queue Q36 is a wind generation project, it was evaluated as an "Energy Only" resource for its full output capability of 80 MW and as a "Capacity" resource for 20% (16 MW) of is full output capability.

Direct Connection

It was proposed that the project be studied for as a connection into the Philipsburg-Tyrone North 115 kV circuit. The Philipsburg-Tyrone North 115 kV line is approximately 18 miles in length and the proposed substation would be 6.5 miles from Tyrone North. The IC is responsible for constructing all of the facilities on its side of the point of interconnection, which will be between the 115 kV line and the customer substation (see Figure #1). The IC will also be responsible for any remote relay and control work at both Philipsburg and Westfall substations that is required due to the connection of the wind facility.

The proposed interconnection facilities must be designed in accordance with the FirstEnergy "Requirements for Transmission Connected Facilities" document.

It will be the developer's responsibility to obtain any needed right-of-way between the plant site and FirstEnergy's facilities.

Below are conceptual estimates for the engineering/construction associated with Direct Connection requirements based upon similar projects that have been designed and/or constructed.

Item	Description	Conceptual Cost Estimate
1	New 115 kV 3-breaker ring bus termination point at a new interconnection substation between Tyrone North and Philipsburg 115 kV substations.	$1,800,000
2	Approximately 0.1 miles of 115 kV transmission line extending from the Tyrone North-Philipsburg 115 kV line to the generation plant interconnection substation. Final distance TBD in Impact Study phase.	N/A Developer cost. Line built, owned and maintained by the developer.
3	Relay and control work at Philipsburg Substation.	$ 180,000
4	Relay and control work at Westfall Substation.	$180,000
Conceptual Estimate:		**$2,160,000**
Estimated Lead Time:		2.0 years from signed IA

Notes:

- Detailed Engineering & Construction Estimates TBD via Facility Study
- The above estimates do not include 1) tax gross-up, 2) property costs and site development up to rough grade which is to be provided by the developer, 3)

interconnection metering and generation SCADA to be provided by the developer, 4) engineering and field activities for design review and commissioning of the developer's facilities, and 5) Real estate costs that may be required for right-of-way easements to extend the 115 kV line.

The 115 kV line would be designed, constructed and maintained by the IC. The attached Figure 1 provides a conceptual one-line of the direct connection facilities needed.

Network Impacts

The **#Q36 project was studied as an injection of 80 MW (16 MW of capacity) into a tap of the Philipsburg-Tyrone North 115 kV line.** Project #Q36 was evaluated for compliance with reliability criteria for summer peak conditions in 2011. Potential network impacts were as follows:

Generator Deliverability – at the 16 MW capacity value level

No problems identified.

New System Reinforcements

Multiple Facility Contingency – Reliability Requirements at the 80 MW full output level

NOTE: For Feasibility Studies, only double circuit (tower) outages are evaluated – not line fault and stuck breaker.

1. The Keystone 500/230 kV #4 transformer is overloaded at around 102% (474.3 MVA) of its emergency rating (465 MVA) for the **tower outage** of the Juniata-Lewisburg 230 kV line and the Juniata-Dauphin 230 kV line. The Q36 project contributes approximately 15 MW to the **contingency** facility loading. **NOTE:** Overloading of the Keystone 500/230 kV #4 transformer was previously identified as a potential congestion issue under contingency conditions for the energy portion of the P22, P28, P45A, P47, P48, P60 and Q04 projects.

   To mitigate this overload condition would require replacement/upgrade of the following:

   Keystone Substation:

   - **Replacement/upgrade of 500-230 kV transformer to one of a larger size (estimated to cost approximately $5,500,000)**

2. The Keystone 500/230 kV #3 transformer is overloaded at around 102% (480.4 MVA) of its emergency rating (47 MVA) for the **tower outage** of the Juniata-Lewisburg 230 kV line and the Juniata-Dauphin 230 kV line. The Q36 project contributes approximately 15 MW to the **contingency** facility loading. **NOTE:** Overloading of the Keystone 500/230 kV #3 transformer was previously identified as a potential congestion issue under contingency conditions for the energy portion of the P22, P28, P45A, P47, P48, P60 and Q04 projects.

To mitigate this overload condition would require replacement/upgrade of the following:
Keystone Substation:

- **Replacement/upgrade of 500-230 kV transformer to one of a larger size (estimated to cost approximately $5,500,000)**

Contribution to Previously Identified Overloads

3. The Garrett 138/115 kV transformer is overloaded at around 180% (162 MVA) of its emergency rating (90 MVA) for the **tower outage** of the Juniata-Lewisburg 230 kV line and the Juniata-Dauphin 230 kV line. The Q36 project contributes approximately 5 MW to the **contingency** facility loading which was previously identified as a potential congestion issue for the energy portion of the O17, P48, P60, Q04 and Q34 projects.

   To mitigate this overload condition would require replacement/upgrade of the following:
   Garrett Substation:

   - **Replacement/upgrade of the transformer, circuit breaker and substation conductor (estimated to cost approximately $1,750,000)**

4. The Garrett-Garrett 115 kV line is overloaded at around 167% (208.8 MVA) of its emergency rating (125 MVA) for the **tower outage** of the Homer City-Quemahoning 230 kV line and the Seward-Tower 115 kV line. The Q36 project contributes approximately 5 MW to the **contingency** facility loading which was previously identified as a potential congestion issue for the energy portion of the O48, P60 and Q34 projects.

   To mitigate this overload condition would require replacement/upgrade of the following:
   Garrett Substation:

   - **Replacement/upgrade of substation conductor (estimated to cost approximately $175,000)**
   - **Replacement/upgrade of a CT circuit (estimated to cost approximately $100,000)**
   - **Replacement/upgrade of a CT circuit (estimated to cost approximately $100,000)**
   - **Replacement/upgrade of a disconnect switch (estimated to cost approximately $90,000)**
   - **Replacement/upgrade of a CT circuit (estimated to cost approximately $100,000)**
   - **Replacement/upgrade of a line/wave trap (estimated to cost approximately $115,000)**

   Reconductor/upgrade of approximately 1.9 miles of transmission line between Garrett tap and Garrett (estimated to cost approximately $450,000)

5. The Rockwood-Penn Mar 115 kV line is overloaded at around 132% (188.8 MVA) of its emergency rating (143 MVA) for the **tower outage** of the Homer City-Quemahoning 230 kV line and the Seward-Tower 115 kV line. The Q36 project

contributes approximately 5 MW to the **contingency** facility loading which was previously identified as a potential congestion issue for the energy portion of the P48, P60, Q04 and Q34 projects.

To mitigate this overload condition would require replacement/upgrade of the following:
Rockwood Substation:

- **Replacement/upgrade of a disconnect switch (estimated to cost approximately $80,000)**

Reconductor/upgrade of approximately 14.7 miles of transmission line between Penn Mar and Rockwood (estimated to cost approximately $3,350,000)

Penn Mar Substation:

- **Replacement/upgrade of a circuit breaker (estimated to cost approximately $325,000)**
- **Replacement/upgrade of a CT circuit (estimated to cost approximately $100,000)**
- **Replacement/upgrade of line/wave trap (estimated to cost approximately $115,000)**

6. The Hillclay-Hilltop 115 kV line is overloaded at around 118% (211.2 MVA) of its emergency rating (179 MVA) for the **tower outage** of the Homer City-Quemahoning 230 kV line and the Seward-Tower 115 kV line. The Q36 project contributes approximately 5 MW to the **contingency** facility loading which was previously identified as a potential congestion issue for the energy portion of the Q34 project.

   To mitigate this overload condition would require replacement/upgrade of the following:
   Hilltop Substation:

   - **Replacement/upgrade of CT circuit (estimated to cost approximately $100,000)**

7. The Penn Mar-Garrett 115 kV line is overloaded at around 116% (193.7 MVA) of its emergency rating (167 MVA) for the **tower outage** of the Homer City-Quemahoning 230 kV line and the Seward-Tower 115 kV line. The Q36 project contributes approximately 5 MW to the **contingency** facility loading which was previously identified as a potential congestion issue for the energy portion of the P60, Q04 and Q34 projects.

   To mitigate this overload condition would require replacement/upgrade of the following:
   Penn Mar Substation:

   - **Replacement/upgrade of a line/wave trap (estimated to cost approximately $115,000)**

   Reconductor/upgrade of approximately 14.95 miles of transmission line between Penn Mar and Garrett (estimated to cost approximately $3,500,000)

8. The Shelocta-Keystone 230 kV line is overloaded at around 115% (982.1 MVA) of its emergency rating (854 MVA) for the **tower outage** of the Juniata-Lewistown 230 kV line and the Juniata-Dauphin 230 kV line. The Q34 project contributes approximately 29 MW to the **contingency** facility loading which was previously identified as a potential congestion issue for the energy portion of the P28, P45A, P47, P48, P60, Q04 and Q34 projects.

   To mitigate this overload condition would require replacement/upgrade of the following:
   Shelocta Substation:
   - **Replacement/upgrade of a disconnect switch (estimated to cost approximately $150,000)**

   Reconductor/upgrade of approximately 2.26 miles of transmission line between Keystone and Shelocta (estimated to cost approximately $1,400,000)

   Keystone Substation:
   - **Replacement/upgrade of a CT circuit (estimated to cost approximately $100,000)**
   - **Replacement/upgrade of a disconnect switch (estimated to cost approximately $150,000)**
   - **Replacement/upgrade of a CT circuit (estimated to cost approximately $100,000)**

9. The Homer City-Shelocta 230 kV line is overloaded at around 110% (939.4 MVA) of its emergency rating (854 MVA) for the **tower outage** of the Juniata-Lewistown 230 kV line and the Juniata-Dauphin 230 kV line. The Q34 project contributes approximately 23 MW to the **contingency** facility loading which was previously identified as a potential congestion issue for the energy portion of the O56, O72, P22, P28, P45A, P47, P48, P60, Q04 and Q34 projects.

   To mitigate this overload condition would require replacement/upgrade of the following:
   Shelocta Substation:
   - **Replacement/upgrade of a disconnect switch (estimated to cost approximately $85,000)**

   Reconductor/upgrade of approximately 10.73 miles of transmission line between Homer City and Shelocta (estimated to cost approximately $4,800,000)

   Homer City Substation:
   - **Replacement/upgrade of a CT circuit (estimated to cost approximately $100,000)**
   - **Replacement/upgrade of line/wave trap (estimated to cost approximately $125,000)**
   - **Replacement/upgrade of a circuit breaker (estimated to cost approximately $425,000)**

Contribution to Previously Identified System Reinforcements

To be determined in the System Impact Study.

Short Circuit

FirstEnergy completed a screening analysis of the Penelec 115kV circuit breaker interrupting duties in the area. This screening found that the Q36 project contributed partially or fully to 21 breakers exceeding the screening criteria and therefore possibly exceeding their fault interrupting capability

Detailed studies will be performed during the System Impact Study and the results will be included in the System Impact Study report.

Potential Congestion Issues

PJM and FirstEnergy also studied the delivery of the energy portion of this interconnection request. The following analysis has been performed to inform the Interconnection Customer (Queue Q36) of potential congestion issues (operational restrictions) that may occur and affect the Q36 project's ability to operate at full output for certain system conditions. **The upgrades listed below are not required reliability upgrades for the Queue Q36 interconnection.** Please note the facilities identified below as requiring upgrades including those facilities requiring reconductoring/rebuilding of transmission lines. Some of the reconductoring/rebuilding projects can be done in a "short" time frame while others are quite extensive and will require a "long" time to complete. In general, the time necessary to design and rebuild an extensive facility upgrade will take approximately 2-3 years to complete. If the Q36 Interconnection Customer wants to pursue construction of any of these upgrades, a separate "Transmission Interconnection" request must be submitted and the upgrades must be performed as merchant transmission projects.

Category A – Transmission System Impacts (Facilities monitored and operated by PJM)

Load flow model used for analysis: Generator Deliverability dispatch with all generators (in-service or active Queue generators preceding Q36) at 100% energy output and Peak summer loading (80/20 load forecast).

Q36 Operational considerations: The facilities below (potentially overloaded) are monitored and operated by PJM. PJM rules and methods for readjusting pre-contingency (N-1) dispatch will be followed if this system condition occurs. This may or may not cause curtailment of Q36 generation to below its 100% energy output.

None.

Category B – Underlying Transmission System Impacts (Facilities monitored and operated by Penelec)

Load flow model used for analysis: Generator Deliverability dispatch with all generators (in-service or active Queue generators preceding Q36) at 100% energy output and Peak summer loading (80/20 load forecast).

Q36 Operational considerations: The facilities below (potentially overloaded) are not monitored and operated by PJM. Penelec monitors these facilities in real time and will readjust the system according to Penelec's rules and methods if this system condition occurs. This may or may not cause curtailment of Q36 generation to below its 100% energy output.

None.

Category C – Underlying Transmission System Impacts (Facilities monitored and operated by Penelec). These contingency overloads were not possible prior to the Queue Q36 project. The identified contingency overloads are caused directly by Q36 and are likely to cause Q36 curtailment to less than 100% energy output during summer and possibly winter operation.

Load flow model used for analysis: Generator Deliverability dispatch with all generators (in-service or active Queue generators preceding Q36) at 100% energy output and Peak summer loading (80/20 load forecast).

Q36 Operational considerations: The facilities below (potentially overloaded) are not monitored and operated by PJM. Penelec monitors these facilities in real time and will readjust the system according to Penelec's rules and methods if this system condition occurs. This may or may not cause curtailment of Q36 generation to below its 100% energy output.

None.

APPENDIX

Figure #1