PJM Generator Interconnection Request
Queue #N14
Feasibility/Impact Study Report

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322072

N14 Frackville-Hauto #3 69kV (Shenandoah) Feasibility/Impact Study

General

Green Energy Products, Inc. has proposed a new 24MW generating facility to be constructed near Shenandoah Pennsylvania. The facility consists of twelve 2MW Gamesa wind turbines that will be installed in Mahanoy Township, Schuylkill County, Pennsylvania. Green Energy Products proposed an in-service date for the project of December 1, 2005.

The intent of the feasibility / impact study is to determine system reinforcements and associated costs and construction time estimates required to facilitate the addition of the new generating plant to the transmission system. The reinforcements include the direct connection of the generator to the system and any network upgrades necessary to maintain the reliability of the transmission system.

Direct Connection

The generation project will be interconnected to the transmission system on the Girard Manor 69kV Tap off the Hauto – Frackville #3 69kV circuit. The connection to the generating facility will be via a short transmission tap near transmission structure 44929s55773. See Figure #1. Based on the latest information, the transmission work for the connection is estimated to cost **$525,000** and the substation work to accommodate the project is estimated to cost **$275,000**.

To complete some of the required work other existing generators may have to be interrupted. This work will require coordination with those generating units to meet their operating needs or to coincide with their outages.

If PPL Electric Utilities (PPL EU) is to provide the metering equipment, the associated costs are estimated to be **$80,000**. Other metering service costs may apply depending on the generation project developer's choice of metering options. The total direct connection cost is estimated to be **$880,000** plus applicable taxes (if any).

If the developer chooses to supply the metering, the $80,000 can be subtracted from the total provided.

After the Interconnection Service Agreement is signed, the typical time needed to complete this work is about 9 months for the transmission work and 9-12 months for the substation work.

Future changes to the PPL EU system that require facilities to accommodate the N14 Shenandoah generating project will be charged to the project at that time. Examples of

such changes would include, but are not limited to, conversion to 138kV operation or rearrangement of the sectionalizing locations.

Transmission Work

The above transmission cost includes siting, Right-Of-Way (R/W) acquisition, construction of approximately a 1000' 69kV line extension, the reconnection of the Wheelabrator-Frackville generator to the Frackville-Gilberton circuit (estimated cost is **$25,000**) and up-rating the Frackville – Gilberton 69kV line from 140 degree C to 150 degree C (network upgrade #427) to accommodate the Wheelabrator-Frackville generator (estimated cost is **$13,000**).

The 69kV extension to the N14 project will be located off the Girard Manor 69kV Tap, which is part of the Hauto – Frackville #3 69kV line, at approximately pole # 44929s55773. In addition, a load sectionalizing air break (LSAB) switch will be installed on the Girard Manor 69kV tap just to the north side of the tap for the N14 generator. Estimated cost for this work is **$487,000**.

The developer will be responsible for installing an air break switch located in the tap on the dead-end structure for the N14 project. This air break switch, which must be capable of interrupting the wind park main step-up transformer when it is unloaded and isolate the N14 generating facility from the PPL EU transmission system when necessary.

The estimates for the tap into the N14 generation project substation has been developed using 69 kV transmission standards. If a 138kV design, operation at 69kV, is requested, there will be additional cost due to PUC certification requirements and construction start and in-service dates would be delayed to account for the PUC certification process. If there are future changes to the system that would require a change to a 138kV design for the tap, the cost would be charged to the generation owner at that time.

Substation Work

The substation work includes the installation of phone line based Direct Transfer Trip (DTT) equipment and phone line protection equipment, installation of control modifications, reconfiguration of controls related to the transmission work required for the interconnection of the N14 at Frackville substation and the associated review and testing of the corresponding equipment at the N14 location. The estimated cost is **$275,000**.

The N14 project will be responsible for procurement from the Telephone Company of a protective relay-grade telephone circuit for the DTT facilities. The project will also be responsible for procuring the DTT receiver to be installed at the interconnecting substation. All installation, maintenance and monthly lease or billing charges for communications facilities for DTT, metering, etc are the responsibility of the N14

project. Lead times for leased telephone lines are usually long. Therefore, the N14 project should investigate the availability of leased telephone facilities immediately.

Power Factor, MW and Mvar Output Schedule

N14 has stated that the plan for the facility is to use Gamesa 2.0 MW induction machines. Depending upon the design of the collector system for the generation at the N14 facility, self-excitation of the induction machines may be possible. If PPL EU determines that self-excitation is a concern, protection requirements as well as the circuit breakers used by the N14 project to isolate its system from the PPL EU transmission system may change significantly during the PJM Facility Study (start of engineering detailed design) stage. These changes may include the stipulation that N14 must purchase circuit breakers rated twice the nominal phase-to-phase voltage for the intertie 69 kV CB and the low side 34.5 kV CB. Reactors may be needed for voltage control.

In order to eliminate significant voltage deviation, the N14 facility will normally be requested to operate at approximately **unity** power factor, as measured at the 69 kV intertie point-of-interconnection. However, the N14 project must have the ability to operate in either the leading or lagging mode as required from time to time. Consequently, it is strongly recommended that the Gamesa units be obtained with power factor control capability.

This power factor calculation was based on the wind park facility using a single 28 MVA, 69-34.5 kV power transformer as described in the data submitted by the N14 project. Additional information regarding the collector system will be required from the N14 project to assist in determining if automatically controlled shunt reactors are also needed to reduce the expected voltage change, if significant underground cable is to be installed.

Load flow studies indicate that at maximum 24.0 MW output with no MVAR of 34.5 kV cable reactance connected to the generator bus, the L18 wind park will be required to absorb approximately 0.5 MVAR from the PPL EU system (measured at the 69 kV intertie connection point). The intertie transformer will absorb some of the MVAR. The N14 project must ensure that it has the capability to hold and automatically maintain, with no time delay, a unity power factor (or leading power factor if the Facility Study stage determines it necessary) as measured on the 69 kV side of the interconnection transformer over the entire MW output range.

Remarks:

- Portions of the transmission work required for this project will impact other NUG/IPPs connected to the Hauto – Frackville #3 69kV line. All work that impacts other NUG/IPPs must be coordinated with these other units. This may impact the schedule to complete the work, depending on their outage schedules.

- The transmission estimate includes normal siting and Right-Of-Way acquisition costs. Additional costs may be incurred if there are excessive Right-Of-Way acquisition costs or for any environmental or archeological costs.

Network Impacts

The #N14 project was studied as an injection of 24 MW energy and 4.8 MW capacity into the Girard Manor extension of the Frackville-Hauto #3 69 kV circuit. Project #N14 was evaluated for compliance with reliability criteria for summer peak conditions in 2008. Potential network impacts were as follows:

Normal System
No identified problems.

Single Contingency (MAAC Criteria IIA)
No identified problems.

Second Contingency (MAAC Criteria IIB)
No identified problems.

Multiple Facility Contingency (MAAC Criteria IIC)
No identified problems.

Generator Deliverability
No identified problems.

Stability (MAAC Criteria IV)
No identified problems.

CETO/CETL (MAAC Criteria III / VIIB)
No identified problems

Short Circuit Analysis
No identified problems

System Reinforcements

Up-rate the Frackville – Gilberton 69kV line from 140 degree C to 150 degree C (network upgrade #427) to accommodate the Wheelabrator-Frackville generator (estimated cost is **$13,000**).

Cost Allocation

The N14 project is responsible for 100% of the $867,000 in direct connection costs listed above and 100% of the $13,000 required for system reinforcements.

Figure 1 – N14