

***PJM Generator Interconnection
O22 Powerton – Goodings Grove 300 MW
Impact Study***

June 2007
Docs # 420680

General

Queue O22 is a Blackstone Wind Farm, LLC request to interconnect 300 MW of wind generation (20% or 60 MW maximum allowable initial Capacity qualification per current PJM rules) consisting of one hundred fifty 2.0 MW wind turbine generators located near the town of Blackstone in Livingston County, Illinois. Queue O22 has been evaluated as a 300 MW interconnection of which 20% (60 MW) was evaluated for deliverability as a Capacity Resource. Queue O22 is proposed to be in service by December 2008.

Direct Connection Requirements

Queue O22 may be interconnected to the 126 mile Powerton – Goodings Grove (0301) 345kV line via a new 345kV three-breaker ring bus substation TSS 196 (Katydid Road) as shown on the one line diagram (Figure 1) below.

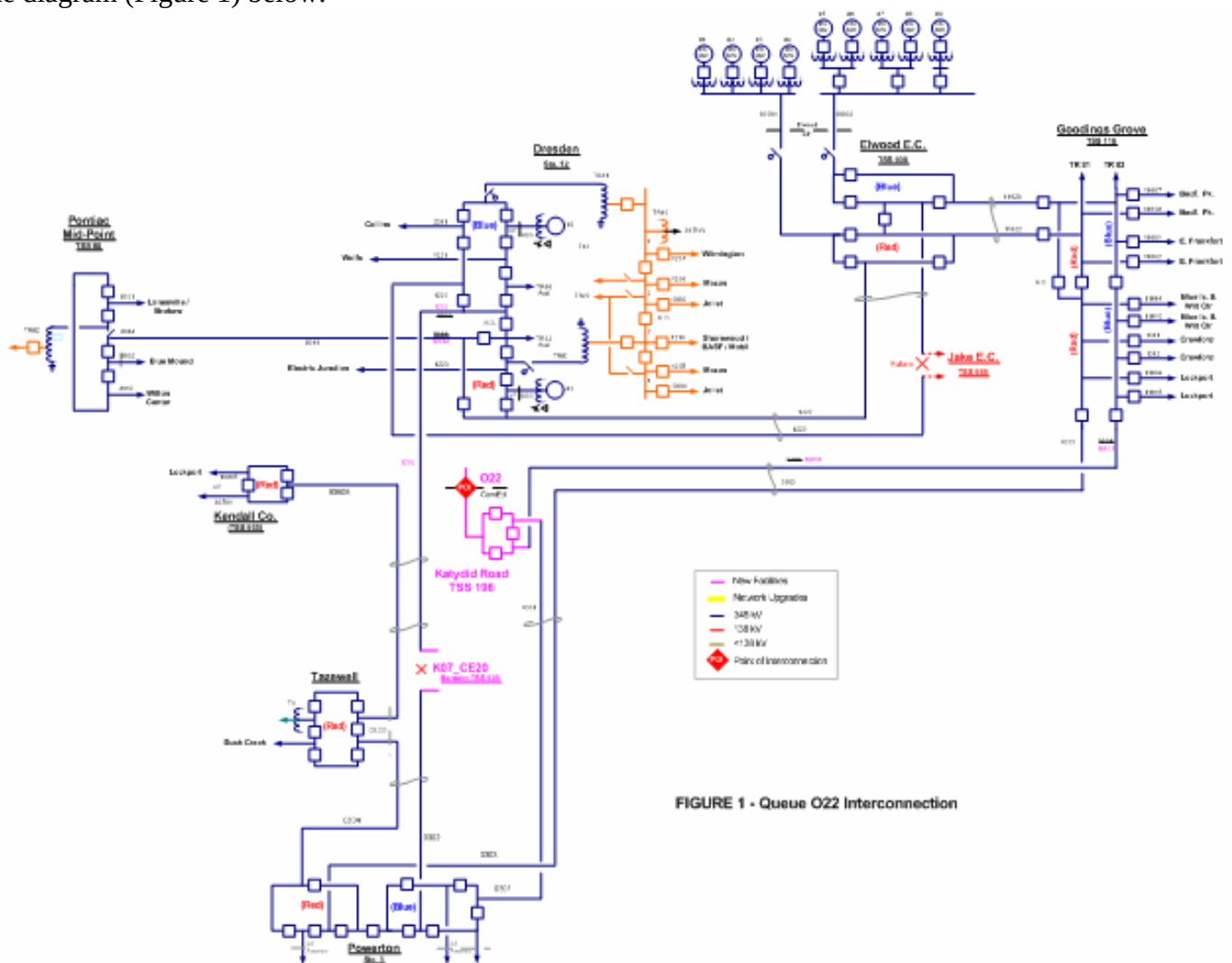
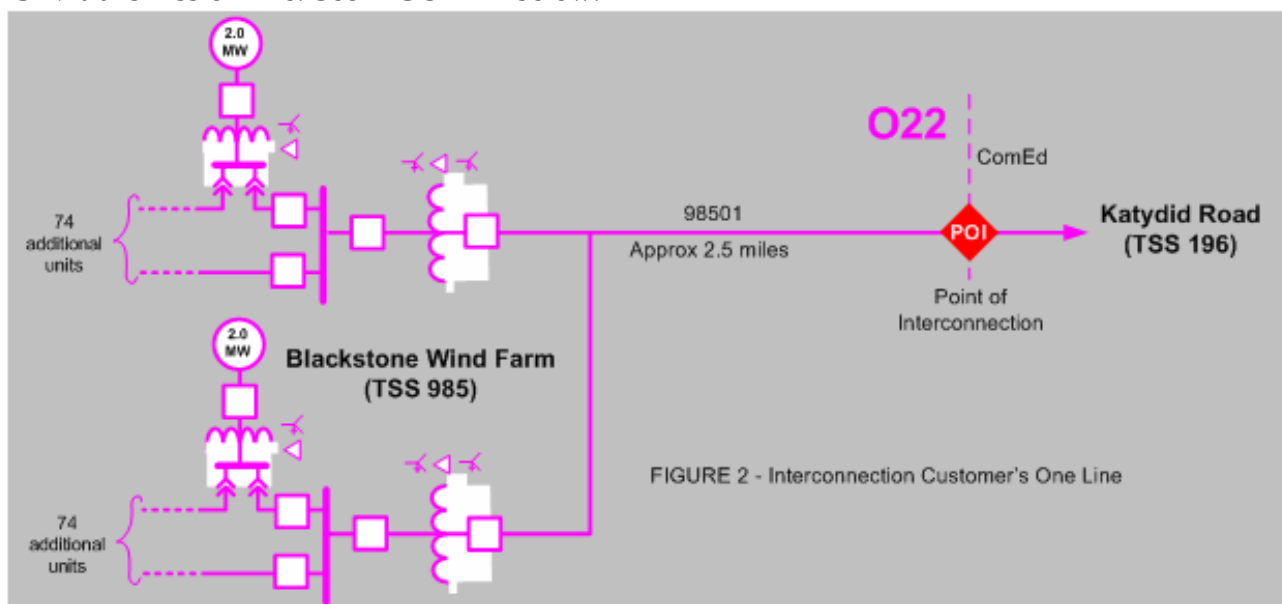


FIGURE 1 - Queue O22 Interconnection

Queue O22 will be interconnected to circuit 0301 by cutting open and tapping the circuit adjacent to the new 345kV substation TSS 196 Katydid Road which is to be sited in proximity to the circuit 0301 Right-of-Way.

Interconnection Customer Scope of Work

Blackstone Wind Farm, LLC, Queue O22, is responsible for constructing all of the facilities on its side of the Point of Interconnection. As illustrated in Figure 2 below, Blackstone Wind Farm, LLC will construct and own a separate substation (identified as TSS 985 Blackstone Wind Farm) which will serve as the collection point for the individual wind farm generators and to step-up the voltage from 34.5kV to 345kV. The 345kV TSS 985 bus will then be connected to TSS 196 Katydid Road via a Blackstone Wind Farm, LLC built and owned two and one half mile long 345kV transmission line. See FIGURE 2 below.



In addition, Queue O22 has indicated that it wants to use the PJM Tariff “Option to Build” provision to construct TSS 196 (Katydid Road) three breaker ring bus 345 kV station and transfer its ownership to ComEd prior to commercial operation of Queue O22 generation. ***Queue O22 will not be responsible for digital microwave facilities located at TSS 196. ComEd will provide all new and upgraded microwave facilities required at TSS 196, Powerton, Goodings Grove and any intermediate repeater site(s), if required.***

It will be the Interconnection Customer’s responsibility to obtain any needed right-of-way between the Queue O22 Wind Farm site and Commonwealth Edison’s facilities.

ComEd proposes to install (and own) the Queue O22 Revenue Metering at TSS 196 Katydid Road station. The Interconnection Customer may instead choose to install (and own) Queue O22 Revenue Metering at its station TSS 985 Blackstone Wind Farm.

ComEd Direct Connection Scope of Work

At the Interconnection Customer's expense ComEd will be responsible for:

1. Cutting new substation TSS 196 in to 0301 line, including new turning structures and termination of conductor from TSS 196 dead end towers to the existing 0301 circuit.
2. Replace remote terminal line protective relaying and control at Powerton and Goodings Grove substations.
3. Install Queue O22 Revenue Metering and substation SCADA equipment at TSS 196.
4. Install digital microwave facilities at TSS 196 Katydid and upgrade microwave facilities from analog to digital at Powerton and Goodings Grove, install new digital microwave facilities at TSS 196 and intermediate sites as necessary.

Conversion from Analog to Digital Microwave Communications for Protective Relaying

ComEd has historically used analog microwave as the communication medium for a vast majority of its EHV protective relaying. Although functional, it is currently technologically obsolete. Analog microwave equipment has not been manufactured since the late 1990's. ComEd must rely on the limited spare parts it has in stock to maintain the existing analog microwave system. Utilizing analog microwave for new substation installations is not feasible. Within the next decade the availability of spare parts and the skilled technicians required to operate analog microwave networks will be greatly diminished. ComEd has itself upgraded from analog to digital microwave communications for recent transmission substation projects. Examples include the installation of Wolfs Substation in 2004 and Pleasant Valley Substation in 2005.

For these reasons, the installation of this project requires the use of digital microwave communications. This will require not only use of digital microwave at the interconnecting substation, but also conversion from analog to digital microwave communications at the remote substations that have lines connected to the interconnecting substation. Also, depending on the distance between these stations, repeater sites have been included in the estimate to maintain an adequate communication path.

Direct Connection Cost and Time Estimates:

The total estimated cost of ComEd work is **\$8,819,000**. The lead-time required for construction of the direct connection facilities is **18 to 24 months** after an Interconnection Service Agreement (ISA) and a Construction Service Agreement (CSA) are executed.

A breakdown of the Direct Connection cost is as follows:

Estimated Cost ComEd Direct Connection Scope of Work

Network Upgrade # n0563 at TSS 196 - ComEd will perform the following:

- \$ 221,000 ❖ ComEd Oversight* of Interconnection Customer's Scope of Work to construct TSS 196 Katydid Road under the "Option to Build".

****Note:*** For applicability of charges for ComEd oversight work see PJM Tariff Sections 11.2.2 and 212.1, and FERC Order Docket number ER06-1170.

- \$ 214,000 ❖ Provide and install 345kV Revenue Metering material (Revenue Meter, optical CTs and PTs, etc.) and SCADA RTU at TSS 196. *Note: The Interconnection Customer may instead elect to install and own Revenue Metering located at the generation site (TSS 985 Blackstone Wind Farm)*

- \$ 224,000 ❖ Acceptance/commissioning testing and legal support related to the transfer of TSS 196 ownership from Blackstone Wind Farm to ComEd.

- \$ 1,354,000 ❖ Tie-in work. ComEd will install 345kV structure(s) and taps to cut-in new station TSS 196 on to line 0301. Includes engineering, site and civil work, material (structures, conductors, foundations) and handling.

- \$ 1,520,000 ❖ Construction of a digital microwave tower and associated communications equipment at TSS 196 Katydid Road as part of the analog to digital conversion for protective relaying.

****Note:*** Network Upgrade n0563 shall not require any ComEd oversight of Interconnection Customer's scope of work at TSS 985 unless mutually agreed to by the Interconnection Customer.

- \$ 382,000 **Network Upgrade number n0564 at Powerton (Sta. 3) - Upgrade existing line 0301 line relaying to be compatible with new line 0301 terminal at TSS 196.**

- \$ 148,000 **Network Upgrade # n0565 at Goodings Grove - Upgrade existing line 0301 line relaying to be compatible with new line 19601 terminal at TSS 196.**

Network Upgrade # n0566 – Digital microwave facilities**

- \$ 4,756,000 ❖ Upgrade, from analog to digital, the existing microwave communications facilities at Powerton (Sta. 3) and Goodings Grove substations. Install new digital microwave equipment (towers and communications equipment) at any intermediate locations as required.

**** Note for Network Upgrade n0566:** ComEd proposes to install a new digital microwave system to provide a communication path necessary for high speed 0301 line (former and new 0301) protective relaying for all line sections between Powerton and Goodings Grove. Replacement of existing analog microwave equipment at Powerton and Goodings Grove is necessary per ComEd because the former analog microwave system equipment is no longer available and supported by the manufacturer.

Network Impacts

Queue O22 was studied as an injection of 300 MW (60 MW of Capacity) into a tap of the Powerton to Goodings Grove 345 kV line 0301. In addition, these studies were performed with the Elwood 345kV bus tie normally closed and the East Frankfort 138kV bus tie normally open. This reflects the normal system configuration in the 2010 study year based upon baseline projects currently listed in the PJM RTEP (Regional Transmission Expansion Plan). Project O22 was evaluated for compliance with reliability criteria for summer peak conditions in 2010. Potential network impacts were as follows:

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

No problems were identified.

Multiple Facility Contingency

(Double Circuit Towerline, Stuck breaker and bus fault contingencies)

1. **Network Upgrade number n0602.** Queue O22 contributes **40.4 MVA** (2.8 MVA above rating) to the overload of the AEP owned Kammer 765-500kV transformer to increase the **loading from 97.8% to 100.2%** of its 4 hour emergency rating (**1434 MVA**) for the “Multiple Facility Contingency” outage of the Belmont to Harrison 500 kV line followed with a stuck breaker at the Belmont substation terminal.

No additional thermal overload problems were identified. However, the initial study result for the Goodings Grove to Queue O22 and the Goodings Grove to Powerton 345kV tower outage of lines 19601 (existing 0301) & 0303, and the Queue O22 project generating at full output indicates a need for reactive support in the area near the Queue O22 project. This will be explored further, along with stability and zero voltage ride-through analysis, during the Queue O22 Facilities Study.

Short Circuit

No problems were identified.

Stability Analysis and Reactive Requirement for Zero Voltage Ride-Through

Will be performed for the Queue O22 Facilities Study

Queue O22 may impact the Powerton Stability Schemes due to the interconnection point on line 0301 Powerton to Goodings Grove.

Contribution to Previously Identified Overloads

(Queue O22 contributes to the following contingency overloads, i.e. Network Impacts”, identified for earlier generation or transmission interconnection projects in the PJM Queue)

2. **Network Upgrade number n0587.** Queue O22 contributes **16.8 MVA** to the overload of the AEP owned 345kV line from Kammer to West Bellaire to increase the **overload from 101 % to 102.5 %** of its 4 hour emergency rating (**1304 MVA**) for the “Multiple Facility Contingency” outage of the Kammer to Scanto 765kV line followed by the stuck breaker NN1 at Kammer Substation. This line was found to be first overloaded by the Queue O09 project.

Network Upgrade Requirements

New System Reinforcements

(Upgrades required to mitigate reliability criteria violations, i.e. “Network Impacts”, initially caused by the addition of Queue O22 generation)

1. **Network Upgrade number n0602.** The overload of the AEP owned Kammer 765-500kV transformer, for the “Multiple Facility Contingency” outage of the Belmont to Harrison 500 kV line followed with a stuck breaker at the Belmont substation terminal, can be mitigated by adding a 500kV circuit breaker at Belmont at an estimated cost of **\$1,500,000** and installation time of **18 months**. **Queue O22 is the first project to cause the need for this upgrade and will be responsible for 100% allocation as of its Queue position.** Other later Queues may have also have an allocation.

Contribution to Previously Identified System Reinforcements

(Overloads initially caused by prior Queue positions with additional contribution to overloading by Queue O22. Queue O22 % allocation cost responsibility was calculated in accordance with the PJM Tariff and reported below)

2. **Network Upgrade number n0587.** Queue O22 is responsible for **\$29,920** of the \$52,000 estimated cost to reinforce the AEP-owned 345kV line from Kammer to West Bellaire by replacing the risers at Kammer 345kV station to increase the 4 hr. emergency line rating from 1304 MVA to 1413 MVA.

Cost allocation at the Queue O22 Queue position for **n0587** (*later Queues may also contribute*).

Queue	MW Overload Contribution	% allocation***	Estimated Cost
O09	12.4 MW	29.1%	\$22,080
O22	16.8 MW	70.9%	\$29,920

*** Note: Allocation calculation above affected by rounding.

Potential Issues

Impacts on the MISO member transmission systems are not included in this analysis, but they will be included in the Facilities Study , which may indicate upgrades needed in the MISO System not identified in this Impact Study.

Delivery of the Energy Portion of the Request

PJM also studied the delivery of the energy portion of this interconnection request. There were no problems identified.