PJM Generator Interconnection
Queue #T148
Caledonia Wind II 100MW
System Impact Study Report

November 16, 2012
Revised November 12, 2013
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Preface

The intent of this System Impact Study is to determine a plan, with 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 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.

The PJM Reliability Planning Process utilizes PJM planning criteria, NERC Planning Standards, NERC Regional Council planning criteria, and the individual Transmission Owner FERC filed planning criteria. In all cases, PJM applies the most conservative of all applicable planning criteria when identifying reliability problems and determining the need for system upgrades on the PJM system. The application of the NERC Planning Standards is adapted to the specific needs of the PJM system.

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. All facilities required for interconnection of a generation interconnection project must be designed in compliance with the technical specifications (on PJM web site) for the appropriate Transmission Owner.

After the System Impact Study Agreement is executed and prior to execution of the Interconnection Service Agreement, an Interconnection Customer may modify its project to reduce the electrical output (MW) (in the case of a Generation Interconnection Request) of the proposed project by up to the larger of 20 percent of the capability considered in the System Impact Study or 50 MW.

The System Impact 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.

General

The Interconnection Customer is proposing 53 Acciona AW 1500 1.5MW wind turbines and has requested to be studied as a 100MW (20 MW Capacity) resource. The wind farm will be located in Caledonia, Illinois. The proposed in-service date for this project was **January 2010 and is currently under review**. Impacts on the MISO member transmission systems are not included in this analysis, but they will be included in the Facilities Study, which may reveal upgrades needed in the MISO system not identified in this Impact Study.

The intent of the System Impact Study is to determine system reinforcements, 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.

Facilities to Accommodate the Interconnection

Scope of Direct Connection Work

The T148 project was studied as a 100 MW (20 MW Capacity) injection at the TSS 890 Kelley Road substation (POI for the T99 project) on the Wempletown to Belvidere 138kV line 17105 in the ComEd area by adding an additional line bay. Project T148 was evaluated for compliance with reliability criteria for summer peak conditions in 2013.

The Interconnection Customer is responsible for constructing all of the facilities on the Interconnection Customer side of the point of interconnection. It will be the Interconnection Customer's responsibility to obtain any required right-of-way between the Collector Substation and Interconnection Substation.

Direct Connection Cost Estimate

The total preliminary cost estimate for Direct Connection work is given in the following tables below:

Description	Total Cost
Install one 138kV circuit breaker at TSS 890 Kelly Road Substation to create line position. Also, upgrade relay/SCADA/Communication at this substation.	**$ 3,000,000**
Total	

Note: Project T99 has in its scope the replacement of a normally open circuit switcher at TSS 122 Belvedere with a circuit breaker. Should T99 withdraw, then T148 would be responsible for the replacement.

Cost Estimate Notes:

1) These Estimates are Order-of-Magnitude estimates of the costs that ComEd would bill to the customer for this interconnection. These estimates are based on a one-line electrical diagram of the project and the information provided to PJM and ComEd by the Interconnection Customer.

2) These cost estimates do not include cost of acquiring right-of-way for the transmission line and purchasing any additional land, if needed, for the line terminations. The need and cost of acquiring property and associated legal costs will be investigated during Facilities Study for this project.

3) There were no site visits performed for these estimates. There may be costs related to specific site related issues that are not identified in these estimates. The site reviews will be performed during the Facilities Study or during detailed engineering.

4) These estimates are not a guarantee of the maximum amount payable by the Interconnection Customer and the actual costs of ComEd's work may differ significantly from these estimates. Per the PJM Tariff, Interconnection Customer will be responsible for paying all actual costs of ComEd's work

5) The Interconnection Customer is responsible for all engineering, procurement, testing and construction of all equipment on the Interconnection Customer's side of the Point of Interconnection (POI).

6) During the Facilities Study kickoff meeting, it has been determined that the Interconnection Customer desires to perform the engineering for work inside the interconnection substation TSS890 Kelley Road. These estimates do not reflect this change in the scope of work. The estimates in the Facilities Study report will.

Project Schedule Notes:

The total time frame to complete engineering, procurement, and construction for the ComEd portion of this project is approximately 18 – 24 months after the Interconnection Service Agreement (ISA) and Construction Service Agreement (CSA) are executed.

Revenue Metering and SCADA Requirements

For PJM: The Interconnection Customer (IC) will be required to install equipment necessary to provide Revenue Metering (KWH, KVARH) and real time data (KW,

KVAR) for the Interconnection Customer's generating Resource. See PJM Manuals M-01 and M-14D, and PJM Tariff Section 24.1 and 24.2.

For ComEd: The Interconnection Customer (IC) will be required to install equipment necessary to provide bi-directional Revenue Metering (KWH, KVARH) and real time data (KW, KVAR, circuit breaker status, and 138 kV voltage) for the Interconnection Customer's generating Resource. See ComEd Applicable Standards available on the PJM website ("TO Standards") – "Exelon Energy Delivery Interconnection Guidelines (Generators Greater than 20 MW)".

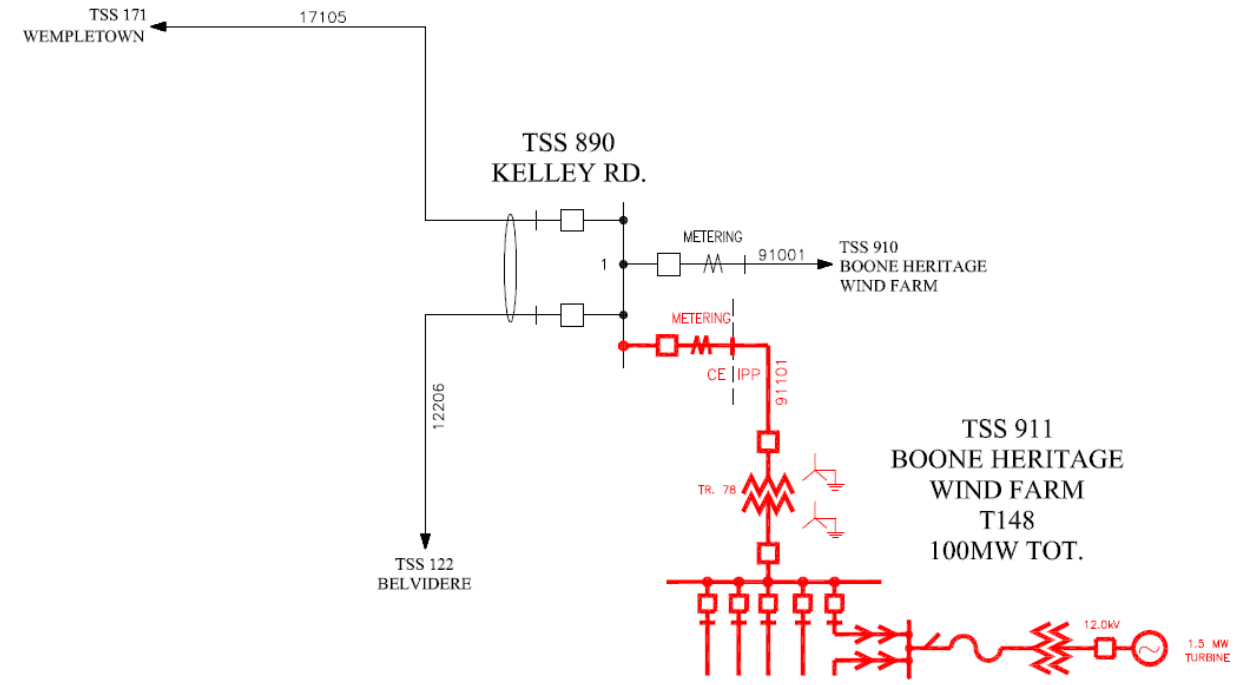

Figure 1. Proposed Interconnection Diagram

Network Impacts
The Queue Project #T-148 was studied as a(n) 100 MW(Capacity 20 MW) injection at the TSS 890 **Kelley Road substation** on the Wempletown to Belvidere 138 kV line 17105 in the ComEd area. Project #T-148 was evaluated for compliance with reliability criteria for summer peak conditions in 2013. 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, Line with Failed Breaker and Bus Fault contingencies for the full energy output)

No problems identified

Multiple Facility Contingency Impacts Caused By MISO Generator Interconnection Projects
(*Double Circuit Tower Line, Line with Failed Breaker and Bus Fault contingencies for the full energy output. Overloads initially caused by projects in the MISO Queue with additional contribution to the overload by this project.)*

No problems identified.

Short Circuit
(Summary form of Cost allocation for breakers will be inserted here if any)

No problems identified

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)

No problems identified

Steady-State Voltage Requirements
(Results of the steady-state voltage studies should be inserted here)

No problems identified

Stability and Low Voltage Ride-Through
(Results of the dynamic studies should be inserted here)

To be determined in Facilities Study.

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

None

Delivery of Energy Portion of Interconnection Request
PJM also studied the delivery of the energy portion of this interconnection request. Any 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 Merchant Transmission Interconnection request.
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 will study all overload conditions associated with the overloaded element(s) identified.

1. (CE - CE) The ARGYL; B-SANDP;BT 138 kV line (from bus 36424 to bus 37200 ckt 1) loads from 57.95% to 106.72% (AC power flow) of its emergency rating (178 MVA) for the single line contingency outage of '138-L12206_B-R'. This project contributes approximately 100.0 MW to the thermal violation.

```
CONTINGENCY '138-L12206_B-R'
 TRIP BRANCH FROM BUS 37215 TO BUS 36532 CKT 1              /* CE #15 KINNIKINNIK TO BELVEDERE
 END
```

2. (CE - CE) The T990 ; T-ARGYL; B 138 kV line (from bus 37215 to bus 36424 ckt 1) loads from 57.33% to 114.52% (AC power flow) of its emergency rating (178 MVA) for the single line contingency outage of '138-L12206_B-R'. This project contributes approximately 100.0 MW to the thermal violation.

```
CONTINGENCY '138-L12206_B-R'
 TRIP BRANCH FROM BUS 37215 TO BUS 36532 CKT 1              /* CE #15 KINNIKINNIK TO BELVEDERE
 END
```

3. (CE - CE) The T990 ; T-BELVI; B 138 kV line (from bus 37215 to bus 36532 ckt 1) loads from 89.42% to 114.93% (AC power flow) of its emergency rating (178 MVA) for the single line contingency outage of '138-L15624_B-R'. This project contributes approximately 44.46 MW to the thermal violation.

```
CONTINGENCY '138-L15624_B-R'
 TRIP BRANCH FROM BUS 36598 TO BUS 36606 CKT 1              /* CHERR; B 138 B465 ;BT 138
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TRIP BRANCH FROM BUS 36606 TO BUS 36608 CKT 1          /* B465 ;BT 138 B465 ; B 138
TRIP BRANCH FROM BUS 36606 TO BUS 36532 CKT 1          /* B465 ;BT 138 BELVI; B 138
MOVE 25.0 PERCENT LOAD FROM BUS 36532 TO BUS 36533
MOVE 100.0 PERCENT LOAD FROM BUS 36608 TO BUS 36609
END
```

Light Load Reliability Analysis

The T148 project was studied as a 100 MW injection at the TSS 890 Kelley Road substation (POI for the TSS 990 Kinnikinnik Creek Wind Farm) on the Wempletown to Belvidere 138kV line 17105 in the ComEd area. Project T99 evaluated for compliance with reliability criteria for **Light Load conditions** in 2014. Potential network impacts were as follows:

Generator Deliverability for Light Load

(Single or N-1 contingencies for the Capacity portion only of the interconnection)

None

Multiple Facility Contingency for Light Load

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

None

Contribution to Previously Identified Overloads for Light Load

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

1. The Cherry Valley – Silver Lake 345 kV line (from bus 270695 to bus 270883 ckt 1) loads from 100.45% to 101.79%(AC power flow) of its emergency rating (1479 MVA) for the single contingency outage '345-L15502_B-R_B'. This project contributes approximately 19.7 MW to the thermal violation.

```
CONTINGENCY '345-L15502_B-R_B'                    / CONTINGENCY # 487 / P20
TRIP BRANCH FROM BUS 294490 TO BUS 270730 CKT 1          / P20(NELSO; B) 345 ELECT; B 345
END
```

Steady-State Voltage Requirements for Light Load

(Results of the steady-state voltage studies should be inserted here)

None

New System Reinforcements for Light Load

(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 for Light Load
(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)
(Summary form of Cost allocation for transmission lines and transformers will be inserted here if any)

For the Cherry Valley – Silver Lake overload, the proposed mitigation is to build a new Byron – Wayne 345 kV line (PJM baseline network upgrade b2141). The need for this baseline was determined subsequent to the identification of the Cherry Valley—Silver Lake overload identified in this report. The cost to this project will be cost capped at the estimated Cherry Valley-Silver Lake reconductor cost of $45,000,000 which will be applied to the Byron-Wayne construction. T99 has been allocated a portion of this cost. Other subsequent projects have/may be given allocations to this $45,000,000 cap. ComEd has proposed a 6/1/2017 in service date for the Byron-Wayne line.

Queue Project	Impact, MW	Impact, %	Cost, $M
T99	6.7	25.38%	11.4205
T148	19.7	74.62%	33.5795

Affected RTOs

Cross border studies with the Midcontinent Independent System Operator (MISO) indicates no issues in their transmission system.