

***PJM Generator Interconnection
Impact Study Report***

***# O35 Providence Heights Wind
138kV
74 MW Energy
(14.8 MW Capacity)***

Amended May 2008

DOCS-420446-v4

Introduction

This System Impact Study Report has been prepared in accordance with the PJM Open Access Tariff § 205 as well as the System Impact Study Agreement dated March 22, 2006 between Crescent Ridge Wind II, LLC (Interconnection Customer (IC)) and PJM Interconnection, LLC (Transmission Provider(TP)).

General

The Developer, Providence Heights Wind, LLC (Interconnection Customer) has proposed the construction and interconnection of the Providence Heights Wind 138kV wind farm consisting of 74 MW of wind generation capability with 20% (14.8 MW) capacity. The proposed facility will Interconnect with the Commonwealth Edison Company (ComEd) transmission system and consists of 37 – 2.0 MW Gamesa G87 wind turbine generators located near the town of Tiskilwa, Illinois. The O35 Providence Heights Wind 138kV interconnection is via the construction of a new 138 kV breaker position added to the existing Transmission Switching Station (TSS) 981 Crescent Ridge.

The estimated total cost to complete all work required to install the facilities for interconnection is dependent upon the withdrawal of prior queue projects O09, O27, and O29. A written notice of option to build has been submitted to the Transmission Provider and the Transmission Owner in accordance with PJM Tariff Part IV, §3.2.3.1 in Appendix 2 of Attachment P in which the IC has elected to build the single circuit breaker expansion at TSS 981 Crescent Ridge switching station.

See Figure 1 for diagram of Interconnection.

Attachment Facilities

The Interconnection Customer will construct all facilities to include the wind turbine systems, lines, generator step-up transformers (GSU's) and breakers up to the point of Interconnection with the single circuit breaker expansion of TSS 981 Crescent Ridge including construction of the new switching station TSS 983 Providence Heights Wind. The Interconnection Customer will purchase real estate to accommodate the expansion of TSS 981 Crescent Ridge, construction of TSS 983 Providence Heights Wind as well as provide right of way for all Interconnection activities. Additionally, under the option to build, the IC will construct the single breaker expansion at TSS 981 Crescent Ridge.

ComEd responsibility for Attachment Facilities includes Oversight of the expansion of TSS 981 Crescent Ridge as well as purchasing and installing metering necessary for this project at TSS 981. ComEd will observe installation and commissioning testing of the expansion at TSS 981 Crescent Ridge. ComEd cost and scope of work for these facilities are further described below.

ComEd Scope of Work consists of the following:

- 1) **TSS 981 Crescent Ridge- ComEd Oversight** ComEd review of Interconnection Customer's engineering design, construction oversight and project management at TSS 981 Crescent Ridge. The estimated cost for this work is **\$ 161,000**.

Network Upgrades

The Interconnection of the proposed facility will require Network Upgrades which include (1) Replacement of one (1) 138kV circuit breaker at TSS 74 Kewanee, (2) Installation of a tap at TSS 981 to allow for Interconnection of the single circuit breaker expansion and (3) Installation of synch check function at Kewanee TSS 74 for SCADA close of line 7413.

ComEd Scope of Work along with associated costs consists of the following:

- 1) **Upgrade at TSS 74 Kewanee** Replace 138kV circuit breaker with new 138kV SF6 gas circuit breaker. This includes site improvement, all engineering, protection and control, testing, material and handling. Revise relay settings for new configuration, line relaying, etc. The estimated cost for this work is **\$770,625**.
- 2) **Install Tap at TSS 981 Crescent Ridge** Install 138kV tap to tie in new circuit breaker at TSS 981 Crescent Ridge. The estimated cost of this work is **\$ 6,954**.
- 3) **Install synch check function at TSS 74 Kewanee** This will provide for SCADA closure of line 7413. This new relay will supervise the closing of the line 7413 circuit breaker at Kewanee when the Transmission Dispatcher closes it manually through SCADA. The estimated cost for this work is **\$29,000**.

The total estimated cost is \$ 1,716,347 for the ComEd Scope of Work. This estimate is based on the scope of work required at the interconnection substation, all remote sites, and network upgrades as described previously. There were no site visits performed for this estimate. There may be costs related to specific site related issues that are not identified in the estimate. These site reviews will be performed during the facilities study or during detailed engineering. The lead-time required for construction of the facilities is 18 to 24 months after an Interconnection Service Agreement (ISA) and Construction Service Agreement (CSA) are executed.

Network Impacts

The O35 project was studied as a total injection of 75 MW (15 MW of Capacity) to the Crescent Ridge 138 kV facility. Project O35 was evaluated for compliance with reliability criteria for summer peak conditions in 2010. Potential network impacts were as follows:

Generator Deliverability

No problems were identified.

Multiple Facility Contingency

The study result for a fault on 138kV line 15508 with a stuck breaker at Nelson and the #O35 project generating at full output indicates the need for reactive support in the area near the #O35 project.

Short Circuit

The #O35 project caused the ComEd-owned 138kV line 7411 circuit breaker at TSS 74 Kewanee to become overdutied at 101.2% of the circuit breaker rating (14.7kA).

Contribution to Previously Identified Overloads

The #O35 project contributes 75MW to the ComEd-owned Crescent Ridge to Oglesby Tap 138kV line 7713 loading, changing it from 82.2% to 144.9% of its load-dump rating (116 MVA; relay setting limited) for the tower contingency of Kewanee to Crescent Ridge 138kV line 7413 and Kewanee to Streator 138kV line 6101. This monitored element was initially overloaded due to the #O29 project for a fault on 138kV line 15508 with a stuck breaker at Nelson. The branch needs to be upgraded to accommodate a minimum loading of 168 MVA.

Stability and Reactive Power Requirement for Low Voltage Ride Through

Stability analysis was performed at 2009 summer peak load condition with plant gross output of 76 MW associated with the proposed O35 queue project, Gamesa 2.0MW turbines were used to perform the study. The turbines were modeled at their power factor control mode and the maximum generation output is considered. The range of contingencies evaluated was limited to that necessary to assess expected compliance with ComEd Stability criteria.

With the specified transformer impedance and the specified turbines, Gamesa 2.0MW, no additional reactive compensation is required and the turbines are required to operate in the power factor control mode with the power factor at the generator terminal set between 0.99 leading* and their full lagging* capability, which is equal to or above 0.953 leading at the interconnection point.

*** Leading means consuming VARs from the system and Lagging means supplying VARs to the system.**

Note: While the stability analysis has been performed at expected extreme system conditions, there is a potential that evaluation at a different level of generator MW and/or MVAR output at different system load levels and operating conditions would disclose unforeseen stability problems. The regional reliability analysis routinely performed to test all system changes will include one such evaluation. Any problems uncovered in that or other operating or planning studies will need to be resolved.

Moreover, when the proposed generating station is designed and plant specific dynamics data for the wind plant and its controls are available, and if it is different than the data provided for this study, a transient stability analysis at a variety of expected operating conditions using the more accurate data shall be performed to verify impact on

the dynamic performance of the system. As more accurate or unit specific dynamics data for the proposed facility, as well as Plant layout become available, it must be forwarded to PJM.

See Attachments 1 and 2 for details of the stability results.

New System Reinforcements

1. The overdutied ComEd-owned 138kV line 7411 circuit breaker at TSS 74 Kewanee needs to be replaced with a new 138kV SF6 gas circuit breaker. Minimum interrupting capability of 40kA at -40°F per assumed standard.

Contribution to Previously Identified System Reinforcements

The overload of the ComEd-owned Crescent Ridge to Oglesby Tap 138 kV line 7713 can be relieved by updating the relays with a load encroachment setting at Crescent Ridge TSS 981.

Impacts to Adjacent Systems

The Midwest Independent System Operator has indicated that this project does not have an adverse impact on transmission facilities within their area.

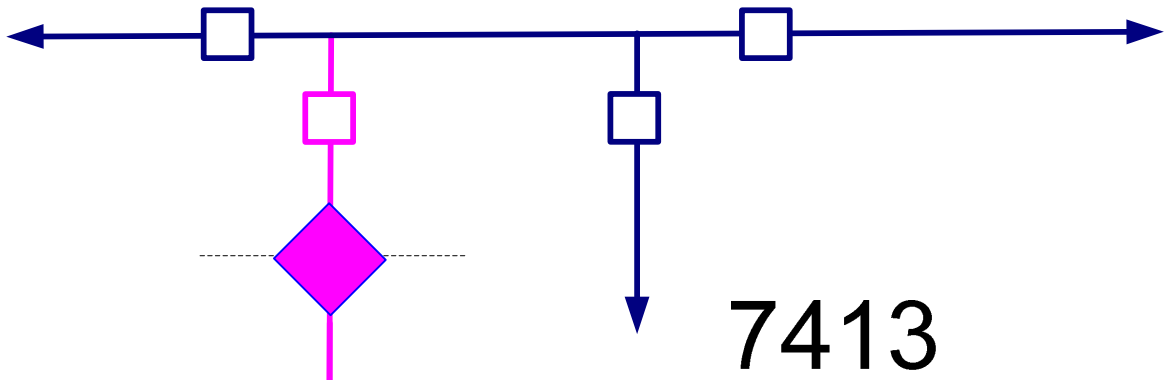
Potential Issues

During certain maintenance outages the #O35 project will be required to be taken off line. For example, during a maintenance outage on the 138kV line 1206 from Mazon to Dresden, a single contingency of 138kV line 7413 from Kewanee to Crescent Ridge would island the existing generation at Crescent Ridge and the #O35 project into the load and generation at Oglesby (AmerenIP). Similar issues may occur for other combinations of maintenance outages involving these and other elements. The typical duration of a maintenance outage on the ComEd system is one week.

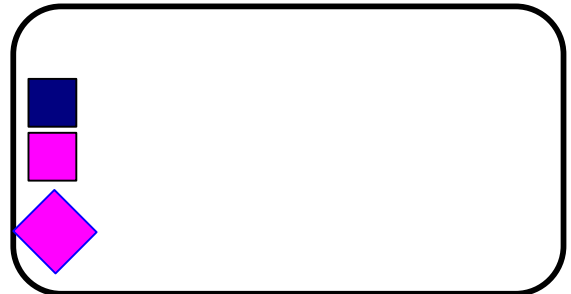
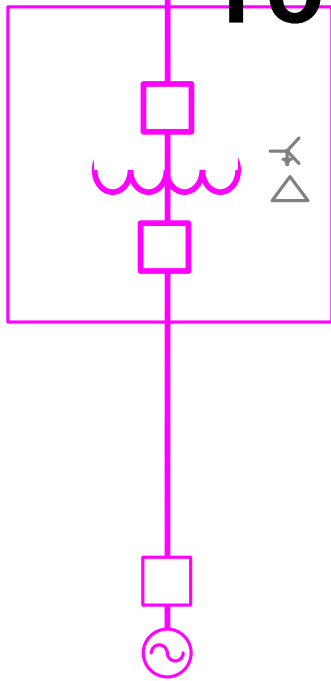
Delivery of Energy Portion of Interconnection Request

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.

1. Contribution of 15 MW increases the loading on the Nelson to Rock Falls 138 kV line (#15509) from 127.6% to 135.1% of its emergency rating (184 MVA) for the outage of 138kV line 15508. The congestion on the monitored element was first caused by the #O29 project.
2. Contribution of 9 MW increases the loading on the Rock Falls to #O09 138kV line (#13311) from 105.4% to 111.4% of its normal rating (140 MVA) for system normal conditions.
3. Contribution of 15 MW increases the loading on the Rock Falls to #O09 138kV line (#13311) from 144.0% to 151.7% of its emergency rating (184 MVA) for the outage of 138kV line 15508.
4. Contribution of 15 MW increases the loading on the #O29 to Nelson Tap portion of 138 kV line #15508 from 109.4% to 115.0% of its emergency rating (265 MVA) for the outage of 138kV line 13311.



To Kewanee



Attachment #1

O35

2009 peak load Stability case

BREAKER CLEARING TIMES (CYCLES)

<u>Station</u>	<u>Primary (3ph/slg)</u>	<u>Stuck Breaker (total)</u>	<u>Zone 2 (total)</u>
Crescent Ridge 138KV (line 7413)	6	-	-
Other 138KV	8	18	-

All facilities in service

- 1a. 3ph@Crescent Ridge on line 7413 (Crescent Ridge – Kewanee)
- 2a. 3ph@Crescent Ridge on line 7713 (Crescent Ridge –Mazon)
- 3a. 3ph@ Kewanee on line 7421 (Kewanee – Toulon)
- 3b. 3ph@ Kewanee on line 7421 (Kewanee – Toulon), with BF@Kewanee
- 4a. 3ph@ Kewanee on line 6101 (Kewanee – Streator)
- 4b. 3ph@ Kewanee on line 6101 (Kewanee – Streator), with BF@Kewanee
- 5a. 3ph@ Kewanee on line 7423 (Kewanee – Edwards)
- 5b. 3ph@ Kewanee on line 7423 (Kewanee – Edwards), with BF@Kewanee
- 6a. 3ph@ Kewanee on line 7411 (Kewanee – Normandy)
- 6b. 3ph@ Kewanee on line 7411 (Kewanee – Normandy), with BF@Kewanee
- 7a. 3ph@ Kewanee on line 15508 (Kewanee – Normandy)
- 7b. 3ph@ Kewanee on line 15508 (Kewanee – Normandy), with BF@Kewanee
- 8a. 3ph@ Kewanee on line 1366(Kewanee – Galesburg)
- 8b. 3ph@ Kewanee on line 1366(Kewanee – Galesburg), with BF@Kewanee
- 9a. 3ph@ Mazon on line 1206 (Mazon – Dresden)
- 9b. 3ph@ Mazon on line 1206 (Mazon – Dresden), with BF@ Mazon

P: 7413 line (Crescent Ridge – Kewanee) is out of service

- 9a. 3ph@ Mazon on line 1206 (Mazon – Dresden)

Q: 7713 line (Crescent Ridge – Mazon) is out of service

- 3a. 3ph@ Kewanee on line 7421 (Kewanee – Toulon)
- 4a. 3ph@ Kewanee on line 6101 (Kewanee – Streator)
- 5a. 3ph@ Kewanee on line 7423 (Kewanee – Edwards)
- 6a. 3ph@ Kewanee on line 7411 (Kewanee – Normandy)
- 7a. 3ph@ Kewanee on line 15508 (Kewanee – Normandy)
- 8a. 3ph@ Kewanee on line 1366(Kewanee – Galesburg)

Attachment #1

R: 6101 line (Kewanee – Streator) is out of service

- 1a. 3ph@Crescent Ridge on line 7413 (Crescent Ridge – Kewanee)
- 2a. 3ph@Crescent Ridge on line 7713 (Crescent Ridge –Mazon)
- 3a. 3ph@ Kewanee on line 7421 (Kewanee – Toulon)
- 5a. 3ph@ Kewanee on line 7423 (Kewanee – Edwards)
- 6a. 3ph@ Kewanee on line 7411 (Kewanee – Normandy)
- 7a. 3ph@ Kewanee on line 15508 (Kewanee – Normandy)
- 8a. 3ph@ Kewanee on MISO tie line
- 9a. 3ph@ Mazon on line 1206 (Mazon – Dresden)

S: 7423 line (Kewanee – Edwards) is out of service

- 1a. 3ph@Crescent Ridge on line 7413 (Crescent Ridge – Kewanee)
- 2a. 3ph@Crescent Ridge on line 7713 (Crescent Ridge –Mazon)
- 3a. 3ph@ Kewanee on line 7421 (Kewanee – Toulon)
- 4a. 3ph@ Kewanee on line 6101 (Kewanee – Streator)
- 6a. 3ph@ Kewanee on line 7411 (Kewanee – Normandy)
- 7a. 3ph@ Kewanee on line 15508 (Kewanee – Normandy)
- 8a. 3ph@ Kewanee on MISO tie line
- 9a. 3ph@ Mazon on line 1206 (Mazon – Dresden)

T: 7411 line (Kewanee – Normandy) is out of service

- 1a. 3ph@Crescent Ridge on line 7413 (Crescent Ridge – Kewanee)
- 2a. 3ph@Crescent Ridge on line 7713 (Crescent Ridge –Mazon)
- 3a. 3ph@ Kewanee on line 7421 (Kewanee – Toulon)
- 4a. 3ph@ Kewanee on line 6101 (Kewanee – Streator)
- 5a. 3ph@ Kewanee on line 7423 (Kewanee – Edwards)
- 7a. 3ph@ Kewanee on line 15508 (Kewanee – Normandy)
- 8a. 3ph@ Kewanee on line 1366(Kewanee – Galesburg)
- 9a. 3ph@ Mazon on line 1206 (Mazon – Dresden)

U: 15508 line (Kewanee – Normandy) is out of service

- 1a. 3ph@Crescent Ridge on line 7413 (Crescent Ridge – Kewanee)
- 2a. 3ph@Crescent Ridge on line 7713 (Crescent Ridge –Mazon)
- 3a. 3ph@ Kewanee on line 7421 (Kewanee – Toulon)
- 4a. 3ph@ Kewanee on line 6101 (Kewanee – Streator)
- 5a. 3ph@ Kewanee on line 7423 (Kewanee – Edwards)
- 6a. 3ph@ Kewanee on line 7411 (Kewanee – Normandy)
- 8a. 3ph@ Kewanee on line 1366(Kewanee – Galesburg)
- 9a. 3ph@ Mazon on line 1206 (Mazon – Dresden)

V: 1366 line (Kewanee – Galesburg) is out of service

- 1a. 3ph@Crescent Ridge on line 7413 (Crescent Ridge – Kewanee)
- 2a. 3ph@Crescent Ridge on line 7713 (Crescent Ridge –Mazon)
- 3a. 3ph@ Kewanee on line 7421 (Kewanee – Toulon)
- 4a. 3ph@ Kewanee on line 6101 (Kewanee – Streator)
- 5a. 3ph@ Kewanee on line 7423 (Kewanee – Edwards)
- 6a. 3ph@ Kewanee on line 7411 (Kewanee – Normandy)
- 7a. 3ph@ Kewanee on line 15508 (Kewanee – Normandy)
- 9a. 3ph@ Mazon on line 1206 (Mazon – Dresden)

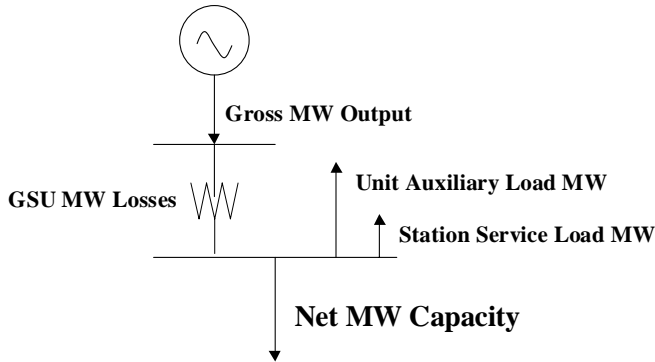
Attachment #1

W: 1206 (Mazon – Dresden) is out of service

- 1a. 3ph@Crescent Ridge on line 7413 (Crescent Ridge – Kewanee)
- 2a. 3ph@Crescent Ridge on line 7713 (Crescent Ridge –Mazon)
- 3a. 3ph@ Kewanee on line 7421 (Kewanee – Toulon)
- 4a. 3ph@ Kewanee on line 6101 (Kewanee – Streator)
- 5a. 3ph@ Kewanee on line 7423 (Kewanee – Edwards)
- 6a. 3ph@ Kewanee on line 7411 (Kewanee – Normandy)
- 7a. 3ph@ Kewanee on line 15508 (Kewanee – Normandy)
- 8a. 3ph@ Kewanee on line 1366(Kewanee – Galesburg)

Attachment #2

Unit Capability Data



$$\text{Net MW Capacity} = (\text{Gross MW Output} - \text{GSU MW Losses}^* - \text{Unit Auxiliary Load MW} - \text{Station Service Load MW})$$

Queue Letter/Position/Unit ID: _____ O35

Primary Fuel Type: _____ Wind /Gamesa 2.0

Maximum Summer (92° F ambient air temp.) Net MW Output**: _____ 75/2.0 per turbine

Maximum Summer (92° F ambient air temp.) Gross MW Output: _____ 76/2.0 per turbine

Minimum Summer (92° F ambient air temp.) Gross MW Output: _____ 76/2.0 per turbine

Maximum Winter (30° F ambient air temp.) Gross MW Output: _____ 76/2.0 per turbine

Minimum Winter (30° F ambient air temp.) Gross MW Output: _____ 76/2.0 per turbine

Gross Reactive Power Capability at Maximum Gross MW Output – Please include Reactive Capability Curve (Leading and Lagging): _____ 25MVAR

Individual Unit Auxiliary Load at Maximum Summer MW Output (MW/MVAR): _____ .04/.02

Individual Unit Auxiliary Load at Minimum Summer MW Output (MW/MVAR): _____ 04/.02

Individual Unit Auxiliary Load at Maximum Winter MW Output (MW/MVAR): _____ 04/.02

Individual Unit Auxiliary Load at Minimum Winter MW Output (MW/MVAR): _____ 04/.02

Station Service Load (MW/MVAR): _____ 0.2/.1

* GSU losses are expected to be minimal.

** Your project’s declared MW, as first submitted in Attachment N, and later confirmed or modified by the Impact Study Agreement, should be based on either the 92° F Ambient Air Temperature rating of the unit(s) or, if less, the declared Capacity rating of your project.

Attachment #2

Unit Generator Dynamics Data

Queue Letter/Position/Unit ID: _____ 035
MVA Base (upon which all reactances, resistance and inertia are calculated): _____ 2.1
Nominal Power Factor: _____ 1.0
Terminal Voltage (kV): _____ 0.69

Unsaturated Reactances (on MVA Base)

Direct Axis Synchronous Reactance, $X_{d(i)}$: _____ 14.05
Direct Axis Transient Reactance, $X'_{d(i)}$: _____ 0.649
Direct Axis Sub-transient Reactance, $X''_{d(i)}$: _____ 0.462
Quadrature Axis Synchronous Reactance, $X_{q(i)}$: _____ 14.05
Quadrature Axis Transient Reactance, $X'_{q(i)}$: _____ 0.649
Quadrature Axis Sub-transient Reactance, $X''_{q(i)}$: _____ 0.462
Stator Leakage Reactance, X_l : _____ 0.3191
Negative Sequence Reactance, $X_{2(i)}$: _____ 13.70
Zero Sequence Reactance, X_0 : _____ 0.06
Saturated Sub-transient Reactance, $X''_{d(v)}$ (on MVA Base): _____ 0.376
Armature Resistance, R_a (on MVA Base): _____ 0.0204

Time Constants (seconds)

Direct Axis Transient Open Circuit, T'_{do} : _____ 1.4
Direct Axis Sub-transient Open Circuit, T''_{do} : _____ 0.025
Quadrature Axis Transient Open Circuit, T'_{qo} : _____ 1.4
Quadrature Axis Sub-transient Open Circuit, T''_{qo} : _____ 0.025
Inertia, H (kW-sec/kVA, on KVA Base): _____ 3.25
Speed Damping, D: _____ n/a
Saturation Values at Per-Unit Voltage [S(1.0), S(1.2)]: _____ n/a

37 turbines are modeled using Gamesa G87 Package for PSS/E. The data in the package are used for the study.

Attachment #2

Unit GSU Data

Queue Letter/Position/Unit ID: _____ O35
Generator Step-up Transformer MVA Base: _____ 2.5
Generator Step-up Transformer Impedance (R+jX, or %, on transformer MVA Base): _____ 6%
Generator Step-up Transformer Reactance-to-Resistance Ration (X/R): _____ 10
Generator Step-up Transformer Rating (MVA): _____ 2.5
Generator Step-up Transformer Low-side Voltage (kV): _____ 0.69
Generator Step-up Transformer High-side Voltage (kV): _____ 34.5
Generator Step-up Transformer Off-nominal Turns Ratio: _____ n/a
Generator Step-up Transformer Number of Taps and Step Size: _____ n/a

Main Transformer Data

Queue Letter/Position/Unit ID: _____ O35
Generator Step-up Transformer MVA Base: _____ 80
Generator Step-up Transformer Impedance (R+jX, or %, on transformer MVA Base): _____ 12.5%
Generator Step-up Transformer Reactance-to-Resistance Ration (X/R): _____ N/A
Generator Step-up Transformer Rating (MVA): _____ 48/64/80
Generator Step-up Transformer Low-side Voltage (kV): _____ 34.5
Generator Step-up Transformer High-side Voltage (kV): _____ 138
Generator Step-up Transformer Off-nominal Turns Ratio: _____ n/a
Generator Step-up Transformer Number of Taps and Step Size: _____ 16+3, +/-10%

PJM Generator Interconnection Impact Study Report

***# O35 Crescent Ridge II 138kV
74 MW Energy
(14.8 MW Capacity)***

June 2007

DOCS-420446-v2

Introduction

This System Impact Study Report has been prepared in accordance with the PJM Open Access Tariff § 205 as well as the System Impact Study Agreement dated March 22, 2006 between Crescent Ridge Wind II, LLC (Interconnection Customer (IC)) and PJM Interconnection, LLC (Transmission Provider(TP)).

General

The Developer, Crescent Ridge Wind II, LLC (Interconnection Customer) has proposed the construction and interconnection of the Crescent Ridge II 138kV wind farm consisting of 74 MW of wind generation capability with 20% (14.8 MW) capacity. The proposed facility will Interconnect with the Commonwealth Edison Company (ComEd) transmission system and consists of 37 – 2.0 MW Gamesa G87 wind turbine generators located near the town of Tiskilwa, Illinois. The O35 Crescent Ridge II 138kV interconnection is via the construction of a new 138 kV breaker position added to the existing Transmission Switching Station (TSS) 981 Crescent Ridge.

The estimated total cost to complete all work required to install the facilities for interconnection is dependent upon the withdrawal of lower queue projects O09, O27, and O29. A written notice of option to build has been submitted to the Transmission Provider and the Transmission Owner in accordance with PJM Tariff Part IV, §3.2.3.1 in Appendix 2 of Attachment P in which the IC has elected to build the single circuit breaker expansion at TSS 981 Crescent Ridge switching station.

See Figure 1 for diagram of Interconnection.

Attachment Facilities

The Interconnection Customer will construct all facilities to include the wind turbine systems, lines, generator step-up transformers (GSU's) and breakers up to the point of Interconnection with the single circuit breaker expansion of TSS 981 Crescent Ridge including construction of the new switching station TSS 983 Crescent Ridge II Wind Farm. The Interconnection Customer will purchase real estate to accommodate the expansion of TSS 981 Crescent Ridge, construction of TSS 983 Crescent Ridge II Wind Farm as well as provide right of way for all Interconnection activities. Additionally, under the option to build, the IC will construct the single breaker expansion at TSS 981 Crescent Ridge.

ComEd responsibility for Attachment Facilities includes Oversight of the expansion of TSS 981 Crescent Ridge as well as purchasing and installing metering necessary for this project at TSS 981. ComEd will observe installation and commissioning testing of the expansion at TSS 981 Crescent Ridge. ComEd cost and scope of work for these facilities are further described below.

ComEd Scope of Work consists of the following:

- 1) **TSS 981 Crescent Ridge- ComEd Oversight** ComEd review of Interconnection Customer's engineering design, construction oversight and project management at TSS 981 Crescent Ridge. The estimated cost for this work is **\$ 153,000**.

- 2) **TSS 981 Crescent Ridge- ComEd Work** This includes purchase and installation of 138kV metering equipment at TSS 981 and the adjustment of the load encroachment relaying setting for 138kV line L7713. . This also includes ComEd witnessing of installation and commission testing, legal review and support for land and ROW acquisition. The estimated cost of this work is \$ **688,000**.

Network Upgrades

The Interconnection of the proposed facility will require Network Upgrades which include (1) Replacement of one (1) 138kV circuit breaker at TSS 74 Kewanee, (2) Installation of a tap at TSS 981 to allow for Interconnection of the single circuit breaker expansion and (3) Installation of synch check function at Kewanee TSS 74 for SCADA close of line 7413.

ComEd Scope of Work along with associated costs consists of the following:

- 1) **Upgrade at TSS 74 Kewanee** Replace 138kV circuit breaker with new 138kV SF6 gas circuit breaker. This includes site improvement, all engineering, protection and control, testing, material and handling. Revise relay settings for new configuration, line relaying, etc. The estimated cost for this work is \$ **1,140,000**.
- 2) **Install Tap at TSS 981 Crescent Ridge** Install 138kV tap to tie in new circuit breaker at TSS 981 Crescent Ridge. The estimated cost of this work is \$ **8,000**.
- 3) **Install synch check function at TSS 74 Kewanee** This will provide for SCADA closure of line 7413. This new relay will supervise the closing of the line 7413 circuit breaker at Kewanee when the Transmission Dispatcher closes it manually through SCADA. The estimated cost for this work is \$10,000.

The total estimated cost is \$ 1,999,000 for the ComEd Scope of Work. This estimate is based on the scope of work required at the interconnection substation, all remote sites, and network upgrades as described previously. There were no site visits performed for this estimate. There may be costs related to specific site related issues that are not identified in the estimate. These site reviews will be performed during the facilities study or during detailed engineering. The lead-time required for construction of the facilities is 18 to 24 months after an Interconnection Service Agreement (ISA) and Construction Service Agreement (CSA) are executed.

Network Impacts

The O35 project was studied as a total injection of 75 MW (15 MW of Capacity) to the Crescent Ridge 138 kV facility. Project O35 was evaluated for compliance with

reliability criteria for summer peak conditions in 2010. Potential network impacts were as follows:

Generator Deliverability

No problems were identified.

Multiple Facility Contingency

The study result for a fault on 138kV line 15508 with a stuck breaker at Nelson and the #O35 project generating at full output indicates the need for reactive support in the area near the #O35 project.

Short Circuit

The #O35 project caused the ComEd-owned 138kV line 7411 circuit breaker at TSS 74 Kewanee to become overdutied at 101.2% of the circuit breaker rating (14.7kA).

Contribution to Previously Identified Overloads

The #O35 project contributes 75MW to the ComEd-owned Crescent Ridge to Oglesby Tap 138kV line 7713 loading, changing it from 82.2% to 144.9% of its load-dump rating (116 MVA; relay setting limited) for the tower contingency of Kewanee to Crescent Ridge 138kV line 7413 and Kewanee to Streator 138kV line 6101. This monitored element was initially overloaded due to the #O29 project for a fault on 138kV line 15508 with a stuck breaker at Nelson. The branch needs to be upgraded to accommodate a minimum loading of 168 MVA.

Stability and Reactive Power Requirement for Low Voltage Ride Through

Stability analysis was performed at 2009 summer peak load condition with plant gross output of 76 MW associated with the proposed O35 queue project, Gamesa 2.0MW turbines were used to perform the study. The turbines were modeled at their power factor control mode and the maximum generation output is considered. The range of contingencies evaluated was limited to that necessary to assess expected compliance with ComEd Stability criteria.

With the specified transformer impedance and the specified turbines, Gamesa 2.0MW, no additional reactive compensation is required and the turbines are required to operate in the power factor control mode with the power factor at the generator terminal set between 0.99 leading* and their full lagging* capability, which is equal to or above 0.953 leading at the interconnection point.

*** Leading means consuming VARs from the system and Lagging means supplying VARs to the system.**

Note: While the stability analysis has been performed at expected extreme system conditions, there is a potential that evaluation at a different level of generator MW and/or MVAR output at different system load levels and operating conditions would disclose unforeseen stability problems. The regional reliability analysis routinely performed to test

all system changes will include one such evaluation. Any problems uncovered in that or other operating or planning studies will need to be resolved.

Moreover, when the proposed generating station is designed and plant specific dynamics data for the wind plant and its controls are available, and if it is different than the data provided for this study, a transient stability analysis at a variety of expected operating conditions using the more accurate data shall be performed to verify impact on the dynamic performance of the system. As more accurate or unit specific dynamics data for the proposed facility, as well as Plant layout become available, it must be forwarded to PJM.

See Attachments 1 and 2 for details of the stability results.

New System Reinforcements

1. The overdutied ComEd-owned 138kV line 7411 circuit breaker at TSS 74 Kewanee needs to be replaced with a new 138kV SF6 gas circuit breaker. Minimum interrupting capability of 40kA at -40°F per assumed standard.
2. The amount of reactive power support required by the #O35 project and the cost responsibility will be determined after the requirements for the #O09 and #O29 projects are determined.

Contribution to Previously Identified System Reinforcements

The overload of the ComEd-owned Crescent Ridge to Oglesby Tap 138 kV line 7713 can be relieved by updating the relays with a load encroachment setting at Crescent Ridge TSS 981.

Potential Issues

During certain maintenance outages the #O35 project will be required to be taken off line. For example, during a maintenance outage on the 138kV line 1206 from Mazon to Dresden, a single contingency of 138kV line 7413 from Kewanee to Crescent Ridge would island the existing generation at Crescent Ridge and the #O35 project into the load and generation at Oglesby (AmerenIP). Similar issues may occur for other combinations of maintenance outages involving these and other elements. The typical duration of a maintenance outage on the ComEd system is one week.

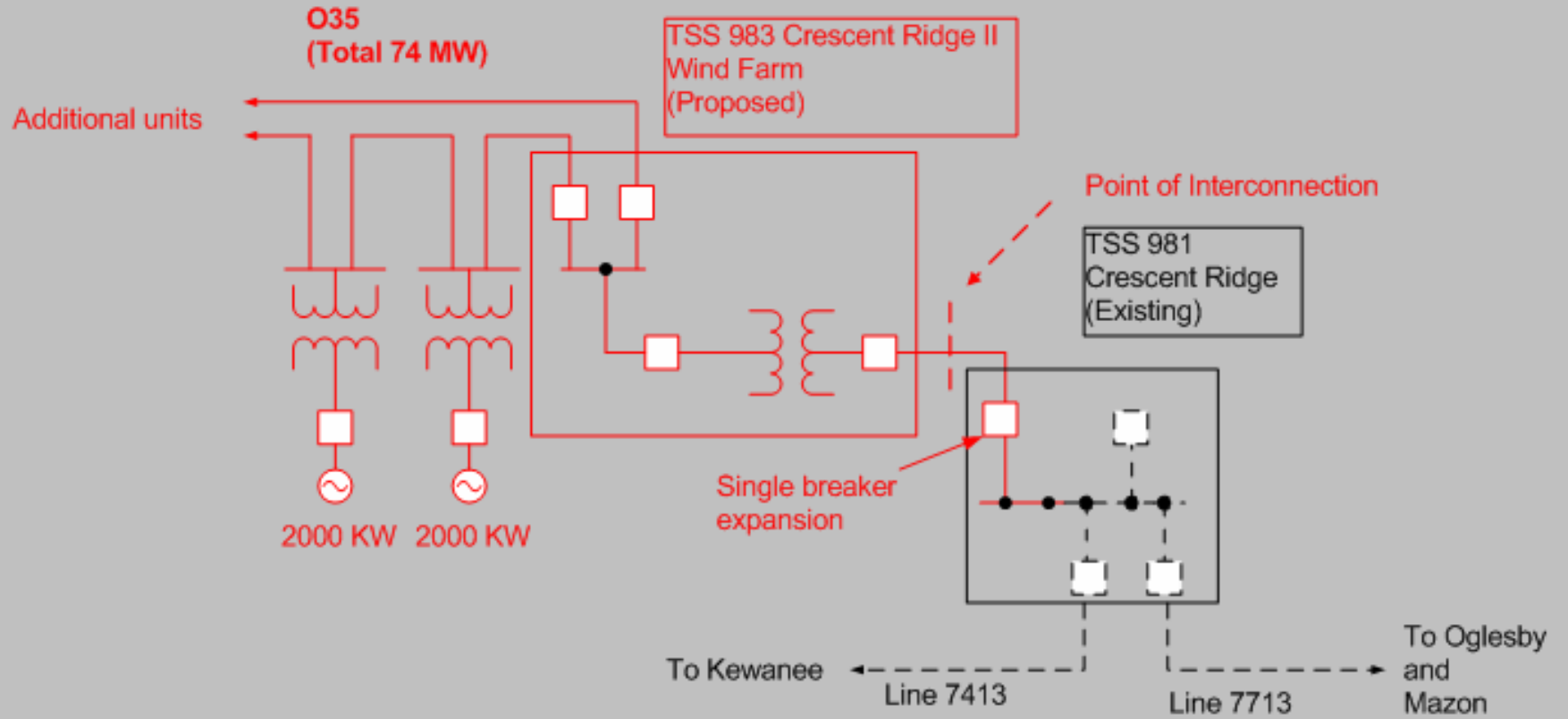
Impacts on the MISO member transmission systems are not included in this analysis, but they will be included in the Facility Study, which may indicate upgrades needed in the MISO system not identified in this Impact Study.

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.

1. Contribution of 15 MW increases the loading on the Nelson to Rock Falls 138 kV line (#15509) from 127.6% to 135.1% of its emergency rating (184 MVA) for the outage of 138kV line 15508. The congestion on the monitored element was first caused by the #O29 project.
2. Contribution of 9 MW increases the loading on the Rock Falls to #O09 138kV line (#13311) from 105.4% to 111.4% of its normal rating (140 MVA) for system normal conditions.
3. Contribution of 15 MW increases the loading on the Rock Falls to #O09 138kV line (#13311) from 144.0% to 151.7% of its emergency rating (184 MVA) for the outage of 138kV line 15508.
4. Contribution of 15 MW increases the loading on the #O29 to Nelson Tap portion of 138 kV line #15508 from 109.4% to 115.0% of its emergency rating (265 MVA) for the outage of 138kV line 13311.

Figure 1: Point of Interconnection



Attachment #1

O35

2009 peak load Stability case

BREAKER CLEARING TIMES (CYCLES)

<u>Station</u>	<u>Primary (3ph/slg)</u>	<u>Stuck Breaker (total)</u>	<u>Zone 2 (total)</u>
Crescent Ridge 138KV (line 7413)	6	-	-
Other 138KV	8	18	-

All facilities in service

- 1a. 3ph@Crescent Ridge on line 7413 (Crescent Ridge – Kewanee)
- 2a. 3ph@Crescent Ridge on line 7713 (Crescent Ridge –Mazon)
- 3a. 3ph@ Kewanee on line 7421 (Kewanee – Toulon)
- 3b. 3ph@ Kewanee on line 7421 (Kewanee – Toulon), with BF@Kewanee
- 4a. 3ph@ Kewanee on line 6101 (Kewanee – Streator)
- 4b. 3ph@ Kewanee on line 6101 (Kewanee – Streator), with BF@Kewanee
- 5a. 3ph@ Kewanee on line 7423 (Kewanee – Edwards)
- 5b. 3ph@ Kewanee on line 7423 (Kewanee – Edwards), with BF@Kewanee
- 6a. 3ph@ Kewanee on line 7411 (Kewanee – Normandy)
- 6b. 3ph@ Kewanee on line 7411 (Kewanee – Normandy), with BF@Kewanee
- 7a. 3ph@ Kewanee on line 15508 (Kewanee – Normandy)
- 7b. 3ph@ Kewanee on line 15508 (Kewanee – Normandy), with BF@Kewanee
- 8a. 3ph@ Kewanee on line 1366(Kewanee – Galesburg)
- 8b. 3ph@ Kewanee on line 1366(Kewanee – Galesburg), with BF@Kewanee
- 9a. 3ph@ Mazon on line 1206 (Mazon – Dresden)
- 9b. 3ph@ Mazon on line 1206 (Mazon – Dresden), with BF@ Mazon

P: 7413 line (Crescent Ridge – Kewanee) is out of service

- 9a. 3ph@ Mazon on line 1206 (Mazon – Dresden)

Q: 7713 line (Crescent Ridge – Mazon) is out of service

- 3a. 3ph@ Kewanee on line 7421 (Kewanee – Toulon)
- 4a. 3ph@ Kewanee on line 6101 (Kewanee – Streator)
- 5a. 3ph@ Kewanee on line 7423 (Kewanee – Edwards)
- 6a. 3ph@ Kewanee on line 7411 (Kewanee – Normandy)
- 7a. 3ph@ Kewanee on line 15508 (Kewanee – Normandy)
- 8a. 3ph@ Kewanee on line 1366(Kewanee – Galesburg)

Attachment #1

R: 6101 line (Kewanee – Streator) is out of service

- 1a. 3ph@Crescent Ridge on line 7413 (Crescent Ridge – Kewanee)
- 2a. 3ph@Crescent Ridge on line 7713 (Crescent Ridge –Mazon)
- 3a. 3ph@ Kewanee on line 7421 (Kewanee – Toulon)
- 5a. 3ph@ Kewanee on line 7423 (Kewanee – Edwards)
- 6a. 3ph@ Kewanee on line 7411 (Kewanee – Normandy)
- 7a. 3ph@ Kewanee on line 15508 (Kewanee – Normandy)
- 8a. 3ph@ Kewanee on MISO tie line
- 9a. 3ph@ Mazon on line 1206 (Mazon – Dresden)

S: 7423 line (Kewanee – Edwards) is out of service

- 1a. 3ph@Crescent Ridge on line 7413 (Crescent Ridge – Kewanee)
- 2a. 3ph@Crescent Ridge on line 7713 (Crescent Ridge –Mazon)
- 3a. 3ph@ Kewanee on line 7421 (Kewanee – Toulon)
- 4a. 3ph@ Kewanee on line 6101 (Kewanee – Streator)
- 6a. 3ph@ Kewanee on line 7411 (Kewanee – Normandy)
- 7a. 3ph@ Kewanee on line 15508 (Kewanee – Normandy)
- 8a. 3ph@ Kewanee on MISO tie line
- 9a. 3ph@ Mazon on line 1206 (Mazon – Dresden)

T: 7411 line (Kewanee – Normandy) is out of service

- 1a. 3ph@Crescent Ridge on line 7413 (Crescent Ridge – Kewanee)
- 2a. 3ph@Crescent Ridge on line 7713 (Crescent Ridge –Mazon)
- 3a. 3ph@ Kewanee on line 7421 (Kewanee – Toulon)
- 4a. 3ph@ Kewanee on line 6101 (Kewanee – Streator)
- 5a. 3ph@ Kewanee on line 7423 (Kewanee – Edwards)
- 7a. 3ph@ Kewanee on line 15508 (Kewanee – Normandy)
- 8a. 3ph@ Kewanee on line 1366(Kewanee – Galesburg)
- 9a. 3ph@ Mazon on line 1206 (Mazon – Dresden)

U: 15508 line (Kewanee – Normandy) is out of service

- 1a. 3ph@Crescent Ridge on line 7413 (Crescent Ridge – Kewanee)
- 2a. 3ph@Crescent Ridge on line 7713 (Crescent Ridge –Mazon)
- 3a. 3ph@ Kewanee on line 7421 (Kewanee – Toulon)
- 4a. 3ph@ Kewanee on line 6101 (Kewanee – Streator)
- 5a. 3ph@ Kewanee on line 7423 (Kewanee – Edwards)
- 6a. 3ph@ Kewanee on line 7411 (Kewanee – Normandy)
- 8a. 3ph@ Kewanee on line 1366(Kewanee – Galesburg)
- 9a. 3ph@ Mazon on line 1206 (Mazon – Dresden)

V: 1366 line (Kewanee – Galesburg) is out of service

- 1a. 3ph@Crescent Ridge on line 7413 (Crescent Ridge – Kewanee)
- 2a. 3ph@Crescent Ridge on line 7713 (Crescent Ridge –Mazon)
- 3a. 3ph@ Kewanee on line 7421 (Kewanee – Toulon)
- 4a. 3ph@ Kewanee on line 6101 (Kewanee – Streator)
- 5a. 3ph@ Kewanee on line 7423 (Kewanee – Edwards)
- 6a. 3ph@ Kewanee on line 7411 (Kewanee – Normandy)
- 7a. 3ph@ Kewanee on line 15508 (Kewanee – Normandy)
- 9a. 3ph@ Mazon on line 1206 (Mazon – Dresden)

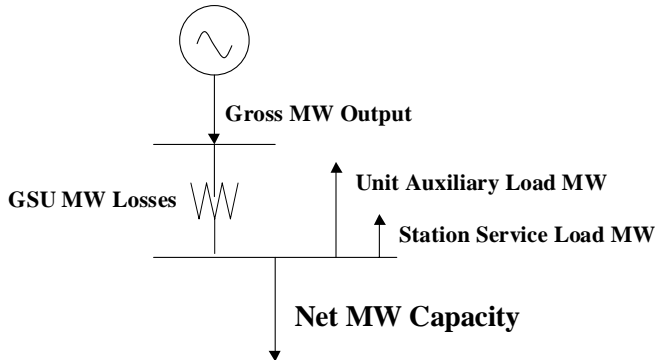
Attachment #1

W: 1206 (Mazon – Dresden) is out of service

- 1a. 3ph@Crescent Ridge on line 7413 (Crescent Ridge – Kewanee)
- 2a. 3ph@Crescent Ridge on line 7713 (Crescent Ridge –Mazon)
- 3a. 3ph@ Kewanee on line 7421 (Kewanee – Toulon)
- 4a. 3ph@ Kewanee on line 6101 (Kewanee – Streator)
- 5a. 3ph@ Kewanee on line 7423 (Kewanee – Edwards)
- 6a. 3ph@ Kewanee on line 7411 (Kewanee – Normandy)
- 7a. 3ph@ Kewanee on line 15508 (Kewanee – Normandy)
- 8a. 3ph@ Kewanee on line 1366(Kewanee – Galesburg)

Attachment #2

Unit Capability Data



$$\text{Net MW Capacity} = (\text{Gross MW Output} - \text{GSU MW Losses}^* - \text{Unit Auxiliary Load MW} - \text{Station Service Load MW})$$

Queue Letter/Position/Unit ID: _____ O35

Primary Fuel Type: _____ Wind /Gamesa 2.0

Maximum Summer (92° F ambient air temp.) Net MW Output**: _____ 75/2.0 per turbine

Maximum Summer (92° F ambient air temp.) Gross MW Output: _____ 76/2.0 per turbine

Minimum Summer (92° F ambient air temp.) Gross MW Output: _____ 76/2.0 per turbine

Maximum Winter (30° F ambient air temp.) Gross MW Output: _____ 76/2.0 per turbine

Minimum Winter (30° F ambient air temp.) Gross MW Output: _____ 76/2.0 per turbine

Gross Reactive Power Capability at Maximum Gross MW Output – Please include Reactive Capability Curve (Leading and Lagging): _____ 25MVAR

Individual Unit Auxiliary Load at Maximum Summer MW Output (MW/MVAR): _____ .04/.02

Individual Unit Auxiliary Load at Minimum Summer MW Output (MW/MVAR): _____ 04/.02

Individual Unit Auxiliary Load at Maximum Winter MW Output (MW/MVAR): _____ 04/.02

Individual Unit Auxiliary Load at Minimum Winter MW Output (MW/MVAR): _____ 04/.02

Station Service Load (MW/MVAR): _____ 0.2/.1

* GSU losses are expected to be minimal.

** Your project's declared MW, as first submitted in Attachment N, and later confirmed or modified by the Impact Study Agreement, should be based on either the 92° F Ambient Air Temperature rating of the unit(s) or, if less, the declared Capacity rating of your project.

Attachment #2

Unit Generator Dynamics Data

Queue Letter/Position/Unit ID: _____ 035
MVA Base (upon which all reactances, resistance and inertia are calculated): _____ 2.1
Nominal Power Factor: _____ 1.0
Terminal Voltage (kV): _____ 0.69

Unsaturated Reactances (on MVA Base)

Direct Axis Synchronous Reactance, $X_{d(i)}$: _____ 14.05
Direct Axis Transient Reactance, $X'd(i)$: _____ 0.649
Direct Axis Sub-transient Reactance, $X''d(i)$: _____ 0.462
Quadrature Axis Synchronous Reactance, $X_{q(i)}$: _____ 14.05
Quadrature Axis Transient Reactance, $X'q(i)$: _____ 0.649
Quadrature Axis Sub-transient Reactance, $X''q(i)$: _____ 0.462
Stator Leakage Reactance, X_l : _____ 0.3191
Negative Sequence Reactance, $X_{2(i)}$: _____ 13.70
Zero Sequence Reactance, X_0 : _____ 0.06
Saturated Sub-transient Reactance, $X''d(v)$ (on MVA Base): _____ 0.376
Armature Resistance, R_a (on MVA Base): _____ 0.0204

Time Constants (seconds)

Direct Axis Transient Open Circuit, T'_{do} : _____ 1.4
Direct Axis Sub-transient Open Circuit, T''_{do} : _____ 0.025
Quadrature Axis Transient Open Circuit, T'_{qo} : _____ 1.4
Quadrature Axis Sub-transient Open Circuit, T''_{qo} : _____ 0.025
Inertia, H (kW-sec/kVA, on KVA Base): _____ 3.25
Speed Damping, D: _____ n/a
Saturation Values at Per-Unit Voltage [S(1.0), S(1.2)]: _____ n/a

37 turbines are modeled using Gamesa G87 Package for PSS/E. The data in the package are used for the study.

Attachment #2

Unit GSU Data

Queue Letter/Position/Unit ID: _____ O35
Generator Step-up Transformer MVA Base: _____ 2.5
Generator Step-up Transformer Impedance (R+jX, or %, on transformer MVA Base): _____ 6%
Generator Step-up Transformer Reactance-to-Resistance Ration (X/R): _____ 10
Generator Step-up Transformer Rating (MVA): _____ 2.5
Generator Step-up Transformer Low-side Voltage (kV): _____ 0.69
Generator Step-up Transformer High-side Voltage (kV): _____ 34.5
Generator Step-up Transformer Off-nominal Turns Ratio: _____ n/a
Generator Step-up Transformer Number of Taps and Step Size: _____ n/a

Main Transformer Data

Queue Letter/Position/Unit ID: _____ O35
Generator Step-up Transformer MVA Base: _____ 80
Generator Step-up Transformer Impedance (R+jX, or %, on transformer MVA Base): _____ 12.5%
Generator Step-up Transformer Reactance-to-Resistance Ration (X/R): _____ N/A
Generator Step-up Transformer Rating (MVA): _____ 48/64/80
Generator Step-up Transformer Low-side Voltage (kV): _____ 34.5
Generator Step-up Transformer High-side Voltage (kV): _____ 138
Generator Step-up Transformer Off-nominal Turns Ratio: _____ n/a
Generator Step-up Transformer Number of Taps and Step Size: _____ 16+3, +/-10%