Southwest Power Pool

# Interconnection Facilities Study For Generator Interconnection Request GEN-2014-025 (IFS-2014-002-05)

***SPP Generator Interconnection Studies***

***(#GEN-2014-025)***
***(#IFS-2014-002-05)***

**September 2015**

# Revision History

| Date | Author | Change Description |
|---|---|---|
| 8/18/2015 | SPP | Draft Interconnection Facilities Study Report Revision 0 Issued |
| 9/18/2015 | SPP | Final Interconnection Facilities Study Report Revision 0 Issued |

**Summary**

Midwest Energy, Inc. (MIDW) performed a detailed Interconnection Facilities Study (IFS) at the request of Southwest Power Pool (SPP) for Generator Interconnection request GEN-2014-025/IFS-2014-002-05 (2.415 MW/Wind) located in Rush County, Kansas. GEN-2014-025/IFS-2014-002-05 is a 2.415MW uprate to GEN-2009-020 (48.3 MW/ Wind) for a combined nameplate rating of 50.715 MW. The Interconnection Customer's originally proposed in-service date for GEN-2014-025/IFS-2014-002-05 is October 15, 2015. SPP has proposed the full interconnection service in-service date will be after the assigned Transmission Owner Interconnection Facilities and Non-Shared Network Upgrade(s) are completed. Full Interconnection Service will require the Network Upgrade(s) listed in the "Other Network Upgrades" section. The request for interconnection was placed with SPP in accordance with SPP's Open Access Transmission Tariff, which covers new generation interconnections on SPP's transmission system.

**Phases of Interconnection Service**

It is not expected that interconnection service will require phases however, interconnection service will not be available until all interconnection facilities and network upgrades can be placed in service.

**Interconnection Customer Interconnection Facilities**

The GEN-2009-020 and GEN-2014-025/IFS-2014-002-05 Interconnection Customer's generation facility consists of twenty-one (21) Siemens 2.3 MW wind turbines with additional wind turbine vendor "Power Boost" and "WeakGrid" features. GEN-2014-025/IFS-2014-002-05 's Interconnection Service amount of 2.415 MW includes the "Power Boost" feature increases all twenty-one (21) Siemens wind turbine generator nameplate rating from 2.3 MW to 2.415 MW. The total combined nameplate rating for GEN-2009-020 and GEN-2014-025/IFS-2014-002-05 is 50.715 MW. The 34.5kV collector system for this wind facility is planned to be connected to one (1) 69/34.5kV Interconnection Customer owned and maintained transformer at the Interconnection Customer owned substation. GEN-2014-025/IFS-2014-002-05 will utilize the GEN-2009-020 overhead 69kV transmission circuit and will connect GEN-2009-020 and GEN-2014-025/IFS-2014-002-05 to the Point of Interconnection (POI) at a new MIDW owned station tapping and looping into the existing MIDW owned Bazine – Nekoma 69kV transmission circuit. The Interconnection Customer will be responsible for all of the transmission facilities connecting the Interconnection Customer owned substation to the POI.

The Interconnection Customer will be responsible for any equipment located at the Customer substation necessary to maintain a power factor of 0.95 lagging to 0.95 leading at the POI, including approximately 0.6 Mvar[1] of reactors to compensate for injection of reactive power from GEN-2009-020 and GEN-2014-025/IFS-2014-002-05 Interconnection Customer Facilities into the transmission system under reduced generating conditions. Also,

[1] This approximate amount of reactors is an approximate minimum amount needed for the configuration of the wind farm studied in the MIDW Facilities Study Report.

the Interconnection Customer will need to coordinate with the Transmission Owner for relay, protection, control, and communication system configurations.

**Transmission Owner Interconnection Facilities and Non-Shared Network Upgrade(s)**
To allow interconnection the Transmission Owner will install two (2) new 1200A continuous rating circuit switchers at the Nekoma Substation due to exceeding short circuit current ampacity interruption capabilities for acceptance of the Interconnection Customer's Interconnection Facilities. Currently, MIDW estimates an Engineering and Construction (E&C) lead time of approximately six (6) months after a fully executed Generator Interconnection Agreement (GIA) for the completion of Transmission Owner Interconnection Facilities and Non-Shared Network Upgrades. At this time, GEN-2014-025/IFS-2014-002-05 is responsible for $184,473 of Transmission Owner Interconnection Facilities and Non-Shared Network Upgrade(s). **Table 1** displays the estimated costs for Transmission Owner Interconnection Facilities and Non-Shared Network Upgrade(s).

**Table 1: GEN-2014-025/IFS-2014-002-05 TOIF and Non-Shared Network Upgrade(s)**

| Transmission Owner Interconnection Facilities and Non-Shared Network Upgrades Description | Allocated Cost ($) | Allocated Percent (%) | Total Cost ($) |
|---|---|---|---|
| **Interconnection Substation - Transmission Owner Interconnection Facilities** | $0 | 100% | $0 |
| **Interconnection Substation - Network Upgrade(s)** | $0 | 100% | $0 |
| **Nekoma Substation - Network Upgrade(s)** 69kV Substation work upgrading two (2) 1200A circuit switchers | $184,473 | 100% | $184,473 |
| | | | |
| Total | $184,473 | 100% | $184,473 |

**Shared Network Upgrade(s)**
The Interconnection Customer was studied within the DISIS-2014-002 Impact Study, DISIS-2014-002-1 Impact Restudy, and DISIS-2014-002-2 Impact Restudy with Energy Resource Interconnection Service (ERIS) only. At this time, the Interconnection Customer is allocated $0 for Shared Network Upgrades. If higher queued interconnection customers withdraw from the queue, suspend or terminate their GIA, restudies will have to be conducted to determine the Interconnection Customers' allocation of Shared Network Upgrades. All studies have been conducted on the basis of higher queued interconnection requests and the upgrades associated with those higher queued interconnection requests being placed in service. At this time, the Interconnection Customer is allocated the following cost for Shared Network Upgrade:

**Table 2: GEN-2014-025/IFS-2014-002-05 Shared Network Upgrade(s)**

| Shared Network Upgrades Description | Allocated Cost ($) | Allocated Percent (%) | Total Cost ($) |
|---|---|---|---|
| Currently, No Shared Network Upgrades | $0 | N/A | $0 |
| | | | |
| Total | $0 | N/A | $0 |

## Other Network Upgrades

Certain Other Network Upgrades are currently not the cost responsibility of the Customer but will be required for full Interconnection Service. Currently, Other Network Upgrades are identified for GEN-2014-025/IFS-2014-002-05.

Depending upon the status of higher or equally queued customers, the Interconnection Customer's in-service date is at risk of being delayed or their Interconnection Service is at risk of being reduced until the in-service date of these Other Network Upgrades.

## Conclusion

Interconnection Service for GEN-2014-025/IFS-2014-002-05 will be delayed until the Transmission Owner Interconnection Facilities and Non-Shared Network Upgrades are constructed. The Interconnection Customer is responsible for $184,473 of Transmission Owner Interconnection Facilities and Non-Shared Network Upgrades. At this time, the Interconnection Customer is allocated $0 for Shared Network Upgrades. After all Interconnection Facilities and Network Upgrades have been placed into service, Interconnection Service for 2.415 MW, as requested by GEN-2014-025/IFS-2014-002-05, can be allowed.

At this time the total allocation of costs assigned to GEN-2014-025/IFS-2014-002-05 for interconnection Service are estimated at $184,473.

Midwest Energy Inc.

# *Facility Study for Uprate Request GEN-2014-025*

**July 20, 2015**

# Contents

## *Study Overview*

At the request of Southwest Power Pool (SPP), Midwest Energy developed the following facility study for uprate request GEN-2014-025 based on the results of Definitive Interconnection System Impact Study 2014-002 (DISIS-2014-002) and GEN-2009-020 Impact Restudy (Final version). GEN-2014-025 is requesting the interconnection of a 2.415 MW uprate of twenty-one (21) Siemens SWT-2.3 MW Wind turbine generators and associated facilities at the GEN-2009-020 which taps the 69 kV line between Midwest Energy's Nekoma 69 kV and Bazine 69 kV substations. This uprate request will be an addition of 2.415 MW to the existing generation capacity of 48.3 MW. The total generation will be 50.715 MW.

The purpose of this study is to identify network upgrades required on Midwest Energy's transmission system. Additional network upgrades required for facilities of other transmission owners are not included in this study. The wind collector system, collector substation, and the 69 kV transmission line required between the collector substation and point of interconnection are not addressed in this study and are considered the responsibility of the Interconnection Customer.

## *Interconnection Facilities and Network Upgrades*

A short circuit study from DISIS-2014-002 was referenced to determine if the fault current level caused by the generator interconnection or uprate exceeded the circuit breaker, circuit switcher, and other equipment's interrupting capabilities on the Midwest Energy transmission system. The study results showed that the fault current level at Nekoma 115 kV substations (4.095 kA) exceeded the fault current duty of circuit switchers 3809 and 3810 (4.0 kA). The circuit switchers have to be replaced with higher fault current duty circuit switchers.

The cost estimate for the circuit switcher replacement is shown in Table 1.

**Table 1-Circuit Switcher Replacement Cost**

| Facility | Estimated Cost |
|---|---|
| Station Cost<br>(Engineering Labor, Construction Labor, etc.) | $71,173 |
| Material (Circuit switchers) | $113,300 |
| Total | $184,473 |

A conceptual one-line diagram for the Nekoma 69 kV and Bazine 69 kV substation including GEN-2014-025 uprate can be found in Attachment A.

## *Turbine Control and Reactive Compensation Considerations*

A reactor study was performed to evaluate the need of the reactor at the collector substation. The study was performed with the worst condition assumption when the Point of Interconnection was at 1.05 p.u. and no wind scenario (the wind farm output was 0.0 MW and 0.0 MVar). The study result showed that the 0.6 MVar or higher

reactor is necessary to compensate the Ferranti effect of the charging from the equivalent collector line to the Point of Interconnection. If the total charging of the collector lines and 69 kV line from the Point of Interconnection to the collector substation is different from the equivalent model, then different size of the reactor will be required.

The power factor analysis in DISIS-2014-002 stated that 'Per tariff requirements, the Generating Facility will be required to meet the standard 95% power factor requirement at the Point of Interconnection'.

Within the GEN-2009-020 Impact Restudy for Turbine Modification from SPP, the transient stability analysis was performed with the control package "SWT WeakGrid Control" in service. The result showed that the transmission system was found to remain stable for all studied conditions. The stability analysis with the uprate request within DISIS-2014-002 also simulated with the control package "SWT WeakGrid Control" in service. The analysis results showed that the transmission system remained stable as well. However, the previous impact study results with other control mode showed that the generator created erratic voltage fluctuation.

Midwest Energy will require the Interconnection Customer to install both:

a. The reactor has to be 0.6 MVar or higher to fully compensate the Ferranti effect of the equivalent collector line.
b. Sufficient capacitors, reactors and switching/control equipment to maintain the 95% power factor at the Point of Interconnection.
c. A control system for the turbines that is comparable to the Siemens SWT WeakGrid Control package that provides for real-time control of the reactive power production of the individual turbines and the generating facility as a whole, especially for the low voltage.

# *Attachment A*

## Conceptual One-Line Diagram