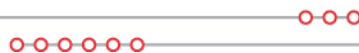


GEN-2011-025
Impact Restudy for
Generator Modification
(Turbine Change)

April 2015
Generator Interconnection



Executive Summary

The GEN-2011-025 Interconnection Customer has requested a modification to its Generator Interconnection Request to change from the previously studied combination of four (4) Alstom ECO 110 3.0 MW and twenty-five (25) Alstom ECO 122 2.7 MW wind turbine generators (aggregate power of 79.5MW) to forty-four (44) G.E. 100m 1.79MW wind turbine generators (aggregate power of 78.76 MW). GEN-2011-025 was initially studied in DISIS-2011-001 Group 6 with Fifty (50) G.E. 1.6 MW wind turbine generators (aggregate power of 80.0 MW). Since the G.E. 1.79 MW wind turbine generator has identical electrical characteristics as the G.E. 1.6 MW wind turbine generator, a stability analysis assessment was not performed for this change request. The results of the system impact study¹ performed for GEN-2011-025 in DISIS-2011-001-1 Group 6 are still valid for this generation interconnection request. As the original request for interconnection is for 80.0 MW, the requested change is not considered a Material Modification.

The point of interconnection (POI) for GEN-2011-025 is at a new Southwestern Public Service Company (SPS) 115kV switching station on the Crosby to Floyd County 115kV transmission line. The interconnection customer has provided documentation that shows the G.E. 1.79 MW wind turbine generator has a reactive capability of 0.95 lagging (providing VARs) and 0.95 leading (absorbing VARs) power factor.

Power factor requirements for GEN-2011-025 can be found in the previous system impact study and are still valid for this change request. The facility will be required to maintain a 95% lagging (providing VARs) and 95% leading (absorbing VARs) power factor at the POI.

Even though a restudy of the stability analysis was not performed for this interconnection change request, a reduced generation analysis was performed to account for collector system changes. The reduced generation (due to unsuitable wind speeds, curtailment, etc.) analysis shows the need for approximately 4.3Mvar of reactor support on the 34.5kV side of the Customer's substation transformer. The reactor support may be in the form of external reactive devices or through the use of the GE wind turbine WindFREE™ Reactive Power option.

With the assumptions outlined in this report and with all the required network upgrades from the GEN-2011-025 GIA in place, GEN-2011-025 with the G.E. 1.79 MW wind turbine generators should be able to reliably interconnect to the SPP transmission grid.

It should be noted that although the studies analyzed many of the most probable contingencies, it is not an all-inclusive list and cannot account for every operational situation. Because of this, it is likely that the customer may be required to reduce its generation output to 0 MW, also known as

¹ *Group 6 System Impact Study Report* performed by Excel Engineering, Inc. in the Southwest Power Pool (SPP) *Definitive Interconnection System Impact Study DISIS-2011-001-1* posted 12/16/2011.

curtailment, under certain system conditions to allow system operators to maintain the reliability of the transmission network.

Nothing in this study should be construed as a guarantee of transmission service or delivery rights. If the customer wishes to obtain deliverability to final customers, a separate request for transmission service must be requested on Southwest Power Pool's OASIS by the customer.

I. Introduction

The GEN-2011-025 Interconnection Customer has requested a modification to its Generator Interconnection Request to change from the previously studied combination of four (4) Alstom ECO 110 3.0 MW and twenty-five (25) Alstom ECO 122 2.7 MW wind turbine generators (aggregate power of 79.5MW) to forty-four (44) G.E. 100m 1.79MW wind turbine generators (aggregate power of 78.76 MW). GEN-2011-025 was initially studied in DISIS-2011-001 Group 6 with Fifty (50) G.E. 1.6 MW wind turbine generators (aggregate power of 80.0 MW). Since the G.E. 1.79 MW wind turbine generator has identical electrical characteristics as the G.E. 1.6 MW wind turbine generator, a stability analysis assessment was not performed for this change request. The results of the system impact study performed for GEN-2011-025 in DISIS-2011-001-1 Group 6 are still valid for this generation interconnection request. As the original request for interconnection is for 80.0 MW, the requested change is not considered a Material Modification.

Even though a stability analysis was not performed for this interconnection change request, a reduced generation analysis was performed to account for the change in the collector system.

It should be noted that although the studies analyzed many of the most probable contingencies, it is not an all-inclusive list and cannot account for every operational situation. Because of this, it is likely that the customer may be required to reduce its generation output to 0 MW, also known as curtailment, under certain system conditions to allow system operators to maintain the reliability of the transmission network.

Nothing in this study should be construed as a guarantee of transmission service or delivery rights. If the customer wishes to obtain deliverability to final customers, a separate request for transmission service must be requested on Southwest Power Pool's OASIS by the customer.

II. Facilities

The point of interconnection (POI) for the GEN-2011-025 interconnection request is a new SPS 115kV switching station on the Floyd County to Crosby County 115kV transmission line. Figure II-1 depicts the one-line diagram of the local transmission system including the POI as well as the power flow model representing the request.

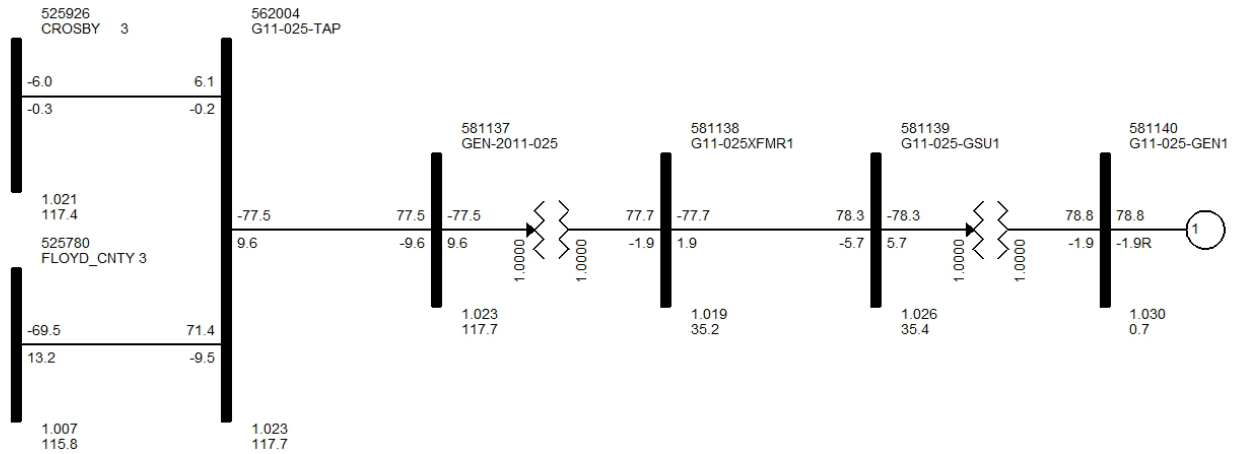


Figure II-1: GEN-2011-025 One-line Diagram

III. Stability Analysis

Transient stability analysis is used to determine if the transmission system can maintain angular stability and ensure bus voltages stay within planning criteria bandwidth during and after a disturbance while considering the addition of a generator interconnection request. Since the G.E. 1.79MW wind turbine generator is electrically similar to the G.E. 1.6MW wind turbine generator, a stability analysis was not performed. The analysis performed in the previous study is still valid.

IV. Power Factor Analysis

The power factor analysis was not performed for this change request. The power factor analysis performed in the previous study is still valid. The final power factor requirement for GEN-2011-025 will be the pro-forma 95% lagging to 95% leading at the POI.

V. Reduced Generation Analysis

Interconnection requests for wind generation projects that interconnect to the SPP system are analyzed for the capacitive charging effects during reduced generation conditions (due to unsuitable wind speeds, curtailment, etc.) at the generation site.

Model Preparation

The project generators and capacitors (if any), and all other wind projects that share the same POI, were turned off in the base case. The resulting reactive power injection into the transmission network comes from the capacitance of the project’s transmission lines and collector cables. This reactive power injection is measured at the POI. Shunt reactors were added at the study project substation low voltage bus to bring the Mvar flow into the POI bus down to approximately zero.

Results

A final shunt reactor requirement for each of the studied interconnection requests is shown in Table V-1. The results shown are for the 2015 summer case. The other two cases (2015 winter and 2025 summer) were almost identical since the generation plant design is the same in all cases.

Table V-1: Summary of Shunt Reactor Requirements

Request	Capacity	POI	Approximate Shunt Reactor Required
GEN-2011-025	78.76MW	Tap on the Floyd County to Crosby County 115kV transmission line	4.3Mvar

One line drawings used in the analysis are shown in **Figure V-1**.

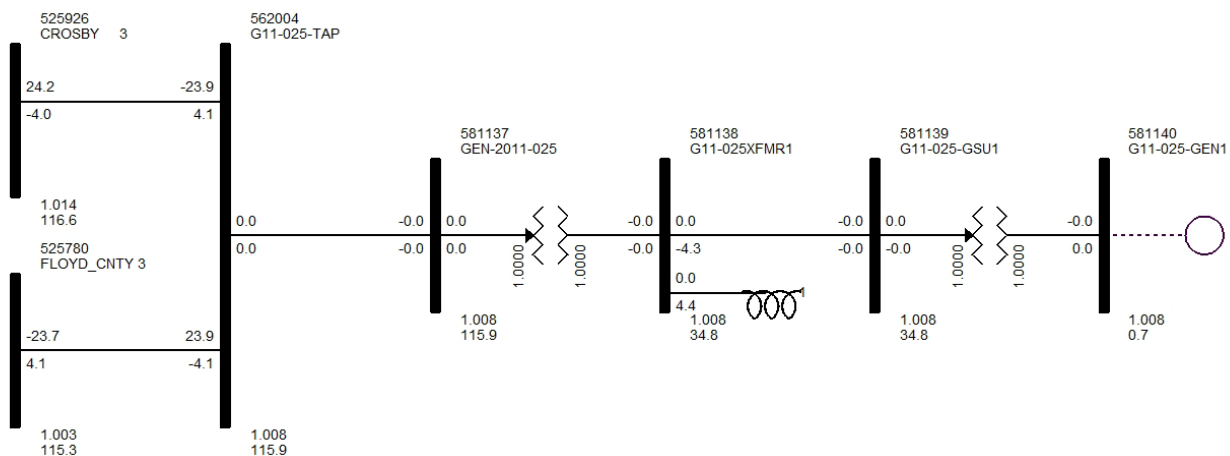


Figure V-1: GEN-2011-025 with generators off and shunt reactors included

VI. Conclusion

The GEN-2011-025 Interconnection Customer has requested a modification to its Generator Interconnection Request to change to forty-four (44) G.E. 100m 1.79MW wind turbine generators (aggregate power of 78.76 MW). GEN-2011-025 was initially studied in DISIS-2011-001 Group 6 with Fifty (50) G.E. 1.6 MW wind turbine generators (aggregate power of 80.0 MW). Since the G.E. 1.79 MW wind turbine generator has identical electrical characteristics as the G.E. 1.6 MW wind turbine generator, a stability analysis assessment was not performed for this change request. The results of the system impact study performed for GEN-2011-025 in DISIS-2011-001-1 Group 6 are still valid for this generation interconnection request. As the original request for interconnection is for 80.0 MW, the requested change is not considered a Material Modification.

A reduced generation analysis was performed for the interconnection request to account for the change in the collector system. GEN-2011-025 may be required to install approximately 4.3Mvar of reactors. The reactor requirements can be implemented by external reactor banks or other means such as the GE WindFREE™ Reactive Power option.

Power factor requirements for GEN-2011-025 from the previous impact study are still valid. The interconnection request will be required to maintain the pro-forma +/- 0.95 power factor at the POI.

Nothing in this study should be construed as a guarantee of delivery or transmission service. If the customer wishes to sell power from the facility, a separate request for transmission service must be requested on Southwest Power Pool's OASIS by the Customer.