

**GEN-2008-013**  
**Impact Restudy for**  
**Generator Modification**  
**(Turbine Change)**

**September 2016**  
**Generator Interconnection**

---

## Revision History

---

Date	Author	Change Description
09/26/2016	SPP	Impact Restudy for Material Modification(Turbine Change) Revision 0 Report Issued

---

## Executive Summary

---

The GEN-2008-013 Interconnection Customer has requested a modification to its Generator Interconnection Request to change from one hundred seventy eight (178) General Electric (G.E.) 1.68 MW wind turbine generators (aggregate power of 299.04 MW to one hundred forty (140) General Electric (G.E.) 1.68 MW and twenty seven (27) General Electric (G.E.) 2.4 MW wind turbine generators (aggregate power of 300.00 MW). Since the GE 1.68 MW wind turbine generator has identical electrical characteristics as the GE 2.4 MW wind turbine generator, a stability analysis assessment was not performed for this change request. The results of the system impact restudy<sup>1</sup> performed for GEN-2008-013 are still valid for this generation interconnection request. As the original request for interconnection is for 300.00 MW, the requested change is not considered a Material Modification.

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 4.7MVAR of reactor support on the 34.5kV side of the Customer's substation transformer or an equivalent means (i.e. General Electric's WindFREE™ Reactive Power option), to prevent charging produced by the Generating Facility's collector systems and transmission lines.

Power factor requirements for GEN-2008-013 can be found in the previous system impact study and are still valid for this change request. The short circuit analysis performed earlier<sup>2</sup> for GEN-2008-013 facility study is still valid.

With the assumptions outlined in this report and with all required network upgrades shown in the previous system impact study in place, GEN-2008-013 with the G.E. 1.68 & G.E. 2.4 MW wind turbine generators should be able to reliably interconnect to the SPP transmission grid.

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.

---

<sup>1</sup> [http://sppoasis.spp.org/documents/swpp/transmission/studies/files/2008\\_Generation\\_Studies/GEN-2008-013\\_IS\\_5-24-12.pdf](http://sppoasis.spp.org/documents/swpp/transmission/studies/files/2008_Generation_Studies/GEN-2008-013_IS_5-24-12.pdf)

<sup>2</sup> [http://sppoasis.spp.org/documents/swpp/transmission/studies/files/2008\\_Generation\\_Studies/Gen-2008-013%20FS.pdf](http://sppoasis.spp.org/documents/swpp/transmission/studies/files/2008_Generation_Studies/Gen-2008-013%20FS.pdf)

---

# 1. Introduction

---

The GEN-2008-013 Interconnection Customer has requested a modification to its Generator Interconnection Request to change from one hundred seventy eight (178) General Electric (G.E.) 1.68 MW wind turbine generators (aggregate power of 299.04 MW) to one hundred forty (140) General Electric (G.E.) 1.68 MW and twenty seven (27) General Electric (G.E.) 2.4 MW wind turbine generators (aggregate power of 300.00 MW). Since the GE 1.68 MW wind turbine generator has identical electrical characteristics as the GE 2.4 MW wind turbine generator, a stability analysis assessment was not performed for this change request. The results of the system impact restudy performed for GEN-2008-013 are still valid for this generation interconnection request. As the original request for interconnection is for 300.00 MW, the requested change is not considered a Material Modification.

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 4.7MVAR of reactor support on the 34.5kV side of the Customer's substation transformer or an equivalent means (i.e. General Electric's WindFREE™ Reactive Power option), to prevent charging produced by the Generating Facility's collector systems and transmission lines.

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.

## 2. Facilities

### Generating Facility

The point of interconnection (POI) for the GEN-2008-013 interconnection request is the Hunter 345kV substation. **Figure 2-1** depicts the one-line diagram of the local transmission system including the POI as well as the power flow model representing the request.

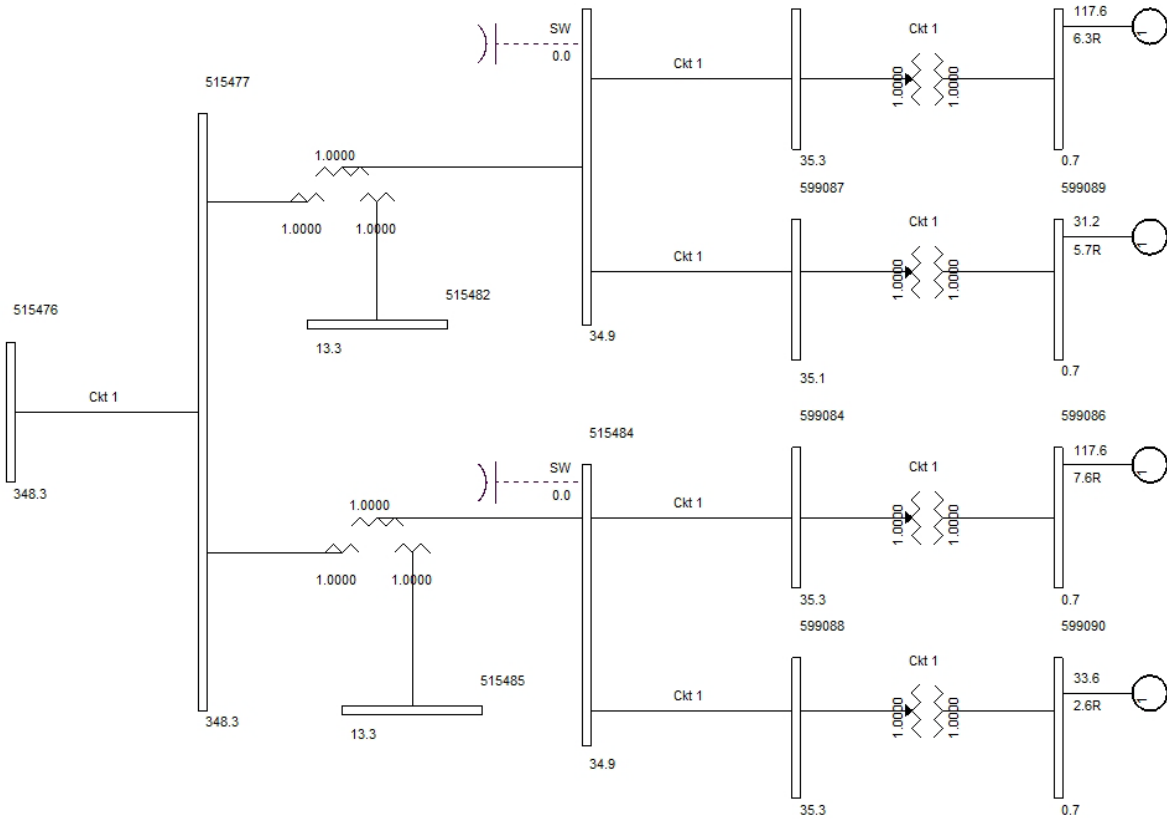


Figure 2-1: Proposed POI Configuration and Request Power Flow Model

---

## 3. 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 GE 1.68 MW wind turbine generator is electrically similar to the GE 2.4 MW wind turbine generator, a stability analysis was not performed. The analysis performed in the previous study is still valid.

---

## 4. 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-2008-013 will be the pro-forma 95% lagging to 95% leading at the POI.

## 5. Reduced Generation Analysis

Interconnection requests for wind or solar generation projects that interconnect on 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. However, GEN-2008-013’s twenty seven (27) G.E. 2.4MW generators share a transmission line to the POI with rest of GEN-2018-013’s generation that is in commercial service. The capacitive contribution from the twenty seven (27) G.E. 2.4 MW generators is measured low side of the two substation transformers where the two seven (27) G.E. 2.4 MW generators’ collector system ties into the rest of the GEN-2008-013 facilities (bus # 515479 and 515484 shown in **Figure 5-1** and **Figure 5.2**). Shunt reactors were added at the study project substation low voltage bus to bring the Mvar flow into the common bus down to approximately zero.

### Results

A final shunt reactor requirement for each of the studied interconnection requests is shown in **Table 5-1**. The results shown are for the 2025 summer case. The other two cases (2016 winter and 2017 summer) were almost identical since the generation plant design is the same in all cases.

*Table 5-1: Summary of Shunt Reactor Requirements*

Request	Capacity	POI	Approximate Shunt Reactor Required
GEN-2008-013	300.0MW	Hunter 345kV Substation	4.7MVAR <sup>3</sup>

One line drawings used in the analysis are shown in **Figure 5-1** and **Figure 5-2**.

---

<sup>3</sup> Shunt reactor sized for the twenty seven (27) General Electric (G.E) 2.4 MW generation collector system charging compenastion



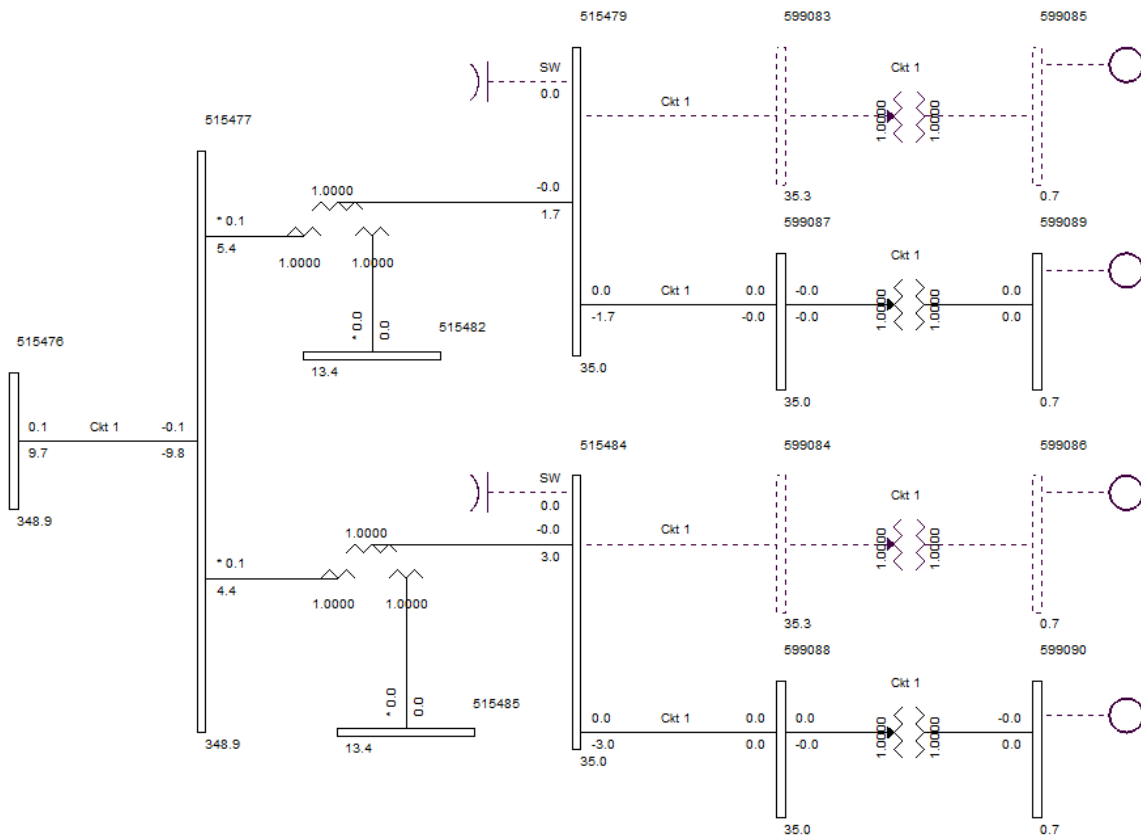


Figure 5-1: GEN-2008-013 with generators off and no shunt reactors

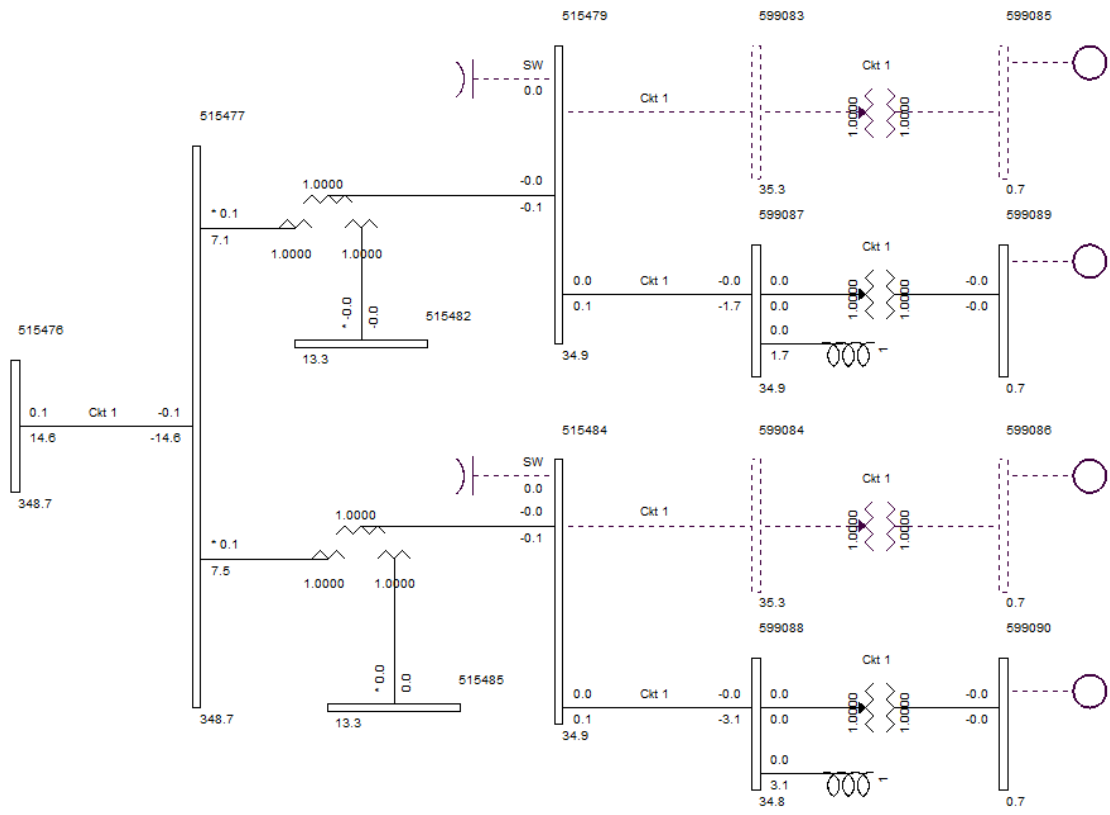


Figure 5-2: GEN-2008-013 with generator turned off and shunt reactor added to the low side of the substation 345/34.5kV transformers

---

## **6. Short Circuit Analysis**

---

The short circuit analysis was performed by OKGE and the results are still valid for this change request.

---

## 7. Conclusion

---

The GEN-2008-013 Interconnection Customer has requested a modification to its Generator Interconnection Request to change from one hundred seventy eight (178) General Electric (G.E.) 1.68 MW wind turbine generators (aggregate power of 299.04 MW) to one hundred forty (140) General Electric (G.E.) 1.68 MW and twenty seven (27) General Electric (G.E.) 2.4 MW wind turbine generators (aggregate power of 300.00 MW). Since the GE 1.68 MW wind turbine generator has identical electrical characteristics as the GE 2.4 MW wind turbine generator, a stability analysis assessment was not performed for this change request. The results of the system impact restudy performed for GEN-2008-013 are still valid for this generation interconnection request. As the original request for interconnection is for 300.00 MW, the requested change is not considered a Material Modification.

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 4.7MVAR of reactor support on the 34.5kV side of the Customer's substation transformer or an equivalent means (i.e. General Electric's WindFREE™ Reactive Power option), to prevent charging produced by the Generating Facility's collector systems and transmission lines.

Power factor requirements for GEN-2008-013 can be found in the previous system impact study and are still valid for this change request. The short circuit analysis performed earlier for GEN-2008-013 facility study is still valid.

With the assumptions outlined in this report and with all required network upgrades shown in the previous system impact study in place, GEN-2008-013 with the G.E. 1.68 & G.E. 2.4 MW wind turbine generators should be able to reliably interconnect to the SPP transmission grid.

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.