GEN-2016-071

Impact Restudy for Generator Modification

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By SPP Generator Interconnections Dept.

REVISION HISTORY

DATE OR VERSION NUMBER	AUTHOR	CHANGE DESCRIPTION
03/03/2020	SPP	Initial Report Issued.

EXECUTIVE SUMMARY

The GEN-2016-071 Interconnection Customer has requested a modification to its Interconnection Request. SPP has performed this system impact restudy to determine the effects of changing wind turbine generators from the previously studied eighty seven (87) GE 2.3 MW wind turbine generators to fifty-four (54) GE 2.82 MW and six (6) GE 2.3MW wind turbine generators. The total output of GEN-2016-071 went from 200.1 MW to 166.08 MW. The point of interconnection (POI) for GEN-2016-071 remains at the Middleton Tap 138 kV Substation.

Because the turbine changes were all from GE turbines to GE turbines and the total change in collector system impedance was deemed negligible, no stability analysis was performed.

In accordance with FERC Order No. 827, the generating facility will be required to provide dynamic reactive power within the range of 0.95 leading to 0.95 lagging at the high-side of the generator substation. Additionally, the project will be required to install approximately 6.64 MVArs of reactor shunts on its collection substation 34.5 kV bus or provide an alternate means of reactive power compensation. This is necessary to offset the capacitive effect on the transmission network caused by the project's transmission line and collector system during low-wind/no-wind conditions.

The requested modification does not have a material impact on the cost or timing of any Interconnection Request with a later Queue priority date. The requested modification has been determined to not be a Material Modification.

It should be noted that this study analyzed the requested modification to change generator technology and layout. Power flow and stability analysis was not performed. 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.

CONTENTS

SECTION 1: INTRODUCTION

GEN-2016-071 Impact Restudy is a generation interconnection study performed to study the impacts of interconnecting the project shown in Table 1-1. This restudy evaluates the requested modification to change from the previously studied eighty seven (87) GE 2.3 MW wind turbine generators to fifty-four (54) GE 2.82 MW and six (6) GE 2.3MW wind turbine generators. The total output of GEN-2016-071 went from 200.1 MW to 166.08 MW.

TABLE 1-1: INTERCONNECTION REQUEST

Request	Capacity (MW)	Generator Model	Point of Interconnection
GEN-2016-071	166.08	GE 2.82MW & GE 2.3 (wind)	Middleton Tap (514804)

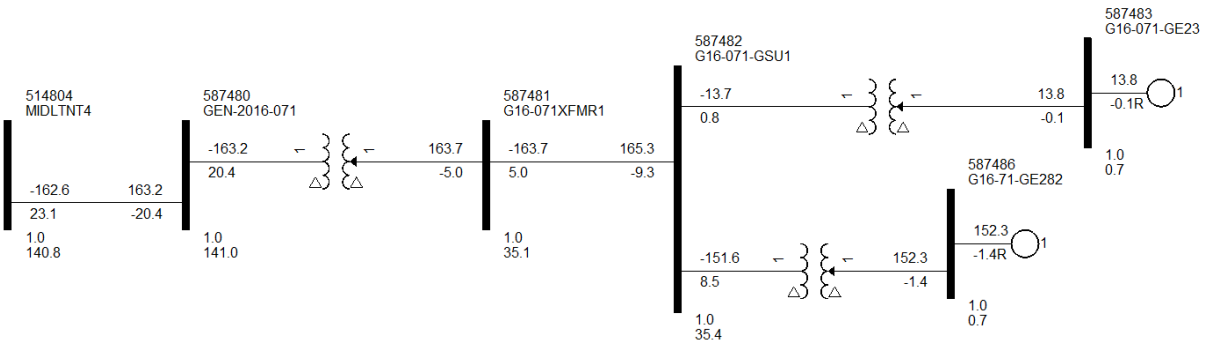
SPP performed a comparison of the collector system impedance between the existing design and the requested modification design. If the change between the two impedance values was significant, SPP would require stability analysis be performed to determine the impact of the requested modification. However, as the turbine changes were all from GE turbines to GE turbines and the total change in collector system impedance was deemed negligible, stability analysis was not required.

A low-wind/no-wind analysis was performed on this project since it is a non-synchronous resource. The low-wind/no-wind analysis determines the capacitive effect at the POI caused by the project's collector system and transmission line capacitance. A shunt reactor size was determined to offset the capacitive effect and to maintain zero MVAr flow at the POI when the plant generators and capacitors are off-line such as might be seen in low-wind or no-wind conditions.

SECTION 2: FACILITIES

A one-line drawing for the GEN-2016-071 generation interconnection request is shown in Figure 2-1.

FIIGURE 2-1: GEN-2016-071 ONE-LINE DIAGRAM



SECTION 3: STABILITY ANALYSIS

Because the turbine changes were all from GE turbines to GE turbines and the total change in collector system impedance was deemed negligible, no stability analysis was performed.

SECTION 4: REDUCED GENERATION ANALYSIS

Interconnection requests for wind generation projects that interconnect on the SPP system are analyzed for the capacitive charging effects during reduced generation conditions (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 down to approximately zero.

RESULTS

A final shunt reactor requirement for each of the studied interconnection requests is shown in Table 4-1. One line drawings used in the analysis are shown in Appendix A: Low Wind Analysis.

TABLE 4-1: SUMMARY OF SHUNT REACTOR REQUIREMENTS

Request	Capacity	POI	Approximate Shunt Reactor Required
GEN-2016-071	166.08 MW	Middleton Tap (514804)	6.64 MVAr

SECTION 5: CONCLUSION

The SPP GEN-2016-071 Impact Restudy evaluated the impact of interconnecting the project shown below in Table 5-1.

TABLE 5-1: INTERCONNECTION REQUEST

Request	Capacity (MW)	Generator Model	Point of Interconnection
GEN-2016-071	166.08 MW	6 GE 2.3 MW & 54 GE 2.82 MW	Middleton Tap (514804)

Because the turbine changes were all from GE turbines to GE turbines and the total change in collector system impedance was deemed negligible, no stability analysis was performed.

A low-wind/no-wind condition analysis was performed for this modification request. The project will be required to install a total of approximately 6.64 MVAr of reactor shunts on its collection substation 34.5kV bus. This is necessary to offset the capacitive effect on the transmission network cause by the project's transmission line and collector system during low-wind or no-wind conditions.

The requested modification does not have a material impact on the cost or timing of any Interconnection Request with a later Queue priority date. The requested modification has been determined to not be a Material Modification.

It should be noted that this study analyzed the requested modification to change generator technology and layout. Power flow and stability analysis was not performed.

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.

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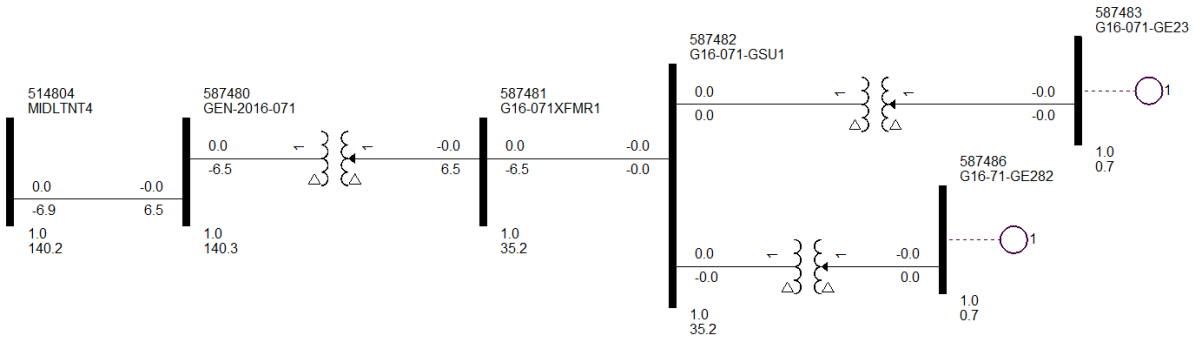
APPENDIX A: LOW WIND ANALYSIS

FIIGURE A-1: GEN-2016-071 WITH GENERATION OFF AND NO SHUNT REACTOR



FIIGURE A-2: GEN-2016-071 WITH GENERATION OFF AND SHUNT REACTOR