



Report on

# GEN-2023-SR1 Surplus Service Impact Study

**Revision R1      June 7, 2023**

Submitted to  
Southwest Power Pool



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## Revision History

DATE OR VERSION NUMBER	AUTHOR	CHANGE DESCRIPTION
6/7/2023	Aneden Consulting	Initial Report Issued

## Executive Summary

Aneden Consulting (Aneden) was retained by the Southwest Power Pool (SPP) to perform a Surplus Interconnection Service Impact Study (Study) for GEN-2023-SR1 to utilize the Surplus Interconnection Service being made available by Ainsworth Wind at its existing Point of Interconnection (POI), the Ainsworth Wind 115 kV Substation in the Nebraska Public Power District (NPPD) control area.

GEN-2023-SR1, the proposed Surplus Generating Facility (SGF), will connect to the existing Ainsworth Wind main collection substation and share its main power transformer.

Ainsworth Wind, the Existing Generating Facility (EGF), has provided a NPPD System Impact Study (SIS) showing a POI capacity of 75 MW and is making 21.9 MW of Surplus Interconnection Service available at its POI. Per the SPP Open Access Transmission Tariff (SPP Tariff), the amount of Surplus Interconnection Service available to the SGF is limited by the amount of Interconnection Service granted to the EGF at the same POI. In this case, the EGF pre-dates NPPD's membership in SPP and does not have a Generation Interconnection Agreement (GIA). Thus, it is limited by the previously studied output per the provided SIS. In addition, the Surplus Interconnection Service is only available up to the amount that can be accommodated without requiring Network Upgrades except those specified in the SPP Tariff<sup>1</sup>.

The proposed SGF configuration consists of 12 x Caterpillar Diesel Generators operating at 1.825 MW for a total assumed dispatch of 21.9 MW. The injection amount of the SGF must be limited to 21.9 MW at the POI. The combined generation from both the SGF and the EGF may not exceed 75 MW at the POI. The SGF and EGF information is shown in Table ES-1 below.

The detailed SGF configuration is captured in Table ES-2 below.

**Table ES-1: EGF & SGF Configuration**

Request	Interconnection Queue Capacity (MW)	Fuel Type	Point of Interconnection
GEN-2023-SR1 (SGF)	21.9	Thermal (Diesel)	Ainsworth Wind 115 kV Substation (640050)
Ainsworth Wind (EGF)	75	Wind	Ainsworth Wind 115 kV Substation (640050)

<sup>1</sup> Allowed Network Upgrades detailed in SPP Open Access Transmission Tariff Attachment V Section 3.3

**Table ES-2: SGF Interconnection Configuration**

Facility	SGF Configuration
Point of Interconnection	Ainsworth Wind 115 kV Substation (640050)
Configuration/Capacity	12 x Caterpillar Diesel Generators operating at 1.825 MW (Thermal) = 21.9 MW [dispatch] GEN-2023-SR1 limited to 21.9 MW at the POI and total POI injection w/ Ainsworth Wind to 75 MW
Main Substation Transformer <sup>1</sup> (Shared with the EGF and unchanged)	X = 14.78%, R = 0.51%, Winding MVA = 100 MVA, Rating MVA = 83 MVA
Equivalent GSU Transformer <sup>1</sup>	Gen 1 Equivalent Qty: 12 X = 5.577%, R = 0.507%, Winding MVA = 30 MVA, Rating MVA = 30 MVA
Generator Dynamic Model <sup>2</sup> & Power Factor	12 x Caterpillar Diesel Generators 2.281 MVA (GENROU) <sup>2</sup> Leading: 0.8 Lagging: 0.8
Reactive Power Devices (shared with the EGF and unchanged)	7 x 6.6 MVAR 34.5 kV Capacitor Bank 1 x Dynamic Reactive Power Device (8 MVA)

1) X/R based on Winding MVA, 2) DYR stability model name

SPP determined that steady-state analysis was not required because the addition of the SGF does not increase the maximum active power output of 75 MW. In addition, the EGF was previously studied at maximum Interconnection Service in the provided SIS.

The scope of this study included short circuit analysis and dynamic stability analysis.

Aneden performed the analyses using the study data provided for the SGF and the DISIS-2017-002 study models:

- 2025 Summer Peak (25SP),
- 2025 Winter Peak (25WP)

In addition, Aneden updated the Ainsworth Wind (EGF) switched shunt configuration modeling details in the base models based on SPP’s confirmation of the correct project configuration.

All analyses were performed using the Siemens PTI PSS/E<sup>2</sup> version 34 software and the results are summarized below.

The short circuit analysis was performed using the 25SP stability model modified for short circuit analysis. The results from the short circuit analysis compared the 25SP model with the EGF online and SGF not connected to the SGF study model (EGF and SGF online). The maximum contribution to three-phase fault currents in the immediate transmission systems due to the addition of the SGF was not greater than 0.27 kA. The maximum three-phase fault current level within 5 buses of the POI with the EGF and SGF generators online was below 19 kA for the 25SP model.

<sup>2</sup> Power System Simulator for Engineering

The dynamic stability analysis was performed using Siemens PTI PSS/E version 34.8.0 software for the two modified study models: 25SP and 25WP, each with two dispatch scenarios. 19 events were simulated, which included three-phase faults and single-line-to-ground stuck breaker faults.

- Scenario 1: SGF at maximum assumed dispatch, 21.9 MW, and EGF disconnected.
- Scenario 2: SGF at maximum assumed dispatch, 21.9 MW, and EGF dispatched with the remaining 53.1 MW for a total combination of 75 MW.

The results of the dynamic stability analysis showed an existing base case issue that was found in both the original DISIS-2017-002 model and in the model with GEN-2023-SR1 included. This issue was not attributed to the GEN-2023-SR1 surplus request and is detailed in Appendix C.

There were no damping or voltage recovery violations attributed to the GEN-2023-SR1 surplus request observed during the simulated faults.

The results of the study showed that the Surplus Interconnection Service Request by GEN-2023-SR1 did not negatively impact the reliability of the Transmission System. There were no additional Interconnection Facilities or Network Upgrades identified by the analyses.

SPP has determined that GEN-2023-SR1 may utilize the requested 21.9 MW of Surplus Interconnection Service being made available by the EGF. The combined generation from both the SGF and the EGF may not exceed 75 MW at the POI.

The customer must install monitoring and control equipment as needed to ensure that the SGF does not exceed the granted surplus amount and to ensure that combination of the SGF and EGF power injected at the POI does not exceed the Interconnection Service amount listed in the EGF's GIA. The monitoring and control scheme may be reviewed by the TO and documented in Appendix C of the SGF GIA.

It is likely that the customer may be required to reduce its generation output to 0 MW in real-time, 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.

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## 1.0 Scope of Study

Aneden Consulting (Aneden) was retained by the Southwest Power Pool (SPP) to perform a Surplus Service Impact Study (Study) for GEN-2023-SR1, the Surplus Generating Facility (SGF). A Surplus Service Impact Study is performed to identify the impact of the Surplus Interconnection Service on the transmission system reliability and any additional Interconnection Facilities necessary pursuant to the SPP Generator Interconnection Procedures (“GIP”) contained in Attachment V Section 3.3 of the SPP Open Access Transmission Tariff (SPP Tariff). The amount of Surplus Interconnection Service available to the SGF is limited by the amount of Interconnection Service granted to the existing interconnection customer for the Existing Generating Facility (EGF) at the same POI. In this case, the EGF is limited by the previously studied output per the provided System Impact Study (SIS). The Surplus Interconnection Service is only available up to the amount that can be accommodated without requiring additional Network Upgrades except those specified in the SPP Tariff<sup>3</sup>. The required scope of the study is dependent upon the EGF and SGF specifications. The criteria sections below include the basis of the analyses included in the scope of study.

All analyses were performed using the Siemens PTI PSS/E version 34 software. The results of each analysis are presented in the following sections.

### 1.1 Reactive Power Analysis

SPP requires that a reactive power analysis be performed on the requested configuration if it is a non-synchronous resource. The reactive power analysis determines the added capacitive effect at the POI caused by the project’s collection system and transmission line’s capacitance. A shunt reactor size was determined for the SGF to offset the capacitive effect and maintain zero (0) MVar injection at the POI while the plant’s generators and capacitors were offline, and the EGF project had a shunt compensating for its charging effects. Since the EGF is a synchronous resource, a reactive study was not performed.

### 1.2 Short Circuit Analysis

SPP requires that a short circuit analysis be performed to determine the maximum available fault current requiring interruption by protective equipment with both the SGF and EGF online, along with the amount of increase in maximum fault current due to the addition of the SGF. The analysis was performed on two scenarios, with the EGF in service and SGF offline, and the modified model with both EGF and SGF in service.

### 1.3 Stability Analysis

SPP requires that a dynamic stability analysis be performed to determine whether the SGF, EGF, and the transmission system will remain stable and within applicable criteria. Dynamic stability analysis was performed on two dispatch scenarios, the first where the SGF was online at 100% of the assumed dispatch with the EGF offline and disconnected, and the second where the SGF was online at 100% of the assumed dispatch and the EGF was picking up the remaining EGF GIA capacity. The stability analyses will identify any additional Interconnection Facilities and Network Upgrades necessary.

### 1.4 Steady-State Analysis

The steady-state (thermal/voltage) analyses may be performed as necessary to ensure that all required reliability conditions are studied. If the EGF was not studied under off-peak conditions, off-peak steady state analyses shall be performed to the required level necessary to demonstrate reliable operation of the

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<sup>3</sup> Allowed Network Upgrades detailed in SPP Open Access Transmission Tariff Attachment V Section 3.3



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Surplus Interconnection Service. If the original system impact study is not available for the Interconnection Service, both off-peak and peak analysis may need to be performed for the EGF associated with the request.

An SGF that includes a fuel type (synchronous/non-synchronous) different from the EGF may require a steady-state analysis to study impacts resultant from changes in dispatch to all equal and lower queued requests. The steady-state analyses will identify any additional Interconnection Facilities and Network Upgrades necessary.

### **1.5 Necessary Interconnection Facilities & Network Upgrades**

The SPP Tariff<sup>4</sup> states that the reactive power, short circuit/fault duty, stability, and steady-state analyses (where applicable) for the Surplus Interconnection Service will identify any additional Interconnection Facilities necessary. In addition, the analyses will determine if any Network Upgrades are required for mitigation. The Surplus Interconnection Service is only available up to the amount that can be accommodated without requiring additional Network Upgrades unless (a) those additional Network Upgrades are either (1) located at the Point of Interconnection substation and at the same voltage level as the Generating Facility with an effective GIA, or (2) are System Protection Facilities; and (b) there are no material adverse impacts on the cost or timing of any Interconnection Requests pending at the time the Surplus Interconnection Service request is submitted.

### **1.6 Study Limitations**

The assessments and conclusions provided in this report are based on assumptions and information provided to Aneden by others. While the assumptions and information provided may be appropriate for the purposes of this report, Aneden does not guarantee that those conditions assumed will occur. In addition, Aneden did not independently verify the accuracy or completeness of the information provided. As such, the conclusions and results presented in this report may vary depending on the extent to which actual future conditions differ from the assumptions made or information used herein.

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<sup>4</sup> SPP Open Access Transmission Tariff Section 3.3.4.1

## 2.0 Surplus Interconnection Service Request

The GEN-2023-SR1 Interconnection Customer has requested a Surplus Interconnection Service Impact Study (Study) for GEN-2023-SR1 to utilize the Surplus Interconnection Service being made available by Ainsworth Wind at its existing Point of Interconnection (POI), the Ainsworth Wind 115 kV Substation in the Nebraska Public Power District (NPPD) control area.

GEN-2023-SR1, the proposed SGF, will connect to the existing Ainsworth Wind main collection substation and share its main power transformer.

Ainsworth Wind, the EGF, has provided a NPPD System Impact Study (SIS) showing a POI capacity of 75 MW and is making 21.9 MW of Surplus Interconnection Service available at its POI. Per the SPP Tariff the amount of Surplus Interconnection Service available to the SGF is limited by the amount of Interconnection Service granted to the EGF at the same POI. In this case, the EGF is limited by the previously studied output per the provided SIS. In addition, the Surplus Interconnection Service is only available up to the amount that can be accommodated without requiring additional Network Upgrades except those specified in the SPP Tariff.

At the time of the posting of this report, Ainsworth Wind (EGF) is an active existing power plant at the same POI (Ainsworth Wind 115 kV Substation) that pre-dates NPPD's membership in SPP and as such does not have a Generation Interconnection Agreement (GIA). Figure 2-1 shows the power flow model single line diagram for the EGF configuration.

The proposed SGF configuration consists of 12 x Caterpillar Diesel Generators operating at 1.825 MW for a total assumed dispatch of 21.9 MW. The injection amount of the SGF must be limited to 21.9 MW at the POI. The combined generation from both the SGF and the EGF may not exceed 75 MW at the POI. The SGF and EGF information is shown in Table 2-1 below.

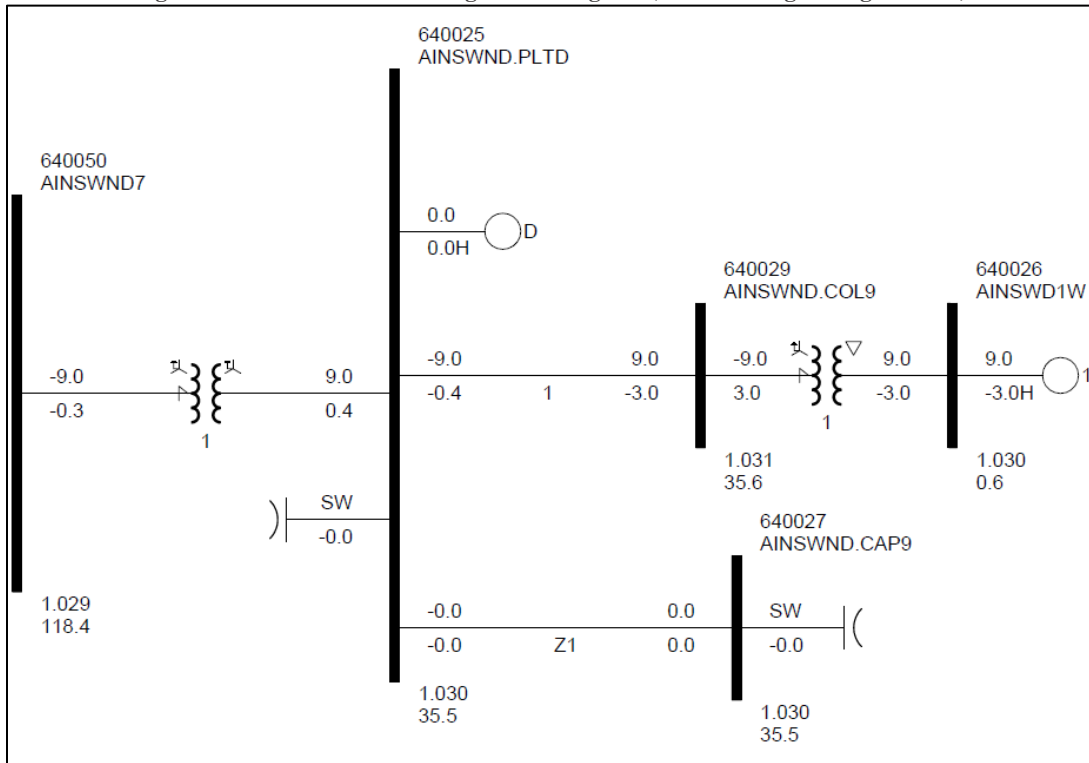
**Table 2-1: EGF & SGF Configuration**

Request	Interconnection Queue Capacity (MW)	Fuel Type	Point of Interconnection
GEN-2023-SR1 (SGF)	21.9	Thermal (Diesel)	Ainsworth Wind 115 kV Substation (640050)
Ainsworth Wind (EGF)	75	Wind	Ainsworth Wind 115 kV Substation (640050)

The proposed detailed SGF configuration is captured in Figure 2-2 and Table 2-2 below.

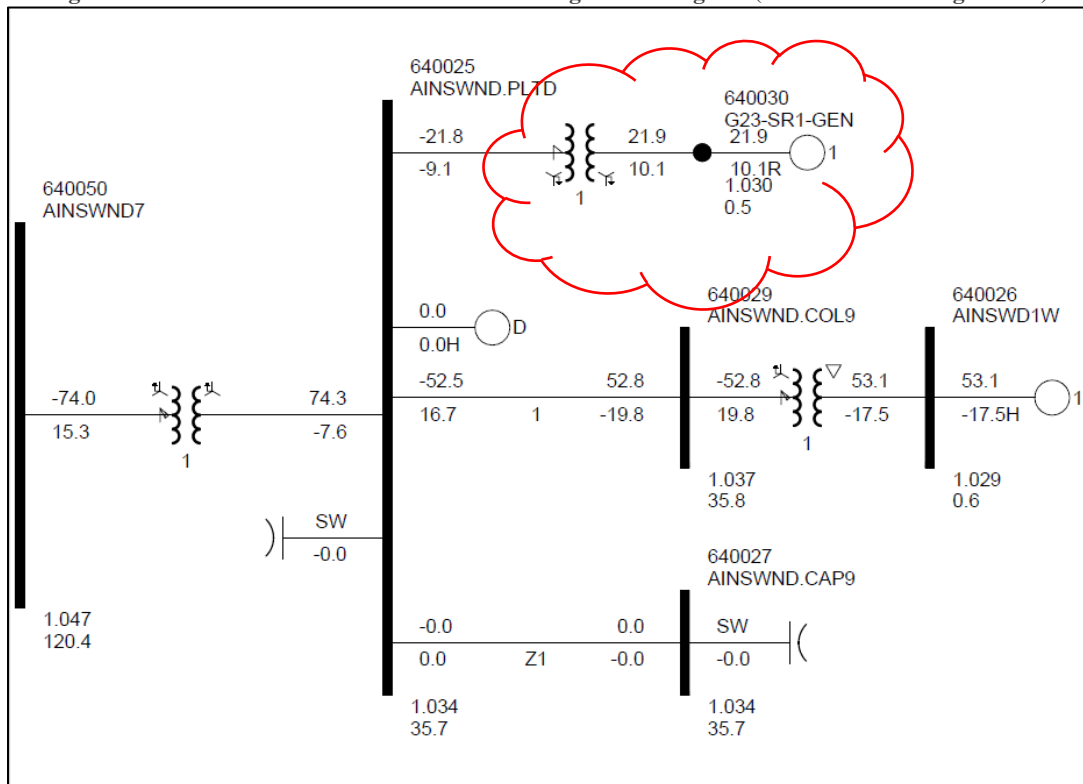
Aneden updated the Ainsworth Wind (EGF) switched shunt configuration modeling details in the base models based on SPP's confirmation of the correct project configuration.

Figure 2-1: Ainsworth Wind Single Line Diagram (EGF Existing Configuration\*)



\*based on the DISIS-2017-002 25SP stability model with EGF modeling corrections

Figure 2-2: Ainsworth Wind & GEN-2023-SR1 Single Line Diagram (EGF & SGF Configuration)



**Table 2-2: SGF Interconnection Configuration**

Facility	SGF Configuration
Point of Interconnection	Ainsworth Wind 115 kV Substation (640050)
Configuration/Capacity	12 x Caterpillar Diesel Generators operating at 1.825 MW (Thermal) = 21.9 MW [dispatch] GEN-2023-SR1 limited to 21.9 MW at the POI and total POI injection w/ Ainsworth Wind to 75 MW
Main Substation Transformer <sup>1</sup> (Shared with the EGF and unchanged)	X = 14.78%, R = 0.51%, Winding MVA = 100 MVA, Rating MVA = 83 MVA
Equivalent GSU Transformer <sup>1</sup>	Gen 1 Equivalent Qty: 12 X = 5.577%, R = 0.507%, Winding MVA = 30 MVA, Rating MVA = 30 MVA
Generator Dynamic Model <sup>2</sup> & Power Factor	12 x Caterpillar Diesel Generators 2.281 MVA (GENROU) <sup>2</sup> Leading: 0.8 Lagging: 0.8
Reactive Power Devices (shared with the EGF and unchanged)	7 x 6.6 MVAR 34.5 kV Capacitor Bank 1 x Dynamic Reactive Power Device (8 MVA)

1) X/R based on Winding MVA, 2) DYR stability model name

### 3.0 Short Circuit Analysis

A short circuit study was performed using the 25SP model to determine the maximum available fault current requiring interruption by protective equipment with both the SGF and EGF online for each bus in the relevant subsystem, and the amount of increase in maximum fault current due to the addition of the SGF. The detailed results of the short circuit analysis are provided in Appendix B.

#### 3.1 Methodology

The short circuit analysis included applying a 3-phase fault on buses up to 5 levels away from the 115 kV POI bus. The PSS/E “Automatic Sequence Fault Calculation (ASCC)” fault analysis module was used to calculate the fault current levels in the transmission system with and without the SGF online. The first scenario was studied with both the SGF and EGF in service. In the second scenario the SGF was disconnected while the EGF stayed online in order to determine the impact of the SGF.

Aneden created a short circuit model using the 25SP DISIS-2017-002 stability study model by adjusting the SGF short circuit parameters consistent with the submitted data. The adjusted parameters used in the short circuit analysis are shown in Table 3-1 below. No other changes were made to the model.

**Table 3-1: Short Circuit Model Parameters\***

Parameter	Value by Generator Bus#
	640030
Machine MVA Base	27.37
R (pu)	0.0
X'' (pu)	0.1347

\*pu values based on Machine MVA Base

#### 3.2 Results

The results of the short circuit analysis compared the 25SP model with the EGF online and SGF not connected to the stability Scenario 2 dispatch model with both the EGF and SGF in service as described in Section 4.1. The GEN-2023-SR1 POI bus (Ainsworth Wind 115 kV - 640050) fault current magnitudes for the comparison cases are provided in Table 3-2 showing a fault current of 3.94 kA with the EGF and SGF online. The addition of the SGF configuration increased the POI bus fault current by 0.27 kA. Table 3-3 shows the maximum fault current magnitudes and fault current increases with the SGF project online.

The maximum fault current calculated within 5 buses of the POI was less than 19 kA for the 25SP model. The maximum contribution to three-phase fault currents due to the addition of the SGF was about 7.3% and 0.27 kA.

**Table 3-2: POI Short Circuit Comparison Results**

Case	EGF Only Current (kA)	SGF & EGF Current (kA)	Max kA Change	Max %Change
25SP	3.67	3.94	0.27	7.3%

Table 3-3: 25SP Short Circuit Comparison Results

Voltage (kV)	Max. Current (EGF & SGF) (kA)	Max kA Change	Max %Change
69	3.3	0.04	1.6%
115	18.1	0.27	7.3%
230	18.9	0.00	0.0%
345	15.5	0.01	0.2%
<b>Max</b>	<b>18.9</b>	<b>0.27</b>	<b>7.3%</b>

## 4.0 Dynamic Stability Analysis

Aneden performed a dynamic stability analysis to identify the impact of the SGF project. The analysis was performed according to SPP's Disturbance Performance Requirements<sup>5</sup>. The project details are described in Section 2.0 above and the dynamic modeling data is provided in Appendix A. The existing base case issues and simulation plots can be found in Appendix C.

### 4.1 Methodology and Criteria

The dynamic stability analysis was performed using models developed with the requested 12 x Caterpillar Diesel Generators operating at 1.825 MW (GENROU) SGF generating facility configuration included in the models. This stability analysis was performed using Siemens PTI's PSS/E version 34.8.0 software.

Two stability model scenarios were developed using the models from DISIS-2017-002. The first scenario (Scenario 1) was comprised of the SGF online at 100% of the assumed dispatch (SGF = 21.9 MW) while the EGF generator was offline and disconnected. The second scenario (Scenario 2) was comprised of the SGF at 100% of the assumed dispatch (SGF = 21.9 MW) while the EGF generator was picking up the remaining EGF GIA capacity (EGF = 53.1 MW). The study scenarios are shown in Table 4-1.

**Table 4-1: Study Scenarios (Generator Dispatch MW)**

Scenario	Ainsworth Wind EGF (MW)	GEN-2023-SR1 SGF (MW)	EGF + SGF (MW)
1	0 (Offline)	21.9	21.9
2	53.1	21.9	75

The GEN-2023-SR1 project details were used to create modified stability models for this impact study based on the DISIS-2017-002 stability study models:

- 2025 Summer Peak (25SP),
- 2025 Winter Peak (25WP)

The dynamic model data for the GEN-2023-SR1 project is provided in Appendix A. The power flow models and associated dynamic database were initialized (no-fault test) to confirm that there were no errors in the initial conditions of the system and the dynamic data.

The following system adjustments were made to address existing base case issues that are not attributed to the surplus request:

- The frequency protective relays at bus 587773 were disabled after observing the generator tripping during initial three phase fault simulations. This frequency tripping issue is a known PSS/E limitation when calculating bus frequency as it relates to non-conventional type devices.
- The voltage protective relays at bus 587773 were disabled to avoid generator tripping due to an instantaneous over voltage spike after fault clearing.
- The fault simulation file acceleration factor was reduced as needed to resolve stability simulation crashes.

<sup>5</sup> [SPP Disturbance Performance Requirements:](https://www.spp.org/documents/28859/spp%20disturbance%20performance%20requirements%20(twg%20approved).pdf)

[https://www.spp.org/documents/28859/spp%20disturbance%20performance%20requirements%20\(twg%20approved\).pdf](https://www.spp.org/documents/28859/spp%20disturbance%20performance%20requirements%20(twg%20approved).pdf)

During the fault simulations, the active power (PELEC), reactive power (QELEC), and terminal voltage (ETERM) were monitored for the EGF and SGF and other current and prior queued projects in their cluster group<sup>6</sup>. In addition, voltages of five (5) buses away from the POI of the SGF were monitored and plotted. The machine rotor angle for synchronous machines and speed for asynchronous machines within the study areas including 627 (ALTW), 635 (MEC), 640 (NPPD), 645 (OPPD), 650 (LES), 652 (WAPA), and 659 (BEPC-SPP) were monitored. The voltages of all 100 kV and above buses within the study area were monitored as well.

**4.2 Fault Definitions**

Aneden developed and simulated fault events as required to study the SGF. The new set of faults was simulated using the modified study models. The fault events included three-phase faults and single-line-to-ground stuck breaker faults. Single-line-to-ground faults are approximated by applying a fault impedance to bring the faulted bus positive sequence voltage to 0.6 pu. The simulated faults are listed and described in Table 4-2 below. These contingencies were applied to the modified 25SP and 25WP models.

**Table 4-2: Fault Definitions**

Fault ID	Planning Event	Fault Descriptions
FLT9001-3PH	P1	3 phase fault on the AINSWND7 (640050) to AINSWRT7 (640051) 115 kV line CKT 1, near AINSWND7. a. Apply fault at the AINSWND7 115 kV bus. b. Clear fault after 7 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 7 cycles, then trip the line in (b) and remove fault.
FLT9002-3PH	P1	3 phase fault on the AINSWND7 (640050) to CALAMS 7 (640096) 115 kV line CKT 1, near AINSWND7. a. Apply fault at the AINSWND7 115 kV bus. b. Clear fault after 7 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 7 cycles, then trip the line in (b) and remove fault.
FLT9003-3PH	P1	3 phase fault on the AINSWORTH T2 115 kV (640051) /69 kV (640052) /13.8 kV (643002) XFMR CKT 1, near AINSWRT7 115 kV. a. Apply fault at the AINSWRT7 115 kV bus. b. Clear fault after 7 cycles and trip the faulted transformer. Trip generator SPRINGVIEWG9 (643185).
FLT9004-3PH	P1	3 phase fault on the AINSWRT7 (640051) to VALENTN7 (640392) 115 kV line CKT 1, near AINSWRT7. a. Apply fault at the AINSWRT7 115 kV bus. b. Clear fault after 7 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 7 cycles, then trip the line in (b) and remove fault.
FLT9005-3PH	P1	3 phase fault on the AINSWORTH T1 115 kV (640051) /34.5 kV (640053) XFMR CKT 1, near AINSWRT7 115 kV. a. Apply fault at the AINSWRT7 115 kV bus. b. Clear fault after 7 cycles and trip the faulted transformer.
FLT9006-3PH	P1	3 phase fault on the AINSWRT7 (640051) to BASSETT 7 (640580) 115 kV line CKT 1, near AINSWRT7. a. Apply fault at the AINSWRT7 115 kV bus. b. Clear fault after 7 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 7 cycles, then trip the line in (b) and remove fault.
FLT9007-3PH	P1	3 phase fault on the VALENTINE T1 115 kV (640392) /34.5 kV (640393) /13.8 kV (643160) XFMR CKT 1, near VALENTN7 115 kV. a. Apply fault at the VALENTN7 115 kV bus. b. Clear fault after 7 cycles and trip the faulted transformer.

<sup>6</sup> Based on the DISIS-2017-002 Cluster Groups



Table 4-2 Continued

Fault ID	Planning Event	Fault Descriptions
FLT9008-3PH	P1	3 phase fault on the VALENTN7 (640392) to VALTN.W7 (640394) 115 kV line CKT 1, near VALENTN7. a. Apply fault at the VALENTN7 115 kV bus. b. Clear fault after 7 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 7 cycles, then trip the line in (b) and remove fault.
FLT9009-3PH	P1	3 phase fault on the VALENTN7 (640392) to HARMONY7 (640210) 115 kV line CKT 1, near VALENTN7. a. Apply fault at the VALENTN7 115 kV bus. b. Clear fault after 7 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 7 cycles, then trip the line in (b) and remove fault.
FLT9010-3PH	P1	3 phase fault on the BASSETT T1 115 kV (640580) /69 kV (640581) /13.8 kV (643180) XFMR CKT 1, near BASSETT 115 kV. a. Apply fault at the BASSETT 115 kV bus. b. Clear fault after 7 cycles and trip the faulted transformer.
FLT9011-3PH	P1	3 phase fault on the BASSETT 7 (640580) to STUART 7 (640367) 115 kV line CKT 1, near BASSETT 7. a. Apply fault at the BASSETT 7 115 kV bus. b. Clear fault after 7 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 7 cycles, then trip the line in (b) and remove fault.
FLT9012-3PH	P1	3 phase fault on the CALAMS 7 (640096) to THEDFRD7 (640381) 115 kV line CKT 1, near AINSWND7. a. Apply fault at the AINSWND7 115 kV bus. b. Clear fault after 7 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 7 cycles, then trip the line in (b) and remove fault.
FLT9013-3PH	P1	3 phase fault on the THEDFRD7 115 kV (640381) /345 kV (640500) /13.8 kV (640570) XFMR CKT 1, near THEDFRD7 115 kV. a. Apply fault at the THEDFRD7 115 kV bus. b. Clear fault after 7 cycles and trip the faulted transformer.
FLT9014-3PH	P1	3 phase fault on the THEDFRD T1 115 kV (640381) /34.5 kV (640382) /13.8 kV (643153) XFMR CKT 1, near THEDFRD7 115 kV. a. Apply fault at the THEDFRD7 115 kV bus. b. Clear fault after 7 cycles and trip the faulted transformer.
FLT9015-3PH	P1	3 phase fault on the THEDFRD7 (640381) to STAPLETON 7 (640359) 115 kV line CKT 1, near THEDFRD7. a. Apply fault at the THEDFRD7 115 kV bus. b. Clear fault after 7 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 7 cycles, then trip the line in (b) and remove fault.
FLT9016-3PH	P1	3 phase fault on the THEDFRD3 (640500) to HOLT.CO3 (640510) 345 kV line CKT 1, near THEDFRD3. a. Apply fault at the THEDFRD3 345 kV bus. b. Clear fault after 6 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 6 cycles, then trip the line in (b) and remove fault.
FLT9017-3PH	P1	3 phase fault on the THEDFRD3 (640500) to GENTLMN3 (640183) 345 kV line CKT 1, near THEDFRD3. a. Apply fault at the THEDFRD3 345 kV bus. b. Clear fault after 6 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 6 cycles, then trip the line in (b) and remove fault.
FLT1001-SB	P4	<b>Stuck Breaker at THEDFRD7 (640381) 115 kV bus</b> a. Apply single phase fault at THEDFRD7 bus. b. Clear fault after 16 cycles and trip the following elements c. Trip the Bus THEDFRD7 (640381).
FLT1002-SB	P4	<b>Stuck Breaker at AINSWRT7 (640051) 115 kV bus</b> a. Apply single phase fault at AINSWRT7 bus. b. Clear fault after 16 cycles and trip the following elements c. Trip the Bus AINSWRT7 (640051).

**4.3 Scenario 1 Results**

Table 4-3 shows the relevant results of the fault events simulated for each of the modified models in Scenario 1. Existing DISIS base case issues are documented separately in Appendix C. The associated stability plots are also provided in Appendix C.

**Table 4-3: Scenario 1 Dynamic Stability Results (EGF = 0 MW, SGF = 21.9MW)**

Fault ID	25SP			25WP		
	Voltage Violation	Voltage Recovery	Stable	Voltage Violation	Voltage Recovery	Stable
FLT9001-3PH	Pass	Pass	Stable	Pass	Pass	Stable
FLT9002-3PH	Pass	Pass	Stable	Pass	Pass	Stable
FLT9003-3PH	Pass	Pass	Stable	Pass	Pass	Stable
FLT9004-3PH	Pass	Pass	Stable	Pass	Pass	Stable
FLT9005-3PH	Pass	Pass	Stable	Pass	Pass	Stable
FLT9006-3PH	Pass	Pass	Stable	Pass	Pass	Stable
FLT9007-3PH	Pass	Pass	Stable	Pass	Pass	Stable
FLT9008-3PH	Pass	Pass	Stable	Pass	Pass	Stable
FLT9009-3PH	Pass	Pass	Stable	Pass	Pass	Stable
FLT9010-3PH	Pass	Pass	Stable	Pass	Pass	Stable
FLT9011-3PH	Pass	Pass	Stable	Pass	Pass	Stable
FLT9012-3PH	Pass	Pass	Stable	Pass	Pass	Stable
FLT9013-3PH	Pass	Pass	Stable	Pass	Pass	Stable
FLT9014-3PH	Pass	Pass	Stable	Pass	Pass	Stable
FLT9015-3PH	Pass	Pass	Stable	Pass	Pass	Stable
FLT9016-3PH	Pass	Pass	Stable	Pass	Pass	Stable
FLT9017-3PH	Pass	Pass	Stable	Pass	Pass	Stable
FLT1001-SB	Pass	Pass	Stable	Pass	Pass	Stable
FLT1002-SB	Pass	Pass	Stable	Pass	Pass	Stable

The results of the Scenario 1 dynamic stability showed an existing base case issue that was found in both the original DISIS-2017-002 model and the model with GEN-2023-SR1 included. This issue was not attributed to the GEN-2023-SR1 surplus request and detailed in Appendix C.

There were no damping or voltage recovery violations attributed to the GEN-2023-SR1 surplus request observed during the simulated faults.

**4.4 Scenario 2 Results**

Table 4-4 shows the relevant results of the fault events simulated for each of the modified models in Scenario 2. Existing DISIS base case issues are documented separately in Appendix C. The associated stability plots are also provided in Appendix C.

**Table 4-4: Scenario 2 Dynamic Stability Results (EGF = 53.1 MW, SGF = 21.9 MW)**

Fault ID	25SP			25WP		
	Voltage Violation	Voltage Recovery	Stable	Voltage Violation	Voltage Recovery	Stable
FLT9001-3PH	Pass	Pass	Stable	Pass	Pass	Stable
FLT9002-3PH	Pass	Pass	Stable	Pass	Pass	Stable
FLT9003-3PH	Pass	Pass	Stable	Pass	Pass	Stable
FLT9004-3PH	Pass	Pass	Stable	Pass	Pass	Stable
FLT9005-3PH	Pass	Pass	Stable	Pass	Pass	Stable
FLT9006-3PH	Pass	Pass	Stable	Pass	Pass	Stable
FLT9007-3PH	Pass	Pass	Stable	Pass	Pass	Stable
FLT9008-3PH	Pass	Pass	Stable	Pass	Pass	Stable
FLT9009-3PH	Pass	Pass	Stable	Pass	Pass	Stable
FLT9010-3PH	Pass	Pass	Stable	Pass	Pass	Stable
FLT9011-3PH	Pass	Pass	Stable	Pass	Pass	Stable
FLT9012-3PH	Pass	Pass	Stable	Pass	Pass	Stable
FLT9013-3PH	Pass	Pass	Stable	Pass	Pass	Stable
FLT9014-3PH	Pass	Pass	Stable	Pass	Pass	Stable
FLT9015-3PH	Pass	Pass	Stable	Pass	Pass	Stable
FLT9016-3PH	Pass	Pass	Stable	Pass	Pass	Stable
FLT9017-3PH	Pass	Pass	Stable	Pass	Pass	Stable
FLT1001-SB	Pass	Pass	Stable	Pass	Pass	Stable
FLT1002-SB	Pass	Pass	Stable	Pass	Pass	Stable

The results of the Scenario 2 dynamic stability showed an existing base case issue that was found in both the original DISIS-2017-002 model and the model with GEN-2023-SR1 included. This issue was not attributed to the GEN-2023-SR1 surplus request and detailed in Appendix C.

There were no damping or voltage recovery violations attributed to the GEN-2023-SR1 surplus request observed during the simulated faults.

## 5.0 Necessary Interconnection Facilities and Network Upgrades

This study identified the impact of the Surplus Interconnection Service on the transmission system reliability and any additional Interconnection Facilities or Network Upgrades necessary. The Surplus Interconnection Service is only available up to the amount that can be accommodated without requiring additional Network Upgrades unless (a) those additional Network Upgrades are either (1) located at the Point of Interconnection substation and at the same voltage level as the Generating Facility with an effective GIA, or (2) are System Protection Facilities; and (b) there are no material adverse impacts on the cost or timing of any Interconnection Requests pending at the time the Surplus Interconnection Service request is submitted.

### 5.1 Interconnection Facilities

This study did not identify any additional Interconnection Facilities required by the addition of the SGF.

### 5.2 Network Upgrades

This study did not identify any Network Upgrades required by the addition of the SGF. SPP will reach out to the TO and/or TOP to determine if there are any necessary additional Network Upgrades that are either (1) located at the Point of Interconnection substation and at the same voltage level as the Generating Facility with an effective GIA, or (2) are System Protection Facilities.

## 6.0 Surplus Interconnection Service Determination and Requirements

In accordance with Attachment V of the SPP Tariff, SPP shall evaluate the request for Surplus Interconnection Service and inform the Interconnection Customer in writing of whether the Surplus Interconnection Service can be utilized without negatively impacting the reliability of the Transmission System and without any additional Network Upgrades necessary except those specified in the SPP Tariff.

### 6.1 Surplus Service Determination

SPP determined the request for Surplus Interconnection Service does not negatively impact the reliability of the Transmission System and no required Network Upgrades or Interconnection Facilities were identified by this Surplus Interconnection Service Impact Study performed by Aneden. Aneden evaluated the impact of the requested Surplus Interconnection Service on the prior study results and determined that the requested Surplus Interconnection Service resulted in similar dynamic stability and short circuit analyses and that the prior study steady-state results are not negatively impacted.

SPP has determined that GEN-2023-SR1 may utilize the requested 21.9 MW of Surplus Interconnection Service being made available by Ainsworth Wind.

### 6.2 Surplus Service Requirements

The amount of Surplus Interconnection Service available to be used is limited by the amount of Interconnection Service granted to the existing interconnection customer at the same POI. The combined generation from both the SGF and the EGF may not exceed 75 MW at the POI, which is the total Interconnection Service amount currently granted to the EGF based on the provided SIS.

The customer must install monitoring and control equipment as needed to ensure that the SGF does not exceed the granted surplus amount and to ensure that combination of the SGF and EGF power injected at the POI does not exceed the Interconnection Service amount listed in the EGF's GIA. The monitoring and control scheme may be reviewed by the TO and documented in Appendix C of the SGF GIA.

SPP will reach out to the TO and/or TOP to determine if there are any necessary additional Network Upgrades that are either (1) located at the Point of Interconnection substation and at the same voltage level as the Generating Facility with an effective GIA, or (2) are System Protection Facilities.