GEN-2017-005

Interim Availability Interconnection System Impact Study

Published November 2020
By SPP Generator Interconnections Dept.

REVISION HISTORY

DATE OR VERSION NUMBER	AUTHOR	CHANGE DESCRIPTION
11/05/2020	SPP	Final report issued, system conditions prior to commercial operation of several requests and completion of several upgrades.
11/11/2020	SPP	Updated cost estimates within Transmission Owner Interim Generation Interconnection Facility Study report

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CONSULTANT'S STUDY REPORT

See next page for the Consultant's Interim Availability Interconnection System Impact Study report.

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GEN-2017-005 Interim Availability

Interconnection System Impact Study

11/05/2020

1.0 EXECUTIVE SUMMARY

Apex Clean Energy retained Electric Power Engineers (EPE) to perform an Interim Availability System Impact Study (the Study or IASIS) of the interconnection request GEN-2017-005 in Group 08. A summary of the project is shown in **Table 1-1**. This study included power flow analysis, stability analysis, and short circuit analysis to determine the impacts on the transmission system caused by the interim interconnection request.

Table 1-1: Interconnection Interim Requests

Group #	Queue Number	Capacity (MW)	MW Requested for Study	Service Type	Type	Point of Interconnection
08	GEN-2017-005	195.0	195.0	ER	Wind	Franklin – Marmaton 161k V

The IASIS assumes that the projects specified within **Table 2-2** of this report will go into service. Higher queued projects with a commercial operation date beyond 12/31/2021, with a suspended status, or a withdrawn status were removed from the study for groups 08, 12, and 13. In addition, select projects were removed from the study due to contingent network upgrades with long term/unknown completion dates. If additional generation projects with queue priority equal to or higher than the study request go into commercial operation, this IASIS may need to be restudied to ensure that interconnection service remains for the customer's request. All the analyses were performed using PSS/E v. 33.10.0 and TARA Version 2001.1.0.

The study focuses on the impact caused by the interim request (GEN-2017-005), and other queue projects' impacts were not monitored. There may be other generation requests that could have limited service, but those are out of the scope of the Study. The study also assumes the Asbury coal plant is retired.

Power Flow Analysis:
For the interim request, GEN-2017-005 was studied at its maximum requested capacity (195.0 MW). The power flow analysis evaluated the system for seven scenarios (2017 Winter Peak (17WP), 2018 Spring (18G), 2018 Summer Peak (18SP), 2021 Light (21L), 2021 Summer Peak (21SP), 2021 Winter Peak (21WP), and 2026 Summer Peak (26SP)).

The steady state analysis focused on SPP's Regional Group 8. In the analysis, Franklin 161/69 kV transformer overloads were identified under different conditions. The worst overload on the transformer was observed at 102.51% in the 21WP case without the Litchfield – Franklin 161 kV circuit. This limited the output of GEN-2017-005 to 184 MWs. GEN-2017-005 has requested a sponsored network upgrade to add an additional Franklin 161/69 kV transformer. After the sponsored upgrade, the highest loading on the Franklin 161/69 kV transformer was observed at 65.54%. Apart from the Franklin 161/69 kV transformer overload, no additional overloads were identified due to the addition of GEN-2017-005. No voltage issues were observed for the study cases.

Dynamic Stability Analysis:
For the interim request, GEN-2017-005 was studied at its maximum requested capacity (195.0 MW). The stability analysis evaluated the system for three scenarios (2017 Winter Peak (17W), 2018 Summer Peak (18S), and 2026 Summer Peak (26S)) simulating faults that included three-phase and single-line-to-ground faults.

The dynamic simulation indicated that the GEN-2017-005 project does not adversely affect system stability. A few select contingencies related to the Waverly-LaCygne 345 kV line resulted in instability both with and without the GEN-2017-005 project in service. Reducing the output of the Wolf Creek facility to 700 MW for identified contingencies mitigates instability and no new violations are observed with GEN-2017-005 in service. No

transient stability violations were observed for the study cases with or without the sponsored upgrade to add an additional Franklin 161/69 kV transformer.

Short Circuit Analysis:

The short circuit analysis was performed on the 2026 Summer Peak stability analysis power flow case using the PSS/E ASCC program tool. Three-phase symmetrical fault currents were calculated for 69 kV and above buses within five levels of the point of interconnection. Under three-phase fault conditions, the short circuit analysis revealed the increase of short circuit currents with and without the sponsored upgrade to add an additional Franklin 161/69 kV transformer due to the interconnection of GEN-2017-005, however, a detailed comparison with the breaker ratings was not performed.

2.0 INTRODUCTION

Apex Clean Energy retained Electric Power Engineers (EPE) to perform an Interim Availability System Impact Study (the Study or the IASIS). The Study evaluated the system impact due to the interconnection of GEN-2017-005 within SPP's system. The purpose of the Study was to evaluate and identify the adverse system impacts on the SPP system. This Study included power flow analysis, stability analysis, short circuit analysis, and limited operation analysis. A summary of the project is listed in **Table 2-1**.

Table 2-1: Interconnection Interim Request

Group #	Queue Number	Capacity	Service Type	Type	Point of Interconnection
08	GEN-2017-005	195.0 MW	ER	Wind	Franklin – Marmaton 161k V

The IASIS considers all Generating Facilities, and any identified Network Upgrades associated with higher queued interconnection, that are directly interconnected to the Transmission System on the date the IASIS is commenced. Network Upgrades included in the cases are listed in **Appendix A: Network Upgrades**.

Any changes to these assumptions may require a re-study of this IASIS. If one or more of the previously queued requests which were not included in the study executes an interconnection agreement and commences commercial operation, a re-study may be triggered.

Table 2-2 lists the generation interconnection requests that are assumed to have either full or partial interconnection service prior to the requested December 2021 commercial operation date for this IASIS. Also listed in **Table 2-2** are the total MWs of interconnection service, the fuel type, the point of interconnection (POI), and the current status of each particular prior queued request. Projects, highlighted in red, were removed from the study. These projects have a commercial operation date beyond December 2021, have a suspended status, have a withdrawn status, or have contingent network upgrades not included in the study due to long term/unknown completion dates.

Table 2-2: Generation Requests Included within IASIS

Project	Current Cluster	Group	COD	Capacity	Service Type	Type	POI	Status	Case Status
GEN-2002-004	ICS-2008-001 Prior Queued	08	12/15/2005	153	ER	Wind	Latham 345kV	IA FULLY EXECUTED/COMMERCIAL OPERATION	Included
GEN-2005-013	ICS-2008-001 Prior Queued	08	7/5/2011	199.8	ER	Wind	Caney River 345kV	IA FULLY EXECUTED/COMMERCIAL OPERATION	Included
GEN-2007-025	ICS-2008-001-6	08	10/1/2012	299.2	ER	Wind	Viola 345kV	IA FULLY EXECUTED/COMMERCIAL OPERATION	Included
GEN-2008-013	ICS-2008-001-6	08	12/7/2012	300	ER	Wind	Hunter 345kV	IA FULLY EXECUTED/COMMERCIAL OPERATION	Included
GEN-2008-098	DISIS-2010-001-8	08	11/30/2015	99.5	ER	Wind	Waverly 345kV	IA FULLY EXECUTED/COMMERCIAL OPERATION	Included
GEN-2009-025	DISIS-2009-001-6	08	11/1/2012	59.8	ER	Wind	TAP Deer Creek - Sinclair 69kV	IA FULLY EXECUTED/COMMERCIAL OPERATION	Included
GEN-2010-003	DISIS-2010-001-8	08	7/31/2014	99.5	ER	Wind	Waverly 345kV	IA FULLY EXECUTED/COMMERCIAL OPERATION	Included
GEN-2010-005	DISIS-2010-001-8	08	12/31/2020	299.2	ER	Wind	Viola 345kV	IA FULLY EXECUTED/ON SCHEDULE	Included

GEN-2011-057	DISIS-2011-002-6	08	12/30/2015	150	ER	Wind	Creswell 138kV	IA FULLY EXECUTED/COMMERCIAL OPERATION	Included
GEN-2012-032	DISIS-2012-002-6	08	6/30/2015	299	ER	Wind	Rose Hill-(Ranch Road) Sooner (Open Sky) 345kV	IA FULLY EXECUTED/COMMERCIAL OPERATION	Included
GEN-2012-033	DISIS-2012-002-6	08	9/1/2015	98.82	ER	Wind	Breckinridge 138kV	IA FULLY EXECUTED/COMMERCIAL OPERATION	Included
GEN-2013-029	DISIS-2013-002-2	08	4/8/2016	299	ER	Wind	Renfrow 345kV	IA FULLY EXECUTED/COMMERCIAL OPERATION	Included
GEN-2014-001	DISIS-2014-001-1	08	7/28/2020	200.6	ER	Wind	Tap Wichita - Emporia Energy Center 345kV	IA FULLY EXECUTED/ON SCHEDULE	Included
GEN-2014-021	DISIS-2014-002-6	13	11/7/2017	300	ER/NR	Wind	Nebraska City-Mullen Creek (Holt County MO) 345kV	IA FULLY EXECUTED/COMMERCIAL OPERATION	Included
GEN-2014-064	DISIS-2014-002-6	08	12/21/2018	248.4	ER	Wind	Otter 138kV	IA FULLY EXECUTED/COMMERCIAL OPERATION	Included
GEN-2015-001	DISIS-2015-001-4	08	12/19/2016	200	ER	Wind	Rose Hill (Open Sky)-Sooner (Ranch Road) 345kV	IA FULLY EXECUTED/COMMERCIAL OPERATION	Included
GEN-2015-005	DISIS-2015-001-4	13	12/16/2016	200.1	ER	Wind	Mullen Creek-Sibley (Ketchum) 345kV	IA FULLY EXECUTED/COMMERCIAL OPERATION	Included
GEN-2015-015	DISIS-2015-001-4	08	12/8/2017	154.56	ER/NR	Wind	Tap Medford - Tap Coyote 138kV	IA FULLY EXECUTED/COMMERCIAL OPERATION	Included
GEN-2015-016	DISIS-2015-001-4	08	9/11/2019	200	ER/NR	Wind	Tap Marmaton - Centerville 161kV	IA FULLY EXECUTED/COMMERCIAL OPERATION	Included
GEN-2015-024	DISIS-2015-001-4	08	12/9/2016	220	ER	Wind	Thistle-Wichita Dbl Ckt (Buffalo Flats) 345kV	IA FULLY EXECUTED/COMMERCIAL OPERATION	Included
GEN-2015-025	DISIS-2015-001-4	08	12/19/2016	220	ER	Wind	Tap Thistle -Wichita 345kV Dbl CKT	IA FULLY EXECUTED/COMMERCIAL OPERATION	Included
GEN-2015-034	DISIS-2015-002-7	08	10/31/2020	200	ER	Wind	Rose Hill (Open Sky)-Sooner (Ranch Road) 345kV	IA FULLY EXECUTED/ON SCHEDULE	Included
GEN-2015-047	DISIS-2015-002-7	08	1/1/2018	300	ER	Wind	Sooner 345kV	IA FULLY EXECUTED/COMMERCIAL OPERATION	Included
GEN-2015-052	DISIS-2015-002-7	08	12/1/2019	300	ER	Wind	Open Sky-Rose Hill 345kV	IA FULLY EXECUTED/ON SUSPENSION	Excluded

GEN-2015-062	DISIS-2015-002-7	08	12/31/2021	4.5	ER	Wind	Breckinridge 138kV	IA FULLY EXECUTED/ON SCHEDULE	Included
GEN-2015-063	DISIS-2015-002-7	08	1/1/2018	300	ER	Wind	Woodring-Matthewson 345kV	IA FULLY EXECUTED/COMMERCIAL OPERATION	Included
GEN-2015-066	DISIS-2015-002-7	08	12/31/2022	248.4	ER	Wind	Sooner - Cleveland 345kV	IA FULLY EXECUTED/ON SCHEDULE	Excluded
GEN-2015-069	DISIS-2015-002-7	08	12/17/2018	300	ER	Wind	Union Ridge 230kV	IA FULLY EXECUTED/COMMERCIAL OPERATION	Included
GEN-2015-073	DISIS-2015-002-7	08	12/19/2019	200.1	ER/NR	Wind	Emporia 345kV	IA FULLY EXECUTED/COMMERCIAL OPERATION	Included
GEN-2015-090	DISIS-2015-002-7	08	12/14/2018	220	ER	Wind	Thistle-Wichita Dbl Ckt (Buffalo Flats) 345kV	IA FULLY EXECUTED/COMMERCIAL OPERATION	Included
GEN-2016-022	DISIS-2016-001-3	08	10/31/2020	151.8	ER	Wind	Rose Hill (Open Sky)-Sooner (Ranch Road) 345kV	IA PENDING	Included
GEN-2016-031	DISIS-2016-001-3	08	5/29/2018	1.5	ER	Wind	Rose Hill (Open Sky)-Sooner (Ranch Road) 345kV	IA FULLY EXECUTED/COMMERCIAL OPERATION	Included
GEN-2016-032	DISIS-2016-001-3	08	12/31/2023	200	ER/NR	Wind	Crescent Substation 138 kV	IA FULLY EXECUTED/ON SCHEDULE	Excluded
GEN-2016-061	DISIS-2016-001-3	08	8/1/2020	250.7	ER	Wind	Sooner-Woodring 345 kV line	IA FULLY EXECUTED/ON SCHEDULE	Included
GEN-2016-068	DISIS-2016-001-3	08	10/21/2020	250	ER	Wind	Woodring 345kV	IA FULLY EXECUTED/ON SCHEDULE	Included
GEN-2016-071	DISIS-2016-001-3	08	11/30/2021	200.1	ER	Wind	Middleton Tap 138kV Substation	IA FULLY EXECUTED/ON SUSPENSION	Excluded
GEN-2016-073	DISIS-2016-001-3	08	10/30/2022	220	ER	WIND	Thistle-Wichita Dbl Ckt (Buffalo Flats) 345kV	IA FULLY EXECUTED/ON SCHEDULE	Excluded
GEN-2016-100	DISIS-2016-002-1	08	11/1/2020	100	ER	Wind	Spring Creek-Sooner 345kV	FACILITY STUDY STAGE	Excluded
GEN-2016-101	DISIS-2016-002-1	08	11/1/2020	195	ER	Wind	Spring Creek-Sooner 345kV	FACILITY STUDY STAGE	Excluded
GEN-2016-115	DISIS-2016-002-1	13	11/16/2020	300	ER	Wind	Nebraska City-Mullen Creek (Holt County MO) 345kV	IA FULLY EXECUTED/ON SCHEDULE	Included
GEN-2016-119	DISIS-2016-002-1	08	9/1/2020	600	ER	Wind	Spring Creek-Sooner 345kV	FACILITY STUDY STAGE	Excluded
GEN-2016-128	DISIS-2016-002-1	08	12/31/2019	176	ER	Wind	Woodring 345kV	FACILITY STUDY STAGE	Excluded
GEN-2016-133	DISIS-2016-002-1	08	10/1/2020	187.5	ER	Wind	Riverside 345kV Substation	FACILITY STUDY STAGE	Excluded

GEN-2016-134	DISIS-2016-002-1	08	10/1/2020	187.5	ER	Wind	Riverside 345kV Substation	FACILITY STUDY STAGE	Excluded
GEN-2016-135	DISIS-2016-002-1	08	10/1/2020	100	ER	Wind	Riverside 345kV Substation	FACILITY STUDY STAGE	Excluded
GEN-2016-136	DISIS-2016-002-1	08	10/1/2020	75	ER	Wind	Riverside 345kV Substation	FACILITY STUDY STAGE	Excluded
GEN-2016-137	DISIS-2016-002-1	08	10/1/2020	187.5	ER	Wind	Riverside 345kV Substation	FACILITY STUDY STAGE	Excluded
GEN-2016-138	DISIS-2016-002-1	08	10/1/2020	187.5	ER	Wind	Riverside 345kV Substation	FACILITY STUDY STAGE	Excluded
GEN-2016-139	DISIS-2016-002-1	08	10/1/2020	100	ER	Wind	Riverside 345kV Substation	FACILITY STUDY STAGE	Excluded
GEN-2016-140	DISIS-2016-002-1	08	10/1/2020	75	ER	Wind	Riverside 345kV Substation	FACILITY STUDY STAGE	Excluded
GEN-2016-141	DISIS-2016-002-1	08	10/1/2020	350	ER	Wind	Riverside 345kV Substation	FACILITY STUDY STAGE	Excluded
GEN-2016-142	DISIS-2016-002-1	08	10/1/2020	350	ER	Wind	Riverside 345kV Substation	FACILITY STUDY STAGE	Excluded
GEN-2016-143	DISIS-2016-002-1	08	10/1/2020	175	ER	Wind	Riverside 345kV Substation	FACILITY STUDY STAGE	Excluded
GEN-2016-144	DISIS-2016-002-1	08	10/1/2020	175	ER	Wind	Riverside 345kV Substation	FACILITY STUDY STAGE	Excluded
GEN-2016-145	DISIS-2016-002-1	08	10/1/2020	175	ER	Wind	Riverside 345kV Substation	FACILITY STUDY STAGE	Excluded
GEN-2016-146	DISIS-2016-002-1	08	10/1/2020	175	ER	Wind	Riverside 345kV Substation	FACILITY STUDY STAGE	Excluded
GEN-2016-149	DISIS-2016-002-1	13	12/31/2022	302	ER	Wind	Stranger Creek 345kV	IA FULLY EXECUTED/ON SCHEDULE	Excluded
GEN-2016-150	DISIS-2016-002-1	13	12/30/2022	302	ER	Wind	Stranger Creek 345kV	IA FULLY EXECUTED/ON SCHEDULE	Excluded
GEN-2016-153	DISIS-2016-002-1	08	12/1/2019	134	ER	Wind	Viola 345kV	FACILITY STUDY STAGE	Excluded
GEN-2016-157	DISIS-2016-002-1	13	12/31/2022	252	ER	Wind	West Gardner 345kV	IA FULLY EXECUTED/ON SUSPENSION	Excluded
GEN-2016-158	DISIS-2016-002-1	13	12/31/2022	252	ER	Wind	West Gardner 345kV	IA FULLY EXECUTED/ON SUSPENSION	Excluded
GEN-2016-162	DISIS-2016-002-1	08	12/31/2019	252	ER	Wind	Benton 345kV	FACILITY STUDY STAGE	Excluded
GEN-2016-163	DISIS-2016-002-1	08	12/31/2019	252	ER	Wind	Benton 345kV	FACILITY STUDY STAGE	Excluded
GEN-2016-166	DISIS-2016-002-1	12		35	ER/NR	Solar	Prairie Grove 69 kV Substation	WITHDRAWN	Excluded
GEN-2016-174	DISIS-2016-002-1	13	11/6/2020	302	ER	Wind	Stranger Creek 345kV	IA FULLY EXECUTED/ON SCHEDULE	Included
GEN-2016-176	DISIS-2016-002-1	13	11/30/2021	302	ER	Wind	Stranger Creek 345kV	IA FULLY EXECUTED/ON SCHEDULE	Included

GEN-2017-005	DISIS-2017-001	08	12/31/2021	195	ER	Wind	Marmaton - Litchfield 161 kV	DISIS STAGE	Included
GEN-2017-009	DISIS-2017-001	08	10/31/2020	302.5	ER	Wind	Neosho - Caney River 345 kV	DISIS STAGE	Included
GEN-2017-060	DISIS-2017-001	12	7/1/2020	149.4	ER	Wind	LaRussell Energy Center 161kV	DISIS STAGE	Included
GEN-2016-024	DISIS-2017-001	08	N/A	55.9	ER/NR	Solar	Midian 138kV Substation	WITHDRAWN	Excluded
GEN-2016-048	DISIS-2017-001	08	N/A	82.3	ER/NR	Solar	Sooner 138 kV	WITHDRAWN	Excluded
GEN-2016-072	DISIS-2017-001	08	N/A	300	ER	Wind	Renfrow 345kV	DISIS STAGE	Excluded
GEN-2016-127	DISIS-2017-001	08	N/A	200.1	ER/NR	Wind	Shidler 138 kV Substation	DISIS STAGE	Excluded
GEN-2016-173	DISIS-2017-001	08	N/A	42	ER/NR	Solar	Creswell 69 kV Sub	DISIS STAGE	Excluded
GEN-2017-022	DISIS-2017-001	08	N/A	65	ER/NR	Solar	Altoona-NE Parson 138kV	DISIS STAGE	Excluded
GEN-2017-040	DISIS-2017-001	08	N/A	200.1	ER	Wind	Canadian River-Muskogee and Muskogee-Seminole 345kV	DISIS STAGE	Excluded
GEN-2017-061	DISIS-2017-001	08	N/A	101.5	ER/NR	Solar	GRDA1 to CLARMR 5 161kV line	DISIS STAGE	Excluded
GEN-2017-068	DISIS-2017-001	08	N/A	103.5	ER/NR	Solar	Wichita 345kV Substation	DISIS STAGE	Excluded
GEN-2017-071	DISIS-2017-001	08	N/A	124.7	ER/NR	Solar	Greenwood 138kV sub	DISIS STAGE	Excluded
GEN-2017-072	DISIS-2017-001	08	N/A	52.2	ER/NR	Solar	Greenwood 138kV sub	DISIS STAGE	Excluded
GEN-2017-073	DISIS-2017-001	08	N/A	72.5	ER/NR	Solar	Dry Gulch 161kV sub	DISIS STAGE	Excluded
GEN-2017-074	DISIS-2017-001	08	N/A	72.5	ER/NR	Solar	Pryor Junction 138kV sub	DISIS STAGE	Excluded
GEN-2017-077	DISIS-2017-001	08	N/A	124.7	ER/NR	Solar	Explorer Claremore Tap EXCLART4	DISIS STAGE	Excluded
GEN-2017-086	DISIS-2017-001	08	N/A	150	ER/NR	Solar	Viola 345kV	DISIS STAGE	Excluded
GEN-2017-092	DISIS-2017-001	08	N/A	200	ER	Solar	Canadian River-Muskogee and Muskogee-Seminole 345kV	DISIS STAGE	Excluded
GEN-2017-082	DISIS-2017-001	12	6/2/2020	149.4	ER	Wind	Asbury Plant 161 kV	DISIS STAGE	Included
Asbury Plant	DISIS-2017-1-PQ	08	N/A	189		Coal	Asbury Plant 161 kV	RETIRED	Excluded

3.0 POWER FLOW ANALYSIS

Power flow analysis is used to determine if the transmission system can accommodate the study project without violating thermal or voltage transmission planning criteria. Detailed power flow information can be seen in the attached power flow spreadsheet in **Appendix B: Power Flow Spreadsheet**.

3.1 Model Preparation

Power flow analysis for the Interim Study was performed using modified versions of the DISIS-2016-002-2 series study models including the 2017 Winter Peak (17WP), 2018 Spring (18G), 2018 Summer Peak (18SP), 2021 Light (21L), 2021 Summer Peak (21SP), 2021 Winter Peak (21WP), and 2026 Summer Peak (26SP) seasonal models.

Variable Energy Resources (VER) (solar/wind) within a geographical area of the interconnection request are dispatched at 100% nameplate of maximum generation (SPP regional group 8 for this study). The VERs in the remaining areas are dispatched at 20% nameplate of maximum generation for Summer, Winter, and Spring seasons and 0% nameplate of maximum generation for the Light Load season. Load factor ratios are used to sink generation adjustments across the SPP footprint.

For this IASIS, only the previous queued requests listed in **Table 2-2** were assumed to be in-service at 100% dispatch if within Group 08.

In the power flow analysis, projects listed in **Table 2-2** were excluded if they have commercial operation dates beyond December 2021, have a suspended status, have a withdrawn status, or have contingent network upgrades not included in the study due to long term/unknown completion dates.

3.1.1 Assumptions

In the power flow analysis, the DISIS-2016-002-2 models included the Litchfield-Baker-Neosho 69kV circuit as a 161kV circuit. Prior to the Interim Study analysis, this circuit was updated in the models to 69kV. In addition, the cases were updated to include the GIR JCT-Franklin-Fronten-Depaul 69 kV circuit as modeled in the DISIS-2017-001 models.

GEN-2017-009, GEN-2017-060, and GEN-2017-082 were included in the study as they have equal queue priority as GEN-2017-005 and are near the study project. GEN-2017-009 was dispatched at 100% capacity while GEN-2017-060 and GEN-2017-082 were dispatched at 20% capacity. This study also removed the retired Asbury coal plant.

Critical line ratings in the cases were updated. Documentation of these line ratings may be requested through SPP. The following line ratings were modified if not already in the cases:

- Asbury Plant – Litchfield 161 kV - (Summer: 251 MVA; Winter: 251 MVA)
- Asbury Plant - Carl Junction East 161 kV - (Summer: 290 MVA; Winter: 322 MVA)
- Asbury Plant – Purcell 161 kV - (Summer: 290 MVA; Winter: 322 MVA)
- La Russel Energy – Springfield SPA 161 kV - (Summer: 167 MVA; Winter: 167 MVA)
- Oronogo Jct. – Joplin Fir Road 161 kV - (Summer: 290 MVA; Winter: 335 MVA)
- Carthage S.W. – Carthage SPA 161 kV - (Summer: 215 MVA; Winter: 293 MVA)
- Franklin – Marmaton 161 kV - (Summer: 251 MVA; Winter: 251 MVA)

3.2 Study Methodology and Criteria

Network constraints were identified by using TARA AC analysis.

Thermal overloads are determined for system intact (n-0) (greater than 100% of Rate A - normal) and contingency (n-1) (greater than 100% of Rate B – emergency) conditions.

The overloads are screened to determine if the generator interconnection request has at least

- 3% Distribution Factor (DF) for system intact conditions (n-0),
- 20% DF upon outage-based conditions (n-1), or
- 3% DF on contingent elements that resulted in a non-converged solution.

The contingency set includes all SPP control area branches and ties 69kV and above, first-tier Non-SPP control area branches and ties 115 kV and above, any defined contingencies for these control areas, and generation unit outages for the SPP control areas.

The monitored elements include all SPP control area branches, ties, and buses 69 kV and above, and all first-tier Non-SPP control area branches and ties 69 kV and above. NERC Power Transfer Distribution Flowgates for SPP and first-tier Non-SPP control areas are monitored. Additional NERC Flowgates are monitored in second-tier or greater Non-SPP control areas. Voltage monitoring was performed for SPP control area buses 69 kV and above.

3.3 Results

The thermal violations and the corresponding transfer distribution factors are listed in **Table 3-1**, and the contingency descriptions associated with the thermal violations are listed in **Table 3-2**.

Franklin 161/69 kV transformer overloads were identified under different conditions. The worst overload on the transformer was observed at 102.51% in the 21WP case during the outage of the Litchfield – Franklin 161 kV circuit. This limited the output of GEN-2017-005 to 184 MWs. GEN-2017-005 has requested a sponsored network upgrade to add an additional Franklin 161/69 kV transformer. After the sponsored upgrade, the highest loading on the Franklin 161/69 kV transformer was observed at 65.54%. Apart from the Franklin 161/69 kV transformer overload, no additional overloads were identified due to the addition of GEN-2017-005. No voltage issues were observed for the study cases.

Table 3-1: Thermal Violations without Additional Franklin Transformer

Monitored Facility	Ckt ID	kVs	Area	Rate A (MVA)	Rate B (MVA)	Cont Name	Scenario	BC Loading (%)	TC Loading (%)	Cont Flow (MVA) 0%	Cont Flow (MVA) 100%	DFAX	Transfer Limit (MW)
532938 FRANKLIN5 161 998094 FRAN TX-1 69.0 1	1	161\69	536	100	110	532932 LITCH 5 161 532938 FRANKLIN5 161 1	21WP	57.13	102.51	62.84	112.76	25.60%	184.21
532938 FRANKLIN5 161 998094 FRAN TX-1 69.0 1	1	161\69	536	100	110	532932 LITCH 5 161 532938 FRANKLIN5 161 1	21SP	55.04	101.09	60.54	111.20	25.98%	190.38
532938 FRANKLIN5 161 998094 FRAN TX-1 69.0 1	1	161\69	536	100	110	532932 LITCH 5 161 532938 FRANKLIN5 161 1	26SP	56.64	101.57	62.30	111.73	25.35%	188.19

Table 3-2: Thermal Violations with Additional Franklin Transformer

Monitored Facility	Ckt ID	kVs	Area	Rate A (MVA)	Rate B (MVA)	Cont Name	Scenario	BC Loading (%)	TC Loading (%)	Cont Flow (MVA) 0%	Cont Flow (MVA) 100%	DFAX	Transfer Limit (MW)
532938 FRANKLIN5 161 998094 FRAN TX-1 69.0 1	1	161\69	536	100	110	532932 LITCH 5 161 532938 FRANKLIN5 161 1	21WP	47.89	65.54	52.68	72.09	9.96%	-
532938 FRANKLIN5 161 998094 FRAN TX-1 69.0 1	1	161\69	536	100	110	532932 LITCH 5 161 532938 FRANKLIN5 161 1	21SP	35.29	59.21	38.82	65.13	13.49%	-
532938 FRANKLIN5 161 998094 FRAN TX-1 69.0 1	1	161\69	536	100	110	532932 LITCH 5 161 532938 FRANKLIN5 161 1	26SP	45.60	62.42	50.16	68.66	9.49%	-

Table 3-3: Contingency Description for the Thermal Violation

Contingency Name	Contingency Description
532932 LITCH 5 161 532938 FRANKLIN5 161 1	OPEN BRANCH FROM BUS 532932 TO BUS 532938

4.0 STABILITY ANALYSIS

Transient stability analysis was performed to evaluate the dynamic performance of the proposed GEN-2017-005 project and to ensure that the transmission system can maintain angular and voltage stability within planning criteria bandwidth during and after a disturbance.

4.1 Methodology

The cases selected for the transient stability analysis were a modified version of the 2016 series of Model Development Working Group (MDWG) dynamic study models including the 2017 Winter, 2018 Summer Peak, and 2026 Summer Peak dynamic cases. The cases were adapted to resemble the power flow study cases with regards to prior queued generation requests and topology. The prior queued and study generation were dispatched into the SPP footprint. The unit dispatch updates for each group are listed in **Table 2-2**. Initial simulations were carried out for a non-disturbance run of twenty (20) seconds to verify the numerical stability of the model.

4.2 Fault Definitions

The study contingencies evaluated include network circuit segments connected within 3 levels for P1 events and 2 levels for P4 and P6 events. Additionally, P1, P4, P6 events on the following stations were considered:

- Neosho
- Delaware
- Rose Hill
- La Cygne
- Blackberry

Based on the configuration of Study Project GEN-2017-005, a total of 143 contingency events were identified for this study. The studied faults are listed in **Appendix C: Contingencies Evaluated for Study Project GEN-2017-005**.

4.3 Results

Table 4-1 summarizes results for the machine rotor angle damping requirement and transient voltage recovery criteria for all the faults studied.

Table 4-1: Stability Analysis Results for IASIS

Fault ID	Fault Name	17W wo GEN-2017-005 & wo Franklin XFMR	17W wo GEN-2017-005 & w Franklin XFMR	17W w GEN-2017-005 & wo Franklin XFMR	17W w GEN-2017-005 & w Franklin XFMR	18S wo GEN-2017-005 & wo Franklin XFMR	18S wo GEN-2017-005 & w Franklin XFMR	18S w GEN-2017-005 & wo Franklin XFMR	18S w GEN-2017-005 & w Franklin XFMR	26S wo GEN-2017-005 & wo Franklin XFMR	26S wo GEN-2017-005 & w Franklin XFMR	26S w GEN-2017-005 & wo Franklin XFMR	26S w GEN-2017-005 & w Franklin XFMR
CON1	CNTRVIL5-G15-016T_161KV	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
CON2	G15-016T -PRQN_WIND5_161	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
CON3	JAYHAWK_TAP-MARMTNE5_161	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
CON4	JAYHAWK_TAP-FRANKLIN5_161	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
CON5	LITCH 5-FRANKLIN5_161	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
CON6	LITCH 5-ASB349 5_ 161	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable

CON7	MARMATN2-MCKEE 2_ 69	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
CON8	MARMATN2-UN1ELSM2_ 69	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
CON9	MARMTNE5-NEOSHO 5_ 161	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
CON10	MARMTNE5-G15-016T_ 161	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
CON11	MULBERY2-FRANKLIN2_69	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
CON12	NEOSHO 5-RIV4525_ 161	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
CON13	SHEFFLD2-FRANKLIN2_69	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
CON14	N345 TX-2	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
CON15	NSES TX-5	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
CON16	NSES TX-4	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
CON17	MARM TX-1	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
CON18	LITC TX-1	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
CON19	LITC TX-2	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
CON20	FRAN TX-1	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
CON21	7BLACKBERRY-7SPORTSMAN	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
CON22	7BLACKBERRY-7JASPER	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
CON23	7BLACKBERRY-NEOSHO7	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
CON24	DELWARE7-N.E.S.7	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
CON25	DELWARE7-NEOSHO7	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
CON26	CANEYRV7-NEOSHO7	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
CON27	BENTON 7-ROSEHIL7	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
CON28	NEOSHO 7-LACYGNE7	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
CON29	ROSEHIL7-WOLFCRK7	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
CON30	ROSEHIL7-LATHAMS7	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
CON31	ROSEHIL7-G15-052T	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
CON32	WAVERLY7-LACYGNE7	Not Stable	Not Stable	Not Stable	Not Stable	Not Stable	Not Stable	Not Stable	Not Stable	Not Stable	Not Stable	Not Stable	Not Stable
CON33	W.GRDNR7-LACYGNE7	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
CON34	STILWEL7-LACYGNE7	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
CON35	LACYGNE7-LACYGNE11_7	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
CON36	LACYGNE7-LACYGNE22_7	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
CON37	LAC_G1_TX	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
CON38	LAC_G2_TX	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
CON39	DELAWARE_TX	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
CON40	N345 TX-2	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
CON41	N345 TX-1	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
CON42	ROSE TX-1	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
CON43	ROSE TX-5	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
CON44	ROSE TX-3	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
CON45	FRANKLIN2-FRONTEN2_69	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
4438	P12_069_WERE_ARKA-CRSW_69	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
4461	P12_069_WERE_FRAN-LITC_69	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
4462	P12_069_WERE_GLEN-OAKL_69	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
4463	P12_069_WERE_HALS-NEWT_69	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable

4557	P12_161_WERE_TECH-KELL-OPPD_161	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
4558	P12_230_WERE_LAWH-MIDJ_230_G1516TAP	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
4587	P13_069-161_WERE_LITC_TX-2_161-69	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
4588	P13_069-161_WERE_MARM TX-1_161-69	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
4592	P13_138-161_WERE_NSES TX-4OR5_161-138	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
P4-1	7BLACKBERRY_345	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
P4-2	DELWARE7_345	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
P4-3	NEOSHO7_345	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
P4-4	ROSEHIL7_345	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
P4-5	LACYGNE7_345	Not Stable	Not Stable	Not Stable	Not Stable	Not Stable	Not Stable	Not Stable	Not Stable	Not Stable	Not Stable	Not Stable	Not Stable
A_C	JAYHAWK_TAP-MARMTNE5_LITCH 5-FRANKLIN5	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
A_B	JAYHAWK_TAP-MARMTNE5_JAYHAWK_TAP-FRANKLIN5	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
A_E	JAYHAWK_TAP-MARMTNE5_MARMTNE5-G15-016T	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
A_D	JAYHAWK_TAP-MARMTNE5_MARMTNE5-NEOSHO 5	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
A_G	JAYHAWK_TAP-MARMTNE5_FRAN TX-1	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
A_F	JAYHAWK_TAP-MARMTNE5_MARM TX-1	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
A_4558	JAYHAWK_TAP-MARMTNE5_P12_230_WERE_LAWH-MIDJ_230_G1516TAP	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
A_4588	JAYHAWK_TAP-MARMTNE5_P13_069-161_WERE_MARM TX-1_161-69	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
C_A	LITCH 5-FRANKLIN5_JAYHAWK_TAP-MARMTNE5	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
C_B	LITCH 5-FRANKLIN5_JAYHAWK_TAP-FRANKLIN5	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
C_E	LITCH 5-FRANKLIN5_MARMTNE5-G15-016T	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
C_D	LITCH 5-FRANKLIN5_MARMTNE5-NEOSHO 5	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
C_G	LITCH 5-FRANKLIN5_FRAN TX-1	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
C_F	LITCH 5-FRANKLIN5_MARM TX-1	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
C_4558	LITCH 5-FRANKLIN5_P12_230_WERE_LAWH-MIDJ_230_G1516TAP	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
C_4588	LITCH 5-FRANKLIN5_P13_069-161_WERE_MARM TX-1_161-69	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
B_A	JAYHAWK_TAP-FRANKLIN5_JAYHAWK_TAP-MARMTNE5	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
B_C	JAYHAWK_TAP-FRANKLIN5_LITCH 5-FRANKLIN5	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable

B_E	JAYHAWK_TAP-FRANKLIN5_MARMTNE5-G15-016T	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
B_D	JAYHAWK_TAP-FRANKLIN5_MARMTNE5-NEOSHO 5	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
B_G	JAYHAWK_TAP-FRANKLIN5_FRAN TX-1	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
B_F	JAYHAWK_TAP-FRANKLIN5_MARM TX-1	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
B_4558	JAYHAWK_TAP-FRANKLIN5_P12_230_WERE_LAWH-MIDJ_230_G1516TAP	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
B_4588	JAYHAWK_TAP-FRANKLIN5_P13_069-161_WERE_MARM TX-1_161-69	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
E_A	MARMTNE5-G15-016T_JAYHAWK_TAP-MARMTNE5	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
E_C	MARMTNE5-G15-016T_LITCH 5-FRANKLIN5	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
E_B	MARMTNE5-G15-016T_JAYHAWK_TAP-FRANKLIN5	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
E_D	MARMTNE5-G15-016T_MARMTNE5-NEOSHO 5	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
E_G	MARMTNE5-G15-016T_FRAN TX-1	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
E_F	MARMTNE5-G15-016T_MARM TX-1	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
E_4558	MARMTNE5-G15-016T_P12_230_WERE_LAWH-MIDJ_230_G1516TAP	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
E_4588	MARMTNE5-G15-016T_P13_069-161_WERE_MARM TX-1_161-69	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
D_A	MARMTNE5-NEOSHO 5_JAYHAWK_TAP-MARMTNE5	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
D_C	MARMTNE5-NEOSHO 5_LITCH 5-FRANKLIN5	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
D_B	MARMTNE5-NEOSHO 5_JAYHAWK_TAP-FRANKLIN5	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
D_E	MARMTNE5-NEOSHO 5_MARMTNE5-G15-016T	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
D_G	MARMTNE5-NEOSHO 5_FRAN TX-1	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
D_F	MARMTNE5-NEOSHO 5_MARM TX-1	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
D_4558	MARMTNE5-NEOSHO 5_P12_230_WERE_LAWH-MIDJ_230_G1516TAP	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
D_4588	MARMTNE5-NEOSHO 5_P13_069-161_WERE_MARM TX-1_161-69	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
G_A	FRAN TX-1_JAYHAWK_TAP-MARMTNE5	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
G_C	FRAN TX-1_LITCH 5-FRANKLIN5	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
G_B	FRAN TX-1_JAYHAWK_TAP-FRANKLIN5	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable

G_E	FRAN TX-1_MARMTNE5-G15-016T	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
G_D	FRAN TX-1_MARMTNE5-NEOSHO 5	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
G_F	FRAN TX-1_MARM TX-1	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
G_4558	FRAN TX-1_P12_230_WERE_LAWH-MIDJ_230_G1516TAP	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
G_4588	FRAN TX-1_P13_069-161_WERE_MARM TX-1_161-69	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
F_A	MARM TX-1_JAYHAWK_TAP-MARMTNE5	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
F_C	MARM TX-1_LITCH 5-FRANKLIN5	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
F_B	MARM TX-1_JAYHAWK_TAP-FRANKLIN5	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
F_E	MARM TX-1_MARMTNE5-G15-016T	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
F_D	MARM TX-1_MARMTNE5-NEOSHO 5	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
F_G	MARM TX-1_FRAN TX-1	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
F_4558	MARM TX-1_P12_230_WERE_LAWH-MIDJ_230_G1516TAP	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
F_4588	MARM TX-1_P13_069-161_WERE_MARM TX-1_161-69	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
4558_A	P12_230_WERE_LAWH-MIDJ_230_G1516TAP_JAYHAWK_TAP-MARMTNE5	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
4558_C	P12_230_WERE_LAWH-MIDJ_230_G1516TAP_LITCH 5-FRANKLIN5	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
4558_B	P12_230_WERE_LAWH-MIDJ_230_G1516TAP_JAYHAWK_TAP-FRANKLIN5	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
4558_E	P12_230_WERE_LAWH-MIDJ_230_G1516TAP_MARMTNE5-G15-016T	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
4558_D	P12_230_WERE_LAWH-MIDJ_230_G1516TAP_MARMTNE5-NEOSHO 5	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
4558_G	P12_230_WERE_LAWH-MIDJ_230_G1516TAP_FRAN TX-1	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
4558_F	P12_230_WERE_LAWH-MIDJ_230_G1516TAP_MARM TX-1	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
4558_4588	P12_230_WERE_LAWH-MIDJ_230_G1516TAP_P13_069-161_WERE_MARM TX-1_161-69	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
4588_A	P13_069-161_WERE_MARM TX-1_161-69_JAYHAWK_TAP-MARMTNE5	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
4588_C	P13_069-161_WERE_MARM TX-1_161-69_LITCH 5-FRANKLIN5	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
4588_B	P13_069-161_WERE_MARM TX-1_161-69_JAYHAWK_TAP-FRANKLIN5	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
4588_E	P13_069-161_WERE_MARM TX-1_161-69_MARMTNE5-G15-016T	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable

4588_D	P13_069-161_WERE_MARM TX-1_161-69_MARMTNE5-NEOSHO 5	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
4588_G	P13_069-161_WERE_MARM TX-1_161-69_FRAN TX-1	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
4588_F	P13_069-161_WERE_MARM TX-1_161-69_MARM TX-1	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
4588_4558	P13_069-161_WERE_MARM TX-1_161-69_P12_230_WERE_LAWH-MIDJ_230_G1516TAP	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
P6-1	EPE_P6_NEO-BLK_LTHM-RHL	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
P6-2	EPE_P6_NEO-BLK_NEO-LCYG	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
P6-3	EPE_P6_NEO-BLK_NEO-DLWR	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
P6-4	EPE_P6_LTHM-RHL_NEO-LCYG	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
P6-5	EPE_P6_LTHM-RHL_NEO-DLWG	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
P6-6	EPE_P6_NEO-LCYG_NEO-DLWG	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
P6-7	EPE_P6_NEO-BLK_LTHM-RHL	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
P6-8	EPE_P6_NEO-BLK_NEO-LCYG	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
P6-9	EPE_P6_NEO-BLK_NEO-DLWR	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
P6-10	EPE_P6_LTHM-RHL_NEO-LCYG	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
P6-11	EPE_P6_LTHM-RHL_NEO-DLWG	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
P6-12	EPE_P6_NEO-LCYG_NEO-DLWG	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable

The dynamic simulations for Study Project GEN-2017-005 demonstrate system stability for all but two events related to the Waverly-LaCygne 345 kV line. These faults include:

- P1 outage of the Waverly to LaCygne 345 kV Line, CKT 1.
- P4 outage of the LaCygne 345 kV bus.

Figure 4-1 and **Figure 4-2** demonstrates the Wolf Creek unit's undamped rotor angle, while maintaining synchronism, regardless of Study Project GEN-2017-005 being online. These plots are representative of both contingencies for all cases and scenarios.

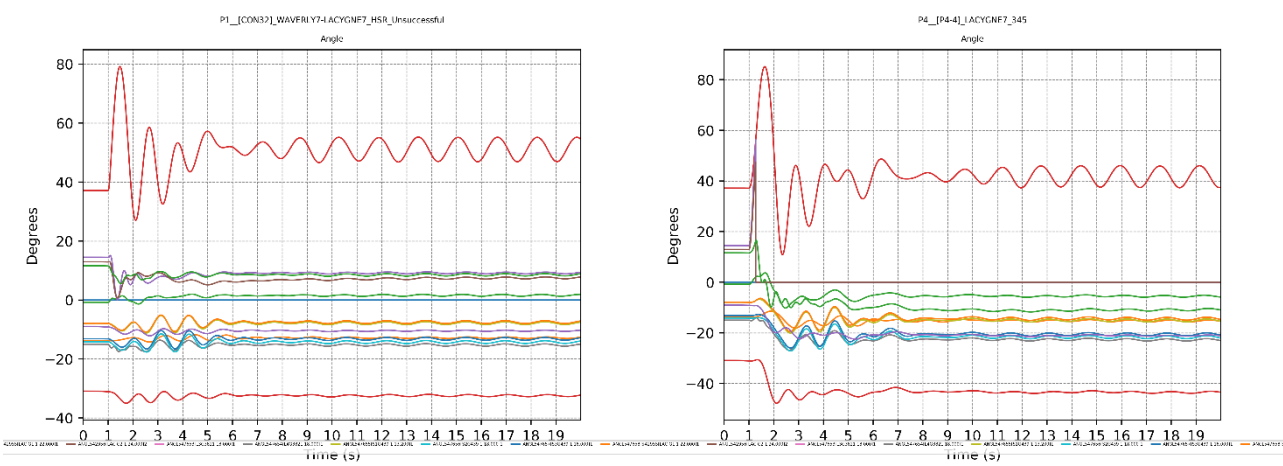


Figure 4-1: Pre-mitigation Response without Study Project GEN-2017-005

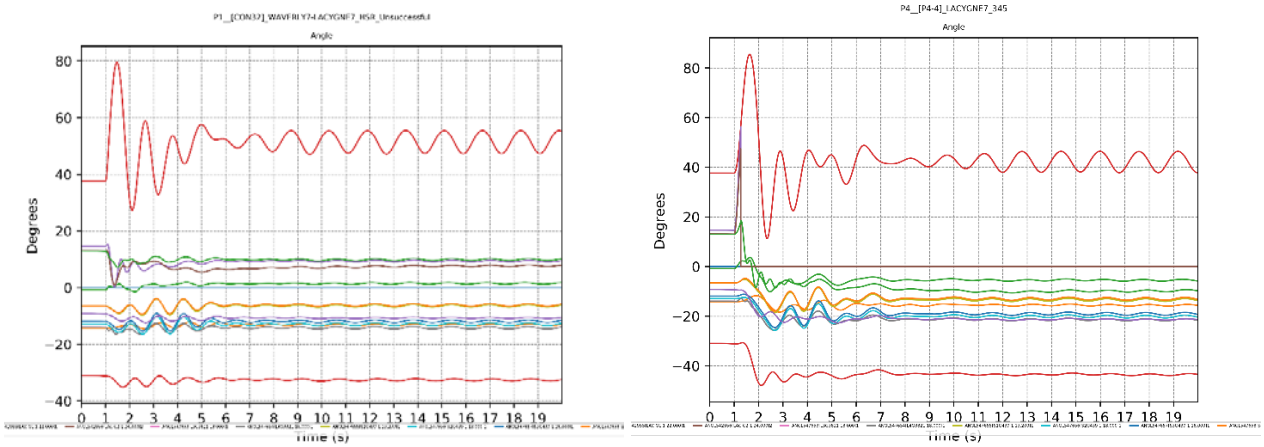


Figure 4-2: Pre-mitigation Response with Study Project GEN-2017-005

SPP identified mitigation for this instability by reducing the output of the Wolf Creek facility to 700 MW. Simulations were rerun to identify any new impact from Study Project GEN-2017-005. **Figure 4-3** and **Figure 4-4** show that the SPP identified mitigation results in system stability. These plots are representative of both contingencies for all cases and scenarios. With the mitigation in place, the stability simulation shows no adverse impact from Study Project GEN-2017-005.

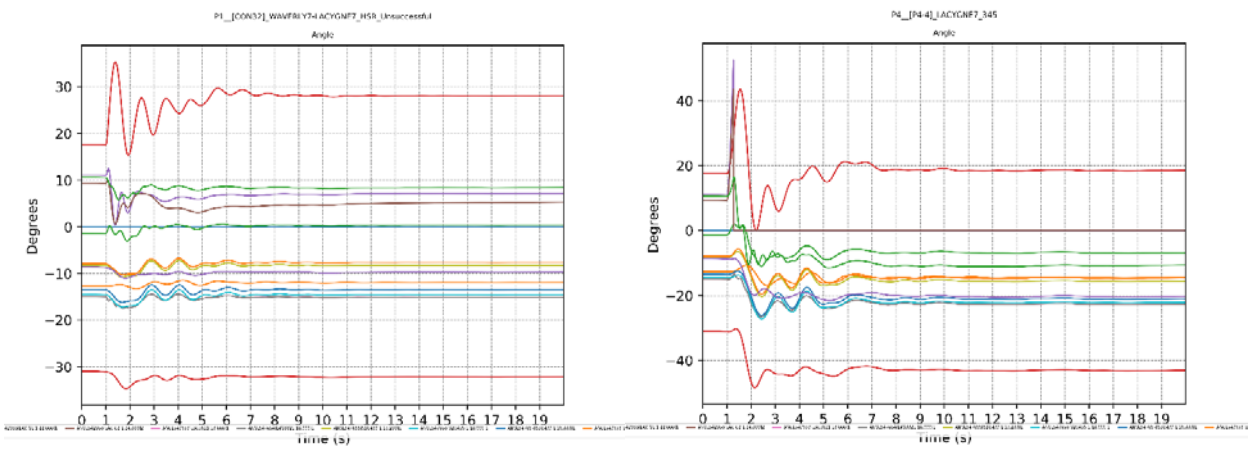


Figure 4-3: Post-mitigation Response without Study Project GEN-2017-005

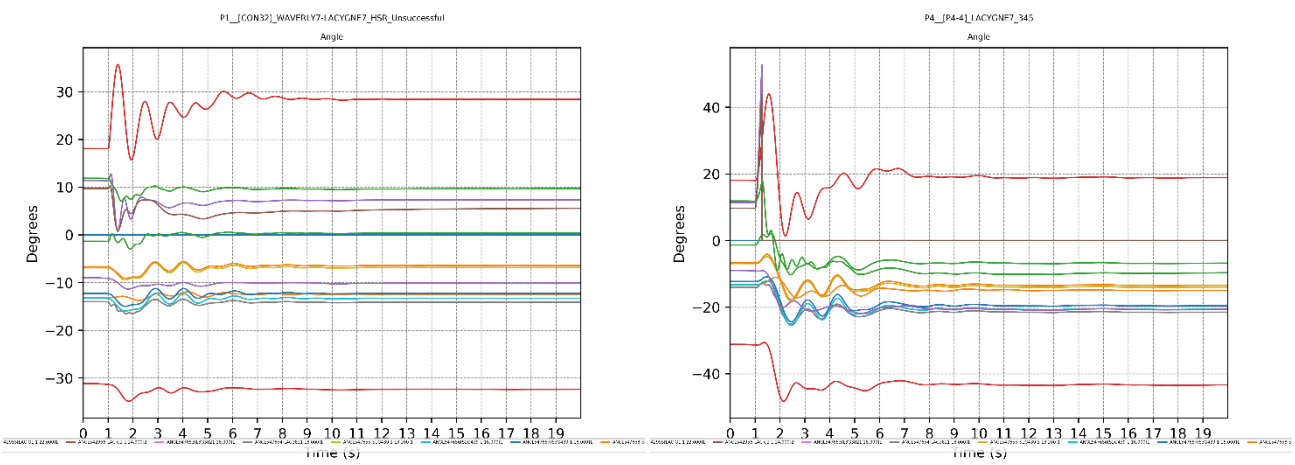


Figure 4-4: Post-mitigation Response with Study Project GEN-2017-005

4.4 Reactive Compensation Analysis

A reactive compensation analysis has been performed for the GEN-2017-005 Interconnection Request. EPE performed this reactive compensation analysis for excessive capacitive charging current for the addition of the Interconnection Request facilities.

The project generators and capacitors (if any) were turned off in the base case. It is the interconnection customer's responsibility to design and install the reactive compensation equipment necessary to control the reactive power injection at the POI. If an equivalent means of compensation is installed, the reactive power required may vary with system conditions (e.g. a higher compensation amount is required for voltages above unity at the POI and a lower compensation amount is required for voltages below unity at the POI). To offset the charging current of the Study Project GEN-2017-005 interconnection facilities, a 6.5 MVAr reactor is needed on the low side (34.5 kV bus) of the Study Project GEN-2017-005 MPT.

4.5 Power Factor Analysis

In accordance with FERC Order 827 GEN-2017-005 will be required to provide dynamic reactive power within the power factor range of 0.95 leading (absorbing Vars from the network) to 0.95 lagging (providing Vars to the network) at continuous rated power output at the high side of the generator substation. To achieve a power factor of 0.95 leading and lagging at the Study Project GEN-2017-005 POI, with the PSS/E equivalent model evaluated in this study, an 18 MVAr capacitor is needed on the low side (34.5 kV bus) of the Study Project GEN-2017-005 MPT. A detailed representation of the plant, including the control system respecting individual voltages, may be necessary to confirm this value.

5.0 SHORT CIRCUIT ANALYSIS

The short circuit analysis was performed on the 2026 Summer Peak stability analysis power flow case using the PSS/E ASCC program tool. Since the power flow model does not contain negative and zero sequence data, only three-phase symmetrical fault current levels were calculated at the point of interconnection up to and including five levels away for bus voltages at and above 69 kV. Calculations were performed both without and with GEN-2017-005 in-service. The analysis was performed in two scenarios. The first scenario does not include the additional Franklin 161/69 kV transformer and the second scenario does contain this upgrade.

5.1 Methodology

The analysis assumed that all upgrades identified in the power flow analysis are in-service unless otherwise noted. The dispatch of projects follows the same methods identified in the power flow analysis as seen in **Table 2-2**. The analysis was conducted using the PSS/E ASCC program settings seen in **Appendix D: Short Circuit Analysis Solution Parameters.**

5.2 Results

Detailed results summarizing the three-phase fault currents observed for buses within five levels away from GEN-2017-005's point of interconnection with and without the additional Franklin transformer can be seen in **Table 5-1** and **Table 5-2**. Under three-phase fault conditions, the short circuit analysis revealed the increase of short circuit currents with and without the sponsored upgrade to add an additional Franklin 161/69 kV transformer due to the interconnection of GEN-2017-005, however, a detailed comparison with the breaker ratings was not performed.

Table 5-1: Gen-2017-005 3 Phase Fault Currents in 2026 SP Case

Gen-2017-005 3 Phase Fault Currents in 2026 SP Case (1.0 Pre-Fault Voltage)									
Levels from POI	Bus Number	Bus Name	Voltage (kV)	Area	Zone	Pre-fault (A)	Post-fault (A)	Change (A)	Change (%)
0	588504	G17-005-TAP	161	536	1536	6211.2	6852.5	641.3	10.32%
1	532934	MARMTNE5	161	536	1536	8064.7	8432.6	367.9	4.56%
1	532938	FRANKLIN5	161	536	1536	7329.9	7578.5	248.6	3.39%
2	532932	LITCH 5	161	536	1536	8414.6	8612.8	198.2	2.36%
2	532937	NEOSHO 5	161	536	1536	20931.3	21020.7	89.4	0.43%
2	533639	MARMATN2	69	536	1536	8280.4	8393.7	113.3	1.37%
2	533876	FRANKLIN2	69	536	1536	10681.9	10833.5	151.6	1.42%
2	543650	G15-016T	161	541	1550	7640.6	7815.5	174.9	2.29%
3	532793	NEOSHO 7	345	536	1536	16181.1	16212.5	31.4	0.19%
3	533020	NEOSHOS4	138	536	1536	22641.9	22723.7	81.8	0.36%
3	533021	NEOSHO 4	138	536	1536	22641.9	22723.7	81.8	0.36%
3	533640	MCKEE 2	69	536	1536	4106.6	4133.3	26.7	0.65%
3	533647	UN1ELSM2	69	536	1536	7376	7458.8	82.8	1.12%
3	533765	LITCH N2	69	536	1536	12198.6	12369.2	170.6	1.40%
3	533766	LITCH S2	69	536	1536	12198.6	12369.2	170.6	1.40%
3	533767	MULBERY2	69	536	1536	7882.3	7959.5	77.2	0.98%
3	533774	SHEFFLD2	69	536	1536	4182.9	4207.4	24.5	0.59%

3	543065	CNTRVIL5	161	541	1550	6240.2	6295.1	54.9	0.88%
3	543651	PRQN_WIND5	161	541	1550	6642.3	6750.4	108.1	1.63%
3	547476	ASB349 5	161	544	1564	10267	10415.8	148.8	1.45%
3	533762	GIR JCT2	69	536	1536	6297.2	6333.9	36.7	0.58%
3	533775	FRONTEN2	69	536	1536	8260	8342.8	82.8	1.00%
4	300739	7BLACKBERRY	345	330	304	12284.5	12292.8	8.3	0.07%
4	510380	DELWARE7	345	520	547	10896.3	10901.3	5	0.05%
4	532926	BAKER 2	69	536	1536	4854	4867.7	13.7	0.28%
4	533008	TV1MNDV4	138	536	1536	6811.3	6815.6	4.3	0.06%
4	533022	NEOSHON4	138	536	1536	22641.9	22723.7	81.8	0.36%
4	533645	SE9HIAT2	69	536	1536	3663.5	3684.3	20.8	0.57%
4	533654	ZILAJCT2	69	536	1536	5484.4	5512.2	27.8	0.51%
4	533756	AQUARS 2	69	536	1536	7631	7699.3	68.3	0.90%
4	533769	PITNAC 2	69	536	1536	10740.7	10874.4	133.7	1.24%
4	533771	ROUSE 2	69	536	1536	9128.1	9226.2	98.1	1.07%
4	533773	CATOTAP2	69	536	1536	4119.2	4143	23.8	0.58%
4	533778	NEOSHOS2	69	536	1536	22202.9	22263.2	60.3	0.27%
4	542981	LACYGNE7	345	541	1544	25176.1	25181.5	5.4	0.02%
4	543069	PAOLA 5	161	541	1550	9960.4	9983	22.6	0.23%
4	547467	ORO110 5	161	544	1564	18421.8	18498.6	76.8	0.42%
4	547477	CJ 366 5	161	544	1564	11751.9	11821.7	69.8	0.59%
4	547487	HOC404 5	161	544	1561	12789.1	12801.6	12.5	0.10%
4	547491	PUR421 5	161	544	1564	9037.5	9098.1	60.6	0.67%
4	547498	STL439 5	161	544	1563	23789.5	23841.8	52.3	0.22%
4	547503	RIV452T 5	161	544	1561	22741.5	22795.7	54.2	0.24%
4	547541	RIV167 2	69	544	1561	17836.3	17851.7	15.4	0.09%
4	588544	G17-009-TAP	345	536	1536	11194.9	11205.6	10.7	0.10%
4	533759	DEPAUL 2	69	536	1536	8975.7	9071.4	95.7	1.07%
4	533761	GIRARD 2	69	536	1536	4423.2	4441.1	17.9	0.40%
4	533772	SE1GREE2	69	536	1536	5942.7	5957.8	15.1	0.25%
5	300740	7SPORTSMAN	345	330	305	24079	24082	3	0.01%
5	300949	7JASPER	345	330	304	10708.5	10713.5	5	0.05%
5	510370	DELAWAR1	13.8	520	547	19041.6	19042.3	0.7	0.00%
5	510379	DELWARE4	138	520	547	10837.5	10839.7	2.2	0.02%
5	510406	N.E.S.-7	345	520	547	15868.9	15872	3.1	0.02%
5	512631	MIAMI 5	161	523	554	9100.6	9105.1	4.5	0.05%
5	532780	CANEYRV7	345	536	1537	9861.5	9863.7	2.2	0.02%
5	532799	WAVERLY7	345	536	1536	14503.7	14504.7	1	0.01%
5	533003	LIBERTY4	138	536	1536	7148.5	7152.2	3.7	0.05%
5	533005	NEPARSN4	138	536	1536	11776.8	11798	21.2	0.18%

5	533621	ALLEN 2	69	536	1536	5425.6	5443.9	18.3	0.34%
5	533644	SE4DEVO2	69	536	1536	3599.4	3619.5	20.1	0.56%
5	533650	UN8HUMB2	69	536	1536	3990.8	4005.7	14.9	0.37%
5	533652	WARE 2	69	536	1536	3592.1	3610.8	18.7	0.52%
5	533703	ORDNJCT2	69	536	1536	8297.4	8305.2	7.8	0.09%
5	533758	CRAWFOR2	69	536	1536	7099.7	7114.8	15.1	0.21%
5	533764	HUDSJCT2	69	536	1536	7624.4	7692.8	68.4	0.90%
5	533768	NEOSHON2	69	536	1536	22202.9	22263.2	60.3	0.27%
5	542965	W.GRDNR7	345	541	1544	25439.6	25443.5	3.9	0.02%
5	542968	STILWEL7	345	541	1544	24150.1	24155	4.9	0.02%
5	543066	S.OTTWA5	161	541	1550	6604.7	6608.5	3.8	0.06%
5	543067	CENTENL5	161	541	1550	9931.2	9949.4	18.2	0.18%
5	543112	OSAWAT 5	161	541	1550	9568	9588.6	20.6	0.22%
5	543629	LACYGNE11_7	345	541	1544	24545.3	24550.3	5	0.02%
5	543632	LACYGNE22_7	345	541	1544	24509.4	24514.4	5	0.02%
5	547459	WWR477	161	544	1563	21720.5	21764	43.5	0.20%
5	547469	RIV4525	161	544	1561	23134.2	23190.9	56.7	0.25%
5	547470	JOP145 5	161	544	1563	16949.3	16992.5	43.2	0.25%
5	547483	JOP389 5	161	544	1563	19334.9	19369.1	34.2	0.18%
5	547485	CAR395 5	161	544	1564	11585.4	11633.6	48.2	0.42%
5	547486	HOC404 4	138	544	1561	6413.9	6416	2.1	0.03%
5	547490	FIR417 5	161	544	1564	13529	13597.1	68.1	0.50%
5	547494	OAK432 5	161	544	1564	16755.7	16818.6	62.9	0.38%
5	547501	RIV453 5	161	544	1561	21963.2	22012.6	49.4	0.22%
5	547502	RIV167 5	161	544	1561	21487.2	21535.6	48.4	0.23%
5	547523	JOP 59 TX	69	544	1563	9570.2	9574.6	4.4	0.05%
5	547530	COL 94 2	69	544	1561	6305.3	6306.9	1.6	0.03%
5	547534	ORO110 2	69	544	1564	17352.2	17372.3	20.1	0.12%
5	547555	GAL278 2	69	544	1561	15765.7	15779	13.3	0.08%
5	547601	HOC404 2	69	544	1561	9368.6	9371.8	3.2	0.03%
5	547602	RIV406 2	69	544	1561	15721.7	15733.6	11.9	0.08%
5	547690	GLF339 2	69	544	1561	8950.1	8953.9	3.8	0.04%
5	587560	ASGI1603	161	541	1550	9960.4	9983	22.6	0.23%
5	588540	GEN-2017-009	345	536	1536	10380	10389.1	9.1	0.09%
5	533770	PITTSBG2	69	536	1536	7867.9	7941	73.1	0.93%

Table 5-2: Gen-2017-005 3 Phase Fault Currents in 2026 SP Case with Additional Franklin 161/69 kV Transformer

Gen-2017-005 3 Phase Fault Currents in 2026 SP Case (1.0 Pre-Fault Voltage) With Additional Franklin Transformer									
Levels from POI	Bus Number	Bus Name	Voltage (kV)	Area	Zone	Pre-fault (A)	Post-fault (A)	Change (A)	Change (%)
0	588504	G17-005-TAP	161	536	1536	6233	6874.3	641.3	10.29%
1	532934	MARMTNE5	161	536	1536	8069.5	8436.3	366.8	4.55%
1	532938	FRANKLIN5	161	536	1536	7447.2	7697.4	250.2	3.36%
2	532932	LITCH 5	161	536	1536	8432.6	8629.5	196.9	2.33%
2	532937	NEOSHO 5	161	536	1536	20938.5	21029	90.5	0.43%
2	533639	MARMATN2	69	536	1536	8283.1	8397.1	114	1.38%
2	533876	FRANKLIN2	69	536	1536	12456.3	12688.3	232	1.86%
2	543650	G15-016T	161	541	1550	7642.9	7817.2	174.3	2.28%
3	532793	NEOSHO 7	345	536	1536	16184.3	16216.1	31.8	0.20%
3	533020	NEOSHOS4	138	536	1536	22657.3	22740.5	83.2	0.37%
3	533021	NEOSHO 4	138	536	1536	22657.3	22740.5	83.2	0.37%
3	533640	MCKEE 2	69	536	1536	4121.6	4149.2	27.6	0.67%
3	533647	UN1ELSM2	69	536	1536	7378	7461.4	83.4	1.13%
3	533765	LITCH N2	69	536	1536	12347.4	12528.4	181	1.47%
3	533766	LITCH S2	69	536	1536	12347.4	12528.4	181	1.47%
3	533767	MULBERY2	69	536	1536	8280.3	8372.6	92.3	1.11%
3	533774	SHEFFLD2	69	536	1536	4327.2	4355.8	28.6	0.66%
3	543065	CNTRVIL5	161	541	1550	6240.9	6295.6	54.7	0.88%
3	543651	PRQN_WIND5	161	541	1550	6643.8	6751.4	107.6	1.62%
3	547476	ASB349 5	161	544	1564	10279.8	10427.5	147.7	1.44%
3	533762	GIR JCT2	69	536	1536	6642.6	6688	45.4	0.68%
3	533775	FRONTEN2	69	536	1536	8554.4	8649.4	95	1.11%
4	300739	7BLACKBERRY	345	330	304	12285.1	12293.5	8.4	0.07%
4	510380	DELWARE7	345	520	547	10896.8	10901.8	5	0.05%
4	532926	BAKER 2	69	536	1536	4865.5	4879.7	14.2	0.29%
4	533008	TV1MNDV4	138	536	1536	6812	6816.3	4.3	0.06%
4	533022	NEOSHON4	138	536	1536	22657.3	22740.5	83.2	0.37%
4	533645	SE9HIAT2	69	536	1536	3684.1	3705.9	21.8	0.59%
4	533654	ZILAJCT2	69	536	1536	5485.2	5513.1	27.9	0.51%
4	533756	AQUARS 2	69	536	1536	7740.3	7814	73.7	0.95%
4	533769	PITNAC 2	69	536	1536	10904.8	11048.4	143.6	1.32%
4	533771	ROUSE 2	69	536	1536	9314.7	9422.1	107.4	1.15%
4	533773	CATOTAP2	69	536	1536	4255.9	4283.6	27.7	0.65%
4	533778	NEOSHOS2	69	536	1536	22247.3	22309.9	62.6	0.28%
4	542981	LACYGNE7	345	541	1544	25176.3	25181.6	5.3	0.02%
4	543069	PAOLA 5	161	541	1550	9960.6	9983.2	22.6	0.23%

4	547467	ORO110 5	161	544	1564	18426.1	18502.2	76.1	0.41%
4	547477	CJ 366 5	161	544	1564	11756.9	11826.1	69.2	0.59%
4	547487	HOC404 5	161	544	1561	12789.3	12801.9	12.6	0.10%
4	547491	PUR421 5	161	544	1564	9042.4	9102.4	60	0.66%
4	547498	STL439 5	161	544	1563	23791.4	23843.4	52	0.22%
4	547503	RIV452T 5	161	544	1561	22742.9	22796.8	53.9	0.24%
4	547541	RIV167 2	69	544	1561	17836.8	17852.1	15.3	0.09%
4	588544	G17-009-TAP	345	536	1536	11196	11206.9	10.9	0.10%
4	533759	DEPAUL 2	69	536	1536	9197.7	9304	106.3	1.16%
4	533761	GIRARD 2	69	536	1536	4588.5	4609.9	21.4	0.47%
4	533772	SE1GREE2	69	536	1536	6031.9	6048.8	16.9	0.28%
5	300740	7SPORTSMAN	345	330	305	24079.1	24082	2.9	0.01%
5	300949	7JASPER	345	330	304	10708.7	10713.8	5.1	0.05%
5	510370	DELAWAR1	13.8	520	547	19041.6	19042.3	0.7	0.00%
5	510379	DELWARE4	138	520	547	10837.7	10840	2.3	0.02%
5	510406	N.E.S.-7	345	520	547	15869.2	15872.2	3	0.02%
5	512631	MIAMI 5	161	523	554	9100.7	9105.2	4.5	0.05%
5	532780	CANEYRV7	345	536	1537	9861.7	9864	2.3	0.02%
5	532799	WAVERLY7	345	536	1536	14503.7	14504.8	1.1	0.01%
5	533003	LIBERTY4	138	536	1536	7149.1	7152.8	3.7	0.05%
5	533005	NEPARSN4	138	536	1536	11780.1	11801.7	21.6	0.18%
5	533621	ALLEN 2	69	536	1536	5426.1	5444.5	18.4	0.34%
5	533644	SE4DEVO2	69	536	1536	3621.4	3642.5	21.1	0.58%
5	533650	UN8HUMB2	69	536	1536	3991.2	4006.1	14.9	0.37%
5	533652	WARE 2	69	536	1536	3669	3689.9	20.9	0.57%
5	533703	ORDNJCT2	69	536	1536	8302.5	8310.6	8.1	0.10%
5	533758	CRAWFOR2	69	536	1536	7165.6	7182.2	16.6	0.23%
5	533764	HUDSJCT2	69	536	1536	7741.9	7815.8	73.9	0.95%
5	533768	NEOSHON2	69	536	1536	22247.3	22309.9	62.6	0.28%
5	542965	W.GRDNR7	345	541	1544	25439.6	25443.5	3.9	0.02%
5	542968	STILWEL7	345	541	1544	24150.1	24155	4.9	0.02%
5	543066	S.OTTWA5	161	541	1550	6604.7	6608.5	3.8	0.06%
5	543067	CENTENL5	161	541	1550	9931.4	9949.5	18.1	0.18%
5	543112	OSAWAT 5	161	541	1550	9568.2	9588.8	20.6	0.22%
5	543629	LACYGNE11_7	345	541	1544	24545.4	24550.5	5.1	0.02%
5	543632	LACYGNE22_7	345	541	1544	24509.5	24514.6	5.1	0.02%
5	547459	WWR477	161	544	1563	21722.1	21765.3	43.2	0.20%
5	547469	RIV4525	161	544	1561	23135.6	23192	56.4	0.24%
5	547470	JOP145 5	161	544	1563	16951.4	16994.3	42.9	0.25%
5	547483	JOP389 5	161	544	1563	19336.2	19370.2	34	0.18%

5	547485	CAR395 5	161	544	1564	11588.8	11636.6	47.8	0.41%
5	547486	HOC404 4	138	544	1561	6414	6416.1	2.1	0.03%
5	547490	FIR417 5	161	544	1564	13533.5	13601	67.5	0.50%
5	547494	OAK432 5	161	544	1564	16759.2	16821.6	62.4	0.37%
5	547501	RIV453 5	161	544	1561	21964.4	22013.6	49.2	0.22%
5	547502	RIV167 5	161	544	1561	21488.4	21536.6	48.2	0.22%
5	547523	JOP 59 TX	69	544	1563	9570.3	9574.7	4.4	0.05%
5	547530	COL 94 2	69	544	1561	6305.3	6306.9	1.6	0.03%
5	547534	ORO110 2	69	544	1564	17353.2	17373.2	20	0.12%
5	547555	GAL278 2	69	544	1561	15766.2	15779.4	13.2	0.08%
5	547601	HOC404 2	69	544	1561	9368.7	9371.9	3.2	0.03%
5	547602	RIV406 2	69	544	1561	15722.1	15733.9	11.8	0.08%
5	547690	GLF339 2	69	544	1561	8950.2	8953.9	3.7	0.04%
5	587560	ASGI1603	161	541	1550	9960.6	9983.2	22.6	0.23%
5	588540	GEN-2017-009	345	536	1536	10380.9	10390.2	9.3	0.09%
5	533770	PITTSBG2	69	536	1536	8010.8	8090.5	79.7	0.99%

6.0 Conclusion

Power Flow Analysis:
For the interim request, GEN-2017-005 was studied at its maximum requested capacity (195.0 MW). The power flow analysis evaluated the system for seven scenarios (2017 Winter Peak, 2018 Spring, 2018 Summer Peak, 2021 Light, 2021 Summer Peak, 2021 Winter Peak, and 2026 Summer Peak).

Franklin 161/69 kV transformer overloads were identified under different conditions. The worst overload on the transformer was observed at 102.51% in the season 21WP case without the Litchfield – Franklin 161 kV circuit. This limited the output of GEN-2017-005 to 184 MWs. GEN-2017-005 has requested a sponsored network upgrade to add an additional Franklin 161/69 kV transformer. After the sponsored upgrade, the highest loading on the Franklin 161/69 kV was observed at 65.54%. Apart from the Franklin transformer 161/69 kV transformer overload, no additional overloads were identified due to the addition of GEN-2017-005. No voltage issues were observed for the study cases.

Dynamic Stability Analysis:
For the interim request, GEN-2017-005 was studied at its maximum requested capacity (195.0 MW). The stability analysis evaluated the system for three load scenarios (2017 Winter Peak (17W), 2018 Summer Peak (18S), and 2026 Summer Peak (26S)) simulating faults that included three-phase and single-line-to-ground faults.

The dynamic stability study identified no new instability or transient voltage violations caused by GEN-2017-005. Pre-existing instabilities were observed and caused by faults related to the Waverly-LaCygne 345 kV line. These faults were mitigated with the reduction of the Wolf Creek facility to 700 MW to study GEN-2017-005's impact. No other transient stability violations were observed for the study cases with or without the sponsored upgrade to add an additional Franklin 161/69 kV transformer.

Short Circuit Analysis:
The short circuit analysis was performed on the 2026 Summer Peak stability analysis power flow case using the PSS/E ASCC program tool. Only three-phase symmetrical fault current levels were calculated at the point of interconnection up to and including five levels away for bus voltages at and above 69 kV. Under three-phase fault conditions, the short circuit analysis revealed the increase of short circuit currents with and without the sponsored upgrade to add an additional Franklin 161/69 kV transformer due to the interconnection of GEN-2017-005, however, a detailed comparison with the breaker ratings was not performed.

APPENDIX A: NETWORK UPGRADES

The following transmission facilities are either (1) excluded/removed/disconnected from the network or (2) included/added/in-service in the study cases.

Upgrade ID	Upgrade Name	Upgrade Description	Identified Study	Cases
50583 (NTC 200228)	Clearwater - Viola 138 kV Ckt 1	Build new 21.8-mile 138 kV line from new Viola substation to Clearwater 138 kV substation.	DISIS-2016-002-2 (in-service)	Include
50584 (NTC 200228)	Gill - Viola 138 kV Ckt 1	Build new 27.9-mile 138 kV line from new Viola substation to Gill 138 kV substation.	DISIS-2016-002-2 (in-service)	Include
50582 (NTC 200228)	Viola 345/138 kV Transformer Ckt 1	Install new 345/138 kV transformer at Viola substation.	DISIS-2016-002-2 (in-service)	Include
50612 (NTC 200228)	Viola 345 kV Terminal Equipment	Install 345 kV breakers at Viola substation.	DISIS-2016-002-2 (in-service)	Include
112174	Ranch Road - Sooner 345 kV Ckt 1 Terminal Upgrades	Upgrade terminal equipment for Ranch Road - Sooner 345 kV Ckt 1 to achieve at least 2065 amps (Rate B = 1234 MVA) summer peak emergency rating.	DISIS-2016-001	Include
122884	G16-133_146 - Sapulpa 345 kV CKT 2 (DISIS-2016-002-2)	Sapulpa Road add 345 kV terminal and build approximately 17 miles Sapulpa Road - G16-133_146 345 kV line.	DISIS-2016-002-2	Exclude
122791	GEN-2016-100/101Tap - Arcadia 345kV (DISIS-2016-002-2)	Build new terminal at new substation on Sooner - Spring Creek line being built for Gen 2016-100 and 119. Expand Arcadia Substation and re-route four transmission lines to allow for room for new transmission line to be brought in. Build approximately 47 miles of 345kV transmission line from new substation serving Gen 2016-100 and 119 to Arcadia substation.	DISIS-2016-002-2	Exclude
122792	Viola 345/138kV Transformer CKT 2 (DISIS-2016-002-2)	Install 2nd 345/138 kV transformer at Viola substation.	DISIS-2016-002-2	Exclude
112508	Blackberry - Wolf Creek 345kV Terminal Equipment	Install terminal equipment to support a new line from Blackberry to Wolf Creek 345kV with a summer emergency rating of 1792 MVA	DISIS-2016-002-2	Exclude
112509	Wolf Creek - Blackberry 345kV Terminal Equipment	Install terminal equipment to support 345kV line from Wolf Creek to Blackberry 345kV rated at 1792 MVA	DISIS-2016-002-2	Exclude

122598	Blackberry - Wolf Creek 345 kV	Build a new 345kV line from Wolf Creek to Blackberry with a summer emergency rating of 1792 MVA	DISIS-2016-002-2	Exclude
122765	Blackberry - Wolfcreek 345 kV Ckt1 (AECI)	Build 86.15 miles of 345kV line from Blackberry to Wolf Creek to achieve 1792/1792/1792/1792 (SN/SE/WN/WE) MVA ratings	DISIS-2016-002-2	Exclude
122767	Blackberry - Wolfcreek 345 kV Ckt1 (WR)	Build 86.15 miles of 345kV line from Blackberry to Wolf Creek to achieve 1792/1792/1792/1792 (SN/SE/WN/WE) MVA ratings	DISIS-2016-002-2	Exclude
N/A	Series Reactors	Install series reactors on the Wolf Creek to Waverly to LaCygne 345kV circuit	N/A	Exclude
	Upgrade Maryville - Nodaway 161 kV	Rebuild the 5.36-mile-long Maryville to Nodaway 161 kV line from 556 ASCR to 954 ASCR	AECI AFS DISIS-2016-002	Exclude
	Uprate Hamburg - NorthboroF 69 kV	Uprate the 18-mile-long Hamburg to Northboro 69 kV line to 100 °C	AECI AFS DISIS-2016-002	Exclude
	Uprate Phelps - Rockport 69 kV	Uprate the 4.4-mile-long Phelps to Rockport 69 kV line to 100 °C	AECI AFS DISIS-2016-002	Exclude
	Rebuild Bevier - Macon Lake 69 kV	Rebuild the 4.136-mile-long Bevier to Macon Lake 69 kV line for 161 kV with 795 ASCR; operate at 69 kV	AECI AFS DISIS-2016-002	Exclude
	Rebuild Macon Lake - Axtell - Macon Tap 69 kV	Rebuild the 2.2-mile-long Macon Lake to Axtell to Macon Tap 69 kV line for 161 kV with 795 ASCR; operate at 69 kV	AECI AFS DISIS-2016-002	Exclude
	Upgrade Neosho - Sweetwater 69 kV	Upgrade 9.3-mile section of Neosho to Sweetwater 69 kV line to 336 ASCR and operate at 100 °C	AECI AFS DISIS-2016-002	Exclude
	Upgrade Dixie - Silver City 69 kV	Upgrade 0.45-mile section of Dixie to Silver City 69 kV line to 336 ASCR	AECI AFS DISIS-2016-002	Exclude
	GEN-2017-009 Tap - Neosho – Caney River 345kV	Neosho – Caney River 345kV circuit, increase the normal and emergency ratings from 956MVA to 1159MVA	IAIS-2017 for Gens 009, 060, 082	Include

APPENDIX B: POWER FLOW SPREADSHEET

Limited Operation and Interim System I

APPENDIX C: CONTINGENCIES EVALUATED FOR STUDY PROJECT GEN-2017-005

GEN-2017-005
Contingency Definit

APPENDIX D: SHORT CIRCUIT ANALYSIS SOLUTION PARAMETERS

The following settings were used for calculating fault current values using Automatic Sequence Fault Calculation (ASCC):

- fault analysis output option (OPTN): physical units
- fault analysis output coordinates option (OPTN): polar coordinates
- fault analysis modeling option (OPTN): normal three-phase
- flat option (FLAT): set classical fault analysis conditions (activity FLAT,CL)
- tap ratio treatment flag (FLAT): set tap ratios to 1.0
- charging treatment flag (FLAT): set charging to 0.0
- switched shunt treatment flag (FLAT): set switched shunts to 0.0 in all sequence networks
- three phase faults (ASCC): Include
- output option (ASCC): fault contributions to N levels away
- number of levels back for contributions output (ASCC): 0
- pre-fault bus voltage (ASCC): All buses at specified voltage (1.00) and 0 degrees

INTERIM FACILITY STUDY

See next page for the Transmission Owner Interim Generation Interconnection Facility Study report.

Interim - Generation Interconnection Facility Study

For

Generation Interconnection Request GEN-2017-005

November 10, 2020

Introduction

This report summarizes the scope of the Interim Generation Interconnection Facility Study to evaluate the Generation Interconnection Request for GEN-2017-005. GEN-2017-005 is proposing to build a 195 MW wind-powered generation facility in south east Kansas with an in-service date of June 30, 2021.

Southwest Power Pool Generation Interconnection Request:

Southwest Power Pool (SPP) GI gave Evergy Kansas Central the option to perform an Interim Interconnection Facility Study (IFS).

GI Request #	Point of Interconnection	Capacity (MW)	Fuel Type
GEN-2017-005	Marmaton - Franklin 161 kV	195	Wind

Estimated Costs for TOIF and Network Upgrades

Transmission Owner Interconnection Facilities (TOIF)

This estimated cost includes work necessary to install one (1) breaker, three (3) switches, three (3) standalone CT's, three (3) 161kV PT's, one (1) control panel to accept a transmission line from the Interconnection Customer's Generating Facility.

161kV Transmission Line Work

The estimated cost is for the cut in of the new Jayhawk switching station on the existing Marmaton-Franklin 161kV line.

161kV Jayhawk Substation Work

The estimated cost is for constructing a new greenfield 161kV breaker and a half substation consisting of three (3) breakers, two (2) wave traps, seven (7) switches, six (6) CCVTs, and two (2) control panels.

161kV Marmaton Substation Work

The estimated cost is for upgrading one (1) wave trap and to review relay settings and apply adjusted settings if needed.

The total cost estimate for the required Network Upgrades and the Transmission Owner Interconnection Facilities (TOIF).

$	**0**	**TOIF (Transmission Line)**
$	**1,105,888**	**TOIF (Substation)**
$	**0**	**TOIF (AFUDC)**
$	**110,589**	**TOIF (Contingency)**
$	**414,762**	**161kV Transmission Line Work**
$	**9,980,082**	**161kV Substation Work**
$	**0**	**AFUDC**
$	**1,039,484**	**Contingency**
$	**12,650,805**	**Total**

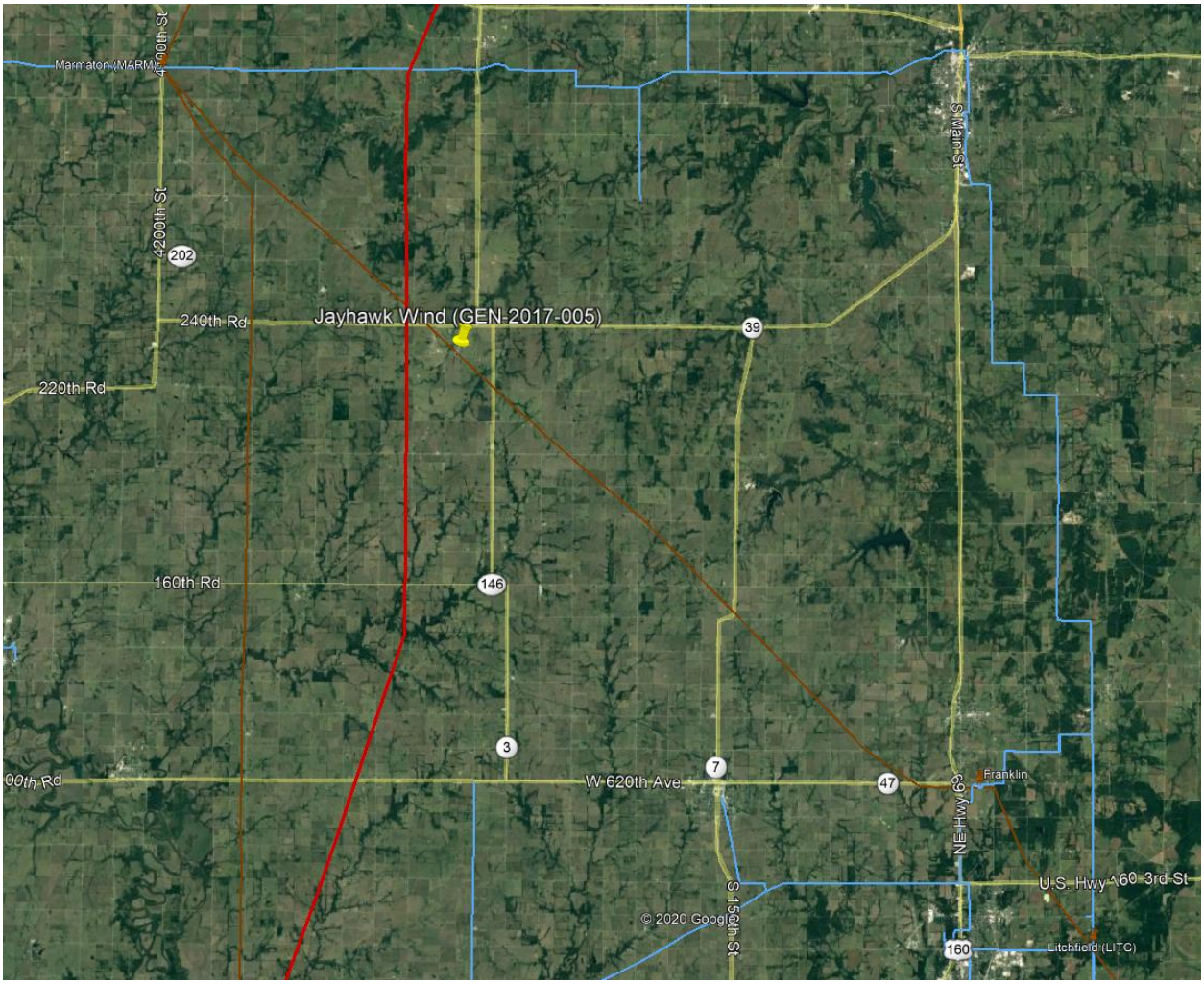
These estimates are accurate to +/- twenty (20) percent, based on current prices, in accordance with Attachment A of Appendix 4 of the Interconnection Facilities Study Agreement. However, recent cost fluctuations in materials are significant and the accuracy of these estimates at the time of actual settings cannot be assured.

Time Estimate

Time estimates are based on current version of the project schedule and some processes of each category run concurrently.

Engineering Time	5 Months
Procurement Time	6 Months
Construction Time	7 Months
Total Project Length	18 Months

Figure 1 – Interconnection Map



The proposed interconnection project is located approximately 13 miles from the Marmaton 161kV substation on the Marmaton-Franklin 161kV line.

Results of Short Circuit Analysis

As a part of this Interim Facility Study, a short circuit study was performed to determine the available fault current at the interconnection bus using PSS/E's activity ASCC. The 2021 Summer Peak case from the 2020 Series MDWG Classical, Max Fault Short-Circuit models was used. The GEN-2017-005 wind farm generation facility was taken out of service for this analysis, and all other transmission facilities are in service. As a result, the numbers generated represent the available utility interconnection fault current:

2021 Summer:

3-PH FAULT		1-PH FAULT		THEVENIN IMPEDANCE (PU on 100 MVA and bus base KV)		
AMP	MVA	AMP	MVA	Positive Sequence	Negative Sequence	Zero Sequence
6068.1	1692.16	4546.4	1267.81	0.010257+j0.059399	0.010245+j0.059409	0.029315+j0.117356