SPP DISIS-2022-001 AFS STUDY REPORT

INTRODUCTION

Associated Electric Cooperative Inc. (AECI), through coordination with the Southwest Power Pool (SPP), has identified generator interconnection requests (GIRs) within the DISIS-2022 Study Cycle (the "Study Cycle") for an Affected System Study (AFS) evaluation on the AECI transmission system (the "Study"). The full list of Study Cycle requests included in the Study is listed in Table 1.

Table 1: Study Cycle Requests Evaluated

Project	TO	SP Capacity (MW)	WP Capacity (MW)	Fuel Type	POI
GEN-2022-001	AEP	100	100	Battery/Storage	Catoosa 138 kV Substation
GEN-2022-005	WERE	200	200	Solar	Northeast Parsons 138kV Substation
GEN-2022-006	WERE	200	200	Solar	Neosho - N345 161 kV Substation
GEN-2022-007	WERE	135	135	Solar	Lang - Reading 115 kV Transmission Line
GEN-2022-010	BEPC	250	250	Thermal	Judson Substation 345 kV
GEN-2022-011	AEP	374	374	Solar	Tap of Oklaunion - Lawton Eastside 345 kV line
GEN-2022-013	WERE	300	300	Solar	Tap of Neosho - LaCygne 345 kV Line
GEN-2022-015	SUNC	270	270	Solar	Tap of Mingo - Red Willow 345 kV Line
GEN-2022-016	OGE	288	288	Solar	Woodward 345kV Substation
GEN-2022-024	WERE	200	200	Battery/Storage	Tap of Neosho - LaCygne 345 kV Line
GEN-2022-038	AEP	200	200	Solar	Longwood to Scottville 138 kV line
GEN-2022-041	WERE	100	100	Solar	Tie Substation 69 kV
GEN-2022-042	OGE	174	174	Solar	Sunnyside to Pooleville 138 kV line
GEN-2022-048	WFEC	250	250	Wind	Mooreland 138 kV
GEN-2022-054	NEET	200	200	Solar	Wolf Creek - Blackberry 345 kV Tap
GEN-2022-055	WFEC	200	200	Solar	Sunshine North to Anadarko 138 kV
GEN-2022-058	EDE	180	180	Solar	Sibley 161 kV substation on the Noel Southwest - Decatur 161 kV line
GEN-2022-062	NEET	200	200	Solar	Wolf Creek- Blackberry 345 kV
GEN-2022-068	BEPC	250	250	Wind	Chappelle Creek 345 kV
GEN-2022-071	AEP	90.824	90.824	Solar	Talawanda to Canadian River 138 kV Line Tap
GEN-2022-072	GRDA	181	181	Solar	Grand River Dam - Claremore 161 kV Line
GEN-2022-073	KCPL	300	300	Battery/Storage	Nashua 161 kV Substation
GEN-2022-074	WFEC	220.86	220.86	Wind	Hanna 138kV Substation
GEN-2022-076	SPS	500	500	Solar	Carpenter 345 kV Substation
GEN-2022-077	NPPD	255	255	Solar	Enders 115 kV Substation
GEN-2022-079	EDE	192	192	Solar	Dadeville East - Bolivar South 161kV
GEN-2022-080	EDE	96	96	Battery/Storage	Dadeville East - Bolivar South 161kV
GEN-2022-081	SUNC	218	218	Battery/Storage	Clifton 115kV Substation

Project	TO	SP Capacity (MW)	WP Capacity (MW)	Fuel Type	POI
GEN-2022-082	SPS	180	180	Solar	Tuco - Carlisle 230 kV line
GEN-2022-085	OGE	241.4	241.4	Wind	Seminole to Muskogee 345kV Substation
GEN-2022-090	AEP	150	150	Solar	Valiant Substation 138kV
GEN-2022-091	AEP	150	150	Battery/Storage	Valiant Substation 138kV
GEN-2022-092	AEP	299.2	299.2	Wind	Neosho-Delaware 345 kV
GEN-2022-094	ITCGP	250	250	Wind	Postrock to Axtell 345 kV line
GEN-2022-098	OGE	200	200	Solar	Bison 345kV Substation
GEN-2022-100	KCPL	80	80	Hybrid	Overton - Sedalia East 161 kV Substation
GEN-2022-102	KCPL	100	100	Battery/Storage	Liberty West 161 kV
GEN-2022-103	EDE	74.99	74.99	Battery/Storage	Ozark South 161kV
GEN-2022-104	WFEC	113.078	113.078	Solar	Brown - South Coleman Junction 138kV line
GEN-2022-105	AEP	300	300	Solar	Tap of Oklaunion to Lawton Eastside 345 kV Transmission Line
GEN-2022-106	AEP	300	300	Solar	Tap of Oklaunion to Lawton Eastside 345 kV Transmission Line
GEN-2022-107	AEP	400	400	Solar	Tap of Oklaunion to Lawton Eastside 345 kV Transmission Line
GEN-2022-110	AEP	150	150	Battery/Storage	Lehigh 138kV Station
GEN-2022-111	AEP	150	150	Hybrid	Wilkes 345 kV Substation
GEN-2022-113	EDE	200	200	Solar	Tipton Station 161 kV Substation
GEN-2022-114	AEP	250	250	Wind	Lawton to Oklaunion 345kV Line
GEN-2022-129	AEP	200	200	Battery/Storage	Webb City Tap - Shidler 138 kV line
GEN-2022-130	OGE	200	200	Battery/Storage	Battlefield BESS 161kV
GEN-2022-131	KCPL	200	200	Battery/Storage	Warrensburg East - Odessa161kV Substation
GEN-2022-132	WFEC	300	300	Battery/Storage	Anadarko 138kV Substation
GEN-2022-136	WFEC	210.5	210.5	Battery/Storage	Colbert 138 kV Substation
GEN-2022-137	WFEC	210.4	210.4	Battery/Storage	Canadian Switchyard 138kV
GEN-2022-138	AEP	300	300	Battery/Storage	Tulsa North - Northeast Station 345 kV Substation
GEN-2022-139	AEP	300	300	Battery/Storage	Pirkey 345kV Substation
GEN-2022-142	KCPL	210.4	210.4	Battery/Storage	Shoal Creek 161 kV Substation
GEN-2022-143	OGE	210.4	210.4	Battery/Storage	Caney Creek 138 kV Substation
GEN-2022-144	KCPL	210.4	210.4	Battery/Storage	Blue Mills BESS 161kV Substation
GEN-2022-145	AEP	195	195	Battery/Storage	Weatherford Jct. to Hinton 138 kV line
GEN-2022-147	SPS	196	203	Thermal	Tuco 345kV
GEN-2022-152	NPPD	80	80	Battery/Storage	Humboldt 161 kV Substation
GEN-2022-154	WFEC	100	100	Battery/Storage	Canadian Switch 138 kV Substation
GEN-2022-155	OGE	200	200	Battery/Storage	Horseshoe Lake 138 kV Substation
GEN-2022-156	GRDA	100	100	Battery/Storage	Silver City 138 kV Substation
GEN-2022-159	NEET	280	280	Wind	Crossroads - Hobbs 345 kV Line
GEN-2022-160	NEET	280	280	Wind	Crossroads - Hobbs 345 kV Line
GEN-2022-161	WERE	400	400	Wind	Burns 345kV Substation
GEN-2022-162	NPPD	118	118	Wind	Friend 115 kV Substation

Project	TO	SP Capacity (MW)	WP Capacity (MW)	Fuel Type	POI
GEN-2022-163	OGE	200	200	Battery/Storage	Cimarron 345kV Substation
GEN-2022-167	AEP	250	250	Solar	Tulsa North - Northeastern 345 kV Line
GEN-2022-168	KCPL	380	380	Solar	Stilwell - Clinton 161 kV Line
GEN-2022-171	SPS	200	200	Wind	Pleasant Hill 230 kV Substation
GEN-2022-176	AEP	215	215	Wind	Northeastern - Delaware 345 kV transmission line
GEN-2022-186	WERE	684	684	Solar	Wolf Creek - Benton 345 kV Substation
GEN-2022-196	AEP	215	215	Wind	Pittsburg 345kV Substation
GEN-2022-204	ITCGP	250	250	Wind	Post Rock - Spearville 345 kV
GEN-2022-205	ITCGP	250	250	Wind	Post Rock - Spearville 345 kV
GEN-2022-206	ITCGP	250	250	Wind	Post Rock - Spearville 345 kV
GEN-2022-208	KCPL	400	400	Wind	Tap on the Mullen Creek to Ketchum 345 kV Line
GEN-2022-209	KCPL	600	600	Hybrid	Tap on the Mullen Creek to Ketchum 345 kV Line
GEN-2022-214	WERE	239	239	Solar	Gill - Viola 138 kV Line Break
GEN-2022-219	WAPA	350	350	Solar	Belfield 230 kV Substation
GEN-2022-231	OGE	166	166	Solar	Crescent to Cottonwood Creek 138 kV Line
GEN-2022-234	AEP	200	200	Solar	Alluwe Tap â€“ Chelsea 138 kV line
GEN-2022-235	WFEC	150	150	Battery/Storage	El Reno SW 138 kV
GEN-2022-237	OGE	150	150	Solar	Maud 138 kV substation
GEN-2022-238	OGE	150	150	Battery/Storage	Maud 138 kV substation
GEN-2022-239	AEP	350	350	Solar	John W Turk Jr Power Plant 345 kV sub
GEN-2022-240	AEP	200	200	Battery/Storage	John W Turk Jr Power Plant 345 kV sub
GEN-2022-241	AEP	200	200	Battery/Storage	John W Turk Jr Power Plant 345 kV sub

Network upgrades from the following studies were added to models prior to the addition of the Study Cycle requests to help alleviate loadings.

- Network Upgrades from AECI GI-083 request
- Network Upgrades from AECI GI-99/100 requests
- Network Upgrades from AECI GI-101/102 requests

The Network Upgrades included from these requests are detailed in Table 6. Should these upgrades no longer be tagged to the higher queued studies, AECI may restudy the Study Cycle.

INPUTS AND ASSUMPTIONS

Each of the SERC member transmission planners is responsible for submitting system modeling data to SERC for development of the power flow models. Power flow analysis utilized the latest Long-Term Working Group (LTWG) models as developed by SERC Reliability Corporation (SERC). Each of the power flow models for the steady state analysis was modified to include appropriate higher-queued generation interconnection requests. Modeling parameters from the SPP DISIS 2022-001 steady state models were referenced for each of the Study Cycle requests.

Full details of the inputs and assumptions are provided in Appendix A.

METHODOLOGY

Steady state analysis was performed to confirm the reliability impacts on the AECI system under a variety of system conditions and outages. AECI's transmission system must be capable of operating within the applicable normal ratings, emergency ratings, and voltage limits of AECI planning criteria. AECI is a member of SERC, one of eight Electric Reliability Organizations under the North American Electric Reliability Corporation (NERC). As a member of SERC, AECI develops its planning criteria consistent with NERC Reliability Planning Standards and the SERC planning criteria. The NERC TPL-001-5 Planning Standard Table 1 requires that, for normal and contingency conditions, line and equipment loading shall be within applicable thermal limits, voltage levels shall be maintained within applicable limits, all customer demands shall be supplied (except as noted), and stability of the network shall be maintained.

In evaluating the impacts of the Study Cycle requests, the following thermal and voltage limits were applied to the analysis for P0 or normal system conditions:

- Thermal Limits within Applicable Rating – Applicable Rating shall be defined as the Normal Rating. The thermal limit shall be 100% of Rating A.
- Voltage Limits within Applicable Rating – Applicable Rating shall have the meaning of Nominal Voltage. Voltage limits shall be set at plus or minus five percent (+/- 5%), 0.95 p.u. - 1.05 p.u. for systems operating at 60 kV or above on load serving buses.

The following thermal and voltage limits were applied to the analysis for contingency conditions under P1 and P2EHV planning events:

- Thermal Limits within Applicable Rating – Applicable Rating shall be defined as the Emergency Rating. The thermal limit shall be 100% of Rating B.
- Voltage Limits within Applicable Rating – Applicable Rating shall have the meaning of Nominal Voltage. Voltage limits shall be set at plus five percent to minus ten percent (+5%/-10%), 0.90 p.u. – 1.05 p.u. for systems operating at 60 kV or above on load serving buses.

In order for the Study Cycle requests to have a negative impact (i.e. criteria violation) on the system, the Study Cycle must cause a three percent (3%) or greater increase in flow on an overloaded facility based upon the rating of the facility. In order for the Project to have a negative voltage impact on the system, the Project must cause a voltage violation and have a two percent (2%) or greater change in the voltage.

System upgrades are required for constraints resulting from the addition of the Study Cycle requests under P0, P1, P2.1, P2.2 (EHV only), and P2.3 (EHV only) system conditions. For the purpose of this study, P2.1

events are included as part of the P1 contingency file. As such, these events will be denoted as a P1 event in the results. All improvements were developed and studied in coordination with AECI.

AECI will perform an annual limited operations study which will indicate seasonal operating limits for SPP/MISO/AECI generation interconnection requests that will reach commercial operation in the 12 month horizon but whose AECI network upgrades have not yet been energized.

STEADY STATE ANALYSIS RESULTS

Steady state analysis results showed sixteen (16) constraints reported on the AECI transmission system, as shown in Table 2, which are attributed to the Study Cycle requests. Transmission upgrades were evaluated to mitigate the impacts reported from the analysis as a result of the Study Cycle requests. Simulations were performed on each of the scenarios with the identified network upgrades and contingent network upgrades included.

The upgrades shown in Table 8 were evaluated in order to mitigate the reported steady state constraints for the Study Cycle requests; results from the simulations found that the network upgrades were able to mitigate the reported overload conditions as shown in Table 2.

Table 2: Steady State Constraints for the Study Cycle Requests with Upgrades

Constraint ID	Event	Monitored Facility	Contingency	Season	Base Loading	Project Loading	Upgrade Loading
NU01	P1	300084 5GRNFRT 161.00 301207 2GRNFOR 69.000 1	OPEN LINE FROM BUS 300084 [5GRNFRT 161.00] TO BUS 505438 [POP BLF5 161.00] CKT 1	28W	111.8	116.9	69.7
				33W	108.9	114.2	68.0
NU02	P1	300534 2LINCLN 69.000 300558 2MTHULD 69.000 1	OPEN LINE FROM BUS 300541 [2SEDALI 69.000] TO BUS 300545 [2SYLVAN 69.000] CKT 1	28W	97.0	118.6	46.8
				33W	98.3	122.2	48.4
	P2EHV		OPEN BRANCH FROM BUS 300042 [7HUBEN 345.00] TO BUS 300045 [7MORGAN 345.00] CKT 1 OPEN BRANCH FROM BUS 300045 [7MORGAN 345.00] TO BUS 549984 [BROOKLINE 7345.00] CKT 1	28W	79.9	102.4	40.5
				33W	80.4	104.1	41.3
NU03	P1	300542 2SMTHTN 69.000 300545 2SYLVAN 69.000 1	OPEN BRANCH FROM BUS 344233 [5CALIF UE 1 161.00] TO BUS 345411 [5OVERTON 2 161.00] CKT 1 OPEN BRANCH FROM BUS 346027 [1CALIF 34.500] TO BUS 344233 [5CALIF UE 1 161.00] CKT 1	28W	88.2	103.1	57.1
			OPEN BRANCH FROM BUS 300063 [5CALIF 161.00] TO BUS 344234 [5CALIF UE 2 161.00] CKT 1 OPEN BRANCH FROM BUS 300550 [2CALIF 69.000] TO BUS 300063 [5CALIF 161.00] CKT 2 OPEN BRANCH FROM BUS 346027 [1CALIF 34.500] TO BUS 344234 [5CALIF UE 2 161.00] CKT 2 OPEN BRANCH FROM BUS 344233 [5CALIF UE 1 161.00] TO BUS 344234 [5CALIF UE 2 161.00] CKT Z	33S	88.9	101.3	48.6
			OPEN BRANCH FROM BUS 344233 [5CALIF UE 1 161.00] TO BUS 345411 [5OVERTON 2 161.00] CKT 1 OPEN BRANCH FROM BUS 346027 [1CALIF 34.500] TO BUS 344233 [5CALIF UE 1 161.00] CKT 1	33W	89.2	105.5	58.9

Constraint ID	Event	Monitored Facility	Contingency	Season	Base Loading	Project Loading	Upgrade Loading
NU04	P1	300557 2IVYBND 69.000 300565 2VERSAL 69.000 1	OPEN LINE FROM BUS 300541 [2SEDALI 69.000] TO BUS 300545 [2SYLVAN 69.000] CKT 1	28W	86.0	119.6	53.0
				33W	84.4	121.7	54.0
NU05[1]	P1	300768 2BNTNVL 69.000 300776 2FRSTOE 69.000 1	OPEN LINE FROM BUS 301402 [5LOSTVALY 161.00] TO BUS 505502 [TRUMAN 5 161.00] CKT 1	28W	75.9	106.1	41.7
				33W	75.7	106.4	42.3
NU06	P1	300768 2BNTNVL 69.000 300809 2ICONTP 69.000 1	OPEN LINE FROM BUS 301402 [5LOSTVALY 161.00] TO BUS 505502 [TRUMAN 5 161.00] CKT 1	28W	81.2	111.7	43.7
				33S	73.3	102.7	35.5
				33W	81.4	112.4	44.4
NU07[1]	P1	300776 2FRSTOE 69.000 300790 2WARSAW 69.000 1	OPEN LINE FROM BUS 301402 [5LOSTVALY 161.00] TO BUS 505502 [TRUMAN 5 161.00] CKT 1	28S	60.2	100.1	29.9
				28W	66.5	111.0	38.0
				33S	59.3	102.8	30.7
				33W	65.5	111.8	38.3
NU08	P1	300809 2ICONTP 69.000 300817 2OSCEOLA 69.000 1	OPEN LINE FROM BUS 301402 [5LOSTVALY 161.00] TO BUS 505502 [TRUMAN 5 161.00] CKT 1	28S	77.1	103.9	35.7
				28W	84.9	115.5	46.9
				33S	77.4	106.9	36.7
				33W	85.3	116.5	47.7
NU09	P1	301042 2BRSHCK 69.000 301064 2LEB 1 69.000 1	OPEN BRANCH FROM BUS 300072 [5COFFMN 161.00] TO BUS 300088 [5HUBEN 161.00] CKT 1 OPEN BRANCH FROM BUS 300072 [5COFFMN 161.00] TO BUS 300092 [5LEBANN 161.00] CKT 1 OPEN BRANCH FROM BUS 301048 [2COFFMN 69.000] TO BUS 300072 [5COFFMN 161.00] CKT 2 REMOVE LOAD 1 FROM BUS 300072 [5COFFMN 161.00]	28H	77.1	104.2	54.5
				28W	81.9	106.7	64.3
				33S	72.9	100.2	52.8
				33W	84.1	108.8	65.8
NU10[1]	P1	301207 2GRNFOR 69.000 301210 2HILLRD 69.000 1	OPEN LINE FROM BUS 300084 [5GRNFRT 161.00] TO BUS 505438 [POP BLF5 161.00] CKT 1	28S	86.8	103.7	71.3
				28W	91.8	108.6	74.1
				33S	84.2	102.2	70.3
				33W	87.3	104.2	71.1
NU11	P2EHV	300101 5MORGAN 161.00 300782 2MORGAN 69.000 1	OPEN BRANCH FROM BUS 300042 [7HUBEN 345.00] TO BUS 300045 [7MORGAN 345.00] CKT 1	28S	74.6	105.9	77.9
				28W	76.0	109.6	79.1

[1] Adverse impact with the inclusion of network upgrades applied for the Projects, Project Loading reported with Network Upgrades included.

Constraint ID	Event	Monitored Facility	Contingency	Season	Base Loading	Project Loading	Upgrade Loading
			OPEN BRANCH FROM BUS 300045 [7MORGAN 345.00] TO BUS 549984 [BROOKLINE 7345.00] CKT 1	33S	75.5	107.6	79.2
				33W	77.0	110.0	79.8
NU12	P2EHV	300774 2EUDORA 69.000 300782 2MORGAN 69.000 1	OPEN BRANCH FROM BUS 300042 [7HUBEN 345.00] TO BUS 300045 [7MORGAN 345.00] CKT 1 OPEN BRANCH FROM BUS 300045 [7MORGAN 345.00] TO BUS 549984 [BROOKLINE 7345.00] CKT 1	28H	67.0	103.5	55.9
				28S	75.5	108.4	59.3
				28W	73.0	102.0	62.3
				33S	76.8	110.8	60.6
				33W	73.6	103.6	63.2
NU13	P2EHV	300774 2EUDORA 69.000 300788 2SLAGLE 69.000 1	OPEN BRANCH FROM BUS 300042 [7HUBEN 345.00] TO BUS 300045 [7MORGAN 345.00] CKT 1 OPEN BRANCH FROM BUS 300045 [7MORGAN 345.00] TO BUS 549984 [BROOKLINE 7345.00] CKT 1	28S	70.1	103.1	57.0
				33S	71.1	105.3	58.3
NU14	P0	301553 4WELEETKA 138.00 521026 PHAROAH4 138.00 1	BASE CASE	28H	56.9	114.4	43.5
				28L	99.0	153.1	62.8
				28S	58.4	116.0	44.2
				28W	57.5	104.4	51.9
				33S	60.0	116.3	44.3
				33W	54.9	103.6	51.4
	P1		OPEN LINE FROM BUS 300137 [4BRISTOW 138.00] TO BUS 300140 [4SILVCTY 138.00] CKT 1	28H	79.0	133.4	51.5
				28L	116.7	166.1	73.3
				28S	75.3	130.5	50.6
				28W	72.0	118.7	58.2
				33S	76.5	130.7	50.7
				33W	68.5	117.2	57.3
	P2EHV		OPEN BRANCH FROM BUS 300045 [7MORGAN 345.00] TO BUS 709500 [GI-95_POI 345.00] CKT 1 OPEN BRANCH FROM BUS 300042 [7HUBEN 345.00] TO BUS 300045 [7MORGAN 345.00] CKT 1	28L	85.8	132.3	63.5
			OPEN BRANCH FROM BUS 300045 [7MORGAN 345.00] TO BUS 709500 [GI-95_POI 345.00] CKT 1 OPEN BRANCH FROM BUS 300042 [7HUBEN 345.00] TO BUS 300045 [7MORGAN 345.00] CKT 1	28S	51.0	100.7	45.0

Constraint ID	Event	Monitored Facility	Contingency	Season	Base Loading	Project Loading	Upgrade Loading
			OPEN BRANCH FROM BUS 300739 [7BLACKBERRY 345.00] TO BUS 300949 [7JASPER 345.00] CKT 1 OPEN BRANCH FROM BUS 300739 [7BLACKBERRY 345.00] TO BUS 910800 [GI108_POI 345.00] CKT 1 OPEN BRANCH FROM BUS 300739 [7BLACKBERRY 345.00] TO BUS 532793 [NEOSHO 7 345.00] CKT 1 OPEN BRANCH FROM BUS 300739 [7BLACKBERRY 345.00] TO BUS 765200 [G20-090-TAP 345.00] CKT 1	33S	52.1	101.0	45.1
NU15	P1	300327 2ELM 69.000 300336 2HOLDEN 69.000 1	OPEN LINE FROM BUS 300110 [5PITTSV 161.00] TO BUS 301561 [5HOLDENB1 161.00] CKT 1	28S	116.3	142.3	72.2
				33S	118.6	143.5	73.1
NU16	P1	300748 2NEOSAC 69.000 547471 NEO184 5 161.00 1	OPEN LINE FROM BUS 300852 [2MIAETP 69.000] TO BUS 512630 [MIAMI 2 69.000] CKT 1	33S	91.3	100.5	83.5[2]

[2] Loading with transformer tap adjustment.

CONTINGENT FACILITY RESULTS

Sixty-four (64) facilities were reported as Contingent Facilities with the addition of the Study Cycle requests, as shown in Table 3. Contingent Facilities are those facilities identified that are the responsibility of higher-queued generators or are included in the Transmission Provider's transmission expansion plan and that if not included in the Study may otherwise be the responsibility of the Study Cycle requests as necessary to interconnect to the transmission system.

The transmission upgrades for the Contingent Facilities were evaluated in order to confirm that the planned system adjustments were sufficient to mitigate the overloads seen for the addition of the Study Cycle requests. Simulations were performed on each of the scenarios with the identified network upgrades and contingent network upgrades included. The upgrades shown in Table 6 were evaluated in order to mitigate the reported constraints as listed in Table 3 below.

Table 3: Steady State Contingent Constraints for the Study Cycle Requests with Upgrades

Constraint ID	Event	Monitored Facility	Season	Base Loading	Project Loading	Upgrade Loading	Contingent Generator(s)
CF01	P1	300069 5CHOTEAU1 161.00 512648 MAID 5 161.00 1	28H	117.5	125.5	125.2	Prior Queued Studies[3]
			28S	129.7	133.4	132.9	
			28W	119.1	122.3	121.8	
			33S	129.7	133.3	132.8	
			33W	118.6	122.8	122.3	
CF02	P1	300091 5LATHRP 161.00 300302 2LATHRP 69.000 1	28H	77.1	104.3	76.5	AECI
CF03	P1	300191 2CROSRDS 69.000 301628 2OSBORNTPN 69.000 1	28H	58.6	111.1	74.8	AECI
CF04	P1	300293 2CAMRNJ 69.000 300312 2TURNEY 69.000 1	28H	32.1	102.7	57.6	AECI
CF05	P1	300302 2LATHRP 69.000 301627 2LATHRPLD 69.000 1	28H	47.8	117.4	72.7	AECI
CF06	P1	300131 4FISHERTP 138.00 300140 4SILVCTY 138.00 1	28H	63.5	103.0	92.1	AECI
			28L	96.9	101.9	96.7	
CF08	P1	300196 2WOODY 69.000 300906 2NUYAKA 69.000 1	28H	115.8	119.1	71.7	AECI
			28S	81.1	105.2	40.7	
			33S	127.4	130.4	81.7	
CF07	P1	300906 2NUYAKA 69.000 513092 BEGGS 2 69.000 1	28H	111.9	115.1	67.5	AECI
			28S	75.9	100.1	35.6	
			33S	77.7	102.7	38.1	
CF09	P1	300172 2TMHILLB1 69.000 301318 2THMINTP 69.000 1	28S	89.9	101.2	76.6	MISO Tranche 1 Projects
			33S	90.2	102.4	77.8	

[3] Ongoing studies show this element will be the responsibility of a higher queue request. Final scope of the upgrades tagged to higher queue request are still being developed.

Constraint ID	Event	Monitored Facility	Season	Base Loading	Project Loading	Upgrade Loading	Contingent Generator(s)
CF10	P1	300355 2SPALDNG 69.000 300373 2CENTER 69.000 1	28S	95.0	112.2	67.0	MISO Tranche 1 Projects
			33S	88.1	104.2	64.4	
	P2EHV		28S	104.6	119.2	74.5	
			33S	90.4	105.3	71.5	
CF11	P1	300373 2CENTER 69.000 300374 2CNTRSW 69.000 1	28S	98.4	115.5	70.3	MISO Tranche 1 Projects
			33S	91.4	107.7	67.7	
	P2EHV		28S	107.9	122.4	77.8	
			33S	93.7	108.9	74.7	
CF12	P1	300381 5BEVIER 161.00 300387 2BEVIER 69.000 1	28S	90.0	102.2	78.4	MISO Tranche 1 Projects
			33S	90.3	103.4	79.5	
	P2EHV		28S	88.7	102.5	72.8	
			33S	88.1	102.8	73.4	
CF13	P1	300390 2CAIRO 69.000 300394 2HUNTSV 69.000 1	33S	89.0	101.2	76.5	MISO Tranche 1 Projects
CF14	P1	300394 2HUNTSV 69.000 301318 2THMINTP 69.000 1	28S	89.9	101.2	76.6	MISO Tranche 1 Projects
			33S	90.2	102.4	77.8	
CF15	P0	300133 5THMHLB3 161.00 344004 5ADAIR1 161.00 1	28S	83.3	105.1	51.0	MISO Tranche 1 Projects
			33S	83.6	105.7	51.9	
	P1		28S	102.2	127.5	56.0	
			33S	103.1	129.9	56.5	
	P2EHV		28S	94.9	120.1	53.0	
			33S	102.1	129.7	55.0	
CF16	P1	300398 2LOVELK 69.000 300401 2MACNTP 69.000 1	28S	86.5	106.3	72.9	MISO Tranche 1 Projects
			33S	86.6	107.3	73.8	
	P2EHV		28S	78.3	102.4	61.9	
			33S	80.7	104.9	61.9	
CF17	P1	300399 2MACN3E 69.000 300401 2MACNTP 69.000 1	28S	93.9	104.7	75.0	MISO Tranche 1 Projects
			33S	92.9	105.3	75.9	
	P2EHV		28S	96.0	106.2	78.1	
			33S	93.5	105.9	78.6	
CF18	P1	300567 5ENON 161.00 301649 5ETHLYNB2 161.00 1	28H	96.3	105.8	96.9	MISO Tranche 1 Projects
CF19	P1	300571 2MEXICO 69.000 300580 2SLTRVR 69.000 1	28S	86.6	104.4	93.5	MISO Tranche 1 Projects
			33S	88.1	106.7	96.1	
CF20	P1	300382 2SFRKTP 69.000 300578 2SANTFE 69.000 1	28S	76.8	109.0	64.4	MISO Tranche 1 Projects
			33S	71.9	106.4	63.5	
	P2EHV		28S	82.7	113.4	70.0	
			33S	73.5	107.7	68.5	
CF21	P1	300104 5NODWAY 161.00 301592 5MARYVLB1 161.00 1	28S	66.0	101.7	92.4	MISO Tranche 1 Projects
			33S	69.1	103.4	94.0	
CF22	P1		28S	85.7	100.8	64.1	SPP DISIS 2016-002

Constraint ID	Event	Monitored Facility	Season	Base Loading	Project Loading	Upgrade Loading	Contingent Generator(s)
		300184 2NORTHB 69.000 301662 2HAMBRGB2 69.000 1	33S	85.6	100.3	63.8	
CF23	P1	300184 2NORTHB 69.000 300189 2TARKIO 69.000 1	28S	94.3	101.0	80.5	SPP DISIS-2017-002
			33S	94.4	100.9	80.5	
CF24	P1	300772 2COFMAN 69.000 300780 2KNOBBY 69.000 1	28S	113.3	125.9	64.3	SPP DISIS-2017-002
			28W	125.5	141.2	88.7	
			33S	112.9	127.2	65.4	
			33W	124.1	141.7	89.3	
CF25	P1	300773 2ELKTON 69.000 300817 2OSCEOLA 69.000 1	28S	97.8	102.9	28.4	SPP DISIS-2017-002
			28W	105.6	110.8	37.8	
			33S	98.3	103.5	28.8	
			33W	106.5	113.0	38.7	
CF26	P1	300780 2KNOBBY 69.000 301401 2TURKEYCRK 69.000 1	28H	82.7	108.0	32.6	SPP DISIS-2017-002
			28S	125.9	138.2	41.0	
			28W	136.7	152.6	54.9	
			33S	126.2	140.3	41.9	
			33W	135.8	153.7	55.5	
	P2EHV		28W	89.8	102.0	39.8	
			33W	89.8	103.5	40.3	
CF27	P1	300530 2GEOGT2 69.000 300541 2SEDALI 69.000 1	28S	135.0	144.3	89.1	SPP DISIS-2017-002
			28W	79.5	102.4	55.2	
			33S	134.0	144.2	90.7	
CF28	P1	300651 2LAMR 69.000 300794 5LAMAR 161.00 1	28H	99.1	116.8	77.4	SPP DISIS-2017-002
			28L	92.2	100.3	86.1	
			28S	122.3	137.6	87.7	
			28W	124.0	140.8	91.4	
			33S	124.5	140.4	88.4	
			33W	120.7	139.8	91.7	
	P2EHV		28H	99.6	115.0	76.2	
			28S	125.1	137.8	87.8	
			28W	125.3	139.3	90.4	
			33S	127.6	140.7	88.4	
			33W	122.2	138.5	90.6	
CF29	P1	300110 5PITTSV 161.00 300320 5LEVASY 161.00 1	28S	84.0	115.5	91.2	SPP DISIS-2017-002 SPP NU
			33S	84.9	115.5	92.0	
	P2EHV		28S	80.3	104.3	90.1	
			33S	81.5	104.6	90.9	
CF30	P1	300110 5PITTSV 161.00 301561 5HOLDENB1 161.00 1	28S	85.0	114.2	89.9	SPP DISIS-2017-002 SPP NU
			33S	86.0	114.4	90.9	
	P2EHV		28S	81.6	103.8	88.9	

Constraint ID	Event	Monitored Facility	Season	Base Loading	Project Loading	Upgrade Loading	Contingent Generator(s)
			33S	82.9	104.2	89.8	
CF31	P1	300320 5LEVASY 161.00 548808 ECKLES-161 161.00 1	28S	82.1	113.6	89.3	SPP DISIS-2017-002 SPP NU
			33S	83.0	113.6	90.1	
	P2EHV		28S	78.4	102.4	88.2	
			33S	79.6	102.6	88.9	
CF32	P1	300323 2CENTRV 69.000 300334 2ROSEHL 69.000 1	28S	89.7	104.3	92.2	SPP DISIS-2017-002 SPP NU
			33S	88.6	102.9	91.5	
CF33	P1	300323 2CENTRV 69.000 300336 2HOLDEN 69.000 1	28S	97.4	110.9	99.7	SPP DISIS-2017-002 SPP NU
			33S	97.0	110.2	99.6	
CF34	P1	300688 2AUSTIN 69.000 300696 2CREIGH 69.000 1	28S	97.9	133.4	96.6	SPP DISIS-2017-002 SPP NU
			33S	95.1	129.6	94.3	
CF35	P1	300688 2AUSTIN 69.000 300699 2ELYNTP 69.000 1	28S	86.1	120.9	84.7	SPP DISIS-2017-002 SPP NU
			33S	82.7	116.6	81.9	
CF36	P2EHV	300045 7MORGAN 345.00 301622 5MORGANXF1 161.00 1	28H	94.5	102.1	76.6	SPP DISIS-2018-001
			28L	96.2	104.9	76.7	
			28S	105.1	111.8	84.7	
			28W	111.6	117.9	87.5	
			33S	105.8	113.4	85.7	
			33W	111.0	119.1	88.7	
CF37	P1	300772 2COFMAN 69.000 300779 2J&7 69.000 1	28S	106.3	118.9	34.4	SPP DISIS-2020-001
			28W	118.5	137.5	47.6	
			33S	105.4	119.8	34.9	
			33W	116.7	137.8	47.8	
CF38	P0	300541 2SEDALI 69.000 300545 2SYLVAN 69.000 1	28W	86.6	103.4	55.5	SPP DISIS-2020-001
			33W	88.2	106.8	57.5	
	P1		28W	110.5	126.2	67.3	
			33W	113.0	130.1	69.9	
	P2EHV		28W	90.5	111.3	59.8	
			33W	91.7	114.7	61.8	
CF39	P1	301402 5LOSTVALY 161.00 505502 TRUMAN 5 161.00 1	28W	86.4	100.1	78.2	SPP DISIS-2021-001
			33W	91.5	101.4	79.0	
	P2EHV		28W	89.0	103.5	80.8	
			33W	88.4	104.3	81.8	
CF40	P1	300101 5MORGAN 161.00 549969 BROOKLINE 5161.00 1	28S	91.8	119.8	74.1	SPP DISIS-2021-001
			28W	80.4	105.2	65.0	
			33S	92.6	120.6	74.5	
			33W	79.7	106.7	66.0	
	P2EHV		28H	70.1	128.1	79.2	
			28S	101.8	147.5	91.5	

Constraint ID	Event	Monitored Facility	Season	Base Loading	Project Loading	Upgrade Loading	Contingent Generator(s)
			28W	98.1	140.3	86.7	
			33S	102.0	148.6	92.2	
			33W	96.3	141.4	87.4	
CF41	P1	301251 2VANDSR 69.000 301255 2MORLEY 69.000 1	28S	97.7	101.6	50.6	MISO DPP-2019
			33S	89.9	102.6	51.2	
	P2EHV		28S	111.9	119.6	59.4	
			33S	112.6	120.9	60.3	
CF42	P0	300387 2BEVIER 69.000 301623 2BEVIERTP 69.000 1	28H	87.9	105.1	48.5	MISO DPP-2019
			28S	120.1	138.7	60.4	
			33S	120.9	140.5	61.4	
	P1		28H	103.9	127.0	52.9	
			28S	149.5	175.4	67.6	
			28W	100.3	116.8	54.8	
			33S	148.9	176.7	68.5	
			33W	97.6	115.2	54.7	
	P2EHV		28H	106.1	129.4	54.8	
			28S	149.0	175.1	69.8	
			28W	105.0	122.2	56.2	
			33S	149.4	177.3	70.4	
			33W	101.9	120.3	56.1	
CF43	P0	300388 2AXTELL 69.000 300400 2MACNLK 69.000 1	28H	99.0	121.7	36.4	MISO DPP-2019
			28S	138.2	162.7	45.7	
			28W	87.8	110.8	33.3	
			33S	138.5	164.3	46.3	
			33W	84.8	108.5	32.9	
	P1		28H	120.1	150.5	40.3	
			28L	101.3	106.1	22.8	
			28S	176.5	210.3	52.0	
			28W	114.8	136.1	34.0	
			33S	175.2	211.2	52.5	
			33W	110.8	133.3	33.6	
	P2EHV		28H	123.0	153.7	42.0	
			28L	110.3	115.7	24.3	
			28S	176.0	210.0	54.0	
			28W	121.0	143.1	35.0	
			33S	175.9	211.9	54.2	
			33W	116.3	140.0	34.6	
CF44	P0	300388 2AXTELL 69.000 300401 2MACNTP 69.000 1	28H	93.7	116.5	34.3	MISO DPP-2019
			28S	131.6	156.1	43.1	

Constraint ID	Event	Monitored Facility	Season	Base Loading	Project Loading	Upgrade Loading	Contingent Generator(s)
			28W	80.1	103.3	30.3	
			33S	131.6	157.5	43.6	
			33W	77.1	100.9	29.9	
	P1		28H	114.9	145.4	38.2	
			28L	99.6	104.4	22.2	
			28S	169.9	203.5	49.4	
			28W	107.3	128.5	31.0	
			33S	168.3	204.1	49.8	
			33W	103.2	125.8	30.7	
	P2EHV		28H	117.9	148.5	40.0	
			28L	108.7	114.0	23.6	
			28S	169.3	203.2	51.4	
			28W	113.4	135.5	32.0	
			33S	169.0	204.9	51.5	
			33W	108.7	132.4	31.6	
CF45	P0	300400 2MACNLK 69.000 301623 2BEVIERTP 69.000 1	28H	109.8	132.2	40.6	MISO DPP-2019
			28S	150.5	174.8	50.6	
			28W	95.7	118.5	36.4	
			33S	151.5	177.1	51.4	
			33W	93.1	116.7	36.2	
	P1		28H	130.7	160.9	44.5	
			28L	104.4	109.2	24.1	
			28S	188.8	222.6	56.9	
			28W	122.5	143.7	37.0	
			33S	188.0	224.2	57.7	
			33W	118.9	141.4	36.9	
	P2EHV		28H	133.6	164.0	46.2	
			28L	113.5	118.8	25.5	
			28S	188.3	222.3	58.9	
			28W	128.6	150.6	38.0	
			33S	188.7	225.0	59.3	
			33W	124.4	148.0	37.9	
CF46	P1	300327 2ELM 69.000 300336 2HOLDEN 69.000 1	28S	116.3	142.3	72.2	MISO DPP-2019
			33S	118.6	143.5	73.1	
CF47	P1	300194 2CHILLI 69.000 300218 5CHILLIS 161.00 1	33S	89.9	101.1	NC[4]	MISO DPP-2019
CF48	P1	300124 5HOLDENB2 161.00 300336 2HOLDEN 69.000 1	28S	122.3	143.7	70.0	MISO DPP-2019
			28W	89.0	109.4	55.9	

[4] Contingency that causes reported overload created or removed as part of the Project or Network Upgrades; no loading available. NC = no contingency.

Constraint ID	Event	Monitored Facility	Season	Base Loading	Project Loading	Upgrade Loading	Contingent Generator(s)
			33S	123.4	144.1	70.6	
			33W	90.1	109.6	56.2	
CF49	P1	300325 2RT Z 69.000 300327 2ELM 69.000 1	28S	82.0	101.2	97.5	MISO DPP-2019
			33S	83.6	102.0	98.7	
CF50	P1	300525 5WRIGHTB2 161.00 300600 5NEWMELB1 161.00 1	28W	100.6	104.4	77.0	MISO DPP-2020
			33W	98.0	102.3	75.5	
	P2EHV		28W	100.1	103.9	76.5	
			33W	97.5	101.8	75.0	
CF51	P1	300053 5OLDMARS 161.00 301476 4OLDMARS 138.00 1	28W	107.8	116.9	50.4	MISO DPP-2021 (West)
			33W	111.7	121.0	52.1	
	P2EHV		28W	101.3	107.5	47.4	
			33W	104.7	110.7	49.2	
CF52	P1	301168 2MANSFL 69.000 301174 2SEYMOR 69.000 1	28L	103.5	111.8	59.9	MISO DPP-2021 (West)
CF53	P1	301243 2IDALIA 69.000 301257 2ARDEOLA 69.000 1	28S	99.9	105.5	53.9	MISO DPP-2021 (South)
			33S	102.0	108.2	55.4	
			28S	103.6	107.3	54.6	
			33S	105.4	109.4	55.8	
CF54	P0	301553 4WELEETKA 138.00 521026 PHAROAH4 138.00 1	28H	56.9	114.4	43.5	MISO DPP-2021 (South)
			28L	99.0	153.1	62.8	
			28S	58.4	116.0	44.2	
			28W	57.5	104.4	51.9	
			33S	60.0	116.3	44.3	
			33W	54.9	103.6	51.4	
	P1		28H	79.0	133.4	51.5	
			28L	116.7	166.1	73.3	
			28S	75.3	130.5	50.6	
			28W	72.0	118.7	58.2	
			33S	76.5	130.7	50.7	
			33W	68.5	117.2	57.3	
	P2EHV		28L	85.8	132.3	63.5	
			28S	51.0	100.7	45.0	
			33S	52.1	101.0	45.1	
CF55	P1	300137 4BRISTOW 138.00 300140 4SILVCTY 138.00 1	28H	97.0	129.3	48.5	GI-103
			28L	116.2	142.2	65.8	
			28S	83.5	117.9	41.6	
			33S	83.1	117.5	41.4	
CF56	P1	300137 4BRISTOW 138.00 300686 4WOODY 138.00 1	28H	NC[4]	102.4	57.1	GI-103
			28L	NC[4]	121.2	67.6	
			28S	NC[4]	110.9	61.9	

Constraint ID	Event	Monitored Facility	Season	Base Loading	Project Loading	Upgrade Loading	Contingent Generator(s)
			33S	NC[4]	110.8	61.8	
CF57	P0	300137 4BRISTOW 138.00 300889 2BRIISTOW 69.000 2	28H	159.3	171.8	42.6	GI-103
			28L	107.4	113.2	35.2	
			28S	172.3	183.1	45.7	
			28W	143.1	153.2	42.0	
			33S	173.4	184.6	46.4	
			33W	145.8	154.8	42.2	
	P1		28H	243.4	271.3	55.9	
			28L	200.0	216.3	52.9	
			28S	242.0	270.2	56.1	
			28W	201.0	224.8	51.1	
			33S	241.8	271.1	56.7	
			33W	199.9	223.8	50.7	
	P2EHV		28H	159.5	172.0	42.7	
			28L	107.6	113.4	35.2	
			28S	172.4	183.2	45.7	
			28W	143.1	153.3	42.0	
			33S	173.5	184.8	46.4	
			33W	145.8	154.9	42.2	
CF58	P1	300686 4WOODY 138.00 521026 PHAROAH4 138.00 1	28L	NC[4]	121.5	75.2	GI-103
			28S	NC[4]	102.0	63.1	
			33S	NC[4]	101.4	62.7	
CF59[1]	P1	300889 2BRIISTOW 69.000 300977 2BRISTOWTP 69.000 1	28L	83.8	102.0	73.1	GI-103
			33S	67.5	101.3	73.2	
CF60	P1	300889 2BRIISTOW 69.000 513092 BEGGS 2 69.000 1	28S	101.3	111.7	76.7	GI-103
			28W	101.1	111.9	70.0	
			33S	104.9	115.2	79.1	
			33W	114.0	117.2	77.7	
CF61[1]	P1	300901 2KELYVIL 69.000 300977 2BRISTOWTP 69.000 1	28L	83.8	102.0	73.1	GI-103
			33S	67.6	101.3	73.2	
CF62	P1	300139 4FAIRFAX 138.00 300929 2FAIRFAX 69.000 1	28S	81.5	109.4	64.1	GI-104
			33S	84.1	111.4	65.3	
CF63	P1	300141 4STILWTR 138.00 300844 4RAMSEY 138.00 1	28H	123.1	130.3	90.4	GI-104
			28S	132.5	136.4	94.6	
			33S	131.8	135.8	94.2	
CF64	P1	300811 2OSCEOL 69.000 301040 5OSCEOL 161.00 1	28S	115.0	118.8	72.0	GI-119
			28W	120.8	128.9	82.9	
			33S	116.2	119.7	73.1	
			33W	121.1	130.6	84.2	

Constraint ID	Event	Monitored Facility	Season	Base Loading	Project Loading	Upgrade Loading	Contingent Generator(s)
	P2EHV		28W	83.9	101.3	71.1	
			33W	84.8	102.0	71.5	

NEIGHBORING SYSTEM RESULTS

The Study has identified impacts from the Study Cycle requests on the AECI ties with neighboring systems. The most limiting component of the AECI owned portion of the facility was evaluated and if found inadequate, a network upgrade for the AECI equipment was determined. Network upgrades for transmission facilities limited by non-AECI equipment are not captured and may need to be coordinated with the appropriate transmission owner.

Seven (7) facilities were reported on the AECI ties with the addition of the Study Cycle requests. The most severe constraints are shown in Table 4.

Table 4: Steady State Neighboring System Constraints for the Study Cycle Requests

Constraint ID	Event	Monitored Facility	Area	Season	Base Loading	Project Loading
AFS01	P0	300044 7MCCRED 345.00 41454 J1145 POI 345.00 1	AMMO/AECI	28L	114.2	118.3
	P1			28L	107.2	110.6
	P2EHV			28L	105.4	108.7
AFS02	P0	300071 5CLINTN 161.00 761278 G17-108-TAP 161.00 1	KCPL/AECI	28W	39.1	100.4
				33W	38.6	101.7
	P1			28H	0.7	111.1
				28S	73.2	153.6
				28W	32.8	126.6
				33S	73.6	154.3
				33W	33.0	127.4
	P2EHV			28W	44.5	105.3
				33S	50.0	100.8
				33W	43.6	106.5
AFS03	P1	300097 5MARYVB2 161.00 652560 CRESTON5 161.00 1	WAPA/AECI	28S	136.5	157.6
				28W	87.0	105.8
				33S	141.0	161.5
				33W	88.3	107.1
	P2EHV			33S	86.3	102.3
AFS04	P1	300098 5MOCITYB2 161.00 541248 LBRTYST5 161.00 1	KCPL/AECI	28S	106.4	115.7
				33S	101.0	115.5
	P2EHV			28S	95.5	111.5
				33S	96.1	110.9
AFS05	P1	300131 4FISHERTP 138.00 505610 KEYSTON4 138.00 1	SWPA/AECI	28L	98.2	104.1
AFS06	P1	300740 7SPORTSMAN 345.00 512650 GRDA1 7 345.00 1	GRDA/AECI	28H	99.3	107.7
				28S	110.7	114.7
				28W	115.8	119.3
				33S	110.6	114.5

Constraint ID	Event	Monitored Facility	Area	Season	Base Loading	Project Loading
				33W	115.4	119.9
	P2EHV			28W	93.3	104.9
				33W	92.2	105.1
AFS07	P1	301521 5REEDSP 161.00 547473 RDS295 5 161.00 1	EMDE/AECI	28W	74.4	110.6
				33W	81.6	116.1
	P2EHV			28W	73.7	109.3
				33W	79.8	114.3

NETWORK UPGRADES

Transmission upgrades were evaluated to mitigate the impacts reported from the analyses as a result of the Study Cycle projects. The upgrades shown in Table 5 were evaluated in order to mitigate the reported steady state constraints for the Study Cycle as listed in Table 2.

Table 5: Network Upgrades for the Study Cycle Constraints

ID	Monitored Facility	Option/Description
NU01	300084 5GRNFRT 161.00 301207 2GRNFOR 69.000 1	Replace Green Forest 161/69 kV xfmr with 84 MVA Summer, 95 MVA Winter rated unit.
NU02	300534 2LINCLN 69.000 300558 2MTHULD 69.000 1	Upgrade bushing CTs on Lincoln - Mt. Hulda 69 kV line (at Lincoln) with 1200 amp equipment. Upgrade jumpers on Lincoln - Mt. Hulda 69 kV line (at Mt. Hulda) to 795 ACSR.
NU03	300542 2SMTHTN 69.000 300545 2SYLVAN 69.000 1	Rebuild 1.8 mile Smithton Switch-Sylvan 69 kV line with 336 ACSR at 100C.
NU04	300557 2IVYBND 69.000 300565 2VERSAL 69.000 1	Upgrade Bushing CT on Ivy Bend-Versailles 69 kV line (at Versailles) to 1200 amps.
NU05	300768 2BNTNVL 69.000 300776 2FRSTOE 69.000 1	Rebuild 10.4 mile Bentonville - Fristoe 69 kV line with 795 ASCR at 100C.
NU06	300768 2BNTNVL 69.000 300809 2ICONTP 69.000 1	Rebuild 3.1 mile Bentonville - Iconium Tap 69 kV line with 795 ASCR at 100C.
NU07	300776 2FRSTOE 69.000 300790 2WARSAW 69.000 1	Rebuild 6.6 mile Fristoe - Warsaw 69 kV line with 795 ASCR at 100C.
NU08	300809 2ICONTP 69.000 300817 2OSCEOLA 69.000 1	Rebuild 7.5 mile Osceola - Iconium Tap 69 kV line with 795 ASCR at 100C. Upgrade jumpers on Osceola - Iconium Tap 69 kV line (at Osceola) to 795 ACSR.
NU09	301042 2BRSHCK 69.000 301064 2LEB 1 69.000 1	Rebuild 5.9 mile Brush Creek-Lebanon 69 kV line with 336 ACSR at 100C.
NU10	301207 2GRNFOR 69.000 301210 2HILLRD 69.000 1	Rebuild 4/0 section (0.35 miles) of Green Forest-Hilliard 69 kV line to 336 ACSR at 100C.
NU11	300101 5MORGAN 161.00 300782 2MORGAN 69.000 1	Replace Morgan 161/69 kV xfmr with 112 MVA Summer, 127 MVA Winter rated unit.
NU12	300774 2EUDORA 69.000 300782 2MORGAN 69.000 1	Rebuild 4.2 mile Eudora - Morgan 69 kV line with 795 ASCR at 100C.
NU13	300774 2EUDORA 69.000 300788 2SLAGLE 69.000 1	Rebuild 9.9 mile Eudora - Slagle 69 kV line with 795 ASCR at 100C.
NU14	301553 4WELEETKA 138.00 521026 PHAROAH4 138.00 1	Reconductor 0.4 mile long 138 kV line from Weleetka - Pharoah to 1192 ACSS at 200C and upgrade jumpers at Weleetka to 1192 ACSS. Replace Breaker Switchers, Disconnect Switches, Bushing CTs, CTs on line at Weleetka with 2000 amp equipment
NU15	300327 2ELM 69.000 300336 2HOLDEN 69.000 1	Uprate 5.4 mile 556 ACSR segment of Elm - Holden to 100C.
NU16	300748 2NEOSAC 69.000 547471 NEO184 5 161.00 1	Overload reported able to be mitigated with the adjustments of transformer taps; no upgrade required.

The upgrades shown in Table 6 were evaluated in order to mitigate the reported steady state contingent constraints for the Study Cycle as listed in Table 3.

Table 6: Contingent Facilities for the Study Cycle Constraints

Constraint ID	Monitored Facility	Contingent Facilities

-	300049 7THOMHL 345.00
	301510 5THOMHLXF4 161.00 4
		Contingent on GI-083:
		- Upgrade Kingdom City 161/69 kV transformer #3 to 84/96 MVA unit.
		- Remove Kingdom City 161/69 kV transformer #2 from service.
		- Salt River area upgrades:
		  - Add two new terminal positions to the Salt River 161 kV substation.
		  - Add Salt River 161/69 kV transformer rated for 84/96 MVA.

Constraint ID	Monitored Facility	Contingent Facilities
-	300099 5MONTCT 161.00 300575 2MONTGY 69.000 2	- Convert Auxvasse 69 kV substation to 161 kV operation. - Rebuild Kingdom City - Auxvasse 69 kV line, 8.00 miles, to 161 kV service, utilize 795 ACSR conductor to be designed for 100ºC and re-terminate line at the Kingdom City 161 kV bus 1. - Rebuild Auxvasse - Salt River 69 kV line, 10.00 miles, to 161 kV service, utilize 795 ACSR conductor to be designed for 100ºC and re-terminate line at the Salt River 161 kV bus. - Add one new terminal position to the Montgomery City 161 kV substation. Construct a ~17 mile double circuit 161/69 kV line from Salt River-Vandiver-Scotts Corner - 161 kV line will be 795 ACSR at 100C. Terminated at Salt River and will continue to Montgomery City. - 69 kV line will be 336 ACSR at 100C. Terminated at Salt River, Vandiver, Lindell, and Scotts Corner. - Upgrade Jumpers at Lindell, Vandiver, Scotts Corner to 336 ACSR. - Build a new 161 kV line from Scotts Corner - Montgomery City, 16.30 miles, utilize 795 ACSR conductor to be designed for 100ºC. Line section will be used as 161 kV path between Salt River and Montgomery City. Line will not terminate at Scotts Corner. - Add two new breakers to Vandalia 69 kV substation. - Build a new 69 kV line from Scotts Corner - Vandalia, 12.00 miles, utilize 336 ACSR conductor to be designed for 100ºC - Upgrade Thomas Hill 345/161 k V transformer #4 to 625/712 MVA unit. - Thomas Hill - Bevier Area Upgrades - Add Thomas Hill - Bus 1 - Bevier 161 kV line. - Add Bevier 161/69 kV transformer, 112/127 MVA unit. - Remove Thomas Hill - Bevier 69 kV line.
-	300172 2TMHILLB1 69.000 300387 2BEVIER 69.000 1	
-	300512 2AUXVAS 69.000 300580 2SLTRVR 69.000 1	
-	300517 2KINGDM 69.000 301497 5KINGDMB2 161.00 2	
-	300517 2KINGDM 69.000 301497 5KINGDMB2 161.00 3	
-	300077 5FLETCH 161.00 301532 5FLETCHXF1 161.00 1	**Contingent on GI-99/100:** Convert Gobbler Knob 345 kV station to a breaker and half configuration. Upgrade 161 kV disconnect switches on Gobbler 345/161 kV transformer #1 with 2,000 amp disconnect switches. Switches 161, 1611, 1613, 1621, 1622 - Add a second 345/161 kV transformer at Gobbler Knob with ratings 500 MVA Summer/570 MVA Winter. Utilize the existing transformer Thomas Hill 4. Rebuild existing 69 kV line from Gobbler-PB South-Harviell-Poplar Bluff-Township-Green Forest to double circuit 161 and 69 kV. The 69 kV circuit will be constructed to 795 ACSR and terminate at stations as it currently does. The 161 kV circuit will be constructed to 795 ACSS High Temp at 200C and terminate only at Gobbler Knob and Green Forest. Add terminals and associated equipment as needed at Gobbler and Green Forest stations. The individual line segments are: - Rebuild 4.4-mile-long Gobbler Knob to Poplar Bluff South 69 kV Line with 795 ACSR at 100C. - Rebuild 2.5-mile-long Green Forest to Township 69kV Line with 795 ACSR at 100C. - Rebuild 4.5-mile-long Harviell to Poplar Bluff South 69 kV Line with 795 ACSR at 100C. - Rebuild 6.3-mile-long Harviell to Poplar Bluff 69 kV Line with 795 ACSR at 100C. - Rebuild 2.7-mile-long Poplar Bluff to Township 69 kV Line with 795 ACSR at 100C. - Construct a new 161 kV circuit from Gobbler Knob to Green Forest along the existing 69 kV path between these stations. Use 795 ACSS High Temp at 200C.
-	300168 5GOBKNOB 161.00 300173 2GOBKNOB 69.000 3	
-	300168 5GOBKNOB 161.00 300173 2GOBKNOB 69.000 4	
-	300173 2GOBKNOB 69.000 301218 2PBSOUTH 69.000 1	
-	301209 2HARVEL 69.000 301218 2PBSOUTH 69.000 1	
-	301209 2HARVEL 69.000 301219 2POPBLF 69.000 1	
-	300173 2GOBKNOB 69.000 301230 2FAIRDLG 69.000 1	
-	301201 2DONIPH 69.000 301227 2RIPLEY 69.000 1	
-	301207 2GRNFOR 69.000 301224 2TWNSHP 69.000 1	
-	301217 2OXLEY 69.000 301227 2RIPLEY 69.000 1	
-	301219 2POPBLF 69.000 301224 2TWNSHP 69.000 1	
-	500 SHOALCR 161.00 300107 5OSBORN 161.00 1	**Contingent on GI-101/102:** Construct a new 161 kV switchyard called Shoal Creek. Cut existing REX-Osborn 161 kV line in/out of new switchyard. Cut existing REX-Lathrop 161 kV line in/out of new switchyard. Build a new 27.8 mile long 161 kV circuit between Shoal Creek and Missouri City utilizing 1192 ACSS at 200C.
-	300039 7FAIRPT 345.00 301559 5FAIRPTXF3 161.00 3	

Constraint ID	Monitored Facility	Contingent Facilities
-	300107 5OSBORN 161.00 300290 2OSBORN 69.000 1	- Line will be overbuilt on the 69 kV line from Turney - Lathrop Load - Lathrop - Holt - Summerset - Kearney - Missouri City. The 69 kV lines will be replaced with 336 ACSR at 100C. Add a new 161 kV terminal and reconfigure Missouri City 161 kV bus to accommodate the new 161 kV line between Missouri City and Shoal Creek. Add second 161/69 kV transformer to Lathrop rated for 56 MVA Summer, 63 MVA Winter. Leave existing transformer in service. Rebuild 2.2 mile long Lathrop-Lathrop East 161 kV line to 1192 ACSRS at 1200C. - Upgrade jumpers at Lathrop East and Lathrop on line to 1192 ACSRS. - Replace disconnect switches at Lathrop on line to 2,000 amp switches Rebuild 23.2 mile long Missouri City-Lathrop 161 kV line to 1192 ACSS at 200C. - Upgrade jumpers at Lathrop and Missouri City on line to 1192 ACSS at 200C. - Upgrade relay limits at Missouri City to 477 MVA Summer, 595 MVA Winter minimum. Rebuild 12.2 mile long Osborn-Shoal Creek 161 kV line to 1192 ACSS at 200C. - Upgrade jumpers at Osborn on line to 1192 ACSS at 200C. - Replace disconnect switches at Osborn to 2,000-amp switches. - Replace bushing CTs at Osborn on line to 2,000 base amps. Rebuild 5.2 mile long Shoal Creek-Lathrop East 161 kV line to 1192 ACSS at 200C. - Upgrade jumpers at Lathrop East on line to 1192 ACSS at 200C.
-	300107 5OSBORN 161.00 301564 5FAIRPTB1 161.00 1	
-	300191 2CROSRDS 69.000 300206 2MABEL 69.000 1	
-	300203 2KIDDER 69.000 300215 2MABELTP 69.000 1	
-	300206 2MABEL 69.000 300215 2MABELTP 69.000 1	
-	300302 2LATHRP 69.000 300313 2WESTBR 69.000 1	
-	300312 2TURNEY 69.000 300316 2LATHRPEMG 69.000 1	
-	300316 2LATHRPEMG 69.000 301627 2LATHRPLD 69.000 1	
CF01	300069 5CHOTEAU1 161.00 512648 MAID 5 161.00 1	**Contingent on Prior Queued Studies** Overload will be mitigated by upgrades tagged to higher queue request. Final scope of the upgrades tagged to higher queue request are still being developed.
CF02	300091 5LATHRP 161.00 300302 2LATHRP 69.000 1	**Contingent on AECI** Build a new 161 kV line from Fairport-Shoal Creek to 1192 ACSS at 200C. Overbuild existing 69 kV lines from Fairport-Kidder-Mabel Tap and Turney-Cameron Junction. Overbuilt 69 kV lines will be built to 336 ACSR at 100C.
CF03	300191 2CROSRDS 69.000 301628 2OSBORNTPN 69.000 1	
CF04	300293 2CAMRNJ 69.000 300312 2TURNEY 69.000 1	
CF05	300302 2LATHRP 69.000 301627 2LATHRPLD 69.000 1	
CF06	300131 4FISHERTP 138.00 300140 4SILVCTY 138.00 1	**Contingent on AECI** Rebuild and convert 0.09-mile-long section of Gypsy - Stroud 69 kV line to 138 kV 1192.5 ACSR at 100C: - Build additional 138kV bay at Stroud. - Convert Gypsy substation to 138 kV. - Install a GOAB near Gypsy station to create a 3 terminal 138 kV line between Stroud, Gypsy, and Bristow. - Re-terminate Gypsy-Stroud line to land on 138 kV bay at Stroud. Rebuild and convert 9.50-mile-long section of Bristow - Gypsy 69 kV line to 138 kV 1192.5 ACSR at 100C: - Build additional 138kV bay at Bristow. - Re-terminate Gypsy – Bristow 138 kV line land on a 138 kV bay at Bristow.
CF07	300196 2WOODY 69.000 300906 2NUYAKA 69.000 1	
CF08	300906 2NUYAKA 69.000 513092 BEGGS 2 69.000 1	
CF09	300172 2TMHILLB1 69.000 301318 2THMINTP 69.000 1	**Contingent on MISO Tranche 1 Projects** Build new 345 kV line from Thomas Hill 345 kV substation (AECI) - Zachary 345 kV substation. Build new 345 kV line from Zachary 345 kV substation - Maywood 345 kV substation (Ameren). Build new 345 kV line from Meredosia 345 kV substation (Ameren) - Maywood 345 kV substation.
CF10	300355 2SPALDNG 69.000 300373 2CENTER 69.000 1	
CF11	300373 2CENTER 69.000 300374 2CNTRSW 69.000 1	
CF12	300381 5BEVIER 161.00 300387 2BEVIER 69.000 1	

Constraint ID	Monitored Facility	Contingent Facilities
CF13	300390 2CAIRO 69.000 300394 2HUNTSV 69.000 1	
CF14	300394 2HUNTSV 69.000 301318 2THMINTP 69.000 1	
CF15	300133 5THMHLB3 161.00 344004 5ADAIR1 161.00 1	
CF16	300398 2LOVELK 69.000 300401 2MACNTP 69.000 1	
CF17	300399 2MACN3E 69.000 300401 2MACNTP 69.000 1	
CF18	300567 5ENON 161.00 301649 5ETHLYNB2 161.00 1	
CF19	300571 2MEXICO 69.000 300580 2SLTRVR 69.000 1	
CF20	300382 2SFRKTP 69.000 300578 2SANTFE 69.000 1	
CF21	300104 5NODWAY 161.00 301592 5MARYVLB1 161.00 1	
CF22	300184 2NORTHB 69.000 301662 2HAMBRGB2 69.000 1	**Contingent on SPP DISIS 2016-002** Rebuild the 18-mile-long Hamburg - Northboro 69 kV line to 336 ACSR.
CF23	300184 2NORTHB 69.000 300189 2TARKIO 69.000 1	**Contingent on SPP DISIS-2017-002** Rebuild 69 kV 13.2 mile long line from Northboro-Tarkio to 336 ACSR rated at 100C.
CF24	300772 2COFMAN 69.000 300780 2KNOBBY 69.000 1	**Contingent on SPP DISIS-2017-002** Rebuild 69 kV 4.70 mile long line from Coffman Bend - Knobby to 795 ACSR rated at 100C.
CF25	300773 2ELKTON 69.000 300817 2OSCEOLA 69.000 1	**Contingent on SPP DISIS-2017-002** Rebuild 69 kV 17.8 mile long line from Elkton - Osceola to 795 ACSR rated at 100C.
CF26	300780 2KNOBBY 69.000 301401 2TURKEYCRK 69.000 1	**Contingent on SPP DISIS-2017-002** Rebuild Knobby - Turkey Creek 69 kV with 795 ASCR, 100C (12.4 mi).
CF27	300530 2GEOGT2 69.000 300541 2SEDALI 69.000 1	**Contingent on SPP DISIS-2017-002** Upgrade bushing CTs (via breaker upgrade), breaker switchers on Georgetown-Sedalia 69 kV line (at Sedalia) to 1200 amp rating.
CF28	300651 2LAMR 69.000 300794 5LAMAR 161.00 1	**Contingent on SPP DISIS-2017-002** Install a second Lamar 161/69 kV Xfmer rated at 84 MVA Summer, 95 MVA Winter unit.
CF29	300110 5PITTSV 161.00 300320 5LEVASY 161.00 1	**Contingent on SPP DISIS-2017-002 Network Upgrades** Build new 161 kV line from Archie - G17-108-Tap and place in service.
CF30	300110 5PITTSV 161.00 301561 5HOLDENB1 161.00 1	
CF31	300320 5LEVASY 161.00 548808 ECKLES-161 161.00 1	
CF32	300323 2CENTRV 69.000 300334 2ROSEHL 69.000 1	
CF33	300323 2CENTRV 69.000 300336 2HOLDEN 69.000 1	
CF34	300688 2AUSTIN 69.000 300696 2CREIGH 69.000 1	
CF35	300688 2AUSTIN 69.000 300699 2ELYNTP 69.000 1	
CF36	300045 7MORGAN 345.00 301622 5MORGANXF1 161.00 1	**Contingent on SPP DISIS-2018-001** Replace the Morgan 345/161 kV transformer with a unit rated 560 MVA Summer and 638 MVA Winter. Upgrade 161 kV breaker switchers and relay limits as needed to accommodate larger transformer rating.
CF37	300772 2COFMAN 69.000 300779 2J&7 69.000 1	**Contingent on SPP DISIS-2020** Rebuild 69 kV 6.31 mile long line from Coffman Bend - J-7 to 795 ACSR rated at 100C.
CF38	300541 2SEDALI 69.000 300545 2SYLVAN 69.000 1	**Contingent on SPP DISIS-2020** Upgrade bushing CTs (via breaker upgrade), breaker switchers on Sylvan-Sedalia 69 kV line (at Sedalia) to 1200 amp rating.
CF39	301402 5LOSTVALY 161.00 505502 TRUMAN 5 161.00 1	**Contingent on SPP DISIS-2021-001** Rebuild Truman - Lost Valley 161 kV line with 1192 ACSR at 100C (2.6 miles). Upgrade jumpers on line at the Truman station to 1192 ACSR.
CF40	300101 5MORGAN 161.00 549969 BROOKLINE 5161.00 1	**Contingent on SPP DISIS-2021-001** Rebuild 161 kV 26.49 mile long line from Morgan - Brookline to 1192 ACSR rated at 100C.

Constraint ID	Monitored Facility	Contingent Facilities
CF41	301251 2VANDSR 69.000 301255 2MORLEY 69.000 1	**Contingent on MISO DPP-2019** Rebuild 2.9-mile-long Vanduser-Morley 69 kV line to 336 ACSR at 100C.
CF42	300387 2BEVIER 69.000 301623 2BEVIERTP 69.000 1	**Contingent on MISO DPP-2019** Rebuild 0.1 mile-long Bevier - Bevier Tap 69 line to 795 ACSR at 100C.
CF43	300388 2AXTELL 69.000 300400 2MACNLK 69.000 1	**Contingent on MISO DPP-2019** Rebuild 1.15 mile-long Axtell - Macon Lake 69 line to 795 ACSR.
CF44	300388 2AXTELL 69.000 300401 2MACNTP 69.000 1	**Contingent on MISO DPP-2019** Rebuild 1.05 mile-long Axtell - Macon Tap 69 kV line to 795 ACSR.
CF45	300400 2MACNLK 69.000 301623 2BEVIERTP 69.000 1	**Contingent on MISO DPP-2019** Rebuild the 4.136-mile-long Bevier - Macon Lake 69 kV line to 795 ACSR.
CF46	300327 2ELM 69.000 300336 2HOLDEN 69.000 1	**Contingent on MISO DPP-2019** Rebuild 3.1 mile 336 ACSR segment of Elm-Holden (existing double circuit). Utilize 556 ACSR at 100C for 69 kV circuit. *CF46 upgrade as described above was not sufficient, additional upgrade required to mitigate overloads seen for Project (NU15).*
CF47	300194 2CHILLI 69.000 300218 5CHILLIS 161.00 1	**Contingent on MISO DPP-2019** Reconfigure Chillicothe 161 kV bus to main/transfer bus configuration.
CF48	300124 5HOLDENB2 161.00 300336 2HOLDEN 69.000 1	**Contingent on MISO DPP-2019** Add a second 161/69 kV transformer at Holden with rating of 84 MVA Summer, 95 MVA Winter.
CF49	300325 2RT Z 69.000 300327 2ELM 69.000 1	
CF50	300525 5WRIGHTB2 161.00 300600 5NEWMELB1 161.00 1	**Contingent on MISO DPP-2020** Rebuild 6.5 mile Wright City-New Melle 161 kV line with 1192 ACSR at 100C. Replace jumpers on line at Wright City with 1192 ACSR. Replace bushing CTs on line at Wright City with 1200 amp minimum units.
CF51	300053 5OLDMARS 161.00 301476 4OLDMARS 138.00 1	**Contingent on MISO DPP-2021 (West)** Replace Old Maries 161/138 Transformer with a 250S/285W Unit.
CF52	301168 2MANSFL 69.000 301174 2SEYMOR 69.000 1	**Contingent on MISO DPP-2021 (West)** Rebuild Mansfield-Seymour 10.6 mile 69 kV line to 336 ACSR at 100C.
CF53	301243 2IDALIA 69.000 301257 2ARDEOLA 69.000 1	**Contingent on MISO DPP-2021 (South)** Rebuild Ardeola-Idalia 6 miles 69 kV line to 336 ACSR at 100C.
CF54	301553 4WELEETKA 138.00 521026 PHAROAH4 138.00 1	**Contingent on MISO DPP-2021 (South)** Rebuild 0.4 mile long Weleetka-Pharoah 138 kV line to 1192 ACSR at 100C. Replace jumpers at Weleetka 138 kV to 1192 ACSR. *CF54 upgrade as described above was not sufficient, additional upgrade required to mitigate overloads seen for Project (NU14).*
CF55	300137 4BRISTOW 138.00 300140 4SILVCTY 138.00 1	**Contingent on GI-103** Rebuild 21.6 mile Bristow - Silver City 138 kV line to 1192 ACSR at 100C. At Bristow 138 kV substation: - Upgrade wave trap to 2000 A - Upgrade jumpers to 1192 ACSR - Upgrade disconnect switches to 2000 A - Upgrade breaker switchers to 2000 A At Silver City 138 KV substation: - Upgrade jumpers to 1192 ACSR
CF56	300137 4BRISTOW 138.00 300686 4WOODY 138.00 1	**Contingent on GI-103** Rebuild 21.7 mile Bristow - Woody 138 kV line to 1192 ACSR at 100C. At Bristow 138 kV substation: - Upgrade wave trap to 2000 A - Upgrade jumpers to 1192 ACSR - Upgrade disconnect switches to 2000 A - Upgrade breaker switchers to 2000 A - Upgrade bushing CTs to 2000 A At Woody 138 KV substation: - Upgrade jumpers to 1192 ACSR

Constraint ID	Monitored Facility	Contingent Facilities
CF57	300137 4BRISTOW 138.00 300889 2BRIISTOW 69.000 2	**Contingent on GI-103** Upgrade existing Bristow 138/69 kV transformer to a 112 MVA Summer/127 MVA Winter rated unit. Add a second 138/69 kV transformer at Bristow with rating of 112 MVA Summer/127 MVA Winter.
CF58	300686 4WOODY 138.00 521026 PHAROAH4 138.00 1	**Contingent on GI-103** Rebuild 13.4 mile Woody-Pharoah 138 kV line to 1192 ACSR at 100C. Replace jumpers on both side of line with 1192 ACSR.
CF59	300889 2BRIISTOW 69.000 300977 2BRISTOWTP 69.000 1	**Contingent on GI-103** Rebuild 0.90 mile Bristow-Bristow Tap 69 kV to 336 ACSR line at 100C.
CF60	300889 2BRIISTOW 69.000 513092 BEGGS 2 69.000 1	**Contingent on GI-103** Rebuild 0.90 mile KAMO owned line section of Bristow-Beggs 69 kV line to 336 ACSR at 100C.
CF61	300901 2KELYVIL 69.000 300977 2BRISTOWTP 69.000 1	**Contingent on GI-103** Uprate 9.90 mile Kellyville-Bristow Tap 69 kV 336 ACSR line from 75C to 100C.
CF62	300139 4FAIRFAX 138.00 300929 2FAIRFAX 69.000 1	**Contingent on GI-104** Add a second 138/69 kV transformer at Fairfax with a rating of 56 MVA Summer/63 MVA Winter.
CF63	300141 4STILWTR 138.00 300844 4RAMSEY 138.00 1	**Contingent on GI-104** Uprate 13.00 mile Stillwater-Ramsey 138 kV 795 ACSR line from 75C to 100C.
CF64	300811 2OSCEOL 69.000 301040 5OSCEOL 161.00 1	**Contingent on GI-119**[5] Upgrade 161/69 kV transformer at Osceola with unit rated for 112 MVA Summer, 127 MVA Winter. Upgrade 69 kV bushing CTs to 1200 amp.

No upgrades were evaluated for the neighboring system constraints listed in Table 4. The upgrades for these impacts may need to be resolved through coordination with the transmission owner as listed in Table 7 below.

Table 7: Neighboring System Constraints

Constraint ID	Monitored Facility	Network Upgrade
AFS01	300044 7MCCRED 345.00 41454 J1145 POI 345.00 1	AMMO Owned; no upgrade evaluated. Elements owned by AECI on this line are not overloaded.
AFS02	300071 5CLINTN 161.00 761278 G17-108-TAP 161.00 1	KCPL Owned; no upgrade evaluated. Elements owned by AECI on this line are not overloaded.
AFS03	300097 5MARYVB2 161.00 652560 CRESTON5 161.00 1	WAPA Owned; no upgrade evaluated. Elements owned by AECI on this line are not overloaded.
AFS04	300098 5MOCITYB2 161.00 541248 LBRTYST5 161.00 1	KCPL Owned; no upgrade evaluated. Elements owned by AECI on this line are not overloaded.
AFS05	300131 4FISHERTP 138.00 505610 KEYSTON4 138.00 1	SWPA Owned; no upgrade evaluated. Elements owned by AECI on this line are not overloaded.
AFS06	300740 7SPORTSMAN 345.00 512650 GRDA1 7 345.00 1	GRDA Owned; no upgrade evaluated. Elements owned by AECI on this line are not overloaded.
AFS07	301521 5REEDSP 161.00 547473 RDS295 5 161.00 1	EMDE Owned; no upgrade evaluated. Elements owned by AECI on this line are not overloaded.

AECI developed non-binding, good faith estimates of the timing and cost estimates for upgrades needed as a result of the addition of the Study Cycle requests as shown in Table 8.

[5] GI-119 withdrew during the Study, this assumption change will be captured in a restudy.

Table 8: Network Upgrade Costs

ID	Option/Description	Estimated Cost	Estimated Lead Time (Months)
NU01	Replace Green Forest 161/69 kV xfmer with 84 MVA Summer, 95 MVA Winter rated unit.	$ 3,300,000	48
NU02	Upgrade bushing CTs on Lincoln to Mt. Hulda 69 kV line (at Lincoln) with 1200 amp equipment. Upgrade jumpers on Lincoln - Mt. Hulda 69 kV line (at Mt. Hulda) to 795 ACSR.	$ 379,000	36
NU03	Rebuild 1.8 mile Smithton Switch-Sylvan 69 kV line with 336 ACSR at 100C.	$ 720,000	36
NU04	Upgrade Bushing CT on Ivy Bend-Versailles 69 kV line (at Versailles) to 1200 amps.	$ 323,000	36
NU05	Rebuild 10.4 mile Bentonville - Fristoe 69 kV line with 795 ASCR at 100C.	$ 9,360,000	48
NU06	Rebuild 3.1 mile Bentonville - Iconium Tap 69 kV line with 795 ASCR at 100C.	$ 2,790,000	48
NU07	Rebuild 6.6 mile Fristoe - Warsaw 69 kV line with 795 ASCR at 100C.	$ 5,940,000	48
NU08	Rebuild 7.5 mile Osceola - Iconium Tap 69 kV line with 795 ASCR at 100C. Upgrade jumpers on Osceola - Iconium Tap 69 kV line (at Osceola) to 795 ACSR.	$ 6,750,000	48
NU09	Rebuild 5.9 mile Brush Creek-Lebanon 69 kV line with 336 ACSR at 100C.	$ 3,300,000	36
NU10	Rebuild 4/0 section (0.35 miles) of Green Forest-Hilliard 69 kV line to 336 ACSR at 100C.	$ 800,000	24
NU11	Replace Morgan 161/69 kV xfmr with 112 MVA Summer, 127 MVA Winter rated unit.	$ 4,000,000	48
NU12	Rebuild 4.2 mile Eudora - Morgan 69 kV line with 795 ASCR at 100C.	$ 3,780,000	42
NU13	Rebuild 9.9 mile Eudora - Slagle 69 kV line with 795 ASCR at 100C.	$ 9,000,000	42
NU14	Reconductor 0.4 mile long 138 kV line from Weleetka-Pharoah to 1192 ACSS at 200C and upgrade jumpers at Weleetka to 1192 ACSS. Replace Breaker Switchers, Disconnect Switches, Bushing CTs, CTs online at Weleetka with 2000 amp equipment	$ 2,575,000	24
NU15	Uprate 5.4 mile 556 ACSR segment of Elm - Holden to 100C.	$ 5,211,000	42
NU16	Overload reported able to be mitigated with the adjustments of transformer taps; no upgrade required.	-	-
	Total Cost:	$58,228,000	

Cost allocations for each of the impacted facilities are discussed in the Cost Allocation section below.

COST ALLOCATION

Network upgrade costs are allocated to each of the Study Cycle projects based on the worst MW impact[6] each project had on the constraint and as described in the steps below:

1. Determine the MW impact each Study Cycle project had on each constraint using the size of each request in the season it was reported:

$$Project\ X\ MW\ Impact\ on\ Constraint\ 1 = DFAX\ (X) * MW\ (X) = X1$$

$$Project\ Y\ MW\ Impact\ on\ Constraint\ 1 = DFAX\ (Y) * MW\ (Y) = Y1$$

$$Project\ Z\ MW\ Impact\ on\ Constraint\ 1 = DFAX\ (Z) * MW\ (Z) = Z1$$

2. Determine the maximum MW% impact each generator has as a percentage of the total Study Cycle impact on a given constraint.

$$X2\ =\ Project\ X\ MW\ impact\ \%\ = \frac{X1}{Total\ MW\ Impact\ of\ Study\ Cycle\ on\ Constraint}$$

$$Y2\ =\ Project\ Y\ MW\ impact\ \%\ = \frac{Y1}{Total\ MW\ Impact\ of\ Study\ Cycle\ on\ Constraint}$$

$$Z2\ =\ Project\ Z\ MW\ impact\ \%\ = \frac{Z1}{Total\ MW\ Impact\ of\ Study\ Cycle\ on\ Constraint}$$

3. Apply three percent (3%) MW impact De Minimis Threshold: If a Study Cycle project MW% impact is less than 3% for a particular constraint then the project MW% impact is adjusted to 0 for that constraint and the Study Cycle project will not be allocated cost for that particular constraint.

4. Determine the cost allocated to each remaining Study Cycle project for each upgrade using the total cost of a given upgrade:

$$Project\ X\ Upgrade\ 1\ Cost\ Allocation\ (\$) = \frac{Network\ Upgrade\ 1\ Cost\ (\$) * X2}{X2 + Y2 + Z2}$$

The associated cost allocation of the network upgrades to each of the Study Cycle projects is shown below in Table 9. Further breakdown of costs is provided in Appendix B.

[6] All negative MW impacts (helpers) were set to 0 MW impact.

Table 9: Network Upgrade Cost Allocation

Project	Cluster Group	POI	MW	Total
GEN-2022-001	04 SOUTHEAST	Catoosa 138 kV Substation	100	$ -
GEN-2022-005	03 CENTRAL	Northeast Parsons 138kV Substation	200	$ 670,482
GEN-2022-006	03 CENTRAL	Neosho - N345 161 kV Substation	200	$ 1,129,393
GEN-2022-007	03 CENTRAL	Lang - Reading 115 kV Transmission Line	135	$ -
GEN-2022-010	01 NORTH	Judson Substation 345 kV	250	$ -
GEN-2022-011	05 SOUTHWEST	Tap of Oklaunion - Lawton Eastside 345 kV line	374	$ -
GEN-2022-013	03 CENTRAL	Tap of Neosho - LaCygne 345 kV Line	300	$ 2,281,515
GEN-2022-015	03 CENTRAL	Tap of Mingo - Red Willow 345 kV Line	270	$ -
GEN-2022-016	04 SOUTHEAST	Woodward 345kV Substation	288	$ -
GEN-2022-024	03 CENTRAL	Tap of Neosho - LaCygne 345 kV Line	200	$ -
GEN-2022-038	04 SOUTHEAST	Longwood to Scottville 138 kV line	200	$ -
GEN-2022-041	03 CENTRAL	Tie Substation 69 kV	100	$ -
GEN-2022-042	04 SOUTHEAST	Sunnyside to Pooleville 138 kV line	174	$ -
GEN-2022-048	04 SOUTHEAST	Mooreland 138 kV	250	$ -
GEN-2022-054	03 CENTRAL	Wolf Creek - Blackberry 345 kV Tap	200	$ 1,676,566
GEN-2022-055	04 SOUTHEAST	Sunshine North to Anadarko 138 kV	200	$ -
GEN-2022-058	03 CENTRAL	Sibley 161 kV substation on the Noel Southwest - Decatur 161 kV line	180	$ 577,830
GEN-2022-062	03 CENTRAL	Wolf Creek- Blackberry 345 kV	200	$ 1,676,566
GEN-2022-068	01 NORTH	Chappelle Creek 345 kV	250	$ -
GEN-2022-071	04 SOUTHEAST	Talawanda to Canadian River 138 kV Line Tap	90.824	$ -
GEN-2022-072	04 SOUTHEAST	Grand River Dam - Claremore 161 kV Line	181	$ -
GEN-2022-073	03 CENTRAL	Nashua 161 kV Substation	300	$ 1,309,529
GEN-2022-074	04 SOUTHEAST	Hanna 138kV Substation	220.86	$ 2,575,000
GEN-2022-076	03 CENTRAL	Carpenter 345 kV Substation	500	$ -
GEN-2022-077	02 NEBRASKA	Enders 115 kV Substation	255	$ -
GEN-2022-079	03 CENTRAL	Dadeville East - Bolivar South 161kV	192	$ 9,662,477
GEN-2022-080	03 CENTRAL	Dadeville East - Bolivar South 161kV	96	$ 4,623,312
GEN-2022-081	03 CENTRAL	Clifton 115kV Substation	218	$ -
GEN-2022-082	05 SOUTHWEST	Tuco - Carlisle 230 kV line	180	$ -
GEN-2022-085	04 SOUTHEAST	Seminole to Muskogee 345kV Substation	241.4	$ -
GEN-2022-090	04 SOUTHEAST	Valiant Substation 138kV	150	$ -
GEN-2022-091	04 SOUTHEAST	Valiant Substation 138kV	150	$ -
GEN-2022-092	04 SOUTHEAST	Neosho-Delaware 345 kV	299.2	$ 1,612,323
GEN-2022-094	03 CENTRAL	Postrock to Axtell 345 kV line	250	$ -
GEN-2022-098	04 SOUTHEAST	Bison 345kV Substation	200	$ -
GEN-2022-100	03 CENTRAL	Overton - Sedalia East 161 kV Substation	80	$ 105,675
GEN-2022-102	03 CENTRAL	Liberty West 161 kV	100	$ -
GEN-2022-103	03 CENTRAL	Ozark South 161kV	74.99	$ 522,370
GEN-2022-104	04 SOUTHEAST	Brown - South Coleman Junction 138kV line	113.078	$ -

Project	Cluster Group	POI	MW	Total
GEN-2022-105	05 SOUTHWEST	Tap of Oklaunion to Lawton Eastside 345 kV Transmission Line	300	$ -
GEN-2022-106	05 SOUTHWEST	Tap of Oklaunion to Lawton Eastside 345 kV Transmission Line	300	$ -
GEN-2022-107	05 SOUTHWEST	Tap of Oklaunion to Lawton Eastside 345 kV Transmission Line	400	$ -
GEN-2022-110	04 SOUTHEAST	Lehigh 138kV Station	150	$ -
GEN-2022-111	04 SOUTHEAST	Wilkes 345 kV Substation	150	$ -
GEN-2022-113	03 CENTRAL	Tipton Station 161 kV Substation	200	$ 1,554,853
GEN-2022-114	05 SOUTHWEST	Lawton to Oklaunion 345kV Line	250	$ -
GEN-2022-129	04 SOUTHEAST	Webb City Tap - Shidler 138 kV line	200	$ -
GEN-2022-130	04 SOUTHEAST	Battlefield BESS 161kV	200	$ -
GEN-2022-131	03 CENTRAL	Warrensburg East - Odessa161kV Substation	200	$ 825,842
GEN-2022-132	04 SOUTHEAST	Anadarko 138kV Substation	300	$ -
GEN-2022-136	04 SOUTHEAST	Colbert 138 kV Substation	210.5	$ -
GEN-2022-137	04 SOUTHEAST	Canadian Switchyard 138kV	210.4	$ -
GEN-2022-138	04 SOUTHEAST	Tulsa North - Northeast Station 345 kV Substation	300	$ 298,872
GEN-2022-139	04 SOUTHEAST	Pirkey 345kV Substation	300	$ -
GEN-2022-142	03 CENTRAL	Shoal Creek 161 kV Substation	210.4	$ 56,806
GEN-2022-143	04 SOUTHEAST	Caney Creek 138 kV Substation	210.4	$ -
GEN-2022-144	03 CENTRAL	Blue Mills BESS 161kV Substation	210.4	$ 1,292,170
GEN-2022-145	04 SOUTHEAST	Weatherford Jct. to Hinton 138 kV line	195	$ -
GEN-2022-147[7]	05 SOUTHWEST	Tuco 345kV	203	$ -
GEN-2022-152	02 NEBRASKA	Humboldt 161 kV Substation	80	$ -
GEN-2022-154	04 SOUTHEAST	Canadian Switch 138 kV Substation	100	$ -
GEN-2022-155	04 SOUTHEAST	Horseshoe Lake 138 kV Substation	200	$ -
GEN-2022-156	04 SOUTHEAST	Silver City 138 kV Substation	100	$ -
GEN-2022-159	05 SOUTHWEST	Crossroads - Hobbs 345 kV Line	280	$ -
GEN-2022-160	05 SOUTHWEST	Crossroads - Hobbs 345 kV Line	280	$ -
GEN-2022-161	03 CENTRAL	Burns 345kV Substation	400	$ -
GEN-2022-162	02 NEBRASKA	Friend 115 kV Substation	118	$ -
GEN-2022-163	04 SOUTHEAST	Cimarron 345kV Substation	200	$ -
GEN-2022-167	04 SOUTHEAST	Tulsa North - Northeastern 345 kV Line	250	$ -
GEN-2022-168	03 CENTRAL	Stilwell - Clinton 161 kV Line	380	$ 20,256,299
GEN-2022-171	05 SOUTHWEST	Pleasant Hill 230 kV Substation	200	$ -
GEN-2022-176	04 SOUTHEAST	Northeastern - Delaware 345 kV transmission line	215	$ -
GEN-2022-186	03 CENTRAL	Wolf Creek - Benton 345 kV Substation	684	$ 5,398,204
GEN-2022-196	04 SOUTHEAST	Pittsburg 345kV Substation	215	$ -
GEN-2022-204	03 CENTRAL	Post Rock - Spearville 345 kV	250	$ -
GEN-2022-205	03 CENTRAL	Post Rock - Spearville 345 kV	250	$ -

[7] GEN-2022-147 had different requested capacities values for Summer and Winter. The Winter capacity was used as it was greater than Summer.

Project	Cluster Group	POI	MW	Total
GEN-2022-206	03 CENTRAL	Post Rock - Spearville 345 kV	250	$ -
GEN-2022-208	03 CENTRAL	Tap on the Mullen Creek to Ketchum 345 kV Line	400	$ 37,050
GEN-2022-209	03 CENTRAL	Tap on the Mullen Creek to Ketchum 345 kV Line	600	$ 84,866
GEN-2022-214	03 CENTRAL	Gill - Viola 138 kV Line Break	239	$ -
GEN-2022-219	01 NORTH	Belfield 230 kV Substation	350	$ -
GEN-2022-231	04 SOUTHEAST	Crescent to Cottonwood Creek 138 kV Line	166	$ -
GEN-2022-234	04 SOUTHEAST	Alluwe Tap Chelsea 138 kV line	200	$ -
GEN-2022-235	04 SOUTHEAST	El Reno SW 138 kV	150	$ -
GEN-2022-237	04 SOUTHEAST	Maud 138 kV substation	150	$ -
GEN-2022-238	04 SOUTHEAST	Maud 138 kV substation	150	$ -
GEN-2022-239	04 SOUTHEAST	John W Turk Jr Power Plant 345 kV sub	350	$ -
GEN-2022-240	04 SOUTHEAST	John W Turk Jr Power Plant 345 kV sub	200	$ -
GEN-2022-241	04 SOUTHEAST	John W Turk Jr Power Plant 345 kV sub	200	$ -
			Total Cost	$ 58,228,000

The Study Cycle requests shown in Table 10 are connecting on transmission lines that terminate at a AECI owned station. These requests are responsible for all costs associated with the work required to ready the AECI station for the newly interconnected Study Cycle request.

Table 10: Interconnection Facility Cost Allocation

Project	POI	Location of Interconnection Facility Work	Interconnection Facility Work Cost Estimate
GEN-2022-054	Wolf Creek- Blackberry 345 kV	Blackberry	$ 125,000
GEN-2022-062	Wolf Creek- Blackberry 345 kV	Blackberry	$ 125,000
GEN-2022-168	Stillwell - Clinton 161 kV Line	Clinton	$ 250,000

VERSION HISTORY

Version	Change Description
V0	Initial release