SPP DISIS-2023-001 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-2023 Study Cycle (the "Study Cycle") for an Affected System Study (AFS) evaluation on the AECI transmission system (the "Study"). The report has been revised to reflect the change in impacts due to the withdrawal of seventy-four (74) Study Cycle requests as listed in Table 1 below.

Table 1: Withdrawn Study Cycle Request

Project	TO	SP Capacity (MW)	WP Capacity (MW)	Fuel Type	POI
GEN-2023-005	AEP	100	100	Solar	Catoosa 138 kV Substation
GEN-2023-006	WERE	200	200	Wind	Northeast Parsons 138kV Substation
GEN-2023-009	AEP	374	374	Battery Storage	Tap of Oklaunion to Lawton Eastside 345 kV line
GEN-2023-010	WERE	100	100	Wind	Tie Substation 69 kV
GEN-2023-011	OGE	174	174	Wind	Sunnyside to Pooleville 138 kV line
GEN-2023-022	WFEC	250	250	Wind	Mooreland 138 kV
GEN-2023-023	EDE	180	180	Battery Storage	Noel Southwest to Decatur 161 kV line tap
GEN-2023-027	NEET	200	200	Solar	Wolf Creek to Blackberry 345 kV
GEN-2023-028	BEPC	250	250	Solar	Chappelle Creek 345 kV
GEN-2023-032	GRDA	181	181	Solar	Grand River Dam to Claremore 161 kV Line
GEN-2023-036	WFEC	220.9	220.9	Battery Storage	Hanna 138kV Substation
GEN-2023-049	SPS	500	500	Solar	Carpenter 345 kV Substation
GEN-2023-050	NPPD	255	255	Solar	Enders 115 kV Substation
GEN-2023-056	EDE	192	192	Battery Storage	Dadeville East to Bolivar South 161kV
GEN-2023-060	EDE	96	96	Solar	Dadeville East to Bolivar South 161kV
GEN-2023-065	SUNC	218	218	Battery Storage	Clifton 115kV Substation
GEN-2023-073	SPS	180	180	Battery Storage	Tuco to Carlisle 230 kV line
GEN-2023-075	OGE	241.4	241.4	Wind	Seminole to Muskogee 345kV Substation
GEN-2023-076	AEP	150	150	Wind	Valiant Substation 138kV
GEN-2023-081	AEP	150	150	Solar	Valiant Substation 138kV
GEN-2023-082	AEP	299.2	299.2	Battery Storage	Neosho to Delaware 345 kV
GEN-2023-085	ITCGP	250	250	Wind	Postrock to Axtell 345 kV line
GEN-2023-086	EDE	75	75	Solar	Ozark South 161kV
GEN-2023-087	AEP	300	300	Solar	Tap of Oklaunion to Lawton Eastside 345 kV Transmission Line
GEN-2023-097	AEP	300	300	Battery Storage	Tap of Oklaunion to Lawton Eastside 345 kV Transmission Line
GEN-2023-100	AEP	400	400	Solar	Tap of Oklaunion to Lawton Eastside 345 kV Transmission Line
GEN-2023-105	AEP	150	150	Wind	Lehigh 138kV Station

Project	TO	SP Capacity (MW)	WP Capacity (MW)	Fuel Type	POI
GEN-2023-116	EDE	200	200	Wind	Tipton Station 161 kV Substation
GEN-2023-117	SPS	256	256	Wind	Plant X 230kV Substation
GEN-2023-123	NEET	202	202	Wind	Wolf Creek- Blackberry 345 kV Line Break
GEN-2023-133	WFEC	250	250	Wind	Hugo 138 kV Substation
GEN-2023-134	SPS	280	280	Wind	Moore Co 230 kV Substation
GEN-2023-138	NPPD	190	190	Wind	Harbine 115 kV Substation
GEN-2023-142	OGE	250	250	Solar	Canadian River 345 kV Substation
GEN-2023-143	KACY	200	200	Battery Storage	Center City 161 kV Substation
GEN-2023-149	AEP	150	150	Battery Storage	Bird Hollow (Langley) - Pryor Junction 138 kV Line
GEN-2023-150	GRDA	230	230	Solar	Dry Gulch - Pensacola 161 kV Line
GEN-2023-151	Evergy	200	200	Solar	Odessa and Lexington 161 kV Line
GEN-2023-154	INDN	165	165	Solar	Eckles Road 161 kV Substation
GEN-2023-158	GRDA	150	150	Solar	Dry Gulch - Pensacola 161 kV Line
GEN-2023-159	Evergy	400	400	Battery Storage	Neosho 345 kV Substation
GEN-2023-164	SWPA	150	150	Battery Storage	Van Buren 161 kV
GEN-2023-165	SPS	256	256	Battery Storage	Plant X 230kV Substation
GEN-2023-166	Evergy	140	140	Battery Storage	Halstead 69 kV Substation
GEN-2023-167	Evergy	250	250	Battery Storage	Rose Hill 345 kV Substation
GEN-2023-168	Evergy	200	200	Battery Storage	Delaware to Neosho 345 kV
GEN-2023-169	Evergy	100	100	Battery Storage	Delaware - Neosho 345 kV
GEN-2023-174	NEET	625	625	Battery Storage	Crossroads - Hobbs 345 kV Line
GEN-2023-176	WAPA	175	175	Wind	White 115 kV Substation
GEN-2023-178	SWPA	150	150	Solar	Mansfield - Logan 161 kV Line
GEN-2023-180	SPS	300	300	Solar	Potter - Newhart 230 kV line
GEN-2023-182	Evergy	200	200	Wind	Archie 161 kV Substation
GEN-2023-183	BEPC	250	250	Thermal	Judson 345 kV Substation
GEN-2023-188	OGE	300	300	Solar	Degrasse 345 kV Substation
GEN-2023-189	BEPC	249	249	Battery Storage	Chappelle Creek 345 kV
GEN-2023-191	NPPD	500	500	Battery Storage	Keystone 345 kV Substation
GEN-2023-194	NPPD	300	300	Solar	Keystone 345 kV Substation
GEN-2023-195	SPS	285	285	Solar	Pringle Interchange 230 kV Substation
GEN-2023-201	NPPD	250	250	Solar	Sweetwater 345 kV Substation
GEN-2023-203	AEP	252	252	Solar	Fixico Tap to Weleetka 138 kV Line
GEN-2023-208	GRDA	250	250	Battery Storage	GRDA1 - Tonece7 345 kV Line
GEN-2023-211	SPS	275	275	Wind	Plant X 230 kV Substation
GEN-2023-212	SPS	200	200	Solar	Plant X 230 kV Substation
GEN-2023-213	Evergy	300	300	Battery Storage	LaCygne - Stilwell 345 kV Line
GEN-2023-214	OGE	150	150	Battery Storage	Gracemont 138 kV Substation
GEN-2023-216	AEP	100	100	Wind	South Nashville - South Murfreesboro 138kV

Project	TO	SP Capacity (MW)	WP Capacity (MW)	Fuel Type	POI
GEN-2023-217	WAPA	175	175	Wind	Fort Thompson - Huron 230 kV Tap
GEN-2023-218	SPS	335	335	Wind	Needmore - Yoakum 230 kV Line
GEN-2023-227	SPS	170	170	Battery Storage	Needmore - Yoakum 230 kV Line
GEN-2023-228	OGE	210	210	Battery Storage	Gracemont 345 kV Substation
GEN-2023-231	OGE	210	210	Wind	Gracemont 345 kV Substation
GEN-2023-236	OGE	150	150	Solar	84th Street - Tennessee Tap 138 kV Line
GEN-2023-237	OGE	250	250	Wind	Washington Park 138 kV Substation
GEN-2023-110	OGE	175	175	Solar	Classen 138 kV Substation

The full list of active Study Cycle requests included in the Study is listed in Table 2 below.

Table 2: Study Cycle Requests Evaluated

Project	TO	SP Capacity (MW)	WP Capacity (MW)	Fuel Type	POI
GEN-2023-015	SPS	330	330	Solar	Finney-Carpenter 345 KV line
GEN-2023-033	Evergy	200	200	Battery Storage	Liberty South 161 kV Substation
GEN-2023-034	Evergy	130	130	Solar	Clear Water - Waco 138 kV line
GEN-2023-035	WFEC	200	200	Solar	Cleveland - Amber Tap 138 kV Line
GEN-2023-037	KACY	200	200	Battery Storage	Nearman 161 kV Substation
GEN-2023-038	OGE	200	200	Solar	Lula 138 kV Substation
GEN-2023-055	GRDA	100	100	Battery Storage	Kerr Grove 161 kV
GEN-2023-057	GRDA	150	150	Battery Storage	Pawnee Switch 138 kV
GEN-2023-059	AEP	200	200	Hybrid	Tap Rockhill to South Shreveport 138 kV line
GEN-2023-061	SWPA	100	100	Battery Storage	Carthage 161 kV Substation
GEN-2023-063	AEP	135	135	Hybrid	Catoosa - Owasso 88th 138 kV line
GEN-2023-064	SWPA	200	200	Hybrid	RS Kerr-Stigler 161 kV line
GEN-2023-069	WFEC	100	100	Hybrid	Tupelo - Atoka 138 kV Line
GEN-2023-077	OPPD	235	255	Thermal	Substation 3740 345 kV
GEN-2023-078	OPPD	235	255	Thermal	Substation 3740 345 kV
GEN-2023-079	OPPD	258	303	Thermal	Substation 3740 345 kV
GEN-2023-088	WFEC	117	117	Wind	Pharaoh 138 kV Substation
GEN-2023-092	WFEC	125	125	Hybrid	Unger - Frogville 138 kV line
GEN-2023-099	Evergy	300	300	Solar	Jeffery Energy Center 345 kV Substation
GEN-2023-102	OGE	475	475	Hybrid	Degrasse 345 kV Substation
GEN-2023-132	SWPA	150	150	Solar	Jonesboro - Independence 161 kV
GEN-2023-170	Evergy	150	150	Battery Storage	Salisbury 161 kV Substation
GEN-2023-171	INDN	150	150	Battery Storage	Sub M 161 kV Substation
GEN-2023-177	OGE	200	200	Solar	Paoli - Seminole 138 kV line tap
GEN-2023-193	AEP	175	175	Hybrid	Pirkey - Whitney 138 kV Line

Project	TO	SP Capacity (MW)	WP Capacity (MW)	Fuel Type	POI
GEN-2023-199	NPPD	250	250	Hybrid	Twin Church 230 kV Substation
GEN-2023-204	AEP	960	960	Thermal	Welsh-Lydia 345kV Line
GEN-2023-205	AEP	180	180	Solar	McAlester City - Weleetka 138 kV line
GEN-2023-206	OGE	50	50	Battery Storage	Battlefield BESS 161 kV Substation
GEN-2023-210	WFEC	191	191	Solar	Prague - Chernicky 138 kV Line
GEN-2023-220	Evergy	250	250	Solar	Emporia Energy Center - Swissvale 345 kV Line
GEN-2023-221	Evergy	250	250	Solar	Emporia Energy Center - Swissvale 345 kV Line
GEN-2023-222	NPPD	478	478	Thermal	New Beatrice Power Station 345 kV
GEN-2023-223	NPPD	239	239	Thermal	New Beatrice Power Station 345 kV
GEN-2023-224	NPPD	478	478	Thermal	Olive Creek 345 kV Substation
GEN-2023-225	NPPD	217	217	Thermal	Olive Creek 345 kV Substation
GEN-2023-229	AEP	230	230	Wind	Southwestern Power Station 138 kV Substation (SWS4)
GEN-2023-241	AEP	93	93	Solar	Winnsboro 138 kV Substation

Network upgrades from the following studies were added to models prior to the addition of the Study Cycle requests:

- Network Upgrades from AECI Expansion Plan
- Network Upgrades from SPP ITP requests
- MISO Tranche 1 System Upgrades
- Network Upgrades from AECI's AFS of SPP DISIS-2017-002 requests
- Network Upgrades from AECI's AFS of MISO DPP-2019-Cycle requests
- Network Upgrades from AECI GI-083 request
- Network Upgrades from AECI GI-101/102 request
- Network Upgrades from AECI GI-103 request
- Network Upgrades from AECI GI-104 request

The Network Upgrades included from these requests are detailed in Table 6 or Appendix A. 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 2023-001 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 four (4) constraints reported on the AECI transmission system, as shown in Table 3, 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 5 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 3.

Table 3: 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	300098 5MOCITYB2 161.00 541248 LBRTYST5 161.00 1	OPEN LINE FROM BUS 301563 [5MOCITYB1 161.00] TO BUS 548808 [ECKLES-161 161.00] CKT 1	28L	96.5	110.3	66.2
NU02	P0	301553 4WELEETKA 138.00 521026 PHAROAH4 138.00 1	BASE CASE	28L	84.0	114.6	61.4
	P1		OPEN LINE FROM BUS 300137 [4BRISTOW 138.00] TO BUS 300140 [4SILVCTY 138.00] CKT 1	28L	91.6	119.7	75.0
NU03	P1	301369 4REMNGTON 138.00 510403 SHIDLER4 138.00 1	OPEN LINE FROM BUS 512710 [KINZEGR4 138.00] TO BUS 515008 [KINZE 4 138.00] CKT 1	28S	82.0	104.6	57.2
				33S	80.5	103.3	56.5
NU04[1]	P1	301201 2DONIPH 69.000 505440 DONIPHN5 161.00 1	OPEN LINE FROM BUS 301201 [2DONIPH 69.000] TO BUS 505440 [DONIPHN5 161.00] CKT 2	28S	124.9	129.7	94.3
				28W	113.2	119.7	84.7
				33S	121.2	129.4	95.9
				33W	113.3	116.6	85.7

[1] Upgrade Loading with transformer tap adjustments applied.

CONTINGENT FACILITY RESULTS

One (1) facility, in addition to those detailed in Appendix A, was reported as a Contingent Facility with the addition of the Study Cycle requests, as shown in Table 4. 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 constraint as listed in Table 4 below.

Table 4: 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	P2EHV	300084 5GRNFRT 161.00 300115 5STFRANB2 161.00 1	28S	102.7	106.3	80.7	DPP-2021 (South)
			33S	104.2	107.6	81.7	

NEIGHBORING SYSTEM RESULTS

The Study has identified no impacts from the Study Cycle requests on the AECI ties with neighboring systems.

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 3.

Table 5: Network Upgrades for the Study Cycle Constraints

ID	Monitored Facility	Option/Description
NU00A	Stigler 161 kV Station Modifications	Modification to Stigler 161 kV station required for GEN-2023-064 to interconnect on RS Kerr-Stigler 161 kV line.
NU01	300098 5MOCITYB2 161.00 541248 LBRTYST5 161.00 1	On MO City-Liberty 161 kV line, upgrade bus work and wavetrap at MO City to 2000 amp minimum.
NU02	301553 4WELEETKA 138.00 521026 PHAROAH4 138.00 1	Rebuild 0.4 mile long 138 kV line from Weleetka-Pharoah to 1590 ACSR at 100C and upgrade jumpers at Weleetka to 1590 ACSR. Replace Breaker Switchers, Disconnect Switches, Bushing CTs, CTs on line at Weleetka with 2000 amp equipment.
NU03	301369 4REMNGTON 138.00 510403 SHIDLER4 138.00 1	Rebuild 795 section of Remington-Shidler (3.4 miles) to 1192 ACSR at 100C. At Remington, replace jumpers with 1192 ACSR, upgrade relay limits to 1600A minimum.
NU04	301201 2DONIPH 69.000 505440 DONIPHN5 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 4.

Table 6: Contingent Facilities for the Study Cycle Constraints

Constraint ID	Monitored Facility	Option/Description
-	300045 7MORGAN 345.00 301622 5MORGANXF1 161.00 1	**Contingent on SPP Project from 2024 ITP.** - Tap the 345 kV line between Brookline and Flint Creek with a new Monett 345 kV station. - Build a new 345 kV line between Monett 345 kV and Delaware 345 kV. - Build a new 345 kV line between Delaware 345 kV and Buffalo 345 kV. - Install a new 345/161 kV transformer at the Monett 345 kV station. - Cut the Compton-Roark 161 kV in and out of the Monett 161 kV station. - Cut the Branson-Reeds Spring 161 kV line in and out of the Monett 161 kV station. - Cut the Cape Fair-Nixa 161 kV line in and out of the Monett 161 kV station. - Install a reactor at the new 345 kV Monett bus.
-	300101 5MORGAN 161.00 505498 STOCKTN5 161.00 1	
-	300069 5CHOTEAU1 161.00 512648 MAID 5 161.00 1	**Contingent on SPP DISIS-2017-002** - Construct a new 161 kV switch yard (Patrol Road) on the Maid-Gerald 161 kV line ~1 mile from Maid. (GRDA SCOPE) - Replace (4) 69 kV switches and associated jumpers/hardware at Afton Substation. (GRDA Scope) - Construct a new 0.8 mile long 161 kV line from Chouteau-Patrol Road switch yard. Construct as double bundle 1590 ACSR at 100C. - Assume series reactor installed on line to match impedance of reactor on existing Chouteau-Maid line. (5 ohm, 12.263 mH via MANTIS). - All terminal equipment/reactors rated for 4,000 amps. - Add 4,000 amp breaker and associated equipment to the existing Chouteau-Maid line at Chouteau. - Add a 161 kV terminal and associated equipment at Chouteau for the new 161 kV line to Patrol Road. - Upgrade Chouteau West Yard E-W bus from 5" to 6" bus.
-	300740 7SPORTSMAN 345.00 300741 5SPORTSMAN 161.00 1	
-	300740 7SPORTSMAN 345.00 300741 5SPORTSMAN 161.00 2	

Constraint ID	Monitored Facility	Option/Description
-	300323 2CENTRV 69.000 300336 2HOLDEN 69.000 1	**Contingent on AECI** -Construct a Golden Valley 345/161 kV substation and install a 345/161 kV transformer. -Install 345/161 kV transformers at Barnett and Golden Valley. -Install 345 kV circuit from Overton-Barnett with 1793 MVA. -Install 345 kV double circuit from Golden Valley-Barnett with 1576 MVA. -Install 345 kV double circuit from Golden Valley-Stillwell with 1576 MVA. -Install 345 kV circuit from Barnett-Loose Creek with 1224 MVA. -At Golden Valley 161 kV, reroute Windsor and Truman Dam 161 kV lines from Clinton to Golden Valley. -Install 2 161 kV lines from Golden Valley to Clinton.
-	300520 2REFORM 69.000 300626 2CHAMOI 69.000 1	
-	300541 2SEDALI 69.000 300545 2SYLVAN 69.000 1	**Contingent on MISO Tranche 1** - Rebuild 69 kV 6.31 mile long line from Coffman Bend - J-7 to 795 ACSR rated at 100C. - Rebuild 69 kV 4.69 mile long line from Coffman Bend - Knobby to 795 ACSR rated at 100C. - Rebuild 69 kV 12.1 mile long line from Knobby - Turkey Creek to 795 ACSR rated at 100C.
CF01	300084 5GRNFRT 161.00 300115 5STFRANB2 161.00 1	**Contingent on MISO DPP-2021 (South)** - Rebuild 24.0 mi Green Forest - St. Francis 161 kV line with 1192 ACSS at 250C. - Upgrade jumpers at St. Francis and Green Forest to 1192 ACSS.

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 7.

Table 7: Network Upgrade Costs

ID	Option/Description	Estimated Cost	Estimated Lead Time
NU00A	Modification to Stigler 161 kV station required for GEN-2023-064 to interconnect on RS Kerr-Stigler 161 kV line.	$ 350,000	30 months
NU01	On MO City-Liberty 161 kV line, upgrade bus work and wavetrap at MO City to 2000 amp minimum.	$ 662,000	48 months
NU02	Rebuild 0.4 mile long 138 kV line from Weleetka-Pharoah to 1590 ACSR at 100C and upgrade jumpers at Weleetka to 1590 ACSR. Replace Breaker Switchers, Disconnect Switches, Bushing CTs, CTs on line at Weleetka with 2000 amp equipment.	$ 2,575,000	48 months
NU03	Rebuild 795 section of Remington-Shidler (3.4 miles) to 1192 ACSR at 100C. At Remington, replace jumpers with 1192 ACSR, upgrade relay limits to 1600A minimum.	$ 3,545,000	48 months
NU04	Overload reported able to be mitigated with the adjustments of transformer taps; no upgrade required.	-	-
	Total Cost:	$ 7,132,000	

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[2] 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:

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

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

The associated cost allocation of the network upgrades to each of the Study Cycle projects is shown below in Table 8. Further breakdown of costs is provided in Appendix B and Appendix C.

Table 8: Network Upgrade Cost Allocation

Project	Cluster Group	POI	MW	Total
GEN-2023-015	03 CENTRAL	Finney-Carpenter 345 KV line	330	$ -
GEN-2023-033	03 CENTRAL	Liberty South 161 kV Substation	200	$ -
GEN-2023-034	03 CENTRAL	Clear Water - Waco 138 kV line	130	$ -
GEN-2023-035	04 SOUTHEAST	Cleveland - Amber Tap 138 kV Line	200	$ -
GEN-2023-037	03 CENTRAL	Nearman 161 kV Substation	200	$ -
GEN-2023-038	04 SOUTHEAST	Lula 138 kV Substation	200	$ -
GEN-2023-055	04 SOUTHEAST	Kerr Grove 161 kV	100	$ -
GEN-2023-057	04 SOUTHEAST	Pawnee Switch 138 kV	150	$ 3,259,271
GEN-2023-059	04 SOUTHEAST	Tap Rockhill to South Shreveport 138 kV line	200	$ -
GEN-2023-061	03 CENTRAL	Carthage 161 kV Substation	100	$ -
GEN-2023-063	04 SOUTHEAST	Catoosa - Owasso 88th 138 kV line	135	$ -
GEN-2023-064	04 SOUTHEAST	RS Kerr-Stigler 161 kV line	200	$ 350,000
GEN-2023-069	04 SOUTHEAST	Tupelo - Atoka 138 kV Line	100	$ -
GEN-2023-077	02 NEBRASKA	Substation 3740 345 kV	235	$ 56,845
GEN-2023-078	02 NEBRASKA	Substation 3740 345 kV	235	$ 56,845
GEN-2023-079	02 NEBRASKA	Substation 3740 345 kV	258	$ 62,408
GEN-2023-088	04 SOUTHEAST	Pharaoh 138 kV Substation	117	$ 1,811,446
GEN-2023-092	04 SOUTHEAST	Unger - Frogville 138 kV line	125	$ -
GEN-2023-099	03 CENTRAL	Jeffery Energy Center 345 kV Substation	300	$ -
GEN-2023-102	04 SOUTHEAST	Degrasse 345 kV Substation	475	$ -
GEN-2023-132	04 SOUTHEAST	Jonesboro - Independence 161 kV	150	$ -
GEN-2023-170	03 CENTRAL	Salisbury 161 kV Substation	150	$ 138,590
GEN-2023-171	03 CENTRAL	Sub M 161 kV Substation	150	$ -
GEN-2023-177	04 SOUTHEAST	Paoli - Seminole 138 kV line tap	200	$ -
GEN-2023-193	04 SOUTHEAST	Pirkey - Whitney 138 kV Line	175	$ -
GEN-2023-199	02 NEBRASKA	Twin Church 230 kV Substation	250	$ 62,919
GEN-2023-204	04 SOUTHEAST	Welsh-Lydia 345kV Line	960	$ 224,379
GEN-2023-205	04 SOUTHEAST	McAlester City - Weleetka 138 kV line	180	$ 147,172
GEN-2023-206	04 SOUTHEAST	Battlefield BESS 161 kV Substation	50	$ -
GEN-2023-210	04 SOUTHEAST	Prague - Chernicky 138 kV Line	191	$ 677,731
GEN-2023-220	03 CENTRAL	Emporia Energy Center - Swissvale 345 kV Line	250	$ -
GEN-2023-221	03 CENTRAL	Emporia Energy Center - Swissvale 345 kV Line	250	$ -
GEN-2023-222	02 NEBRASKA	New Beatrice Power Station 345 kV	478	$ 88,988
GEN-2023-223	02 NEBRASKA	New Beatrice Power Station 345 kV	239	$ 44,494
GEN-2023-224	02 NEBRASKA	Olive Creek 345 kV Substation	478	$ 103,792

Project	Cluster Group	POI	MW	Total
GEN-2023-225	02 NEBRASKA	Olive Creek 345 kV Substation	217	$ 47,119
GEN-2023-229	04 SOUTHEAST	Southwestern Power Station 138 kV Substation (SWS4)	230	$ -
GEN-2023-241	04 SOUTHEAST	Winnsboro 138 kV Substation	93	$ -
			Total Cost	$ 7,132,000

VERSION HISTORY

Version	Change Description
V0 – 12/19/2024	Initial release
V1 – 06/11/2026	Withdrawal of seventy-four (74) SPP requests from Study Cycle Withdrawal of MISO, SPP, and AECI higher queued requests