SPP DISIS 2017-001 AFS STUDY REPORT

INTRODUCTION

Associated Electric Cooperative Inc. (AECI), through coordination with the Southwest Power Pool (SPP), has updated the analysis for generator interconnection requests (GIRs) within the DISIS 2017-001 Study Cycle (the "Study Cycle") for an Affected System Study (AFS) evaluation on the AECI transmission system (the "Study"). The restudy has been conducted to include the withdrawal of the thirteen (13) SPP Study Cycle requests as listed Table 1 below.

Table 1: Withdrawn Study Cycle Requests

Project #	CA	Capacity (MW)	Service Type	Fuel Type	POI	Cluster Group
GEN-2017-030	KCPL	200.0	ER	Wind	Eastown - Iatan 345kV	13 - Northeast Kansas/Northwest Missouri
GEN-2017-008	NPPD	305.0	ER	Solar	Pauline 345kV Substation	09 - Nebraska
GEN-2017-055	LES	228.3	ER/NR	Solar	Wagener 115 kV Sub	09 - Nebraska
GEN-2016-159	NPPD	427.8	ER	Wind	Hoskins 345kV	09 - Nebraska
GEN-2016-103	WAPA	240.0	ER	Wind	Chappelle Creek 345kV	15 - Eastern South Dakota
GEN-2017-065	AEPW	200.3	ER/NR	Solar	Oklaunion 345 kV sub	06 - South Texas Panhandle/New Mexico
GEN-2017-026	SWPS	235.0	ER/NR	Wind	Tolk 230kV	06 - South Texas Panhandle/New Mexico
GEN-2017-080	SWPS	525.0	ER	Solar	Tolk 230 kV substation	06 - South Texas Panhandle/New Mexico
GEN-2017-039	SWPS	200.1	ER	Wind	Needmore 230 kV sub	06 - South Texas Panhandle/New Mexico
GEN-2017-078	SWPS	220.0	ER/NR	Wind	Eddy County-Tolk (Crossroads) 345kV	06 - South Texas Panhandle/New Mexico
GEN-2017-104	SWPS	240.0	ER/NR	Solar	Hobbs 230kV Substation	06 - South Texas Panhandle/New Mexico
GEN-2016-172	SWPS	231.0	ER	Wind	Newhart 115kV	06 - South Texas Panhandle/New Mexico
GEN-2017-007	SWPS	297.5	ER	Wind	Pleasant Hill 230 kV sub	06 - South Texas Panhandle/New Mexico

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

Table 2: Study Cycle Requests Evaluated

Project #	CA	Capacity (MW)	Service Type	Fuel Type	POI	Cluster Group
GEN-2017-090	KCPL	150.0	ER	Solar	Adrian 161 kV sub	13 - Northeast Kansas/Northwest Missouri
GEN-2017-009	WERE	302.0	ER	Wind	Neosho - Caney River 345 kV	08 - North Oklahoma/South Central Kansas
GEN-2017-061	GRDA	101.5	ER/NR	Solar	GRDA1 to CLARMR 5 161kV line	08 - North Oklahoma/South Central 1Kansas
GEN-2017-005	WERE	190.0	ER	Wind	Marmaton - Litchfield 161 kV	08 - North Oklahoma/South Central Kansas
GEN-2017-060	EDE	149.4	ER	Wind	LaRussell Energy Center 161kV	12 - Northwest Arkansas
GEN-2017-073	GRDA	72.5	ER	Solar	Dry Gulch 161kV sub	08 - North Oklahoma/South Central Kansas

Project #	CA	Capacity (MW)	Service Type	Fuel Type	POI	Cluster Group
GEN-2017-022	WERE	65.0	ER/NR	Solar	Altoona- NE Parson 138kV	08 - North Oklahoma/South Central Kansas
GEN-2017-076	AEPW	52.2	ER	Solar	Chamber Springs 161kV sub	12 - Northwest Arkansas
GEN-2017-074	AEPW	72.5	ER	Solar	Pryor Junction 138kV sub	08 - North Oklahoma/South Central Kansas
GEN-2017-082	EDE	149.4	ER	Wind	Asbury Plant 161 kV	12 - Northwest Arkansas
GEN-2017-092	OKGE	200.0	ER	Solar	Canadian River-Muskogee and Muskogee-Seminole 345kV	08 - North Oklahoma/South Central Kansas
GEN-2017-077	AEPW	124.7	ER	Solar	Explorer Claremore Tap EXCLART4	08 - North Oklahoma/South Central Kansas
GEN-2017-086	WERE	150.0	ER/NR	Wind	Viola 345kV	08 - North Oklahoma/South Central Kansas
GEN-2017-018	SUNC	189.0	ER/NR	Solar	Thistle 345 kV sub	03 - Spearville
GEN-2017-040	OKGE	200.1	ER	Solar	Canadian River-Muskogee and Muskogee-Seminole 345kV	08 - North Oklahoma/South Central Kansas
GEN-2017-071	OKGE	124.7	ER	Solar	Greenwood 138kV sub	08 - North Oklahoma/South Central Kansas
GEN-2017-072	OKGE	52.2	ER	Solar	Greenwood 138kV sub	08 - North Oklahoma/South Central Kansas
GEN-2017-075	OKGE	200.0	ER	Solar	Hugo-Sunnyside 345 kV	14 - South Central Oklahoma
GEN-2016-037	AEPW	300.0	ER	Wind	Chisholm-Gracemont 345kV	07 - Southwestern Oklahoma
GEN-2017-004	SUNC	201.6	ER	Wind	Elm Creek - Summit 345 kV	04 - Northwest Kansas
GEN-2017-094	WAPA	200.0	ER/NR	Wind	Fort Thompson-Huron 230 kV	15 - Eastern South Dakota
GEN-2017-027	OKGE	140.0	ER	Wind	Pooleville-Ratliff (Carter County) 138kV	14 - South Central Oklahoma
GEN-2017-014	WAPA	300.0	ER/NR	Wind	Underwood - Philip Tap 230 kV[1]	17 - Western South Dakota
GEN-2017-033	AEPW	200.0	ER/NR	Wind	Oklaunion 345 kV sub	06 - South Texas Panhandle/New Mexico
GEN-2017-064	WAPA	110.0	ER/NR	Solar	Underwood - Wayside 230 kV	17 - Western South Dakota
GEN-2017-097	WAPA	128.0	ER	Solar	Underwood 115 kV Sub	17 - Western South Dakota
GEN-2017-048	BEPC	300.0	ER	Wind	Neset 230 kV Substation	16 - Western North Dakota
GEN-2017-010	WAPA	200.1	ER	Wind	Rhame 230 kV Sub	16 - Western North Dakota

The results of the analysis for the Study Cycle requests are included below. Network upgrades and cost allocations are subject to change in accounting for any withdraws of equally queued or higher queued requests included in this Study.

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

[1] Point of Interconnection (POI) has since changed to Phillip Tap 230 kV, this change will be reflected in future restudies for this cluster.

power flow models for the steady state analysis was modified to include appropriate higher-queued generation interconnection requests at the level of dispatch consistent with requirements of the service type requested as defined in AECI's GI Study Guidelines document. The direct connection network upgrades for MISO higher queued requests J1488 and J1490, as identified through their merchant HVDC requests H104 and H105, were included in the models:

- New J1145 – Montgomery 345 kV double circuit (2 and 3, Ameren facilities)

Modeling parameters in the SPP DISIS 2017-001 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-001-4 Planning Standard Table I 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 projects, 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. All improvements were developed and studied in coordination with AECI.

STEADY STATE ANALYSIS RESULTS

Steady state analysis results showed four (4) new thermal violations on the AECI system due to the addition of the Study Cycle projects as shown in Table 3.

Table 3: Steady State Constraints for the Study Cycle

Constraint ID	Event	Monitored Facility	Contingency	Season	Rating (MVA)	Base Loading	Project Loading
NU01	P2EHV	300740 7SPORTSMAN 345.00 300741 5SPORTSMAN 161.00 1	OPEN BRANCH FROM BUS 300741 [5SPORTSMAN 161.00] TO BUS 300740 [7SPORTSMAN 345.00] CKT 2 OPEN BRANCH FROM BUS 300739 [7BLACKBERRY 345.00] TO BUS 300740 [7SPORTSMAN 345.00] CKT 1	25H	500	97.3	101.9
				25L		101.8	106.1
NU02	P2EHV	300740 7SPORTSMAN 345.00 300741 5SPORTSMAN 161.00 2	OPEN BRANCH FROM BUS 300739 [7BLACKBERRY 345.00] TO BUS 300740 [7SPORTSMAN 345.00] CKT 1 OPEN BRANCH FROM BUS 300741 [5SPORTSMAN 161.00] TO BUS 300740 [7SPORTSMAN 345.00] CKT 1	25H	500	97.3	101.9
				25L		101.8	106.1
NU03	P2EHV	301251 2VANDSR 69.000 301255 2MORLEY 69.000 1	OPEN BRANCH FROM BUS 300038 [7ESSEX 345.00] TO BUS 301407 [7WNWMADRID1A345.00] CKT 1 OPEN BRANCH FROM BUS 300038 [7ESSEX 345.00] TO BUS 344974 [7LUTESVIL 345.00] CKT 1 OPEN BRANCH FROM BUS 301407 [7WNWMADRID1A345.00] TO BUS 301416 [7WNWMADRID1B345.00] CKT Z1 OPEN BRANCH FROM BUS 300075 [5ESSEX 161.00] TO BUS 300038 [7ESSEX 345.00] CKT 1 OPEN BRANCH FROM BUS 300075 [5ESSEX 161.00] TO BUS 505434 [IDALIA 5 161.00] CKT 1 OPEN BRANCH FROM BUS 300075 [5ESSEX 161.00] TO BUS 301533 [5ESSEXGSU1 161.00] CKT 1 OPEN BRANCH FROM BUS 300075 [5ESSEX 161.00] TO BUS 345791 [5STODDARD 2 161.00] CKT 1	30S	35	106.1	109.2
NU04	P1	300101 5MORGAN 161.00 300782 2MORGAN 69.000 1	OPEN LINE FROM BUS 300774 [2EUDORA 69.000] TO BUS 300788 [2SLAGLE 69.000] CKT 1	25L	56	104.8	109.3

CONTINGENT FACILITY RESULTS

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 would otherwise be the responsibility of the Study Cycle requests as necessary to interconnect to the transmission system.

Eleven (11) facilities were reported as Contingent Facilities with the addition of the Study Cycle requests. The most severe constraints are shown in Table 4.

Table 4: Steady State Contingent Constraints for the Study Cycle

Constraint ID	Event	Monitored Facility	Season	Rating (MVA)	Base Loading	Project Loading	Contingent Generator(s)
CF01	P0	300774 2EUDORA 69.000 300788 2SLAGLE 69.000 1	25H	51	100.1	104.3	GI-088
			25S		96.8	101.3	
			30S		97.3	101.6	
	P2EHV		25H		122.7	129.4	
			25L		109.6	116.5	
			25S		108.9	113.7	
			30S		110.4	114.7	
CF02	P1	300061 5BOONE 161.00 300519 5MLRSBGB1 161.00 1	30S	285	96.8	100.1	MISO DPP 2019
	P2EHV		30S		100.5	104.8	
CF03	P1	300090 5KINGDMB1 161.00 301498 5MLRSBGB2 161.00 1	30S	285	100.4	103.7	GI-083
	P2EHV		30S		104.1	108.4	
CF04	P1	300124 5HOLDENB2 161.00 300336 2HOLDEN 69.000 1	25S	56	156.7	161.8	MISO DPP 2019
			25W	63	140.7	144.0	
			30S	56	161.5	166.0	
CF05	P1	300173 2GOBKNOB 69.000 301218 2PBSOUTH 69.000 1	25L	35	102.7	105.7	MISO DPP 2019
	P2EHV		25L		104.3	107.6	
CF06	P1	300199 2HALE 69.000 300201 2INGROV 69.000 1	25S	35	116.5	120.8	MISO DPP 2019
	P2EHV		30S		96.3	101.9	
CF07	P1	300327 2ELM 69.000 300336 2HOLDEN 69.000 1	25S	51	99.6	107.1	MISO DPP 2019
			30S		103.3	110.3	
CF08	P1	300519 5MLRSBGB1 161.00 301498 5MLRSBGB2 161.00 Z1	30S	285	100.4	103.7	GI-083
	P2EHV		30S		104.1	108.4	

Constraint ID	Event	Monitored Facility	Season	Rating (MVA)	Base Loading	Project Loading	Contingent Generator(s)
CF09	P1	301168 2MANSFL 69.000 301174 2SEYMOR 69.000 1	25L	35	109.8	117.2	GI-085, GI-088[2]
CF10	P2EHV	301209 2HARVEL 69.000 301218 2PBSOUTH 69.000 1	25L	35	101.1	104.5	GI-084
CF11	P1	300194 2CHILLI 69.000 300218 5CHILLIS 161.00 1	25S	56	123.8	128.1	MISO DPP 2019
			30S		129.4	133.6	

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 will need to be coordinated with the appropriate transmission owner.

Three (3) facilities were reported on the AECI ties with the addition of the Study Cycle requests. The most severe constraints are shown in Table 5.

Table 5: Steady State Neighboring System Constraints for the Study Cycle Requests

Constraint ID	Event	Monitored Facility	Contingency	Area	Season	Rating (MVA)	Base Loading	Project Loading
AFS01	P1	300044 7MCCRED 345.00 345408 7OVERTON 345.00 1	OPEN LINE FROM BUS 40264 [J1026 POI 345.00] TO BUS 345435 [7MAYWOOD 345.00] CKT 1	AECI/AMMO	30S	956	96.7	100.2
	P2EHV		OPEN BRANCH FROM BUS 345435 [7MAYWOOD 345.00] TO BUS 636645 [SUB T HSK 3 345.00] CKT 1 OPEN BRANCH FROM BUS 40264 [J1026 POI 345.00] TO BUS 345435 [7MAYWOOD 345.00] CKT 1	AECI/AMMO	30S	956	97.3	100.8

[2] Mansfield – Seymour was previously assigned as contingent upon GI-085 and GI-088. During the course of the analysis, GI-068 withdrew from the AECI queue. AECI is currently revisiting active GIs who may be impacted by the withdrawal of GI-068. As a result of this withdrawal, the upgrade of Mansfield-Seymour is no longer assigned to GI-085. AECI is currently evaluating how this withdrawal will impact GI-088. Resolution of the assignment of this contingent facility will be provided in future restudies.

Constraint ID	Event	Monitored Facility	Contingency	Area	Season	Rating (MVA)	Base Loading	Project Loading
AFS02	P1	300194 2CHILLI 69.000 300232 2MPSLAR 69.000 1	OPEN BRANCH FROM BUS 300068 [5CHILLIN 161.00] TO BUS 300087 [5HICKCK 161.00] CKT 1	AECI/KCPL	30S	31	102.2	108.6
AFS03	P1	300232 2MPSLAR 69.000 300233 2MPSTRE 69.000 1	OPEN BRANCH FROM BUS 300068 [5CHILLIN 161.00] TO BUS 300087 [5HICKCK 161.00] CKT 1	AECI/KCPL	30S	31	97.6	104

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

Table 6: Network Upgrades for the Study Cycle Constraints

Constraint ID	Monitored Facility	Network Upgrade
NU01	300740 7SPORTSMAN 345.00 300741 5SPORTSMAN 161.00 1	Replace Sportsman 161/345 kV transformer #1 with 625/712 MVA transformer[3]
NU02	300740 7SPORTSMAN 345.00 300741 5SPORTSMAN 161.00 2	Replace Sportsman 161/345 kV transformer #2 with 625/712 MVA transformer[3]
NU03	301251 2VANDSR 69.000 301255 2MORLEY 69.000 1	Rebuild 2.6-mile-long Vanduser-Morley 69 kV line to 336 ACSR at 100C
NU04	300101 5MORGAN 161.00 300782 2MORGAN 69.000 1	Adjustment of transformer taps able to mitigate overload, no upgrade evaluated

The upgrades shown in Table 7 were evaluated in order to mitigate the reported steady state contingent constraints for the Study Cycle as listed in Table 4.

Table 7: Network Upgrades for the Study Cycle Contingent Constraints

Constraint ID	Monitored Facility	Network Upgrade
CF01	300774 2EUDORA 69.000 300788 2SLAGLE 69.000 1	Contingent on GI-088 Rebuild 9.9 mile-long line to 795 ACSR at 100C
CF02	300061 5BOONE 161.00 300519 5MLRSBGB1 161.00 1	Contingent on MISO DPP 2019 Rebuild 9.36 mile-long line to 1272 ACSR at 100C Replace jumpers at Boone and Millersburg 161 kV buses to 1192 ACSR at 100C
CF03	300090 5KINGDMB1 161.00 301498 5MLRSBGB2 161.00 1	Contingent on GI-083 Rebuild 8.07 mile-long line to 795 ACSS at 250C
CF04	300124 5HOLDENB2 161.00 300336 2HOLDEN 69.000 1	Contingent on MISO DPP 2019 Replace Holden 161/69 kV transformer 1 with 112 MVA unit
CF05	300173 2GOBKNOB 69.000 301218 2PBSOUTH 69.000 1	Contingent on MISO DPP 2019 Rebuild 4.36 mile-long line to 336 ACSR at 100C
CF06	300199 2HALE 69.000 300201 2INGROV 69.000 1	Contingent on MISO DPP 2019 Rebuild 10.9 mile-long 4/0 section of line to 336 ACSR at 100C
CF07	300327 2ELM 69.000 300336 2HOLDEN 69.000 1	Contingent on MISO DPP 2019 Use of Holden Operating Guide unable to mitigate overload Uprate 3.1 mile-long segment of 336 ACSR at 75C to 100C
CF08	300519 5MLRSBGB1 161.00 301498 5MLRSBGB2 161.00 Z1	Contingent on GI-083 Upgrade Millersburg 161 kV bus tie jumpers to 1590 ACSR at 100C
CF09	301168 2MANSFL 69.000 301174 2SEYMOR 69.000 1	Contingent on GI-085, GI-088 Rebuild 8.3 mile-long line to 336 ACSR at 100C
CF10	301209 2HARVEL 69.000 301218 2PBSOUTH 69.000 1	Contingent on GI-084 Uprate 2.34 mile-long 4/0 portion of line from 75C to 100C
CF11	300194 2CHILLI 69.000 300218 5CHILLIS 161.00 1	Contingent on MISO DPP 2019 Replace Chillicothe 161/69 kV transformer 1 with 84 MVA unit With larger unit, adjustment of transformer taps also required to mitigate overload

[3] The Network Upgrade shown may change in a future report refresh as alternative solutions are being evaluated in conjunction with GRDA.

No upgrades were evaluated for the neighboring system constraints listed in Table 5. The upgrades for these impacts will need to be resolved through coordination with the transmission owner as listed in Table 8 below.

Table 8: Neighboring System Constraints

Constraint ID	Monitored Facility	Network Upgrade
AFS01	300044 7MCCRED 345.00 345408 7OVERTON 345.00 1	Ameren owned line - coordination with MISO required, no upgrade evaluated
AFS02	300194 2CHILLI 69.000 300232 2MPSLAR 69.000 1	Evergy owned line - coordination with SPP required, no upgrade evaluated
AFS03	300232 2MPSLAR 69.000 300233 2MPSTRE 69.000 1	Evergy owned line - coordination with SPP required, no upgrade evaluated

Simulations were performed on each of the scenarios with the identified network upgrade and contingent network upgrades included. Results from the simulations found that the network upgrades were able to mitigate the reported overload conditions as shown in Table 9 below.

Table 9: Steady State Results with Upgrades

Constraint ID	Event	Monitored Facility	Season	Rating (MVA)	Base Loading (%MVA)	Project Loading (%MVA)	Mitigation Loading (%MVA)
NU01	P2EHV	300740 7SPORTSMAN 345.00 300741 5SPORTSMAN 161.00 1	25H	500	97.3	101.9	83.4
			25L	500	101.8	106.1	86.9
NU02		300740 7SPORTSMAN 345.00 300741 5SPORTSMAN 161.00 2	25H	500	97.3	101.9	83.4
			25L	500	101.8	106.1	86.9
NU03		301251 2VANDSR 69.000 301255 2MORLEY 69.000 1	30S	35	106.1	109.2	55.8
NU04	P1	300101 5MORGAN 161.00 300782 2MORGAN 69.000 1	25L	56	104.8	109.3	96.4*
CF01	P0	300774 2EUDORA 69.000 300788 2SLAGLE 69.000 1	25H	51	100.1	104.3	46.3
			25S	51	96.8	101.3	45.0
			30S	51	97.3	101.6	45.1
	P2EHV		25H	51	122.7	129.4	57.5
			25L	51	109.6	116.5	51.6
			25S	51	108.9	113.7	50.5
			30S	51	110.4	114.7	51.1
CF02	P1	300061 5BOONE 161.00 300519 5MLRSBGB1 161.00 1	30S	285	96.8	100.1	77.2
	P2EHV		30S	285	100.5	104.8	81.4
CF03	P1	300090 5KINGDMB1 161.00 301498 5MLRSBGB2 161.00 1	30S	285	100.4	103.7	89.1
	P2EHV		30S	285	104.1	108.4	93.8
CF04	P1	300124 5HOLDENB2 161.00 300336 2HOLDEN 69.000 1	25S	56	156.7	161.8	87.8
			25W	63	140.7	144.0	77.7
			30S	56	161.5	166.0	90.1
CF05		300173 2GOBKNOB 69.000 301218 2PBSOUTH 69.000 1	25L	35	102.7	105.7	55.5
	P2EHV		25L	35	104.3	107.6	56.2

Constraint ID	Event	Monitored Facility	Season	Rating (MVA)	Base Loading (%MVA)	Project Loading (%MVA)	Mitigation Loading (%MVA)
CF06	P1	300199 2HALE 69.000 300201 2INGROV 69.000 1	25S	35	116.5	120.8	52.3
	P2EHV		30S	35	96.3	101.9	53.4
CF07	P1	300327 2ELM 69.000 300336 2HOLDEN 69.000 1	25S	51	99.6	107.1	85.6
			30S	51	103.3	110.3	88.0
CF08		300519 5MLRSBGB1 161.00 301498 5MLRSBGB2 161.00 Z1	30S	285	100.4	103.7	68.3
	P2EHV		30S	285	104.1	108.4	71.8
CF09	P1	301168 2MANSFL 69.000 301174 2SEYMOR 69.000 1	25L	35	109.8	117.2	64.3
CF10	P2EHV	301209 2HARVEL 69.000 301218 2PBSOUTH 69.000 1	25L	35	101.1	104.5	83.1
CF11	P1	300194 2CHILLI 69.000 300218 5CHILLIS 161.00 1	25S	56	123.8	128.1	93.3*
			30S	56	129.4	133.6	98.4*

**Loading with network upgrade and/or transformer tap adjustment*

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 projects as shown in Table 10.

Table 10: Network Upgrade Costs

ID	Option / Description	Estimated Cost (2021$)	Lead Time from Written Authorization
NU01	Replace Sportsman 161/345 kV transformer #1 with 625/712 MVA transformer	$5,000,000	36 months
NU02	Replace Sportsman 161/345 kV transformer #2 with 625/712 MVA transformer	$5,000,000	36 months
NU03	Rebuild 2.6-mile-long Vanduser-Morley 69 kV line to 336 ACSR at 100C	$1,650,000	14 months
	Engineering	$2,330,000	
	Contingencies	$1,165,000	
	Total Cost:	$15,145,000	

Cost allocations for each of the impacted facilities is 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[4] each project had on the constraint and as described in the steps below:

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

1. Determine the MW impact each Study Cycle project had on each constraint using the size of each request:

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

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

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

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 provided in Table 11. Further breakdown of costs is provided in Appendix B.

Table 11: Network Upgrade Cost Allocation

Project	NU01	NU02	NU03	Total Cost
GEN-2016-037	$ 0	$ 0	$ 0	$ 0
GEN-2017-004	$ 0	$ 0	$ 88,272	$ 88,272
GEN-2017-005	$ 0	$ 0	$ 0	$ 0
GEN-2017-009	$ 0	$ 0	$ 0	$ 0
GEN-2017-010	$ 0	$ 0	$ 329,750	$ 329,750
GEN-2017-014	$ 0	$ 0	$ 451,388	$ 451,388
GEN-2017-018	$ 0	$ 0	$ 0	$ 0
GEN-2017-022	$ 0	$ 0	$ 0	$ 0
GEN-2017-027	$ 0	$ 0	$ 0	$ 0
GEN-2017-033	$ 0	$ 0	$ 0	$ 0
GEN-2017-040	$ 323,548	$ 323,548	$ 0	$ 647,095
GEN-2017-048	$ 0	$ 0	$ 511,096	$ 511,096
GEN-2017-060	$ 0	$ 0	$ 0	$ 0
GEN-2017-061	$ 2,275,791	$ 2,275,791	$ 0	$ 4,551,582
GEN-2017-064	$ 0	$ 0	$ 153,249	$ 153,249
GEN-2017-071	$ 0	$ 0	$ 0	$ 0
GEN-2017-072	$ 0	$ 0	$ 0	$ 0
GEN-2017-073	$ 1,654,452	$ 1,654,452	$ 0	$ 3,308,904
GEN-2017-074	$ 747,594	$ 747,594	$ 0	$ 1,495,189
GEN-2017-075	$ 0	$ 0	$ 0	$ 0
GEN-2017-076	$ 0	$ 0	$ 0	$ 0
GEN-2017-077	$ 1,175,229	$ 1,175,229	$ 0	$ 2,350,458
GEN-2017-082	$ 0	$ 0	$ 0	$ 0
GEN-2017-086	$ 0	$ 0	$ 0	$ 0
GEN-2017-090	$ 0	$ 0	$ 97,920	$ 97,920
GEN-2017-092	$ 323,386	$ 323,386	$ 0	$ 646,772
GEN-2017-094	$ 0	$ 0	$ 324,809	$ 324,809
GEN-2017-097	$ 0	$ 0	$ 188,516	$ 188,516
Total Cost	$ 6,500,000	$ 6,500,000	$ 2,145,000	$ 15,145,000

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VERSION HISTORY

Version Number and Date	Author	Change Description
V0 – 04/07/2020	AECI	Initial release
V1 – 10/28/2021	AECI	Withdrawal of the thirteen (13) SPP Study Cycle requests