INTERCONNECTION FACILITIES STUDY REPORT

GEN-2021-048

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By SPP Generator Interconnections Dept.

REVISION HISTORY

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SUMMARY

INTRODUCTION

This Interconnection Facilities Study (IFS) for Interconnection Request GEN-2021-048 is for a 75 MW generating facility located in Lancaster County, NE. The Interconnection Request was studied in the DISIS-2021-001 Impact Study for ERIS/NRIS. The Interconnection Customer's requested in-service date is 9/1/2027.

The interconnecting Transmission Owner, Lincoln Electric System (LES), performed a detailed IFS at the request of SPP. The full report is included in Appendix A. SPP has determined that full Interconnection Service will be available after the assigned Transmission Owner Interconnection Facilities (TOIF), Non-Shared Network Upgrades, Shared Network Upgrades, Contingent Network Upgrades, and Affected System Upgrades that are required for full interconnection service are completed.

The primary objective of the IFS is to identify necessary Transmission Owner Interconnection Facilities, Network Upgrades, other direct assigned upgrades, cost estimates, and associated upgrade lead times needed to grant the requested Interconnection Service.

PHASE(S) OF INTERCONNECTION SERVICE

It is not expected that Interconnection Service will occur in phases. However, full Interconnection Service will not be available until all Interconnection Facilities and Network Upgrade(s) can be placed in service.

COMPENSATION FOR AMOUNTS ADVANCED FOR NETWORK UPGRADE(S)

FERC Order ER20-1687-000 eliminated the use of Attachment Z2 revenue crediting as an option for compensation. The Incremental Long Term Congestion Right (ILTCR) process will be the sole process to compensate upgrade sponsors as of July 1st, 2020.

INTERCONNECTION CUSTOMER INTERCONNECTION FACILITIES

The Generating Facility is proposed to consist of twenty-four (24) 3.6 MW Sungrow SG3600UD inverters for a total generating nameplate capacity of 75 MW.

The Interconnection Customer's Interconnection Facilities to be designed, procured, constructed, installed, maintained, and owned by the Interconnection Customer at its sole expense include:

- 34.5 kV underground cable collection circuits;
- 34.5 kV to 115 kV transformation substation with associated 34.5 kV and 115 kV switchgear;
- One 115 kV/34.5 kV 51/68/85 MVA (ONAN/ONAF/ONAF) step-up transformer to be owned and maintained by the Interconnection Customer at the Interconnection Customer's substation;
- An Approximately <1 mile overhead 115 kV line to connect the Interconnection Customer's substation to the Point of Interconnection ("POI") at the 115 kV bus at existing Transmission Owner substation ("Wagener 115kV Substation") that is owned and maintained by Transmission Owner;
- All transmission facilities required to connect the Interconnection Customer's substation to the POI;
- Equipment at the Interconnection Customer's substation necessary to maintain a composite power delivery at continuous rated power output at the high-side of the generator substation at a power factor within the range of 95% lagging and 95% leading in accordance with Federal Energy Regulatory Commission (FERC) Order 827. The Interconnection Customer may use inverter manufacturing options for providing reactive power under no/reduced generation conditions. The Interconnection Customer will be required to provide documentation and design specifications demonstrating how the requirements are met; and,
- All necessary relay, protection, control and communication systems required to protect Interconnection Customer's Interconnection Facilities and Generating Facilities and coordinate with Transmission Owner's relay, protection, control and communication systems.

TRANSMISSION OWNER INTERCONNECTION FACILITIES AND NON-SHARED NETWORK UPGRADE(S)

To facilitate interconnection, the interconnecting Transmission Owner will perform work as shown below necessary for the acceptance of the Interconnection Customer's Interconnection Facilities.

Table 1 and **Table 2** list the Interconnection Customer's estimated cost responsibility for Transmission Owner Interconnection Facilities (TOIF) and Non-Shared Network Upgrade(s) and provides an estimated lead time for completion of construction. The estimated lead time begins when the Generator Interconnection Agreement has been fully executed.

Table 1: Transmission Owner Interconnection Facilities (TOIF)

Transmission Owner Interconnection Facilities (TOIF)	Total Cost Estimate ($)	Allocated Percent (%)	Allocated Cost Estimate ($)
Transmission Owner's Wagener 115kV Substation GEN-2021-048 Interconnection (TOIF) (UID 157145): Interconnection upgrades and cost estimates needed to interconnect the following Interconnection Customer facility, GEN-2021-048 (75/Battery/Storage), into the Point of Interconnection (POI) at Wagener 115kV Substation. Estimated Lead Time: 30 Months	$0	100.00%	$0
Total	**$0**		**$0**

Table 2: Non-Shared Network Upgrade(s)

Non-Shared Network Upgrades Description	ILTCR	Total Cost Estimate ($)	Allocated Percent (%)	Allocated Cost Estimate ($)
NA				
Total		**$0**		**$0**

SHARED NETWORK UPGRADE(S)

The Interconnection Customer's share of costs for Shared Network Upgrades is estimated in **Table 3** below.

Table 3: Interconnection Customer Shared Network Upgrade(s)

Shared Network Upgrades Description	ILTCR	Total Cost Estimate ($)	Allocated Percent (%)	Allocated Cost Estimate ($)
Transmission Owner's Wagener 115kV Substation GEN-2021-048 / GEN-2021-049 Interconnection Expansion (DISIS-2021-001) (UID 157144): Wagener 115kV Substation GEN-2021-048 / GEN-2021-049 Interconnection Expansion (LES). Estimated Lead Time: 30 Months	Ineligible	$2,235,318	25.00%	$558,830
Total		**$2,235,318**		**$558,830**

All studies have been conducted assuming that higher-queued Interconnection Request(s) and the associated Network Upgrade(s) will be placed into service. If higher-queued Interconnection Request(s) withdraw from the queue, suspend or terminate service, the Interconnection Customer's share of costs may be revised. Restudies, conducted at the customer's expense, will determine the Interconnection Customer's revised allocation of Shared Network Upgrades.

CONTINGENT NETWORK UPGRADE(S)

Certain Contingent Network Upgrades are **currently not the cost responsibility** of the Interconnection Customer but will be required for full Interconnection Service.

Table 4: Interconnection Customer Contingent Network Upgrade(s)

Contingent Network Upgrade(s) Description	Current Cost Assignment	Estimated In-Service Date
NA		

Depending upon the status of higher- or equally-queued customers, the Interconnection Request's in-service date is at risk of being delayed or Interconnection Service is at risk of being reduced until the in-service date of these Contingent Network Upgrades.

AFFECTED SYSTEM UPGRADE(S)

To facilitate interconnection, the Affected System Transmission Owner will be required to perform the facilities study work as shown below necessary for the acceptance of the Interconnection Customer's Interconnection Facilities. **Table 5** displays the current impact study costs provided by either MISO or AECI as part of the Affected System Impact review. The Affected System facilities study could provide revised costs and will provide each Interconnection Customer's allocation responsibilities for the upgrades.

Table 5: Interconnection Customer Affected System Upgrade(s)

Affected System Upgrades Description	Total Cost Estimate ($)	Allocated Percent (%)	Allocated Cost Estimate ($)
NA			
Total	**$0**		**$0**

CONCLUSION

After all Interconnection Facilities and Network Upgrades have been placed into service, Interconnection Service for 75 MW can be granted. Full Interconnection Service will be delayed until the TOIF, Non-Shared NU, Shared NU, Contingent NU, Affected System Upgrades that are required for full interconnection service are completed. The Interconnection Customer's estimated cost responsibility for full interconnection service is summarized in the table below.

Table 6: Cost Summary

Description	Allocated Cost Estimate
Transmission Owner Interconnection Facilities Upgrade(s)	$0
Non-Shared Network Upgrade(s)	$0
Shared Network Upgrade(s)	$558,830
Affected System Upgrade(s)	$0
Total	**$558,830**

Use the following link for Quarterly Updates on upgrades from this report: https://spp.org/spp-documents-filings/?id=18641

A draft Generator Interconnection Agreement will be provided to the Interconnection Customer consistent with the final results of this IFS report. The Transmission Owner and Interconnection Customer will have 60 days to negotiate the terms of the GIA consistent with the SPP Open Access Transmission Tariff (OATT).

APPENDICES

A: TRANSMISSION OWNER'S INTERCONNECTION FACILITIES STUDY REPORT AND NETWORK UPGRADES REPORT(S)

See next page for the Transmission Owner's Interconnection Facilities Study Report and Network Upgrades Report(s).

DISIS-2021-001 – INTERCONNECTION FACILITY STUDY (IFS)

GEN-2021-034
GEN-2021-043
GEN-2021-048
GEN-2021-049

Lincoln Electric System

AUGUST 2025

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Executive Summary

Lincoln Electric System (LES) was tasked with completing Facility Studies by Southwest Power Pool (SPP) in accordance with Open Access Transmission Tariff (OATT), Sixth Revised Volume No.1, Attachment V, Section 8.11 of the Generator Interconnection Procedures (GIP). SPP is proposing to make new interconnections to the transmission system by installing generation projects at the Wagener (S85) and Rokeby (S90) substations. These new interconnections will involve the following generation facility requests:

- GEN-2021-034 → 113 MW solar generation plant requesting interconnection at S90
- GEN-2021-043 → 250 MW battery storage facility requesting interconnection at S90
- GEN-2021-048 → 75 MW battery storage facility requesting interconnection at S85
- GEN-2021-049 → 225 MW solar generation plant requesting interconnection at S85

This assessment examined the reliability impact of these interconnections to Lincoln Electric System's portion of the Bulk Electric System (BES).

This report documents all relevant information pertaining to the new interconnections at the Wagener and Rokeby substations including a dynamic analysis which exhibited stablity, positive damping, and acceptable transient voltages and a short circuit analysis that identified no deficient devices. Steady state analysis was conducted previously by SPP. These new generation interconnections result in no adverse impacts on the transmission system and all dynamic and short circuit criteria is within acceptable limits in both pre- and post-contingency conditions.

Introduction

Lincoln Electric System (LES), as the Transmission Owner (TO) and Transmission Planner (TP), was tasked with completing Facility Studies by Southwest Power Pool (SPP) in accordance with Open Access Transmission Tariff (OATT), Sixth Revised Volume No.1, Attachment V, Section 8.11 of the Generator Interconnection Procedures (GIP). SPP is proposing to make new interconnections to the transmission system by installing generation projects at the Wagener (S85) and Rokeby (S90) substations. These new interconnections will involve the following generation facility requests:

- GEN-2021-034 → 113 MW solar generation plant requesting interconnection at S90
- GEN-2021-043 → 250 MW battery storage facility requesting interconnection at S90
- GEN-2021-048 → 75 MW battery storage facility requesting interconnection at S85
- GEN-2021-049 → 225 MW solar generation plant requesting interconnection at S85

These interconnections are being studied under the NERC Facility Interconnection Studies (FAC-002-4) standard due to Interconnecting Customers (IC) seeking to make qualified changes to LES' portion of the bulk electric system for new generation facilities.

Study Assumptions

The stability analysis utilized both the 2029 Summer Peak case and the 2029 Winter Peak case, from the SPP Model Development Advisory Group (MDAG) 2024 Series dynamics package, the most current set of finalized dynamic models posted by SPP at the time this study was performed. The year 2029 cases were chosen due to being in the timeframe in which these generation interconnections would be in place and generators would be operational with currently known LES construction lead times.

The short circuit model used in this study was created in-house utilizing Aspen OneLiner modeling software containing LES and neighboring utility models. Output currents and breaker duty calculations determine the maximum fault current each interrupting device must interrupt.

This study adheres to the NERC Reliability Standards, specifically NERC FAC-002-4, the SPP Planning Criteria, SPP Zone 16 Zonal Planning Criteria (ZPC), and the LES Facility Interconnection Requirements (LES Requirements for System Interconnections to Generations, Transmission, and End-User Facilities).

Study Criteria

Transient Stability Criteria

LES adheres to the SPP Disturbance Performance Requirement (Appendix A). This criterion specifies both the Rotor Angle Damping Requirement and Transient Voltage Recovery Requirement.

Breaker Rating Criteria

Short circuit analysis determined the maximum fault current anticipated during system operation. All protection equipment (circuit breakers, circuit switchers, etc.) must have a fault-interrupting rating greater than the projected maximum fault current.

Alternatives Considered

The SPP tariff in Attachment V section 3.1 and 3.4.4 specifies the only alternatives a TO can consider when reviewing interconnection customer requests, at the interconnection customers option, are the project's Point Of Interconnection (POI) and configuration during a scoping meeting. Due to LES having no issues with any of the interconnection customers' POIs or configuration requested, no other alternatives were considered.

Coordination

The LES Resource & Transmission Planning department, serving as the LES Transmission Planner (TP), coordinated these interconnection requests to the Wagener (S85) and Rokeby (S90) substations with SPP as the Planning Coordinator (PC) for LES through the SPP GIP process. This interconnection request was also coordinated with the LES Energy Delivery division, serving as the Transmission Owner (TO) for LES, to receive the following information: substation one-lines, scope of interconnection projects, cost estimates and the short circuit study.

Steady State Analysis

FAC-002-4 R1.3 states that steady-state, short-circuit, and dynamics studies shall be studied as necessary. LES will defer this portion of this FAC-002 study to SPP's steady state analysis completed in the DISIS-2021-001 study process. SPP currently runs steady state studies that encompass all of LES' contingencies. Completing a steady state study for these generation interconnections would be considered redundant and unnecessary by LES engineering judgement.

Dynamic Analysis

The PSS/E Power System Simulator, version 35.3.3, was used for stability analysis of the near-term planning horizon and was conducted using the SPP Model Development Advisory Group (MDAG) 2029 (Year 5) Summer peak and Winter peak dynamic cases. These cases were selected from the library of cases included in the SPP 2024 MDAG Series Models, the most current set of finalized models at the time this study was performed. Interconnection facilities configuration and dynamic model data was extracted from SPP's Generation Interconnection DISIS-2021-001 Dynamic models. Appendix B outlines the extracted dynamic model data and interconnection facilities, while configuration one-line diagrams from PSS/E can be found below.

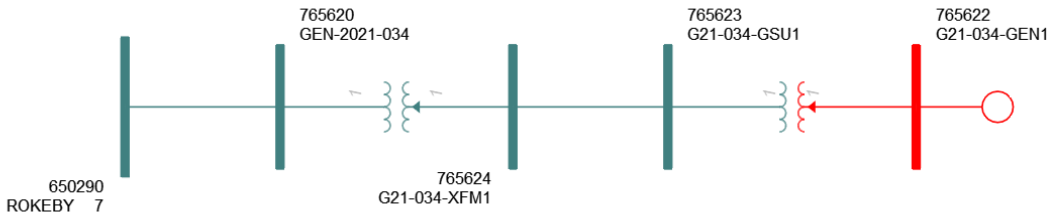

Fig.1 GEN-2021-034 113 MW solar generation plant

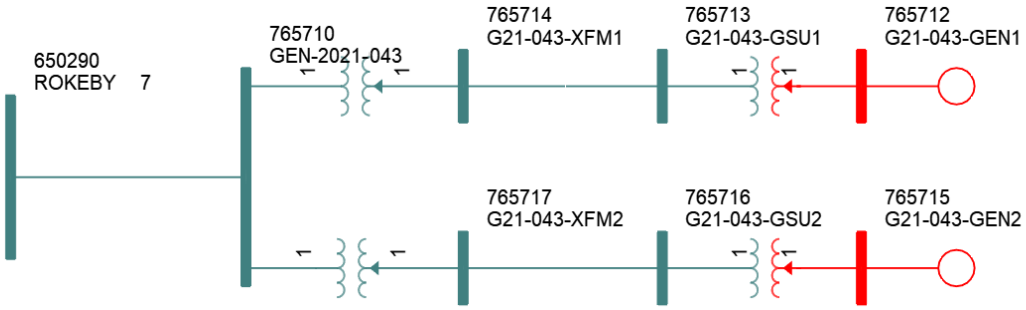

Fig.2 GEN-2021-043 250 MW battery storage facility

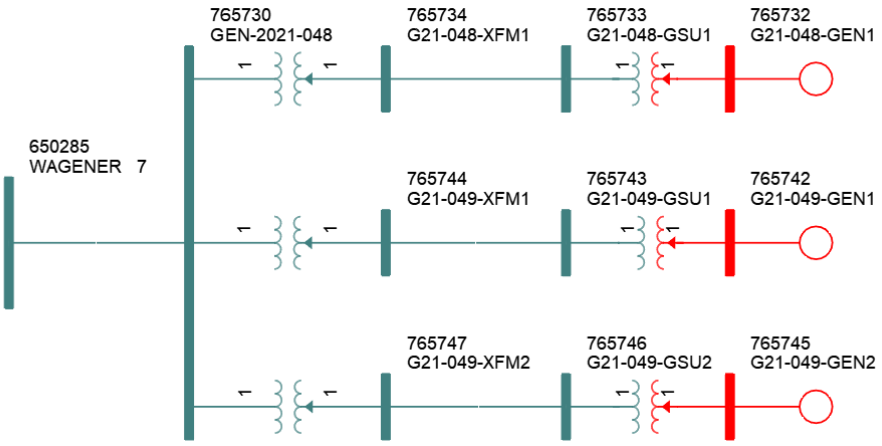

Fig.3 GEN-2021-048 75 MW battery storage facility and GEN-2021-049 225 MW solar generation plant

Extracted PSS/E data was loaded into the selected dynamic cases and generators were dispatched to their respected maximum real power (Pmax) value. Pmax values can be identified by the lesser value of either the generator's project maximum or by dynamic models that incorporate other electrical limits such as the project's inverter specifications for example. Each generators dispatched real power (Pgen) is identified in Table 1. In order to offset the additional generation included in these selected cases, PSS/E's scaling function was used to reduce generation in surrounding Nebraska areas by the incremental amount. Generation was scaled for the areas of NPPD (640), HAST (641), GRIS (642), and OPPD (645) with PSS/E uniformly decreasing the Pgen of generators in these areas.

These generation changes allowed LES to study these new interconnecting generators with local generation online to assess local machine dynamic interactions and to simulate stresses to tie-lines as this additional power is transferred outside of the LES footprint. Also, this adjustment in dispatch allows for a strong system swing bus which is necessary for starting stable contingency simulations. With these adjustments, the updated dynamic models were able to flat start and run a no-contingency simulation with no initial conditions suspect of interconnecting generators dynamic models. The initial conditions suspect output table for each flat start can be found in Appendix C.

DISIS Generation Pmax and Pgen								
DISIS Generator	**Project Pmax (MW)**	**Electrical Model**	**Con**	**Pmax (PU)**	**Plant Control Model**	**Con**	**Pmax (PU)**	**Pgen (MW)**
G21-034-GEN1	113	REECA1	26	0.9	REPCA1	23	0.9	90.0
G21-043-GEN1	125	REECC1	22	0.8667	REAX4BU1	N/A	N/A	86.6
G21-043-GEN2	125	REECC1	22	0.8667	REAX4BU1	N/A	N/A	86.6
G21-048-GEN1	75	REECC1	22	0.8681	REPCA1	23	0.8681	75
G21-049-GEN1	112.5	REECA1	26	0.9138	REPCA1	23	0.9138	91.3
G21-049-GEN2	112.5	REECA1	26	0.9138	REPCA1	23	0.9138	91.3
Total Generator Dispatch (Pgen):								**520.8**

Table 1: DISIS generator Pmax and Pgen

The purpose of this stability assessment was to evaluate the impact of the proposed new interconnections to the LES transmission system. This analysis evaluated 42 contingencies in the summer peak and winter peak load cases. These contingencies developed for the Annual LES System Performance Assessment represent the following categories from NERC standard TPL-001-4: P0, P1, P3, P4, P5, P6 and extreme events. These contingencies were chosen to fully study the dynamic impact these new generation interconnections have on the transmission system and the behavior associated with dynamic loads. Graphical output of the findings of each contingency simulation can be found in Appendix D for the 2029 Summer Peak and Appendix E for 2029 Winter Peak Cases. Based on the results from this analysis, the LES transmission system is stable and compliant with transient stability criteria following the interconnection of these generators at the Wagener and Rokeby substations.

Short-Circuit Analysis

A short-circuit study was performed using Aspen OneLiner modeling software version 15.7 containing LES and neighboring utility models to determine the maximum fault current each interupting device may need to interrupt. By comparing this to the rating of the interupting device, it can be determined if there are any deficient devices. Only circuit breakers and circuit switchers that are classified as Bulk Electric System were included as a part of this study.

The Breaker Rating Spreadsheet in Appendix F included load forecast changes and facilities that are in service or planned to be in service within two years of the Breaker Rating's report date and planned facilities that are up to five years away were included based on engineering judgment. In summarizing the results from the Breaker Rating spreadsheet, the short circuit study did not identify any breakers that are over 100% and are not already identified in the base case. All deficient devices identified have corrective actions in place to ensure proper operation during a fault condition, and some devices have corrective actions that involve having a different device interrupt the fault current. LES also verified fault currents identified in SPP's DISIS-2021-001 short circuit study against breaker ratings and found no short circuit issues. In conclusion, there are no deficient devices and all devices have fault-interrupting ratings greater than the projected maximum fault currents.

Project Cost Estimates, Lead Times and Scope of Work

Cost Estimates, Lead Times and Scope of Work (SOW) are identified below for each IC's request individually and combined for each substation. This allows for a generation interconnection request to withdraw from the GIP process and the other IC interconnecting to the same substation to have project details available. The provided cost estimates bandwidth are considered "Study Estimates" as defined in Section 8.2 of SPP's OATT Business Practice (BP) 7060 and are expected to be within a -30% to +30% variance from the final project cost. Provided lead times are based on LES' current project schedule and known procurement times. One-lines for each substation can be found in Appendix G.

Wagener Substation (S85)

GEN-2021-048 and GEN-2021-049 Combined

Project scope includes adding an additional terminal to the existing LES Wagener substation. This will require the addition of a 115kV breaker and all the associated bus, switches, CVTs, CTs, PTs, and relays. This will also require the re-routing of LES 115kV L7985 to the new terminal to allow clearance for the new customer 115kV line from GEN-2021-048 and GEN-2021-049.

Shared Network Upgrade			
SCERT UID	**Upgrade Name**	**Cost Estimate**	**Lead Time**
157144	Wagener 115kV Substation GEN-2021-048 / GEN-2021-049 Interconnection Expansion (DISIS-2021-001) (LES)	$ 2,235,318	30 Months

GEN-2021-048 or GEN-2021-049 Individually

Project scope includes adding an additional terminal to the existing LES Wagener substation. This will require the addition of a 115kV breaker and all the associated bus, switches, CVTs, CTs, PTs, and relays. This will also require the re-routing of LES 115kV L7985 to the new terminal to allow clearance for the new customer 115kV line from GEN-2021-048 or GEN-2021-049.

Individual Transmission Owner Interconnection Facilities (TOIF)			
SCERT UID	**Upgrade Name**	**Cost Estimate**	**Lead Time**
157145	Wagener 115kV Substation GEN-2021-048 Interconnection (TOIF) (LES)	$ 2,235,318	30 Months
157146	Wagener 115kV Substation GEN-2021-049 Interconnection (TOIF) (LES)	$ 2,235,318	30 Months

Rokeby Substation (S90)

GEN-2021-034 and GEN-2021-043 Combined

Project scope includes converting existing 6 terminal LES Rokeby substation to a breaker and a half design. This will require relay replacements, additional relays and wiring of existing breakers, new 115kV bus, switches, CVTs, CTs, PTs, relaying and 6 new 115kV Breakers. This will all support the addition of the seventh and eighth terminal at the Rokeby Substation to accept the new lines from the GEN-2021-034 and GEN-2024-043 customer 115kV lines.

Shared Network Upgrade (NU)			
SCERT UID	**Upgrade Name**	**Cost Estimate**	**Lead Time**
157015	Rokeby 115kV Substation GEN-2021-043/034 Interconnection (DISIS-2021-001) (LES)	$ 6,862,677	36 Months

GEN-2021-034 or GEN-2021-043 Individually

Project scope includes converting existing 6 terminal LES Rokeby substation to a breaker and a half design. This will require relay replacements, additional relays and wiring of existing breakers, new 115kV bus, switches, CVTs, CTs, PTs, relaying and 5 new 115kV Breakers. This will all support the addition of the seventh terminal at the Rokeby Substation to accept the new line from the GEN-2021-034 or GEN-2021-043 customer 115kV line.

Individual Transmission Owner Interconnection Facilities (TOIF)			
SCERT UID	**Upgrade Name**	**Cost Estimate**	**Lead Time**
157111	Rokeby 115 kV Substation GEN-2021-034 Interconnection (TOIF) (LES)	$ 5,274,388	36 Months
157014	Rokeby 115 kV Substation GEN-2021-043 Interconnection (TOIF) (LES)	$ 5,274,388	36 Months

Summary and Recommendations

As shown in the the stability analysis, all simulated distubances were stable and had acceptable transient voltages. Under system intact and contingency events, the LES system performance satisfies the criteria specified in the SPP Disturbance Performance Requirements. The short-circuit analysis conclusion is that there are no deficient devices and that all devices have fault-interrupting ratings greater than the projected maximum fault currents. Therefore, this assessment of new generation interconnections to the Wagener and Rokeby substations demonstrate that there will be minimal impact to system reliability and LES makes no recommendations for these generation interconnection requests.

Appendix A

2025 LES FAC-002 DISIS-2021-001 IFS

SPP Disturbance Performance Requirement

LES Resource & Transmission Planning Department

Southwest Power Pool
Disturbance Performance Requirements

OVERVIEW

These Disturbance Performance Requirements ("Requirements") shall be applicable to the Bulk Electric System within the Southwest Power Pool Planning Area. Utilization of these Requirements applies to all registered entities within the Southwest Power Pool Planning Area. These Requirements shall not be applicable to facilities that are not part of Bulk Electric System. More stringent Requirements are at the sole discretion of each Transmission Planner.

Transient and dynamic stability assessments are generally performed to assure adequate avoidance of loss of generator synchronism and prevention of system voltage collapse within the first 20 seconds after a system disturbance. These Requirements provide a basis for evaluating the system response during the initial transient period following a disturbance on the Bulk Electric System by establishing minimum requirements for machine rotor angle damping and transient voltage recovery.

ROTOR ANGLE DAMPING REQUIREMENT

Machine Rotor Angles shall exhibit well damped angular oscillations following a disturbance on the Bulk Electric System for all NERC TPL-001-4 P1 through P7 events.

Machines with rotor angle deviations greater than or equal to 16 degrees (measured as absolute maximum peak to absolute minimum peak) shall be evaluated against SPPR1 or SPPR5 requirements below. Machines with rotor angle deviations less than 16 degrees which do not exhibit convergence shall be evaluated on an individual basis. Rotor angle deviations will be calculated relative to the system swing machine.

Well damped angular oscillations shall meet one of the following two requirements when calculated directly from the rotor angle:

1. Successive Positive Peak Ratio One (SPPR1) must be less than or equal to 0.95 where SPPR1 is calculated as follows:

$$SPPR1 = \frac{\text{Peak Rotor Angle of } 2^{nd} \text{ Positive Peak minus Minimum Value}}{\text{Peak Rotor Angle of } 1^{st} \text{ Positive Peak minus Minimum Value}} \leq 0.95$$

   -or- Damping Factor % = (1 – SPPR1) x 100% $\geq$ 5%

   The machine rotor angle damping ratio may be determined by appropriate modal analysis (i.e. Prony Analysis) where the following equivalent requirement must be met:

   Damping Ratio $\geq$ 0.0081633

2. Successive Positive Peak Ratio Five (SPPR5) must be less than or equal to 0.774 where SPPR5 is calculated as follows:

$$SPPR5 = \frac{\text{Peak Rotor Angle of } 6^{th} \text{ Positive Peak minus Minimum Value}}{\text{Peak Rotor Angle of } 1^{st} \text{ Positive Peak minus Minimum Value}} \leq 0.774$$

   -or- Damping Factor % = (1 – SPPR5) x 100% $\geq$ 22.6%

   The machine rotor angle damping ratio may be determined by appropriate modal analysis (i.e. Prony Analysis) where the following equivalent requirement must be met:

   Damping Ratio $\geq$ 0.0081633

Qualitatively, these Requirements are shown in Figure 1 & 2 below.

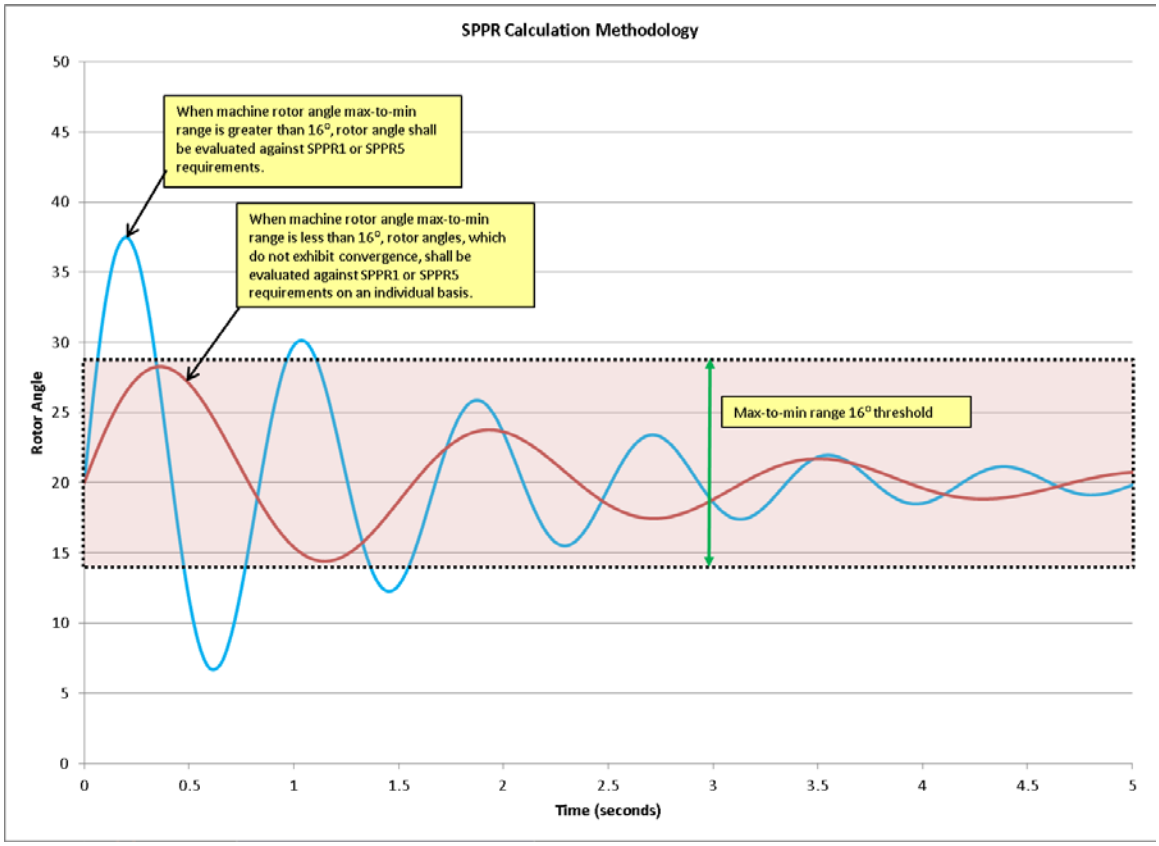

Figure 1. Applicability of 16 Degree Threshold

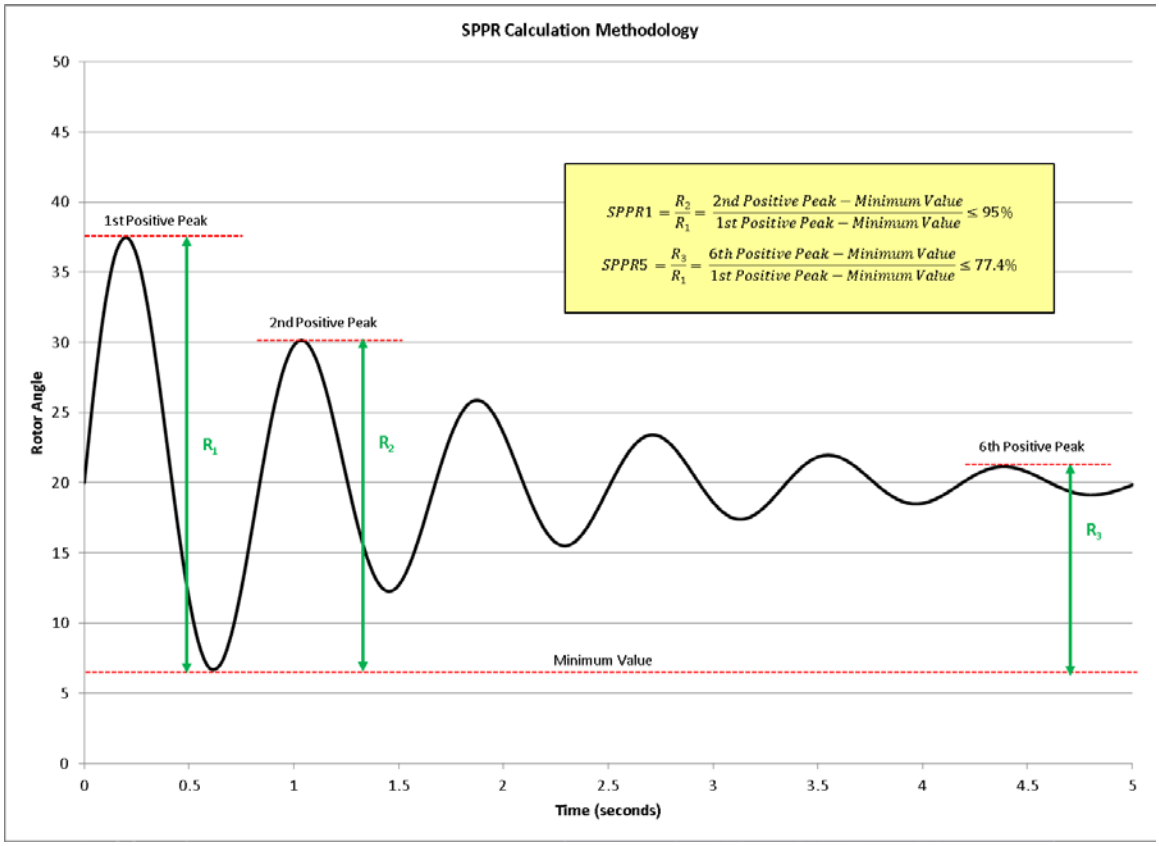

Figure 2. SPPR1 and SPPR5 Calculations

TRANSIENT VOLTAGE RECOVERY REQUIREMENT

Bus voltages on the Bulk Electric System shall recover above 0.70 per unit, 2.5 seconds after the fault is cleared. Bus voltages shall not swing above 1.20 per unit after the fault is cleared, unless affected transmission system elements are designed to handle the rise above 1.2 per unit.

Qualitatively, this Requirement is shown in Figure 3 below.

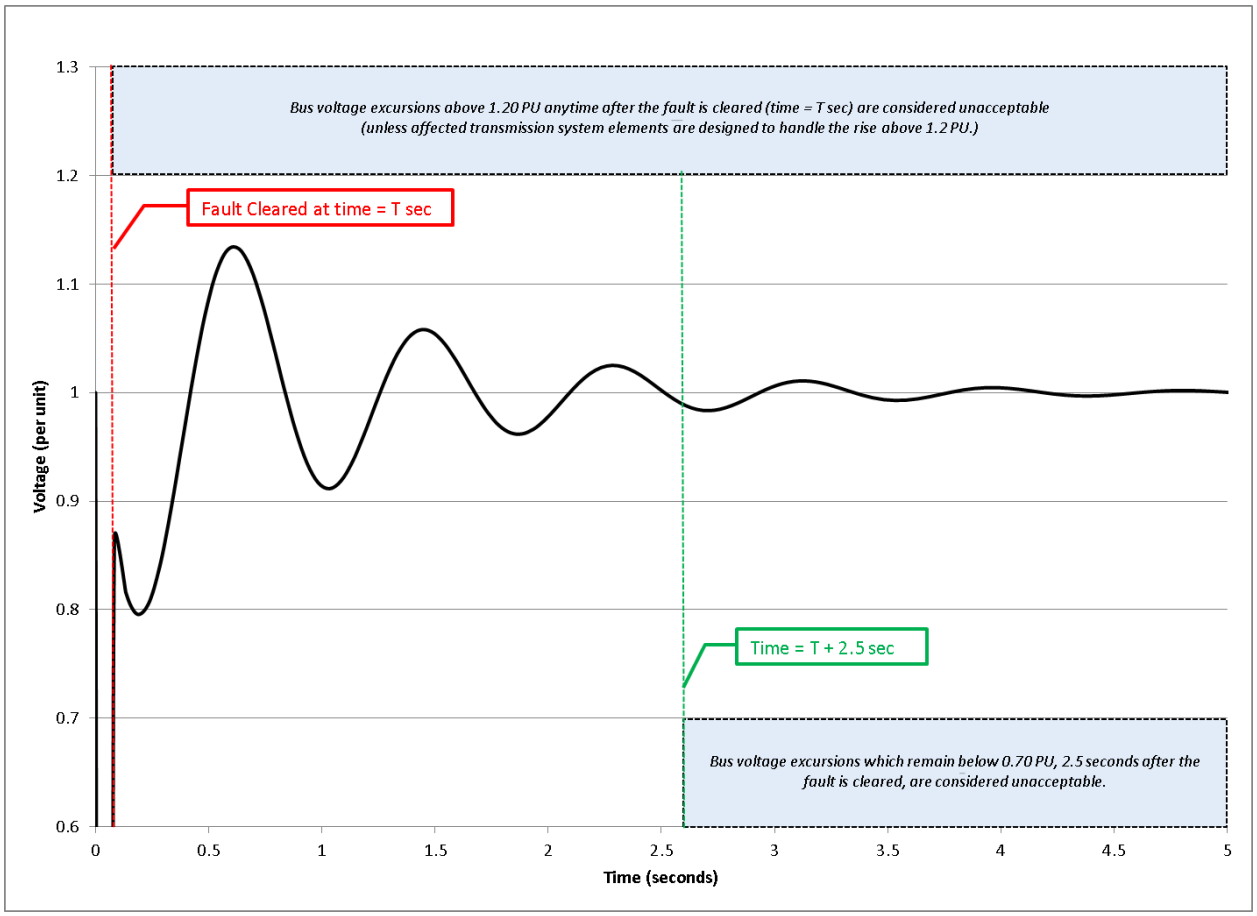

Figure 3. Transient Voltage Recovery Requirement

Appendix B

2025 LES FAC-002 DISIS-2021-001 IFS

Extracted Dynamic Model Data

LES Resource & Transmission Planning Department

RENEWABLE MODELS

REPORT FOR ALL MODELS BUS 765622 [G21-034-GEN10.6900] MODELS

Model REGCA1 Bus 765622 [G21-034-GEN10.6900] Machine "1 " :

I C O N	C O N S	S T A T E S	V A R S
79729	231586-231599	90292-90294	219063-219066

Tg	Rrpwr	Brkpt	Zerox	Lvpl1
0.0200	1.5000	0.7500	0.0000	0.2300

Volim	Lvpnt1	Lvpnt0	Iolim
1.1500	0.0100	0.0000	-0.4502

Tfltr	Khv	Iqrmax	Iqrmin	Accel
0.0333	0.0000	10.0000	-10.0000	1.0000

LVPL Switch flag: 0

Model REECA1 Bus 765622 [G21-034-GEN10.6900] Machine "1 " :

I C O N S	C O N S	S T A T E S	V A R S
86367-86372	279044-279088	99391-99396	229570-229578

Vdip	Vup	Trv	dbd1	dbd2	Kqv	Iqhl
0.8500	1.1500	0.0333	-0.1500	0.1500	2.0000	1.0000

Iqll	Vref0	Iqfrz	Thld	Thld2	Tp	QMAX
-1.0000	0.0000	0.0000	0.0000	0.0000	0.0333	0.4360

QMIN	VMAX	VMIN	Kqp	Kqi	Kvp	Kvi
-0.4360	1.1500	0.8500	1.0000	3.0000	1.5000	3.0000

Vbias	Tiq	dPMax	dPMin	Pmax	Pmin
0.0000	0.0333	10.0000	-10.0000	0.9000	0.0000

Imax	Tpord	VQ1	IQ1	VQ2	IQ2	VQ3
1.0400	0.0333	0.0000	1.0000	1.2400	1.0000	1.2500

IQ3	VQ4	IQ4	VP1	IP1	VP2	IP2
0.0000	0.0000	0.0000	0.2000	1.0000	1.0000	1.0000

```
    VP3       IP3       VP4       IP4
    1.2400    1.0000    1.2500    0.0000


        PfFLAG: 0
         VFLAG: 1
         QFLAG: 1
         PFLAG: 0
        PQFLAG: 0


Model REPCA1 Bus 765622 [G21-034-GEN10.6900] Machine "1 " :

  I C O N S        C O N S       S T A T E S       V A R S
  95289-95295    313827-313853   108754-108760   244773-244781

    Tfltr     Kp        Ki        Tft       Tfv       Vfrz      Rc
    0.0333    1.0000   10.0000    0.0000    0.1000    0.8000    0.0000

    Xc        Kc        emax      emin       dbd1      dbd2      QMAX
    0.0000    0.0511    1.0000    -1.0000   -0.0010    0.0010    0.4502

    QMIN      Kpg       Kig       tp        fdbd1     fdbd2     femax
   -0.4502    0.1000    1.0000    0.2000   -0.0003    0.0003  999.0000

    femin     Pmax      Pmin        Tg       Ddn        Dup
  -999.0000    0.9000     0.0000    0.0333   17.5465   17.5465


  Bus Number for Voltage Control (if 0 local control):  765620
   Branch FROM bus number:  765620
     Branch TO bus number:  650290
        Branch circuit ID:       1
                   VCFlag:       0
                  RefFlag:       1
                    Fflag:       1
↑    PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS(R)E     THU, JUL 10 2025   7:14
2020 MDWG PRE-FINAL 1 WITH 2019 MMWG FINAL-DIS00
2020MDWG 2025S WITH 2019MMWG 2024S. CEII & RSD DATA - DO NOT

RENEWABLE MODELS

REPORT FOR ALL MODELS                    BUS 765712 [G21-043-GEN10.6600] MODELS


Model REGCA1 Bus 765712 [G21-043-GEN10.6600] Machine "1 " :

   I C O N        C O N S       S T A T E S       V A R S
     79738       231712-231725    90319-90321    219099-219102
```

Tg	Rrpwr	Brkpt	Zerox	Lvpl1
0.0200	10.0000	0.8000	0.7900	1.0000

Volim	Lvpnt1	Lvpnt0	Iolim
2.0000	0.8000	0.0000	-1.0000

Tfltr	Khv	Iqrmax	Iqrmin	Accel
0.0200	1.0000	2.0000	-2.0000	1.0000

LVPL Switch flag: 0

Model REECCU1 Bus 765712 [G21-043-GEN10.6600] Machine "1 " :

I C O N S	C O N S	S T A T E S	V A R S
86415-86419	279449-279493	99451-99457	229633-229638

Vdip	Vup	Trv	dbd1	dbd2	Kqv	Iqhl
0.8500	2.0000	0.0167	-0.1000	0.1000	2.0000	1.0000

Iqll	Vref0	Tp	QMAX
-1.0000	0.0000	0.0167	0.4989

QMIN	VMAX	VMIN	Kqp	Kqi	Kvp	Kvi
-0.4989	1.2000	-1.2000	1.0000	5.0000	1.0000	5.0000

Tiq	dPMax	dPMin	Pmax	Pmin
0.0200	10.0000	-10.0000	0.8667	-0.8541

Imax	Tpord	VQ1	IQ1	VQ2	IQ2	VQ3
1.0000	0.0250	0.7000	1.0000	0.8000	1.0000	0.9000

IQ3	VQ4	IQ4	VP1	IP1	VP2	IP2
1.0000	1.0000	1.0000	0.7000	1.0000	0.9000	1.0000

VP3	IP3	VP4	IP4
1.0000	1.0000	1.0000	1.0000

T	SOCini	SOCmax	SOCmin
0.80E+04	0.50	0.95	0.50E-01

PfFLAG: 0
VFLAG: 0
QFLAG: 0
PQFLAG: 0

Model REAX4BU1 Bus 765712 [G21-043-GEN10.6600] Machine "1 " :

I C O N	C O N S	S T A T E S	V A R S
95334	314010-314016	108802-108803	244839-244842

Tw1	Kw1	Kp1
0.0042	1.0000	0.5000

Wmax	Wmin	Pmax	Pmin
99.000	-99.000	99.000	-99.000

Bus Number associated with Plant Controller (PLNTBU1): 765710

RENEWABLE MODELS

REPORT FOR ALL MODELS BUS 765715 [G21-043-GEN20.6600] MODELS

Model REGCA1 Bus 765715 [G21-043-GEN20.6600] Machine "1 " :

I C O N	C O N S	S T A T E S	V A R S
79739	231726-231739	90322-90324	219103-219106

Tg	Rrpwr	Brkpt	Zerox	Lvpl1
0.0200	10.0000	0.8000	0.7900	1.0000

Volim	Lvpnt1	Lvpnt0	Iolim
2.0000	0.8000	0.0000	-1.0000

Tfltr	Khv	Iqrmax	Iqrmin	Accel
0.0200	1.0000	2.0000	-2.0000	1.0000

LVPL Switch flag: 0

Model REECCU1 Bus 765715 [G21-043-GEN20.6600] Machine "1 " :

I C O N S	C O N S	S T A T E S	V A R S
86420-86424	279494-279538	99458-99464	229639-229644

Vdip	Vup	Trv	dbd1	dbd2	Kqv	Iqhl
0.8500	2.0000	0.0167	-0.1000	0.1000	2.0000	1.0000

Iqll	Vref0	Tp	QMAX

```
   -1.0000    0.0000    0.0167    0.4989

    QMIN      VMAX      VMIN      Kqp       Kqi       Kvp       Kvi
   -0.4989    1.2000   -1.2000    1.0000    5.0000    1.0000    5.0000

    Tiq       dPMax     dPMin     Pmax      Pmin
    0.0200   10.0000  -10.0000    0.8667   -0.8541

    Imax      Tpord     VQ1       IQ1       VQ2       IQ2       VQ3
    1.0000    0.0250    0.7000    1.0000    0.8000    1.0000    0.9000

    IQ3       VQ4       IQ4       VP1       IP1       VP2       IP2
    1.0000    1.0000    1.0000    0.7000    1.0000    0.9000    1.0000

    VP3       IP3       VP4       IP4
    1.0000    1.0000    1.0000    1.0000

    T         SOCini    SOCmax    SOCmin
   0.18E+05   0.50       0.90       0.10


        PfFLAG: 0
         VFLAG: 0
         QFLAG: 0
        PQFLAG: 0


Model REAX4BU1 Bus 765715 [G21-043-GEN20.6600] Machine "1 " :

   I C O N         C O N S       S T A T E S       V A R S
     95335       314017-314023   108804-108805   244843-244846

    Tw1        Kw1      Kp1
    0.0042    1.0000    0.5000

    Wmax        Wmin        Pmax        Pmin
   99.000     -99.000      99.000     -99.000

Bus Number associated with Plant Controller (PLNTBU1):  765710
↟    PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS(R)E     THU, JUL 10 2025   7:14
2020 MDWG PRE-FINAL 1 WITH 2019 MMWG FINAL-DIS00
2020MDWG 2025S WITH 2019MMWG 2024S. CEII & RSD DATA - DO NOT

BUS OTHER MODELS

REPORT FOR ALL MODELS                    BUS 765710 [GEN-2021-043115.00] MODELS


Model PLNTBU1 Bus 765710 [GEN-2021-043115.00] :
```

```
  I C O N S        C O N S       S T A T E S       V A R S
  95933-95939    319047-319074   109883-109889   246070-246084

    Tfltr     Kp        Ki        Tft       Tfv       Vfrz      Rc
    0.0400    0.0000    5.0000    0.0000    0.0400   -1.0000    0.0000

    Xc        Kc        emax      emin       dbd1      dbd2      QMAX
    0.0000    0.0400  999.0000  -999.0000    0.0000    0.0000    1.4602

    QMIN      Kpg       Kig       tp        fdbd1     fdbd2     femax
   -1.4602    1.0000    4.0000    0.0400   -0.0006    0.0006  999.0000

    femin     Pmax      Pmin        Tg       Ddn        Dup        PC_MVA
  -999.0000    0.8541    -0.8541    0.0400   58.5480   58.5480    0.0000


  Bus Number for Voltage Control (if 0 local control):  765710
   Branch FROM bus number:  765710
     Branch TO bus number:  650290
        Branch circuit ID:       1
                   VCFlag:       0
                  RefFlag:       1
                    Fflag:       1
```


RENEWABLE MODELS

REPORT FOR ALL MODELS BUS 765732 [G21-048-GEN10.6300] MODELS

Model REGCA1 Bus 765732 [G21-048-GEN10.6300] Machine "1 " :

```
   I C O N         C O N S       S T A T E S       V A R S
     79742       231768-231781    90331-90333    219115-219118


    Tg         Rrpwr      Brkpt       Zerox     Lvpl1
    0.0200    10.0000     0.9000      0.5000    1.1000

    Volim     Lvpnt1      Lvpnt0      Iolim
    1.1000     0.9000     0.0000     -1.0000

    Tfltr      Khv         Iqrmax       Iqrmin         Accel
    0.0100     0.0000       99.0000       -99.0000      1.0000


    LVPL Switch flag:   0
```

Model REECCU1 Bus 765732 [G21-048-GEN10.6300] Machine "1 " :

I C O N S	C O N S	S T A T E S	V A R S
86437-86441	279629-279673	99477-99483	229663-229668

Vdip	Vup	Trv	dbd1	dbd2	Kqv	Iqhl
0.9000	1.1000	0.0100	-0.1000	0.1000	1.0000	1.0000

Iqll	Vref0	Tp	QMAX
-1.0000	1.0000	0.0100	0.4966

QMIN	VMAX	VMIN	Kqp	Kqi	Kvp	Kvi
-0.4966	1.1000	0.9000	0.3000	5.0000	0.5000	0.0000

Tiq	dPMax	dPMin	Pmax	Pmin
0.0100	99.0000	-99.0000	0.8681	-0.8681

Imax	Tpord	VQ1	IQ1	VQ2	IQ2	VQ3
1.1000	0.0100	0.0000	0.0100	0.0490	0.0100	0.0500

IQ3	VQ4	IQ4	VP1	IP1	VP2	IP2
1.0000	1.2000	1.0000	0.0000	0.0100	0.0490	0.0100

VP3	IP3	VP4	IP4
0.0500	1.0000	1.2000	1.0000

T	SOCini	SOCmax	SOCmin
0.18E+04	0.50	1.0	0.0

PfFLAG: 0
VFLAG: 1
QFLAG: 0
PQFLAG: 0

Model REPCA1 Bus 765732 [G21-048-GEN10.6300] Machine "1 " :

I C O N S	C O N S	S T A T E S	V A R S
95350-95356	314078-314104	108820-108826	244865-244873

Tfltr	Kp	Ki	Tft	Tfv	Vfrz	Rc
0.0500	0.5000	3.0000	0.0000	0.0500	0.9000	0.0000

Xc	Kc	emax	emin	dbd1	dbd2	QMAX
0.0000	0.0000	0.0500	-0.0500	0.0000	0.0000	0.3000

QMIN	Kpg	Kig	tp	fdbd1	fdbd2	femax
-0.3000	0.5000	0.2500	0.2500	-0.0006	0.0006	999.0000

femin	Pmax	Pmin	Tg	Ddn	Dup
-999.0000	0.8681	-0.8681	0.5000	20.0000	20.0000

Bus Number for Voltage Control (if 0 local control): 765730
Branch FROM bus number: 765730
Branch TO bus number: 650285
Branch circuit ID: 1
VCFlag: 1
RefFlag: 1
Fflag: 1

RENEWABLE MODELS

REPORT FOR ALL MODELS BUS 765742 [G21-049-GEN10.6300] MODELS

Model REGCA1 Bus 765742 [G21-049-GEN10.6300] Machine "1 " :

I C O N	C O N S	S T A T E S	V A R S
79743	231782-231795	90334-90336	219119-219122

Tg	Rrpwr	Brkpt	Zerox	Lvpl1
0.0200	10.0000	0.9000	0.5000	1.1000

Volim	Lvpnt1	Lvpnt0	Iolim
1.1000	0.9000	0.0000	-1.0000

Tfltr	Khv	Iqrmax	Iqrmin	Accel
0.0100	0.0000	99.0000	-99.0000	1.0000

LVPL Switch flag: 0

Model REECA1 Bus 765742 [G21-049-GEN10.6300] Machine "1 " :

I C O N S	C O N S	S T A T E S	V A R S
86442-86447	279674-279718	99484-99489	229669-229677

Vdip	Vup	Trv	dbd1	dbd2	Kqv	Iqhl
0.9000	1.1000	0.0100	-0.1000	0.1000	1.0000	1.0000

Iqll	Vref0	Iqfrz	Thld	Thld2	Tp	QMAX
-1.0000	1.0000	0.0000	0.0000	0.0000	0.0100	0.4056

QMIN	VMAX	VMIN	Kqp	Kqi	Kvp	Kvi
-0.4056	1.1000	0.9000	0.3000	5.0000	0.5000	0.0000

Vbias	Tiq	dPMax	dPMin	Pmax	Pmin
0.0000	0.0100	99.0000	-99.0000	0.9138	0.0000

Imax	Tpord	VQ1	IQ1	VQ2	IQ2	VQ3
1.0000	0.0100	0.0000	0.0100	0.4900	0.0100	0.5000

IQ3	VQ4	IQ4	VP1	IP1	VP2	IP2
1.0000	1.2000	1.0000	0.0000	0.0100	0.4900	0.0100

VP3	IP3	VP4	IP4
0.5000	1.0000	1.2000	1.0000

PfFLAG: 0
VFLAG: 1
QFLAG: 0
PFLAG: 0
PQFLAG: 0

Model REPCA1 Bus 765742 [G21-049-GEN10.6300] Machine "1 " :

I C O N S	C O N S	S T A T E S	V A R S
95357-95363	314105-314131	108827-108833	244874-244882

Tfltr	Kp	Ki	Tft	Tfv	Vfrz	Rc
0.0500	0.5000	3.0000	0.0000	0.0500	0.9000	0.0000

Xc	Kc	emax	emin	dbd1	dbd2	QMAX
0.0000	0.0000	0.0500	-0.0500	0.0000	0.0000	0.3000

QMIN	Kpg	Kig	tp	fdbd1	fdbd2	femax
-0.3000	0.5000	0.2500	0.2500	-0.0006	0.0006	999.0000

femin	Pmax	Pmin	Tg	Ddn	Dup
-999.0000	0.9138	0.0000	0.5000	20.0000	20.0000

Bus Number for Voltage Control (if 0 local control): 765730
Branch FROM bus number: 765730
Branch TO bus number: 650285
Branch circuit ID: 1
VCFlag: 1
RefFlag: 1
Fflag: 1

2020 MDWG PRE-FINAL 1 WITH 2019 MMWG FINAL-DIS00
2020MDWG 2025S WITH 2019MMWG 2024S. CEII & RSD DATA - DO NOT

RENEWABLE MODELS

REPORT FOR ALL MODELS BUS 765745 [G21-049-GEN20.6300] MODELS

Model REGCA1 Bus 765745 [G21-049-GEN20.6300] Machine "1 " :

I C O N	C O N S	S T A T E S	V A R S
79744	231796-231809	90337-90339	219123-219126

Tg	Rrpwr	Brkpt	Zerox	Lvpl1
0.0200	10.0000	0.9000	0.5000	1.1000

Volim	Lvpnt1	Lvpnt0	Iolim
1.1000	0.9000	0.0000	-1.0000

Tfltr	Khv	Iqrmax	Iqrmin	Accel
0.0100	0.0000	99.0000	-99.0000	1.0000

LVPL Switch flag: 0

Model REECA1 Bus 765745 [G21-049-GEN20.6300] Machine "1 " :

I C O N S	C O N S	S T A T E S	V A R S
86448-86453	279719-279763	99490-99495	229678-229686

Vdip	Vup	Trv	dbd1	dbd2	Kqv	Iqhl
0.9000	1.1000	0.0100	-0.1000	0.1000	1.0000	1.0000

Iqll	Vref0	Iqfrz	Thld	Thld2	Tp	QMAX
-1.0000	1.0000	0.0000	0.0000	0.0000	0.0100	0.4056

QMIN	VMAX	VMIN	Kqp	Kqi	Kvp	Kvi
-0.4056	1.1000	0.9000	0.3000	5.0000	0.5000	0.0000

Vbias	Tiq	dPMax	dPMin	Pmax	Pmin
0.0000	0.0100	99.0000	-99.0000	0.9138	0.0000

Imax	Tpord	VQ1	IQ1	VQ2	IQ2	VQ3
1.0000	0.0100	0.0000	0.0100	0.4900	0.0100	0.5000

IQ3	VQ4	IQ4	VP1	IP1	VP2	IP2
1.0000	1.2000	1.0000	0.0000	0.0100	0.4900	0.0100

VP3	IP3	VP4	IP4
0.5000	1.0000	1.2000	1.0000

PfFLAG: 0
VFLAG: 1
QFLAG: 0
PFLAG: 0
PQFLAG: 0

Model REPCA1 Bus 765745 [G21-049-GEN20.6300] Machine "1 " :

I C O N S	C O N S	S T A T E S	V A R S
95364-95370	314132-314158	108834-108840	244883-244891

Tfltr	Kp	Ki	Tft	Tfv	Vfrz	Rc
0.0500	0.5000	3.0000	0.0000	0.0500	0.9000	0.0000

Xc	Kc	emax	emin	dbd1	dbd2	QMAX
0.0000	0.0000	0.0500	-0.0500	0.0000	0.0000	0.3000

QMIN	Kpg	Kig	tp	fdbd1	fdbd2	femax
-0.3000	0.5000	0.2500	0.2500	-0.0006	0.0006	999.0000

femin	Pmax	Pmin	Tg	Ddn	Dup
-999.0000	0.9138	0.0000	0.5000	20.0000	20.0000

Bus Number for Voltage Control (if 0 local control): 765730
Branch FROM bus number: 765730
Branch TO bus number: 650285
Branch circuit ID: 1
VCFlag: 1
RefFlag: 1
Fflag: 1

Appendix C

2025 LES FAC-002 DISIS-2021-001 IFS

Flat Start Initial Conditions Suspect

LES Resource & Transmission Planning Department

2024 MDAG 2029 Summer Peak = No Contingency Simulation

INITIAL CONDITIONS SUSPECT:

I	DSTATE(I)	STATE(I)	MODEL	STATE	BUS#-SCT	X-- NAME --X	BASKV	ID
33754	-0.18909	0.30254	UEL2	K+3	335370	1ACADIA_S26	16.000	1
33995	-0.46352	0.74163	UEL2	K+3	345397	1OSAGE 3&4	13.800	1
34016	-0.29768E-01	0.47628E-01	UEL2	K+3	345502	1PNKY 2	13.800	2
34023	-0.29768E-01	0.47628E-01	UEL2	K+3	345503	1PNKY 3	13.800	3
34030	-0.29768E-01	0.47628E-01	UEL2	K+3	345504	1PNKY 4	13.800	4
34037	-0.21654	0.34647	UEL2	K+3	345670	1RUSH G1	18.000	1
34044	-0.21714	0.34743	UEL2	K+3	345671	1RUSH G2	18.000	2
34106	-0.28157	0.45051	UEL2	K+3	345994	1RCEC G1	13.800	1
34271	-0.58945E-01	0.11789	UEL2	K+3	364702	1BROWNSVL T2	13.800	2
34292	-0.57879	0.86818E-01	UEL2	K+3	383511	2ROCKY MTN 1	20.000	1
34299	-0.57818	0.86727E-01	UEL2	K+3	383512	2ROCKY MTN 2	20.000	2
34375	-0.17697	0.28315	UEL2	K+3	635691	GDMECGT1	18.000	1
34531	-0.34856E-01	0.69712E-01	UEL2	K+3	514945	HSL 10G	13.800	1
34631	-0.11124	0.17798	UEL2	K+3	532743	EMPEC6 1	18.000	6
34756	0.96769	-1.0000	UEL2CU1	K+5	640011	GENTLM2G	24.000	2
34757	0.96769	-1.0000	UEL2CU1	K+6	640011	GENTLM2G	24.000	2
34779	-0.14734	0.23574	UEL2	K+3	652457	GARISN1G	13.800	1
34807	-0.22723	0.36357	UEL2	K+3	652461	GARISN5G	13.800	5
52010	0.10106	0.66651	GAST2A	K+5	386082	2WASH CO 2	13.800	1A
58611	0.23402	0.92774	GAST2A	K+5	656573	WISDOM G	69.000	2
84604	0.11913E-03	-0.31209E-02	CMLDBLU2	K	337516	3MCNEIL!	115.00	1
84606	0.11019E-03	0.76150E-02	CMLDBLU2	K+2	337516	3MCNEIL!	115.00	1
84687	0.72307E-04	-0.36110E-02	CMLDBLU2	K+2	337517	3LAMARTINE	115.00	IN
87171	0.10930E-03	-0.50687E-02	CMLDBLU2	K+2	337647	3ARSENAL D	115.00	IN
87196	0.11533E-03	0.74001E-02	CMLDBLU2	K	337648	3WHT BLUFF!	115.00	1
87223	0.11131E-03	-0.87010E-02	CMLDBLU2	K	337649	3HENSLEY	115.00	1
87225	0.10282E-03	0.18179E-02	CMLDBLU2	K+2	337649	3HENSLEY	115.00	1
88008	0.11042E-03	-0.11029E-01	CMLDBLU2	K+2	337717	3HS.S	115.00	1
88035	0.10908E-03	-0.98689E-02	CMLDBLU2	K+2	337718	3CARPENTER!	115.00	1
88305	0.10259E-03	-0.61012E-02	CMLDBLU2	K+2	337744	3GIFFORD	115.00	1
89709	0.84489E-04	-0.55876E-02	CMLDBLU2	K+2	337908	5MORELAND	161.00	1
89842	0.11980E-03	0.98419E-02	CMLDBLU2	K	337914	5LONDON.N	161.00	1
92569	0.14573E-03	0.84297E-02	CMLDBLU2	K	338143	1ISES U1	26.000	AX
121446	0.43250E-04	0.19562E-02	CMLDBLU2	K+14	532653	JEC U3	26.000	V1
184641	0.52303E-04	-0.20507E-02	CMLDBLU2	K+2	655333	ONIDA-ER8	69.000	BB
227596	0.73648E-04	-0.21743E-02	CMLDARU2	K	661075	POPLAR 7	115.00	Y0
227716	6045.0	-2.0000	CDCSID	K+3	652584	SIDNEYW4	230.00	MRO_SIDDC
227768	0.50590	0.20000	WELDCC	K+18	508847	WELSHDC1	345.00	WELSH-HVDC
227823	-0.65272E-01	0.0000	WELDCC	K+73	508847	WELSHDC1	345.00	WELSH-HVDC
229240	0.65899E-03	0.48928E-02	WT2G1	K	600078	G255 BUF RDG	0.6000	W
230232	0.44918E-03	-0.35852E-01	WT2G1	K	658025	G532	0.6000	W1
231025	0.64707E-03	0.40224E-01	WT2G1	K	530594	SMKYP1V80	0.6900	1
232241	0.11194E-02	0.10053	WT2E1	K+1	300008	1GNTRYG1	0.6000	1
232244	0.13001E-02	0.99206E-01	WT2E1	K+1	300009	1ACHSNG1	0.6000	1
232247	0.99331E-03	0.99206E-01	WT2E1	K+1	300273	1CLYDEG1	0.6000	1
233921	0.30100E-04	0.29630E-02	PVEU1	K+1	386887	2ORIGIS SLR	34.500	S1
233927	0.72263E-03	0.29727E-02	PVEU1	K+7	386887	2ORIGIS SLR	34.500	S1
234008	0.14172E-02	0.10973	WT2E1	K+1	600078	G255 BUF RDG	0.6000	W
234168	0.13590E-02	0.78890E-01	WT2E1	K+1	600122	G518 JHDEERW	0.5750	W
235709	0.12280E-02	0.77561E-01	WT2E1	K+1	658020	MMU WNDW	0.6000	W1
241139	-21.638	0.0000	WT3P1	K+2	274850	MENDOTA H;RU	0.6900	W
241142	-25.824	0.0000	WT3P1	K+2	274851	PROVIDENC;RU	0.6900	W3
241163	-24.588	0.0000	WT3P1	K+2	274861	TOP CROP ;1U	0.6900	W1
241166	-25.682	0.0000	WT3P1	K+2	274862	TOP CROP ;2U	0.6900	W2

241178	-30.000	0.0000	WT3P1	K+2	274872	LEE DEKAL;1U0.5750	W1
241181	-24.415	0.0000	WT3P1	K+2	274877	BISHOP HL;1U0.6900	W1
241184	-24.415	0.0000	WT3P1	K+2	274878	BISHOP HL;2U0.6900	W2
241187	-24.300	0.0000	WT3P1	K+2	274879	MINONK ;1U0.6900	W1
246590	0.60000E-03	0.24192E-02	REPCTA1	K+2	530634	SMKYP1V100 0.6900	1
246591	0.70588E-03	0.24192E-02	REPCTA1	K+3	530634	SMKYP1V100 0.6900	1

2024 MDAG 2029 Winter Peak = No Contingency Simulation

INITIAL CONDITIONS SUSPECT:

I	DSTATE(I)	STATE(I)	MODEL	STATE	BUS#-SCT	X-- NAME --X	BASKV	ID
33959	-0.16929	0.13712	UEL2	K+3	344897	1LAB G4	20.000	4
34008	-0.21840	0.34944	UEL2	K+3	345670	1RUSH G1	18.000	1
34022	-0.41676E-01	0.66681E-01	UEL2	K+3	345756	1SIOUX 1	18.000	H
34029	-0.32054E-01	0.51286E-01	UEL2	K+3	345756	1SIOUX 1	18.000	L
34263	-0.57553	0.86330E-01	UEL2	K+3	383511	2ROCKY MTN	120.000	1
34595	-0.87200E-01	0.13952	UEL2	K+3	532742	EMPEC5 1	18.000	5
34727	0.95841	-1.0000	UEL2CU1	K+5	640011	GENTLM2G	24.000	2
34728	0.95841	-1.0000	UEL2CU1	K+6	640011	GENTLM2G	24.000	2
34750	-0.16294	0.26070	UEL2	K+3	652457	GARISN1G	13.800	1
34771	-0.13119	0.20991	UEL2	K+3	652460	GARISN4G	13.800	4
50940	0.11233	0.62932	GAST2A	K+5	383661	2DAHLBERG 1	13.800	1
50953	0.11636	0.61603	GAST2A	K+5	383662	2DAHLBERG 2	13.800	2
50966	0.11256	0.62856	GAST2A	K+5	383663	2DAHLBERG 3	13.800	3
50989	0.11256	0.62856	GAST2A	K+5	383665	2DAHLBERG 5	13.800	5
51002	0.11171	0.63135	GAST2A	K+5	383666	2DAHLBERG 6	13.800	6
51028	0.11568	0.61826	GAST2A	K+5	383668	2DAHLBERG 8	13.800	8
51051	0.11039	0.63572	GAST2A	K+5	383670	2DAHLBERG 10	13.800	10
51198	0.89393E-01	0.70500	GAST2A	K+5	383741	2RAFB CT A	13.800	A
51211	0.89392E-01	0.70500	GAST2A	K+5	383742	2RAFB CT B	13.800	B
51508	0.23381	0.22844	GAST2A	K+5	383855	2TIGER CK1	18.000	1
51521	0.23381	0.22844	GAST2A	K+5	383856	2TIGER CK2	18.000	2
51534	0.24535	0.19034	GAST2A	K+5	383857	2TIGER CK3	18.000	3
51547	0.24535	0.19034	GAST2A	K+5	383858	2TIGER CK4	18.000	4
51982	0.10140	0.66537	GAST2A	K+5	386082	2WASH CO 2	13.800	1A
52214	0.30143E-01	0.90053	GAST2A	K+5	386450	2GREENCOA	13.800	A
52227	0.39953E-01	0.86816	GAST2A	K+5	386451	2GREENCOB	13.800	B
52240	0.44855E-01	0.85198	GAST2A	K+5	386452	2GREENCOC	13.800	C
52253	0.39950E-01	0.86816	GAST2A	K+5	386453	2GREENCOD	13.800	D
52266	0.44855E-01	0.85198	GAST2A	K+5	386454	2GREENCOE	13.800	E
52279	0.49760E-01	0.83579	GAST2A	K+5	386455	2GREENCOF	13.800	F
52292	0.35045E-01	0.88435	GAST2A	K+5	386456	2GREENCOG	13.800	G
52305	0.39951E-01	0.86816	GAST2A	K+5	386457	2GREENCOH	13.800	H
58586	0.23401	0.92777	GAST2A	K+5	656573	WISDOM G	69.000	2
150198	0.48838E-04	0.17750E-02	CMLDBLU2	K+2	635225	MORNINGSIDE5	161.00	M0
165291	0.52973E-04	-0.31616E-02	CMLDBLU2	K+2	655408	SXFCHCLR-ER7	115.00	BB
167584	0.56382E-04	0.10758E-02	CMLDBLU2	K	659172	LUDDEN -CP7	115.00	BB
167829	0.51744E-04	0.26021E-02	CMLDBLU2	K+2	659536	BEAVRHIL-GW7	115.00	BB
174226	0.78454E-04	0.60053E-02	CMLDOWU2	K	658098	BENSONM7	115.00	R0
206061	0.67055E-04	-0.52670E-02	CMLDARU2	K+2	661077	PLNTYWD7	115.00	Y0
206169	0.77783E-04	-0.77400E-02	CMLDARU2	K+2	661089	LTLMUDY7	115.00	Y0
206599	0.78789E-04	0.18987E-02	CMLDARU2	K	652421	WILISTN7	115.00	Y0
206989	6045.0	-2.0000	CDCSID	K+3	652584	SIDNEYW4	230.00	MRO_SIDDC
207041	0.50590	0.20000	WELDCC	K+18	508847	WELSHDC1	345.00	WELSH-HVDC
207096	-0.65272E-01	0.0000	WELDCC	K+73	508847	WELSHDC1	345.00	WELSH-HVDC
208756	-0.63658E-04	-0.62829E-02	WT1G1	K	600165	LK AGASSIZ G	0.6000	W
220412	-10.990	0.0000	WT3P1	K+2	274850	MENDOTA H;RU	0.6900	W

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220415   -17.100       0.0000     WT3P1              K+2    274851     PROVIDENC;RU0.6900  W3
220436   -11.029       0.0000     WT3P1              K+2    274861     TOP CROP ;1U0.6900  W1
220439   -20.227       0.0000     WT3P1              K+2    274862     TOP CROP ;2U0.6900  W2
220451   -30.000       0.0000     WT3P1              K+2    274872     LEE DEKAL;1U0.5750  W1
220454   -17.360       0.0000     WT3P1              K+2    274877     BISHOP HL;1U0.6900  W1
220457   -17.360       0.0000     WT3P1              K+2    274878     BISHOP HL;2U0.6900  W2
220460   -17.100       0.0000     WT3P1              K+2    274879     MINONK   ;1U0.6900  W1
225863   0.60000E-03  0.39830E-01 REPCTA1            K+2    530634     SMKYP1V100  0.6900  1
225864   0.70588E-03  0.39830E-01 REPCTA1            K+3    530634     SMKYP1V100  0.6900  1
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Appendix D

2025 LES FAC-002 DISIS-2021-001 IFS

2029 Summer Peak Dynamic Study Graphic Output

LES Resource & Transmission Planning Department

Dynamic Study Results for the 2029 Summer Peak are available upon request from LES Resource and Transmission Planning Department

Appendix E

2025 LES FAC-002 DISIS-2021-001 IFS

2029 Winter Peak Dynamic Study Graphic Output

LES Resource & Transmission Planning Department

Dynamic Study Results for the 2029 Winter Peak are available upon request from LES Resource and Transmission Planning Department

Appendix F

2025 LES FAC-002 DISIS-2021-001 IFS

Breaker Rating Spreadsheet

LES Resource & Transmission Planning Department

DATE_TIME	VERSION	BASE_MVA
Thu Aug 07 14:20:31 2025	15.7	100

			Base Case	Forecasted Load. DISIS Gens all OFF			Forecasted Load. DISIS Gens all ON				
					Delta from Base			Delta from Base	Delta from Forecasted Load		Delta from DISIS Gens
BUS_NO	BUS	BREAKER	% Loaded	% Loaded	Case % Loaded	Fault Current (A)	% Loaded	Case % Loaded	Case % Loaded	Fault Current (A)	OFF Fault Current
650189	103ROK 3 345.kV	CB3001	37.3	37.8	0.5	15289.5	38.2	0.9	0.4	15108.7	181
650189	103ROK 3 345.kV	CB3002	39.1	39.7	0.6	16142.8	40.4	1.3	0.7	15871.5	271
650189	103ROK 3 345.kV	CB3003	39.1	39.7	0.6	16142.8	40.4	1.3	0.7	15871.5	271
650279	120&ALVO7 115.kV	CB1001	24.2	24.5	0.3	15812.1	25.1	0.9	0.6	15419.4	393
650219	17&HOL 7 115.kV	CB1001	32.1	33.9	1.8	21785.3	34.6	2.5	0.7	21333.7	452
650219	17&HOL 7 115.kV	CB1002	32.1	34.2	2.1	21952	34.8	2.7	0.6	21526.7	425
650219	17&HOL 7 115.kV	CB1003	31.7	34.2	2.5	21952	34.8	3.1	0.6	21526.7	425
650215	19&ALVO7 115.kV	CB1001	59.5	73.5	14	26244.5	74.9	15.4	1.4	25754.9	490
650215	19&ALVO7 115.kV	CB1002	58.8	72.6	13.8	25903.6	74	15.2	1.4	25433.3	470
650215	19&ALVO7 115.kV	CB1003	53.5	66	12.5	26947.5	67.4	13.9	1.4	26396	552
650215	19&ALVO7 115.kV	CB1004	53.5	66	12.5	26947.5	67.4	13.9	1.4	26396	552
650230	2&N 7 115.kV	CB1001	59.2	63.2	4	25894.8	64.7	5.5	1.5	25279.1	616
650230	2&N 7 115.kV	CB1002	61.4	65.8	4.4	26937	67.3	5.9	1.5	26302.1	635
650230	2&N 7 115.kV	CB1003	61.4	65.8	4.4	26959.7	67.4	6	1.6	26323.4	636
650230	2&N 7 115.kV	CB1004	61.2	65.8	4.6	26959.7	67.4	6.2	1.6	26323.4	636
650230	2&N 7 115.kV	CB1005	60.3	63.2	2.9	25955.2	64.9	4.6	1.7	25297.5	658
650230	2&N 7 115.kV	CS3092	65.4	69.9	4.5	28712.6	71.8	6.4	1.9	27960.6	752
650238	20&PIO 7 115.kV	CB1001	42.6	44.7	2.1	29110.4	46.2	3.6	1.5	28171.2	939
650238	20&PIO 7 115.kV	CB1002	44.1	46.6	2.5	30366.2	48.2	4.1	1.6	29378.3	988
650238	20&PIO 7 115.kV	CB1003	44.1	46.6	2.5	30366.2	48.2	4.1	1.6	29378.3	988
650238	20&PIO 7 115.kV	CB1004	41.8	44	2.2	28629.4	45.4	3.6	1.4	27737	892
650238	20&PIO 7 115.kV	CB1005	42.6	44.7	2.1	29126	46.2	3.6	1.5	28186.3	940
650238	20&PIO 7 115.kV	CB1006	42.6	44.7	2.1	29126	46.2	3.6	1.5	28186.3	940
650248	21&N 7 115.kV	CB1001	28.1	30.1	2	19269.5	30.6	2.5	0.5	18941	329
650229	27&PINE7 115.kV	CB1001	39.9	40.6	0.7	16783.5	42	2.1	1.4	16241.3	542
650240	29&LEIG7 115.kV	CB1001	25.8	26.9	1.1	17262.1	27.4	1.6	0.5	16977.3	285
650240	29&LEIG7 115.kV	CB1002	25.8	26.9	1.1	17262.1	27.4	1.6	0.5	16977.3	285
650240	29&LEIG7 115.kV	CB1003	25.8	26.9	1.1	17261.7	27.4	1.6	0.5	16976.9	285
650252	30&A 7 115.kV	CB1001	25.1	26.2	1.1	16762	26.6	1.5	0.4	16523	239
650233	33&SUP 7 115.kV	CB3301	47.7	52.9	5.2	21540.1	53.9	6.2	1	21150	390
650233	33&SUP 7 115.kV	CB3302	47.7	52.9	5.2	21540.1	53.9	6.2	1	21150	390
650233	33&SUP 7 115.kV	CB3303	46.1	51.2	5.1	20836.9	52.1	6	0.9	20482.5	354
650233	33&SUP 7 115.kV	CB3391	55.9	61.7	5.8	25233.6	63.1	7.2	1.4	24680.6	553
650205	48&MORT 7 115.kV	CB1001	39	45.4	6.4	18414.2	46	7	0.6	18171.8	242
650247	40&BEN 7 115.kV	CB1001	31.7	32.3	0.6	20857.7	33.1	1.4	0.8	20354.7	503
650247	40&BEN 7 115.kV	CB1003	31.7	32.3	0.6	20857.7	33.1	1.4	0.8	20354.7	503
650247	40&BEN 7 115.kV	CB1004	28	28.4	0.4	18216.9	28.9	0.9	0.5	17885.9	331
650258	40&GER 7 115.kV	CB1001	49.8	51.5	1.7	18406.9	52.6	2.8	1.1	18030.2	377
650250	40&ROK 7 115.kV	CB1001	47.9	48.8	0.9	20058.2	50.1	2.2	1.3	19527.4	531
650250	40&ROK 7 115.kV	CB1002	47.9	48.8	0.9	20058.2	50.1	2.2	1.3	19527.4	531
650250	40&ROK 7 115.kV	CB1003	27.7	28.3	0.6	18282.7	29	1.3	0.7	17810.5	472
650250	40&ROK 7 115.kV	CS5091	54	55.3	1.3	22775.3	56.9	2.9	1.6	22133.1	642
650256	56&EV 7 115.kV	CB1001	32.1	33.8	1.7	21750	34.5	2.4	0.7	21278.3	472
650256	56&EV 7 115.kV	CB1002	34	35.9	1.9	23127.2	36.7	2.7	0.8	22586.8	540
650256	56&EV 7 115.kV	CB1004	34	35.9	1.9	23127.2	36.7	2.7	0.8	22586.8	540
650260	56&Q 7 115.kV	CB1001	83.7	88.6	4.9	18495.8	90.2	6.5	1.6	18166.6	329
650262	57&GAR 7 115.kV	CB1001	45.9	48.9	3	25435.8	50.2	4.3	1.3	24785.8	650
650262	57&GAR 7 115.kV	CB1002	58.1	62	3.9	25435.8	63.6	5.5	1.6	24785.8	650
650262	57&GAR 7 115.kV	CB1003	57.2	61.8	4.6	25313.4	63.3	6.1	1.5	24701.1	612
650269	70&BLUF7 115.kV	CB1001	36.7	48	11.3	24495.9	49	12.3	1	24017.4	479
650269	70&BLUF7 115.kV	CB1002	46.4	61.3	14.9	31388.8	62.8	16.4	1.5	30647.3	742
650269	70&BLUF7 115.kV	CB1003	62.8	81.1	18.3	33209	83	20.2	1.9	32455.4	754
650269	70&BLUF7 115.kV	CB1004	43.9	54.6	10.7	27802.3	55.6	11.7	1	27303.3	499
650269	70&BLUF7 115.kV	CB6900	57.9	76.6	18.7	31388.8	78.5	20.6	1.9	30647.3	742
650270	70&CAL 7 115.kV	CB1001	41.3	43.8	2.5	28459	45.2	3.9	1.4	27622.2	837
650270	70&CAL 7 115.kV	CB1002	41.3	43.8	2.5	28459	45.2	3.9	1.4	27622.2	837
650270	70&CAL 7 115.kV	CB1003	41.7	44	2.3	28586.2	45.4	3.7	1.4	27728.1	858
650270	70&CAL 7 115.kV	CB1005	41.7	44.1	2.4	28614.4	45.4	3.7	1.3	27754.7	860
650270	70&CAL 7 115.kV	CB1006	41.7	44.1	2.4	28614.4	45.4	3.7	1.3	27754.7	860
650217	8&N 7 115.kV	CB1001	58.7	62.1	3.4	22213.9	63.4	4.7	1.3	21759.3	455
650271	81&OC 7 115.kV	CB7101	54.9	57.3	2.4	23508.3	58.8	3.9	1.5	22925.7	583
650271	81&OC 7 115.kV	CB7102	54.9	57.3	2.4	23508.3	58.8	3.9	1.5	22925.7	583
650271	81&OC 7 115.kV	CB7103	53.2	55.9	2.7	22913.4	57.3	4.1	1.4	22349.8	564
650275	84&BLUF7 115.kV	CB1001	49.5	56.8	7.3	36437	57.8	8.3	1	35796	641
650275	84&BLUF7 115.kV	CB1002	41.8	56	14.2	35774.8	56.8	15	0.8	35281.1	494
650275	84&BLUF7 115.kV	CB1003	44	58.5	14.5	37406.1	59.4	15.4	0.9	36852.5	554
650275	84&BLUF7 115.kV	CB1004	46.1	59	12.9	37889	60.1	14	1.1	37141.5	748
650275	84&BLUF7 115.kV	CB1005	46.1	59	12.9	37889	60.1	14	1.1	37141.5	748
650275	84&BLUF7 115.kV	CB1006	49.5	56.8	7.3	36437	57.8	8.3	1	35796	641
650267	84&LEIG7 115.kV	CB1001	67.9	73.7	5.8	30419.8	76	8.1	2.3	29468	952
650267	84&LEIG7 115.kV	CB1002	65.6	68.2	2.6	28247.1	70.6	5	2.4	27297.5	950
650267	84&LEIG7 115.kV	CB1003	71.2	77.9	6.7	32185.5	80.5	9.3	2.6	31163	1023
650267	84&LEIG7 115.kV	CB1004	71.2	77.9	6.7	32185.5	80.5	9.3	2.6	31163	1023
650267	84&LEIG7 115.kV	CB1005	71.1	77.9	6.8	32168.8	80.4	9.3	2.5	31147.4	1021
650274	91&HWY27 115.kV	CB1001	48.7	50.3	1.6	20590.8	51.5	2.8	1.2	20132.4	458
650274	91&HWY27 115.kV	CB1002	32	33.1	1.1	21360.6	33.9	1.9	0.8	20849.8	511
650274	91&HWY27 115.kV	CB1004	32	33.1	1.1	21360.6	33.9	1.9	0.8	20849.8	511
0	NORTH BLUFF 115KV 115.kV	CB1003	N/A	65	N/A	41786	66.3	N/A	1.3	40932.6	853
0	NORTH BLUFF 115KV 115.kV	CB1004	N/A	65	N/A	41787.1	66.3	N/A	1.3	40933.8	853
0	NORTH BLUFF 115KV 115.kV	CB1005	N/A	65	N/A	41786	66.3	N/A	1.3	40932.6	853
0	NORTH BLUFF 115KV 115.kV	CB1006	N/A	65	N/A	41786.7	66.3	N/A	1.3	40933.4	853
0	NORTH BLUFF 115KV 115.kV	CB1007	N/A	65	N/A	41786	66.3	N/A	1.3	40932.6	853
0	NORTH BLUFF 115KV 115.kV	CB1008	N/A	65	N/A	41787.1	66.3	N/A	1.3	40933.8	853
0	NORTH BLUFF 115KV 115.kV	CB1009	N/A	65	N/A	41786	66.3	N/A	1.3	40932.6	853
0	NORTH BLUFF 115KV 115.kV	CB1010	N/A	65	N/A	41786.7	66.3	N/A	1.3	40933.4	853
0	NORTH BLUFF 115KV 115.kV	CB1011	N/A	65	N/A	41786	66.3	N/A	1.3	40932.6	853
0	NORTH BLUFF 115KV 115.kV	CB1103	N/A	65	N/A	41787.1	66.3	N/A	1.3	40933.8	853
0	NORTH BLUFF 115KV 115.kV	CB1105	N/A	65	N/A	41786.7	66.3	N/A	1.3	40933.4	853
0	NORTH BLUFF 115KV 115.kV	CB1107	N/A	65	N/A	41787.1	66.3	N/A	1.3	40933.8	853
0	NORTH BLUFF 115KV 115.kV	CB1109	N/A	65	N/A	41786.7	66.3	N/A	1.3	40933.4	853
0	NORTH BLUFF 115KV 115.kV	CB1111	N/A	65	N/A	41786	66.3	N/A	1.3	40932.6	853
0	NORTH BLUFF 345 KV 345.kV	CB3001	N/A	42.5	N/A	17296.8	43.2	N/A	0.7	17018.8	278
0	NORTH BLUFF 345 KV 345.kV	CB3002	N/A	42.5	N/A	17296.8	43.2	N/A	0.7	17018.8	278
0	NORTH BLUFF 345 KV 345.kV	CB3003	N/A	42.5	N/A	17296.8	43.2	N/A	0.7	17018.8	278
0	NORTH BLUFF 345 KV 345.kV	CB3004	N/A	42.5	N/A	17296.8	43.2	N/A	0.7	17018.8	278
650470	Cap 7091 115.kV	CS7091	68.9	73.2	4.3	30220.6	75.6	6.7	2.4	29275.7	945
650242	FOLSOM&PH 7 115.kV	CB1001	42.6	43.6	1	28757.8	45.6	3	2	27441.8	1316
650242	FOLSOM&PH 7 115.kV	CB1002	43.8	44.6	0.8	29528.2	46.9	3.1	2.3	28071.2	1457
650242	FOLSOM&PH 7 115.kV	CB1003	43.8	44.6	0.8	29528.2	46.9	3.1	2.3	28071.2	1457
650242	FOLSOM&PH 7 115.kV	CB1004	42.6	43.6	1	28757.8	45.6	3	2	27441.8	1316
650314	NW68HOL19 13.8kV	CB1411	108.5	109	0.5	33282.5	109.4	0.9	0.4	33175.8	107
650314	NW68HOL19 13.8kV	RS1412	1422.7	1429.8	7.1	28691.7	1434.6	11.9	4.8	28595.5	96
650114	NW68HOL3 345.kV	CB3001	39.5	41.2	1.7	16660.1	41.7	2.2	0.5	16468	192
650114	NW68HOL3 345.kV	CB3003	39.5	41.2	1.7	16660.1	41.7	2.2	0.5	16468	192
650114	NW68HOL3 345.kV	CB3004	32.3	32.4	0.1	13059.6	32.6	0.3	0.2	12948.2	111
650114	NW68HOL3 345.kV	CB3005	36	37.1	1.1	15079.3	37.7	1.7	0.6	14834.6	245
650114	NW68HOL3 345.kV	CB3006	36	37.1	1.1	15079.3	37.7	1.7	0.6	14834.6	245
650214	NW68HOL7 115.kV	CB1001	65.3	66.4	1.1	26994.3	67.5	2.2	1.1	26567.6	427
650214	NW68HOL7 115.kV	CB1002	67.8	69.4	1.6	28277.6	70.7	2.9	1.3	27775.5	502
650214	NW68HOL7 115.kV	CB1003	39.7	40.3	0.6	25723.1	40.8	1.1	0.5	25366.5	357
650214	NW68HOL7 115.kV	CB1004	67.8	69.4	1.6	28277.6	70.7	2.9	1.3	27775.5	502
650214	NW68HOL7 115.kV	CB1005	62.5	63.8	1.3	25827.2	64.6	2.1	0.8	25531.9	295
650214	NW68HOL7 115.kV	CB1006	39.7	40.5	0.8	25827.2	41	1.3	0.5	25531.9	295
650210	NW70&FAIR 115.kV	CB1001	29	29.3	0.3	18660.1	29.6	0.6	0.3	18457.5	203
650290	ROKEBY 7 115.kV	CB9001	69.2	70.9	1.7	30899.4	77.2	8	6.3	28357	2542
650290	ROKEBY 7 115.kV	CB9002	66	67.3	1.3	29455.7	73.6	7.6	6.3	26936.8	2519
650290	ROKEBY 7 115.kV	CB9003	70.3	72	1.7	31375.9	78.4	8.1	6.4	28818.9	2557
650290	ROKEBY 7 115.kV	CB9004	69.2	70.9	1.7	30899.4	77.2	8	6.3	28357	2542
650290	ROKEBY 7 115.kV	CB9005	68.8	70.3	1.5	30640.4	76.6	7.8	6.3	28123.2	2517
650290	ROKEBY 7 115.kV	CB9006	70.3	72	1.7	31375.9	78.4	8.1	6.4	28818.9	2557
650091	ROKEBY1G 13.8kV	CB901	77.8	77.8	0	31298.3	77.8	0	0	31299.8	-2
650092	ROKEBY2G 13.8kV	CB902	79.2	79.4	0.2	39936.8	79.9	0.7	0.5	39706.9	230
650093	ROKEBY3G 13.8kV	CB903	62.4	62.6	0.2	31558.9	63.1	0.7	0.5	31309.9	249

650001	SVGS 1G 13.8kV	CB771	80.1	82	1.9	33035.1	82.1	2	0.1	32975.9	59
650002	SVGS 2G 13.8kV	CB772	77	78.8	1.8	31761.4	79	2	0.2	31702.1	59
650003	SVGS 3G 13.8kV	CB773	77.8	79.7	1.9	32131.7	79.9	2.1	0.2	32070.9	61
650004	SVGS 4G 13.8kV	CB774	79.9	81.8	1.9	32952.8	81.9	2	0.1	32894.3	59
749	SVGS North 115.kV	CB7701	46	57.3	11.3	36744.2	58.3	12.3	1	36101.9	642
749	SVGS North 115.kV	CB7702	45.1	56.4	11.3	36206.7	57.5	12.4	1.1	35562.4	644
749	SVGS North 115.kV	CB7703	45	56.4	11.4	36182.9	57.4	12.4	1	35538.9	644
748	SVGS South 115.kV	CB7704	42.9	53.6	10.7	34400.6	54.6	11.7	1	33792	609
650006	SVGS Unit3 0.48kV	CB7732	59	59	0	50176.7	59	0	0	50174.7	2
650008	SVGS Unit4 0.48kV	CB7742	54.4	54.4	0	46263.7	54.4	0	0	46262.2	2
650246	SW7 & BENNET 115.kV	CB1001	31.2	31.5	0.3	20215.7	32.1	0.9	0.6	19855.8	360
650246	SW7 & BENNET 115.kV	CB1002	37.6	38.3	0.7	24722.8	39.2	1.6	0.9	24107.1	616
650246	SW7 & BENNET 115.kV	CB1004	37.6	38.3	0.7	24722.8	39.2	1.6	0.9	24107.1	616
650005	SWG0100 4.16kV	CB7731	71.2	71.3	0.1	33463	71.3	0.1	0	33457.8	5
650007	SWG0200 4.16kV	CB7741	73.8	74	0.2	34701.6	74	0.2	0	34696.1	6
650009	SWG0300 BS 4.16kV	CB301	85.4	85.5	0.1	40136.6	85.6	0.2	0.1	40131.2	5
0	T901 Hi Side 115.kV	CS9010	511.3	523	11.7	33771.9	562.9	51.6	39.9	31382.4	2390
0	T902 Hi Side 115.kV	CS9020	115	117.7	2.7	31689	126.8	11.8	9.1	29435.6	2253
0	T903 Hi Side 115.kV	CS9030	114.8	117.6	2.8	31640.7	126.6	11.8	9	29389.3	2251
650185	WAGENER3 345.kV	CB3001	49.2	50.5	1.3	20548	51.4	2.2	0.9	20212.2	336
650185	WAGENER3 345.kV	CB3002	49.1	50.5	1.4	20523.3	51.3	2.2	0.8	20192.1	331
650185	WAGENER3 345.kV	CB3003	49.2	50.5	1.3	20548	51.4	2.2	0.9	20212.2	336
650185	WAGENER3 345.kV	CB3004	49.1	50.5	1.4	20523.3	51.3	2.2	0.8	20192.1	331
650185	WAGENER3 345.kV	CB3006	44.3	44.4	0.1	18027.6	45.1	0.8	0.7	17753.2	274
650285	WAGENER7 115.kV	CB1001	47.3	48.2	0.9	32789.9	52	4.7	3.8	30384.8	2405
650285	WAGENER7 115.kV	CB1003	52.7	54.1	1.4	36181.8	57.4	4.7	3.3	34083.8	2098
650285	WAGENER7 115.kV	CB1004	81.4	83.5	2.1	35529	88.8	7.4	5.3	33390.2	2139
650285	WAGENER7 115.kV	CB1005	52.7	54.1	1.4	36181.8	57.4	4.7	3.3	34083.8	2098
650285	WAGENER7 115.kV	CB1006	51.7	53	1.3	35529	56.4	4.7	3.4	33390.2	2139
650385	WAGENR19 13.8kV	CB8511	1122.5	1127	4.5	33883.4	1129.4	6.9	2.4	33809.2	74
650485	WAGENR29 13.8kV	CB8521	100.5	100.7	0.2	30850.7	101.4	0.9	0.7	30661.7	189
650283	WAVERLY7 115.kV	CB8301	34.4	40.7	6.3	16414.3	41	6.6	0.3	16262.2	152
650208	WLINC 7 115.kV	CB1001	29.2	30.3	1.1	19448.5	30.9	1.7	0.6	19077.1	371

Appendix G

2025 LES FAC-002 DISIS-2021-001 IFS

Scope of Work One-lines

LES Resource & Transmission Planning Department

Wagener Substation (S85) One-line

TO OH LINE, SW 4826

115kV CONTROL BLDG
ALTERNATE BACK-UP
STATION SERVICE
12.5kV - 208/120V
150kVA - #101636

SEE DRAWING #010837
FOR MORE DETAIL

TO OH LINE, SW 5919

ALTERNATE BACK-UP
STATION SERVICE
(SOURCE 3)
12.5kV - 480/277V
300kVA - #88197

PRIMARY BACK-UP
STATION SERVICE
(SOURCE 2)
13.8kV - 480/277V
300kVA - #98336

AUTO-
TRANSFER
SWITCH

LOAD

AUXILIARY TRF
(DRY TYPE)
480V - 208/120V
150kVA - #202513

8511-D

CB8511

30 MVAR
SHUNT
REACTOR

S & C
POTENTIAL
DEVICE

.5A

117D

GROUND
TRANSFORMER
3-5 kVA

13.8kV BUS

20A

115D

STATION SERVICE
(SOURCE 1)
13.8kV - 480/277V
300kVA - #64377

8512-D

T851
AUTOTRANSFORMER
180/336MVA
345/115/13.8kV

L1485 TO NW 68TH & HOLDREGE
345kV

L3472 TO GRETNA
345kV

NORTH

LT-34L CVT, AØ

MOS
3064L

LT-34 CVT'S

LT-36L CVT, AØ

345kV SWITCH
MOS 3066L

3-CT'S, METERING

3-PT'S, METERING

LT-36 CVT'S

L7985 TO
120TH & ALVO
115kV

MOS1066L

LT-16 CVT'S

RANGER

MOS
1064L

LT-14 CVT'S

3-PT'S, METERING

3-CT'S, METERING

1062T

1004-D2

CB1004

1004-D1

LT-12
CVT'S

1006-D1

CB1006

1006-D2

1010-D2

1002-D1

CB1002

1002-D2

MOS
3062T

LT-32
CVT'S

3004-D2

CB3004

3004-D1

3002-D2

CB3002

3002-D1

3006-D2

CB3006

3006-D1

TOP BUS

LT-12
CVT'S

1007-D2

1005-D1

1001-D2

CB1005

CB1001

1005-D2

1001-D1

LT-15 CVT'S

1003-D1

CB1003

1003-D2

LT-13 CVT'S

MOS
1065L

MOS
1063L

1061T

L6785 TO
84TH & LEIGHTON
115kV

L7185 TO
81ST & OLD CHENEY
115kV

1-PT

S & C
POTENTIAL
DEVICE

30 MVAR
SHUNT
REACTOR #2

CB8521

217D

3-PT'S

8521-D

T852
AUTOTRANSFORMER
180/336MVA
345/115/13.8kV

MOS
3061T

3001-D1

CB3001

3001-D2

3003 - D1

CB3003

3003-D2

3005-D1

LT-33 CVT'S, BØ & CØ

MOS
3063L

LT-33L CVT, AØ

L8589 TO
103RD & ROKEBY SUBSTATION
345kV

E-0200

MT 05/20/2019
AS-BUILT #5026972-03

MT 05/15/2019 PRI LINE
RELAY #5026972-03

JB 10/04/2018 CLARIFY
STA SRV TRFS

GP 09/20/2016
AS-BUILT #5023205

GP 06/15/2015
UPGRADE 115KV
EQUIPMENT #5023205

DW 07/20/2011
AS-BUILT #5017037

GP 07/20/2011
AS-BUILT #5017047

DW 12/16/2010 ADD
SW 8512-D #5017037

GP 07/2010 ADD CB'S
3001 & 3003 CENTRAL
POWER #5017047

GP/JP 06/11/2010
AS-BUILT #5016876 &
#5015850

GP 04/02/2010
REPLACE PT'S WITH
CVT'S #5016876

REVISIONS

LINCOLN ELECTRIC SYSTEM

BASE	V STRATTON	07/07/97
DRAWN BY		
DESIGNED BY	WESOLOWSKI	11/10/2003
CHECKED BY		
CHECKED BY		
APPROVED BY		

NETWORK:
W.O.
JOB:
D.N.
STR.
SCALE: NONE

S085 - WAGENER SUBSTATION
115kV/345kV
1-LINE DIAGRAM

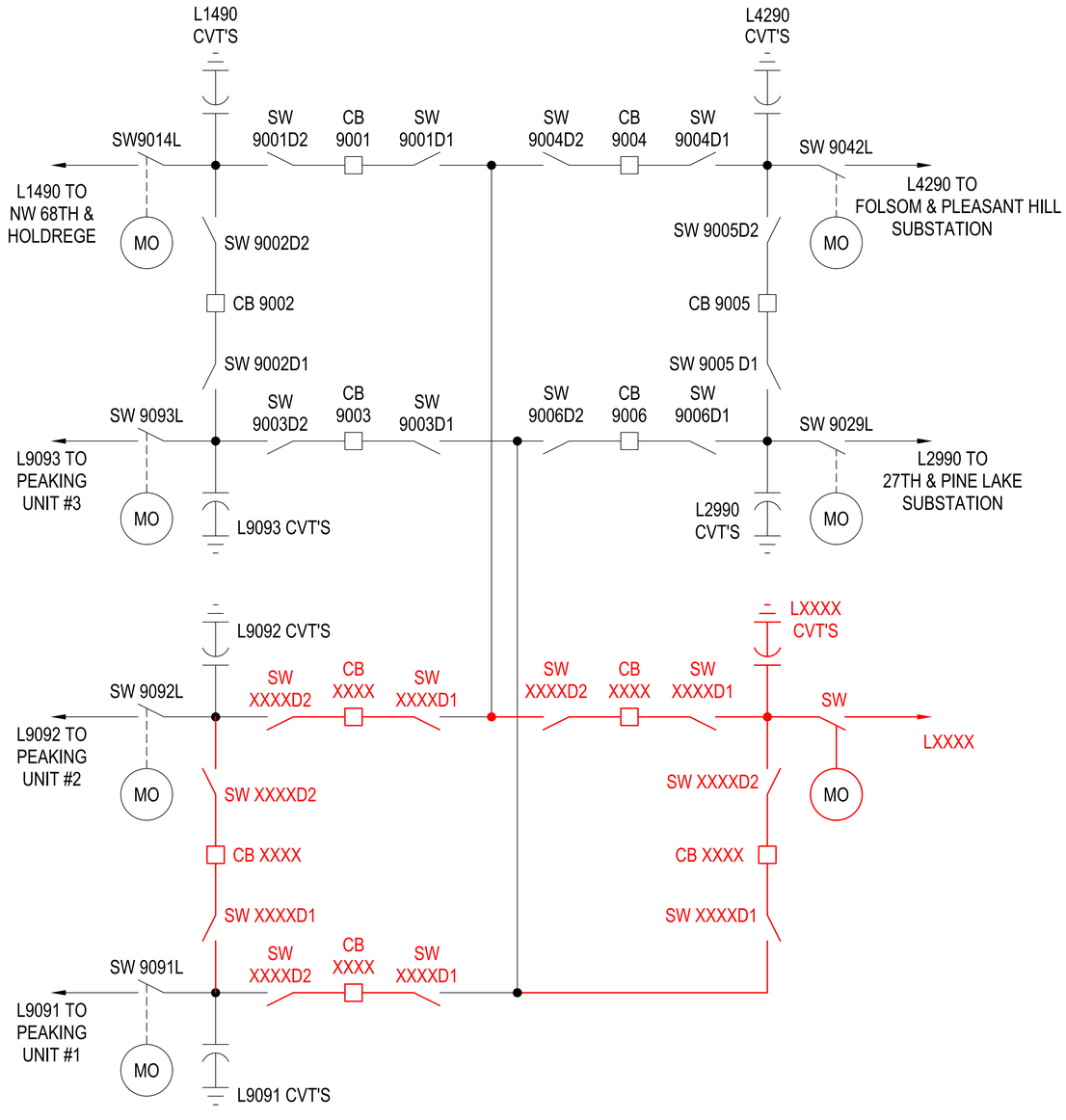
DRAWING NO.
000280
SHT. 1 of 1

L:\ED\Substation\Design\Engineers\GPella\IP's\S085 Ranger\S085SCERT\DesignFiles\Approved\Concept\S085SCERT_1-Line_260.dwg CB1002 Jun 01, 2023 - 9:47

Rokeby Substation (S90) One-line

7 Terminal Configuration

NORTH



REV	DESCRIPTION	APPROVED	DATE
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

REVISIONS

LINCOLN ELECTRIC SYSTEM

BASE	####	####
DRAWN BY	ER	6/1/23
DESIGNED BY	####	####
CHECKED BY	####	####
CHECKED BY	####	####
APPROVED BY	####	####

NETWORK: ####
W.O.
JOB:
D.N. ####
STR.
SCALE: ########

S090 PRELIM 1-LINE FOR FIRST TERMINAL ADDITION

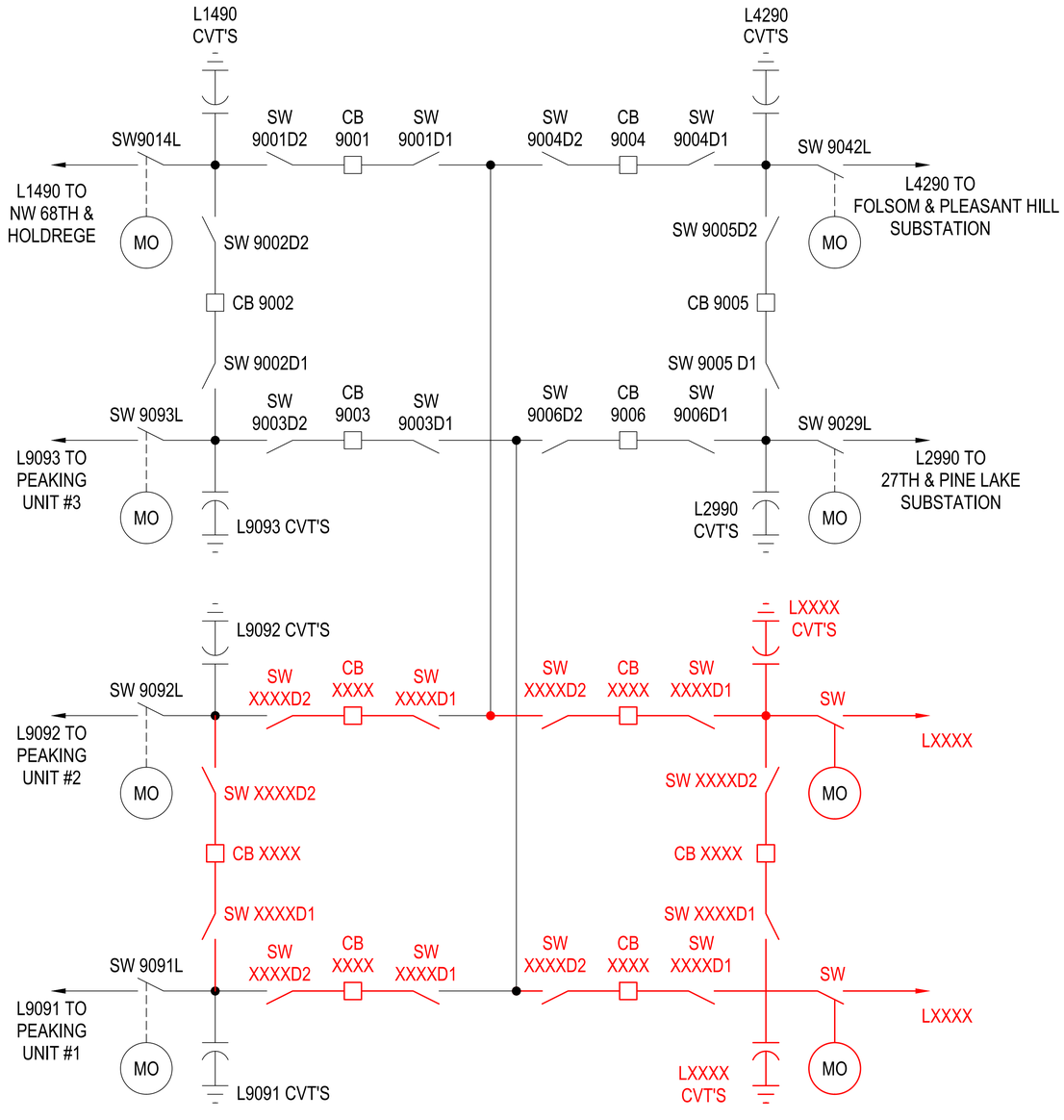
DRAWING NO.

C:\Users\ereimer\AppData\Local\Temp\AcPublish_20344\2023.02.06 Prelim 1 Line 1 or 2 Terminal Addition.dwg FIRST TERMINAL ADD Jun 01, 2023 - 12:34

Rokeby Substation (S90) One-line

8 Terminal Configuration

NORTH



REV	DESCRIPTION	APPROVED	DATE
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

REVISIONS

LINCOLN ELECTRIC SYSTEM

BASE	####	####
DRAWN BY	ER	6/1/23
DESIGNED BY	####	####
CHECKED BY	####	####
CHECKED BY	####	####
APPROVED BY	####	####

NETWORK: ####
W.O.
JOB:
D.N. ####
STR.
SCALE: #########

S090 PRELIM 1-LINE FOR 2 TERMINAL ADDITION

DRAWING NO.

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