# NPPD
# DISIS-2023-001
# FACILITY STUDY

## GEN-2023-222/223 (Beatrice Power Station)
## GEN-2023-224/225 (Princeton Road Station)

## FEBRUARY 2026

**PREPARED FOR:**
**SOUTHWEST POWER POOL**

**PREPARED BY:**
**NEBRASKA PUBLIC POWER DISTRICT**
**ENERGY DELIVERY**
**TRANSMISSION ASSET PLANNING**
**ENGINEERING & ASSET MANAGEMENT**

**Nebraska Public Power District**
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## Introduction

The *NPPD DISIS-2023-001 Facility Study* was performed to document the interconnection facilities and network upgrades identified by SPP in Phase 2 Re-Study #1 of the SPP DISIS-2023-001 Study for the following requests:

GEN-2023-222 (Beatrice Power Station)
GEN-2023-223 (Beatrice Power Station)
GEN-2023-224 (Princeton Road Station)
GEN-2023-225 (Princeton Road Station)

NPPD also reviewed the proposed interconnection facilities and network upgrades and associated generation interconnection request impacts on the Short Circuit capability of the NPPD system. The NPPD Facility Study includes detailed cost estimates and estimated project schedules for the upgrades identified in the SPP and NPPD studies.

The initial list of Interconnection / Network Upgrades from DISIS-2023-001 Phase 2 Re-Study #1 for the GEN-2023-222, GEN-2023-223, GEN-2023-224, and GEN-2023-225 GI requests is below:

- Beatrice Power Station 345 kV Substation
- Princeton Road Station 345/115 kV Substation
    - Connected to NPPD Olive Creek and LES 345/115 kV transmission lines at site location
- Daykin 345 kV substation
- Beatrice Power Station – Daykin 345 kV line
- Beatrice Power Station – Olive Creek 345 kV line
- Second Red Willow 345 kV Transformer
- Upgrade Lowell – Minden 115 kV line

**Short Circuit Study – Initial**

NPPD's Engineering group has reviewed the short circuit impacts of the initial SPP DISIS-2023-001 Generation Interconnection projects and associated network upgrades interconnected to the NPPD transmission system. The result of this study is documented in Appendix 1.

The short circuit study identified 39 breakers on the NPPD system that were overdutied with the initial interconnection plan for GEN-2023-222, GEN-2023-223, GEN-2023-224, and GEN-2023-225. Many of these breakers (37 total) are 63kA units that were recently installed at the Sheldon / Olive Creek 115 kV substations associated with the Monolith Materials project. 63kA is the maximum standard 115 kV breaker for NPPD. Replacement of these brand-new breakers is not a feasible solution, and alternatives must be considered.

NPPD evaluated several options to determine the optimal solution to mitigate the short circuit impacts for the local area. At this time, the following system topology changes are considered the optimal transmission plan (transmission option 1e) for the local area to address the short circuit issues identified in the DISIS-2023-001 Short Circuit Study – Phase 1.

Transmission Option 1e

- Relocate Moore T1 transformer to Princeton Road Station and install new 115 kV line from Princeton Road to Sheldon using the existing Moore T1 115 kV tie line terminal at Sheldon Station.
- Relocate Olive Creek T2 transformer to Beatrice Power Station.
- Single 345 kV transmission line from Princeton Road Station to Olive Creek.
- Install additional grounding on generation interconnection request step-up transformers associated with all IBR's at Olive Creek 115 kV substation (GEN-2013-002, GEN-2013-019, GEN-2019-041, GEN-2021-027)

## Loadflow Study

In order to ensure the proposed short circuit solutions listed above can be implemented reliably, NPPD performed a loadflow study evaluating the transmission configuration alternatives. These transmission options were evaluated using the out-year LVER study models associated with DISIS-2023-001 Phase 2 Re-study #1.

In addition, NPPD evaluated several different generation dispatch scenarios for units in the local area. The SPP LVER models do not properly account for the output of all prior queued network resources (NITS) in the local area (Sheldon Station, Hallam, Beatrice Power Station). It is important to ensure these resources are evaluated at full output levels to ensure deliverability to NPPD network load and reliability is not compromised and to meet NERC FAC-001 requirements documented in NPPD's Facility Connection Requirements Document. NPPD also reviewed alternative load scenarios for the load customer at Olive Creek (Monolith Materials) as it has been slow to develop and may not reach the forecasted levels modeled in the SPP LVER cases utilized for DISIS-2023-001.

NPPD utilized PSS/E Activity ACCC to scan for local area transmission issues for system intact and single contingency event scenarios in the NPPD modeling area. The transmission options and dispatch scenarios evaluated in this loadflow study are listed in Tabel 1 below. A total of 60 study cases were developed to evaluate the transmission options and dispatch scenarios selected for this analysis.

## Table 1. Loadflow Study Parameters

| SPP GI Study Models | |
|---|---|
| 27SP | SPP LVER model: DIS231-TC00ALL-27SP0.sav, 2027 Summer Peak |
| 27WP | SPP LVER model: DIS231-TC00ALL-27WP0.sav, 2027 Winter Peak |

| Transmission Options | |
|---|---|
| 1a | SPP re-study1 transmission with additions of LES lines interconnected at Princeton Road |
| 1b | remove 1 Olive Creek-Princeton Road 345 kV |
| 1c | remove 1 Olive Creek-Princeton Road 345 kV and remove 1 Olive Creek 345/115 kV |
| 1d | remove 1 Olive Creek-Princeton Road 345 kV and remove Moore 345/115 kV and add Sheldon-PRS 115 kV CKT 2 |
| 1e | remove 1 Olive Creek-Princeton Road 345 kV and remove Moore 345/115 kV and add Sheldon-PRS 115 kV CKT 2 and remove Olive Creek 345/115 kV T2 |

| Dispatch Scenarios | |
|---|---|
| S00 | Standard SPP LVER Dispatch |
| S2A | LVER + Sheldon, Hallam, BPS dispatched to PMAX |
| S2B | LVER + Sheldon, Hallam, BPS dispatched to PMAX + Monolith load reduction to 30 MW (from 255 MW) |
| S2C | LVER + Monolith load reduction to 30 MW (from 255 MW) |
| S2D | all generation offline |
| S2E | all generation offline + Monolith load reduction to 30 MW (from 255 MW) |

**Table 2. 2027 Summer Peak Loadflow Study Result Summary**

| Case | Dispatch Scenario | Transmission Option | Thermal Issue |
|---|---|---|---|
| 27SP | S00 | 1a | 99.8% loading on Firth-Olive Creek 115 kV FLO S1263 Wbrock 161/69 kV Trf |
| 27SP | S00 | 1b | 99.8% loading on Firth-Olive Creek 115 kV FLO S1263 Wbrock 161/69 kV Trf |
| 27SP | S00 | 1c | None |
| 27SP | S00 | 1d | 99.0% loading on Firth-Olive Creek 115 kV FLO S1263 Wbrock 161/69 kV Trf |
| 27SP | S00 | 1e | None |
| 27SP | S2A | 1a | 109.6% loading on Beatrice-Harbine 115 kV FLO McCool 345/115 kV Trf |
| 27SP | S2A | 1a | 105.5% loading on Firth-Olive Creek 115 kV FLO S1263 Wbrock 161/69 kV Trf |
| 27SP | S2A | 1b | 109.6% loading on Beatrice-Harbine 115 kV FLO McCool 345/115 kV Trf |
| 27SP | S2A | 1b | 105.5% loading on Firth-Olive Creek 115 kV FLO S1263 Wbrock 161/69 kV Trf |
| 27SP | S2A | 1c | 109.4% loading on Beatrice-Harbine 115 kV FLO McCool 345/115 kV Trf |
| 27SP | S2A | 1c | 104.5% loading on Firth-Olive Creek 115 kV FLO S1263 Wbrock 161/69 kV Trf |
| 27SP | S2A | 1d | 109.5% loading on Beatrice-Harbine 115 kV FLO McCool 345/115 kV Trf |
| 27SP | S2A | 1d | 105.2% loading on Firth-Olive Creek 115 kV FLO S1263 Wbrock 161/69 kV Trf |
| 27SP | S2A | 1e | 109.3% loading on Beatrice-Harbine 115 kV FLO McCool 345/115 kV Trf |
| 27SP | S2A | 1e | 103.9% loading on Firth-Olive Creek 115 kV FLO S1263 Wbrock 161/69 kV Trf |
| 27SP | S2B | 1a | 114.7% loading on Firth-Olive Creek 115 kV FLO S1263 Wbrock 161/69 kV Trf |
| 27SP | S2B | 1a | **101.6% loading on Beatrice-Harbine 115 kV SYSTEM INTACT** |
| 27SP | S2B | 1a | 115.4% loading on Beatrice-Harbine 115 kV FLO Daykin - Elm Creek 345 kV |
| 27SP | S2B | 1a | 111.5% loading on Beatrice-BPS 115 kV 2 FLO Beatrice-BPS 115 kV 1 |
| 27SP | S2B | 1a | 111.0% loading on Beatrice-BPS 115 kV 1 FLO Beatrice-BPS 115 kV 2 |
| 27SP | S2B | 1b | 114.7% loading on Firth-Olive Creek 115 kV FLO S1263 Wbrock 161/69 kV Trf |
| 27SP | S2B | 1b | **101.6% loading on Beatrice-Harbine 115 kV SYSTEM INTACT** |
| 27SP | S2B | 1b | 115.4% loading on Beatrice-Harbine 115 kV FLO Daykin - Elm Creek 345 kV |
| 27SP | S2B | 1b | 111.5% loading on Beatrice-BPS 115 kV 2 FLO Beatrice-BPS 115 kV 1 |
| 27SP | S2B | 1b | 111.0% loading on Beatrice-BPS 115 kV 1 FLO Beatrice-BPS 115 kV 2 |
| 27SP | S2B | 1c | 114.7% loading on Firth-Olive Creek 115 kV FLO S1263 Wbrock 161/69 kV Trf |
| 27SP | S2B | 1c | **101.6% loading on Beatrice-Harbine 115 kV SYSTEM INTACT** |
| 27SP | S2B | 1c | 115.5% loading on Beatrice-Harbine 115 kV FLO Daykin - Elm Creek 345 kV |
| 27SP | S2B | 1c | 111.5% loading on Beatrice-BPS 115 kV 2 FLO Beatrice-BPS 115 kV 1 |
| 27SP | S2B | 1c | 111.0% loading on Beatrice-BPS 115 kV 1 FLO Beatrice-BPS 115 kV 2 |
| 27SP | S2B | 1d | 110.8% loading on Firth-Olive Creek 115 kV FLO S1263 Wbrock 161/69 kV Trf |
| 27SP | S2B | 1d | **101.7% loading on Beatrice-Harbine 115 kV SYSTEM INTACT** |
| 27SP | S2B | 1d | 115.6% loading on Beatrice-Harbine 115 kV FLO Daykin - Elm Creek 345 kV |
| 27SP | S2B | 1d | 102.3% loading on Beatrice-BPS 115 kV 2 FLO Beatrice-BPS 115 kV 1 |
| 27SP | S2B | 1d | 101.7% loading on Beatrice-BPS 115 kV 1 FLO Beatrice-BPS 115 kV 2 |
| 27SP | S2B | 1e | 111.2% loading on Firth-Olive Creek 115 kV FLO S1263 Wbrock 161/69 kV Trf |
| 27SP | S2B | 1e | **101.8% loading on Beatrice-Harbine 115 kV SYSTEM INTACT** |
| 27SP | S2B | 1e | 115.6% loading on Beatrice-Harbine 115 kV FLO Daykin - Elm Creek 345 kV |
| 27SP | S2B | 1e | 102.3% loading on Beatrice-BPS 115 kV 2 FLO Beatrice-BPS 115 kV 1 |

| Case | Dispatch Scenario | Transmission Option | Thermal Issue |
|---|---|---|---|
| 27SP | S2B | 1e | 101.8% loading on Beatrice-BPS 115 kV 1 FLO Beatrice-BPS 115 kV 2 |
| 27SP | S2C | 1a | 104.4% loading on Firth-Olive Creek 115 kV FLO S1263 Wbrock 161/69 kV Trf |
| 27SP | S2C | 1b | 104.4% loading on Firth-Olive Creek 115 kV FLO S1263 Wbrock 161/69 kV Trf |
| 27SP | S2C | 1c | 104.2% loading on Firth-Olive Creek 115 kV FLO S1263 Wbrock 161/69 kV Trf |
| 27SP | S2C | 1d | 104.6% loading on Firth-Olive Creek 115 kV FLO S1263 Wbrock 161/69 kV Trf |
| 27SP | S2C | 1e | 103.6% loading on Firth-Olive Creek 115 kV FLO S1263 Wbrock 161/69 kV Trf |
| 27SP | S2D | 1a | None |
| 27SP | S2D | 1b | None |
| 27SP | S2D | 1c | None |
| 27SP | S2D | 1d | None |
| 27SP | S2D | 1e | None |
| 27SP | S2E | 1a | None |
| 27SP | S2E | 1b | None |
| 27SP | S2E | 1c | None |
| 27SP | S2E | 1d | None |
| 27SP | S2E | 1e | None |

**Table 3. 2027 Winter Peak Loadflow Study Result Summary**

| Case | Dispatch Scenario | Transmission Option | Thermal Issue |
|---|---|---|---|
| 27WP | S00 | 1a | None |
| 27WP | S00 | 1b | None |
| 27WP | S00 | 1c | None |
| 27WP | S00 | 1d | None |
| 27WP | S00 | 1e | None |
| 27WP | S2A | 1a | 99.2% loading on Beatrice-Harbine 115 kV FLO Daykin - Elm Creek 345 kV |
| 27WP | S2A | 1a | 104.7% loading on Firth-Olive Creek 115 kV FLO S1263 Wbrock 161/69 kV Trf |
| 27WP | S2A | 1b | 99.2% loading on Beatrice-Harbine 115 kV FLO Daykin - Elm Creek 345 kV |
| 27WP | S2A | 1b | 104.7% loading on Firth-Olive Creek 115 kV FLO S1263 Wbrock 161/69 kV Trf |
| 27WP | S2A | 1c | 99.0% loading on Beatrice-Harbine 115 kV FLO Daykin - Elm Creek 345 kV |
| 27WP | S2A | 1c | 104.2% loading on Firth-Olive Creek 115 kV FLO S1263 Wbrock 161/69 kV Trf |
| 27WP | S2A | 1d | 99.2% loading on Beatrice-Harbine 115 kV FLO Daykin - Elm Creek 345 kV |
| 27WP | S2A | 1d | 104.4% loading on Firth-Olive Creek 115 kV FLO S1263 Wbrock 161/69 kV Trf |
| 27WP | S2A | 1e | 98.9% loading on Beatrice-Harbine 115 kV FLO Daykin - Elm Creek 345 kV |
| 27WP | S2A | 1e | 104.3% loading on Firth-Olive Creek 115 kV FLO S1263 Wbrock 161/69 kV Trf |
| 27WP | S2B | 1a | 109.7% loading on Firth-Olive Creek 115 kV FLO S1263 Wbrock 161/69 kV Trf |
| 27WP | S2B | 1a | 105.0% loading on Beatrice-Harbine 115 kV FLO Daykin - Elm Creek 345 kV |
| 27WP | S2B | 1a | 101.0% loading on Beatrice-BPS 115 kV 2 FLO Beatrice-BPS 115 kV 1 |
| 27WP | S2B | 1a | 100.5% loading on Beatrice-BPS 115 kV 1 FLO Beatrice-BPS 115 kV 2 |
| 27WP | S2B | 1b | 109.7% loading on Firth-Olive Creek 115 kV FLO S1263 Wbrock 161/69 kV Trf |
| 27WP | S2B | 1b | 105.0% loading on Beatrice-Harbine 115 kV FLO Daykin - Elm Creek 345 kV |
| 27WP | S2B | 1b | 101.0% loading on Beatrice-BPS 115 kV 2 FLO Beatrice-BPS 115 kV 1 |
| 27WP | S2B | 1b | 100.5% loading on Beatrice-BPS 115 kV 1 FLO Beatrice-BPS 115 kV 2 |
| 27WP | S2B | 1c | 109.6% loading on Firth-Olive Creek 115 kV FLO S1263 Wbrock 161/69 kV Trf |
| 27WP | S2B | 1c | 105.1% loading on Beatrice-Harbine 115 kV FLO Daykin - Elm Creek 345 kV |
| 27WP | S2B | 1c | 101.0% loading on Beatrice-BPS 115 kV 2 FLO Beatrice-BPS 115 kV 1 |
| 27WP | S2B | 1c | 100.5% loading on Beatrice-BPS 115 kV 1 FLO Beatrice-BPS 115 kV 2 |
| 27WP | S2B | 1d | 109.9% loading on Firth-Olive Creek 115 kV FLO S1263 Wbrock 161/69 kV Trf |
| 27WP | S2B | 1d | 105.2% loading on Beatrice-Harbine 115 kV FLO Daykin - Elm Creek 345 kV |
| 27WP | S2B | 1d | 101.1% loading on Beatrice-BPS 115 kV 2 FLO Beatrice-BPS 115 kV 1 |
| 27WP | S2B | 1d | 100.6% loading on Beatrice-BPS 115 kV 1 FLO Beatrice-BPS 115 kV 2 |
| 27WP | S2B | 1e | 110.4% loading on Firth-Olive Creek 115 kV FLO S1263 Wbrock 161/69 kV Trf |
| 27WP | S2B | 1e | 105.2% loading on Beatrice-Harbine 115 kV FLO Daykin - Elm Creek 345 kV |
| 27WP | S2B | 1e | 115.6% loading on Beatrice-Harbine 115 kV FLO Daykin - Elm Creek 345 kV |
| 27WP | S2B | 1e | 101.2% loading on Beatrice-BPS 115 kV 2 FLO Beatrice-BPS 115 kV 1 |
| 27WP | S2B | 1e | 100.7% loading on Beatrice-BPS 115 kV 1 FLO Beatrice-BPS 115 kV 2 |
| 27WP | S2C | 1a | 102.7% loading on Firth-Olive Creek 115 kV FLO S1263 Wbrock 161/69 kV Trf |
| 27WP | S2C | 1b | 102.7% loading on Firth-Olive Creek 115 kV FLO S1263 Wbrock 161/69 kV Trf |
| 27WP | S2C | 1c | 102.4% loading on Firth-Olive Creek 115 kV FLO S1263 Wbrock 161/69 kV Trf |

| Case | Dispatch Scenario | Transmission Option | Thermal Issue |
|---|---|---|---|
| 27WP | S2C | 1d | 102.3% loading on Firth-Olive Creek 115 kV FLO S1263 Wbrock 161/69 kV Trf |
| 27WP | S2C | 1e | 101.8% loading on Firth-Olive Creek 115 kV FLO S1263 Wbrock 161/69 kV Trf |
| 27WP | S2D | 1a | None |
| 27WP | S2D | 1b | None |
| 27WP | S2D | 1c | None |
| 27WP | S2D | 1d | None |
| 27WP | S2D | 1e | None |
| 27WP | S2E | 1a | None |
| 27WP | S2E | 1b | None |
| 27WP | S2E | 1c | None |
| 27WP | S2E | 1d | None |
| 27WP | S2E | 1e | None |

*Loadflow Study Result Summary*

The loadflow study results show the transmission option 1e does not have materially different or adverse reliability performance than either of the other transmission options evaluated in this analysis. There were no additional transmission constraint issues associated with transmission option 1e. Transmission option 1e is estimated to be the lowest cost alternative of the transmission options evaluated in this analysis. The results demonstrate the transmission constraints discovered in this study are related to the alternative generation dispatch / load scenarios and not the transmission options under consideration. Based on these study results, transmission option 1e is the preferred transmission solution to the short circuit issues identified in the Sheldon/Olive Creek areas.

Also, there were several additional transmission constraints discovered in this analysis due to the dispatch of existing NITS resources and alternative Monolith load scenarios. It is recommended that these constraints be addressed for the GEN-2023-222, GEN-2023-223, GEN-2023-224, and GEN-2023-225 GI requests to connect reliably. There were 4 transmission lines identified that would need to be rebuilt to address the local area transmission constraints in this study:

- Olive Creek – Firth 115 kV (L1180B)
- Beatrice Power Station – Beatrice 115 kV Circuit #1 (L1177A)
- Beatrice Power Station – Beatrice 115 kV Circuit #2 (L1178A)
- Beatrice – Harbine 115 kV (L1175C)

**Interconnection Facility and Network Upgrades**

NPPD's Engineering, Asset Management, and Project Management groups have reviewed the interconnection facility upgrades that are required for SPP DISIS-2023-001 Generation Interconnection projects. Detailed cost estimates have been prepared for the facility upgrades that were identified in the system impact study for the requests. The prepared cost estimates are study level estimates (+20%/-20%) and assume implementation of standard NPPD construction and procurement practices. The cost estimates for the interconnection facilities are below:

Interconnection Facility Upgrades

- Beatrice Power Station 345 kV Substation
  - GEN-2023-222/GEN-2023-223
    - 478 MW Thermal
    - 239 MW Thermal
  - Addition of Beatrice Power Station 345 kV Substation
    - Includes 345/115 kV Transformer (relocated existing Olive Creek T2)
  - 60 Month Lead Time

**$ 44,400,000**

- Princeton Road Station 345 kV Substation (connected to Olive Creek 345 kV Substation)
  - GEN-2023-224/GEN-2023-225
    - 478 MW Thermal
    - 217 MW Thermal
  - Addition of Princeton Road Station 345 kV Substation connected to the existing Olive Creek 345 kV substation and interconnected with existing LES transmission lines at the site.
    - Interconnects LES L1099 & LES L3503
    - Single 345 kV line from Princeton Road Station to Olive Creek
    - Includes 345/115 kV Transformer (relocated existing Moore T1)
    - 115 kV line connection from Princeton Road Station to Sheldon using existing Moore T1 115 kV line & terminal at Sheldon
  - 60 Month Lead Time

**$ 78,600,000**

Network Upgrades

- Build Daykin 345 kV Substation
  - Upgrade would require new 345 kV substation interconnected to the planned Tobias – Elm Creek 345 kV line approximately 10 miles south of the existing Tobias 345 kV substation assumed to be near Daykin, NE.
  - At least 1793 MVA
  - 60 Month Lead Time

**$ 26,800,000**

- Build a new Beatrice Power Station – Olive Creek 345 kV line
  - Upgrade would require a new 345 kV transmission line from the new Beatrice Power Station 345 kV substation to Olive Creek 345 kV including terminal upgrades at both ends.
  - At least 1793 MVA
  - 60 Month Lead Time

**$ 76,500,000**

- Build a new Beatrice Power Station – Daykin 345 kV line
  - Upgrade would require a new 345 kV transmission line from the new Beatrice Power Station 345 kV substation to the proposed new Daykin 345 kV substation (interconnected to the planned Tobias – Elm Creek 345 kV line) including terminal upgrades at both ends.
  - At least 1793 MVA
  - 60 Month Lead Time

**$ 56,300,000**

- Lowell – Minden 115 kV Line Upgrade
  - Upgrade existing Lowell – Minden 115 kV Line to the conductor rating at 100 Deg C and terminal upgrades at both ends.
  - At least 175 MVA (summer)
  - 36 Month Lead Time

**$ 1,000,000**

- Beatrice 115 kV Substation – Breaker Upgrades
  - Upgrade existing 115 kV breakers in Beatrice 115 kV Substation to accommodate short circuit impacts identified in the Facility Study.
  - 36 Month Lead Time

**$ 1,800,000**

Network Upgrades allocated to GI requests external to NPPD

- Build second Red Willow 345/115 kV transformer
  - Upgrade would require expansion of the Red Willow 345 kV substation to accommodate a second 345 / 115 kV transformer at this location. Upgrade would include terminal upgrades at both voltage levels and the addition of a second 345 / 115 kV transformer. Upgrade Bay 104/106 due to short circuit study results.
  - At least 336 MVA
  - 60 Month Lead Time

**$ 35,400,000**

Additional Network Upgrades identified in NPPD Loadflow Study

- Uprate Olive Creek – Firth 115 kV line
  - Upgrade would require conductor uprates and terminal upgrades at both ends of L1180B.
  - At least 137 MVA
  - 60 Month Lead Time

**$ 2,000,000**

- Uprate Beatrice Power Station – Beatrice 115 kV line #1
  - Upgrade would require conductor uprates and terminal upgrades at both ends of L1177A.
  - At least 250 MVA
  - 60 Month Lead Time

**$ 5,200,000**

- Uprate Beatrice Power Station – Beatrice 115 kV line #2
  - Upgrade would require conductor uprates and terminal upgrades at both ends of L1178A.
  - At least 250 MVA
  - 60 Month Lead Time

**$ 4,700,000**

- Uprate Beatrice – Harbine 115 kV line
  - Upgrade would require conductor uprates and terminal upgrades at both ends of L1175C.
  - At least 250 MVA
  - 60 Month Lead Time

**$ 11,200,000**

Preliminary one-line diagrams for the local area and each generation interconnection project are in Appendix 2.

Interconnection Facilities and Network Upgrade project schedule details will be further discussed in the development of the generator interconnection agreements (GIA) and the milestones associated with the generation interconnection projects.

## Contingent Upgrades

The results of DISIS-2023-001 documented that several Generation Interconnection requests are contingent on the completion of the following previously allocated required network upgrades:

- Tobias – Elm Creek 345 kV transmission line (ITP24)

If the generation interconnection projects proceed to the generation interconnection agreement, then an operating study may need to be performed to fully assess and evaluate the operation of the generation facility and network upgrades in accordance with NERC Standards. The operating study requirement will be included in the generation interconnection agreement with NPPD. If any generation interconnection projects are identified to have significant impact on the GGS Stability Interface (Flowgate #6006) and LRS/DC stability limitations in western NE, then the operating study will need to take these issues into account. The operating study may also need to evaluate the reactive power control requirements and associated equipment necessary to meet operational voltage requirements at the requested point of interconnection.

**Short Circuit Study - Final**

NPPD's Engineering group has reviewed the short circuit impacts of the SPP DISIS-2023-001 Generation Interconnection projects and updated list of network upgrades interconnected to the NPPD transmission system. The result of this study is documented in Appendix 1. The short circuit study identified several breakers that required mitigation. The details of these mitigations are listed below. These mitigation projects should be included in the appropriate Generation Interconnection agreements associated with the DISIS-2023-001 GI projects.

- The Olive Creek and Sheldon 115 kV breaker issues will be mitigated by implementing transmission option 1e below.

  Transmission Option 1e
  - Relocate Moore T1 transformer to Princeton Road Station and install new 115 kV line from Princeton Road to Sheldon using the existing Moore T1 115 kV tie line terminal at Sheldon Station.
  - Relocate Olive Creek T2 transformer to Beatrice Power Station.
  - Single 345 kV transmission line from Princeton Road Station to Olive Creek.
  - Install additional grounding on generation interconnection request step-up transformers associated with all IBR's at Olive Creek 115 kV substation (GEN-2013-002, GEN-2013-019, GEN-2019-041, GEN-2021-027)

- The Beatrice 115 kV Bay 1110/1112/1120/1122 breakers will be mitigated through replacement with higher capacity units.

- The Red Willow 345 kV Bay 104/106 breakers will be mitigated through the 2nd Red Willow 345/115 kV transformer project.

# Appendix 1

# NPPD Short Circuit Study Report

# DISIS-2023-001 Initial & Final Plans

# Short Circuit Study

## Model Development

### Computer Programs

The Aspen OneLiner software program was utilized to perform short circuit simulations and studies on the transmission system. Where elements were added to the short-circuit model, best estimates for impedance parameters were used based on available data and typical modeling practices. Short-circuit calculation options used were as follows:

- Flat voltage profile with V(pu) = 1.0
- Generator Impedance = Subtransient
- Ignore loads, transmission line G+jB, and shunts with positive sequence values

OneLiner was used to calculate three-phase (3PH) and single-line-to-ground (SLG) system-intact bus fault currents for all system buses associated with interrupting devices being evaluated in this study. For devices that the full bus fault current approached or exceeded the device's interrupting rating, more detailed fault calculations were done, calculating the maximum phase current through the breaker for close-in faults, close-in faults with the remote end open, and bus faults with all other branches to the bus open. The maximum phase current of these faults was recorded.

### Base System Model Additions ("Base Case")

The base system model used by the transmission system protection department as of October 27, 2025 was used as the starting point for the short-circuit model used for this study. The base system model included all projects that were in-service at the time the model was copied. All Nebraska-area generation in the short-circuit model was enabled in order to provide maximum short-circuit current. For the study base case, planned system upgrades in the area of the studied projects and prior-queued large generator interconnections expected to be in-service prior to the projects being studied were added to the base case model. The following table lists the prior-queued large generator interconnections that were added to the base model for this study.

**Prior Queued Large Generator Interconnections**

| Queue Designation | Proposed POI | Capacity (MW) |
|---|---|---|
| GEN-2013-002 | Hallam 115kV / Panama IBR to Olive Creek | 50.6 |
| GEN-2013-019 | Hallam 115kV / Panama IBR to Olive Creek | 73.6 |
| GEN-2016-074 | Sweetwater 345kV (Expand substation) | 200 |
| GEN-2017-144 | Holt County 345kV Substation (Expand substation) | 200 |
| GEN-2017-181 | Tobias 345kV Substation (Expand substation) | 300 |
| GEN-2017-182 | Tobias 345kV Substation (Expand substation) | 128 |
| GEN-2017-201 | Turtle Creek 345kV connect at Sholes WF | 250 |
| GEN-2017-234 | Greeley 115kV Substation (New substation) | 115 |
| GEN-2018-060 | Macon 345kV (Expand substation) | 50 |
| GEN-2018-125 | Etna 345kV (New substation) | 231 |
| GEN-2018-131 | Pierce County 345kV (New substation) | 221.4 |
| GEN-2018-132 | Pierce County 345kV (New substation) | 201.6 |
| GEN-2019-039 | Butler County 115kV (New substation) | 174.5 |
| GEN-2019-041 | Olive Creek 115kV (Expand substation) | 78 |
| GEN-2020-011 | Axtell 345kV Substation (Expand substation) | 320 |
| GEN-2020-013 | Orleans 115kV Substation (Expand substation) | 215 |
| GEN-2020-069 | Kilgore 115kV Substation (New substation) | 52.85 |
| GEN-2021-027 | Olive Creek 115kV Substation (Expand substation) | 102 |
| GEN-2021-057 | Antelope 345kV Substation (Expand substation) | 300 |

In addition to the prior-queued large generator interconnections, planned system upgrades in the area of the studied projects were added to the base model. These include:

- The planned 345kV line from GGS – Thedford – Holt County "RPLAN" was included with a 345kV/115kV tie transformer at Thedford 115 kV
- New 345kV line from Antelope to Holt County
- New Olive Creek sub addition near Mark Moore/Sheldon
- Upgrade of the Columbus East T3 to 336MVA
- Stanton North expansion for a new 100MVA load-serving transformer, future 115kV line Stanton North to Norfolk, Hoskins T1 replaced with a 336MVA
- Upgrade of Mark Moore T1 replacement with a 417MVA
- Rebuild of L1153B Columbus SE to new collector sub for G19-39-TAP (Butler County) to Rising City
- Rebuild of L1132 Holdrege-Orleans to new collector sub for G20-13 at/near Orleans
- Addition at Antelope of a 345kV/115kV transformer at 417MVA
- Addition at Axtell of a 345kV/115kV transformer at 417MVA
- Rebuild of L1067 Axtell-Kearney.

## Model Additions for Projects Being Studied ("Study Case")

The base-case study model was modified to include the new generation interconnections being considered in this study as well as the system upgrades identified to accommodate this additional generation. The following table lists the large generator interconnections that were added to the study-case model for this study.

**Large Generator Interconnections Added to Study Case**

| Queue Designation | Proposed POI | Capacity (MW) |
|---|---|---|
| GEN-2023-199 | Twin Church 230kV Substation (Expand substation) | 250 |
| GEN-2023-222 | NPPD BPS 345kV Substation (New substation) | 478 |
| GEN-2023-223 | NPPD BPS 345kV Substation (New substation) | 239 |
| GEN-2023-224 | NPPD Princeton Road 345kV Substation (New substation) | 478 |
| GEN-2023-225 | NPPD Princeton Road 345kV Substation (New substation-115kV) | 217 |

In addition to the DISIS-2021-001 generator interconnections, network system upgrades in the area of the studied projects were added to the base model. These include:

- New 345kV line Tobias 345kV substation to Elm Creek Kansas
- New substation Daykin 345kV ~10mi from Tobias on Tobias-ElmCreek
- New 345kV line BPS 345kV substation to Olive Creek
- New 345kV line Olive Creek 345kV substation to Princeton Road
- Addition at Red Willow of a 345kV/115kV transformer at 336MVA
- Rebuild of L1089 115kV Lowell to Minden

The short circuit study revealed extremely high fault currents on several 115kV buses. An additional short circuit was performed using some system modifications to limit the 115kV fault current to below 63kA. Mitigation changes to include:

- Move Mark Moore 345kV/115kV transformer at 417MVA to use at Princeton Road
- Move Olive Creek 345kV/115kV transformer #2 at 417MVA to use at BPS 345kV
- Existing L1180B Olive Creek-Firth rebuild to 137MVA
- Existing L1177A Beatrice-BPS 115kV rebuild to 250MVA
- Existing L1178A Beatrice-BPS 115kV rebuild to 250MVA
- Existing L1175C Beatrice-Harbine rebuild to 250MVA

## Study Methodology

Circuit breaker, circuit switcher, and fuse ratings were identified by querying NPPD's SAP equipment database and extracting equipment data including short-circuit ratings. Breaker ratings given on an asymmetrical (total current) basis were converted to symmetrical current ratings using an assumed maximum system operating voltage of 1.00 per unit.

The calculated short-circuit current at the equipment bus was extracted from the short-circuit results from Aspen OneLiner and compared against the interrupting device interrupting rating. It is recommended that all equipment be replaced if it is found to be at or above 95% of its interrupting rating and seeing an increase of 1% or more in its interrupting duty as a result of the studied projects.

## Results

The following devices were found to be above 95% of their interrupting rating due to the addition of the projects considered in this study and are recommended for mitigation.

| Location – Breaker | Manuf. | Model Number | Interrupting Rating | Max Expected Interrupting (A) | Relative Change (%) | Max Current (% of Rating) |
|---|---|---|---|---|---|---|
| All (21) OLIVE CREEK 115kV breakers | GENERAL ELECTRIC | Dt1-145-63-f1 | 63000 | 67096 | 19.5% | 106.5% |
| All (15) SHELDON 115kV GE breakers | GENERAL ELECTRIC | DT1-145-63-F1 | 63000 | 66233 | 24.0% | 105.1% |
| SHELDON 115-BAY 1126 | SIEMENS | SPS2S-123-63-2 | 63000 | 69545 | 24.0% | 110.4% |
| RED WILLOW 345-BAY 104 | ABB | RMAG | 25000 | 23741 | 7.1% | 95.0% |
| RED WILLOW 345-BAY 106 | ABB | RMAG | 25000 | 23741 | 7.1% | 95.0% |

The mitigation changes studied would change the affected breakers to the list below:

| Location – Breaker | Manuf. | Model Number | Interrupting Rating | Max Expected Interrupting (A) | Relative Change (%) | Max Current (% of Rating) |
|---|---|---|---|---|---|---|
| BEATRICE 115-BAY 1110 | ALLIS CHALMERS | BZO-121-20-7 | 20000 | 19356.4 | 46.6% | 96.8% |
| BEATRICE 115-BAY 1112 | ALLIS CHALMERS | BZO-121-20-7 | 20000 | 19356.4 | 46.6% | 96.8% |
| BEATRICE 115-BAY 1120 | MCGRAW EDISON | AHF-48-121-20 | 20000 | 19356.4 | 46.6% | 96.8% |
| BEATRICE 115-BAY 1122 | MCGRAW EDISON | AHF-48-121-20 | 20000 | 19356.4 | 46.6% | 96.8% |
| RED WILLOW 345-BAY 104 | ABB | RMAG | 25000 | 23741 | 7.1% | 95.0% |
| RED WILLOW 345-BAY 106 | ABB | RMAG | 25000 | 23741 | 7.1% | 95.0% |

## Mitigation Summary

The Olive Creek and Sheldon 115 kV breaker issues will be mitigated by implementing transmission option 1e below.

Transmission Option 1e

- Relocate Moore T1 transformer to Princeton Road Station and install new 115 kV line from Princeton Road to Sheldon using the existing Moore T1 115 kV tie line terminal at Sheldon Station.
- Relocate Olive Creek T2 transformer to Beatrice Power Station.
- Single 345 kV transmission line from Princeton Road Station to Olive Creek.
- Install additional grounding on generation interconnection request step-up transformers associated with all IBR's at Olive Creek 115 kV substation (GEN-2013-002, GEN-2013-019, GEN-2019-041, GEN-2021-027)

The Beatrice 115 kV Bay 1110/1112/1120/1122 breakers will be mitigated through replacement with higher capacity units.

The Red Willow 345 kV Bay 104/106 breakers will be mitigated through the 2nd Red Willow 345/115 kV transformer project.

After the mitigations, all devices were found to be below 95% of the interrupting ratings after the addition of the projects considered in this study.

# Appendix 2

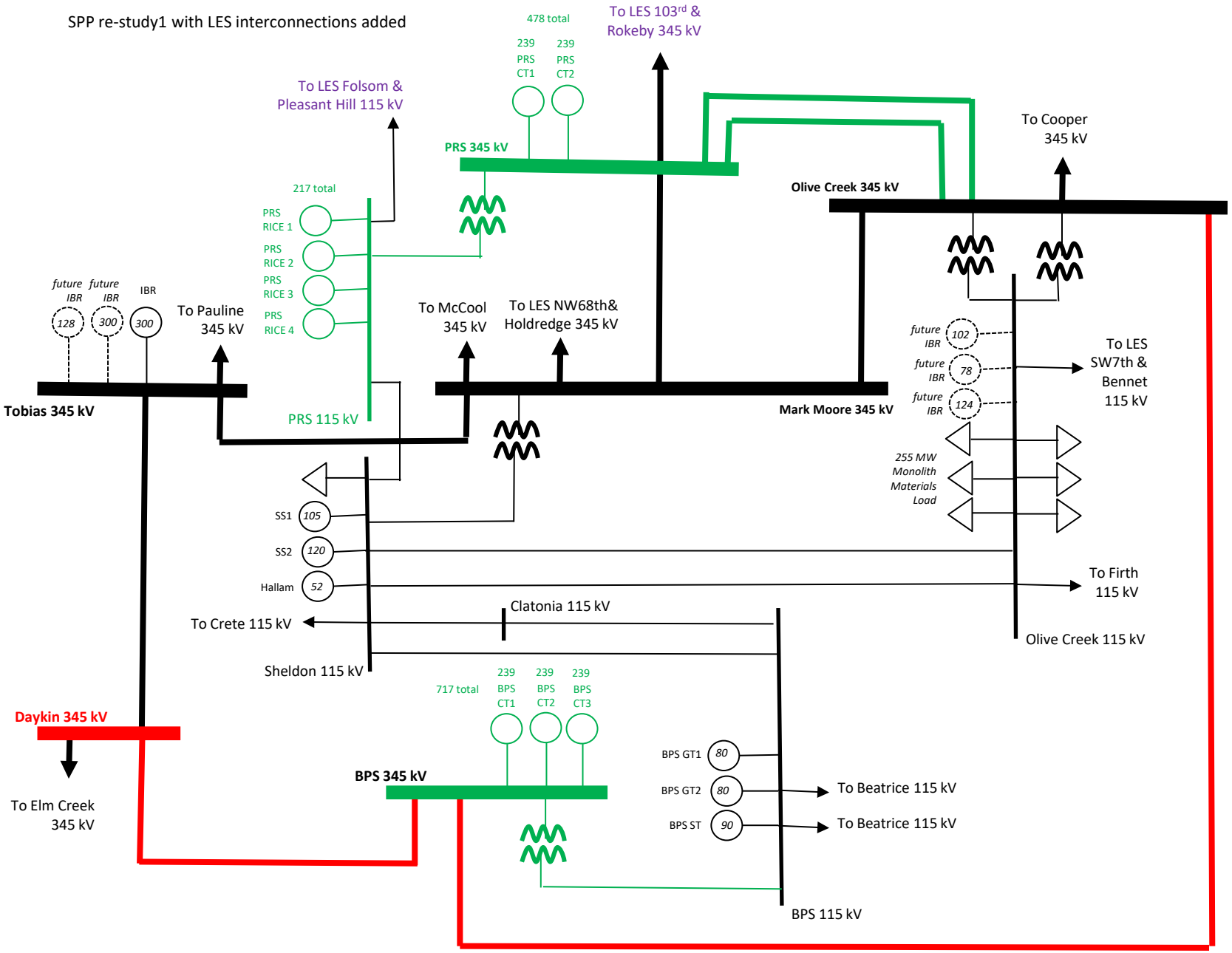
# PRS & BPS Local Area One-Line Diagrams

Transmission Topology 1e included as part of interconnection plan for PRS/BPS generation additions.

**DISIS-2023-001 Interconnection & Network Upgrades**

Transmission Topology 1a

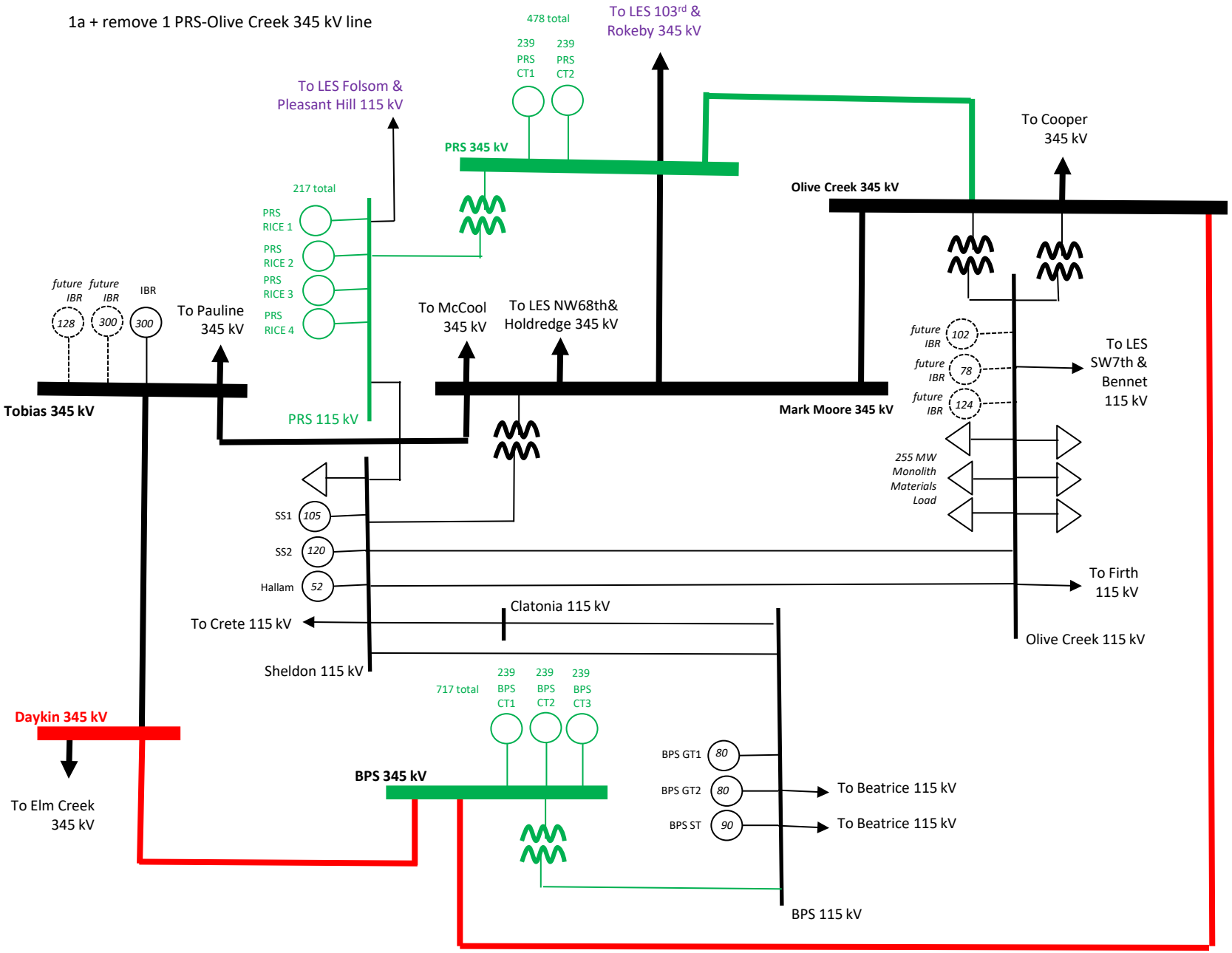
SPP re-study1 with LES interconnections added



**DISIS-2023-001 Interconnection & Network Upgrades**

Transmission Topology 1b

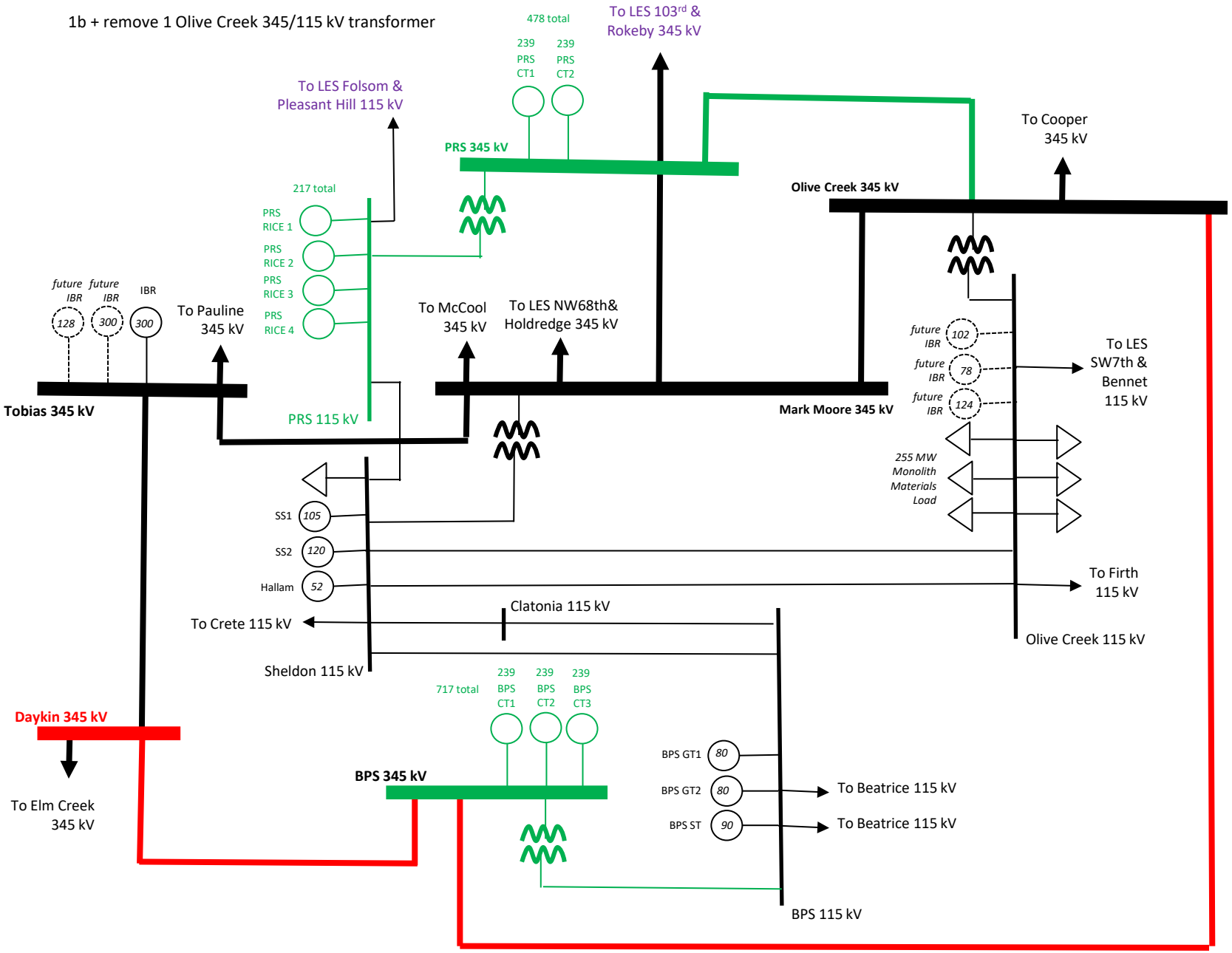
1a + remove 1 PRS-Olive Creek 345 kV line



**DISIS-2023-001 Interconnection & Network Upgrades**

Transmission Topology 1c

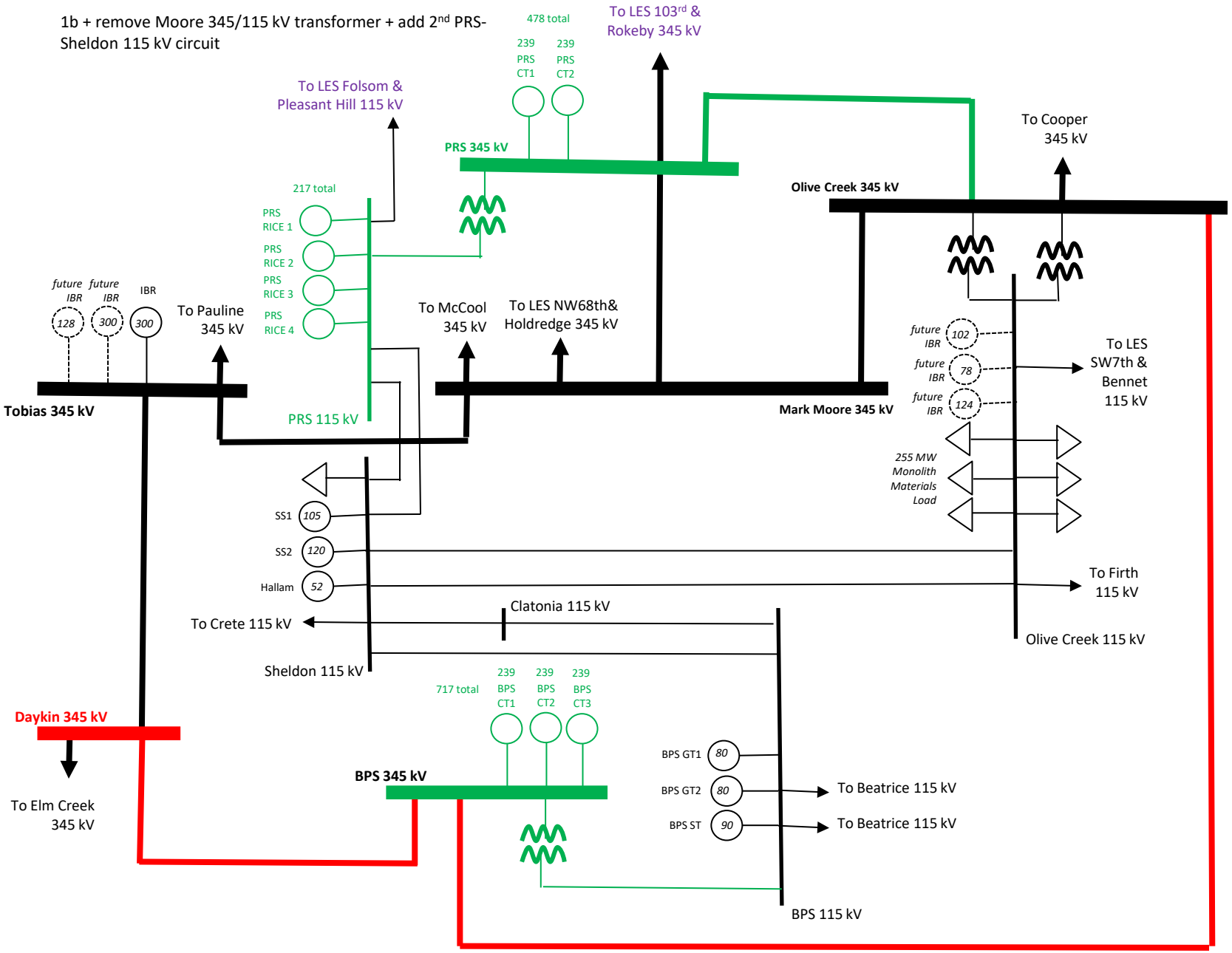
1b + remove 1 Olive Creek 345/115 kV transformer



**DISIS-2023-001 Interconnection & Network Upgrades**

Transmission Topology 1d

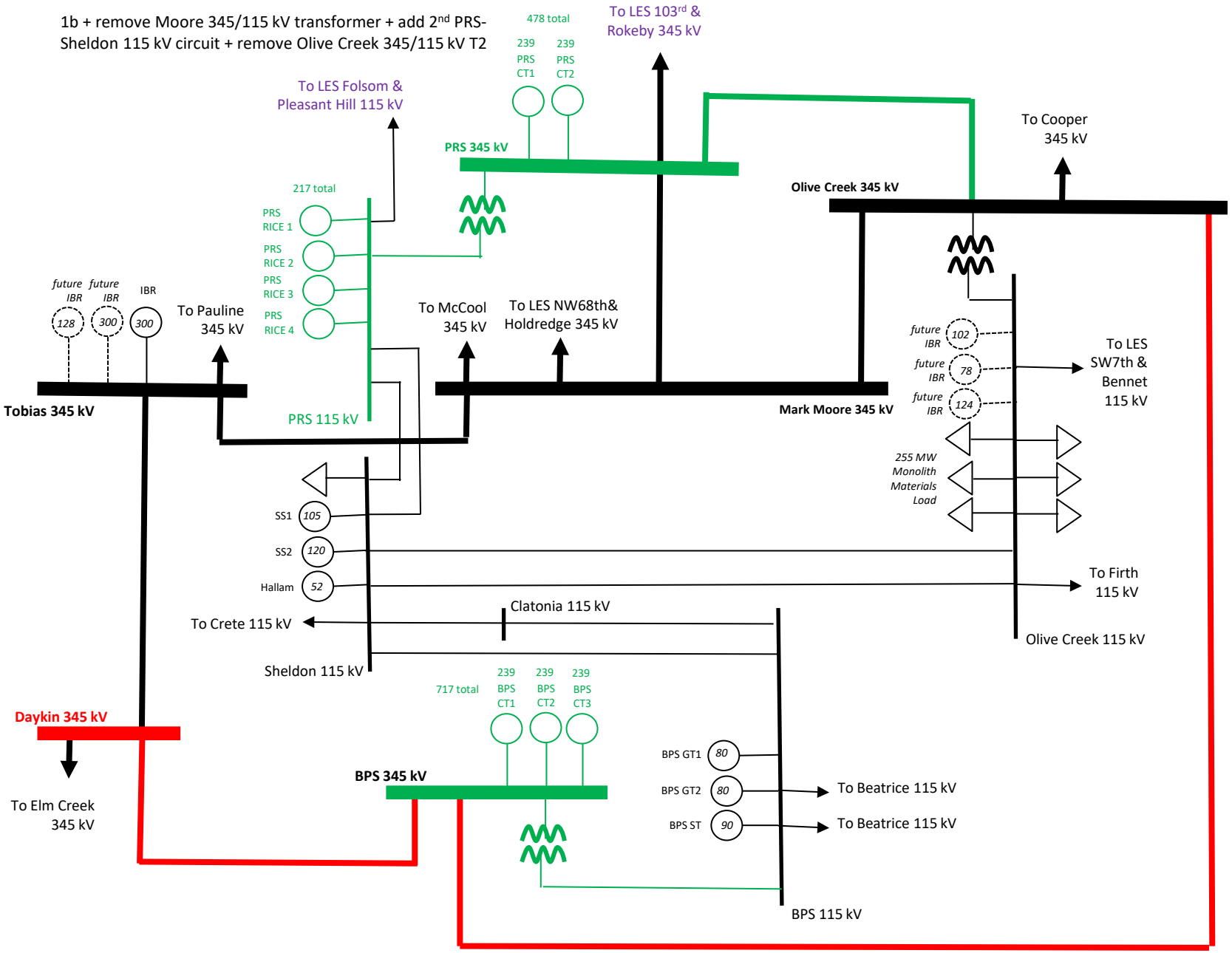
1b + remove Moore 345/115 kV transformer + add 2nd PRS-Sheldon 115 kV circuit



**DISIS-2023-001 Interconnection & Network Upgrades**

Transmission Topology 1e

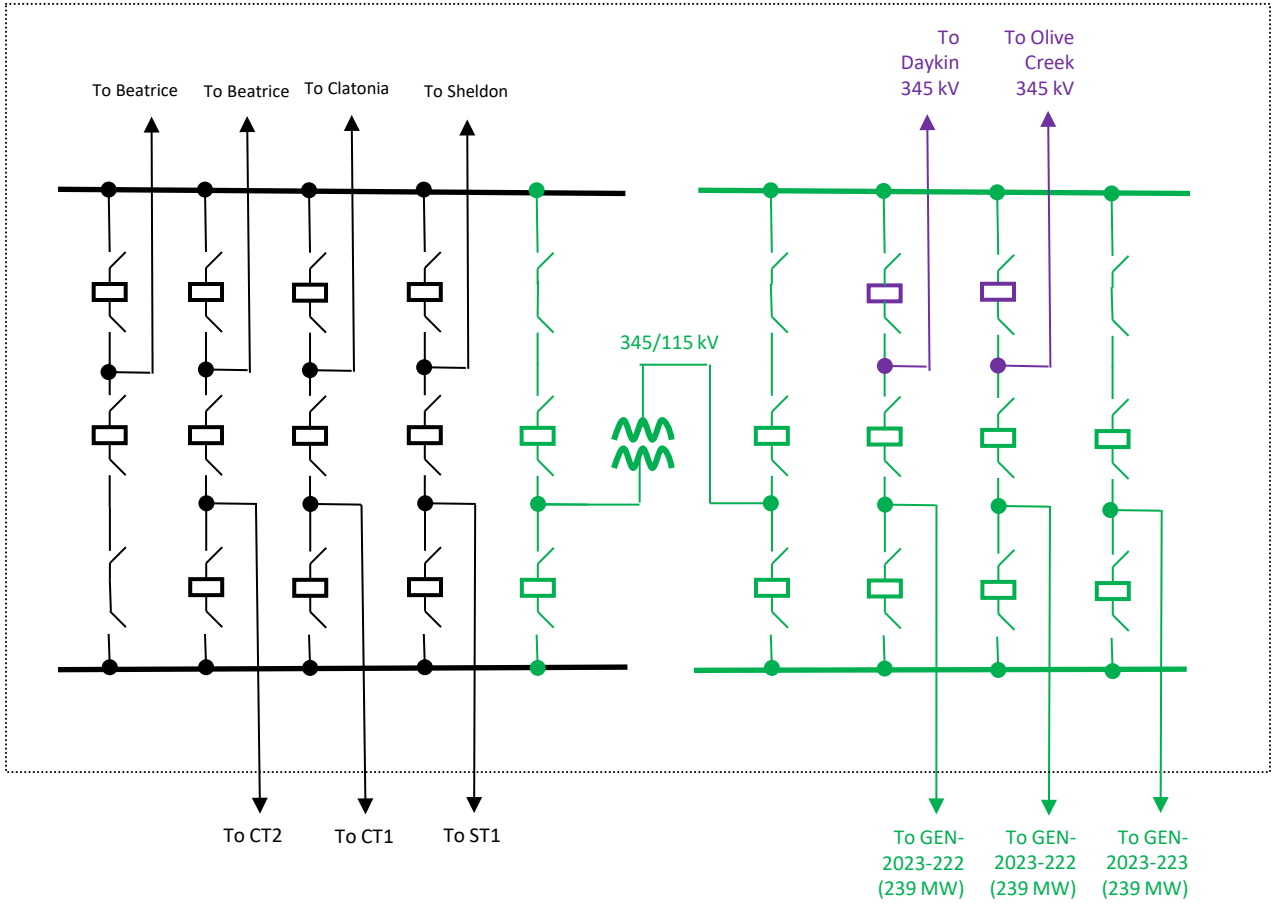
1b + remove Moore 345/115 kV transformer + add 2nd PRS-Sheldon 115 kV circuit + remove Olive Creek 345/115 kV T2



# Appendix 3

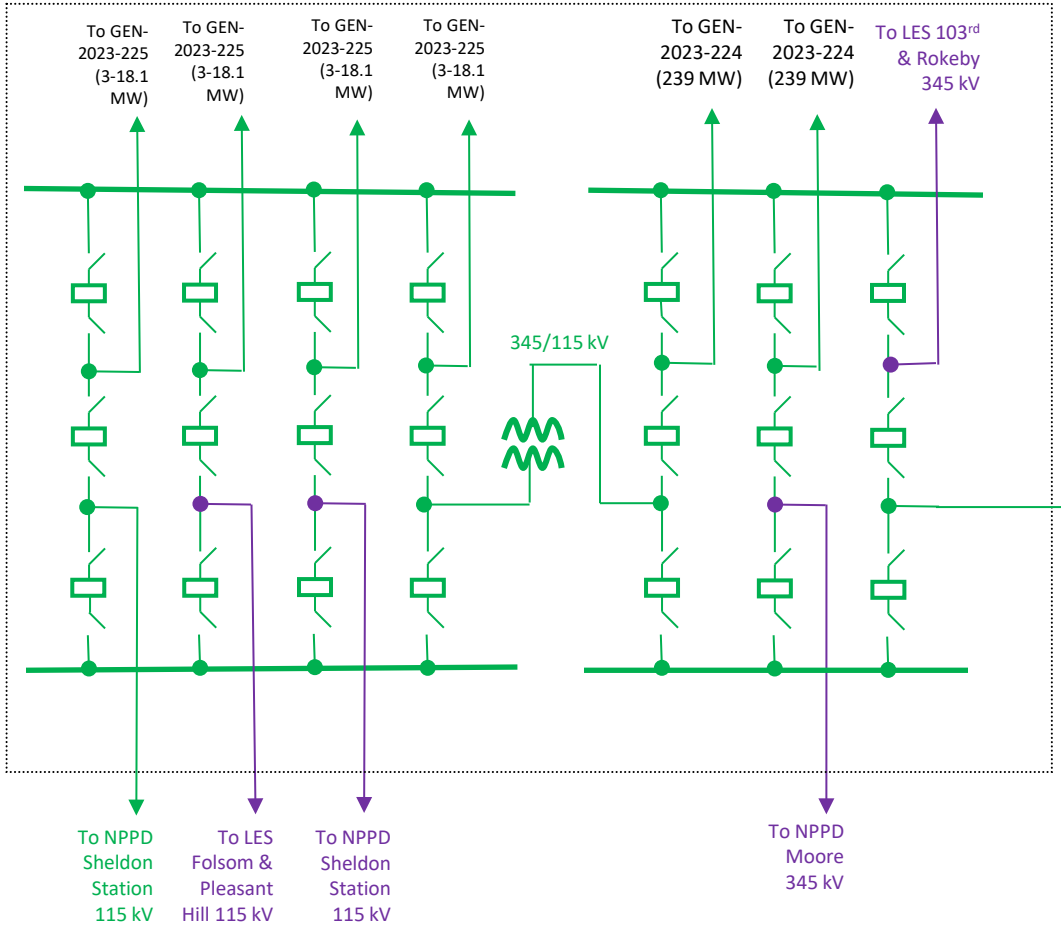
# Generation Interconnection Facilities One-Line Diagrams

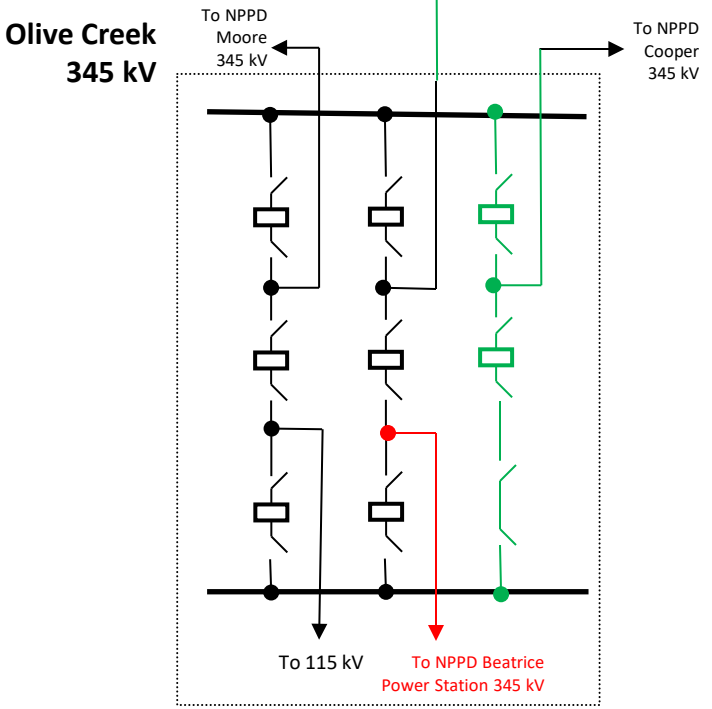
## Beatrice Power Station 345/115 kV




- DISIS-2023-001 Interconnection Facilities for GEN-2023-222 and GEN-2023-223
- Network Upgrades to address transmission system constraints

## Princeton Road 345/115 kV




- DISIS-2023-001 Network Upgrades
- DISIS-2023-001 Interconnection Facilities for GEN-2023-224 and GEN-2023-225
- LES Transmission Line Conflicts resolved through interconnection with new Princeton Road 345/115 kV substation