Engineering Connection Assessment

P2411 Jurassic Solar Project Connection

Jurassic Solar LP

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Role	Name	Date	Signature
Prepared	Myron Jin-Li, P. Eng	Jan 17, 2023	Myron Jin-Li
Reviewed	Mahmoud Ahmed, P. Eng	Jan. 18, 2023	Mahmoud Ahmed
Approved	Pravin Koshti, P. Eng	Jan 18,2023	Pravin Koshti

PROFESSIONAL ENGINEER ALBERTA
MYRON JIN-LI
ID#218383
2023-01-17

PERMIT TO PRACTICE
INDEPENDENT SYSTEM OPERATOR
RM SIGNATURE: Pravin Koshti
RM APEGA ID #: 110749
DATE: Jan 18,2023
PERMIT NUMBER: P008200
The Association of Professional Engineers and Geoscientists of Alberta (APEGA)

NOTE:

The conclusions and recommendations in this report are based on the results presented in *Attachment A: Engineering Connection Assessment: Study Results*, which was prepared by a third party consultant in accordance with the AESO Connection Process.

The AESO has reviewed the *Engineering Connection Assessment: Study Results*, and finds it acceptable for the purpose of assessing the potential impacts of the proposed connection on the performance of the Alberta interconnected electric system.

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1 Introduction

This AESO Engineering Connection Assessment describes the engineering studies that were completed to assess the impact of the Project (as defined below) on the performance of the Alberta interconnected electric system (AIES). This report also provides the AESO's conclusions and recommendations based on the results of the engineering studies.

Attached to this Engineering Connection Assessment are the results of the engineering studies (see Attachment A) and the scope and methodology used to perform the studies (see Attachment A1 to Attachment A). These attachments provide details regarding the technical criteria, assumptions, and methods for performing these engineering studies, and the results of the engineering studies.

1.1 Project Overview

Jurassic Solar LP (Market Participant) has submitted a request for system access service to the Alberta Electric System Operator (AESO) to connect its proposed Jurassic Solar (Facility) to the AIES. The Facility includes a proposed collector substation, to be designated Raptor 1080S.

The Market Participant's request includes: a request for a new system access service in the area, with a Rate STS, *Supply Transmission Service*, contract capacity of 300 MW and a Rate DTS, *Demand Transmission Service*, contract capacity of 1.5 MW; and a request for transmission development (collectively, the Project). The STS contract capacity represents the combined capacity of both the solar and energy storage components of the project.

The Project in-service date (ISD) is December 14, 2023.

2 Assessment Scope

2.1 Objectives

The objectives of the AESO Engineering Connection Assessment are as follows:

- Assess the impact of the Project on the performance of the AIES.
- Evaluate Project connection alternatives and identify the AESO's preferred alternative.
- Recommend mitigation measures, if required, to reliably connect the Project to the AIES.
- Identify Project dependencies, including any TFO projects or AESO plans to expand or enhance the transmission system that must be completed prior to connection.

2.2 Existing System

Geographically, the Project is located in the AESO planning area Empress (Area 48), which is part of the AESO South planning region. Empress (Area 48) is surrounded by the planning areas of Medicine Hat (Area 4), Vauxhall (Area 52), Brooks (Area 47), Sheerness (Area 43), and Hanna (Area 42).

From a transmission system perspective, Empress (Area 48) consists primarily of a 240 kV and 138 kV transmission system. The Empress Area (Area 48) is connected to the Hanna Area (Area 42) with a 138kV line, the Brooks Area (Area 47) with two 240kV lines, and the Medicine Hat Area (Area 4) with a 240kV line.

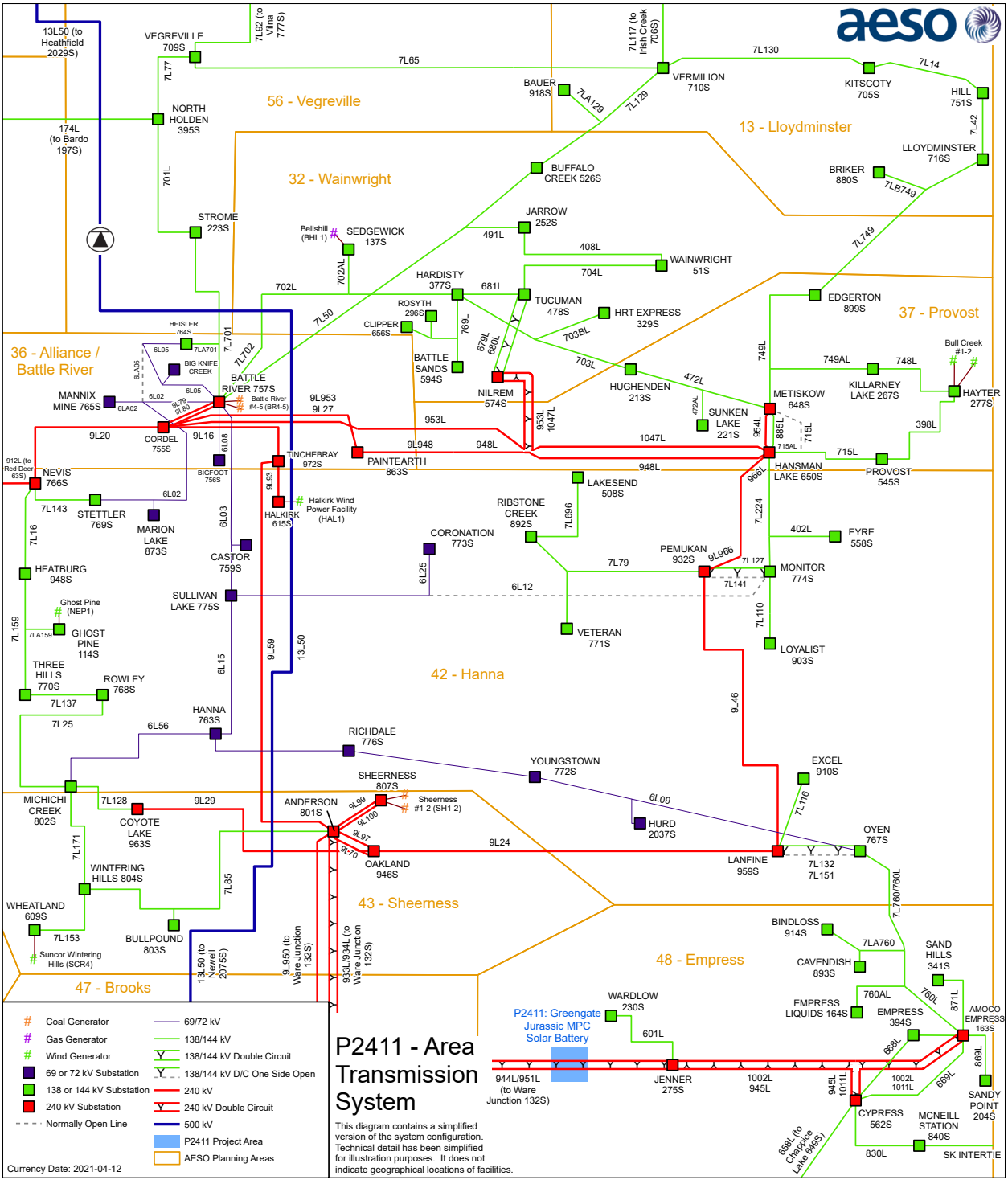
Existing constraints in the Empress planning region are managed in accordance with the procedures set out in Section 302.1 of the ISO rules, Real Time Transmission Constraint Management (TCM Rule).

2.3 Study Area

The Study Area consists of the AESO planning areas of Empress (Area 48), Sheerness (Area 43), Hanna (Area 42), Alliance/Battle River (Area 36), Wainwright (Area 32), and Provost (Area 37), including the tie lines connecting these planning areas to the rest of the AIES. All transmission facilities 69 kV and above within the Study Area will be studied and monitored for violations of the Reliability Criteria (defined in Section 3.1 of Attachment A1). In addition, 174L (North Holden 395S – Bardo 197S) will be included in the monitored elements.

The existing transmission system in the Study Area is shown in Figure1-1.

Figure1-1: Transmission System in the Study Area



3 Connection Alternatives

3.1 Overview

The AESO, in consultation with the TFO in the Study Area and the Market Participant, examined 3 transmission alternatives to meet the Market Participant's request for system access service, as detailed in Section 3.2.

3.2 Connection Alternatives Examined

Alternative 1 – Radial 240 kV connection to Jenner 275S substation

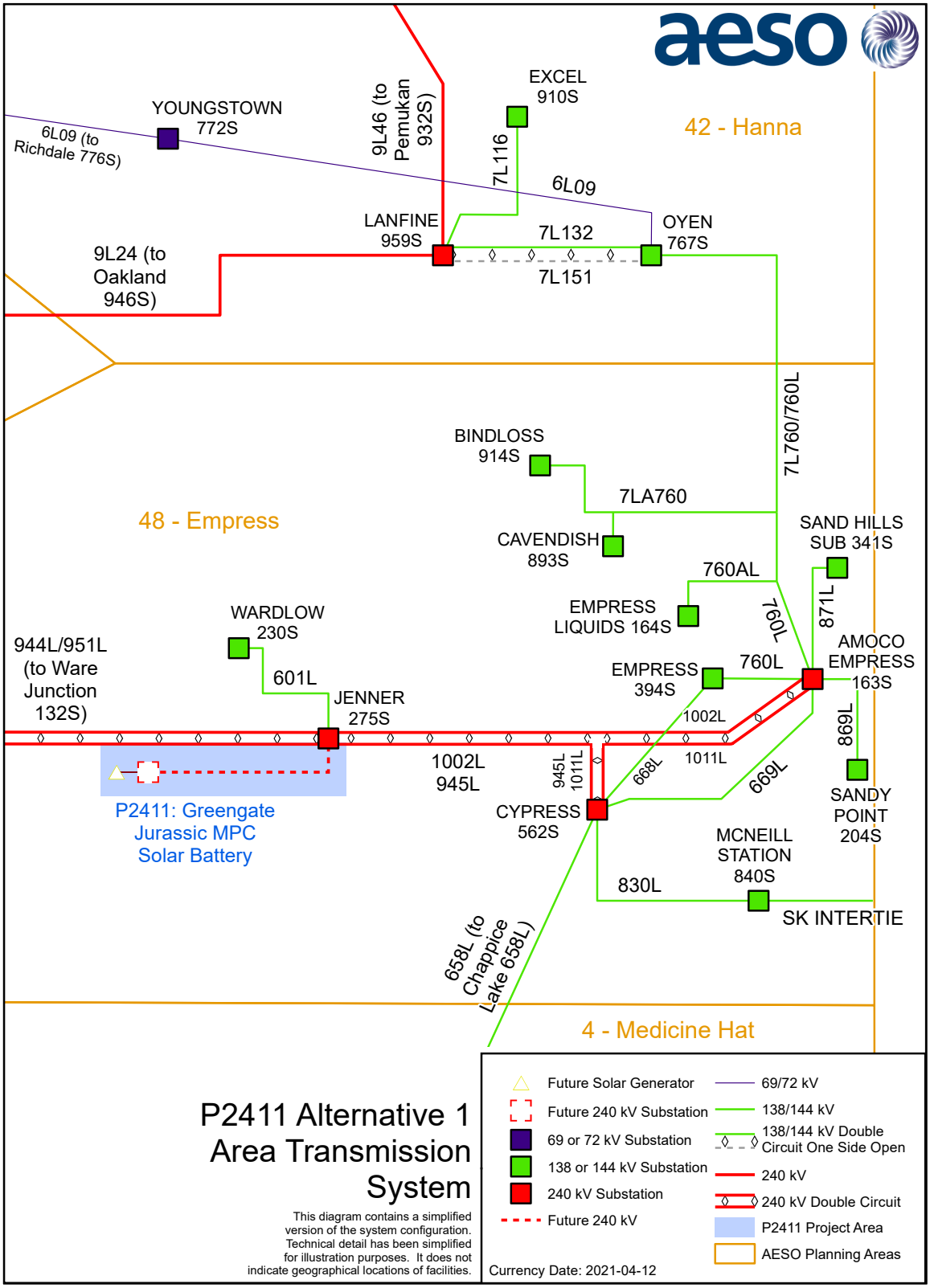
This alternative includes the following developments:

- Add one 240 kV circuit, approximately 18 km in length,[1] to connect the Facility to the existing Jenner 275S substation in a radial configuration;
- Modify Jenner 275S substation, including adding two 240 kV circuit breakers; and
- Add or modify associated equipment as required for the above transmission developments.

The proposed connection configuration is shown in Figure 2-1.

[1] Exact line length to be determined by the Market Participant

Figure 2-1: Connection Alternative 1



Alternative 2 – T-tap connection to 240 kV transmission line 944L

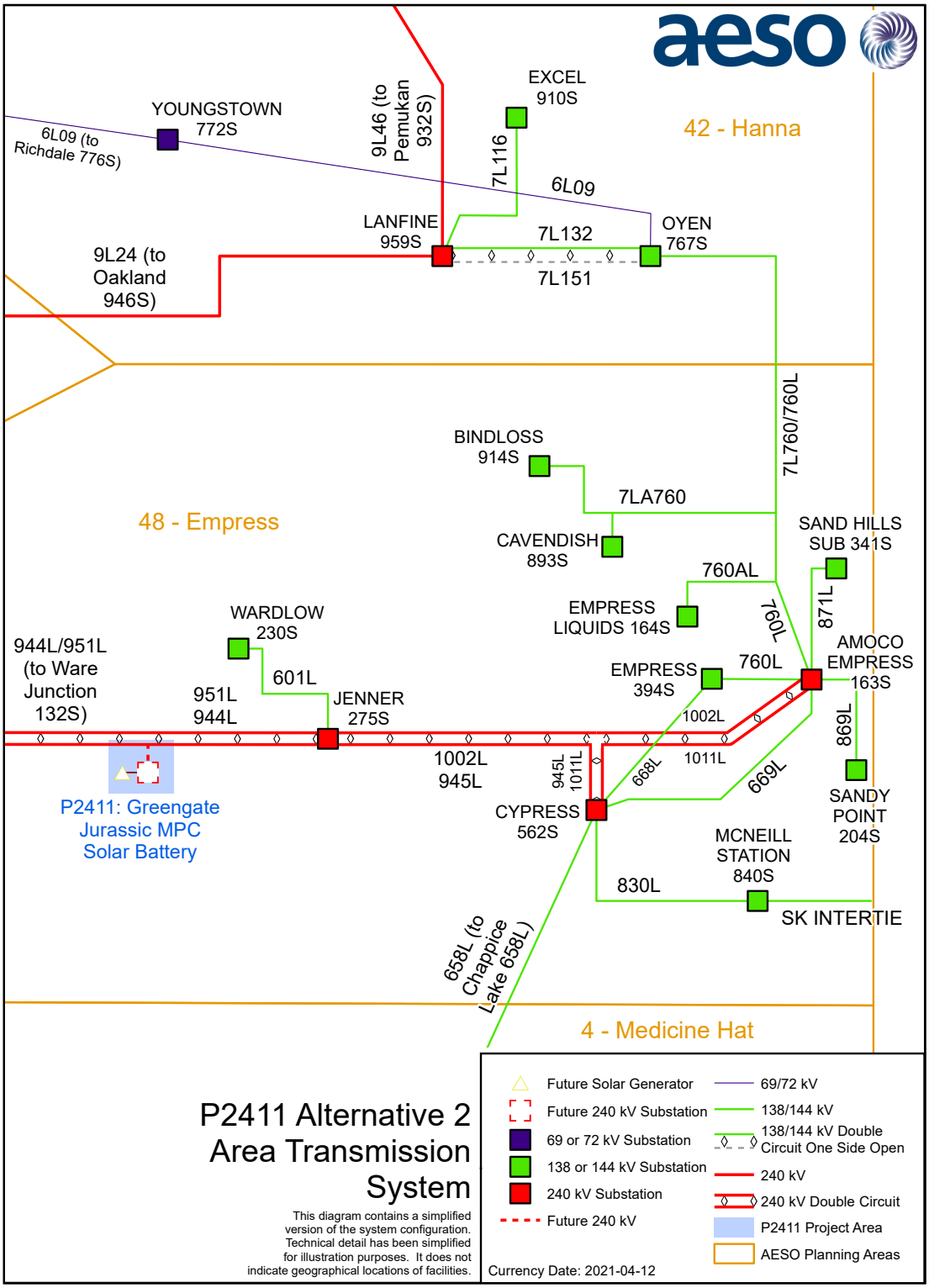
This alternative includes the following developments:

- Add one 240 kV circuit, approximately 500 m in length,[2] to connect the Facility to the existing 240 kV transmission line 944L in a T-tap configuration; and
- Add or modify associated equipment as required for the above transmission developments.

The proposed connection configuration is shown in Figure 2-2.

[2] Exact line length to be determined by the Market Participant

Figure 2-2: Connection Alternative 2



Alternative 3 – In-and-out connection to the 240 kV transmission line 944L

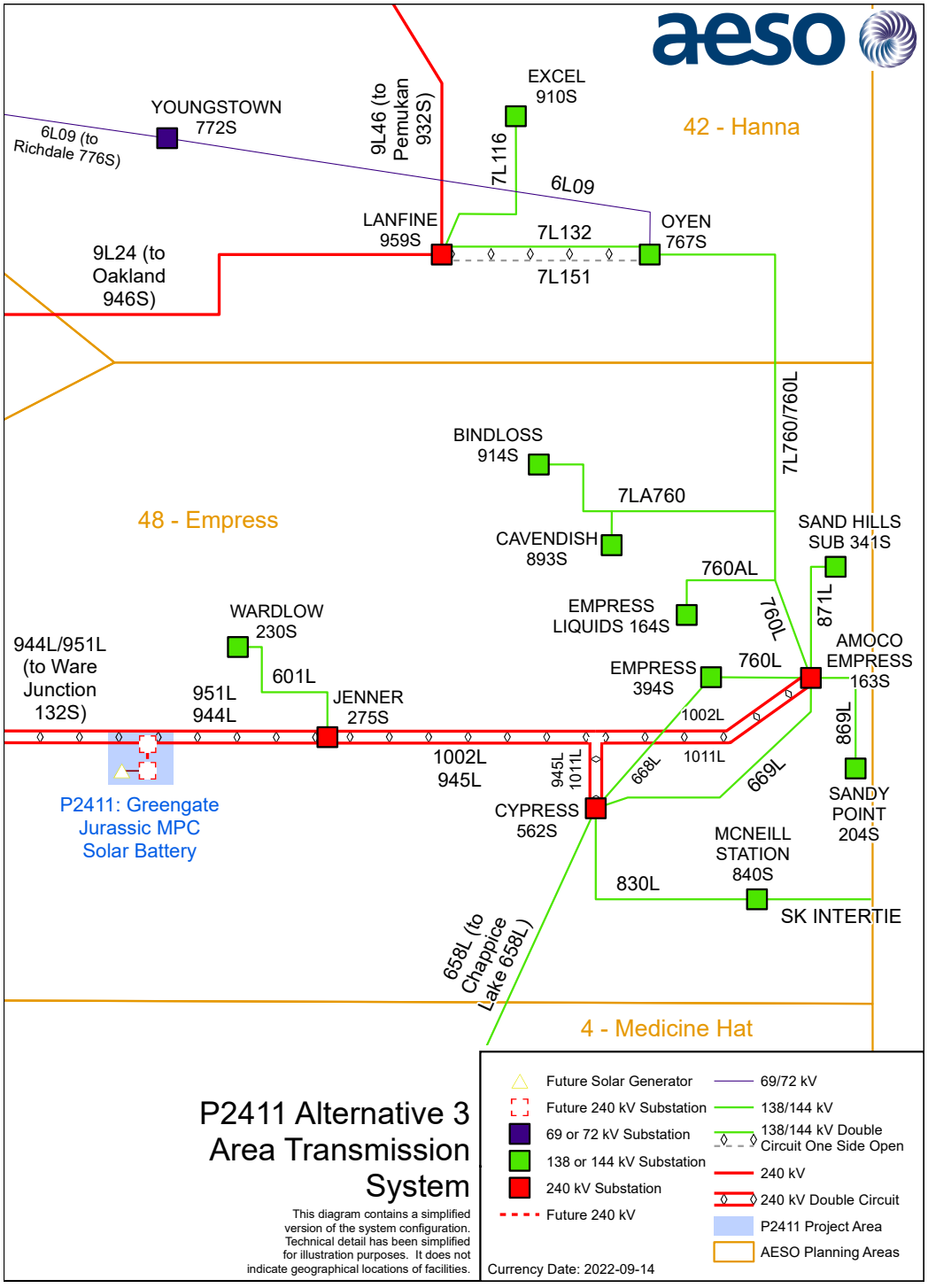
This alternative includes the following developments:

- Add a new 240 kV switching substation, including three 240 kV circuit breakers;
- Connect the proposed 240 kV switching substation to the existing 240 kV transmission line 944L (between the Ware Junction 132S and Jenner 275S substations) using an in-and-out configuration;
- Add one 240 kV circuit, approximately 500 m in length,[3] to connect the Facility to the 240 kV switching substation; and
- Add or modify associated equipment as required for the above transmission developments.

The proposed connection configuration is shown in Figure 2-3.

[3] Exact line length to be determined by the Market Participant

Figure 2-3: Connection Alternative 3



3.3 Connection Alternatives Selected for Further Study

Alternative 2 is considered technically feasible and was selected for further study.

3.4 Connection Alternatives Not Selected for Further Study

Alternatives 1, 2 and 3 all would show similar technical performance however, Alternatives 1 and 3 would involve increased transmission development, and hence, overall increased cost, compared to Alternative 2. Therefore, Alternatives 1 and 3 were not selected for further study.

4 Assessment Approach

4.1 Standards, Criteria and Assumptions

A detailed description of the standards, criteria, and assumptions that were used for the connection assessment is provided in Attachment A (see Attachment A1).

4.2 Studies Performed

The scheduled ISD for the Project is December 14, 2023, therefore, studies were performed using scenarios for 2023 Summer Peak (SP), 2023 Winter Peak and 2023 Summer light (SL).

Short-circuit studies were performed using the 2023 WP pre-Project scenario, 2023 WP and 2031 WP post-Project scenarios.

Table 4-1 lists the study scenarios. Post-Project scenarios reflect the requested Rate STS contract capacity of 300 MW at the Raptor 1080S substation.

Sensitivity scenario 4a was added to account for a number of customer connection projects being proposed in the vicinity.

The scenarios studied include the Provost to Edgerton and Nilrem to Vermilion (PENV) transmission development, as the project has met the inclusion criteria for system projects. In October 2022, the AESO notified the public through a stakeholder session that the need for the PENV development could potentially be deferred.

Table 4-1: Connection Study Scenarios

Scenario No.	Year/Season	System Generation Dispatch Conditions	Scenario Name	Project Load (MW)	Project Generation (MW)
Pre-Project					
1	2023 Summer Peak (2023 SP)	High Renewable, Economic Coal	2023 SP Pre-Project	0	0
2	2023 Summer Light (2023 SL)		2023 SL Pre-Project	0	0
3	2023 Winter Peak (2023 WP)		2023 WP Pre-Project	0	0
Post-Project					
4	2023 SP	High Renewable, Economic Coal	2023 SP Post-Project	0	220 (solar) 80 (battery storage)
5	2023 SL		2023 SL Post-Project	0	220 (solar) 80 (battery storage)
6	2023 WP		2023 WP Post-Project	0	220 (solar) 80 (battery storage)

Scenario No.	Year/Season	System Generation Dispatch Conditions	Scenario Name	Project Load (MW)	Project Generation (MW)
7	2031 WP	All study area generation in-service	2031 WP Post-Project	0	220 (solar) 80 (battery storage)
Post-Project					
4a	2023 SP	High renewable, Economic Coal, P1250, P2065, P1704, P2059, P2061 in service	2023 SP Post-Project Sensitivity	0	220 (solar) 80 (battery storage)

The AESO Planning Region load forecasts used for the connection studies were based on *2021 Long Term Outlook* (2021 LTO).

4.2.1 Power Flow Studies

The purpose of the power flow studies is to identify and quantify any thermal and voltage criteria violations in the Study Area.

In addition, power flow studies are also used to identify point of delivery (POD) low voltage bus voltage deviations beyond the limits listed in Table 3-1 of Attachment A1.[4]

Power flow studies were performed for 2023 SP, 2023 SL, and 2023 WP pre-Project scenarios, and for the 2023 SP, 2023 SL and 2023 WP post-Project scenarios as well as the 2023 SP post-Project sensitivity scenario.

4.2.2 Transient Stability Studies

The purpose of the transient stability studies is to assess the post-Project stability of the transmission system after three-phase to ground faults are applied on select transmission lines in the Study Area.

Transient stability studies were performed for 2023 SL and 2023 WP post-Project scenarios.

4.2.3 Short-Circuit Current Level Studies

The purpose of short-circuit current level studies is to determine the expected system short-circuit current levels in the vicinity of the Project.

Short circuit studies were performed for the 2023 WP pre-Project scenario and for 2023 WP and 2031 WP post-Project scenarios.

[4] The AESO's desired post-contingency voltage deviations for low voltage busses represent guidelines rather than criteria. A POD bus voltage deviation that exceeds the desired limits shown in Table 3-1 of Attachment A1 does not represent a Reliability Criteria violation. Mitigation measures would not be developed to specifically address POD bus voltage deviations that exceed the desired values in Table 3-1 of Attachment A1.

4.3 Mitigation Measure Development and Evaluation

As explained in Section 6 of Attachment A1, mitigation measures were developed to address system performance issues that were identified in the post-Project and post-Project sensitivity scenarios. Studies performed to assess the effectiveness of mitigation measures are briefly outlined below.

4.3.1 Post-Mitigation Studies

Power flow studies were performed to assess the impact of the Project on the performance of the AIES following implementation of the AESO's proposed mitigation measures.

4.3.2 Constraint Effective Factor Studies

Constraint effective factor studies were used to determine the generator and load constraint effective factors and to identify the most effective generators or loads to manage thermal criteria violations that were observed under Category B conditions.

5 Interpretation of Results

5.1 Results Overview

This section provides an assessment of the impact of the Project on the performance of the AIES. The Reliability Criteria violations observed during the connection assessment studies, and the proposed mitigation measures are summarized in Table 5-1.

- Section 5.2 includes an overview of the pre-Project studies results.
- Section 5.3 includes an overview of the post-Project studies results.
- Section 5.4 includes an overview of the post-Project sensitivity studies results.
- Section 5.5 includes a description of the proposed mitigation measures to address observed Reliability Criteria violations and an overview of the post-mitigation studies results.

Detailed study results are provided in Attachment A.

Table 5-1: Summary of Reliability Criteria Violations, Project Impact and Mitigation Measures

Scenario	Type of Reliability Criteria Violation		Contingency (System Element Lost)	Details of Violation	Project Impact	Pre-Project Mitigation Measures	Post-Project Mitigation Measures
	Pre-Project	Post-Project					
2023 SP	Thermal - above normal rating	Thermal - above normal rating	N-0 (System Normal Condition)	7L171 (Michichi Creek 802S - Wintering Hills 804S)	Materially increased violation	RTOP	RTOP
2023 SL	Thermal - above normal rating	Thermal - above normal rating	N-0 (System Normal Condition)	7L171 (Michichi Creek 802S - Wintering Hills 804S)	Materially increased violation	RTOP	RTOP
2023 SP	Thermal - above emergency rating	Thermal - above emergency rating	766S901T (Nevis 766S Transformer 901T)	174L (Bardo 197S - North Holden 395S)	Materially increased violation	Planned RAS 134	Planned RAS 134
2023 SP	No violation	Thermal - above normal rating	766S901T (Nevis 766S Transformer 901T)	701L (Strome 223S - Heisler Tap)	New violation	Planned RAS 134	Planned RAS 134
2023 SP	No violation	Thermal - above normal rating	766S901T (Nevis 766S Transformer 901T)	7L701 (Heisler Tap - Battle River 757S)	New violation	Planned RAS 134	Planned RAS 134
2023 SP	Thermal - above emergency rating	Thermal - above emergency rating	EATL (Newell 2075S - Heathfield 2029S)	174L (Bardo 197S - North Holden 395S)	Materially increased violation	Planned RAS 134/Planned RAS 202	Planned RAS 134/Planned RAS 202
2023 SP	No violation	Thermal - above normal rating	EATL (Newell 2075S - Heathfield 2029S)	7L159 (Ghost Tap - Heatburg 948S)	New violation	Planned RAS 134/Planned RAS 202	Planned RAS 134/Planned RAS 202
2023 SP	No violation	Thermal - above normal rating	EATL (Newell 2075S - Heathfield 2029S)	701L (Strome 223S - Heisler Tap)	New violation	Planned RAS 134/Planned RAS 202	Planned RAS 134/Planned RAS 202
2023 SP	Thermal - above normal rating	Thermal - above normal rating	EATL (Newell 2075S - Heathfield 2029S)	7L701 (Heisler Tap - Battle River 757S)	Materially increased violation	Planned RAS 134/Planned RAS 202	Planned RAS 134/Planned RAS 202
2023 SP	Thermal - above normal rating	Thermal - above emergency rating	EATL (Newell 2075S - Heathfield 2029S)	912L\9L912 (Red Deer 63S - Nevis 766S)	Materially increased violation	Planned RAS 134/Planned RAS 202	Planned RAS 134/Planned RAS 202
2023 SP	No violation	Thermal - above normal rating	EATL (Newell 2075S - Heathfield 2029S)	9L20 (Nevis 766S - Cordel 755S)	New violation	Planned RAS 134/Planned RAS 202	Planned RAS 134/Planned RAS 202
2023 SP	No violation	Thermal - above normal rating	EATL (Newell 2075S - Heathfield 2029S)	7L16 (Nevis 766S - Heatburg 948S)	New violation	Planned RAS 134/Planned RAS 202	Planned RAS 134/Planned RAS 202
2023 SP	Thermal - above emergency rating	Thermal - above emergency rating	EATL (Newell 2075S - Heathfield 2029S)	9L16 (Tinchebray 972S - Cordel 755S)	Materially increased violation	Planned RAS 134/Planned RAS 202	Planned RAS 134/Planned RAS 202
2023 SP	Thermal - above normal rating	Thermal - above normal rating	EATL (Newell 2075S - Heathfield 2029S)	7L171 (Michichi Creek 802S - Wintering Hills 804S)	Marginally increased violation	Planned RAS 134/Planned RAS 202	Planned RAS 134/Planned RAS 202
2023 SP	No violation	Thermal - above normal rating	9LA59TAP (Anderson 801S - P1909 - Tinchebray 972S)	7L171 (Michichi Creek 802S - Wintering Hills 804S)	New violation	None	Planned RAS 202
2023 SP	Thermal - above normal rating	Thermal - above normal rating	669L (Amoco Empress 163S - Cypress 562S)	668L (Empress 394S - Cypress 562S)	Materially increased violation	Real time operational practices	Real time operational practices
2023 SP	Thermal - above normal rating	Thermal - above emergency rating	9L20 (Nevis 766S - Cordel 755S)	174L (Bardo 197S - North Holden 395S)	Materially increased violation	Planned RAS 134/Planned RAS 202	Planned RAS 134/Planned RAS 202
2023 SP	No violation	Thermal - above normal rating	9L20 (Nevis 766S - Cordel 755S)	7L159 (Ghost Tap - Heatburg 948S)	New violation	Planned RAS 134/Planned RAS 202	Planned RAS 134/Planned RAS 202
2023 SP	No violation	Thermal - above normal rating	9L20 (Nevis 766S - Cordel 755S)	7L701 (Heisler Tap - Battle River 757S)	New violation	Planned RAS 134/Planned RAS 202	Planned RAS 134/Planned RAS 202
2023 SP	Thermal - above emergency rating	Thermal - above emergency rating	9L20 (Nevis 766S - Cordel 755S)	766S901T (Nevis 766S Transformer 901T)	Materially increased violation	Planned RAS 134/Planned RAS 202	Planned RAS 134/Planned RAS 202
2023 SP	No violation	Thermal - above normal rating	9L20 (Nevis 766S - Cordel 755S)	7L16 (Nevis 766S - Heatburg 948S)	New violation	Planned RAS 134/Planned RAS 202	Planned RAS 134/Planned RAS 202
2023 SP	Thermal - above normal rating	Thermal - above normal rating	9L20 (Nevis 766S - Cordel 755S)	7L171 (Michichi Creek 802S - Wintering Hills 804S)	Marginally increased violation	Planned RAS 134/Planned RAS 202	Planned RAS 134/Planned RAS 202
2023 SP	No violation	Thermal - above normal rating	9L16 (Switch 972S - Cordel 755S)	7L159 (Ghost Tap - Heatburg 948S)	New violation	None	Planned RAS 202
2023 SP	Thermal - above normal rating	Thermal - above normal rating	9L16 (Switch 972S - Cordel 755S)	7L171 (Michichi Creek 802S - Wintering Hills 804S)	Marginally increased violation	Planned RAS 202	Planned RAS 202
2023 SP	No violation	Thermal - above normal rating	9L29 (Oakland 946S - Coyote Lake 963S)	7L171 (Michichi Creek 802S - Wintering Hills 804S)	New violation	None	Planned RAS 202
2023 SP	No violation	Thermal - above normal rating	9L966 (Hansman Lake 650S - Pemukan 932S)	7L224 (Hansman Lake 650S - Monitor 774S)	New violation	None	Modified Planned RAS 201
2023 SP	Thermal - above emergency rating	Thermal - above emergency rating	912L\9L912 (Red Deer 63S - Nevis 766S)	174L (Bardo 197S - North Holden 395S)	Materially increased violation	Planned RAS 134	Planned RAS 134
2023 SP	No violation	Thermal - above normal rating	912L\9L912 (Red Deer 63S - Nevis 766S)	701L (Strome 223S - Heisler Tap)	New violation	None	Planned RAS 134
2023 SP	No violation	Thermal - above normal rating	912L\9L912 (Red Deer 63S - Nevis 766S)	7L701 (Heisler Tap - Battle River 757S)	New violation	None	Planned RAS 134

Scenario	Type of Reliability Criteria Violation		Contingency (System Element Lost)	Details of Violation	Project Impact	Pre-Project Mitigation Measures	Post-Project Mitigation Measures
	Pre-Project	Post-Project					
2023 SP	No violation	Thermal - above normal rating	963S901T (Coyote Lake 963S Transformer 901T)	7L171 (Michichi Creek 802S - Wintering Hills 804S)	New violation	None	Planned RAS 202
2023 SP	Thermal - above emergency rating	Thermal - above emergency rating	7L171 (Michichi Creek 802S - Wintering Hills 804S)	7L85 (Bullpound 803S - Parker 2027S)	Materially decreased violation	Planned RAS 200	Planned RAS 200
2023 SP	Thermal - above emergency rating	Thermal - above emergency rating	7L171 (Michichi Creek 802S - Wintering Hills 804S)	801S901T (Anderson 801S Transformer 901T)	Materially decreased violation	Planned RAS 200	Planned RAS 200
2023 SP	Thermal - above emergency rating	Thermal - above emergency rating	801S901T (Anderson 801S Transformer 901T)	7L171 (Michichi Creek 802S - Wintering Hills 804S)	Materially decreased violation	Planned RAS 202	Planned RAS 202
2023 SP	Thermal - above normal rating	Thermal - above normal rating	114ST1 (Ghost Pine 114S Transformer T1)	7L171 (Michichi Creek 802S - Wintering Hills 804S)	Marginally increased violation	Planned RAS 202	Planned RAS 202
2023 SL	Thermal - above normal rating	Thermal - above emergency rating	766S901T (Nevis 766S Transformer 901T)	174L (Bardo 197S - North Holden 395S)	Materially increased violation	Planned RAS 134	Planned RAS 134
2023 SL	Thermal - above emergency rating	Thermal - above emergency rating	EATL (Newell 2075S - Heathfield 2029S)	174L (Bardo 197S - North Holden 395S)	Materially increased violation	Planned RAS 134/Planned RAS 202	Planned RAS 134/Planned RAS 202
2023 SL	No violation	Thermal - above normal rating	EATL (Newell 2075S - Heathfield 2029S)	7L159 (Ghost Tap - Heatburg 948S)	New violation	Planned RAS 134/Planned RAS 202	Planned RAS 134/Planned RAS 202
2023 SL	No violation	Thermal - above normal rating	EATL (Newell 2075S - Heathfield 2029S)	912L\9L912 (Red Deer 63S - Nevis 766S)	New violation	Planned RAS 134/Planned RAS 202	Planned RAS 134/Planned RAS 202
2023 SL	No violation	Thermal - above normal rating	EATL (Newell 2075S - Heathfield 2029S)	9L16 (Tinchebray 972S - Cordel 755S)	New violation	Planned RAS 134/Planned RAS 202	Planned RAS 134/Planned RAS 202
2023 SL	Thermal - above normal rating	Thermal - above normal rating	EATL (Newell 2075S - Heathfield 2029S)	7L171 (Michichi Creek 802S - Wintering Hills 804S)	Marginally decreased violation	Planned RAS 134/Planned RAS 202	Planned RAS 134/Planned RAS 202
2023 SL	No violation	Thermal - above normal rating	669L (Amoco Empress 163S - Cypress 562S)	668L (Empress 394S - Cypress 562S)	New violation	None	Real time operational practices
2023 SL	No violation	Thermal - above emergency rating	9L20 (Nevis 766S - Cordel 755S)	174L (Bardo 197S - North Holden 395S)	New violation	Planned RAS 134/Planned RAS 202	Planned RAS 134/Planned RAS 202
2023 SL	No violation	Thermal - above normal rating	9L20 (Nevis 766S - Cordel 755S)	7L159 (Ghost Tap - Heatburg 948S)	New violation	Planned RAS 134/Planned RAS 202	Planned RAS 134/Planned RAS 202
2023 SL	Thermal - above emergency rating	Thermal - above emergency rating	9L20 (Nevis 766S - Cordel 755S)	766S901T (Nevis 766S Transformer 901T)	Materially increased violation	Planned RAS 134/Planned RAS 202	Planned RAS 134/Planned RAS 202
2023 SL	No violation	Thermal - above normal rating	9L20 (Nevis 766S - Cordel 755S)	7L16 (Nevis 766S - Heatburg 948S)	New violation	None	Planned RAS 134/Planned RAS 202
2023 SL	Thermal - above normal rating	Thermal - above normal rating	9L20 (Nevis 766S - Cordel 755S)	7L171 (Michichi Creek 802S - Wintering Hills 804S)	Marginally increased violation	Planned RAS 134/Planned RAS 202	Planned RAS 134/Planned RAS 202
2023 SL	Thermal - above normal rating	Thermal - above normal rating	9L16 (Switch 972S - Cordel 755S)	7L171 (Michichi Creek 802S - Wintering Hills 804S)	Marginally increased violation	Planned RAS 202	Planned RAS 202
2023 SL	Thermal - above normal rating	Thermal - above emergency rating	912L\9L912 (Red Deer 63S - Nevis 766S)	174L (Bardo 197S - North Holden 395S)	Materially increased violation	Planned RAS 134	Planned RAS 134
2023 SL	Thermal - above normal rating	Thermal - above normal rating	959S901T (Lanfine 959S Transformer 901T)	7L132 (Oyen 767S - Lanfine 959S)	No impact	Real time operational practices	Real time operational practices
2023 SL	Thermal - above normal rating	Thermal - above normal rating	7L171 (Michichi Creek 802S - Wintering Hills 804S)	7L85 (Bullpound 803S - Anderson 801S)	Materially decreased violation	Planned RAS 200	Planned RAS 200
2023 SL	Thermal - above emergency rating	Thermal - above emergency rating	7L171 (Michichi Creek 802S - Wintering Hills 804S)	7L85 (Bullpound 803S - Parker 2027S)	Materially decreased violation	Planned RAS 200	Planned RAS 200
2023 SL	Thermal - above emergency rating	Thermal - above emergency rating	7L171 (Michichi Creek 802S - Wintering Hills 804S)	801S901T (Anderson 801S Transformer 901T)	Materially decreased violation	Planned RAS 200	Planned RAS 200
2023 SL	Thermal - above emergency rating	Thermal - above emergency rating	801S901T (Anderson 801S Transformer 901T)	7L171 (Michichi Creek 802S - Wintering Hills 804S)	Materially decreased violation	Planned RAS 202	Planned RAS 202
2023 SL	Thermal - above normal rating	Thermal - above normal rating	114ST1 (Ghost Pine 114S Transformer T1)	7L171 (Michichi Creek 802S - Wintering Hills 804S)	Marginally decreased violation	Planned RAS 202	Planned RAS 202
2023 WP	No violation	Thermal - above emergency rating	766S901T (Nevis 766S Transformer 901T)	174L (Bardo 197S - North Holden 395S)	New violation	None	Planned RAS 134
2023 WP	Thermal - above normal rating	Thermal - above emergency rating	EATL (Newell 2075S - Heathfield 2029S)	174L (Bardo 197S - North Holden 395S)	Materially increased violation	Planned RAS 134	Planned RAS 134
2023 WP	No violation	Thermal - above normal rating	EATL (Newell 2075S - Heathfield 2029S)	9L16 (Tinchebray 972S - Cordel 755S)	New violation	Planned RAS 134	Planned RAS 134
2023 WP	No violation	Thermal - above emergency rating	9L20 (Nevis 766S - Cordel 755S)	766S901T (Nevis 766S Transformer 901T)	New violation	None	Planned RAS 134

Scenario	Type of Reliability Criteria Violation		Contingency (System Element Lost)	Details of Violation	Project Impact	Pre-Project Mitigation Measures	Post-Project Mitigation Measures
	Pre-Project	Post-Project					
2023 WP	No violation	Thermal - above emergency rating	912L\9L912 (Red Deer 63S - Nevis 766S)	174L (Bardo 197S - North Holden 395S)	New violation	None	Planned RAS 134
2023 WP	Thermal - above normal rating	Thermal - above normal rating	7L171 (Michichi Creek 802S - Wintering Hills 804S)	7L85 (Bullpound 803S - Parker 2027S)	No impact	Planned RAS 200	Planned RAS 200
2023 WP	Thermal - above emergency rating	Thermal - above emergency rating	7L171 (Michichi Creek 802S - Wintering Hills 804S)	801S901T (Anderson 801S Transformer 901T)	Marginally decreased violation	Planned RAS 200	Planned RAS 200
2023 WP	Thermal - above emergency rating	Thermal - above emergency rating	801S901T (Anderson 801S Transformer 901T)	7L171 (Michichi Creek 802S - Wintering Hills 804S)	Marginally decreased violation	Planned RAS 202	Planned RAS 202
2023 SP Sensitivity	N/A	Thermal - above normal rating	N-0 (System Normal Condition)	174L (Bardo 197S - North Holden 395S)	N/A	N/A	RTOP
2023 SP Sensitivity	N/A	Thermal - above normal rating	N-0 (System Normal Condition)	912L\9L912 (Red Deer 63S - Nevis 766S)	N/A	N/A	RTOP
2023 SP Sensitivity	N/A	Thermal - above emergency rating	766S901T (Nevis 766S Transformer 901T)	701L (Strome 223S - Heisler Tap)	N/A	N/A	Planned RAS 134
2023 SP Sensitivity	N/A	Thermal - above emergency rating	766S901T (Nevis 766S Transformer 901T)	7L701 (Heisler Tap - Battle River 757S)	N/A	N/A	Planned RAS 134
2023 SP Sensitivity	N/A	Thermal - above emergency rating	EATL (Newell 2075S - Heathfield 2029S)	7L159 (Ghost Tap - Heatburg 948S)	N/A	N/A	Planned RAS 199, Planned RAS 134
2023 SP Sensitivity	N/A	Thermal - above emergency rating	EATL (Newell 2075S - Heathfield 2029S)	701L (Strome 223S - Heisler Tap)	N/A	N/A	Planned RAS 199, Planned RAS 134
2023 SP Sensitivity	N/A	Thermal - above emergency rating	EATL (Newell 2075S - Heathfield 2029S)	7L701 (Heisler Tap - Battle River 757S)	N/A	N/A	Planned RAS 199, Planned RAS 134
2023 SP Sensitivity	N/A	Thermal - above emergency rating	EATL (Newell 2075S - Heathfield 2029S)	766S901T (Nevis 766S Transformer 901T)	N/A	N/A	Planned RAS 199, Planned RAS 134
2023 SP Sensitivity	N/A	Thermal - above emergency rating	EATL (Newell 2075S - Heathfield 2029S)	9L20 (Nevis 766S - Cordel 755S)	N/A	N/A	Planned RAS 199, Planned RAS 134
2023 SP Sensitivity	N/A	Thermal - above emergency rating	EATL (Newell 2075S - Heathfield 2029S)	7L16 (Nevis 766S - Heatburg 948S)	N/A	N/A	Planned RAS 199, Planned RAS 134
2023 SP Sensitivity	N/A	Thermal - above emergency rating	EATL (Newell 2075S - Heathfield 2029S)	9L16 (Tinchebray 972S - Cordel 755S)	N/A	N/A	Planned RAS 199, Planned RAS 134
2023 SP Sensitivity	N/A	Thermal - above normal rating	9LA59TAP (Anderson 801S - P1909 - Tinchebray 972S)	7L159 (Ghost Tap - Heatburg 948S)	N/A	N/A	Planned RAS 199
2023 SP Sensitivity	N/A	Thermal - above emergency rating	9L20 (Nevis 766S - Cordel 755S)	7L159 (Ghost Tap - Heatburg 948S)	N/A	N/A	Planned RAS 199, Planned RAS 134
2023 SP Sensitivity	N/A	Thermal - above normal rating	9L20 (Nevis 766S - Cordel 755S)	701L (Strome 223S - Heisler Tap)	N/A	N/A	Planned RAS 199, Planned RAS 134
2023 SP Sensitivity	N/A	Thermal - above emergency rating	9L20 (Nevis 766S - Cordel 755S)	7L701 (Heisler Tap - Battle River 757S)	N/A	N/A	Planned RAS 199, Planned RAS 134
2023 SP Sensitivity	N/A	Thermal - above emergency rating	9L20 (Nevis 766S - Cordel 755S)	766S901T (Nevis 766S Transformer 901T)	N/A	N/A	Planned RAS 199, Planned RAS 134
2023 SP Sensitivity	N/A	Thermal - above emergency rating	9L20 (Nevis 766S - Cordel 755S)	7L16 (Nevis 766S - Heatburg 948S)	N/A	N/A	Planned RAS 199, Planned RAS 134
2023 SP Sensitivity	N/A	Thermal - above normal rating	9L20 (Nevis 766S - Cordel 755S)	7L137 (Three Hills 770S - Rowley 768S)	N/A	N/A	Planned RAS 199, Planned RAS 134
2023 SP Sensitivity	N/A	Thermal - above normal rating	9L20 (Nevis 766S - Cordel 755S)	7L25 (Rowley 768S - Michichi Creek 802S)	N/A	N/A	Planned RAS 199, Planned RAS 134
2023 SP Sensitivity	N/A	Thermal - above emergency rating	9L16 (Switch 972S - Cordel 755S)	7L159 (Ghost Tap - Heatburg 948S)	N/A	N/A	Planned RAS 199, Planned RAS 134
2023 SP Sensitivity	N/A	Thermal - above emergency rating	9L16 (Switch 972S - Cordel 755S)	6L15 (Sullivan Lake 775S - Hanna 763S)	N/A	N/A	Planned RAS 199, Planned RAS 134
2023 SP Sensitivity	N/A	Thermal - above emergency rating	9L16 (Switch 972S - Cordel 755S)	766S901T (Nevis 766S Transformer 901T)	N/A	N/A	Planned RAS 199, Planned RAS 134
2023 SP Sensitivity	N/A	Thermal - above emergency rating	9L16 (Switch 972S - Cordel 755S)	7L16 (Nevis 766S - Heatburg 948S)	N/A	N/A	Planned RAS 199, Planned RAS 134
2023 SP Sensitivity	N/A	Thermal - above emergency rating	9L29 (Oakland 946S - Coyote Lake 963S)	7L159 (Ghost Tap - Heatburg 948S)	N/A	N/A	Planned RAS 199, Planned RAS 134

Scenario	Type of Reliability Criteria Violation		Contingency (System Element Lost)	Details of Violation	Project Impact	Pre-Project Mitigation Measures	Post-Project Mitigation Measures
	Pre-Project	Post-Project					
2023 SP Sensitivity	N/A	Thermal - above emergency rating	9L29 (Oakland 946S - Coyote Lake 963S)	766S901T (Nevis 766S Transformer 901T)	N/A	N/A	Planned RAS 199, Planned RAS 134
2023 SP Sensitivity	N/A	Thermal - above emergency rating	9L29 (Oakland 946S - Coyote Lake 963S)	7L16 (Nevis 766S - Heatburg 948S)	N/A	N/A	Planned RAS 199, Planned RAS 134
2023 SP Sensitivity	N/A	Thermal - above emergency rating	912L\9L912 (Red Deer 63S - Nevis 766S)	701L (Strome 223S - Heisler Tap)	N/A	N/A	Planned RAS 134
2023 SP Sensitivity	N/A	Thermal - above emergency rating	912L\9L912 (Red Deer 63S - Nevis 766S)	7L701 (Heisler Tap - Battle River 757S)	N/A	N/A	Planned RAS 134
2023 SP Sensitivity	N/A	Thermal - above normal rating	9L51 (Pemukan 932S - Sedalia 363S)	7L159 (Ghost Tap - Heatburg 948S)	N/A	N/A	Planned 9L16 RAS
2023 SP Sensitivity	N/A	Thermal - above emergency rating	9L51 (Pemukan 932S - Sedalia 363S)	9L16 (Tinchebray 972S - Cordel 755S)	N/A	N/A	Planned 9L16 RAS
2023 SP Sensitivity	N/A	Thermal - above normal rating	9L46 (Lanfine 959S - Sedalia 363S)	7L159 (Ghost Tap - Heatburg 948S)	N/A	N/A	Planned 9L16 RAS
2023 SP Sensitivity	N/A	Thermal - above emergency rating	9L46 (Lanfine 959S - Sedalia 363S)	9L16 (Tinchebray 972S - Cordel 755S)	N/A	N/A	Planned 9L16 RAS
2023 SP Sensitivity	N/A	Thermal - above emergency rating	959S901T (Lanfine 959S Transformer 901T)	767S701T (Oyen 767S Transformer T1)	N/A	N/A	Planned RAS 134
2023 SP Sensitivity	N/A	Thermal - above emergency rating	959S901T (Lanfine 959S Transformer 901T)	6L09\6LA09 (Oyen 767S - ACE Tap)	N/A	N/A	Planned RAS 134
2023 SP Sensitivity	N/A	Thermal - above emergency rating	959S901T (Lanfine 959S Transformer 901T)	767S701T (Oyen 767S Transformer T1)	N/A	N/A	Planned RAS 134
2023 SP Sensitivity	N/A	Thermal - above emergency rating	963S901T (Coyote Lake 963S Transformer 901T)	7L159 (Ghost Tap - Heatburg 948S)	N/A	N/A	Planned RAS 134
2023 SP Sensitivity	N/A	Thermal - above emergency rating	963S901T (Coyote Lake 963S Transformer 901T)	766S901T (Nevis 766S Transformer 901T)	N/A	N/A	Planned RAS 134
2023 SP Sensitivity	N/A	Thermal - above emergency rating	963S901T (Coyote Lake 963S Transformer 901T)	7L16 (Nevis 766S - Heatburg 948S)	N/A	N/A	Planned RAS 134
2023 SP Sensitivity	N/A	Thermal - above emergency rating	7L171 (Michichi Creek 802S - Wintering Hills 804S)	7L85 (Bullpound 803S - Parker 2027S)	N/A	N/A	Planned RAS 200
2023 SP Sensitivity	N/A	Thermal - above emergency rating	7L171 (Michichi Creek 802S - Wintering Hills 804S)	801S901T (Anderson 801S Transformer 901T)	N/A	N/A	Planned RAS 200
2023 SP Sensitivity	N/A	Thermal - above emergency rating	801S901T (Anderson 801S Transformer 901T)	7L171 (Michichi Creek 802S - Wintering Hills 804S)	N/A	N/A	Planned RAS 202
2023 SP Sensitivity	N/A	Thermal - above normal rating	9LA59 Tap (Anderson 801S - P1909 - Tinchebray 972S)	7L159 (Ghost Tap - Heatburg 948S)	N/A	N/A	Planned RAS 159
2023 SP Sensitivity	N/A	Thermal - above emergency rating	7L128 (Michichi Creek 802S - Coyote Lake 963S)	7L159 (Ghost Tap - Heatburg 948S)	N/A	N/A	Planned RAS 134
2023 SP Sensitivity	N/A	Thermal - above emergency rating	7L128 (Michichi Creek 802S - Coyote Lake 963S)	766S901T (Nevis 766S Transformer 901T)	N/A	N/A	Planned RAS 134
2023 SP Sensitivity	N/A	Thermal - above emergency rating	7L128 (Michichi Creek 802S - Coyote Lake 963S)	7L16 (Nevis 766S - Heatburg 948S)	N/A	N/A	Planned RAS 134
2023 SP Sensitivity	N/A	Thermal - above normal rating	770S703T (Three Hills 770S Transformer 703T)	7L159 (Ghost Tap - Heatburg 948S)	N/A	N/A	Planned RAS 134
2023 SP Sensitivity	N/A	Thermal – above normal rating	P2236 Transformer T1	7L171 (Michichi Creek 802S - Wintering Hills 804S)	N/A	N/A	Planned RAS 202
2023 SP Sensitivity	N/A	Thermal - above emergency rating	770S703T (Three Hills 770S Transformer 703T)	766S901T (Nevis 766S Transformer 901T)	N/A	N/A	Planned RAS 134

Notes:

- Marginally increased (or marginally decreased) refers to a percent loading difference (post-Project percent loading minus pre-Project percent loading) between 0% and 3% (or -3%).
- Materially increased (or materially decreased) refers to a percent loading difference (post-Project percent loading minus pre-Project percent loading) above or equal to 3% (or below or equal to -3%).
- 2023 SP Sensitivity only included post-Project scenario to assess RAS effectiveness and whether MSSC would be exceeded when including projects that had met certainty
- RAS 134, 199, 200, 201, and 202 were identified as required to mitigate certain thermal criteria violations in the AESO's operational studies. These RASs are referred to as "Planned RAS 134," "Planned RAS 199," "Planned RAS 200," "Planned RAS 201" and "Planned RAS 202"
- A new RAS has been identified as required for 9L16 through the AESO's operational studies. This RAS is referred to as "Planned 9L16 RAS."
- In this table, "Modify" refers to adding the Project to the logic of the respective RAS
- The observed 2023 SP Sensitivity Category A violations would be addressed in the long term by the Central East Transfer Out project, real-time operational practices are only used as an interim measure

5.2 Pre-Project Study Results

5.2.1 Category A Conditions

Category A thermal criteria violations were observed on the 144 kV transmission line 7L171. The short-circuit fault levels were found to be within the typical capabilities of the nearby facilities.

5.2.2 Category B Conditions

The pre-Project power flow studies identified a number of thermal violations under Category B conditions (i.e., loss of a single system element).

5.3 Post-Project Study Results

5.3.1 Category A Conditions

Category A thermal criteria violations were observed on the 144 kV transmission line 7L171. Post-Project short-circuit fault levels were not significantly higher than pre-Project levels.

The long term short circuit levels were found to be within the designed capabilities of the nearby facilities.

5.3.2 Category B Conditions

Category B post-Project studies were conducted with effective generation curtailed to mitigate the observed Category A thermal criteria violations.

Post-Project power flow studies identified a number of system performance issues under Category B conditions. In particular, thermal criteria violations were observed on the 138 kV/144 kV transmission lines 174L, 701L, 7L701, 7L224, 7L171 and transformers Nevis 766S substation 901T and Anderson 801S substation 901T.

Although a number of these violations appear to be “new” post-Project, it is important to note that the pre-Project loading of some transmission facilities, in particular 7L171 and 174L, were near normal ratings.

Results did not indicate any transient stability concerns, and the system showed acceptable dynamic response to all Category B conditions studied.

5.4 Post-Project Sensitivity Study Results

5.4.1 Category A Conditions

The Category A thermal criteria violations on 7L171 were no longer observed in the post-Project sensitivity scenarios, however Category A thermal criteria violations were observed on the 138 kV transmission line 174L and on the 240 kV transmission line 912L/9L912.

5.4.2 Category B Conditions

Category B post-Project studies were conducted with effective generation curtailed to mitigate the observed Category A thermal criteria violations.

Post-Project power flow studies identified a number of system performance issues under Category B conditions. Compared to the post-Project results, most of the same thermal criteria violations are observed, as well as several new thermal criteria violations.

5.5 Mitigation Measures

This section discusses the AESO's proposed mitigation measures to address the system performance issues that were identified in the pre-Project and post-Project scenarios.

5.5.1 Pre-Project

Prior to connection of the Project, some of the observed thermal criteria violations can be managed by using real-time operational practices. The remaining thermal criteria violations can be mitigated by planned RAS 134, planned RAS 200, and planned RAS 202.

5.5.2 Post-Project

After connection of the Project, some of the thermal criteria violations observed can be mitigated by using real-time operational practices. The remaining Category A thermal criteria violation observed on the 144 kV transmission line 7L171 is dependent upon whether future projects proceed as planned; however, as noted in Section 5.4.1, this thermal criteria violation no longer appears in the post-Project sensitivity studies which represent more up-to-date project inclusions.

The remaining thermal criteria violations can be mitigated by planned RAS 134, planned RAS 200, modified planned RAS 201, and planned RAS 202.

5.5.3 Post-Project Sensitivity

Under Category A conditions, thermal criteria violations are being observed on the 138 kV transmission line 174L and on the 240 kV transmission line 912L/9L912 in the post-Project Sensitivity scenarios, following the inclusion of a number of projects planning to connect in the South and Central East areas. These thermal criteria violations can be managed by applying the TCM Rule to curtail generation as required until such a time that system projects are in place to alleviate congestion. If the AESO determines congestion is likely to occur, the AESO will file an application for an "exception" under Section 15(2) of the *Transmission Regulation*. In the longer term, the energization of the approved Central East Transfer-Out (CETO) system project would reduce the thermal overloads observed on the transmission facilities 174L and 912L/9L912. The AESO would similarly file an "exception" application if it determines congestion is likely to occur for facilities related to the approved PENV system project.

Under Category B conditions, most of the observed Reliability Criteria violations requiring RAS were mitigated, however, contingencies including EATL, 912L/9L912, and 9L20 would involve generation curtailment exceeding the current Most Severe Single Contingency (MSCC) limit of 466 MW. As a result, real-time operational procedures would be required to fully alleviate the thermal criteria violations observed on the 138 kV transmission line 174L or Nevis transformer 766S901T under certain Category B conditions. This may include the AESO having to curtail area generation including the Project in the pre-contingency condition to avoid tripping more than 466 MW of generation by RAS.

If the AESO determines that pre-contingency curtailment is likely to occur resulting in congestion, then the AESO will file an application for an exception under Section 15(2) of the *Transmission Regulation,* until such a time that system projects are in place to alleviate congestion.

6 Project Dependencies

The Project does not require the completion of any other AESO plans to expand or enhance the transmission system prior to connection.

7 Conclusions and Recommendations

Based on the study results, Alternative 2 is technically viable. The connection assessment identified a number of pre-Project and post-Project system performance issues under certain Category A and Category B conditions.

The identified system performance issues can be mitigated through the use of the planned 9L16 RAS, planned RAS 134, planned RAS 200, modified planned RAS 201, planned RAS 202, and real-time operational practices alone or in combination, as appropriate. The use of these mitigation measures may result in generation curtailment during the Category A condition. With implementation of these mitigation measures, connecting the project with the preferred alternative does not adversely affect the performance of the AIES.

The total amount of generation tied to planned RAS 134 and 201 exceeds the MSSC limit of 466 MW. The post-Project studies indicate that in order to mitigate the thermal violations following certain contingencies including EATL, 9L20 and 912L/9L912, the actions of RAS 134 and 201 may result in generation curtailment in excess of the MSSC limit. Pre-contingency generation curtailment under the Category A condition may be required using real-time operational practices to prevent generation curtailment by RAS action above the MSSC level. The probability of pre-curtailment being required would be dependent on generation profiles and operating conditions.

Closer to the ISD, if the AESO determines that congestion will arise under Category A conditions, the AESO will make an application to the AUC to obtain approval for an “exception” under Section 15(2) of the *Transmission Regulation*.

The AESO recommends proceeding with the Project using Alternative 2 as the preferred alternative to respond to the Market Participant’s request for system access service. Real-time operational practices and the RASs mentioned above are recommended to mitigate the identified system performance issues.

Alternative 2 involves adding one 240 kV circuit to connect the Facility to the existing 240 kV transmission line 944L in a T-tap configuration. The conductor used for the 240 kV circuit should have a minimum capacity of 340 MVA to meet the Market Participant’s requested STS contract capacity.

Attachment A:
Engineering Connection Assessment Results

Engineering Connection Assessment: Study Results

P2411 Greengate Jurassic MPC Solar Battery

Jurassic Solar LP

Date: November 07, 2022
Version: V1
Classification: Public

Role	Name	Date	Signature
Prepared	Dibakar Shil, P. Eng.	November 29, 2022	Shil, Dibakar Digitally signed by Shil, Dibakar Date: 2022.11.29 12:05:41 -07'00'
Reviewed	Ashraf Haque, PhD, PEng, PMP	November 29, 2022	Haque, Ashraf Digitally signed by Haque, Ashraf Date: 2022.11.29 11:54:49 -07'00'
Approved	Ashikur Bhuiya, PhD, PEng	November 29, 2022	Bhuiya, Ashikur Digitally signed by Bhuiya, Ashikur Date: 2022.11.29 12:44:27 -07'00'

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STANTEC CONSULTING LTD
RM SIGNATURE: GTG
RM APEGA ID #: 179391
DATE: Nov 29, 2022
PERMIT NUMBER: P000258
The Association of Professional Engineers and Geoscientists of Alberta (APEGA)

PROFESSIONAL ENGINEER ALBERTA
ASHRAF UL HAQUE
ID 179391
Nov 29, 2022

Contents

Tables

Attachments

1 Introduction

This report presents the results of the engineering studies that were completed by Stantec Consulting Ltd. (the Studies Consultant) to assess the impact of the Project (as defined in Attachment A1: AESO Engineering Connection Assessment Scope) on the performance of the Alberta interconnected electric system (AIES). The studies were performed in accordance with Attachment A1: AESO Engineering Connection Assessment: Study Scope, which was prepared by the AESO.

The power system network analysis tool that was used for the studies in this connection assessment was PSS/E version 34.

2 Pre-Project Study Results

This section describes the results of the pre-Project power flow studies.

2.1 Power Flow Studies

Power flow diagrams illustrating the pre-Project power flow studies results for Category A and Category B conditions are provided in Attachment A2.

2.1.1 Scenario 1: 2023 Summer Peak High Renewable, Economic Coal Pre-Project

Category A Conditions

No Reliability Criteria (as defined in Section 3.1 of Attachment A1) violations were observed under Category A conditions. However, Wheatland and Wintering Hills wind farm facility generations were scaled down proportionally to reduce loading of 7L171 (Michichi Creek 802S - Wintering Hills 804S) to 95% prior to running the Category B conditions.

Category B Conditions

Thermal Criteria Violations

Thermal criteria violations were observed under certain Category B conditions as shown in Table 2-1.

Table 2-1: Thermal Criteria Violations under Category B Conditions for Scenario 1

Contingency (System Element Lost)	Violation Location Details	Thermal Ratings[a] (MVA)		Pre-Project Results	
		Normal Rating	Emergency Rating	Power Flow[b] (MVA)	% Loading[c]
766S901T (Nevis 766S Transformer 901T)	174L (Bardo 197S - North Holden 395S)	85.0	94.0	107.4	126.3
EATL (Newell 2075S - Heathfield 2029S)	174L (Bardo 197S - North Holden 395S)	85.0	94.0	109.4	128.7
	7L701 (Heisler Tap - Battle River 757S)	141.8	159.1	145.6	102.7
	912L\9L912 (Red Deer 63S - Nevis 766S)	507.0	553.0	529.3	104.4
	9L16 (Tinchebray 972S - Cordel 755S)	499.0	499.0	502.5	100.7
	7L171 (Michichi Creek 802S - Wintering Hills 804S)	107.3	121.7	114.3	106.6

Contingency (System Element Lost)	Violation Location Details	Thermal Ratings[a] (MVA)		Pre-Project Results	
		Normal Rating	Emergency Rating	Power Flow[b] (MVA)	% Loading[c]
669L (Amoco Empress 163S - Cypress 562S)	668L (Empress 394S - Cypress 562S)	121.0	133.0	123.8	102.3
9L20 (Nevis 766S - Cordel 755S)	174L (Bardo 197S - North Holden 395S)	85.0	94.0	92.7	109.1
	766S901T (Nevis 766S Transformer 901T)	100.0	100.0	112.4	112.4
	7L171 (Michichi Creek 802S - Wintering Hills 804S)	107.3	123.6	110.8	103.3
9L16 (Tinchebray 972S - Cordel 755S)	7L171 (Michichi Creek 802S - Wintering Hills 804S)	107.3	121.7	112.1	104.5
912L\9L912 (Red Deer 63S - Nevis 766S)	174L (Bardo 197S - North Holden 395S)	85.0	94.0	107.3	126.3
7L171 (Michichi Creek 802S - Wintering Hills 804S)	7L85 (Bullpound 803S - Anderson 801S)	139.0	123.6	141.2	101.6
	7L85 (Bullpound 803S - Parker 2027S)	112.1	138.0	150.0	133.8
	801S901T (Anderson 801S Transformer 901T)	125.0	125.0	146.4	117.1
801S901T (Anderson 801S Transformer 901T)	7L171 (Michichi Creek 802S - Wintering Hills 804S)	107.3	121.7	138.2	128.8
114ST1 (Ghost Pine 114S Transformer T1)	7L171 (Michichi Creek 802S - Wintering Hills 804S)	107.3	121.7	108.5	101.1

Notes:

[a] The facility ratings shown in Attachment A1 have been adjusted from a 72/144 kV voltage base to a 69/138 kV voltage base, as is used by the power system network analysis tool.

[b] Power flow (MVA) is current expressed as MVA (i.e., $S = \sqrt{3} \times V_{base} \times I_{actual}$)

[c] Reported as a percentage of the power flow (in MVA, i.e., $S = \sqrt{3} \times V_{base} \times I_{actual}$) relative to the transmission line's Normal Rating (also in MVA), as shown in Attachment A1.

Voltage Criteria Violations

No voltage criteria violations were observed under Category B conditions.

POD Bus Voltage Deviations

No voltage deviations beyond the limits listed in Table 3-1 of Attachment A1 (hereafter referred to as point of delivery (POD) bus voltage deviations) were observed.

2.1.2 Scenario 2: 2023 Summer Light High Renewable, Economic Coal Pre-Project

Category A Conditions

Thermal Criteria Violations

Thermal criteria violations were observed under certain Category A conditions as shown in Table 2-2.

Table 2-2: Thermal Criteria Violations under Category A Conditions for Scenario 2

Contingency (System Element Lost)	Violation Location Details	Thermal Ratings[a] (MVA)		Pre-Project Results	
		Normal Rating	Emergency Rating	Power Flow[b] (MVA)	% Loading[c]
N-0 (System Normal Condition)	7L171 (Michichi Creek 802S - Wintering Hills 804S)	107.3	121.7	110.8	103.3

Wheatland and Wintering Hills wind farm facility generations were scaled down proportionally to reduce loading of 7L171 (Michichi Creek 802S - Wintering Hills 804S) to 95% prior to running the Category B conditions.

Voltage Criteria Violations

No voltage criteria violations were observed under Category A conditions.

POD Bus Voltage Deviations

No voltage deviations beyond the limits listed in Table 3-1 of Attachment A1 (hereafter referred to as point of delivery (POD) bus voltage deviations) were observed.

Category B Conditions

Thermal Criteria Violations

Thermal criteria violations were observed under certain Category B conditions as shown in Table 2-3.

Table 2-3: Thermal Criteria Violations under Category B Conditions for Scenario 2

Contingency (System Element Lost)	Violation Location Details	Thermal Ratings[a] (MVA)		Pre-Project Results	
		Normal Rating	Emergency Rating	Power Flow[b] (MVA)	% Loading[c]
766S901T (Nevis 766S Transformer 901T)	174L (Bardo 197S - North Holden 395S)	85.0	94.0	92.8	109.2

Contingency (System Element Lost)	Violation Location Details	Thermal Ratings[a] (MVA)		Pre-Project Results	
		Normal Rating	Emergency Rating	Power Flow[b] (MVA)	% Loading[c]
EATL (Newell 2075S - Heathfield 2029S)	174L (Bardo 197S - North Holden 395S)	85.0	94.0	98.2	115.5
	7L171 (Michichi Creek 802S - Wintering Hills 804S)	107.3	121.7	113.8	106.0
9L20 (Nevis 766S - Cordel 755S)	766S901T (Nevis 766S Transformer 901T)	100.0	100.0	108.8	108.8
	7L171 (Michichi Creek 802S - Wintering Hills 804S)	107.3	121.7	109.3	101.9
9L16 (Tinchebray 972S - Cordel 755S)	7L171 (Michichi Creek 802S - Wintering Hills 804S)	107.3	121.7	111.1	103.6
912L\9L912 (Red Deer 63S - Nevis 766S)	174L (Bardo 197S - North Holden 395S)	85.0	94.0	92.9	109.3
959S901T (Lanfine 959S Transformer 901T)	7L132 (Oyen 767S - Lanfine 959S)	112.1	138.0	117.4	104.8
7L171 (Michichi Creek 802S - Wintering Hills 804S)	7L85 (Bullpound 803S - Anderson 801S)	139.0	123.6	147.7	106.3
	7L85 (Bullpound 803S - Parker 2027S)	112.1	138.0	154.3	137.6
	801S901T (Anderson 801S Transformer 901T)	125.0	125.0	153.9	123.1
801S901T (Anderson 801S Transformer 901T)	7L171 (Michichi Creek 802S - Wintering Hills 804S)	107.3	121.7	144.8	134.9
114ST1 (Ghost Pine 114S Transformer T1)	7L171 (Michichi Creek 802S - Wintering Hills 804S)	107.3	121.7	109.3	101.8

Notes:

[a] The facility ratings shown in Attachment A1 have been adjusted from a 72/144 kV voltage base to a 69/138 kV voltage base, as is used by the power system network analysis tool.

[b] Power flow (MVA) is current expressed as MVA (i.e., $S = \sqrt{3} \times V_{base} \times I_{actual}$)

[c] Reported as a percentage of the power flow (in MVA, i.e., $S = \sqrt{3} \times V_{base} \times I_{actual}$) relative to the transmission line's Normal Rating (also in MVA), as shown in Attachment A1.

Voltage Criteria Violations

No voltage criteria violations were observed under Category B conditions.

POD Bus Voltage Deviations

No POD bus voltage deviations were observed.

2.1.3 Scenario 3: 2023 Winter Peak High Renewable, Economic Coal Pre-Project

Category A Conditions

No Reliability Criteria (as defined in Section 3.1 of Attachment A1) violations were observed under Category A conditions.

Category B Conditions

Thermal Criteria Violations

Thermal criteria violations were observed under certain Category B conditions as shown in Table 2-4.

Table 2-4: Thermal Criteria Violations under Category B Conditions for Scenario 3

Contingency (System Element Lost)	Violation Location Details	Thermal Ratings[a] (MVA)		Pre-Project Results	
		Normal Rating	Emergency Rating	Power Flow[b] (MVA)	% Loading[c]
EATL (Newell 2075S - Heathfield 2029S)	174L (Bardo 197S - North Holden 395S)	90.0	99.0	90.5	100.6
7L171 (Michichi Creek 802S - Wintering Hills 804S)	7L85 (Bullpound 803S - Parker 2027S)	140.9	176.3	171.0	121.3
	801S901T (Anderson 801S Transformer 901T)	125.0	125.0	174.5	139.6
801S901T (Anderson 801S Transformer 901T)	7L171 (Michichi Creek 802S - Wintering Hills 804S)	140.9	143.8	163.4	116.0

Notes:

[a] The facility ratings shown in Attachment A1 have been adjusted from a 72/144 kV voltage base to a 69/138 kV voltage base, as is used by the power system network analysis tool.

[b] Power flow (MVA) is current expressed as MVA (i.e., $S = \sqrt{3} \times V_{base} \times I_{actual}$)

[c] Reported as a percentage of the power flow (in MVA, i.e., $S = \sqrt{3} \times V_{base} \times I_{actual}$) relative to the transmission line's Normal Rating (also in MVA), as shown in Attachment A1.

Voltage Criteria Violations

No voltage criteria violations were observed under Category B conditions.

POD Bus Voltage Deviations

No POD bus voltage deviations were observed.

3 Post-Project Study Results

This section describes the results of the post-Project power flow studies.

As described in Section 2 of Attachment A1, the post-Project studies were performed using Alternative 2.

3.1 Power Flow Studies

Power flow diagrams illustrating the post-Project power flow studies results for Category A and Category B conditions are included in Attachment A3.

3.1.1 Scenario 4: 2023 Summer Peak High Renewable, Economic Coal Post-Project

Category A Conditions

Thermal Criteria Violations

Thermal criteria violations were observed under certain Category A conditions as shown in Table 3-1.

Table 3-1: Thermal Criteria Violations under Category A Conditions for Scenario 4

Contingency (System Element Lost)	Violation Location Details	Thermal Ratings[a] (MVA)		Post-Project Results	
		Normal Rating	Emergency Rating	Power Flow[b] (MVA)	% Loading[c]
N-0 (System Normal Condition)	7L171 (Michichi Creek 802S - Wintering Hills 804S)	107.3	121.7	109.3	101.9

Notes:

[a] The facility ratings shown in Attachment A1 have been adjusted from a 72/144 kV voltage base to a 69/138 kV voltage base, as is used by the power system network analysis tool.

[b] Power flow (MVA) is current expressed as MVA (i.e., $S = \sqrt{3} \times V_{base} \times I_{actual}$)

[c] Reported as a percentage of the power flow (in MVA, i.e., $S = \sqrt{3} \times V_{base} \times I_{actual}$) relative to the transmission line's Normal Rating (also in MVA), as shown in Attachment A1.

Wheatland and Wintering Hills wind farm facility generations were scaled down proportionally to reduce loading of 7L171 (Michichi Creek 802S - Wintering Hills 804S) to 95% prior to running the Category B conditions.

Voltage Criteria Violations

No voltage criteria violations were observed under Category A conditions.

POD Bus Voltage Deviations

No POD bus voltage deviations were observed.

Category B Conditions

Thermal criteria violations were observed under certain Category B conditions as shown in Table 3-2.

Table 3-2: Thermal Criteria Violations under Category B Conditions for Scenario 4

Contingency (System Element Lost)	Details of Violation (Violation Observed On)	Normal Rating (MVA)	Emergency Rating (MVA)	Pre-Project Results		Post-Project Results		% Loading Difference (Post-Pre)
				Observed Power Flow (MVA)	% Loading	Observed Power Flow (MVA)	% Loading	
766S901T (Nevis 766S Transformer 901T)	174L (Bardo 197S - North Holden 395S)	85.0	94.0	107.4	126.3	127.9	150.4	24.1
	701L (Strome 223S - Heisler Tap)	158.0	174.0	145.2	91.9	164.7	104.2	12.4
	7L701 (Heisler Tap - Battle River 757S)	141.8	159.1	138.0	97.3	155.9	109.9	12.6
EATL (Newell 2075S - Heathfield 2029S)	174L (Bardo 197S - North Holden 395S)	85.0	94.0	109.4	128.7	123.1	144.8	16.1
	7L159 (Ghost Tap - Heatburg 948S)	107.3	118.8	102.2	95.2	113.1	105.5	10.2
	701L (Strome 223S - Heisler Tap)	158.0	174.0	151.0	95.6	164.8	104.3	8.7
	7L701 (Heisler Tap - Battle River 757S)	141.8	159.1	145.6	102.7	158.5	111.8	9.1
	912L\9L912 (Red Deer 63S - Nevis 766S)	507.0	553.0	529.3	104.4	597.1	117.8	13.4
	9L20 (Nevis 766S - Cordel 755S)	488.0	558.0	451.4	92.5	508.8	104.3	11.8
	7L16 (Nevis 766S - Heatburg 948S)	107.3	119.8	98.3	91.6	109.2	101.8	10.2
	9L16 (Tinchebray 972S - Cordel 755S)	499.0	499.0	502.5	100.7	558.1	111.8	11.1
	7L171 (Michichi Creek 802S - Wintering Hills 804S)	107.3	121.7	114.3	106.6	114.8	107.0	0.4
9LA59TAP (Anderson 801S - P1909 - Tinchebray 972S)	7L171 (Michichi Creek 802S - Wintering Hills 804S)	107.3	121.7	106.3	99.0	107.6	100.3	1.2
669L (Amoco Empress 163S - Cypress 562S)	668L (Empress 394S - Cypress 562S)	121.0	133.0	123.8	102.3	128.0	105.7	3.4
9L20 (Nevis 766S - Cordel 755S)	174L (Bardo 197S - North Holden 395S)	85.0	94.0	92.7	109.1	110.2	129.6	20.5

Contingency (System Element Lost)	Details of Violation (Violation Observed On)	Normal Rating (MVA)	Emergency Rating (MVA)	Pre-Project Results		Post-Project Results		% Loading Difference (Post-Pre)
				Observed Power Flow (MVA)	% Loading	Observed Power Flow (MVA)	% Loading	
	7L159 (Ghost Tap - Heatburg 948S)	107.3	118.8	101.5	94.6	116.9	108.9	14.3
	7L701 (Heisler Tap - Battle River 757S)	141.8	159.1	132.8	93.6	149.3	105.3	11.6
	766S901T (Nevis 766S Transformer 901T)	100.0	100.0	112.4	112.4	136.7	136.7	24.4
	7L16 (Nevis 766S - Heatburg 948S)	107.3	119.8	97.7	91.1	113.1	105.4	14.3
	7L171 (Michichi Creek 802S - Wintering Hills 804S)	107.3	121.7	110.8	103.3	112.0	104.4	1.1
9L16 (Tinchebray 972S - Cordel 755S)	7L159 (Ghost Tap - Heatburg 948S)	107.3	118.8	95.4	88.9	109.9	102.4	13.5
	7L171 (Michichi Creek 802S - Wintering Hills 804S)	107.3	121.7	112.1	104.5	113.5	105.8	1.3
9L29 (Oakland 946S - Coyote Lake 963S)	7L171 (Michichi Creek 802S - Wintering Hills 804S)	107.3	121.7	103.4	96.4	107.7	100.4	4.0
9L966 (Hansman Lake 650S - Pemukan 932S)	7L224 (Hansman Lake 650S - Monitor 774S)	108.3	123.6	94.5	87.3	111.8	103.2	16.0
912L\9L912 (Red Deer 63S - Nevis 766S)	174L (Bardo 197S - North Holden 395S)	85.0	94.0	107.3	126.3	127.7	150.3	24.0
	701L (Strome 223S - Heisler Tap)	158.0	174.0	145.1	91.8	164.6	104.2	12.4
	7L701 (Heisler Tap - Battle River 757S)	141.8	159.1	137.5	97.0	155.1	109.4	12.4
963S901T (Coyote Lake 963S Transformer 901T)	7L171 (Michichi Creek 802S - Wintering Hills 804S)	107.3	121.7	103.4	96.3	107.7	100.3	4.0
7L171 (Michichi Creek 802S - Wintering Hills 804S)	7L85 (Bullpound 803S - Parker 2027S)	112.1	138.0	150.0	133.8	143.8	128.3	-5.5
	801S901T (Anderson 801S Transformer 901T)	125.0	125.0	146.4	117.1	139.7	111.7	-5.4

Contingency (System Element Lost)	Details of Violation (Violation Observed On)	Normal Rating (MVA)	Emergency Rating (MVA)	Pre-Project Results		Post-Project Results		% Loading Difference (Post-Pre)
				Observed Power Flow (MVA)	% Loading	Observed Power Flow (MVA)	% Loading	
801S901T (Anderson 801S Transformer 901T)	7L171 (Michichi Creek 802S - Wintering Hills 804S)	107.3	121.7	138.2	128.8	132.2	123.2	-5.6
114ST1 (Ghost Pine 114S Transformer T1)	7L171 (Michichi Creek 802S - Wintering Hills 804S)	107.3	121.7	108.5	101.1	108.6	101.2	0.1

Notes:

[a] The facility ratings shown in Attachment A1 have been adjusted from a 72/144 kV voltage base to a 69/138 kV voltage base, as is used by the power system network analysis tool.

[b] Power flow (MVA) is current expressed as MVA (i.e., $S = \sqrt{3} \times V_{base} \times I_{actual}$)

[c] Reported as a percentage of the power flow (in MVA, i.e., $S = \sqrt{3} \times V_{base} \times I_{actual}$) relative to the transmission line's Normal Rating (also in MVA), as shown in Attachment A1.

Voltage Criteria Violations

No voltage criteria violations were observed under Category B conditions.

POD Bus Voltage Deviations

No POD bus voltage deviations were observed.

3.1.2 Scenario 5: 2023 Summer Light High Renewable, Economic Coal Post-Project

Category A Conditions

Thermal Criteria Violations

Thermal criteria violations were observed under certain Category A conditions as shown in Table 3-3.

Table 3-3: Thermal Criteria Violations under Category A Conditions for Scenario 5

Contingency (System Element Lost)	Violation Location Details	Thermal Ratings[a] (MVA)		Post-Project Results	
		Normal Rating	Emergency Rating	Power Flow[b] (MVA)	% Loading[c]
N-0 (System Normal Condition)	7L171 (Michichi Creek 802S - Wintering Hills 804S)	107.3	121.7	113.9	106.2

Notes:

[a] The facility ratings shown in Attachment A1 have been adjusted from a 72/144 kV voltage base to a 69/138 kV voltage base, as is used by the power system network analysis tool.

[b] Power flow (MVA) is current expressed as MVA (i.e., $S = \sqrt{3} \times V_{base} \times I_{actual}$)

[c] Reported as a percentage of the power flow (in MVA, i.e., $S = \sqrt{3} \times V_{base} \times I_{actual}$) relative to the transmission line's Normal Rating (also in MVA), as shown in Attachment A1.

Wheatland and Wintering Hills wind farm facility generations were scaled down proportionally to reduce loading of 7L171 (Michichi Creek 802S - Wintering Hills 804S) to 95% prior to running the Category B conditions.

Category B Conditions

Thermal criteria violations were observed under certain Category B conditions as shown in Table 3-4.

Table 3-4: Thermal Criteria Violations under Category B Conditions for Scenario 5

Contingency (System Element Lost)	Details of Violation (Violation Observed On)	Normal Rating (MVA)	Emergency Rating (MVA)	Pre-Project Results		Post-Project Results		% Loading Difference (Post-Pre)
				Observed Power Flow (MVA)	% Loading	Observed Power Flow (MVA)	% Loading	
766S901T (Nevis 766S Transformer 901T)	174L (Bardo 197S - North Holden 395S)	85.0	94.0	92.8	109.2	113.9	134.0	24.8
EATL (Newell 2075S - Heathfield 2029S)	174L (Bardo 197S - North Holden 395S)	85.0	94.0	98.2	115.5	109.5	128.8	13.3
	7L159 (Ghost Tap - Heatburg 948S)	107.3	123.6	100.8	93.9	109.5	102.0	8.1
	912L\9L912 (Red Deer 63S - Nevis 766S)	507.0	553.0	490.0	96.7	552.7	109.0	12.4
	9L16 (Tinchebray 972S - Cordel 755S)	499.0	627.0	477.8	95.8	525.2	105.3	9.5
	7L171 (Michichi Creek 802S - Wintering Hills 804S)	107.3	121.7	113.8	106.0	113.7	105.9	-0.1
669L (Amoco Empress 163S - Cypress 562S)	668L (Empress 394S - Cypress 562S)	121.0	133.0	118.5	98.0	122.5	101.2	3.3
9L20 (Nevis 766S - Cordel 755S)	174L (Bardo 197S - North Holden 395S)	85.0	94.0	78.8	92.7	97.1	114.3	21.6
	7L159 (Ghost Tap - Heatburg 948S)	107.3	118.8	97.2	90.5	111.4	103.8	13.3
	766S901T (Nevis 766S Transformer 901T)	100.0	100.0	108.8	108.8	130.8	130.8	22.1
	7L16 (Nevis 766S - Heatburg 948S)	107.3	119.8	94.3	87.9	108.5	101.1	13.3
	7L171 (Michichi Creek 802S -	107.3	121.7	109.3	101.9	110.7	103.2	1.3

Contingency (System Element Lost)	Details of Violation (Violation Observed On)	Normal Rating (MVA)	Emergency Rating (MVA)	Pre-Project Results		Post-Project Results		% Loading Difference (Post-Pre)
				Observed Power Flow (MVA)	% Loading	Observed Power Flow (MVA)	% Loading	
	Wintering Hills 804S)							
9L16 (Tinchebray 972S - Cordel 755S)	7L171 (Michichi Creek 802S - Wintering Hills 804S)	107.3	121.7	111.1	103.6	112.4	104.8	1.2
912L\9L912 (Red Deer 63S - Nevis 766S)	174L (Bardo 197S - North Holden 395S)	85.0	94.0	92.9	109.3	114.0	134.1	24.8
959S901T (Lanfine 959S Transformer 901T)	7L132 (Oyen 767S - Lanfine 959S)	112.1	138.0	117.4	104.8	117.4	104.8	0.0
7L171 (Michichi Creek 802S - Wintering Hills 804S)	7L85 (Bullpound 803S - Anderson 801S)	139.0	165.8	147.7	106.3	141.4	101.8	-4.5
	7L85 (Bullpound 803S - Parker 2027S)	112.1	138.0	154.3	137.6	148.0	132.0	-5.6
	801S901T (Anderson 801S Transformer 901T)	125.0	125.0	153.9	123.1	147.2	117.8	-5.3
801S901T (Anderson 801S Transformer 901T)	7L171 (Michichi Creek 802S - Wintering Hills 804S)	107.3	121.7	144.8	134.9	138.6	129.2	-5.8
114ST1 (Ghost Pine 114S Transformer T1)	7L171 (Michichi Creek 802S - Wintering Hills 804S)	107.3	121.7	109.3	101.8	109.1	101.7	-0.1

Notes:

[a] The facility ratings shown in Attachment A1 have been adjusted from a 72/144 kV voltage base to a 69/138 kV voltage base, as is used by the power system network analysis tool.

[b] Power flow (MVA) is current expressed as MVA (i.e., $S = \sqrt{3} \times V_{base} \times I_{actual}$)

[c] Reported as a percentage of the power flow (in MVA, i.e., $S = \sqrt{3} \times V_{base} \times I_{actual}$) relative to the transmission line's Normal Rating (also in MVA), as shown in Attachment A1.

Voltage Criteria Violations

No voltage criteria violations were observed under Category B conditions.

POD Bus Voltage Deviations

No POD bus voltage deviations were observed.

3.1.3 Scenario 6: 2023 Winter Peak High Renewable, Economic Coal Post-Project

Category A Conditions

No Reliability Criteria violations were observed under Category A conditions.

Category B Conditions

Thermal criteria violations were observed under certain Category B conditions as shown in Table 3-5.

Table 3-5: Thermal Criteria Violations under Category B Conditions for Scenario 6

Contingency (System Element Lost)	Details of Violation (Violation Observed On)	Normal Rating (MVA)	Emergency Rating (MVA)	Pre-Project Results		Post-Project Results		% Loading Difference (Post-Pre)
				Observed Power Flow (MVA)	% Loading	Observed Power Flow (MVA)	% Loading	
766S901T (Nevis 766S Transformer 901T)	174L (Bardo 197S - North Holden 395S)	90.0	99.0	79.5	88.3	101.1	112.3	24.0
EATL (Newell 2075S - Heathfield 2029S)	174L (Bardo 197S - North Holden 395S)	90.0	99.0	90.5	100.6	103.1	114.6	14.0
	9L16 (Tinchebray 972S - Cordel 755S)	499.0	663.0	458.1	91.8	508.5	101.9	10.1
9L20 (Nevis 766S - Cordel 755S)	766S901T (Nevis 766S Transformer 901T)	100.0	100.0	90.9	90.9	113.3	113.3	22.4
912L\9L912 (Red Deer 63S - Nevis 766S)	174L (Bardo 197S - North Holden 395S)	90.0	99.0	79.4	88.2	101.0	112.2	24.0
7L171 (Michichi Creek 802S - Wintering Hills 804S)	7L85 (Bullpound 803S - Parker 2027S)	140.9	176.3	171.0	121.3	171.0	121.4	0.0
	801S901T (Anderson 801S Transformer 901T)	125.0	125.0	174.5	139.6	174.4	139.5	-0.1
801S901T (Anderson 801S Transformer 901T)	7L171 (Michichi Creek 802S - Wintering Hills 804S)	140.9	143.8	163.4	116.0	163.3	115.9	-0.1

Notes:

[a] The facility ratings shown in Attachment A1 have been adjusted from a 72/144 kV voltage base to a 69/138 kV voltage base, as is used by the power system network analysis tool.

[b] Power flow (MVA) is current expressed as MVA (i.e., $S = \sqrt{3} \times V_{base} \times I_{actual}$)

[c] Reported as a percentage of the power flow (in MVA, i.e., $S = \sqrt{3} \times V_{base} \times I_{actual}$) relative to the transmission line's Normal Rating (also in MVA), as shown in Attachment A1.

Voltage Criteria Violations

No voltage criteria violations were observed under Category B conditions.

POD Bus Voltage Deviations

No POD bus voltage deviations were observed.

3.1.4 Scenario 4a: 2023 Summer Peak High Renewable, Economic Coal Post-Project Sensitivity

Category A Conditions

Thermal criteria violations were observed under Category A conditions as shown in Table 3-6.

Table 3-6: Thermal Criteria Violations under Category A Conditions for Scenario 4a

Contingency (System Element Lost)	Details of Violation (Violation Observed On)	Normal Rating (MVA)	Emergency Rating (MVA)	Post-Project Results	
				Observed Power Flow (MVA)	% Loading
N-0 (System Normal Condition)	174L (Bardo 197S - North Holden 395S)	85.0	94.0	94.4	111.0
	912L\9L912 (Red Deer 63S - Nevis 766S)	507.0	553.0	520.0	102.6

Voltage Criteria Violations

No voltage criteria violations were observed under Category A conditions.

POD Bus Voltage Deviations

No POD bus voltage deviations were observed.

For the Sensitivity Study Scenario, Wheatland and Wintering Hills wind farm facility generations were not required to scale down to reduce loading of 7L171 (Michichi Creek 802S - Wintering Hills 804S) to 95% prior to running the Category B conditions. However, P1250 Wild Run Grizzly Bear wind farm generation was curtailed to alleviate N-0 thermal overload on 174L (Bardo 197S - North Holden 395S) and 912L\9L912 (Red Deer 63S - Nevis 766S).

Category B Conditions

Thermal criteria violations were observed under certain Category B conditions as shown in Table 3-7.

Table 3-7: Thermal Criteria Violations under Category B Conditions for Scenario 4a

Contingency (System Element Lost)	Details of Violation (Violation Observed On)	Normal Rating (MVA)	Emergency Rating (MVA)	Post-Project Results	
				Observed Power Flow (MVA)	% Loading
7L701\7LA701\701L (Battle River 757S - Heisler 764S - Strome 223S)	912L\9L912 (Red Deer 63S - Nevis 766S)	507.0	553.0	536.5	105.8

Contingency (System Element Lost)	Details of Violation (Violation Observed On)	Normal Rating (MVA)	Emergency Rating (MVA)	Post-Project Results	
				Observed Power Flow (MVA)	% Loading
766S901T (Nevis 766S Transformer 901T)	174L (Bardo 197S - North Holden 395S)	85.0	94.0	162.1	190.8
	701L (Strome 223S - Heisler Tap)	158.0	174.0	193.1	122.2
	7L701 (Heisler Tap - Battle River 757S)	141.8	159.1	181.4	127.9
EATL (Newell 2075S - Heathfield 2029S)	174L (Bardo 197S - North Holden 395S)	85.0	94.0	140.5	165.3
	7L159 (Ghost Tap - Heatburg 948S)	107.3	118.8	131.3	122.4
	701L (Strome 223S - Heisler Tap)	158.0	174.0	177.0	112.0
	7L701 (Heisler Tap - Battle River 757S)	141.8	159.1	170.4	120.2
	912L\9L912 (Red Deer 63S - Nevis 766S)	507.0	553.0	709.2	139.9
	766S901T (Nevis 766S Transformer 901T)	100.0	100.0	115.8	115.8
	9L20 (Nevis 766S - Cordel 755S)	488.0	558.0	601.1	123.2
	7L16 (Nevis 766S - Heatburg 948S)	107.3	119.8	127.4	118.7
	9L16 (Tinchebray 972S - Cordel 755S)	499.0	499.0	658.5	132.0
	7L171 (Michichi Creek 802S - Wintering Hills 804S)	107.3	121.7	109.8	102.3
9LA59TAP (Anderson 801S - P1909 - Tinchebray 972S)	7L159 (Ghost Tap - Heatburg 948S)	107.3	118.8	111.9	104.3
	766S901T (Nevis 766S Transformer 901T)	100.0	100.0	100.3	100.3
	7L16 (Nevis 766S - Heatburg 948S)	107.3	119.8	108.1	100.8
669L (Amoco Empress 163S - Cypress 562S)	668L (Empress 394S - Cypress 562S)	121.0	133.0	122.4	101.2
9L20 (Nevis 766S - Cordel 755S)	174L (Bardo 197S - North Holden 395S)	85.0	94.0	138.9	163.4
	7L159 (Ghost Tap - Heatburg 948S)	107.3	118.8	143.4	133.7
	701L (Strome 223S - Heisler Tap)	158.0	174.0	169.0	107.0
	7L701 (Heisler Tap - Battle River 757S)	141.8	159.1	172.4	121.6
	766S901T (Nevis 766S Transformer 901T)	100.0	100.0	173.6	173.6
	7L16 (Nevis 766S - Heatburg 948S)	107.3	119.8	139.6	130.1
	7L137 (Three Hills 770S - Rowley 768S)	108.3	120.8	109.5	101.1
	7L25 (Rowley 768S - Michichi Creek 802S)	109.3	122.7	113.8	104.2
	7L171 (Michichi Creek 802S - Wintering Hills 804S)	107.3	121.7	109.9	102.4
9L16 (Tinchebray 972S - Cordel 755S)	7L159 (Ghost Tap - Heatburg 948S)	107.3	118.8	134.8	125.6
	6L15 (Sullivan Lake 775S - Hanna 763S)	23.0	23.0	24.8	107.9

Contingency (System Element Lost)	Details of Violation (Violation Observed On)	Normal Rating (MVA)	Emergency Rating (MVA)	Post-Project Results	
				Observed Power Flow (MVA)	% Loading
	766S901T (Nevis 766S Transformer 901T)	100.0	100.0	123.3	123.3
	7L16 (Nevis 766S - Heatburg 948S)	107.3	119.8	131.0	122.1
	7L171 (Michichi Creek 802S - Wintering Hills 804S)	107.3	121.7	112.0	104.4
9L29 (Oakland 946S - Coyote Lake 963S)	7L159 (Ghost Tap - Heatburg 948S)	107.3	118.8	129.2	120.4
	766S901T (Nevis 766S Transformer 901T)	100.0	100.0	118.9	118.9
	7L16 (Nevis 766S - Heatburg 948S)	107.3	119.8	125.4	116.9
9L966 (Hansman Lake 650S - Pemukan 932S)	7L224 (Hansman Lake 650S - Monitor 774S)	108.3	123.6	108.7	100.4
912L\9L912 (Red Deer 63S - Nevis 766S)	174L (Bardo 197S - North Holden 395S)	85.0	94.0	162.2	190.8
	701L (Strome 223S - Heisler Tap)	158.0	174.0	193.2	122.3
	7L701 (Heisler Tap - Battle River 757S)	141.8	159.1	181.1	127.7
959S901T (Lanfine 959S Transformer 901T)	6L09\6LA09 (Oyen 767S - ACE Tap)	23.0	23.0	23.4	101.8
963S901T (Coyote Lake 963S Transformer 901T)	7L159 (Ghost Tap - Heatburg 948S)	107.3	118.8	129.2	120.4
	766S901T (Nevis 766S Transformer 901T)	100.0	100.0	118.9	118.9
	7L16 (Nevis 766S - Heatburg 948S)	107.3	119.8	125.4	116.9
7L171 (Michichi Creek 802S - Wintering Hills 804S)	7L85 (Bullpound 803S - Anderson 801S)	139.0	165.8	149.8	107.8
	7L85 (Bullpound 803S - Parker 2027S)	112.1	138.0	158.6	141.5
	801S901T (Anderson 801S Transformer 901T)	125.0	125.0	155.2	124.2
801S901T (Anderson 801S Transformer 901T)	7L159 (Ghost Tap - Heatburg 948S)	107.3	118.8	108.5	101.2
	7L171 (Michichi Creek 802S - Wintering Hills 804S)	107.3	121.7	146.6	136.6
7L128 Tap (Michichi Creek 802S - P2263 - Coyote Lake 963S	7L171 (Michichi Creek 802S - Wintering Hills 804S)	107.3	121.7	108.7	101.3
9L51 (Pemukan 932S - New Brigden 2088S)	7L159 (Ghost Tap - Heatburg 948S)	107.3	118.8	111.6	104.0
	7L16 (Nevis 766S - Heatburg 948S)	107.3	119.8	107.8	100.5
	9L16 (Tinchebray 972S - Cordel 755S)	499.0	499.0	575.9	115.4
9L46 (Lanfine 959S - New Brigden 2088S)	7L159 (Ghost Tap - Heatburg 948S)	107.3	118.8	111.6	104.0
	7L16 (Nevis 766S - Heatburg 948S)	107.3	119.8	107.8	100.5
	9L16 (Tinchebray 972S - Cordel 755S)	499.0	499.0	576.0	115.4
770S703T (Three Hills 770S Transformer 703T)	7L159 (Ghost Tap - Heatburg 948S)	107.3	118.8	113.2	105.5
	766S901T (Nevis 766S Transformer 901T)	100.0	100.0	102.0	102.0

Contingency (System Element Lost)	Details of Violation (Violation Observed On)	Normal Rating (MVA)	Emergency Rating (MVA)	Post-Project Results	
				Observed Power Flow (MVA)	% Loading
	7L16 (Nevis 766S - Heatburg 948S)	107.3	119.8	109.4	102.0
757S905T (Battle River 757S Transformer 905T)	9L16 (Tinchebray 972S - Cordel 755S)	499.0	499.0	511.2	102.5
757ST2 (Battle River 757S Transformer T2)	912L\9L912 (Red Deer 63S - Nevis 766S)	507.0	553.0	512.7	101.1
P2263T1 (P2263 BER Hand Hills MPC Wind Farm Transformer T1)	7L171 (Michichi Creek 802S - Wintering Hills 804S)	107.3	121.7	108.1	100.8

Voltage Criteria Violations

No voltage criteria violations were observed under Category B conditions.

POD Bus Voltage Deviations

No POD bus voltage deviations were observed.

3.2 Transient Stability Studies

Transient stability studies were completed for Scenario 4: 2023 Summer Peak High Renewable, Economic Coal Post-Project, Scenario 5: 2023 Summer Light High Renewable, Economic Coal Post-Project and Scenario 6: 2023 Winter Peak High Renewable, Economic Coal Post-Project.

The results did not indicate any transient stability concerns, and the system showed acceptable dynamic response to all Category B conditions studied, as shown in Table 3-8. The post-Project transient stability plots are provided in Attachment A4. The dynamic data and assumptions of all equipment proposed for the Facility are provided in Attachment A5.

Table 3-8: Transient Stability Study Results under Category B Conditions for Scenario 3

Studied Contingency	Fault Description and Location	Results
9L24 (Oakland 946S – Lanfine 959S)	3-phase fault at Oakland 946S	Stable
	3-phase fault at Lanfine 959S	Stable
9L29 (Oakland 946S – Coyote Lake 963S)	3-phase fault at Oakland 946S	Stable
	3-phase fault at Coyote Lake 963S	Stable
9L16 (Cordel 755S – Tinchebray 972S)	3-phase fault at Cordel 755S	Stable
	3-phase fault at Tinchebray 972S	Stable
9L966 (Pemukan 932S – Hansman Lake 650S)	3-phase fault at Pemukan 932S	Stable
	3-phase fault at Hansman Lake 650S	Stable
9L20 (Cordel 755S – Nevis 766S)	3-phase fault at Cordel 755S	Stable
	3-phase fault at Nevis 766S	Stable

Studied Contingency	Fault Description and Location	Results
912L (Red Deer 63S – Nevis 766S)	3-phase fault at Red Deer 63S	Stable
	3-phase fault at Nevis 766S	Stable
9L59 (Tinchebray 972S – Anderson 801S)	3-phase fault at Tinchebray 972S	Stable
	3-phase fault at Anderson 801S	Stable

4 Short Circuit Studies

4.1 Pre-Project Results

4.1.1 Scenario 3: 2023 Winter Peak High Renewable, Economic Coal Pre-Project

Pre-Project short-circuit current levels are provided in Table 4-1[1].

Table 4-1: Pre-Project Short-Circuit Current Levels for Scenario 3: 2023 Winter Peak High Renewable, Economic Coal Pre-Project

Substation Name and Number	Base Voltage (kV)	Pre-Fault Voltage (kV)	3-Φ Fault (kA)	Positive Sequence Thevenin Source Impedance (R1+jX1) (pu)	1-Φ Fault (kA)	Zero Sequence Thevenin Source Impedance (R0+jX0) (pu)
Ware Junction 132S	240.0	254.2	13.3	0.0041 + 0.0214j	12.7	0.0041 + 0.0253j
Jenner 275S	240.0	254.0	9.0	0.0053 + 0.0313j	5.2	0.0216 + 0.0995j
Amoco Empress 163S	240.0	254.8	7.1	0.0055 + 0.0388j	5.0	0.0129 + 0.0893j
Empress Liquids 164S	138.0	141.5	7.8	0.0136 + 0.0584j	5.4	0.0279 + 0.136j
Empress 394S	138.0	141.3	10.6	0.0063 + 0.0438j	7.5	0.0144 + 0.0956j
Amoco Empress 163S	138.0	141.3	10.7	0.006 + 0.0433j	7.6	0.0141 + 0.0951j
Jenner 275S	138.0	141.6	0.7	0.0637 + 0.6359j	0.6	0.0402 + 0.8792j
Wardlow 230S	138.0	141.4	0.7	0.0957 + 0.6982j	0.6	0.1048 + 1.108j
Cypress 562S	138.0	141.7	10.8	0.0056 + 0.043j	7.9	0.0119 + 0.0899j
Cypress 562S	240.0	254.6	7.1	0.0056 + 0.039j	5.2	0.0107 + 0.0822j

4.2 Post-Project Results

4.2.1 Scenario 6: 2023 Winter Peak High Renewable, Economic Coal Post-Project

Post-Project short-circuit current levels for Scenario 6 are provided in Table 4-2.

[1] Short-circuit current studies were based on modeling information provided to the AESO by third parties. The authenticity of the modeling information has not been validated. Fault levels could change as a result of system developments, new customer connections, or additional generation in the area. It is recommended that these changes be monitored and fault levels reviewed to ensure that the fault levels are within equipment operating limits. The information provided in this study should not be used as the sole source of information for electrical equipment specifications or for the design of safety-grounding systems.

Table 4-2: Post-Project Short-Circuit Current Levels for Scenario 6: 2023 Winter Peak High Renewable, Economic Coal Post-Project

Substation Name and Number	Base Voltage (kV)	Pre-Fault Voltage (kV)	3-Φ Fault (kA)	Positive Sequence Thevenin Source Impedance (R1+jX1) (pu)	1-Φ Fault (kA)	Zero Sequence Thevenin Source Impedance (R0+jX0) (pu)
Ware Junction 132S	240.0	252.9	13.3	0.0042 + 0.0215j	12.7	0.004 + 0.0249j
Jenner 275S	240.0	252.2	9.0	0.0054 + 0.0313j	6.0	0.0162 + 0.0766j
Amoco Empress 163S	240.0	253.0	7.2	0.0055 + 0.0384j	5.1	0.0128 + 0.0848j
Empress Liquids 164S	138.0	142.9	7.8	0.0137 + 0.059j	5.5	0.028 + 0.1348j
Empress 394S	138.0	142.9	10.6	0.0064 + 0.0444j	7.7	0.0145 + 0.0942j
Amoco Empress 163S	138.0	142.9	10.7	0.0062 + 0.0439j	7.7	0.0143 + 0.0937j
Jenner 275S	138.0	141.1	0.7	0.0639 + 0.6358j	0.7	0.0376 + 0.8705j
Wardlow 230S	138.0	140.9	0.7	0.0959 + 0.6981j	0.6	0.1022 + 1.0994j
Cypress 562S	138.0	143.3	10.8	0.0058 + 0.0436j	8.0	0.0121 + 0.0885j
Cypress 562S	240.0	252.8	7.2	0.0056 + 0.0386j	5.4	0.0106 + 0.0778j
Raptor 1080S	240.0	252.3	8.2	0.0061 + 0.0345j	5.5	0.0191 + 0.0849j

4.2.2 Scenario 7: 2031 WP Post-Project

Post-Project short-circuit current levels for Scenario 7 are provided in Table 4-3.

Table 4-3: Post-Project Short-Circuit Current Levels for Scenario 7

Substation Name and Number	Base Voltage (kV)	Pre-Fault Voltage (kV)	3-Φ Fault (kA)	Positive Sequence Thevenin Source Impedance (R1+jX1) (pu)	1-Φ Fault (kA)	Zero Sequence Thevenin Source Impedance (R0+jX0) (pu)
Ware Junction 132S	240.0	253.4	14.2	0.003 + 0.0181j	14.6	0.0025 + 0.0171j
Jenner 275S	240.0	252.5	10.0	0.0043 + 0.0256j	7.3	0.0103 + 0.0533j
Amoco Empress 163S	240.0	253.1	7.4	0.0058 + 0.0346j	6.0	0.0081 + 0.0575j
Empress Liquids 164S	138.0	141.0	7.6	0.0149 + 0.0556j	5.7	0.0239 + 0.1127j
Empress 394S	138.0	140.7	10.5	0.0076 + 0.0407j	8.5	0.0099 + 0.0696j
Amoco Empress 163S	138.0	140.8	10.6	0.0074 + 0.0403j	8.5	0.0098 + 0.0696j
Jenner 275S	138.0	139.6	0.7	0.0601 + 0.6293j	0.6	0.0346 + 0.8608j
Wardlow 230S	138.0	139.4	0.6	0.0912 + 0.6913j	0.5	0.0991 + 1.0896j
Cypress 562S	138.0	140.7	10.8	0.0071 + 0.0396j	9.1	0.0068 + 0.0624j

Substation Name and Number	Base Voltage (kV)	Pre-Fault Voltage (kV)	3-Φ Fault (kA)	Positive Sequence Thevenin Source Impedance (R1+jX1) (pu)	1-Φ Fault (kA)	Zero Sequence Thevenin Source Impedance (R0+jX0) (pu)
Cypress 562S	240.0	252.9	7.3	0.0058 + 0.0347j	6.4	0.0057 + 0.0496j
Raptor 1080S	240.0	251.7	8.4	0.0052 + 0.0302j	5.9	0.0149 + 0.0678j

5 Mitigation Measure Development and Evaluation

The Studies Consultant, in consultation with the AESO, developed mitigation measures to address the system performance issues that were identified in the post-Project scenarios. Existing remedial action schemes (RASs) are described in Section 1.2.2 of Attachment A1.

As part of this Project, mitigation measures will not be specifically developed for the POD bus voltage deviations observed under certain Category B conditions during pre-Project and post-Project scenarios.[2]

5.1 Pre-Project

Pre-Project mitigation measures are summarized in Table 5-1.

Table 5-1: Pre-Project Mitigation Measures

Mitigation Measure	Location of Observed Violation	Contingency
Planned RAS No. 134	174L (Bardo 197S - North Holden 395S)	766S901T (Nevis 766S Transformer 901T)
	701L (Strome 223S - Heisler Tap)	
	174L (Bardo 197S - North Holden 395S)	912L\9L912 (Red Deer 63S - Nevis 766S)
	701L (Strome 223S - Heisler Tap)	
	174L (Bardo 197S - North Holden 395S)	9L20 (Nevis 766S - Cordel 755S)
	701L (Strome 223S - Heisler Tap)	
	7L171 (Michichi Creek 802S - Wintering Hills 804S)	
	766S901T (Nevis 766S Transformer 901T)	
	174L (Bardo 197S - North Holden 395S)	EATL (Newell 2075S - Heathfield 2029S)
	701L (Strome 223S - Heisler Tap)	
	7L171 (Michichi Creek 802S - Wintering Hills 804S)	
	7L701 (Heisler Tap - Battle River 757S)	
	912L\9L912 (Red Deer 63S - Nevis 766S)	
	9L16 (Tinchebray 972S - Cordel 755S)	
Planned RAS No. 202	7L171 (Michichi Creek 802S - Wintering Hills 804S)	9L16 (Tinchebray 972S - Cordel 755S)
	7L85 (Bullpound 803S - Anderson 801S)	7L171 (Michichi Creek 802S - Wintering Hills 804S)
	7L85 (Bullpound 803S - Parker 2027S)	
	801S901T (Anderson 801S Transformer 901T)	
	7L171 (Michichi Creek 802S - Wintering Hills 804S)	114ST1 (Ghost Pine 114S Transformer T1)

[2] The AESO's desired post-contingency voltage deviations for low voltage busses represent guidelines rather than criteria. A POD bus voltage deviation that exceeds the desired limits shown in Table 3-1 of Attachment A1 does not represent a Reliability Criteria violation.

Mitigation Measure	Location of Observed Violation	Contingency
	7L171 (Michichi Creek 802S - Wintering Hills 804S)	801S901T (Anderson 801S Transformer 901T)
RTOP	7L132 (Oyen 767S - Lanfine 959S)	959S901T (Lanfine 959S Transformer 901T)
	668L (Empress 394S - Cypress 562S)	669L (Amoco Empress 163S - Cypress 562S)

Notes:

[a] RAS No. 134 is an existing planned RAS. Modifications to RAS No. 134 is proposed for the projects and facility of P1898, P1909, P1718 and Halkirk.

5.2 Post-Project

Post-Project mitigation measures are summarized in Table 5-2.

Table 5-2: Post-Project Mitigation Measures

Mitigation Measure	Location of Observed Violation	Contingency
AESO TCM Rule 302.1	174L (Bardo 197S - North Holden 395S)	N-0 (System Normal Condition)
	912L\9L912 (Red Deer 63S - Nevis 766S)	
Planned RAS No. 134	174L (Bardo 197S - North Holden 395S)	766S901T (Nevis 766S Transformer 901T)
	701L (Strome 223S - Heisler Tap)	
	7L701 (Heisler Tap - Battle River 757S)	
	174L (Bardo 197S - North Holden 395S)	912L\9L912 (Red Deer 63S - Nevis 766S)
	701L (Strome 223S - Heisler Tap)	
	7L701 (Heisler Tap - Battle River 757S)	
	174L (Bardo 197S - North Holden 395S)	9L20 (Nevis 766S - Cordel 755S)
	7L171 (Michichi Creek 802S - Wintering Hills 804S)	
	7L701 (Heisler Tap - Battle River 757S)	
	7L159 (Ghost Tap - Heatburg 948S)	
	7L16 (Nevis 766S - Heatburg 948S)	
	766S901T (Nevis 766S Transformer 901T)	
	668L (Empress 394S - Cypress 562S)	
	174L (Bardo 197S - North Holden 395S)	EATL (Newell 2075S - Heathfield 2029S)
	7L159 (Ghost Tap - Heatburg 948S)	
	912L\9L912 (Red Deer 63S - Nevis 766S)	
	9L16 (Tinchebray 972S - Cordel 755S)	
	7L171 (Michichi Creek 802S - Wintering Hills 804S)	
	701L (Strome 223S - Heisler Tap)	

Mitigation Measure	Location of Observed Violation	Contingency
	7L701 (Heisler Tap - Battle River 757S)	
	9L20 (Nevis 766S - Cordel 755S)	
	7L16 (Nevis 766S - Heatburg 948S)	
	7L159 (Ghost Tap - Heatburg 948S)	9L29 (Oakland 946S - Coyote Lake 963S)
	766S901T (Nevis 766S Transformer 901T)	
	7L16 (Nevis 766S - Heatburg 948S)	
	7L159 (Ghost Tap - Heatburg 948S)	9L16 (Tinchebray 972S - Cordel 755S)
	6L15 (Sullivan Lake 775S - Hanna 763S)	
	766S901T (Nevis 766S Transformer 901T)	
	7L16 (Nevis 766S - Heatburg 948S)	
	7L171 (Michichi Creek 802S - Wintering Hills 804S)	
	7L159 (Ghost Tap - Heatburg 948S)	963S901T (Coyote Lake 963S Transformer 901T)
	766S901T (Nevis 766S Transformer 901T)	
	7L16 (Nevis 766S - Heatburg 948S)	
	7L159 (Ghost Tap - Heatburg 948S)	770S703T (Three Hills 770S Transformer T3)
	766S901T (Nevis 766S Transformer 901T)	
	7L16 (Nevis 766S - Heatburg 948S)	
Planned RAS No. 199	7L159 (Ghost Tap - Heatburg 948S)	9LA59TAP (Anderson 801S - P1909 - Tinchebray 972S)
	7L159 (Ghost Tap - Heatburg 948S)	9L46 (Lanfine 959S - Sedalia 363S)
	9L16 (Tinchebray 972S - Cordel 755S)	
	7L159 (Ghost Tap - Heatburg 948S	9L51 (Pemukan 932S - Sedalia 363S)
	9L16 (Tinchebray 972S - Cordel 755S)	
Planned RAS No. 200	801S901T (Anderson 801S Transformer 901T)	7L171 (Michichi Creek 802S - Wintering Hills 804S)
Planned RAS No. 201	7L224 (Hansman Lake 650S - Monitor 774S)	9L966 (Hansman Lake 650S - Pemukan 932S)
Planned RAS No. 202	7L171 (Michichi Creek 802S - Wintering Hills 804S)	9L16 (Tinchebray 972S - Cordel 755S)
		9L29 (Oakland 946S - Coyote Lake 963S)
		9LA59TAP (Anderson 801S - P1909 - Tinchebray 972S)
		114ST1 (Ghost Pine 114S Transformer T1)
		801S901T (Anderson 801S Transformer 901T)
		963S901T (Coyote Lake 963S Transformer 901T)

Mitigation Measure	Location of Observed Violation	Contingency
		P2263 Transformer T1
	7L159 (Ghost Tap - Heatburg 948S)	9L16 (Tinchebray 972S - Cordel 755S)
		801S901T (Anderson 801S Transformer 901T)
	7L85 (Bullpound 803S - Anderson 801S)	7L171 (Michichi Creek 802S - Wintering Hills 804S)
	7L85 (Bullpound 803S - Parker 2027S)	7L171 (Michichi Creek 802S - Wintering Hills 804S)
	801S901T (Anderson 801S Transformer 901T)	7L171 (Michichi Creek 802S - Wintering Hills 804S)
Planned RAS No. 199 Planned RAS No. 202	7L159 (Ghost Tap - Heatburg 948S)	801S901T (Anderson 801S Transformer 901T)
	7L171 (Michichi Creek 802S - Wintering Hills 804S)	
Planned RAS No. 199 Planned RAS No. 215	7L159 (Ghost Tap - Heatburg 948S)	9L51 (Pemukan 932S - New Brigden 2088S)
	7L16 (Nevis 766S - Heatburg 948S)	9L46 (Lanfine 959S - New Brigden 2088S)
	9L16 (Tinchebray 972S - Cordel 755S)	
Planned RAS No. 215	9L16 (Tinchebray 972S - Cordel 755S)	757S905T (Battle River 757S Transformer 905T)
RTOP	668L (Empress 394S - Cypress 562S)	669L (Amoco Empress 163S - Cypress 562S)
	7L132 (Oyen 767S - Lanfine 959S)	959S901T (Lanfine 959S Transformer 901T)
	912L\9L912 (Red Deer 63S - Nevis 766S)	7L701\7LA701\701L (Battle River 757S - Heisler 764S - Strome 223S)
		757ST2 (Battle River 757S Transformer T2)
	7L224 (Hansman Lake 650S - Monitor 774S)	9L966 (Hansman Lake 650S - Pemukan 932S)
	6L09\6LA09 (Oyen 767S - ACE Tap)	959S901T (Lanfine 959S Transformer 901T)

5.3 Evaluation of Mitigation Measures

This section describes the results of the power flow studies that were performed to assess the impact of the Project on the performance of the AIES following the implementation of proposed mitigation measures.

5.3.1 Pre-Project

The post-mitigation measures studies for the Pre-Project study scenarios were performed under Category B conditions for 2023 Summer Peak High Renewable, Economic Coal Pre-Project, 2023 Summer Light High Renewable, Economic Coal Pre-Project and 2023 Winter Peak High Renewable, Economic Coal Pre-Project using the RASs described in Section 5.1.

The post-mitigation power flow diagrams for selected Category B conditions of the Pre-Project study scenarios are provided in Attachment A6. Post-mitigation power flow diagrams present only those post-Project contingencies that result in thermal criteria violations that require RAS mitigation. Post-Project contingencies that result in thermal criteria violations that can be mitigated by real-time operational practices (RTOPs) or TFO capital maintenance projects were not studied.

5.3.1.1 Scenario 1: 2023 Summer Peak High Renewable, Economic Coal Pre-Project

Category B Conditions

Thermal criteria violations observed under certain Category B conditions in the post-Project studies were mitigated by RASs as shown in Table 5-3.

Table 5-3: Post-RAS Power Flow Study Results for Scenario 1

Contingency (System Element Lost)	Details of Violation (Violation Observed On)	Seasonal Continuous Rating (MVA)	Short-term (Emergency) Rating (MVA)	Post-Project Results		Post-RAS Action Results	
				Power Flow (MVA)	% Loading	Power Flow (MVA)	% Loading
766S901T (Nevis 766S Transformer 901T)	174L (Bardo 197S - North Holden 395S)	85.0	94.0	107.4	126.3	78.1	91.9
	701L (Strome 223S - Heisler Tap)	127.5	158.0	145.2	113.9	95.5	74.9
EATL (Newell 2075S - Heathfield 2029S)	174L (Bardo 197S - North Holden 395S)	85.0	94.0	109.4	128.7	0.0	0.0
	701L (Strome 223S - Heisler Tap)	127.5	158.0	151.0	118.5	73.4	57.6
	7L701 (Heisler Tap - Battle River 757S)	141.8	160.0	145.6	102.7	89.8	63.3
	912L\9L912 (Red Deer 63S - Nevis 766S)	507.0	553.0	529.3	104.4	412.9	81.4
	9L16 (Tinchebray 972S - Cordel 755S)	499.0	627.0	502.5	100.7	340.9	68.3
	7L171 (Michichi Creek 802S - Wintering Hills 804S)	107.3	123.6	114.3	106.6	68.0	63.4
9L20 (Nevis 766S - Cordel 755S)	174L (Bardo 197S - North Holden 395S)	85.0	94.0	92.7	109.1	68.2	80.3

Contingency (System Element Lost)	Details of Violation (Violation Observed On)	Seasonal Continuous Rating (MVA)	Short-term (Emergency) Rating (MVA)	Post-Project Results		Post-RAS Action Results	
				Power Flow (MVA)	% Loading	Power Flow (MVA)	% Loading
	701L (Strome 223S - Heisler Tap)	127.5	158.0	130.2	102.2	87.5	68.6
	766S901T (Nevis 766S Transformer 901T)	100.0	100.0	112.4	112.4	76.8	76.8
	7L171 (Michichi Creek 802S - Wintering Hills 804S)	107.3	123.6	110.8	103.3	62.1	57.9
9L16 (Tinchebray 972S - Cordel 755S)	7L171 (Michichi Creek 802S - Wintering Hills 804S)	107.3	123.6	112.1	104.5	66.3	61.8
7L171 (Michichi Creek 802S - Wintering Hills 804S)	7L85 (Bullpound 803S - Anderson 801S)	139.0	165.8	142.2	101.6	54.2	39.0
	7L85 (Bullpound 803S - Parker 2027S)	112.1	138.0	150.0	107.9	72.2	55.5
	801S901T (Anderson 801S Transformer 901T)	125.0	125.0	146.6	117.1	53.2	42.6
801S901T (Anderson 801S Transformer 901T)	7L171 (Michichi Creek 802S - Wintering Hills 804S)	107.3	123.6	138.2	1288	51.0	47.5
114ST1 (Ghost Pine 114S Transformer T1)	7L171 (Michichi Creek 802S - Wintering Hills 804S)	107.3	123.6	108.5	101.1	63.1	58.8
912L\9L912 (Red Deer 63S - Nevis 766S)	174L (Bardo 197S - North Holden 395S)	85.0	94.0	107.3	126.3	77.9	91.6
	701L (Strome 223S - Heisler Tap)	127.5	158.0	145.1	113.8	95.4	74.9

5.3.1.2 Scenario 2: 2023 Summer Light High Renewable, Economic Coal Pre-Project

Category B Conditions

Thermal criteria violations observed under certain Category B conditions in the post-Project studies were mitigated by RASs as shown in Table 5-4.

Table 5-4: Post-RAS Power Flow Study Results for Scenario 2

Contingency (System Element Lost)	Details of Violation (Violation Observed On)	Seasonal Continuous Rating (MVA)	Short-term (Emergency) Rating (MVA)	Post-Project Results		Post-RAS Action Results	
				Power Flow (MVA)	% Loading	Power Flow (MVA)	% Loading
766S901T (Nevis 766S Transformer 901T)	174L (Bardo 197S - North Holden 395S)	85.0	94.0	92.8	109.2	61.4	72.2
EATL (Newell 2075S - Heathfield 2029S)	174L (Bardo 197S - North Holden 395S)	85.0	94.0	98.2	115.5	82.9	97.5
	7L171 (Michichi Creek 802S - Wintering Hills 804S)	107.3	123.6	113.8	106.0	66.0	61.5
9L20 (Nevis 766S - Cordel 755S)	766S901T (Nevis 766S Transformer 901T)	100.0	100.0	108.8	108.8	87.3	87.3
	7L171 (Michichi Creek 802S - Wintering Hills 804S)	107.3	123.6	109.3	101.9	106.2	99.0
9L16 (Tinchebray 972S - Cordel 755S)	7L171 (Michichi Creek 802S - Wintering Hills 804S)	107.3	123.6	111.1	103.6	64.0	59.7
7L171 (Michichi Creek 802S - Wintering Hills 804S)	7L85 (Bullpound 803S - Anderson 801S)	139.0	165.8	147.7	106.3	58.3	41.9
7L171 (Michichi Creek 802S - Wintering Hills 804S)	7L85 (Bullpound 803S - Parker 2027S)	112.1	138.0	154.3	111.0	79.8	57.4
7L171 (Michichi Creek 802S -	801S901T (Anderson 801S	125.0	125.0	153.9	123.1	58.1	46.5

Contingency (System Element Lost)	Details of Violation (Violation Observed On)	Seasonal Continuous Rating (MVA)	Short-term (Emergency) Rating (MVA)	Post-Project Results		Post-RAS Action Results	
				Power Flow (MVA)	% Loading	Power Flow (MVA)	% Loading
Wintering Hills 804S)	Transformer 901T)						
801S901T (Anderson 801S Transformer 901T)	7L171 (Michichi Creek 802S - Wintering Hills 804S)	107.3	123.6	144.8	134.9	55.1	51.3
114ST1 (Ghost Pine 114S Transformer T1)	7L171 (Michichi Creek 802S - Wintering Hills 804S)	107.3	123.6	109.3	101.8	62.7	58.4
912L\9L912 (Red Deer 63S - Nevis 766S)	174L (Bardo 197S - North Holden 395S)	85.0	94.0	92.9	109.3	61.3	72.1

5.3.1.3 Scenario 3: 2023 Winter Peak High Renewable, Economic Coal Pre-Project

Category B Conditions

Thermal criteria violations observed under certain Category B conditions in the post-Project studies were mitigated by RASs as shown in Table 5-5.

Table 5-5: Post-RAS Power Flow Study Results for Scenario 3

Contingency (System Element Lost)	Details of Violation (Violation Observed On)	Seasonal Continuous Rating (MVA)	Short-term (Emergency) Rating (MVA)	Post-Project Results		Post-RAS Action Results	
				Power Flow (MVA)	% Loading	Power Flow (MVA)	% Loading
EATL (Newell 2075S - Heathfield 2029S)	174L (Bardo 197S - North Holden 395S)	90.0	99.0	90.5	100.6	75.0	83.3
	701L (Strome 223S - Heisler Tap)	127.5	169.0	137.7	108.1	82.8	65.0
7L171 (Michichi Creek 802S - Wintering Hills 804S)	801S901T (Anderson 801S Transformer 901T)	125.0	125.0	174.5	139.6	67.4	53.9
801S901T (Anderson 801S	7L171 (Michichi Creek 802S -	140.9	142.8	163.4	116.0	64.1	45.5

Contingency (System Element Lost)	Details of Violation (Violation Observed On)	Seasonal Continuous Rating (MVA)	Short-term (Emergency) Rating (MVA)	Post-Project Results		Post-RAS Action Results	
				Power Flow (MVA)	% Loading	Power Flow (MVA)	% Loading
Transformer 901T)	Wintering Hills 804S)						

5.3.2 Post-Project

The post-mitigation measures studies for the Post-Project study scenarios were performed under Category B conditions for 2023 Summer Peak High Renewable, Economic Coal Post-Project, 2023 Summer Light High Renewable, Economic Coal Post-Project and 2023 Winter Peak High Renewable, Economic Coal Post-Project using Alternative 2 and the RASs described in Section 5.2.

The post-mitigation power flow diagrams for selected Category B conditions are provided in Attachment A6. Post-mitigation power flow diagrams present only those post-Project contingencies that result in thermal criteria violations that require RAS mitigation. Post-Project contingencies that result in thermal criteria violations that can be mitigated by RTOPs or TFO capital maintenance projects were not studied.

5.3.2.1 Scenario 4: 2023 Summer Peak High Renewable, Economic Coal Post-Project

Category B Conditions

Thermal criteria violations observed under certain Category B conditions in the post-Project studies were mitigated by RASs as shown in Table 5-6.

Table 5-6: Post-RAS Power Flow Study Results for Scenario 4

Contingency (System Element Lost)	Details of Violation (Violation Observed On)	Seasonal Continuous Rating (MVA)	Short-term (Emergency) Rating (MVA)	Post-Project Results		Post-RAS Action Results	
				Power Flow (MVA)	% Loading	Power Flow (MVA)	% Loading
766S901T (Nevis 766S Transformer 901T)	174L (Bardo 197S - North Holden 395S)	85.0	94.0	127.9	150.4	82.4	97.0
	701L (Strome 223S - Heisler Tap)	158.0	174.0	164.7	104.2	122.4	77.5
	7L701 (Heisler Tap - Battle River 757S)	141.8	159.1	155.9	109.9	117.2	82.6
EATL (Newell 2075S -	174L (Bardo 197S - North Holden 395S)	85.0	94.0	123.1	144.8	0.0	0.0

Contingency (System Element Lost)	Details of Violation (Violation Observed On)	Seasonal Continuous Rating (MVA)	Short-term (Emergency) Rating (MVA)	Post-Project Results		Post-RAS Action Results	
				Power Flow (MVA)	% Loading	Power Flow (MVA)	% Loading
Heathfield 2029S)	7L159 (Ghost Tap - Heatburg 948S)	107.3	118.8	113.1	105.5	97.4	90.8
	701L (Strome 223S - Heisler Tap)	158.0	174.0	164.8	104.3	98.1	62.1
	7L701 (Heisler Tap - Battle River 757S)	141.8	159.1	158.5	111.8	96.7	68.2
	912L\9L912 (Red Deer 63S - Nevis 766S)	507.0	553.0	597.1	117.8	483.5	95.4
	9L20 (Nevis 766S - Cordel 755S)	488.0	558.0	508.8	104.3	412.5	84.5
	7L16 (Nevis 766S - Heatburg 948S)	107.3	119.8	109.2	101.8	93.5	87.2
	9L16 (Tinchebray 972S - Cordel 755S)	499.0	499.0	558.1	111.8	391.8	78.5
	7L171 (Michichi Creek 802S - Wintering Hills 804S)	107.3	121.7	114.8	107.0	70.0	65.2
9L20 (Nevis 766S - Cordel 755S)	174L (Bardo 197S - North Holden 395S)	85.0	94.0	110.2	129.6	71.5	84.1
	7L159 (Ghost Tap - Heatburg 948S)	107.3	118.8	116.9	108.9	87.9	81.9
	7L701 (Heisler Tap - Battle River 757S)	141.8	159.1	149.3	105.3	113.2	79.8
	766S901T (Nevis 766S Transformer 901T)	100.0	100.0	136.7	136.7	90.2	90.2
	7L16 (Nevis 766S - Heatburg 948S)	107.3	119.8	113.1	105.4	84.1	78.4
	7L171 (Michichi Creek 802S -	107.3	121.7	112.0	104.4	63.7	59.4

Contingency (System Element Lost)	Details of Violation (Violation Observed On)	Seasonal Continuous Rating (MVA)	Short-term (Emergency) Rating (MVA)	Post-Project Results		Post-RAS Action Results	
				Power Flow (MVA)	% Loading	Power Flow (MVA)	% Loading
	Wintering Hills 804S)						
912L\9L912 (Red Deer 63S - Nevis 766S)	174L (Bardo 197S - North Holden 395S)	85.0	94.0	127.7	150.3	82.3	96.8
	701L (Strome 223S - Heisler Tap)	158.0	174.0	164.6	104.2	122.4	77.5
	7L701 (Heisler Tap - Battle River 757S)	141.8	159.1	155.1	109.4	116.5	82.2
9LA59TAP (Anderson 801S - P1909 - Tinchebray 972S)	7L171 (Michichi Creek 802S - Wintering Hills 804S)	107.3	121.7	107.6	100.3	63.5	59.2
9L16 (Tinchebray 972S - Cordel 755S)	7L159 (Ghost Tap - Heatburg 948S)	107.3	118.8	109.9	102.4	97.5	90.8
9L16 (Tinchebray 972S - Cordel 755S)	7L171 (Michichi Creek 802S - Wintering Hills 804S)	107.3	121.7	113.5	105.8	69.4	64.7
9L29 (Oakland 946S - Coyote Lake 963S)	7L171 (Michichi Creek 802S - Wintering Hills 804S)	107.3	121.7	107.7	100.4	78.5	73.2
9L966 (Hansman Lake 650S - Pemukan 932S)	7L224 (Hansman Lake 650S - Monitor 774S)	108.3	123.6	111.8	103.2	90.2	83.3
963S901T (Coyote Lake 963S Transformer 901T)	7L171 (Michichi Creek 802S - Wintering Hills 804S)	107.3	121.7	107.7	100.3	78.5	73.2
7L171 (Michichi Creek 802S - Wintering Hills 804S)	7L85 (Bullpound 803S - Parker 2027S)	112.1	138	143.8	128.3	59.6	53.2
7L171 (Michichi	801S901T (Anderson 801S	125	125	139.7	111.7	50.4	40.3

Contingency (System Element Lost)	Details of Violation (Violation Observed On)	Seasonal Continuous Rating (MVA)	Short-term (Emergency) Rating (MVA)	Post-Project Results		Post-RAS Action Results	
				Power Flow (MVA)	% Loading	Power Flow (MVA)	% Loading
Creek 802S - Wintering Hills 804S)	Transformer 901T)						
801S901T (Anderson 801S Transformer 901T)	7L171 (Michichi Creek 802S - Wintering Hills 804S)	107.3	121.7	132.2	123.2	48.3	45.1
114ST1 (Ghost Pine 114S Transformer T1)	7L171 (Michichi Creek 802S - Wintering Hills 804S)	107.3	121.7	108.6	101.2	65.0	60.6

5.3.2.2 Scenario 5: 2023 Summer Light High Renewable, Economic Coal Post-Project

Category B Conditions

The thermal criteria violations observed under certain Category B conditions in the post-Project studies were mitigated by RASs as shown in Table 5-7.

Table 5-7: Post-RAS Power Flow Study Results for Scenario 5

Contingency (System Element Lost)	Details of Violation (Violation Observed On)	Seasonal Continuous Rating (MVA)	Short-term (Emergency) Rating (MVA)	Post-Project Results		Post-RAS Action Results	
				Power Flow (MVA)	% Loading	Power Flow (MVA)	% Loading
766S901T (Nevis 766S Transformer 901T)	174L (Bardo 197S - North Holden 395S)	85.0	94.0	113.9	134.0	82.7	97.3
EATL (Newell 2075S - Heathfield 2029S)	174L (Bardo 197S - North Holden 395S)	85.0	94.0	109.5	128.8	0.0	0.0
	7L159 (Ghost Tap - Heatburg 948S)	107.3	118.8	109.5	102.1	93.1	86.8
	912L\9L912 (Red Deer 63S - Nevis 766S)	507.0	553.0	552.7	109.0	456.4	90.0
	9L16 (Tinchebray	499.0	499.0	525.2	105.3	396.0	79.4

Contingency (System Element Lost)	Details of Violation (Violation Observed On)	Seasonal Continuous Rating (MVA)	Short-term (Emergency) Rating (MVA)	Post-Project Results		Post-RAS Action Results	
				Power Flow (MVA)	% Loading	Power Flow (MVA)	% Loading
	972S - Cordel 755S)						
	7L171 (Michichi Creek 802S - Wintering Hills 804S)	107.3	121.7	113.7	105.9	67.7	63.1
9L20 (Nevis 766S - Cordel 755S)	174L (Bardo 197S - North Holden 395S)	85.0	94.0	97.1	114.3	71.0	83.5
	7L159 (Ghost Tap - Heatburg 948S)	107.3	118.8	111.4	103.8	86.2	80.3
	766S901T (Nevis 766S Transformer 901T)	100.0	100.0	130.8	130.8	94.0	94.0
	7L16 (Nevis 766S - Heatburg 948S)	107.3	119.8	108.5	101.1	83.3	77.6
	7L171 (Michichi Creek 802S - Wintering Hills 804S)	107.3	121.7	110.7	103.2	62.3	58.1
912L\9L912 (Red Deer 63S - Nevis 766S)	174L (Bardo 197S - North Holden 395S)	85.0	94.0	114.0	134.1	82.6	97.2
9L16 (Tinchebray 972S - Cordel 755S)	7L171 (Michichi Creek 802S - Wintering Hills 804S)	107.3	121.7	112.4	104.8	67.1	62.6
7L171 (Michichi Creek 802S - Wintering Hills 804S)	7L85 (Bullpound 803S - Anderson 801S)	139.0	165.8	141.4	101.8	55.6	40.0
7L171 (Michichi Creek 802S - Wintering Hills 804S)	7L85 (Bullpound 803S - Parker 2027S)	112.1	138.0	148.0	132.0	61.7	55.0
7L171 (Michichi Creek 802S -	801S901T (Anderson 801S Transformer 901T)	125.0	125.0	147.2	117.8	55.3	44.2

Contingency (System Element Lost)	Details of Violation (Violation Observed On)	Seasonal Continuous Rating (MVA)	Short-term (Emergency) Rating (MVA)	Post-Project Results		Post-RAS Action Results	
				Power Flow (MVA)	% Loading	Power Flow (MVA)	% Loading
Wintering Hills 804S)							
801S901T (Anderson 801S Transformer 901T)	7L171 (Michichi Creek 802S - Wintering Hills 804S)	107.3	121.7	138.6	129.2	52.3	48.8
114ST1 (Ghost Pine 114S Transformer T1)	7L171 (Michichi Creek 802S - Wintering Hills 804S)	107.3	121.7	109.1	101.7	64.3	60.0

5.3.2.3 Scenario 6: 2023 Winter Peak High Renewable, Economic Coal Post-Project

Category B Conditions

The thermal criteria violations observed under certain Category B conditions in the post-Project studies were mitigated by RASs as shown in Table 5-8.

Table 5-8: Post-RAS Power Flow Study Results for Scenario 6

Contingency (System Element Lost)	Details of Violation (Violation Observed On)	Seasonal Continuous Rating (MVA)	Short-term (Emergency) Rating (MVA)	Post-Project Results		Post-RAS Action Results	
				Power Flow (MVA)	% Loading	Power Flow (MVA)	% Loading
766S901T (Nevis 766S Transformer 901T)	174L (Bardo 197S - North Holden 395S)	90.0	99.0	101.1	112.3	77.1	85.7
EATL (Newell 2075S - Heathfield 2029S)	174L (Bardo 197S - North Holden 395S)	90.0	99.0	103.1	114.6	87.1	96.8
	9L16 (Tinchebray 972S - Cordel 755S)	499.0	499.0	508.5	101.9	434.8	87.1
9L20 (Nevis 766S - Cordel 755S)	766S901T (Nevis 766S Transformer 901T)	100.0	100.0	113.3	113.3	92.4	92.4

Contingency (System Element Lost)	Details of Violation (Violation Observed On)	Seasonal Continuous Rating (MVA)	Short-term (Emergency) Rating (MVA)	Post-Project Results		Post-RAS Action Results	
				Power Flow (MVA)	% Loading	Power Flow (MVA)	% Loading
912L\9L912 (Red Deer 63S - Nevis 766S)	174L (Bardo 197S - North Holden 395S)	90.0	99.0	101.0	112.2	77.1	85.7
7L171 (Michichi Creek 802S - Wintering Hills 804S)	7L85 (Bullpound 803S - Parker 2027S)	140.9	176.3	171.0	121.4	71.0	50.4
7L171 (Michichi Creek 802S - Wintering Hills 804S)	801S901T (Anderson 801S Transformer 901T)	125.0	125.0	174.4	139.5	67.4	53.9
801S901T (Anderson 801S Transformer 901T)	7L171 (Michichi Creek 802S - Wintering Hills 804S)	140.9	143.8	163.3	115.9	63.8	45.3

5.3.2.4 Scenario 4a: 2023 Summer Peak High Renewable, Economic Coal Post-Project Sensitivity

Category A Conditions

The thermal criteria violations observed under Category A condition in the post-Project studies were mitigated by curtailing generation of P1250 Wild Run Grizzly Bear Wind Farm as shown in Table 5-9.

Table 5-9: Thermal Criteria Violations under Category A Conditions for Scenario 4a

Contingency (System Element Lost)	Details of Violation (Violation Observed On)	Seasonal Continuous Rating (MVA)	Short-term (Emergency) Rating (MVA)	Post-Project Results		Post-RAS Action Results	
				Power Flow (MVA)	% Loading	Power Flow (MVA)	% Loading
N-0 (System Normal Condition)	174L (Bardo 197S - North Holden 395S)	85.0	94.0	94.4	111.0	81.0	95.3
	912L\9L912 (Red Deer 63S - Nevis 766S)	507.0	553.0	520.0	102.6	490.3	96.7

Category B Conditions

The thermal criteria violations observed under certain Category B conditions in the post-Project studies were mitigated by RASs as shown in Table 5-10.

Table 5-10: Post-RAS Power Flow Study Results for Scenario 4a

Contingency (System Element Lost)	Details of Violation (Violation Observed On)	Seasonal Continuous Rating (MVA)	Short-term (Emergency) Rating (MVA)	Post-Project Results		Post-RAS Action Results	
				Power Flow (MVA)	% Loading	Power Flow (MVA)	% Loading
766S901T (Nevis 766S Transformer 901T)	174L (Bardo 197S - North Holden 395S)	85.0	94.0	162.1	190.8	83.9	98.7
	701L (Strome 223S - Heisler Tap)	158.0	174.0	193.1	122.2	123.5	78.2
	7L701 (Heisler Tap - Battle River 757S)	141.8	159.1	181.4	127.9	117.5	82.9
EATL (Newell 2075S - Heathfield 2029S)	174L (Bardo 197S - North Holden 395S)	85.0	94.0	140.5	165.3	0.0	0.0
	7L159 (Ghost Tap - Heatburg 948S)	107.3	118.8	131.3	122.4	102.6	95.6
	701L (Strome 223S - Heisler Tap)	158.0	174.0	177.0	112.0	97.2	61.5
	7L701 (Heisler Tap - Battle River 757S)	141.8	159.1	170.4	120.2	95.6	67.4
	912L\9L912 (Red Deer 63S - Nevis 766S)	507.0	553.0	709.2	139.9	488.5	96.4
	766S901T (Nevis 766S Transformer 901T)	100.0	100.0	115.8	115.8	88.1	88.1
	9L20 (Nevis 766S - Cordel 755S)	488.0	558.0	601.1	123.2	412.0	84.4
	7L16 (Nevis 766S - Heatburg 948S)	107.3	119.8	127.4	118.7	98.7	92.0
	9L16 (Tinchebray 972S - Cordel 755S)	499.0	499.0	658.5	132.0	392.0	78.6

Contingency (System Element Lost)	Details of Violation (Violation Observed On)	Seasonal Continuous Rating (MVA)	Short-term (Emergency) Rating (MVA)	Post-Project Results		Post-RAS Action Results	
				Power Flow (MVA)	% Loading	Power Flow (MVA)	% Loading
	7L171 (Michichi Creek 802S - Wintering Hills 804S)	107.3	121.7	109.8	102.3	73.1	68.1
9LA59TAP (Anderson 801S - P1909 - Tinchebray 972S)	7L159 (Ghost Tap - Heatburg 948S)	107.3	118.8	111.9	104.3	107.2	99.9
	766S901T (Nevis 766S Transformer 901T)	100.0	100.0	100.3	100.3	95.5	95.5
	7L16 (Nevis 766S - Heatburg 948S)	107.3	119.8	108.1	100.8	103.5	96.4
9L20 (Nevis 766S - Cordel 755S)	174L (Bardo 197S - North Holden 395S)	85.0	94.0	138.9	163.4	71.9	84.6
	7L159 (Ghost Tap - Heatburg 948S)	107.3	118.8	143.4	133.7	92.7	86.4
	701L (Strome 223S - Heisler Tap)	158.0	174.0	169.0	107.0	111.4	70.5
	7L701 (Heisler Tap - Battle River 757S)	141.8	159.1	172.4	121.6	113.1	79.8
	766S901T (Nevis 766S Transformer 901T)	100.0	100.0	173.6	173.6	95.4	95.4
	7L16 (Nevis 766S - Heatburg 948S)	107.3	119.8	139.6	130.1	89.0	82.9
	7L137 (Three Hills 770S - Rowley 768S)	108.3	120.8	109.5	101.1	52.3	48.3
	7L25 (Rowley 768S - Michichi Creek 802S)	109.3	122.7	113.8	104.2	56.6	51.8
	7L171 (Michichi Creek 802S - Wintering Hills 804S)	107.3	121.7	109.9	102.4	67.6	63.0

Contingency (System Element Lost)	Details of Violation (Violation Observed On)	Seasonal Continuous Rating (MVA)	Short-term (Emergency) Rating (MVA)	Post-Project Results		Post-RAS Action Results	
				Power Flow (MVA)	% Loading	Power Flow (MVA)	% Loading
9L16 (Tinchebray 972S - Cordel 755S)	7L159 (Ghost Tap - Heatburg 948S)	107.3	118.8	134.8	125.6	94.1	87.7
	6L15 (Sullivan Lake 775S - Hanna 763S)	23.0	23.0	24.8	107.9	16.2	70.3
	766S901T (Nevis 766S Transformer 901T)	100.0	100.0	123.3	123.3	77.2	77.2
	7L16 (Nevis 766S - Heatburg 948S)	107.3	119.8	131.0	122.1	90.4	84.3
	7L171 (Michichi Creek 802S - Wintering Hills 804S)	107.3	121.7	112.0	104.4	70.8	66.0
9L29 (Oakland 946S - Coyote Lake 963S)	7L159 (Ghost Tap - Heatburg 948S)	107.3	118.8	129.2	120.4	84.7	79.0
	766S901T (Nevis 766S Transformer 901T)	100.0	100.0	118.9	118.9	71.6	71.6
	7L16 (Nevis 766S - Heatburg 948S)	107.3	119.8	125.4	116.9	81.0	75.5
912L\9L912 (Red Deer 63S - Nevis 766S)	174L (Bardo 197S - North Holden 395S)	85.0	94.0	162.2	190.8	83.9	98.7
	701L (Strome 223S - Heisler Tap)	158.0	174.0	193.2	122.3	123.6	78.2
	7L701 (Heisler Tap - Battle River 757S)	141.8	159.1	181.1	127.7	117.3	82.7
963S901T (Coyote Lake 963S Transformer 901T)	7L159 (Ghost Tap - Heatburg 948S)	107.3	118.8	129.2	120.4	84.7	79.0
	766S901T (Nevis 766S Transformer 901T)	100.0	100.0	118.9	118.9	71.6	71.6

Contingency (System Element Lost)	Details of Violation (Violation Observed On)	Seasonal Continuous Rating (MVA)	Short-term (Emergency) Rating (MVA)	Post-Project Results		Post-RAS Action Results	
				Power Flow (MVA)	% Loading	Power Flow (MVA)	% Loading
	7L16 (Nevis 766S - Heatburg 948S)	107.3	119.8	125.4	116.9	81.0	75.5
7L171 (Michichi Creek 802S - Wintering Hills 804S)	7L85 (Bullpound 803S - Anderson 801S)	139.0	165.8	149.8	107.8	57.8	41.6
	7L85 (Bullpound 803S - Parker 2027S)	112.1	138.0	158.6	141.5	65.8	58.7
	801S901T (Anderson 801S Transformer 901T)	125.0	125.0	155.2	124.2	57.0	45.6
801S901T (Anderson 801S Transformer 901T)	7L159 (Ghost Tap - Heatburg 948S)	107.3	118.8	108.5	101.2	82.2	76.6
	7L171 (Michichi Creek 802S - Wintering Hills 804S)	107.3	121.7	146.6	136.6	54.7	51.0
7L128 Tap (Michichi Creek 802S - P2263 - Coyote Lake 963S	7L171 (Michichi Creek 802S - Wintering Hills 804S)	107.3	121.7	108.7	101.3	76.7	71.5
9L51 (Pemukan 932S - New Brigden 2088S)	7L159 (Ghost Tap - Heatburg 948S)	107.3	118.8	111.6	104.0	106.8	99.5
	7L16 (Nevis 766S - Heatburg 948S)	107.3	119.8	107.8	100.5	102.9	95.9
	9L16 (Tinchebray 972S - Cordel 755S)	499.0	499.0	575.9	115.4	506.0	101.4
9L46 (Lanfine 959S - New Brigden 2088S)	7L159 (Ghost Tap - Heatburg 948S)	107.3	118.8	111.6	104.0	106.8	99.5
	7L16 (Nevis 766S - Heatburg 948S)	107.3	119.8	107.8	100.5	102.9	95.9
	9L16 (Tinchebray	499.0	499.0	576.0	115.4	506.0	101.4

Contingency (System Element Lost)	Details of Violation (Violation Observed On)	Seasonal Continuous Rating (MVA)	Short-term (Emergency) Rating (MVA)	Post-Project Results		Post-RAS Action Results	
				Power Flow (MVA)	% Loading	Power Flow (MVA)	% Loading
	972S - Cordel 755S)						
770S703T (Three Hills 770S Transformer 703T)	7L159 (Ghost Tap - Heatburg 948S)	107.3	118.8	113.2	105.5	100.8	93.9
	766S901T (Nevis 766S Transformer 901T)	100.0	100.0	102.0	102.0	88.2	88.2
	7L16 (Nevis 766S - Heatburg 948S)	107.3	119.8	109.4	102.0	97.0	90.4
757S905T (Battle River 757S Transformer 905T)	9L16 (Tinchebray 972S - Cordel 755S)	499.0	499.0	511.2	102.5	431.8	86.5
P2263T1 (P2263 BER Hand Hills MPC Wind Farm Transformer T1)	7L171 (Michichi Creek 802S - Wintering Hills 804S)	107.3	121.7	108.1	100.8	60.5	56.4

Thermal violations remained on 9L16 (Tinchebray 972S - Cordel 755S) after RAS actions will be mitigated by AESO's RTOPs.

5.4 Constraint Effective Factor Studies

Constraint effective factor studies were conducted for all post-Project scenarios. The constraint effective factors were calculated for all Category B conditions when the loadings of the monitored transmission elements in the Study Area exceeded 100% (i.e., for all of the contingencies that resulted in thermal criteria violations). The results of the constraint effective factor studies are provided in Attachment A8.

Attachment A1
Engineering Connection Assessment: Study Scope

Study Scope

P2411 Greengate Jurassic MPC Solar Battery

Jurassic Solar LP

Date: October 25, 2022

Version: V4

Classification: Public

Company Name	Name and Credentials	Date	Signature
Stantec Consulting Ltd. (Studies Consultant)	Ashraf Haque, P. Eng	November 9, 2022	Haque, Ashraf Digitally signed by Haque, Ashraf Date: 2022.11.09 14:05:24 -07'00'
AESO	Myron Jin-Li, P. Eng	November 2, 2022	
Jurassic Solar LP (Market Participant)	Jordan Balaban	11/10/2022	DocuSigned by: Jordan Balaban D45E00D004FA412...

Contents

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1 Introduction

This Study Scope provides an overview of the engineering studies to be completed by Stantec Consulting Ltd. (the Studies Consultant) to assess the impact of the Project (as defined in section 1.1) on the performance of the Alberta interconnected electric system (AIES). Technical criteria, assumptions and methods for performing these engineering studies are provided in this document.

1.1 Project Overview

Jurassic Solar LP (Market Participant) has submitted a request for system access service to the Alberta Electric System Operator (AESO) to connect its proposed Jurassic Solar (Facility) to the AIES.

The Facility includes a proposed collector substation, to be designated Raptor 1080S.

The Market Participant's request includes: a request for a new system access service in the area, with a Rate STS, *Supply Transmission Service*, contract capacity of 300 MW and a Rate DTS, *Demand Transmission Service*, contract capacity of 1.5 MW; and a request for transmission development (collectively, the Project).

The Project in-service date (ISD) used for the purpose of the studies is December 14, 2023.

Load and generation components of the Project are listed in Table 1-1.

Table 1-1: Project Load and Generation Details

Project Component		Description
Load	Existing Rate DTS, *Demand Transmission Service,* contract capacity	No existing contract
	Requested Rate DTS	1.5 MW
	Type	Station service
	Motors (number and size)	N/A
	Power factor	0.9 pf
	Future load expansion plans	No
Generation	Generation type	Solar + battery
	Existing Rate STS, *Supply Transmission Service,* contract capacity	No existing contract
	Requested Rate STS	300 MW
	Number and size of generating units	TBD
	Maximum authorized real power (MARP)	305.5 MW
	Maximum capability (MC)	304 MW
	Reactive power capability	145.3 MVAr (0.9 pf when supplying)
		98.61 MVAr (0.95 pf when absorbing)

Project Component		Description
	Future generation expansion plans	No

Note:

MARP and MC are defined in the AESO's *Consolidated Authoritative Document Glossary*, which can be found on the AESO's website.

1.2 Existing System Overview

1.2.1 Study Area

Geographically, the Project is located in the AESO planning area Empress (Area 48), which is part of the AESO South planning region. Empress (Area 48) is surrounded by the planning areas of Medicine Hat (Area 4), Vauxhall (Area 52), Brooks (Area 47), Sheerness (Area 43), and Hanna (Area 42).

From a transmission system perspective, Empress (Area 48) consists primarily of a 240 kV and 138 kV transmission system. The Empress Area (Area 48) is connected to the Hanna Area (Area 42) with a 138kV line, the Brooks Area (Area 47) with two 240kV lines, and the Medicine Hat Area (Area 4) with a 240kV line.

The Study Area consists of the AESO planning areas of Empress (Area 48), Sheerness (Area 43), Hanna (Area 42), Alliance/Battle River (Area 36), Wainwright (Area 32), and Provost (Area 37), including the tie lines connecting these planning areas to the rest of the AIES. All transmission facilities 69 kV and above within the Study Area will be studied and monitored for violations of the Reliability Criteria. In addition, 174L (North Holden 395S – Bardo 197S) will be included in the monitored elements.

The existing transmission system in the Study Area is shown in Figure 1-1.

1.2.2 Existing Constraints

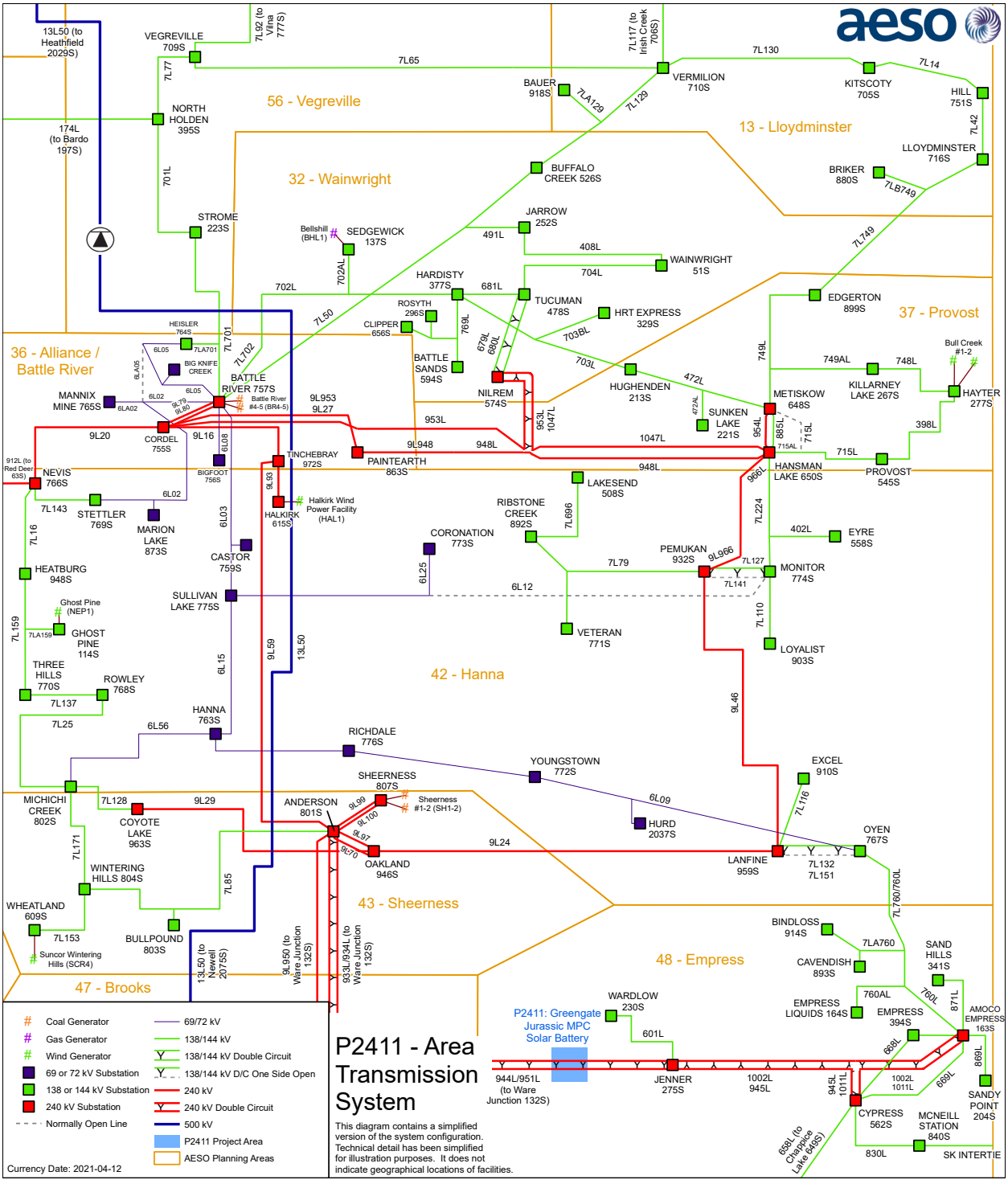
Existing constraints in the Study Area are managed in accordance with the procedures set out in Section 302.1 of the ISO rules, *Real Time Transmission Constraint Management* (TCM Rule).

There are a number of constraints in the Study Area that are mitigated by existing remedial action schemes (RASs) and/or other protection schemes.

The following existing RASs and/or other protection schemes are used to manage constraints in the area:

- RAS #134: 174L and 701L Overload Mitigation Scheme
- RAS #138: 7L50 – Buffalo Creek 526S Overload Mitigation Scheme
- RAS #139: 901T – Nevis 766S Overload Mitigation Scheme

Figure 1-1: Transmission System in the Study Area



2 Connection Alternative to be Studied

The following alternative will be studied.

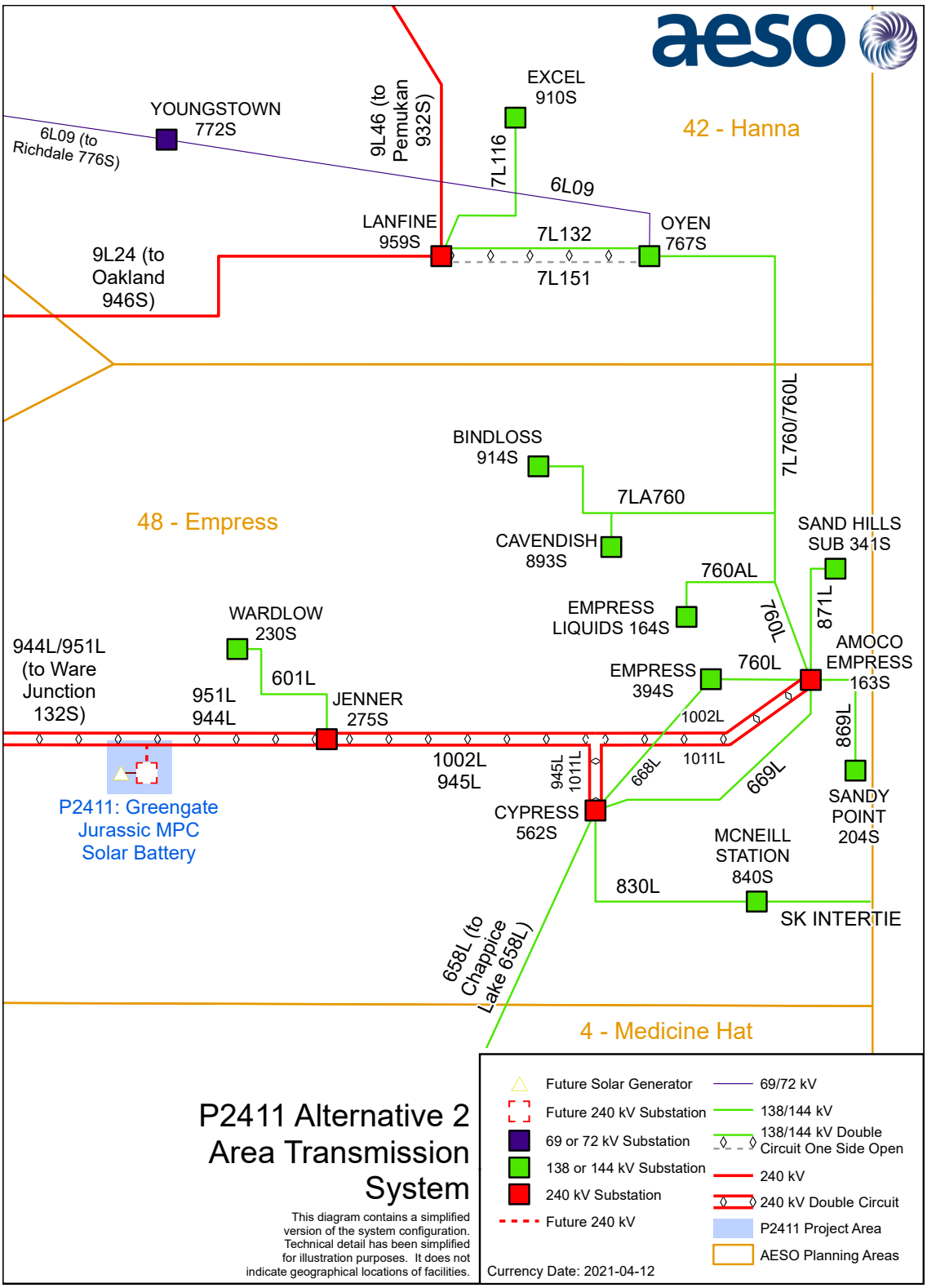
2.1 Alternative 2 – T-tap to existing 240 kV transmission line 944L

This alternative included the following developments:

- Add one 240 kV circuit, approximately 500 m in length, to connect the Facility to 944L via T-tap configuration
- Add or modify associated equipment as required for the above transmission developments.

The proposed connection configuration is shown in Figure 2-1.

Figure 2-1: Connection Alternative 2



3 Criteria, Standards and Requirements

3.1 AESO Reliability Criteria

The Transmission Planning (TPL) Standards, which are included in the Alberta Reliability Standards, and *Transmission Planning Criteria – Basis and Assumptions (see Attachment A),* (collectively, the Reliability Criteria) will be applied to evaluate system performance under Category A system conditions (i.e., all elements in-service) and following Category B contingencies (i.e., single element outage), prior to and following the studied alternatives. Below is a summary of Category A and Category B system conditions.

Category A, often referred to as the N-0 condition, represents a normal system with no contingencies and all facilities in service. Under this condition, the system must be able to supply all firm load and firm transfers to other areas. All equipment must operate within its applicable rating, voltages must be within their applicable range, and the system must be stable with no cascading outages.

Category B events, often referred to as an N-1 or N-G-1 with the most critical generator out of service, result in the loss of any single specified system element under specified fault conditions with normal clearing. These elements are a generator, a transmission circuit, a transformer, or a single pole of a DC transmission line. The acceptable impact on the system is the same as Category A. Planned or controlled interruptions of electric supply to radial customers or some local network customers, connected to or supplied by the faulted element or by the affected area, may occur in certain areas without impacting the overall reliability of the interconnected transmission systems. To prepare for the next contingency, system adjustments are permitted, including curtailments of contracted firm (non-recallable reserved) transmission service electric power transfers.

The TPL standards, TPL-001-AB-0 and TPL-002-AB1-0 have referenced Applicable Ratings when specifying the required system performance under Category A and Category B. For the purpose of applying the TPL standards to the studies documented in this report, Applicable Ratings are defined as follows:

- Normal thermal rating of the line's loading limits for each season;
- The highest specified loading limits for transformers;
- For Category A conditions: Voltage range under normal operating condition per AESO Information Document #2010-007RS, *General Operating Practices – Voltage Control* (ID #2010-007RS). For the busses not listed in ID #2010-007RS, Table 2-1 in the *Transmission Planning Criteria – Basis and Assumptions* applies;
- For Category B conditions: The extreme voltage range values per Table 2-1 in the *Transmission Planning Criteria – Basis and Assumptions; and*
- Desired post-contingency voltage deviation limits for three defined post-event timeframes as provided in Table 3-1.

Table 3-1: Post-Contingency Voltage Deviation Guidelines for Low Voltage Busses

Parameter and reference point	Time Period		
	Post Transient (up to 30 sec)	Post Auto Control (30 sec to 5 min)	Post Manual Control (Steady State)
Voltage deviation from steady state at point of delivery (POD) low voltage bus.	±10%	±7%	±5%

3.2 ISO Rules and Information Documents

ID #2010-007RS will be used to establish system normal (i.e., pre-contingency) voltage profiles for the Study Area.

The TCM Rule will be followed to set up the study scenarios and assess the impact of the Project. In addition, due regard will be given to the following:

- The AESO's *Connection Study Requirements*;
- Section 502.1 of the ISO rules, *Aggregated Generating Facilities Technical Requirements*;
- Section 502.16 of the ISO rules, *Aggregated Generating Facilities Operating Requirements*;
- Section 502.5 of the ISO rules *Generating Unit Technical Requirements*;
- Section 502.6 of the ISO rules *Generating Unit Operating Requirements*;
- Section 502.13 of the ISO rules, *Battery Energy Storage Facility Technical Requirements*; and
- Section 502.14 of the ISO rules, *Battery Energy Storage Facility Operating Requirements*.

4 Scenarios and Assumptions

4.1 Scenarios

The following section describes the scenarios to be studied and the assumptions to be used in the studies.

Connection scenarios must be studied as outlined in Table 4-1.

Table 4-1: Connection Study Scenarios

Scenario No.	Year/Season	System Generation Dispatch Conditions	Scenario Name	Project Load (MW)	Project Generation (MW)
Pre-Project					
1	2023 Summer Peak (2023 SP)	High Renewable, Economic Coal	2023 SP Pre-Project	0	0
2	2023 Summer Light (2023 SL)		2023 SL Pre-Project	0	0
3	2023 Winter Peak (2023 WP)		2023 WP Pre-Project	0	0
Post-Project					
4	2023 SP	High Renewable, Economic Coal	2023 SP Post-Project	0	220 (solar) + 80 (battery storage)
5	2023 SL		2023 SL Post-Project	0	220 (solar) + 80 (battery storage)
6	2023 WP		2023 WP Post-Project	0	220 (solar) + 80 (battery storage)
7	2031 WP	All study area generation in-service	2031 WP Post-Project	0	220 (solar) + 80 (battery storage)
Post-Project Sensitivity					
4a	2023 SP	High renewable, Economic Coal, P1250, P2065, P1704, P2059, P2061 in service	2023 SP Post-Project	0	220 (solar) + 80 (battery storage)

4.2 Assumptions

4.2.1 System Project Assumptions

AESO Project No.	Project Name/Description	Scheduled ISD	AUC NID Decision No.
1781	Provost to Edgerton & Nilrem to Vermilion Transmission Development	Dec. 31, 2022 (Stage 1)	23429-D01-2019

As more information becomes available about the planned in-service date and milestone progress of the Provost to Edgerton/Nilrem to Vermilion (PENV) and Central East Transfer Out (CETO) system projects, additional sensitivity scenarios may be added.

4.2.2 Connection Project Assumptions

Table 4-4, Table 4-5, Table 4-6 and Table 4-7 summarize the connection projects in the Study Area that are to be included in the studies.

4.2.3 Load Assumptions

The load forecast to be used for the studies is shown in Table 4-2 and is a forecast for the AESO Central Planning Region peak based on the AESO 2021 Long-Term Outlook (2021 LTO)[1] with modifications to incorporate the latest forecast intelligence. For the post-Project studies, when the Study Area loads are modified to align with the regional load forecast, the active power to reactive power ratio in the base case scenarios shall be maintained.

Table 4-2: Forecast Load (at AESO Central Planning Region Peak)

AESO Planning Region Name	Forecast Peak Load by Year/Season (MW)		
	2023 SP	2023 SL	2023 WP
Central Planning Region[1]	1940	1566	2212

Note:
[1] The Central Region comprises the following AESO planning areas: 29, 30, 34, 38, 39, 35, 36, 42, 32, 37, 13, 56, 28

IDEV files contain non-motor loads in zones 34, 36, and 351. These loads are not accounted for in the forecasted peak loads shown above and should not be considered when scaling load. The AESO engineer will provide guidance to load scaling procedures as required.

4.2.4 Generation Assumptions

The generation forecast to be used for the studies is based on the 2021 LTO with modifications to incorporate the latest forecast intelligence. The generation assumptions for the studies will assume high renewable generation across the province as well as economic coal generation. Additional studies may be required in the event of changes to the AESO's corporate forecast.

[1] The 2021 LTO is available on the AESO website.

The existing generation (excluding wind and solar) dispatch conditions for the study scenarios are described in Table 4-3.

Table 4-3: Existing Generation (excluding Wind and Solar) Dispatch Conditions

Facility Name	Unit No.	Bus No.	MC (MW)	AESO Planning Area No.	Unit Net Generation[a] (MW) by Scenario		
					2023 SP	2023 SL	2023 WP
Sheerness	1	1482	400	43	135	135	135
	2	1487	390	43	135	103	135
Battle River	3	1495	149	36	0	0	0
	4	1496	155	36	80	0	80
	5	1497	385	36	231	154	245

Notes:
a "Unit Net Generation" refers to gross generating unit output (MW) less unit service load.

The wind and solar generation facilities will be dispatched to yield the credible worst-case power flow conditions for the Study Area. Pre-Project dispatch levels for the existing and under construction wind and solar generation facilities are shown in Table 4-3 and Table 4-5, respectively.

Table 4-4: Dispatch Conditions for Existing and Under Construction Wind Generation Facilities

Facility Name and Code	AESO Planning Area No.	Bus No.	MC (MW)	Unit Net Generation[s] (MW)		
				2023 SL	2023 SP	2023 WP
Ardenville Wind (ARD1)	53	4735, 4740	68	63	58	63
Blue Trail Wind (BTR1)	53	66328, 67328	66	61	56	61
Castle River #1 (CR1)	53	2234, 3234	39	36	33	36
Castle Rock Wind Farm (CRR1)	53	67221	77	71	65	71
Cowley Ridge (CRE3)	53	4264	20	18	17	18
Enmax Taber (TAB1)	52	15343, 16343	81	75	69	75
Kettles Hill (KHW1)	53	2402, 3402	63	58	54	58
McBride Lake Windfarm (AKE1)	53	2901, 3901, 4901	73	67	62	67
Soderglen Wind (GWW1)	53	12358, 13358	71	65	60	65

Facility Name and Code	AESO Planning Area No.	Bus No.	MC (MW)	Unit Net Generation[s] (MW)		
				2023 SL	2023 SP	2023 WP
Summerview 1 (IEW1)	53	2338, 3338	66	61	56	61
Summerview 2 (IEW2)	53	4339, 5337	66	61	56	61
Suncor Chin Chute (SCR3)	54	2389	30	28	26	28
Suncor Magrath (SCR2)	53	11002	30	28	26	28
Suncor Wintering Hills (SCR4)	43	60789, 60791, 60793, 60846, 60848, 60850	88	81	75	81
Old Man River(OWF1)	53	61543	46	42	39	42
Blackspring Ridge(BSR1)	49	61736, 61737	300	276	255	276
Castle Rock Ridge 2 (CRR2)	53	567221	30.6	27	25	27
Enel Riverview Wind Farm (RIV1)	53	69221	115	97	89	97
Capital Power Whitla Wind Power Facility (WHT1)	4	60990	201.6	186	172	186
Capital Power Whitla Wind Power Facility Phase 2	4	61990	97.2	89	82	89
Capital Power Whitla Wind Power Facility Phase 3	4	64990	54	50	46	50
TransAlta Windrise (WRW1)	53	567031	207	190	176	190
Ghost Pine (NEP1)	42	2621, 2622, 2623, 2624, 2625	82	75	70	75
Halkirk (HAL1)	42	66435, 67435	150	138	128	138
Fortis Bull Creek Phases 1 and 2(Bul1 & BUL2)	37	550003, 550004	29.5	27	25	27

Table 4-5: Dispatch Conditions for Existing and Under Construction Solar Generation Facilities

Facility Name and Code	AESO Planning Area No.	Bus No.	MC (MW)	Unit Net Generation[a] (MW)		
				2023 SL	2023 SP	2023 WP
Brooks Solar (BSC1)	47	553257	15	0	8	0
Hull DER Solar (HUL1)	52	2401	24.5	0	13	0
Vauxhall Solar (VXH1)	52	4274	22	0	11	0
Suffield Solar (SUF1)	4	3270	23	0	12	0
Claresholm Solar (CLR1)	49	60894	58	0	29	0
Claresholm Solar (CLR2)	49	61894	75	0	38	0
Burdett (BRD1)	52	2269	11	0	6	0
Westfield Yellow Lake (WEF1)	52	557277	19	0	10	0
Burdett (BUR1)	52	557269	20	0	10	0
Hays Solar	52	554401	24	0	12	0
Jenner Solar DER	48	554986	23	0	12	0
Innisfail Solar (INF1)	39	557120	22	0	11	0
P2362 Fortis Enchant 447S DER Solar	52	993287	22	0	11	0
P2363 Fortis Enchant 447S DER Solar	52	993289	18	0	9	0
P2364 Fortis Enchant 447S DER Solar	52	994287	9	0	4.5	0
P2365 Fortis Enchant 447S DER Solar	52	994289	23	0	11.5	0

Note:
[a] "Unit Net Generation" refers to gross generating unit output (MW) less unit service load.

Table 4-6 and Table 4-7 list the pre-Project dispatch levels for the planned wind and solar generation projects in the AESO South and Central planning regions that are included in the study scenarios.

Table 4-6: Dispatch Conditions for Planned Wind Generation Projects

Facility Name and Code	Bus No.	Planned ISD	Planning Area No.	AESO Stage	MC (MW)	Unit Net Generation[s] (MW)		
						2023 SL	2023 SP	2023 WP
P1250 Wild Run Grizzly Bear**	67308	Oct 1, 2022	13	5	120	110	102	110
P2065 Wild Run Grizzly Bear Phase 2**	67308	Oct 1, 2022	13	5	34	31.2	28.9	31.2
P1892 Fortis Buffalo Atlee Cluster 3 WAGF	552260	Dec 1, 2021	47	3	17.3	16	15	16

Facility Name and Code	Bus No.	Planned ISD	Planning Area No.	AESO Stage	MC (MW)	Unit Net Generation[a] (MW)		
						2023 SL	2023 SP	2023 WP
P1853 Fortis Buffalo Atlee Cluster 1 WAGF	553260	Dec 1, 2021	47	3	17.3	16	15	16
P2199 Buffalo Atlee Wind Farm 2	557261	Dec 1, 2021	47	3	13.8	13	12	13
P1719 Stirling WAGF Project	61630	Nov 1, 2022	54	5	113	104	96	104
P2122 EDF Cypress Wind	560003	Nov 1, 2022	4	5	201.6	185	171	185
P1533 Joss MPC WAGF	60798, 60799	Jun 30, 2022	47	5	122	113	104	113
P1698 Joss Jenner WAGF - Phase 2	61798, 61799	Jun 30, 2022	47	3	71.4	66	61	66
P1704 Paintearth Wind Power**	61418	Jul 1, 2023	42	5	150	138	128	138
P1812 Suncor Forty Mile Granlea WAGF	61994, 62994	Nov 16, 2021	4	5	200	184	170	184
P2212 RES Rattlesnake Ridge	60873	Jul 30, 2021	4	5	117.6	105	97	105
P1718 Wheatland WAGF Project	60632, 61632	Jun 30, 2022	43	5	120	110	102	110
P1909 TransAlta Garden Plain Wind	565002	Jul 1, 2022	42	4	130	120	110.5	120
P2234 Jenner Wind Phase 3	61798, 61799	Jun 30, 2022	48	3	109.2	101	93	101
P1898 Pattern Lanfine North Wind	60996	Sep 30, 2022	42	5	145	133	123	133
P2263 BER Hand Hills MPC Wind**	560045	Dec 2, 2022	42	5	151	139	128.3	139

Note:
[a] "Unit Net Generation" refers to gross generating unit output (MW) less unit service load.

** Only in sensitivity scenario

Table 4-7: Dispatch Conditions for Planned Solar Generation Projects

Facility Name and Code	Bus No.	Planned ISD	Planning Area No.	AESO Stage	MC (MW)	Unit Net Generations (MW)		
						2023 SL	2023 SP	2023 WP
P2009 Greengate Travers MPC Solar & P2341 Travers Solar Phase 2	560026, 561026, 562026	Dec 10, 2021& Apr 1, 2022	49	5	465	0	232.5	0
P1831 Fortis 255S Vulcan Faribault Farms DG PV	4244	May 24, 2021	49	5	22	0	11	0
P1850 Fortis Coaldale 254S DER Solar 3	554691	May. 24, 2021	54	5	22	0	11	0
P1851 Fortis Monarch 492S DER Solar	2005	May. 24, 2021	54	5	23.6	0	12	0
P1862 Fortis Spring Coulee 385S Solar DG	553246 554246	Oct. 15, 2021	55	5	29.5	0	15	0
P1870 Fortis Stavely 349S DER Solar	2004	Feb 1, 2022	49	5	18.5	0	9	0
P1918 FortisAlberta Conrad DER Solar 1	554291	Dec 21, 2021	52	5	23.4	0	12	0
P1932 FortisAlberta Namaka DER Solar	552340	Sep 3, 2021	45	5	20.1	0	10	0
P1959 FortisAlberta Conrad DER Solar 2	553291	Dec 21, 2021	52	5	22.5	0	12	0
P2029 FortisAlberta Strathmore 151S DER Solar 1	557259	Nov 8, 2021	45	5	19.5	0	9	0
P2030 FortisAlberta Strathmore 151S DER Solar 2	558259	Nov 8, 2021	45	5	25	0	12	0
P2195 FortisAlberta Bassano 435S DER Solar	557399	Feb 1, 2023	47	3	9.25	0	4.5	0
P2249 FortisAlberta Empress 394S DER Solar 1	558316	Nov 1, 2021	48	5	22	0	11	0

Facility Name and Code	Bus No.	Planned ISD	Planning Area No.	AESO Stage	MC (MW)	Unit Net Generations (MW)		
						2023 SL	2023 SP	2023 WP
P2250 FortisAlberta Empress 394S DER Solar 2	558016	Nov 1, 2021	48	5	16	0	8	0
P2300 RESC Enterprise MPC Solar	563070	Aug 31, 2022	49	4	65	0	33	0
P2335 Fortis Vulcan 255S DER Solar	990002	May 1, 2022	49	3	13	0	6.5	0
P2337 Dunmore Solar	560044	Apr 1, 2023	4	3	216	0	108	0
P2059 ATCO Three Hills 770S DER Solar 1*	990001	Sep 1, 2022	42	5	14	0	7	
P2061 ATCO Michichi Creek 802S DER Solar*	554448	Sep 1, 2022	42	5	11	0	5.5	

* Only in sensitivity scenario

The post-Project scenario wind and solar generation dispatch levels are identical to the pre-Project scenario dispatch levels, other than that the Facility will be dispatched to 300 MW in all post-Project scenarios. Areas 25 and 40 will be used to balance the tieline.

4.2.5 Intertie Flow Assumptions

The intertie flow assumptions for the Alberta-British Columbia (AB-BC), Alberta-Saskatchewan (AB-SK), and Alberta-Montana (MATL) interties are shown in Table 4-8.

For the 2030 WP scenario, the intertie flow values should be set to the AESO planning base cases.

Table 4-8: Intertie Flows by Scenario

Scenario Number	Scenario Name	Import (-) / Export (+) (MW) by Intertie		
		AB-BC	AB-SK	MATL
1	2023 SP Pre-Project	0	-150	-187
2	2023 SL Pre-Project	0	-150	-187
3	2023 WP Pre-Project	0	-150	-187
4	2023 SP Post-Project	0	-150	-187
5	2023 SL Post-Project	0	-150	-187
6	2023 WP Post-Project	0	-150	-187

4.2.6 HVDC Power Order Assumptions

The Western Alberta Transmission Line (WATL) and the Eastern Alberta Transmission Line (EATL) are high-voltage direct current (HVDC) transmission lines. The HVDC power order assumptions for the studies will be set to minimize losses for the pre-Project and post-Project study scenarios.

For the 2031 WP scenario, the HVDC power order should be as per the AESO base cases and will not be adjusted.

The reactive power limits of the MVAr exchanges between the HVDC terminals (WATL and EATL) and the connected alternating current (AC) transmission systems are shown in Table 4-9. These limits must be maintained when performing the studies.

Table 4-9: HVDC to Adjacent AC System MVAr Exchange Limits

HVDC Facility	North Terminal Reactive Power Limit (MVAr)	South Terminal Reactive Power Limit (MVAr)
EATL	-85 to 75	-35 to 35
WATL	-75 to 75	-35 to 35

4.2.7 Transmission Facility Ratings

The legal owners of transmission facilities (TFOs) provided the thermal ratings assumptions for the existing transmission lines in the Study Area. Table 4-10 shows the normal ratings and emergency ratings for the key transmission lines in the Study Area, which will be used to perform the engineering studies.

Table 4-10: Thermal Rating Assumptions for Key Transmission Lines in the Study Area

Line ID	Line Description	Voltage Class (kV)	Normal Rating (MVA)		Emergency Rating (MVA)	
			Summer	Winter	Summer	Winter
174L	Bardo 197S - 395S North Holden	138	85	90	94	99
408L	Jarrow 252S - Wainwright 51S	138	75	79	83	87
472L	Metiskow 648S - Sunken Lake 221S Tap	138	121	150	133	153
472L	Sunken Lake 221S Tap - Hughenden 213S	138	121	150	133	165
679L	Nilrem 574S - Tucuman 478S	138	167CT	191	184	218
680L	Nilrem 574S - Tucuman 478S	138	167CT	191	184	218
681L	Tucuman 478S - Hardisty 377S	138	143	172	184	218
701L	North Holden 395S - Strome 223S	138	119	146	131	161
6L02	Battle River 757S - Marion Lake 873S	72	59	74	67	74
6L02	Marion Lake 873S - Stettler 769S	72	59	66CT	66CT	66CT

Line ID	Line Description	Voltage Class (kV)	Normal Rating (MVA)		Emergency Rating (MVA)	
			Summer	Winter	Summer	Winter
6L03	Battle River 757S - Sullivan Lake 775S	72	49CT	49CT	49CT	49CT
6L05	Heisler 764S - Battle River 757S	72	57	72	64	74CT
6L09	Oyen 767S - Hanna 763S	72	24CT	24CT	24CT	24CT
6L12	Sulivan Lake 775S - Coronation 773S	72	24CT	24CT	24CT	24CT
6L15	Hanna 763S - Sulivan Lake 775S	72	24CT	24CT	24CT	24CT
6L56	Hanna 763S - Michichi Creek 802S	72	37CT	37CT	37CT	37CT
701L	Heisler T-Tap - Strome 223S	138	158	191	174	213
703L	Hughenden 213S - HRT Express 329S Tap	138	121	145	133	160
703L	HRT Express 329S Tap - Hardisty 377S	138	96CT	96CT	133	143
704L	Wainwright 51S - Tucuman 478S	138	75	79	83	87
704L	Jarrow 252S - Jarrow 252S Tap	138	85	90	94	99
748L	Killarney Lake 267S - Hayter 277S	138	119	146	131	161
749L	Metiskow 648S - Killarney T-Tap	138	122	150	134	163
749L	Edgerton 899S - Killarney T-Tap	138	96CT	96CT	134	143
749L/7L749	Edgerton 899S - Briker Tap	138	96CT	96CT	130	140
760L	Empress Liquid 164S tap - Bindloss 914S Tap	138	120	142	132	156
760L	Empress Liquid 164S tap - Amoco Empress 163S	138	120	148	132	163
760L	Amoco Empress 163S - Empress 394S	138	119	146	131	161
760L/7L760	Empress Liquid 164S tap - Bindloss Tap	138	109.3	139	123.6	142.8CT
769L	Hardisty 377S - Rosyth	138	86	115	95	127
7L110	Monitor 774S - Loyalist 903S	144	99CT	99CT	99CT	99CT
7L116	Excel 910S - Lanfine 959S	144	99CT	99CT	99CT	99CT
7L117	Vermilion 710S - Irish Creek 706S	144	131	166	147	189
7L127	Pemukan 932S - Monitor 774S	144	151 bus cond.	190 bus cond.	194 bus cond.	254 bus cond.
7L128	Coyote Lake 963S - Michichi Creek 802S	144	117 bus cond.	147 bus cond.	144 bus cond.	185 bus cond.
7L129	Buffalo Creek 526S - Vermilion 710S	144	129	161	138	178

Line ID	Line Description	Voltage Class (kV)	Normal Rating (MVA)		Emergency Rating (MVA)	
			Summer	Winter	Summer	Winter
7L130	Vermilion 710S - Kitscoty 705S	144	114	151	125	170
7L132	Lanfine 959S - Oyen 767S	144	117 bus cond.	147 bus cond.	144 Bus cond.	179 Prot.
7L137	Three Hills 770S - Rowley 768S	144	113	149	126	171
7L139	Whitby Lake 819S - Norberg 936S Tap	144	114	151	127	173
7L139	Norberg 936S Tap - St. Paul 707S	144	114	151	127	173
7L14	Kitscoty 705S - Hill 751S	144	114	151	125	170
7L143	Nevis 766S - Stettler 769S	144	100CT	100CT	100CT	100CT
7L153	Wintering Hils 804S - Wheatland 609S	144	185	199CT	199CT	1199CT
7L159	Three Hills 770S - Ghostpine Tap	144	112	149	124	150CT
7L159	Heatburg 948S - Ghostpine Tap	144	112	149	124	167CT
7L16	Nevis 766S - Heatburg 948S	144	112	133CT	125	133CT
7L171	Michichi Creek 802S - Wintering Hills 804S	144	112	147	127	150CT
7L224	Hansman Lake 650S - Monitor 774S	144	113	150	125	171
7L25	Michichi Creek 802S - Rowley 768S	144	114	154	128	177
7L134 (Future Line)	Future Vincent 2019S - Vegreville 709S	144	114	146	127	157
7L42	Hill 751S - Lloydminster 716S	144	130	150CT	142	150CT
7L50	Battle River 757S - Jarrow 252S Tap	144	114	150GS	122	150GS
7L53	Irish Creek 706S - Lindberg 969S Tap	144	130	162	145	185
7L53	Lindberg 969S Tap - Bonnyville 700S	144	130	162	145	185
7L65	Vermilion 710S - Future Vincent 2019S	144	114	146	127	172
7L70	St. Paul 707S - Bonnyville 700S	144	115	152	128	174
7L77	North Holden 395S - Vegreville 709S	138	114	151	125	169
7L701	Battle River 757S - Strome IPL	144	148	200	166	239

Line ID	Line Description	Voltage Class (kV)	Normal Rating (MVA)		Emergency Rating (MVA)	
			Summer	Winter	Summer	Winter
7L702	Battle River 757S - Sedgewick 137S Tap	144	115	155	128	177
702L	Sedgewick 137S tap - Hardisty 377S	138	87	135	96	146
7L749	Lloydminster 716S - Briker Tap	144	114	151	126	170
7L760	Oyen 767S - Bindloss 914S Tap	144	115	153	128	175
7L79	Pemukan 932S - Ribstone Creek 892S	144	114	145	129	157
7L85	Wintering Hills 804S - Bullpound 803S Tap	144	117 bus cond.	147 bus cond.	144 bus cond.	184 bus cond.
7L85	Bullpound 803S Tap - Anderson 801S	144	145	193	173	199CT
7L92	Vegreville 709S - Whitby Lake 819S (All segments)	144	114	133CT	126	133CT
7LA159	Ghost Pine 114S - 7L159 Tap	144	114	145	129	149CT
7LA701	Heisler 764S - Heisler Tap	144	133CT	133CT	133CT	133CT
885L	Metiskow 648S - Hansman Lake 650S	138	287	287	344	373
912L/ 9L912	Nevis 766S - Red Deer 63S*	240	507	624CT (ATCO)	553	624CT (ATCO)
931L	Ware Junction 132S - West Brooks 28S	240	592	665	654	773
953L	Cordel 755S - Nilrem 574S	240	544	663CT	641	663CT
954L	Metiskow 648S - Hansman Lake 650S	240	333CT	333CT	499CT	499CT
9L16	Tinchebray 972S - Cordel 755S	240	499CT	499CT	499CT	499CT
9L20*	Nevis 766S - Cordel 755S	240	488	623.5CT	558	623.5CT
9L24	Oakland 946S - Lanfine 959S	240	740	831SG	831SG	831SG
9L27	Paintearth 863S - Cordel 755S	240	442CT	442CT	442CT	442CT
9L29	Oakland 946S - Coyote Lake 963S	240	740	831SG	831SG	831SG
9L46	Lanfine 959S - Pemukan 932S	240	755	831CT	831CT	831CT
9L51	Sedalia 363S - Pemukan 932S	240	753	831	866	1049
9L59	Tinchebray 972S - Anderson 801S	240	499SG	499SG	499SG	499SG
9L70	Anderson 801S - Oakland 946S	240	499SG	499SG	499SG	499SG
9L79	Battle River 757S - Cordel 755S	240	499CT	499CT	499CT	499CT
9L80	Battle River 757S - Cordel 755S	240	499CT	499CT	499CT	499CT
9L93	Halkirk 615S - Tinchebray 972S	240	378	520	517	733

Line ID	Line Description	Voltage Class (kV)	Normal Rating (MVA)		Emergency Rating (MVA)	
			Summer	Winter	Summer	Winter
9L933	Anderson 801S - Ware Junction 132S	240	550	748	651	831SG
9L934	Anderson 801S - Ware Junction 132S	240	499SG	499SG	499SG	499SG
9L948	Paintearth 863S - Hansman Lake 650S	240	442CT	442CT	442CT	442CT
9L950	Anderson 801S - Ware Junction 132S	240	499SG	499SG	499SG	499SG
9L953	Cordel 755S - Nilrem 574S	240	544	663CT	641	663CT
9L966	Pemukan 932S - Hansman Lake 650S	240	442CT	442CT	442CT	442CT
9L97	Anderson 801S - Oakland 946S	240	499SG	499SG	499SG	499SG
9L99	Sheerness 807S - Anderson 801S	240	470	499SG	499SG	499SG
9L100	Sheerness 807S - Anderson 801S	240	470	499SG	499SG	499SG
1047L	Nilrem 574S - Hansman Lake 650S	240	499CT	499CT	680	748CT

Note:

*Ratings for 912L/9L912 and 9L20 are assumed to be restored prior to the in-service date of the Project and are discussed in further detail in Appendix A
"CT" indicates that the transmission line is limited by current transformer.

"L" indicates that the transmission line is limited by the line.

"SG" indicates that the transmission line is limited by gang switch.

"Bus Cond" indicates that the transmission line is limited by bus conductor.

"M" indicates that the transmission line rating is limited by reasons other than protection equipment, transformer, current transformer, line, ganged switch, circuit breaker, or regulator.

The TFOs provided the details of the substation transformers in the Study Area. The key transformers in the Study Area are shown in Table 4-11.

Table 4-11: Summary of Key Transformer Ratings in the Study Area

Substation Name and Number	Transformer ID	Transformer Voltages (kV)	Transformer Rating (MVA)
Anderson 801S	901T	240/144	125CT
Battle River 757S	912T	240/144	299CT
	701T	144/72	75
Nevis 766S	901T	240/144	100CT
	701T	144/25	12/16/20
Nilrem 574S	T1	240/138	400
	T2	240/138	400

Substation Name and Number	Transformer ID	Transformer Voltages (kV)	Transformer Rating (MVA)
Metiskow 648S	T3	240/138	200
Hansman Lake 650S	T1	240/138	200
	T3	240/18	200

The TFOs provided the details of the shunt elements in the Study Area. The key shunt elements in the Study Area are shown in Table 4-12.

Table 4-12: Summary of Key Shunt Elements in the Study Area

Substation Name and Number	Voltage Class (kV)	Capacitors		Reactors	
		Number of Switched Shunt Blocks	Total at Nominal Voltage (MVAr)	Number of Switched Shunt Blocks	Total at Nominal Voltage (MVAr)
Buffalo Creek 526S	138	1 x 15.00 MVAr	15.00	-	-
Sunken Lake 221S	138	1 x 18.00 MVAr	18.00	-	-
Halkirk 615S	34.5	1 x 6.00 MVAr + 3 x 18.00 MVAr	60.00	2 x -14.00 MVAr	-14.00
	0.5	2 x 12.50 MVAr	25.00	2 x -12.50 MVAr	-25.00
Hansman Lake 650S	18.0	1 x 176.8 MVAr	200.0	1 x -88.2 MVAr	-100.0
Hardisty 377S	138	1 x 27.02 MVAr	27.02	-	-
Hill 751S	138	1 x 18.37 MVAr + 1 x 22.96 MVAr	41.33	-	-
Stettler 769S	138	1 x 13.78 MVAr	13.78	-	-
Killarney Lake 267S	138	1 x 9.10 MVAr + 2 x 10.90 MVAr	30.90	-	-
Lloydminster 716S	138	1 x 18.37 MVAr	18.37	-	-
Tucuman 478S	138	1 x 27.17 MVAr	27.17	-	-

Substation Name and Number	Voltage Class (kV)	Capacitors		Reactors	
		Number of Switched Shunt Blocks	Total at Nominal Voltage (MVAr)	Number of Switched Shunt Blocks	Total at Nominal Voltage (MVAr)
Vermilion 710S	138	1 x 22.96 MVAr	22.96	-	-
Lanfine 959S	34.5	1 x 200 MVAr	200	1 x -100 MVAr	-100
	138	2 x 27.55 MVAr	55.10	-	-
Monitor 774S	138	1 x 18.38 MVAr + 1 x 27.55 MVAr	45.93	-	-
Pemukan 932S	138	2 x 27.55 MVAr	55.10	-	-

4.2.8 Protection Fault Clearing Times

The transient stability studies will be performed using the actual fault clearing times for the selected contingencies, as provided by the TFOs and as shown in Table 4-13. Only those contingencies shown in Table 4-13 will be studied for transient stability studies. If the TFOs did not specify the fault clearing times (e.g. for new transmission lines) for a selected contingency, then the studies for that contingency will be performed using the standard fault clearing times that are specified in Table 2-3 of the AESO's *Transmission Planning Criteria – Basis and Assumptions*.

Table 4-13: Protection Fault Clearing Times

Contingency (System Element Lost)				Fault Location	Clearing Times	
Transmission Line ID	Nominal Bus Voltage (kV)	Terminal Location				
		Terminal 1	Terminal 2		Terminal 1	Terminal 2
9L24	240	Oakland 946S	Lanfine 959S	Oakland 946S	5 cycles	6 cycles
9L24	240	Lanfine 959S	Oakland 946S	Lanfine 959S	5 cycles	6 cycles
9L29	240	Oakland 946S	Coyote Lake 963S	Oakland 946S	5 cycles	6 cycles
9L29	240	Coyote Lake 963S	Oakland 946S	Coyote Lake 963S	5 cycles	6 cycles
9L16	240	Cordel 755S	Tinchebray 972S	Cordel 755S	5 cycles	6 cycles
9L16	240	Tinchebray 972S	Cordel 755S	Tinchebray 972S	5 cycles	6 cycles
9L966	240	Pemukan 932S	Hansman Lake 650S	Pemukan 932S	5 cycles	6 cycles
9L966	240	Hansman Lake 650S	Pemukan 932S	Hansman Lake 650S	5 cycles	6 cycles
9L20	240	Cordel 755S	Nevis 766S	Cordel 755S	5 cycles	6 cycles
9L20	240	Nevis 766S	Cordel 755S	Nevis 766S	5 cycles	6 cycles
912L	240	Red Deer 63S	Nevis 766S	Red Deer 63S	5 cycles	6 cycles
912L	240	Nevis 766S	Red Deer 63S	Nevis 766S	5 cycles	6 cycles
9L59	240	Tinchebray 972S	Anderson 801S	Tinchebray 972S	5 cycles	6 cycles
9L59	240	Anderson 801S	Tinchebray 972S	Anderson 801S	5 cycles	6 cycles

4.2.9 Project Dynamic Data

Dynamic data for the Project will be based on the Stage 1 Project Data Update Package (PDUP-1).

4.2.10 Voltage Profile Assumption

ID #2010-007RS will be used to establish system normal (i.e., pre-contingency) voltage profiles for key area busses prior to commencing any studies. Table 2-1 of the *Transmission Planning Criteria – Basis and*

Assumptions applies for the busses not included in ID #2010-007RS. These voltages will be used to set the voltage profile for the study base cases prior to the power flow studies.

5 Study Methodology

The studies to be performed for this connection assessment are identified in Table 5-1.

Table 5-1: Summary of the Studies to be Performed

Scenario No. and Name		Power Flow		Voltage Stability		Transient Stability		Motor Starting		Short Circuit
		Category		Category		Category		Category		Category A
		A	B	A	B	A	B	A	B	
Pre-Project										
1	2023 SP	X	X							
2	2023 SL	X	X							
3	2023 WP	X	X							X
Post-Project										
4	2023 SP	X	X			X	X			
5	2023 SL	X	X			X	X			
6	2023 WP	X	X			X	X			X
7	2031 WP									X
Post-Project Sensitivity										
4a	2023 SP	X	X							

*Pre-project transient stability studies will be performed if post-project transient stability studies identify potential issues

For the engineering studies, all transmission facilities 69 kV and above, within the Study Area and the transmission lines connecting these planning areas to neighbouring planning areas will be studied and monitored to assess the impact of the Project on the performance of the AIES, including any violations of the Reliability Criteria (as defined in Section 3.1).

5.1 Power Flow Studies

Power flow studies will be performed to identify thermal and voltage criteria violations as per the Reliability Criteria, and any deviations from the limits listed in Table 3-1.

For information purposes, the Studies Consultant must also provide, as a separate file, a list of any transmission elements where the thermal loading exceeds 95% of the element's normal rating under Category A and Category B conditions.

For the Category B power flow studies, the transformer taps and switched shunt reactive compensating devices such as shunt capacitors and reactors will be locked and continuous shunt devices will be enabled.

Voltage deviations at point-of-delivery (POD) low voltage busses will also be assessed for both the pre-Project and post-Project networks by first locking all tap changers and area shunt reactive compensating devices to identify any post-transient voltage deviations above 10%. Second, tap changers will be allowed to move while shunt reactive compensating devices remained locked to determine if any voltage deviations above 7% would occur in the area. Third, all the taps and shunt reactive compensating devices will be allowed to adjust, and voltage deviations above 5% will be reported.

The scenarios to be studied are shown in Table 5-1.

5.1.1 Contingencies to be Studied

Power flow studies will be performed for the Category A and all Category B conditions in the Study Area as well as Category C5 conditions listed in Table 4-13.

5.2 Transient Stability Studies

The Keephills 3 unit in Area 40 will be used as the reference for the studies.

The report presenting the results of the transient stability studies must provide response plots for several variables, including rotor angle, and active and reactive power output for the Sheerness and Battle River units. The results report must also provide the 500 kV, 240 kV and 138 kV bus voltage levels for substations near the point of connection. Other busses will be monitored and will be reported as determined by the results. The results report must also provide the key branch active and reactive power flow surrounding the Facility.

Transient stability studies will be performed for the post-Project scenarios as shown in Table 5-1. If any transient stability issues are observed, transient stability analysis will be performed for the corresponding pre-Project scenarios.

5.2.1 Contingencies to be Studied

Transient stability studies will be performed for the contingencies shown in Table 4-13.

5.3 Short-Circuit Current Level Studies

A maximum fault level must be provided for the substations in the vicinity of the Project assuming normal system operation with all transmission elements in service and generation dispatched. Three-phase faults and single line-to-ground faults will be simulated. Fault currents will be calculated in polar coordinates (kilo amperes) and positive and zero sequence impedances in rectangular coordinates (per-unit values).

Winter peak scenarios will be used for the short-circuit studies because winter peak scenarios generally produce higher short-circuit current levels than summer peak scenarios.

Estimated maximum three-phase faults and single line-to-ground short-circuit current levels will be reported for the following substations:

- Jenner 275S
- Wardlow 230S
- Cypress 562S

- Ware Junction 132S
- Amoco Empress 163S
- Empress 394S
- Empress Liquids 164S
- The Project substation

Further sensitivity studies, in consultation with the TFO, may be required if the primary short-circuit analysis indicates a potential to exceed or approach the existing fault rating of the transmission facilities.

The scenarios to be studied are as shown in Table 5-1.

6 Mitigation Measures

6.1 Development

Mitigation measures may be required if the post-Project study results identify system performance issues. Mitigation measures for the Project may involve modifying or adding real-time operational practices and/or remedial action schemes (RASs).

The Studies Consultant must notify the AESO of any system performance issues in a timely manner, following which the AESO Studies Engineer may instruct the Studies Consultant as follows:

- Develop tables showing the constraint effective factors[2] for generation or load based on thermal criteria violations that are observed.
- Collaborate with the AESO to propose changes, if any, to the connection alternatives that could remove the requirement for a RAS.
- Collaborate with the AESO to study modifications to existing and/or planned RASs, proposed by the AESO, to ensure the coordination of existing protection schemes with the addition of any proposed protection schemes.
- Collaborate with the AESO to identify and study new RASs, if any, that may be required to ensure system reliability is maintained after connecting the Project to the AIES.

The AESO Studies Engineer will work closely with the Studies Consultant and guide the development and/or modifications of the proposed mitigation measures to ensure system reliability, security and compliance with AESO ID #2018-018T, *Provision of System Access Service and the Connection Process*.

6.2 Evaluation

6.2.1 Post-Mitigation Studies

Studies to evaluate the effectiveness of mitigation measures, if required, will be performed in accordance with the technical criteria, assumptions, and methods provided in this Study Scope and in accordance with further instructions from the AESO.

6.2.2 Constraint Effective Factor Studies

Constraint effective factor analysis are used to determine the generator- and load- constraint effective factors and to identify the most effective generators or loads to manage the thermal criteria violations, if any, that are observed under Category B conditions.

[2] Constraint effective factor studies are performed to determine the generator- and load- constraint effective factors. Constraint effective factors are used to estimate the ability of generators and loads to manage transmission constraints. A generator's or load's constraint effective factor is defined as the change in power flow over a specific transmission line following a change in the generator's energy production or in the load's energy consumption. The greater the constraint effective factor, the more effective a generator or load can be in managing a thermal criteria violation on the specific transmission line.

7 Changes to Study Assumptions

This study will utilize the AESO's planning base cases, which are based on the AESO's current corporate forecast (2021 LTO) with modifications to incorporate the latest forecast intelligence. Sensitivity studies or restudy may be required in the event of revisions to the AESO's corporate forecast, forecast intelligence, or other study assumptions.

Additional engineering studies may also be required to assess new connection alternatives, changes to project ISD, or delays in proposed system developments. Any additional or revised study requirements shall be captured in a signed Study Scope Amendment document.

Attachment A: Transmission Planning Criteria – Basis and Assumptions

Transmission Planning Criteria – Basis and Assumptions

Date: July 9, 2019

Version: V1.2

Alberta Electric System Operator

Calgary Place, 2500, 330-5th Avenue SW Calgary, AB T2P 0L4

Phone: 403-539-2450 | Fax: 403-539-2949

www.aeso.ca

@theaeso

1. Introduction

This document presents the reliability standards, criteria, and assumptions to be used as the basis for planning the Alberta Transmission System. The criteria, standards and assumptions identified in this document supersede those previously established.

2. Transmission Reliability Standards and Criteria[1]

The AESO applies the following Alberta Reliability Standards to ensure that the transmission system is planned to meet applicable performance requirements under a defined set of system conditions and contingencies. A brief description of each of these standards is given below:

1. **TPL-001-AB-0: System Performance Under Normal Conditions**

   Category A represents a normal system condition with all elements in service (N-0). All equipment must be within its applicable rating, voltages must be within their applicable ratings and the system must be stable with no cascading outages. Under Category A, electric supply to load cannot be interrupted and generating units cannot be removed from service.

2. **TPL-002-AB1-0: System Performance Following Loss of a Single BES Element**

   Category B events result in the loss of any single element (N-1) under specified fault conditions with normal clearing. The specified elements are a generating unit, a transmission circuit, a transformer or a single pole of a direct current transmission line. The acceptable impact on the system is the same as Category A with the exception that radial customers or some local network customers, including loads or generating units, are allowed to be disconnected from the system if they are connected through the faulted element. The loss of opportunity load or opportunity interchanges is allowed. No cascading can occur.

3. **TPL-003-AB-0: System Performance Following Loss of Two or More BES Elements**

   Category C events result in the loss of two or more bulk electric system elements (sequential, N-1-1 or concurrent, N-2) under specified fault conditions and include both normal and delayed fault clearing. All of the system limits for Category A and B events apply with the exception that planned and controlled loss of firm load, firm transfers and/or generation is acceptable provided there is no cascading.

4. **TPL-004-AB-0: System Performance Following Extreme BES Events**

   Category D represents a wide variety of extreme, rare and unpredictable events, which may result in the loss of load and generation in widespread areas. The system may not be able to reach a new stable steady state, which means a blackout is a possible outcome. The AESO needs to evaluate these events, at its discretion, for risks and consequences prior to creating mitigation plans.

5. **FAC-014-AB1-2: Establishing and Communicating System Operating Limits**

   The AESO is required to establish system operating limits where a contingency is not mitigated through construction of transmission facilities

[1] A complete description of the *Alberta Reliability Standards* can be found on the AESO's website: https://www.aeso.ca/rules-standards-and-tariff/alberta-reliability-standards/

2.1 Thermal Loading Criteria

The AESO Thermal Loading Criteria require that the continuous thermal rating of any transmission element is not exceeded under normal and post-contingency operating conditions. Thermal limits are assumed to be 100% of the respective normal summer and winter ratings. Emergency limits are not considered in the planning evaluations.

2.2 Voltage Range and Voltage Stability Criteria

The normal minimum and maximum voltage limits as specified in the following table are used to identify Category A system voltage violations, while the extreme minimum and maximum limits are used to identify Category B and C system violations. Table 2-1 presents the acceptable steady state and contingency state voltage ranges for the AIES. Table 2-2 provides voltage stability criteria used to test the system performance.

Table 2-1: Acceptable Range of Steady State Voltage (kV)

Nominal Voltage	Extreme Minimum	Normal Minimum	Normal Maximum	Extreme Maximum
500	475	500	525	550
240	216	234	252	264
260 (Northeast & Northwest)*	234	247	266	275
144	130	137	151	155
138	124	135	145	150
72	65	68.5	75.5	79
69	62	65.5	72.5	76

Table 2-2: Voltage Stability Criteria

Performance Level	Disturbance (1)(2)(3)(4) Initiated by: Fault of No Fault DC Disturbance	MW Margin (P-V method) (5)(6)(7)	MVAr Margin (V-Q method) (6)(7)
A	Any element such as: One Generator One Circuit One Transformer One Reactive Power Source One DC Monopole	≥5%	Worst Case Scenario(8)
B	Bus Section	≥5%	50% of Margin Requirement in Level A
C	Any combination of two elements such as: A Line and a Generator A Line and a Reactive Power Source Two Generators Two Circuits Two Transformers Two Reactive Power Sources DC Bipole	≥2.5%	50% of Margin Requirement in Level A
D	Any combination of three or more elements such as: Three or More Circuits on ROW Entire Substation Entire Plant Including Switchyard	> 0	> 0

2.3 Transient Stability Analysis Assumptions

Standard fault clearing times as shown in Table 2-3 are used for the new facilities or when the actual clearing times are not available for the existing facilities. Double line-to-ground faults are applied for the Category C5 events with normal clearing times. Single line-to-ground faults are applied for Category C6 to C9 events with delayed clearing times as depicted in Table 2-4 and Table 2-5.

Table 2-3: Fault Clearing Times

Nominal (kV)	Near End (Cycles)	Far End (Cycles)
500	4	5
240	5	6
144/138 with telecommunications	6	8
144/138 without telecommunications	6	30

Table 2-4: Stuck Breaker Clearing Times for Lines

Voltage (kV)	Fault Clearing Times (Cycles)		
	Near End	Far End	2nd Ckt (C5 and C7 only)
138/144	15	24	24
240	12	6	14
500	9	5	11

Table 2-5: Stuck Breaker Clearing Times for Transformers

Voltage (kV)	Fault Location	Fault Clearing Times (Cycles)		
		High Side	Low Side	2nd Ckt (breaker fail)
240/138	240 kV side	12	6	14
	138 kV side	5	15	24
500/240	500 kV side	9	5	11
	240 kV side	4	12	14

Attachment A2
Pre-Project Power Flow Diagrams

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Figure A2-1: 2023 Summer Peak Pre-Project - N-0 (System Normal Condition)

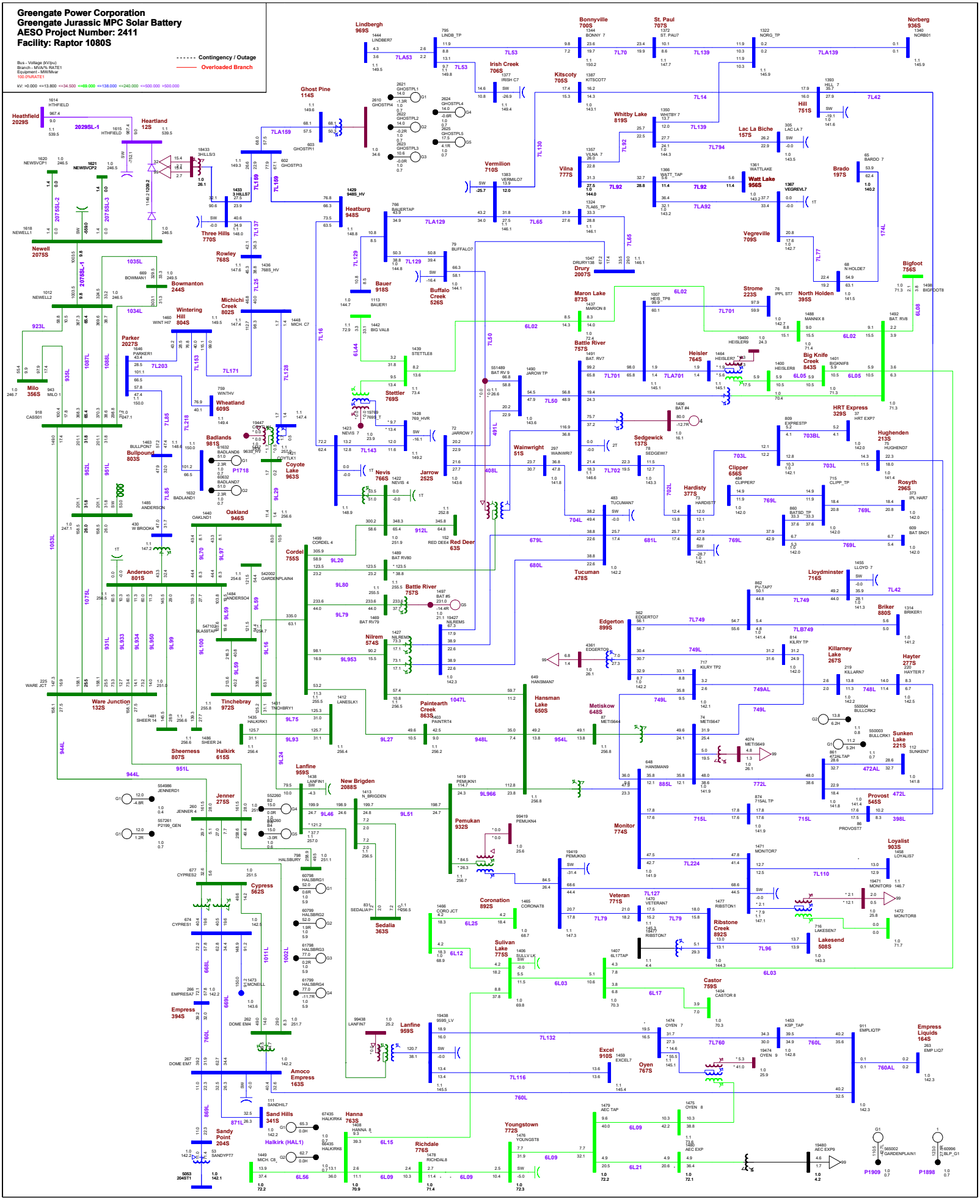


Figure A2-2: 2023 Summer Peak Pre-Project - N-1 Contingency of 766S901T (Nevis 766S Transformer 901T)

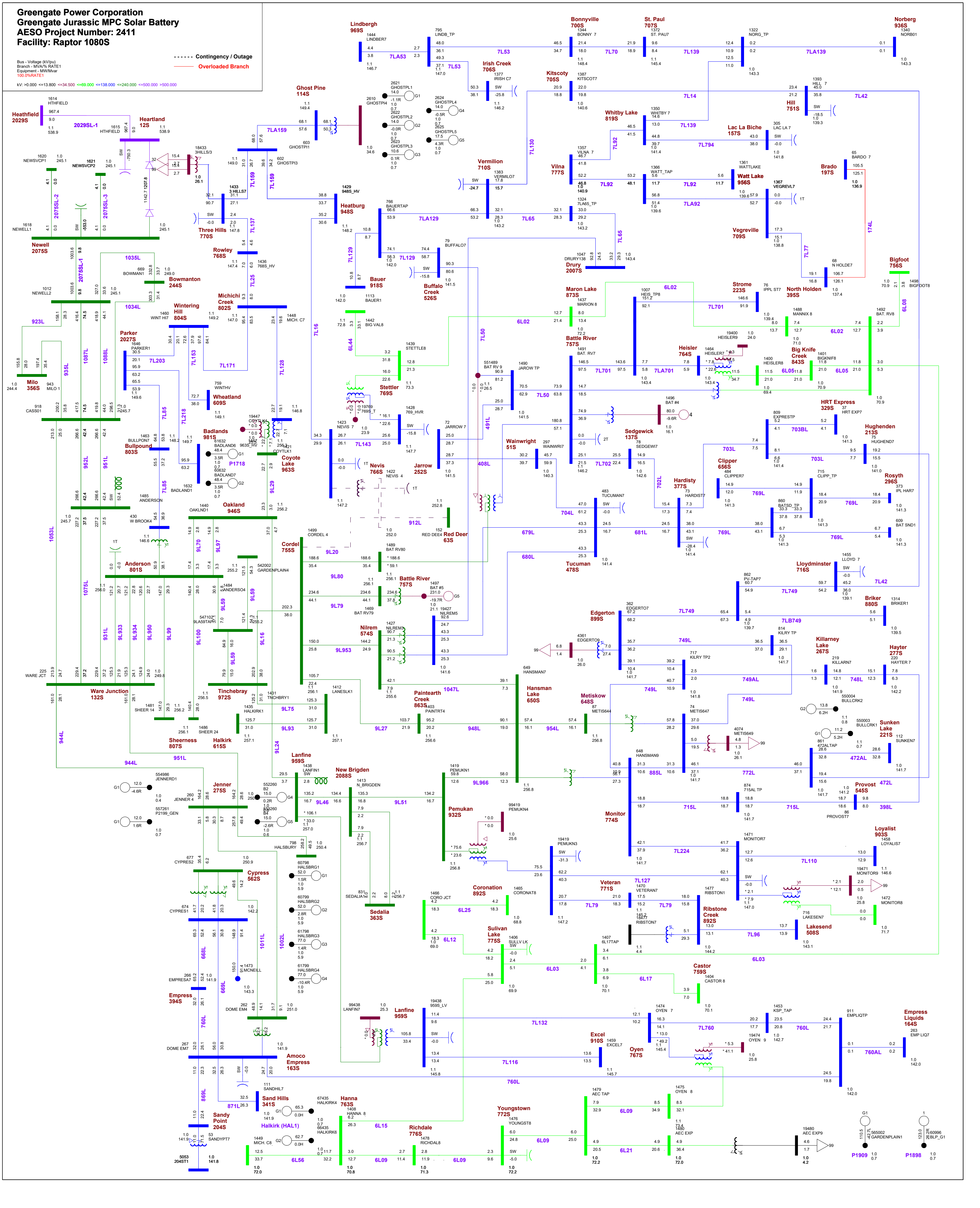


Figure A2-3: 2023 Summer Peak Pre-Project - N-1 Contingency of EATL (Newell 2075S - Heathfield 2029S)

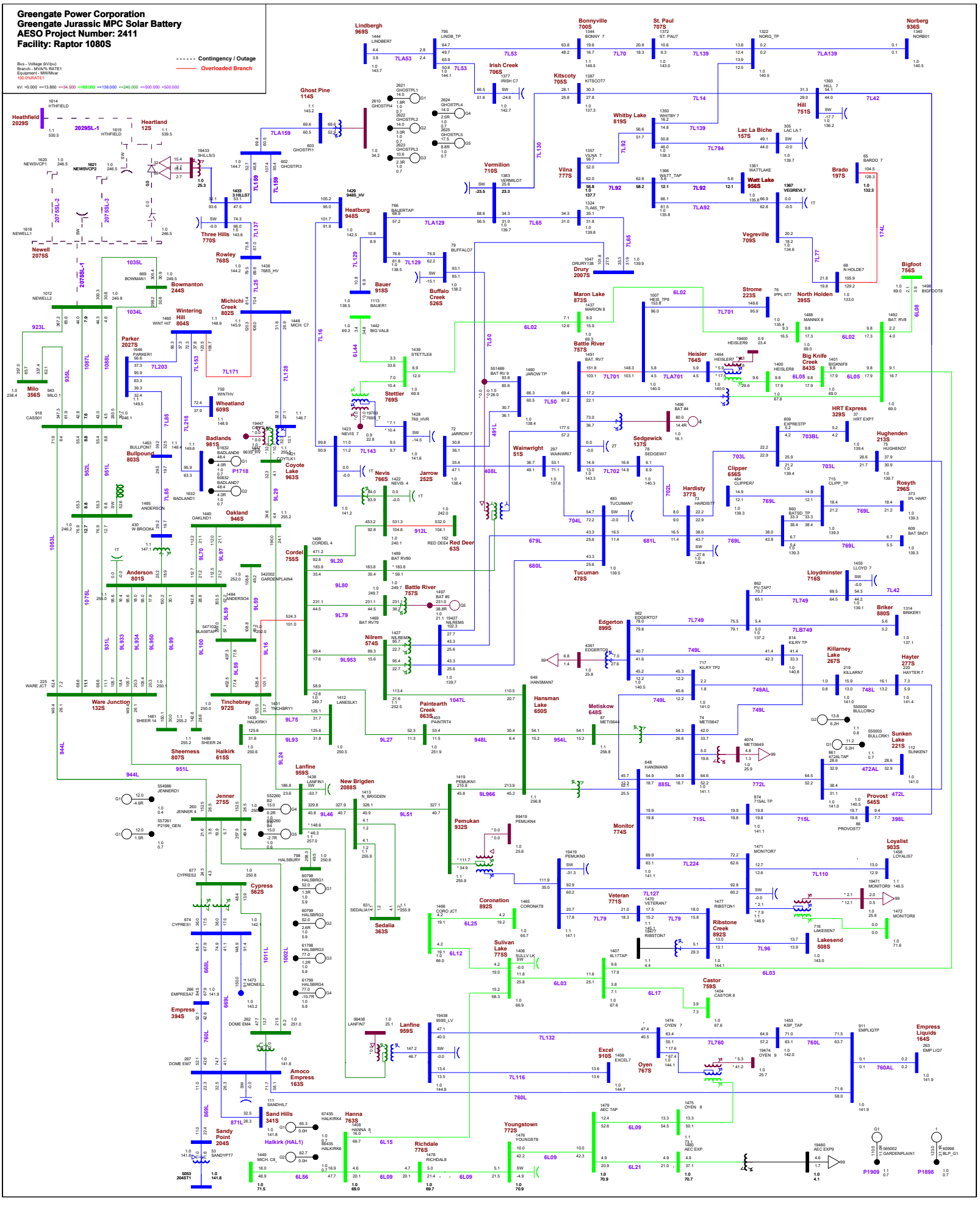


Figure A2-4: 2023 Summer Peak Pre-Project - N-1 Contingency of 669L (Amoco Empress 163S - Cypress 562S)

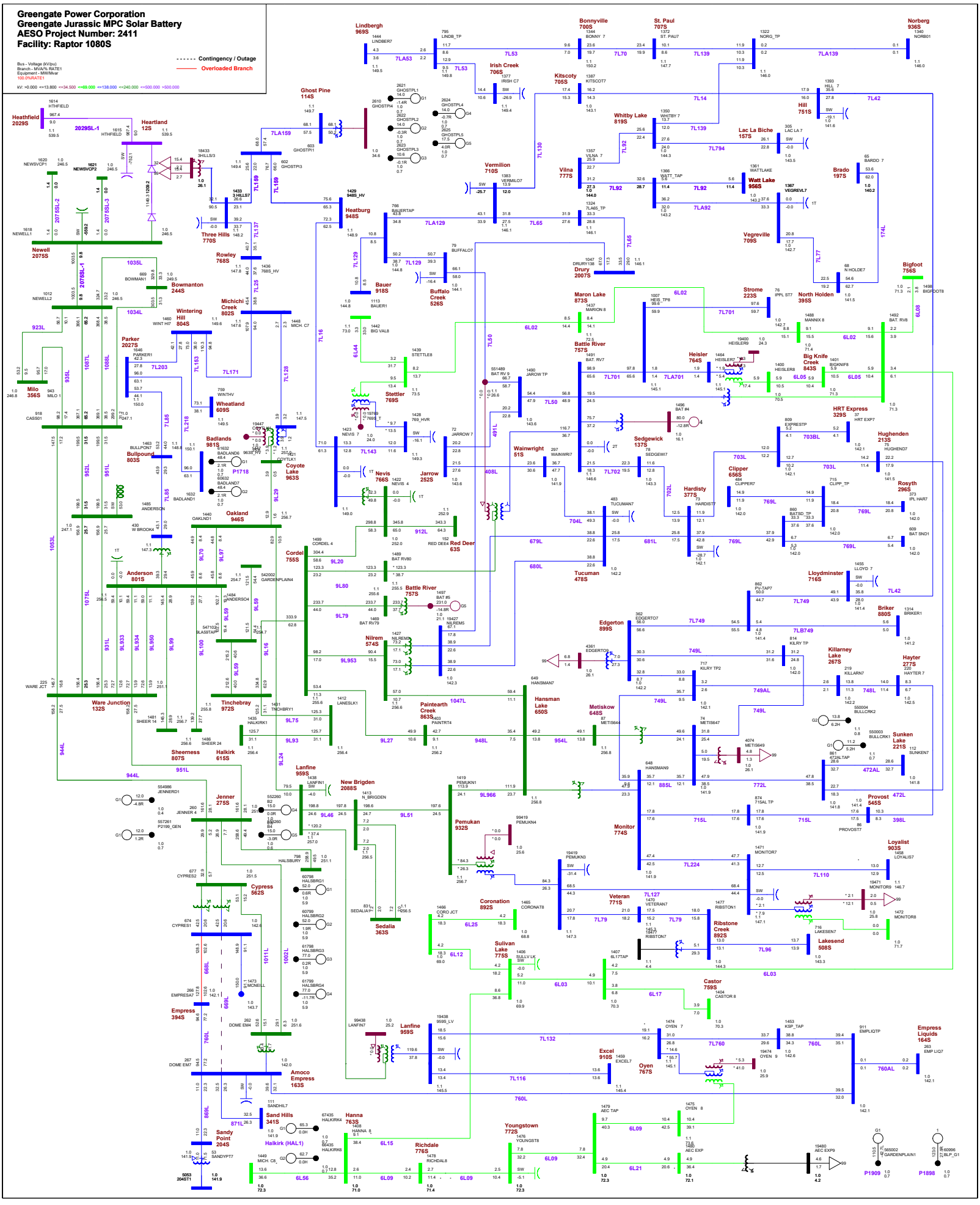


Figure A2-5: 2023 Summer Peak Pre-Project - N-1 Contingency of 9L20 (Nevis 766S - Cordel 755S)

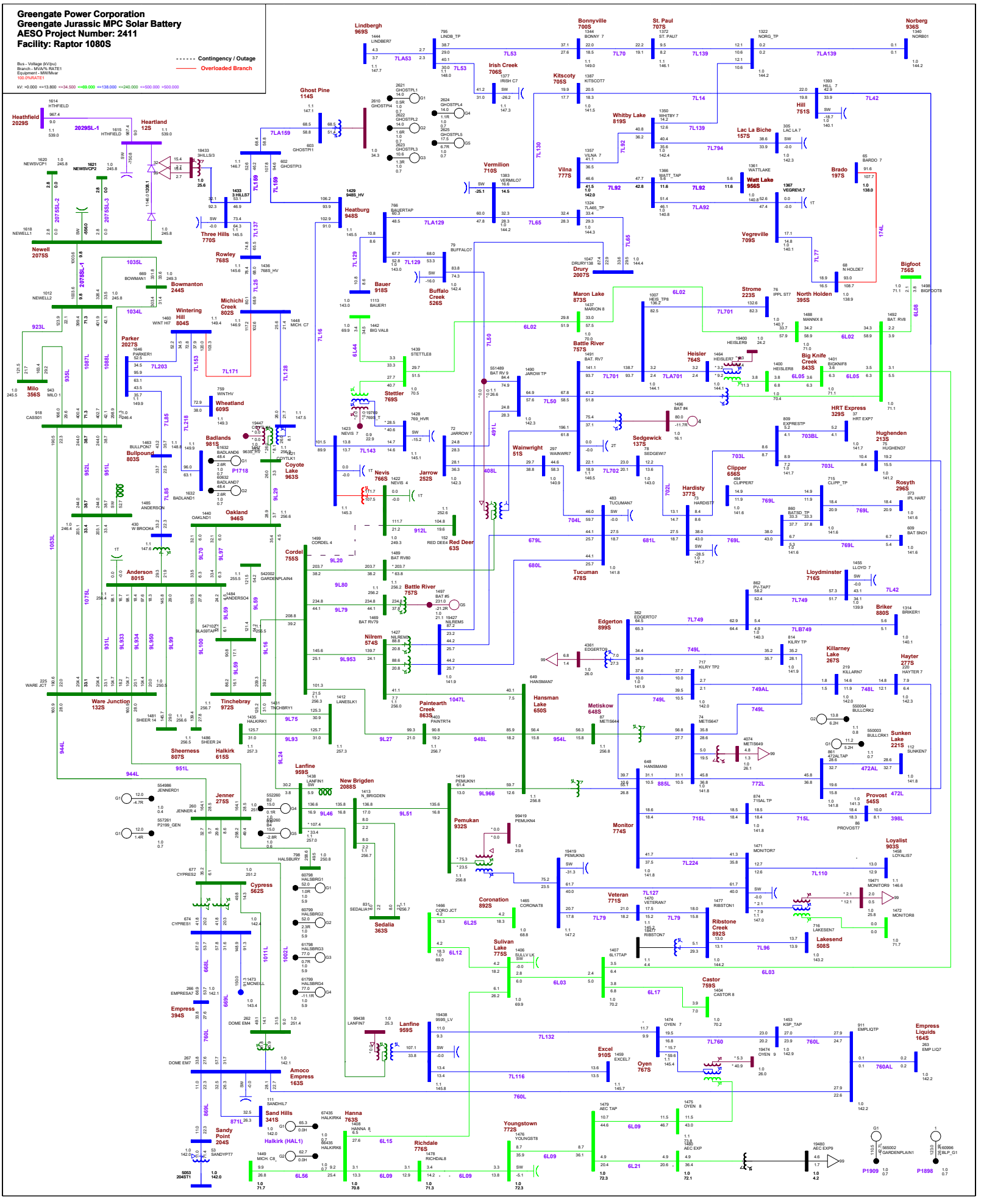


Figure A2-6: 2023 Summer Peak Pre-Project - N-1 Contingency of 9L16 (Tinchebray 972S - Cordel 755S)

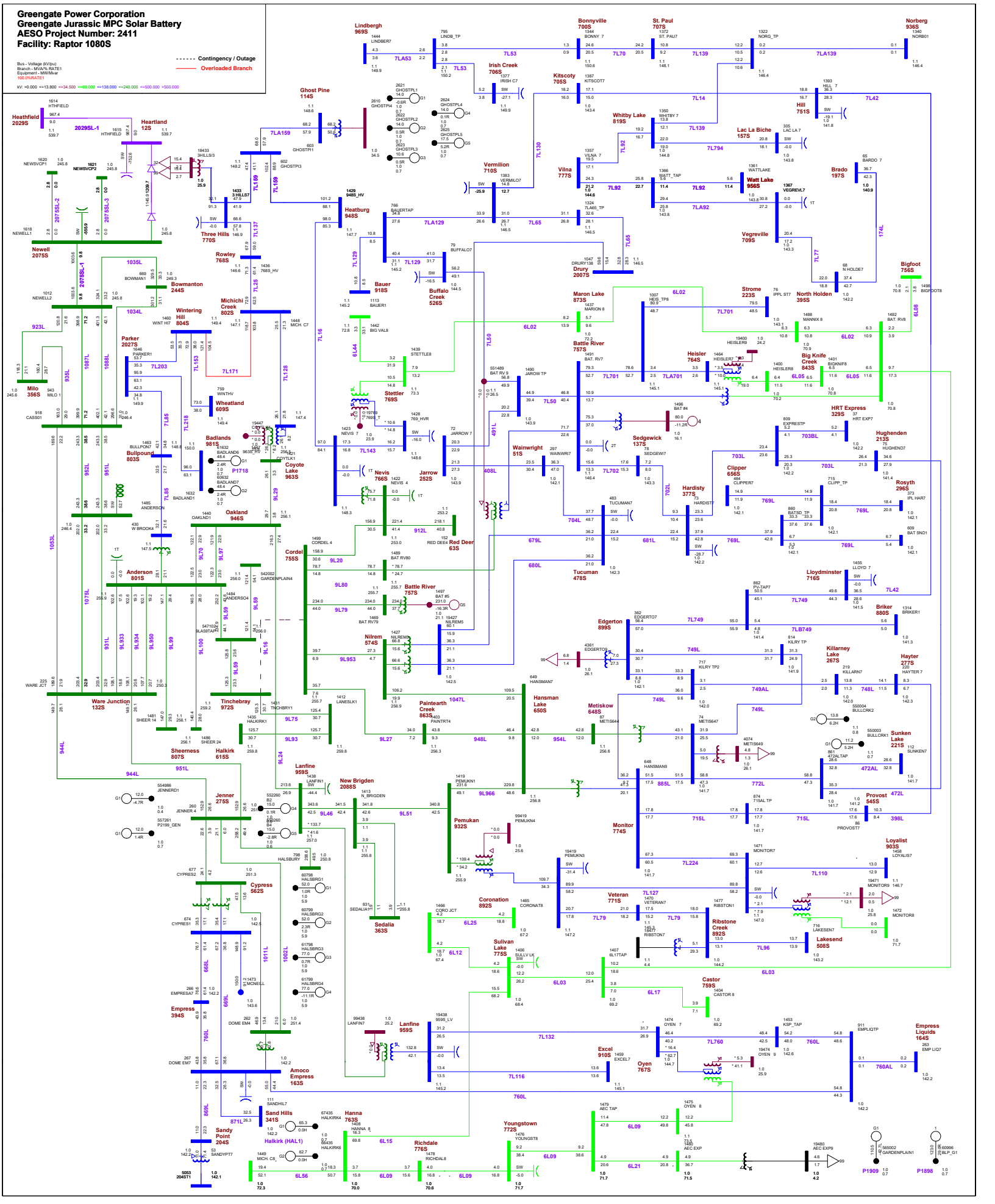


Figure A2-7: 2023 Summer Peak Pre-Project - N-1 Contingency of 912L\9L912 (Red Deer 63S - Nevis 766S)

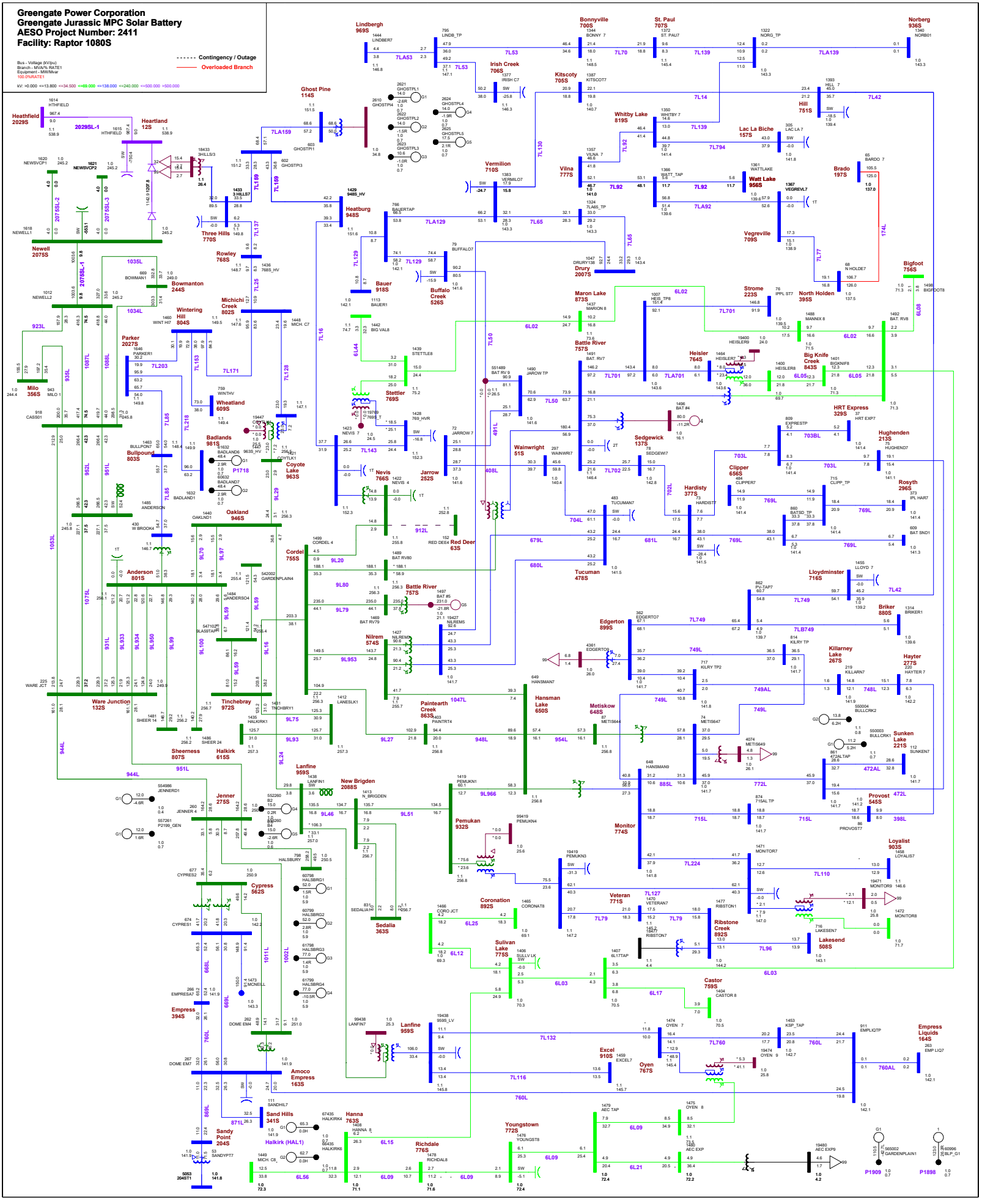


Figure A2-8: 2023 Summer Peak Pre-Project - N-1 Contingency of 7L171 (Michichi Creek 802S - Wintering Hills 804S)

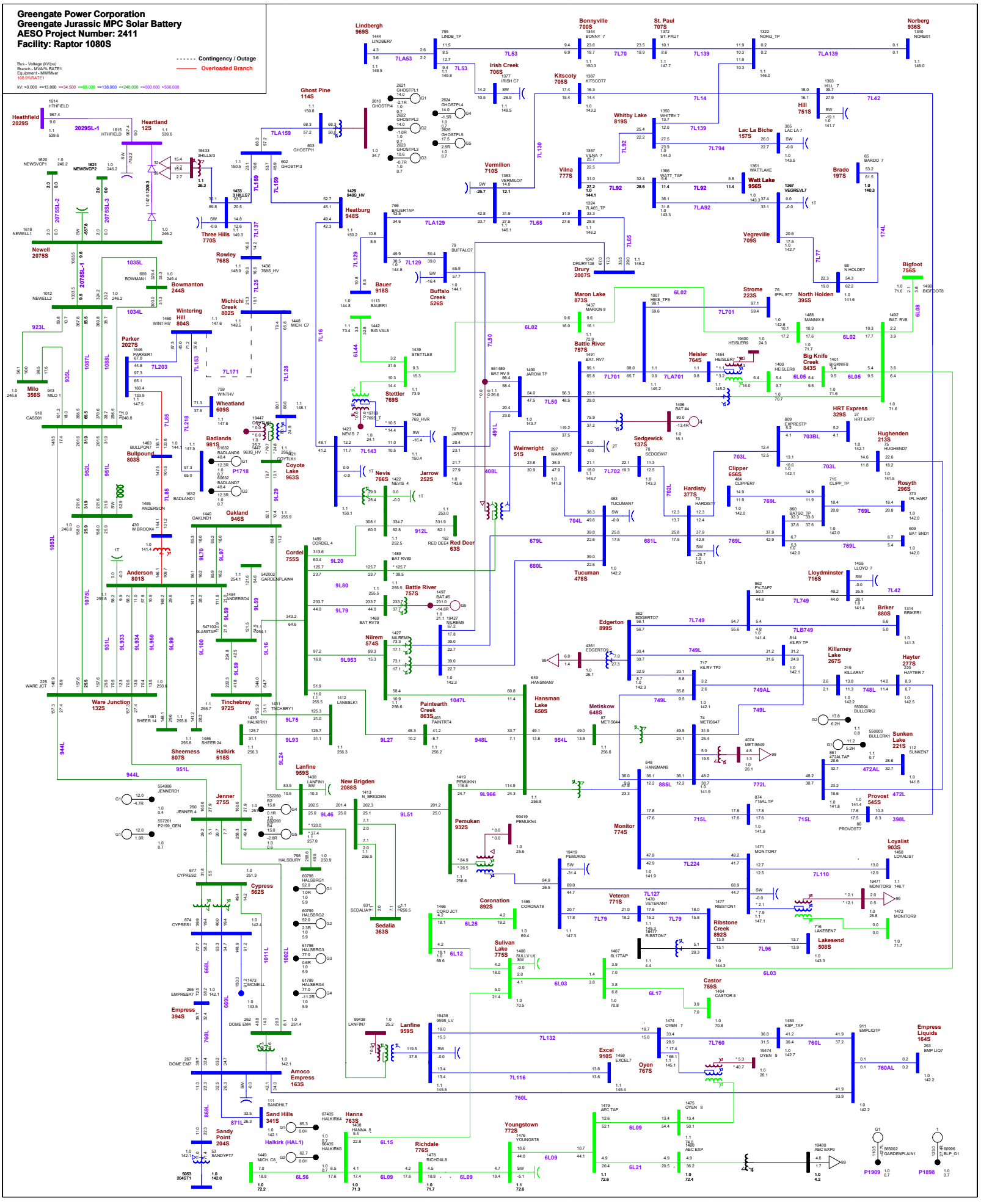


Figure A2-9: 2023 Summer Peak Pre-Project - N-1 Contingency of 801S901T (Anderson 801S Transformer 901T)

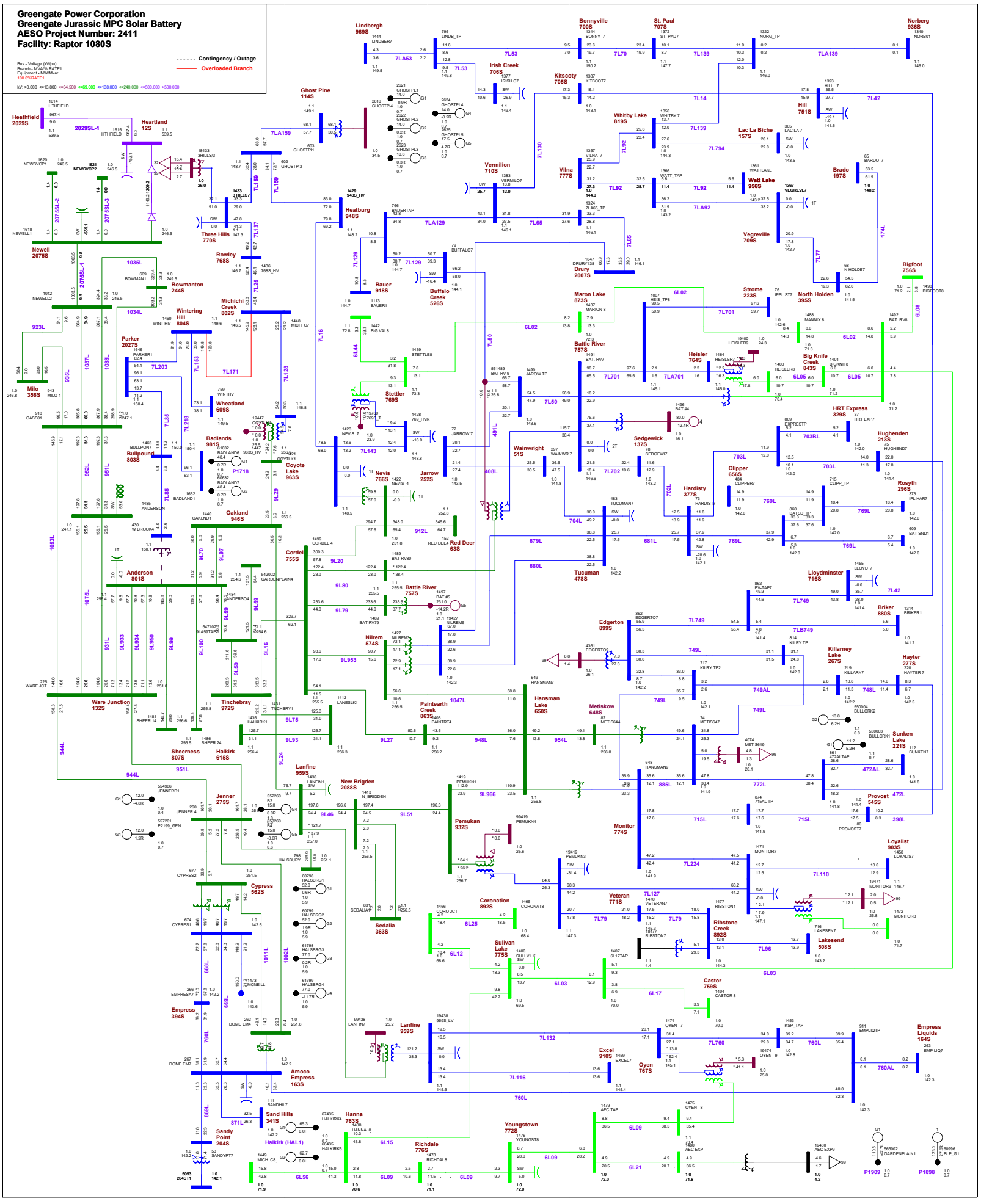


Figure A2-10: 2023 Summer Peak Pre-Project - N-1 Contingency of 114ST1 (Ghost Pine 114S Transformer T1)

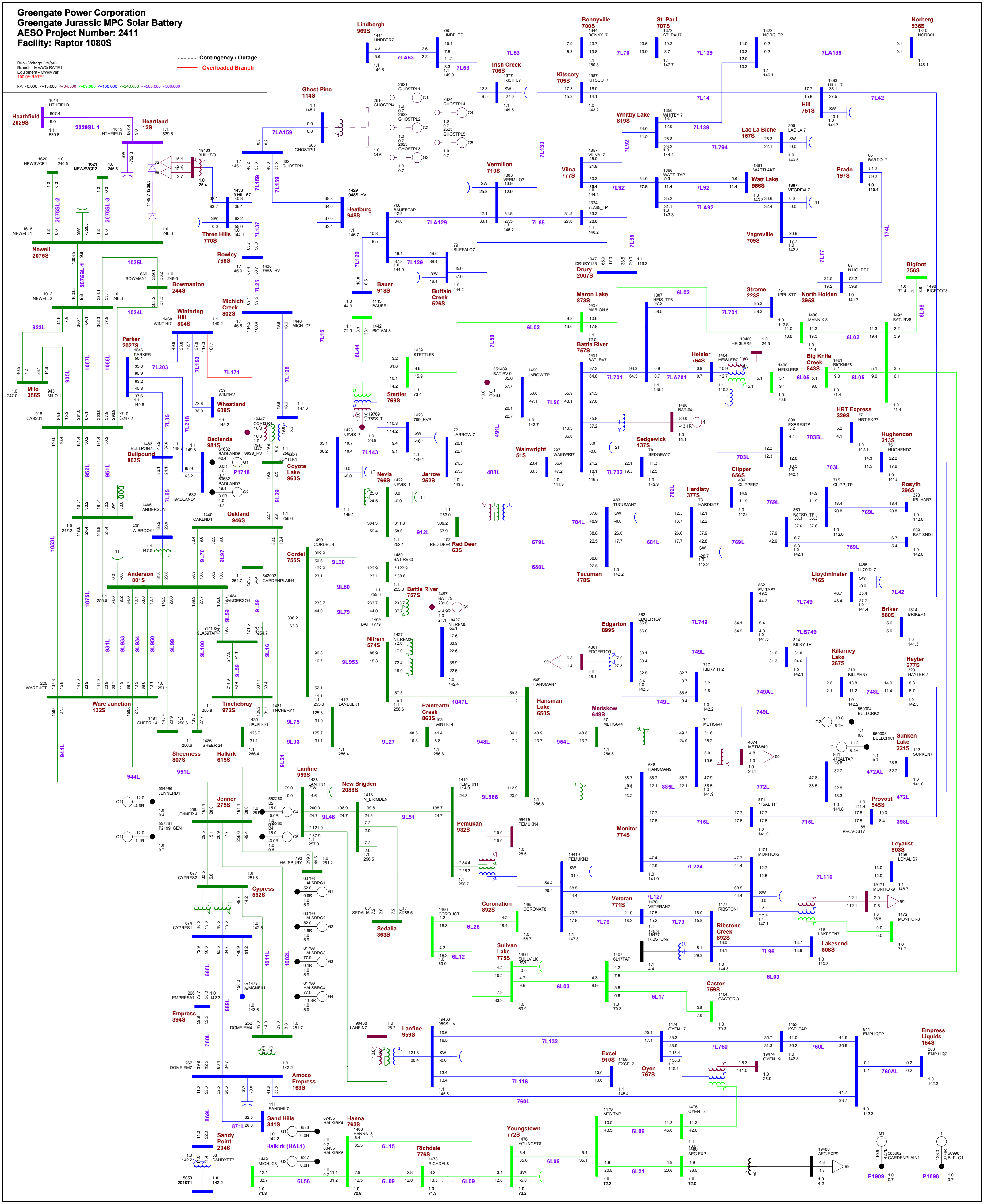
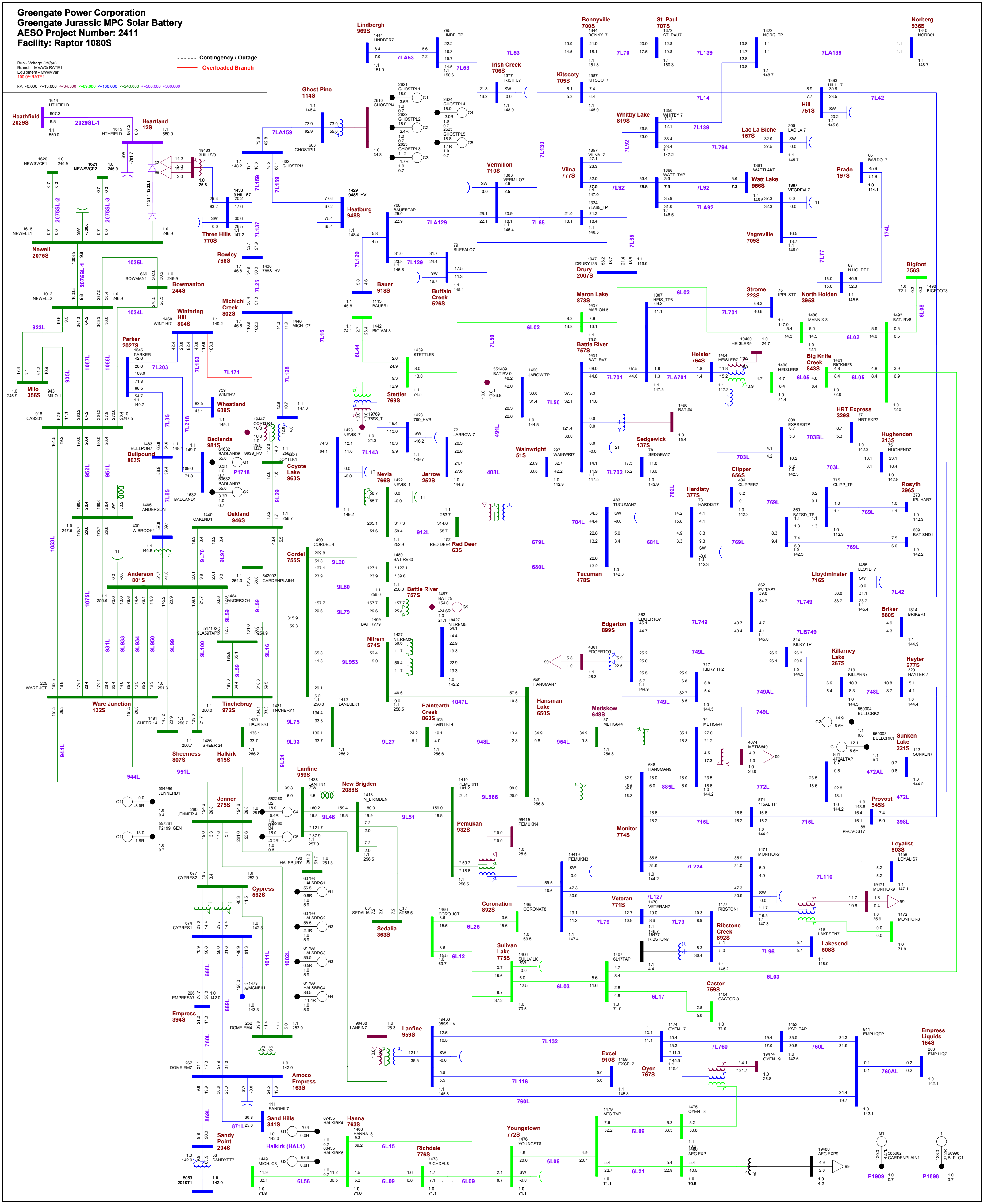


Figure A2-11: 2023 Summer Light Pre-Project - N-0 (System Normal Condition)



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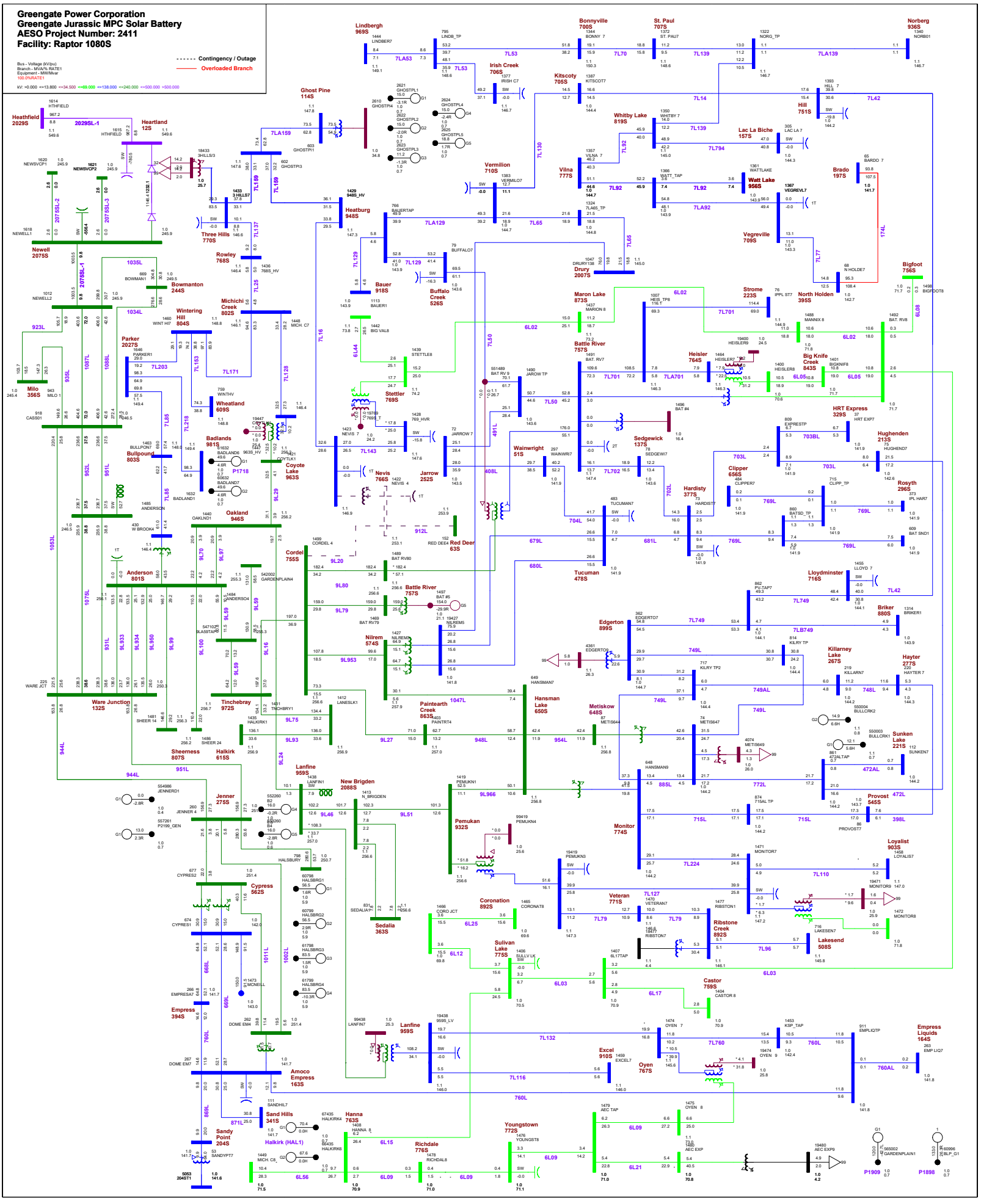
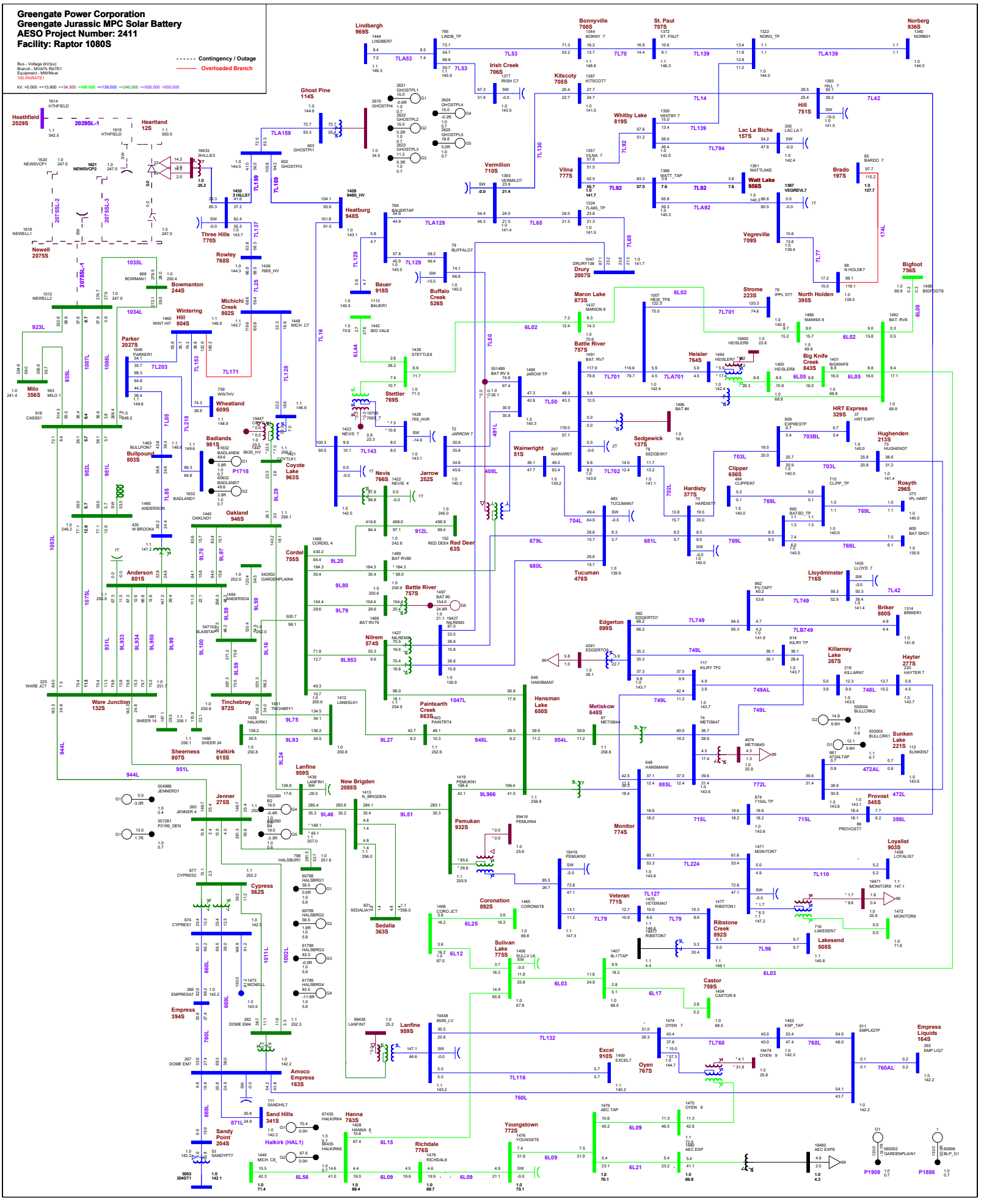


Figure A2-13: 2023 Summer Light Pre-Project - N-1 Contingency of EATL (Newell 2075S - Heathfield 2029S)



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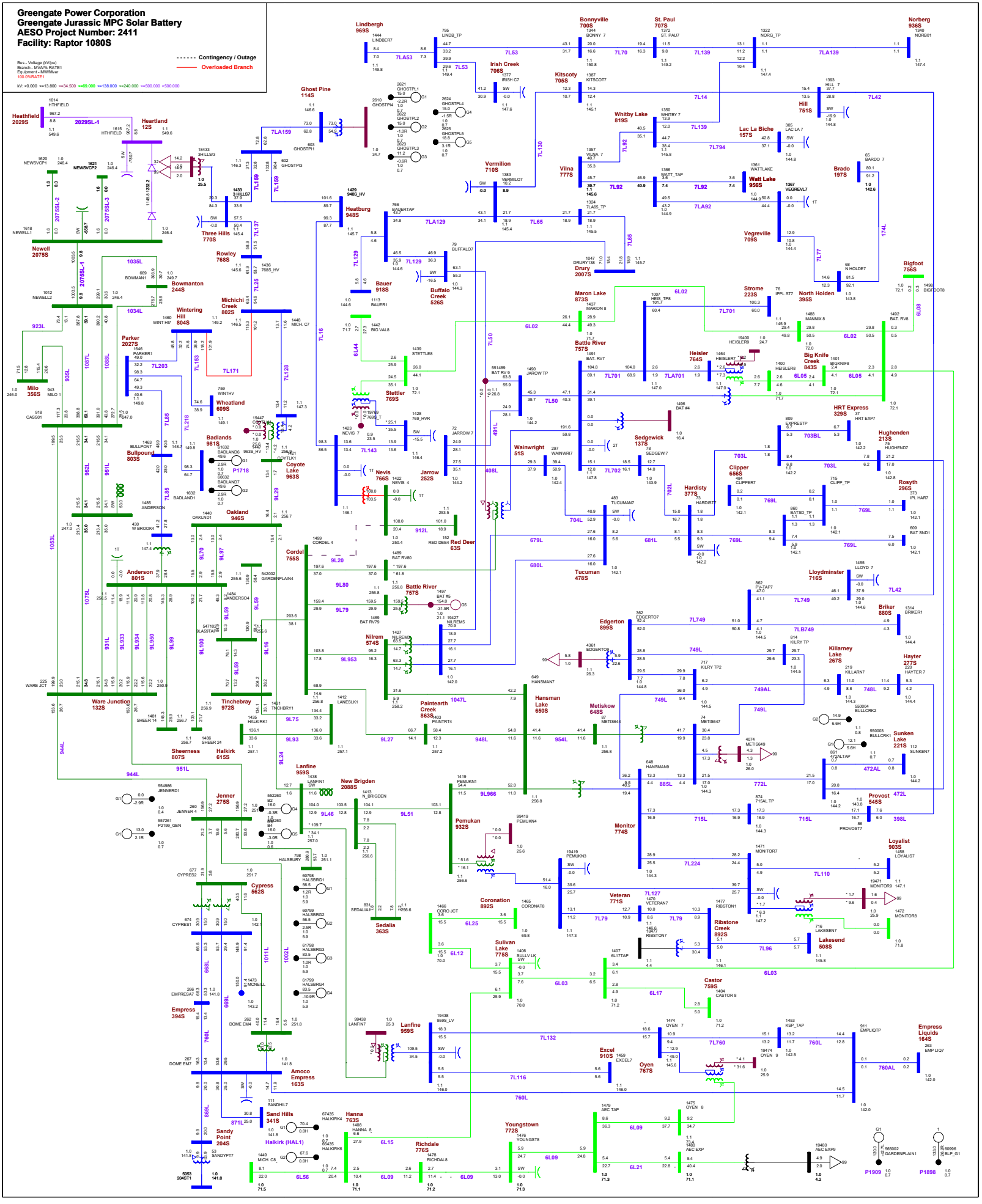

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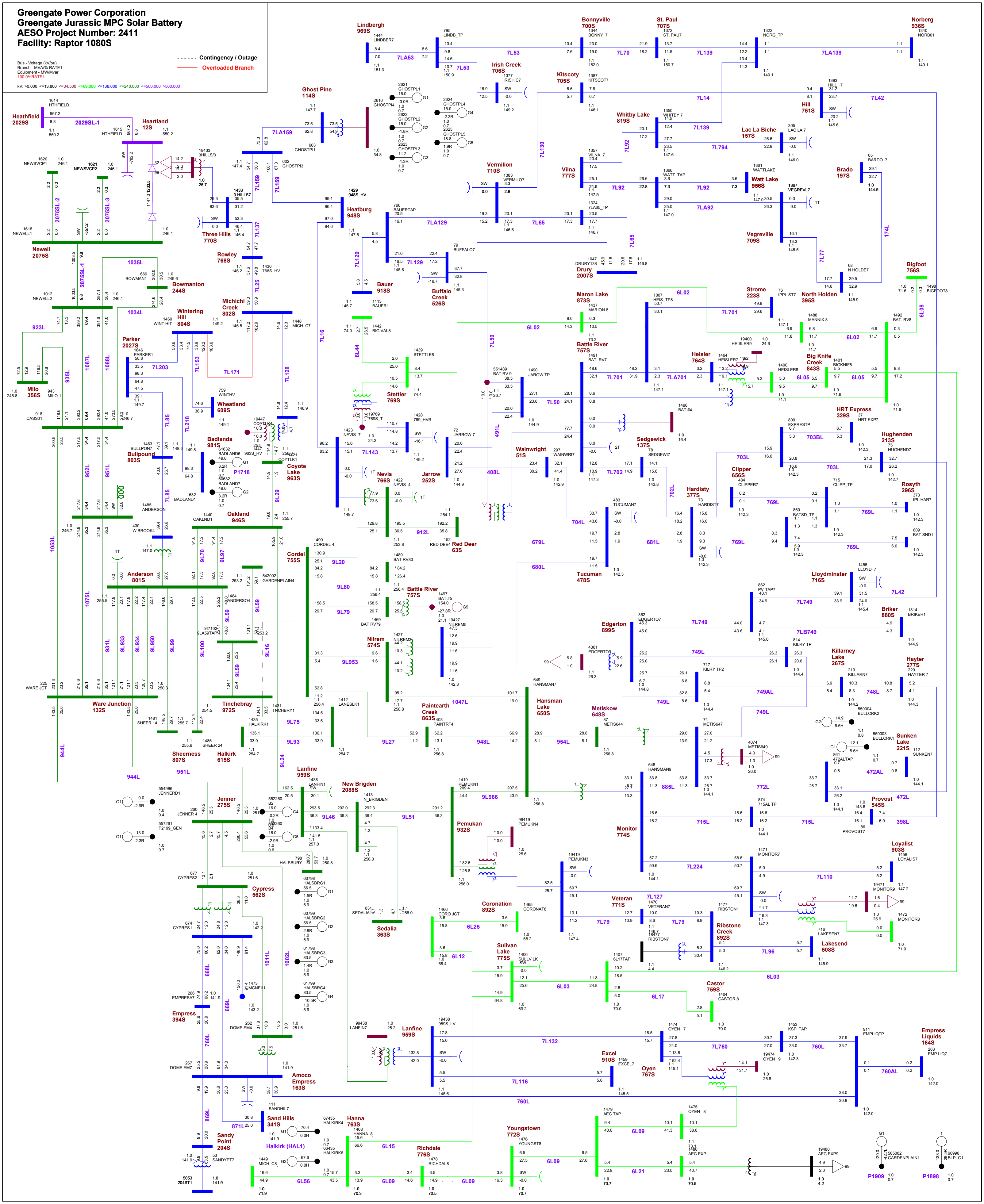


Figure A2-16: 2023 Summer Light Pre-Project - N-1 Contingency of 912L\9L912 (Red Deer 63S - Nevis 766S)

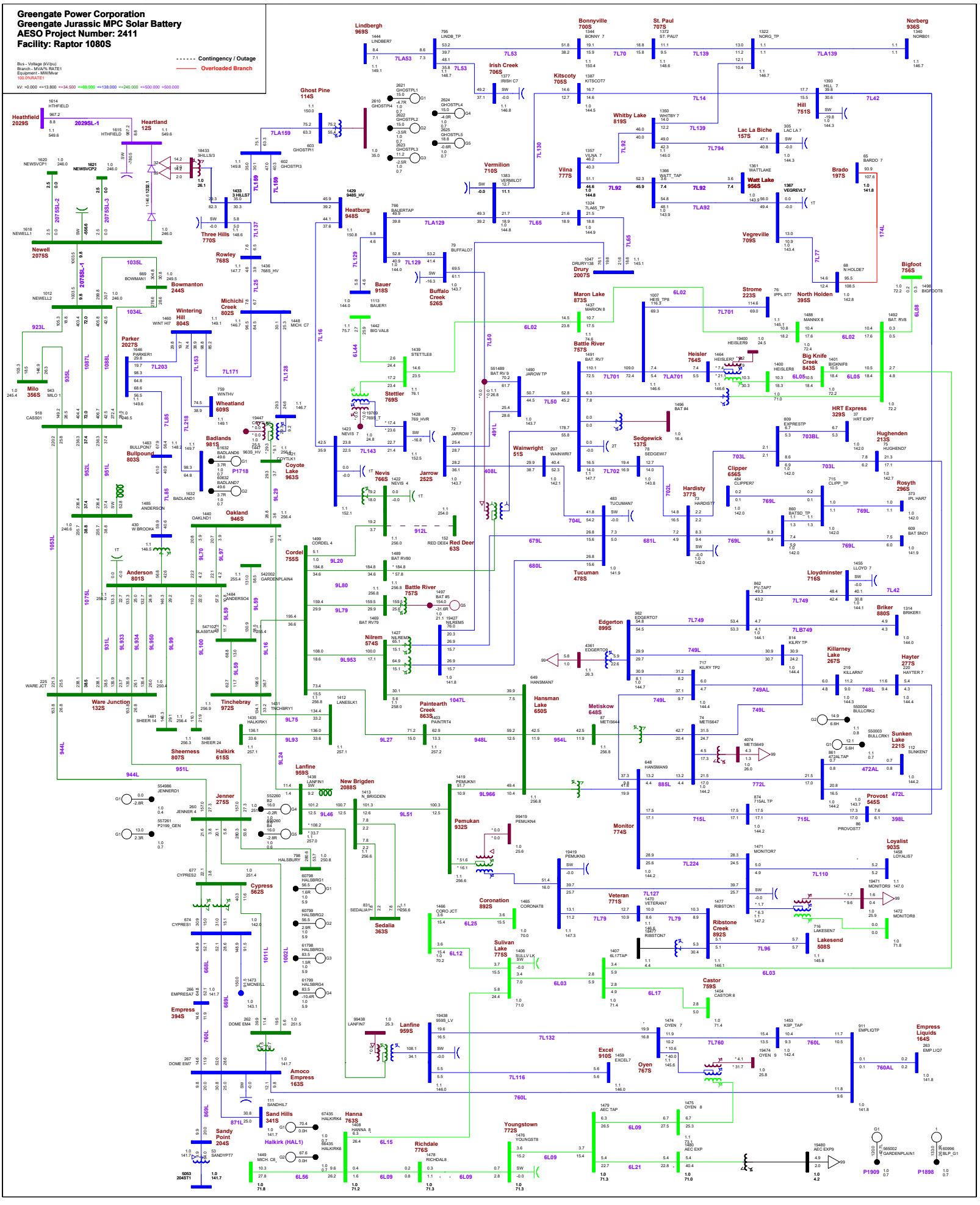
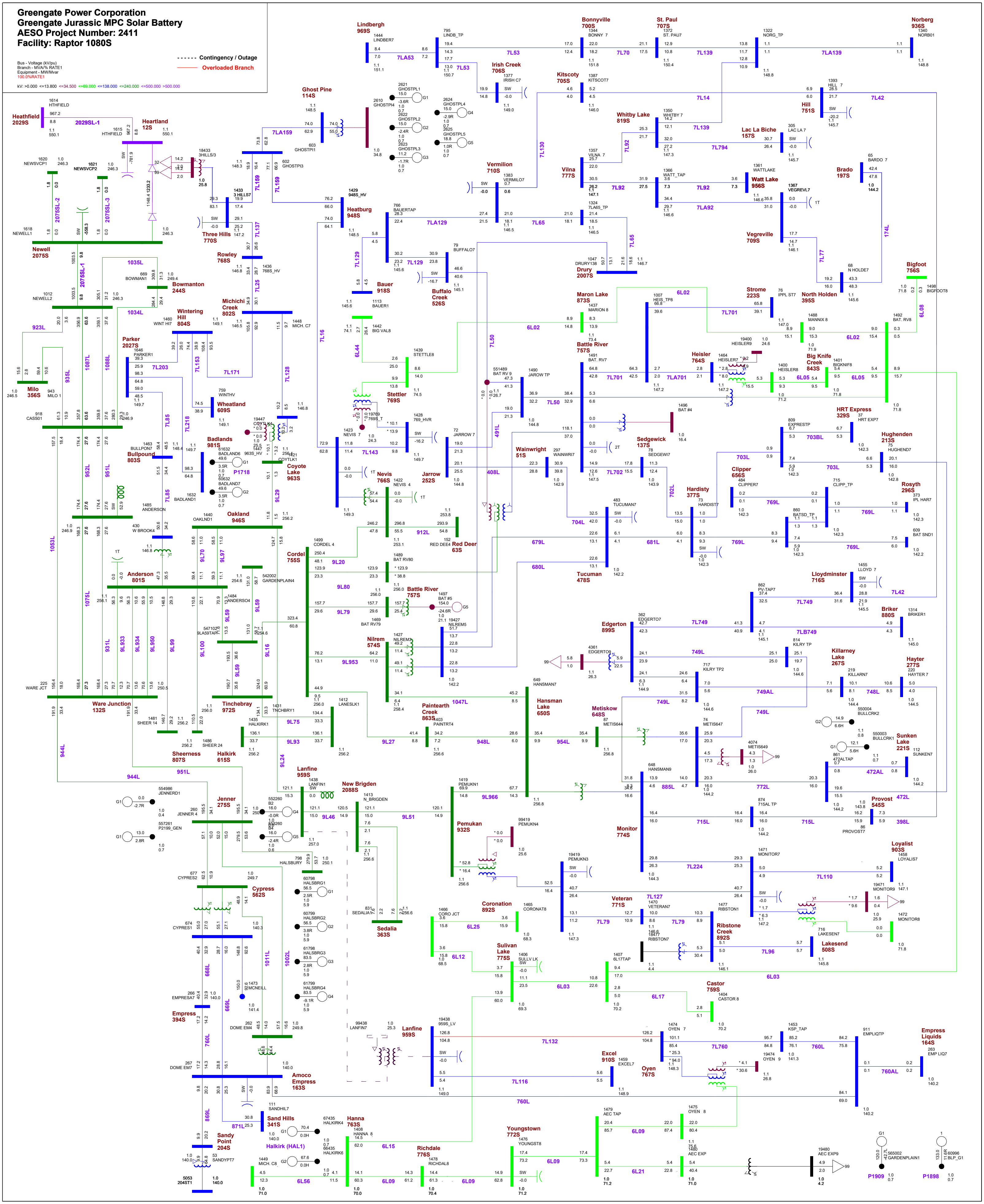


Figure A2-17: 2023 Summer Light Pre-Project - N-1 Contingency of 959S901T (Lanfine 959S Transformer 901T)



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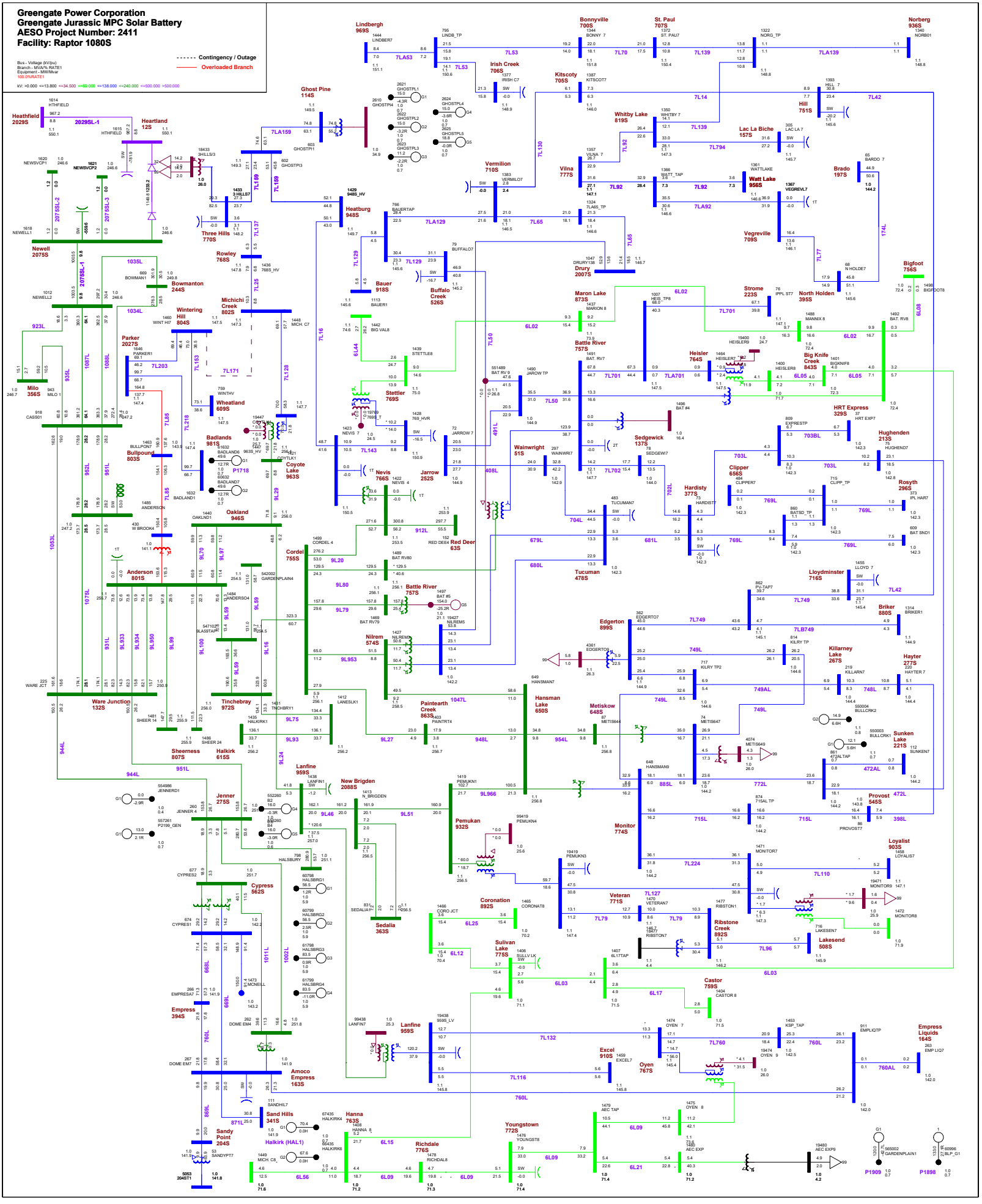


Figure A2-19: 2023 Summer Light Pre-Project - N-1 Contingency of 801S901T (Anderson 801S Transformer 901T)

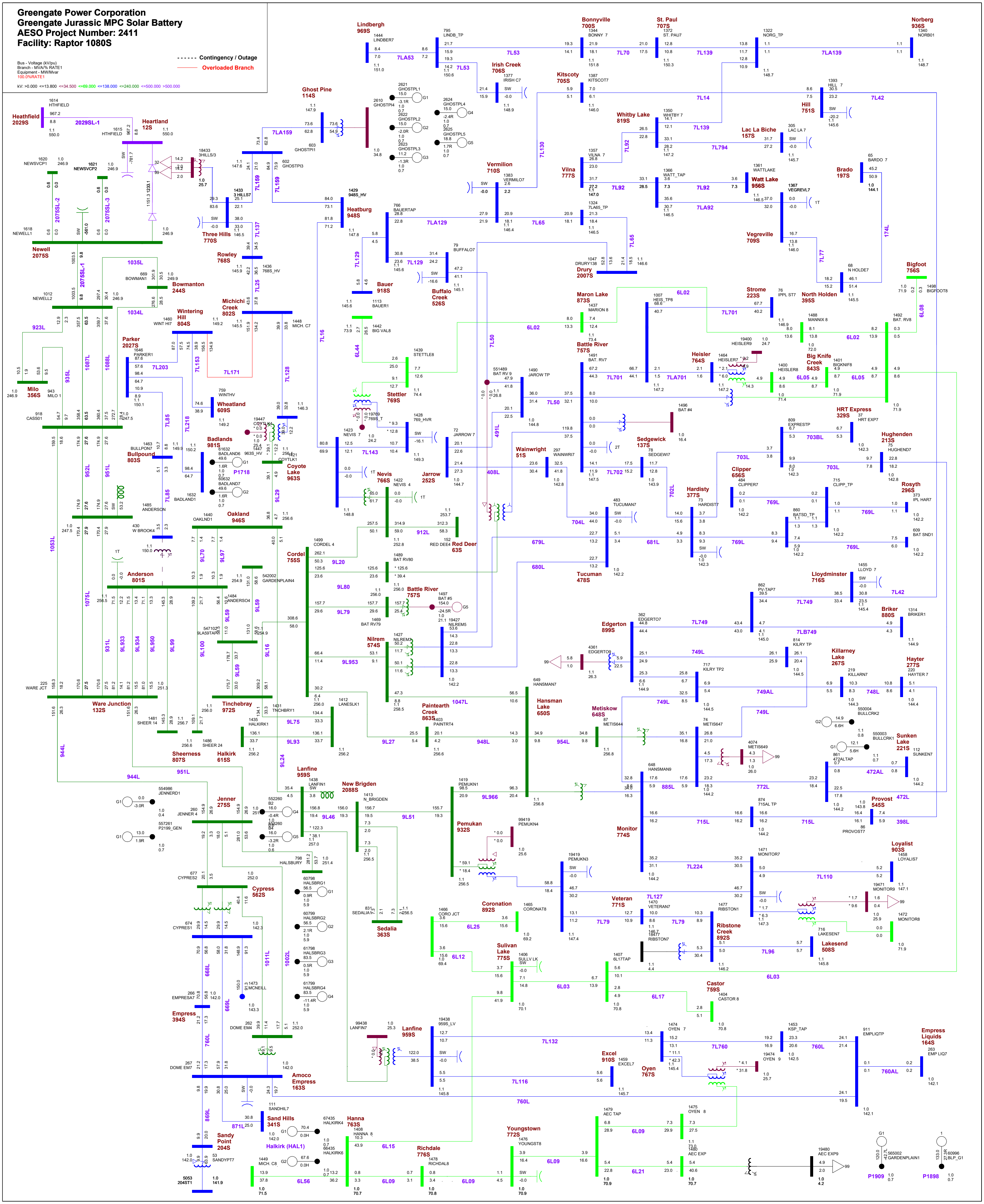


Figure A2-20: 2023 Summer Light Pre-Project - N-1 Contingency of 114ST1 (Ghost Pine 114S Transformer T1)

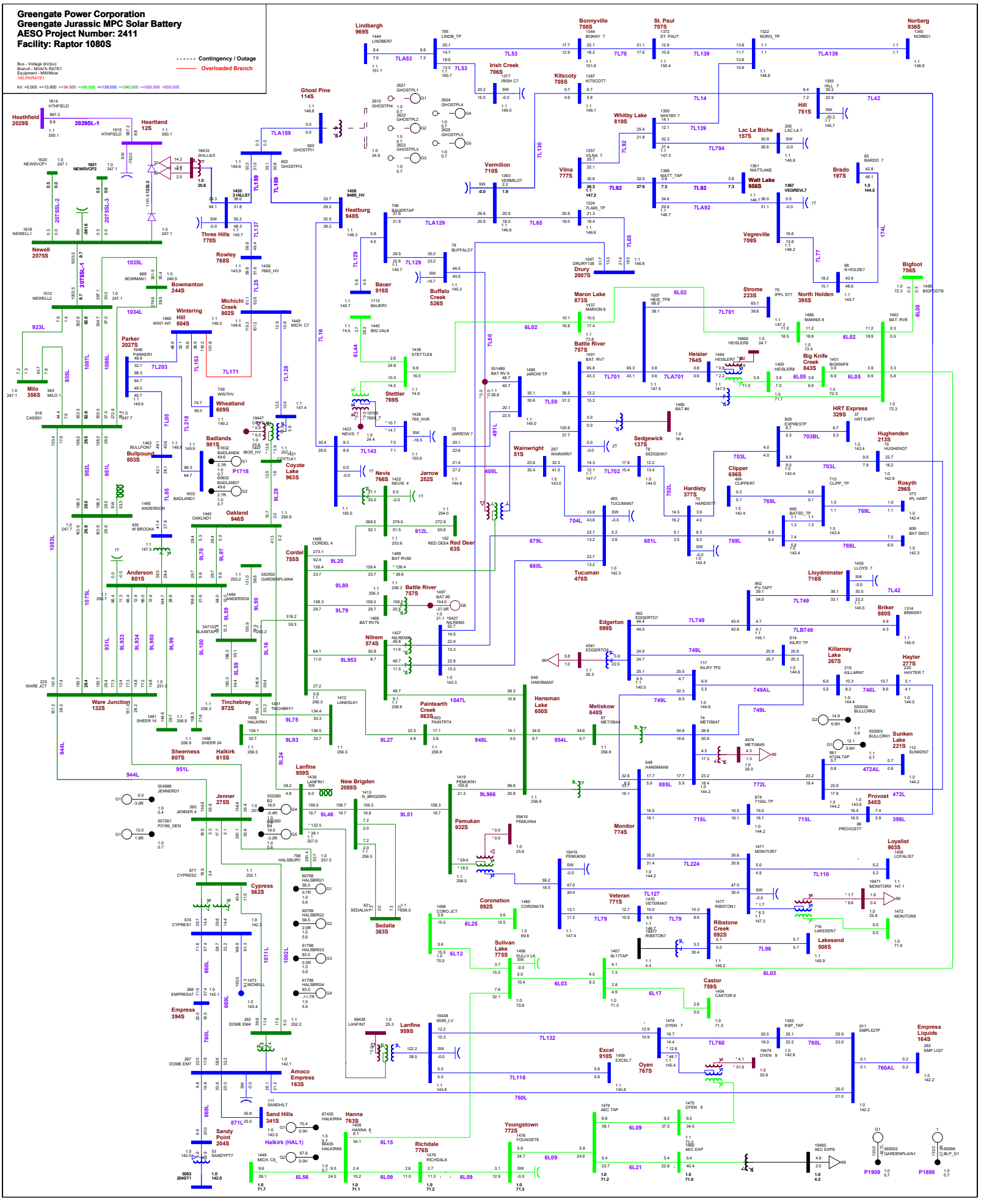


Figure A2-21: 2023 Winter Peak Pre-Project - N-0 (System Normal Condition)

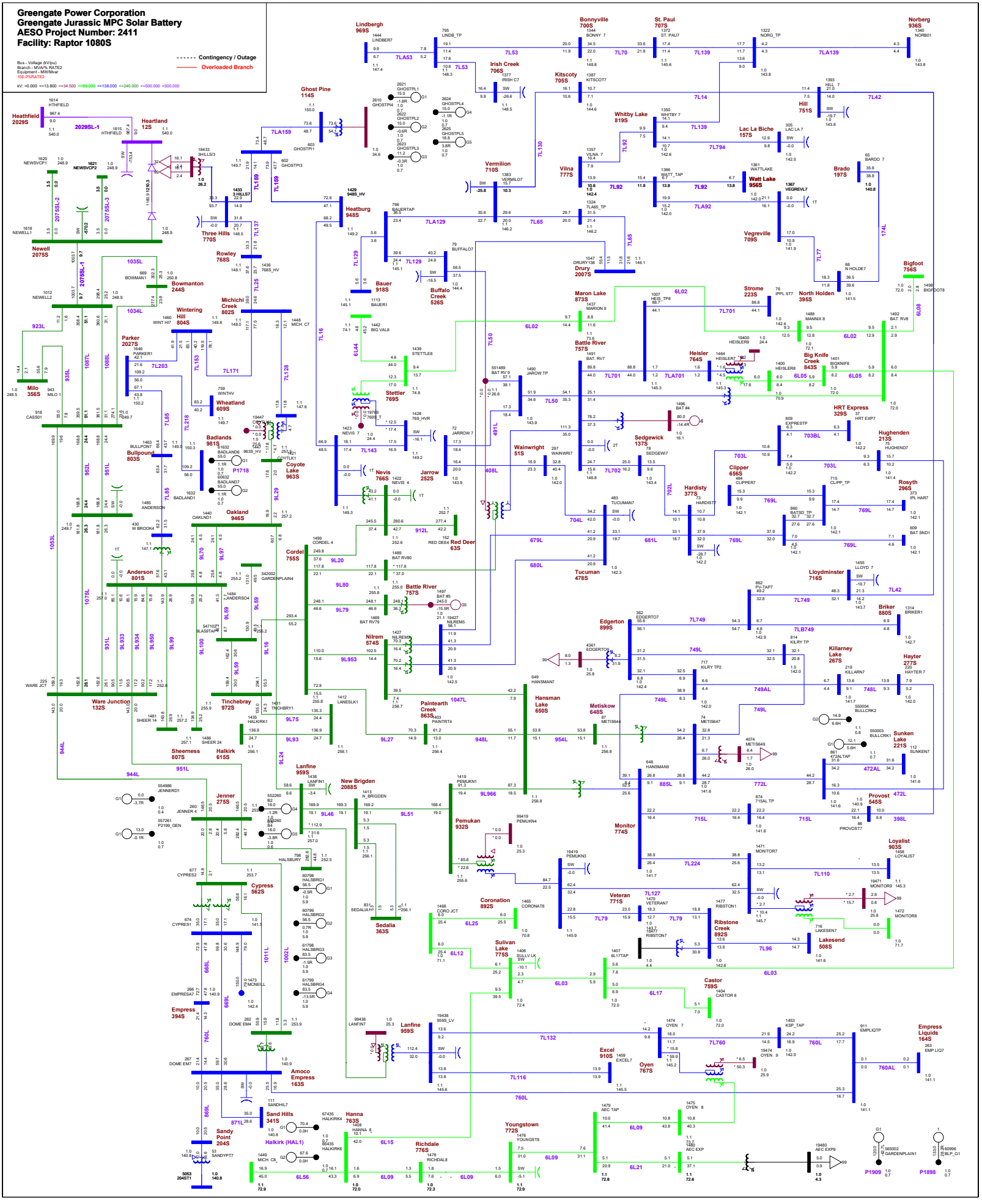


Figure A2-22: 2023 Winter Peak Pre-Project - N-1 Contingency of EATL (Newell 2075S - Heathfield 2029S)

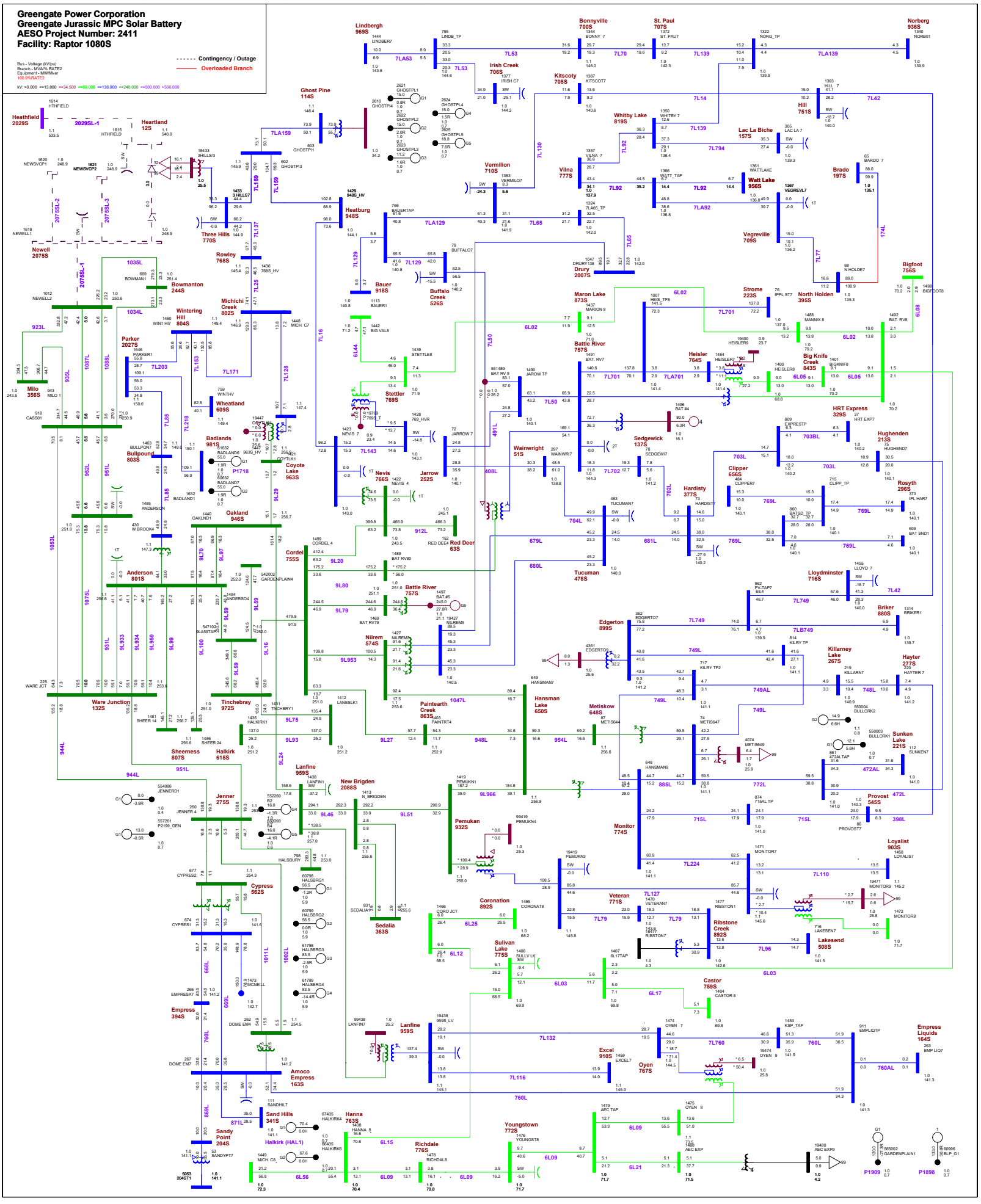


Figure A2-23: 2023 Winter Peak Pre-Project - N-1 Contingency of 7L171 (Michichi Creek 802S - Wintering Hills 804S)

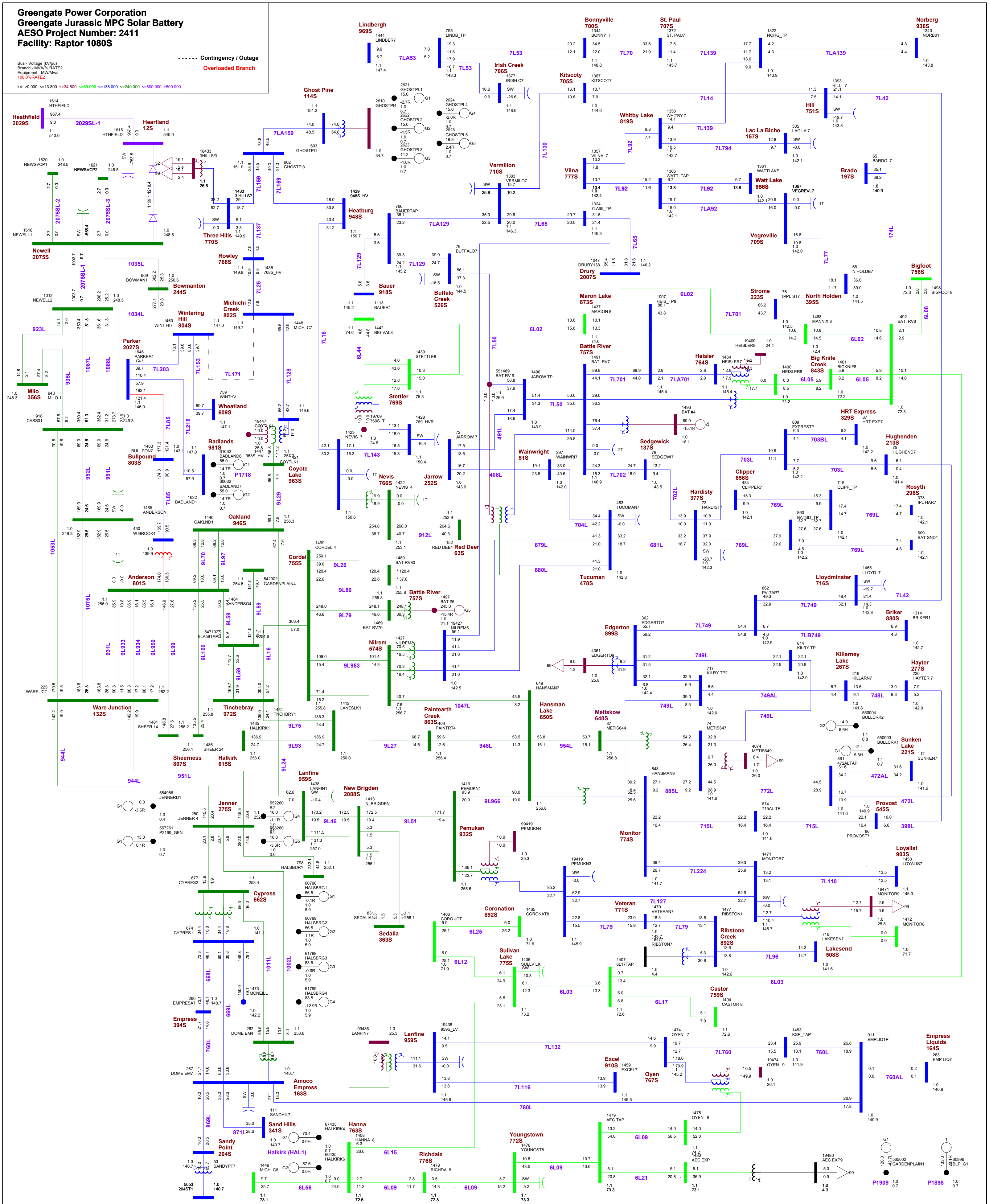
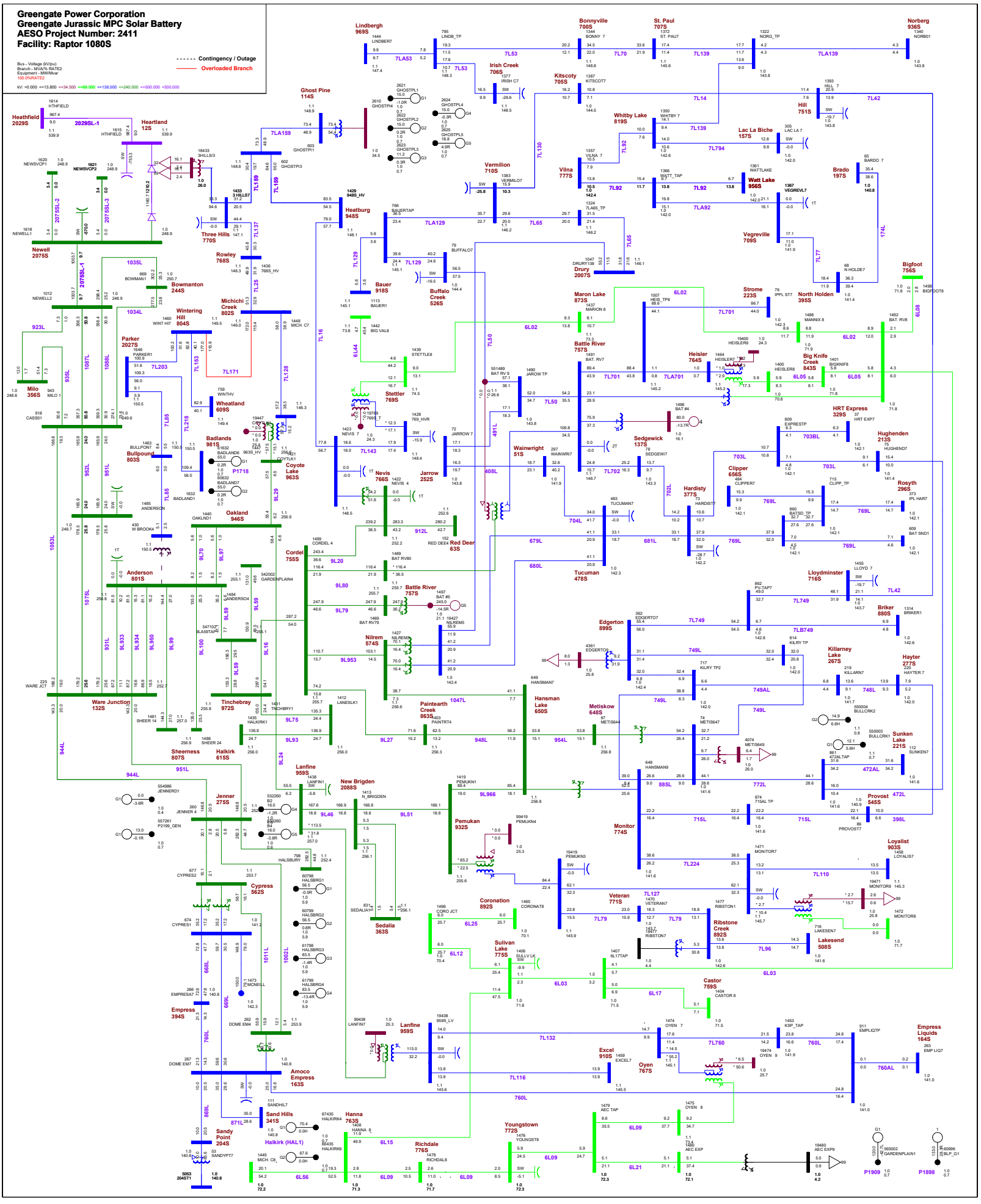


Figure A2-24: 2023 Winter Peak Pre-Project - N-1 Contingency of 801S901T (Anderson 801S Transformer 901T)



Attachment A3
Post-Project Power Flow Diagrams

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Scenario Name	Contingency	Figure Number
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Figure A3-1: 2023 Summer Peak Post-Project - N-0 (System Normal Condition)

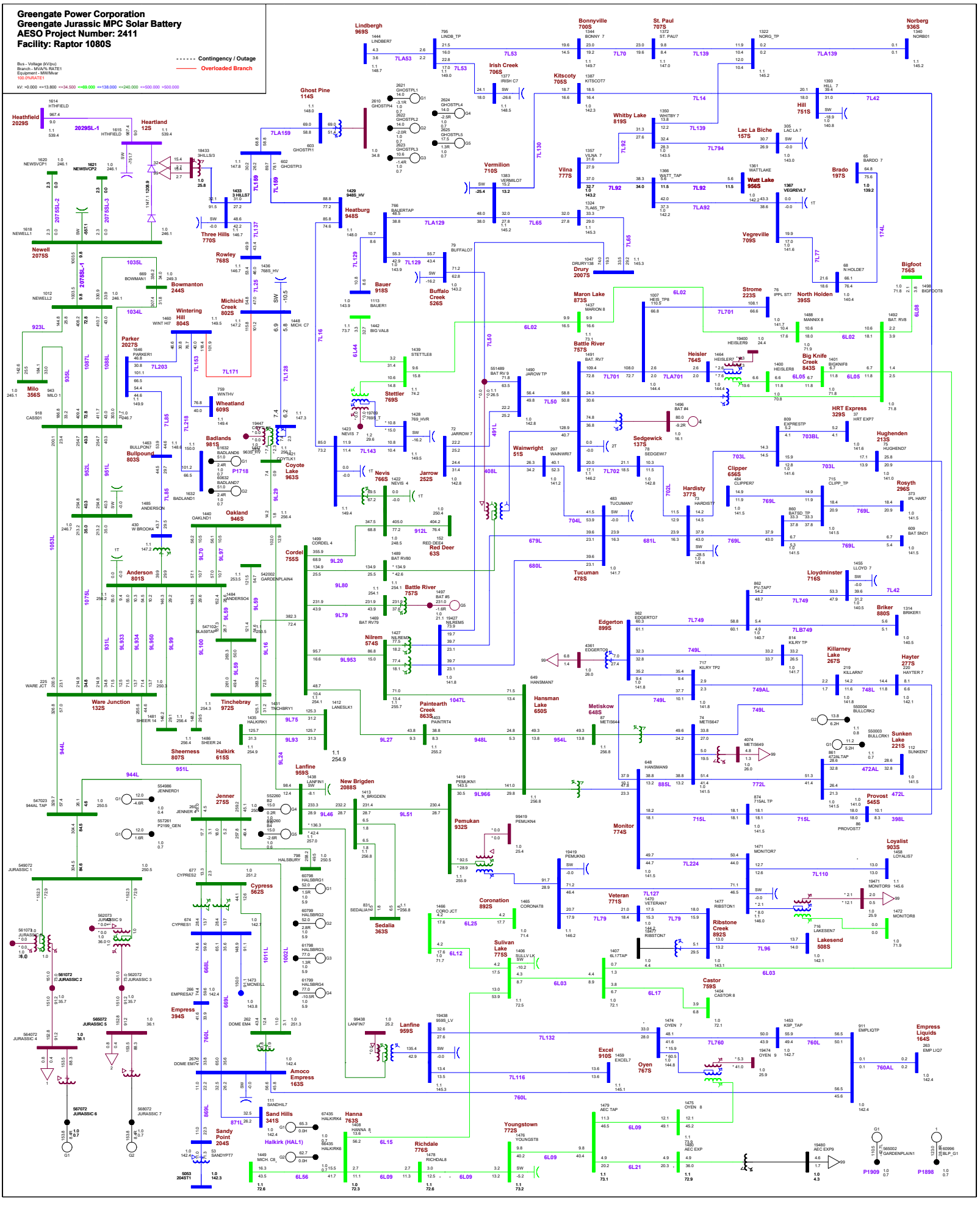


Figure A3-2: 2023 Summer Peak Post-Project - N-1 Contingency of 766S901T (Nevis 766S Transformer 901T)

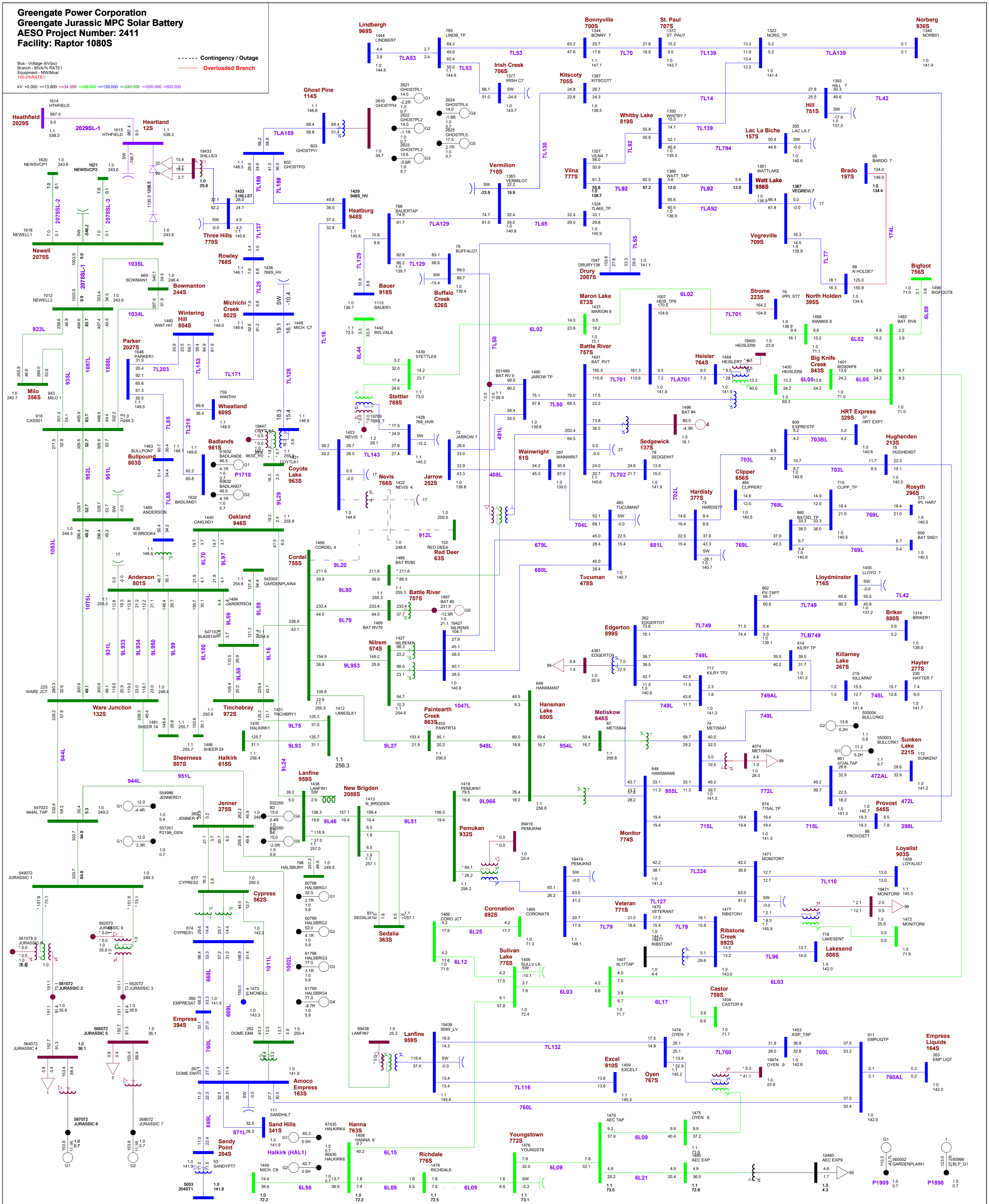


Figure A3-3: 2023 Summer Peak Post-Project - N-1 Contingency of EATL (Newell 2075S - Heathfield 2029S)

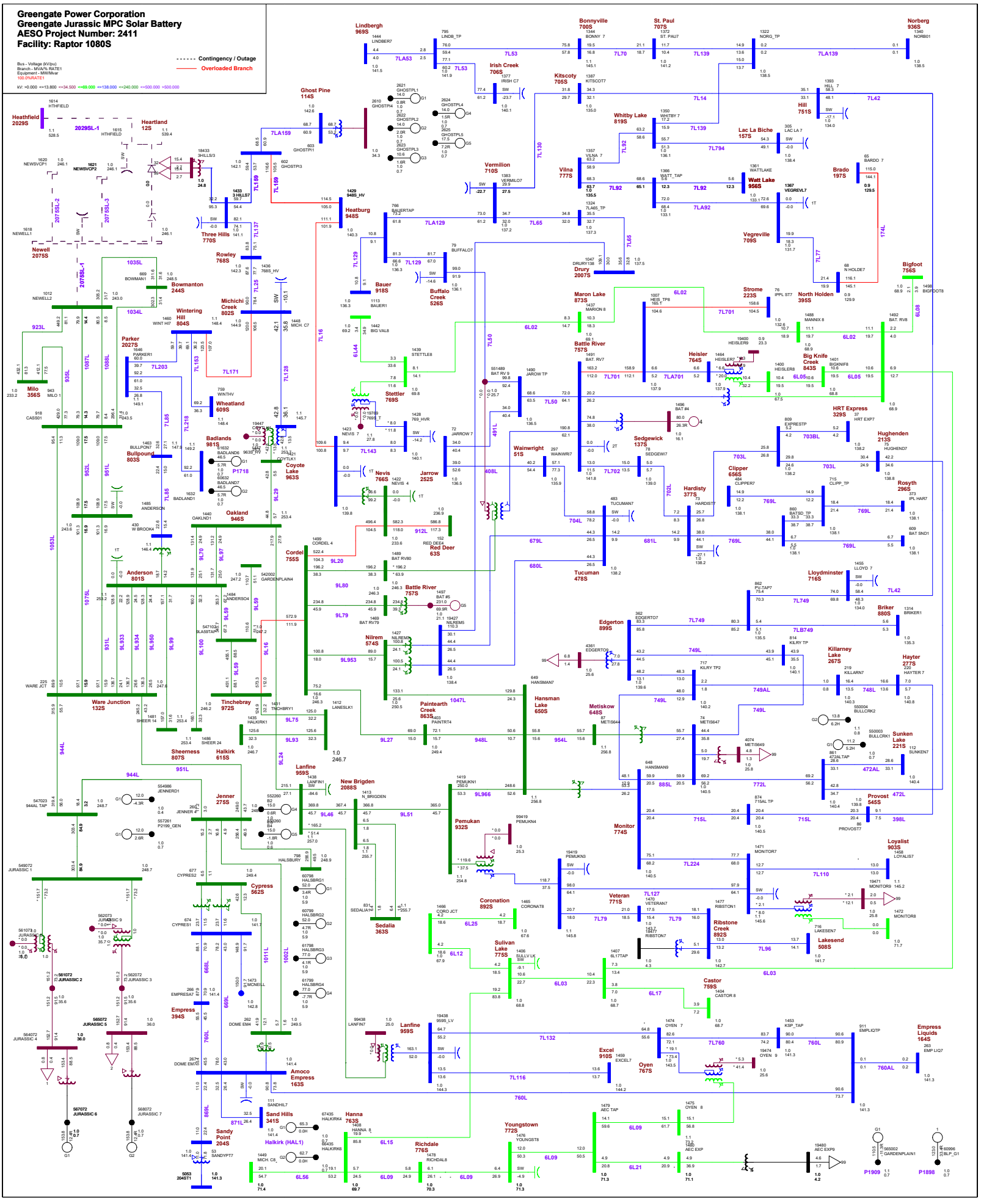


Figure A3-4: 2023 Summer Peak Post-Project - N-1 Contingency of 9LA59TAP (Anderson 801S - P1909 - Tinchebray 972S)

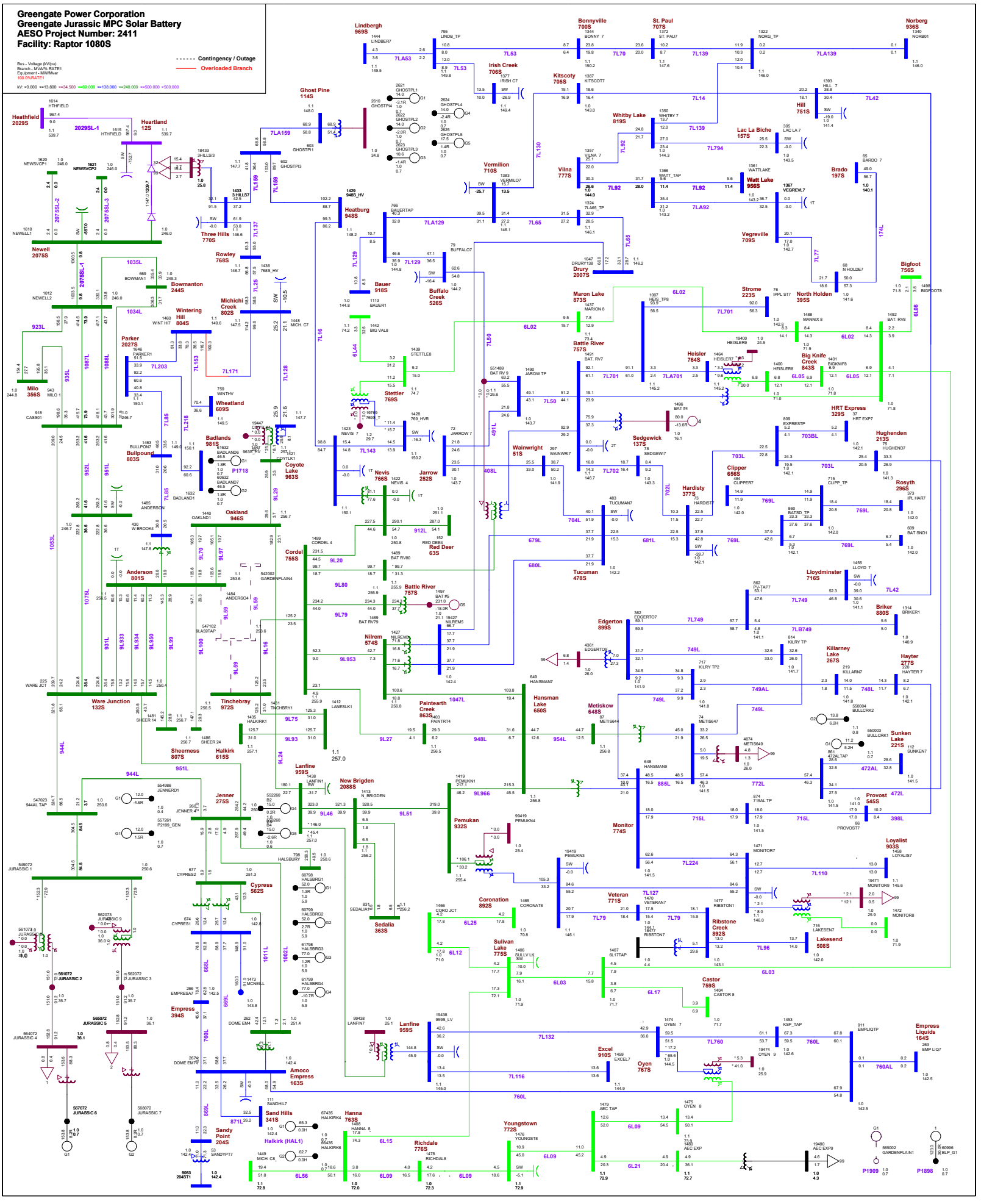


Figure A3-5: 2023 Summer Peak Post-Project - N-1 Contingency of 669L (Amoco Empress 163S - Cypress 562S)

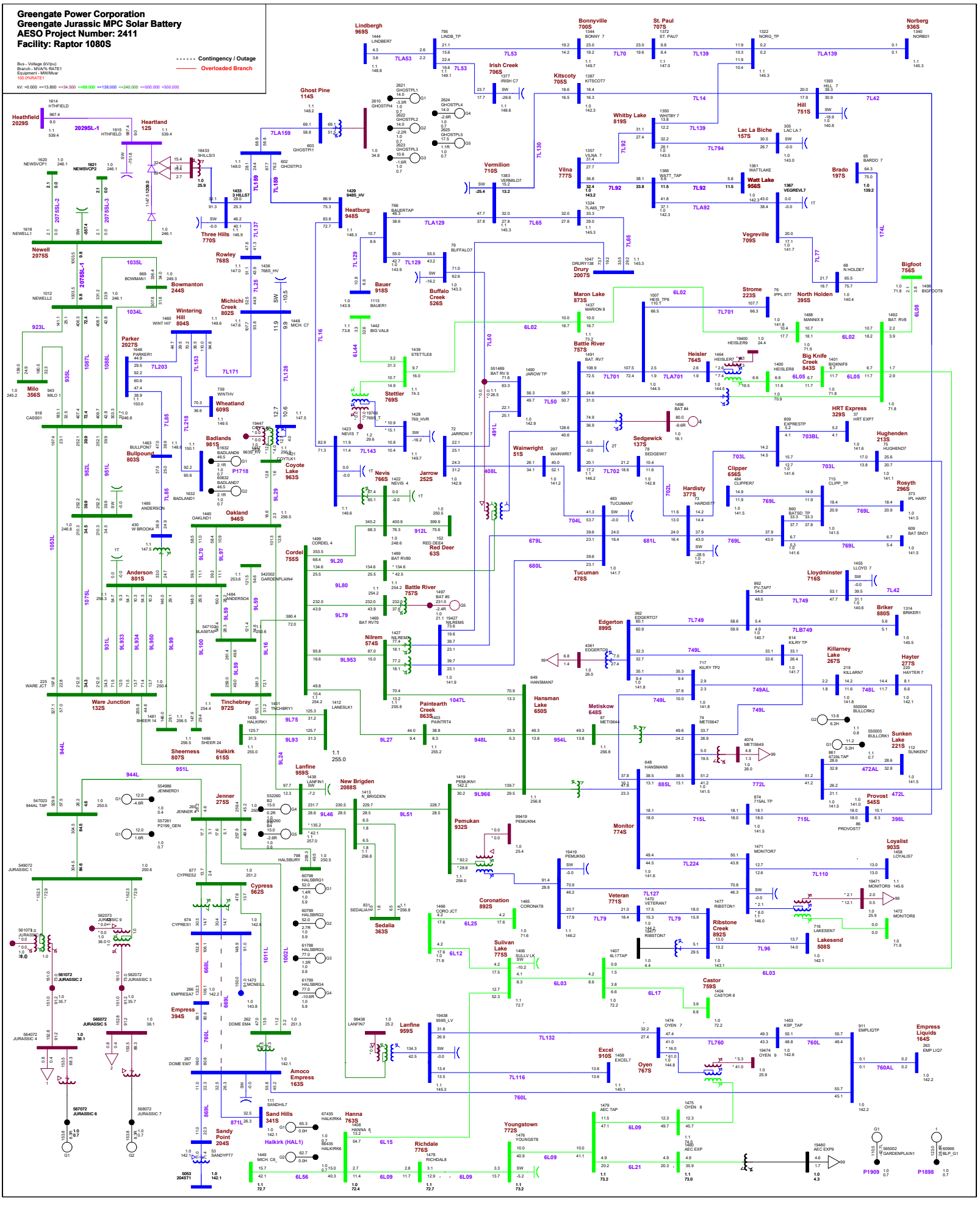


Figure A3-6: 2023 Summer Peak Post-Project - N-1 Contingency of 9L20 (Nevis 766S - Cordel 755S)

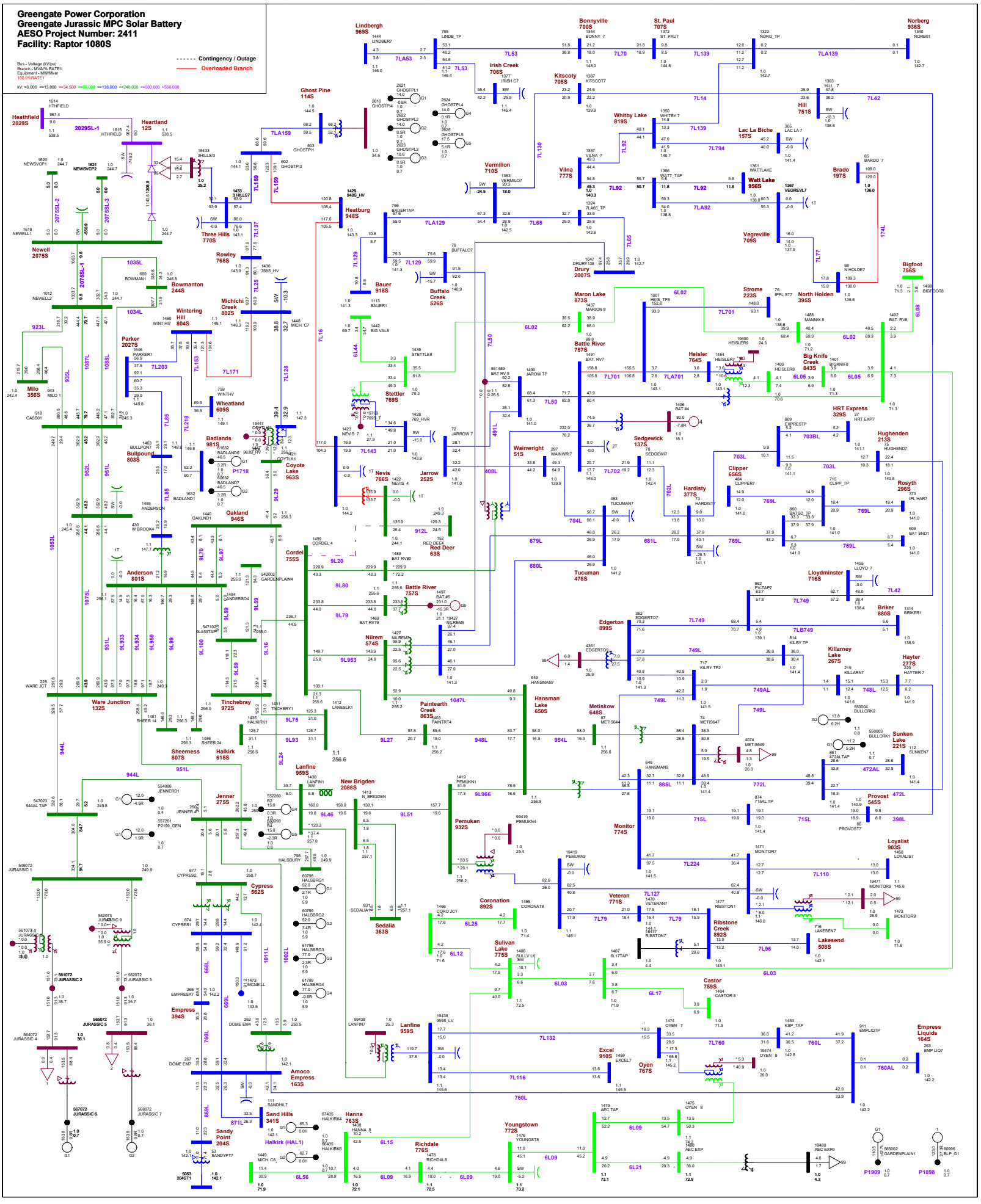


Figure A3-7: 2023 Summer Peak Post-Project - N-1 Contingency of 9L16 (Tinchebray 972S - Cordel 755S)

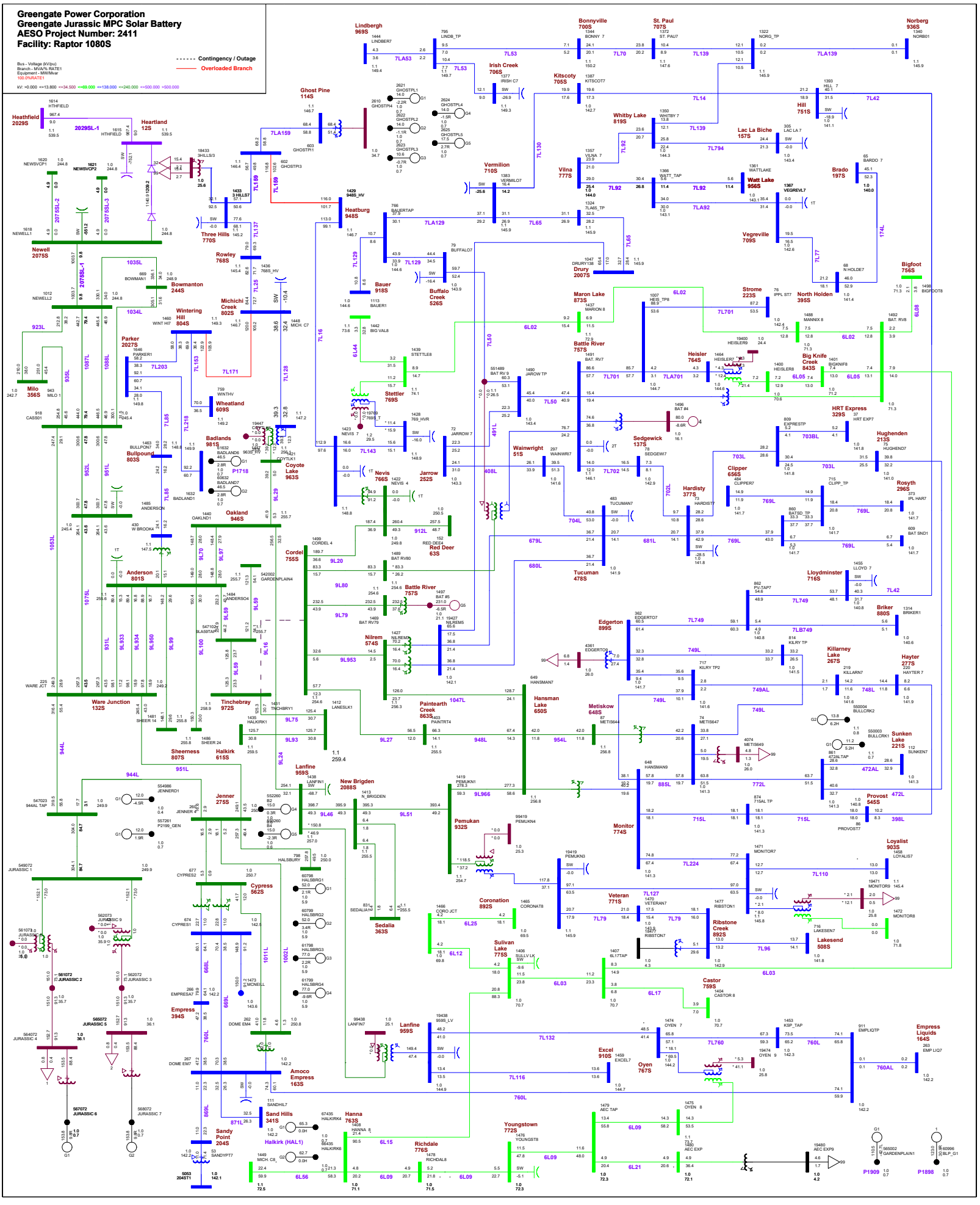


Figure A3-8: 2023 Summer Peak Post-Project - N-1 Contingency of 9L29 (Oakland 946S - Coyote Lake 963S)

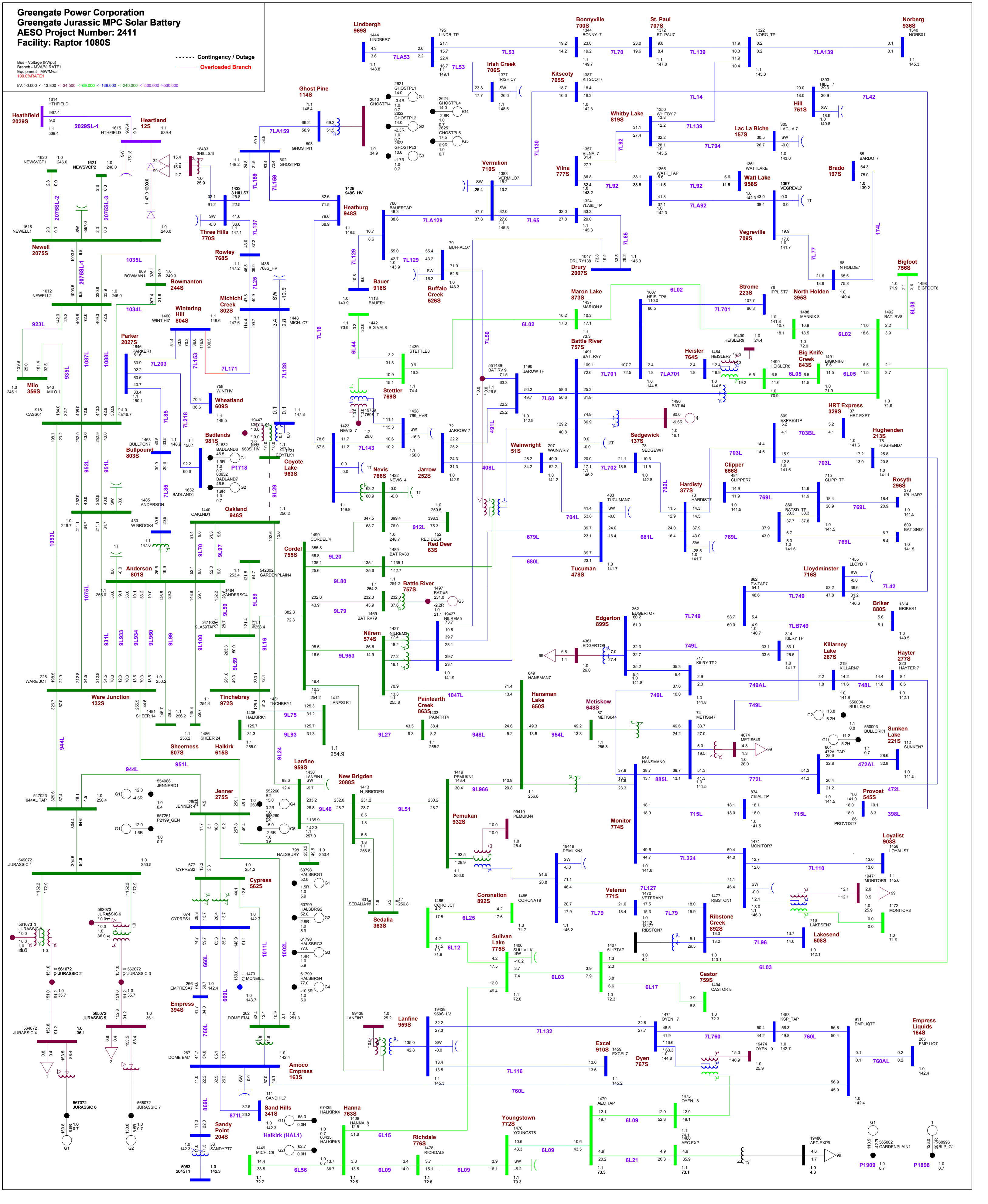


Figure A3-9: 2023 Summer Peak Post-Project - N-1 Contingency of 9L966 (Hansman Lake 650S - Pemukan 932S)

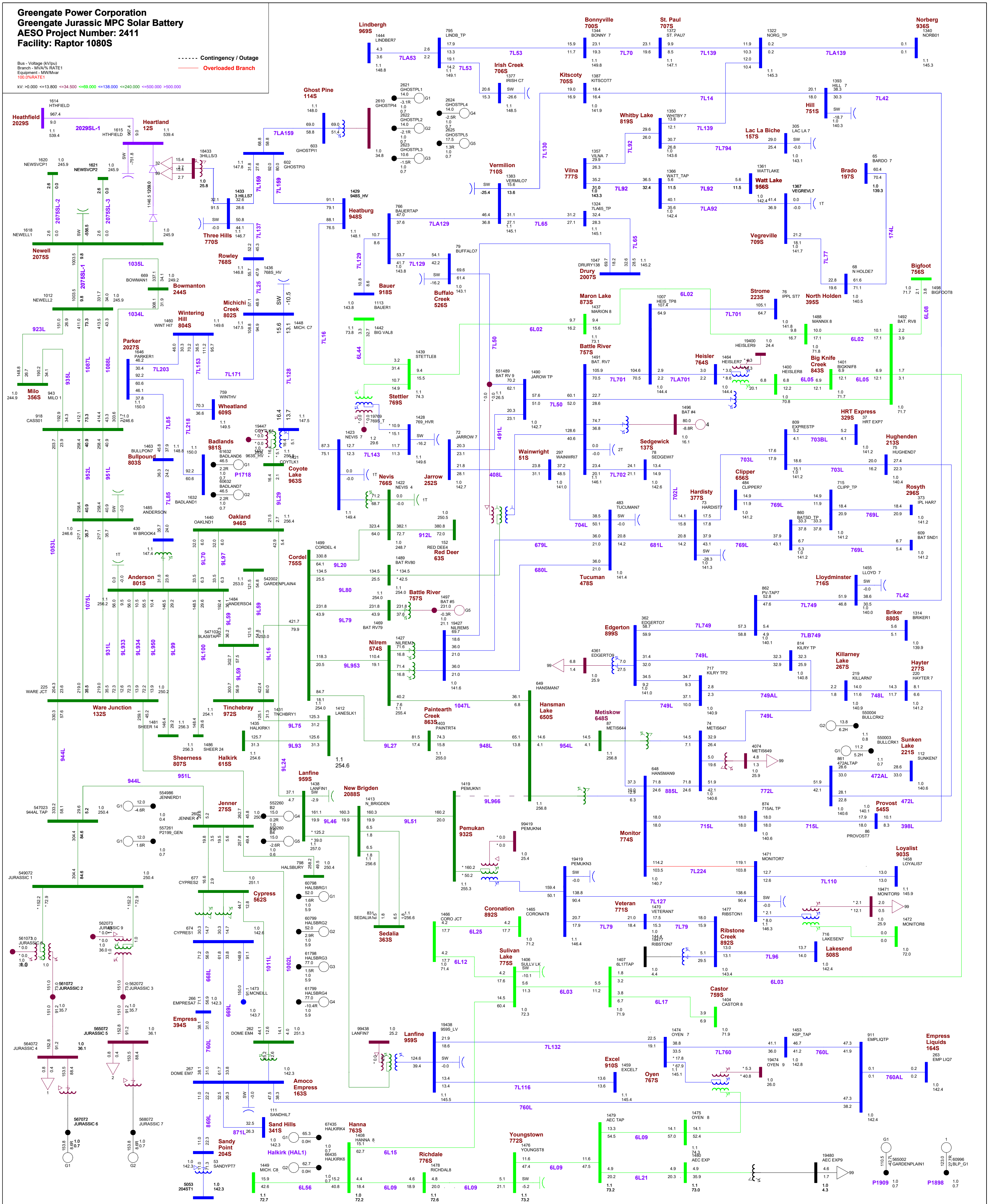
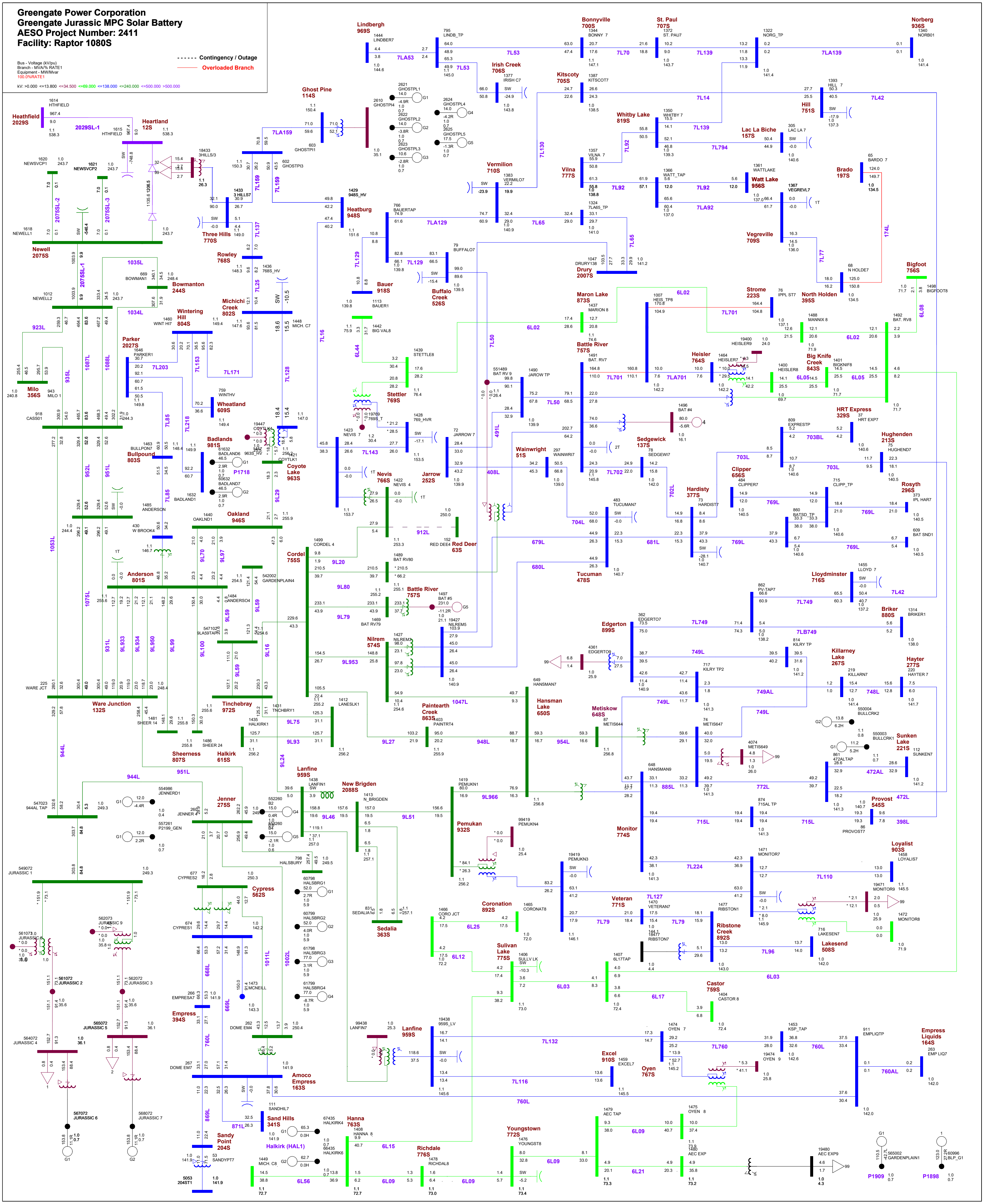


Figure A3-10: 2023 Summer Peak Post-Project - N-1 Contingency of 912L\9L912 (Red Deer 63S - Nevis 766S)



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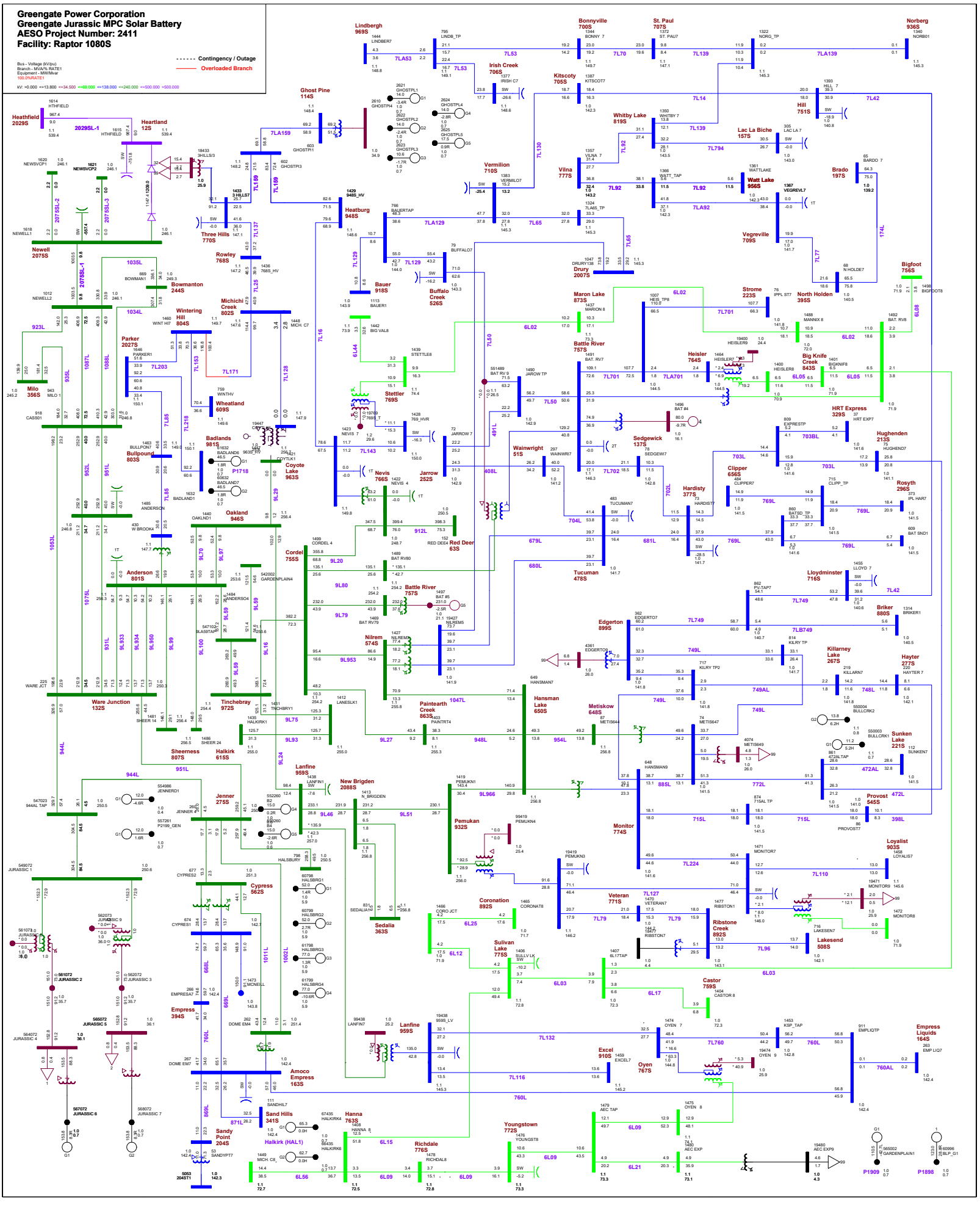


Figure A3-12: 2023 Summer Peak Post-Project - N-1 Contingency of 7L171 (Michichi Creek 802S - Wintering Hills 804S)

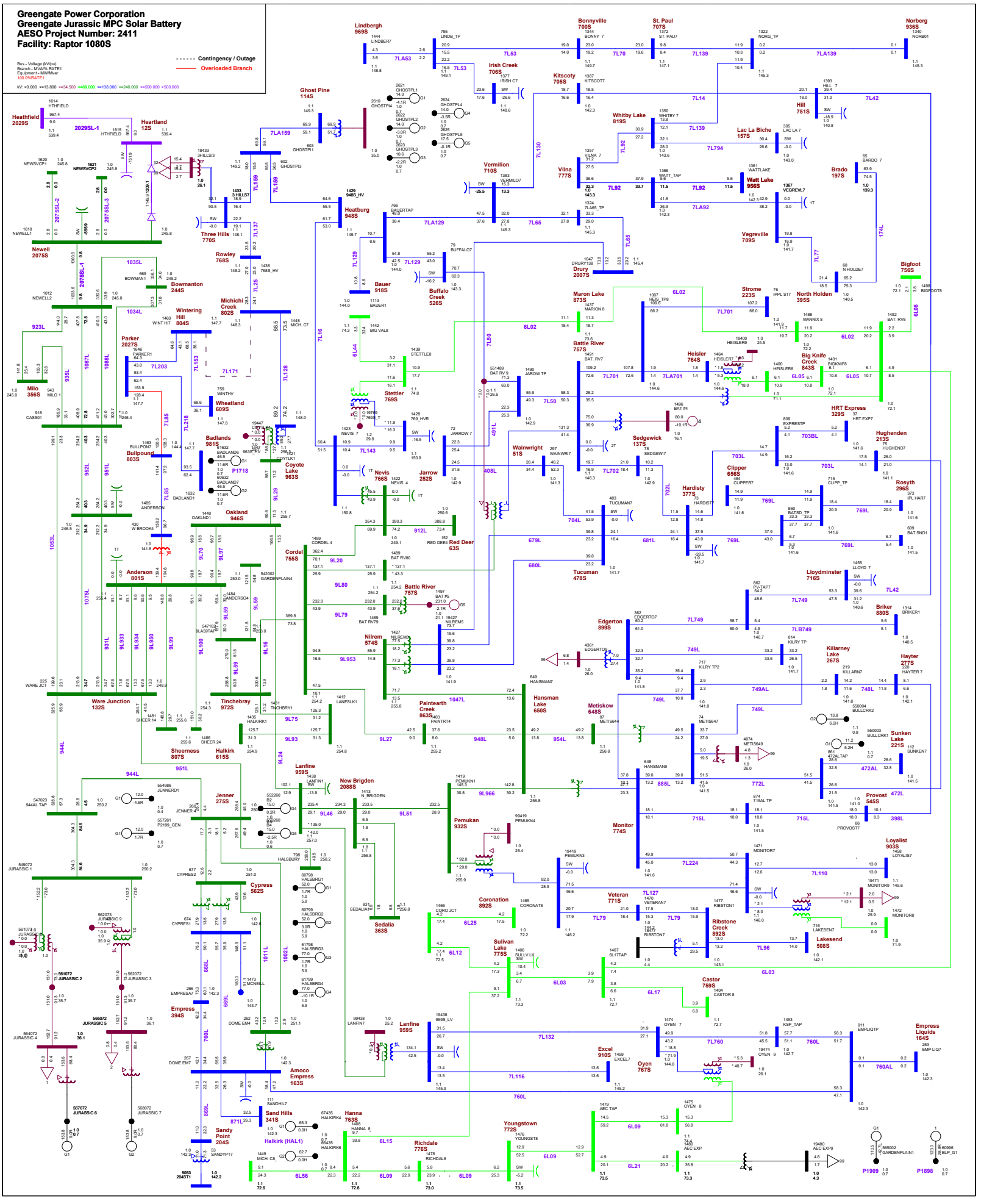


Figure A3-13: 2023 Summer Peak Post-Project - N-1 Contingency of 801S901T (Anderson 801S Transformer 901T)

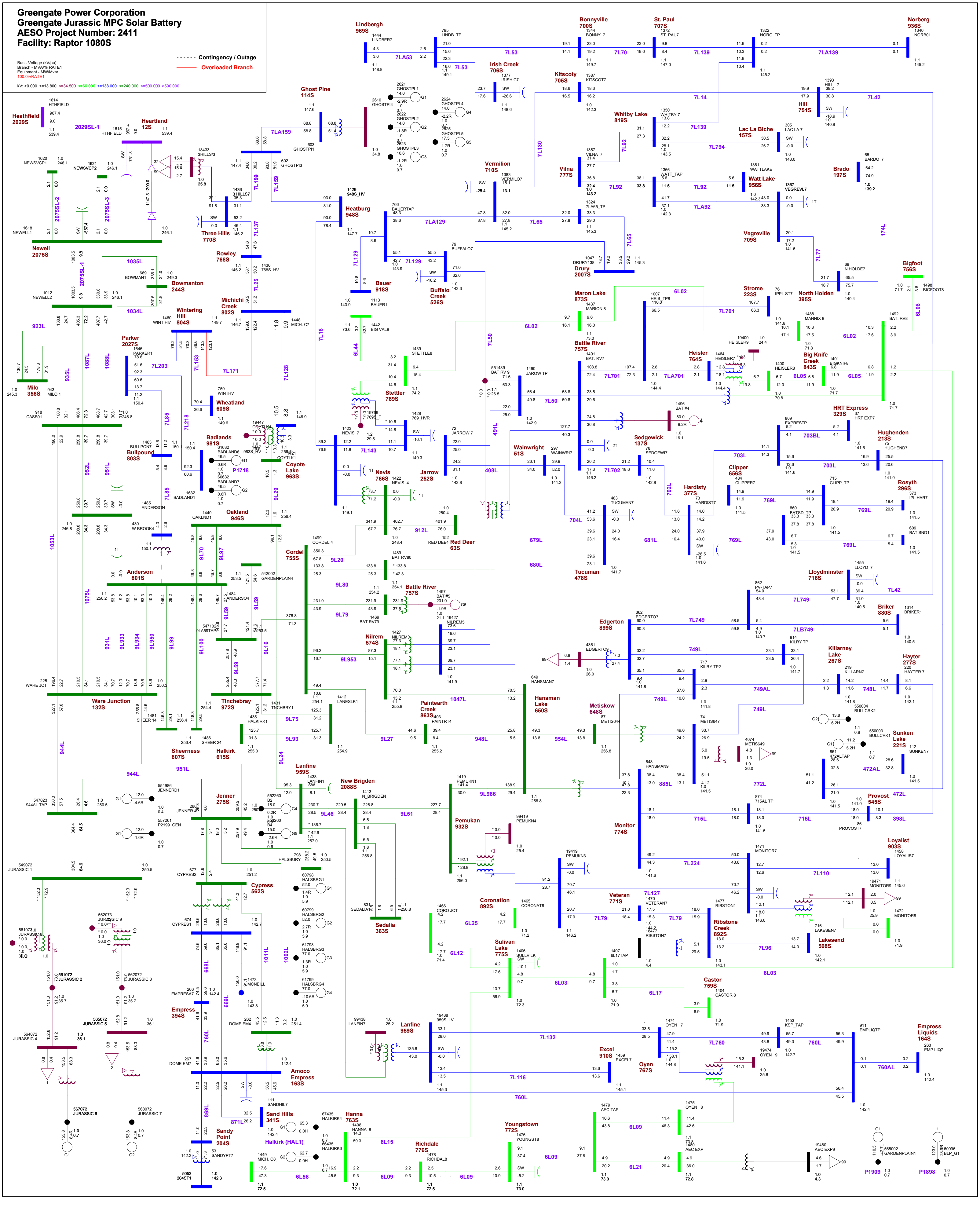


Figure A3-14: 2023 Summer Peak Post-Project - N-1 Contingency of 114ST1 (Ghost Pine 114S Transformer T1)

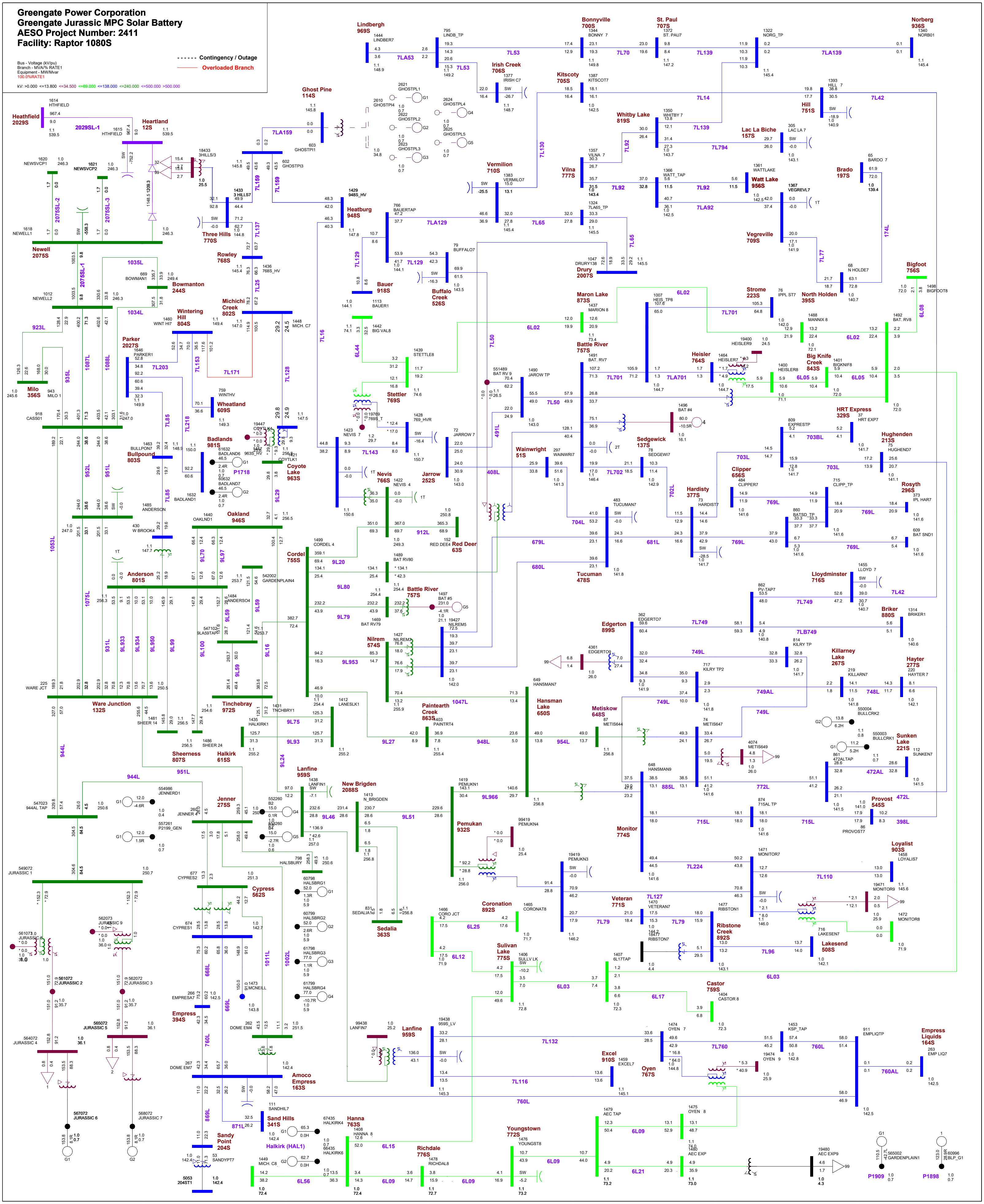


Figure A3-15: 2023 Summer Light Post-Project - N-0 (System Normal Condition)

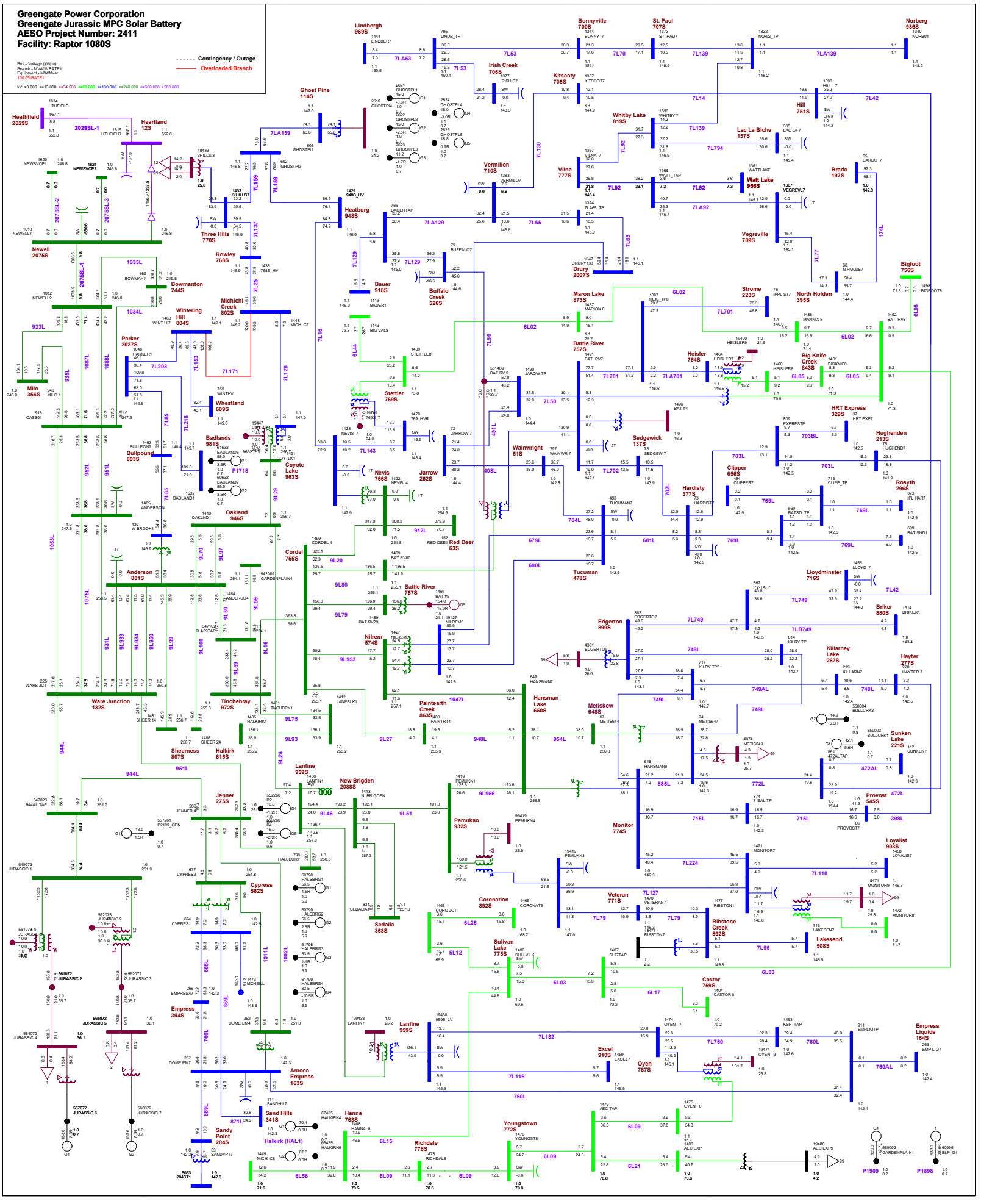


Figure A3-16: 2023 Summer Light Post-Project - N-1 Contingency of 766S901T (Nevis 766S Transformer 901T)

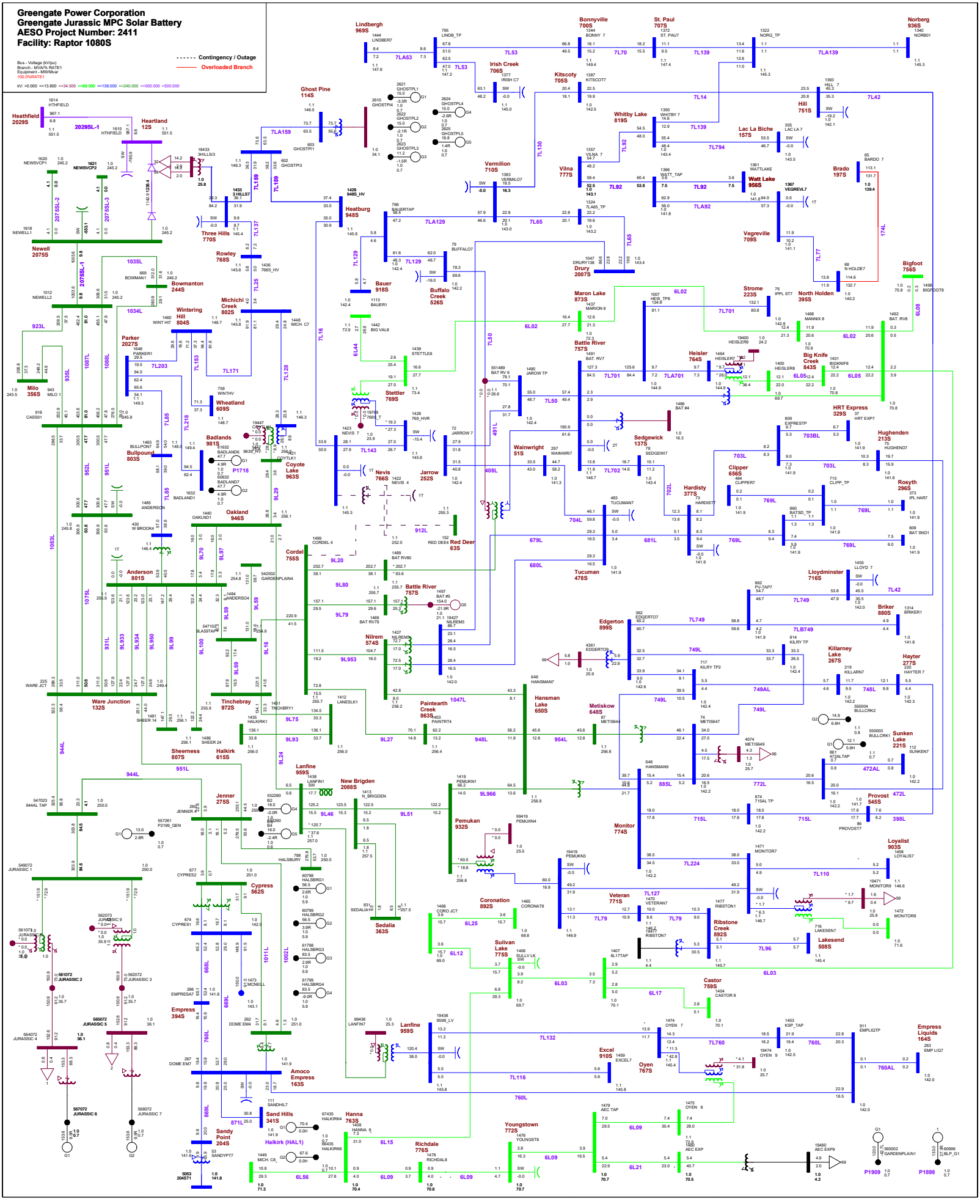


Figure A3-17: 2023 Summer Light Post-Project - N-1 Contingency of EATL (Newell 2075S - Heathfield 2029S)

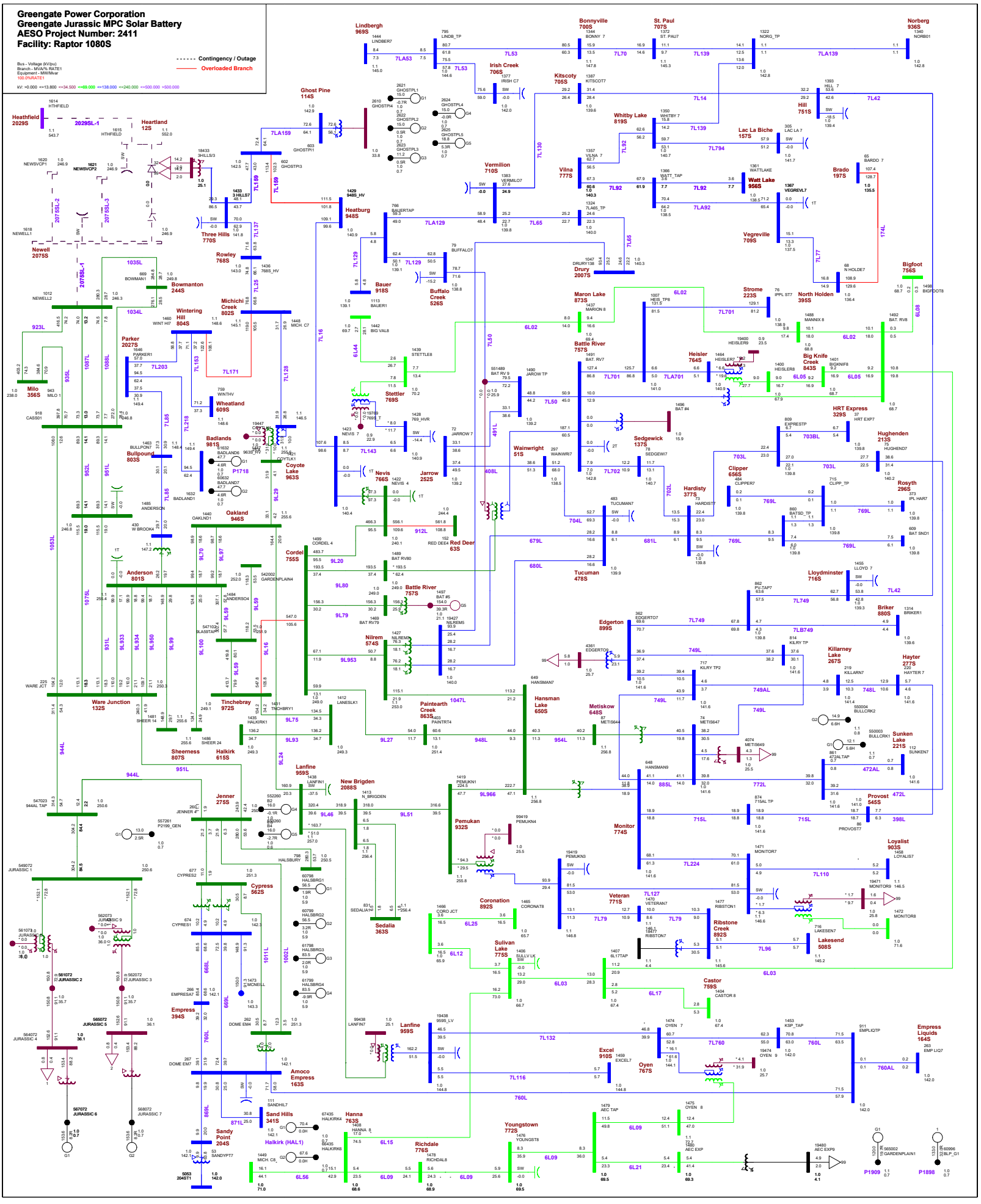


Figure A3-18: 2023 Summer Light Post-Project - N-1 Contingency of 669L (Amoco Empress 163S - Cypress 562S)

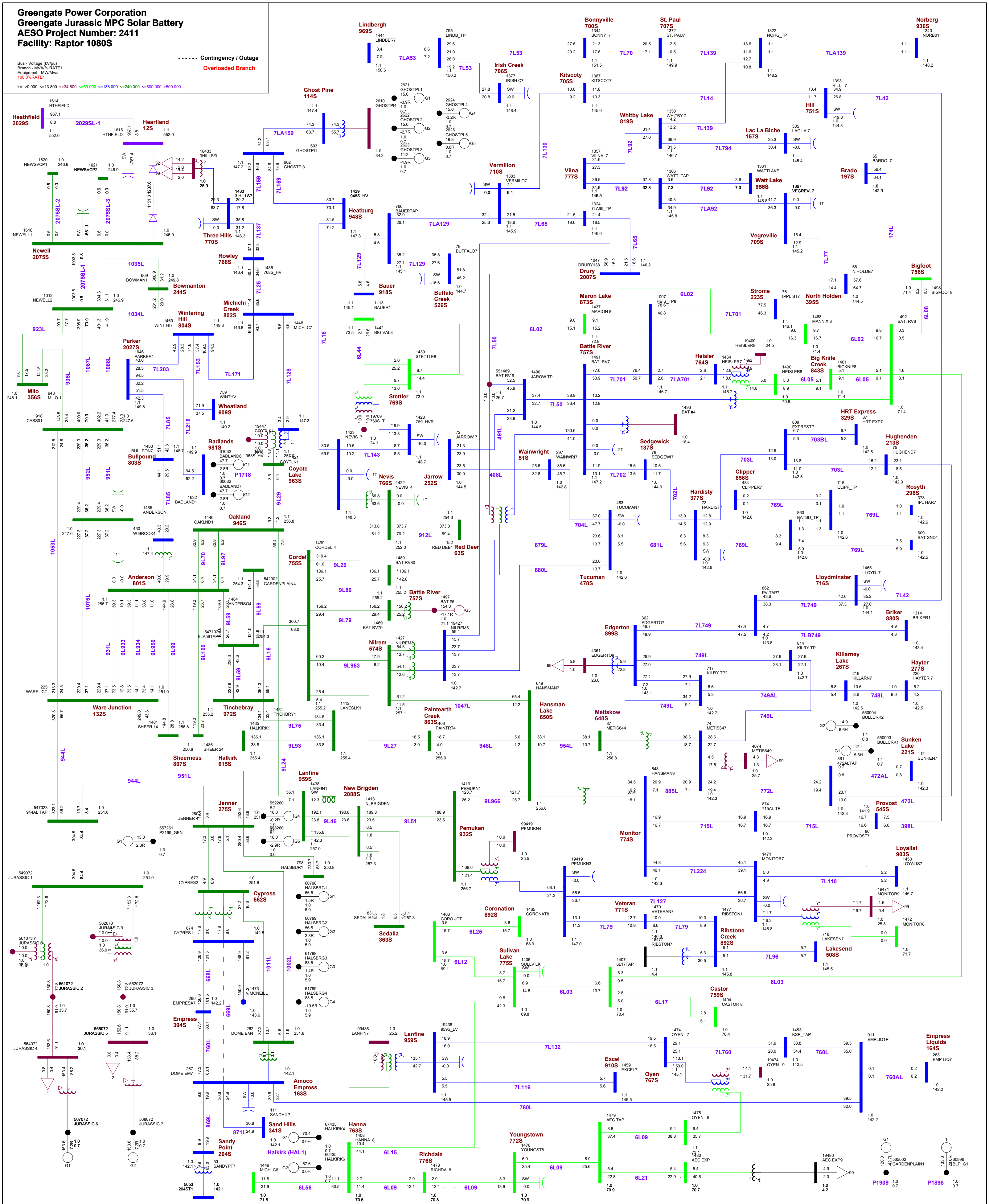


Figure A3-19: 2023 Summer Light Post-Project - N-1 Contingency of 9L20 (Nevis 766S - Cordel 755S)

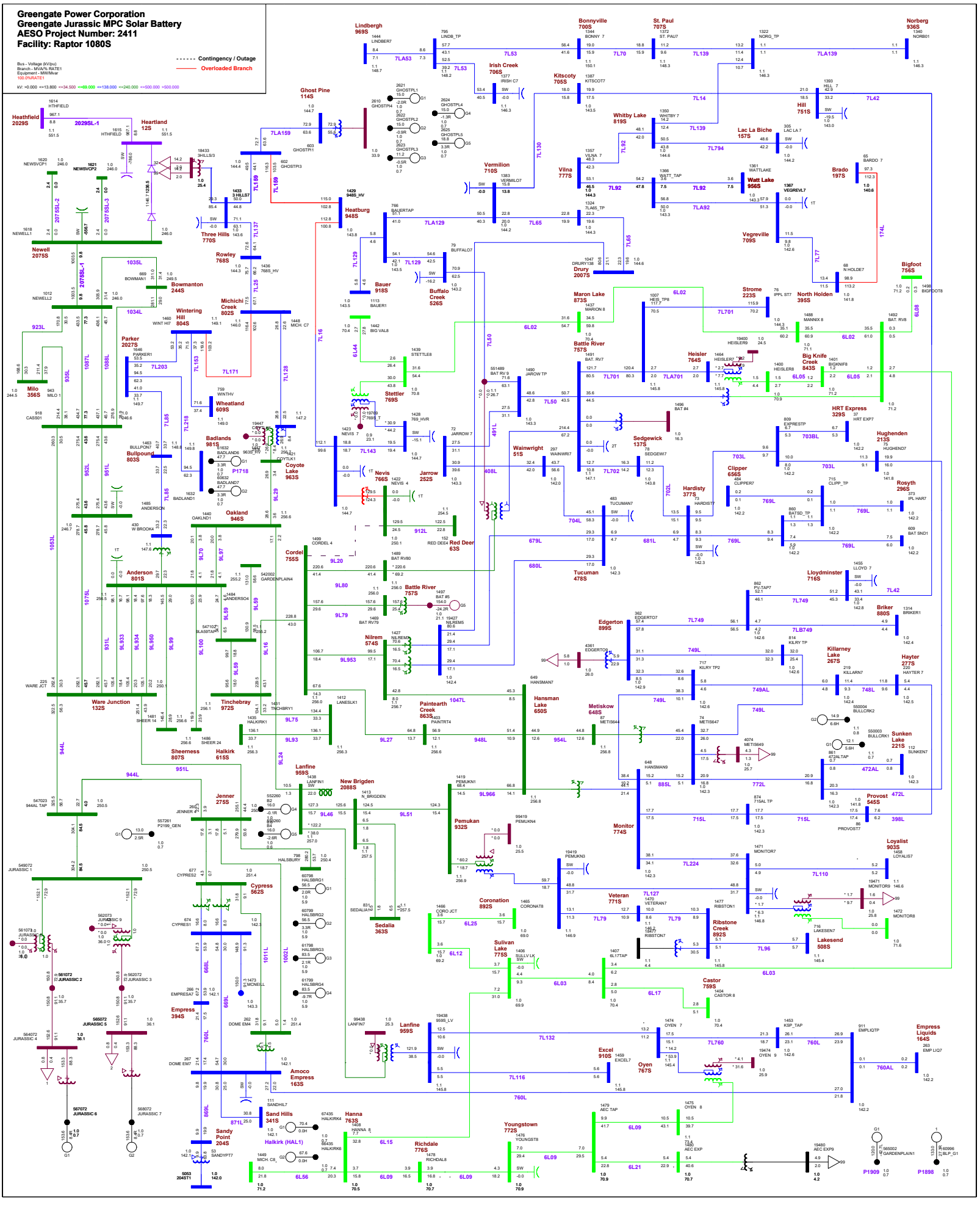


Figure A3-20: 2023 Summer Light Post-Project - N-1 Contingency of 9L16 (Tinchebray 972S - Cordel 755S)

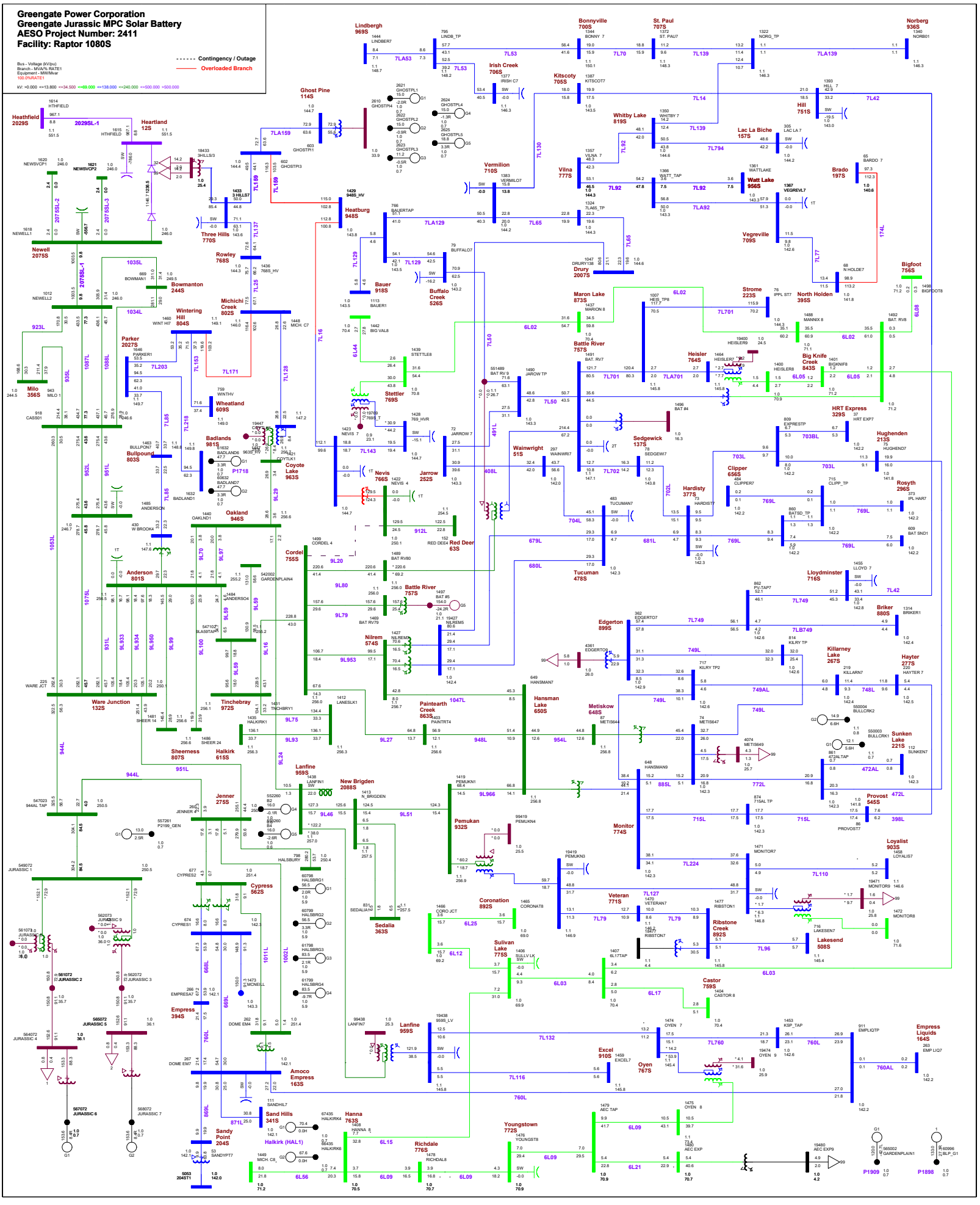


Figure A3-21: 2023 Summer Light Post-Project - N-1 Contingency of 912L\9L912 (Red Deer 63S - Nevis 766S)

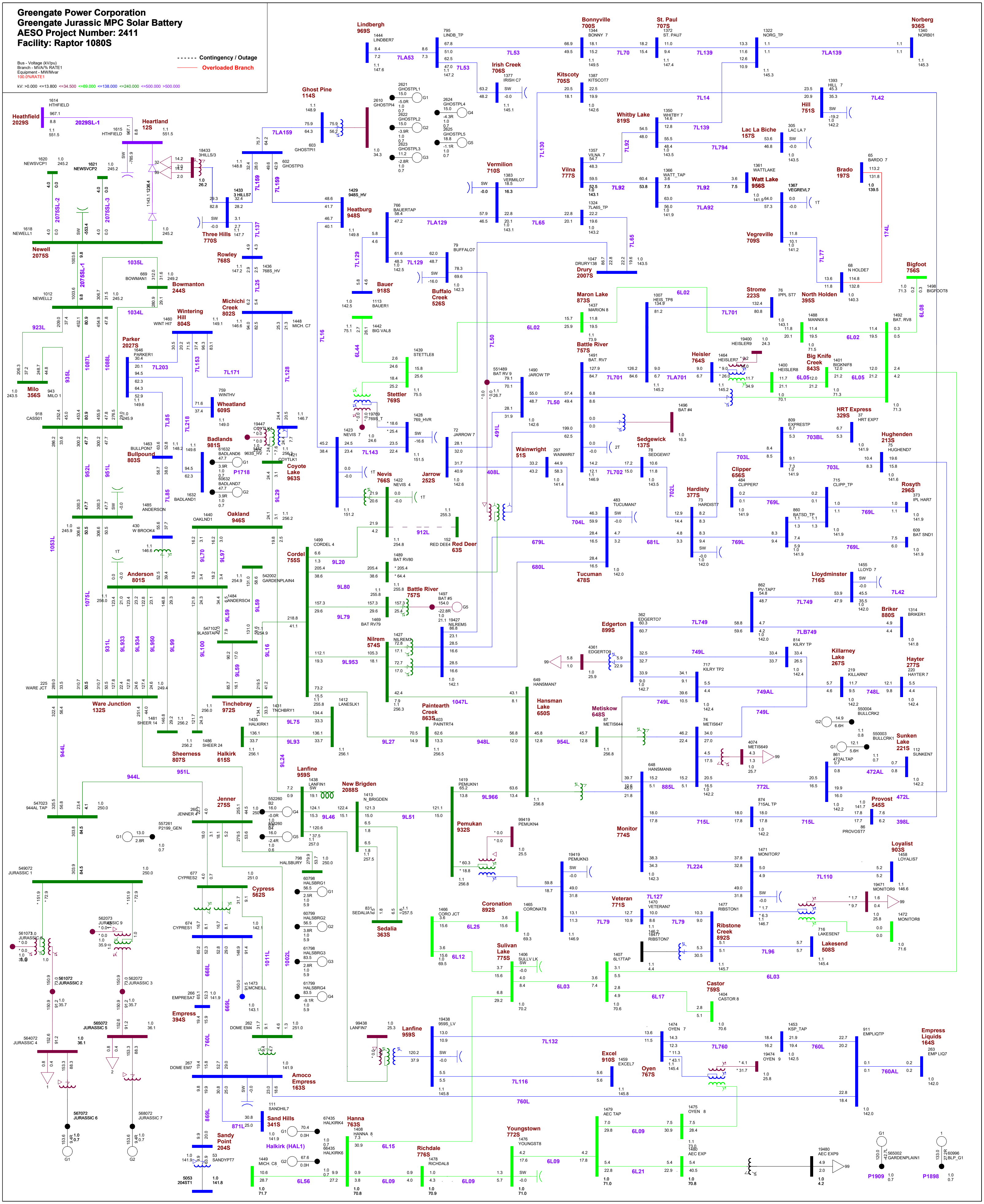


Figure A3-22: 2023 Summer Light Post-Project - N-1 Contingency of 959S901T (Lanfine 959S Transformer 901T)

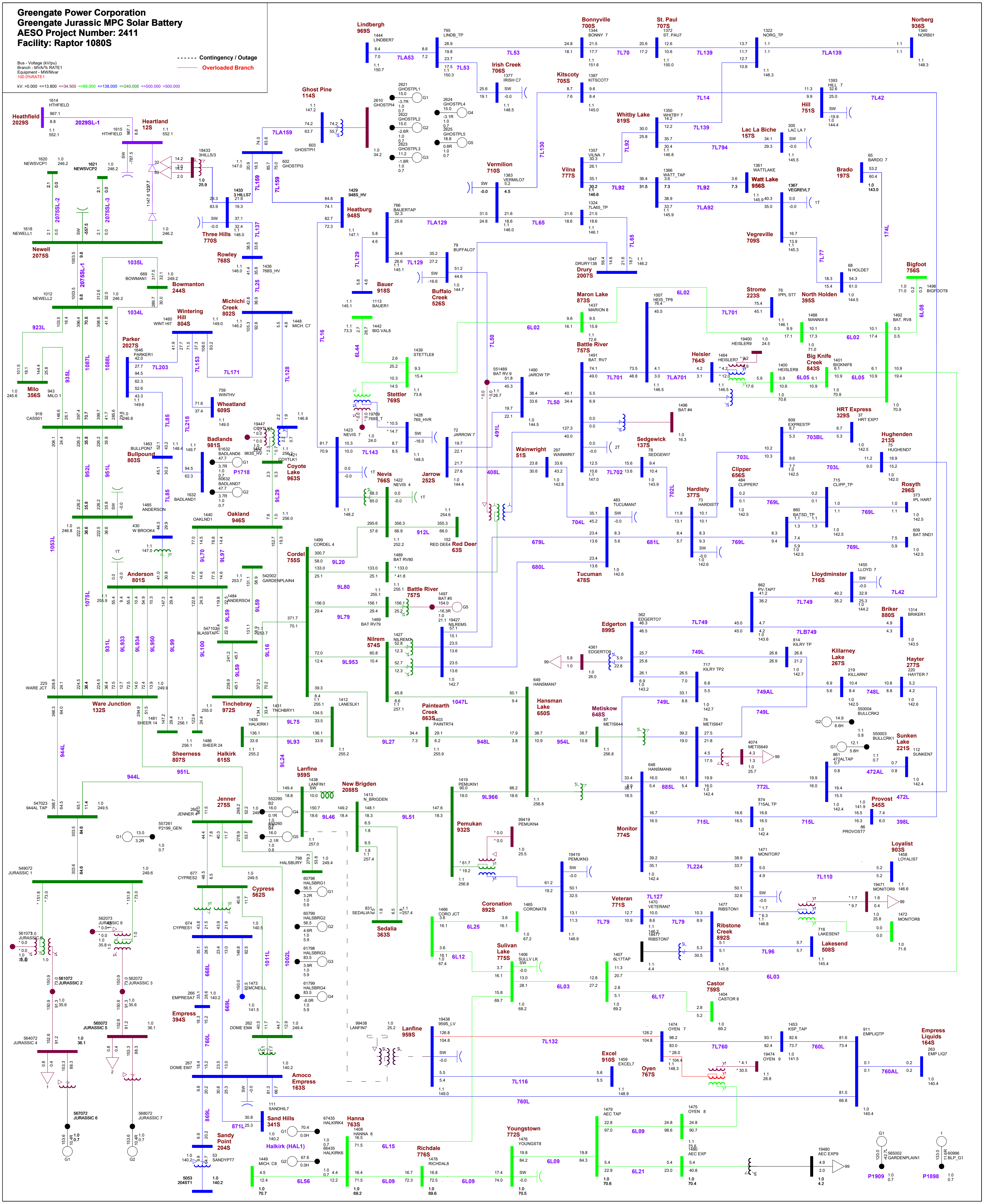


Figure A3-23: 2023 Summer Light Post-Project - N-1 Contingency of 7L171 (Michichi Creek 802S - Wintering Hills 804S)

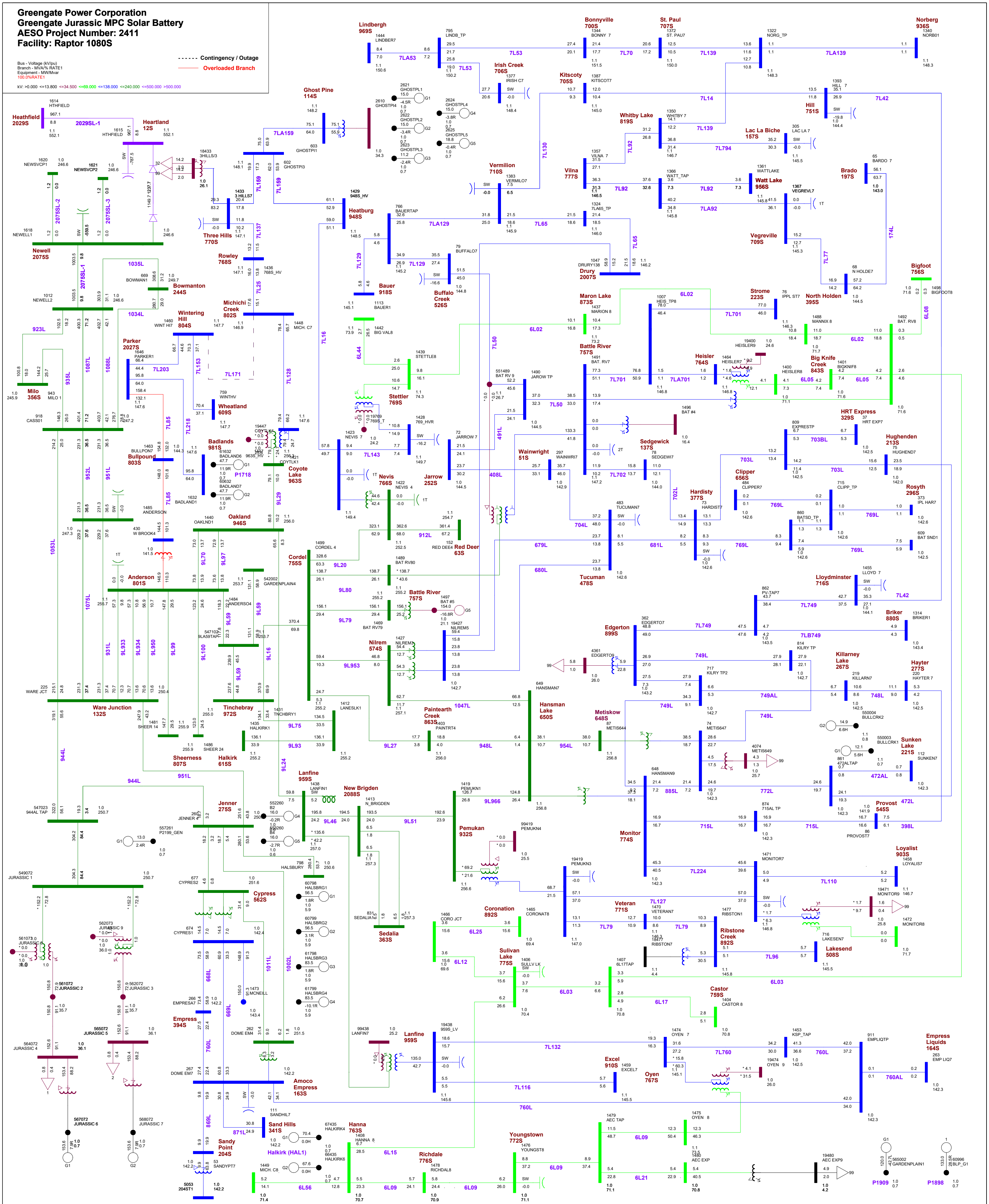


Figure A3-24: 2023 Summer Light Post-Project - N-1 Contingency of 801S901T (Anderson 801S Transformer 901T)

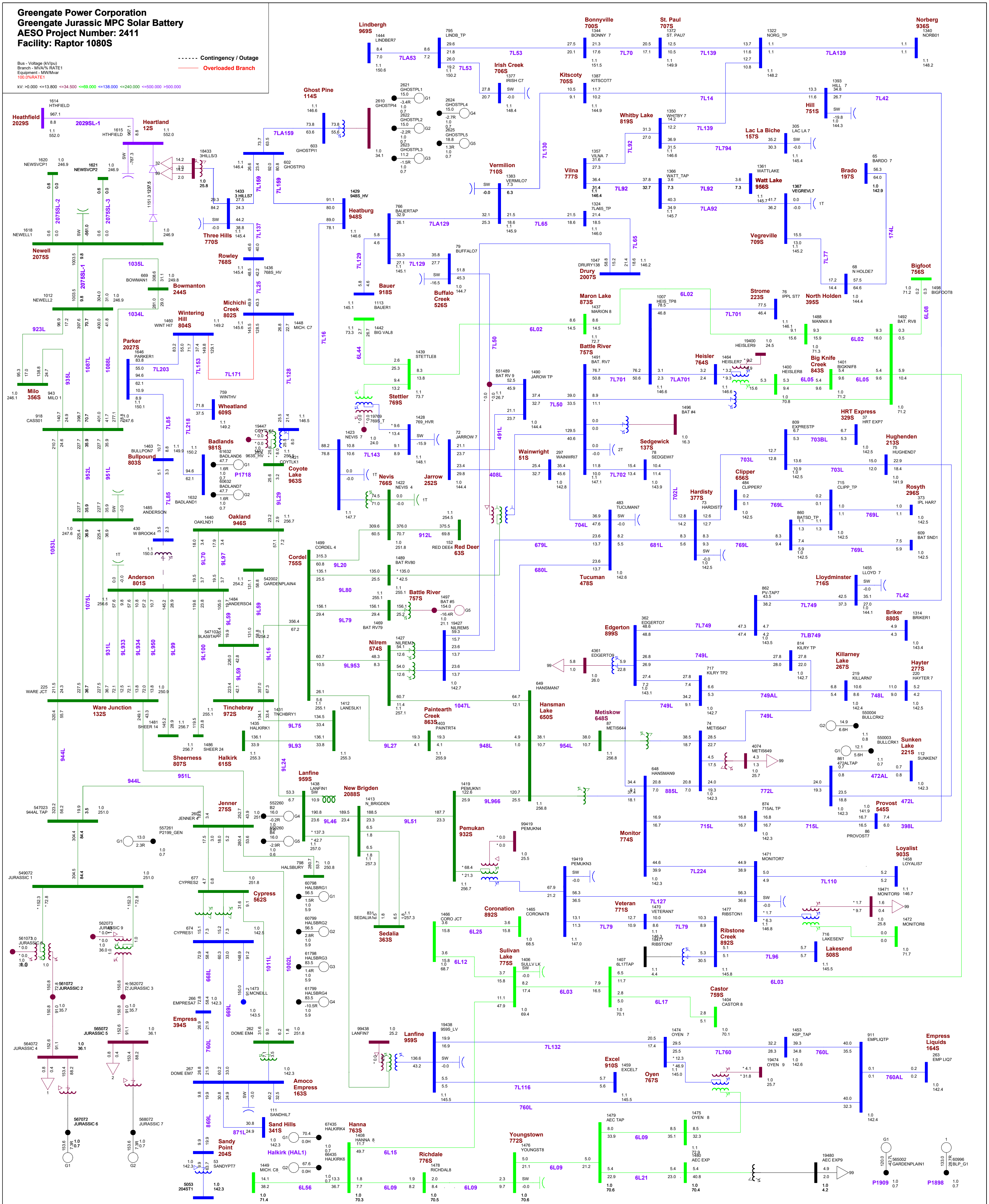


Figure A3-25: 2023 Summer Light Post-Project - N-1 Contingency of 114ST1 (Ghost Pine 114S Transformer T1)

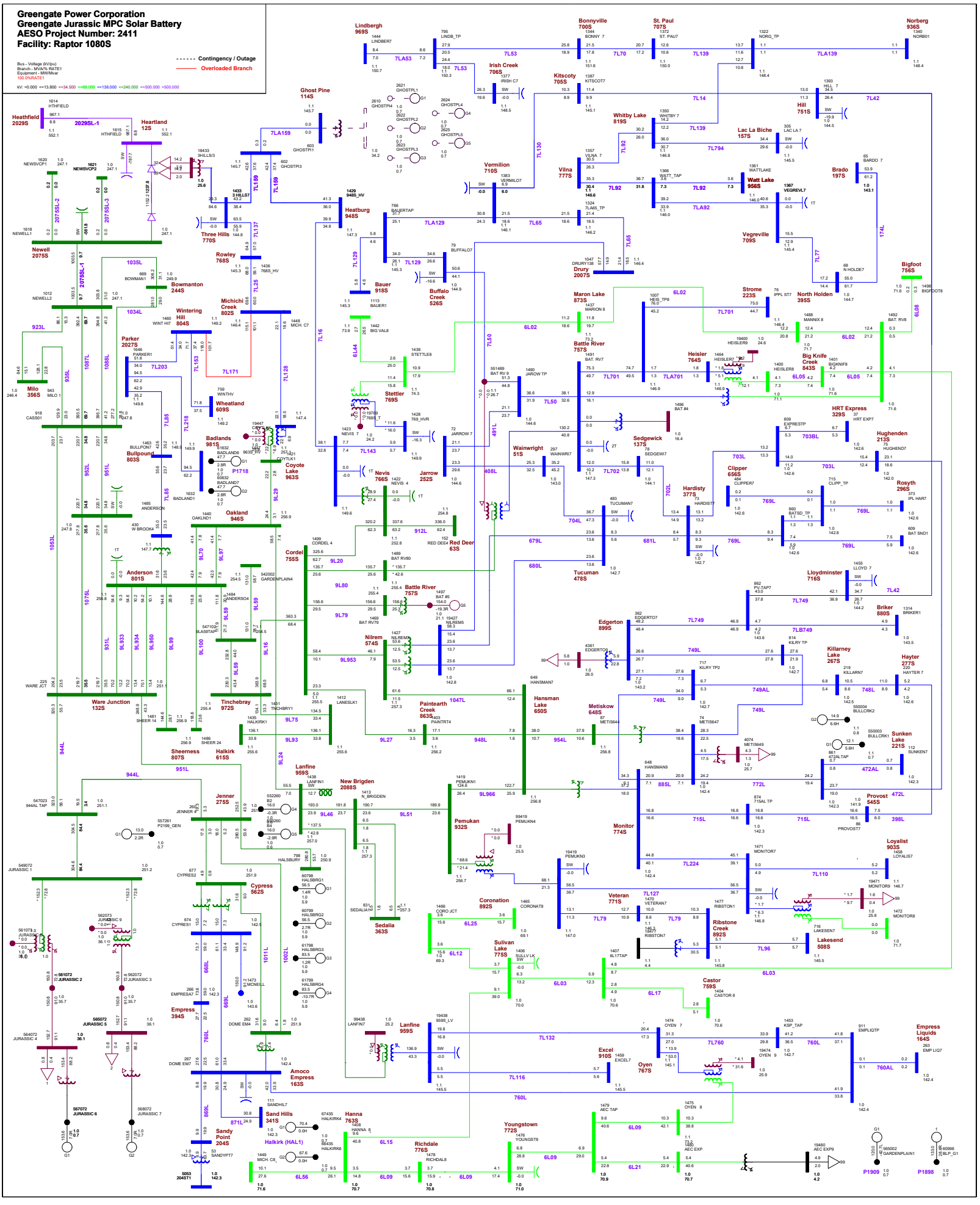


Figure A3-26: 2023 Winter Peak Post-Project - N-0 (System Normal Condition)

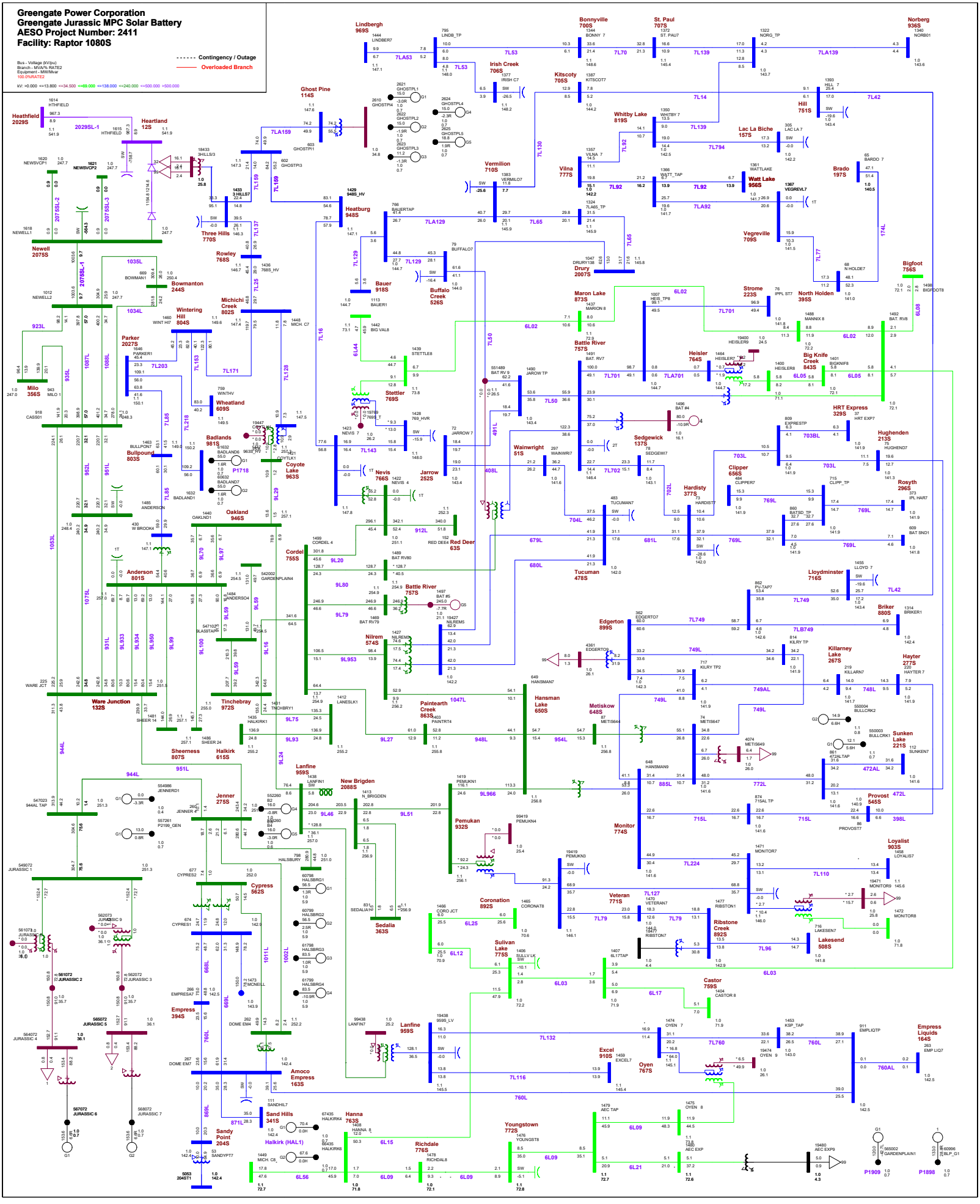


Figure A3-27: 2023 Winter Peak Post-Project - N-1 Contingency of 766S901T (Nevis 766S Transformer 901T)

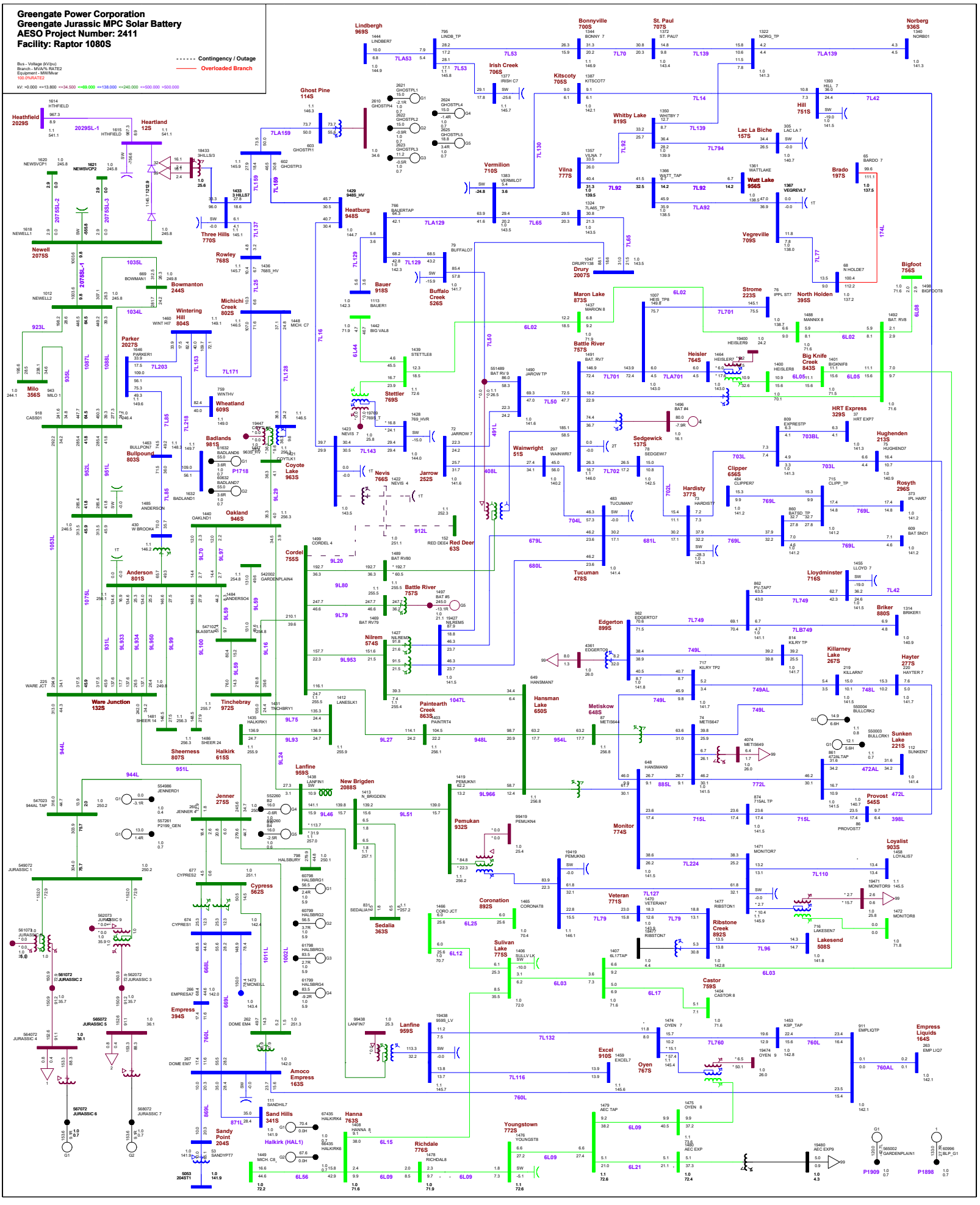


Figure A3-28: 2023 Winter Peak Post-Project - N-1 Contingency of EATL (Newell 2075S - Heathfield 2029S)

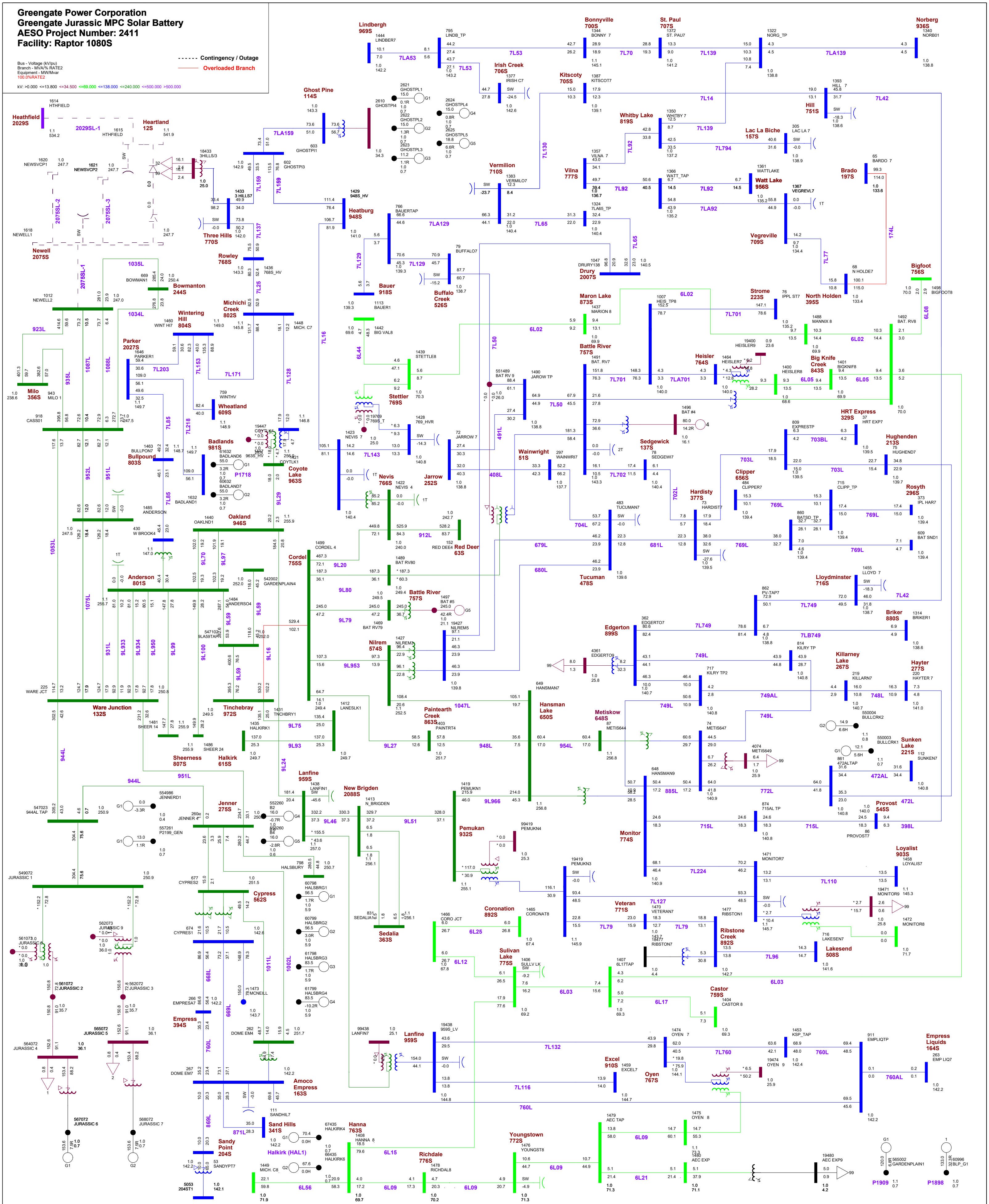


Figure A3-29: 2023 Winter Peak Post-Project - N-1 Contingency of 9L20 (Nevis 766S - Cordel 755S)

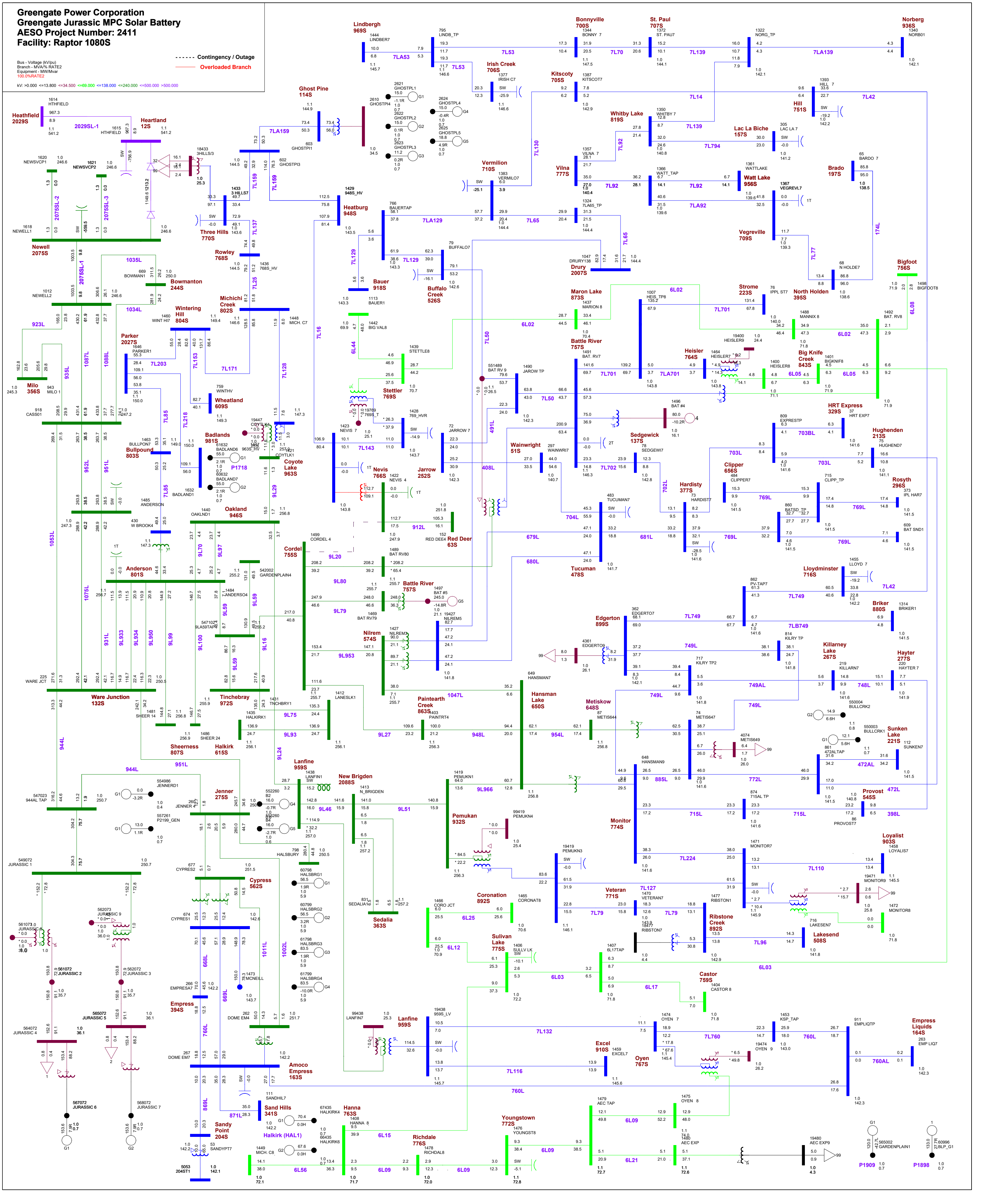


Figure A3-30: 2023 Winter Peak Post-Project - N-1 Contingency of 912L\9L912 (Red Deer 63S - Nevis 766S)

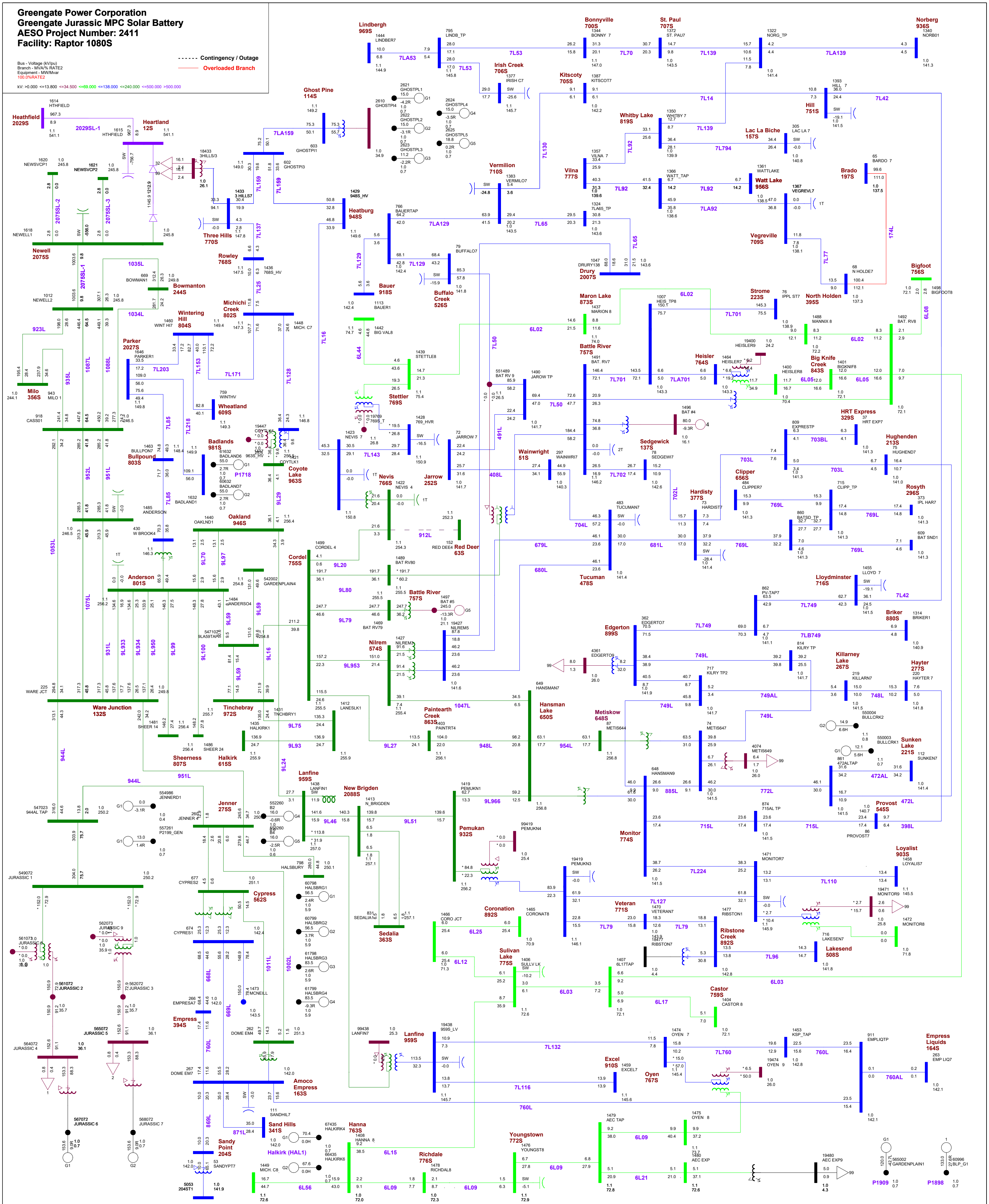


Figure A3-31: 2023 Winter Peak Post-Project - N-1 Contingency of 7L171 (Michichi Creek 802S - Wintering Hills 804S)

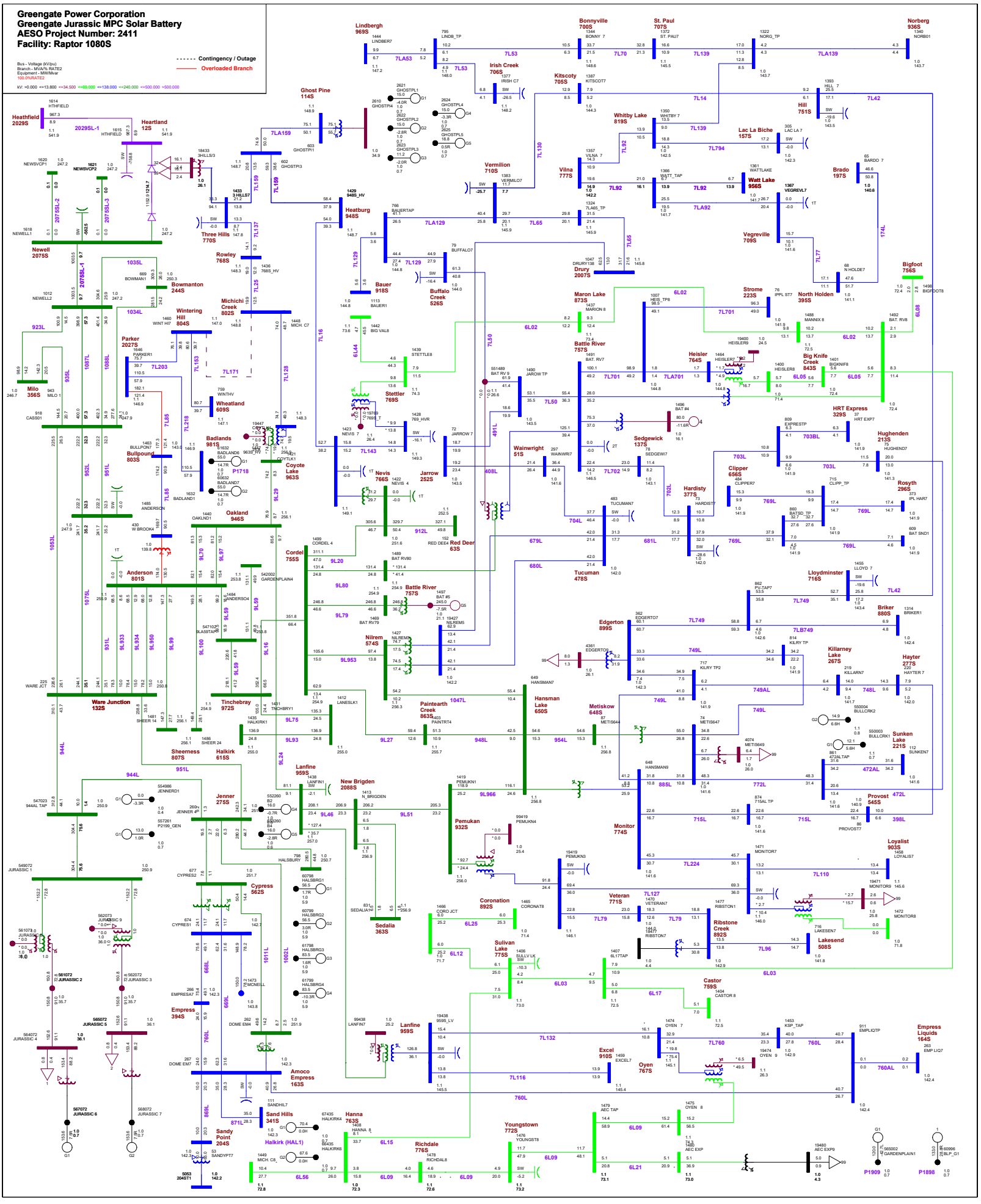


Figure A3-32: 2023 Winter Peak Post-Project - N-1 Contingency of 801S901T (Anderson 801S Transformer 901T)

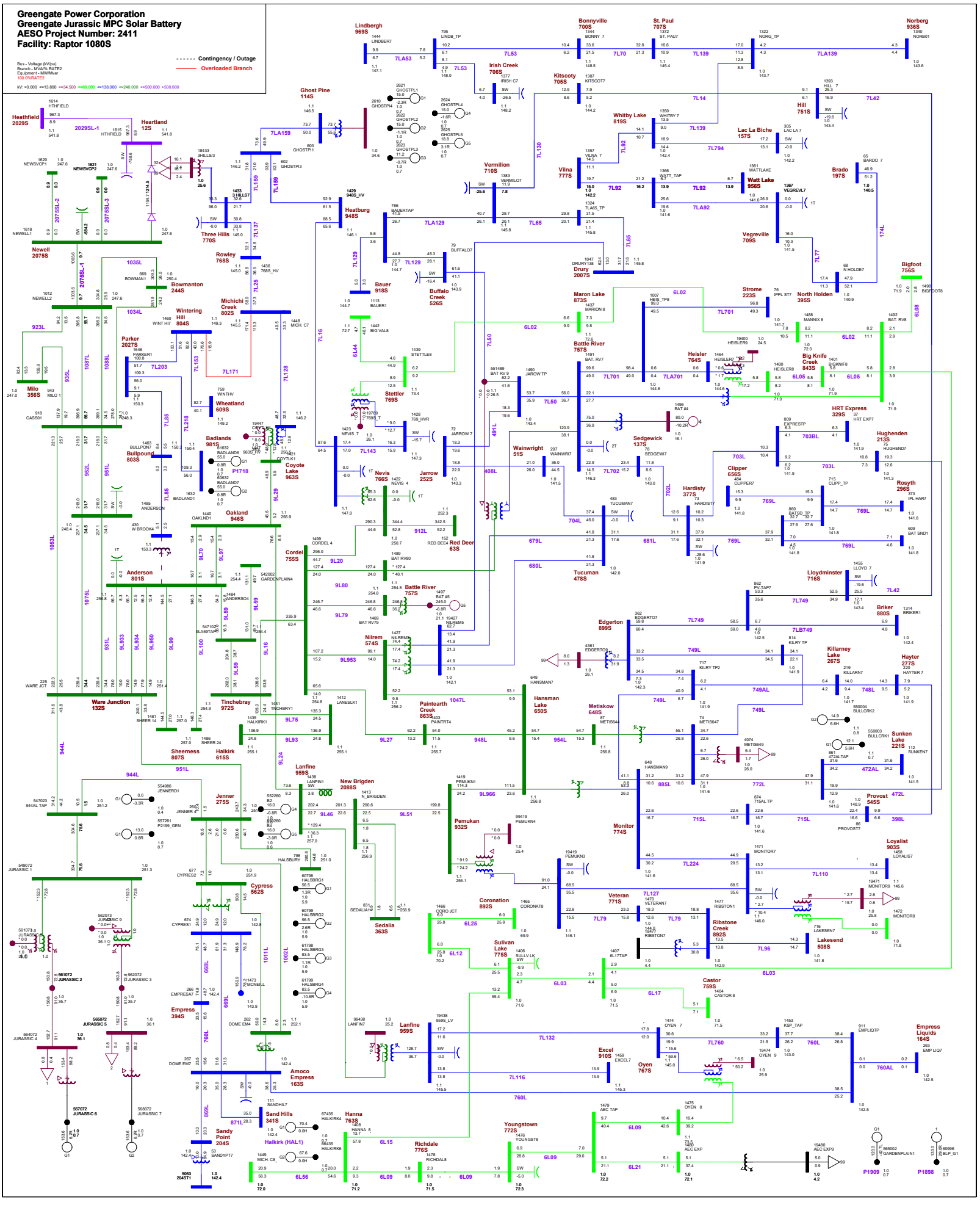


Figure A3-33: 2023 Summer Peak Sensitivity Post-Project - N-0 (System Normal Condition)

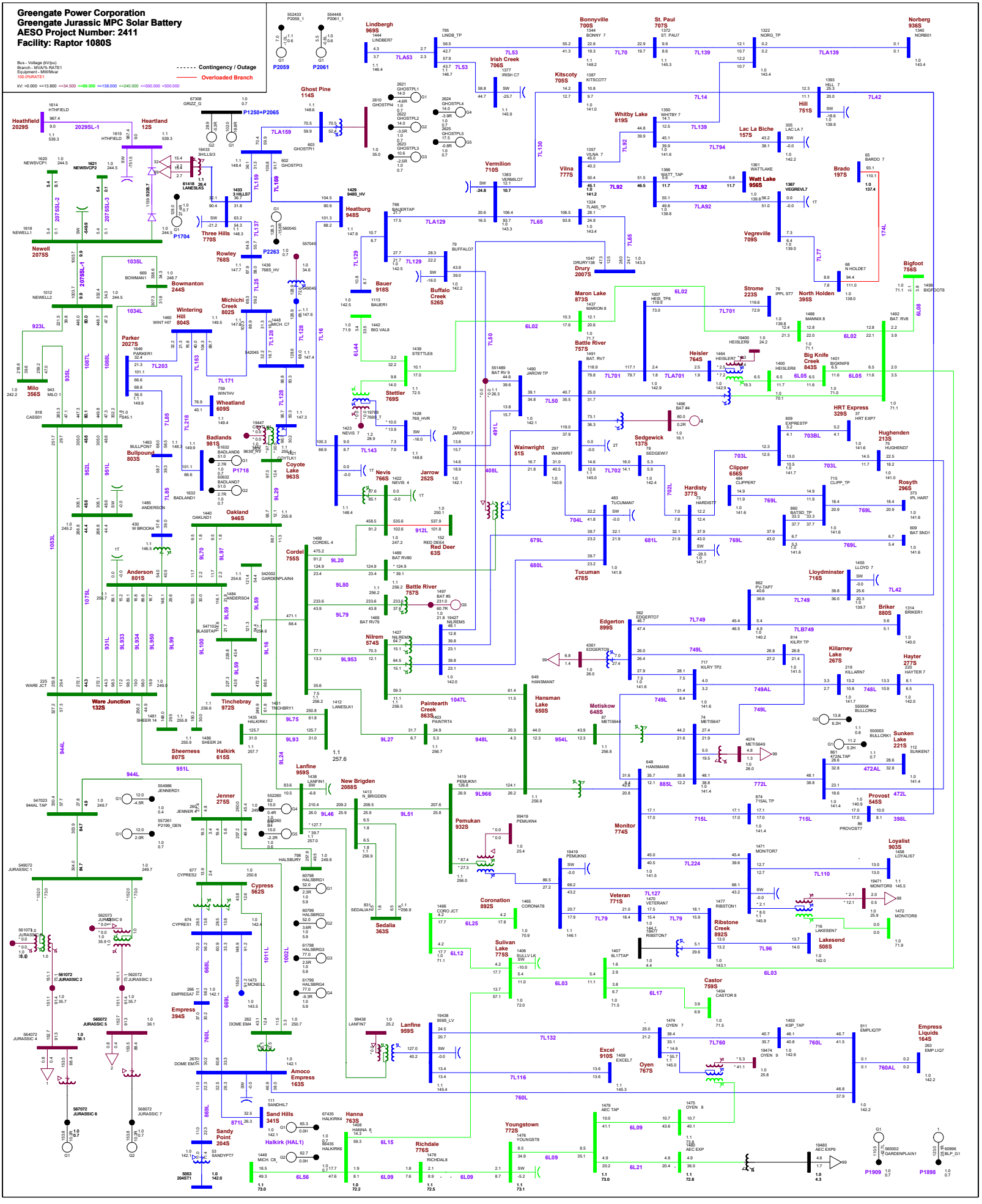


Figure A3-34: 2023 Summer Peak Sensitivity Post-Project - N-1 Contingency of 7L701\7LA701\701L (Battle River 757S - Heisler 764S - Strome 223S)

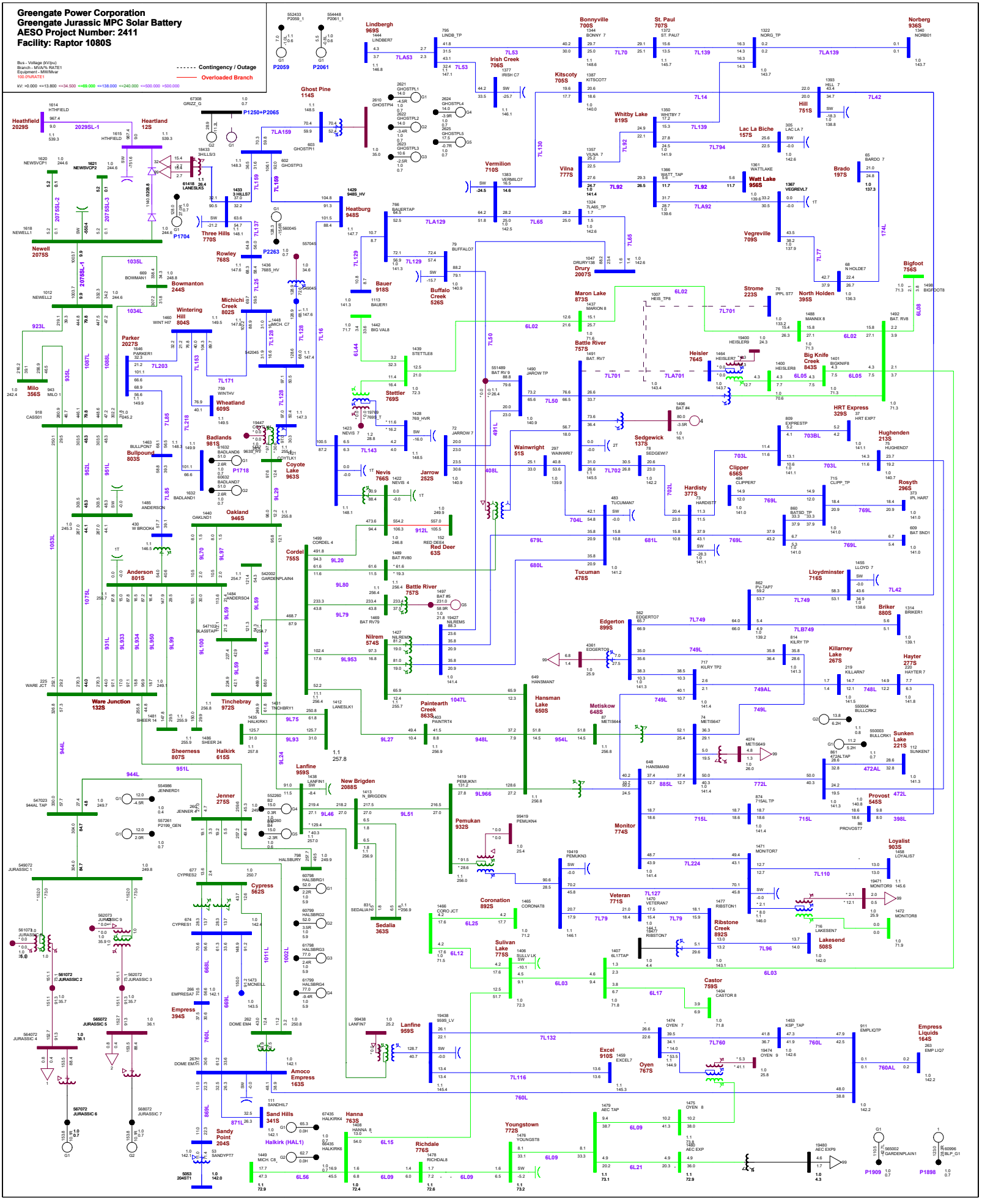


Figure A3-35: 2023 Summer Peak Sensitivity Post-Project - N-1 Contingency of 766S901T (Nevis 766S Transformer 901T)

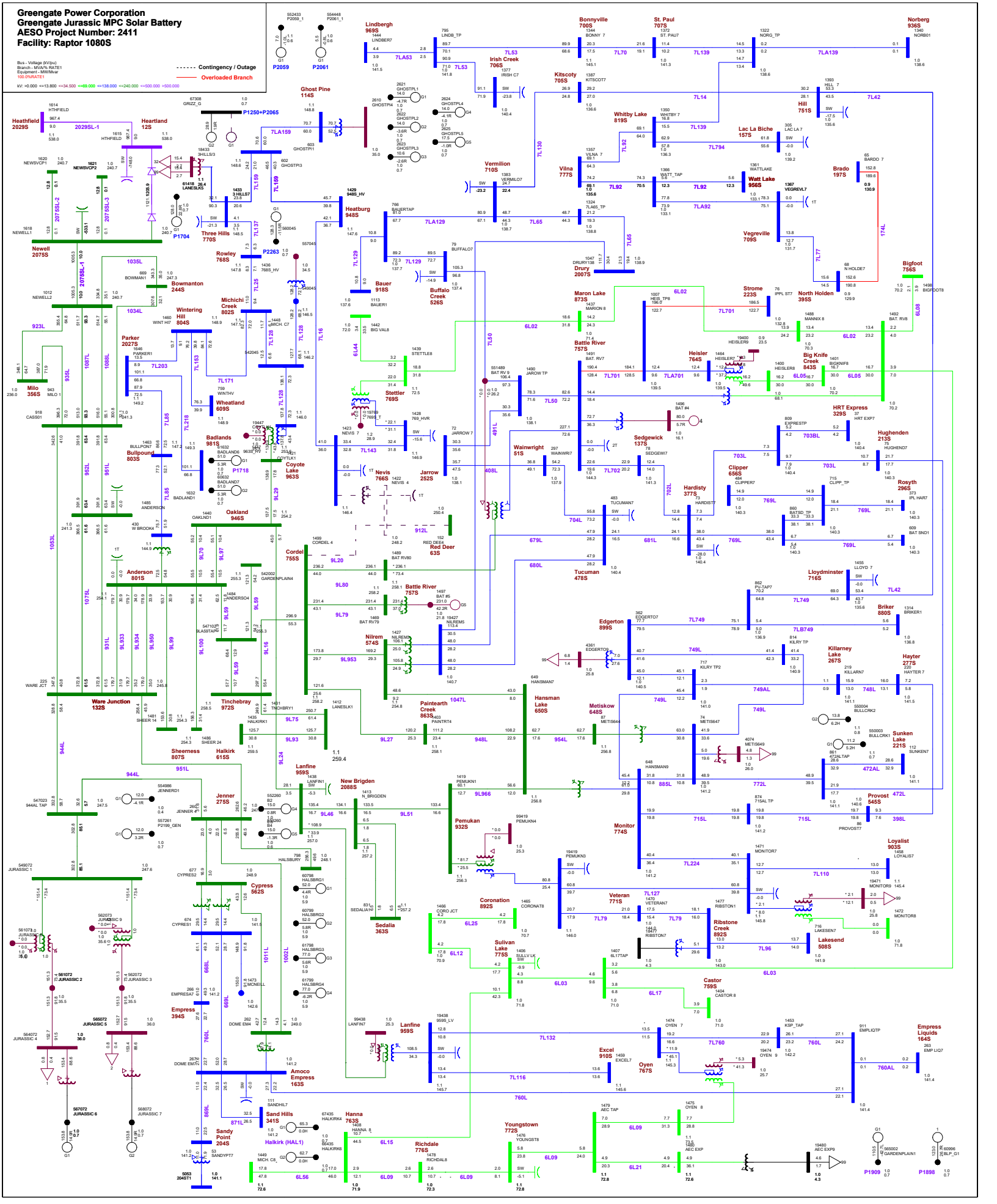


Figure A3-36: 2023 Summer Peak Sensitivity Post-Project - N-1 Contingency of EATL (Newell 2075S - Heathfield 2029S)

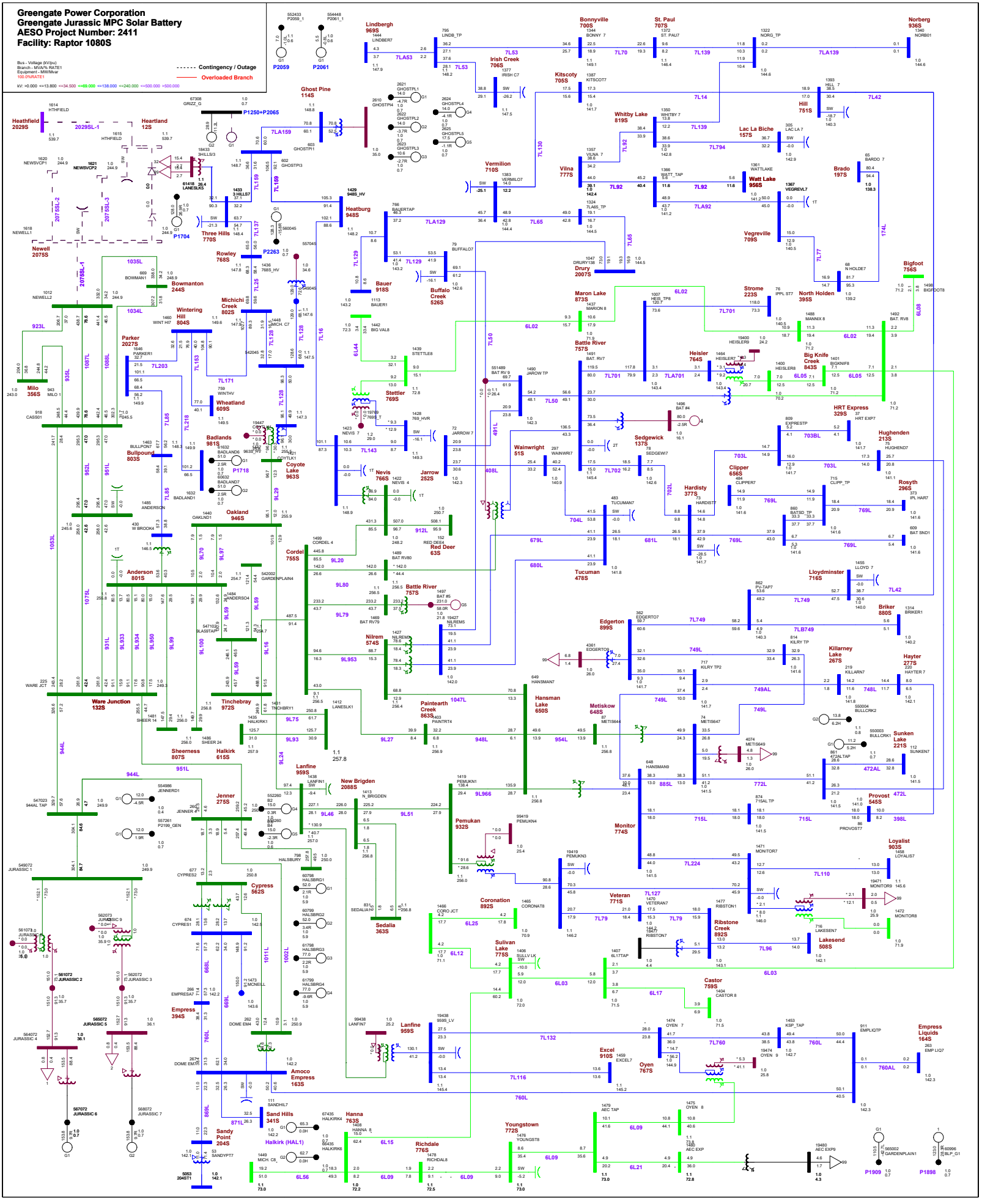


Figure A3-37: 2023 Summer Peak Sensitivity Post-Project - N-1 Contingency of 9LA59TAP (Anderson 801S - P1909 - Tinchebray 972S)

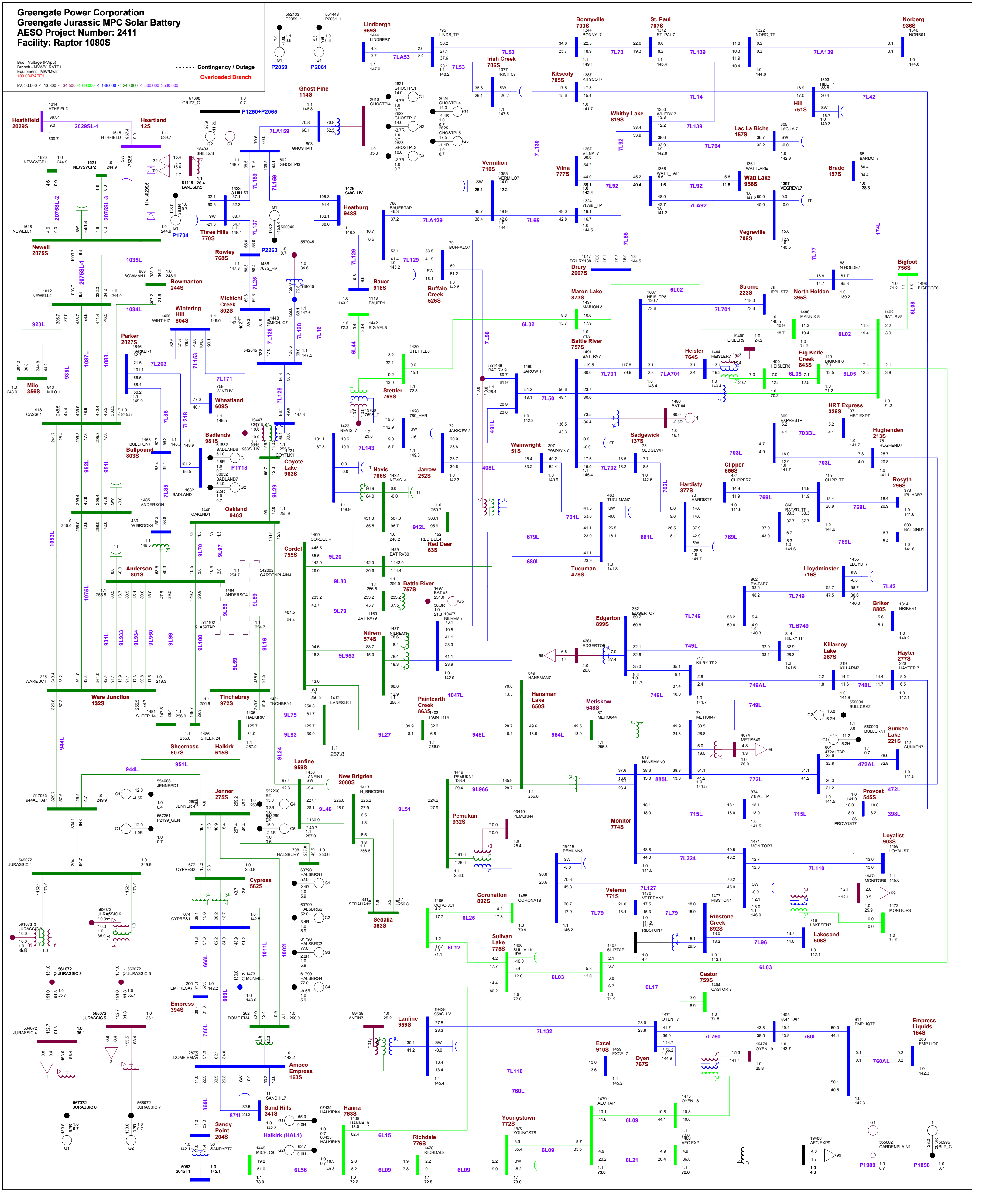


Figure A3-38: 2023 Summer Peak Sensitivity Post-Project - N-1 Contingency of 669L (Amoco Empress 163S - Cypress 562S)

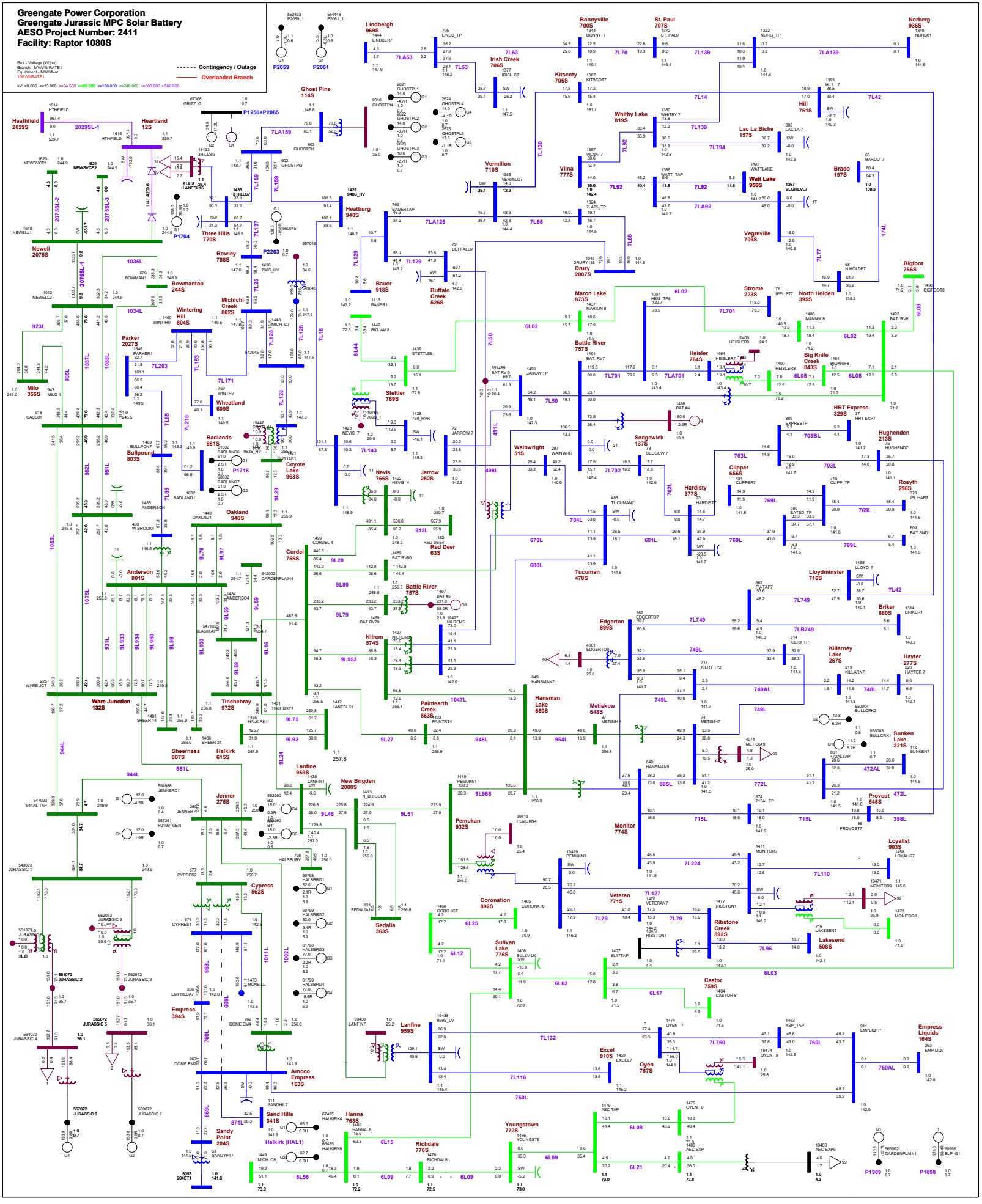


Figure A3-39: 2023 Summer Peak Sensitivity Post-Project - N-1 Contingency of 9L20 (Nevis 766S - Cordel 755S)

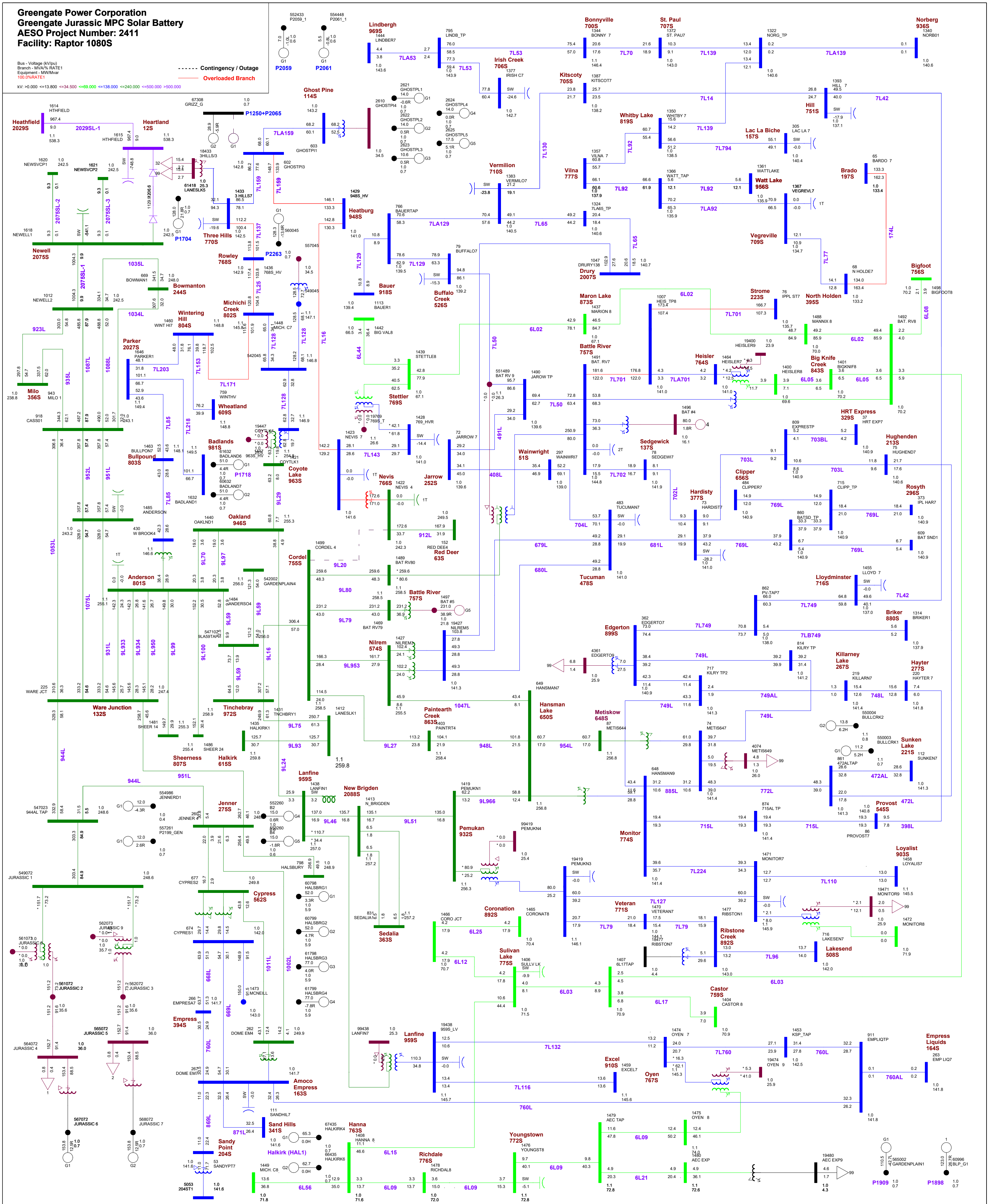


Figure A3-40: 2023 Summer Peak Sensitivity Post-Project - N-1 Contingency of 9L16 (Tinchebray 972S - Cordel 755S)

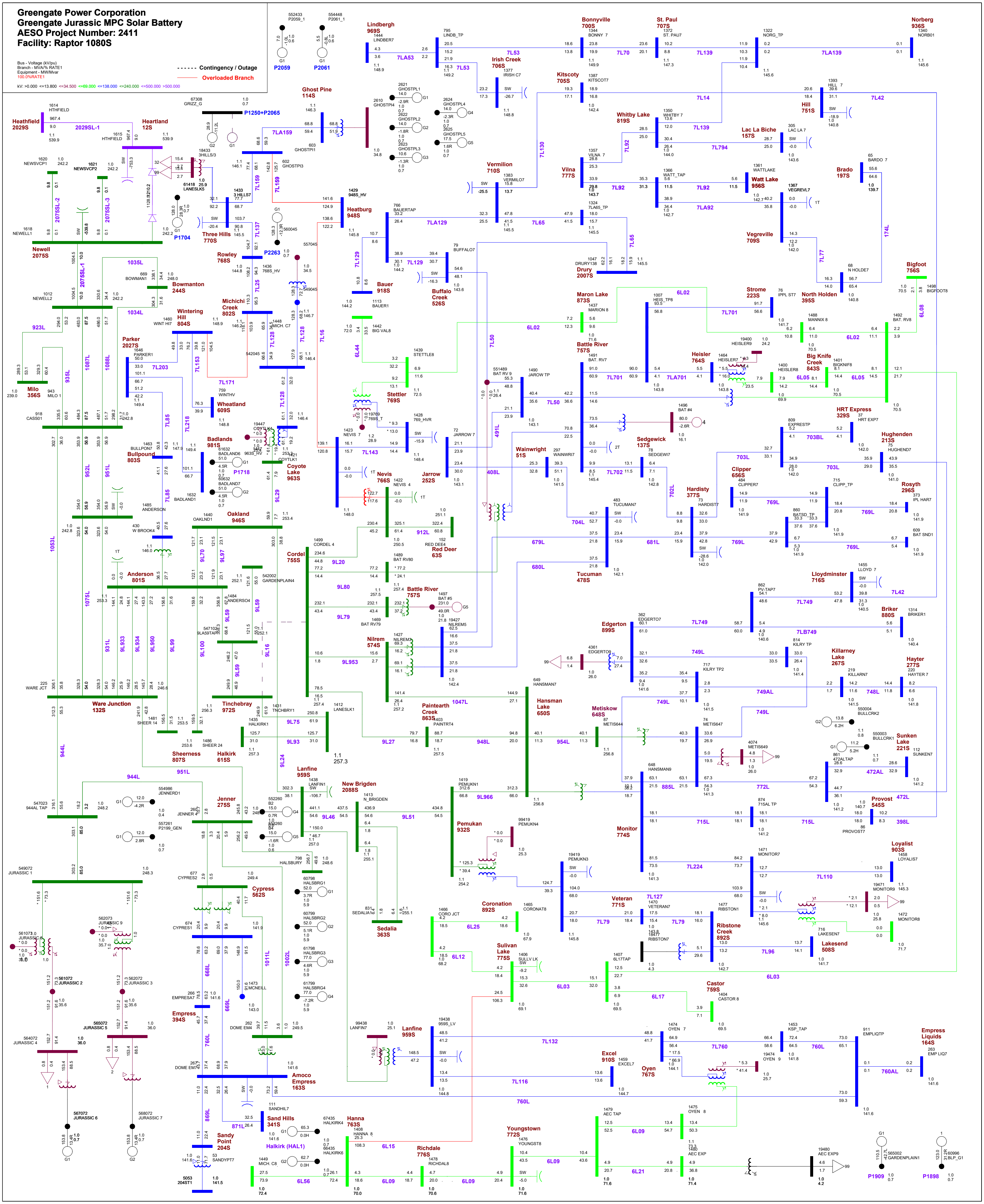


Figure A3-41: 2023 Summer Peak Sensitivity Post-Project - N-1 Contingency of 9L29 (Oakland 946S - Coyote Lake 963S)

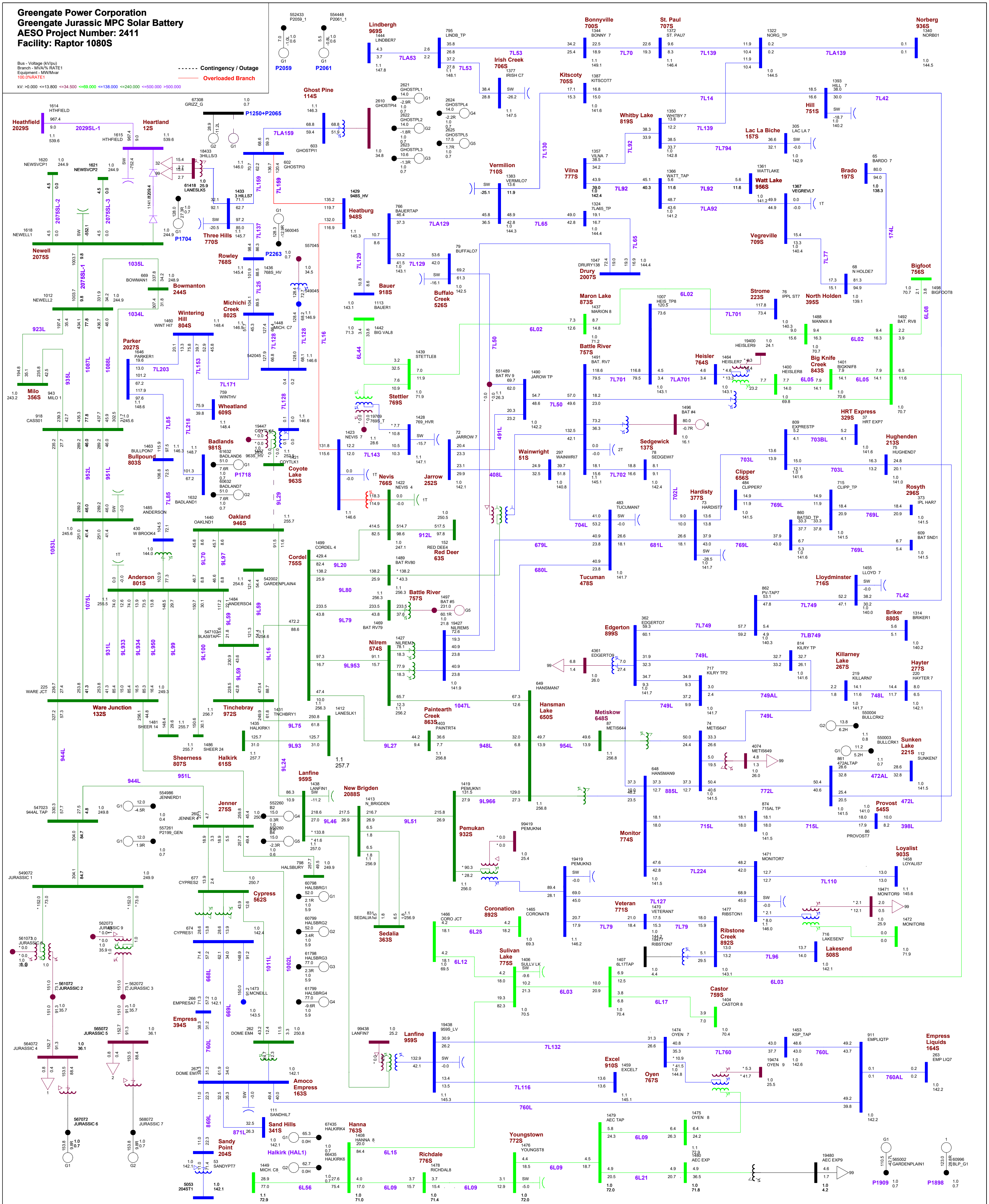


Figure A3-42: 2023 Summer Peak Sensitivity Post-Project - N-1 Contingency of 9L966 (Hansman Lake 650S - Pemukan 932S)

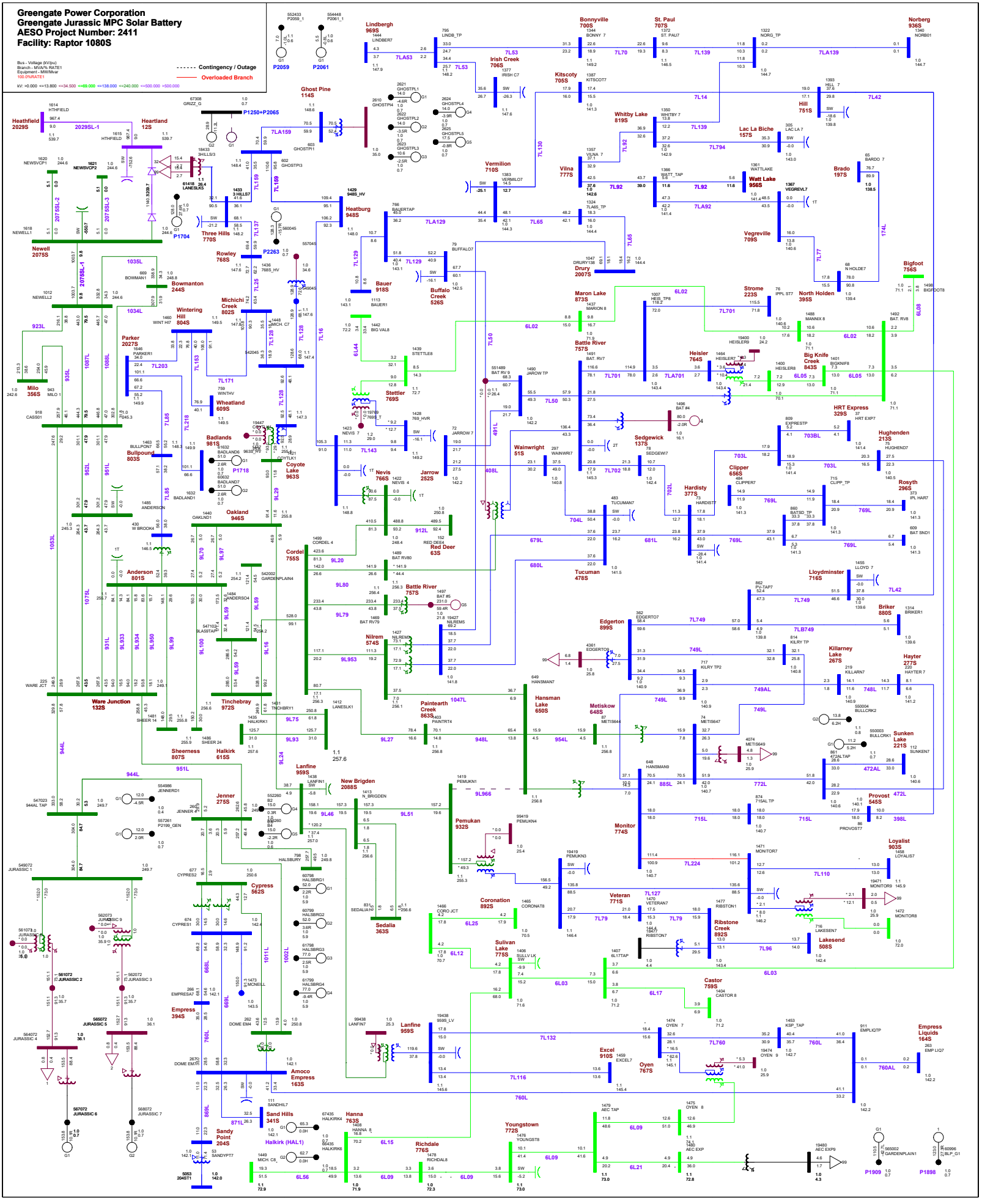


Figure A3-43: 2023 Summer Peak Sensitivity Post-Project - N-1 Contingency of 912L\9L912 (Red Deer 63S - Nevis 766S)

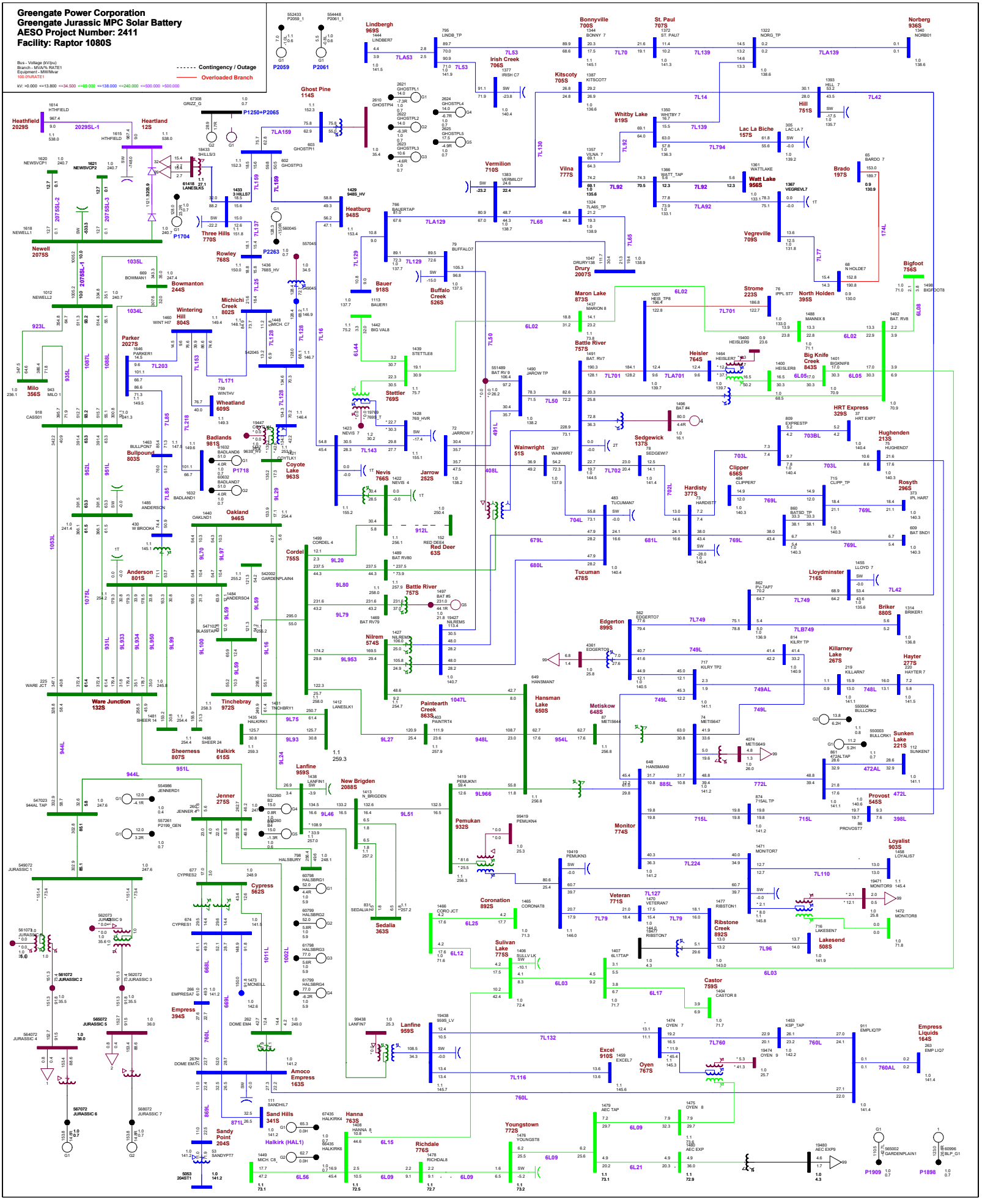


Figure A3-44: 2023 Summer Peak Sensitivity Post-Project_N-1 Contingency of 959S901T (Lanfine 959S Transformer 901T)

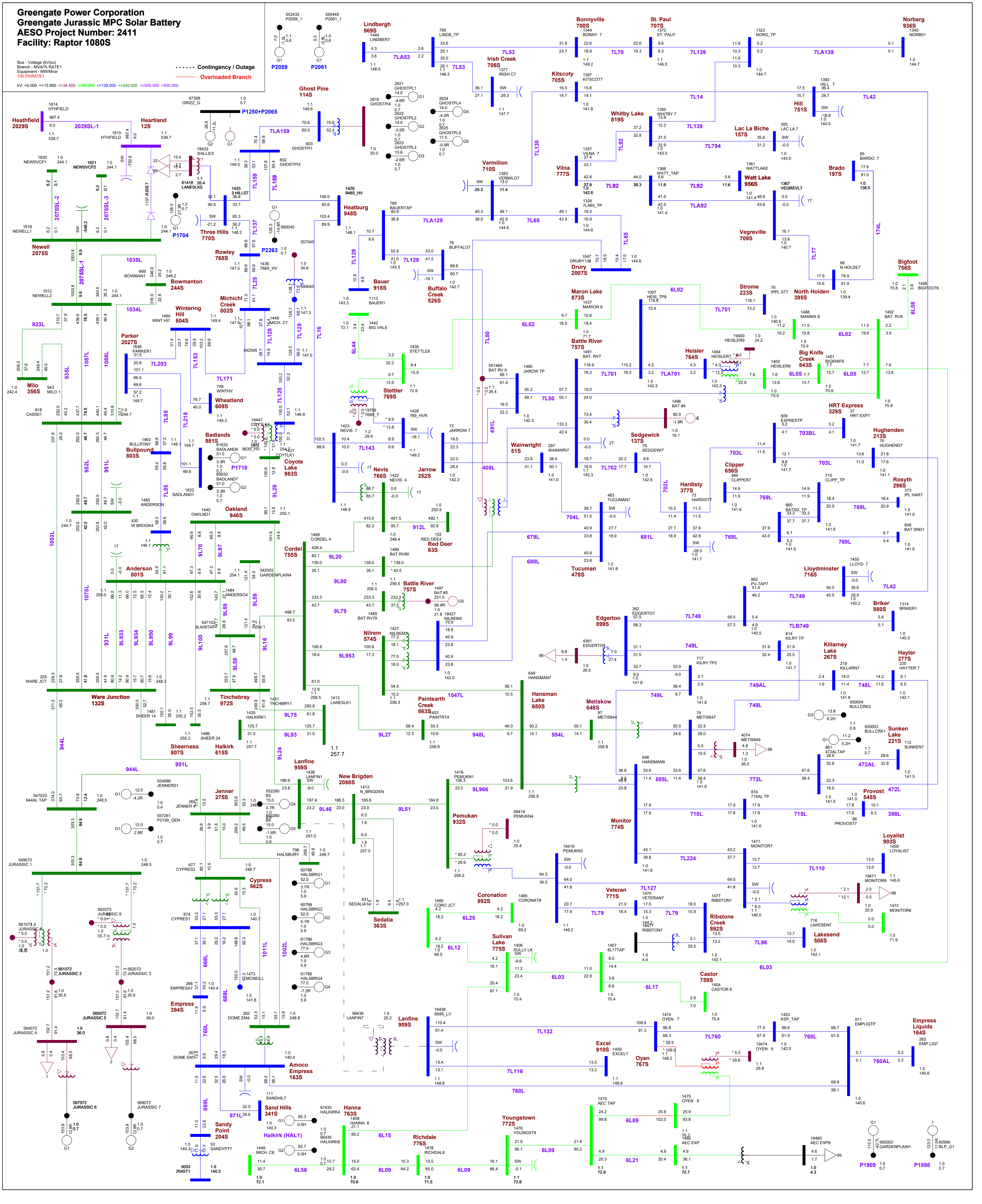


Figure A3-45: 2023 Summer Peak Sensitivity Post-Project - N-1 Contingency of 963S901T (Coyote Lake 963S Transformer 901T)

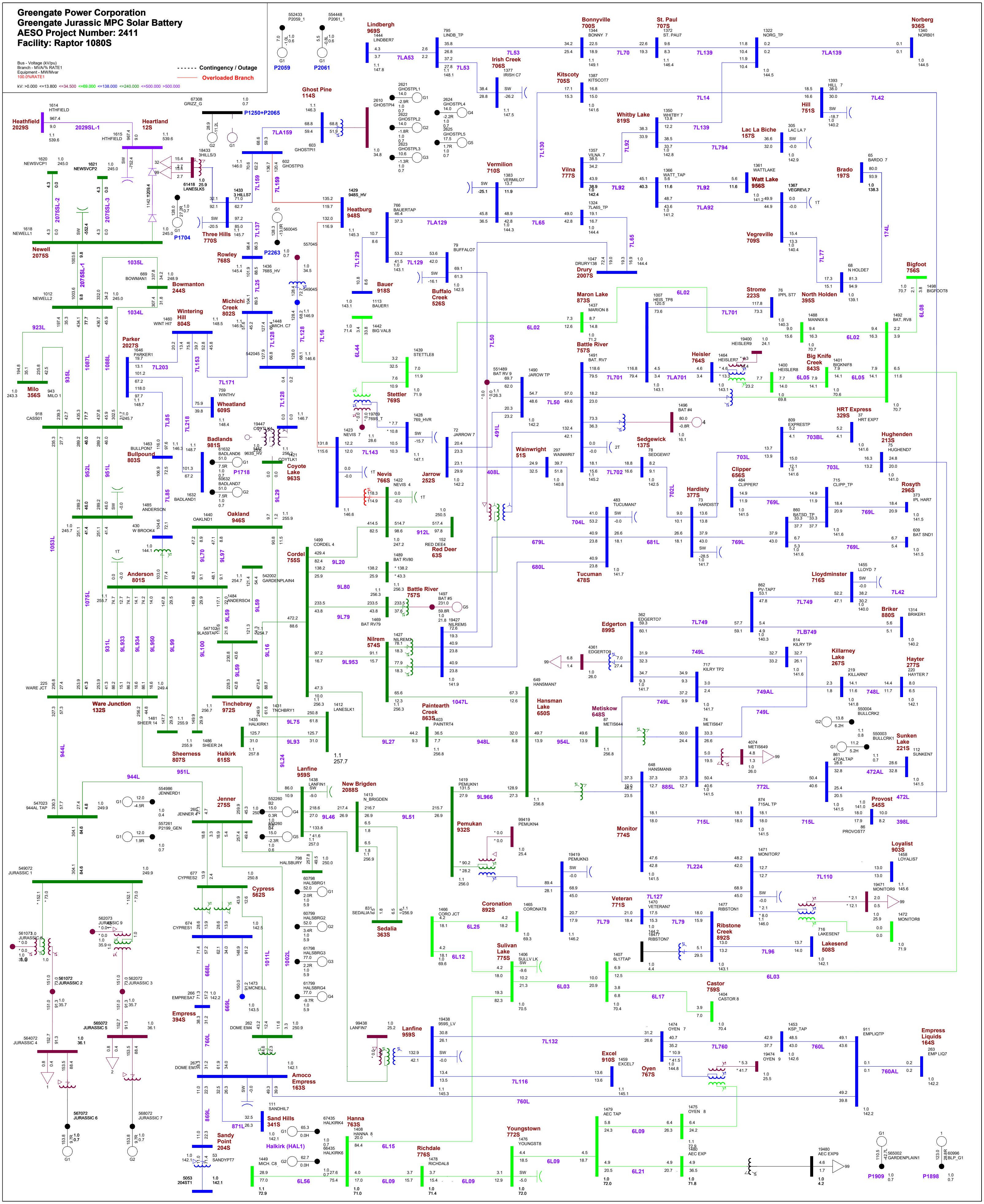


Figure A3-46: 2023 Summer Peak Sensitivity Post-Project - N-1 Contingency of 7L171 (Michichi Creek 802S - Wintering Hills 804S)

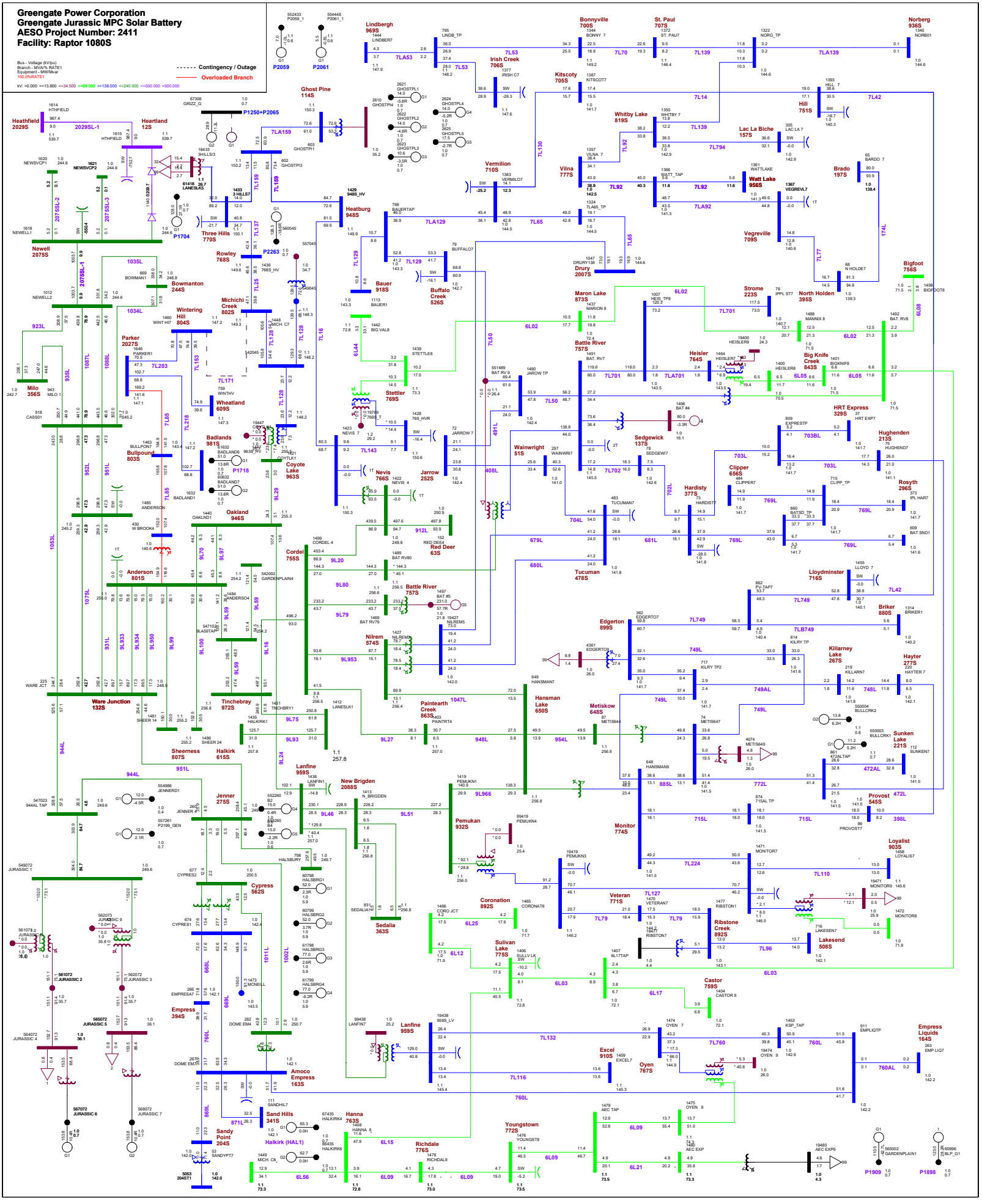


Figure A3-47: 2023 Summer Peak Sensitivity Post-Project - N-1 Contingency of 801S901T (Anderson 801S Transformer 901T)

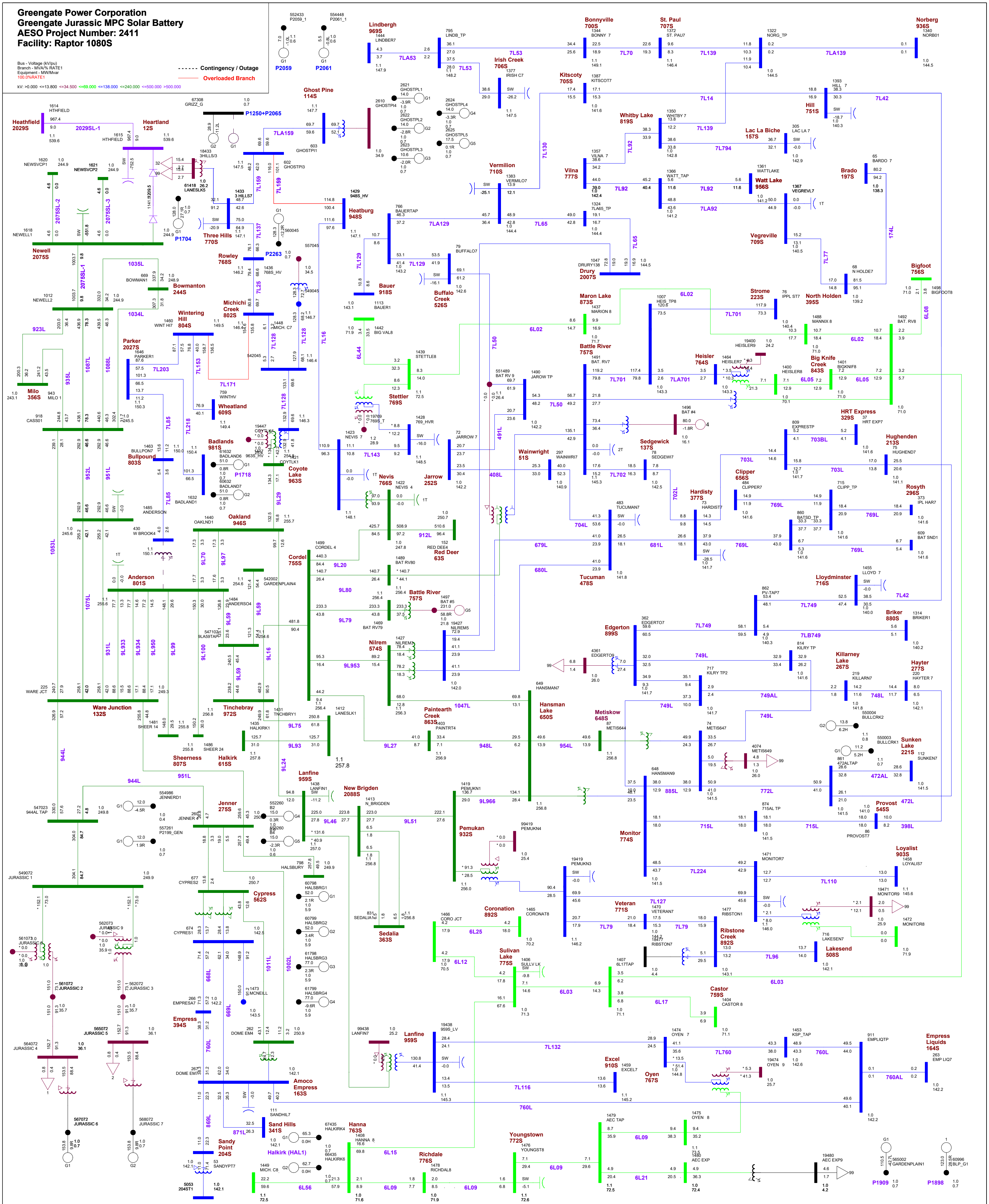


Figure A3-48: 2023 Summer Peak Sensitivity Post-Project - N-1 Contingency of P2263_TAP (Michichi Creek 802S - P2263 - Coyote Lake 963S)

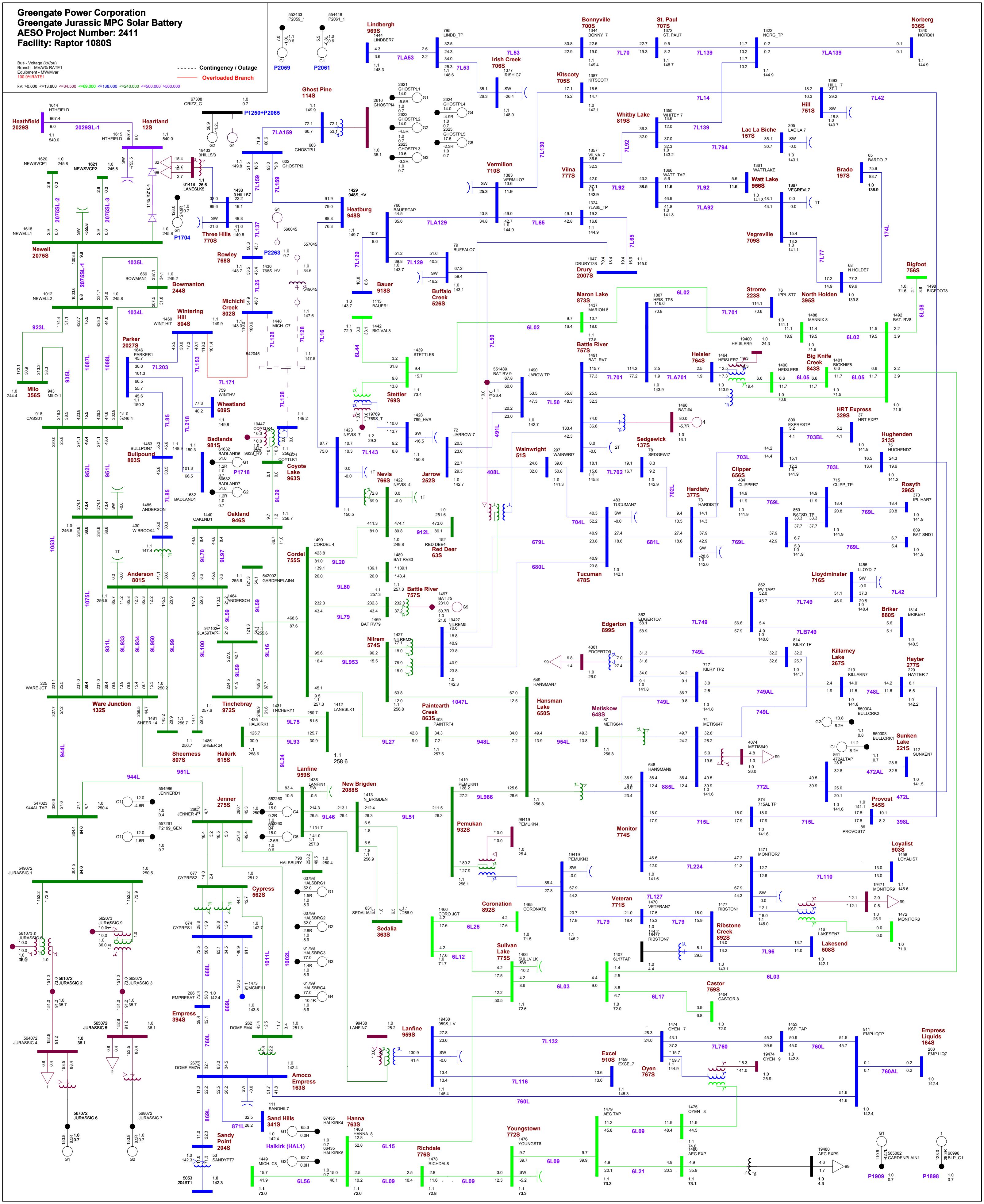


Figure A3-49: 2023 Summer Peak Sensitivity Post-Project - N-1 Contingency of 9L51 (Pemukan 932S - New Brigden 2088S)

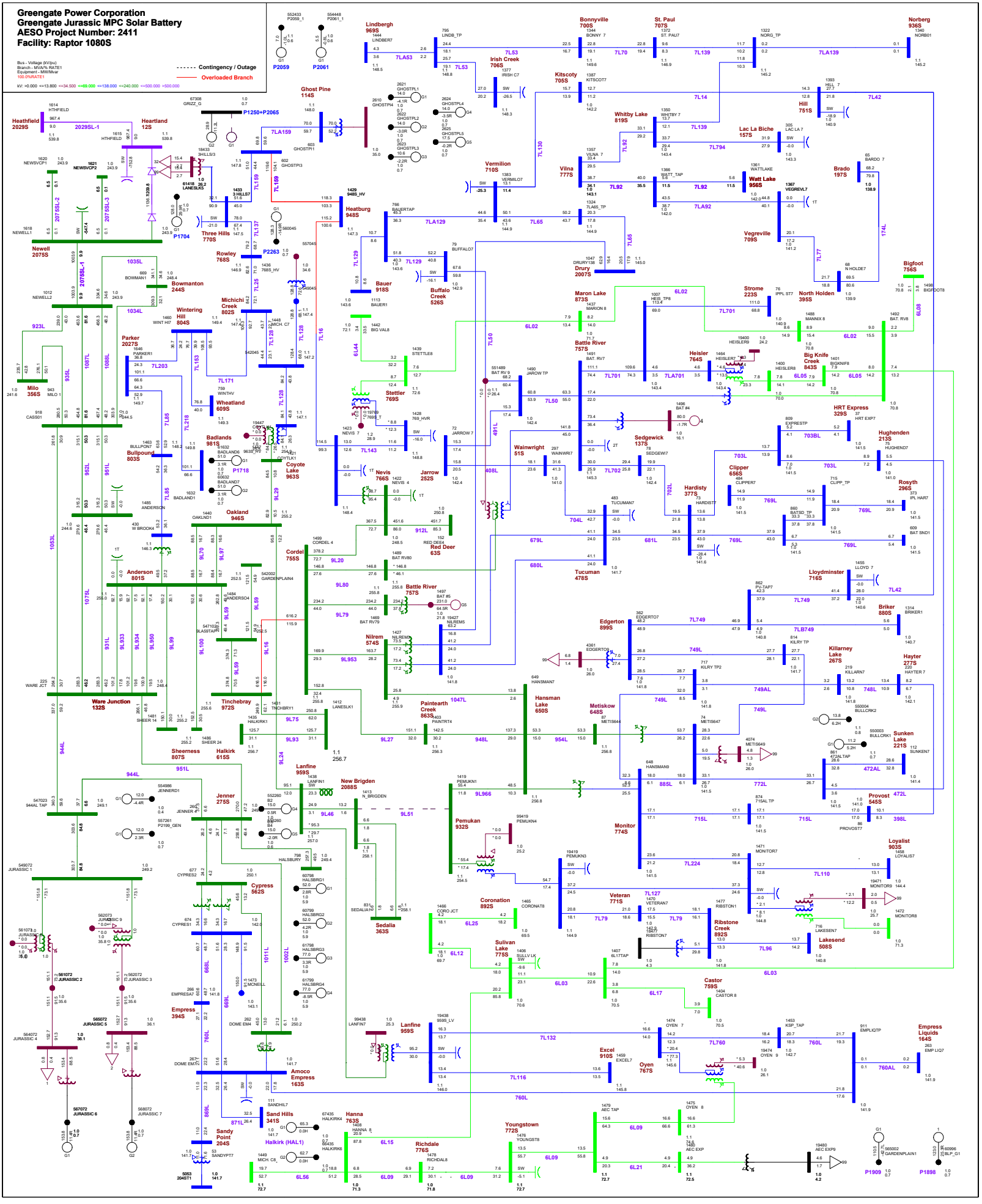


Figure A3-50: 2023 Summer Peak Sensitivity Post-Project - N-1 Contingency of 9L46 (Lanfine 959S - New Brigden 2088S)

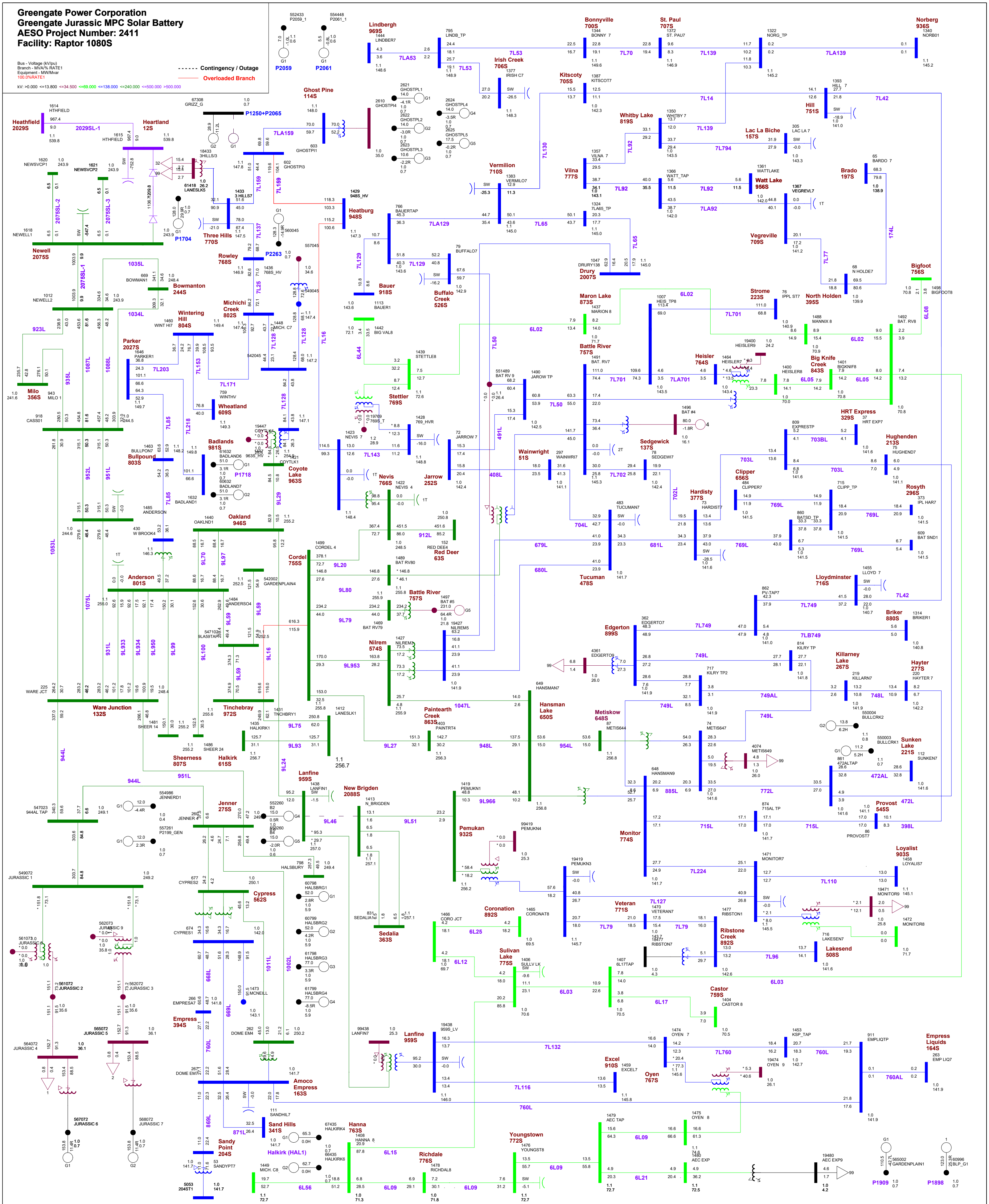


Figure A3-51: 2023 Summer Peak Sensitivity Post-Project - N-1 Contingency of 770S703T (Three Hills 770S Transformer 703T)

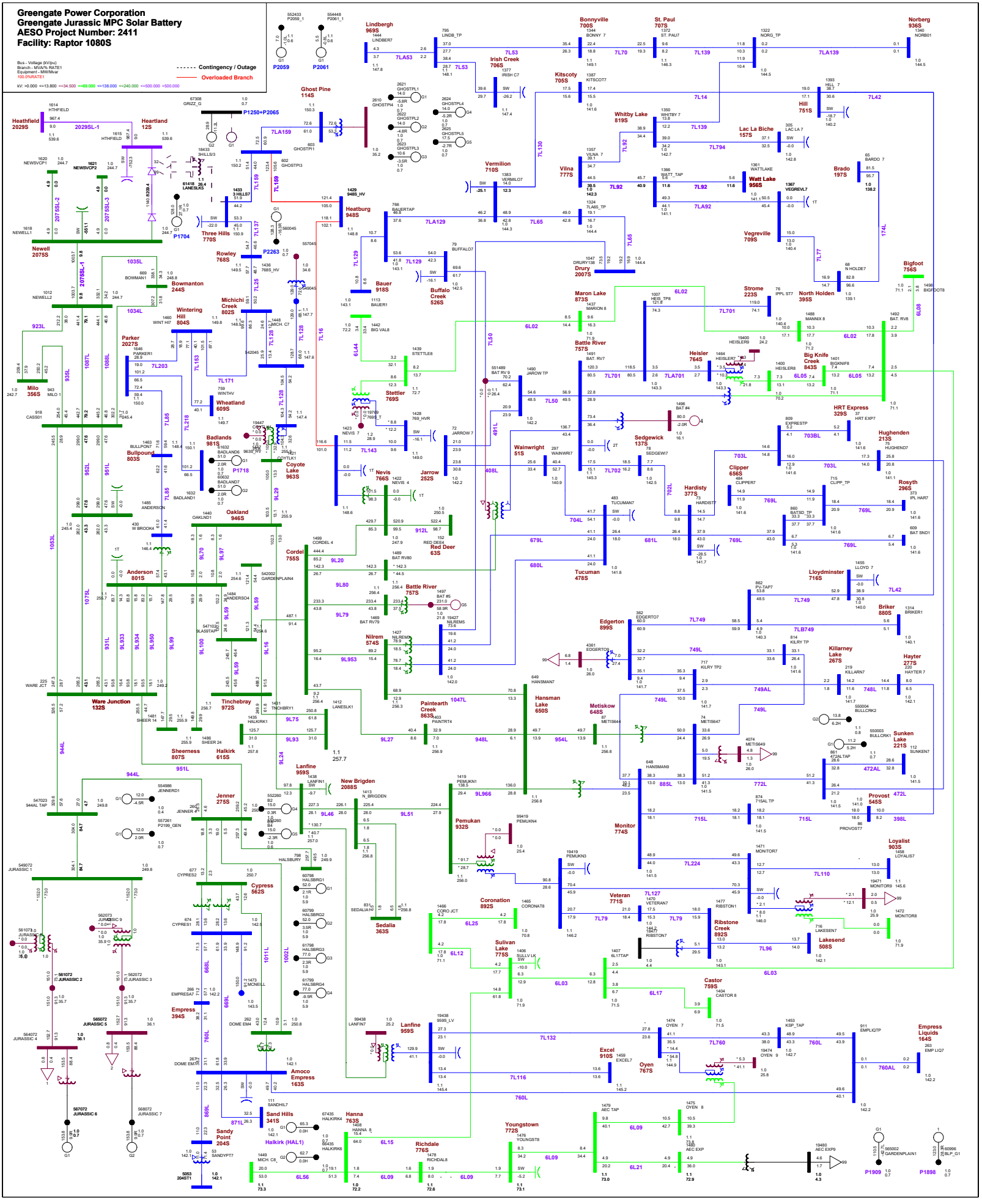


Figure A3-52: 2023 Summer Peak Sensitivity Post-Project - N-1 Contingency of 757S905T (Battle River 757S Transformer 905T)

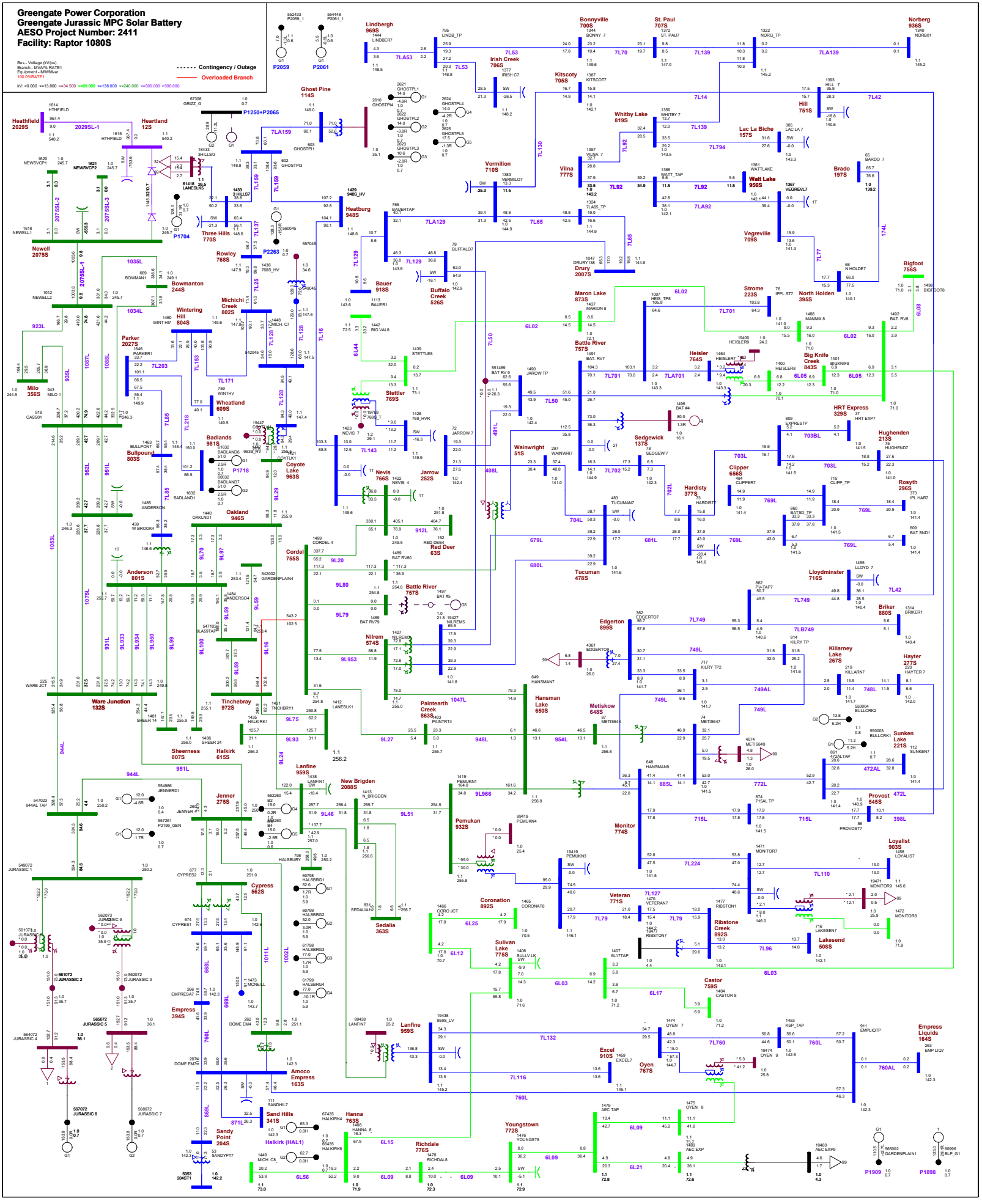


Figure A3-53: 2023 Summer Peak Sensitivity Post-Project - N-1 Contingency of 757ST2 (Battle River 757S Transformer T2)

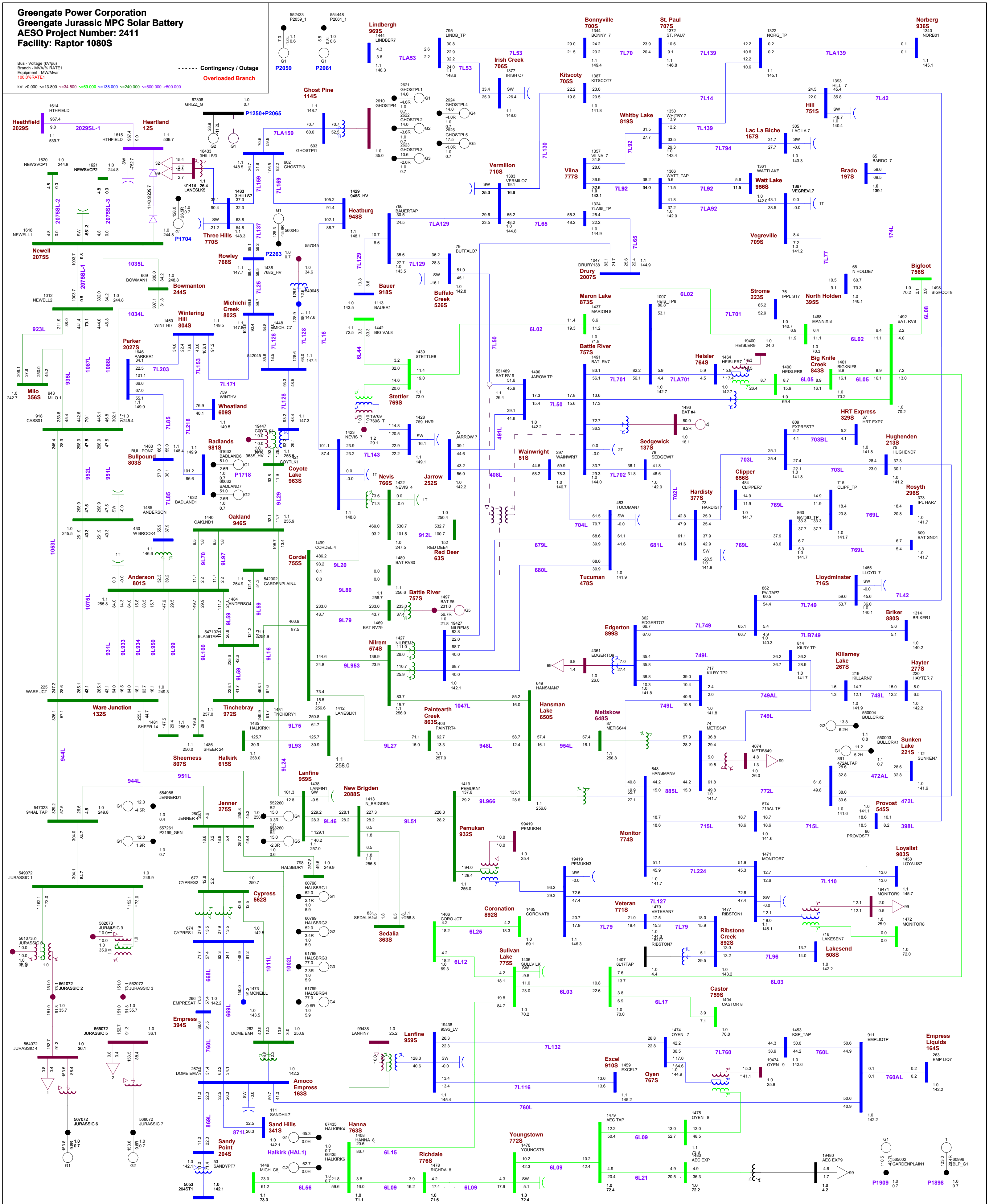
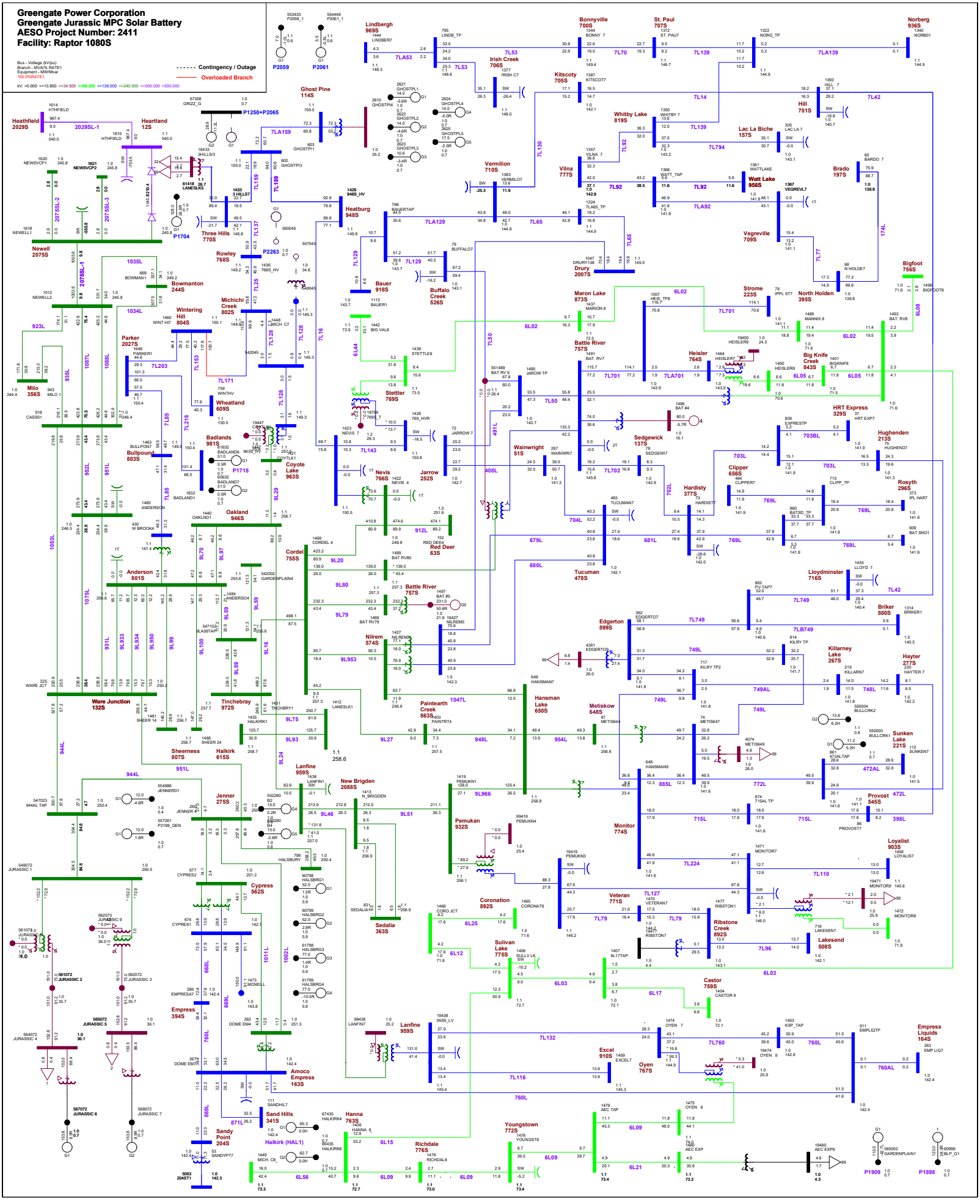


Figure A3-54: 2023 Summer Peak Sensitivity Post-Project - N-1 Contingency of P2263T1 (P2263 BER Hand Hills MPC Wind Farm Transformer T1)



Attachment A4
Dynamic Data and Assumptions

Table A4-1: Renewable Energy Generator / Convertor Model

Generator/Converter Model (REGCA1)									
Lvplsw	Tg	Rrpwr	Brkpt	Zerx	Lvpl1	Volim	Lvpnt1	Lvpnt0	Iolim
1.0	0.02	10.0	0.9	0.4	1.22	1.2	0.8	0.4	-1.3
Tfltr	Khv	Iqrmax	Iqrmin	Accel					
0.02	0.0	999.0	-999.0	0.7					

Table A4-2: Electrical Control Model for Large Scale PV

Electrical Control Model (REECA1)							
PFFLAG	VFLAG	QFLAG	PFFLAG	PQFLAG	Vdip (pu)	Vup (pu)	Trv (s)
1	0	0	0	1	0.9	1.1	0.02
dbd1 (pu)	dbd2 (pu)	Kqv (pu)	Iqh1 (pu)	Iql1 (pu)	Vref0(pu)	Iqfrz (pu)	Thld(s)
-0.1	0.1	2.0	1.1	-1.1	0	0	0
Thld2 (s)	Tp (s)	QMax (pu)	QMin (pu)	VMAX (pu)	VMIN (pu)	Kqp (pu)	Kqi (pu)
0	0.02	0	0	1.05	0.95	0.1	0.1
Kvp (pu)	Kvi (pu)	Vbias (pu)	Tiq (s)	DPmax (pu/s)	DPmin (pu/s)	PMAX (pu)	PMIN (pu)
5.0	1.0	0	0	999	-999	1.0	0
Imax (pu)	Tpord (s)	Vq1 (pu)	Iq1 (pu)	Vq2 (pu)	Iq2 (pu)	Vq3 (pu)	Iq3 (pu)
1.0	0.02	0.4	0.4	0.6	0.6	0.8	0.8
Vq4 (pu)	Iq4 (pu)	Vp1 (pu)	Ip1 (pu)	Vp2 (pu)	Ip2 (pu)	Vp3 (pu)	Ip3 (pu)
1.0	1.0	0.4	0.4	0.6	0.6	0.8	0.8
Vp4 (pu)	Ip4 (pu)						
1.0	1.0						

Table A4-3: Generic Renewable Plant Control Model

Generic Renewable Plant Control Model (REPCA1)											
VCFlag	RefFlag	Fflag	Tfltr	Kp	Ki	Tft	Tfv	Vfrz	Rc	Xc	Kc
0	1	1	0.02	1.0	20.0	0.0	0.0	0.0	0.0	0.0	0.0
emax	emin	dbd1	dbd2	QMax	QMin	Kpg	Kig	Tp	fdbd1	Fdbd2	femax
1.0	-1.0	0.0	0.0	1.0	-1.0	1.0	20.0	0.02	-0.01	0.01	1.0
femin	Pmax	Pmin	Tg	Ddn	Dup						
-1.0	1.0	-1.0	0.0	125.0	125.0						

Attachment A5
Dynamic Data and Assumptions

Table A5-1: Renewable Energy Generator / Convertor Model

Generator/Converter Model (REGCA1)									
Lvplsw	Tg	Rrpwr	Brkpt	Zerx	Lvpl1	Volim	Lvpnt1	Lvpnt0	Iolim
1.0	0.02	10.0	0.9	0.4	1.22	1.2	0.8	0.4	-1.3
Tfltr	Khv	Iqrmax	Iqrmin	Accel					
0.02	0.0	999.0	-999.0	0.7					

Table A5-2: Electrical Control Model for Large Scale PV / BESS

Electrical Control Model (REECA1)							
PFFLAG	VFLAG	QFLAG	PFFLAG	PQFLAG	Vdip (pu)	Vup (pu)	Trv (s)
1	0	0	0	1	0.9	1.1	0.02
dbd1 (pu)	dbd2 (pu)	Kqv (pu)	Iqh1 (pu)	Iql1 (pu)	Vref0(pu)	Iqfrz (pu)	Thld(s)
-0.1	0.1	2.0	1.1	-1.1	0	0	0
Thld2 (s)	Tp (s)	QMax (pu)	QMin (pu)	VMAX (pu)	VMIN (pu)	Kqp (pu)	Kqi (pu)
0	0.02	0	0	1.05	0.95	0.1	0.1
Kvp (pu)	Kvi (pu)	Vbias (pu)	Tiq (s)	DPmax (pu/s)	DPmin (pu/s)	PMAX (pu)	PMIN (pu)
5.0	1.0	0	0	999	-999	1.0	0
Imax (pu)	Tpord (s)	Vq1 (pu)	Iq1 (pu)	Vq2 (pu)	Iq2 (pu)	Vq3 (pu)	Iq3 (pu)
1.0	0.02	0.4	0.4	0.6	0.6	0.8	0.8
Vq4 (pu)	Iq4 (pu)	Vp1 (pu)	Ip1 (pu)	Vp2 (pu)	Ip2 (pu)	Vp3 (pu)	Ip3 (pu)
1.0	1.0	0.4	0.4	0.6	0.6	0.8	0.8
Vp4 (pu)	Ip4 (pu)						
1.0	1.0						

Table A5-3: Generic Renewable Plant Control Model for PV / BESS

Generic Renewable Plant Control Model (REPCA1)											
VCFlag	RefFlag	Fflag	Tfltr	Kp	Ki	Tft	Tfv	Vfrz	Rc	Xc	Kc
0	1	1	0.02	1.0	20.0	0.0	0.0	0.0	0.0	0.0	0.0
emax	emin	dbd1	dbd2	QMax	QMin	Kpg	Kig	Tp	fdbd1	Fdbd2	femax
1.0	-1.0	0.0	0.0	1.0	-1.0	1.0	20.0	0.02	-0.01	0.01	1.0
femin	Pmax	Pmin	Tg	Ddn	Dup						
-1.0	1.0	-1.0	0.0	125.0	125.0						

Attachment A6
Pre-Project Post-Mitigation Power Flow Diagrams

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Figure A6-1: 2023 Summer Peak Pre-Project - N-1 Contingency of 766S901T (Nevis 766S Transformer 901T)

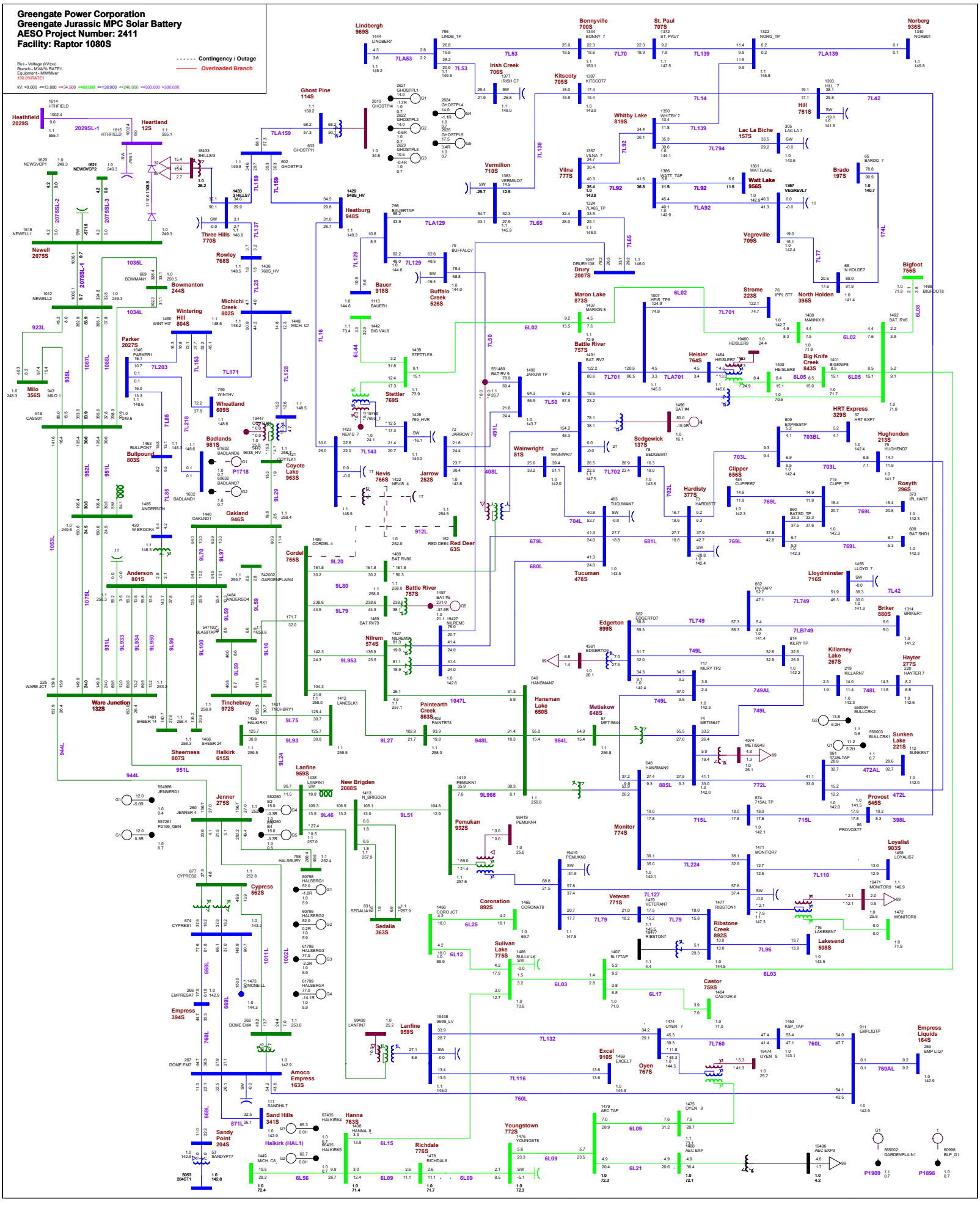


Figure A6-2: 2023 Summer Peak Pre-Project - N-1 Contingency of EATL (Newell 2075S - Heathfield 2029S)

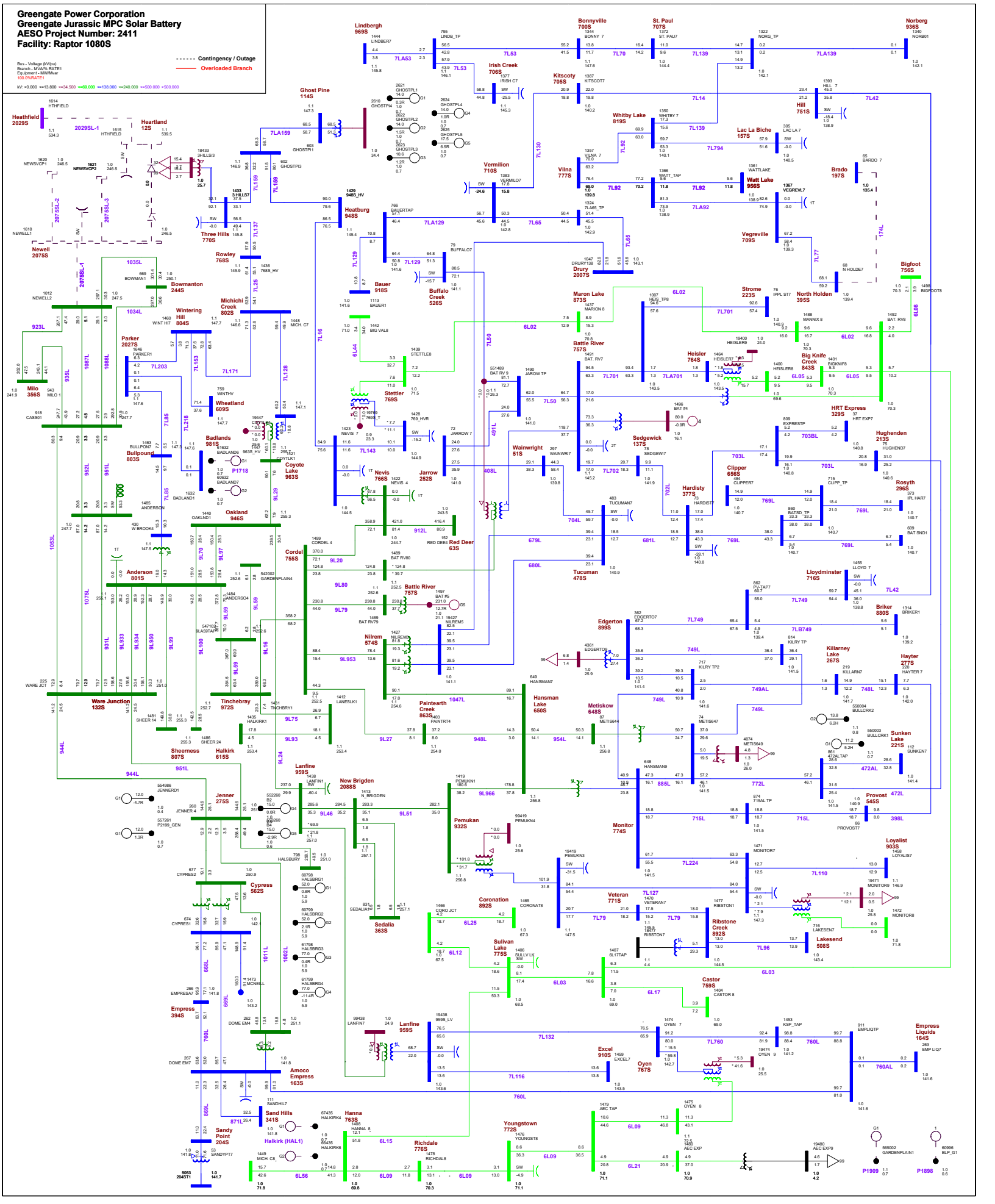


Figure A6-3: 2023 Summer Peak Pre-Project - N-1 Contingency of 9L20 (Nevis 766S - Cordel 755S)

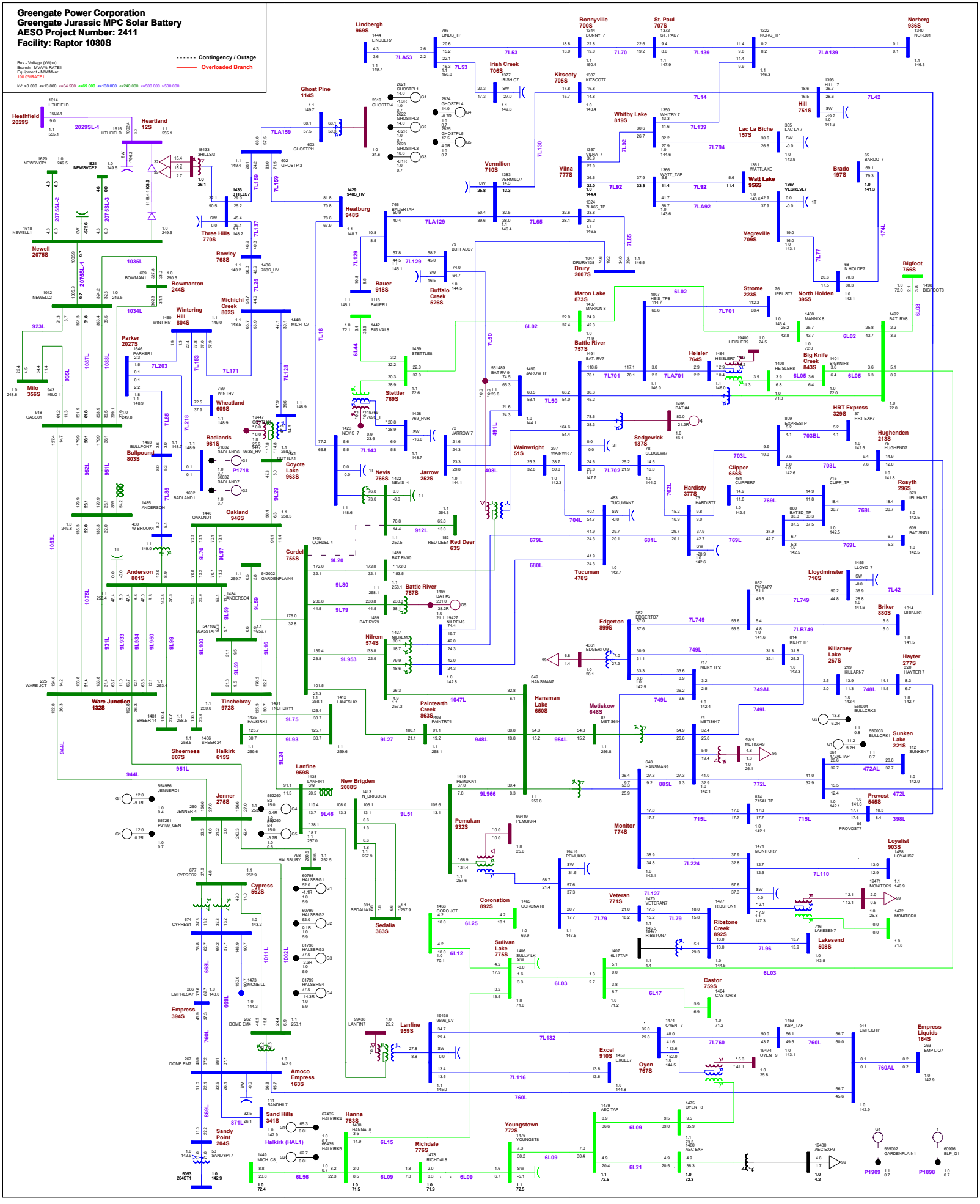


Figure A6-4: 2023 Summer Peak Pre-Project - N-1 Contingency of 9L16 (Tinchebray 972S - Cordel 755S)

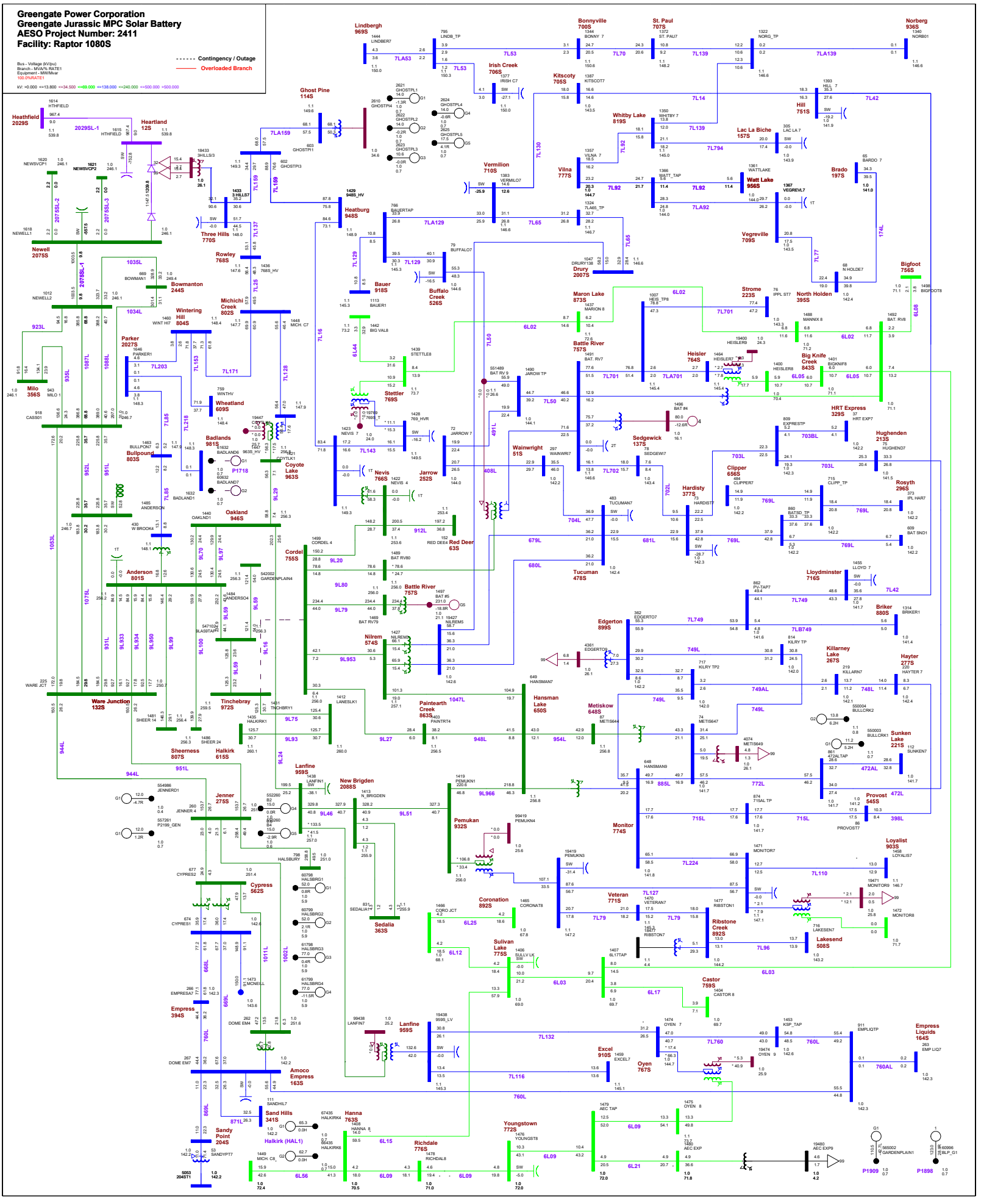


Figure A6-5: 2023 Summer Peak Pre-Project - N-1 Contingency of 7L171 (Michichi Creek 802S - Wintering Hills 804S)

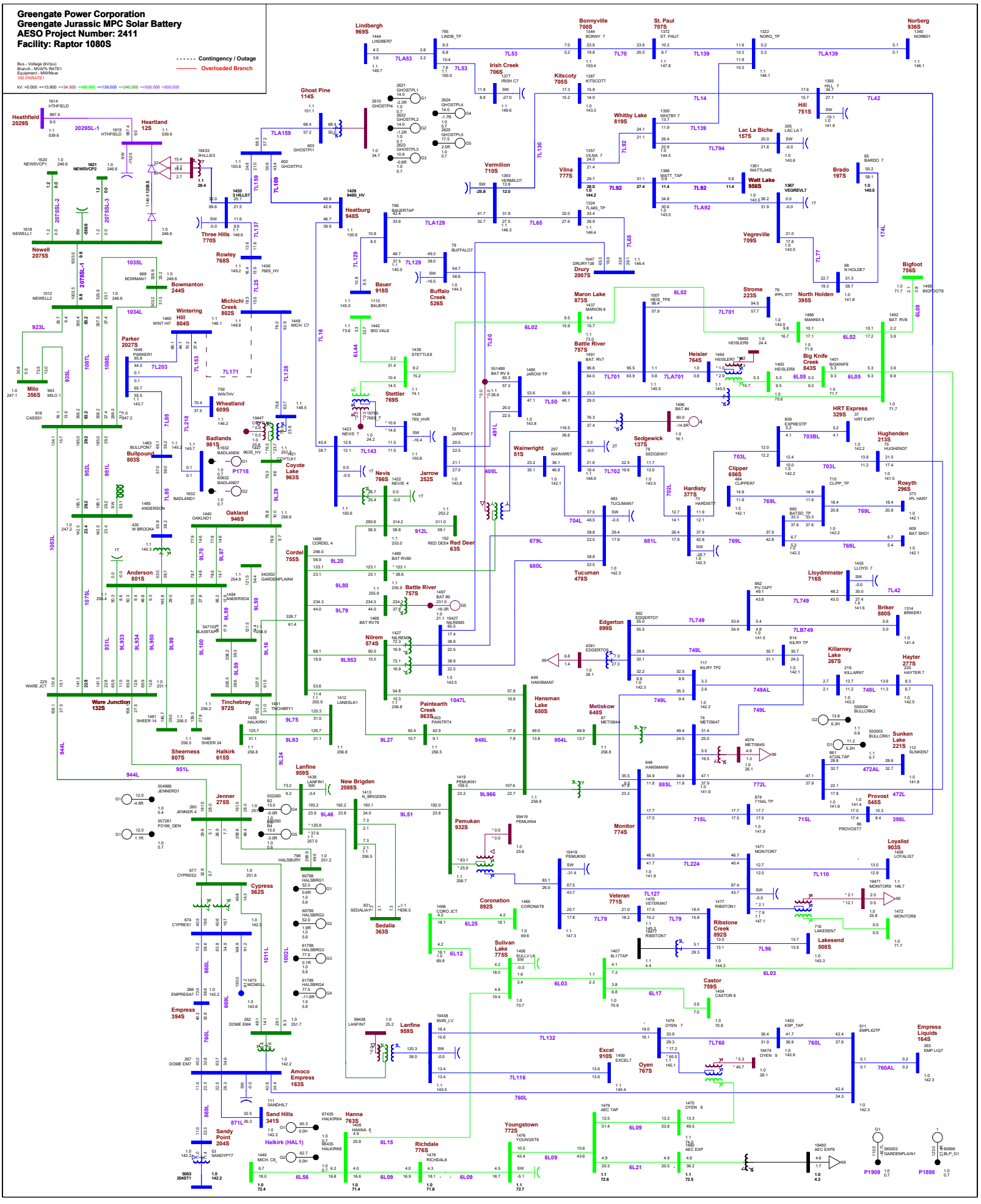


Figure A6-6: 2023 Summer Peak Pre-Project - N-1 Contingency of 801S901T (Anderson 801S Transformer 901T)

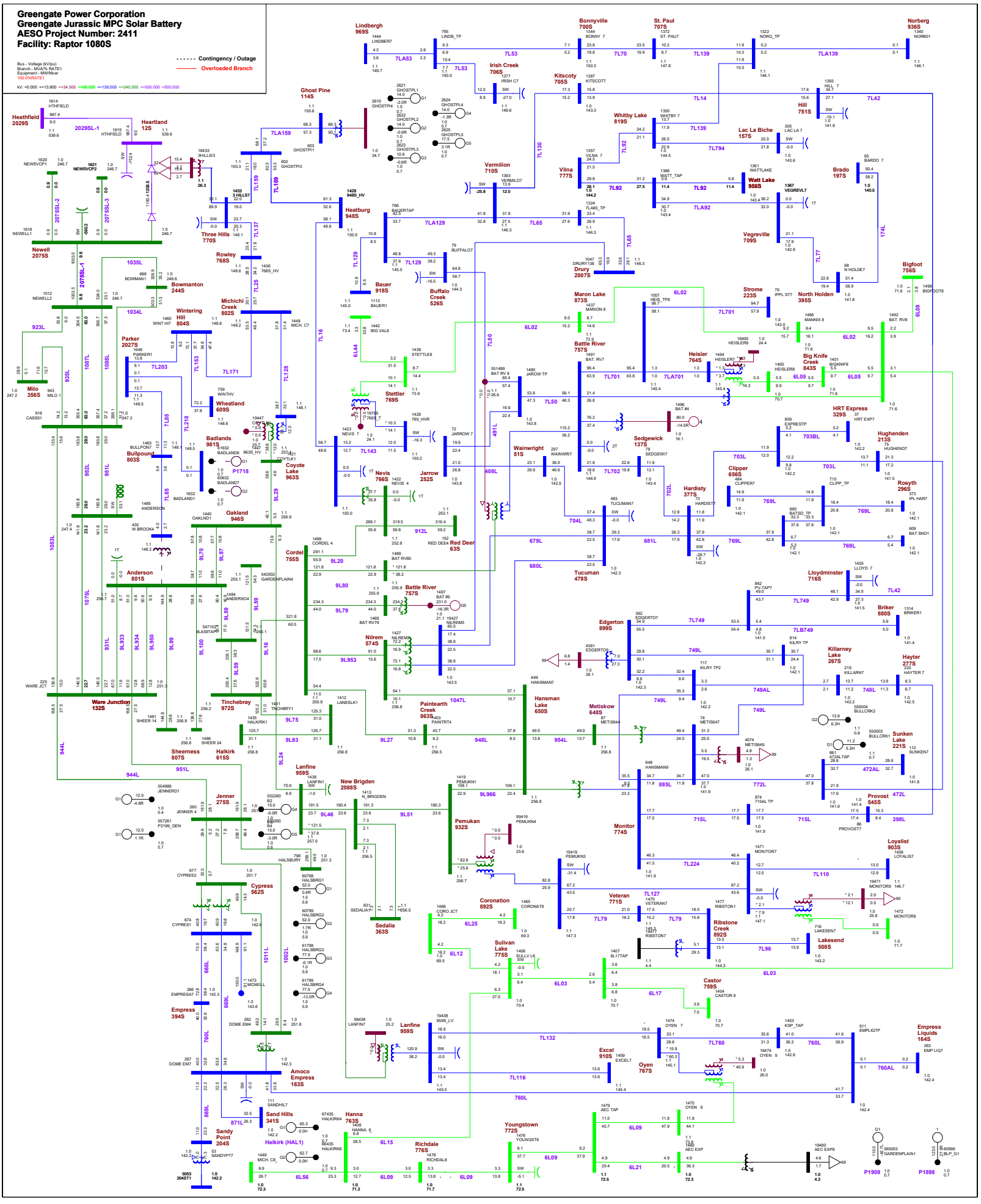


Figure A6-7: 2023 Summer Peak Pre-Project - N-1 Contingency of 114ST1 (Ghost Pine 114S Transformer T1)

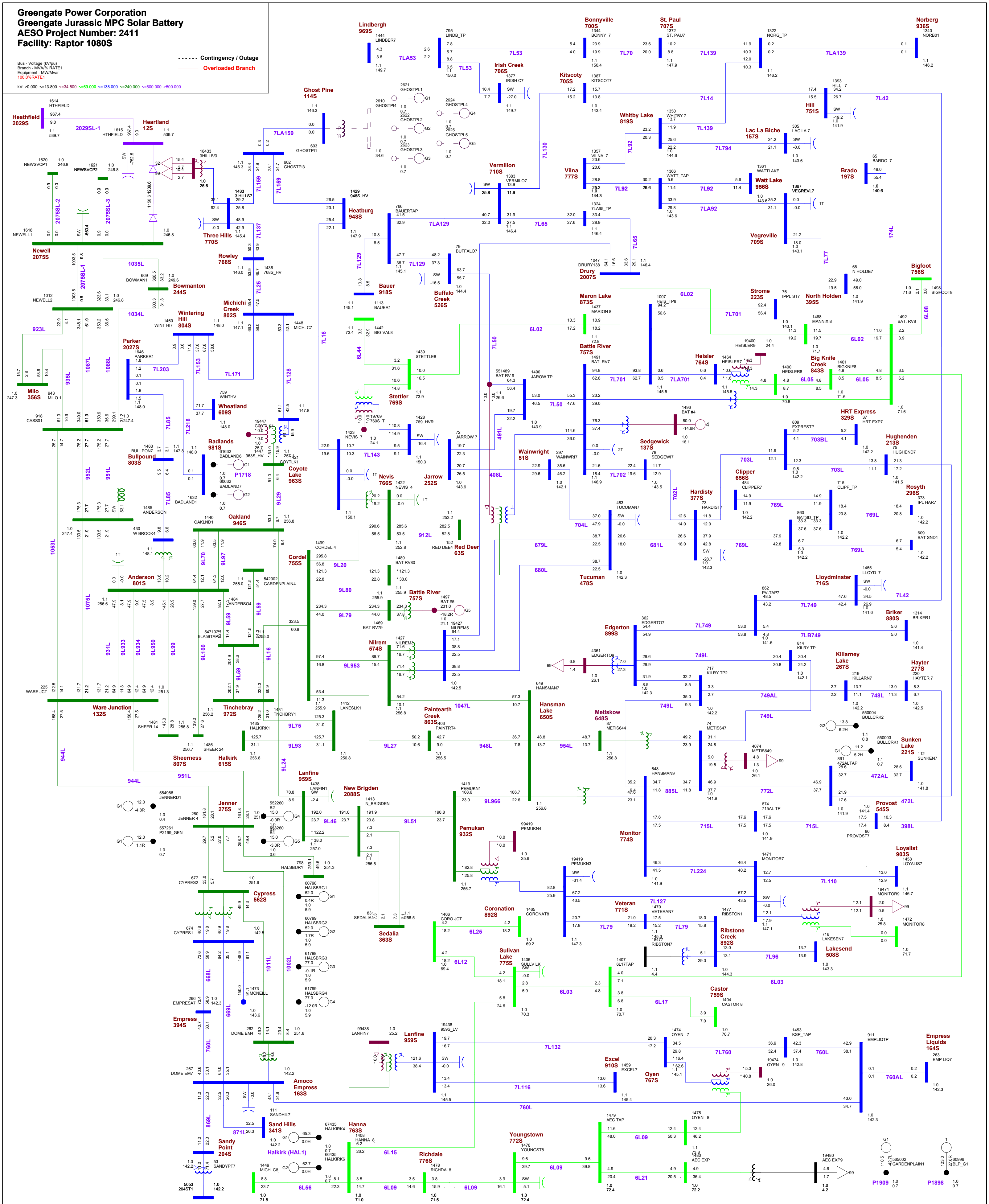


Figure A6-8: 2023 Summer Peak Pre-Project - N-1 Contingency of 912L\9L912 (Red Deer 63S - Nevis 766S)

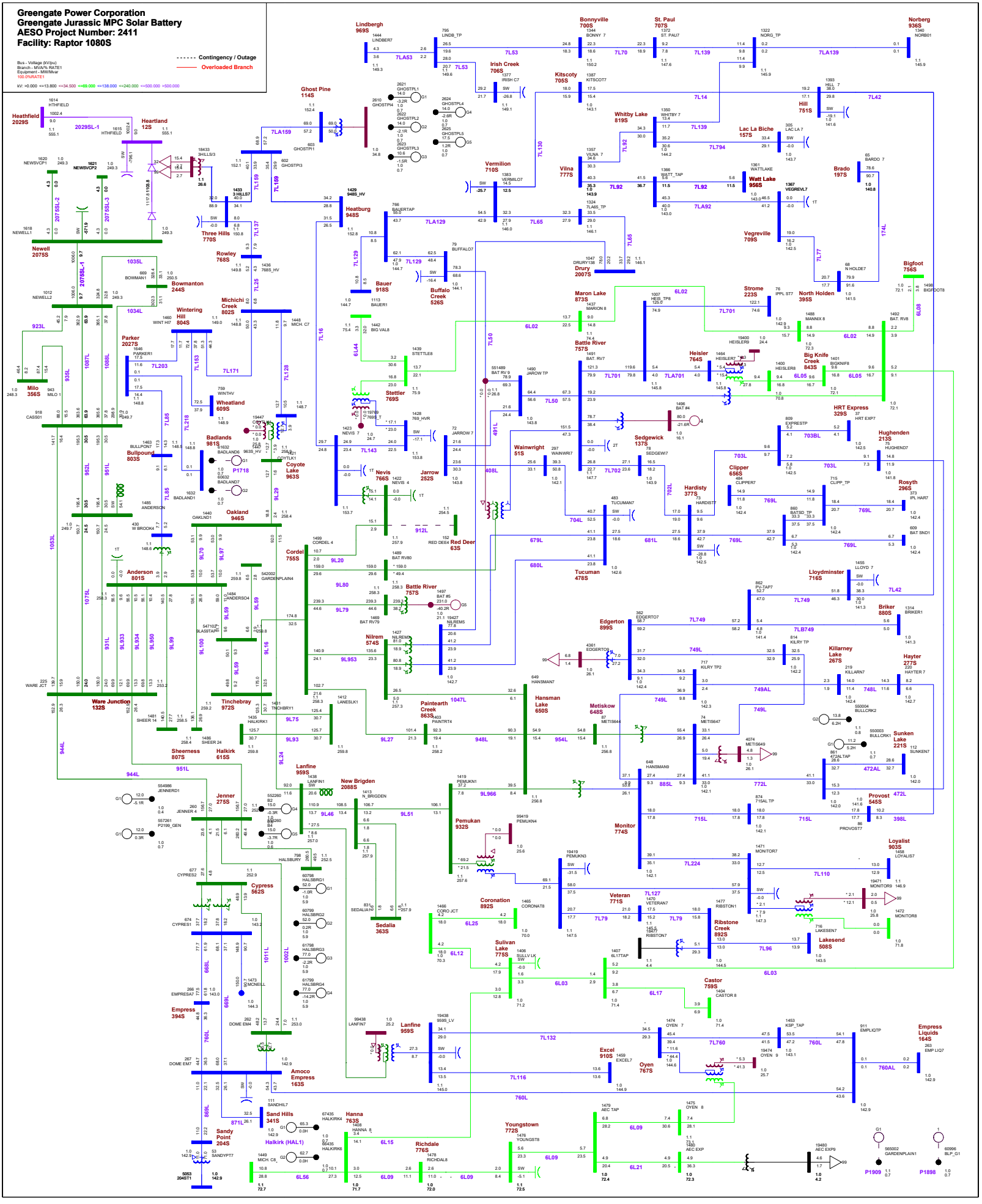


Figure A6-9: 2023 Summer Light Pre-Project - N-1 Contingency of 766S901T (Nevis 766S Transformer 901T)

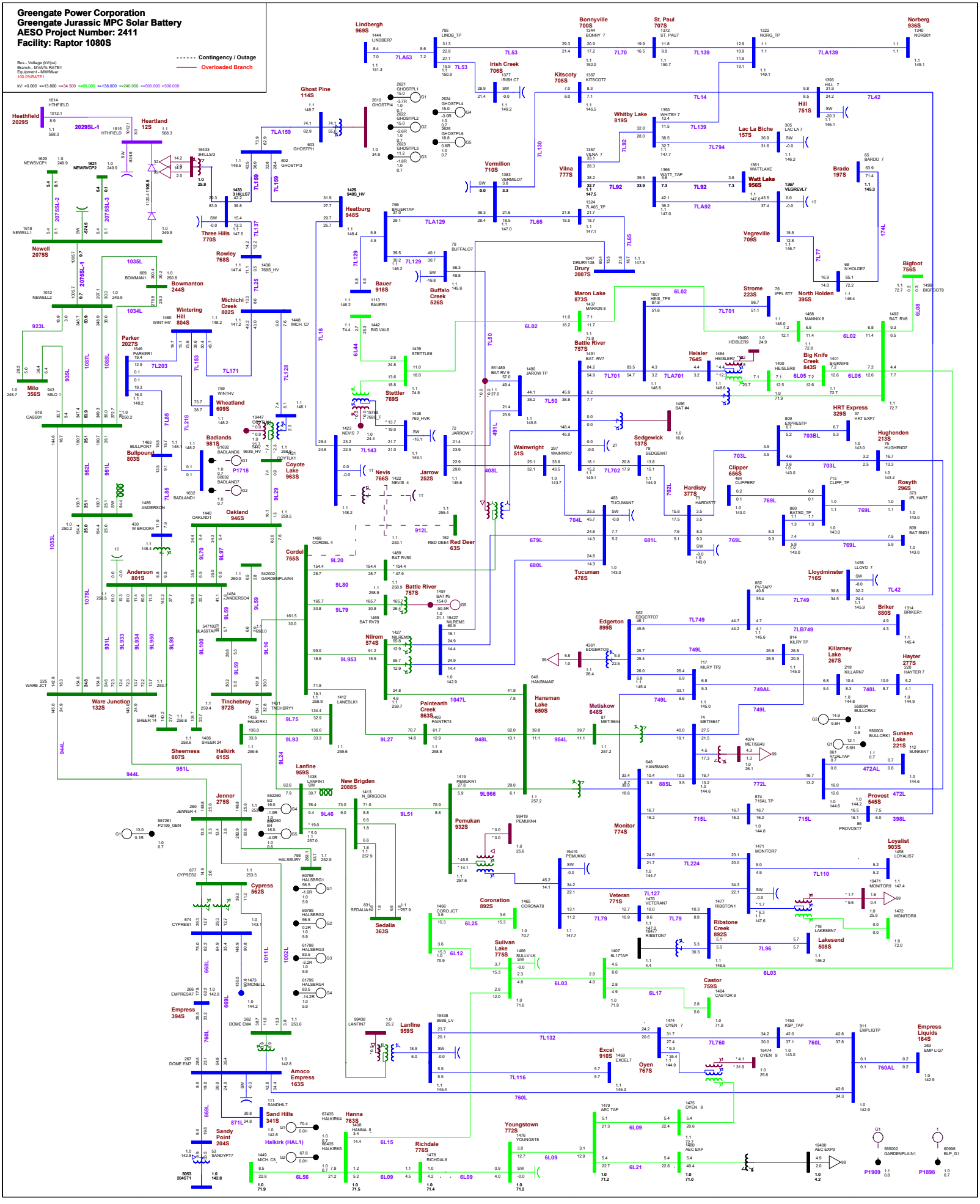


Figure A6-10: 2023 Summer Light Pre-Project - N-1 Contingency of EATL (Newell 2075S - Heathfield 2029S)

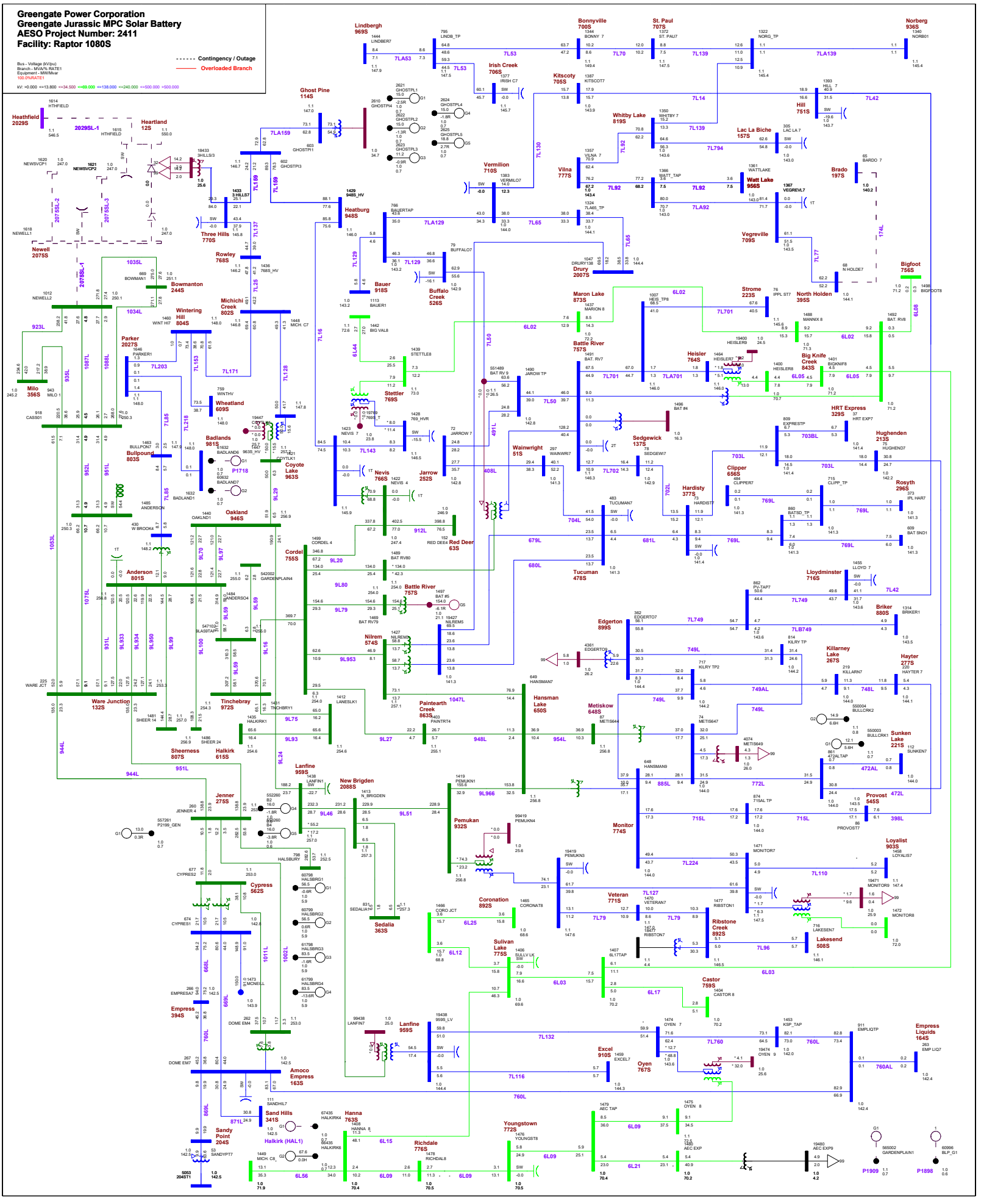


Figure A6-11: 2023 Summer Light Pre-Project - N-1 Contingency of 9L20 (Nevis 766S - Cordel 755S)

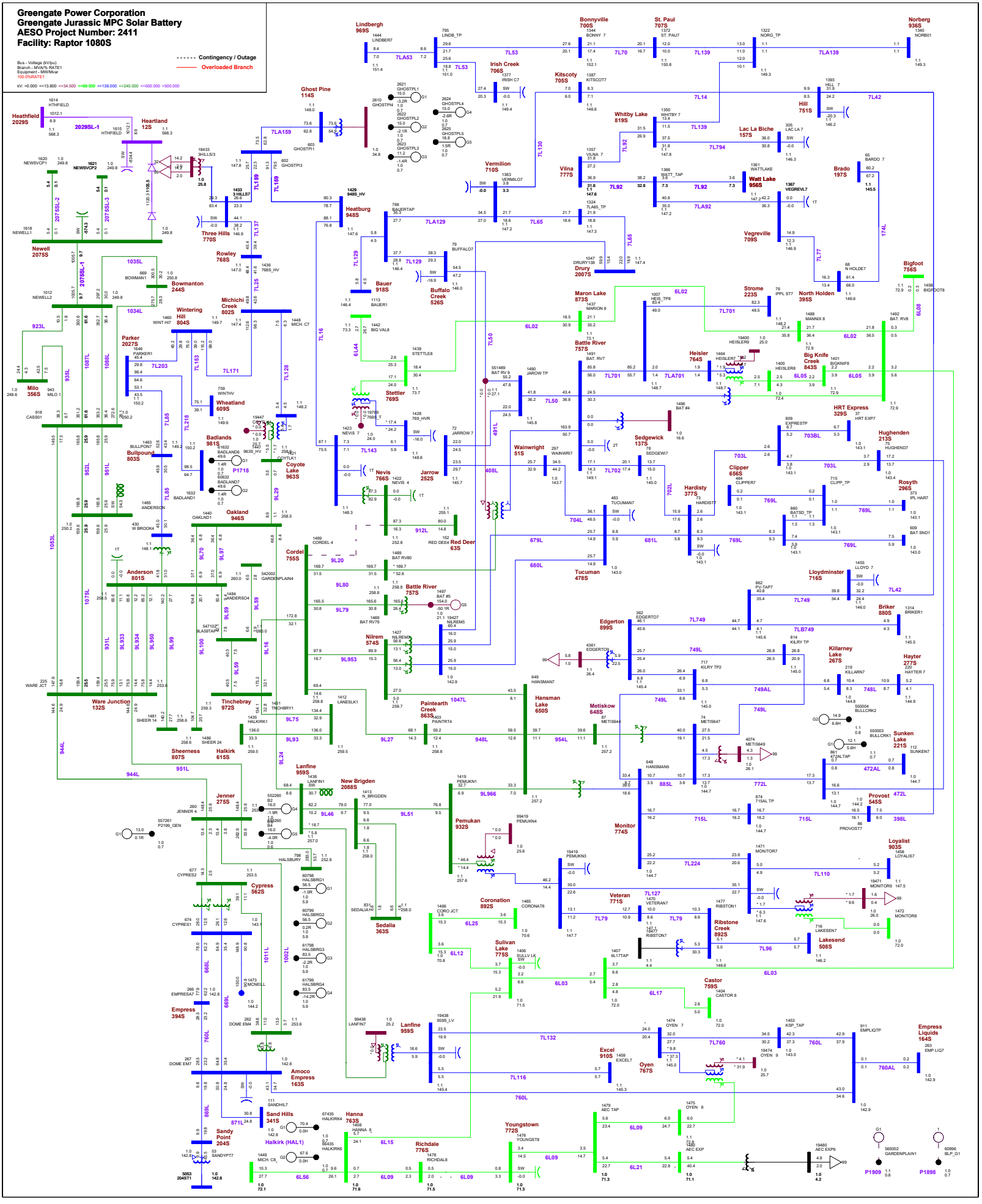


Figure A6-12: 2023 Summer Light Pre-Project - N-1 Contingency of 9L16 (Tinchebray 972S - Cordel 755S)

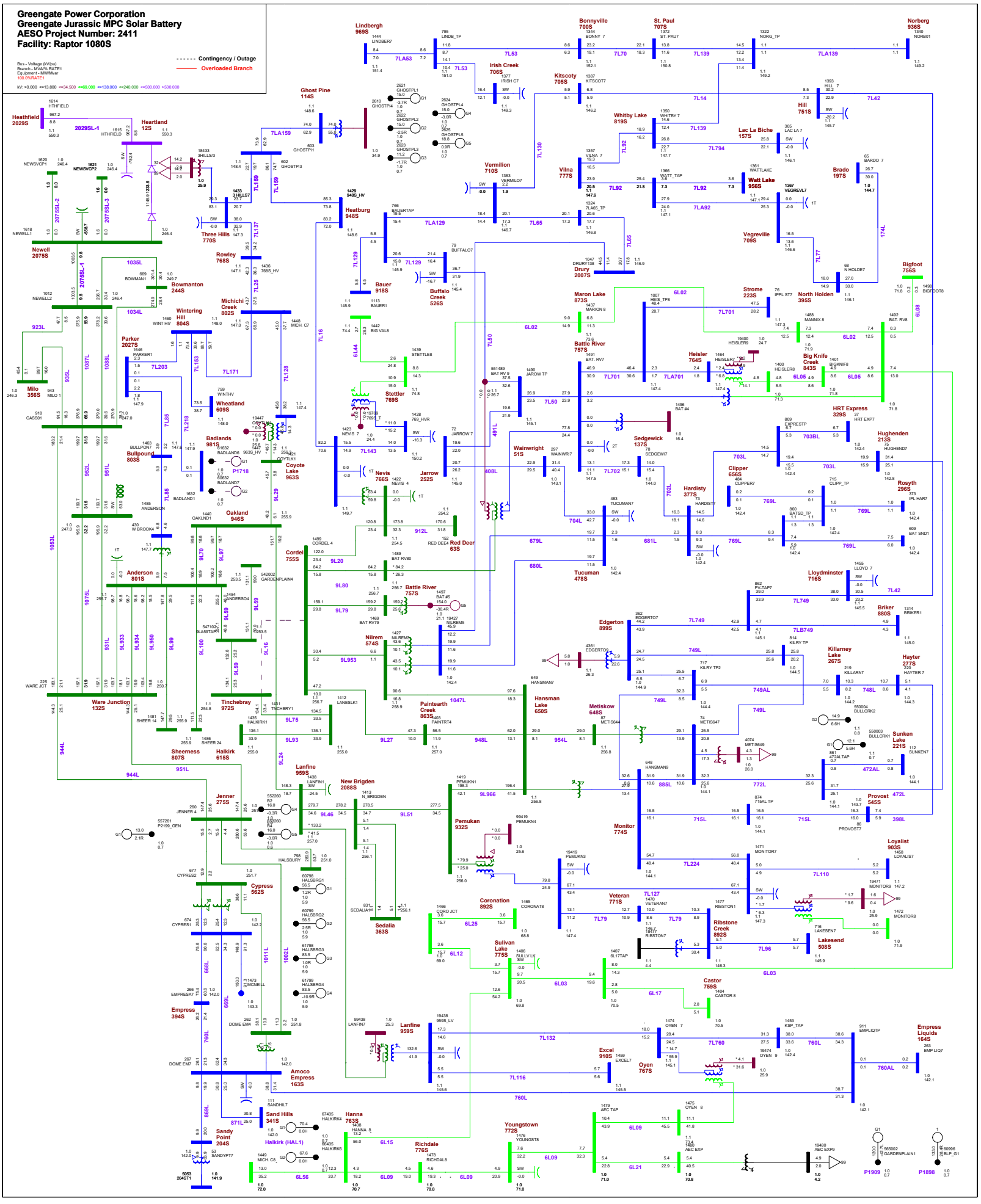


Figure A6-13: 2023 Summer Light Pre-Project - N-1 Contingency of 7L171 (Michichi Creek 802S - Wintering Hills 804S)

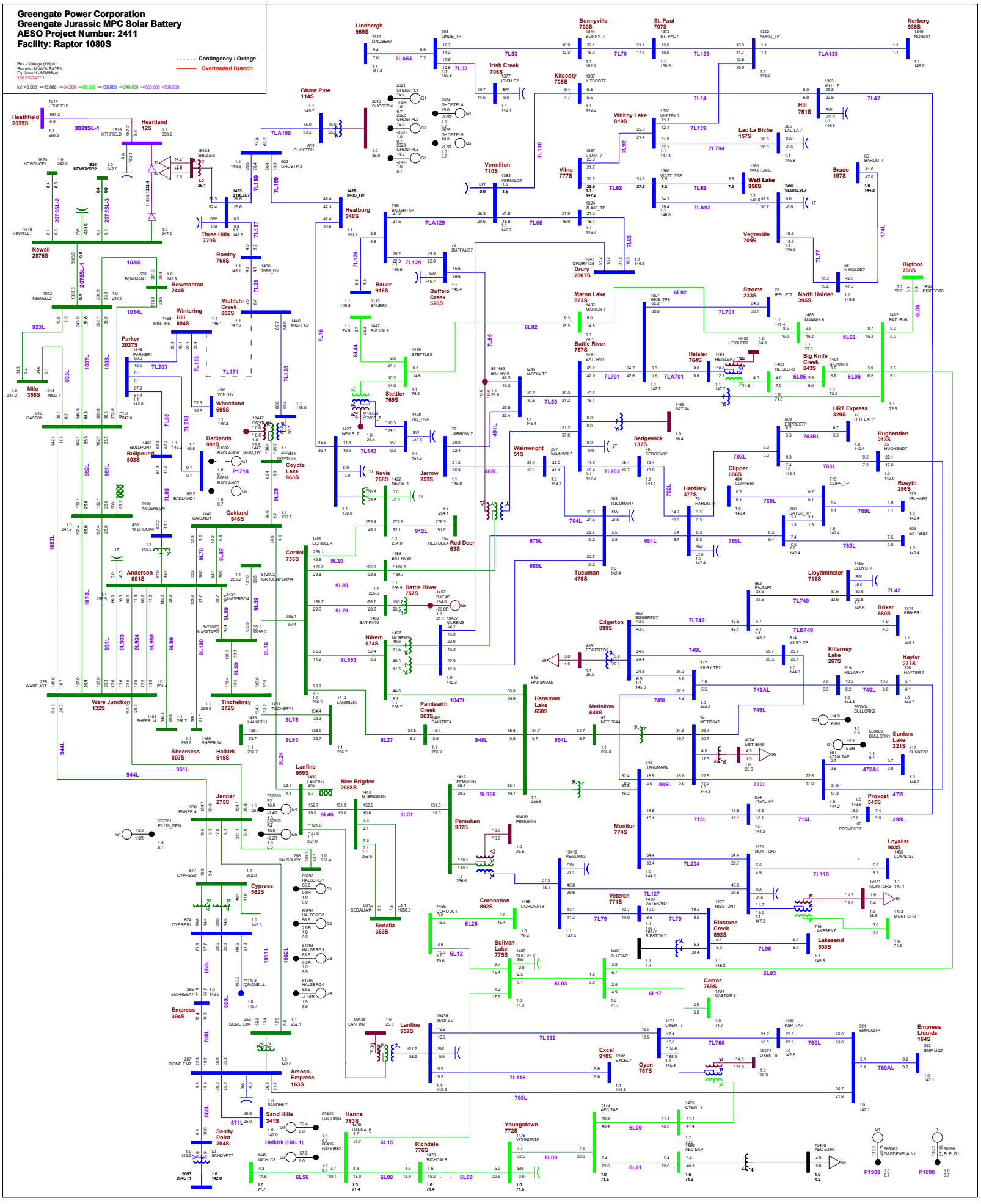
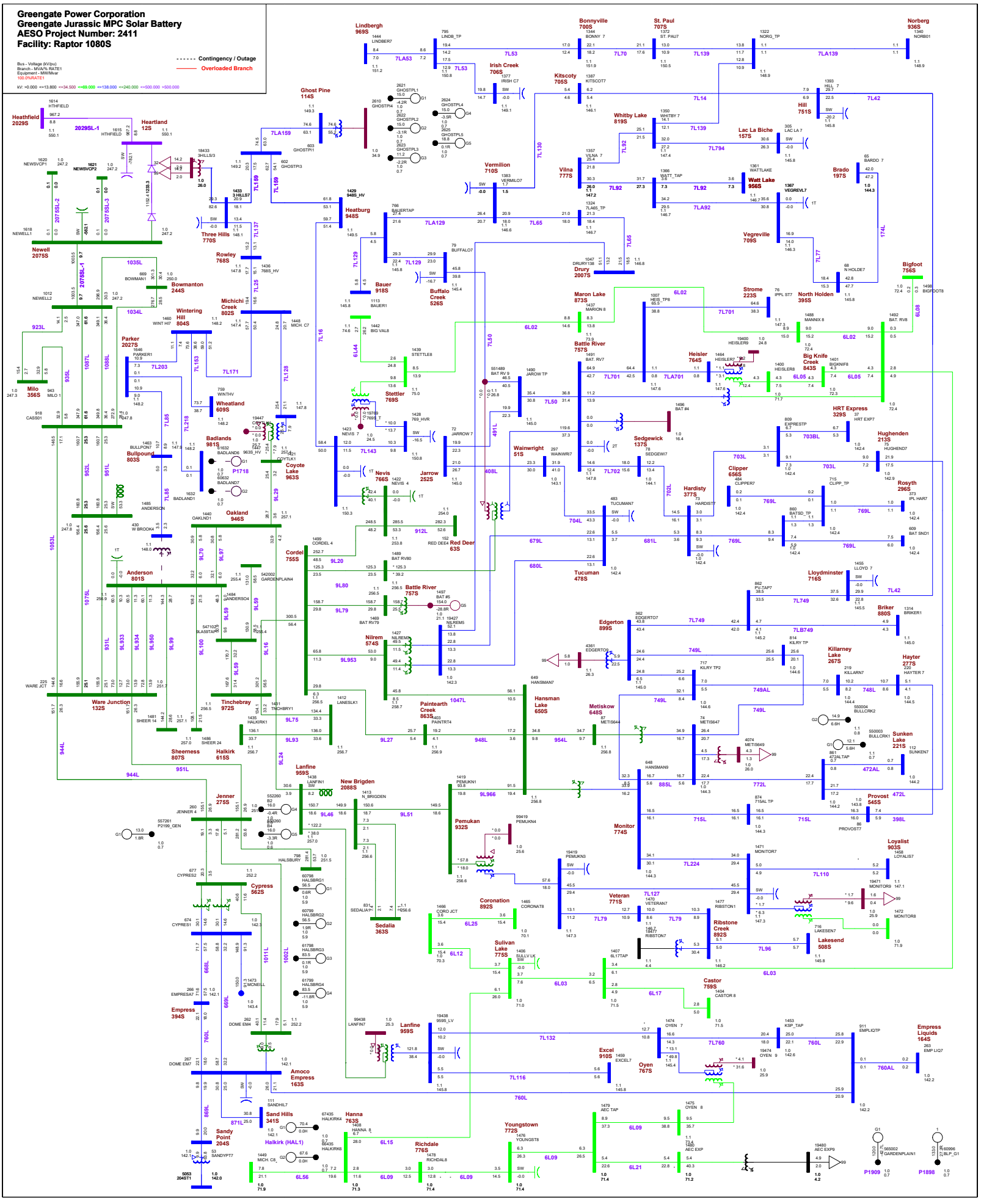


Figure A6-14: 2023 Summer Light Pre-Project - N-1 Contingency of 801S901T (Anderson 801S Transformer 901T)



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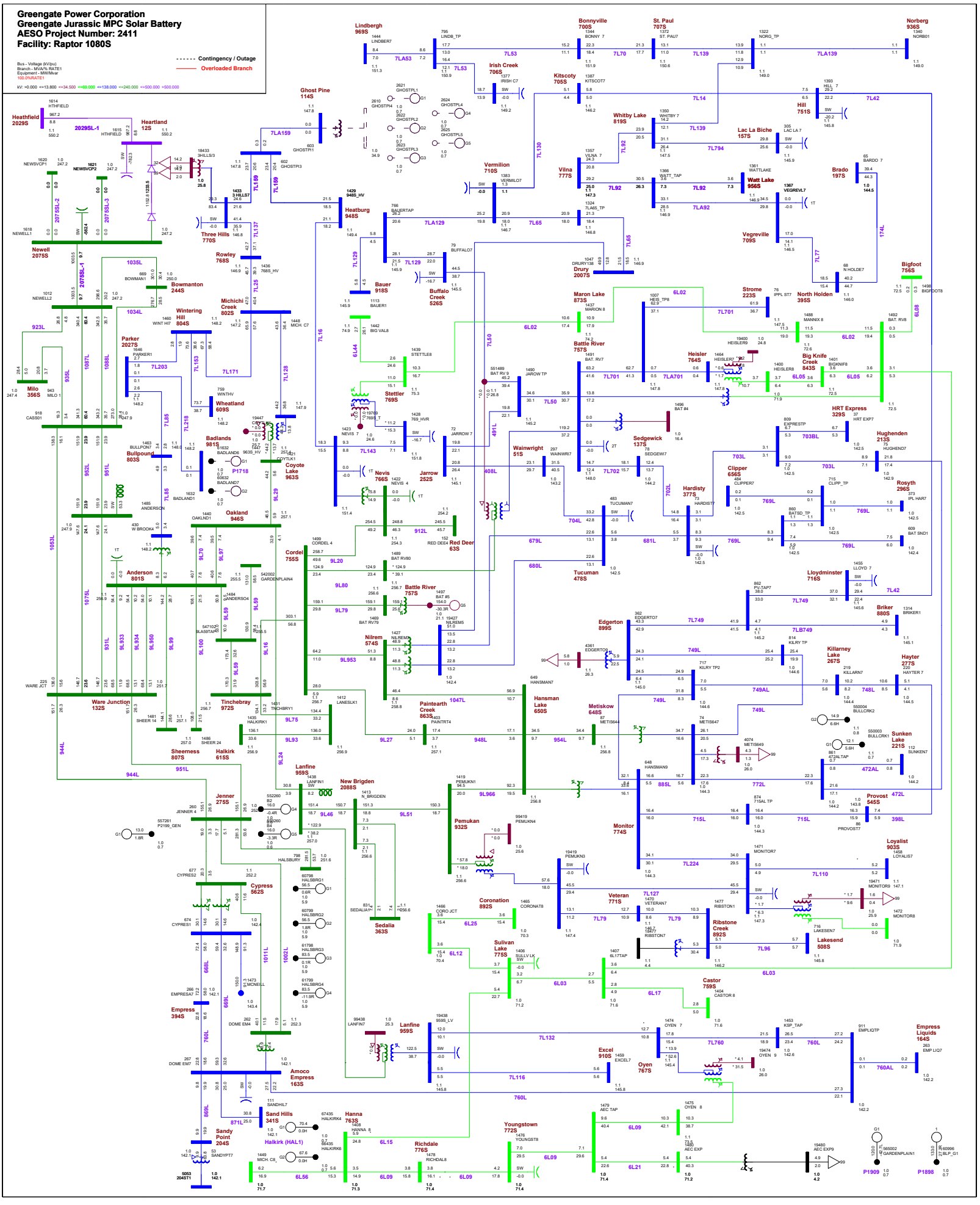


Figure A6-16: 2023 Summer Light Pre-Project - N-1 Contingency of 912L\9L912 (Red Deer 63S - Nevis 766S)

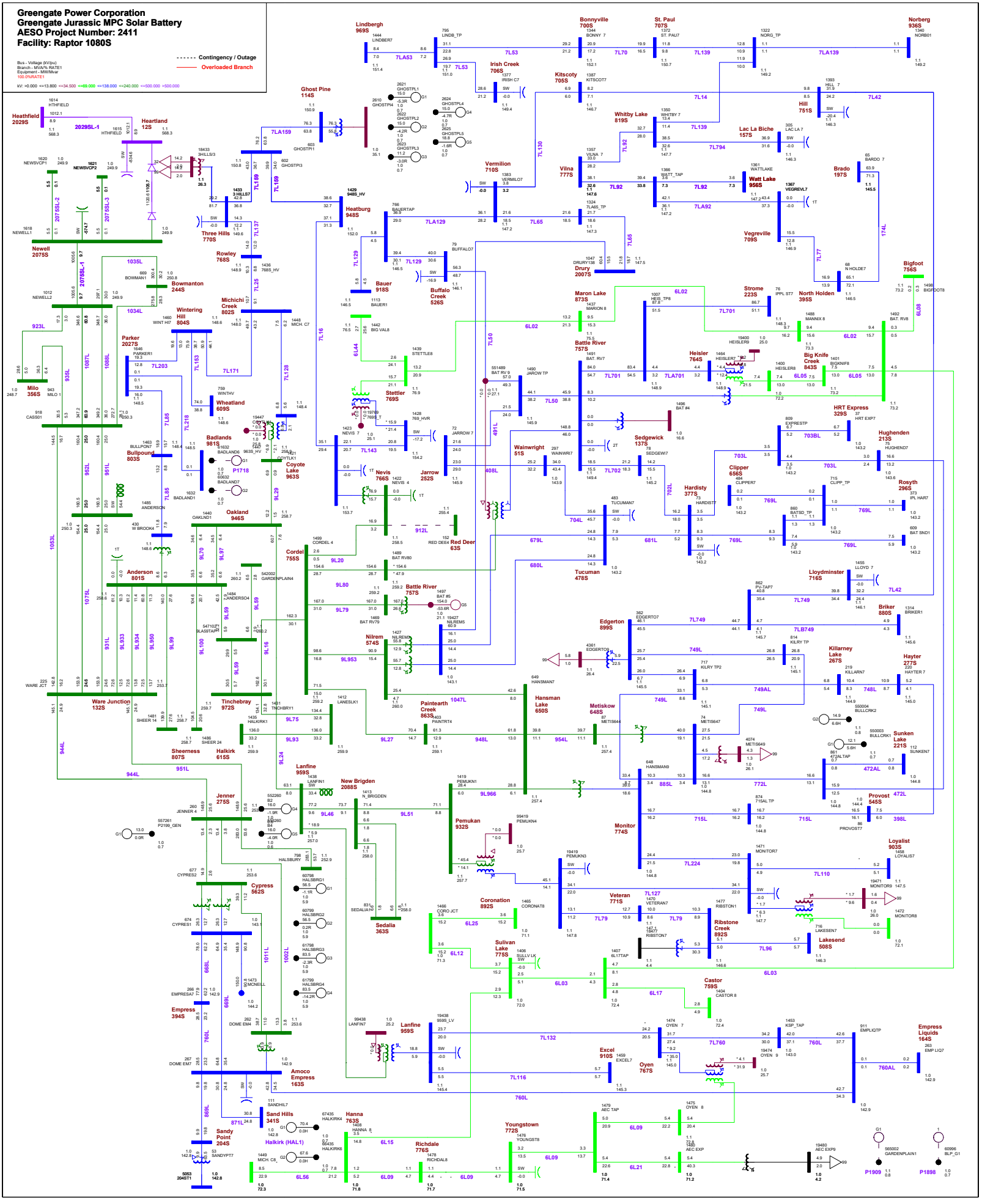


Figure A6-17: 2023 Winter Peak Pre-Project - N-1 Contingency of EATL (Newell 2075S - Heathfield 2029S)

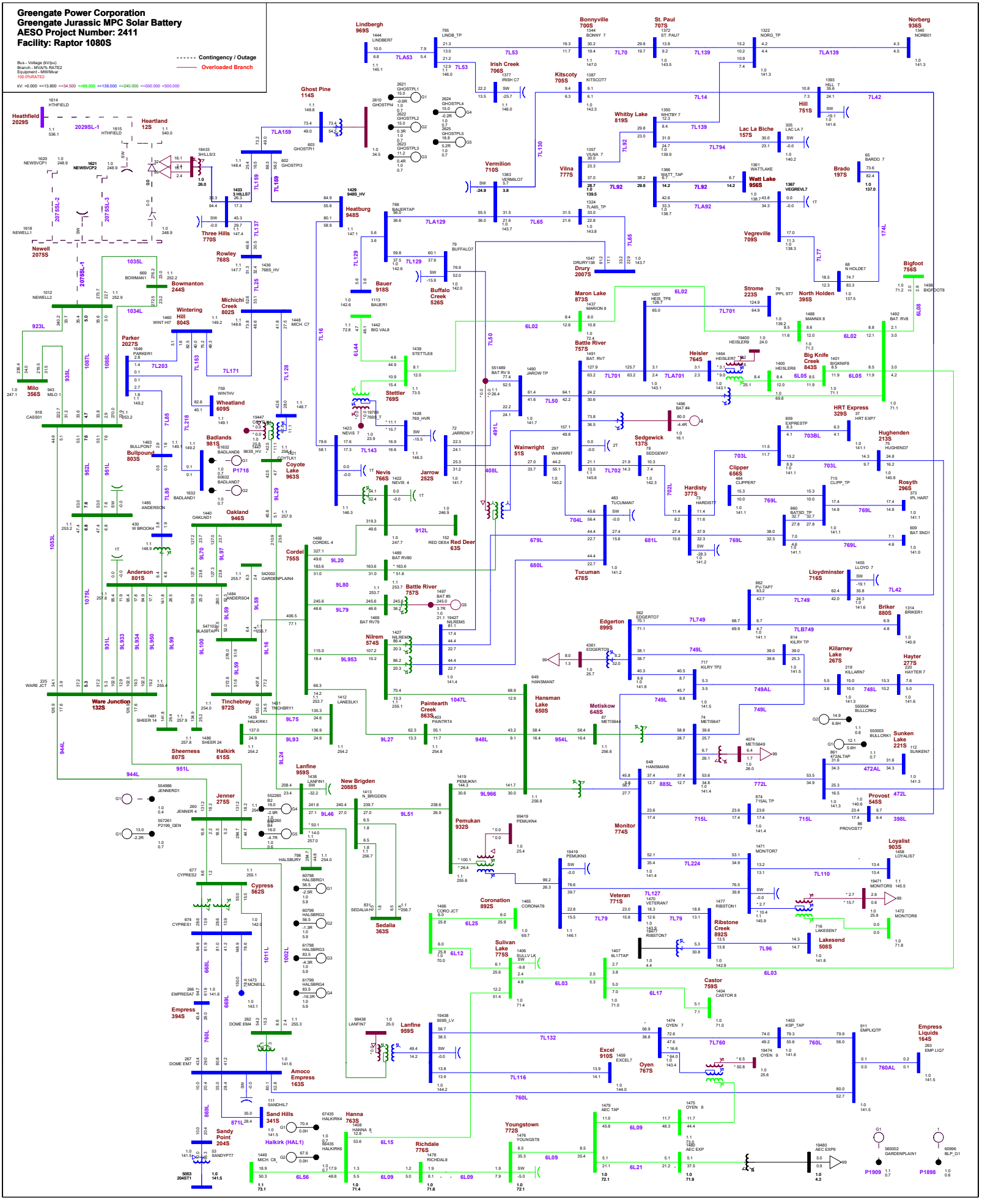


Figure A6-18: 2023 Winter Peak Pre-Project - N-1 Contingency of 7L171 (Michichi Creek 802S - Wintering Hills 804S)

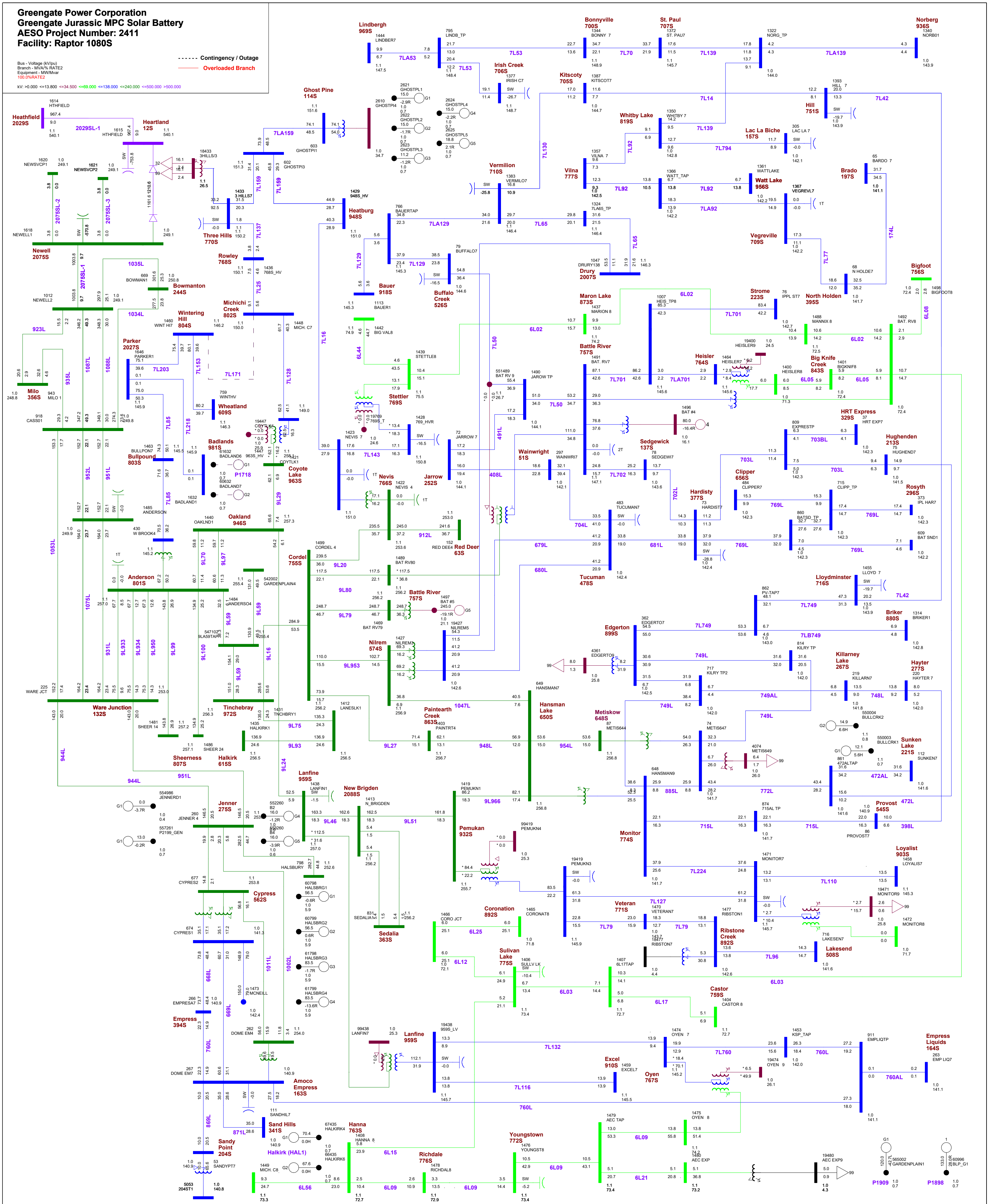
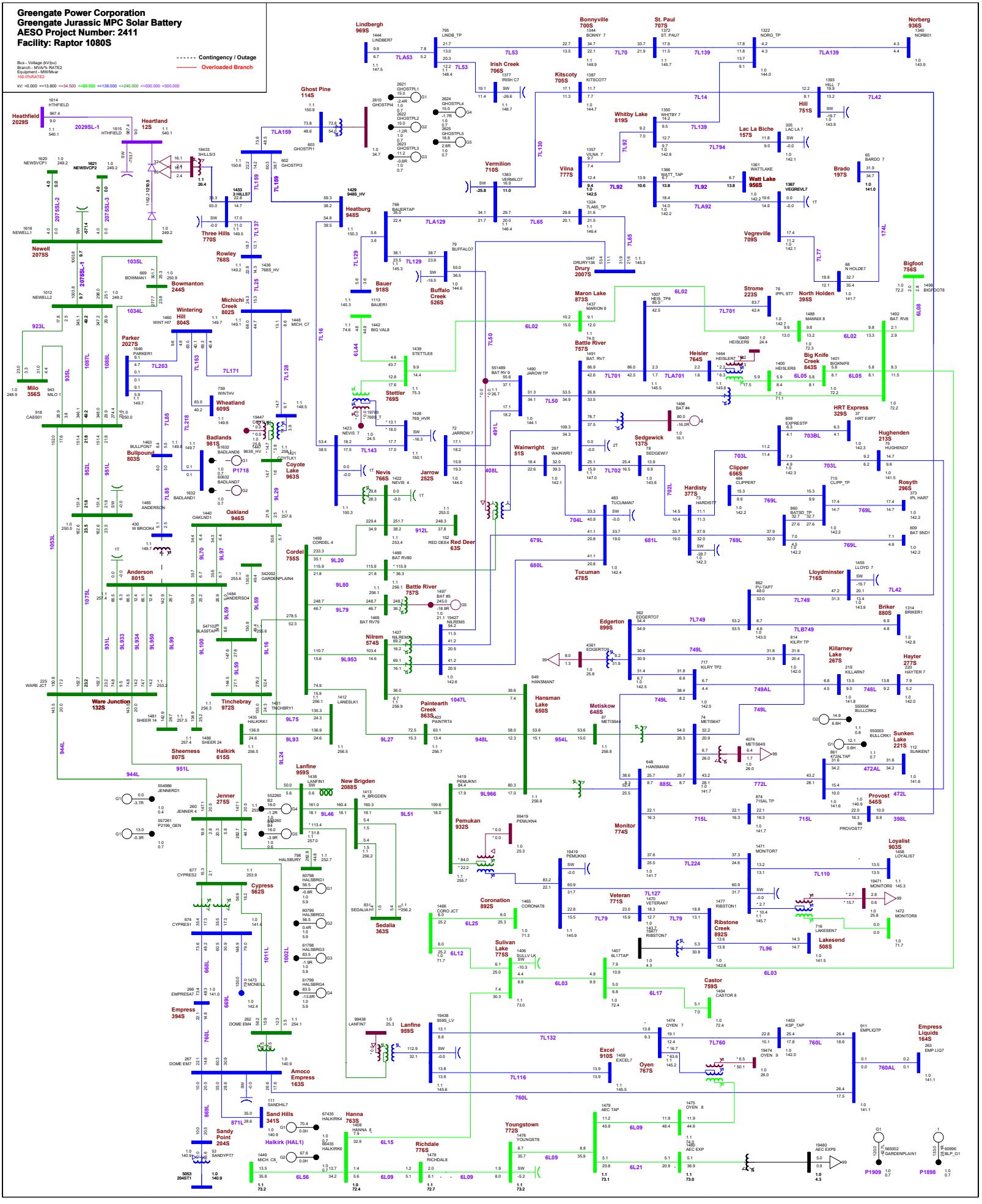


Figure A6-19: 2023 Winter Peak Pre-Project - N-1 Contingency of 801S901T (Anderson 801S Transformer 901T)



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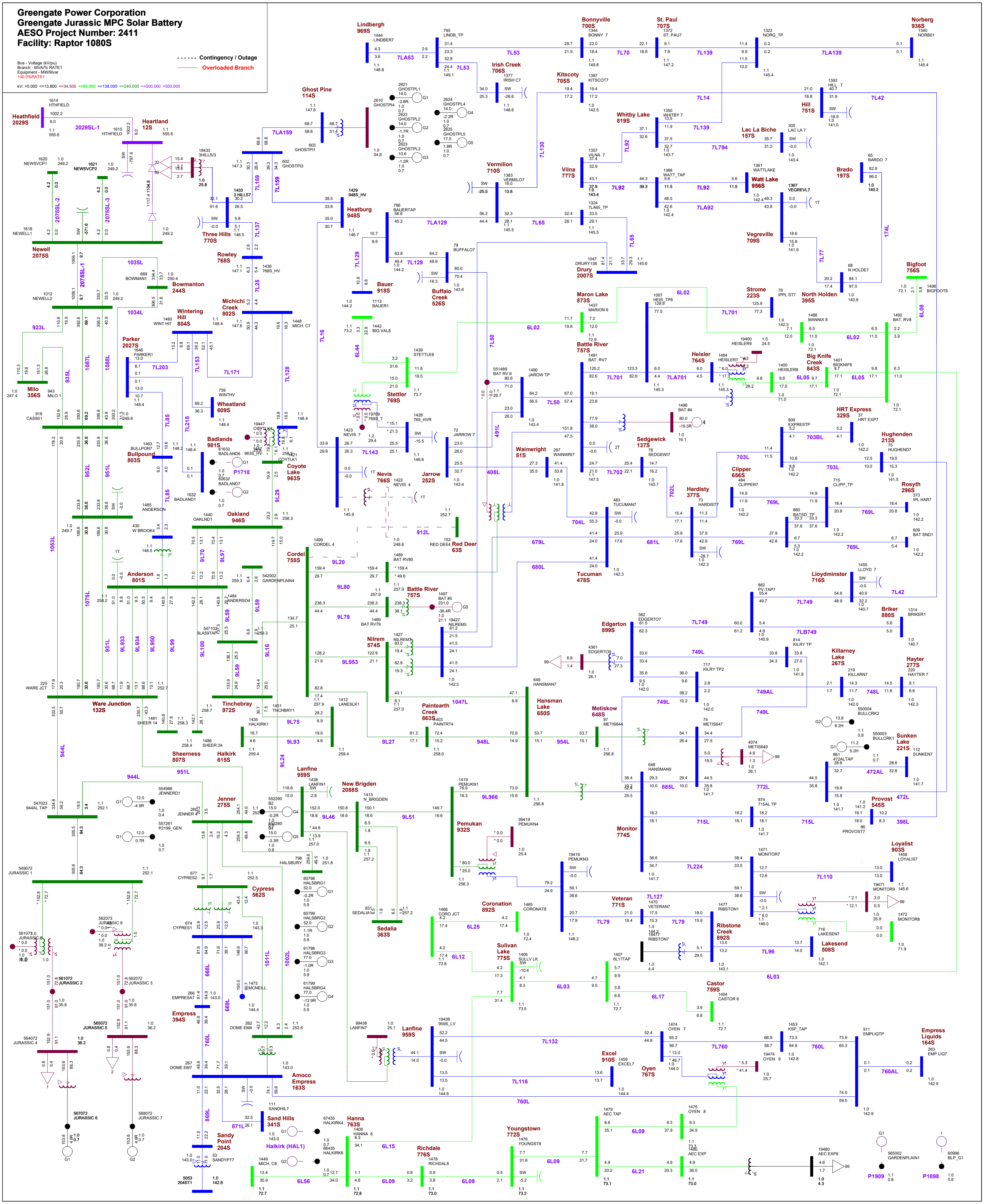


Figure A7-2: 2023 Summer Peak Post-Project - N-1 Contingency of EATL (Newell 2075S - Heathfield 2029S)

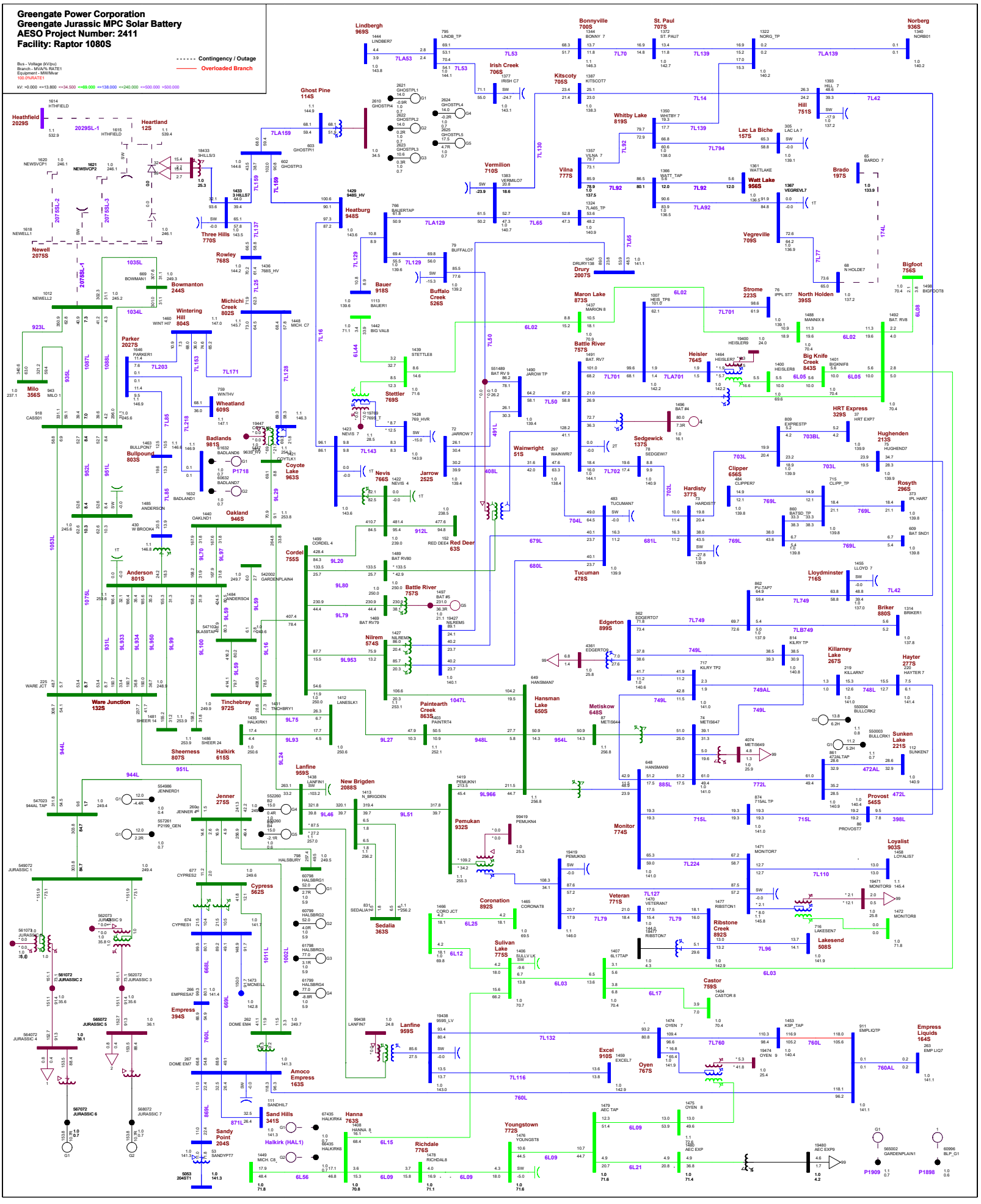


Figure A7-3: 2023 Summer Peak Post-Project - N-1 Contingency of 9L20 (Nevis 766S - Cordel 755S)

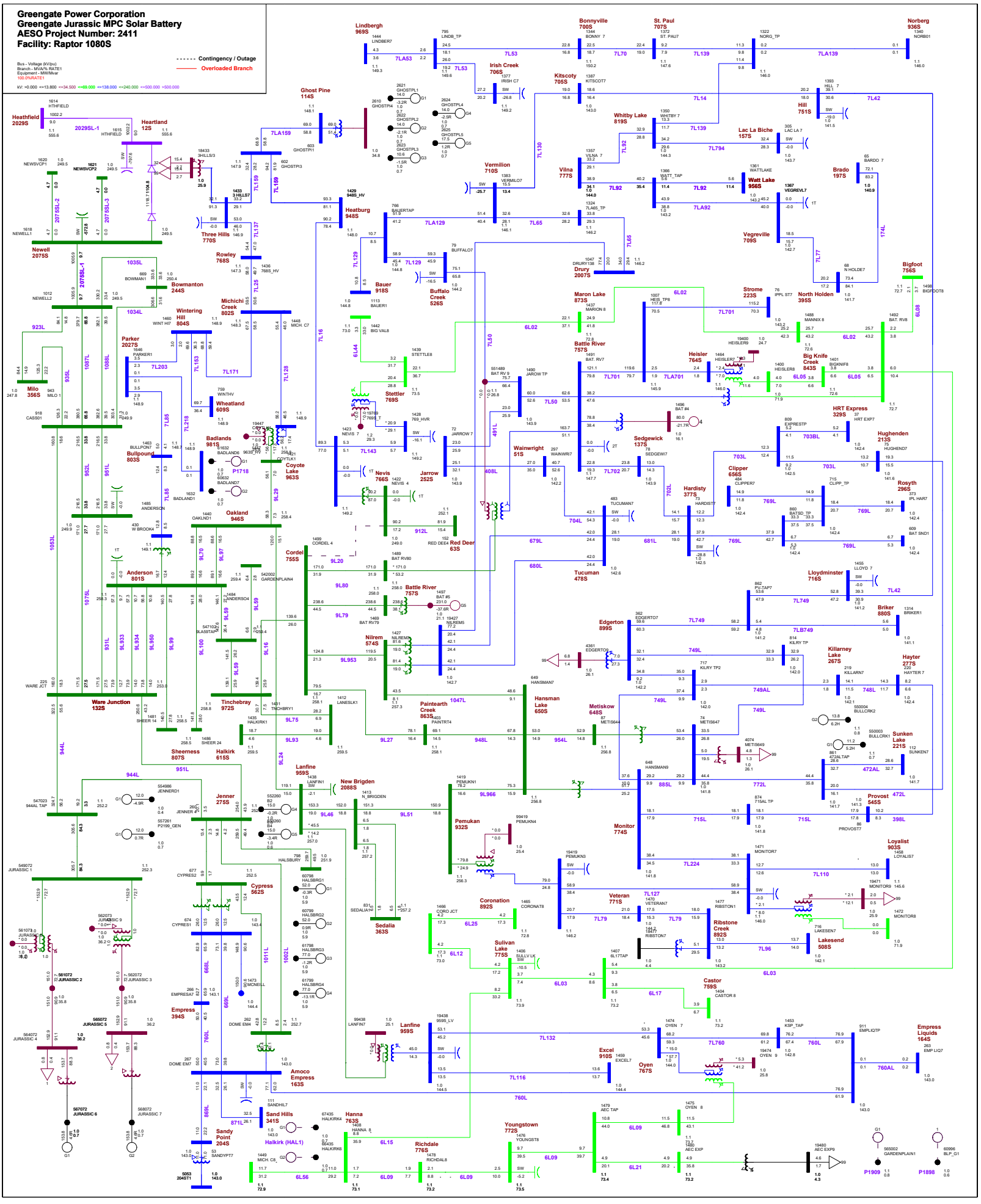
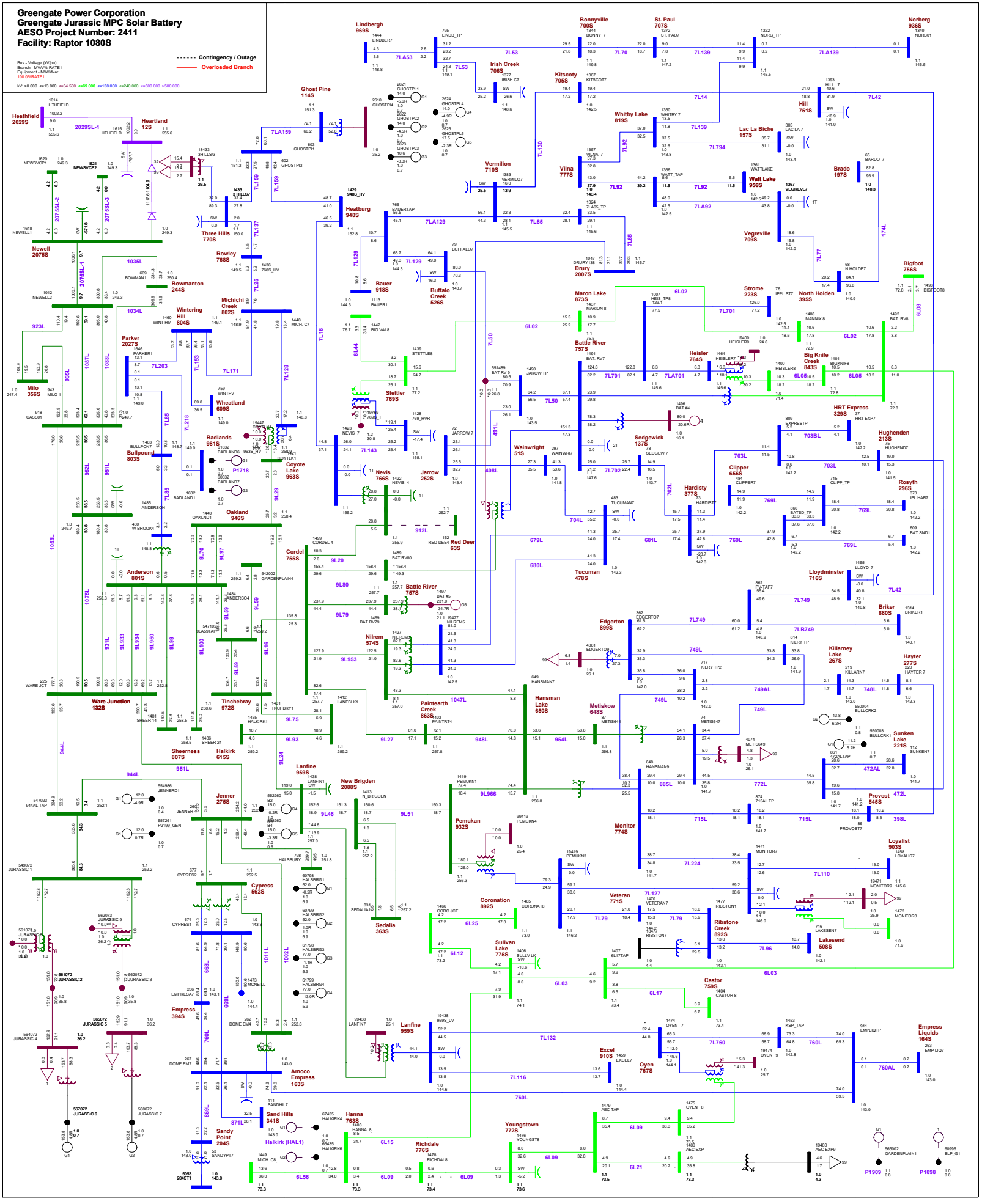


Figure A7-4: 2023 Summer Peak Post-Project - N-1 Contingency of 912L\9L912 (Red Deer 63S - Nevis 766S)



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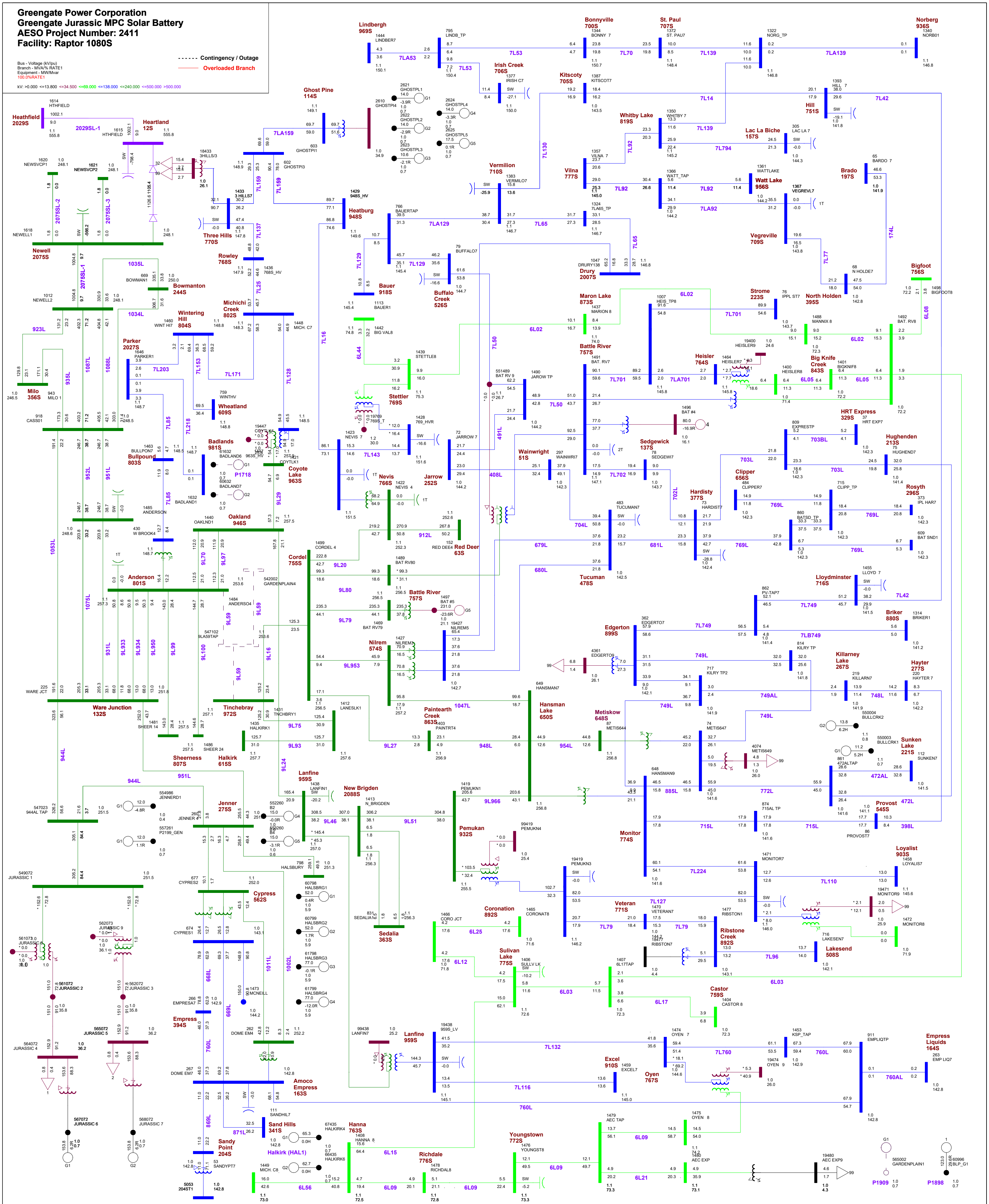
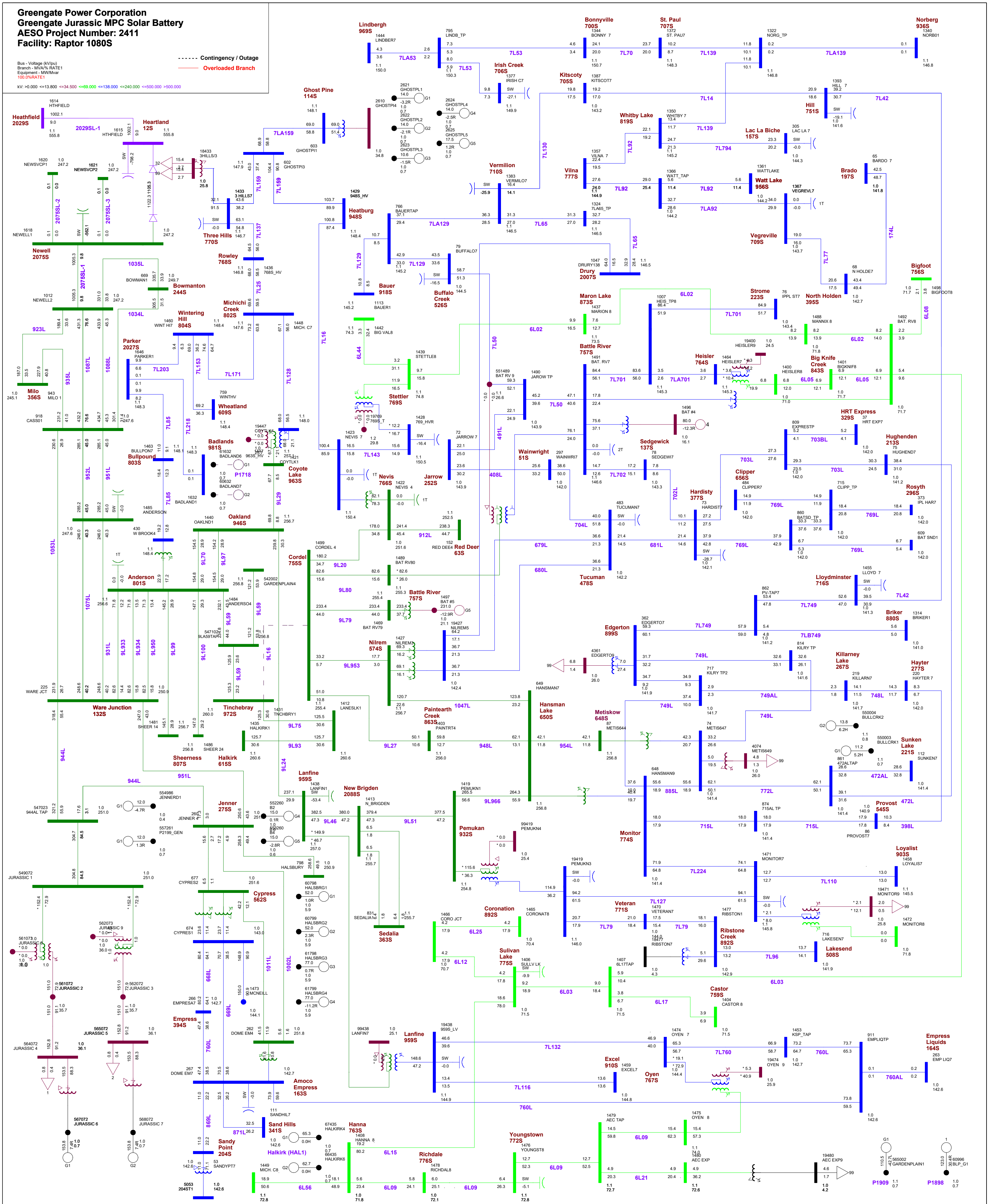


Figure A7-6: 2023 Summer Peak Post-Project - N-1 Contingency of 9L16 (Tinchebray 972S - Cordel 755S)



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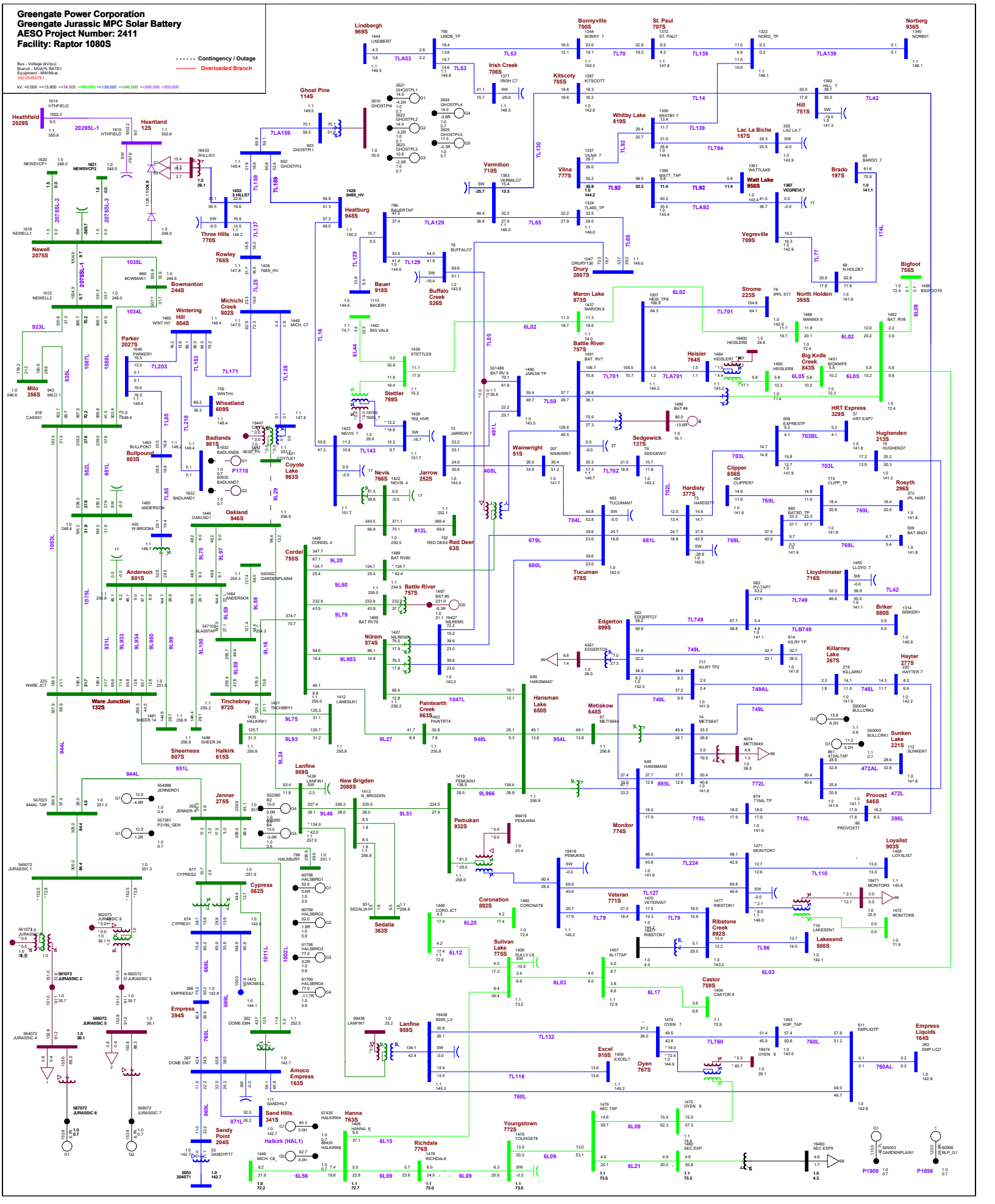

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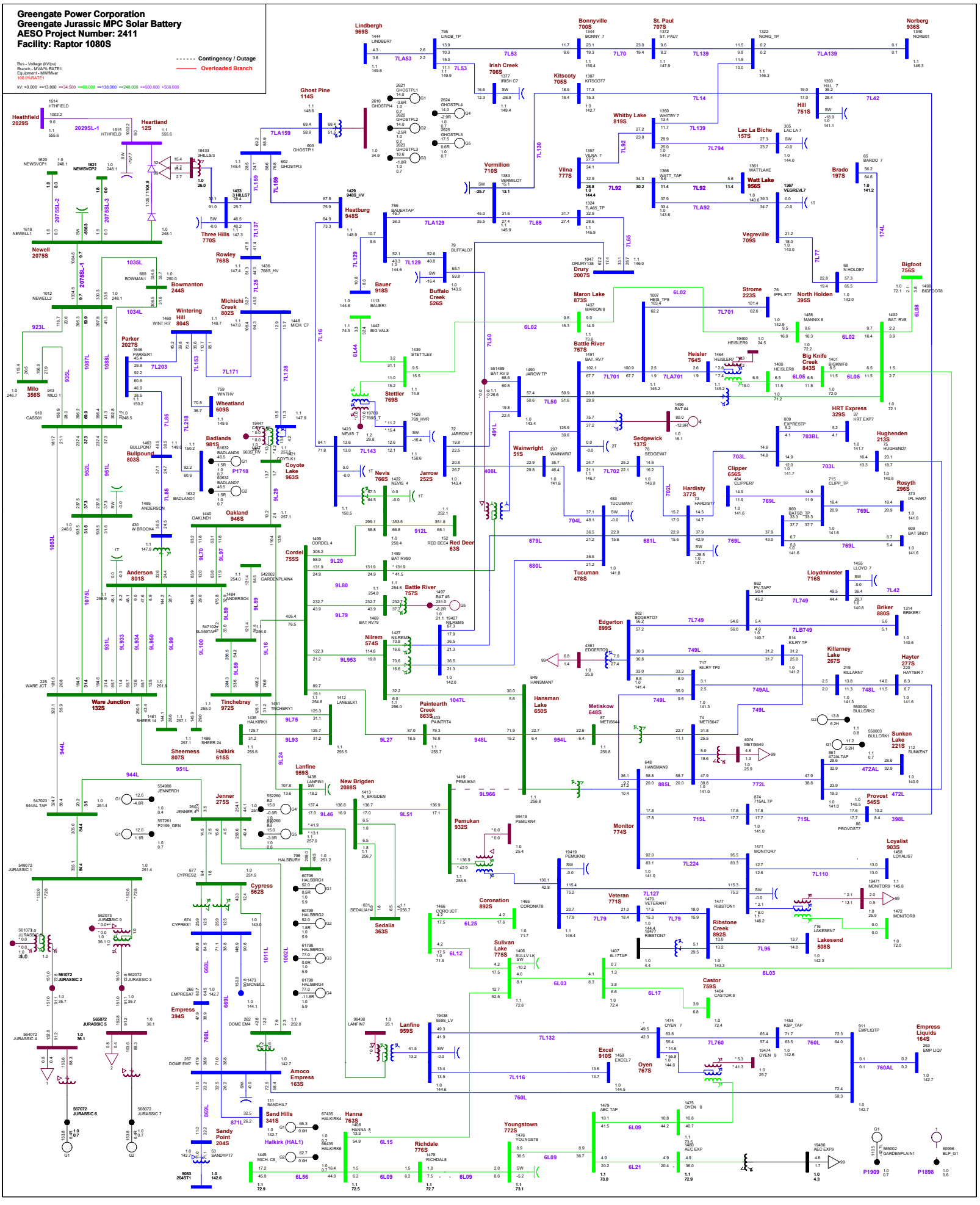

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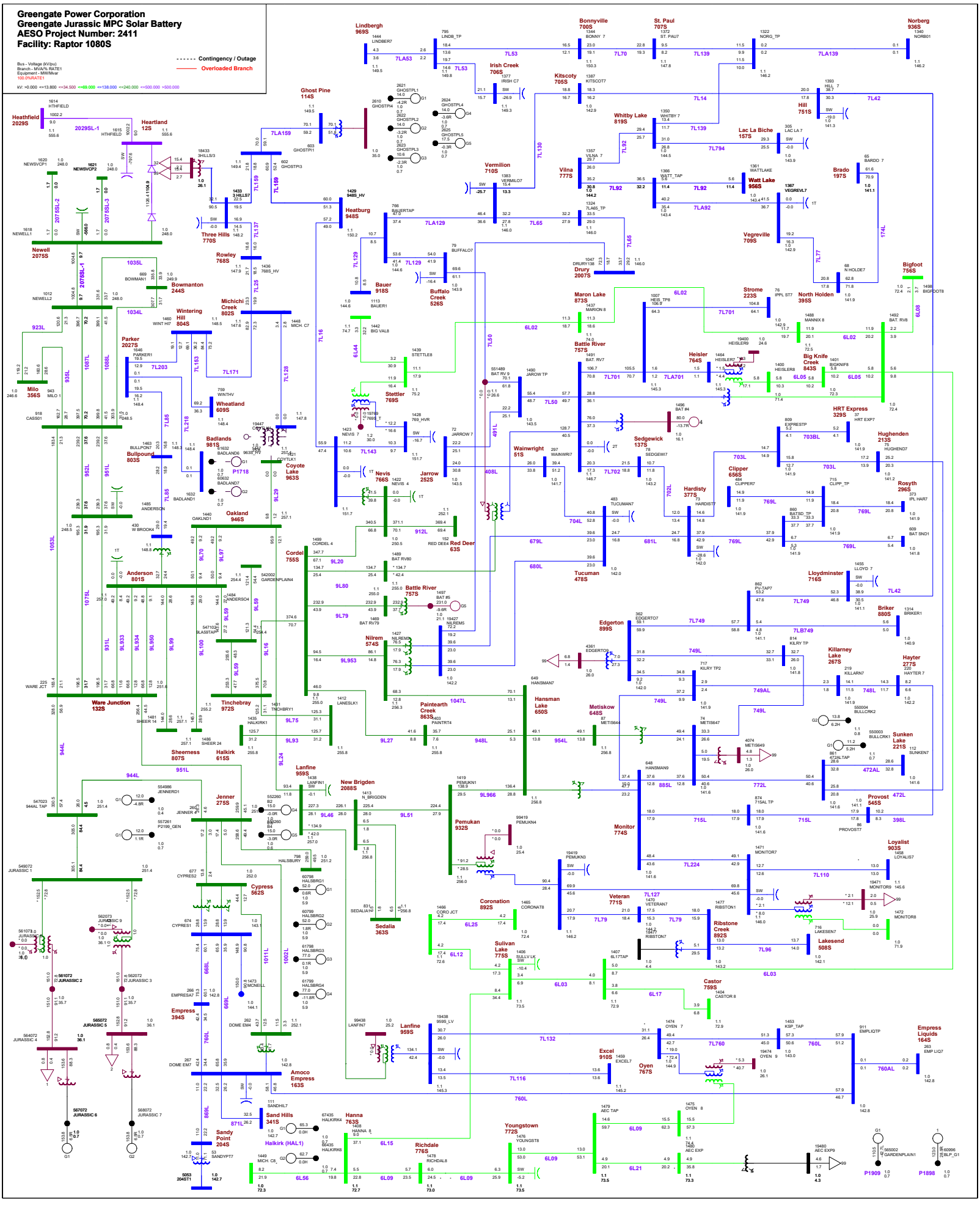

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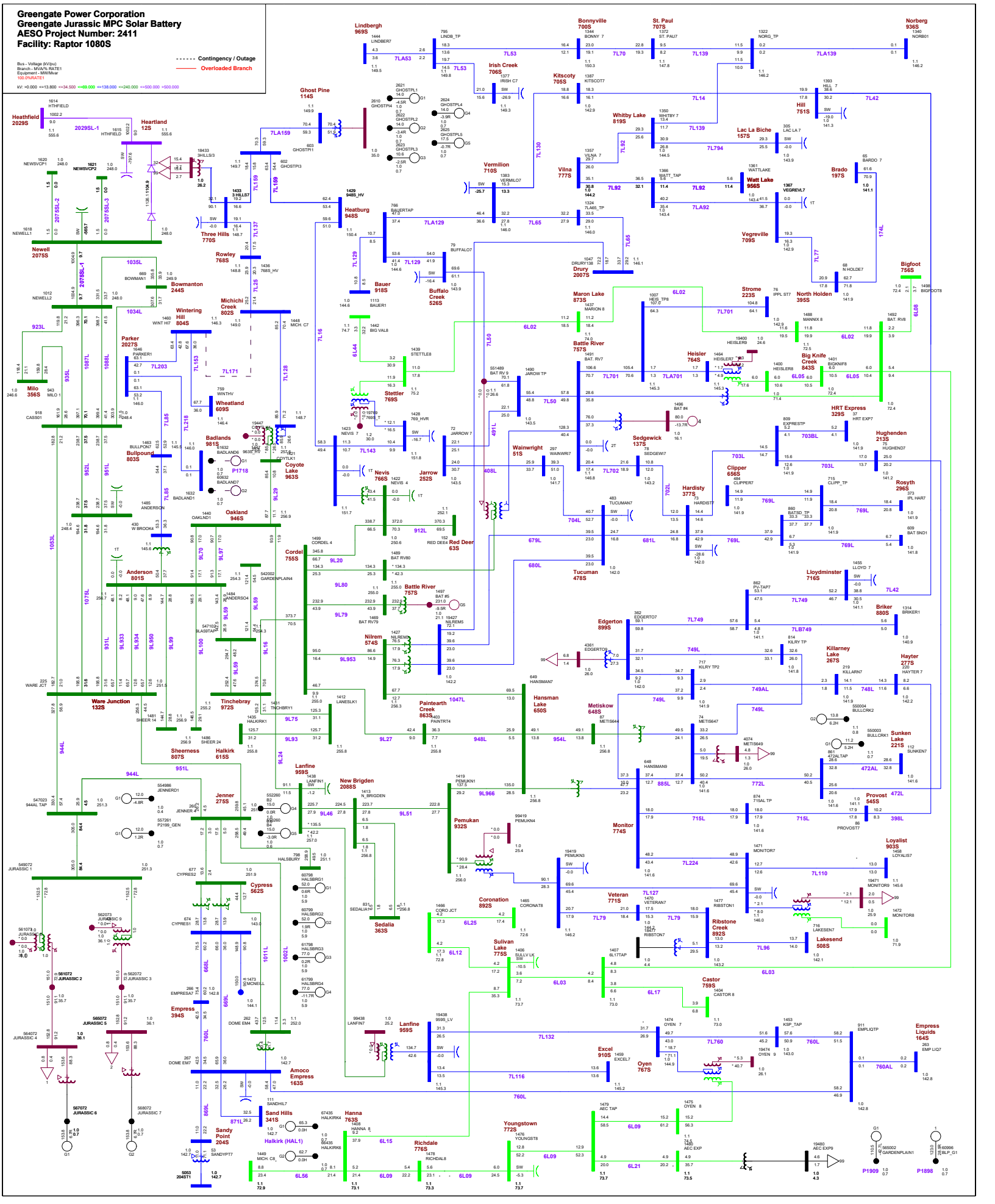

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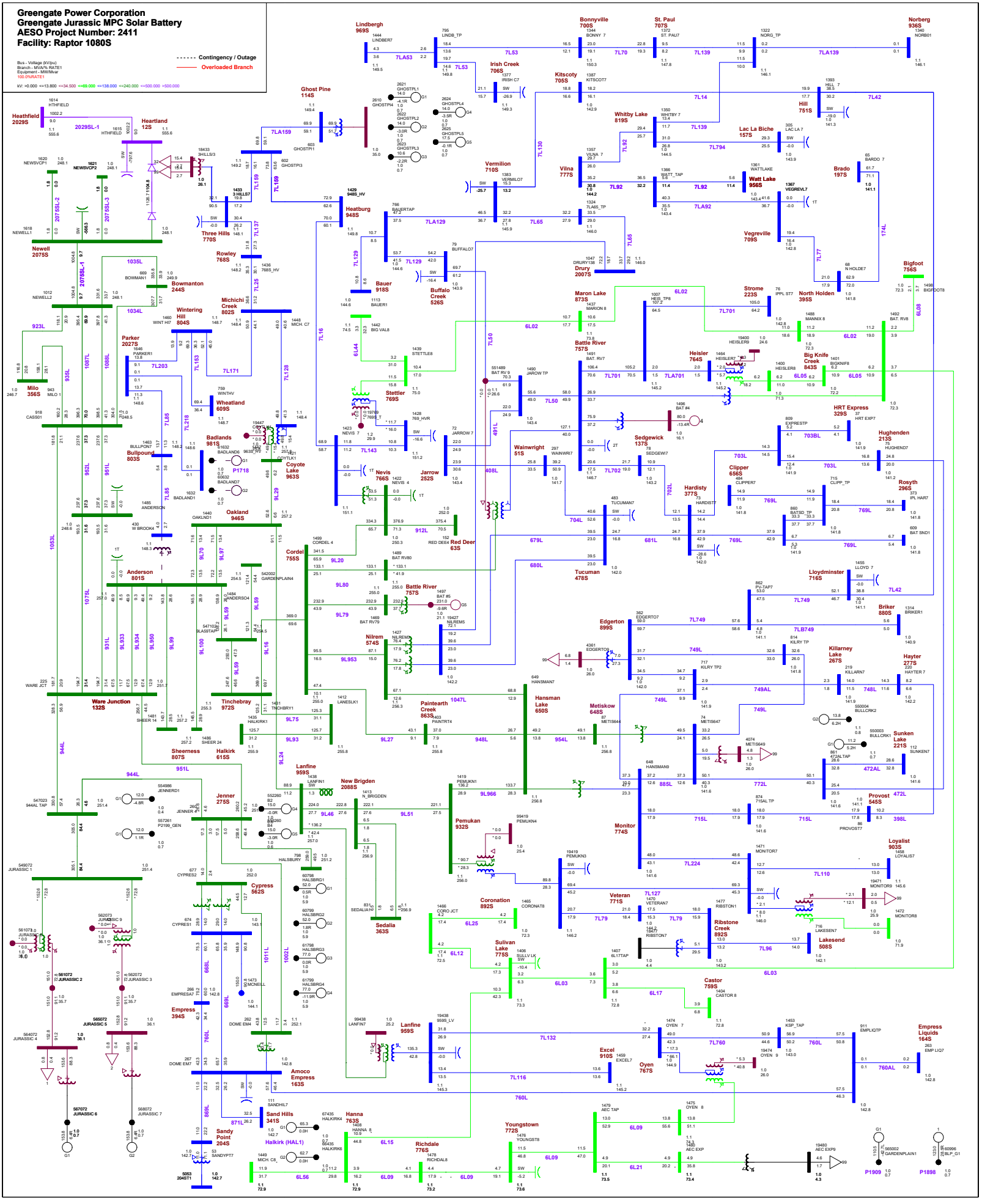

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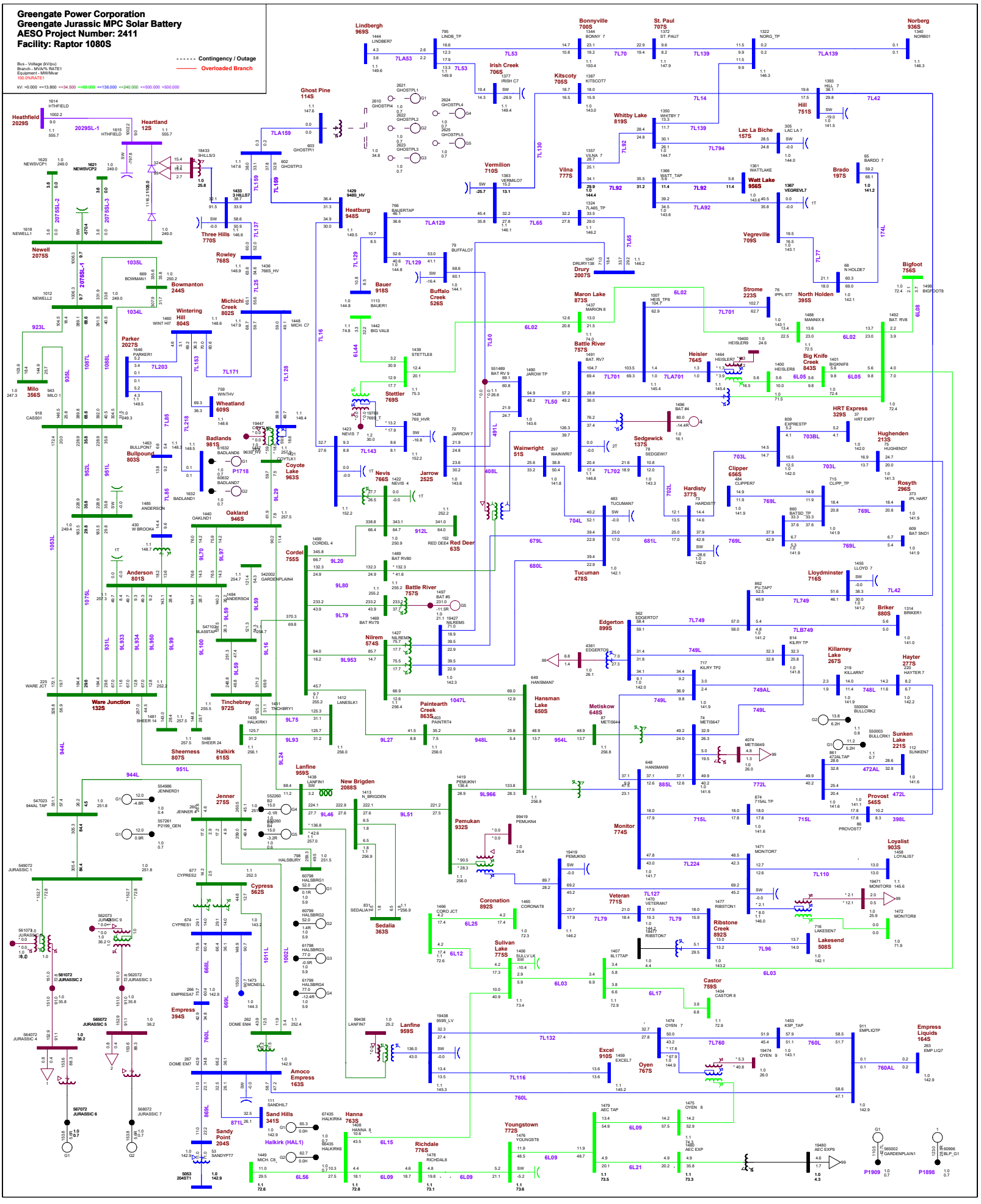
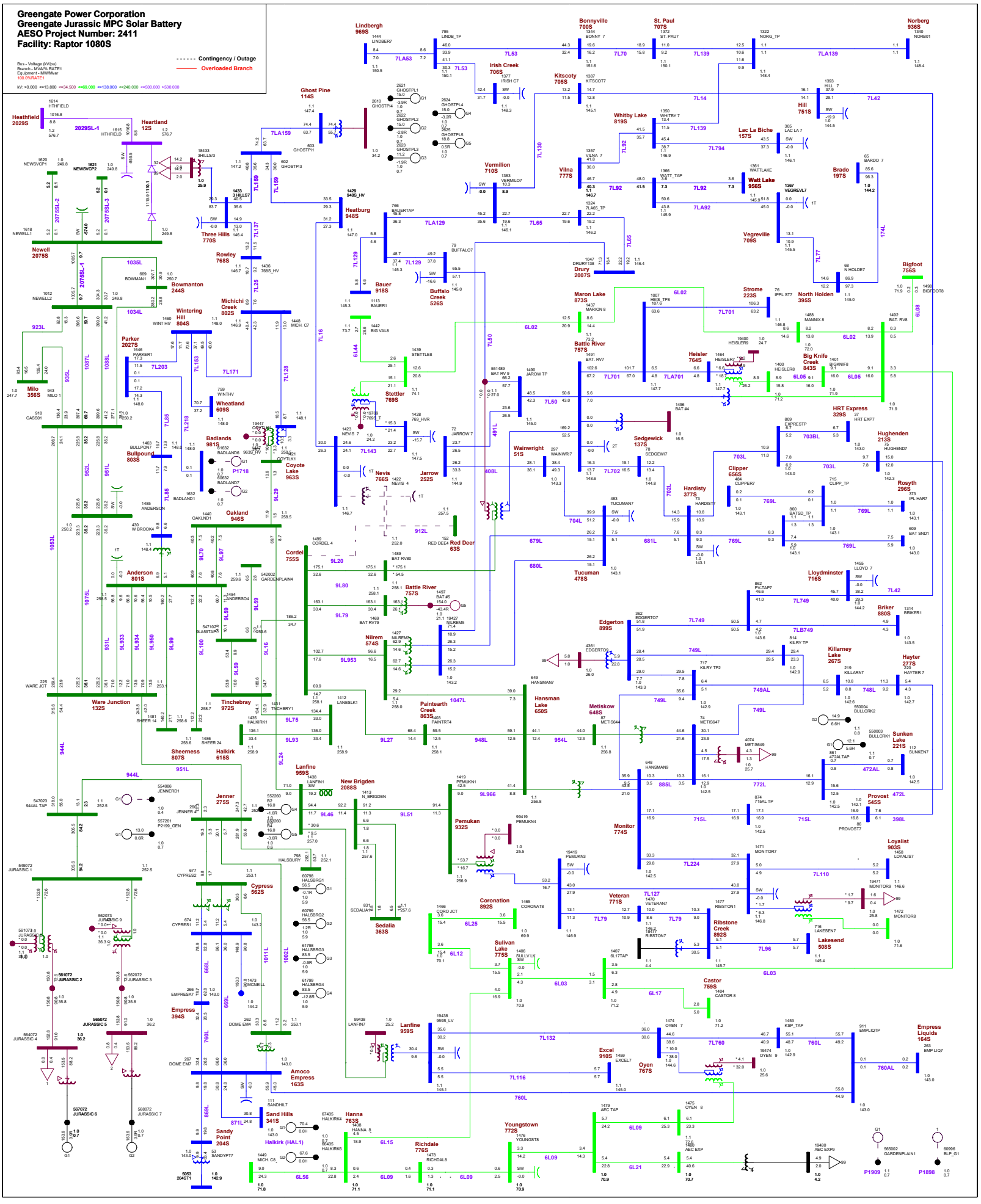


Figure A7-13: 2023 Summer Light Post-Project - N-1 Contingency of 766S901T (Nevis 766S Transformer 901T)



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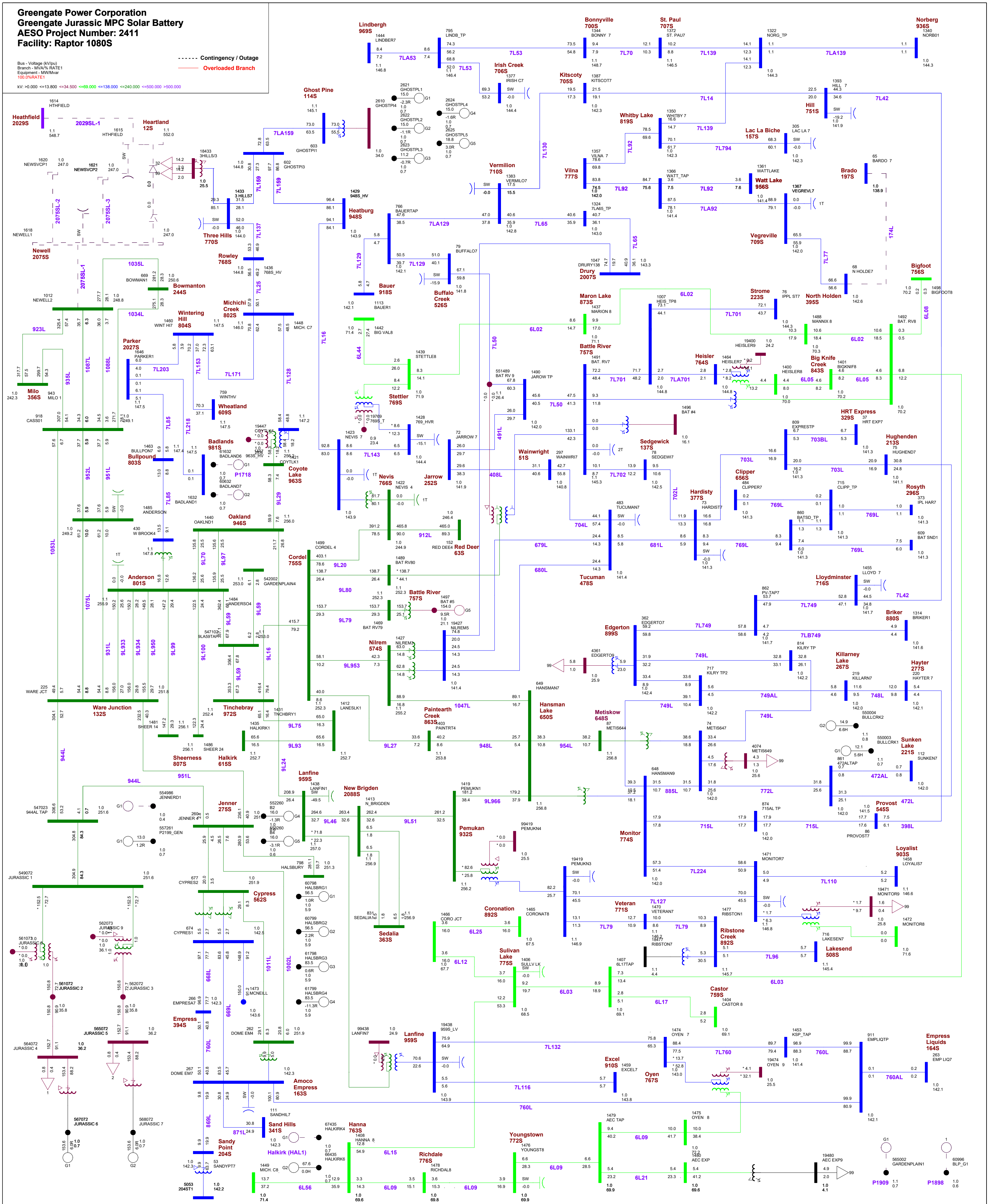

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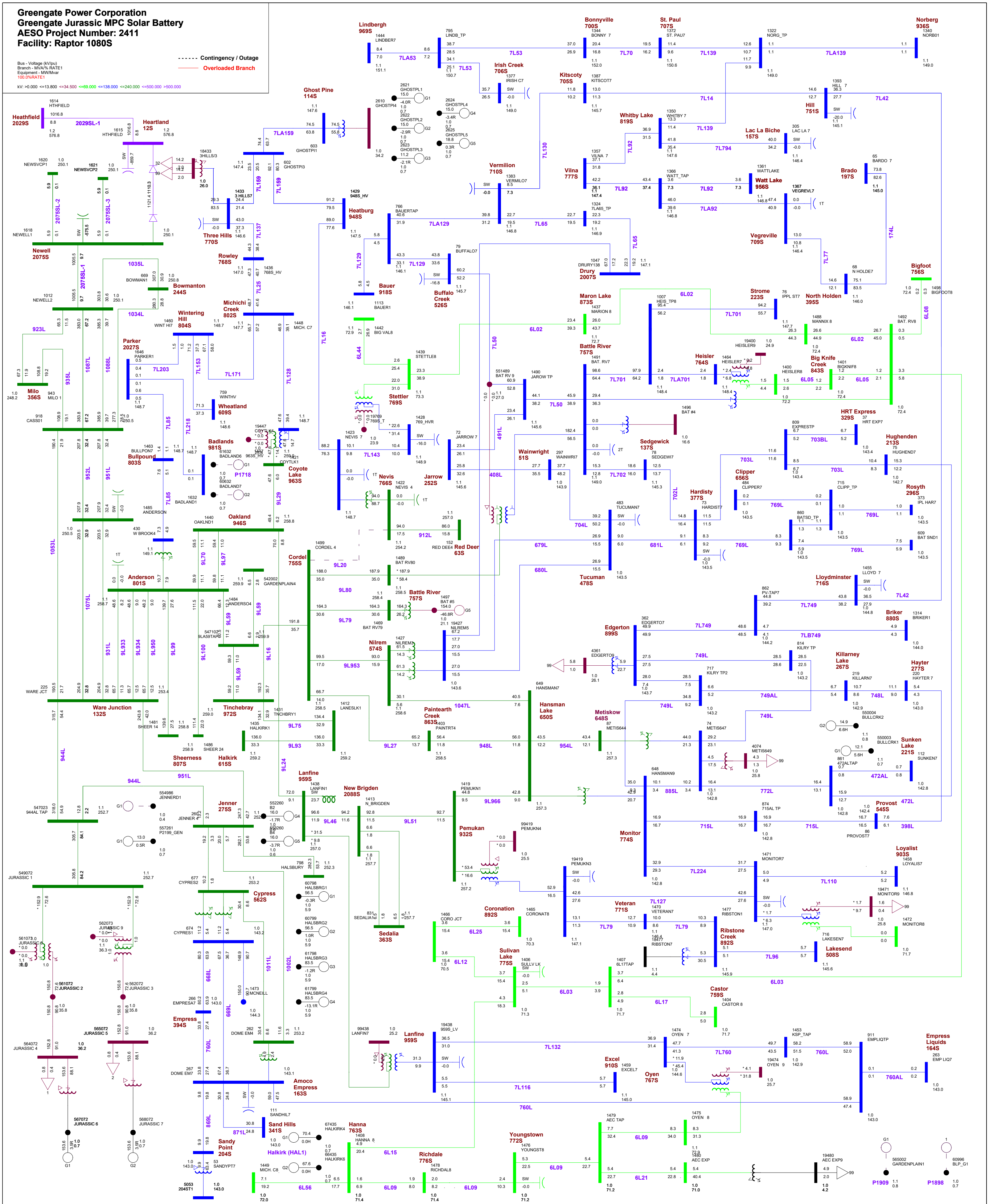

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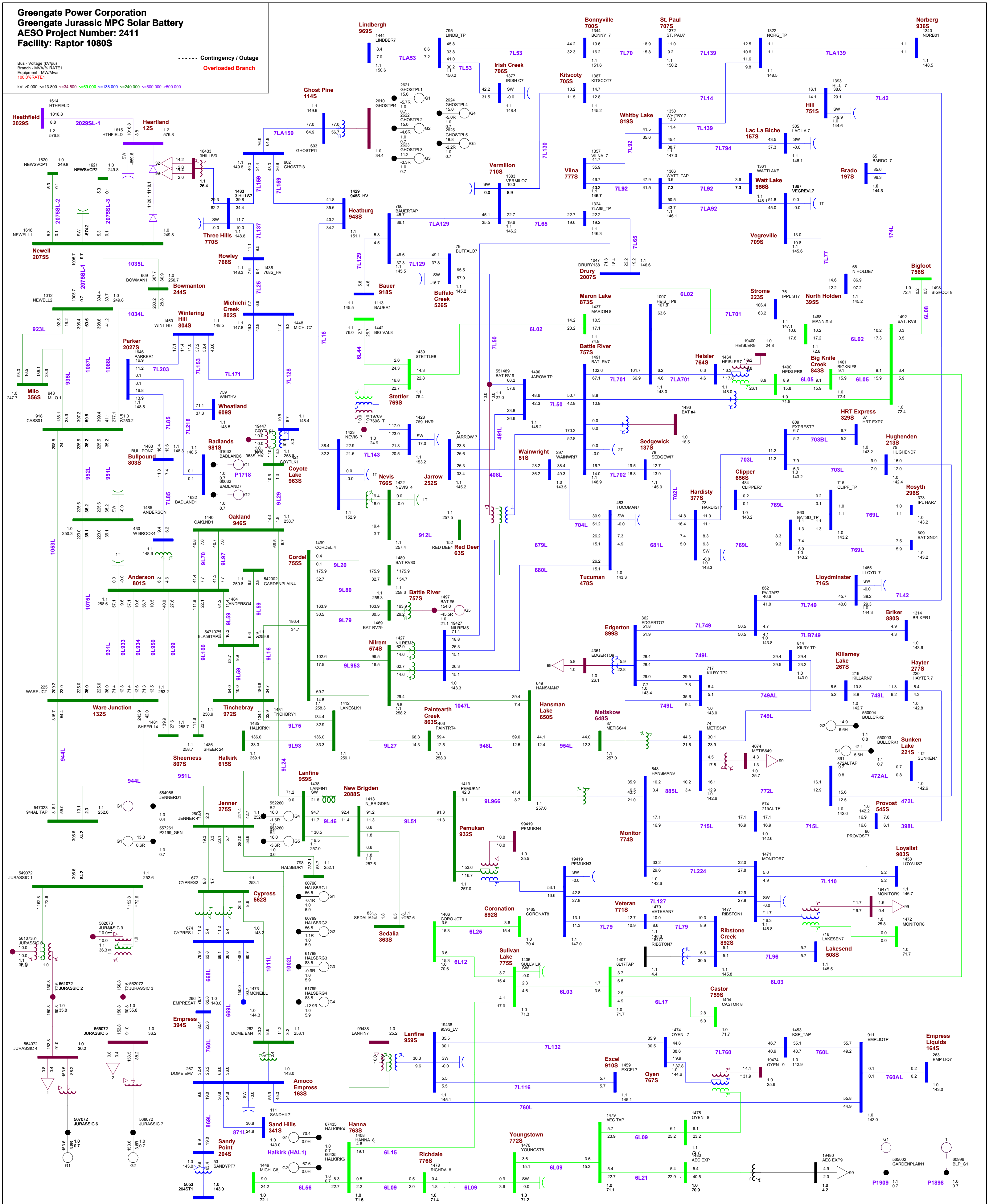

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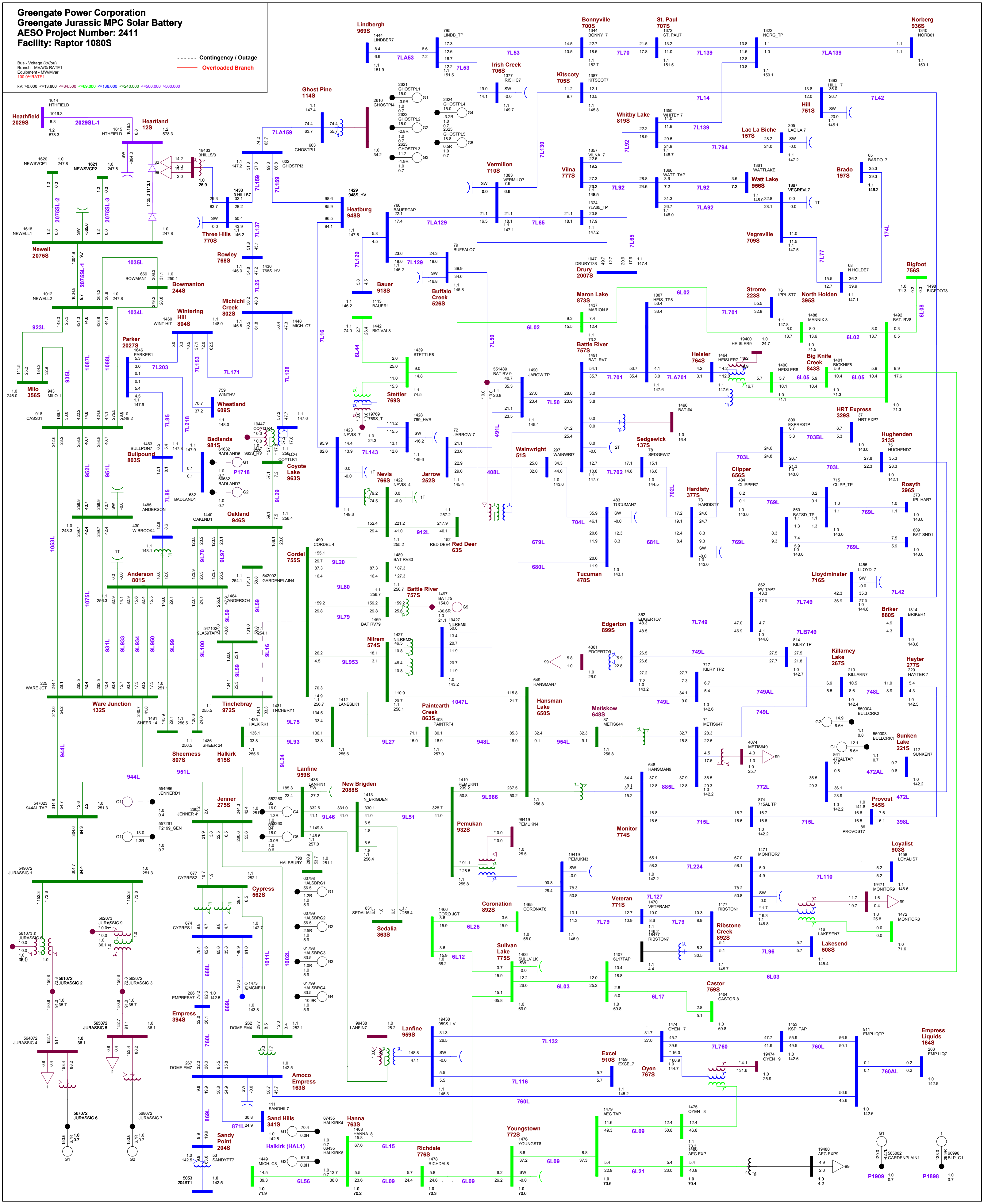

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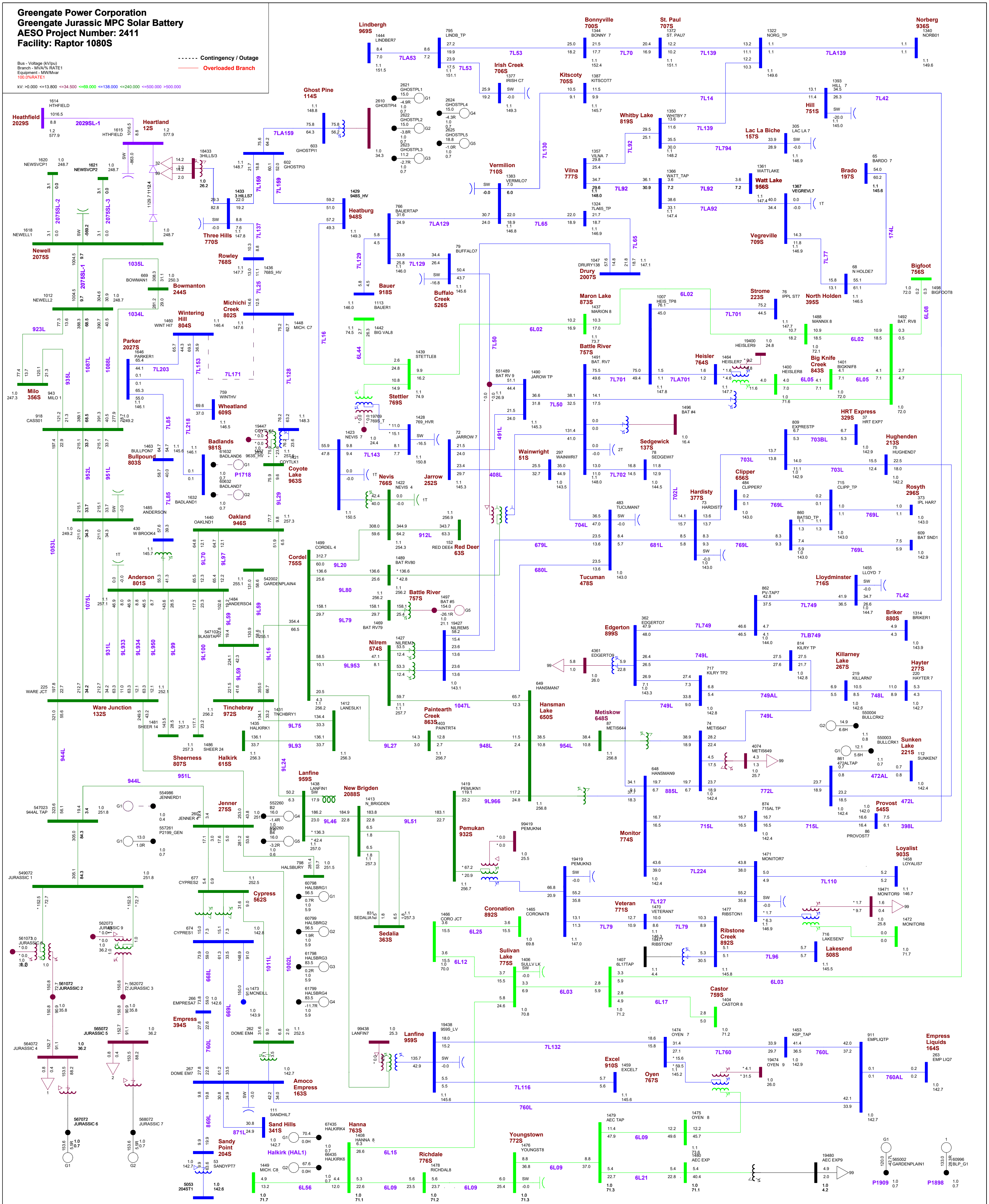
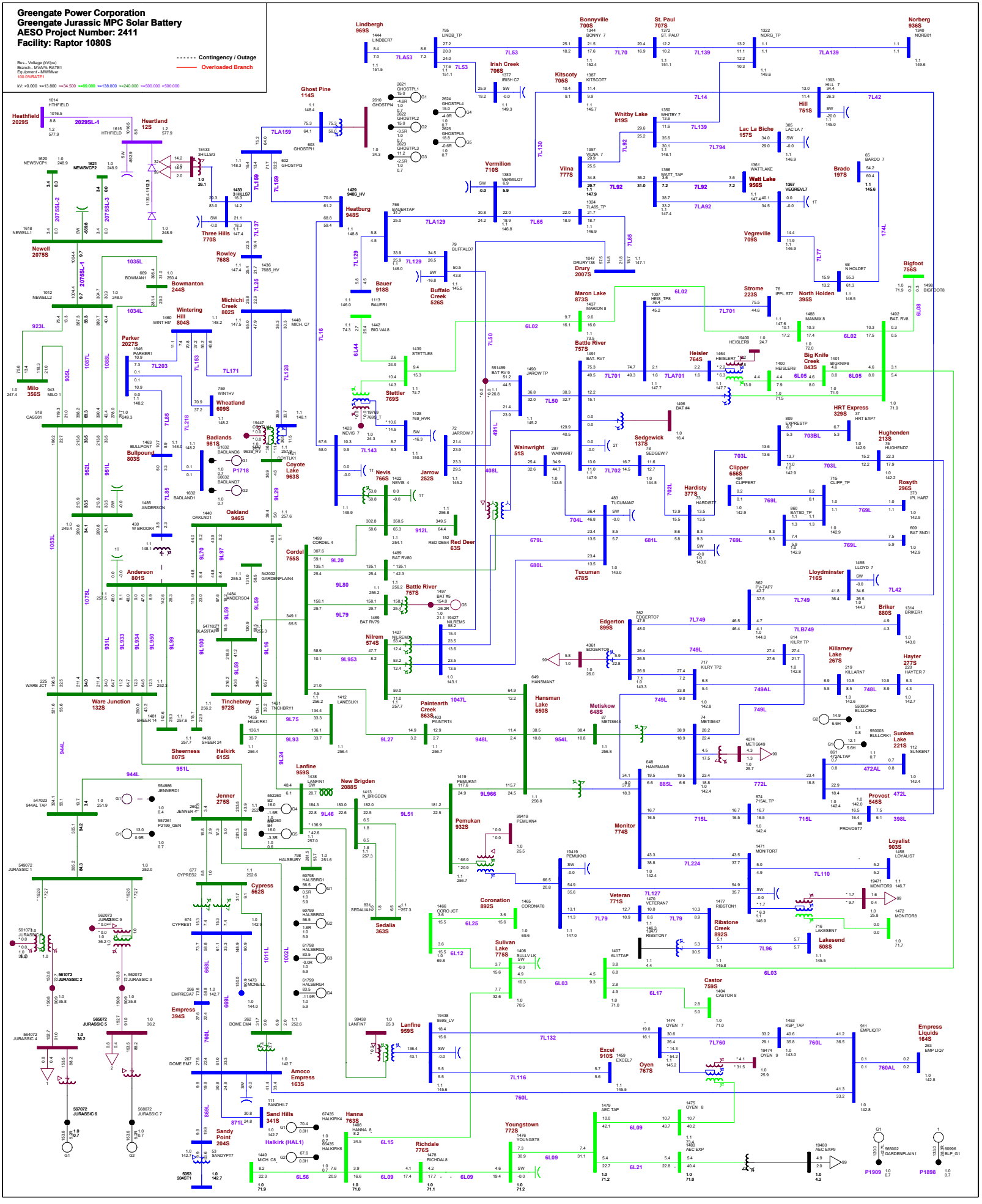


Figure A7-19: 2023 Summer Light Post-Project - N-1 Contingency of 801S901T (Anderson 801S Transformer 901T)



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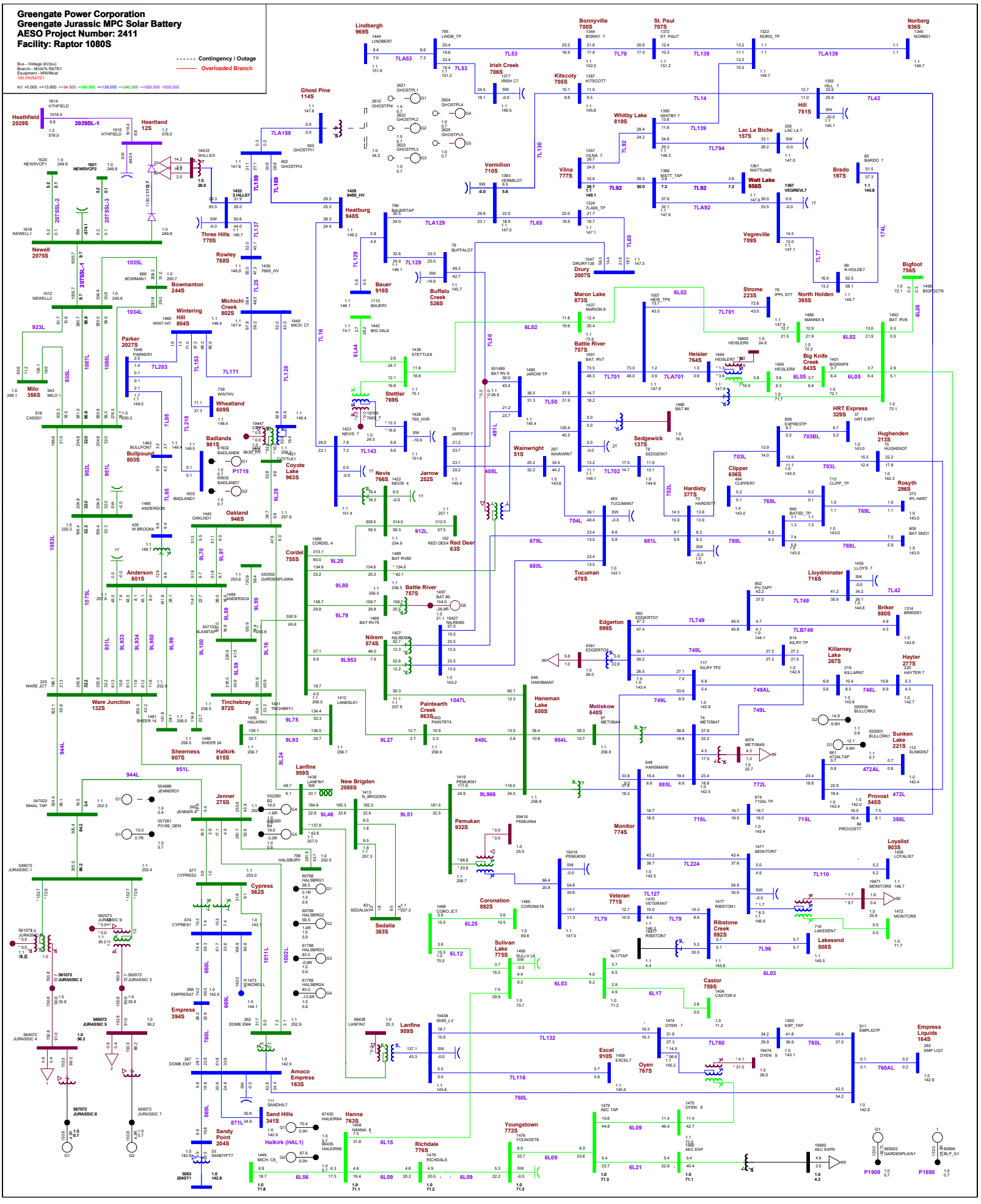

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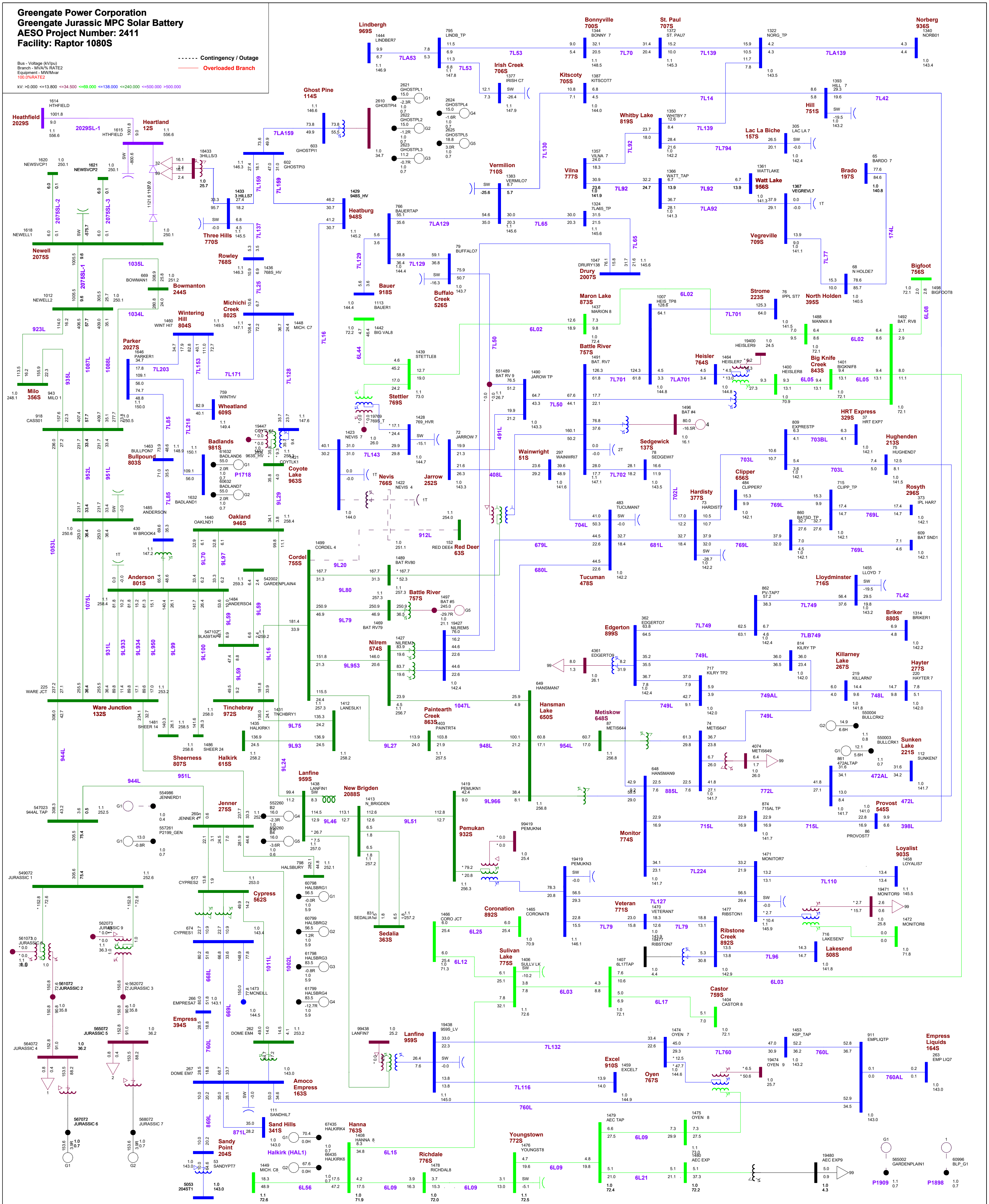

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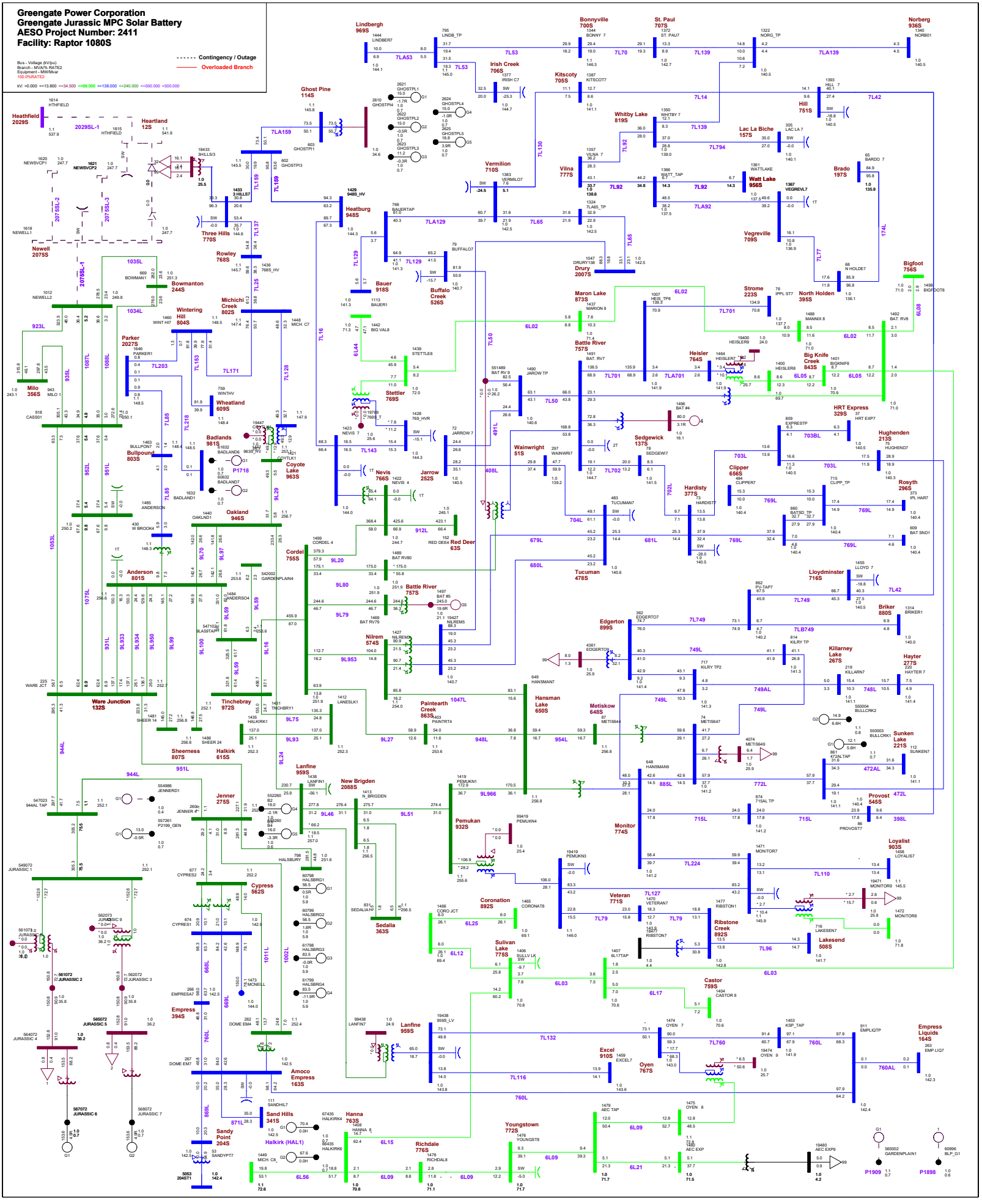

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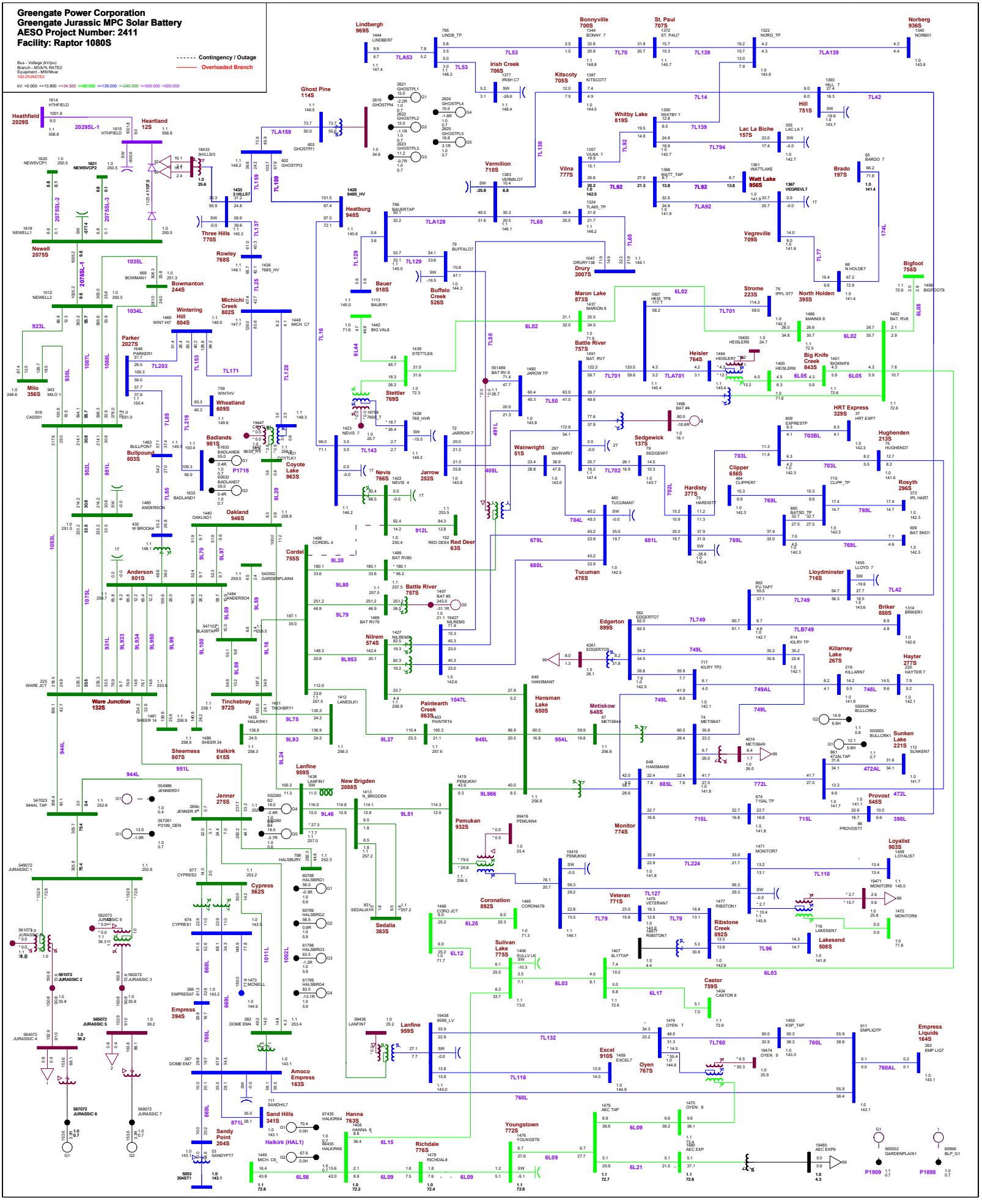


Figure A7-24: 2023 Winter Peak Post-Project - N-1 Contingency of 912L\9L912 (Red Deer 63S - Nevis 766S)

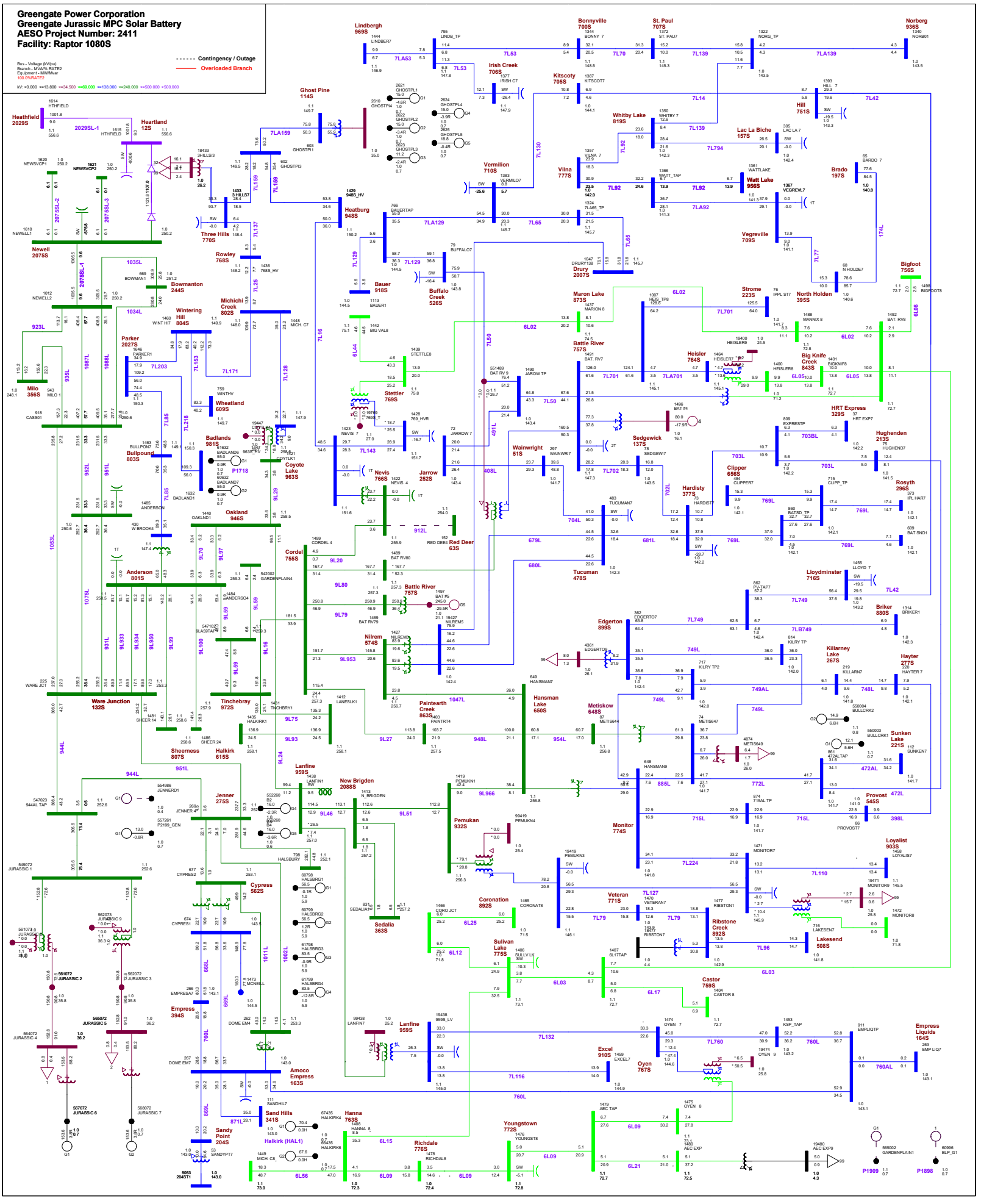


Figure A7-25: 2023 Winter Peak Post-Project - N-1 Contingency of 7L171 (Michichi Creek 802S - Wintering Hills 804S)

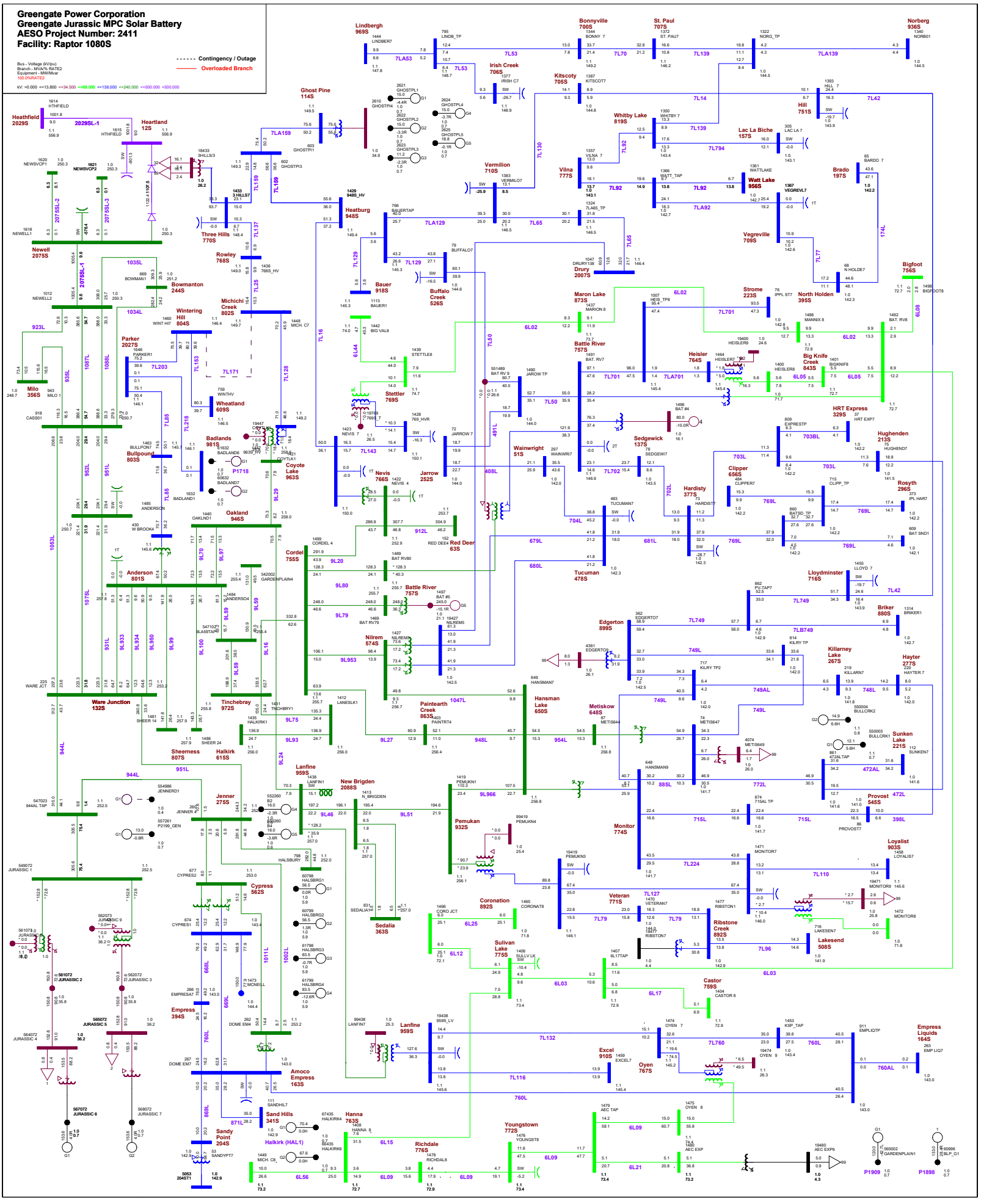


Figure A7-26: 2023 Winter Peak Post-Project - N-1 Contingency of 801S901T (Anderson 801S Transformer 901T)

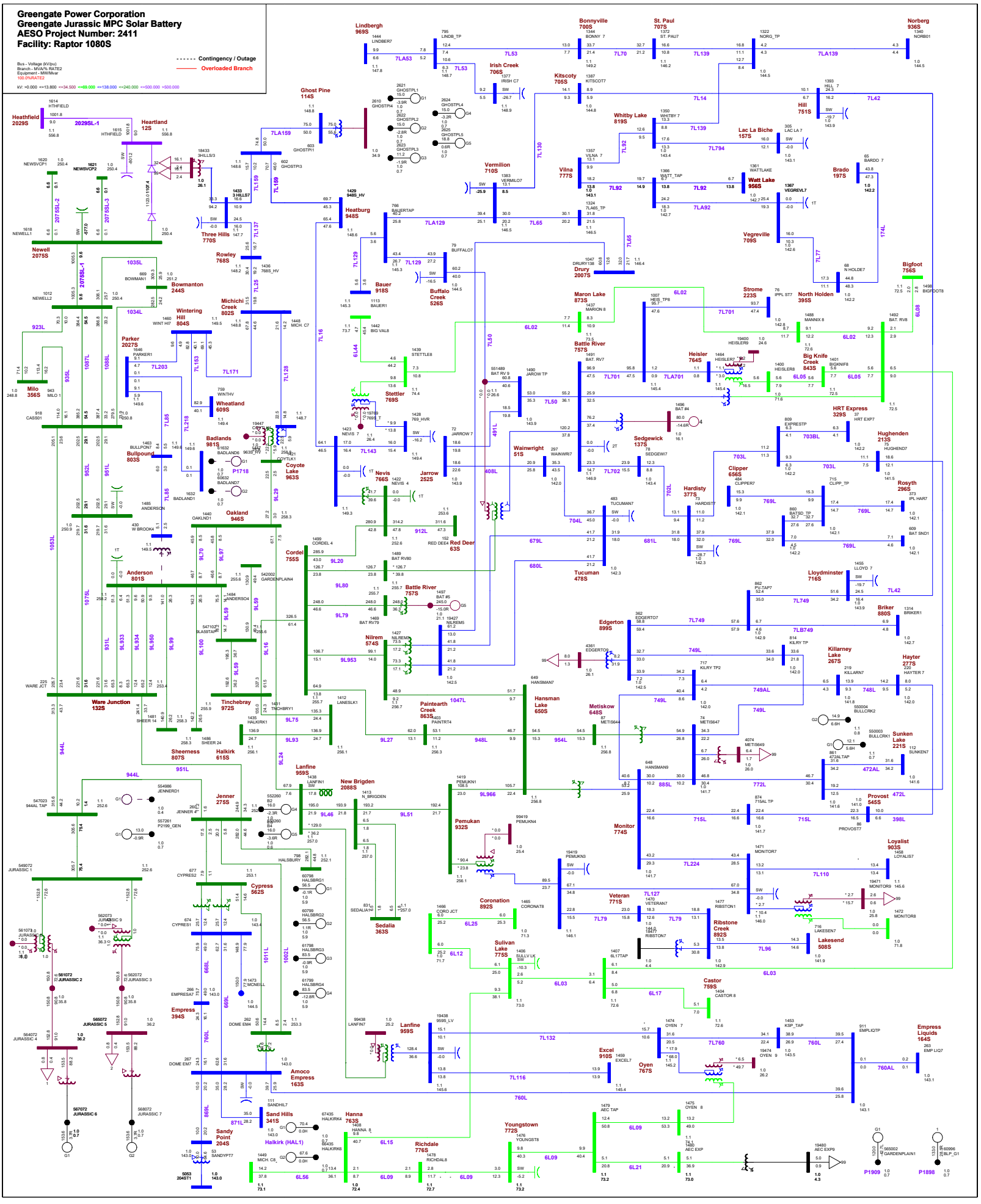


Figure A7-27: 2023 Summer Peak Sensitivity Post-Project - N-1 Contingency of 766S901T (Nevis 766S Transformer 901T)

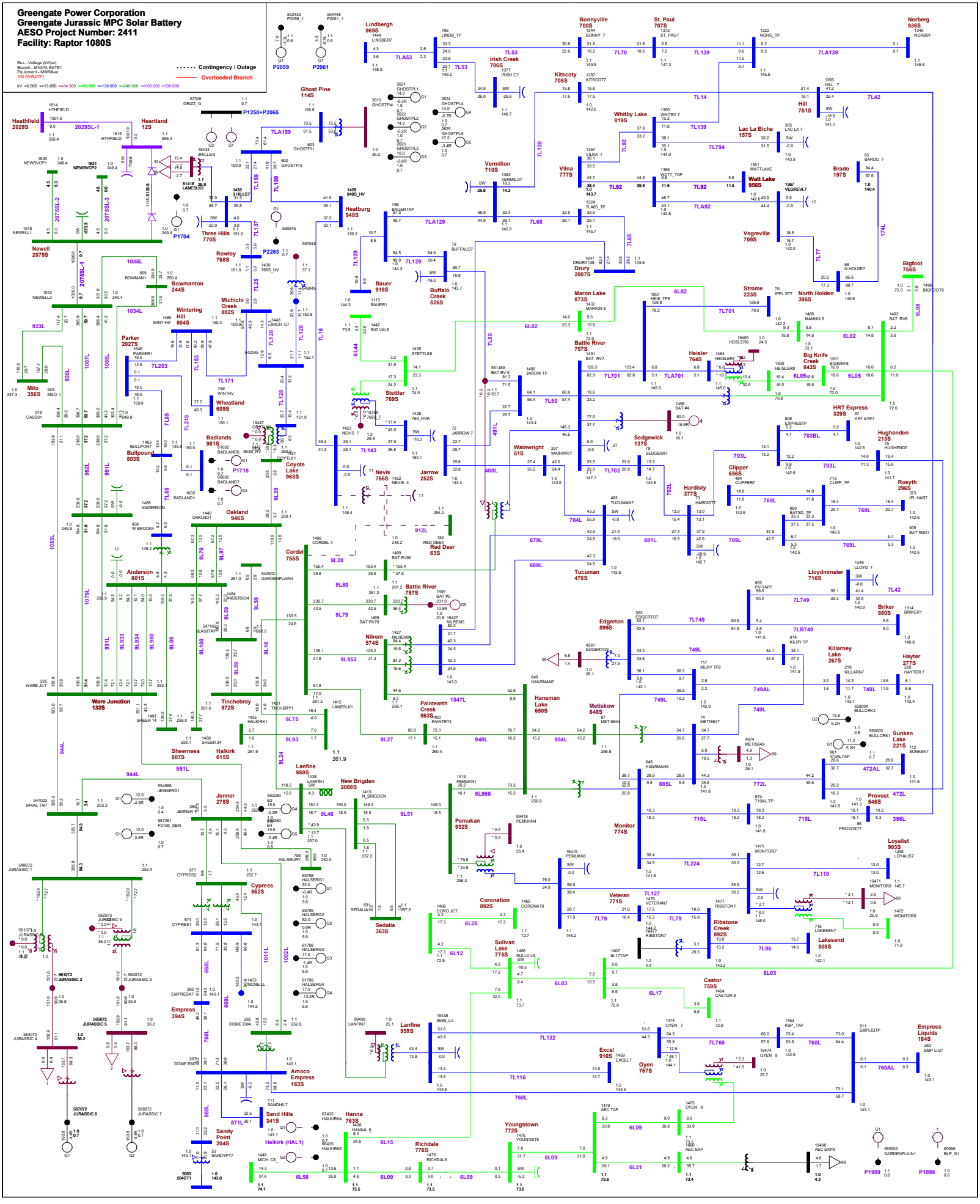


Figure A7-28: 2023 Summer Peak Sensitivity Post-Project - N-1 Contingency of EATL (Newell 2075S - Heathfield 2029S)

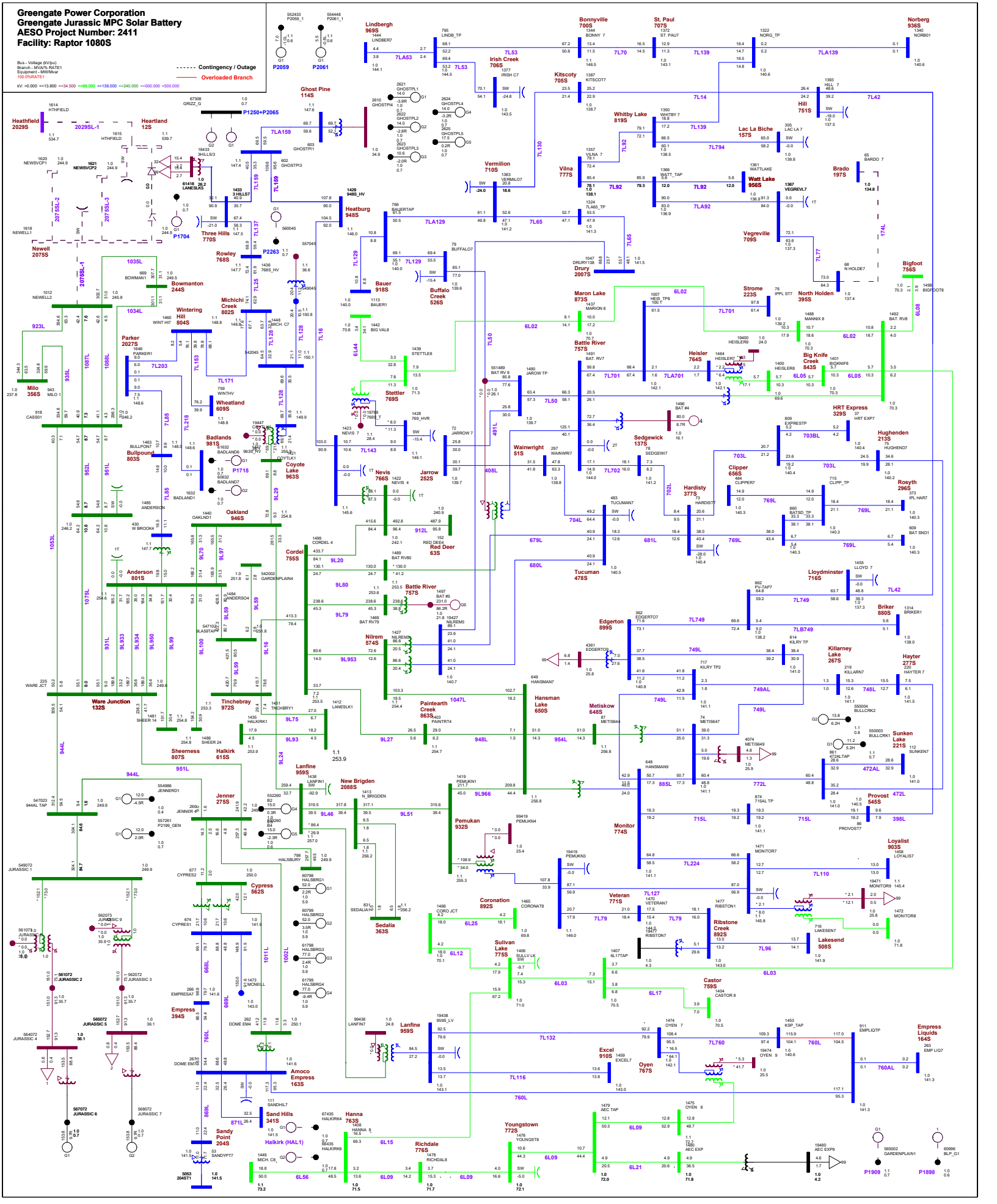


Figure A7-29: 2023 Summer Peak Sensitivity Post-Project - N-1 Contingency of 9LA59TAP (Anderson 801S - P1909 - Tinchebray 972S)

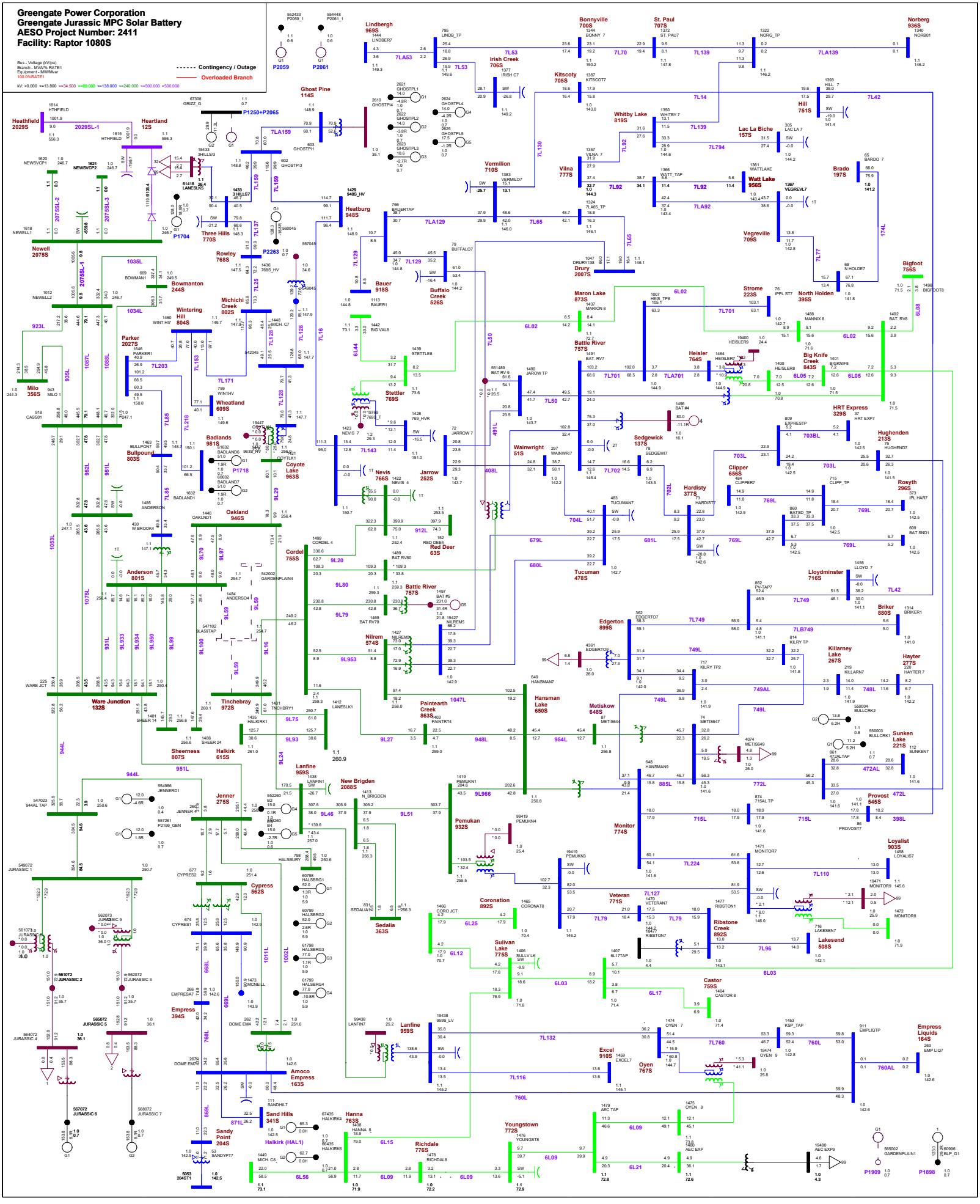


Figure A7-30: 2023 Summer Peak Sensitivity Post-Project - N-1 Contingency of 9L20 (Nevis 766S - Cordel 755S)

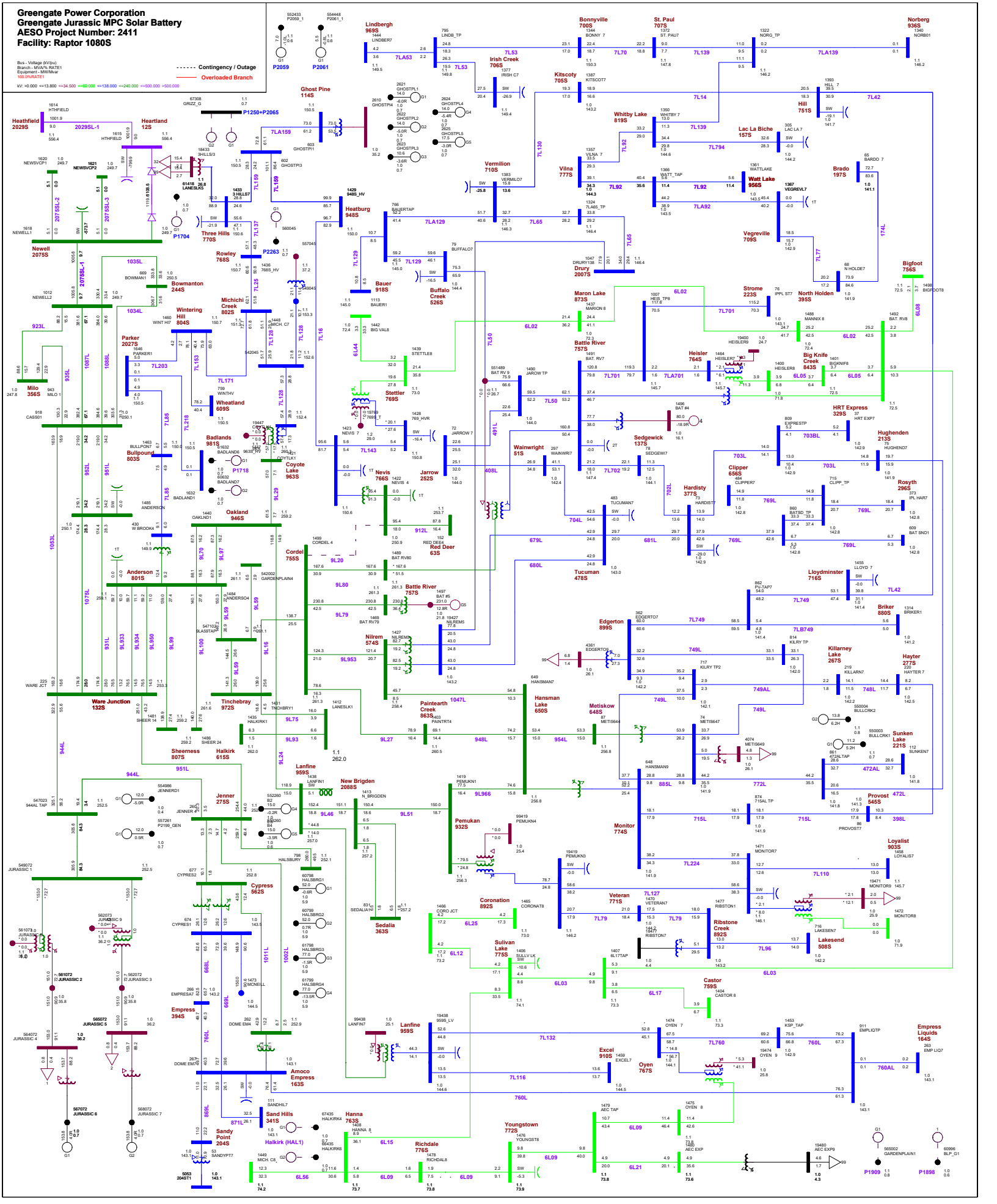


Figure A7-31: 2023 Summer Peak Sensitivity Post-Project - N-1 Contingency of 9L16 (Tinchebray 972S - Cordel 755S)

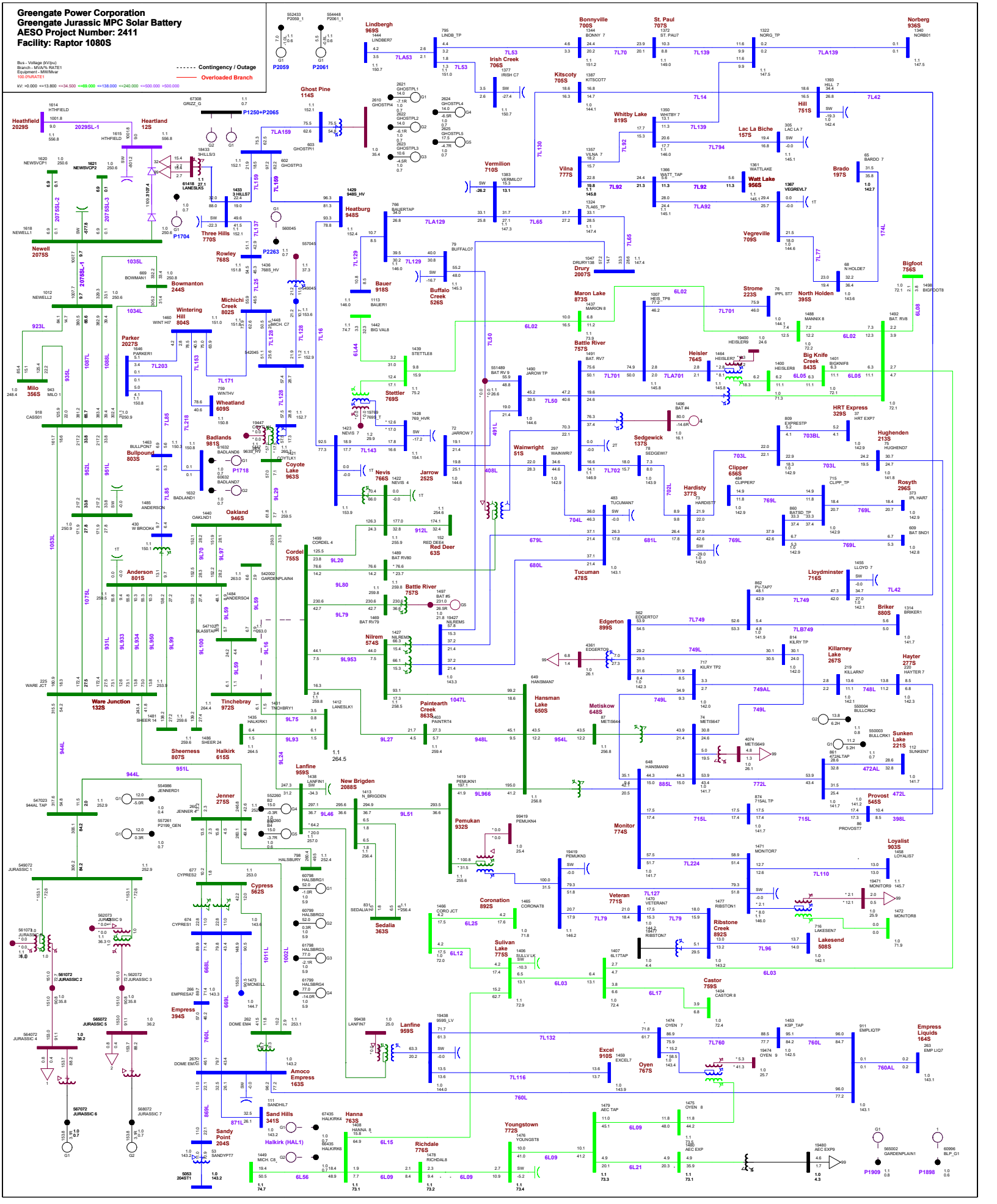


Figure A7-32: 2023 Summer Peak Sensitivity Post-Project - N-1 Contingency of 9L29 (Oakland 946S - Coyote Lake 963S)

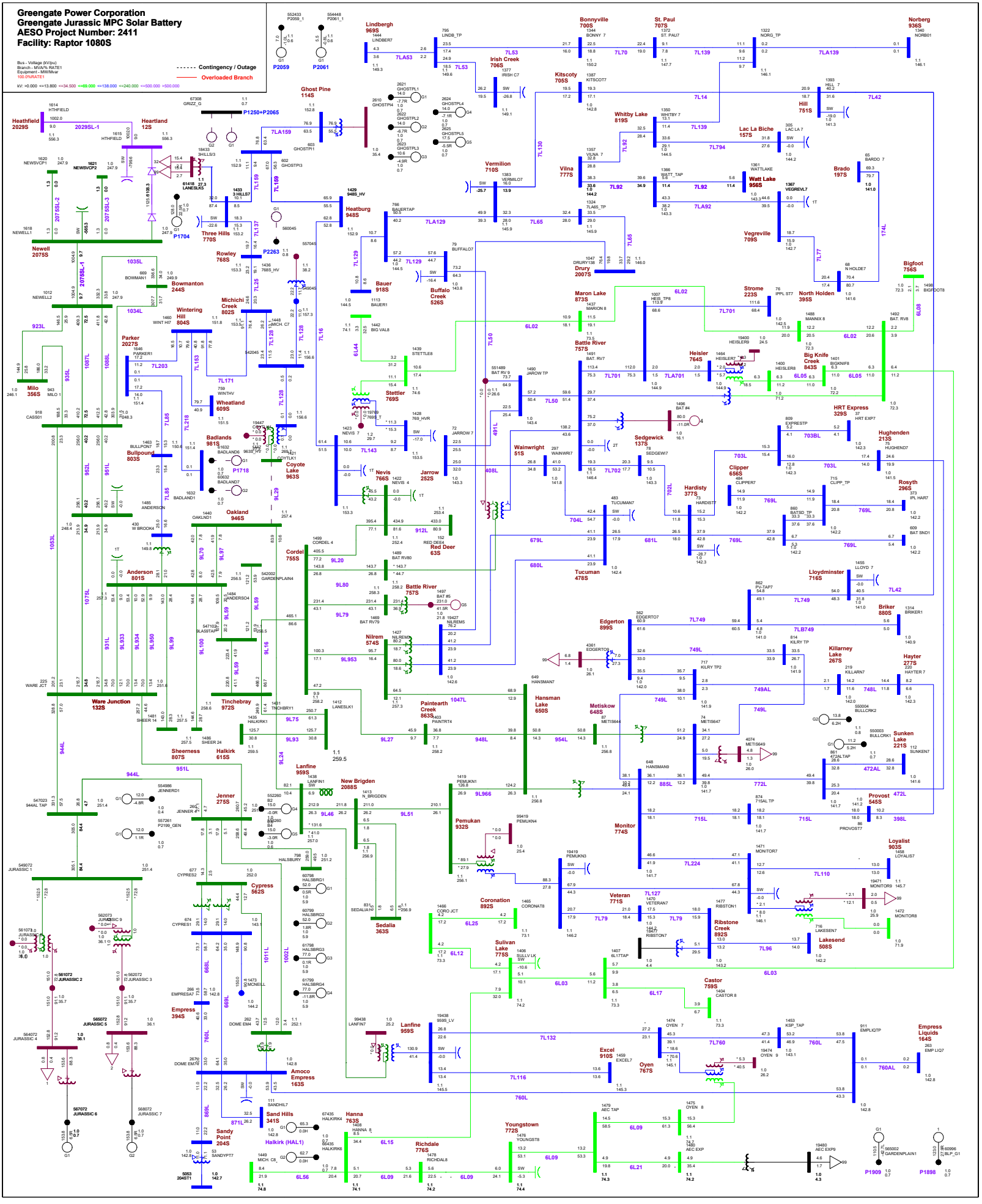


Figure A7-33: 2023 Summer Peak Sensitivity Post-Project - N-1 Contingency of 912L\9L912 (Red Deer 63S - Nevis 766S)

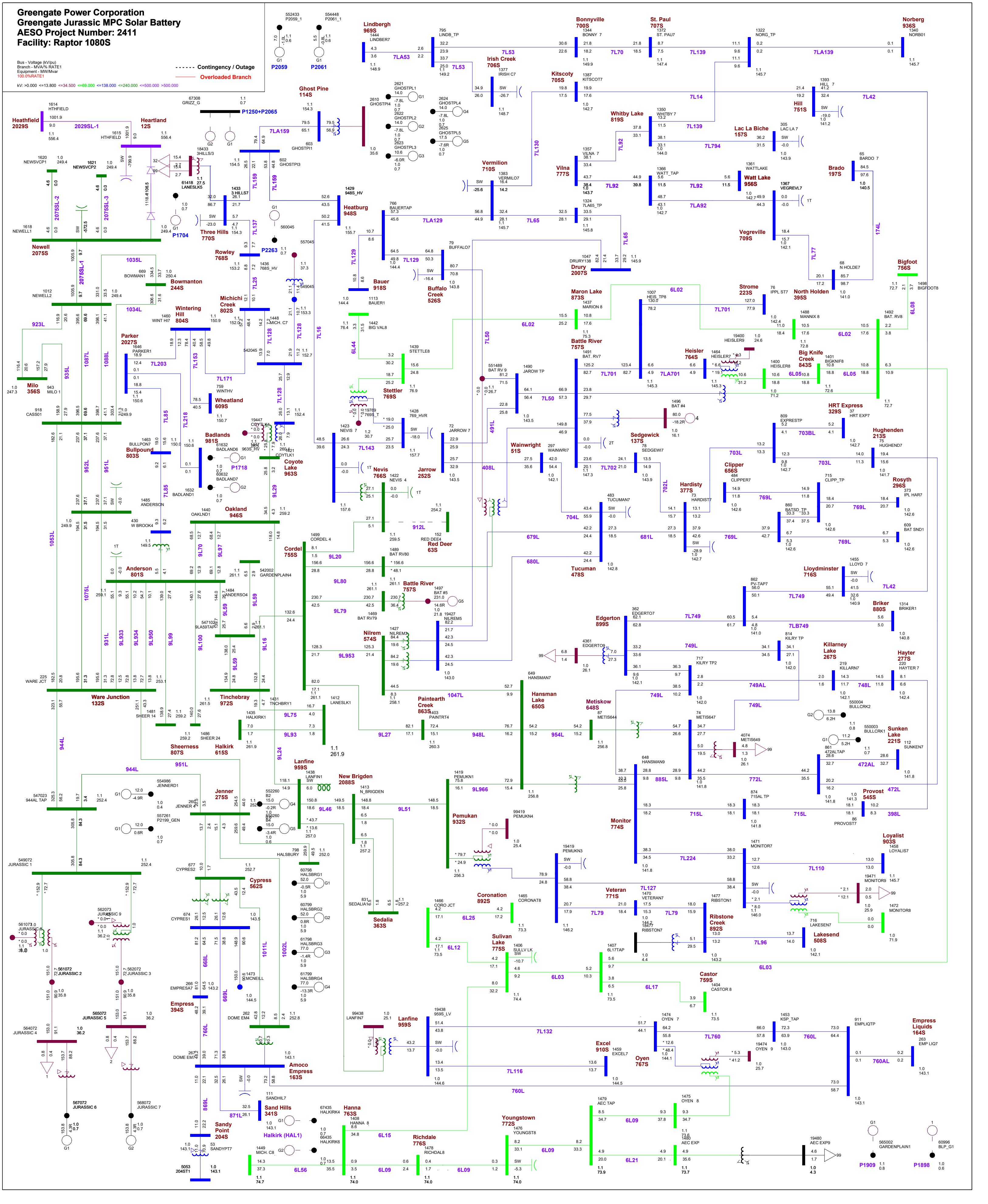


Figure A7-34: 2023 Summer Peak Sensitivity Post-Project - N-1 Contingency of 963S901T (Coyote Lake 963S Transformer 901T)

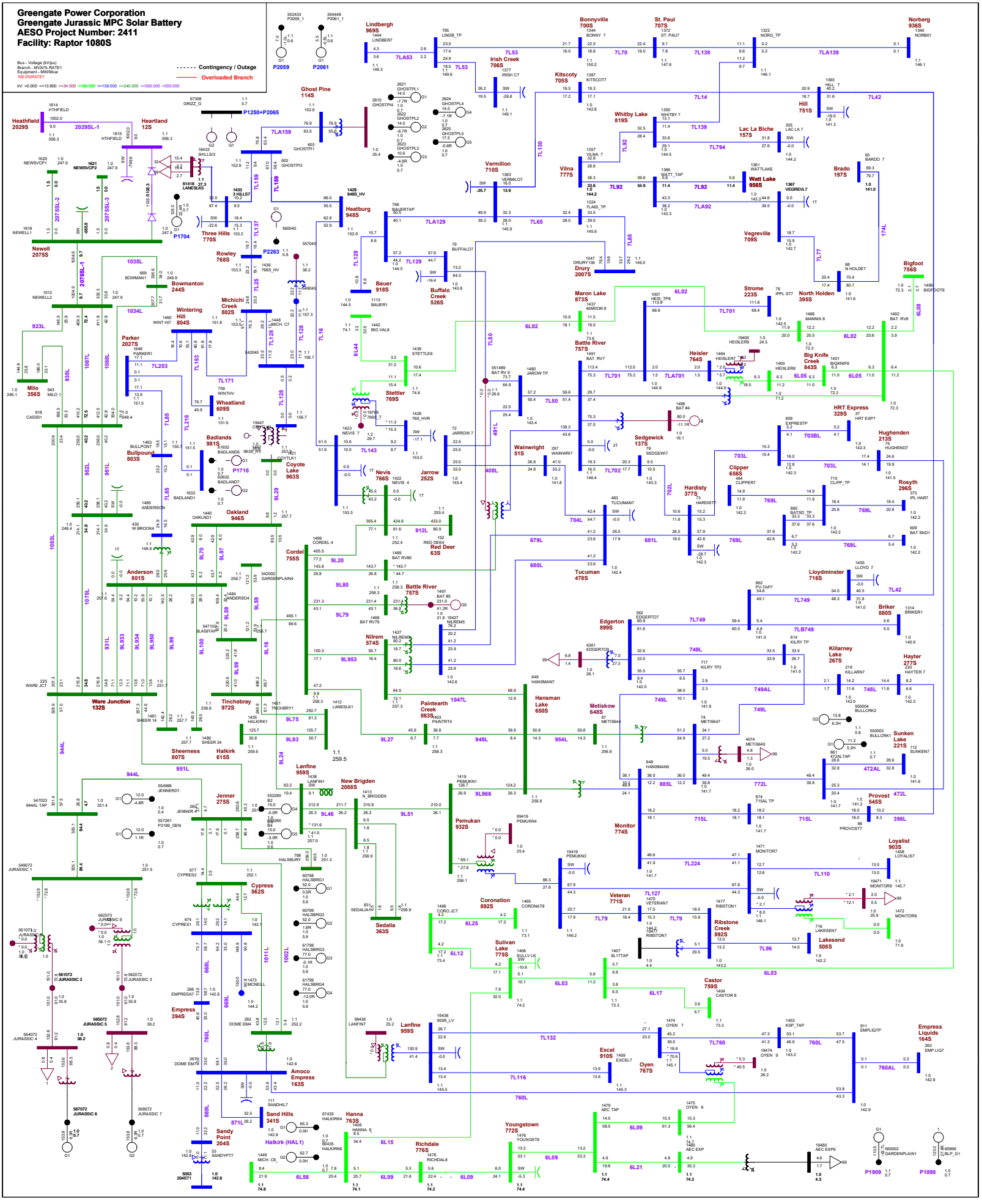


Figure A7-35: 2023 Summer Peak Sensitivity Post-Project - N-1 Contingency of 7L171 (Michichi Creek 802S - Wintering Hills 804S)

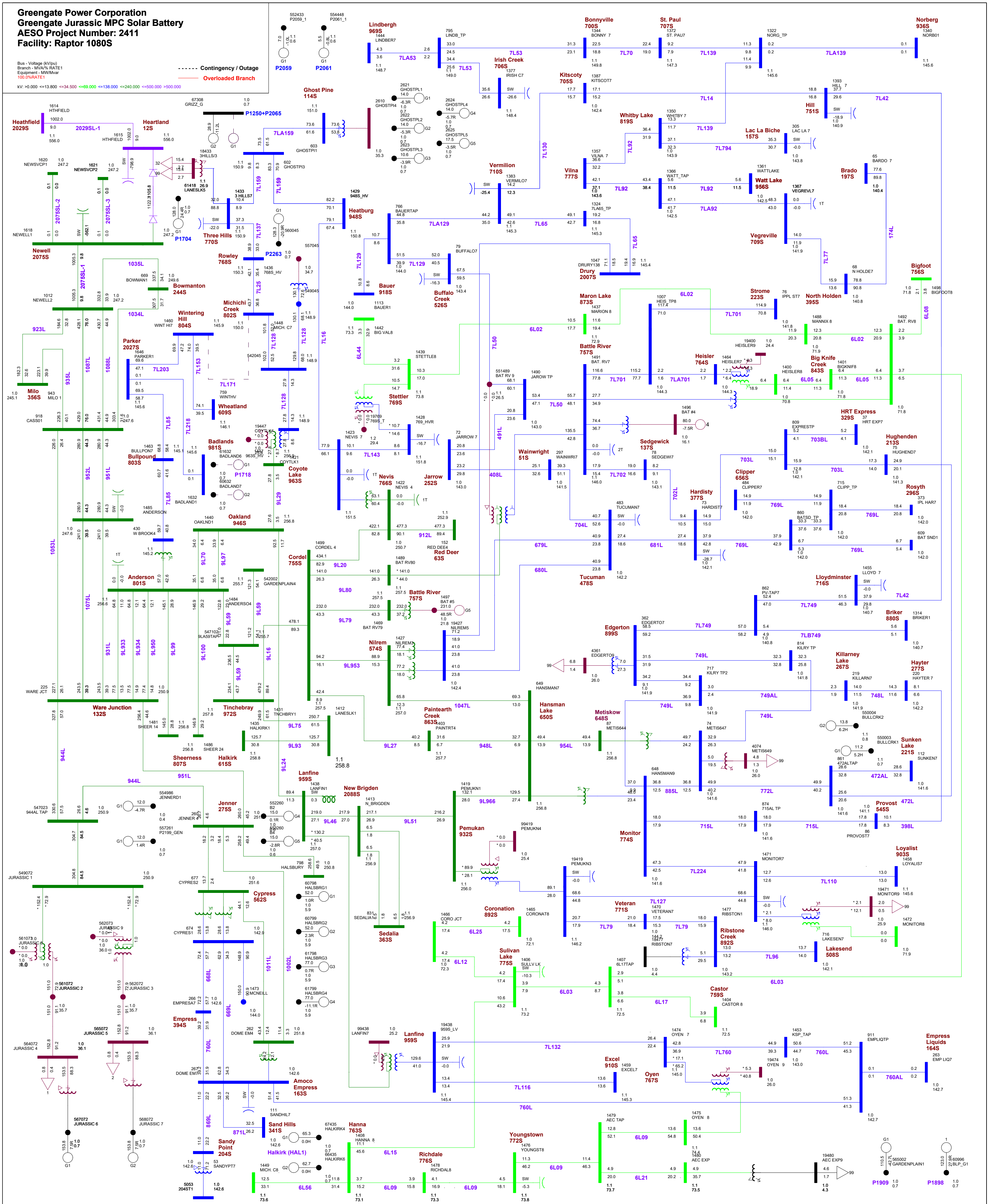


Figure A7-36: 2023 Summer Peak Sensitivity Post-Project - N-1 Contingency of 801S901T (Anderson 801S Transformer 901T)

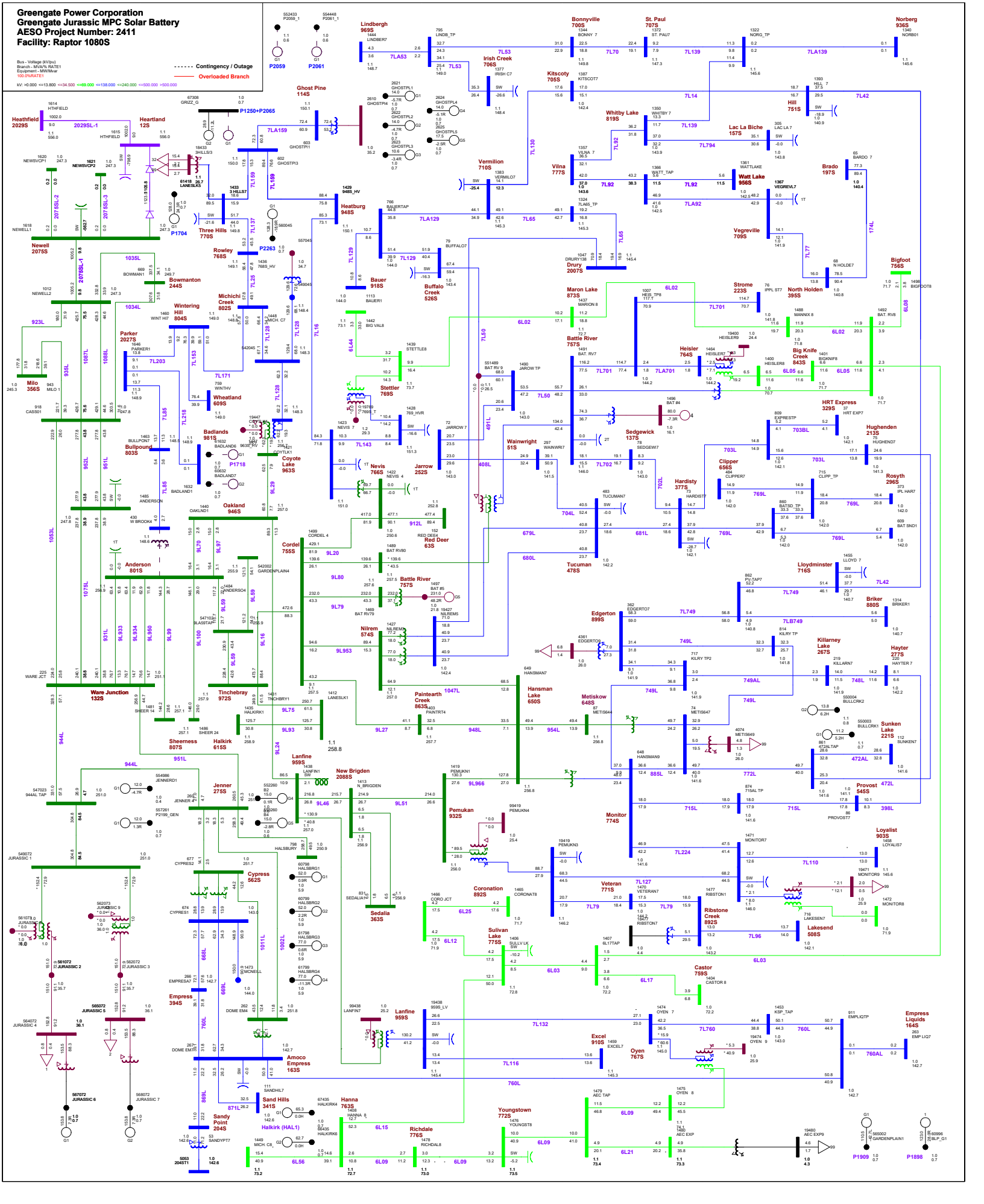


Figure A7-37: 2023 Summer Peak Sensitivity Post-Project - N-1 Contingency of 7L128 (Michichi Creek 802S - P2263 - Coyote Lake 963S)

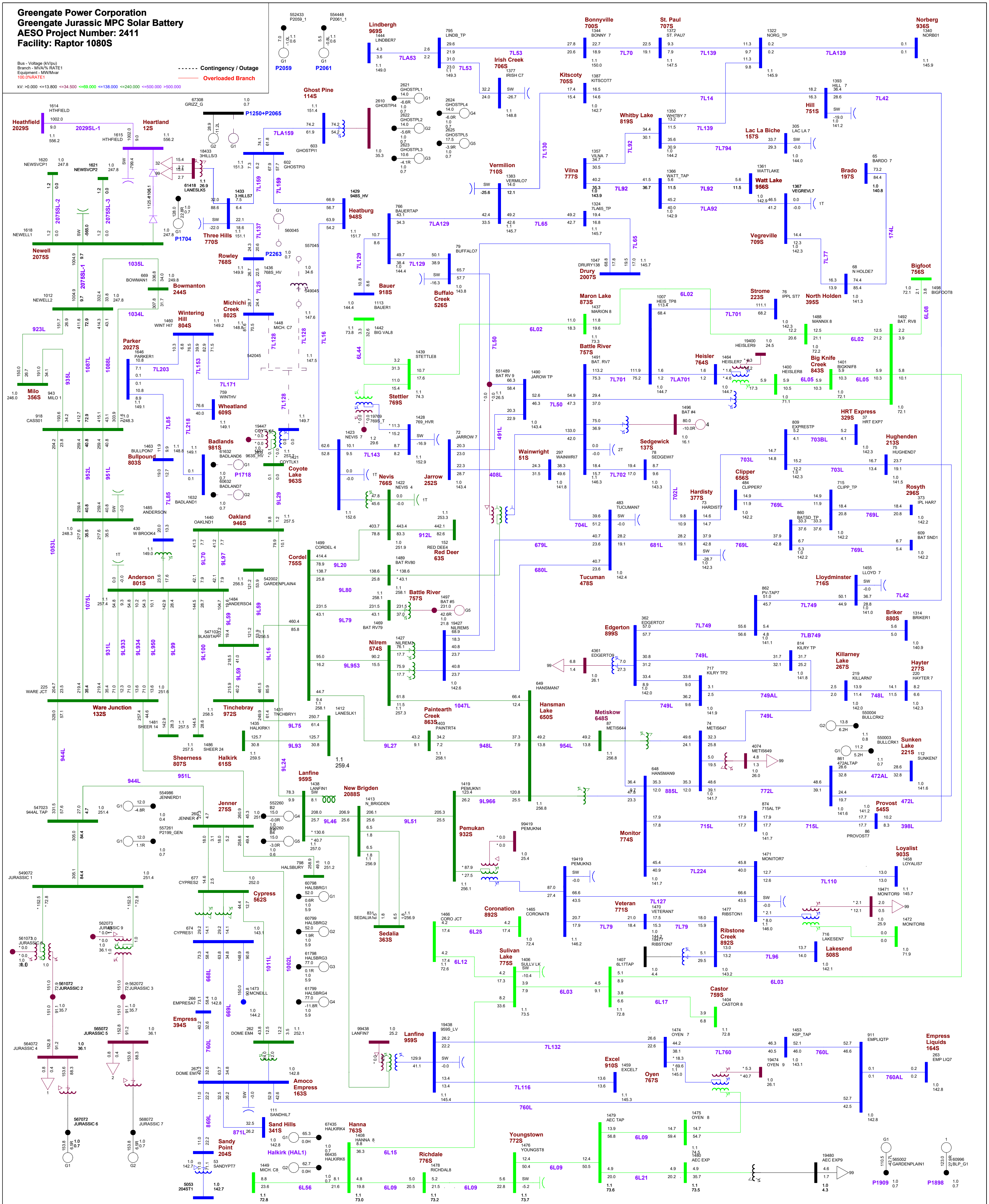


Figure A7-38: 2023 Summer Peak Sensitivity Post-Project - N-1 Contingency of 9L51 (Pemukan 932S - New Brigden 2088S)

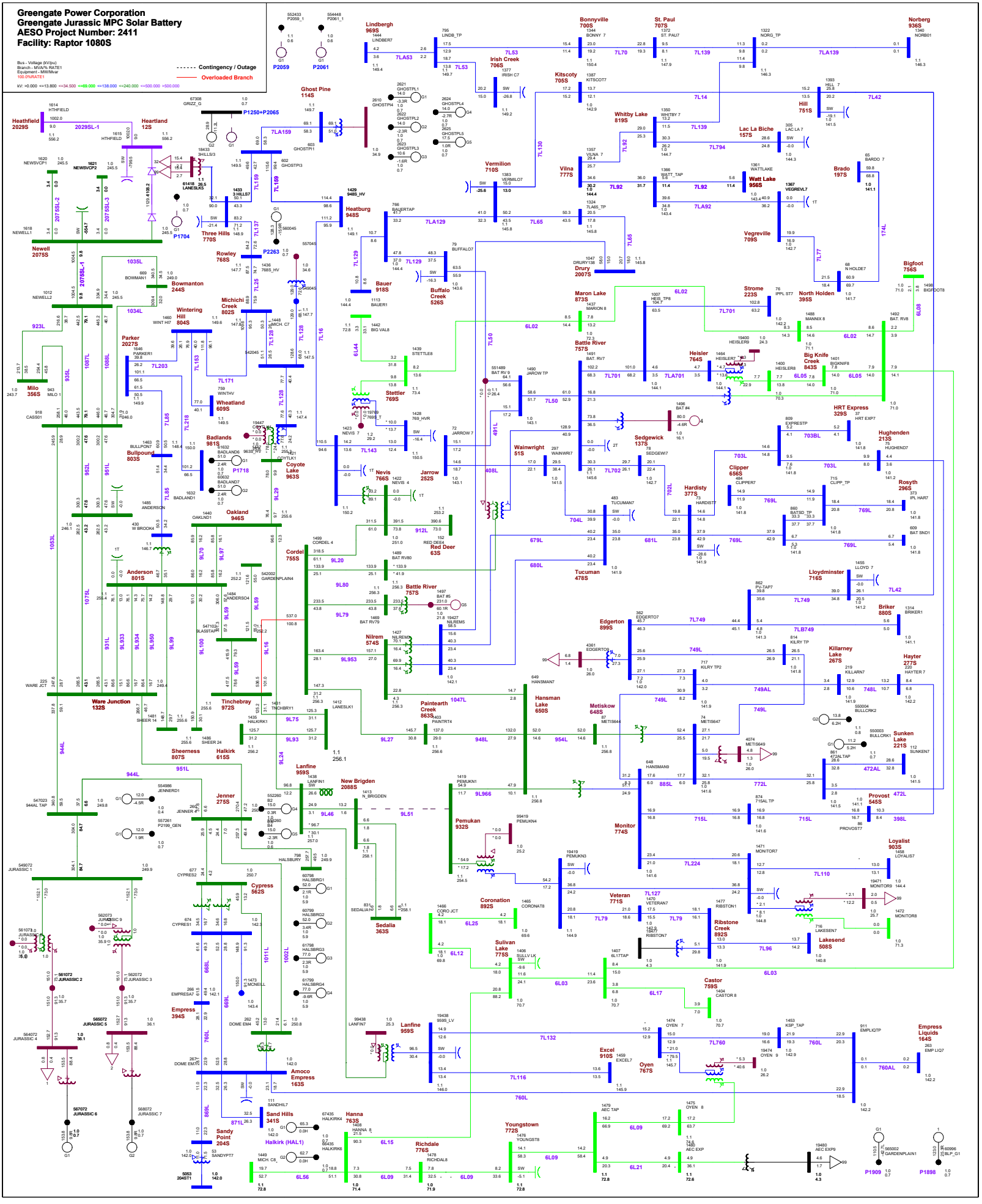


Figure A7-39: 2023 Summer Peak Sensitivity Post-Project - N-1 Contingency of 9L46 (Lanfine 959S - New Brigden 2088S)

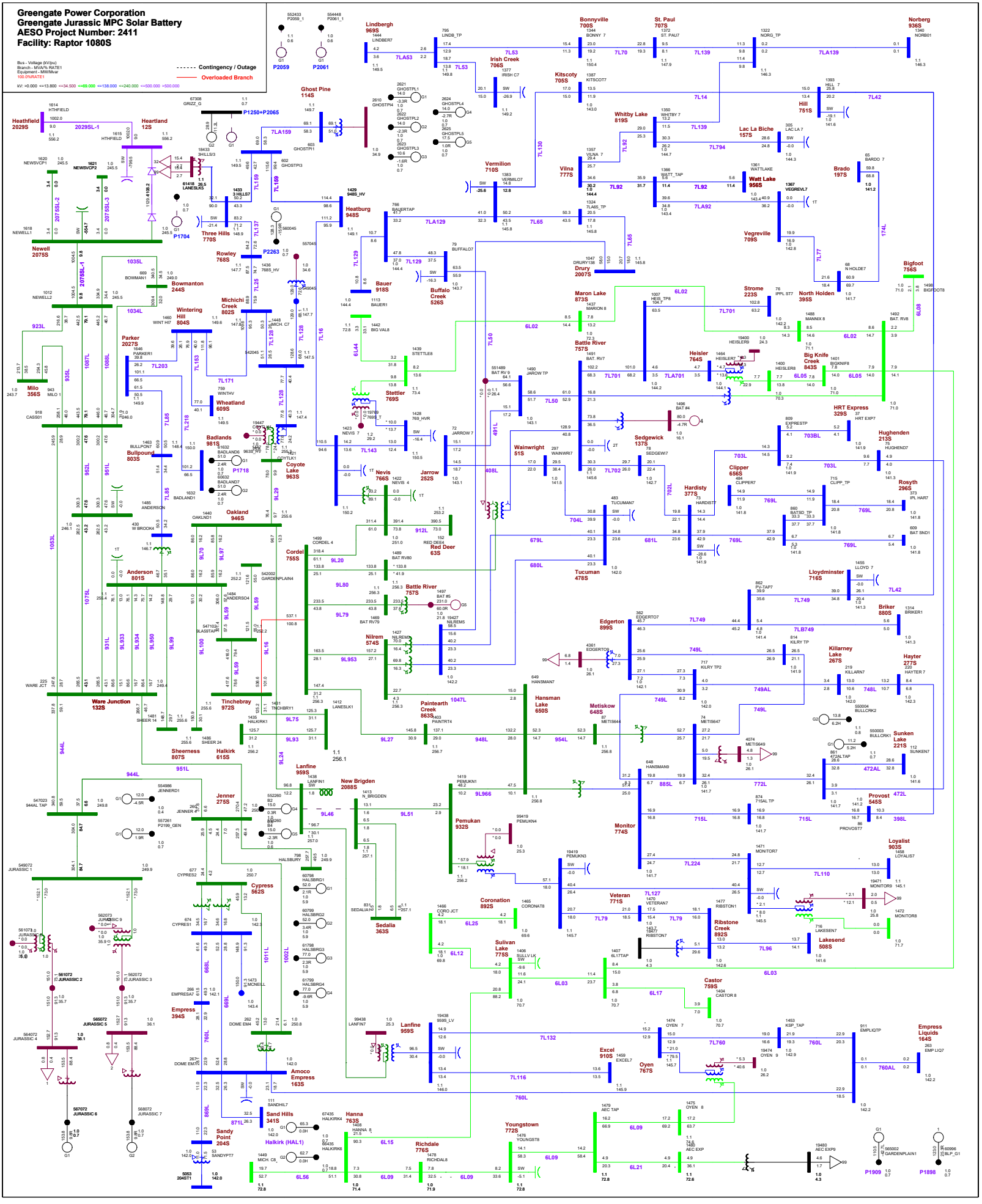


Figure A7-40: 2023 Summer Peak Sensitivity Post-Project - N-1 Contingency of 770S703T (Three Hills 770S Transformer 703T)

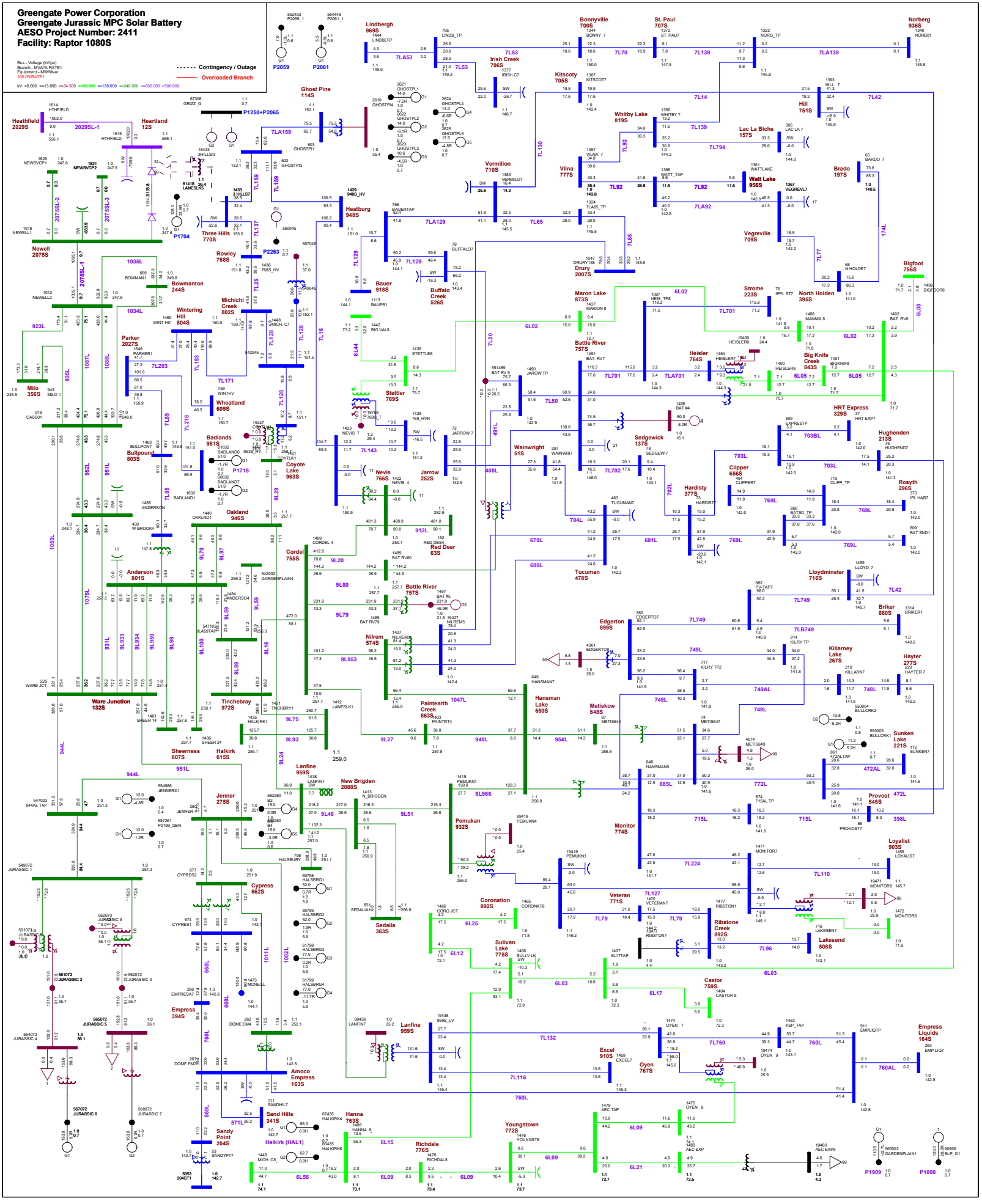


Figure A7-41: 2023 Summer Peak Sensitivity Post-Project - N-1 Contingency of 757S905T (Battle River 757S Transformer 905T)

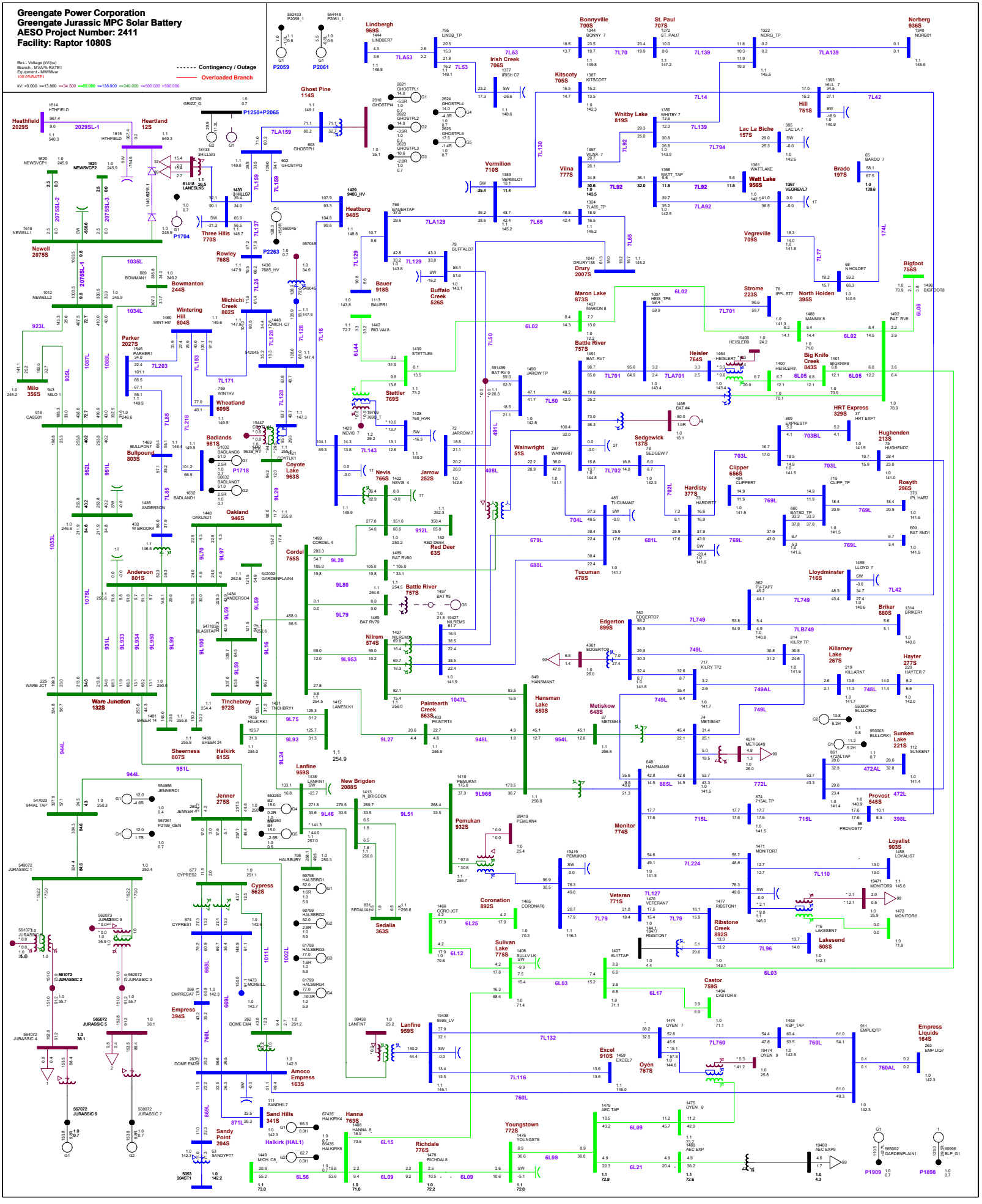
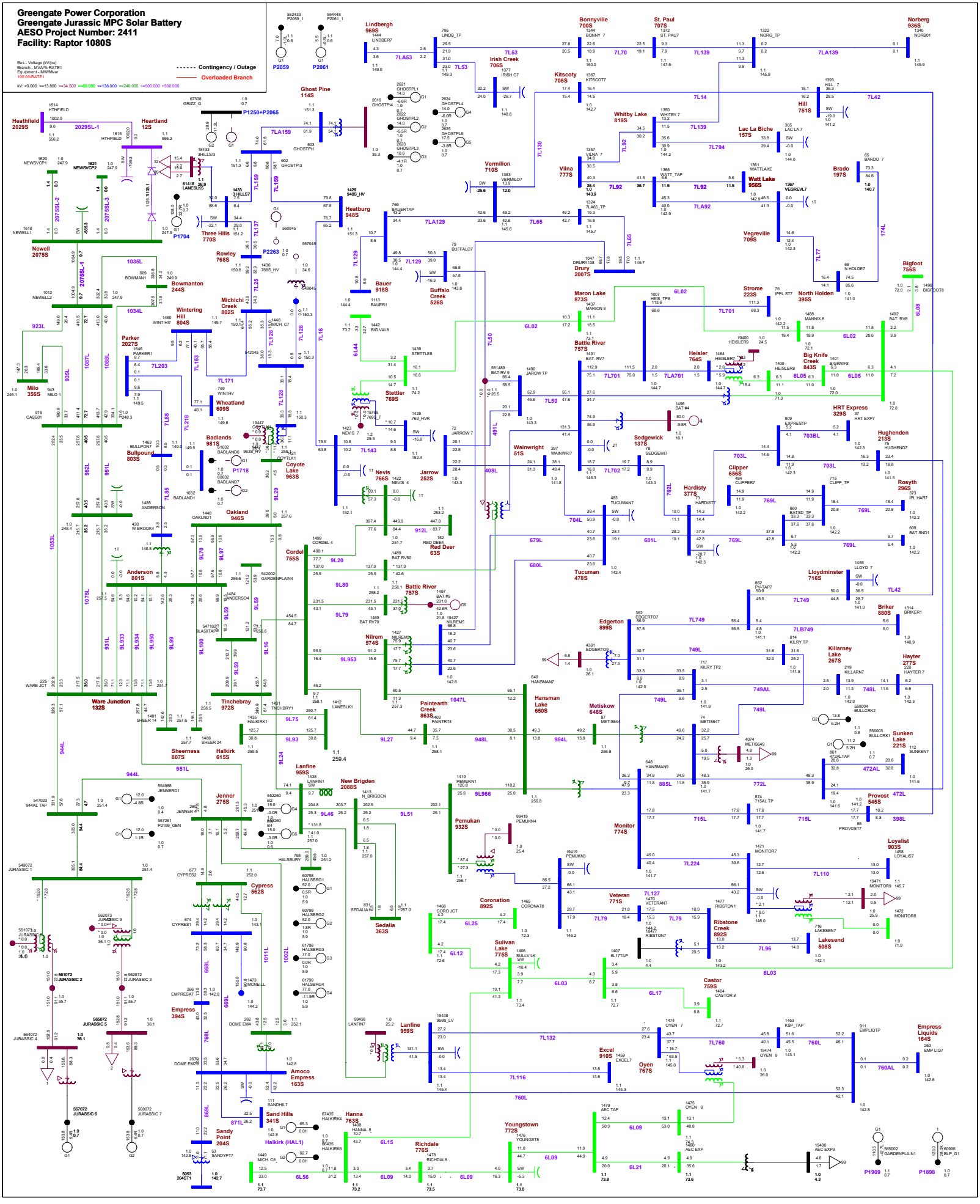


Figure A7-42: 2023 Summer Peak Sensitivity Post-Project - N-1 Contingency of P2263T1 (P2263 BER Hand Hills MPC Wind Farm Transformer T1)



Attachment A8
Constraint Effective Factors Table

Table A8-1: Generator Type

Generating Facility Name and Unit Number	Battle River #4	Battle River #5	Sheerness #1	Sheerness #2	Ghost Pine	Wintering Hills	Sharp Hills	Bull Creek DG	Joss MPC Ph. 1	Joss MPC Ph. 2	P2199	P1898	P1909	Wheatland	Halkirk (HAL1)	BER Hand Hills	P1704	P2059	P2061	P2411
Type	Coal	Coal	Coal	Coal	Wind	Wind	Wind	Wind	Wind	Wind	Wind	Wind	Wind	Wind	Wind	Wind	Wind	Solar	Solar	Solar + Storage

Table A8-2: Constraint Effective Factors under N-1 Contingencies for Post-Project Scenarios

Scenario Names	Contingency	Limiting Branch	Plants																	
			Battle River #4	Battle River #5	Sheerness #1	Sheerness #2	Ghost Pine	Wintering Hills	Sharp Hills	Bull Creek DG	Joss MPC Ph. 1	Joss MPC Ph. 2	P2199	P1898	P1909	Wheatland	Halkirk (HAL1)	BER Hand Hills	P1704	P2059	P2061	P2411
2023SL Post-Project.sav	766S901T (Nevis 766S Transformer 901T)	174L (Bardo 197S - North Holden 395S)	14.7%	11.1%	6.0%	6.0%	6.5%	5.3%	8.9%	9.8%	4.6%	4.6%	4.6%	7.0%	7.4%	5.5%	9.2%	-	-	-	-	4.6%
2023SL Post-Project.sav	EATL (Newell 2075S - Heathfield 2029S)	174L (Bardo 197S - North Holden 395S)	9.1%	5.3%	2.5%	2.5%	2.3%	2.0%	4.2%	5.0%	1.9%	1.9%	1.9%	2.9%	3.3%	2.1%	4.1%	-	-	-	-	1.9%
2023SL Post-Project.sav	EATL (Newell 2075S - Heathfield 2029S)	7L159 (Ghost Tap - Heatburg 948S)	-0.5%	-0.4%	3.4%	3.4%	61.5%	11.0%	1.8%	0.4%	2.5%	2.5%	2.5%	2.5%	1.7%	10.7%	0.1%	-	-	-	-	2.5%
2023SL Post-Project.sav	EATL (Newell 2075S - Heathfield 2029S)	912L\9L912 (Red Deer 63S - Nevis 766S)	39.6%	43.0%	22.2%	22.2%	41.7%	21.7%	30.5%	32.8%	17.2%	17.2%	17.3%	25.7%	29.5%	22.4%	37.9%	-	-	-	-	17.2%
2023SL Post-Project.sav	EATL (Newell 2075S - Heathfield 2029S)	9L16 (Tinchebray 972S - Cordel 755S)	-21.0%	-25.0%	19.2%	19.2%	-1.9%	13.1%	-1.5%	-13.2%	14.2%	14.2%	14.3%	6.8%	41.7%	13.9%	66.1%	-	-	-	-	14.4%
2023SL Post-Project.sav	EATL (Newell 2075S - Heathfield 2029S)	7L171 (Michichi Creek 802S - Wintering Hills	-0.7%	-0.4%	1.6%	1.6%	-11.8%	54.3%	0.3%	-0.1%	1.2%	1.2%	1.2%	0.6%	0.7%	50.7%	-0.1%	-	-	-	-	1.2%
2023SL Post-Project.sav	669L (Amoco Empress 163S - Cypress 562S)	668L (Empress 394S - Cypress 562S)	-2.5%	-2.4%	-1.1%	-1.1%	-1.5%	-1.3%	-6.1%	-3.6%	1.3%	1.3%	1.3%	-12.6%	-1.6%	-1.3%	-2.3%	-	-	-	-	1.1%
2023SL Post-Project.sav	9L20 (Nevis 766S - Cordel 755S)	174L (Bardo 197S - North Holden 395S)	13.9%	10.5%	5.3%	5.3%	2.2%	4.1%	8.2%	9.3%	4.1%	4.0%	4.1%	6.3%	6.8%	4.3%	8.7%	-	-	-	-	4.0%
2023SL Post-Project.sav	9L20 (Nevis 766S - Cordel 755S)	7L159 (Ghost Tap - Heatburg 948S)	3.1%	3.9%	5.4%	5.4%	61.4%	12.6%	4.6%	3.7%	4.1%	4.1%	4.1%	4.8%	4.6%	12.4%	4.0%	-	-	-	-	4.1%
2023SL Post-Project.sav	9L20 (Nevis 766S - Cordel 755S)	766S901T (Nevis 766S Transformer 901T)	9.5%	8.2%	6.9%	6.9%	52.1%	12.1%	7.5%	7.0%	5.3%	5.3%	5.3%	6.9%	7.1%	12.1%	7.6%	-	-	-	-	5.3%
2023SL Post-Project.sav	9L20 (Nevis 766S - Cordel 755S)	7L16 (Nevis 766S - Heatburg 948S)	2.9%	3.6%	5.0%	5.0%	57.0%	11.5%	4.3%	3.4%	3.7%	3.7%	3.8%	4.4%	4.2%	11.3%	3.7%	-	-	-	-	3.7%
2023SL Post-Project.sav	9L20 (Nevis 766S - Cordel 755S)	7L171 (Michichi Creek 802S - Wintering Hills	0.6%	1.2%	2.2%	2.2%	-11.7%	54.9%	1.3%	1.1%	1.7%	1.7%	1.7%	1.4%	1.7%	51.3%	1.3%	-	-	-	-	1.7%
2023SL Post-Project.sav	9L16 (Switch 972S - Cordel 755S)	7L171 (Michichi Creek 802S - Wintering Hills	-1.5%	-1.4%	2.2%	2.2%	-11.3%	55.0%	0.2%	-0.7%	1.6%	1.6%	1.6%	0.8%	2.2%	51.4%	2.2%	-	-	-	-	1.7%
2023SL Post-Project.sav	912L\9L912 (Red Deer 63S - Nevis 766S)	174L (Bardo 197S - North Holden 395S)	14.7%	11.1%	6.0%	6.0%	7.5%	5.5%	8.9%	9.8%	4.6%	4.6%	4.7%	7.0%	7.4%	5.7%	9.2%	-	-	-	-	4.6%
2023SL Post-Project.sav	959S901T (Lanfine 959S Transformer 901T)	7L132 (Oyen 767S - Lanfine 959S)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	97.6%	0.0%	0.0%	0.0%	-	-	-	-	0.0%
2023SL Post-Project.sav	959S901T (Lanfine 959S Transformer 901T)	767S701T (Oyen 767S Transformer T1)	-0.8%	-0.5%	0.1%	0.1%	-1.1%	-1.2%	-0.2%	-0.4%	1.0%	1.0%	1.0%	9.7%	-0.1%	-1.1%	-0.4%	-	-	-	-	0.9%
2023SL Post-Project.sav	7L171 (Michichi Creek 802S - Wintering Hills 804S)	7L85 (Bullpound 803S - Anderson 801S)	0.0%	0.0%	0.0%	0.0%	0.0%	88.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	93.1%	0.0%	-	-	-	-	0.0%
2023SL Post-Project.sav	7L171 (Michichi Creek 802S - Wintering Hills 804S)	7L85 (Bullpound 803S - Parker 2027S)	0.0%	0.0%	0.0%	0.0%	0.0%	93.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	98.4%	0.0%	-	-	-	-	0.0%
2023SL Post-Project.sav	7L171 (Michichi Creek 802S - Wintering Hills 804S)	801S901T (Anderson 801S Transformer 901T)	0.0%	0.0%	0.0%	0.0%	0.0%	79.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	83.6%	0.0%	-	-	-	-	0.0%
2023SL Post-Project.sav	801S901T (Anderson 801S Transformer 901T)	7L171 (Michichi Creek 802S - Wintering Hills	0.0%	0.0%	0.0%	0.0%	0.0%	94.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	97.2%	0.0%	-	-	-	-	0.0%
2023SL Post-Project.sav	114ST1 (Ghost Pine 114S Transformer T1)	7L171 (Michichi Creek 802S - Wintering Hills	-0.7%	-0.4%	1.5%	1.5%	-	54.4%	0.3%	-0.1%	1.1%	1.1%	1.1%	0.5%	0.7%	50.8%	-0.1%	-	-	-	-	1.1%
2023SP Post-Project .sav	766S901T (Nevis 766S Transformer 901T)	174L (Bardo 197S - North Holden 395S)	12.4%	9.9%	5.4%	5.4%	6.2%	4.9%	8.2%	9.1%	4.2%	4.2%	4.2%	6.4%	6.7%	5.1%	8.4%	-	-	-	-	4.2%
2023SP Post-Project .sav	766S901T (Nevis 766S Transformer 901T)	701L (Strome 223S - Heisler Tap)	17.6%	12.4%	6.7%	6.7%	8.5%	6.3%	9.0%	9.3%	5.3%	5.3%	5.3%	7.6%	8.6%	6.5%	10.9%	-	-	-	-	5.2%
2023SP Post-Project .sav	766S901T (Nevis 766S Transformer 901T)	7L701 (Heisler Tap - Battle River 757S)	18.0%	12.5%	6.3%	6.3%	3.9%	5.1%	8.8%	9.4%	5.0%	5.0%	5.0%	7.3%	8.5%	5.4%	11.0%	-	-	-	-	5.0%
2023SP Post-Project .sav	EATL (Newell 2075S - Heathfield 2029S)	174L (Bardo 197S - North Holden 395S)	7.5%	4.7%	2.3%	2.3%	2.3%	1.9%	3.9%	4.7%	1.7%	1.7%	1.7%	2.8%	3.0%	2.0%	3.8%	-	-	-	-	1.7%
2023SP Post-Project .sav	EATL (Newell 2075S - Heathfield 2029S)	7L159 (Ghost Tap - Heatburg 948S)	-0.4%	-0.4%	3.4%	3.4%	62.8%	10.7%	1.8%	0.5%	2.5%	2.5%	2.6%	2.6%	1.8%	10.5%	0.1%	-	-	-	-	2.5%
2023SP Post-Project .sav	EATL (Newell 2075S - Heathfield 2029S)	701L (Strome 223S - Heisler Tap)	11.8%	6.1%	3.0%	3.0%	3.2%	2.6%	4.1%	4.3%	2.4%	2.4%	2.4%	3.4%	4.1%	2.7%	5.3%	-	-	-	-	2.4%
2023SP Post-Project .sav	EATL (Newell 2075S - Heathfield 2029S)	7L701 (Heisler Tap - Battle River 757S)	12.5%	6.4%	3.1%	3.1%	2.6%	2.6%	4.3%	4.5%	2.5%	2.4%	2.5%	3.5%	4.2%	2.7%	5.5%	-	-	-	-	2.4%
2023SP Post-Project .sav	EATL (Newell 2075S - Heathfield 2029S)	912L\9L912 (Red Deer 63S - Nevis 766S)	39.1%	42.2%	21.9%	21.9%	41.9%	21.2%	30.4%	33.0%	17.0%	17.0%	17.1%	25.7%	29.0%	21.9%	37.4%	-	-	-	-	17.0%
2023SP Post-Project .sav	EATL (Newell 2075S - Heathfield 2029S)	9L20 (Nevis 766S - Cordel 755S)	39.1%	45.1%	20.5%	20.5%	-7.1%	14.1%	30.6%	34.3%	16.1%	16.1%	16.2%	25.2%	29.4%	15.0%	39.8%	-	-	-	-	16.1%
2023SP Post-Project .sav	EATL (Newell 2075S - Heathfield 2029S)	7L16 (Nevis 766S - Heatburg 948S)	-0.4%	-0.3%	3.2%	3.2%	58.0%	9.7%	1.7%	0.5%	2.3%	2.3%	2.3%	2.4%	1.6%	9.5%	0.1%	-	-	-	-	2.3%
2023SP Post-Project .sav	EATL (Newell 2075S - Heathfield 2029S)	9L16 (Tinchebray 972S - Cordel 755S)	-21.1%	-24.8%	19.5%	19.5%	-1.8%	13.5%	-1.3%	-13.2%	14.7%	14.7%	14.7%	7.3%	41.9%	14.3%	66.9%	-	-	-	-	14.9%
2023SP Post-Project .sav	EATL (Newell 2075S - Heathfield 2029S)	7L171 (Michichi Creek 802S - Wintering Hills	-0.6%	-0.4%	1.7%	1.7%	-12.0%	54.7%	0.4%	-0.1%	1.3%	1.3%	1.3%	0.6%	0.8%	51.0%	-0.1%	-	-	-	-	1.3%
2023SP Post-Project .sav	9LA59TAP (Anderson 801S - P1909 - Tinchebray 972S)	7L171 (Michichi Creek 802S - Wintering Hills	-1.5%	-1.4%	2.2%	2.2%	-11.2%	55.3%	0.2%	-0.7%	1.6%	1.6%	1.6%	0.7%	-	51.6%	-1.3%	-	-	-	-	1.6%
2023SP Post-Project .sav	669L (Amoco Empress 163S - Cypress 562S)	668L (Empress 394S - Cypress 562S)	-2.5%	-2.5%	-1.1%	-1.1%	-1.6%	-1.3%	-6.2%	-3.7%	1.5%	1.5%	1.5%	-13.0%	-1.7%	-1.3%	-2.3%	-	-	-	-	1.2%
2023SP Post-Project .sav	9L20 (Nevis 766S - Cordel 755S)	174L (Bardo 197S - North Holden 395S)	11.9%	9.4%	4.8%	4.8%	2.1%	3.8%	7.6%	8.7%	3.7%	3.7%	3.7%	5.9%	6.3%	4.0%	8.0%	-	-	-	-	3.7%
2023SP Post-Project .sav	9L20 (Nevis 766S - Cordel 755S)	7L159 (Ghost Tap - Heatburg 948S)	3.3%	4.0%	5.3%	5.3%	62.7%	12.1%	4.6%	3.7%	4.0%	4.0%	4.0%	4.8%	4.5%	12.0%	4.0%	-	-	-	-	4.0%
2023SP Post-Project .sav	9L20 (Nevis 766S - Cordel 755S)	7L701 (Heisler Tap - Battle River 757S)	17.8%	12.2%	5.9%	5.9%	1.6%	4.5%	8.5%	9.1%	4.6%	4.6%	4.6%	7.0%	8.2%	4.7%	10.7%	-	-	-	-	4.6%
2023SP Post-Project .sav	9L20 (Nevis 766S - Cordel 755S)	766S901T (Nevis 766S Transformer 901T)	9.2%	8.1%	6.8%	6.8%	52.8%	11.6%	7.4%	7.1%	5.2%	5.1%	5.2%	6.9%	7.0%	11.6%	7.6%	-	-	-	-	5.1%
2023SP Post-Project .sav	9L20 (Nevis 766S - Cordel 755S)	7L16 (Nevis 766S - Heatburg 948S)	3.0%	3.6%	4.9%	4.9%	58.0%	11.0%	4.2%	3.4%	3.7%	3.6%	3.7%	4.4%	4.1%	10.9%	3.7%	-	-	-	-	3.6%
2023SP Post-Project .sav	9L20 (Nevis 766S - Cordel 755S)	7L171 (Michichi Creek 802S - Wintering Hills	0.7%	1.2%	2.3%	2.3%	-12.0%	55.2%	1.4%	1.1%	1.7%	1.7%	1.7%	1.4%	1.8%	51.5%	1.4%	-	-	-	-	1.8%
2023SP Post-Project .sav	9L16 (Switch 972S - Cordel 755S)	7L159 (Ghost Tap - Heatburg 948S)	-2.2%	-2.4%	4.8%	4.8%	63.2%	12.3%	1.5%	-0.7%	3.5%	3.5%	3.5%	3.0%	4.4%	12.0%	4.3%	-	-	-	-	3.5%
2023SP Post-Project .sav	9L16 (Switch 972S - Cordel 755S)	7L171 (Michichi Creek 802S - Wintering Hills	-1.5%	-1.4%	2.3%	2.3%	-11.4%	55.4%	0.2%	-0.7%	1.7%	1.7%	1.7%	0.8%	2.3%	51.7%	2.3%	-	-	-	-	1.7%
2023SP Post-Project .sav	9L29 (Oakland 946S - Coyote Lake 963S)	7L171 (Michichi Creek 802S - Wintering Hills	-1.3%	-0.8%	3.2%	3.2%	-24.2%	36.6%	0.9%	-0.1%	2.4%	2.3%	2.4%	1.4%	1.5%	34.4%	-0.3%	-	-	-	-	2.4%
2023SP Post-Project .sav	9L966 (Hansman Lake 650S - Pemukan 932S)	7L224 (Hansman Lake 650S - Monitor 774S)	-8.0%	-7.6%	6.2%	6.2%	-0.4%	4.3%	28.5%	-21.0%	5.3%	5.3%	5.4%	17.6%	0.0%	4.6%	-6.2%	-	-	-	-	5.2%
2023SP Post-Project .sav	912L\9L912 (Red Deer 63S - Nevis 766S)	174L (Bardo 197S - North Holden 395S)	12.4%	9.8%	5.4%	5.4%	6.9%	5.0%	8.2%	9.1%	4.2%	4.2%	4.2%	6.4%	6.7%	5.2%	8.4%	-	-	-	-	4.2%
2023SP Post-Project .sav	912L\9L912 (Red Deer 63S - Nevis 766S)	701L (Strome 223S - Heisler Tap)	17.5%	12.3%	6.7%	6.7%	9.0%	6.4%	9.0%	9.3%	5.3%	5.3%	5.3%	7.6%	8.6%	6.6%	10.9%	-	-	-	-	5.2%
2023SP Post-Project .sav	912L\9L912 (Red Deer 63S - Nevis 766S)	7L701 (Heisler Tap - Battle River 757S)	17.8%	12.0%	6.4%	6.4%	8.0%	5.9%	8.7%	9.1%	5.0%	5.0%	5.0%	7.3%	8.3%	6.1%	10.6%	-	-	-	-	5.0%
2023SP Post-Project .sav	959S901T (Lanfine 959S Transformer 901T)	767S701T (Oyen 767S Transformer T1)	-0.9%	-0.5%	0.1%	0.1%	-1.1%	-1.2%	-0.2%	-0.4%	1.1%	1.1%	1.1%	10.3%	-0.1%	-1.1%	-0.4%	-	-	-	-	0.9%
2023SP Post-Project .sav	959S901T (Lanfine 959S Transformer 901T)	6L09\6LA09 (Oyen 767S - ACE Tap)	-0.9%	-0.5%	0.1%	0.1%	-1.1%	-1.2%	-0.2%	-0.4%	1.1%	1.1%	1.1%	10.2%	-0.1%	-1.1%	-0.4%	-	-	-	-	0.9%
2023SP Post-Project .sav	959S901T (Lanfine 959S Transformer 901T)	767S701T (Oyen 767S Transformer T1)	-0.9%	-0.5%	0.1%	0.1%	-1.1%	-1.2%	-0.2%	-0.4%	1.1%	1.1%	1.1%	10.2%	-0.1%	-1.1%	-0.4%	-	-	-	-	0.9%
2023SP Post-Project .sav	963S901T (Coyote Lake 963S Transformer 901T)	7L171 (Michichi Creek 802S - Wintering Hills	-1.3%	-0.8%	3.2%	3.2%	-24.3%	36.5%	0.9%	-0.1%	2.4%	2.3%	2.4%	1.4%	1.5%	34.4%	-0.3%	-	-	-	-	2.4%
2023SP Post-Project .sav	7L171 (Michichi Creek 802S - Wintering Hills 804S)	7L85 (Bullpound 803S - Parker 2027S)	0.0%	0.0%	0.0%	0.0%	0.0%	93.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	98.5%	0.0%	-	-	-	-	0.0%
2023SP Post-Project .sav	7L171 (Michichi Creek 802S - Wintering Hills 804S)	801S901T (Anderson 801S Transformer 901T)	0.0%	0.0%	0.0%	0.0%	0.0%	79.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	84.3%	0.0%	-	-	-	-	0.0%
2023SP Post-Project .sav	801S901T (Anderson 801S Transformer 901T)	7L171 (Michichi Creek 802S - Wintering Hills	0.0%	0.0%	0.0%	0.0%	0.0%	94.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	97.3%	0.0%	-	-	-	-	0.0%
2023SP Post-Project .sav	114ST1 (Ghost Pine 114S Transformer T1)	7L171 (Michichi Creek 802S - Wintering Hills	-0.7%	-0.4%	1.5%	1.5%	-	54.7%	0.3%	-0.1%	1.1%	1.1%	1.1%	0.5%	0.7%	51.0%	-0.1%	-	-	-	-	1.1%
2023WP Post-Project .sav	766S901T (Nevis 766S Transformer 901T)	174L (Bardo 197S - North Holden 395S)	13.5%	10.8%	5.9%	5.9%	6.9%	5.2%	8.9%	10.0%	4.6%	4.6%	4.6%	7.1%	7.4%	5.4%	9.2%	-	-	-	-	4.6%
2023WP Post-Project .sav	EATL (Newell 2075S - Heathfield 2029S)	174L (Bardo 197S - North Holden 395S)	8.1%	5.1%	2.5%	2.5%	2.4%	2.0%	4.3%	5.2%	1.9%	1.9%	2.0%	3.1%	3.4%	2.2%	4.2%	-	-	-	-	1.9%
2023WP Post-Project .sav	EATL (Newell 2075S - Heathfield 2029S)	9L16 (Tinchebray 972S - Cordel 755S)	-21.6%	-25.3%	19.0%	19.0%	-2.0%	12.8%	-1.8%	-13.6%	14.1%	14.1%	14.1%	6.7%	41.5%	13.7%	66.0%	-	-	-	-	14.3%
2023WP Post-Project .sav	9L20 (Nevis 766S - Cordel 755S)	766S901T (Nevis 766S Transformer 901T)	9.4%	8.2%	6.9%	6.9%	52.2%	11.6%	7.6%	7.2%	5.3%	5.3%	5.3%	7.0%	7.1%	11.7%	7.7%	-	-	-	-	5.3%
2023WP Post-Project .sav	912L\9L912 (Red Deer 63S - Nevis 766S)	174L (Bardo 197S - North Holden 395S)	13.5%	10.7%	5.9%	5.9%	7.6%	5.3%	8.9%	10.0%	4.6%	4.6%	4.6%	7.1%	7.4%	5.6%	9.2%	-	-	-	-	4.6%
2023WP Post-Project .sav	959S901T (Lanfine 959S Transformer 901T)	767S701T (Oyen 767S Transformer T1)	-0.9%	-0.5%	0.1%	0.1%	-1.1%	-1.1%	-0.3%	-0.4%	1.0%	1.0%	1.0%	10.0%	-0.2%	-1.0%	-0.4%	-	-	-	-	0.9%

Scenario Names	Contingency	Limiting Branch	Plants																		
			Battle River #4	Battle River #5	Sheerness #1	Sheerness #2	Ghost Pine	Wintering Hills	Sharp Hills	Bull Creek DG	Joss MPC Ph. 1	Joss MPC Ph. 2	P2199	P1898	P1909	Wheatland	Halkirk (HAL1)	BER Hand Hills	P1704	P2059	P2061	P2411
2023WP Post-Project .sav	959S901T (Lanfine 959S Transformer 901T)	6L09\6LA09 (Oyen 767S - ACE Tap)	-0.9%	-0.5%	0.1%	0.1%	-1.1%	-1.1%	-0.3%	-0.4%	1.0%	1.0%	1.0%	9.9%	-0.2%	-1.0%	-0.4%	-	-	-	-	0.9%
2023WP Post-Project .sav	959S901T (Lanfine 959S Transformer 901T)	767S701T (Oyen 767S Transformer T1)	-0.9%	-0.5%	0.1%	0.1%	-1.1%	-1.1%	-0.3%	-0.4%	1.0%	1.0%	1.0%	9.9%	-0.2%	-1.0%	-0.4%	-	-	-	-	0.9%
2023WP Post-Project .sav	7L171 (Michichi Creek 802S - Wintering Hills 804S)	7L85 (Bullpound 803S - Parker 2027S)	0.0%	0.0%	0.0%	0.0%	0.0%	92.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	98.1%	0.0%	-	-	-	-	0.0%
2023WP Post-Project .sav	7L171 (Michichi Creek 802S - Wintering Hills 804S)	801S901T (Anderson 801S Transformer 901T)	0.0%	0.0%	0.0%	0.0%	0.0%	75.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	80.4%	0.0%	-	-	-	-	0.0%
2023WP Post-Project .sav	801S901T (Anderson 801S Transformer 901T)	7L171 (Michichi Creek 802S - Wintering Hills	0.0%	0.0%	0.0%	0.0%	0.0%	93.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	96.7%	0.0%	-	-	-	-	0.0%
2023SP Sensitivity Post-	7L701\7LA701\701L (Battle River 757S - Heisler 764S - Strome	912L\9L912 (Red Deer 63S - Nevis 766S)	43.5%	45.2%	23.9%	23.9%	44.2%	23.4%	32.8%	35.2%	18.6%	18.6%	18.6%	27.8%	31.3%	24.2%	40.3%	24.4%	40.2%	44.7%	28.9%	18.5%
2023SP Sensitivity Post-	766S901T (Nevis 766S Transformer 901T)	174L (Bardo 197S - North Holden 395S)	10.9%	8.6%	5.0%	5.0%	5.2%	4.3%	7.3%	8.1%	4.0%	4.0%	4.0%	5.8%	6.1%	4.5%	7.3%	4.7%	7.3%	5.6%	5.0%	4.0%
2023SP Sensitivity Post-	766S901T (Nevis 766S Transformer 901T)	701L (Strome 223S - Heisler Tap)	16.8%	11.7%	6.6%	6.6%	7.8%	6.0%	8.7%	8.9%	5.4%	5.3%	5.4%	7.5%	8.4%	6.2%	10.3%	6.4%	10.3%	8.3%	7.0%	5.3%
2023SP Sensitivity Post-	766S901T (Nevis 766S Transformer 901T)	7L701 (Heisler Tap - Battle River 757S)	17.3%	11.9%	6.3%	6.3%	3.7%	5.0%	8.6%	9.1%	5.1%	5.1%	5.2%	7.2%	8.3%	5.3%	10.5%	5.7%	10.5%	4.0%	5.2%	5.1%
2023SP Sensitivity Post-	EATL (Newell 2075S - Heathfield 2029S)	174L (Bardo 197S - North Holden 395S)	7.3%	4.7%	2.4%	2.4%	2.4%	2.0%	3.9%	4.7%	1.9%	1.9%	2.0%	2.9%	3.1%	2.1%	3.9%	2.2%	3.9%	2.5%	2.3%	1.9%
2023SP Sensitivity Post-	EATL (Newell 2075S - Heathfield 2029S)	7L159 (Ghost Tap - Heatburg 948S)	-0.3%	-0.2%	3.5%	3.5%	63.3%	10.3%	1.9%	0.6%	2.7%	2.7%	2.7%	2.7%	1.9%	10.2%	0.2%	8.0%	0.2%	59.1%	18.4%	2.7%
2023SP Sensitivity Post-	EATL (Newell 2075S - Heathfield 2029S)	701L (Strome 223S - Heisler Tap)	11.8%	6.3%	3.2%	3.2%	3.5%	2.7%	4.3%	4.4%	2.6%	2.6%	2.7%	3.6%	4.2%	2.8%	5.4%	3.0%	5.4%	3.5%	3.2%	2.6%
2023SP Sensitivity Post-	EATL (Newell 2075S - Heathfield 2029S)	7L701 (Heisler Tap - Battle River 757S)	12.6%	6.5%	3.3%	3.3%	2.9%	2.8%	4.5%	4.7%	2.8%	2.7%	2.8%	3.8%	4.4%	2.9%	5.7%	3.1%	5.7%	3.0%	2.9%	2.8%
2023SP Sensitivity Post-	EATL (Newell 2075S - Heathfield 2029S)	912L\9L912 (Red Deer 63S - Nevis 766S)	38.6%	41.5%	21.8%	21.8%	40.3%	20.2%	30.0%	32.5%	17.4%	17.4%	17.4%	25.5%	28.5%	21.0%	36.4%	21.5%	36.5%	40.1%	25.2%	17.3%
2023SP Sensitivity Post-	EATL (Newell 2075S - Heathfield 2029S)	766S901T (Nevis 766S Transformer 901T)	3.6%	1.2%	3.6%	3.6%	52.0%	8.6%	2.7%	1.8%	2.8%	2.8%	2.8%	3.1%	2.5%	8.6%	1.5%	6.9%	1.4%	48.8%	15.6%	2.8%
2023SP Sensitivity Post-	EATL (Newell 2075S - Heathfield 2029S)	9L20 (Nevis 766S - Cordel 755S)	39.5%	45.3%	21.1%	21.1%	-6.9%	14.2%	31.1%	34.6%	16.9%	16.9%	17.0%	25.7%	29.6%	15.2%	39.5%	17.4%	39.7%	-4.1%	12.8%	16.9%
2023SP Sensitivity Post-	EATL (Newell 2075S - Heathfield 2029S)	7L16 (Nevis 766S - Heatburg 948S)	-0.2%	-0.2%	3.2%	3.2%	57.7%	9.2%	1.7%	0.5%	2.5%	2.4%	2.5%	2.4%	1.7%	9.1%	0.2%	7.1%	0.2%	53.9%	16.6%	2.5%
2023SP Sensitivity Post-	EATL (Newell 2075S - Heathfield 2029S)	9L16 (Tinchebray 972S - Cordel 755S)	-20.2%	-23.9%	21.0%	21.0%	-0.6%	14.6%	-0.2%	-12.3%	16.2%	16.2%	16.3%	8.6%	43.1%	15.5%	67.7%	17.1%	67.7%	1.4%	12.9%	16.4%
2023SP Sensitivity Post-	EATL (Newell 2075S - Heathfield 2029S)	7L171 (Michichi Creek 802S - Wintering Hills	-0.6%	-0.3%	1.8%	1.8%	-12.3%	54.3%	0.5%	0.0%	1.4%	1.4%	1.4%	0.7%	0.9%	50.9%	0.0%	-8.4%	0.0%	-14.2%	-22.5%	1.4%
2023SP Sensitivity Post-	9LA59TAP (Anderson 801S - P1909 - Tinchebray 972S)	7L159 (Ghost Tap - Heatburg 948S)	-2.1%	-2.4%	5.0%	5.0%	62.9%	12.6%	1.6%	-0.6%	3.7%	3.7%	3.7%	3.1%	-	12.4%	-2.2%	10.0%	-2.2%	59.8%	20.4%	3.7%
2023SP Sensitivity Post-	9LA59TAP (Anderson 801S - P1909 - Tinchebray 972S)	766S901T (Nevis 766S Transformer 901T)	2.5%	-0.3%	4.8%	4.8%	54.7%	11.1%	2.7%	1.0%	3.6%	3.6%	3.6%	3.6%	-	11.0%	-0.2%	9.0%	-0.2%	52.6%	18.3%	3.6%
2023SP Sensitivity Post-	9LA59TAP (Anderson 801S - P1909 - Tinchebray 972S)	7L16 (Nevis 766S - Heatburg 948S)	-1.9%	-2.1%	4.6%	4.6%	58.5%	11.5%	1.5%	-0.6%	3.4%	3.4%	3.4%	2.8%	-	11.4%	-2.0%	9.2%	-2.0%	55.8%	18.9%	3.4%
2023SP Sensitivity Post-	669L (Amoco Empress 163S - Cypress 562S)	668L (Empress 394S - Cypress 562S)	-2.5%	-2.4%	-1.0%	-1.0%	-1.5%	-1.2%	-6.2%	-3.6%	1.5%	1.5%	1.5%	-12.9%	-1.6%	-1.2%	-2.3%	-1.3%	-2.2%	-1.6%	-1.5%	1.3%
2023SP Sensitivity Post-	9L20 (Nevis 766S - Cordel 755S)	174L (Bardo 197S - North Holden 395S)	11.0%	8.6%	4.7%	4.7%	2.2%	3.7%	7.1%	8.0%	3.7%	3.7%	3.7%	5.6%	5.9%	3.9%	7.4%	4.2%	7.4%	2.5%	3.9%	3.7%
2023SP Sensitivity Post-	9L20 (Nevis 766S - Cordel 755S)	7L159 (Ghost Tap - Heatburg 948S)	3.2%	3.9%	5.1%	5.1%	63.9%	11.0%	4.5%	3.6%	4.0%	4.0%	4.0%	4.6%	4.4%	11.0%	3.9%	9.1%	3.9%	60.8%	19.3%	4.0%
2023SP Sensitivity Post-	9L20 (Nevis 766S - Cordel 755S)	701L (Strome 223S - Heisler Tap)	15.8%	10.7%	5.6%	5.6%	2.9%	4.5%	7.7%	8.0%	4.5%	4.5%	4.5%	6.4%	7.4%	4.7%	9.4%	5.0%	9.4%	3.3%	4.8%	4.5%
2023SP Sensitivity Post-	9L20 (Nevis 766S - Cordel 755S)	7L701 (Heisler Tap - Battle River 757S)	17.5%	11.9%	6.0%	6.0%	1.8%	4.6%	8.5%	9.0%	4.9%	4.9%	4.9%	7.0%	8.2%	4.9%	10.5%	5.3%	10.5%	2.1%	4.5%	4.9%
2023SP Sensitivity Post-	9L20 (Nevis 766S - Cordel 755S)	766S901T (Nevis 766S Transformer 901T)	8.2%	7.1%	6.0%	6.0%	51.1%	9.6%	6.6%	6.3%	4.7%	4.7%	4.7%	6.1%	6.2%	9.7%	6.6%	8.5%	6.6%	49.6%	16.6%	4.7%
2023SP Sensitivity Post-	9L20 (Nevis 766S - Cordel 755S)	7L16 (Nevis 766S - Heatburg 948S)	2.9%	3.4%	4.5%	4.5%	57.9%	9.7%	4.0%	3.2%	3.5%	3.5%	3.5%	4.1%	3.9%	9.7%	3.4%	8.0%	3.4%	55.4%	17.3%	3.5%
2023SP Sensitivity Post-	9L20 (Nevis 766S - Cordel 755S)	7L137 (Three Hills 770S - Rowley 768S)	3.8%	4.6%	6.1%	6.1%	-36.1%	13.4%	5.3%	4.3%	4.7%	4.7%	4.7%	5.5%	5.2%	13.3%	4.6%	10.9%	4.6%	-40.6%	22.2%	4.7%
2023SP Sensitivity Post-	9L20 (Nevis 766S - Cordel 755S)	7L25 (Rowly 768S - Michichi Creek 802S)	4.3%	5.2%	6.8%	6.8%	-40.7%	15.3%	6.0%	4.8%	5.3%	5.3%	5.4%	6.2%	5.9%	15.1%	5.2%	12.4%	5.2%	-45.7%	24.6%	5.4%
2023SP Sensitivity Post-	9L20 (Nevis 766S - Cordel 755S)	7L171 (Michichi Creek 802S - Wintering Hills	0.9%	1.3%	2.4%	2.4%	-12.5%	54.7%	1.5%	1.2%	1.8%	1.8%	1.8%	1.5%	1.9%	51.3%	1.4%	-7.8%	1.4%	-14.0%	-22.1%	1.8%
2023SP Sensitivity Post-	9L16 (Tinchebray 972S - Cordel 755S)	7L159 (Ghost Tap - Heatburg 948S)	-2.0%	-2.2%	4.8%	4.8%	64.7%	11.5%	1.6%	-0.6%	3.6%	3.6%	3.6%	3.1%	4.4%	11.5%	4.3%	9.3%	4.3%	61.5%	19.8%	3.7%
2023SP Sensitivity Post-	9L16 (Tinchebray 972S - Cordel 755S)	6L15 (Sullivan Lake 775S - Hanna 763S)	-1.7%	-0.9%	0.9%	0.9%	1.1%	1.7%	0.4%	-0.4%	0.7%	0.7%	0.7%	1.1%	0.8%	1.8%	0.8%	1.5%	0.8%	1.6%	3.2%	0.7%
2023SP Sensitivity Post-	9L16 (Tinchebray 972S - Cordel 755S)	766S901T (Nevis 766S Transformer 901T)	2.8%	-0.1%	4.3%	4.3%	54.1%	9.5%	2.5%	1.1%	3.3%	3.3%	3.3%	3.4%	4.0%	9.5%	3.8%	7.8%	3.8%	52.1%	16.9%	3.3%
2023SP Sensitivity Post-	9L16 (Tinchebray 972S - Cordel 755S)	7L16 (Nevis 766S - Heatburg 948S)	-1.8%	-2.0%	4.3%	4.3%	59.2%	10.3%	1.5%	-0.5%	3.3%	3.3%	3.3%	2.8%	4.0%	10.2%	3.8%	8.3%	3.8%	56.6%	18.0%	3.3%
2023SP Sensitivity Post-	9L16 (Tinchebray 972S - Cordel 755S)	7L171 (Michichi Creek 802S - Wintering Hills	-1.5%	-1.4%	2.4%	2.4%	-11.7%	55.0%	0.3%	-0.6%	1.9%	1.9%	1.9%	0.9%	2.4%	51.6%	2.3%	-7.7%	2.3%	-13.3%	-21.8%	1.9%
2023SP Sensitivity Post-	9L29 (Oakland 946S - Coyote Lake 963S)	7L159 (Ghost Tap - Heatburg 948S)	-0.1%	-0.2%	2.3%	2.3%	71.6%	21.4%	1.2%	0.3%	1.8%	1.8%	1.8%	1.9%	1.2%	20.5%	0.0%	28.4%	0.0%	69.3%	33.2%	1.8%
2023SP Sensitivity Post-	9L29 (Oakland 946S - Coyote Lake 963S)	766S901T (Nevis 766S Transformer 901T)	3.9%	1.2%	2.6%	2.6%	59.7%	17.7%	2.2%	1.7%	2.1%	2.1%	2.1%	2.6%	2.0%	17.1%	1.3%	23.1%	1.3%	58.5%	28.0%	2.1%
2023SP Sensitivity Post-	9L29 (Oakland 946S - Coyote Lake 963S)	7L16 (Nevis 766S - Heatburg 948S)	-0.1%	-0.2%	2.1%	2.1%	65.6%	19.2%	1.1%	0.3%	1.6%	1.6%	1.6%	1.7%	1.1%	18.5%	0.1%	25.5%	0.1%	63.8%	30.2%	1.6%
2023SP Sensitivity Post-	9L966 (Hansman Lake 650S - Pemukan 932S)	7L224 (Hansman Lake 650S - Monitor 774S)	-7.9%	-7.5%	6.2%	6.2%	-0.3%	4.3%	28.6%	-20.8%	5.5%	5.5%	5.5%	17.7%	0.1%	4.6%	-6.1%	5.4%	-6.1%	0.3%	4.2%	5.3%
2023SP Sensitivity Post-	912L\9L912 (Red Deer 63S - Nevis 766S)	174L (Bardo 197S - North Holden 395S)	10.9%	8.6%	5.0%	5.0%	5.9%	4.4%	7.3%	8.1%	4.0%	4.0%	4.0%	5.9%	6.1%	4.6%	7.3%	4.8%	7.3%	6.3%	5.3%	4.0%
2023SP Sensitivity Post-	912L\9L912 (Red Deer 63S - Nevis 766S)	701L (Strome 223S - Heisler Tap)	16.7%	11.7%	6.6%	6.6%	8.5%	6.1%	8.8%	8.9%	5.4%	5.4%	5.4%	7.5%	8.4%	6.4%	10.3%	6.5%	10.3%	8.9%	7.2%	5.4%
2023SP Sensitivity Post-	912L\9L912 (Red Deer 63S - Nevis 766S)	7L701 (Heisler Tap - Battle River 757S)	17.2%	11.5%	6.4%	6.4%	7.6%	5.7%	8.5%	8.8%	5.2%	5.2%	5.2%	7.2%	8.2%	6.0%	10.2%	6.2%	10.2%	7.9%	6.5%	5.2%
2023SP Sensitivity Post-	959S901T (Lanfine 959S Transformer 901T)	6L09\6LA09 (Oyen 767S - ACE Tap)	-0.8%	-0.5%	0.1%	0.1%	-1.1%	-1.1%	-0.2%	-0.4%	1.1%	1.1%	1.1%	10.1%	-0.1%	-1.0%	-0.4%	-0.7%	-0.4%	-1.3%	-1.8%	0.9%
2023SP Sensitivity Post-	963S901T (Coyote Lake 963S Transformer 901T)	7L159 (Ghost Tap - Heatburg 948S)	-0.1%	-0.2%	2.3%	2.3%	71.6%	21.4%	1.2%	0.3%	1.8%	1.8%	1.8%	1.9%	1.2%	20.5%	0.0%	28.4%	0.0%	69.3%	33.2%	1.8%
2023SP Sensitivity Post-	963S901T (Coyote Lake 963S Transformer 901T)	766S901T (Nevis 766S Transformer 901T)	3.9%	1.2%	2.6%	2.6%	59.7%	17.7%	2.2%	1.7%	2.1%	2.1%	2.1%	2.6%	2.0%	17.1%	1.3%	23.1%	1.3%	58.5%	28.0%	2.1%
2023SP Sensitivity Post-	963S901T (Coyote Lake 963S Transformer 901T)	7L16 (Nevis 766S - Heatburg 948S)	-0.1%	-0.2%	2.1%	2.1%	65.5%	19.2%	1.1%	0.3%	1.6%	1.6%	1.6%	1.7%	1.1%	18.5%	0.1%	25.5%	0.1%	63.8%	30.2%	1.6%
2023SP Sensitivity Post-	7L171 (Michichi Creek 802S - Wintering Hills 804S)	7L85 (Bullpound 803S - Anderson 801S)	0.0%	0.0%	0.0%	0.0%	0.0%	87.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	92.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2023SP Sensitivity Post-	7L171 (Michichi Creek 802S - Wintering Hills 804S)	7L85 (Bullpound 803S - Parker 2027S)	0.0%	0.0%	0.0%	0.0%	0.0%	92.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	98.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2023SP Sensitivity Post-	7L171 (Michichi Creek 802S - Wintering Hills 804S)	801S901T (Anderson 801S Transformer 901T)	0.0%	0.0%	0.0%	0.0%	0.0%	77.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	82.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2023SP Sensitivity Post-	801S901T (Anderson 801S Transformer 901T)	7L159 (Ghost Tap - Heatburg 948S)	-0.4%	-0.4%	3.2%	3.2%	64.6%	16.9%	1.7%	0.4%	2.5%	2.5%	2.5%	2.5%	1.6%	17.7%	0.1%	10.5%	0.0%	61.5%	22.8%	2.5%
2023SP Sensitivity Post-	801S901T (Anderson 801S Transformer 901T)	7L171 (Michichi Creek 802S - Wintering Hills	0.0%	0.0%	0.0%	0.0%	0.0%	94.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	97.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2023SP Sensitivity Post-	7L128 (Michichi Creek 802S - P2263 - Coyote Lake 963S	7L171 (Michichi Creek 802S - Wintering Hills	-1.3%	-0.7%	3.2%	3.2%	-24.3%	36.4%	1.0%	-0.1%	2.4%	2.4%	2.4%	1.4%	1.5%	34.5%	-0.2%	-	-0.3%	-28.4%	-48.5%	2.4%
2023SP Sensitivity Post-	9L51 (Pemukan 932S - New Brigden 2088S)	7L159 (Ghost Tap - Heatburg 948S)	-1.2%	-1.2%	4.1%	4.1%	62.9%	12.1%	4.3%	-1.1%	3.2%	3.2%	3.2%	4.1%	1.8%	11.9%	-0.5%	9.4%	-0.5%	59.7%	19.9%	3.2%
2023SP Sensitivity Post-	9L51 (Pemukan 932S - New Brigden 2088S)	7L16 (Nevis 766S - Heatburg 948S)	-1.1%	-1.0%	3.8%	3.8%	58.5%	11.1%	3.9%	-1.0%	3.0%	3.0%	3.0%	3.8%	1.7%	10.9%	-0.5%	8.6%	-0.5%	55.7%	18.5%	3.0%
2023SP Sensitivity Post-	9L51 (Pemukan 932S - New Brigden 2088S)	9L16 (Tinchebray 972S - Cordel 755S)	-27.6%	-31.4%	24.0%	24.0%	-2.9%	15.6%	22.6%	-27.5%	18.2%	18.2%	18.3%	21.5%	40.7%	16.7%	60.8%	19.1%	60.8%	-0.6%	14.1%	18.2%
2023SP Sensitivity Post-	9L46 (Lanfine 959S - New Brigden 2088S)	7L159 (Ghost Tap - Heatburg 948S)	-1.2%	-1.2%	4.1%	4.1%	62.9%	12.1%	-1.3%	-1.1%	3.2%	3.2%	3.2%	4.1%	1.8%	11.9%	-0.5%	9.4%	-0.6%	59.7%	19.9%	3.2%
2023SP Sensitivity Post-	9L46 (Lanfine 959S - New Brigden 2088S)	7L16 (Nevis 766S - Heatburg 948S)	-1.1%	-1.0%	3.8%	3.8%	58.5%	11.1%	-1.2%	-1.0%	3.0%	3.0%	3.0%	3.8%	1.7%	10.9%	-0.5%	8.6%	-0.5%	55.7%	18.5%	3.0%
2023SP Sensitivity Post-	9L46 (Lanfine 959S - New Brigden 2088S)	9L16 (Tinchebray 972S - Cordel 755S)	-27.6%	-31.4%	23.9%	23.9%	-2.9%	15.5%	-29.1%	-27.5%	18.2%	18.2%	18.2%	21.4%	40.7%	16.7%	60.7%	19.0%	60.8%	-0.6%	14.0%	18.2%
2023SP Sensitivity Post-	770S703T (Three Hills 770S Transformer 703T)	7L159 (Ghost Tap - Heatburg 948S)	-0.5%	-0.4%	3.7%	3.7%	61.5%	12.6%	1.8%	0.4%	2.8%	2.8%	2.8%	2.7%	1.9%	12.2%	0.0%	9.5%	0.0%	57.9%	20.0%	2.8%
2023SP Sensitivity Post-	770S703T (Three Hills 770S Transformer 703T)	766S901T (Nevis 766S Transformer 901T)	3.6%	1.0%	4.0%	4.0%	53.0%	11.2%	2.8%	1.8%	3.0%	3.0%	3.0%	3.4%	2.6%	11.0%	1.3%	8.8%	1.3%	50.5%	18.0%	3.0%
2023SP Sensitivity Post-	770S703T (Three Hills 770S Transformer 703T)	7L16 (Nevis 766S - Heatburg 948S)	-0.4%	-0.4%	3.4%	3.4%	57.0%	11.5%	1.7%	0.4%	2.6%	2.6%	2.6%	2.5%	1.7%	11.2%	0.1%	8.8%	0.0%	53.9%	18.5%	2.6%
2023SP Sensitivity Post-	757S905T (Battle River 757S Transformer 905T)	9L16 (Tinchebray 972S - Cordel 755S)	-21.0%	-	18.1%	18.1%	-3.2%	11.0%	-1.9%	-13.5%	12.6%	12.5%	12.6%	5.3%	40.3%	11.9%	65.6%	13.6%	65.7%	-1.3%	9.8%	12.6%
2023SP Sensitivity Post-	757ST2 (Battle River 757S Transformer T2)	912L\9L912 (Red Deer 63S - Nevis 766S)	30.8%	44.4%	23.0%	23.0%	43.1%	22.5%	31.4%	33.4%	17.8%	17.8%	17.9%	26.6%	30.5%	23.3%	39.4%	23.4%	39.4%	43.6%	27.8%	17.8%
2023SP Sensitivity Post-	P2263T1 (P2263 BER Hand Hills MPC Wind Farm Transformer T1)	7L171 (Michichi Creek 802S - Wintering Hills	-0.6%	-0.4%	1.5%	1.5%	-11.0%	54.7%	0.3%	-0.1%	1.1%	1.1%	1.1%	0.5%	0.7%	51.2%	-0.1%	-	-0.1%	-13.0%	-22.2%	1.2%