APPENDIX A CONNECTION ASSESSMENT

Engineering Connection Assessment

Claresholm Solar Project Connection

Claresholm Solar Inc.

AESO Project Number: P1879

Date: May 30, 2019

Version: Final

Classification: Public

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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

Clareshom Solar Inc. (Market Participant) has submitted a request for system access service to the Alberta Electric System Operator (AESO) to connect its approved Claresholm Solar Project A and Claresholm Solar Project B (Facilities) to the AIES.

The Facilities are solar aggregated generating facilities, and includes an approved collector substation, designated as the Granum 604S substation. The Facilities are located in the Claresholm area, in the AESO planning area of Stavely (Area 49).

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 56.875 MW and a Rate DTS, *Demand Transmission Service*, contract capacity of 0.245 MW for the Claresholm Solar Project A; a request for a new system access service in the area, with a Rate STS capacity of 73.125 MW and a Rate DTS contract capacity of 0.315 MW for the Claresholm Solar Project B; and a request for transmission development (collectively, the Project).

The scheduled in-service date (ISD) for the Project is June 30, 2020.

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 legal owner of a Transmission Facility (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 of Stavely (Area 49), which is part of the AESO South Planning Region.

From a transmission system perspective, Stavely (Area 49) consists primarily of 138 kV and 240 kV transmission systems. Stavely (Area 49) is connected to Brooks (Area 47) through the 240 kV transmission lines 1005L and 1036L, connected to Strathmore/Blackie (Area 45) through the 138 kV transmission line 161L, connected to High River (Area 46) through the 240 kV transmission lines 1037L and 1038L, connected to Lethbridge (Area 54) through the 240 kV transmission lines 1041L and 1005L, and connected to Fort Macleod (Area 53) through the 138 kV transmission line 180L.

Existing constraints in the South 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 for the Project consists of the AESO planning areas of Fort Macleod (Area 53), Lethbridge (Area 54), and Stavely (Area 49), including the transmission lines connecting these planning areas to the neighboring planning areas. All transmission facilities within the Study Area will be studied and monitored for violations of the Reliability Criteria (defined in Section 3.1 of Attachment A1).

3 Connection Alternatives

3.1 Overview

The AESO, in consultation with the TFO in the Study Area and the Market Participant, examined four (4) 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 – In-and-out connection to the 240 kV transmission lines 1037L or 1038L

This alternative includes the following developments:

- Add a 240 kV switching station, including three 240 kV circuit breakers and connecting the 240 kV switching station to the existing transmission line 1037L or 1038L (between Windy Flats 138S and SC1 266S substations) using an in-and-out connection configuration ;
- Add a 240 kV circuit, approximately 12 km in length[1], to connect the Market Participant's approved Granum 604S substation to the 240kV switching station using a radial connection configuration; and
- Add or modify associated equipment as required for the above transmission developments.

[1] Exact line length to be determined by the TFO

Figure 3-1: Connection Alternative 1

Alternative 2 – Radial connection to the existing SC1 266S substation

This alternative includes the following developments:

- Modify the existing SC1 266S substation, including adding one 240 kV circuit breaker;
- Add a 240 kV circuit, approximately 21 km[2] to connect the Market Participant's approved Granum 604S substation to the existing SC1 266S substation using a radial configuration; and
- Add or modify associated equipment as required for the above transmission developments.

[2] Exact line length to be determined by the TFO

Figure 3-2: Connection Alternative 2

Alternative 3 – T-tap connection to 138 kV transmission line 180L

This alternative includes the following developments:

- Add a 138 kV circuit, approximately 100 meters in length,[3] to connect the Market Participant's approved Granum 604S substation to the existing 138 kV transmission line 180L (between East Stavely 928S and Fort Macleod 15S substations) using a T-tap connection configuration; and
- Add or modify associated equipment as required for the above transmission developments.

[3] Exact line length to be determined by the TFO

Figure 3-3: Connection Alternative 3

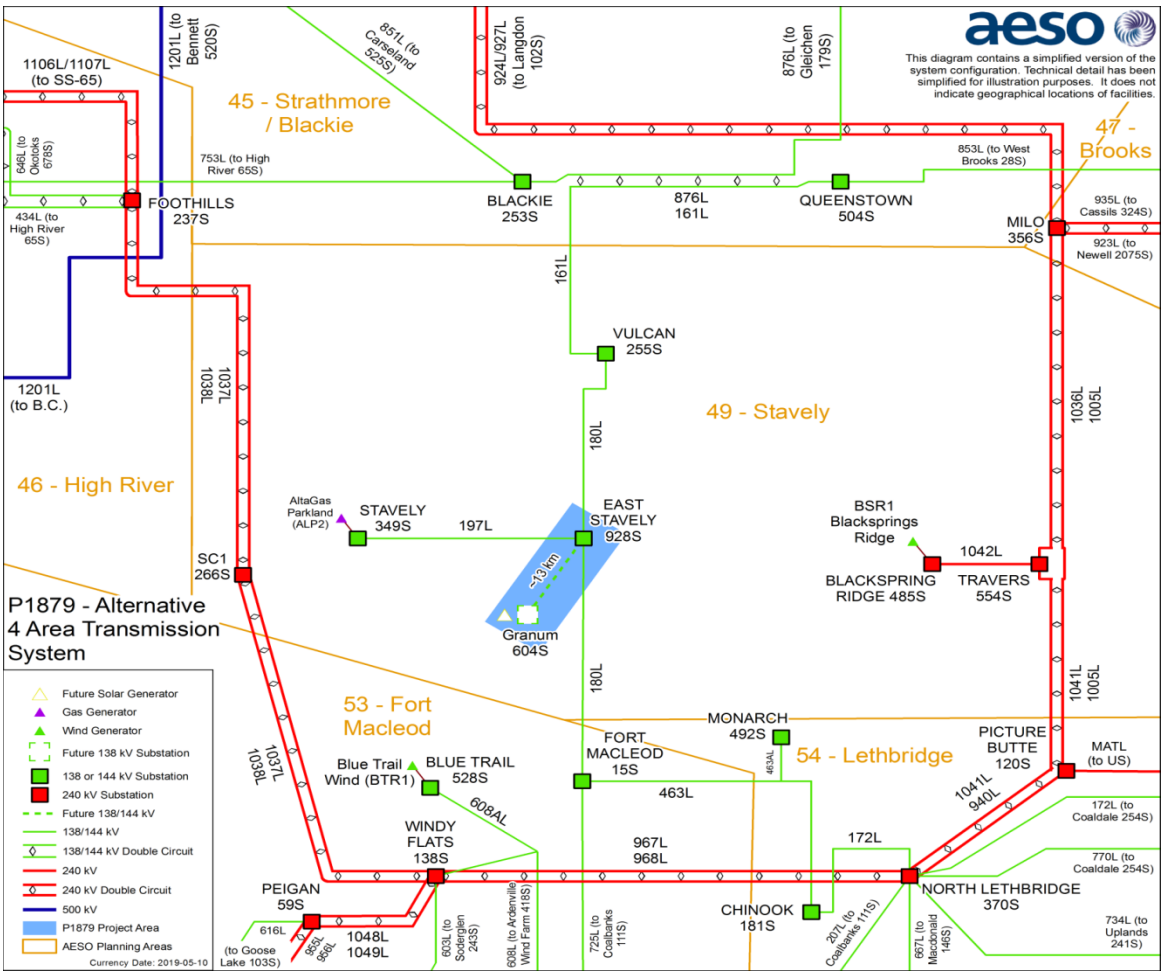
Alternative 4 – Radial connection to the existing East Stavely 928S substation

This alternative includes the following developments:

- Modify the existing East Stavely 928S substation, including adding one 138 kV circuit breaker;
- Add a 138 kV circuit, approximately 13 km[4] to connect the Market Participant's approved Granum 604S substation to the existing East Stavely 928S substation using a radial configuration; and
- Add or modify associated equipment as required for the above transmission developments.

[4] Exact line length to be determined by the TFO

Figure 3-4: Connection Alternative 4



3.3 Connection Alternatives Selected for Further Study

Alternative three (3) is considered technically feasible and was selected for further study.

3.4 Connection Alternatives Not Selected for Further Study

Alternatives 1, 2, and 4 would involve increased transmission development and hence, increased cost, compared to Alternative 3. Therefore, Alternatives 1, 2, and 4 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 June 30, 2020. Therefore, studies were performed using scenarios for 2020 Summer Light (SL) and 2020 Summer Peak (SP).

Short-circuit studies were performed using the 2020 and 2028 SP scenarios.

Table 4-1 lists the study scenarios. Post-Project scenarios reflect the requested Rate STS contract capacity of 130 MW at the Granum 604S substation.

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	2020 SL	High wind (HW), zero import (ZI)	2020 SL Pre-Project	0	0
2	2020 SP	HW, high import (HI)	2020 SP Pre-Project	0	0
Post-Project					
3	2020 SL	HW, ZI	2020 SL Post-Project	0.56	130
4	2020 SP	HW, HI	2020 SP Post-Project	0.56	130
5	2028 SP	All generation in the Study Area on	2028 SP Post-Project	0.56	130

The AESO Planning Region load forecasts used for the connection studies were based on the *AESO 2017 Long Term Outlook* (2017 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.[5]

Power flow studies were performed for 2020 SL and 2020 SP pre-Project scenarios, and for 2020 SL and 2020 SP post-Project scenarios.

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 2020 SL and 2020 SP 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 2020 SP pre-Project scenario and for 2020 SP and 2028 SP post-Project scenarios.

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 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] 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.

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 a description of the proposed mitigation measures to address observed Reliability Criteria violations.
- Section 5.5 includes 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					
2020 SL	Thermal - above normal rating	Thermal - above normal rating	618ST1 (Transformer T1 at Riverbend 618S)	820L (Stirling Wind Project Tap Point - 820AL Tap Point)	Marginally reduced violation	Real time operational practices	Real time operational practices
	Thermal - above normal rating	Thermal - above normal rating		820L (Coaldale 254S - 820AL Tap Point)	Marginally reduced violation	Real time operational practices	Real time operational practices
	None	Thermal - above emergency rating	161L (Vulcan 255S - Queenstown 504S)	463L (Fort Macleod 15S - 463AL Tap Point)	New violation	None	New RAS for 463L
	None	Thermal - above normal rating		180L (Fort Macleod 15S - P1879 Tap Point)	New violation	None	New RAS for 463L
	None	Thermal - above normal rating		172L (Chinook 181S - North Lethbridge 370S)	New violation	None	New RAS for 463L
	None	Thermal - above normal rating		725L (Bowron 674S - 725BL Tap Point)	New violation	None	New RAS for 463L
	None	Thermal - above normal rating		463L (Chinook 181S - 463AL Tap Point)	New violation	None	New RAS for 463L
	None	Thermal - above emergency rating	725L (Bowron 674S - Coalbanks 111S/Riverbend 618S)	463L (Fort Macleod 15S - 463AL Tap Point)	New violation	None	New RAS for 463L
	None	Thermal - above emergency rating		463L (Chinook 181S - 463AL Tap Point)	New violation	None	New RAS for 463L
	None	Thermal - above emergency rating		172L (Chinook 181S - North Lethbridge 370S)	New violation	None	New RAS for 463L
	None	Thermal - above emergency rating	674ST1 (Transformer T1 in Bowron 674S)	463L (Fort Macleod 15S - 463AL Tap Point)	New violation	None	New RAS for 463L
	None	Thermal - above emergency rating		463L (Chinook 181S - 463AL Tap Point)	New violation	None	New RAS for 463L
	None	Thermal - above emergency rating		172L (Chinook 181S - North Lethbridge 370S)	New violation	None	New RAS for 463L
	None	Thermal - above emergency rating	255ST1 (Transformer T1 in Vulcan 255S)	463L (Fort Macleod 15S - 463AL Tap Point)	New violation	None	New RAS for 463L
	None	Thermal - above emergency rating		463L (Chinook 181S - 463AL Tap Point)	New violation	None	New RAS for 463L
	None	Thermal - above normal rating		725L (Bowron 674S - 725BL Tap Point)	New violation	None	New RAS for 463L
	None	Thermal - above normal rating		180L (Fort Macleod 15S - P1879 Tap Point)	New violation	None	New RAS for 463L
	None	Thermal - above normal rating		172L (Chinook 181S - North Lethbridge 370S)	New violation	None	New RAS for 463L
	None	Thermal - above normal rating	15ST1 (Transformer T1 in Fort Macleod 15S)	180L (Vulcan 255S - East Stavely 928S)	New violation	None	New RAS for 180L
	None	Thermal - above emergency rating		180L (East Stavely 928S - P1879 Tap Point)	New violation	None	New RAS for 180L
	None	Thermal - above emergency rating	370ST1 (Transformer T1 at North Lethbridge 370S)	725L (Bowron 674S - 725BL Tap Point)	New violation	None	New RAS for 725L
	None	Thermal - above emergency rating	463L (Fort Macleod 15S - Monarch 492S/Chinook 181S)	725L (Bowron 674S - 725BL Tap Point)	New violation	None	New RAS for 725L
	None	Thermal - above emergency rating	172L (Chinook 181S - North Lethbridge 370S)	725L (Bowron 674S - 725BL Tap Point)	New violation	None	New RAS for 725L
	None	Thermal - above normal rating	1036L (Milo 356S - Travers 554S)	172L (Taber 38S - 172EL Tap Point)	New violation	None	Real time operational practices
2020 SP	Thermal - above normal rating	Thermal - above normal rating	618ST1 (Transformer T1 at Riverbend 618S)	820L (Stirling Wind Project Tap Point - 820AL Tap Point)	Marginally reduced violation	Real time operational practices	Real time operational practices
	Thermal - above normal rating	Thermal - above normal rating		820L (Coaldale 254S - 820AL Tap Point)	Marginally reduced violation	Real time operational practices	Real time operational practices
	Thermal - above normal rating	Thermal - above emergency rating	1036L (Milo 356S - Travers 554S)	172L (Taber 38S - 172EL Tap Point)	Materially increased violation	Real time operational practices	Modify planned RAS for 172L
	None	Thermal - above emergency rating	1005L (Picture Butte 120S - Milo 356S)	172L (Taber 38S - 172EL Tap Point)	New violation	None	Modify planned RAS for 172L

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					
	None	Thermal - above normal rating		1036L (Milo 356S - Travers 554S)	New violation	None	Modify planned RAS for 172L
	None	Thermal - above normal rating	161L (Vulcan 255S - Queenstown 504S)	463L (Fort Macleod 15S - 463AL Tap Point)	New violation	None	Real time operational practices
	None	Thermal - above normal rating	725L (Bowron 674S - Coalbanks 111S/Riverbend 618S)	172L (Chinook 181S - North Lethbridge 370S)	New violation	None	New RAS for 463L
	None	Thermal - above emergency rating		463L (Fort Macleod 15S - 463AL Tap Point)	New violation	None	New RAS for 463L
	None	Thermal - above normal rating		463L (Chinook 181S - 463AL Tap Point)	New violation	None	New RAS for 463L
	None	Thermal - above emergency rating	674ST1 (Transformer T1 in Bowron 674S)	172L (Chinook 181S - North Lethbridge 370S)	New violation	None	New RAS for 463L
	None	Thermal - above emergency rating		463L (Fort Macleod 15S - 463AL Tap Point)	New violation	None	New RAS for 463L
	None	Thermal - above emergency rating		463L (Chinook 181S - 463AL Tap Point)	New violation	None	New RAS for 463L
	None	Thermal - above normal rating	255ST1 (Transformer T1 in Vulcan 255S)	463L (Fort Macleod 15S - 463AL Tap Point)	New violation	None	Real time operational practices
	None	Thermal - above normal rating		725L (Bowron 674S - 725BL Tap Point)	New violation	None	Real time operational practices
	None	Thermal - above normal rating		180L (Fort Macleod 15S - P1879 Tap Point)	New violation	None	Real time operational practices
	None	Thermal - above normal rating	15ST1 (Transformer T1 in Fort Macleod 15S)	180L (Vulcan 255S - East Stavely 928S)	New violation	None	New RAS for 180L
	None	Thermal - above emergency rating		180L (East Stavely 928S - P1879 Tap Point)	New violation	None	New RAS for 180L
	None	Thermal - above normal rating	370ST1 (Transformer T1 at North Lethbridge 370S)	725L (Bowron 674S - 725BL Tap Point)	New violation	None	Real time operational practices
	None	Thermal - above emergency rating	463L (Fort Macleod 15S - Monarch 492S/Chinook 181S)	725L (Bowron 674S - 725BL Tap Point)	New violation	None	New RAS for 725L
	None	Thermal - above normal rating	172L (Chinook 181S - North Lethbridge 370S)	725L (Bowron 674S - 725BL Tap Point)	New violation	None	Real time operational practices
	None	Thermal - above normal rating	1037L (Foothills 237S - Windy Flats 138S)	172L (Taber 38S - 172EL Tap Point)	New violation	None	Real time operational practices
	None	Thermal - above normal rating	1038L (Foothills 237S - Windy Flats 138S)	172L (Taber 38S - 172EL Tap Point)	New violation	None	Real time operational practices

Notes:

- Marginally increased or marginally decreased refers to a percent loading difference (post-Project percent loading minus pre-Project percent loading) below 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%.
- RAS for 172L was proposed for the approved Stirling WAGF in the *Stirling Wind Project Connection NID*. This RAS is referred to herein as “Planned RAS for 172L”.Further information is provided in Section 5.3 of Attachment A.
- In this table, “Modify” refers to adding the Project to the logic of the respective RAS.

5.2 Pre-Project Study Results

5.2.1 Category A Conditions

No Reliability Criteria violations were observed under the Category A conditions (i.e., all elements in service) for any of the pre-Project scenarios. 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).

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

5.3 Post-Project Study Results

5.3.1 Category A Conditions

No Reliability Criteria violations were observed under Category A conditions for any pre-Project scenarios. 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

Post-Project power flow studies identified a number of thermal violation under Category B conditions.

No POD bus voltage deviations were observed under Category B conditions.

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

5.4 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.

5.4.1 Pre-Project

Prior to connection of the Project, the observed thermal criteria violations can be managed by using real-time operational practices.

5.4.2 Post-Project

After connection of the Project, some of the thermal criteria violations observed can be mitigated by using real-time operational practices.

After the Project is connected, new RASs are required to mitigate observed Reliability Criteria violations. The thermal criteria violations observed on 138 kV transmission lines 172L, 463L, 180L, and 725L, can be mitigated by new RASs, referred to as the "Modify planned RAS for 172L", "new RAS for 463L" , "new RAS for 180L", and "new RAS for 725L" respectively, in combination with real time operational practices, if necessary.

5.4.3 Post-Project Mitigation Study Results

Under Category B conditions, all of the observed Reliability Criteria violations requiring RAS were mitigated. Please refer to Section 5.3 of Attachment A for the detailed evaluation results.

5.5 Study Considerations

As shown in Table 5-2, there are three behind-the-fence (BTF), distribution-connected, renewable generation projects in the Study Area that were not dispatched in the studies because these projects have not presently met the AESO's criteria for inclusion in the studies. Should any of the projects outlined in Table 5-2 energize before the Project's ISD, the connection assessment results and conclusions presented herein may need to be amended.

The actual impacts of the planned renewable generation projects connecting in the Study Area, including the Facility, will depend on the energization timing of these planned generation facilities. The AESO will ensure plans are in place when impacts of the Project and the other planned renewable generation projects in the area become certain.

Table 5-2: Summary of Planned BTF Projects in the Study Area not dispatched in the Studies

AESO Project Name and Number	AESO Planning Area	Requested STS Contract Change (MW)	AESO Connection Process Stage	Planned ISD
P1831 Fortis 255S Vulcan Faribault Farms DG PV	49-Stavely	14.0	3	Aug 1, 2020
P1851 Fortis Monarch 492S DER Solar	54-Lethbridge	20.0	3	Aug 1, 2020
P1870 Fortis Stavely 349S DER Solar	49-Stavely	8.5	3	Aug 1, 2020

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 3 is technically viable. The connection assessment identified a number of pre-Project and post-Project system performance issues.

These issues can be mitigated through the use of new RAS for 725L, the new RAS for 463L, the new RAS for 180L, Modify planned RAS for 172L, and real-time operational practices, alone or in combination, as appropriate. With implementation of these mitigation measures, connecting the project with the preferred alternative does not adversely affect the performance of the AIES.

The AESO recommends proceeding with the Project using Alternative 3 as the preferred option 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 3 involves adding one 138 kV circuit to connect the Market Participant's approved Granum 604S substation to the existing 138 kV transmission line 180L (between East Stavely 928S and Fort Macleod 15S substations) using a T-tap connection configuration. The conductor used for the 138 kV circuit should have a minimum thermal rating similar to the existing 138 kV transmission line 180L.

Attachment A:
Engineering Connection Assessment Results

Engineering Connection Assessment: Study Results

Claresholm Solar Project Connection

Claresholm Solar Inc.

AESO Project Number: P1879

Date: May 23, 2019

Version: Final

Classification: Public

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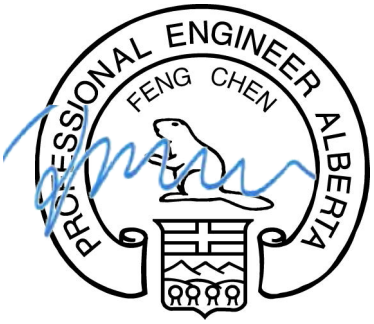

Contents

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1 Introduction

This report presents the results of the engineering studies that were completed by CF Power 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 33.

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: 2020 SL 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 2-1.

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

Contingency (System Element Lost)	Details of Violation (Violation Observed On)	Thermal Ratings (MVA)		Pre-Project Results	
		Normal Rating (MVA)	Emergency Rating (MVA)	Observed Power Flow[a] (MVA)	% Loading[b]
618ST1 (Transformer T1 at Riverbend 618S)	820L (Stirling Wind Project Tap Point - 820AL Tap Point)	120	132	122.50	102.09
	820L (Coaldale 254S - 820AL Tap Point)	120	132	131.03	109.20

Notes:

[a] Power Flow (MVA) is current expressed as MVA (ie. S = $\sqrt{3}$ x V_{base} x I_{actual})

[b] % loading is reported as a percentage of the observed power flow (in MVA ie. S =√3 x Vbase x Iactual) 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: 2020 SP 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 2-2.

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

Contingency (System Element Lost)	Details of Violation (Violation Observed On)	Thermal Ratings (MVA)		Pre-Project Results	
		Normal Rating (MVA)	Emergency Rating (MVA)	Observed Power Flow (MVA)	% Loading
618ST1 (Transformer T1 at Riverbend 618S)	820L (Stirling Wind Project Tap Point - 820AL Tap Point)	120	132	126.69	105.58
	820L (Coaldale 254S - 820AL Tap Point)	120	132	130.70	108.93
1036L (Travers 554S - Milo 356S)	172L (Taber 83S - 172EL Tap Point)	119	131	129.50	108.79

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 and transient stability studies.

As described in Section 2 of Attachment A1, the post-Project studies were performed using Alternative 3

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 3: 2020 SL Post-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 3-1.

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

Contingency (System Element Lost)	Details of Violation (Violation Observed On)	Thermal Ratings (MVA)		Pre-Project Results		Post-Project Results		% Loading Difference (Post-Pre)
		Normal Rating (MVA)	Emergency Rating (MVA)	Observed Power Flow (MVA)	% Loading	Observed Power Flow (MVA)	% Loading	
618ST1 (Transformer T1 at Riverbend 618S)	820L (Stirling Wind Project Tap Point - 820AL Tap Point)	120	132	122.50	102.09	122.30	101.91	-0.18
	820L (Coaldale 254S - 820AL Tap Point)	120	132	131.03	109.20	130.84	109.04	-0.16
161L (Vulcan 255S - Queenstown 504S)	463L (Fort Macleod 15S - 463AL Tap Point)	85	94	29.02	34.14	96.97	113.96	69.40
	180L (Fort Macleod 15S - P1879 Tap Point)	112	124	-	-	115.97	103.54	-
	172L (Chinook 181S - North Lethbridge 370S)	85	94	21.78	25.68	88.55	104.36	78.68

Contingency (System Element Lost)	Details of Violation (Violation Observed On)	Thermal Ratings (MVA)		Pre-Project Results		Post-Project Results		% Loading Difference (Post-Pre)
		Normal Rating (MVA)	Emergency Rating (MVA)	Observed Power Flow (MVA)	% Loading	Observed Power Flow (MVA)	% Loading	
	725L (Bowron 674S - 725BL Tap Point)	91	100	37.92	41.63	93.87	103.08	61.45
	463L (Chinook 181S - 463AL Tap Point)	85	94	24.85	29.30	92.95	109.55	80.25
725L (Bowron 674S - Coalbanks 111S/Riverbend 618S)	463L (Fort Macleod 15S - 463AL Tap Point)	85	94	33.02	38.85	113.38	133.24	94.39
	463L (Chinook 181S - 463AL Tap Point)	85	94	28.83	34.00	109.31	128.82	94.82
	172L (Chinook 181S - North Lethbridge 370S)	85	94	28.12	33.16	105.32	124.13	90.97
674ST1 (Transformer T1 in Bowron 674S)	463L (Fort Macleod 15S - 463AL Tap Point)	85	94	39.39	46.34	121.28	142.54	96.20
	463L (Chinook 181S - 463AL Tap Point)	85	94	35.16	41.46	117.23	138.16	96.70
	172L (Chinook 181S - North Lethbridge 370S)	85	94	33.25	39.21	113.18	133.39	94.18
255ST1 (Transformer T1 in Vulcan 255S)	463L (Fort Macleod 15S - 463AL Tap Point)	85	94	31.72	37.32	99.67	117.13	79.81
	463L (Chinook 181S - 463AL Tap Point)	85	94	27.55	32.49	95.64	112.72	80.23
	725L (Bowron 674S - 725BL Tap Point)	91	100	40.18	44.10	96.16	105.59	61.49
	180L (Fort Macleod 15S - P1879 Tap Point)	112	124	-	-	120.70	107.77	-
	172L (Chinook 181S - North Lethbridge 370S)	85	94	24.36	28.73	91.27	107.57	78.84
15ST1 (Transformer T1 in Fort Macleod 15S)	180L (Vulcan 255S - East Stavely 928S)	112	124	4.20	3.75	121.79	108.74	104.99
	180L (East Stavely	112	124	-	-	125.43	111.99	-

Contingency (System Element Lost)	Details of Violation (Violation Observed On)	Thermal Ratings (MVA)		Pre-Project Results		Post-Project Results		% Loading Difference (Post-Pre)
		Normal Rating (MVA)	Emergency Rating (MVA)	Observed Power Flow (MVA)	% Loading	Observed Power Flow (MVA)	% Loading	
	928S - P1879 Tap Point)							
370ST1 (Transformer T1 at North Lethbridge 370S)	725L (Bowron 674S - 725BL Tap Point)	91	100	33.75	37.05	108.23	118.84	81.79
463L (Fort Macleod 15S - Monarch 492S/Chinook 181S)		91	100	40.26	44.19	120.27	132.07	87.88
172L (Chinook 181S - North Lethbridge 370S)		91	100	35.01	38.43	113.27	124.38	85.95
1036L (Milo 356S - Travers 554S)	172L (Taber 83S - 172EL Tap Point)	119	131	113.06	95.01	129.33	108.65	13.64

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 4: 2020 SP Post-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 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)	Thermal Ratings (MVA)		Pre-Project Results		Post-Project Results		% Loading Difference (Post-Pre)
		Normal Rating (MVA)	Emergency Rating (MVA)	Observed Power Flow (MVA)	% Loading	Observed Power Flow (MVA)	% Loading	
618ST1 (Transformer T1 at	820L (Stirling Wind Project Tap Point -	120	132	126.69	105.58	125.80	104.84	-0.74

Contingency (System Element Lost)	Details of Violation (Violation Observed On)	Thermal Ratings (MVA)		Pre-Project Results		Post-Project Results		% Loading Difference (Post-Pre)
		Normal Rating (MVA)	Emergency Rating (MVA)	Observed Power Flow (MVA)	% Loading	Observed Power Flow (MVA)	% Loading	
Riverbend 618S)	820AL Tap Point)							
	820L (Coaldale 254S - 820AL Tap Point)	120	132	130.70	108.93	129.83	108.20	-0.73
1036L (Milo 356S - Travers 554S)	172L (Taber 83S - 172EL Tap Point)	119	131	129.50	108.79	145.75	122.44	13.65
1005L (Picture Butte 120S - Milo 356S)	172L (Taber 83S - 172EL Tap Point)	119	131	116.99	98.31	132.94	111.68	13.37
	1036L (Milo 356S - Travers 554S)	481	581	449.30	93.41	484.35	100.70	7.29
161L (Vulcan 255S - Queenstown 504S)	463L (Fort Macleod 15S - 463AL Tap Point)	85	94	24.62	28.96	86.10	101.19	72.23
725L (Bowron 674S - Coalbanks 111S/Riverbend 618S)	172L (Chinook 181S - North Lethbridge 370S)	85	94	61.84	72.92	88.07	103.80	30.88
	463L (Fort Macleod 15S - 463AL Tap Point)	85	94	43.61	51.30	96.66	113.59	62.29
	463L (Chinook 181S - 463AL Tap Point)	85	94	49.63	58.53	90.65	106.83	48.30
674ST1 (Transformer T1 in Bowron 674S)	172L (Chinook 181S - North Lethbridge 370S)	85	94	47.48	55.99	100.23	118.13	62.14
	463L (Fort Macleod 15S - 463AL Tap Point)	85	94	39.40	46.35	112.44	132.14	85.79
	463L (Chinook 181S - 463AL Tap Point)	85	94	39.67	46.78	105.14	123.91	77.13
255ST1 (Transformer T1 in Vulcan 255S)	463L (Fort Macleod 15S - 463AL Tap Point)	85	94	26.34	30.99	91.61	107.66	76.67
	725L (Bowron 674S - 725BL Tap Point)	91	100	38.22	42.00	93.00	102.12	60.12
	180L (Fort Macleod 15S - P1879 Tap Point)	112	124	-	-	115.92	103.50	-
15ST1 (Transformer T1 in	180L (Vulcan 255S - East Stavely	112	124	9.35	8.35	116.40	104.34	95.99

Contingency (System Element Lost)	Details of Violation (Violation Observed On)	Thermal Ratings (MVA)		Pre-Project Results		Post-Project Results		% Loading Difference (Post-Pre)
		Normal Rating (MVA)	Emergency Rating (MVA)	Observed Power Flow (MVA)	% Loading	Observed Power Flow (MVA)	% Loading	
Fort Macleod 15S)	928S)							
	180L (East Stavely 928S - P1879 Tap Point)	112	124	-	-	125.99	112.49	-
370ST1 (Transformer T1 at North Lethbridge 370S)	725L (Bowron 674S - 725BL Tap Point)	91	100	47.13	51.73	97.86	107.46	55.73
463L (Fort Macleod 15S - Monarch 492S/Chinook 181S)		91	100	40.00	43.91	112.38	123.41	79.50
172L (Chinook 181S - North Lethbridge 370S)		91	100	46.79	51.36	99.75	109.54	58.18
1037L (Foothills 237S - Windy Flats 183S)	172L (Taber 83S - 172EL Tap Point)	119	131	109.22	91.02	122.42	102.85	11.83
1038L (Foothills 237S - Windy Flats 183S)		119	131	109.25	91.04	122.45	102.87	11.83

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 3 - 2020 Summer Light post-Project and Scenario 4 - 2020 Summer Peak 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 3-3 and Table 3-4. 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 3-3: Transient Stability Study Results under Category B Conditions for Scenario 3

Studied Contingency (System Element Lost)	Fault Description and Location	Results
180L (Fort Macleod 15S to Vulcan 255S/East Stavely 928S)	3-phase fault at Fort Macleod 15S	Stable
	3-phase fault at Vulcan 255S	Stable
463L (Fort Macleod 15S to Chinook 181S/Monarch 492S)	3-phase fault at Fort Macleod 15S	Stable
	3-phase fault at Chinook 181S	Stable
725L (Fort Macleod 15S to Bowron 674S/Macbride Lake 240S)	3-phase fault at Fort Macleod 15S	Stable
	3-phase fault at Bowron 674S	Stable
1041L (Travers 554S to North Lethbridge 370S)	3-phase fault at Travers 554S	Stable
	3-phase fault at North Lethbridge 370S	Stable

Table 3-4: Transient Stability Study Results under Category B Conditions for Scenario 4

Studied Contingency (System Element Lost)	Fault Description and Location	Results
180L (Fort Macleod 15S to Vulcan 255S/East Stavely 928S)	3-phase fault at Fort Macleod 15S	Stable
	3-phase fault at Vulcan 255S	Stable
463L (Fort Macleod 15S to Chinook 181S/Monarch 492S)	3-phase fault at Fort Macleod 15S	Stable
	3-phase fault at Chinook 181S	Stable
725L (Fort Macleod 15S to Bowron 674S/Macbride Lake 240S)	3-phase fault at Fort Macleod 15S	Stable
	3-phase fault at Bowron 674S	Stable
1041L (Travers 554S to North Lethbridge 370S)	3-phase fault at Travers 554S	Stable
	3-phase fault at North Lethbridge 370S	Stable

4 Short Circuit Studies

4.1 Pre-Project Results

4.1.1 Scenario 2: 2020 SP 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 2

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)
North Lethbridge 370S	138.00	141.3	12.689	0.0084883+0.0356623j	9.669	0.01578+0.0694094j
East Stavely 928S	138.00	138.1	2.975	0.0575491+0.1418752j	2.22	0.0906726+0.2964684j
Vulcan 256S	138.00	137.8	2.573	0.0699715+0.1642546j	1.89	0.1061614+0.3580634j
Fort Macleod 15S	138.00	139.1	5.64	0.02643+0.0759094j	3.635	0.0536155+0.2069535j

4.2 Post-Project Results

4.2.1 Scenario 4: 2020 SP Post-Project

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

Table 4-2: Post-Project Short-Circuit Current Levels for Scenario 4

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)
North Lethbridge 370S	138.00	141.3	12.635	0.0085335+0.035655j	9.791	0.0151488+0.0670849j
East Stavely 928S	138.00	139.9	3.037	0.0578627+0.1418585j	2.704	0.0474502+0.2061099j
Vulcan 256S	138.00	138.6	2.607	0.0701892+0.1642855j	2.053	0.0861232+0.3134668j
Fort Macleod 15S	138.00	139.7	5.685	0.0264991+0.0759477j	4.166	0.0371193+0.1649245j
Granum Facility 604S	138.00	141.2	3.552	0.0485293+0.1222133j	3.592	0.0177993+0.1285148j

[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.

4.2.2 Scenario 5: 2028 SP Post-Project

Post-Project short-circuit current levels for Scenario 5 are provided in Table 4-3.

Table 4-3: Post-Project Short-Circuit Current Levels for Scenario 5

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)
North Lethbridge 370S	138.00	138.8	12.799	0.0069658+0.0322251j	11.682	0.0049572+0.042403j
East Stavely 928S	138.00	140.9	3.523	0.0459052+0.1125833j	3.103	0.0399427+0.1675175j
Vulcan 256S	138.00	141.0	2.711	0.0631113+0.1451686j	2.074	0.0828884+0.2944973j
Fort Macleod 15S	138.00	139.2	5.268	0.0274895+0.075457j	4.199	0.0312723+0.1389161j
Granum Facility 604S	138.00	141.5	3.469	0.0462821+0.1149679j	3.466	0.0175917+0.1256516j

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.

5.1 Pre-Project

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

Table 5-1: Pre-Project Mitigation Measures

Mitigation Measure	Details of Reliability Criteria Violation	Contingency (System Element Lost)
Real Time Operational Practices	172L (Taber 83S - 172EL Tap Point)	1036L (Travers 554S - Milo 356S)
	820L (Stirling Wind Project Tap Point - 820AL Tap Point)	618ST1 (Transformer T1 at Riverbend 618S)
	820L (Coaldale 254S - 820AL Tap Point)	

5.1 Post-Project

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

Table 5-2: Post-Project Mitigation Measures

Mitigation Measure	Details of Reliability Criteria Violation	Contingency (System Element Lost)
Modify Planned RAS 172L[a]	172L (Taber 83S - 172EL Tap Point)	1036L (Milo 356S - Travers 554S)
	172L (Taber 83S - 172EL Tap Point)	1005L (Picture Butte 120S - Milo 356S)
	1036L (Milo 356S - Travers 554S)	
New RAS 463L[b]	463L (Fort Macleod 15S - 463AL Tap Point)	161L (Vulcan 255S - Queenstown 504S)
	180L (Fort Macleod 15S - P1879 Tap Point)	
	172L (Chinook 181S - North Lethbridge 370S)	
	725L (Bowron 674S - 725BL Tap Point)	
	463L (Chinook 181S - 463AL Tap Point)	
	172L (Chinook 181S - North Lethbridge 370S)	725L (Bowron 674S - Coalbanks 111S/Riverbend 618S)
	463L (Fort Macleod 15S - 463AL Tap Point)	
	463L (Chinook 181S - 463AL Tap Point)	
	172L (Chinook 181S - North Lethbridge 370S)	674ST1 (Transformer T1 in Bowron 674S)

	463L (Fort Macleod 15S - 463AL Tap Point)	
	463L (Chinook 181S - 463AL Tap Point)	
	463L (Fort Macleod 15S - 463AL Tap Point)	255ST1 (Transformer T1 in Vulcan 255S)
	463L (Chinook 181S - 463AL Tap Point)	
	725L (Bowron 674S - 725BL Tap Point)	
	180L (Fort Macleod 15S - P1879 Tap Point)	
	172L (Chinook 181S - North Lethbridge 370S)	
New RAS 180L	180L (Vulcan 255S - East Stavely 928S)	15ST1 (Transformer T1 in Fort Macleod 15S)
	180L (East Stavely 928S - P1879 Tap Point)	
New RAS 725L	725L (Bowron 674S - 725BL Tap Point)	370ST1 (Transformer T1 at North Lethbridge 370S)
		463L (Fort Macleod 15S - Monarch 492S/Chinook 181S)
		172L (Chinook 181S - North Lethbridge 370S)
Real Time Operational Practices	172L (Taber 83S - 172EL Tap Point)	1037L (Foothills 237S - Windy Flats 183S)
		1038L (Foothills 237S - Windy Flats 183S)
	820L (Stirling Wind Project Tap Point - 820AL Tap Point)	618ST1 (Transformer T1 at Riverbend 618S)
	820L (Coaldale 254S - 820AL Tap Point)	

Notes:

[a] "Modify" refers to adding the Project to the logic of the planned RAS 172L.

[b] "New" refers to adding the new RASs for the project.

5.2 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.

- Modify Planned RAS 172L: Trip P1719 Stirling Wind Project and P1879 Claresholm Solar Project
- New RAS 463L: Trip P1879 Claresholm Solar Project
- New RAS 180L: Trip P1879 Claresholm Solar Project
- New RAS 725L: Trip P1879 Claresholm Solar Project

The post-mitigation measures studies were performed under Category B conditions for Scenario #3 and #4 using Alternative 3 and the RASs described in Section 5.1.

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 real-time operational practices or TFO capital maintenance projects were not studied.

5.1.1 Scenario #3: 2020 SL/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 5-3.

Table 5-3: 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
618ST1 (Transformer T1 at Riverbend 618S)	820L (Stirling Wind Project Tap Point - 820AL Tap Point)	120	132	122.30	101.91	Real Time Operational Practices	
	820L (Coaldale 254S - 820AL Tap Point)	120	132	130.84	109.04		
161L (Vulcan 255S - Queenstown 504S)	463L (Fort Macleod 15S - 463AL Tap Point)	85	94	96.97	113.96	28.67	33.73
	180L (Fort Macleod 15S - P1879 Tap Point)	112	124	115.97	103.54	10.32	9.21
	172L (Chinook 181S - North Lethbridge 370S)	85	94	88.55	104.36	21.38	25.15
	725L (Bowron 674S - 725BL Tap Point)	91	100	93.87	103.08	37.52	41.23
	463L (Chinook 181S - 463AL Tap Point)	85	94	92.95	109.55	24.57	28.91
725L (Bowron 674S - Coalbanks 111S/Riverbend 618S)	463L (Fort Macleod 15S - 463AL Tap Point)	85	94	113.38	133.24	30.85	36.29
	463L (Chinook 181S - 463AL Tap Point)	85	94	109.31	128.82	26.72	31.44
	172L (Chinook 181S - North Lethbridge 370S)	85	94	105.32	124.13	26.27	30.90
674ST1 (Transformer T1 in Bowron 674S)	463L (Fort Macleod 15S - 463AL Tap Point)	85	94	121.28	142.54	37.14	43.69
	463L (Chinook 181S - 463AL Tap Point)	85	94	117.23	138.16	32.98	38.80
	172L (Chinook 181S - North Lethbridge 370S)	85	94	113.18	133.39	31.19	36.69

255ST1 (Transformer T1 in Vulcan 255S)	463L (Fort Macleod 15S - 463AL Tap Point)	85	94	99.67	117.13	31.38	36.92
	463L (Chinook 181S - 463AL Tap Point)	85	94	95.64	112.72	27.29	32.11
	725L (Bowron 674S - 725BL Tap Point)	91	100	96.16	105.59	39.78	43.71
	180L (Fort Macleod 15S - P1879 Tap Point)	112	124	120.70	107.77	5.71	5.10
	172L (Chinook 181S - North Lethbridge 370S)	85	94	91.27	107.57	23.99	28.22
15ST1 (Transformer T1 in Fort Macleod 15S)	180L (Vulcan 255S - East Stavely 928S)	112	124	121.79	108.74	6.38	5.32
	180L (East Stavely 928S - P1879 Tap Point)	112	124	125.43	111.99	2.52	2.10
370ST1 (Transformer T1 at North Lethbridge 370S)	725L (Bowron 674S - 725BL Tap Point)	91	100	108.23	118.84	31.67	34.80
463L (Fort Macleod 15S - Monarch 492S/Chinook 181S)		91	100	120.27	132.07	38.01	41.77
172L (Chinook 181S - North Lethbridge 370S)		91	100	113.27	124.38	32.84	36.09
1036L (Milo 356S - Travers 554S)	172L (Taber 83S - 172EL Tap Point)	119	131	129.33	108.65	Real Time Operational Practices	

5.1.2 Scenario #4: 2020 SP/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 5-4.

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

Contingency (System Element Lost)	Details of Violation (Violation	Seasonal Continuous Rating	Short-term (Emergency) Rating (MVA)	Post-Project Results	Post-RAS Action Results

	Observed On)	(MVA)		Power Flow (MVA)	% Loading	Power Flow (MVA)	% Loading
618ST1 (Transformer T1 at Riverbend 618S)	820L (Stirling Wind Project Tap Point - 820AL Tap Point)	120	132	125.80	104.84	Real Time Operational Practices	
	820L (Coaldale 254S - 820AL Tap Point)	120	132	129.83	108.20		
1036L (Milo 356S - Travers 554S)	172L (Taber 83S - 172EL Tap Point	119	131	145.75	122.44	112.46	94.50
1005L (Picture Butte 120S - Milo 356S)	172L (Taber 83S - 172EL Tap Point)	119	131	132.94	111.68	100.44	84.40
	1036L (Milo 356S - Travers 554S)	481	577	484.35	100.70	432.90	90.00
161L (Vulcan 255S - Queenstown 504S)	463L (Fort Macleod 15S - 463AL Tap Point)	85	94	86.10	101.19	Real Time Operational Practices	
725L (Bowron 674S - Coalbanks 111S/Riverbend 618S)	172L (Chinook 181S - North Lethbridge 370S)	85	94	88.07	103.80	61.84	72.75
	463L (Fort Macleod 15S - 463AL Tap Point)	85	94	96.66	113.59	42.66	50.19
	463L (Chinook 181S - 463AL Tap Point)	85	94	90.65	106.83	49.26	57.95
674ST1 (Transformer T1 in Bowron 674S)	172L (Chinook 181S - North Lethbridge 370S)	85	94	100.23	118.13	46.70	54.94
	463L (Fort Macleod 15S - 463AL Tap Point)	85	94	112.44	132.14	37.49	44.10
	463L (Chinook 181S - 463AL Tap Point)	85	94	105.14	123.91	38.30	45.06
255ST1 (Transformer T1 in Vulcan 255S)	463L (Fort Macleod 15S - 463AL Tap Point)	85	94	91.61	107.66	Real Time Operational Practices	
	725L (Bowron 674S - 725BL Tap Point)	91	100	93.00	102.12		
	180L (Fort Macleod 15S - P1879 Tap Point)	112	124	115.92	103.50		
15ST1 (Transformer T1 in Fort Macleod 15S)	180L (Vulcan 255S - East Stavely 928S)	112	124	116.40	104.34	9.84	8.79
	180L (East Stavely 928S - P1879 Tap Point)	112	124	125.99	112.49	2.24	2.00

370ST1 (Transformer T1 at North Lethbridge 370S)	725L (Bowron 674S - 725BL Tap Point)	91	100	97.86	107.46	Real Time Operational Practices	
463L (Fort Macleod 15S - Monarch 492S/Chinook 181S)		91	100	112.38	123.41	38.04	41.80
172L (Chinook 181S - North Lethbridge 370S)		91	100	99.75	109.54	Real Time Operational Practices	
1037L (Foothills 237S - Windy Flats 183S)	172L (Taber 83S - 172EL Tap Point)	119	131	122.42	102.85	Real Time Operational Practices	
1038L (Foothills 237S - Windy Flats 183S)		119	131	122.45	102.87		

5.2 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 A7.

Attachment A1
Engineering Connection Assessment: Study Scope

Engineering Connection Assessment: Study Scope

Claresholm Solar Project Connection

Claresholm Solar Inc.

AESO Project Number: P1879

Date: May 13, 2019

Version: Final

Classification: Public

Company Name	Name and Credentials	Date	Signature
CF Power Ltd. (Study Consultant)	Feng Chen, P.Eng.	May 23, 2019	
AESO	Siavash Zoroofi, P.Eng.	May 23, 2019	
Claresholm Solar Inc. (Market Participant)	Philip Andres	May 22, 2019	

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1 Introduction

This Study Scope provides an overview of the engineering studies to be completed by CF Power 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

Claresholm Solar Inc. (Market Participant) has submitted a request for system access service to the Alberta Electric System Operator (AESO) to connect its approved Claresholm Solar Project to the AIES. The Claresholm Solar Project consists of two separately metered solar generation facilities, Claresholm Solar Project A, and Claresholm Solar Project B, and an approved collector substation, designated as the Granum 604S substation (collectively, the Facilities).

The Facilities are solar aggregated generating facilities. The Facilities are located in the Claresholm area, in the AESO planning area of Stavely (Area 49).

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 56.875 MW and a Rate DTS, *Demand Transmission Service*, contract capacity of 0.245 MW for the Claresholm Solar Project A; a request for a new system access service in the area, with a Rate STS capacity of 73.125 MW and a Rate DTS contract capacity of 0.315 MW for the Claresholm Solar Project B; and a request for transmission development (collectively, the Project).

The Project in-service date (ISD) used for the purpose of the studies is June 30, 2020.

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	0.245 MW for the Claresholm Solar Project A; 0.315 MW for the Claresholm Solar Project B (Total 0.56 MW)
	Type	Substation service and auxiliary load
	Motors (number and size)	Parasitic Load: Inverters (preliminary: SMA SC 2750-EV-US (48) , MV transformers, HV single transformer, P&C
	Power factor	0.9 pf
	Future load expansion plans	No
Generation *	Generation type	Solar PV

Project Component		Description
	Existing Rate STS, *Supply Transmission Service,* contract capacity	0 MW
	Requested Rate STS	56.875 MW for the Claresholm Solar Project A; 73.125 MW for the Claresholm Solar Project B (Total 130 MW)
	Number and size of generating units	to be finalized
	Maximum authorized real power (MARP)	57.75 MW for the Claresholm Solar Project A; 74.25 MW for the Claresholm Solar Project B (Total 132 MW)
	Maximum capability (MC)	57.75 MW for the Claresholm Solar Project A 74.25 MW for the Claresholm Solar Project B (Total 132 MW)
	Reactive power capability	42.7 MVAr (0.95 pf absorbing)
		59.6 MVAr (0.9 pf producing)
	Future generation expansion plans	No

Notes:

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

* It is assumed that the aggregated generating facilities have the minimum continuous reactive power capability of either supplying reactive power at 0.9 power factor (PF) lagging or absorbing reactive power at 0.95 PF leading, per the technical requirements of Section 502.1 of the ISO rules, *Wind Aggregated Generating Facilities Technical Requirements*.

1.2 Existing System Overview

1.2.1 Study Area

Geographically, the Project is located in the AESO planning area of Stavely (Area 49), which is part of AESO south planning region.

The Study Area for the Project consists of the AESO planning areas of Fort Macleod (Area 53), Lethbridge (Area 54), and Stavely (Area 49), including the tie lines connecting these planning areas to the rest of the AIES.

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

1.2.2 Existing Constraints

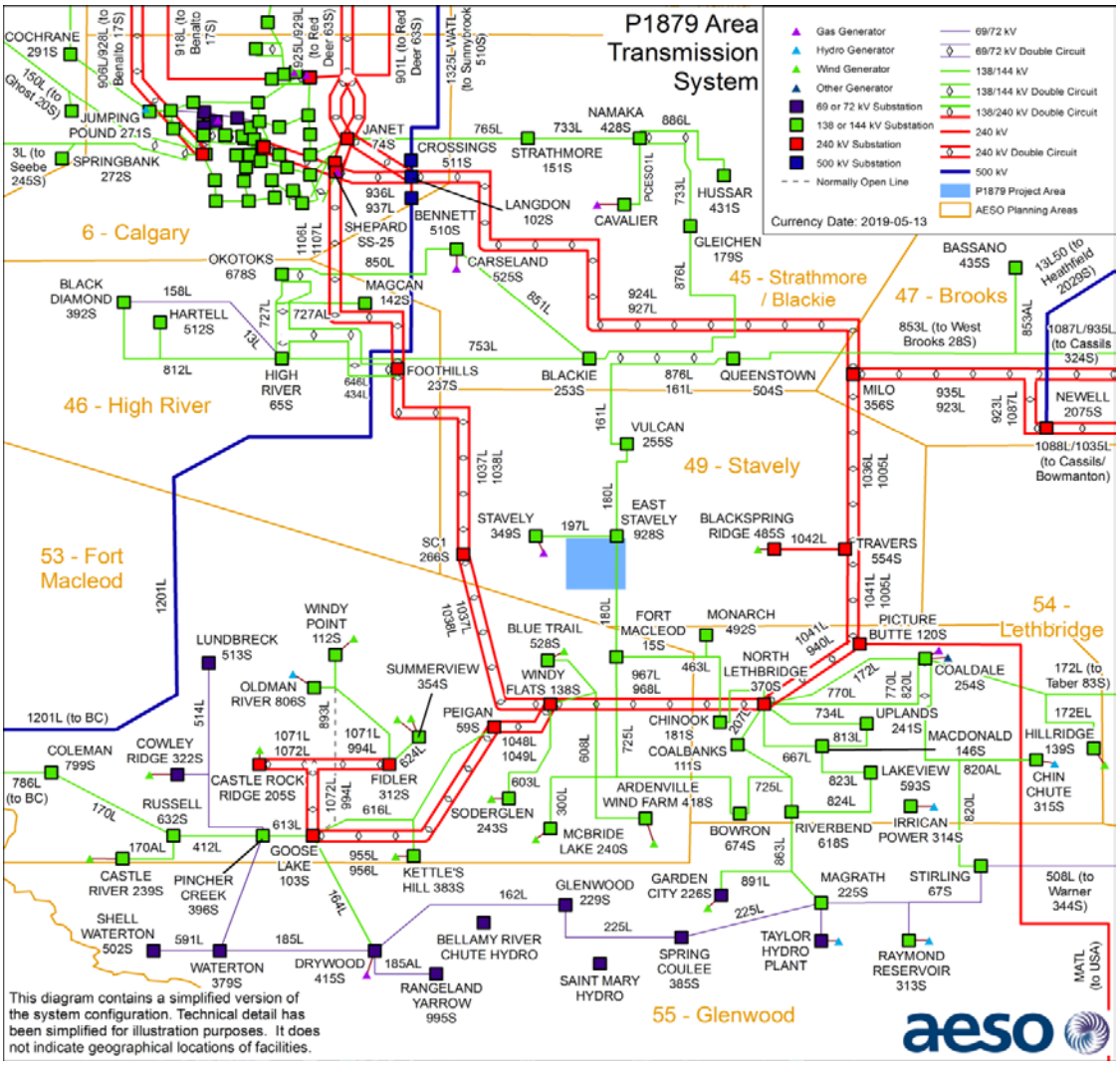
Existing constraints in the Study Area are managed in accordance with the procedures set out in Section 302.1 of the ISO rules, *Real Time Transmission Constraint Management* (TCM Rule).

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 schems are used to manage constraints in the area:

- RAS 37: Peigan 59S - 616L Overload Mitigation Scheme
- RAS 40: Coleman 799S - 786L Overload Mitigation Scheme
- RAS 129: Goose Lake 103S 613L Overload Mitigation Scheme
- RAS 136: Direct Transfer Trip to MATL on Loss of 1201L
- RAS 36: Garden City 226S WAGF Trip Scheme
- RAS 136: Direct Transfer Trip to MATL on Loss of 1201L
- RAS 137: MATL Local Detection Sceme
- RAS 604: Windy Point/Oldman River Tripping Scheme
- RAS 605: Summerview Tripping Scheme

Figure 1-1: Existing Transmission System in the Study Area



2 Connection Alternative(s) to be Studied

The following alternative(s) will be studied.

2.1 Alternative 3: T-tap connection to the 138 kV line 180L

This alternative includes the following developments:

- Add one 138 kV circuit, approximately 100 meters in length[1], to connect the Market Participant's approved Granum 604S substation to the existing 138 kV transmission line 180L (between East Stavely 928S and Fort Macleod 15S substations) in a T-tap connection configuration; and
- Add or modify associated equipment as required for the above transmission developments.

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

[1] Exact line length is to be determined by the TFO.

Figure 2-1: Proposed connection alternative

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 events. 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.*
- 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 AESO's *Connection Study Requirements*, the AESO's *Generation and Load Interconnection Standard*, Section 502.5 of the ISO rules, *Generating Unit Technical Requirements*, and Section 502.6 of the ISO rules, *Generating Unit Operating Requirements*.

3.3 Aggregated Generating Facilities Requirements

The Facilities should meet the technical requirements presented in Section 502.1 of the ISO rules, *Aggregated Generating Facilities Technical 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	2020 SL	High wind (HW), zero import (ZI)	2020 SL Pre-Project	0	0
2	2020 SP	HW, high import (HI)	2020 SP Pre-Project	0	0
Post-Project					
3	2020 SL	HW, ZI	2020 SL Post-Project	0.56	130
4	2020 SP	HW, HI	2020 SP Post-Project	0.56	130
5	2028 SP	All generation in the Study Area on	2028 SP Post-Project	0.56	130

4.2 Assumptions

4.2.1 System Project Assumptions

The pre-Project and post-Project connection assessment will not include any system transmission projects because there are no planned system transmission developments in the Study Area that are expected to be in service before the scheduled Project ISD.

4.2.2 Connection Project Assumptions

Table 4-2 summarizes the connection projects in the Study Area that will be included in the studies in addition to those listed in Table 4-6.

Table 4-2: Planned Connection Projects Included in the Studies

AESO Project No.	AESO Project Name	AESO Planning Area No.	Generation (MW)	Load (MW)	Scheduled ISD	AUC NID Approval No.
1907	FortisAlberta Vulcan-Stavely Area Capacity and Reliability	49	0.0	3.5	November 1, 2019	23388-D02-2018

4.2.3 Load Assumptions

The load forecast to be used for the studies is shown in Table 4-3 and is a forecast for the AESO South Planning Region peak based on the *AESO 2017 Long-term Outlook* (2017 LTO)[2]. For the post-Project studies, when the Study Area loads are modified to align with the regional load forecast in the 2017 LTO, the active power to reactive power ratio in the base case scenarios shall be maintained.

Table 4-3: Forecast Area Peak Load (2017 LTO at AESO South Planning Region Peak)

AESO Planning Region Name	Forecast Peak Load by Year/Season (MW)	
	2020 SP	2020 SL
South Planning Region[1]	1,397	839

Note:
[1] The South Region comprises the following AESO planning areas: Medicine Hat (Area 4), Sheerness (Area 43) ,Seebe (Area 44) ,Strathmore/Blackie (Area 45) ,HighRiver (Area 46) ,Brooks (Area 47), Empress (Area 48), Stavely (Area 49), Vauxhaul (Area 52), Fort Macleod (Area 53) ,Lethbridge (Area 54), and Glenwood (Area 55)

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 2017 LTO. The generation assumptions for the studies will assume high wind dispatch conditions. Additional studies may be required in the event of changes to the AESO's corporate forecast.

The existing generation dispatch conditions for the study scenarios are described in Table 4-4.

[2] The 2017 LTO is available on the AESO website.

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

Facility Name	Bus No.	MC (MW)	AESO Planning Area No.	Unit Net Generation[a] (MW) by Scenario	
				2020 SL	2020 SP
Irrican Hydro Facility	450	7	55	3.8	4.2
Lethbridge Coaldale	4690	6	54	0	4.6
Chin Chute Hydroelectric Facility	407	15	54	9.1	6
Taylor Hydro Facility	4670	13.7	55	10.7	11.5
Altagas Parkland	4235	10	49	0	1

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

Per the 2017 LTO, the total forecast wind and solar capacity in 2020 is 2,594 MW. Using this value, the wind and solar generation facilties 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 4-5.

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

Facility Name and Code	Bus No.	MC (MW)	AESO Planning Area No.	Unit Net Generation[a] (MW) by Scenario	
				2020 SL	2020 SP
AESO South Planning Region					
Ardenville Wind (ARD1)	4735, 4740	68	53	68	68
Blue Trail Wind (BTR1)	66328, 67328	66	53	66	66
Castle River #1 (CR1)	2234, 3234	39	53	39	39
Castle Rock Wind Farm (CRR1)	67221	77	53	77	77
Cowley Ridge (CRWD)	255, 265, 4264	20	53	20	20
Enmax Taber (TAB1)	15343, 16343	81	52	81	81
Kettles Hill (KHW1)	2402, 3402	63	53	63	63
McBride Lake Windfarm (AKE1)	2901, 3901, 4901	73	53	73	73
Soderglen Wind (GWW1)	12358, 13358	71	53	71	71

Facility Name and Code	Bus No.	MC (MW)	AESO Planning Area No.	Unit Net Generation[a] (MW) by Scenario	
				2020 SL	2020 SP
Summerview 1 (IEW1)	2338, 3338	66	53	66	66
Summerview 2 (IEW2)	4339, 5337	66	53	66	66
Suncor Chin Chute (SCR3)	2389	30	54	30	30
Suncor Magrath (SCR2)	11002	30	53	30	30
Suncor Wintering Hills (SCR4)	60789, 60791, 60793, 60846, 60848, 60850	88	43	88	88
Old Man River (OWF1)	61543	46	53	46	46
Blackspring Ridge (BSR1)	61736, 61737	300	49	300	300
Brooks Solar (BSC1)	15	15	47	12	12
AESO South Planning Region Subtotal				1196	1196
AESO Central Planning Region					
Ghost Pine (NEP1)	2621 to 2625	82	42	39	39
Halkirk (HAL1)	66435, 67435	150	42	0	0
Fortis Bull Creek Phases 1 and 2 (BUL1 & BUL2)	550003,550004	29.5	37	0	0
AESO Central Planning Region Subtotal				39	39
Total				1235	1235

Note:

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

Table 4-6 lists 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 and Solar Generation Projects

Project Number	Project Name	Project Type	Planned ISD	Bus No.	MC (MW)	AESO Planning Area No.	Unit Net Generation Dispatch[a] (MW) by Scenario	
							2020 SL	2020SP
South Planning Region								
462	Enel Alberta Castle Rock Wind Farm (	Wind	01-Nov-19	67221,55 00061	30.6	53	30.6	30.6

Project Number	Project Name	Project Type	Planned ISD	Bus No.	MC (MW)	AESO Planning Area No.	Unit Net Generation Dispatch[a] (MW) by Scenario	
							2020 SL	2020SP
524	Enel Riverview Wind Farm	Wind	03-Jun-19	69221	115	53	115	115
1800	Capital Power Whitla	Wind	01-Sep-19	60990,61990	201.6	4	201.6	201.6
1892	Fortis Buffalo Atlee Cluster 3 WAGF	Wind	18-Mar-19	553260	17.3	47	17.25	17.25
1853	Fortis Buffalo Atlee Cluster 1 WAGF	Wind	01-Mar-19	552260	18.3	47	17.25	17.25
2199	Buffalo Atlee Wind Farm 2	Wind	30-Jun-21	652260	13.8	47	13.8	13.8
1719	Stirling WAGF Project	Wind	20-Dec-19	61630	113	54	113	113
2122	EDF Cypress Wind	Wind	01-Jun-21	962122	450	4	201.6	201.6
1533	Joss MPC WAGF	Wind	28-Jun-19	60798,60799	122	47	122.4	122.4
1698	Joss Jenner WAGF - Phase 2	Wind	01-May-19	61798,61799	180	47	71.4	71.4
2041	TransAlta Windrise MPC Wind	Wind	02-Nov-20	990001,990004	220	53	207	207
Subtotal (Southern Alberta)							1111	1111
Central Planning Region								
1567	EDPR Sharp Hills Wind Farm	Wind	01-May-19	60831,60832	300	42	248.4	248.4
Subtotal (Central Alberta)							248.4	248.4
Total Planned							**1359**	**1359**
Total Planned, Existing and Under Construction							**2594**	**2594**

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

The post-Project scenario wind and solar generation dispatch levels were identical to the pre-Project scenario dispatch levels shown in Table 4-5 and Table 4-6 , except that the existing Suncor Wintering Hills (SCR4) and existing Ghost Pine (NEP1) were switched off and Brooks Solar (BSC1) was dispatched to 9 MW. The Facilities were dispatched to 130 MW in all post-Project scenarios. This will result in a total wind and solar generation dispatch consistent with the 2017 LTO's 2020 forecast wind and solar capacity of 2594 MW for 2020.

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 4-7.

For the 2028 SP scenario, the intertie flow values should be set to the AESO planning base cases.

Table 4-7: Intertie Flows by Scenario

Scenario Number	Scenario Name	Import (-) / Export (+) by Intertie		
		AB-BC	AB-SK	MATL
1	2020 SL Pre-Project, Zero Import	0	0	0
2	2020 SP Pre-Project, High Import	-430	0	-300
3	2020 SL Post-Project, Zero Import	0	0	0
4	2020 SP Post-Project, High Import	-430	0	-300

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.

Table 4-8: HVDC Power Order by Scenario

Scenario Number	Scenario Name	WATL (MW)*	EATL (MW)*
1	2020 SL Pre-Project	250 *S → N*	575 *S → N*
2	2020 SP Pre-Project	375 *S → N*	900 *S → N*
3	2020 SL Post-Project	250 *S → N*	575 *S → N*
4	2020 SP Post-Project	375 *S → N*	900 *S → N*

Notes:
N → S: HVDC flow direction is North to South
S → N: HVDC flow direction is South to North

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
820L	Stirling 67S - 820L Tap - Coaldale 254S	138	120	148	132	163
820AL	Chin Chute 315S - 820L Tap	138	120	148	132	163
1041L	North Lethbridge 370S - Travers 554S	240	481	499	553	648
940L	North Lethbridge 370S - Picture Butte 120S	240	481	499	577	697
1036L	Travers 554S - Milo 356S	240	481	581	577	697
1005L	Picture Butte 120S - Milo 356S	240	481	581	577	697
863L	Magrath 225S - Riverbend 618S	138	120	148	132	162
725AL	Riverbend 618S - 725L	138	120	148	132	163
725L	Bowron 674S - 725AL tap	138	122	150	134	165
725L	Bowron 674S - 725BL tap	138	91	128	100	141
725L	725AL tap - Coalbanks 111S	138	116	146	128	161
172L	North Lethbridge 370S - Coaldale 254S	138	119	146	131	161

Line ID	Line Description	Voltage Class (kV)	Normal Rating (MVA)		Emergency Rating (MVA)	
			Summer	Winter	Summer	Winter
172L	Fort Macleod 15S - North Lethbridge 370S	138	85	90	94	99
172L	Coaldale 254S - Taber 83S	138	119	146	131	161
180L	East Stavely 926S - FortMacleod 15S	138	112	135	124	146
180L	Vulcan 255S - East Stavely 926S	138	112#	120	124	146
161L	Vulcan 255S - Queenstown 504S	138	117	120	129	160
463L	Fort MacLeod 15S - Chinook L181S	138	85	90	94	99
853L	Queenstown 504S - Westbrooks 28S	138	121	148	133	163

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)
North Lethbridge 370S	T3	240/138	193.6
	T5	240/138	200
	T6	240/138	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)
Hillridge 139S	138	1 x 1.8 MVAr	1.8	-	-
Windy Flats 138S	240	-	-	2x75 MVAr	150

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 (Cycles)		
Line ID	Nominal Bus Voltage (kV)	Terminal Location						
		Terminal 1	Terminal 2	Terminal 3		Terminal 1	Terminal 2	Terminal 3
180L	138	Fort Macleod 15S	Vulcan 255S	East Stavely 928S	Fort Macleod 15S	9	60	30
					Vulcan 255S	60	9	30
463L	138	Fort Macleod 15S	Chinook 181S	Monarch 492S	Fort Macleod 15S	9	60	30
					Chinook 181S	60	9	30
725L	138	Fort Macleod 15S	Bowron 674S	Macbride Lake 240S	Fort Macleod 15S	9	60	30
					Bowron 674S	60	9	30
1041L	240	Travers 554S	North Lethbridge 370S	n/a	Travers 554S	5	6	N/A
					North Lethbridge 370S	6	5	N/A

NOTE: N/A means not applicable

4.2.9 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		Transient Stability		Short Circuit*
		Category		Category		Category A
		A	B	A	B	
Pre-Project						
1	2020 SL	X	X			
2	2020 SP	X	X			X
Post-Project						
3	2020 SL	X	X	X	X	
4	2020 SP	X	X	X	X	X
5	2028 SP					X

Notes: *Only Category A with all generators in the study area on.

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 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.

5.2 Transient Stability Studies

The Keephills generating Unit 3 in the AESO planning area of Wabamun (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#3 Power Plant, Altagas Parkland, and Lethbridge Coaldale. The results report must also provide the 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 Facilities.

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 selected 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. Polar coordinates and per-unit values will be used for reporting the results.

Summer peak scenarios will be used for the short-circuit studies.

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

- North Lethbridge 370S substation
- East Stavley 928S substation
- Vulcan 256S substation
- Fort Macleod 15S substation
- Granum 604S 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[3] 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.

[3] 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 include the AESO's current corporate forecast (2017 LTO). Sensitivity studies or restudy may be required in the event of revisions to the AESO's corporate forecast. 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

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 these standards are given in: AESO. *Alberta Reliability Standards*. Available from http://www.aeso.ca/rulesprocedures/17004.html

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 or 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

Performance Level	Disturbance (1)(2)(3)(4) Initiated by: Fault or No fault DC Disturbance	MW Margin (P-V method) (5)(6)(7)	MVAr Margin (V-Q method) (6)(7)
			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. i.e.: 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	Near End	Far End
kV	Cycles	Cycles
500	4	5
240	5	6
144/138	6	8

with telecommunications		
144/138	6	30
without telecommunications		

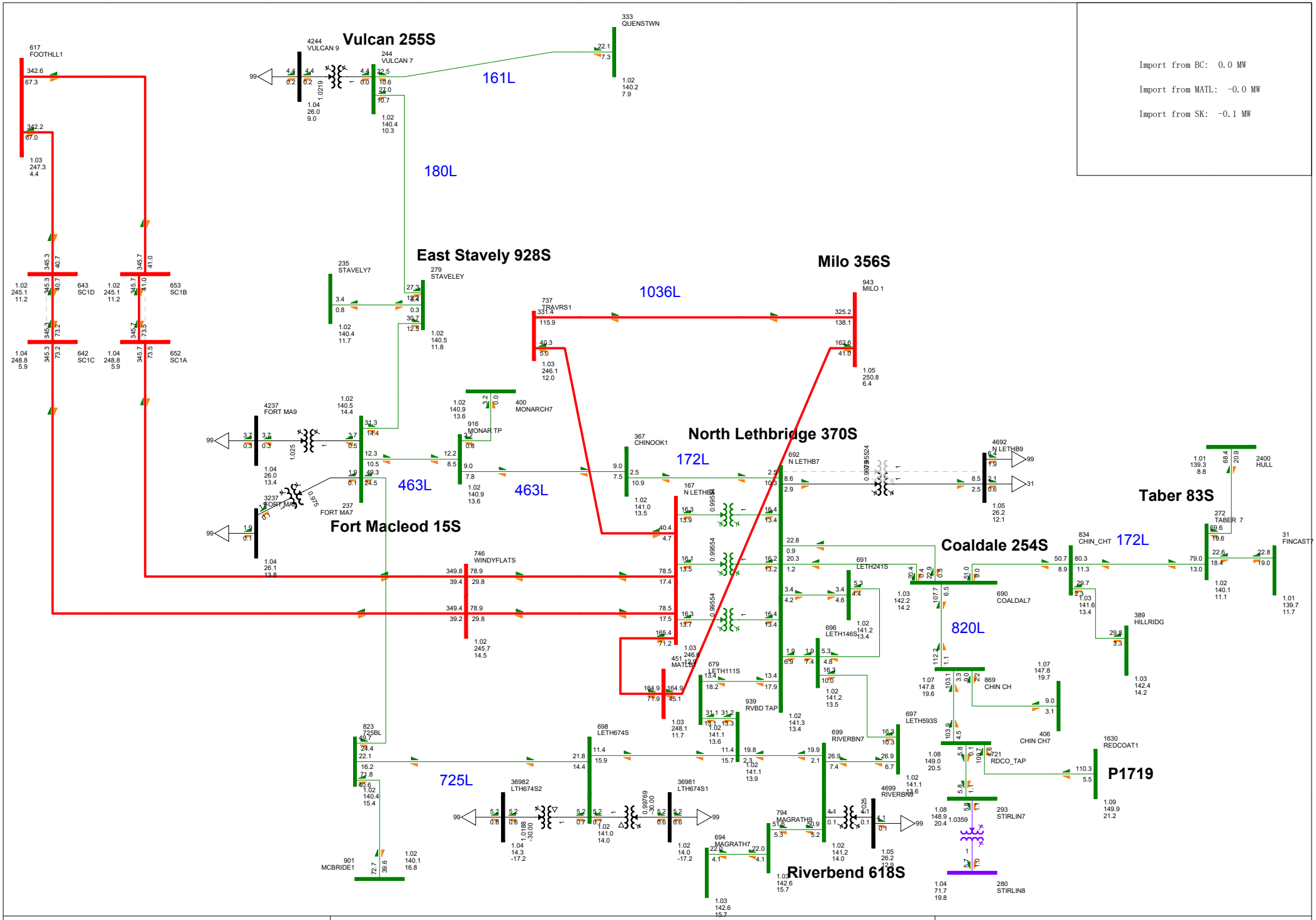
Table 2-4: Stuck Breaker Clearing Times for Lines

Fault Clearing Time			Fault Clearing Time			Fault Clearing Time		
138/144 kV			240 kV			500 kV		
Near End	Far End	2nd Ckt (for C5 and C7 Only)	Near End	Far End	2nd Ckt (for C5 and C7 Only)	Near End	Far End	2nd Ckt (for C5 and C7 Only)
15	24	24	12	6	14	9	5	11

Table 2-5: Stuck Breaker Clearing Times for Transformers

Fault Clearing Time (Cycles)						Fault Clearing Time (Cycles)					
240/138 kV						500/240 kV					
Fault on 240 kV Side			Fault on 138 kV Side			Fault on 500 kV Side			Fault on 240 kV Side		
240 kV Side	138 kV Side	2nd Ckt (for Breaker Fail)	138 kV Side	240 kV Side	2nd Ckt (for Breaker Fail)	500 kV Side	240 kV Side	2nd Ckt (for Breaker Fail)	240 kV Side	500 kV Side	2nd Ckt (for Breaker Fail)
12	6	14	15	5	24	9	5	11	12	4	14

Attachment A2
Pre-Project Power Flow Diagrams

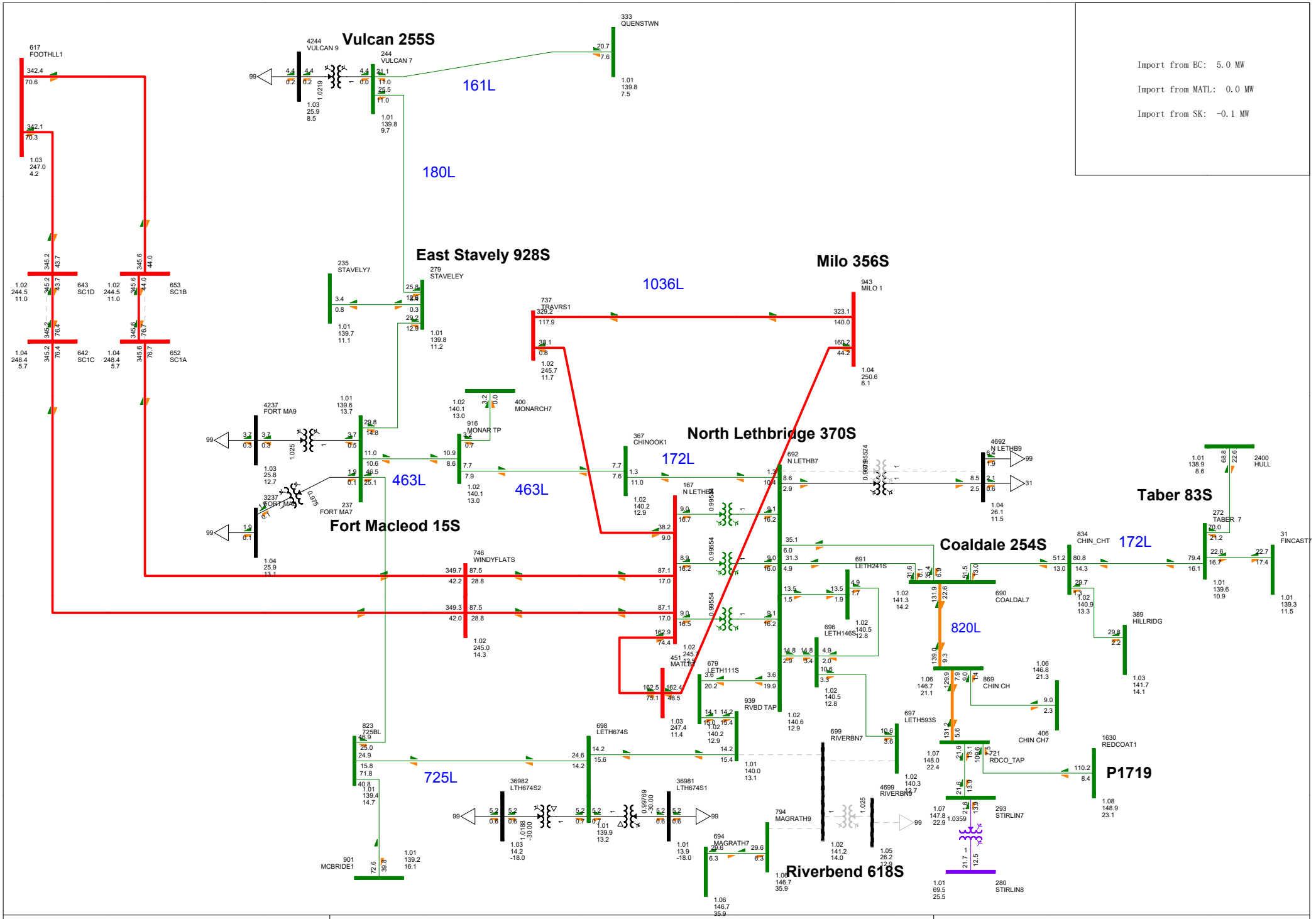


Claresholm Solar Project

AESO Project Number: P1879

FIGURE A-1-1: P1879_SL_PRE
CATEGORY A - NO CONTINGENCY
WED, APR 10 2019 13:12

Bus - Voltage (kV/pu)/Angle
Branch - MW/Mvar
Equipment - MW/Mvar
100.0%Rate A
1.100UV 0.900UV
kV: <=25.000 <=69.000 <=138.000 <=240.000 <=500.000 >500.000



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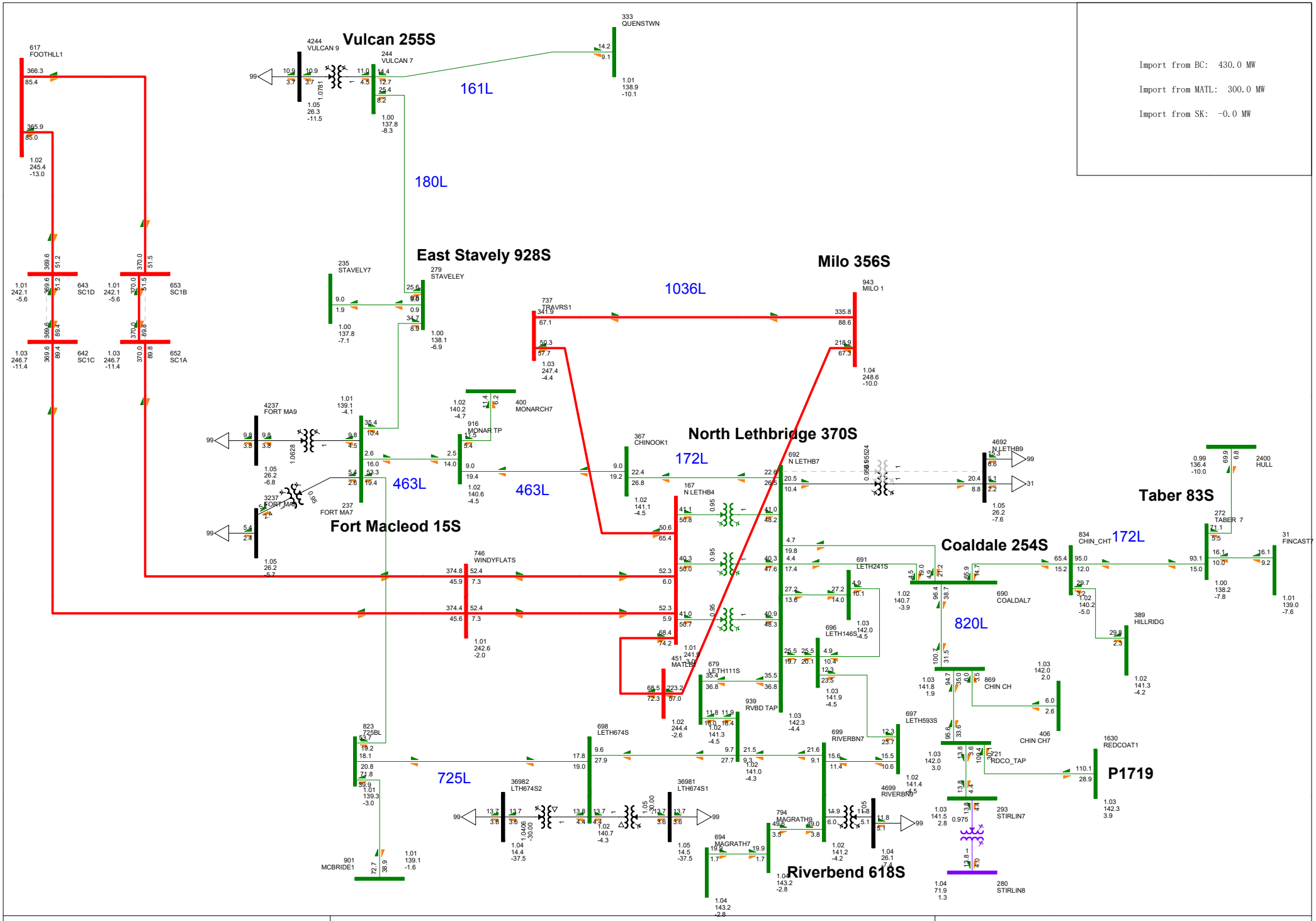
AESO Project Number: P1879

FIGURE B-1-1: P1879_SL_PRE
CATEGORY B - RIVERBEND TRANSFORMER T1
WED, APR 10 2019 13:13

Bus - Voltage (kV/pu)/Angle
Branch - MW/Mvar
Equipment - MW/Mvar
100.0%Rate A
1.100OV 0.900UV
kV: <=25.000 <=69.000 <=138.000 <=240.000 <=500.000 >500.000

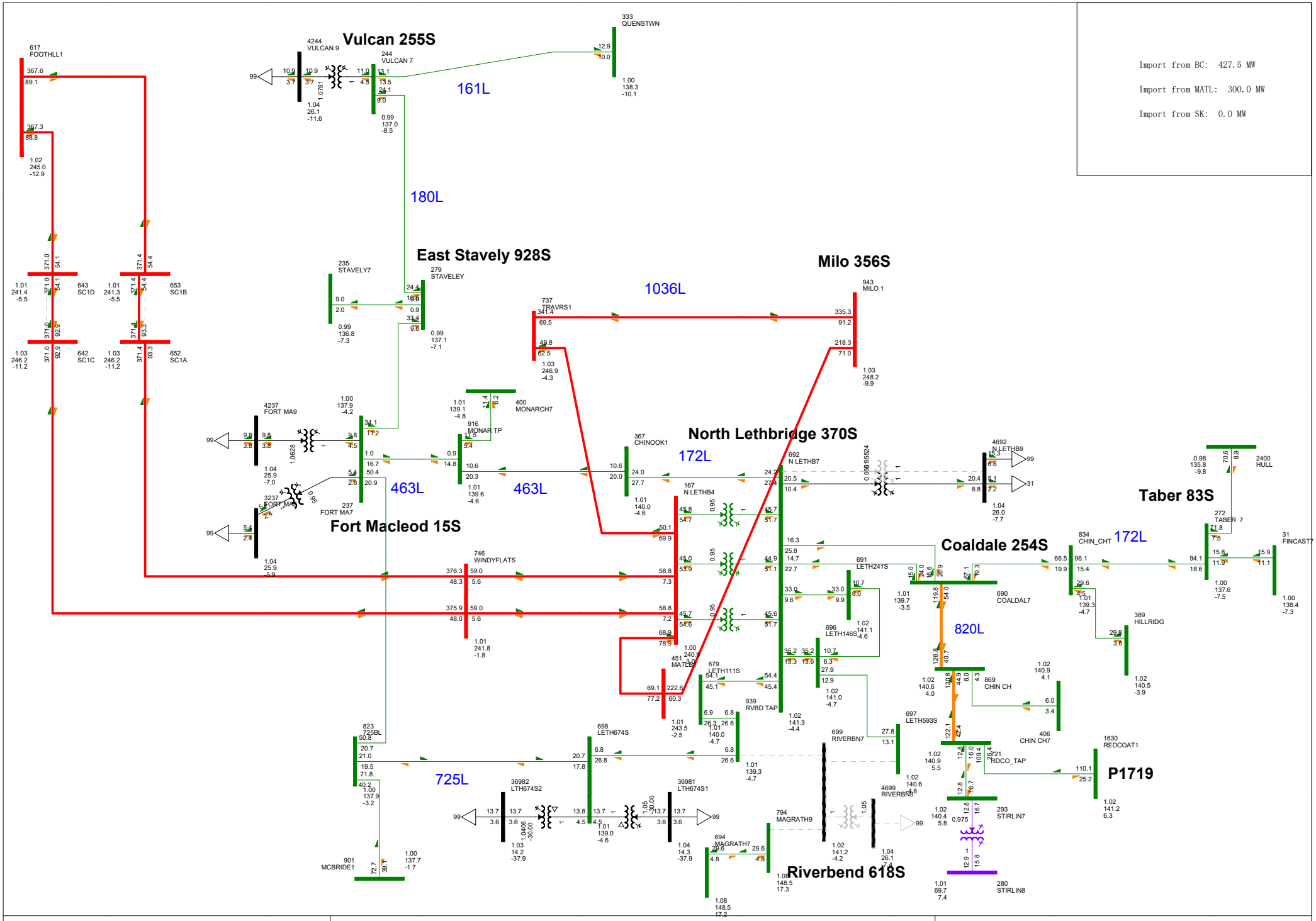


Claresholm Solar Project

AESO Project Number: P1879

FIGURE A-2-1: P1879_SP_PRE
CATEGORY A - NO CONTINGENCY
WED, APR 10 2019 13:13

Bus - Voltage (kV/pu)/Angle
Branch - MW/Mvar
Equipment - MW/Mvar
100.0%Rate A
1.100UV 0.900UV
kV: <=25.000 <=69.000 <=138.000 <=240.000 <=500.000 >500.000



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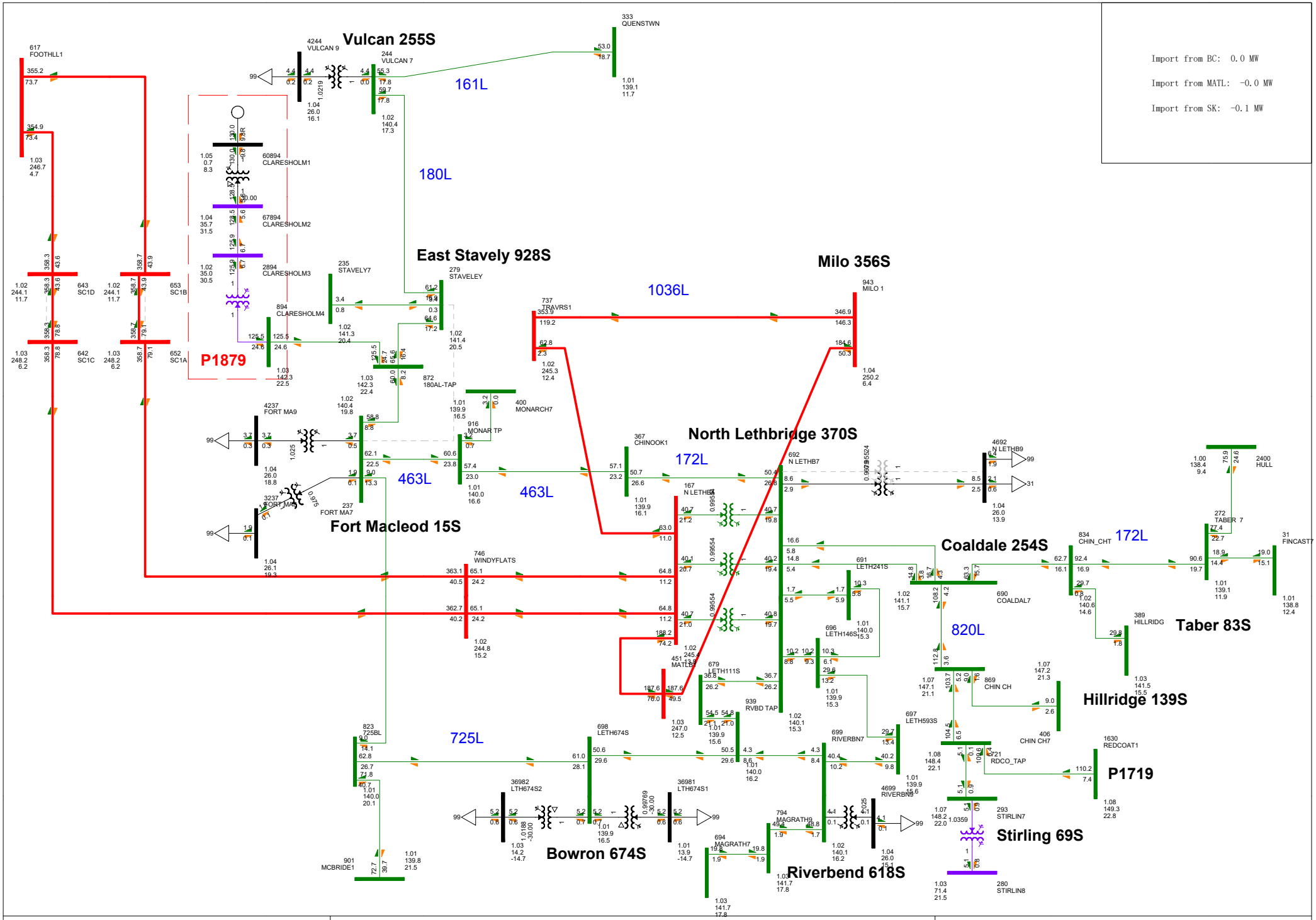
AESO Project Number: P1879

FIGURE B-2-1: P1879_SP_PRE
CATEGORY B - RIVERBEND TRANSFORMER T1
WED, APR 10 2019 13:14

Bus - Voltage (kV/pu)/Angle
Branch - MW/Mvar
Equipment - MW/Mvar
100.0%Rate A
1.100OV 0.900UV
kV: <=25.000 <=69.000 <=138.000 <=240.000 <=500.000 >500.000

Attachment A3
Post-Project Power Flow Diagrams

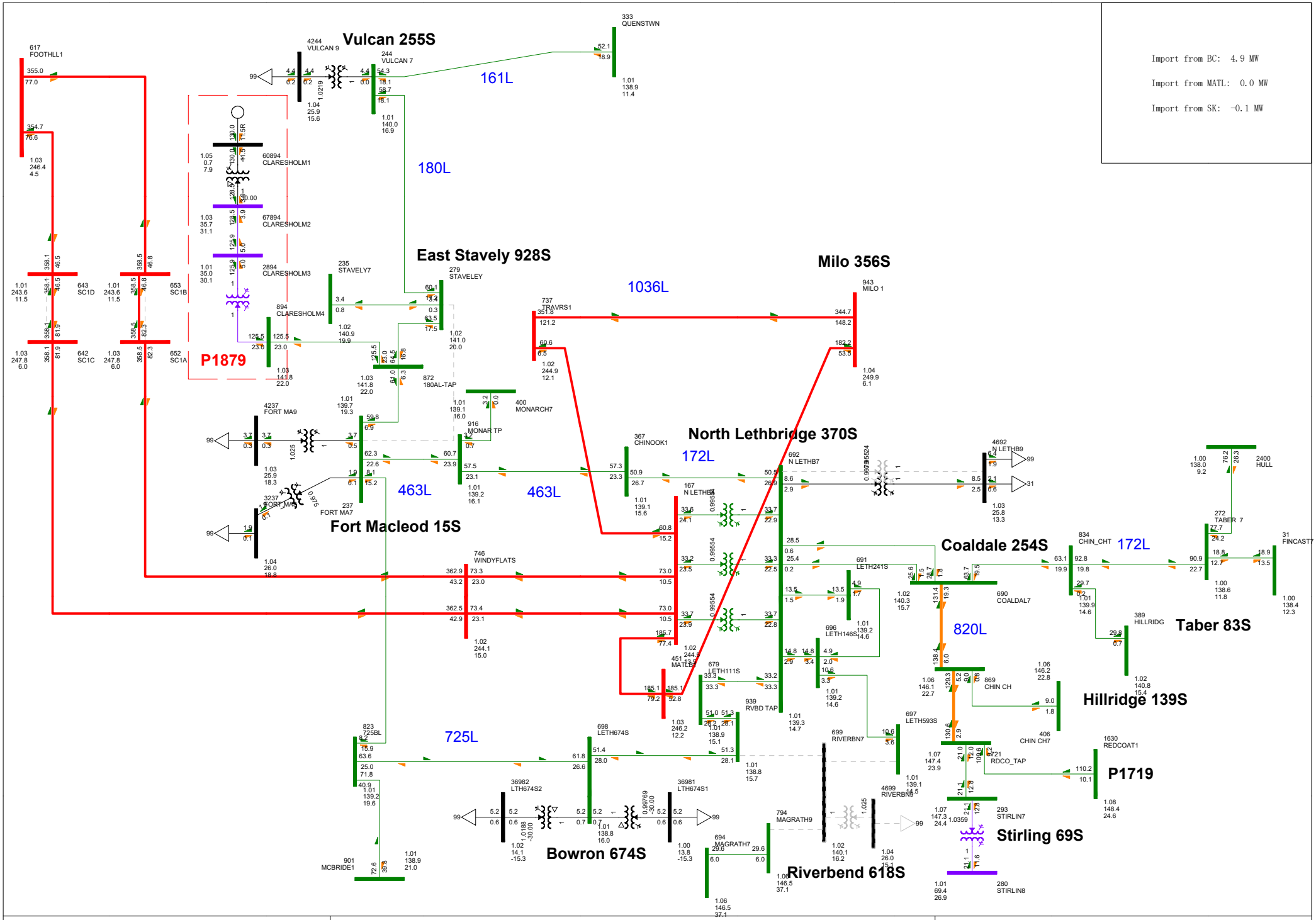


Claresholm Solar Project

AESO Project Number: P1879

FIGURE A-3-1: P1879_SL_POST
CATEGORY A - NO CONTINGENCY
WED, APR 10 2019 13:17

Bus - Voltage (kV/pu)/Angle
Branch - MW/Mvar
Equipment - MW/Mvar
100.0%Rate A
1.100OV 0.900UV
kV: <=25.000 <=69.000 <=138.000 <=240.000 <=500.000 >500.000



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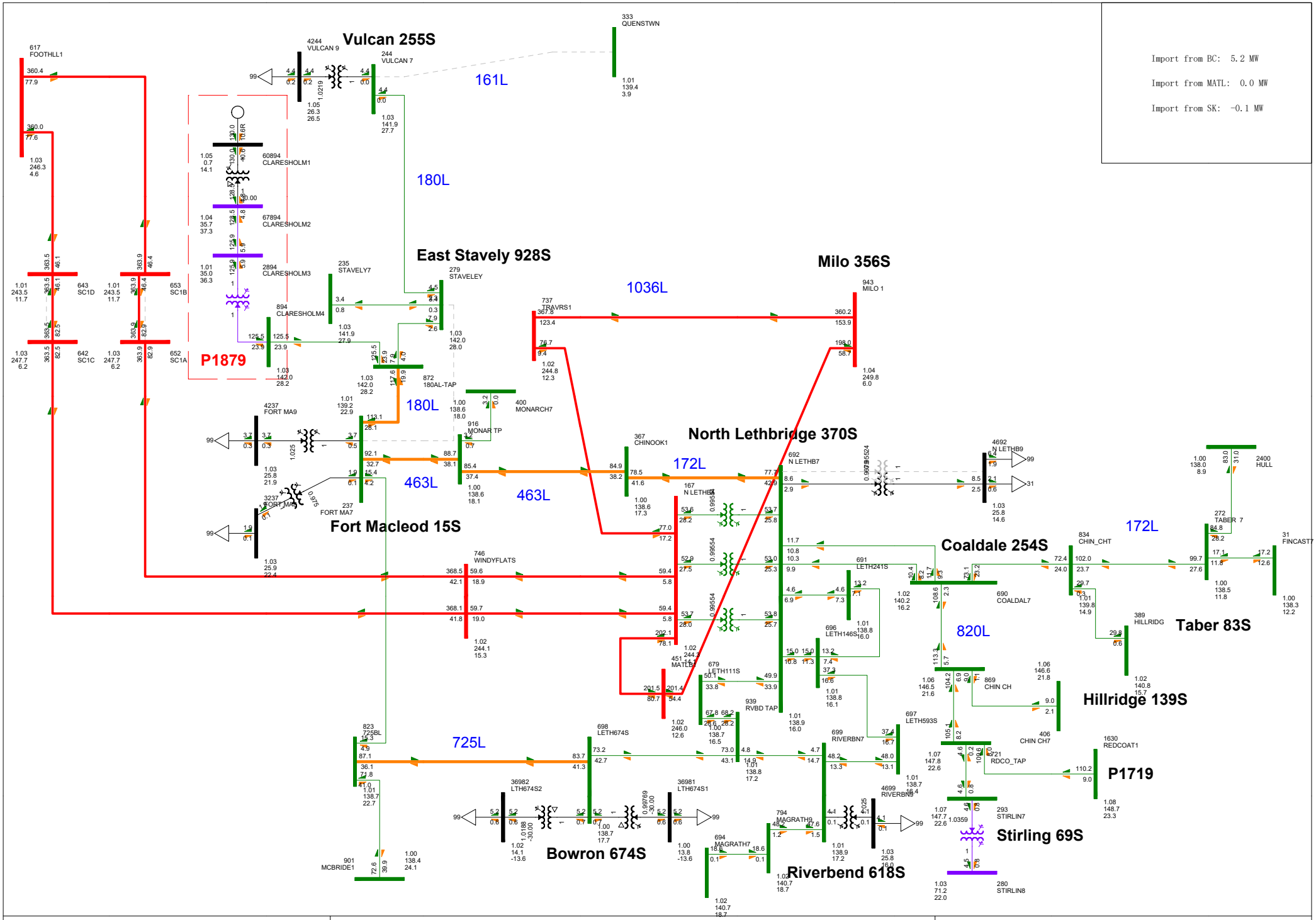
AESO Project Number: P1879

FIGURE B-3-1: P1879_SL_POST
CATEGORY B - RIVERBEND TRANSFORMER T1
WED, APR 10 2019 13:23

Bus - Voltage (kV/pu)/Angle
Branch - MW/Mvar
Equipment - MW/Mvar
100.0%Rate A
1.1000UV 0.900UV
kV: <=25.000 <=69.000 <=138.000 <=240.000 <=500.000 >500.000



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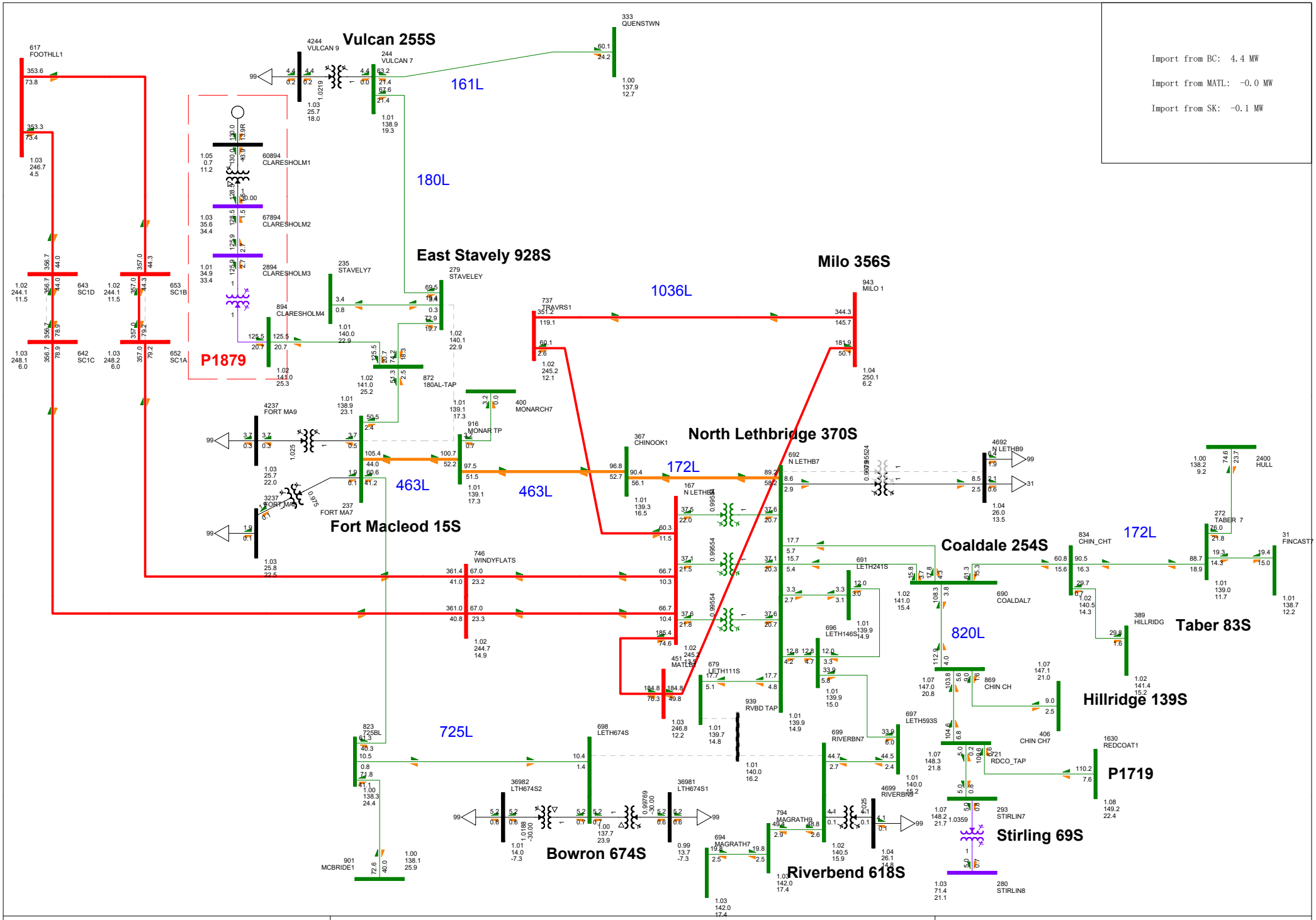
AESO Project Number: P1879

FIGURE B-3-2: P1879_SL_POST
CATEGORY B - 161L (255S - 504S)
WED, APR 10 2019 13:24

Bus - Voltage (kV/pu)/Angle
Branch - MW/Mvar
Equipment - MW/Mvar
100.0%Rate A
1.1000V 0.900UV
kV: <=25.000 <=69.000 <=138.000 <=240.000 <=500.000 >500.000



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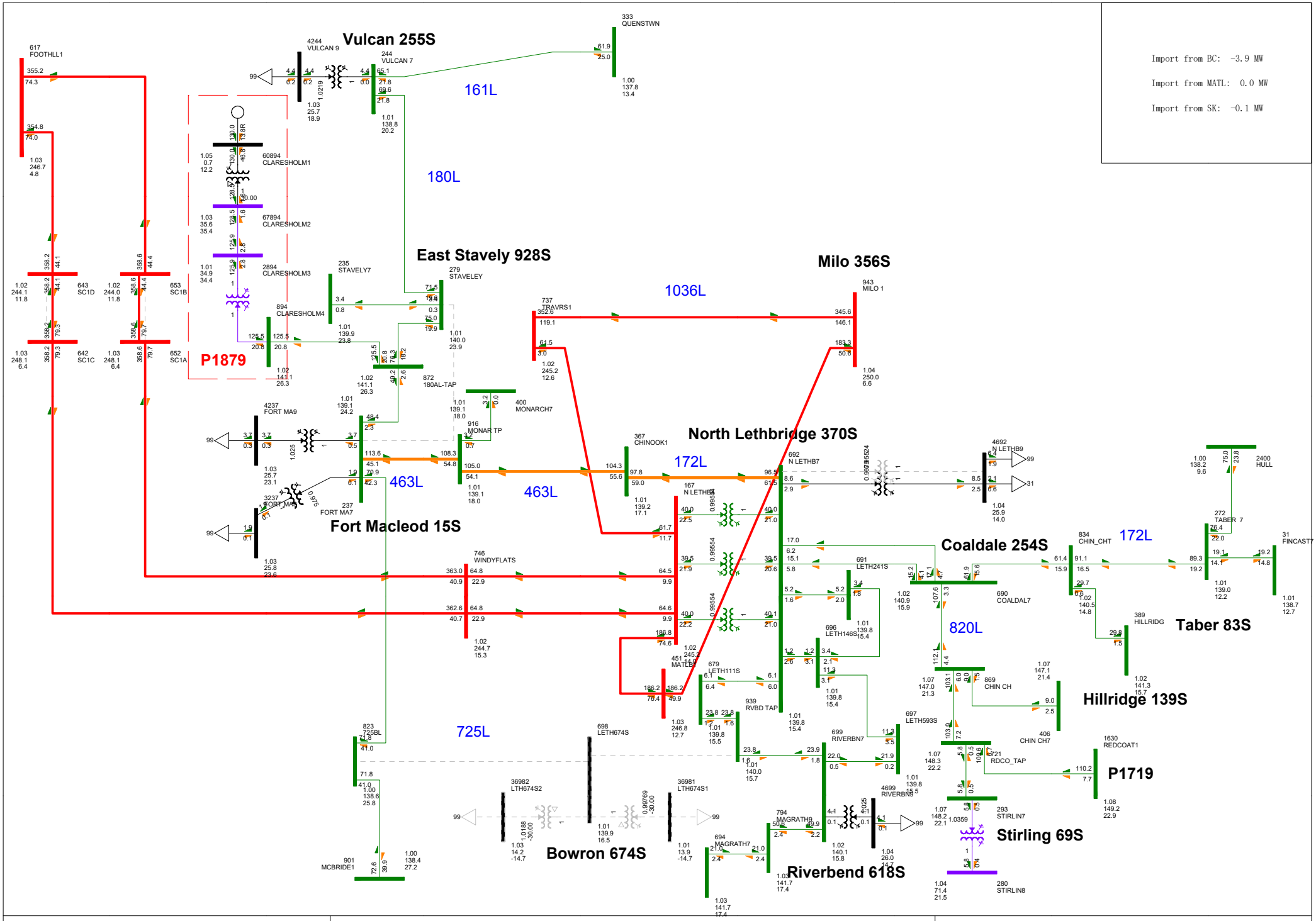
AESO Project Number: P1879

FIGURE B-3-3: P1879_SL_POST
CATEGORY B - 725L (674S - 111S/618S)
WED, APR 10 2019 13:24

Bus - Voltage (kV/pu)/Angle
Branch - MW/Mvar
Equipment - MW/Mvar
100.0%Rate A
1.000OV 0.900UV
kV: <=25.000 <=69.000 <=138.000 <=240.000 <=500.000 >500.000



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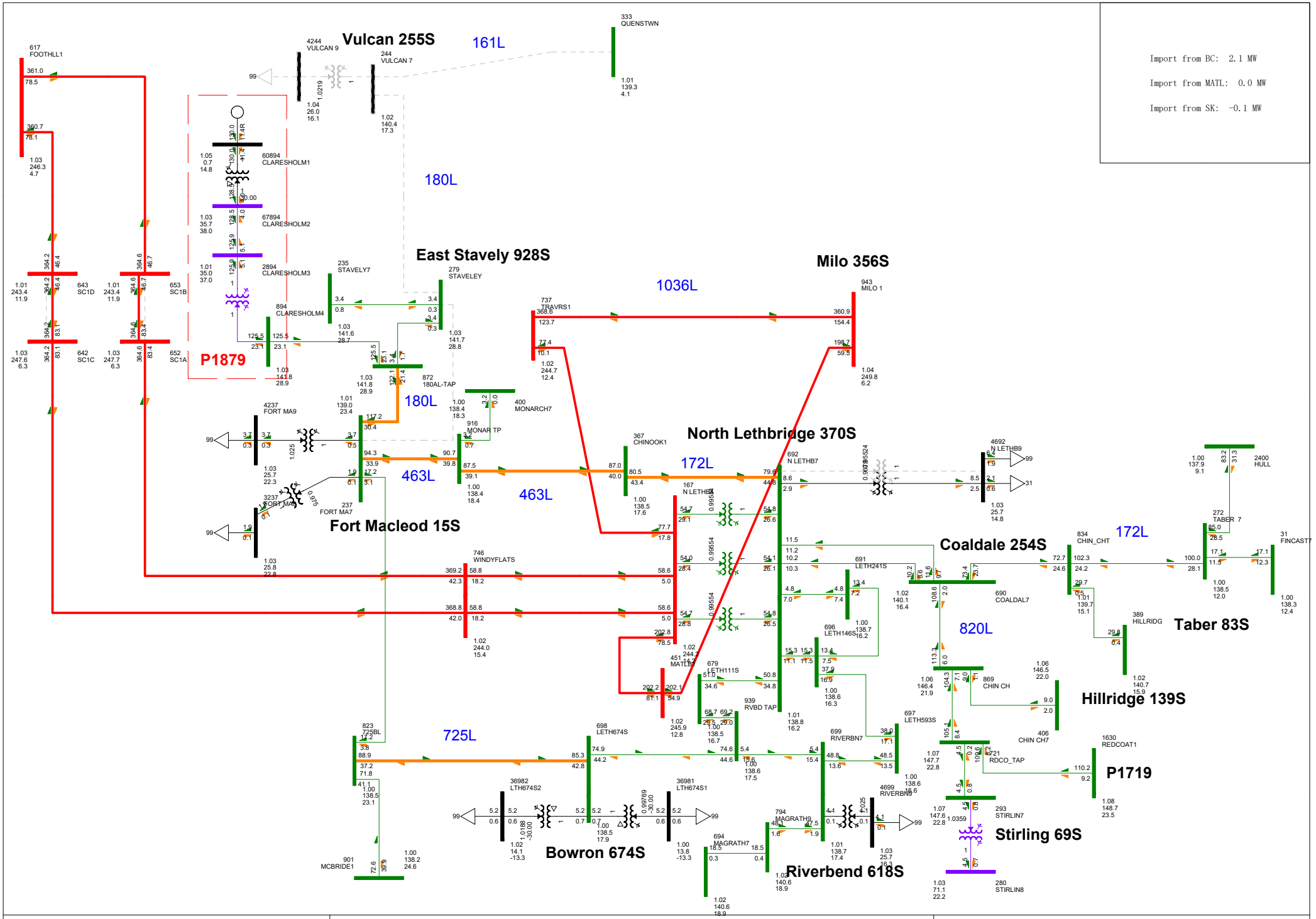
AESO Project Number: P1879

FIGURE B-3-4: P1879_SL_POST
CATEGORY B - BOWRON 674S TRANSFORMER T1
WED, APR 10 2019 13:24

Bus - Voltage (kV/pu)/Angle
Branch - MW/Mvar
Equipment - MW/Mvar
100.0%Rate A
1.100UV 0.900UV
kV: <=25.000 <=69.000 <=138.000 <=240.000 <=500.000 >500.000



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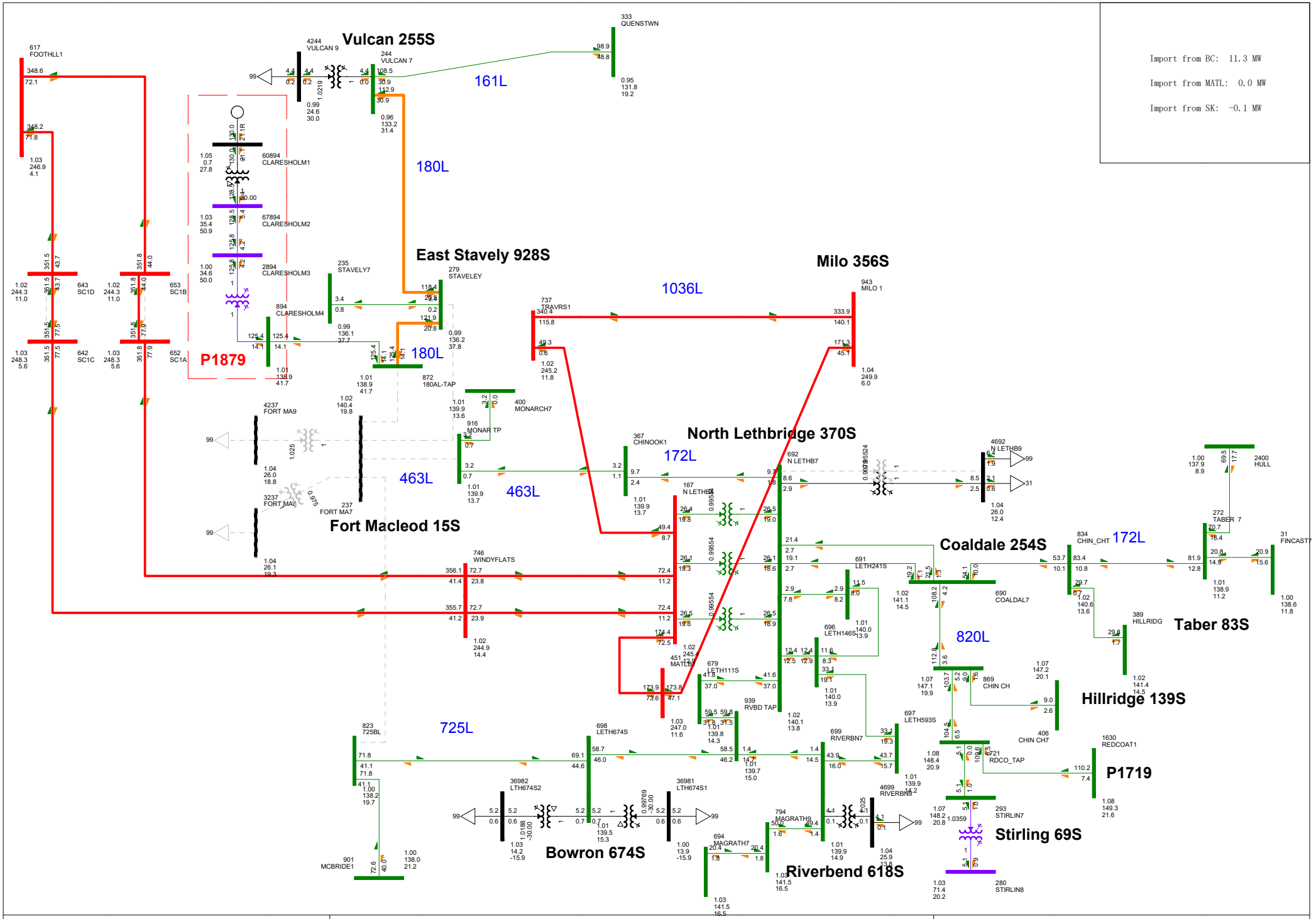
AESO Project Number: P1879

FIGURE B-3-5: P1879_SL_POST
CATEGORY B - VULCAN 255S TRANSFORMER T1
WED, APR 10 2019 13:25

Bus - Voltage (kV/pu)/Angle
Branch - MW/Mvar
Equipment - MW/Mvar
100.0%Rate A
1.100OV 0.900UV
kV: <=25.000 <=69.000 <=138.000 <=240.000 <=500.000 >500.000

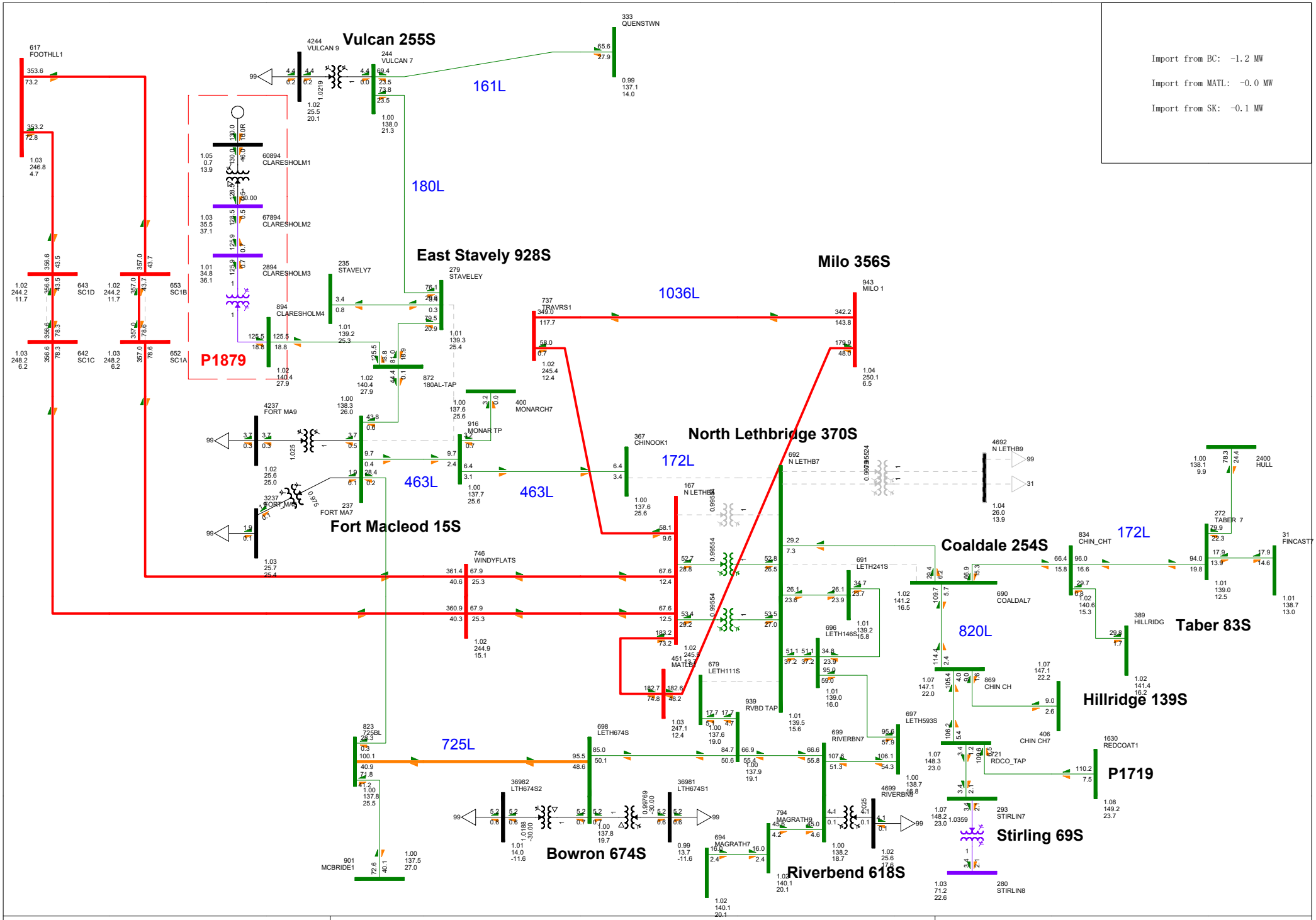


Claresholm Solar Project

AESO Project Number: P1879

FIGURE B-3-6: P1879_SL_POST
CATEGORY B - FORTMACLEOD 15S TRANSFORMER T1
WED, APR 10 2019 13:25

Bus - Voltage (kV/pu)/Angle
Branch - MW/Mvar
Equipment - MW/Mvar
100.0%Rate A
1.100OV 0.900UV
kV: <=25.000 <=69.000 <=138.000 <=240.000 <=500.000 >500.000

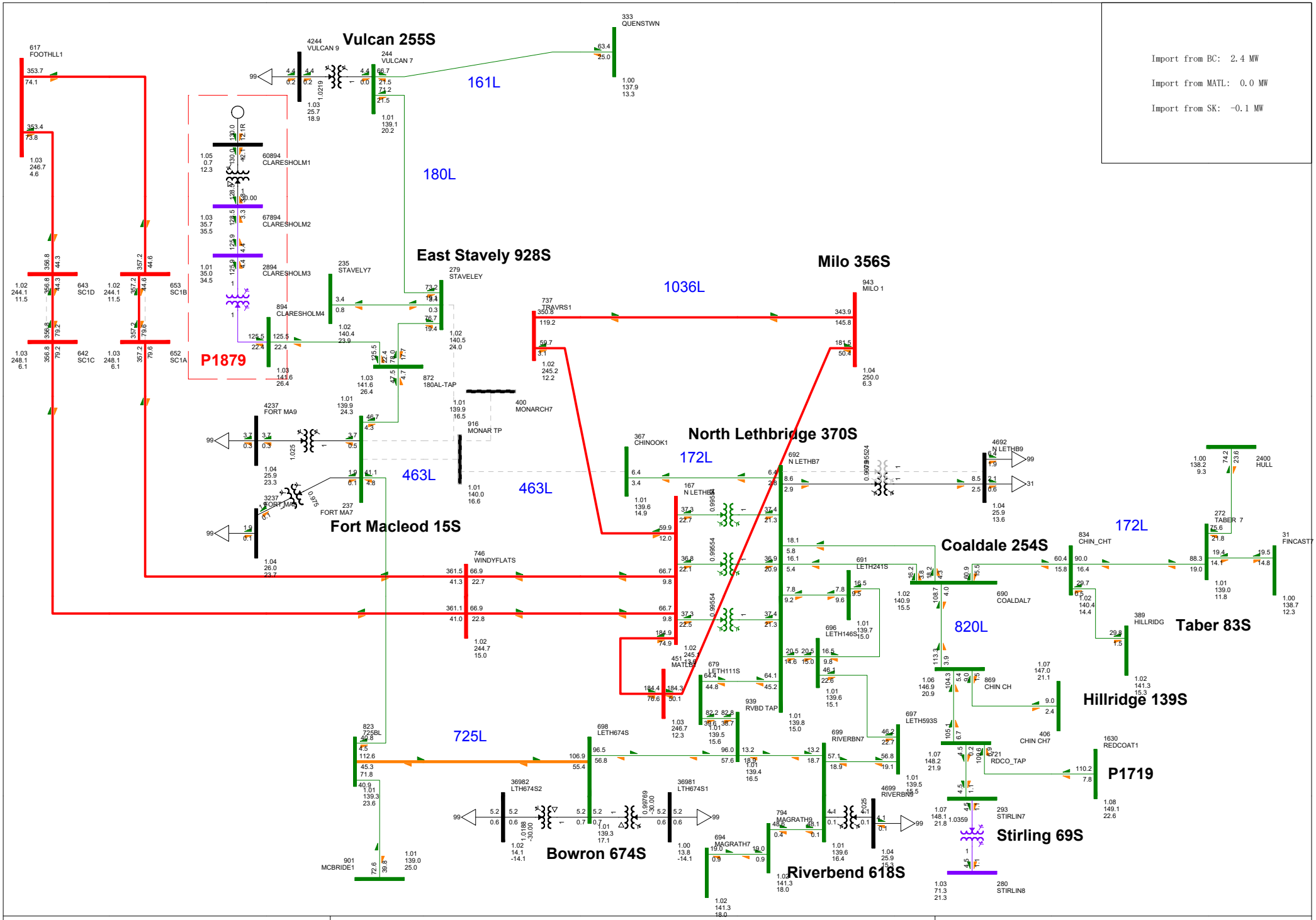


Claresholm Solar Project

AESO Project Number: P1879

FIGURE B-3-7: P1879_SL_POST
CATEGORY B - N LETHBRIDGE 370S TRANSFORMER T1
WED, APR 10 2019 13:28

Bus - Voltage (kV/pu)/Angle
Branch - MW/Mvar
Equipment - MW/Mvar
100.0%Rate A
1.100UV 0.900UV
kV: <=25.000 <=69.000 <=138.000 <=240.000 <=500.000 >500.000

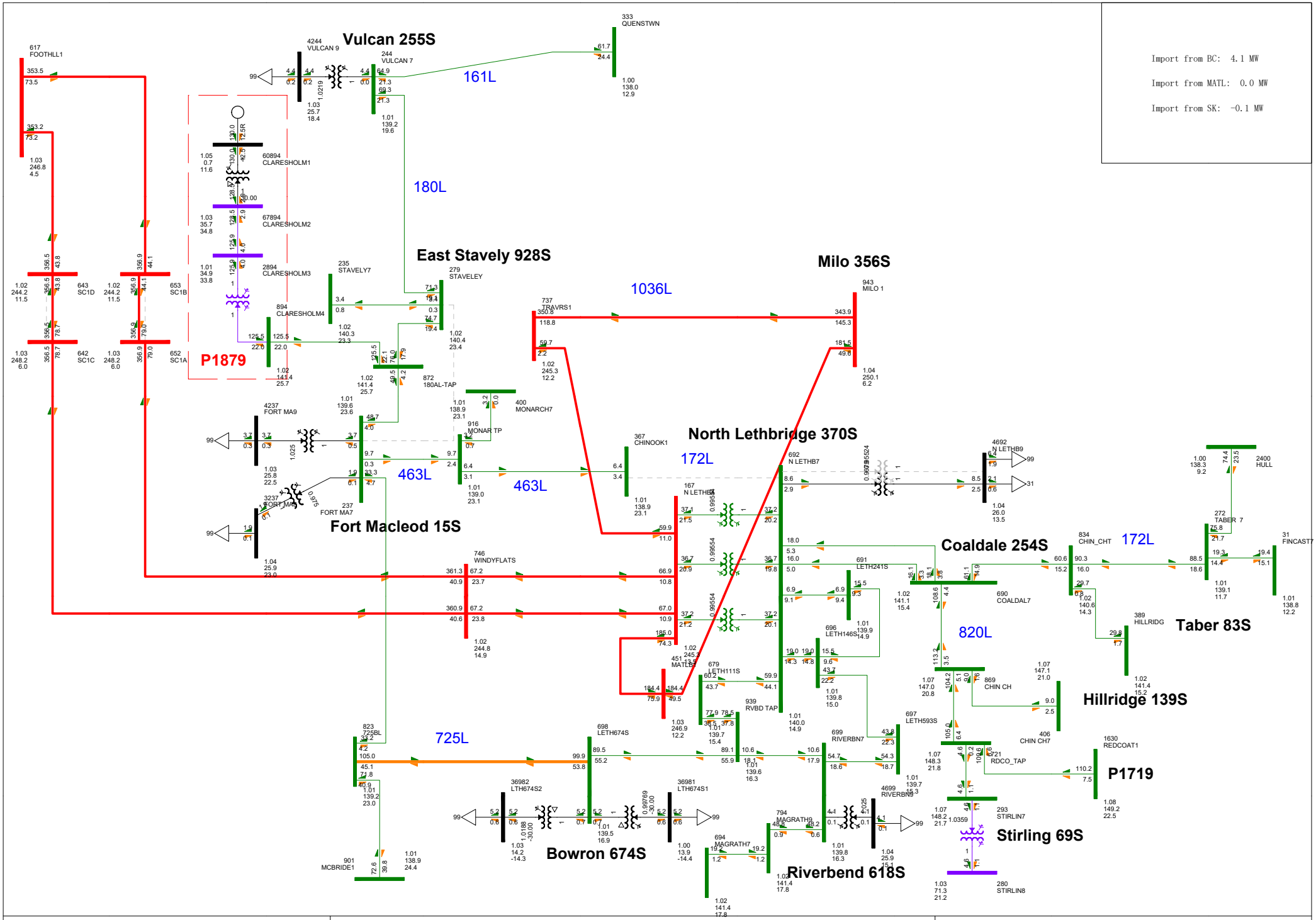


Claresholm Solar Project

AESO Project Number: P1879

FIGURE B-3-8: P1879_SL_POST
CATEGORY B - 463L (15S - 492S/181S)
WED, APR 10 2019 13:26

Bus - Voltage (kV/pu)/Angle
Branch - MW/Mvar
Equipment - MW/Mvar
100.0%Rate A
1.100OV 0.900UV
kV: <=25.000 <=69.000 <=138.000 <=240.000 <=500.000 >500.000

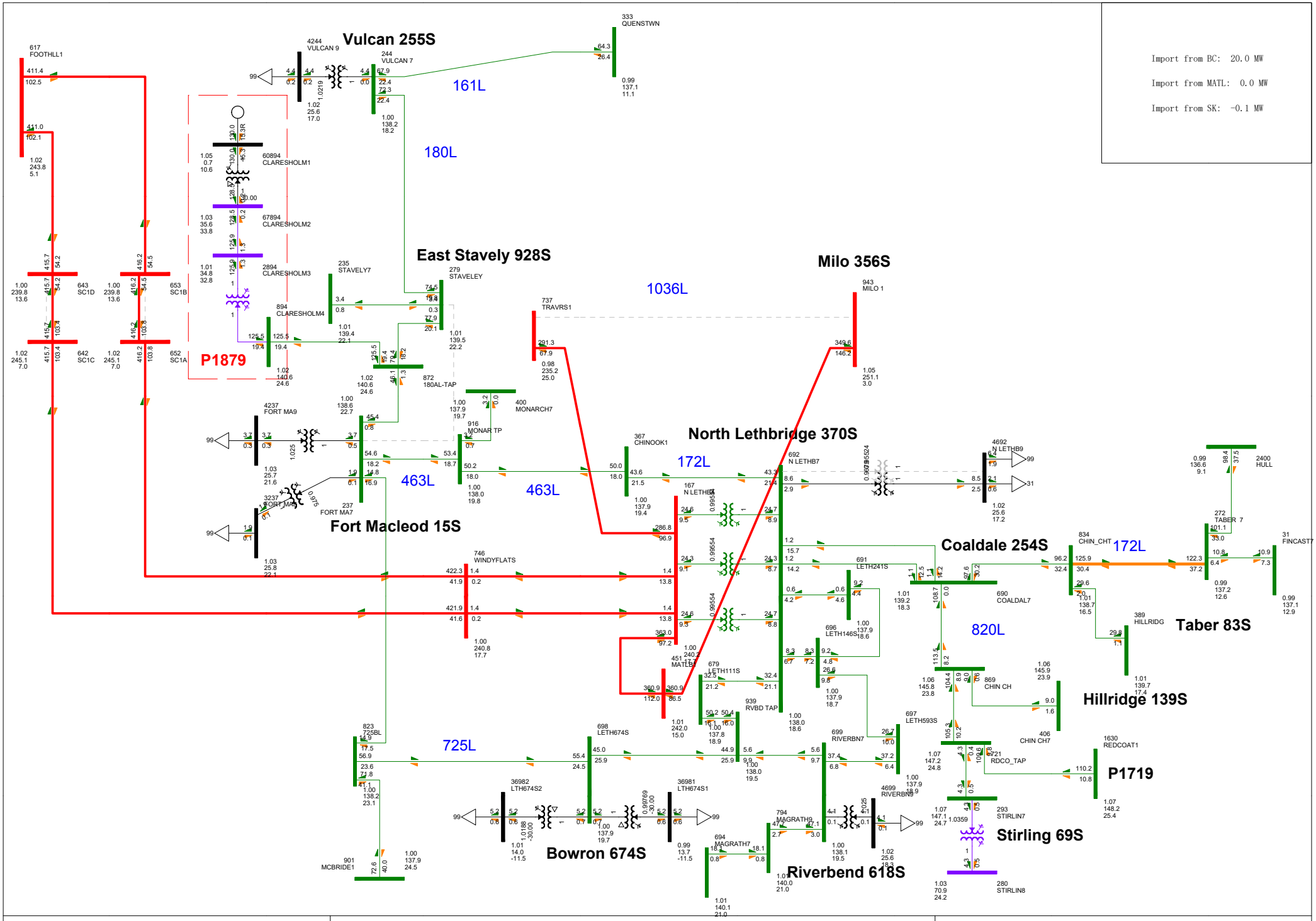


Claresholm Solar Project

AESO Project Number: P1879

FIGURE B-3-9: P1879_SL_POST
CATEGORY B - 172L (181S - 370S)
WED, APR 10 2019 13:27

Bus - Voltage (kV/pu)/Angle
Branch - MW/Mvar
Equipment - MW/Mvar
100.0%Rate A
1.000UV 0.900UV
kV: <=25.000 <=69.000 <=138.000 <=240.000 <=500.000 >500.000

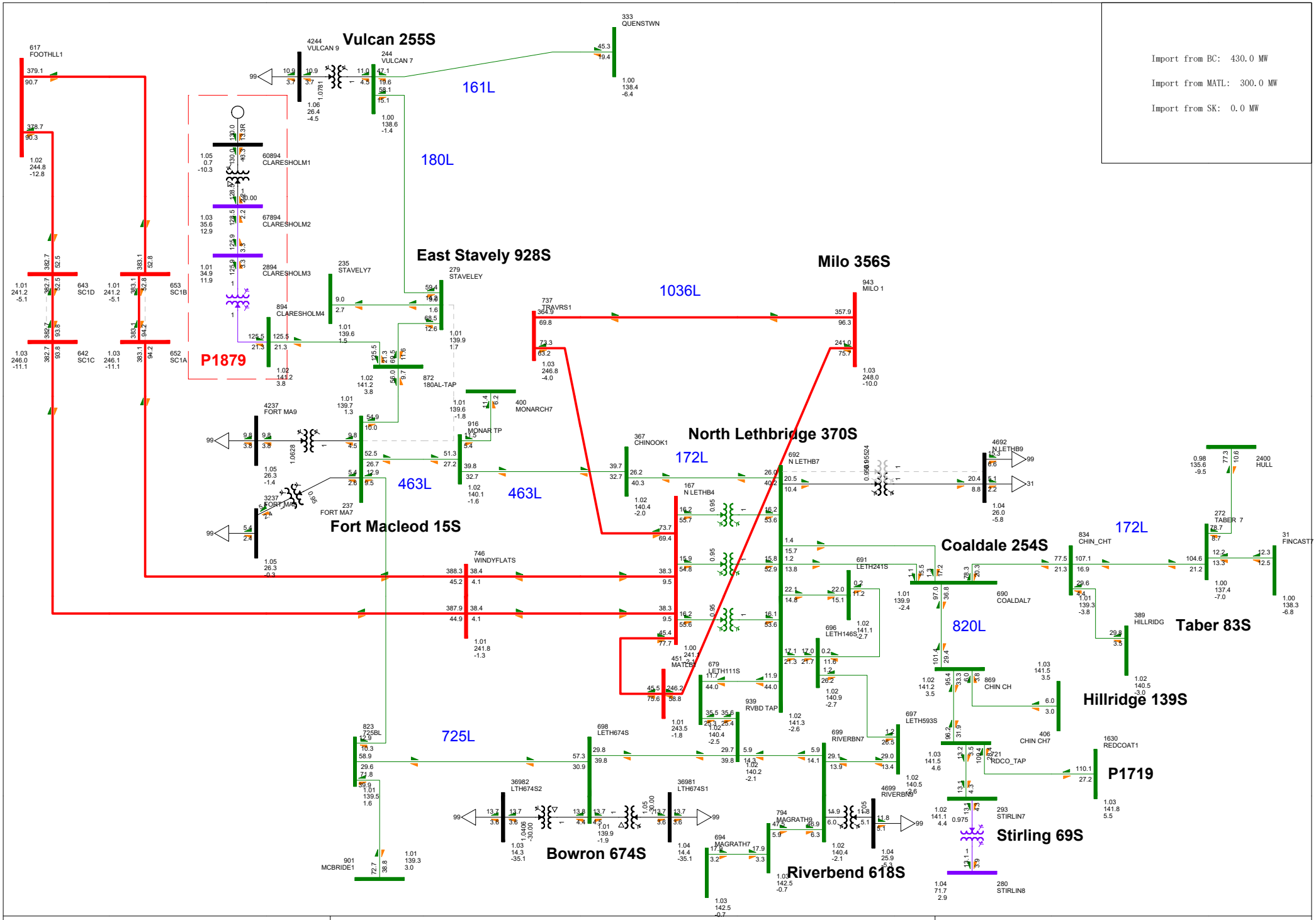


Claresholm Solar Project

AESO Project Number: P1879

FIGURE B-3-10: P1879_SL_POST
CATEGORY B - 1036L (356S - 554S)
WED, APR 10 2019 13:27

Bus - Voltage (kV/pu)/Angle
Branch - MW/Mvar
Equipment - MW/Mvar
100.0%Rate A
1.100UV 0.900UV
kV: <=25.000 <=69.000 <=138.000 <=240.000 <=500.000 >500.000

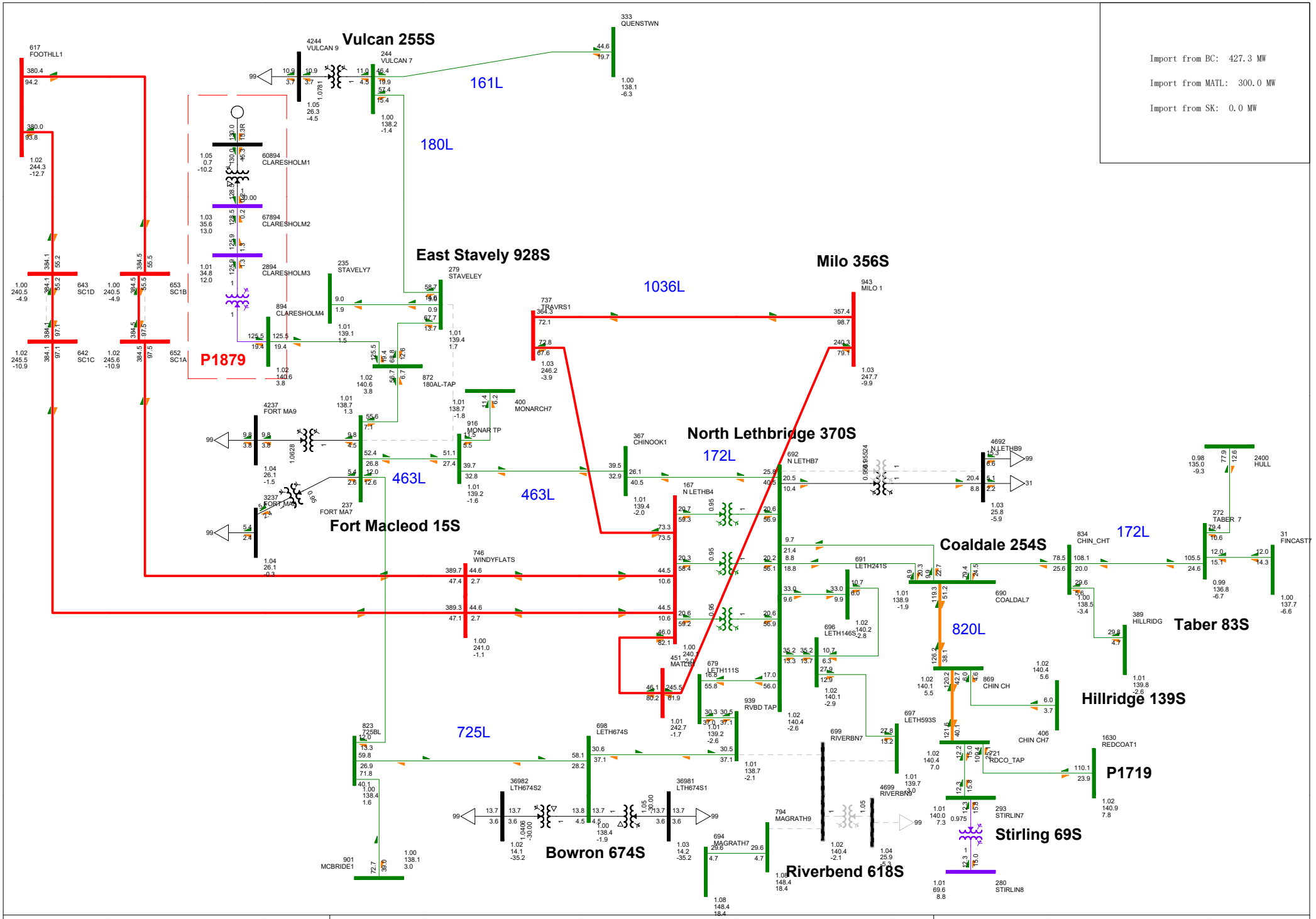


Claresholm Solar Project

AESO Project Number: P1879

FIGURE A-4-1: P1879_SP_POST
CATEGORY A - NO CONTINGENCY
WED, APR 10 2019 13:28

Bus - Voltage (kV/pu)/Angle
Branch - MW/Mvar
Equipment - MW/Mvar
100.0%Rate A
1.100UV 0.900UV
kV: <=25.000 <=69.000 <=138.000 <=240.000 <=500.000 >500.000

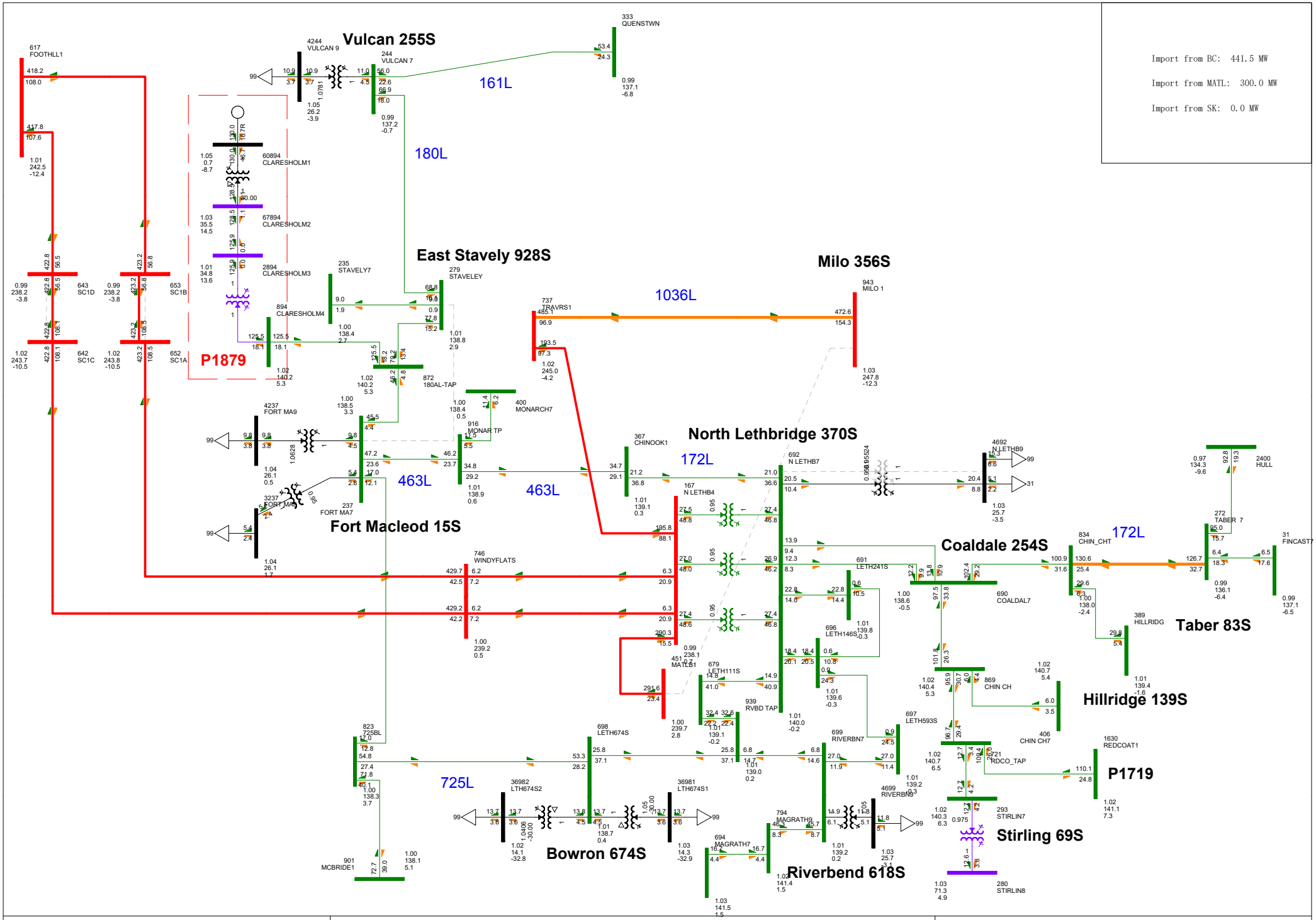


Claresholm Solar Project

AESO Project Number: P1879

FIGURE B-4-1: P1879_SP_POST
CATEGORY B - RIVERBEND TRANSFORMER T1
WED, APR 10 2019 13:29

Bus - Voltage (kV/pu)/Angle
Branch - MW/Mvar
Equipment - MW/Mvar
100.0%Rate A
1.100UV 0.900UV
kV: <=25.000 <=69.000 <=138.000 <=240.000 <=500.000 >500.000

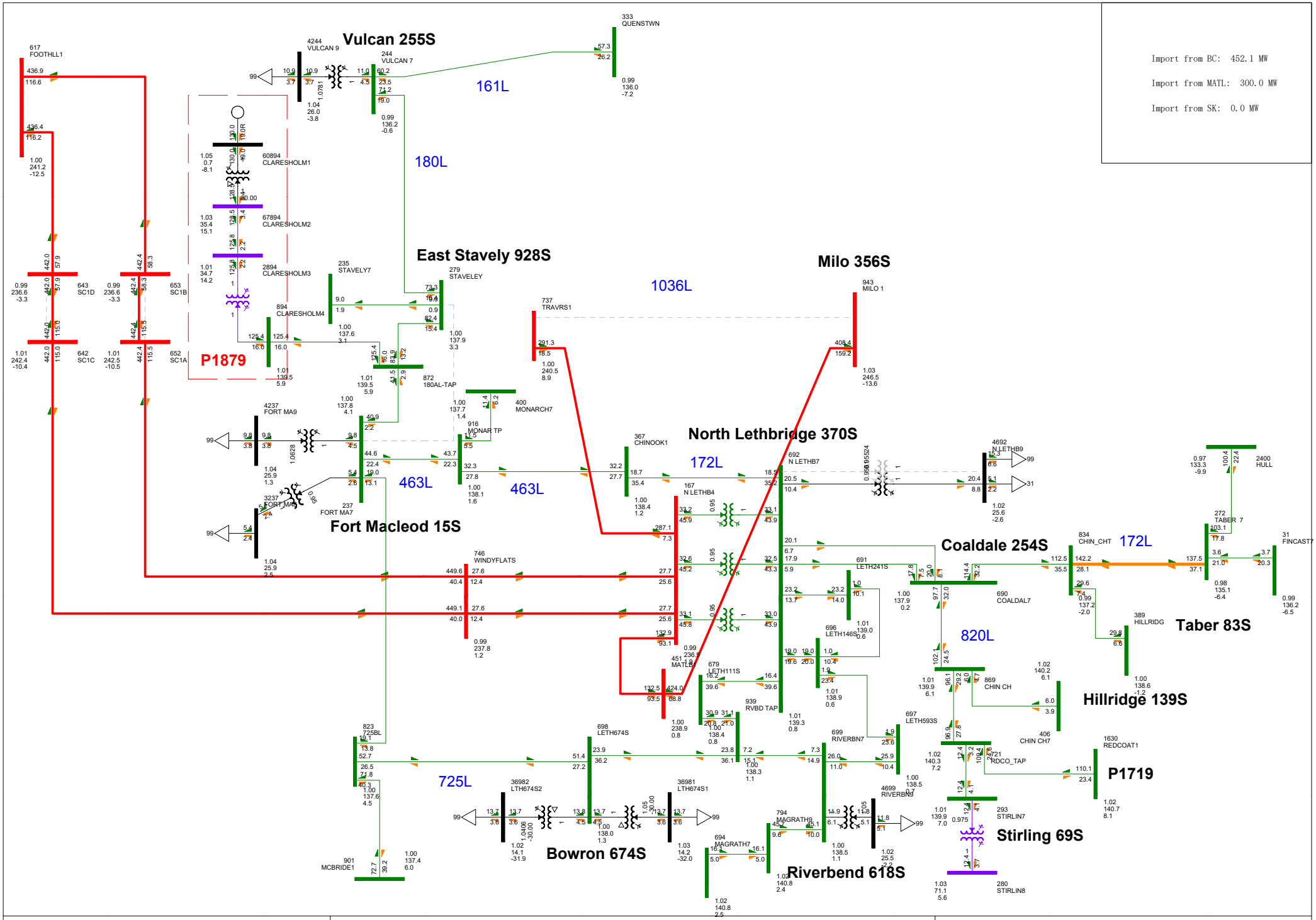


Claresholm Solar Project

AESO Project Number: P1879

FIGURE B-4-2: P1879_SP_POST
CATEGORY B - 1005L (356S - 120S)
WED, APR 10 2019 13:30

Bus - Voltage (kV/pu)/Angle
Branch - MW/Mvar
Equipment - MW/Mvar
100.0%Rate A
1.100OV 0.900UV
kV: <=25.000 <=69.000 <=138.000 <=240.000 <=500.000 >500.000

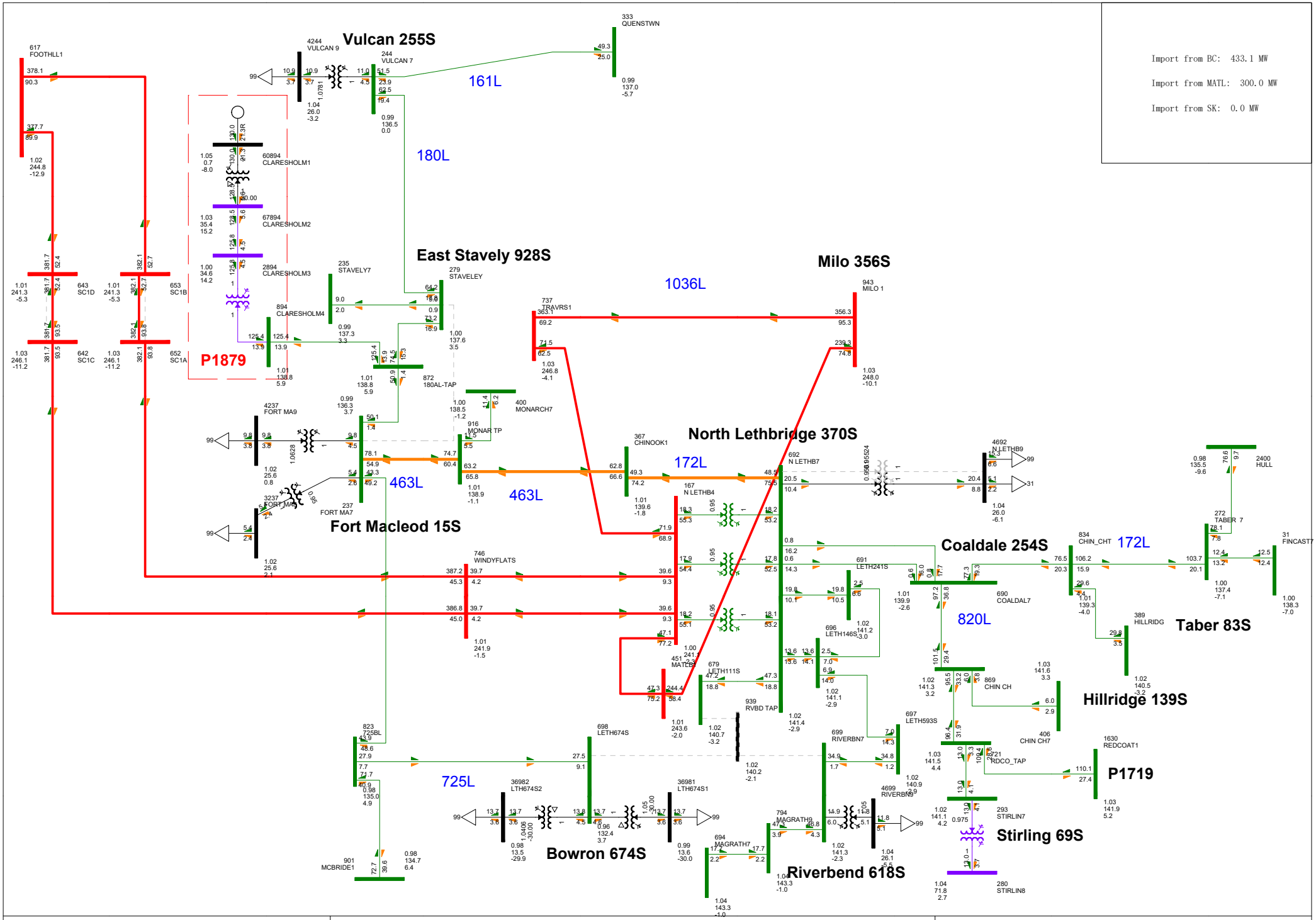


Claresholm Solar Project

AESO Project Number: P1879

FIGURE B-4-3: P1879_SP_POST
CATEGORY B - 1036L (356S - 554S)
WED, APR 10 2019 13:30

Bus - Voltage (kV/pu)/Angle
Branch - MW/Mvar
Equipment - MW/Mvar
100.0%Rate A
1.100UV 0.900UV
kV: <=25.000 <=69.000 <=138.000 <=240.000 <=500.000 >500.000

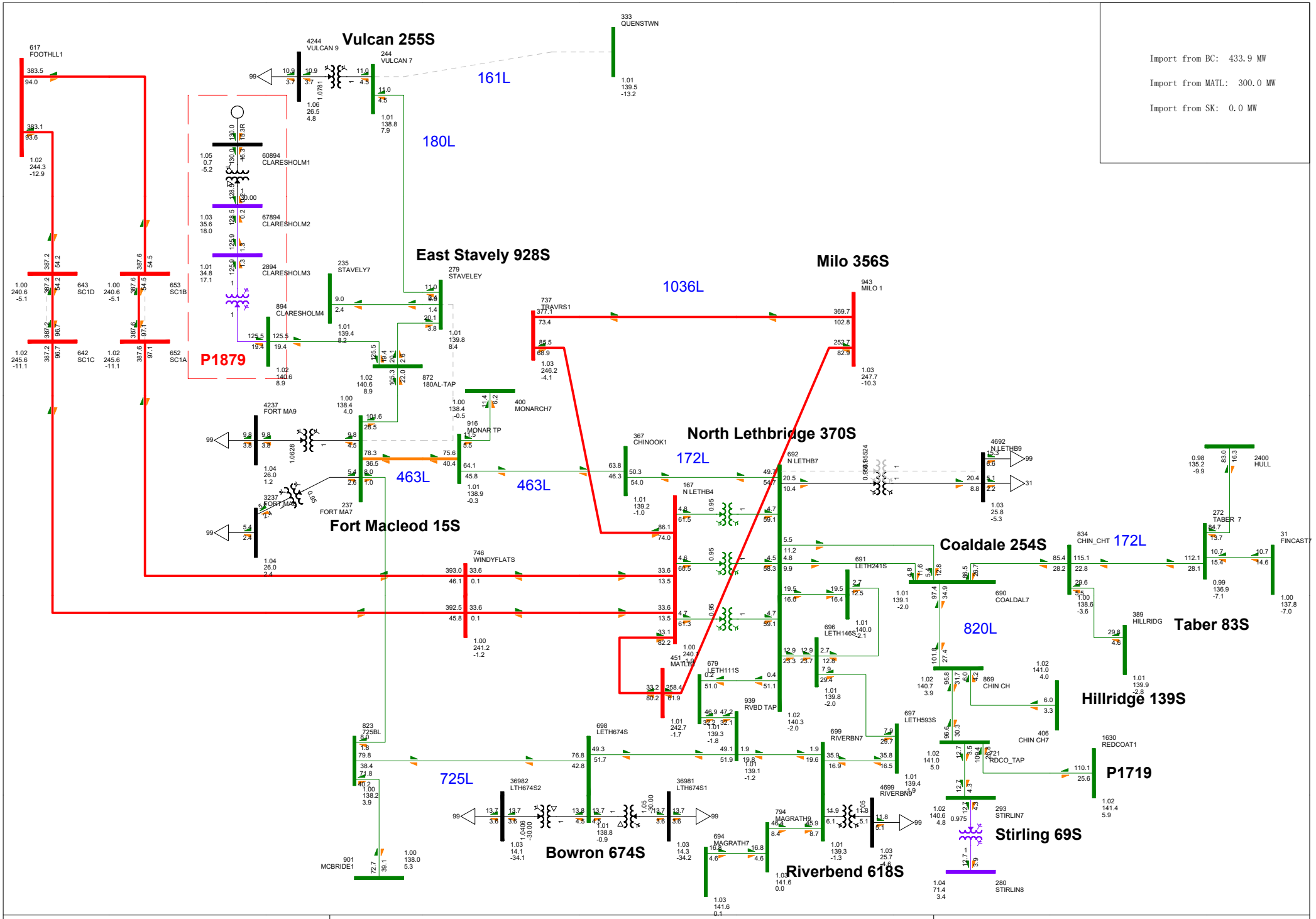


Claresholm Solar Project

AESO Project Number: P1879

FIGURE B-4-4: P1879_SP_POST
CATEGORY B - 725L (674S - 111S/618S)
WED, APR 10 2019 13:31

Bus - Voltage (kV/pu)/Angle
Branch - MW/Mvar
Equipment - MW/Mvar
100.0%Rate A
1.100UV 0.900UV
kV: <=25.000 <=69.000 <=138.000 <=240.000 <=500.000 >500.000

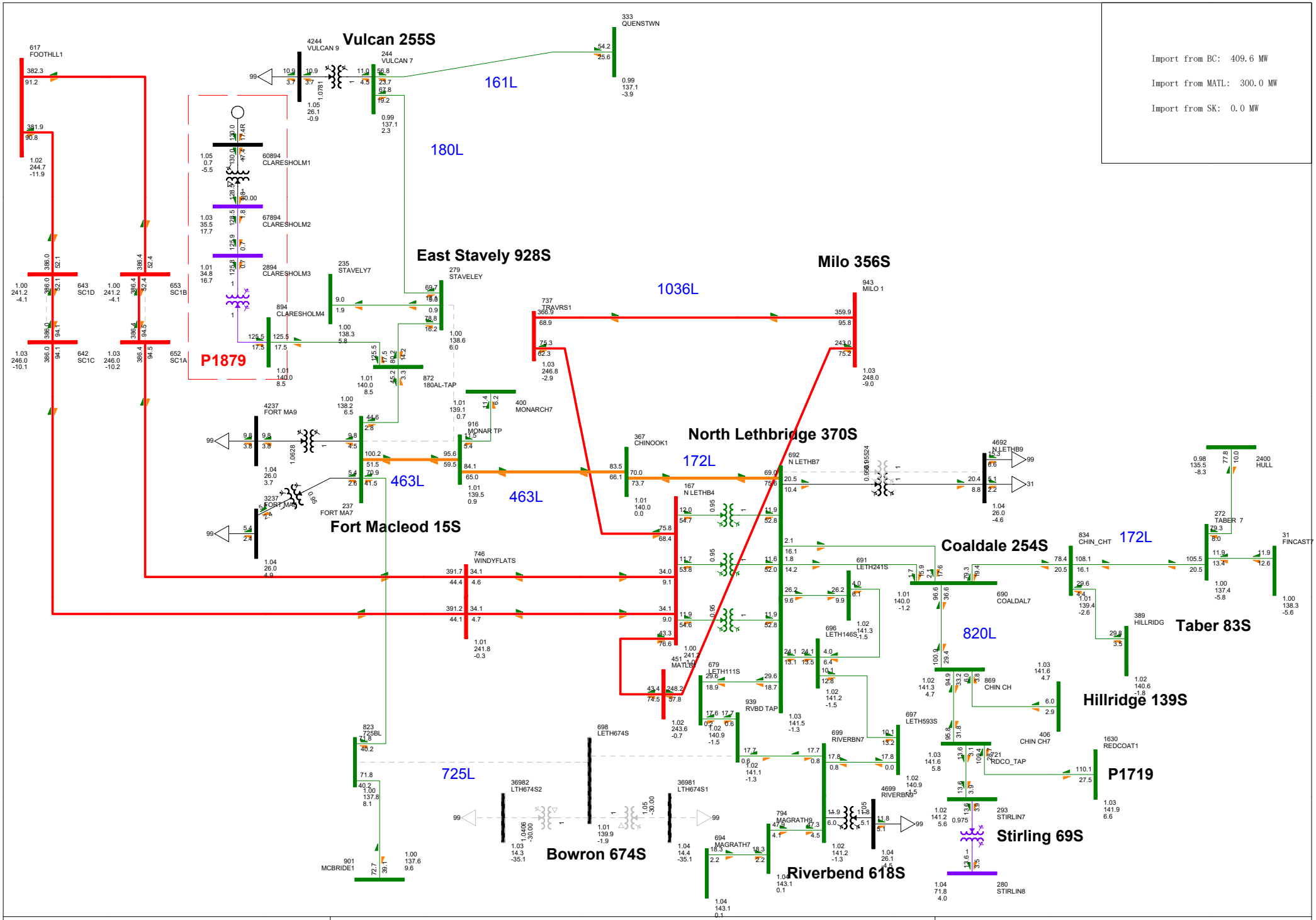


Claresholm Solar Project

AESO Project Number: P1879

FIGURE B-4-5: P1879_SP_POST
CATEGORY B - 161L (255S - 504S)
WED, APR 10 2019 13:31

Bus - Voltage (kV/pu)/Angle
Branch - MW/Mvar
Equipment - MW/Mvar
100.0%Rate A
1.100UV 0.900UV
kV: <=25.000 <=69.000 <=138.000 <=240.000 <=500.000 >500.000

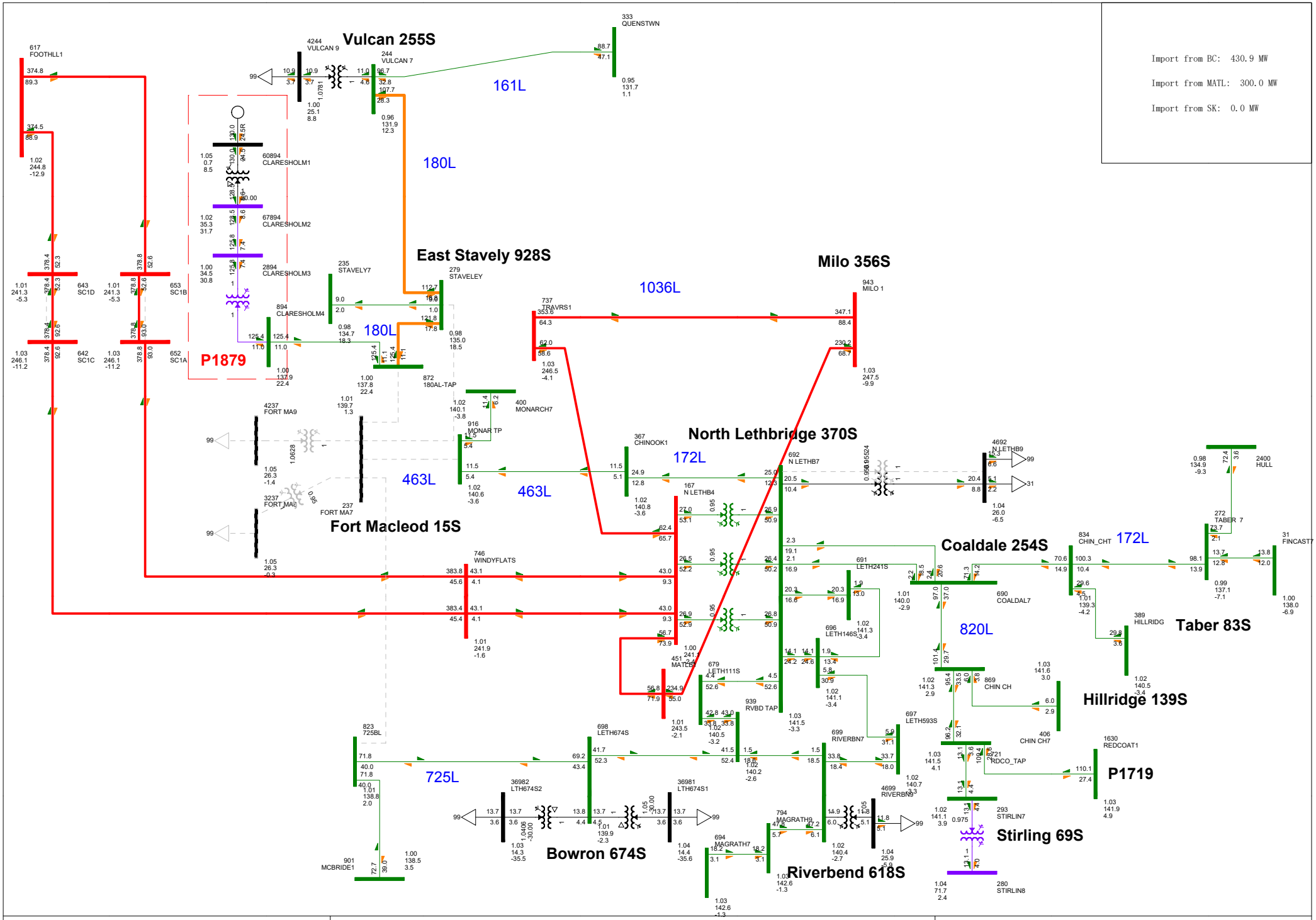


Claresholm Solar Project

AESO Project Number: P1879

FIGURE B-4-6: P1879_SP_POST
CATEGORY B - BOWRON 674S TRANSFORMER T1
WED, APR 10 2019 13:31

Bus - Voltage (kV/pu)/Angle
Branch - MW/Mvar
Equipment - MW/Mvar
100.0%Rate A
1.100UV 0.900UV
kV: <=25.000 <=69.000 <=138.000 <=240.000 <=500.000 >500.000

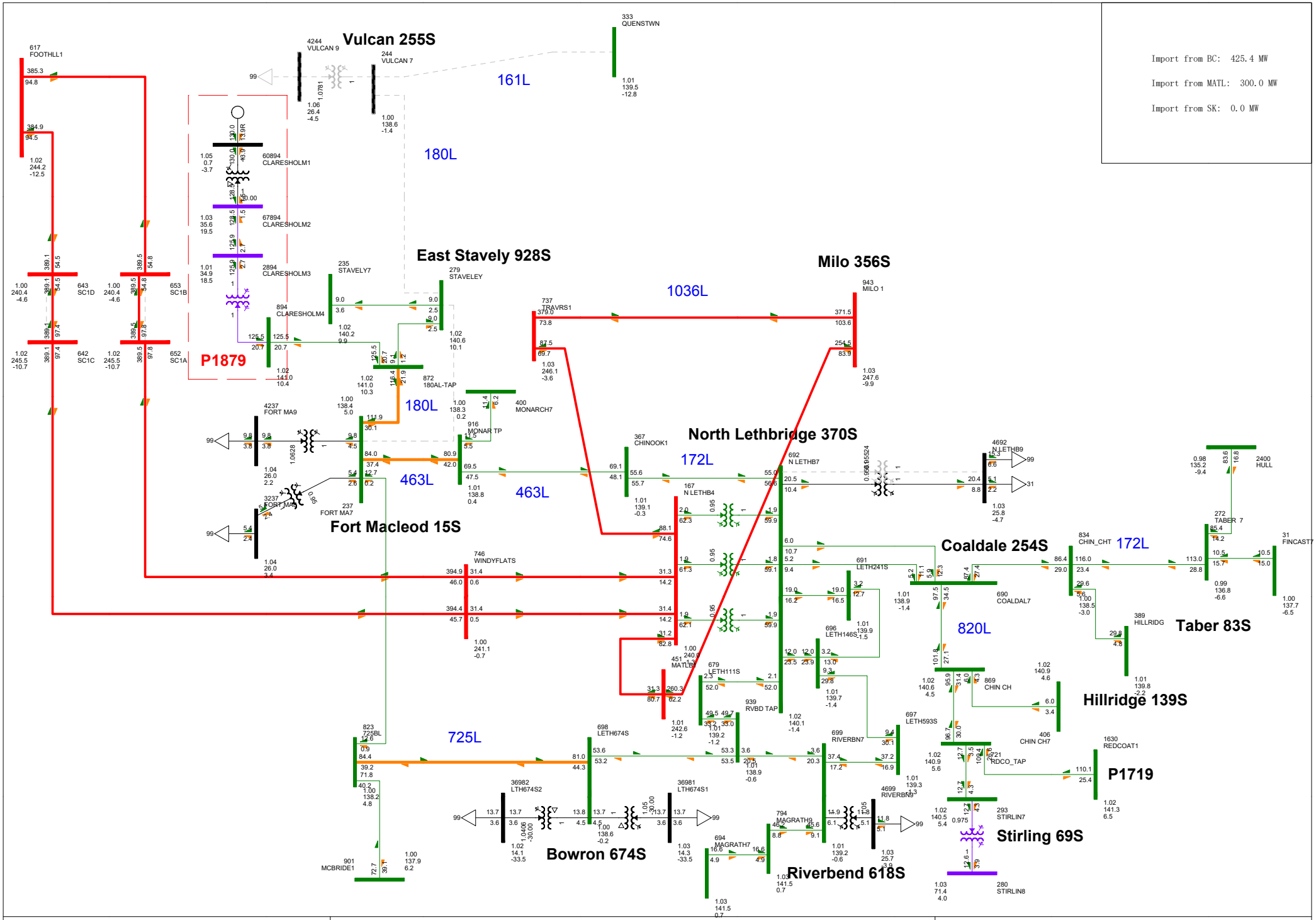


Claresholm Solar Project

AESO Project Number: P1879

FIGURE B-4-7: P1879_SP_POST
CATEGORY B - FORTMACLEOD 15S TRANSFORMER T1
WED, APR 10 2019 13:32

Bus - Voltage (kV/pu)/Angle
Branch - MW/Mvar
Equipment - MW/Mvar
100.0%Rate A
1.100UV 0.900UV
kV: <=25.000 <=69.000 <=138.000 <=240.000 <=500.000 >500.000

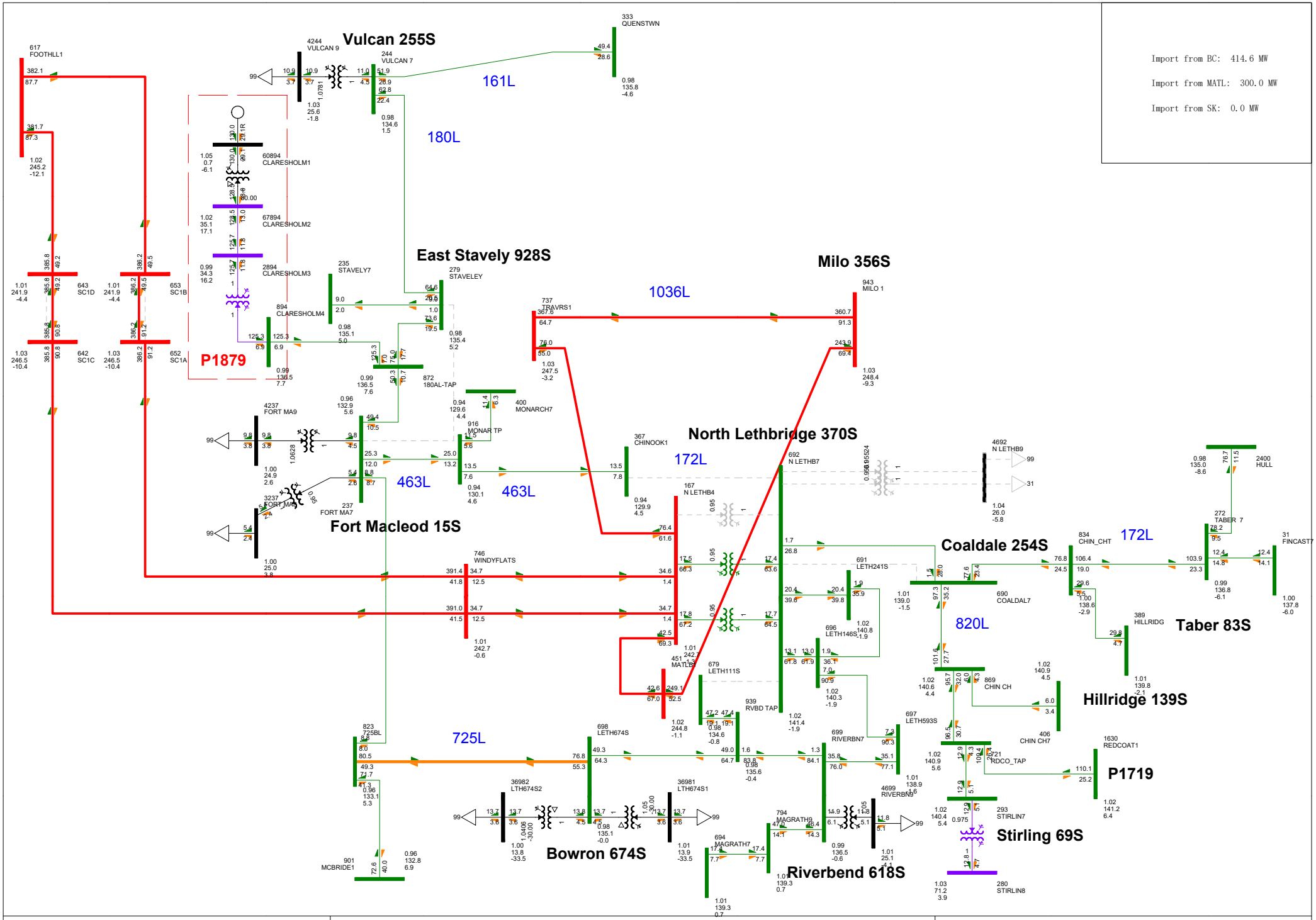


Claresholm Solar Project

AESO Project Number: P1879

FIGURE B-4-8: P1879_SP_POST
CATEGORY B - VULCAN 255S TRANSFORMER T1
WED, APR 10 2019 13:32

Bus - Voltage (kV/pu)/Angle
Branch - MW/Mvar
Equipment - MW/Mvar
100.0%Rate A
1.100UV 0.900UV
kV: <=25.000 <=69.000 <=138.000 <=240.000 <=500.000 >500.000

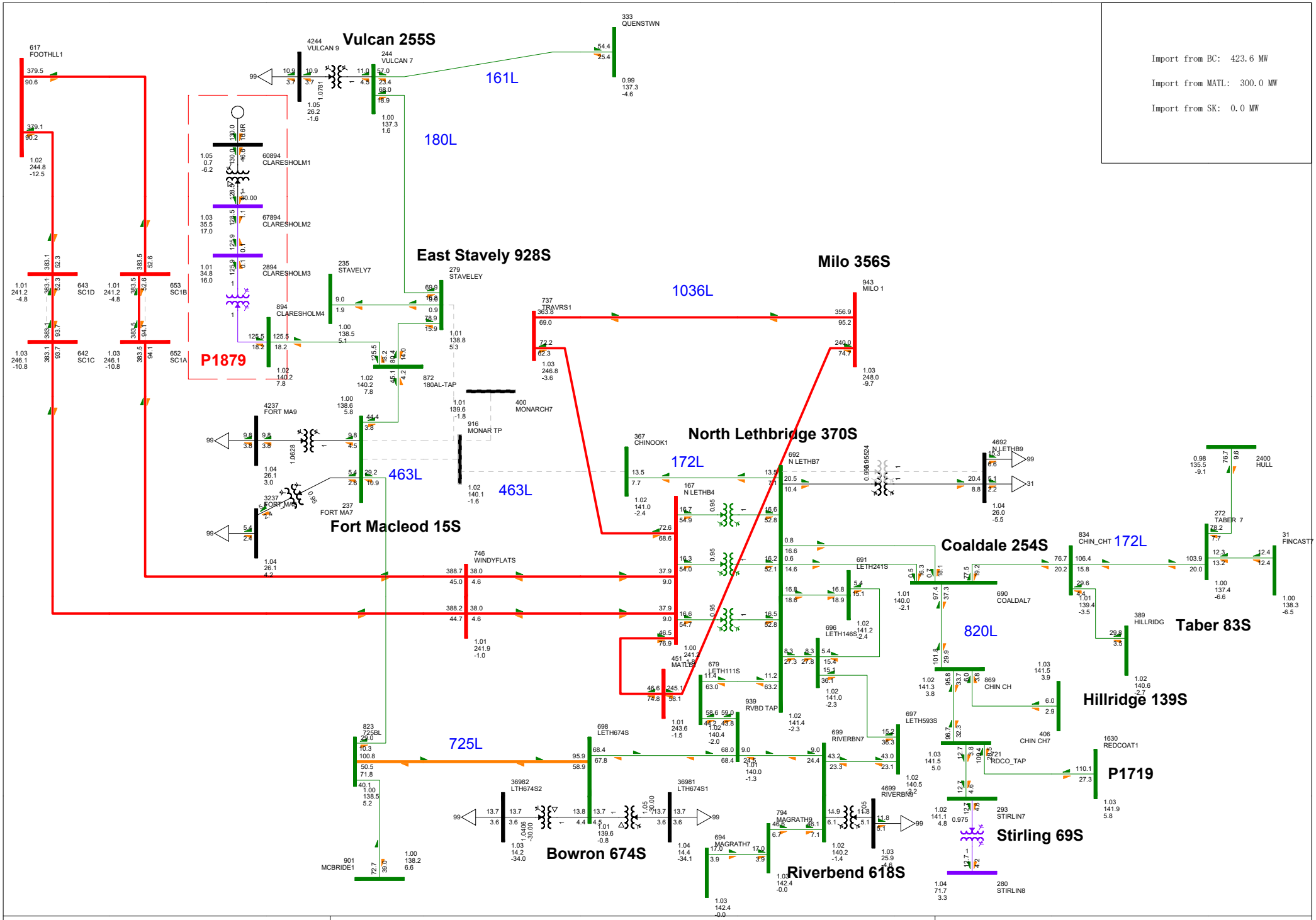


Claresholm Solar Project

AESO Project Number: P1879

FIGURE B-4-9: P1879_SP_POST
CATEGORY B - N LETHBRIDGE 370S TRANSFORMER T1
WED, APR 10 2019 13:36

Bus - Voltage (kV/pu)/Angle
Branch - MW/Mvar
Equipment - MW/Mvar
100.0%Rate A
1.100UV 0.900UV
kV: <=25.000 <=69.000 <=138.000 <=240.000 <=500.000 >500.000

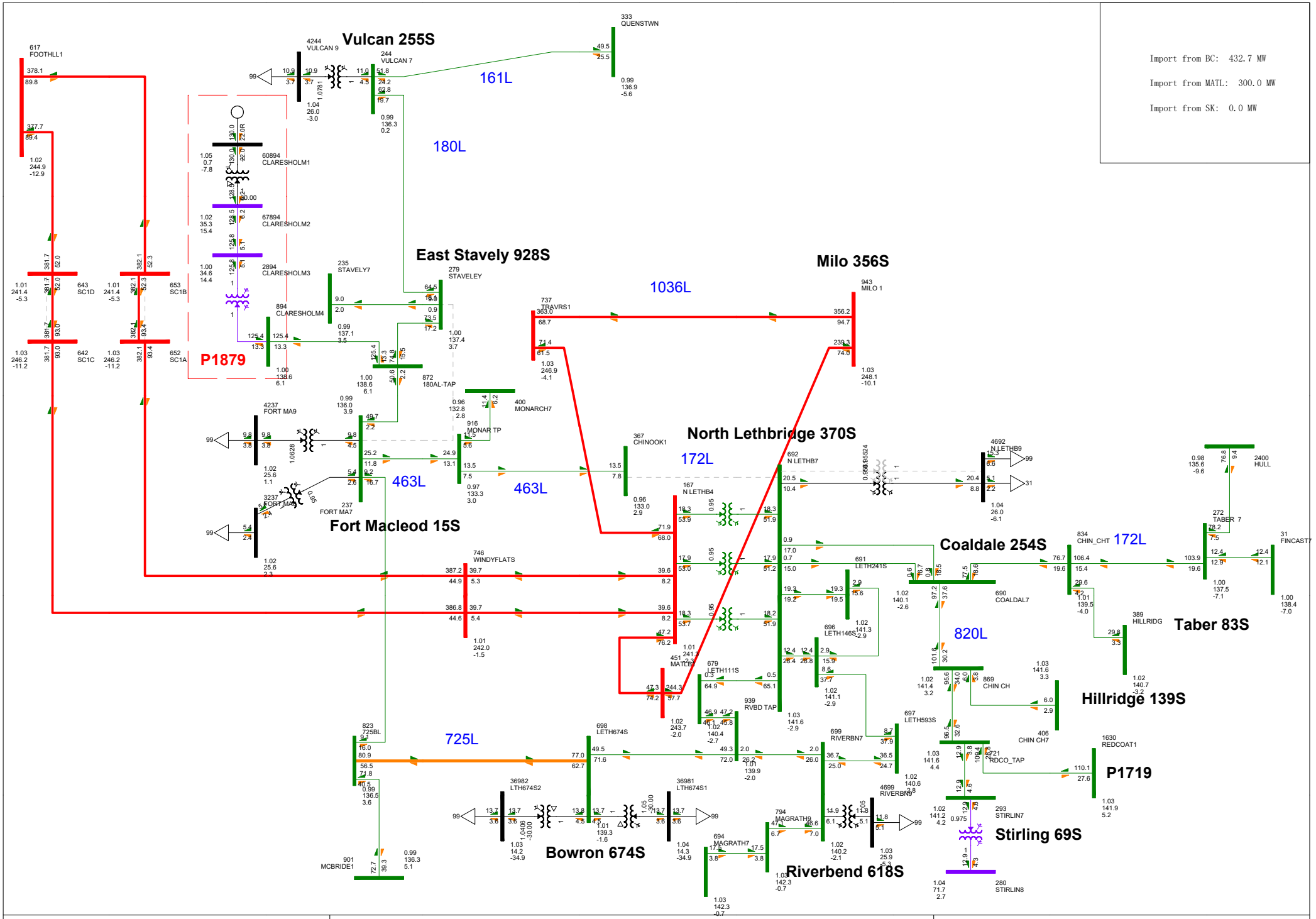


Claresholm Solar Project

AESO Project Number: P1879

FIGURE B-4-10: P1879_SP_POST
CATEGORY B - 463L (15S - 492S/181S)
WED, APR 10 2019 13:33

Bus - Voltage (kV/pu)/Angle
Branch - MW/Mvar
Equipment - MW/Mvar
100.0%Rate A
1.000UV 0.900UV
kV: <=25.000 <=69.000 <=138.000 <=240.000 <=500.000 >500.000

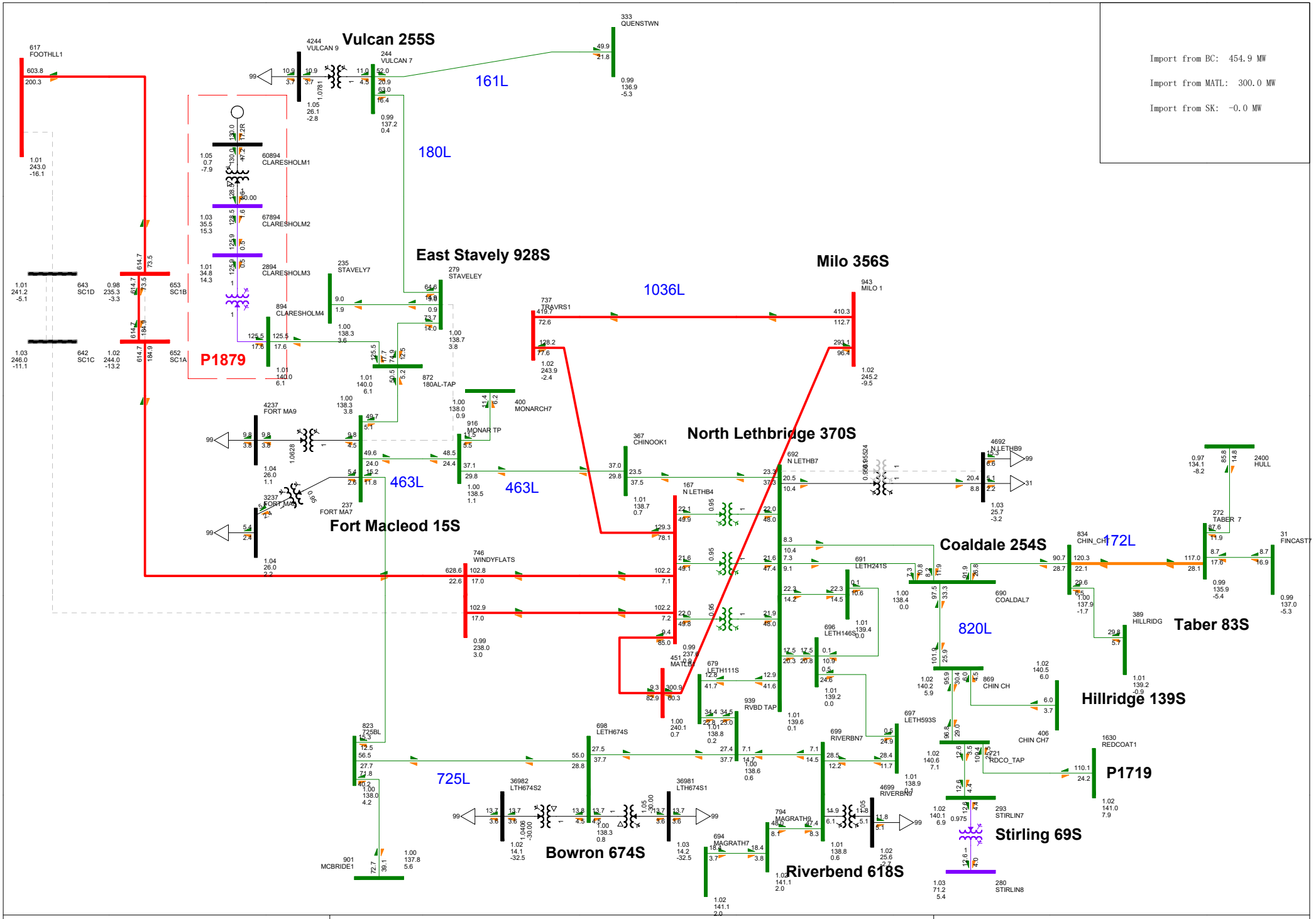


Claresholm Solar Project

AESO Project Number: P1879

FIGURE B-4-11: P1879_SP_POST
CATEGORY B - 172L (181S - 370S)
WED, APR 10 2019 13:34

Bus - Voltage (kV/pu)/Angle
Branch - MW/Mvar
Equipment - MW/Mvar
100.0%Rate A
1.100UV 0.900UV
kV: <=25.000 <=69.000 <=138.000 <=240.000 <=500.000 >500.000

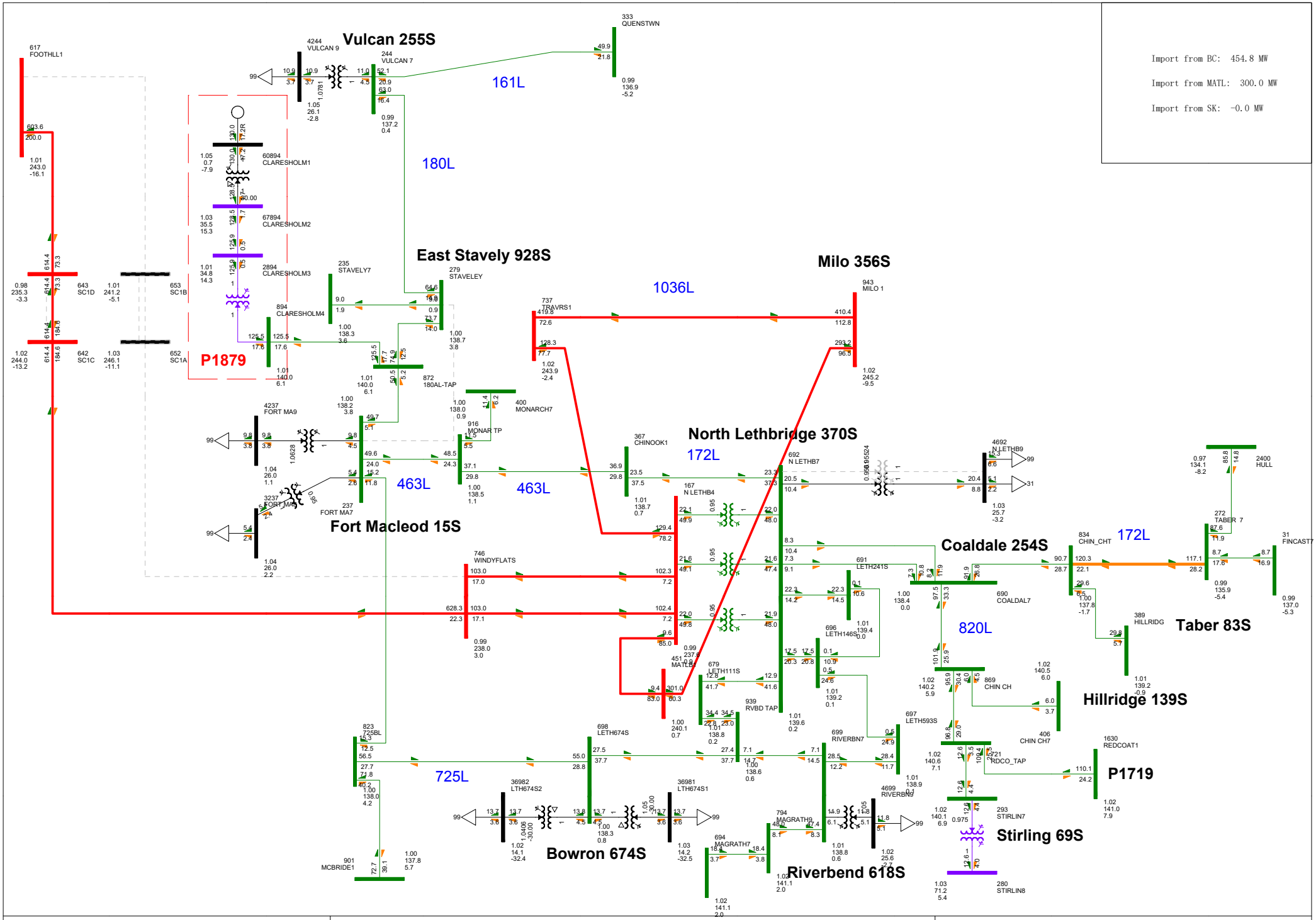


Claresholm Solar Project

AESO Project Number: P1879

FIGURE B-4-12: P1879_SP_POST
CATEGORY B - 1037L (138S - 237S)
WED, APR 10 2019 13:37

Bus - Voltage (kV/pu)/Angle
Branch - MW/Mvar
Equipment - MW/Mvar
100.0%Rate A
1.100UV 0.900UV
kV: <=25.000 <=69.000 <=138.000 <=240.000 <=500.000 >500.000



Claresholm Solar Project

AESO Project Number: P1879

FIGURE B-4-13: P1879_SP_POST
CATEGORY B - 1038L (138S - 237S)
WED, APR 10 2019 13:37

Bus - Voltage (kV/pu)/Angle
Branch - MW/Mvar
Equipment - MW/Mvar
100.0%Rate A
1.100UV 0.900UV
kV: <=25.000 <=69.000 <=138.000 <=240.000 <=500.000 >500.000

Attachment A4
Post-Project Transient Stability Diagrams

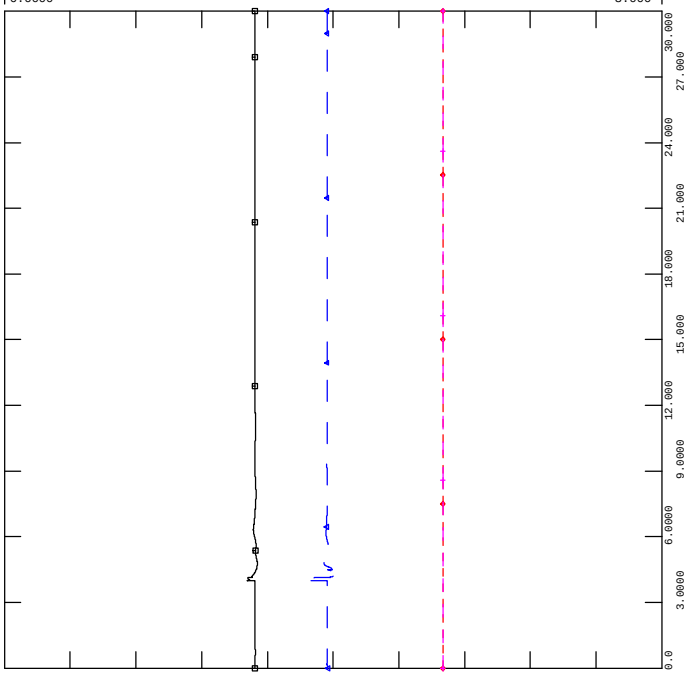
SCENARIO #3: 2020SL/POST PROJECT
CATB -180L_FAULT_AT_FORTMACLEOD15S

FILE: 180L_Fault_at_FortMacleod15S.out

THU, APR 11 2019 13:26

MACHINE POWER

CHNL# 8: [POWR 4690[COALDAL9 25.000]4]
CHNL# 7: [POWR 4235[STAVELY9 25.000]1]
CHNL# 6: [POWR 1482[SHEER 1 19.000]1]
CHNL# 5: [POWR 403[KEEP#3GN 22.000]3]



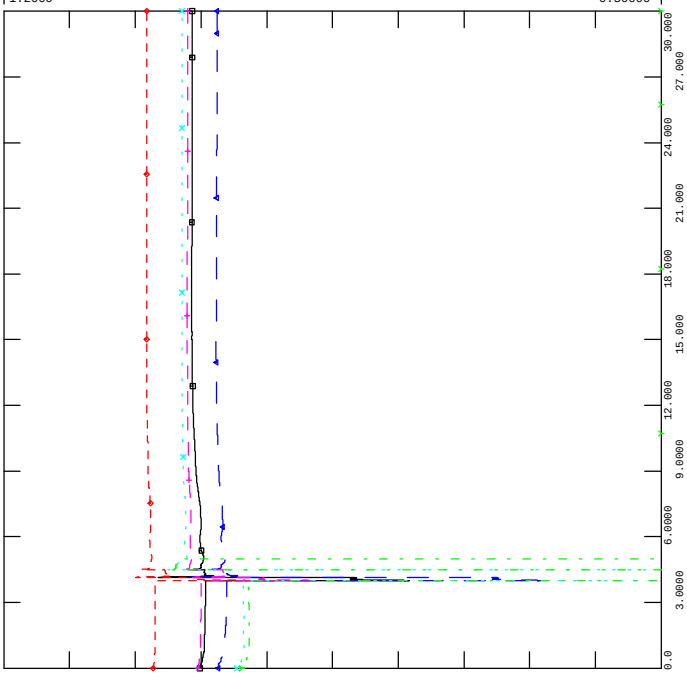
SCENARIO #3: 2020SL/POST PROJECT
CATB -180L_FAULT_AT_FORTMACLEOD15S

FILE: 180L_Fault_at_FortMacleod15S.out

THU, APR 11 2019 13:26

MACHINE VOLTAGE

CHNL# 18: [VOLT 279 [STAVELEY 138.00]]
CHNL# 17: [VOLT 244 [VULCAN 7 138.00]]
CHNL# 16: [VOLT 276 [W BROOK7 138.00]]
CHNL# 15: [VOLT 430 [W BROOK4 240.00]]
CHNL# 14: [VOLT 692 [N LETHB7 138.00]]
CHNL# 13: [VOLT 167 [N LETHB4 240.00]]



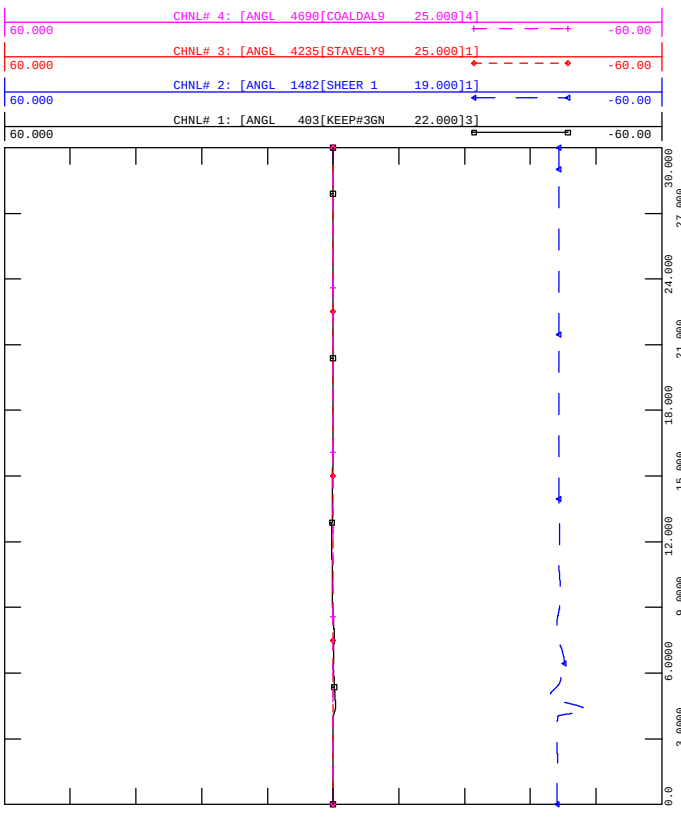
SCENARIO #3: 2020SL/POST PROJECT
CATB -180L_FAULT_AT_FORTMACLEOD15S

FILE: 180L_Fault_at_FortMacleod15S.out

THU, APR 11 2019 13:26

MACHINE ANGEL

CHNL# 4: [ANGL 4690[COALDAL9 25.000]4]
CHNL# 3: [ANGL 4235[STAVELY9 25.000]1]
CHNL# 2: [ANGL 1482[SHEER 1 19.000]1]
CHNL# 1: [ANGL 403[KEEP#3GN 22.000]3]



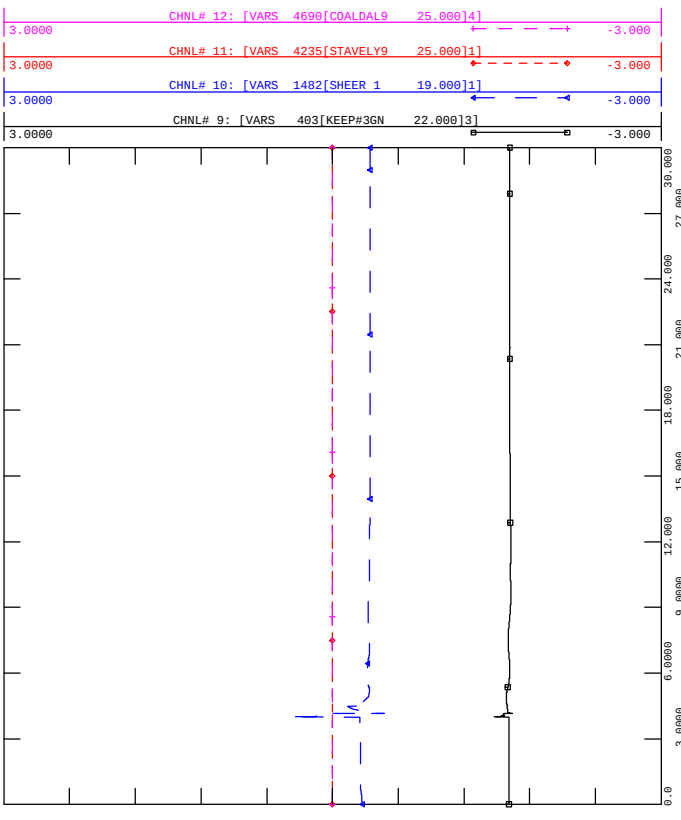
SCENARIO #3: 2020SL/POST PROJECT
CATB -180L_FAULT_AT_FORTMACLEOD15S

FILE: 180L_Fault_at_FortMacleod15S.out

THU, APR 11 2019 13:26

MACHINE VAR

CHNL# 12: [VARS 4690[COALDAL9 25.000]4]
CHNL# 11: [VARS 4235[STAVELY9 25.000]1]
CHNL# 10: [VARS 1482[SHEER 1 19.000]1]
CHNL# 9: [VARS 403[KEEP#3GN 22.000]3]



SCENARIO #3: 2020SL/POST PROJECT
CATB -180L_FAULT_AT_FORTMACLEOD15S

FILE: 180L_Fault_at_FortMacleod15S.out

THU, APR 11 2019 13:26 LINE VAR

CHNL# 33: [VARS 237 TO 916 CKT '63'] 400.00 -400.0
CHNL# 31: [VARS 737 TO 943 CKT '36'] 400.00 -400.0
CHNL# 29: [VARS 737 TO 167 CKT '41'] 400.00 -400.0
CHNL# 27: [VARS 451 TO 943 CKT '05'] 400.00 -400.0
CHNL# 25: [VARS 244 TO 333 CKT '61'] 400.00 -400.0
CHNL# 23: [VARS 367 TO 692 CKT '72'] 400.00 -400.0

TIME (SECONDS) 0.0 3.0000 6.0000 9.0000 12.000 15.000 18.000 21.000 24.000 27.000 30.000

SCENARIO #3: 2020SL/POST PROJECT
CATB -180L_FAULT_AT_VULCAN 255S

FILE: 180L_Fault_at_Vulcan 255S.out

THU, APR 11 2019 13:26 MACHINE POWER

CHNL# 8: [POWR 4690[COALDAL9 25.000]4] 6.0000 -3.000
CHNL# 7: [POWR 4235[STAVELY9 25.000]1] 6.0000 -3.000
CHNL# 6: [POWR 1482[SHEER 1 19.000]1] 6.0000 -3.000
CHNL# 5: [POWR 403[KEEP#3GN 22.000]3] 6.0000 -3.000

TIME (SECONDS) 0.0 3.0000 6.0000 9.0000 12.000 15.000 18.000 21.000 24.000 27.000 30.000

SCENARIO #3: 2020SL/POST PROJECT
CATB -180L_FAULT_AT_FORTMACLEOD15S

FILE: 180L_Fault_at_FortMacleod15S.out

THU, APR 11 2019 13:26 LINE POWER

CHNL# 32: [POWR 237 TO 916 CKT '63'] 500.00 -400.0
CHNL# 30: [POWR 737 TO 943 CKT '36'] 500.00 -400.0
CHNL# 28: [POWR 737 TO 167 CKT '41'] 500.00 -400.0
CHNL# 26: [POWR 451 TO 943 CKT '05'] 500.00 -400.0
CHNL# 24: [POWR 244 TO 333 CKT '61'] 500.00 -400.0
CHNL# 22: [POWR 367 TO 692 CKT '72'] 500.00 -400.0

TIME (SECONDS) 0.0 3.0000 6.0000 9.0000 12.000 15.000 18.000 21.000 24.000 27.000 30.000

SCENARIO #3: 2020SL/POST PROJECT
CATB -180L_FAULT_AT_VULCAN 255S

FILE: 180L_Fault_at_Vulcan 255S.out

THU, APR 11 2019 13:26 MACHINE ANGEL

CHNL# 4: [ANGL 4690[COALDAL9 25.000]4] 60.000 -60.00
CHNL# 3: [ANGL 4235[STAVELY9 25.000]1] 60.000 -60.00
CHNL# 2: [ANGL 1482[SHEER 1 19.000]1] 60.000 -60.00
CHNL# 1: [ANGL 403[KEEP#3GN 22.000]3] 60.000 -60.00

TIME (SECONDS) 0.0 3.0000 6.0000 9.0000 12.000 15.000 18.000 21.000 24.000 27.000 30.000

SCENARIO #3: 2020SL/POST PROJECT
CATB -180L_FAULT_AT_VULCAN 255S

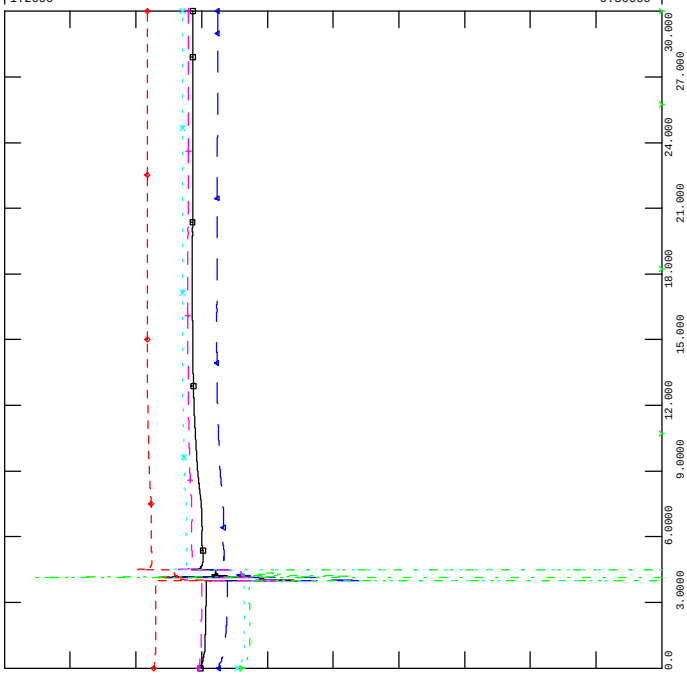
FILE: 180L_Fault_at_Vulcan 255S.out

THU, APR 11 2019 13:27

MACHINE VOLTAGE

CHNL# 18: [VOLT 279 [STAVELEY 138.00]]
CHNL# 17: [VOLT 244 [VULCAN 7 138.00]]
CHNL# 16: [VOLT 276 [W BROOK7 138.00]]
CHNL# 15: [VOLT 430 [W BROOK4 240.00]]
CHNL# 14: [VOLT 692 [N LETHB7 138.00]]
CHNL# 13: [VOLT 167 [N LETHB4 240.00]]

1.2000 0.50000



SCENARIO #3: 2020SL/POST PROJECT
CATB -180L_FAULT_AT_VULCAN 255S

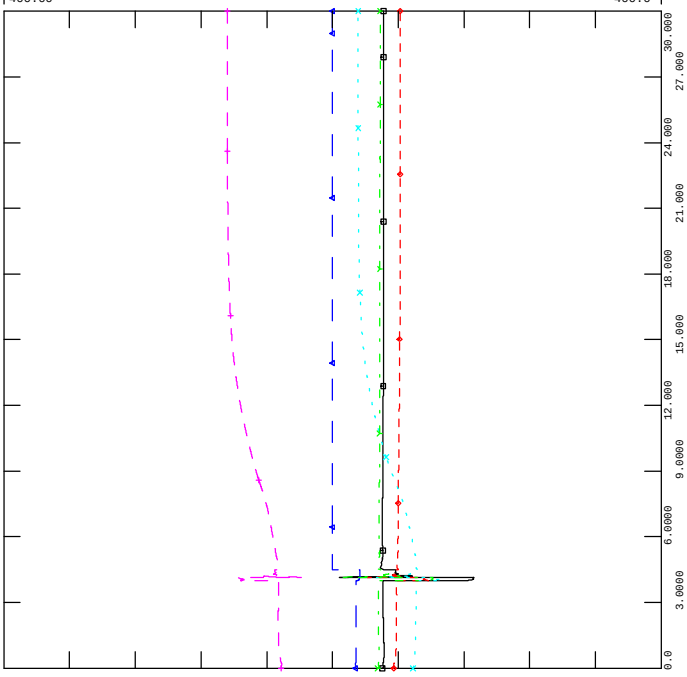
FILE: 180L_Fault_at_Vulcan 255S.out

THU, APR 11 2019 13:27

LINE VAR

CHNL# 33: [VARS 237 TO 916 CKT '63']
CHNL# 31: [VARS 737 TO 943 CKT '36']
CHNL# 29: [VARS 737 TO 167 CKT '41']
CHNL# 27: [VARS 451 TO 943 CKT '05']
CHNL# 25: [VARS 244 TO 333 CKT '61']
CHNL# 23: [VARS 367 TO 692 CKT '72']

400.00 -400.0



SCENARIO #3: 2020SL/POST PROJECT
CATB -180L_FAULT_AT_VULCAN 255S

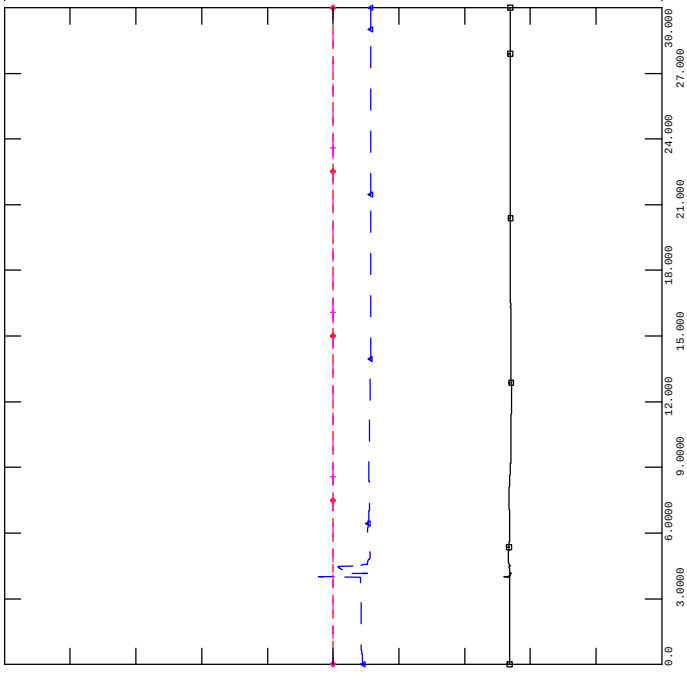
FILE: 180L_Fault_at_Vulcan 255S.out

THU, APR 11 2019 13:27

MACHINE VAR

CHNL# 12: [VARS 4690[COALDAL9 25.000]4]
CHNL# 11: [VARS 4235[STAVELY9 25.000]1]
CHNL# 10: [VARS 1482[SHEER 1 19.000]1]
CHNL# 9: [VARS 403[KEEP#3GN 22.000]3]

3.0000 -3.000



SCENARIO #3: 2020SL/POST PROJECT
CATB -180L_FAULT_AT_VULCAN 255S

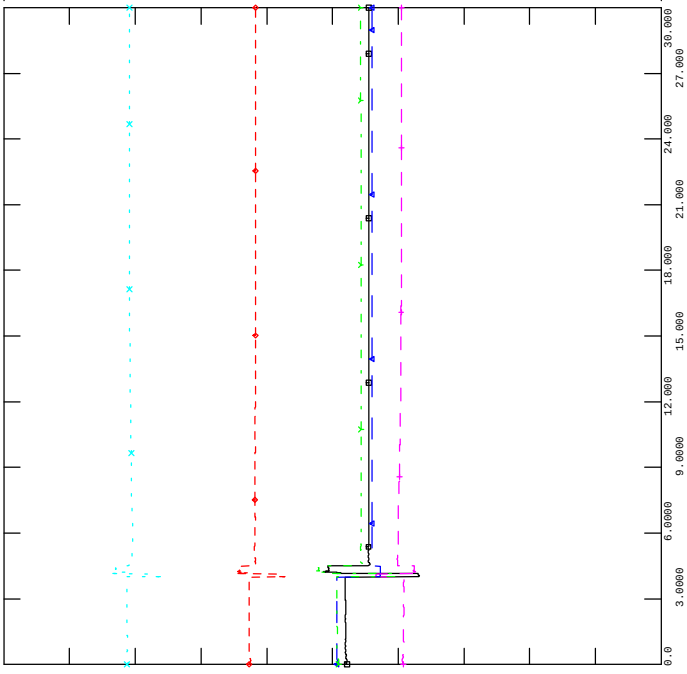
FILE: 180L_Fault_at_Vulcan 255S.out

THU, APR 11 2019 13:27

LINE POWER

CHNL# 32: [POWR 237 TO 916 CKT '63']
CHNL# 30: [POWR 737 TO 943 CKT '36']
CHNL# 28: [POWR 737 TO 167 CKT '41']
CHNL# 26: [POWR 451 TO 943 CKT '05']
CHNL# 24: [POWR 244 TO 333 CKT '61']
CHNL# 22: [POWR 367 TO 692 CKT '72']

500.00 -400.0

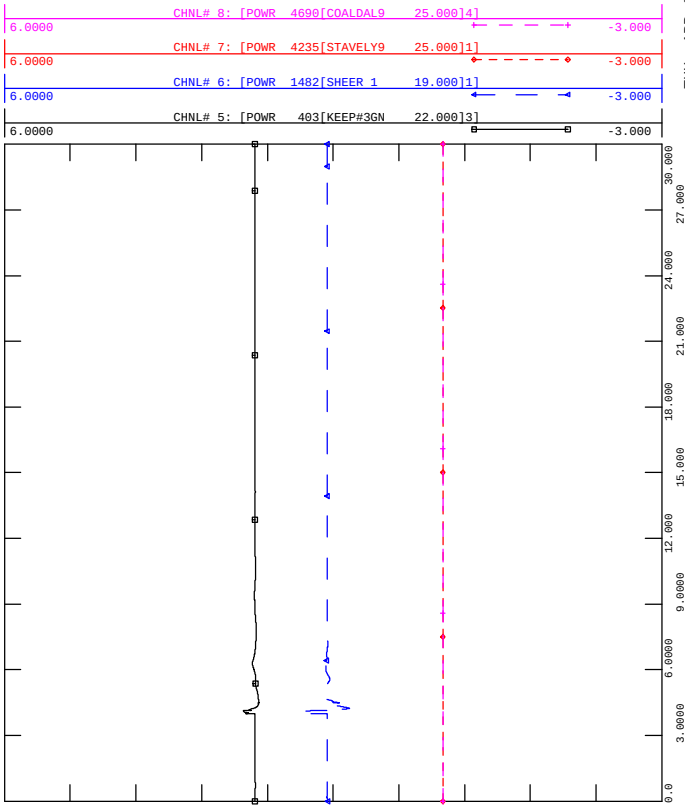


SCENARIO #3: 2020SL/POST PROJECT
CATB -463L_FAULT_AT_CHINOOK181S

FILE: 463L_Fault_at_Chinook181S.out

THU, APR 11 2019 13:27

MACHINE POWER

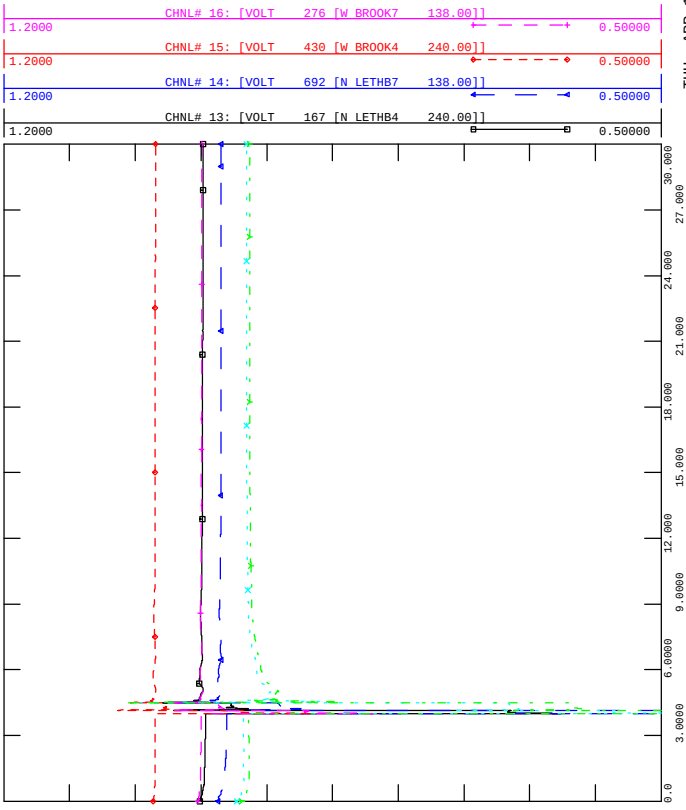


SCENARIO #3: 2020SL/POST PROJECT
CATB -463L_FAULT_AT_CHINOOK181S

FILE: 463L_Fault_at_Chinook181S.out

THU, APR 11 2019 13:27

MACHINE VOLTAGE

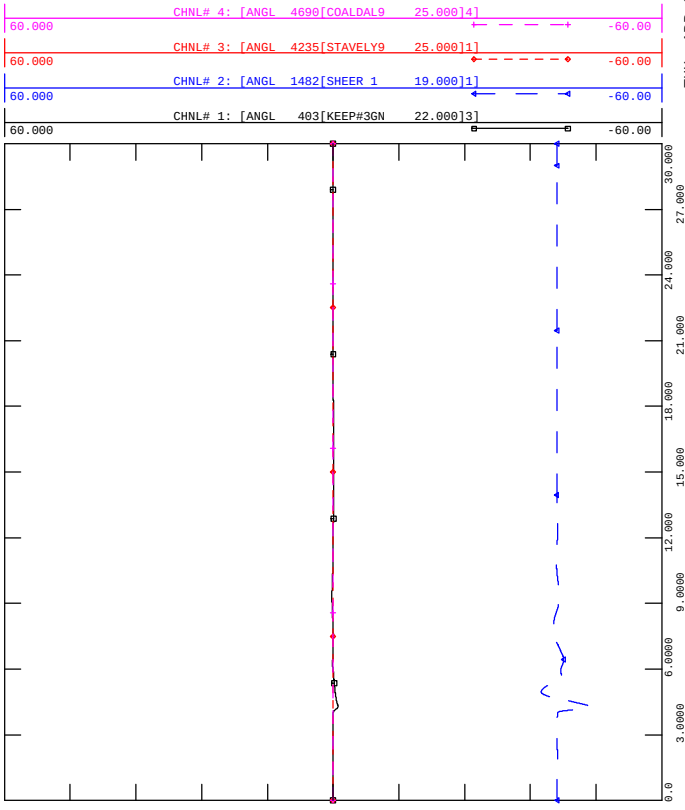


SCENARIO #3: 2020SL/POST PROJECT
CATB -463L_FAULT_AT_CHINOOK181S

FILE: 463L_Fault_at_Chinook181S.out

THU, APR 11 2019 13:27

MACHINE ANGEL

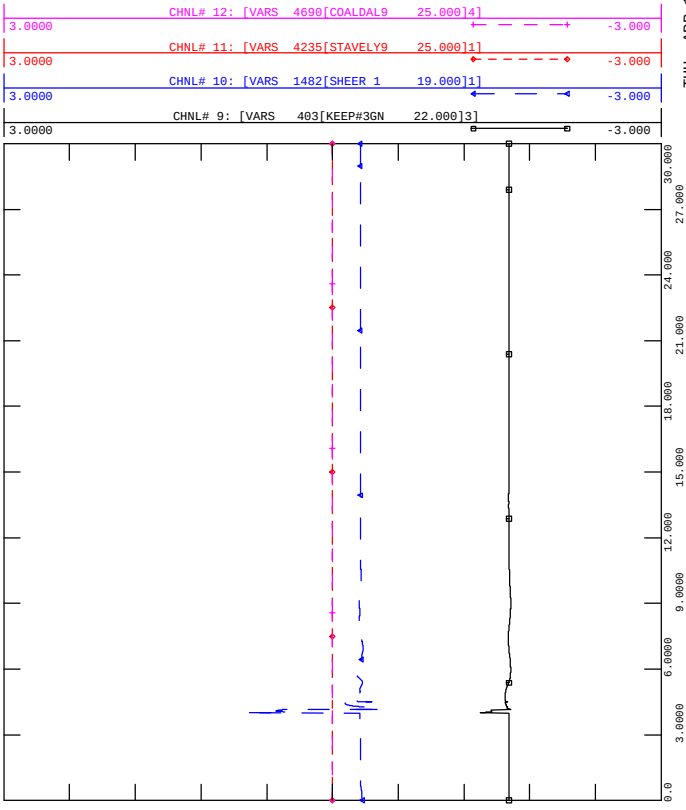


SCENARIO #3: 2020SL/POST PROJECT
CATB -463L_FAULT_AT_CHINOOK181S

FILE: 463L_Fault_at_Chinook181S.out

THU, APR 11 2019 13:27

MACHINE VAR



SCENARIO #3: 2020SL/POST PROJECT
CATB -463L_FAULT_AT_CHINOOK181S

FILE: 463L_Fault_at_Chinook181S.out

THU, APR 11 2019 13:27 LINE VAR

CHNL# 33: [VARS 237 TO 916 CKT '63']
CHNL# 31: [VARS 737 TO 943 CKT '36']
CHNL# 29: [VARS 737 TO 167 CKT '41']
CHNL# 27: [VARS 451 TO 943 CKT '05']
CHNL# 25: [VARS 244 TO 333 CKT '61']
CHNL# 23: [VARS 367 TO 692 CKT '72']

400.00 / -400.0

TIME (SECONDS)

0.0 3.0000 6.0000 9.0000 12.000 15.000 18.000 21.000 24.000 27.000 30.000

SCENARIO #3: 2020SL/POST PROJECT
CATB -463L_FAULT_AT_FORTMACLEOD15S

FILE: 463L_Fault_at_FortMacleod15S.out

THU, APR 11 2019 13:27 MACHINE POWER

CHNL# 8: [POWR 4690[COALDAL9 25.000]4]
CHNL# 7: [POWR 4235[STAVELY9 25.000]1]
CHNL# 6: [POWR 1482[SHEER 1 19.000]1]
CHNL# 5: [POWR 403[KEEP#3GN 22.000]3]

6.0000 / -3.000

TIME (SECONDS)

0.0 3.0000 6.0000 9.0000 12.000 15.000 18.000 21.000 24.000 27.000 30.000

SCENARIO #3: 2020SL/POST PROJECT
CATB -463L_FAULT_AT_CHINOOK181S

FILE: 463L_Fault_at_Chinook181S.out

THU, APR 11 2019 13:27 LINE POWER

CHNL# 32: [POWR 237 TO 916 CKT '63']
CHNL# 30: [POWR 737 TO 943 CKT '36']
CHNL# 28: [POWR 737 TO 167 CKT '41']
CHNL# 26: [POWR 451 TO 943 CKT '05']
CHNL# 24: [POWR 244 TO 333 CKT '61']
CHNL# 22: [POWR 367 TO 692 CKT '72']

500.00 / -400.0

TIME (SECONDS)

0.0 3.0000 6.0000 9.0000 12.000 15.000 18.000 21.000 24.000 27.000 30.000

SCENARIO #3: 2020SL/POST PROJECT
CATB -463L_FAULT_AT_FORTMACLEOD15S

FILE: 463L_Fault_at_FortMacleod15S.out

THU, APR 11 2019 13:27 MACHINE ANGEL

CHNL# 4: [ANGL 4690[COALDAL9 25.000]4]
CHNL# 3: [ANGL 4235[STAVELY9 25.000]1]
CHNL# 2: [ANGL 1482[SHEER 1 19.000]1]
CHNL# 1: [ANGL 403[KEEP#3GN 22.000]3]

60.000 / -60.00

TIME (SECONDS)

0.0 3.0000 6.0000 9.0000 12.000 15.000 18.000 21.000 24.000 27.000 30.000

SCENARIO #3: 2020SL/POST PROJECT
CATB -463L_FAULT_AT_FORTMACLEOD15S

FILE: 463L_Fault_at_FortMacleod15S.out

THU, APR 11 2019 13:27

MACHINE VOLTAGE

CHNL# 18: [VOLT 279 [STAVELEY 138.00]]
CHNL# 17: [VOLT 244 [VULCAN 7 138.00]]
CHNL# 16: [VOLT 276 [W BROOK7 138.00]]
CHNL# 15: [VOLT 430 [W BROOK4 240.00]]
CHNL# 14: [VOLT 692 [N LETHB7 138.00]]
CHNL# 13: [VOLT 167 [N LETHB4 240.00]]

1.2000 / 0.50000

0.0 / 3.0000 / 6.0000 / 9.0000 / 12.000 / 15.000 / 18.000 / 21.000 / 24.000 / 27.000 / 30.000

TIME (SECONDS)

SCENARIO #3: 2020SL/POST PROJECT
CATB -463L_FAULT_AT_FORTMACLEOD15S

FILE: 463L_Fault_at_FortMacleod15S.out

THU, APR 11 2019 13:27

LINE VAR

CHNL# 33: [VARS 237 TO 916 CKT '63']
CHNL# 31: [VARS 737 TO 943 CKT '36']
CHNL# 29: [VARS 737 TO 167 CKT '41']
CHNL# 27: [VARS 451 TO 943 CKT '05']
CHNL# 25: [VARS 244 TO 333 CKT '61']
CHNL# 23: [VARS 367 TO 692 CKT '72']

400.00 / -400.0

0.0 / 3.0000 / 6.0000 / 9.0000 / 12.000 / 15.000 / 18.000 / 21.000 / 24.000 / 27.000 / 30.000

TIME (SECONDS)

SCENARIO #3: 2020SL/POST PROJECT
CATB -463L_FAULT_AT_FORTMACLEOD15S

FILE: 463L_Fault_at_FortMacleod15S.out

THU, APR 11 2019 13:27

MACHINE VAR

CHNL# 12: [VARS 4690[COALDAL9 25.000]4]
CHNL# 11: [VARS 4235[STAVELY9 25.000]1]
CHNL# 10: [VARS 1482[SHEER 1 19.000]1]
CHNL# 9: [VARS 403[KEEP#3GN 22.000]3]

3.0000 / -3.000

0.0 / 3.0000 / 6.0000 / 9.0000 / 12.000 / 15.000 / 18.000 / 21.000 / 24.000 / 27.000 / 30.000

TIME (SECONDS)

SCENARIO #3: 2020SL/POST PROJECT
CATB -463L_FAULT_AT_FORTMACLEOD15S

FILE: 463L_Fault_at_FortMacleod15S.out

THU, APR 11 2019 13:27

LINE POWER

CHNL# 32: [POWR 237 TO 916 CKT '63']
CHNL# 30: [POWR 737 TO 943 CKT '36']
CHNL# 28: [POWR 737 TO 167 CKT '41']
CHNL# 26: [POWR 451 TO 943 CKT '05']
CHNL# 24: [POWR 244 TO 333 CKT '61']
CHNL# 22: [POWR 367 TO 692 CKT '72']

500.00 / -400.0

0.0 / 3.0000 / 6.0000 / 9.0000 / 12.000 / 15.000 / 18.000 / 21.000 / 24.000 / 27.000 / 30.000

TIME (SECONDS)

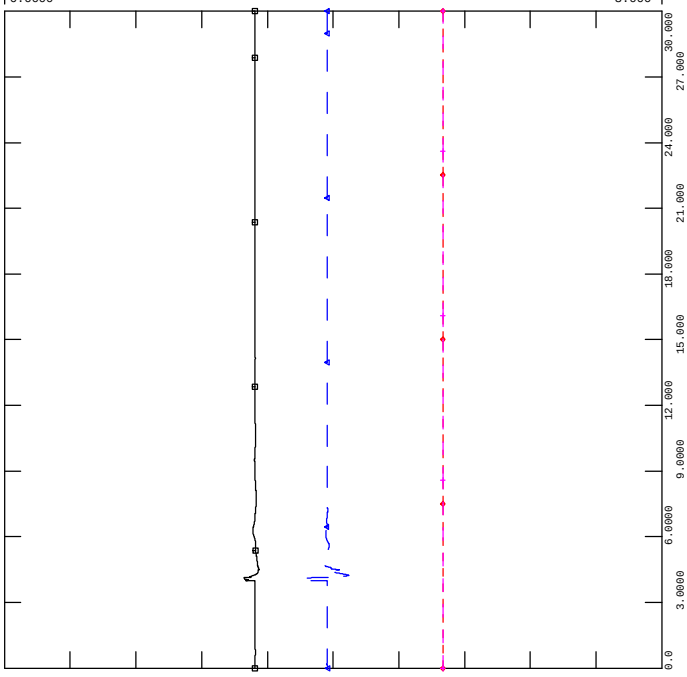
SCENARIO #3: 2020SL/POST PROJECT
CATB -725L_FAULT_AT_BOWRON674S

FILE: 725L_Fault_at_Bowron674S.out

THU, APR 11 2019 13:27

MACHINE POWER

CHNL# 8: [POWR 4690[COALDAL9 25.000]4] 6.0000 -3.000
CHNL# 7: [POWR 4235[STAVELY9 25.000]1] 6.0000 -3.000
CHNL# 6: [POWR 1482[SHEER 1 19.000]1] 6.0000 -3.000
CHNL# 5: [POWR 403[KEEP#3GN 22.000]3] 6.0000 -3.000



TIME (SECONDS)

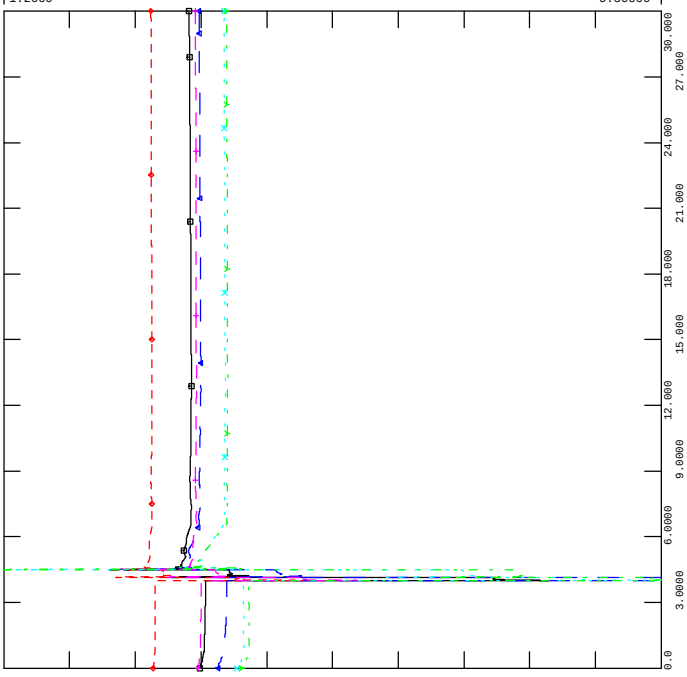
SCENARIO #3: 2020SL/POST PROJECT
CATB -725L_FAULT_AT_BOWRON674S

FILE: 725L_Fault_at_Bowron674S.out

THU, APR 11 2019 13:27

MACHINE VOLTAGE

CHNL# 18: [VOLT 279 [STAVELEY 138.00]] 1.2000 0.50000
CHNL# 17: [VOLT 244 [VULCAN 7 138.00]] 1.2000 0.50000
CHNL# 16: [VOLT 276 [W BROOK7 138.00]] 1.2000 0.50000
CHNL# 15: [VOLT 430 [W BROOK4 240.00]] 1.2000 0.50000
CHNL# 14: [VOLT 692 [N LETHB7 138.00]] 1.2000 0.50000
CHNL# 13: [VOLT 167 [N LETHB4 240.00]] 1.2000 0.50000



TIME (SECONDS)

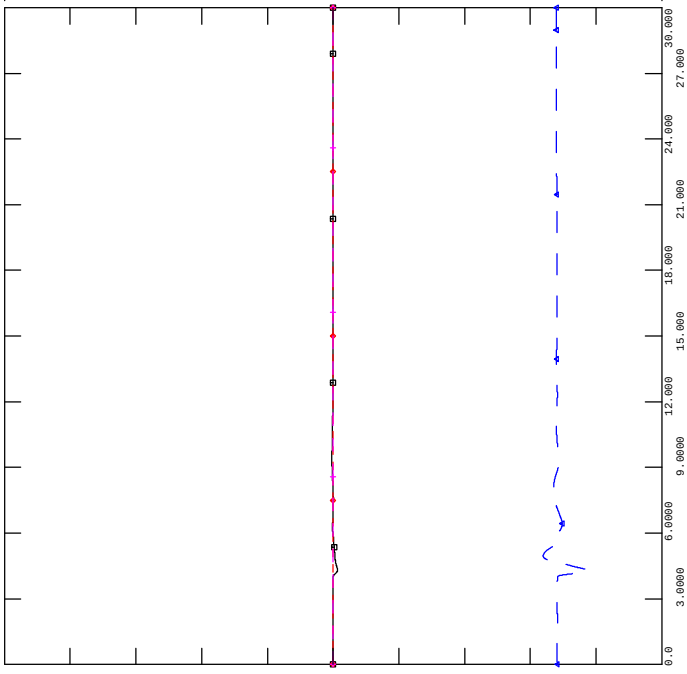
SCENARIO #3: 2020SL/POST PROJECT
CATB -725L_FAULT_AT_BOWRON674S

FILE: 725L_Fault_at_Bowron674S.out

THU, APR 11 2019 13:27

MACHINE ANGEL

CHNL# 4: [ANGL 4690[COALDAL9 25.000]4] 60.000 -60.00
CHNL# 3: [ANGL 4235[STAVELY9 25.000]1] 60.000 -60.00
CHNL# 2: [ANGL 1482[SHEER 1 19.000]1] 60.000 -60.00
CHNL# 1: [ANGL 403[KEEP#3GN 22.000]3] 60.000 -60.00



TIME (SECONDS)

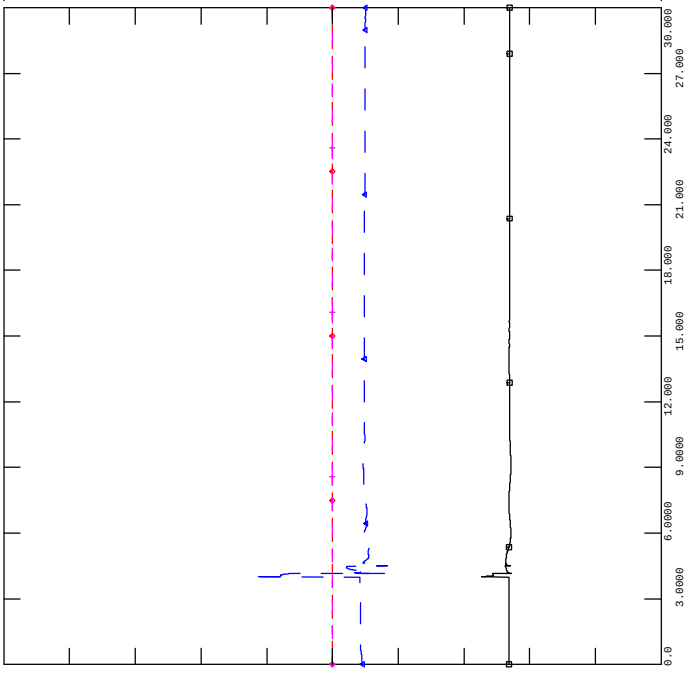
SCENARIO #3: 2020SL/POST PROJECT
CATB -725L_FAULT_AT_BOWRON674S

FILE: 725L_Fault_at_Bowron674S.out

THU, APR 11 2019 13:27

MACHINE VAR

CHNL# 12: [VARS 4690[COALDAL9 25.000]4] 3.0000 -3.000
CHNL# 11: [VARS 4235[STAVELY9 25.000]1] 3.0000 -3.000
CHNL# 10: [VARS 1482[SHEER 1 19.000]1] 3.0000 -3.000
CHNL# 9: [VARS 403[KEEP#3GN 22.000]3] 3.0000 -3.000



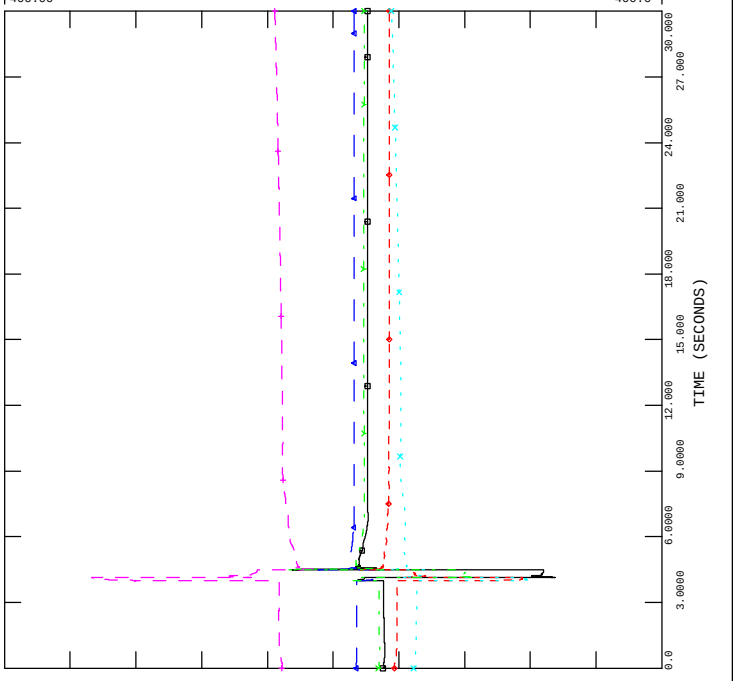
TIME (SECONDS)

SCENARIO #3: 2020SL/POST PROJECT
CATB -725L_FAULT_AT_BOWRON674S

FILE: 725L_Fault_at_Bowron674S.out

THU, APR 11 2019 13:27 LINE VAR

CHNL# 33: [VARS 237 TO 916 CKT '63']
CHNL# 31: [VARS 737 TO 943 CKT '36']
CHNL# 29: [VARS 737 TO 167 CKT '41']
CHNL# 27: [VARS 451 TO 943 CKT '05']
CHNL# 25: [VARS 244 TO 333 CKT '61']
CHNL# 23: [VARS 367 TO 692 CKT '72']

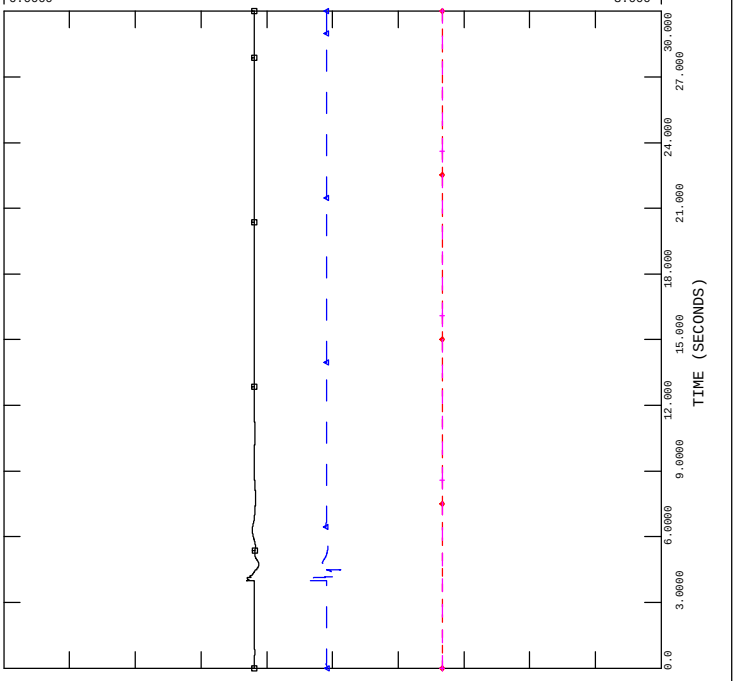


SCENARIO #3: 2020SL/POST PROJECT
CATB -725L_FAULT_AT_FORTMACLEOD15S

FILE: 725L_Fault_at_FortMacleod15S.out

THU, APR 11 2019 13:27 MACHINE POWER

CHNL# 8: [POWR 4690[COALDAL9 25.000]4]
CHNL# 7: [POWR 4235[STAVELY9 25.000]1]
CHNL# 6: [POWR 1482[SHEER 1 19.000]1]
CHNL# 5: [POWR 403[KEEP#3GN 22.000]3]

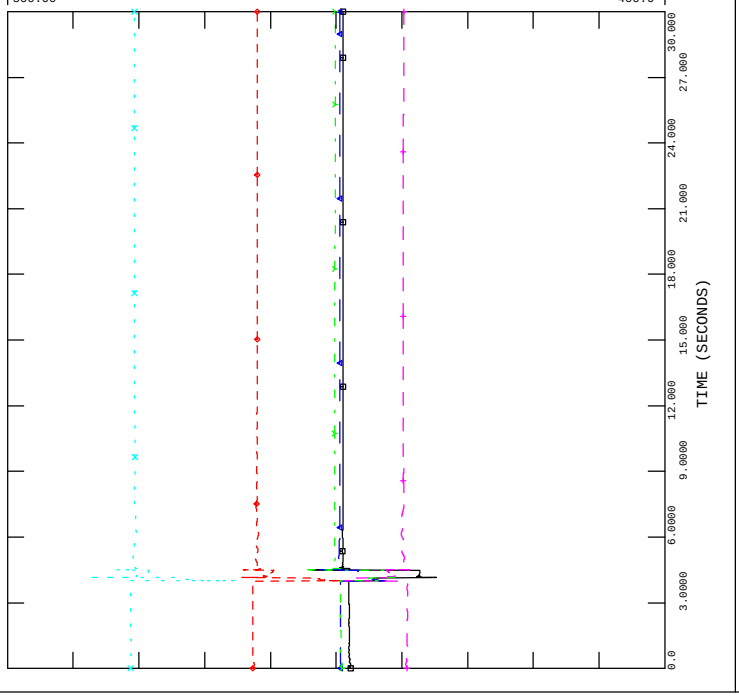


SCENARIO #3: 2020SL/POST PROJECT
CATB -725L_FAULT_AT_BOWRON674S

FILE: 725L_Fault_at_Bowron674S.out

THU, APR 11 2019 13:27 LINE POWER

CHNL# 32: [POWR 237 TO 916 CKT '63']
CHNL# 30: [POWR 737 TO 943 CKT '36']
CHNL# 28: [POWR 737 TO 167 CKT '41']
CHNL# 26: [POWR 451 TO 943 CKT '05']
CHNL# 24: [POWR 244 TO 333 CKT '61']
CHNL# 22: [POWR 367 TO 692 CKT '72']

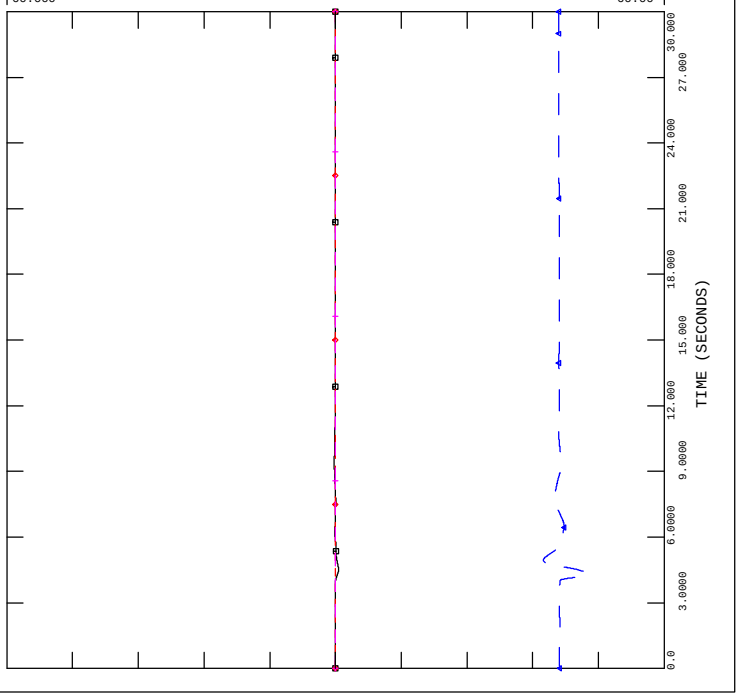


SCENARIO #3: 2020SL/POST PROJECT
CATB -725L_FAULT_AT_FORTMACLEOD15S

FILE: 725L_Fault_at_FortMacleod15S.out

THU, APR 11 2019 13:27 MACHINE ANGEL

CHNL# 4: [ANGL 4690[COALDAL9 25.000]4]
CHNL# 3: [ANGL 4235[STAVELY9 25.000]1]
CHNL# 2: [ANGL 1482[SHEER 1 19.000]1]
CHNL# 1: [ANGL 403[KEEP#3GN 22.000]3]



SCENARIO #3: 2020SL/POST PROJECT
CATB -725L_FAULT_AT_FORTMACLEOD15S

FILE: 725L_Fault_at_FortMacleod15S.out

THU, APR 11 2019 13:27

MACHINE VOLTAGE

CHNL# 18: [VOLT 279 [STAVELEY 138.00]]
CHNL# 17: [VOLT 244 [VULCAN 7 138.00]]
CHNL# 16: [VOLT 276 [W BROOK7 138.00]]
CHNL# 15: [VOLT 430 [W BROOK4 240.00]]
CHNL# 14: [VOLT 692 [N LETHB7 138.00]]
CHNL# 13: [VOLT 167 [N LETHB4 240.00]]

1.2000 0.50000

TIME (SECONDS)

0.0 3.0000 6.0000 9.0000 12.000 15.000 18.000 21.000 24.000 27.000 30.000

SCENARIO #3: 2020SL/POST PROJECT
CATB -725L_FAULT_AT_FORTMACLEOD15S

FILE: 725L_Fault_at_FortMacleod15S.out

THU, APR 11 2019 13:27

LINE VAR

CHNL# 33: [VARS 237 TO 916 CKT '63']
CHNL# 31: [VARS 737 TO 943 CKT '36']
CHNL# 29: [VARS 737 TO 167 CKT '41']
CHNL# 27: [VARS 451 TO 943 CKT '05']
CHNL# 25: [VARS 244 TO 333 CKT '61']
CHNL# 23: [VARS 367 TO 692 CKT '72']

400.00 -400.0

TIME (SECONDS)

0.0 3.0000 6.0000 9.0000 12.000 15.000 18.000 21.000 24.000 27.000 30.000

SCENARIO #3: 2020SL/POST PROJECT
CATB -725L_FAULT_AT_FORTMACLEOD15S

FILE: 725L_Fault_at_FortMacleod15S.out

THU, APR 11 2019 13:27

MACHINE VAR

CHNL# 12: [VARS 4690[COALDAL9 25.000]4]
CHNL# 11: [VARS 4235[STAVELY9 25.000]1]
CHNL# 10: [VARS 1482[SHEER 1 19.000]1]
CHNL# 9: [VARS 403[KEEP#3GN 22.000]3]

3.0000 -3.000

TIME (SECONDS)

0.0 3.0000 6.0000 9.0000 12.000 15.000 18.000 21.000 24.000 27.000 30.000

SCENARIO #3: 2020SL/POST PROJECT
CATB -725L_FAULT_AT_FORTMACLEOD15S

FILE: 725L_Fault_at_FortMacleod15S.out

THU, APR 11 2019 13:27

LINE POWER

CHNL# 32: [POWR 237 TO 916 CKT '63']
CHNL# 30: [POWR 737 TO 943 CKT '36']
CHNL# 28: [POWR 737 TO 167 CKT '41']
CHNL# 26: [POWR 451 TO 943 CKT '05']
CHNL# 24: [POWR 244 TO 333 CKT '61']
CHNL# 22: [POWR 367 TO 692 CKT '72']

500.00 -400.0

TIME (SECONDS)

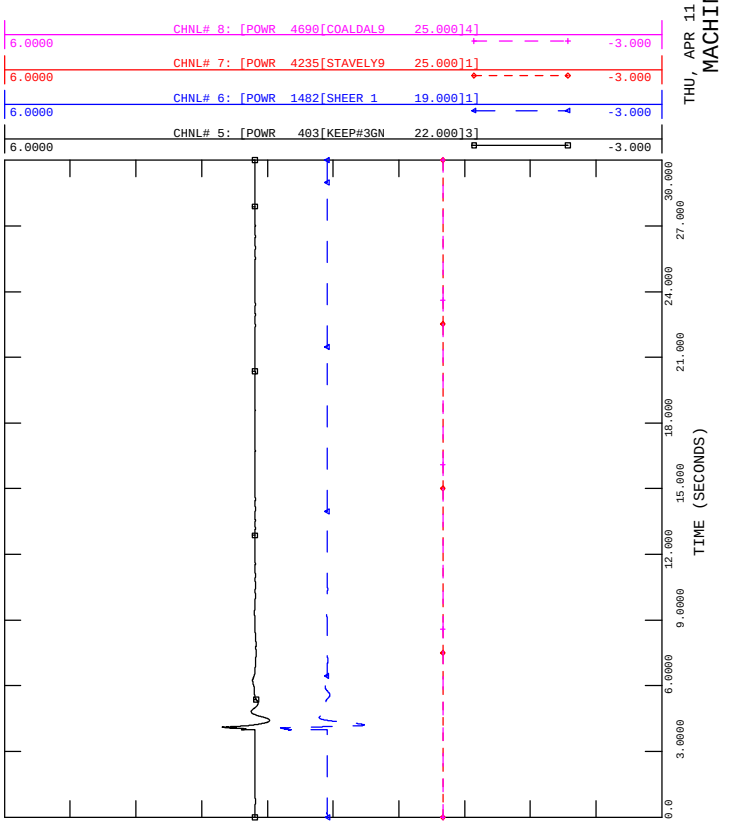
0.0 3.0000 6.0000 9.0000 12.000 15.000 18.000 21.000 24.000 27.000 30.000

SCENARIO #3: 2020SL/POST PROJECT
CATB -1041L_FAULT_AT_NORTHLETHBRIDGE370S

FILE: 1041L_Fault_at_NorthLethbridge370S.out

THU, APR 11 2019 13:27

MACHINE POWER

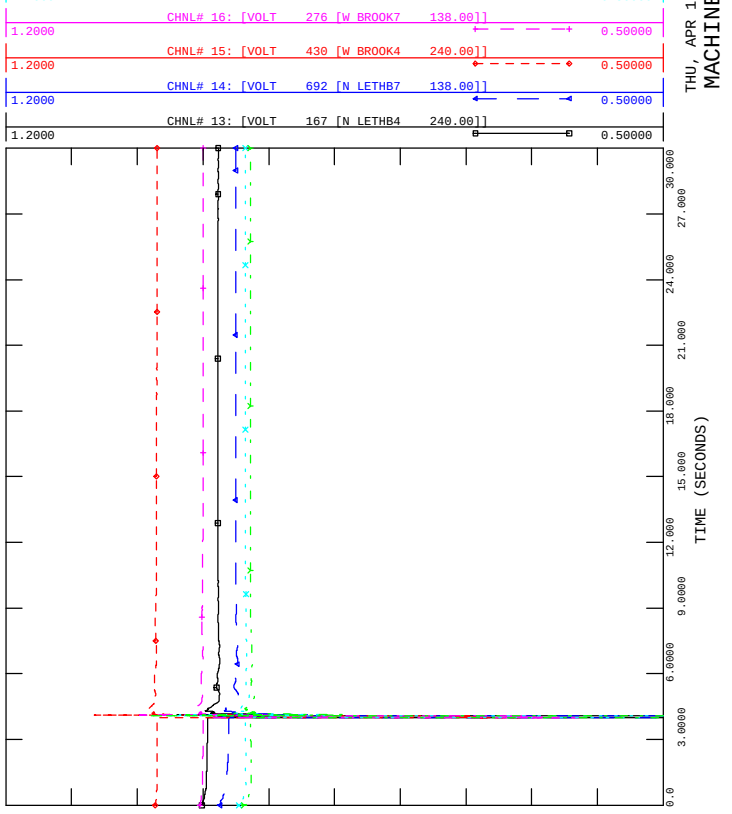


SCENARIO #3: 2020SL/POST PROJECT
CATB -1041L_FAULT_AT_NORTHLETHBRIDGE370S

FILE: 1041L_Fault_at_NorthLethbridge370S.out

THU, APR 11 2019 13:27

MACHINE VOLTAGE

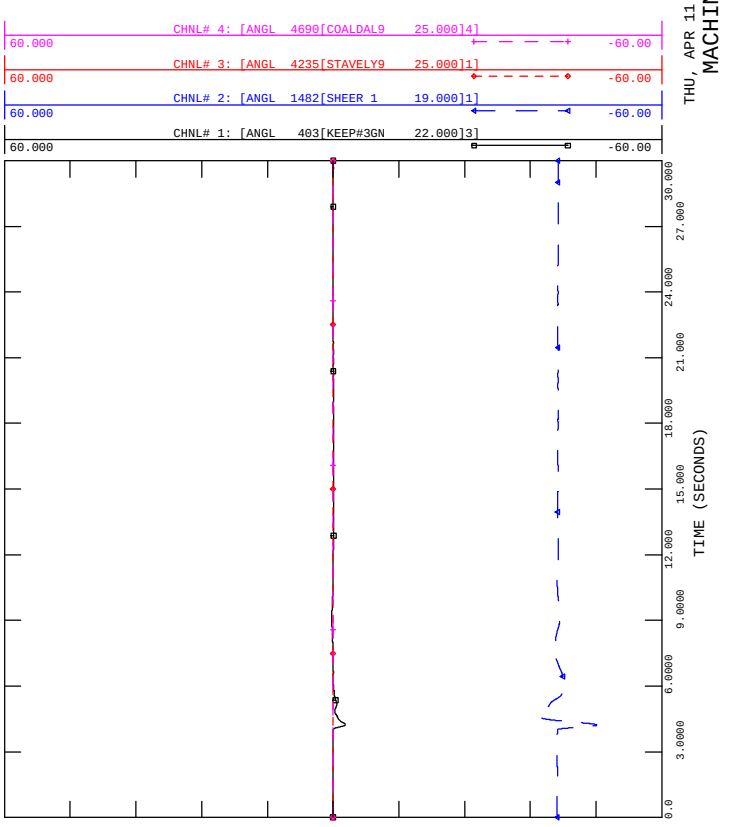


SCENARIO #3: 2020SL/POST PROJECT
CATB -1041L_FAULT_AT_NORTHLETHBRIDGE370S

FILE: 1041L_Fault_at_NorthLethbridge370S.out

THU, APR 11 2019 13:27

MACHINE ANGEL

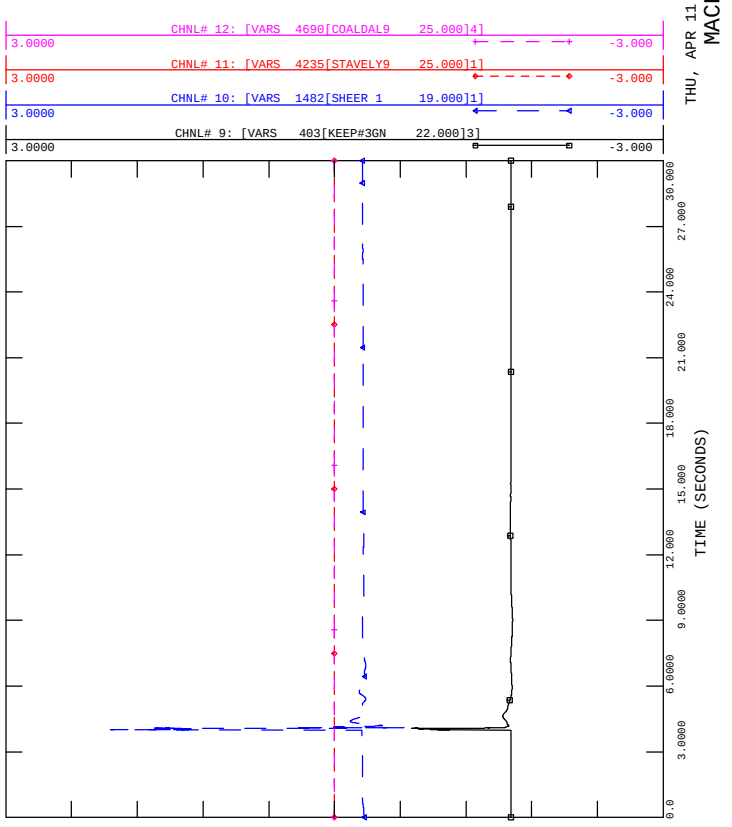


SCENARIO #3: 2020SL/POST PROJECT
CATB -1041L_FAULT_AT_NORTHLETHBRIDGE370S

FILE: 1041L_Fault_at_NorthLethbridge370S.out

THU, APR 11 2019 13:27

MACHINE VAR



SCENARIO #3: 2020SL/POST PROJECT
CATB -1041L_FAULT_AT_NORTHLETHBRIDGE370S

FILE: 1041L_Fault_at_NorthLethbridge370S.out

THU, APR 11 2019 13:27

LINE VAR

CHNL# 33: [VARS 237 TO 916 CKT '63']
CHNL# 31: [VARS 737 TO 943 CKT '36']
CHNL# 29: [VARS 737 TO 167 CKT '41']
CHNL# 27: [VARS 451 TO 943 CKT '05']
CHNL# 25: [VARS 244 TO 333 CKT '61']
CHNL# 23: [VARS 367 TO 692 CKT '72']

400.00 / -400.0

TIME (SECONDS)

0.0 3.0000 6.0000 9.0000 12.000 15.000 18.000 21.000 24.000 27.000 30.000

SCENARIO #3: 2020SL/POST PROJECT
CATB -1041L_FAULT_AT_TRAVERS554S

FILE: 1041L_Fault_at_Travers554S.out

THU, APR 11 2019 13:27

MACHINE POWER

CHNL# 8: [POWR 4690[COALDAL9 25.000]4]
CHNL# 7: [POWR 4235[STAVELY9 25.000]1]
CHNL# 6: [POWR 1482[SHEER 1 19.000]1]
CHNL# 5: [POWR 403[KEEP#3GN 22.000]3]

6.0000 / -3.000

TIME (SECONDS)

0.0 3.0000 6.0000 9.0000 12.000 15.000 18.000 21.000 24.000 27.000 30.000

SCENARIO #3: 2020SL/POST PROJECT
CATB -1041L_FAULT_AT_NORTHLETHBRIDGE370S

FILE: 1041L_Fault_at_NorthLethbridge370S.out

THU, APR 11 2019 13:27

LINE POWER

CHNL# 32: [POWR 237 TO 916 CKT '63']
CHNL# 30: [POWR 737 TO 943 CKT '36']
CHNL# 28: [POWR 737 TO 167 CKT '41']
CHNL# 26: [POWR 451 TO 943 CKT '05']
CHNL# 24: [POWR 244 TO 333 CKT '61']
CHNL# 22: [POWR 367 TO 692 CKT '72']

500.00 / -400.0

TIME (SECONDS)

0.0 3.0000 6.0000 9.0000 12.000 15.000 18.000 21.000 24.000 27.000 30.000

SCENARIO #3: 2020SL/POST PROJECT
CATB -1041L_FAULT_AT_TRAVERS554S

FILE: 1041L_Fault_at_Travers554S.out

THU, APR 11 2019 13:27

MACHINE ANGEL

CHNL# 4: [ANGL 4690[COALDAL9 25.000]4]
CHNL# 3: [ANGL 4235[STAVELY9 25.000]1]
CHNL# 2: [ANGL 1482[SHEER 1 19.000]1]
CHNL# 1: [ANGL 403[KEEP#3GN 22.000]3]

60.000 / -60.00

TIME (SECONDS)

0.0 3.0000 6.0000 9.0000 12.000 15.000 18.000 21.000 24.000 27.000 30.000

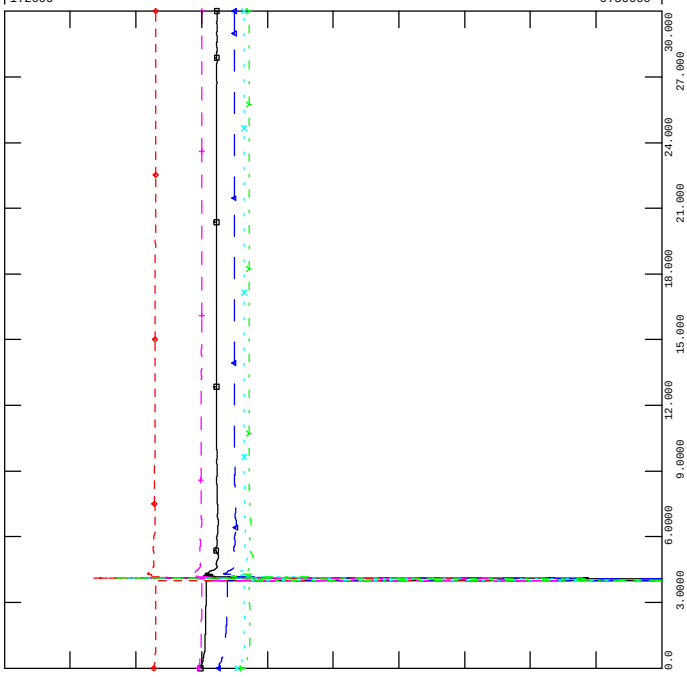
SCENARIO #3: 2020SL/POST PROJECT
CATB -1041L_FAULT_AT_TRAVERS554S

FILE: 1041L_Fault_at_Travers554S.out

THU, APR 11 2019 13:27

MACHINE VOLTAGE

CHNL# 18: [VOLT 279 [STAVELEY 138.00]] 1.2000 0.50000
CHNL# 17: [VOLT 244 [VULCAN 7 138.00]] 1.2000 0.50000
CHNL# 16: [VOLT 276 [W BROOK7 138.00]] 1.2000 0.50000
CHNL# 15: [VOLT 430 [W BROOK4 240.00]] 1.2000 0.50000
CHNL# 14: [VOLT 692 [N LETHB7 138.00]] 1.2000 0.50000
CHNL# 13: [VOLT 167 [N LETHB4 240.00]] 1.2000 0.50000



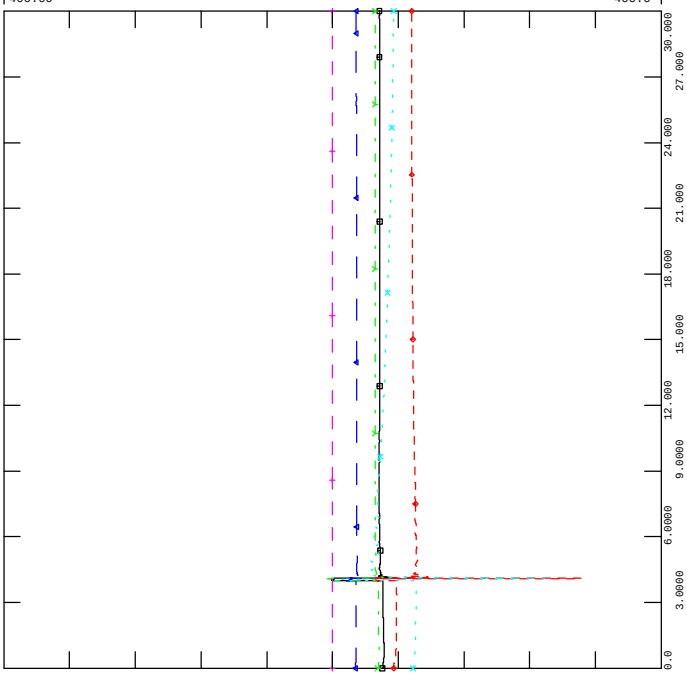
SCENARIO #3: 2020SL/POST PROJECT
CATB -1041L_FAULT_AT_TRAVERS554S

FILE: 1041L_Fault_at_Travers554S.out

THU, APR 11 2019 13:27

LINE VAR

CHNL# 33: [VARS 237 TO 916 CKT '63'] 400.00 -400.0
CHNL# 31: [VARS 737 TO 943 CKT '36'] 400.00 -400.0
CHNL# 29: [VARS 737 TO 167 CKT '41'] 400.00 -400.0
CHNL# 27: [VARS 451 TO 943 CKT '05'] 400.00 -400.0
CHNL# 25: [VARS 244 TO 333 CKT '61'] 400.00 -400.0
CHNL# 23: [VARS 367 TO 692 CKT '72'] 400.00 -400.0



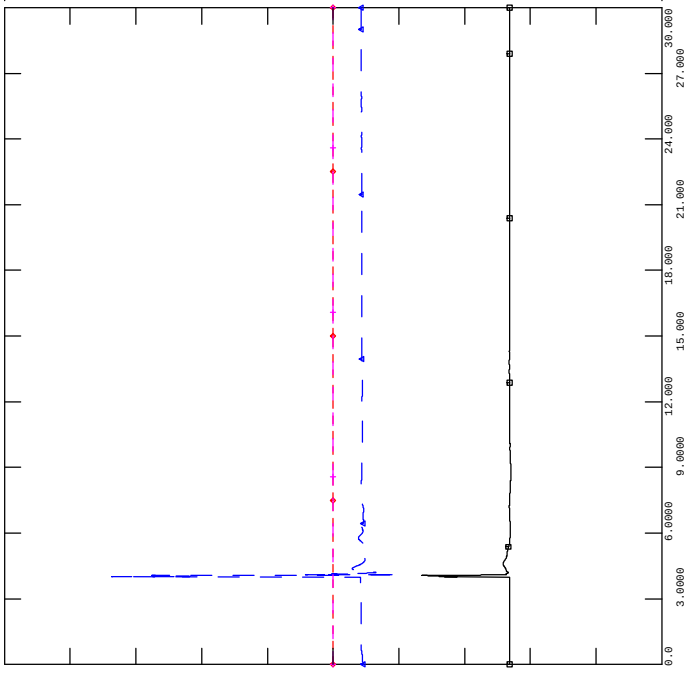
SCENARIO #3: 2020SL/POST PROJECT
CATB -1041L_FAULT_AT_TRAVERS554S

FILE: 1041L_Fault_at_Travers554S.out

THU, APR 11 2019 13:27

MACHINE VAR

CHNL# 12: [VARS 4690[COALDAL9 25.000]4] 3.0000 -3.000
CHNL# 11: [VARS 4235[STAVELY9 25.000]1] 3.0000 -3.000
CHNL# 10: [VARS 1482[SHEER 1 19.000]1] 3.0000 -3.000
CHNL# 9: [VARS 403[KEEP#3GN 22.000]3] 3.0000 -3.000



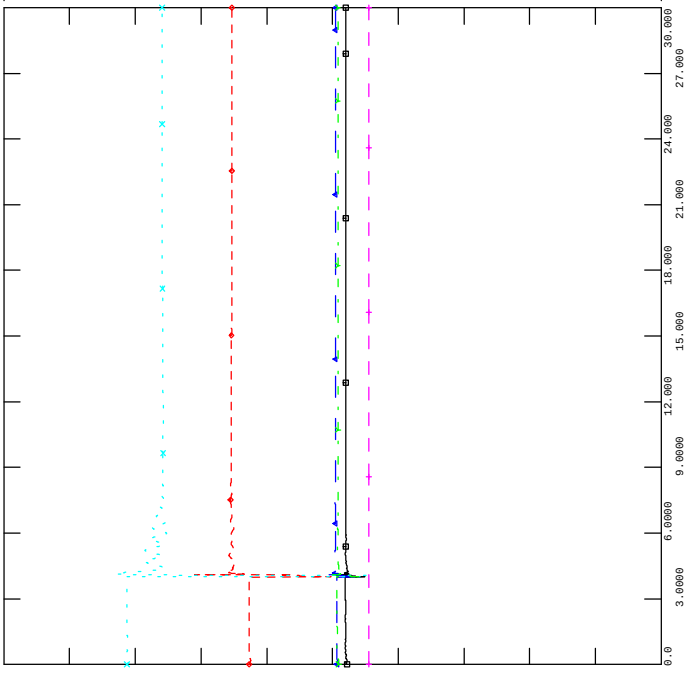
SCENARIO #3: 2020SL/POST PROJECT
CATB -1041L_FAULT_AT_TRAVERS554S

FILE: 1041L_Fault_at_Travers554S.out

THU, APR 11 2019 13:27

LINE POWER

CHNL# 32: [POWR 237 TO 916 CKT '63'] 500.00 -400.0
CHNL# 30: [POWR 737 TO 943 CKT '36'] 500.00 -400.0
CHNL# 28: [POWR 737 TO 167 CKT '41'] 500.00 -400.0
CHNL# 26: [POWR 451 TO 943 CKT '05'] 500.00 -400.0
CHNL# 24: [POWR 244 TO 333 CKT '61'] 500.00 -400.0
CHNL# 22: [POWR 367 TO 692 CKT '72'] 500.00 -400.0



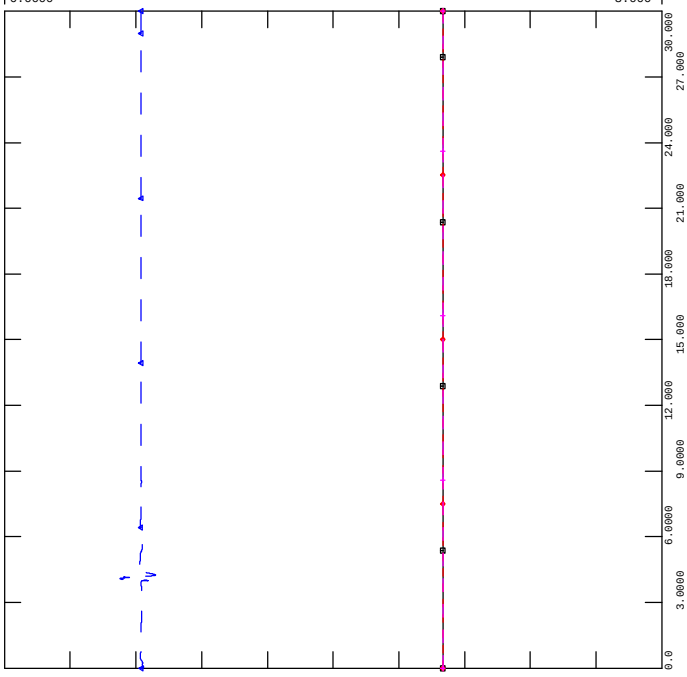
SCENARIO #4: 2020SP/POST PROJECT
CATB -180L_FAULT_AT_FORTMACLEOD15S

FILE: 180L_Fault_at_FortMacleod15S.out

THU, APR 11 2019 13:27

MACHINE POWER

CHNL# 8: [POWR 4690[COALDAL9 25.000]4]
CHNL# 7: [POWR 4235[STAVELY9 25.000]1]
CHNL# 6: [POWR 1482[SHEER 1 19.000]1]
CHNL# 5: [POWR 403[KEEP#3GN 22.000]3]



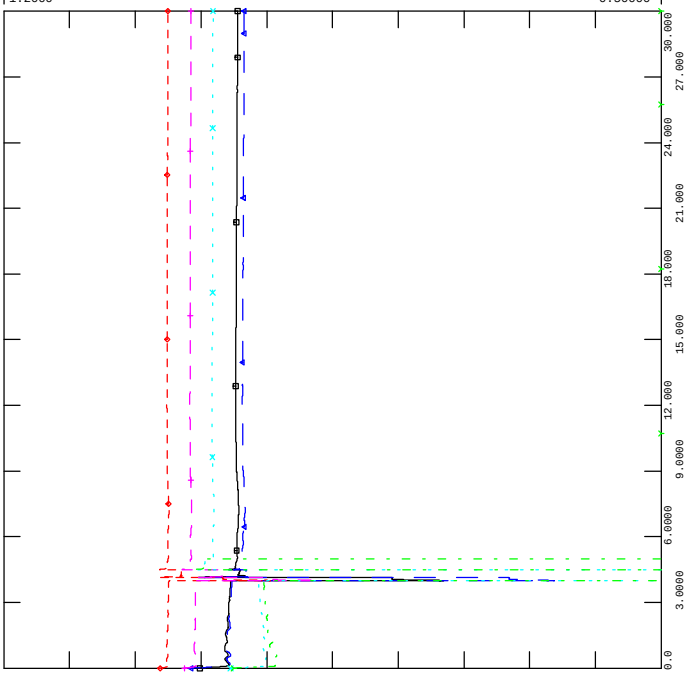
SCENARIO #4: 2020SP/POST PROJECT
CATB -180L_FAULT_AT_FORTMACLEOD15S

FILE: 180L_Fault_at_FortMacleod15S.out

THU, APR 11 2019 13:27

MACHINE VOLTAGE

CHNL# 18: [VOLT 279 [STAVELEY 138.00]]
CHNL# 17: [VOLT 244 [VULCAN 7 138.00]]
CHNL# 16: [VOLT 276 [W BROOK7 138.00]]
CHNL# 15: [VOLT 430 [W BROOK4 240.00]]
CHNL# 14: [VOLT 692 [N LETHB7 138.00]]
CHNL# 13: [VOLT 167 [N LETHB4 240.00]]



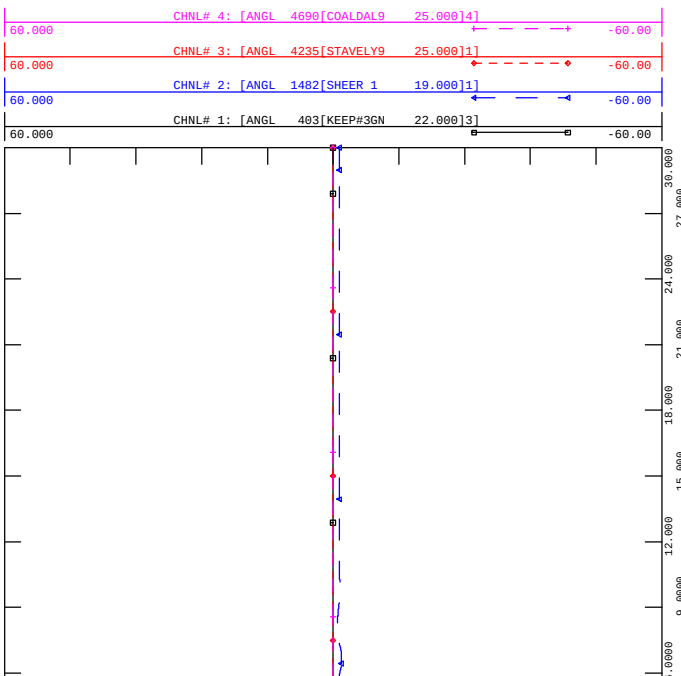
SCENARIO #4: 2020SP/POST PROJECT
CATB -180L_FAULT_AT_FORTMACLEOD15S

FILE: 180L_Fault_at_FortMacleod15S.out

THU, APR 11 2019 13:27

MACHINE ANGEL

CHNL# 4: [ANGL 4690[COALDAL9 25.000]4]
CHNL# 3: [ANGL 4235[STAVELY9 25.000]1]
CHNL# 2: [ANGL 1482[SHEER 1 19.000]1]
CHNL# 1: [ANGL 403[KEEP#3GN 22.000]3]



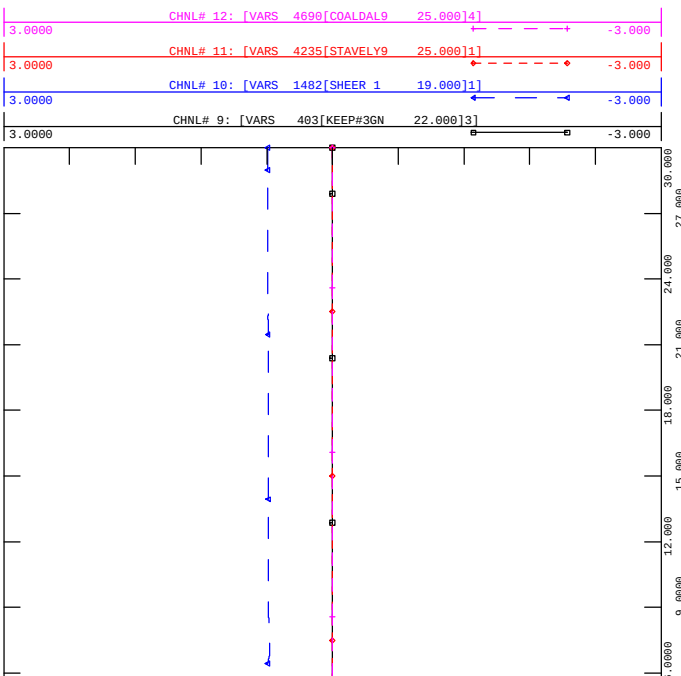
SCENARIO #4: 2020SP/POST PROJECT
CATB -180L_FAULT_AT_FORTMACLEOD15S

FILE: 180L_Fault_at_FortMacleod15S.out

THU, APR 11 2019 13:27

MACHINE VAR

CHNL# 12: [VARS 4690[COALDAL9 25.000]4]
CHNL# 11: [VARS 4235[STAVELY9 25.000]1]
CHNL# 10: [VARS 1482[SHEER 1 19.000]1]
CHNL# 9: [VARS 403[KEEP#3GN 22.000]3]



SCENARIO #4: 2020SP/POST PROJECT
CATB -180L_FAULT_AT_FORTMACLEOD15S

FILE: 180L_Fault_at_FortMacleod15S.out

THU, APR 11 2019 13:27 LINE VAR

CHNL# 33: [VARS 237 TO 916 CKT '63'] 400.00 -400.0
CHNL# 31: [VARS 737 TO 943 CKT '36'] 400.00 -400.0
CHNL# 29: [VARS 737 TO 167 CKT '41'] 400.00 -400.0
CHNL# 27: [VARS 451 TO 943 CKT '05'] 400.00 -400.0
CHNL# 25: [VARS 244 TO 333 CKT '61'] 400.00 -400.0
CHNL# 23: [VARS 367 TO 692 CKT '72'] 400.00 -400.0

TIME (SECONDS) 0.0 3.0000 6.0000 9.0000 12.000 15.000 18.000 21.000 24.000 27.000 30.000

SCENARIO #4: 2020SP/POST PROJECT
CATB -180L_FAULT_AT_VULCAN 255S

FILE: 180L_Fault_at_Vulcan 255S.out

THU, APR 11 2019 13:27 MACHINE POWER

CHNL# 8: [POWR 4690[COALDAL9 25.000]4] 6.0000 -3.000
CHNL# 7: [POWR 4235[STAVELY9 25.000]1] 6.0000 -3.000
CHNL# 6: [POWR 1482[SHEER 1 19.000]1] 6.0000 -3.000
CHNL# 5: [POWR 403[KEEP#3GN 22.000]3] 6.0000 -3.000

TIME (SECONDS) 0.0 3.0000 6.0000 9.0000 12.000 15.000 18.000 21.000 24.000 27.000 30.000

SCENARIO #4: 2020SP/POST PROJECT
CATB -180L_FAULT_AT_FORTMACLEOD15S

FILE: 180L_Fault_at_FortMacleod15S.out

THU, APR 11 2019 13:27 LINE POWER

CHNL# 32: [POWR 237 TO 916 CKT '63'] 500.00 -400.0
CHNL# 30: [POWR 737 TO 943 CKT '36'] 500.00 -400.0
CHNL# 28: [POWR 737 TO 167 CKT '41'] 500.00 -400.0
CHNL# 26: [POWR 451 TO 943 CKT '05'] 500.00 -400.0
CHNL# 24: [POWR 244 TO 333 CKT '61'] 500.00 -400.0
CHNL# 22: [POWR 367 TO 692 CKT '72'] 500.00 -400.0

TIME (SECONDS) 0.0 3.0000 6.0000 9.0000 12.000 15.000 18.000 21.000 24.000 27.000 30.000

SCENARIO #4: 2020SP/POST PROJECT
CATB -180L_FAULT_AT_VULCAN 255S

FILE: 180L_Fault_at_Vulcan 255S.out

THU, APR 11 2019 13:27 MACHINE ANGEL

CHNL# 4: [ANGL 4690[COALDAL9 25.000]4] 60.000 -60.00
CHNL# 3: [ANGL 4235[STAVELY9 25.000]1] 60.000 -60.00
CHNL# 2: [ANGL 1482[SHEER 1 19.000]1] 60.000 -60.00
CHNL# 1: [ANGL 403[KEEP#3GN 22.000]3] 60.000 -60.00

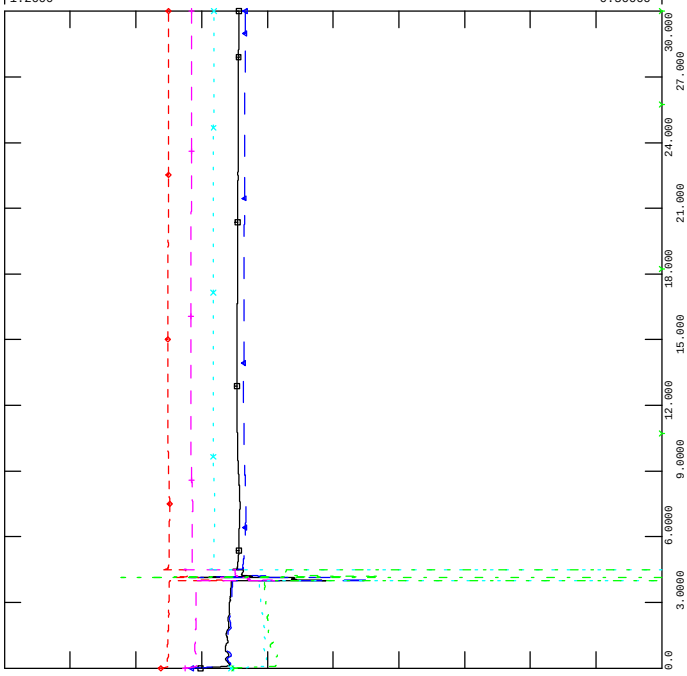
TIME (SECONDS) 0.0 3.0000 6.0000 9.0000 12.000 15.000 18.000 21.000 24.000 27.000 30.000

SCENARIO #4: 2020SP/POST PROJECT
CATB -180L_FAULT_AT_VULCAN 255S

FILE: 180L_Fault_at_Vulcan 255S.out

CHNL# 18: [VOLT 279 [STAVELEY 138.00]]
CHNL# 17: [VOLT 244 [VULCAN 7 138.00]]
CHNL# 16: [VOLT 276 [W BROOK7 138.00]]
CHNL# 15: [VOLT 430 [W BROOK4 240.00]]
CHNL# 14: [VOLT 692 [N LETHB7 138.00]]
CHNL# 13: [VOLT 167 [N LETHB4 240.00]]

1.2000 0.50000



TIME (SECONDS)

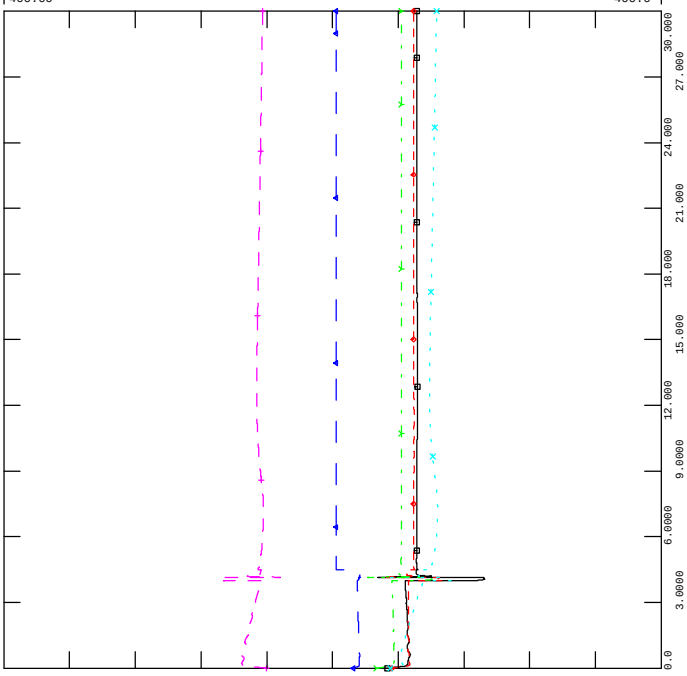
THU, APR 11 2019 13:27
MACHINE VOLTAGE

SCENARIO #4: 2020SP/POST PROJECT
CATB -180L_FAULT_AT_VULCAN 255S

FILE: 180L_Fault_at_Vulcan 255S.out

CHNL# 33: [VARS 237 TO 916 CKT '63']
CHNL# 31: [VARS 737 TO 943 CKT '36']
CHNL# 29: [VARS 737 TO 167 CKT '41']
CHNL# 27: [VARS 451 TO 943 CKT '05']
CHNL# 25: [VARS 244 TO 333 CKT '61']
CHNL# 23: [VARS 367 TO 692 CKT '72']

400.00 -400.0



TIME (SECONDS)

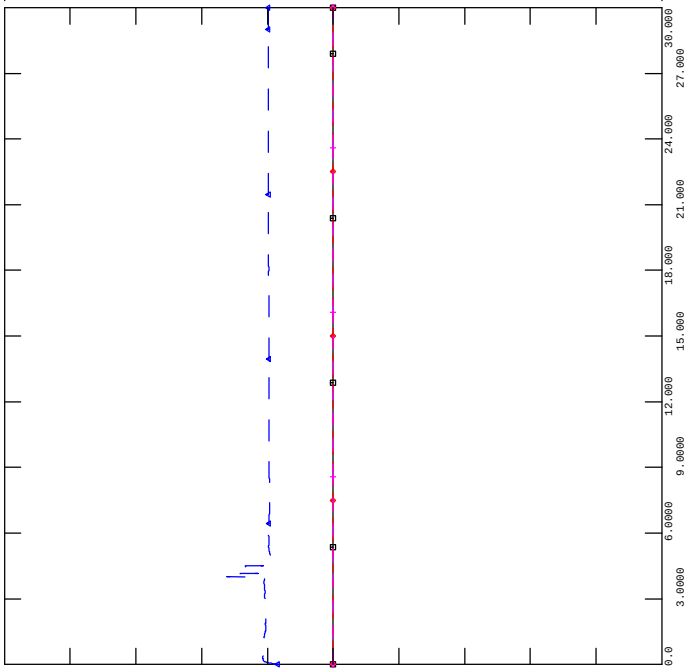
THU, APR 11 2019 13:27
LINE VAR

SCENARIO #4: 2020SP/POST PROJECT
CATB -180L_FAULT_AT_VULCAN 255S

FILE: 180L_Fault_at_Vulcan 255S.out

CHNL# 12: [VARS 4690[COALDAL9 25.000]4]
CHNL# 11: [VARS 4235[STAVELY9 25.000]1]
CHNL# 10: [VARS 1482[SHEER 1 19.000]1]
CHNL# 9: [VARS 403[KEEP#3GN 22.000]3]

3.0000 -3.000



TIME (SECONDS)

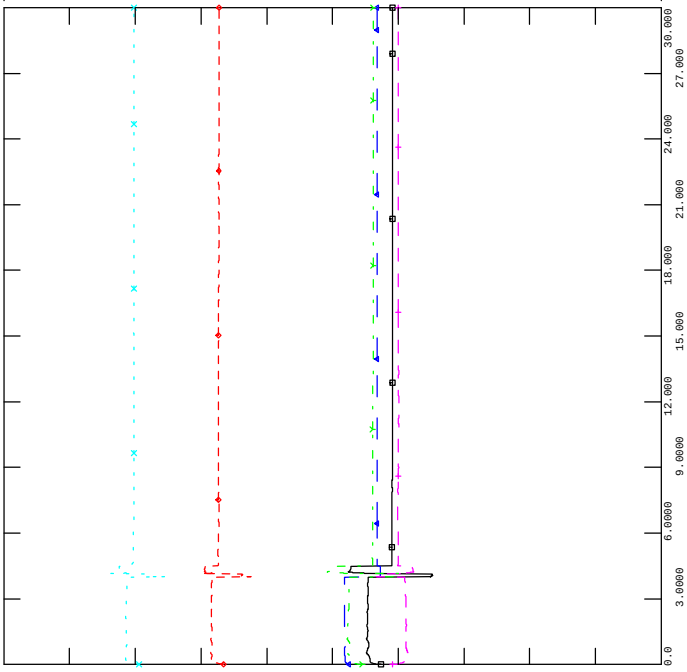
THU, APR 11 2019 13:27
MACHINE VAR

SCENARIO #4: 2020SP/POST PROJECT
CATB -180L_FAULT_AT_VULCAN 255S

FILE: 180L_Fault_at_Vulcan 255S.out

CHNL# 32: [POWR 237 TO 916 CKT '63']
CHNL# 30: [POWR 737 TO 943 CKT '36']
CHNL# 28: [POWR 737 TO 167 CKT '41']
CHNL# 26: [POWR 451 TO 943 CKT '05']
CHNL# 24: [POWR 244 TO 333 CKT '61']
CHNL# 22: [POWR 367 TO 692 CKT '72']

500.00 -400.0



TIME (SECONDS)

THU, APR 11 2019 13:27
LINE POWER

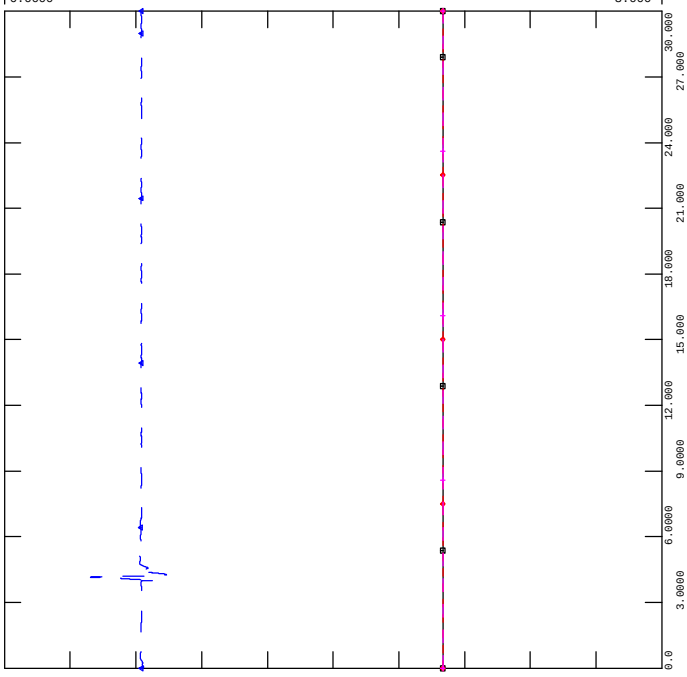
SCENARIO #4: 2020SP/POST PROJECT
CATB -463L_FAULT_AT_CHINOOK181S

FILE: 463L_Fault_at_Chinook181S.out

THU, APR 11 2019 13:27

MACHINE POWER

CHNL# 8: [POWR 4690[COALDAL9 25.000]4]
CHNL# 7: [POWR 4235[STAVELY9 25.000]1]
CHNL# 6: [POWR 1482[SHEER 1 19.000]1]
CHNL# 5: [POWR 403[KEEP#3GN 22.000]3]



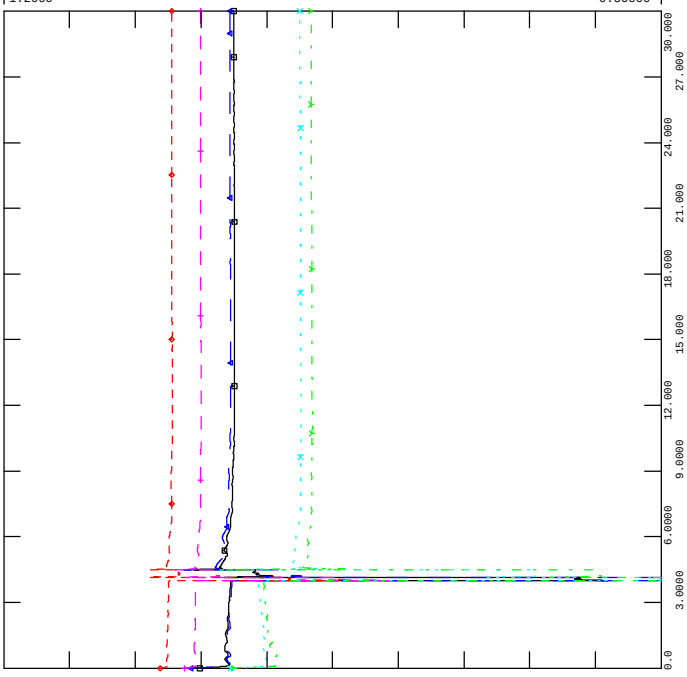
SCENARIO #4: 2020SP/POST PROJECT
CATB -463L_FAULT_AT_CHINOOK181S

FILE: 463L_Fault_at_Chinook181S.out

THU, APR 11 2019 13:27

MACHINE VOLTAGE

CHNL# 18: [VOLT 279 [STAVELEY 138.00]]
CHNL# 17: [VOLT 244 [VULCAN 7 138.00]]
CHNL# 16: [VOLT 276 [W BROOK7 138.00]]
CHNL# 15: [VOLT 430 [W BROOK4 240.00]]
CHNL# 14: [VOLT 692 [N LETHB7 138.00]]
CHNL# 13: [VOLT 167 [N LETHB4 240.00]]



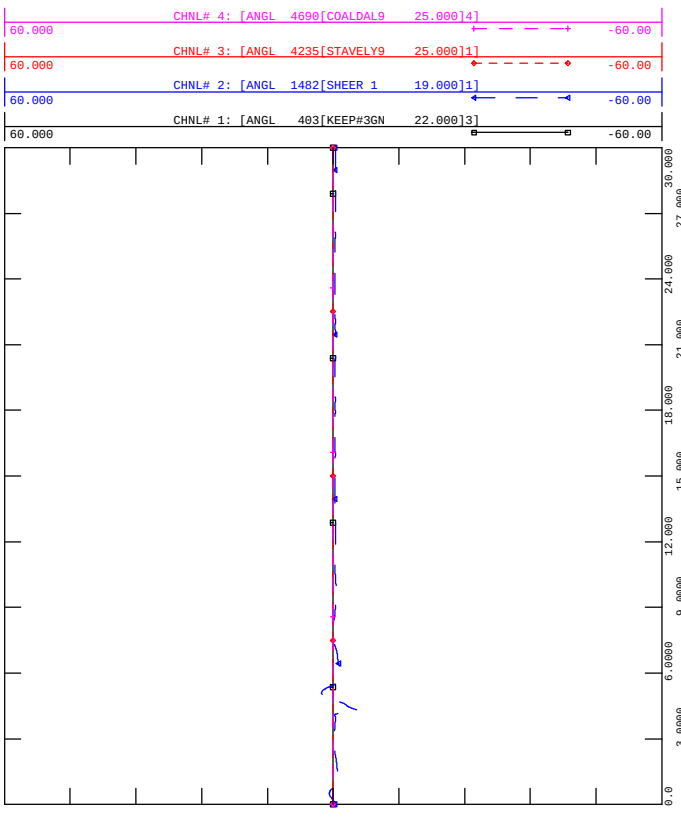
SCENARIO #4: 2020SP/POST PROJECT
CATB -463L_FAULT_AT_CHINOOK181S

FILE: 463L_Fault_at_Chinook181S.out

THU, APR 11 2019 13:27

MACHINE ANGEL

CHNL# 4: [ANGL 4690[COALDAL9 25.000]4]
CHNL# 3: [ANGL 4235[STAVELY9 25.000]1]
CHNL# 2: [ANGL 1482[SHEER 1 19.000]1]
CHNL# 1: [ANGL 403[KEEP#3GN 22.000]3]



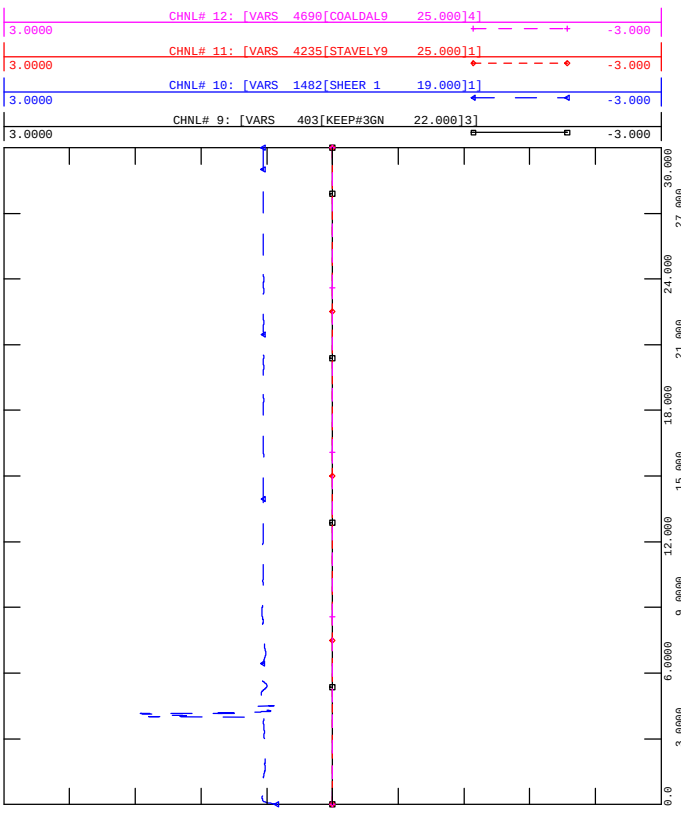
SCENARIO #4: 2020SP/POST PROJECT
CATB -463L_FAULT_AT_CHINOOK181S

FILE: 463L_Fault_at_Chinook181S.out

THU, APR 11 2019 13:27

MACHINE VAR

CHNL# 12: [VARS 4690[COALDAL9 25.000]4]
CHNL# 11: [VARS 4235[STAVELY9 25.000]1]
CHNL# 10: [VARS 1482[SHEER 1 19.000]1]
CHNL# 9: [VARS 403[KEEP#3GN 22.000]3]

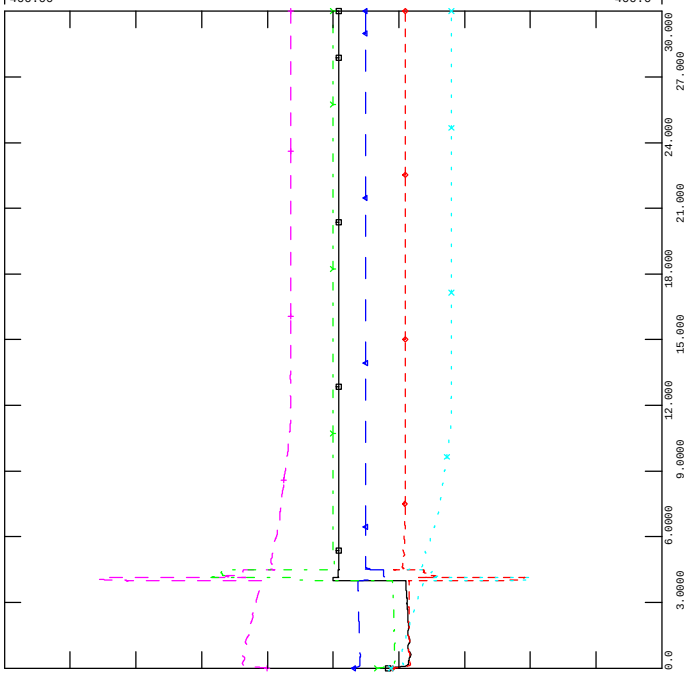


SCENARIO #4: 2020SP/POST PROJECT
CATB -463L_FAULT_AT_CHINOOK181S

FILE: 463L_Fault_at_Chinook181S.out

THU, APR 11 2019 13:27 LINE VAR

CHNL# 33: [VARS 237 TO 916 CKT '63'] 400.00 -400.0
CHNL# 31: [VARS 737 TO 943 CKT '36'] 400.00 -400.0
CHNL# 29: [VARS 737 TO 167 CKT '41'] 400.00 -400.0
CHNL# 27: [VARS 451 TO 943 CKT '05'] 400.00 -400.0
CHNL# 25: [VARS 244 TO 333 CKT '61'] 400.00 -400.0
CHNL# 23: [VARS 367 TO 692 CKT '72'] 400.00 -400.0

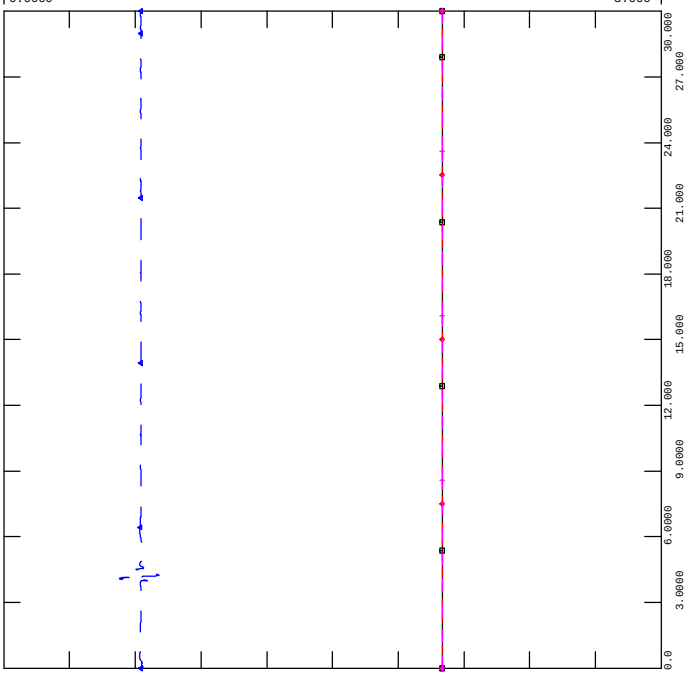


SCENARIO #4: 2020SP/POST PROJECT
CATB -463L_FAULT_AT_FORTMACLEOD15S

FILE: 463L_Fault_at_FortMacleod15S.out

THU, APR 11 2019 13:27 MACHINE POWER

CHNL# 8: [POWR 4690[COALDAL9 25.000]4] 6.0000 -3.000
CHNL# 7: [POWR 4235[STAVELY9 25.000]1] 6.0000 -3.000
CHNL# 6: [POWR 1482[SHEER 1 19.000]1] 6.0000 -3.000
CHNL# 5: [POWR 403[KEEP#3GN 22.000]3] 6.0000 -3.000

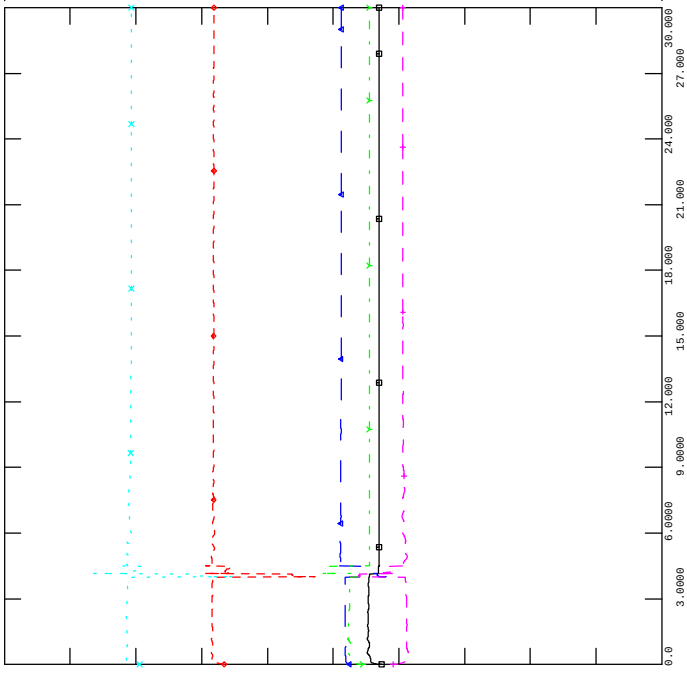


SCENARIO #4: 2020SP/POST PROJECT
CATB -463L_FAULT_AT_CHINOOK181S

FILE: 463L_Fault_at_Chinook181S.out

THU, APR 11 2019 13:27 LINE POWER

CHNL# 32: [POWR 237 TO 916 CKT '63'] 500.00 -400.0
CHNL# 30: [POWR 737 TO 943 CKT '36'] 500.00 -400.0
CHNL# 28: [POWR 737 TO 167 CKT '41'] 500.00 -400.0
CHNL# 26: [POWR 451 TO 943 CKT '05'] 500.00 -400.0
CHNL# 24: [POWR 244 TO 333 CKT '61'] 500.00 -400.0
CHNL# 22: [POWR 367 TO 692 CKT '72'] 500.00 -400.0

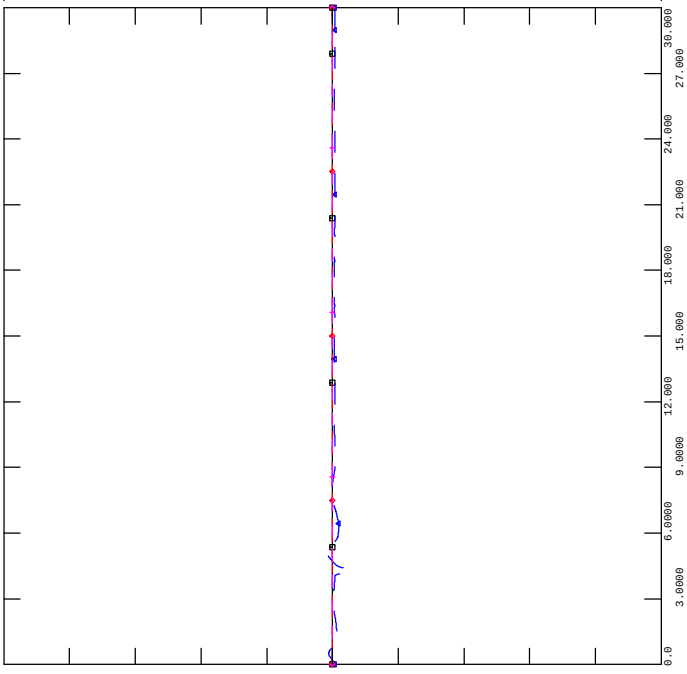


SCENARIO #4: 2020SP/POST PROJECT
CATB -463L_FAULT_AT_FORTMACLEOD15S

FILE: 463L_Fault_at_FortMacleod15S.out

THU, APR 11 2019 13:27 MACHINE ANGEL

CHNL# 4: [ANGL 4690[COALDAL9 25.000]4] 60.000 -60.00
CHNL# 3: [ANGL 4235[STAVELY9 25.000]1] 60.000 -60.00
CHNL# 2: [ANGL 1482[SHEER 1 19.000]1] 60.000 -60.00
CHNL# 1: [ANGL 403[KEEP#3GN 22.000]3] 60.000 -60.00



SCENARIO #4: 2020SP/POST PROJECT
CATB -463L_FAULT_AT_FORTMACLEOD15S

FILE: 463L_Fault_at_FortMacleod15S.out

THU, APR 11 2019 13:27

MACHINE VOLTAGE

CHNL# 18: [VOLT 279 [STAVELEY 138.00]]
CHNL# 17: [VOLT 244 [VULCAN 7 138.00]]
CHNL# 16: [VOLT 276 [W BROOK7 138.00]]
CHNL# 15: [VOLT 430 [W BROOK4 240.00]]
CHNL# 14: [VOLT 692 [N LETHB7 138.00]]
CHNL# 13: [VOLT 167 [N LETHB4 240.00]]

1.2000 / 0.50000

TIME (SECONDS)

0.0 3.0000 6.0000 9.0000 12.000 15.000 18.000 21.000 24.000 27.000 30.000

SCENARIO #4: 2020SP/POST PROJECT
CATB -463L_FAULT_AT_FORTMACLEOD15S

FILE: 463L_Fault_at_FortMacleod15S.out

THU, APR 11 2019 13:27

LINE VAR

CHNL# 33: [VARS 237 TO 916 CKT '63']
CHNL# 31: [VARS 737 TO 943 CKT '36']
CHNL# 29: [VARS 737 TO 167 CKT '41']
CHNL# 27: [VARS 451 TO 943 CKT '05']
CHNL# 25: [VARS 244 TO 333 CKT '61']
CHNL# 23: [VARS 367 TO 692 CKT '72']

400.00 / -400.0

TIME (SECONDS)

0.0 3.0000 6.0000 9.0000 12.000 15.000 18.000 21.000 24.000 27.000 30.000

SCENARIO #4: 2020SP/POST PROJECT
CATB -463L_FAULT_AT_FORTMACLEOD15S

FILE: 463L_Fault_at_FortMacleod15S.out

THU, APR 11 2019 13:27

MACHINE VAR

CHNL# 12: [VARS 4690[COALDAL9 25.000]4]
CHNL# 11: [VARS 4235[STAVELY9 25.000]1]
CHNL# 10: [VARS 1482[SHEER 1 19.000]1]
CHNL# 9: [VARS 403[KEEP#3GN 22.000]3]

3.0000 / -3.000

TIME (SECONDS)

0.0 3.0000 6.0000 9.0000 12.000 15.000 18.000 21.000 24.000 27.000 30.000

SCENARIO #4: 2020SP/POST PROJECT
CATB -463L_FAULT_AT_FORTMACLEOD15S

FILE: 463L_Fault_at_FortMacleod15S.out

THU, APR 11 2019 13:27

LINE POWER

CHNL# 32: [POWR 237 TO 916 CKT '63']
CHNL# 30: [POWR 737 TO 943 CKT '36']
CHNL# 28: [POWR 737 TO 167 CKT '41']
CHNL# 26: [POWR 451 TO 943 CKT '05']
CHNL# 24: [POWR 244 TO 333 CKT '61']
CHNL# 22: [POWR 367 TO 692 CKT '72']

500.00 / -400.0

TIME (SECONDS)

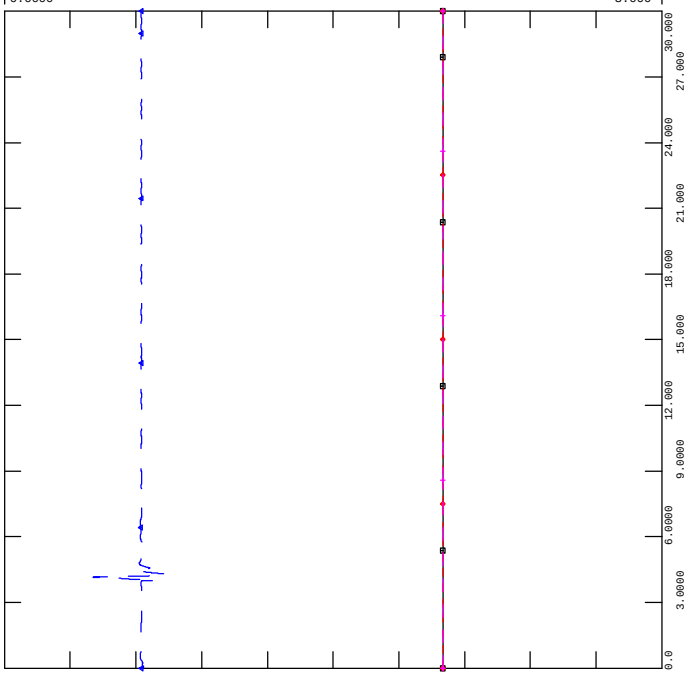
0.0 3.0000 6.0000 9.0000 12.000 15.000 18.000 21.000 24.000 27.000 30.000

SCENARIO #4: 2020SP/POST PROJECT
CATB -725L_FAULT_AT_BOWRON674S

FILE: 725L_Fault_at_Bowron674S.out

THU, APR 11 2019 13:27
MACHINE POWER

CHNL# 8: [POWR 4690[COALDAL9 25.000]4]
CHNL# 7: [POWR 4235[STAVELY9 25.000]1]
CHNL# 6: [POWR 1482[SHEER 1 19.000]1]
CHNL# 5: [POWR 403[KEEP#3GN 22.000]3]

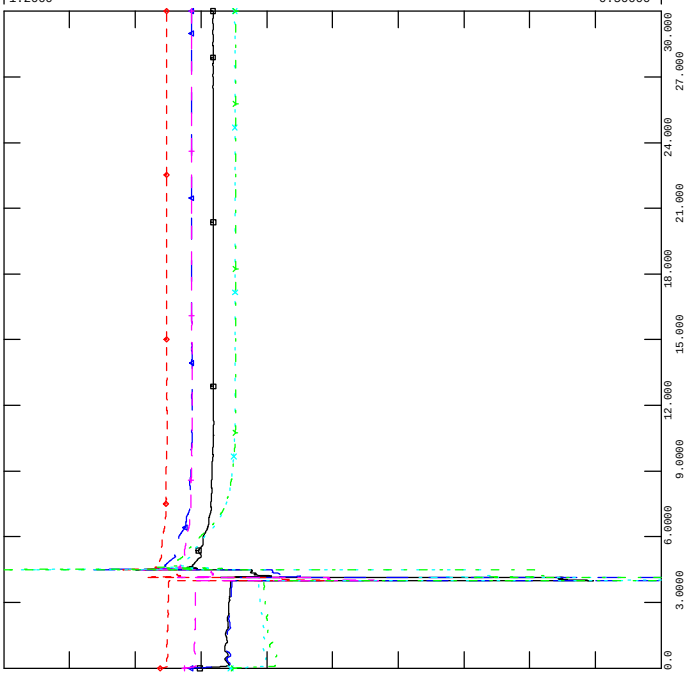


SCENARIO #4: 2020SP/POST PROJECT
CATB -725L_FAULT_AT_BOWRON674S

FILE: 725L_Fault_at_Bowron674S.out

THU, APR 11 2019 13:27
MACHINE VOLTAGE

CHNL# 18: [VOLT 279 [STAVELEY 138.00]]
CHNL# 17: [VOLT 244 [VULCAN 7 138.00]]
CHNL# 16: [VOLT 276 [W BROOK7 138.00]]
CHNL# 15: [VOLT 430 [W BROOK4 240.00]]
CHNL# 14: [VOLT 692 [N LETHB7 138.00]]
CHNL# 13: [VOLT 167 [N LETHB4 240.00]]

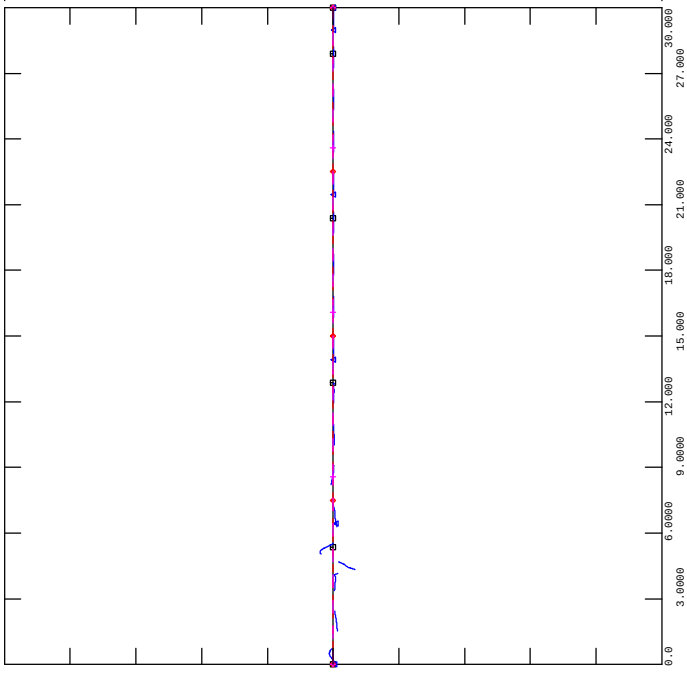


SCENARIO #4: 2020SP/POST PROJECT
CATB -725L_FAULT_AT_BOWRON674S

FILE: 725L_Fault_at_Bowron674S.out

THU, APR 11 2019 13:27
MACHINE ANGEL

CHNL# 4: [ANGL 4690[COALDAL9 25.000]4]
CHNL# 3: [ANGL 4235[STAVELY9 25.000]1]
CHNL# 2: [ANGL 1482[SHEER 1 19.000]1]
CHNL# 1: [ANGL 403[KEEP#3GN 22.000]3]

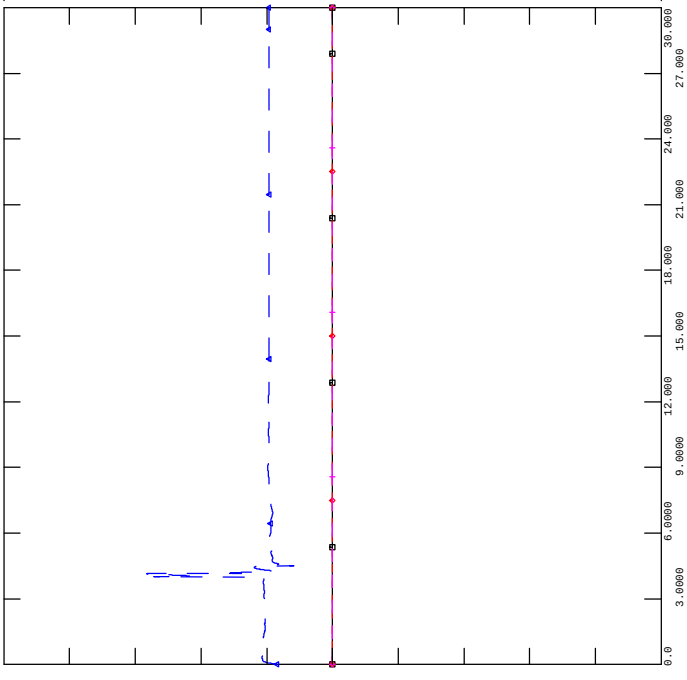


SCENARIO #4: 2020SP/POST PROJECT
CATB -725L_FAULT_AT_BOWRON674S

FILE: 725L_Fault_at_Bowron674S.out

THU, APR 11 2019 13:27
MACHINE VAR

CHNL# 12: [VARS 4690[COALDAL9 25.000]4]
CHNL# 11: [VARS 4235[STAVELY9 25.000]1]
CHNL# 10: [VARS 1482[SHEER 1 19.000]1]
CHNL# 9: [VARS 403[KEEP#3GN 22.000]3]

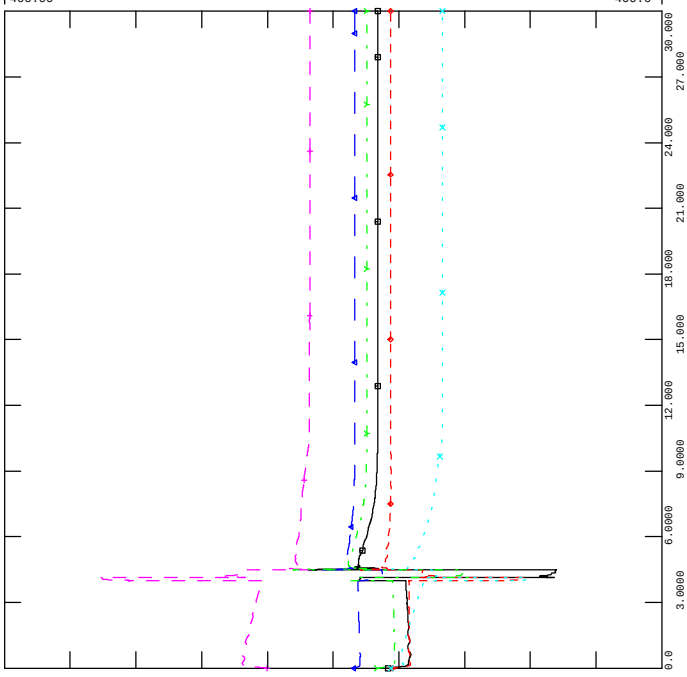


SCENARIO #4: 2020SP/POST PROJECT
CATB -725L_FAULT_AT_BOWRON674S

FILE: 725L_Fault_at_Bowron674S.out

THU, APR 11 2019 13:27 LINE VAR

CHNL# 33: [VARS 237 TO 916 CKT '63'] 400.00 -400.0
CHNL# 31: [VARS 737 TO 943 CKT '36'] 400.00 -400.0
CHNL# 29: [VARS 737 TO 167 CKT '41'] 400.00 -400.0
CHNL# 27: [VARS 451 TO 943 CKT '05'] 400.00 -400.0
CHNL# 25: [VARS 244 TO 333 CKT '61'] 400.00 -400.0
CHNL# 23: [VARS 367 TO 692 CKT '72'] 400.00 -400.0

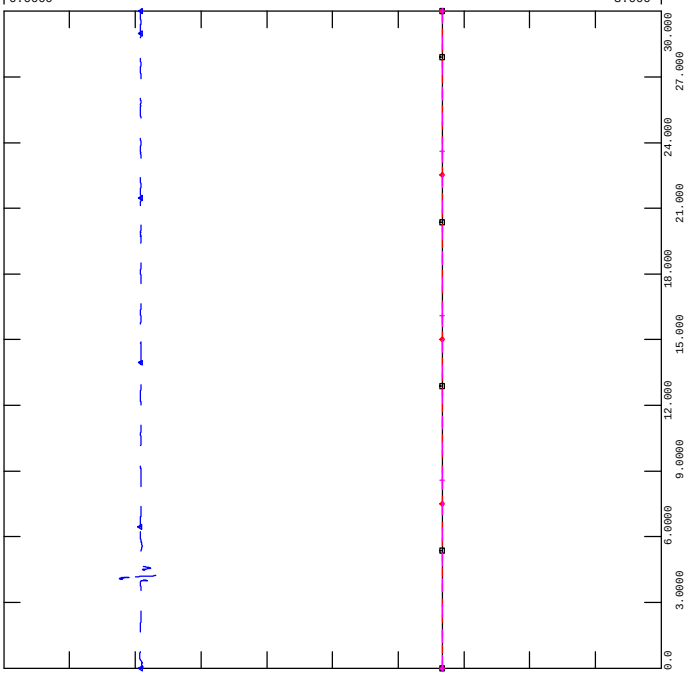


SCENARIO #4: 2020SP/POST PROJECT
CATB -725L_FAULT_AT_FORTMACLEOD15S

FILE: 725L_Fault_at_FortMacleod15S.out

THU, APR 11 2019 13:27 MACHINE POWER

CHNL# 8: [POWR 4690[COALDAL9 25.000]4] 6.0000 -3.000
CHNL# 7: [POWR 4235[STAVELY9 25.000]1] 6.0000 -3.000
CHNL# 6: [POWR 1482[SHEER 1 19.000]1] 6.0000 -3.000
CHNL# 5: [POWR 403[KEEP#3GN 22.000]3] 6.0000 -3.000

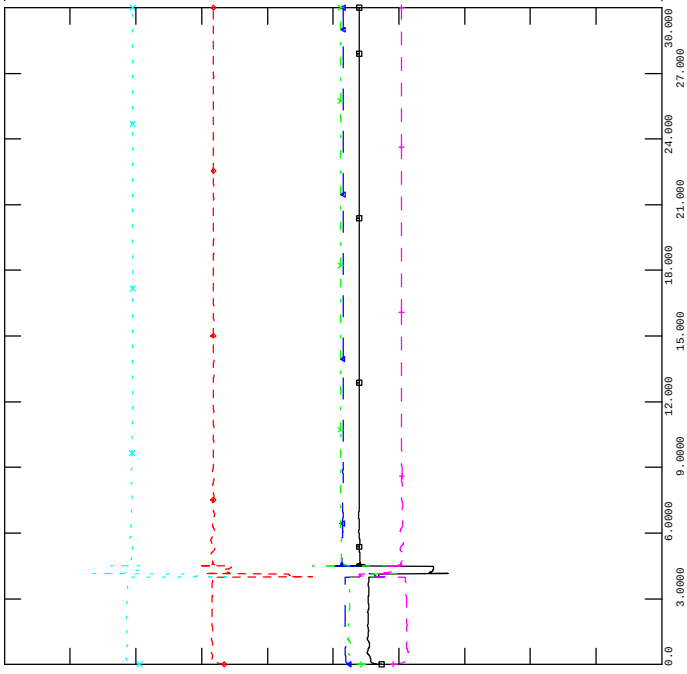


SCENARIO #4: 2020SP/POST PROJECT
CATB -725L_FAULT_AT_BOWRON674S

FILE: 725L_Fault_at_Bowron674S.out

THU, APR 11 2019 13:27 LINE POWER

CHNL# 32: [POWR 237 TO 916 CKT '63'] 500.00 -400.0
CHNL# 30: [POWR 737 TO 943 CKT '36'] 500.00 -400.0
CHNL# 28: [POWR 737 TO 167 CKT '41'] 500.00 -400.0
CHNL# 26: [POWR 451 TO 943 CKT '05'] 500.00 -400.0
CHNL# 24: [POWR 244 TO 333 CKT '61'] 500.00 -400.0
CHNL# 22: [POWR 367 TO 692 CKT '72'] 500.00 -400.0

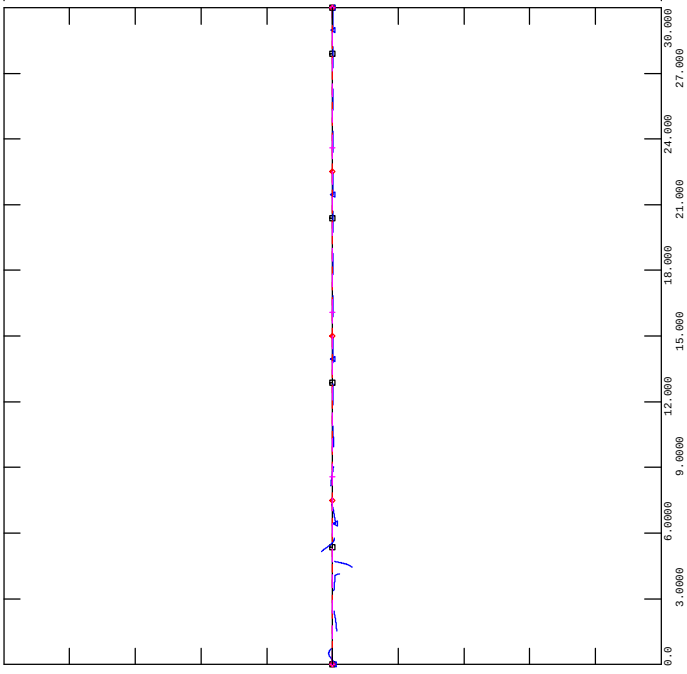


SCENARIO #4: 2020SP/POST PROJECT
CATB -725L_FAULT_AT_FORTMACLEOD15S

FILE: 725L_Fault_at_FortMacleod15S.out

THU, APR 11 2019 13:27 MACHINE ANGEL

CHNL# 4: [ANGL 4690[COALDAL9 25.000]4] 60.000 -60.00
CHNL# 3: [ANGL 4235[STAVELY9 25.000]1] 60.000 -60.00
CHNL# 2: [ANGL 1482[SHEER 1 19.000]1] 60.000 -60.00
CHNL# 1: [ANGL 403[KEEP#3GN 22.000]3] 60.000 -60.00



SCENARIO #4: 2020SP/POST PROJECT
CATB -725L_FAULT_AT_FORTMACLEOD15S

FILE: 725L_Fault_at_FortMacleod15S.out

THU, APR 11 2019 13:27

MACHINE VOLTAGE

CHNL# 18: [VOLT 279 [STAVELEY 138.00]]
CHNL# 17: [VOLT 244 [VULCAN 7 138.00]]
CHNL# 16: [VOLT 276 [W BROOK7 138.00]]
CHNL# 15: [VOLT 430 [W BROOK4 240.00]]
CHNL# 14: [VOLT 692 [N LETHB7 138.00]]
CHNL# 13: [VOLT 167 [N LETHB4 240.00]]

1.2000 / 0.50000

TIME (SECONDS)

0.0 3.0000 6.0000 9.0000 12.000 15.000 18.000 21.000 24.000 27.000 30.000

SCENARIO #4: 2020SP/POST PROJECT
CATB -725L_FAULT_AT_FORTMACLEOD15S

FILE: 725L_Fault_at_FortMacleod15S.out

THU, APR 11 2019 13:27

LINE VAR

CHNL# 33: [VARS 237 TO 916 CKT '63']
CHNL# 31: [VARS 737 TO 943 CKT '36']
CHNL# 29: [VARS 737 TO 167 CKT '41']
CHNL# 27: [VARS 451 TO 943 CKT '05']
CHNL# 25: [VARS 244 TO 333 CKT '61']
CHNL# 23: [VARS 367 TO 692 CKT '72']

400.00 / -400.0

TIME (SECONDS)

0.0 3.0000 6.0000 9.0000 12.000 15.000 18.000 21.000 24.000 27.000 30.000

SCENARIO #4: 2020SP/POST PROJECT
CATB -725L_FAULT_AT_FORTMACLEOD15S

FILE: 725L_Fault_at_FortMacleod15S.out

THU, APR 11 2019 13:27

MACHINE VAR

CHNL# 12: [VARS 4690[COALDAL9 25.000]4]
CHNL# 11: [VARS 4235[STAVELY9 25.000]1]
CHNL# 10: [VARS 1482[SHEER 1 19.000]1]
CHNL# 9: [VARS 403[KEEP#3GN 22.000]3]

3.0000 / -3.000

TIME (SECONDS)

0.0 3.0000 6.0000 9.0000 12.000 15.000 18.000 21.000 24.000 27.000 30.000

SCENARIO #4: 2020SP/POST PROJECT
CATB -725L_FAULT_AT_FORTMACLEOD15S

FILE: 725L_Fault_at_FortMacleod15S.out

THU, APR 11 2019 13:27

LINE POWER

CHNL# 32: [POWR 237 TO 916 CKT '63']
CHNL# 30: [POWR 737 TO 943 CKT '36']
CHNL# 28: [POWR 737 TO 167 CKT '41']
CHNL# 26: [POWR 451 TO 943 CKT '05']
CHNL# 24: [POWR 244 TO 333 CKT '61']
CHNL# 22: [POWR 367 TO 692 CKT '72']

500.00 / -400.0

TIME (SECONDS)

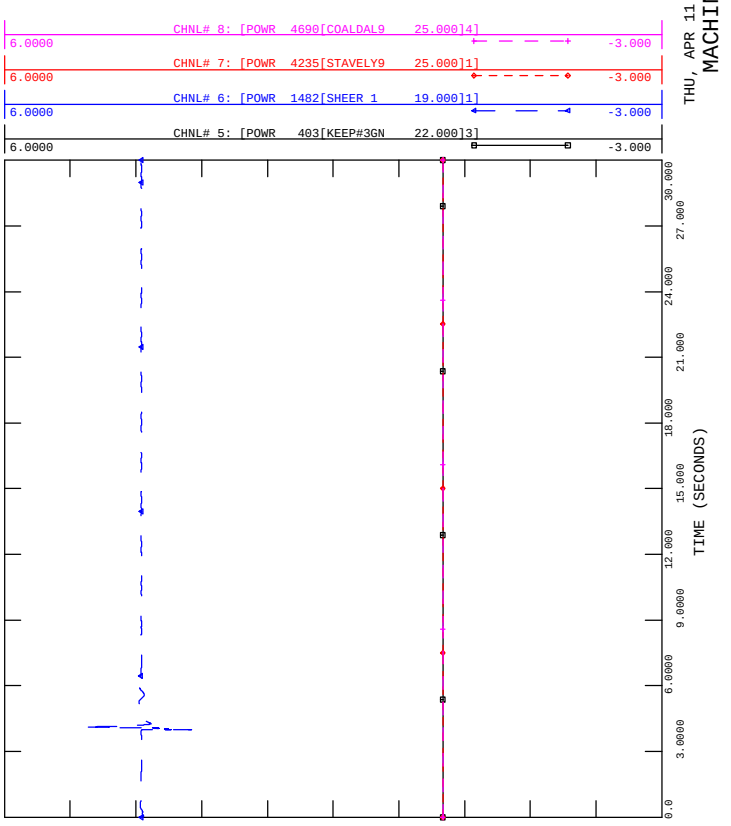
0.0 3.0000 6.0000 9.0000 12.000 15.000 18.000 21.000 24.000 27.000 30.000

SCENARIO #4: 2020SP/POST PROJECT
CATB -1041L_FAULT_AT_NORTHLETHBRIDGE370S

FILE: 1041L_Fault_at_NorthLethbridge370S.out

THU, APR 11 2019 13:27

MACHINE POWER

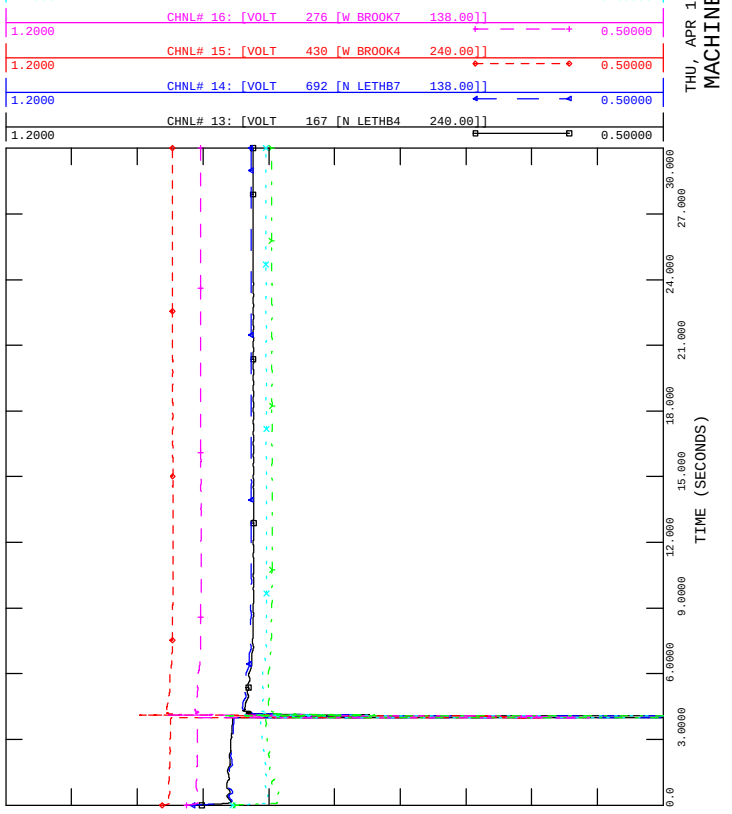


SCENARIO #4: 2020SP/POST PROJECT
CATB -1041L_FAULT_AT_NORTHLETHBRIDGE370S

FILE: 1041L_Fault_at_NorthLethbridge370S.out

THU, APR 11 2019 13:27

MACHINE VOLTAGE

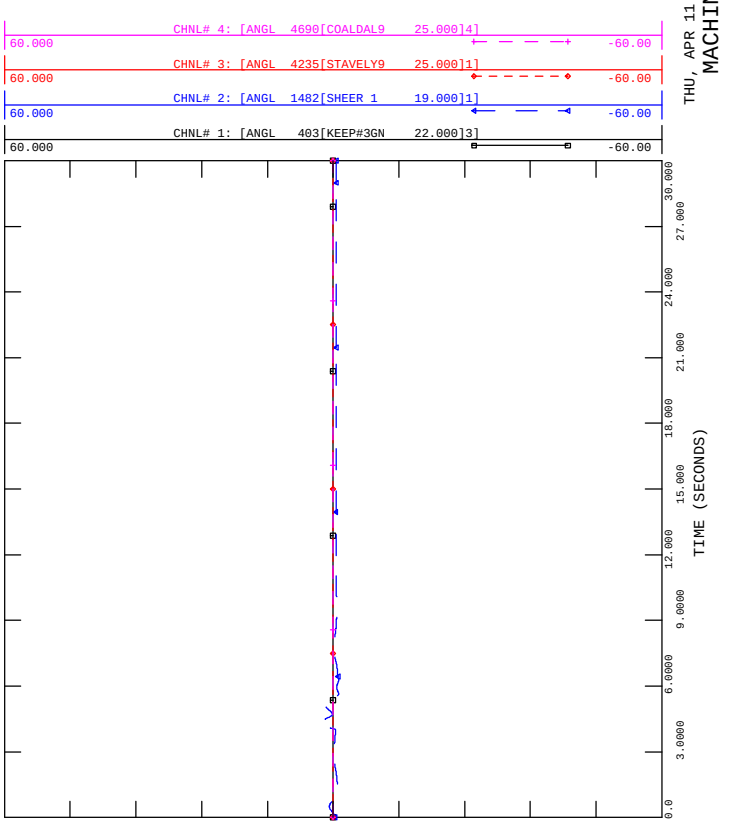


SCENARIO #4: 2020SP/POST PROJECT
CATB -1041L_FAULT_AT_NORTHLETHBRIDGE370S

FILE: 1041L_Fault_at_NorthLethbridge370S.out

THU, APR 11 2019 13:27

MACHINE ANGEL

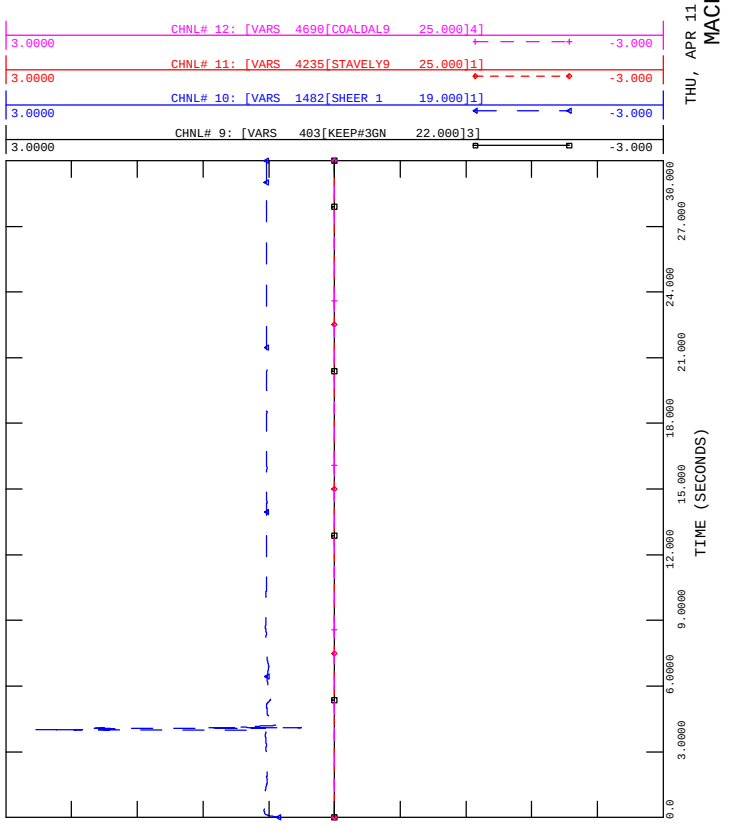


SCENARIO #4: 2020SP/POST PROJECT
CATB -1041L_FAULT_AT_NORTHLETHBRIDGE370S

FILE: 1041L_Fault_at_NorthLethbridge370S.out

THU, APR 11 2019 13:27

MACHINE VAR



SCENARIO #4: 2020SP/POST PROJECT
CATB -1041L_FAULT_AT_NORTHLETHBRIDGE370S

FILE: 1041L_Fault_at_NorthLethbridge370S.out

THU, APR 11 2019 13:27

LINE VAR

CHNL# 33: [VARS 237 TO 916 CKT '63']
CHNL# 31: [VARS 737 TO 943 CKT '36']
CHNL# 29: [VARS 737 TO 167 CKT '41']
CHNL# 27: [VARS 451 TO 943 CKT '05']
CHNL# 25: [VARS 244 TO 333 CKT '61']
CHNL# 23: [VARS 367 TO 692 CKT '72']

400.00 / -400.0

TIME (SECONDS)

0.0 3.0000 6.0000 9.0000 12.000 15.000 18.000 21.000 24.000 27.000 30.000

SCENARIO #4: 2020SP/POST PROJECT
CATB -1041L_FAULT_AT_TRAVERS554S

FILE: 1041L_Fault_at_Travers554S.out

THU, APR 11 2019 13:27

MACHINE POWER

CHNL# 8: [POWR 4690[COALDAL9 25.000]4]
CHNL# 7: [POWR 4235[STAVELY9 25.000]1]
CHNL# 6: [POWR 1482[SHEER 1 19.000]1]
CHNL# 5: [POWR 403[KEEP#3GN 22.000]3]

6.0000 / -3.000

TIME (SECONDS)

0.0 3.0000 6.0000 9.0000 12.000 15.000 18.000 21.000 24.000 27.000 30.000

SCENARIO #4: 2020SP/POST PROJECT
CATB -1041L_FAULT_AT_NORTHLETHBRIDGE370S

FILE: 1041L_Fault_at_NorthLethbridge370S.out

THU, APR 11 2019 13:27

LINE POWER

CHNL# 32: [POWR 237 TO 916 CKT '63']
CHNL# 30: [POWR 737 TO 943 CKT '36']
CHNL# 28: [POWR 737 TO 167 CKT '41']
CHNL# 26: [POWR 451 TO 943 CKT '05']
CHNL# 24: [POWR 244 TO 333 CKT '61']
CHNL# 22: [POWR 367 TO 692 CKT '72']

500.00 / -400.0

TIME (SECONDS)

0.0 3.0000 6.0000 9.0000 12.000 15.000 18.000 21.000 24.000 27.000 30.000

SCENARIO #4: 2020SP/POST PROJECT
CATB -1041L_FAULT_AT_TRAVERS554S

FILE: 1041L_Fault_at_Travers554S.out

THU, APR 11 2019 13:27

MACHINE ANGEL

CHNL# 4: [ANGL 4690[COALDAL9 25.000]4]
CHNL# 3: [ANGL 4235[STAVELY9 25.000]1]
CHNL# 2: [ANGL 1482[SHEER 1 19.000]1]
CHNL# 1: [ANGL 403[KEEP#3GN 22.000]3]

60.000 / -60.00

TIME (SECONDS)

0.0 3.0000 6.0000 9.0000 12.000 15.000 18.000 21.000 24.000 27.000 30.000

SCENARIO #4: 2020SP/POST PROJECT
CATB -1041L_FAULT_AT_TRAVERS554S

FILE: 1041L_Fault_at_Travers554S.out

THU, APR 11 2019 13:27

MACHINE VOLTAGE

CHNL# 18: [VOLT 279 [STAVELEY 138.00]]
1.2000 0.50000

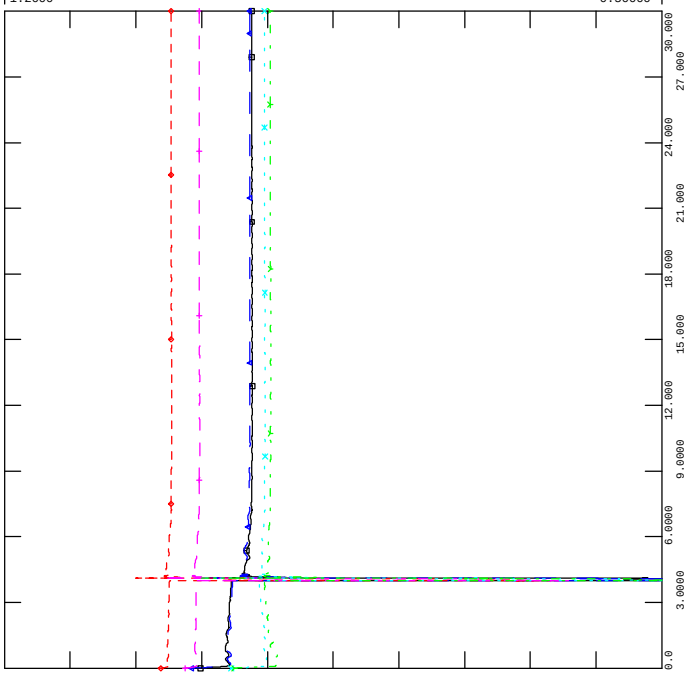
CHNL# 17: [VOLT 244 [VULCAN 7 138.00]]
1.2000 0.50000

CHNL# 16: [VOLT 276 [W BROOK7 138.00]]
1.2000 0.50000

CHNL# 15: [VOLT 430 [W BROOK4 240.00]]
1.2000 0.50000

CHNL# 14: [VOLT 692 [N LETHB7 138.00]]
1.2000 0.50000

CHNL# 13: [VOLT 167 [N LETHB4 240.00]]
1.2000 0.50000



SCENARIO #4: 2020SP/POST PROJECT
CATB -1041L_FAULT_AT_TRAVERS554S

FILE: 1041L_Fault_at_Travers554S.out

THU, APR 11 2019 13:27

LINE VAR

CHNL# 33: [VARS 237 TO 916 CKT '63']
400.00 -400.0

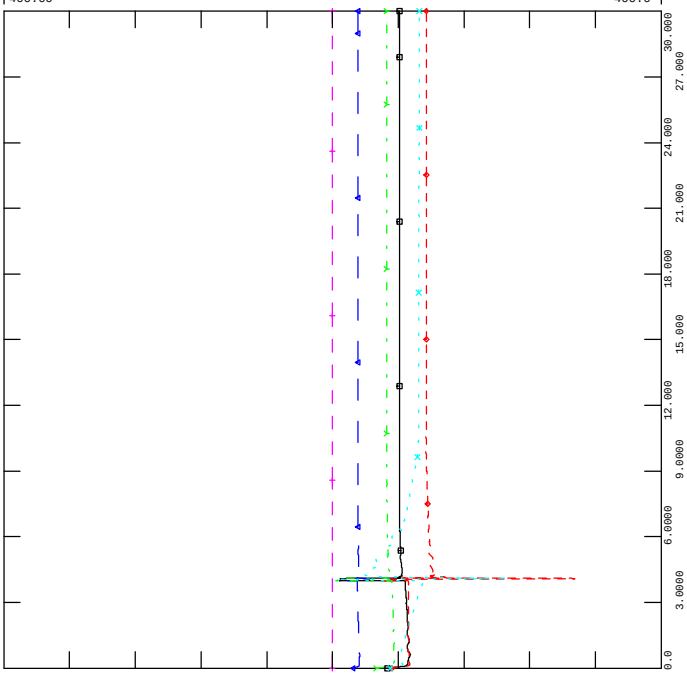
CHNL# 31: [VARS 737 TO 943 CKT '36']
400.00 -400.0

CHNL# 29: [VARS 737 TO 167 CKT '41']
400.00 -400.0

CHNL# 27: [VARS 451 TO 943 CKT '05']
400.00 -400.0

CHNL# 25: [VARS 244 TO 333 CKT '61']
400.00 -400.0

CHNL# 23: [VARS 367 TO 692 CKT '72']
400.00 -400.0



SCENARIO #4: 2020SP/POST PROJECT
CATB -1041L_FAULT_AT_TRAVERS554S

FILE: 1041L_Fault_at_Travers554S.out

THU, APR 11 2019 13:27

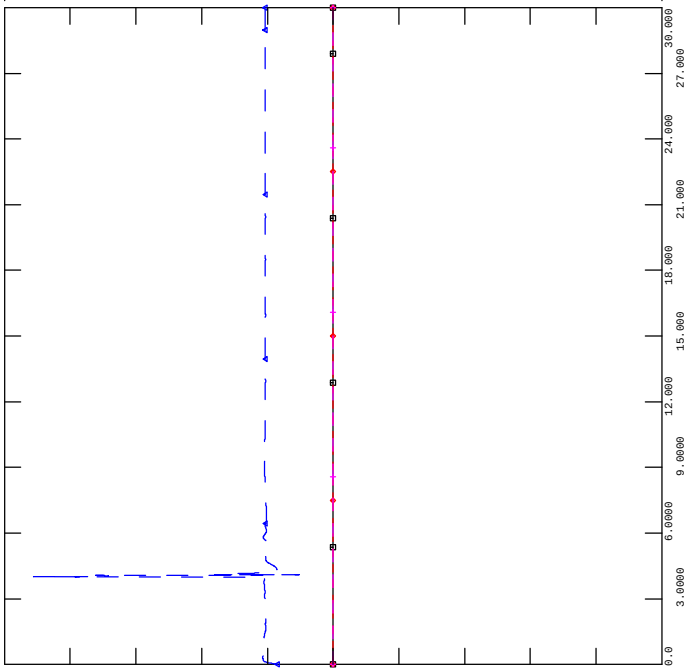
MACHINE VAR

CHNL# 12: [VARS 4690[COALDAL9 25.000]4]
3.0000 -3.000

CHNL# 11: [VARS 4235[STAVELY9 25.000]1]
3.0000 -3.000

CHNL# 10: [VARS 1482[SHEER 1 19.000]1]
3.0000 -3.000

CHNL# 9: [VARS 403[KEEP#3GN 22.000]3]
3.0000 -3.000



SCENARIO #4: 2020SP/POST PROJECT
CATB -1041L_FAULT_AT_TRAVERS554S

FILE: 1041L_Fault_at_Travers554S.out

THU, APR 11 2019 13:27

LINE POWER

CHNL# 32: [POWR 237 TO 916 CKT '63']
500.00 -400.0

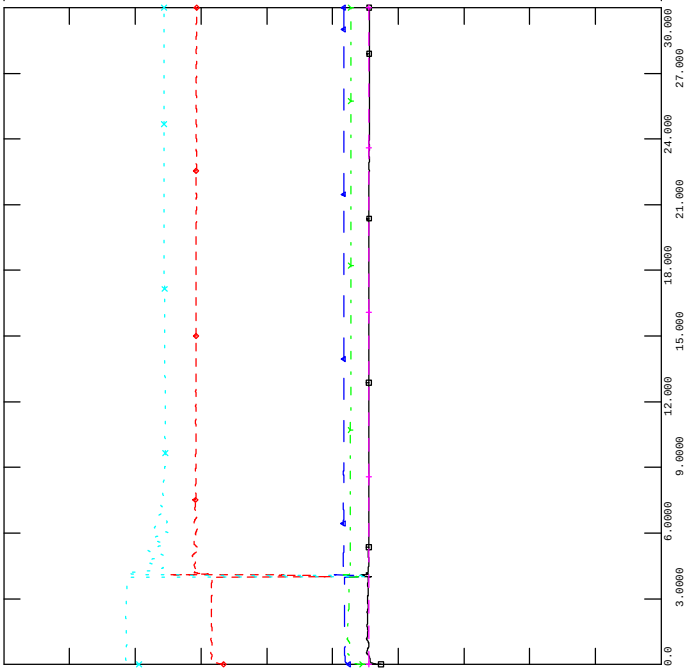
CHNL# 30: [POWR 737 TO 943 CKT '36']
500.00 -400.0

CHNL# 28: [POWR 737 TO 167 CKT '41']
500.00 -400.0

CHNL# 26: [POWR 451 TO 943 CKT '05']
500.00 -400.0

CHNL# 24: [POWR 244 TO 333 CKT '61']
500.00 -400.0

CHNL# 22: [POWR 367 TO 692 CKT '72']
500.00 -400.0



Attachment A5
Dynamic Data and Assumptions

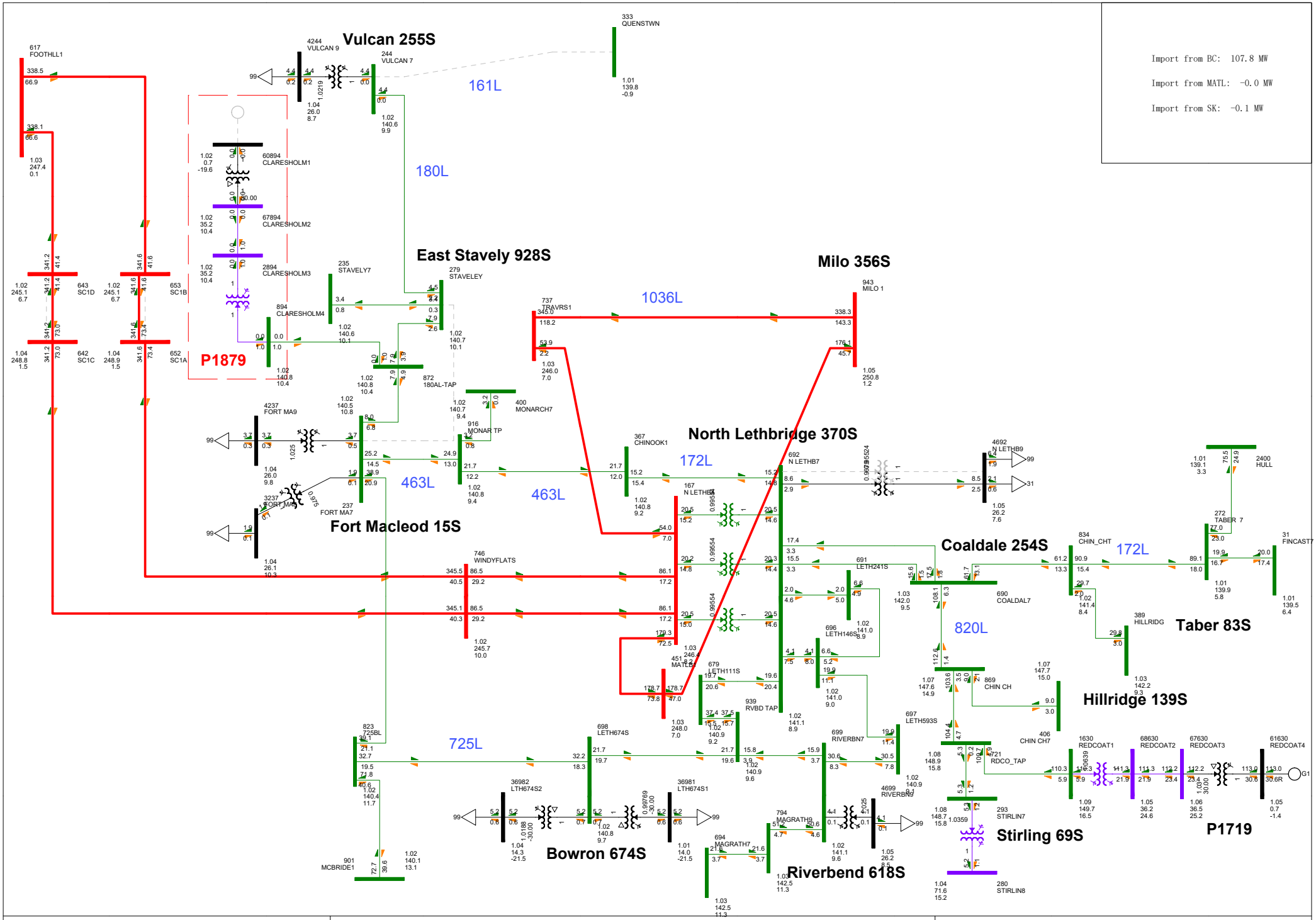
Table A5-1: Generic Renewable Energy Generator/Converter Model

Renewable Energy Generator/Converter Model (PVGU1)								
TIQCmd	**TIpCmd**	**VLVPL1**	**VLVPL2**	**GLVPL**	**HVRC**	**CURHVRCR**	**RIp_LVPL**	**T_LVPL**
0.02	0.02	0.4	0.9	1.11	1.5	1.5	10	0.02

Table A5-2: Generic Renewable Electrical Control Model

Generic Renewable Electrical Control Model (PVEU1)											
Tfv	**Kpv**	**Kiv**	**Kpp**	**Kip**	**Kf**	**Tf**	**QMX**	**QMN**	**IPMAX**	**TRV**	**dPMX**
0.15	18	5	0.05	0.1	0	0.08	0.47	-0.47	1.1	0	0.5
dPMN	**T_POWER**	**KQi**	**VMINCL**	**VMAXCL**	**KVi**	**Tv**	**Tp**	**ImaxTD**	**Iphl**	**Iqhl**	**PMAX**
-0.5	0.05	0.1	0.9	1.1	120	0.05	0.05	1.7	1.11	1.11	130
Remote bus #			**PFAFLG**			**VARFLG**			**PQFLAG**		
872			0			1			0		

Attachment A6
Post-Mitigation Power Flow Diagrams

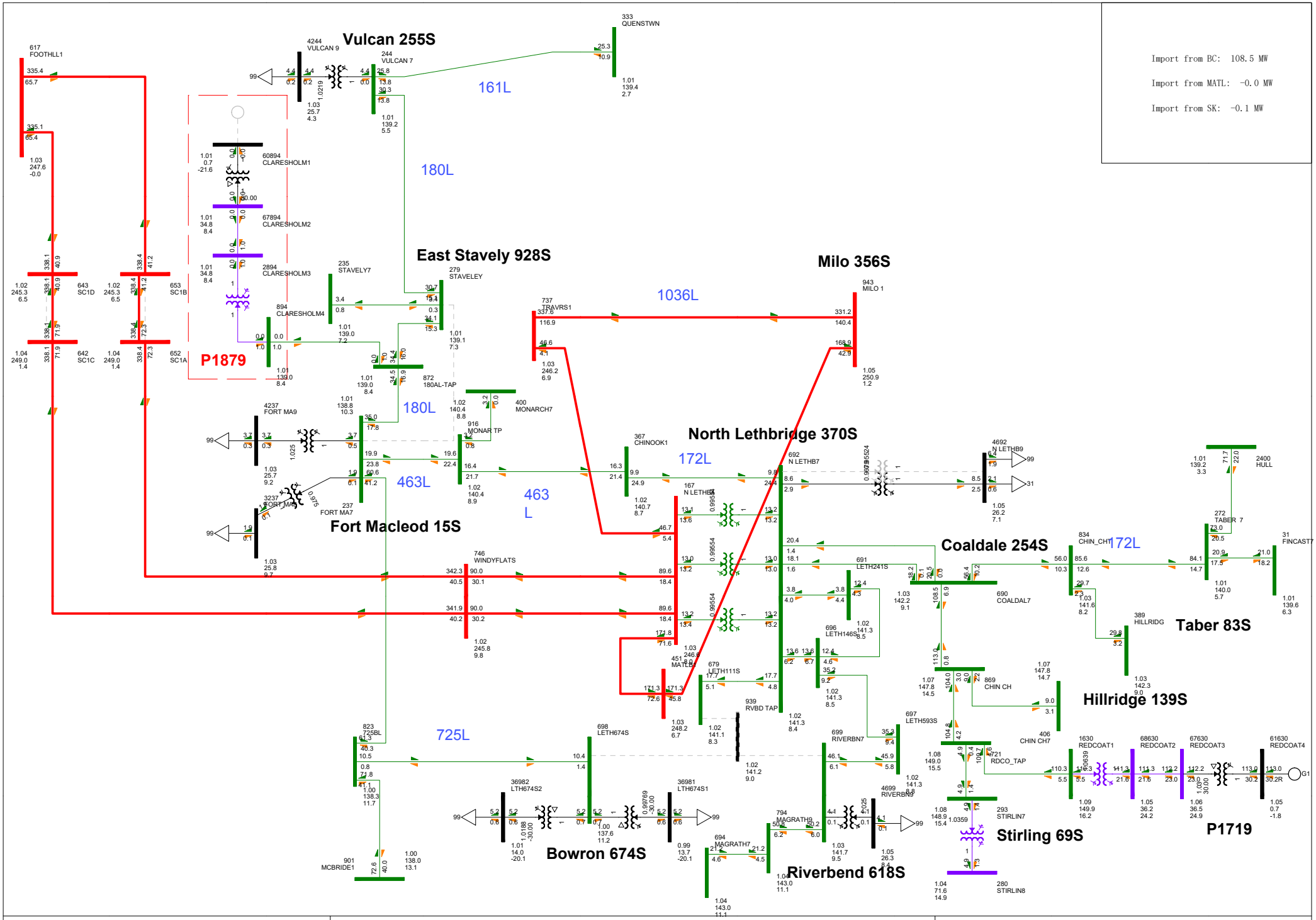


Claresholm Solar Project

AESO Project Number: P1879

FIGURE B-3-1: P1879_SL_POSTRAS
CATEGORY B - 161L (255S - 504S)
WED, APR 10 2019 13:05

Bus - Voltage (kV/pu)/Angle
Branch - MW/Mvar
Equipment - MW/Mvar
100.0%Rate A
1.100OV 0.900UV
kV: <=25.000 <=69.000 <=138.000 <=240.000 <=500.000 >500.000

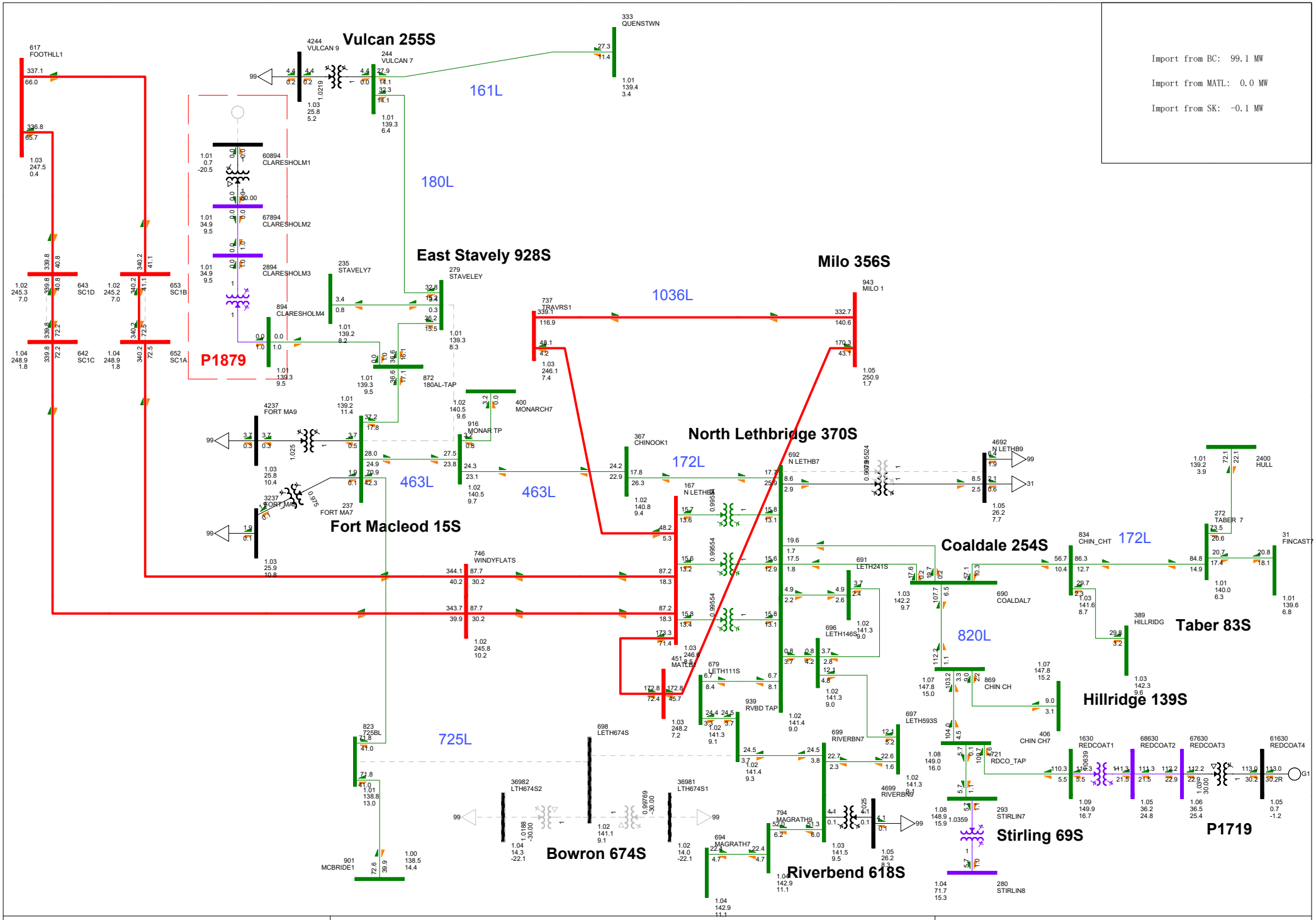


Claresholm Solar Project

AESO Project Number: P1879

FIGURE B-3-2: P1879_SL_POSTRAS
CATEGORY B - 725L (674S - 111S/618S)
WED, APR 10 2019 13:06

Bus - Voltage (kV/pu)/Angle
Branch - MW/Mvar
Equipment - MW/Mvar
100.0%Rate A
1.100UV 0.900UV
kV: <=25.000 <=69.000 <=138.000 <=240.000 <=500.000 >500.000

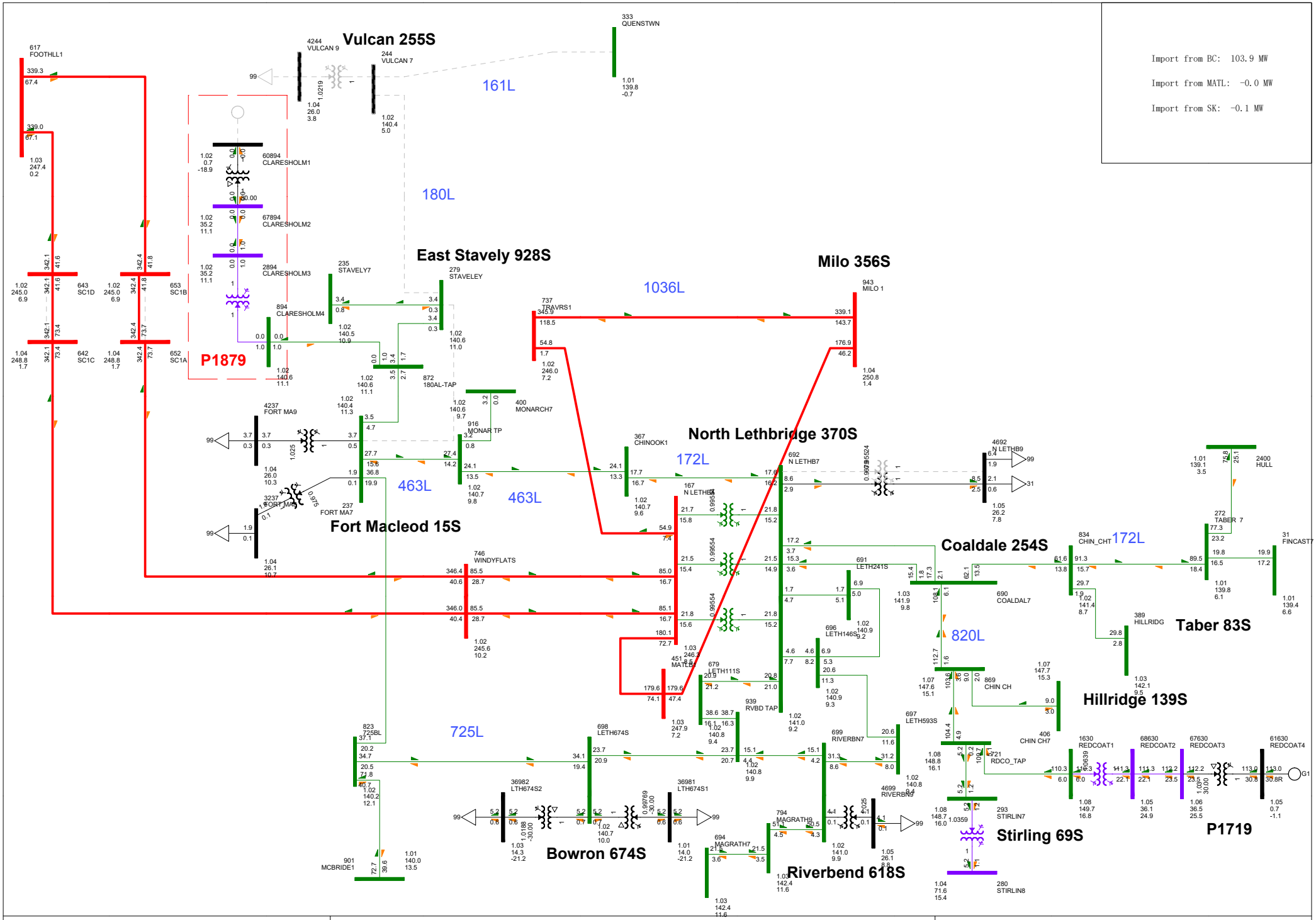


Claresholm Solar Project

AESO Project Number: P1879

FIGURE B-3-3: P1879_SL_POSTRAS
CATEGORY B - BOWRON 674S TRANSFORMER T1
WED, APR 10 2019 13:07

Bus - Voltage (kV/pu)/Angle
Branch - MW/Mvar
Equipment - MW/Mvar
100.0%Rate A
1.100UV 0.900UV
kV: <=25.000 <=69.000 <=138.000 <=240.000 <=500.000 >500.000

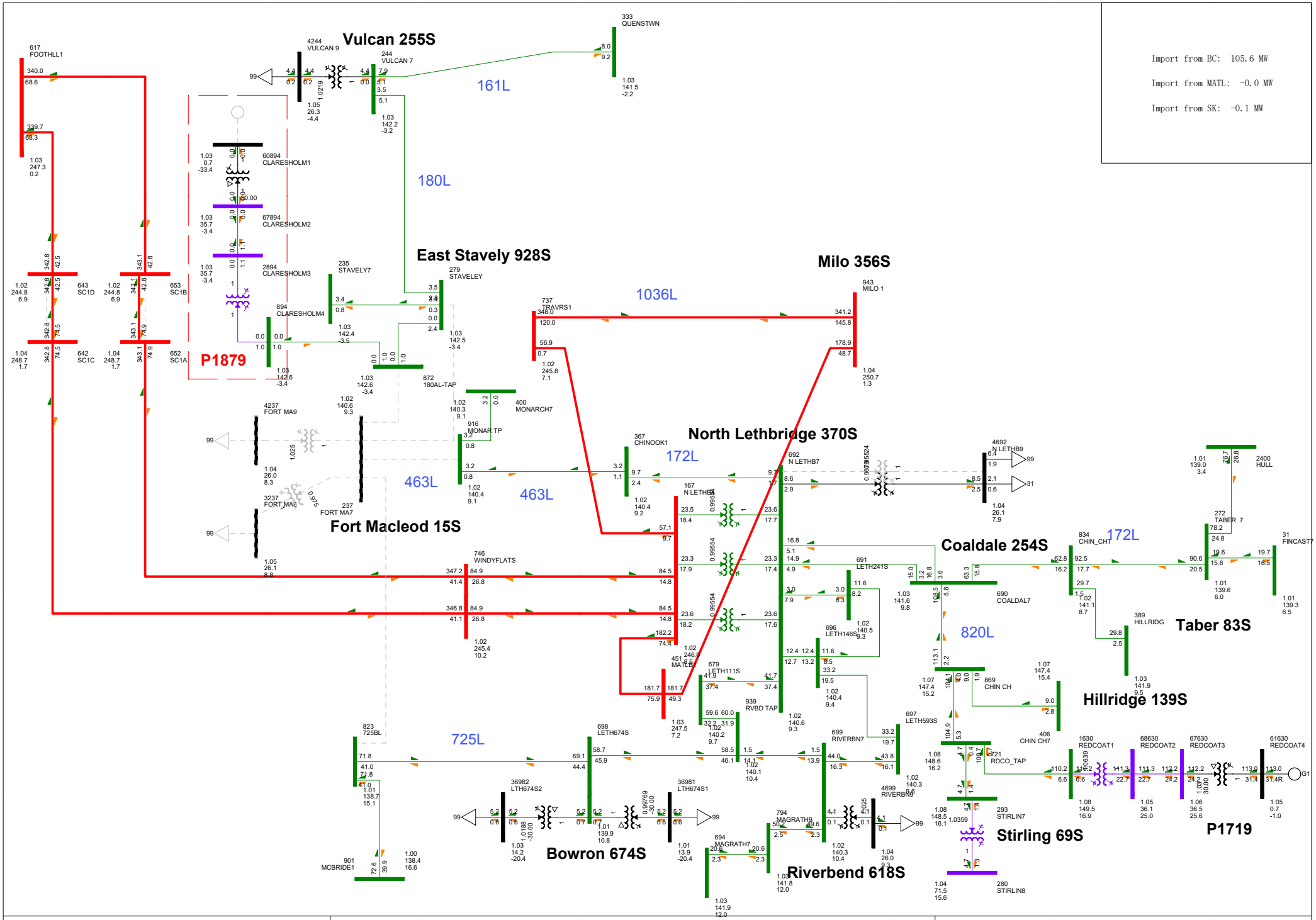


Claresholm Solar Project

AESO Project Number: P1879

FIGURE B-3-4: P1879_SL_POSTRAS
CATEGORY B - VULCAN 255S TRANSFORMER T1
WED, APR 10 2019 13:07

Bus - Voltage (kV/pu)/Angle
Branch - MW/Mvar
Equipment - MW/Mvar
100.0%Rate A
1.1000V 0.900UV
kV: <=25.000 <=69.000 <=138.000 <=240.000 <=500.000 >500.000

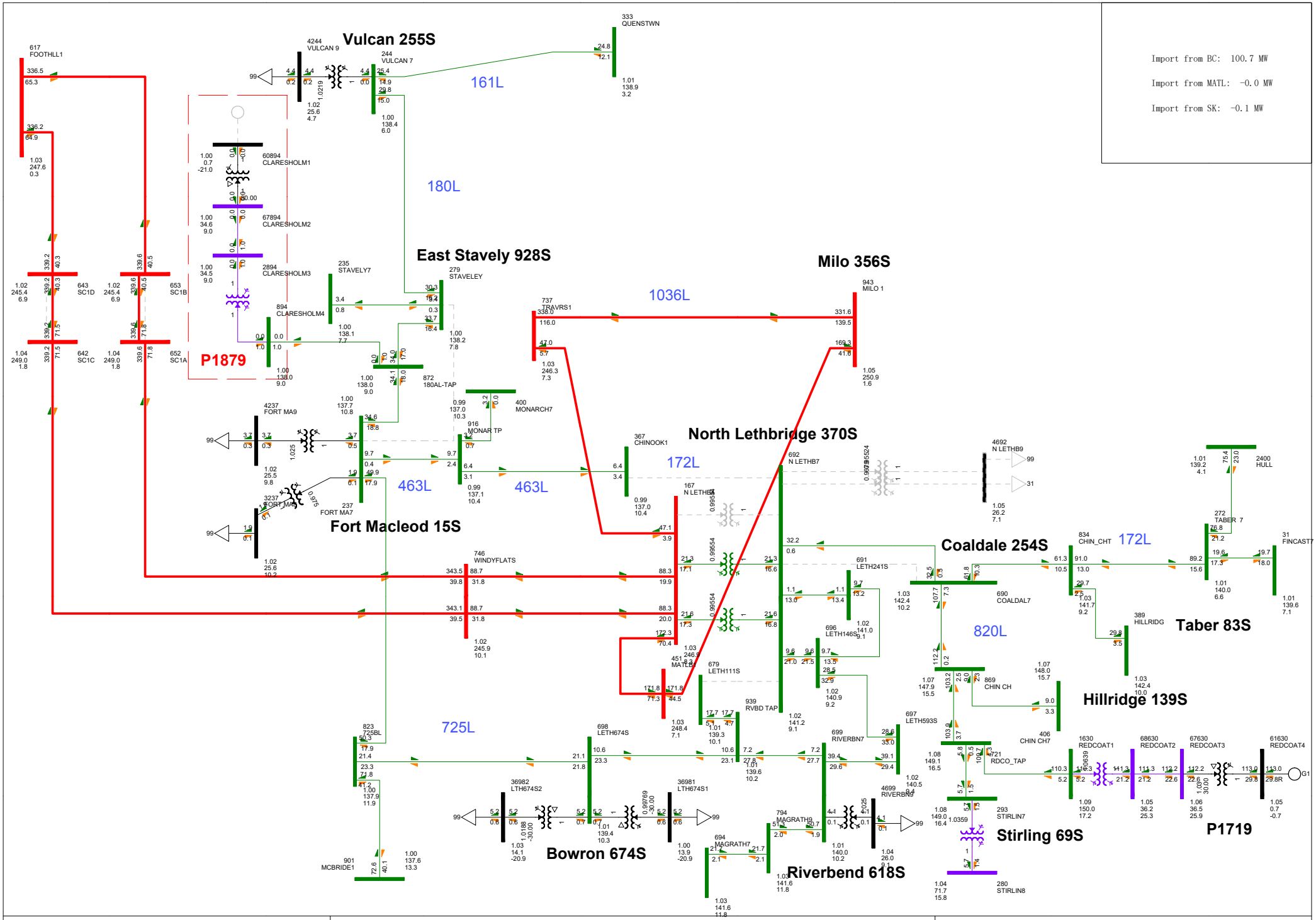


Claresholm Solar Project

AESO Project Number: P1879

FIGURE B-3-5: P1879_SL_POSTRAS
CATEGORY B - FORTMACLEOD 15S TRANSFORMER T1
WED, APR 10 2019 13:08

Bus - Voltage (kV/pu)/Angle
Branch - MW/Mvar
Equipment - MW/Mvar
100.0%Rate A
1.1000V 0.900UV
kV: <=25.000 <=69.000 <=138.000 <=240.000 <=500.000 >500.000

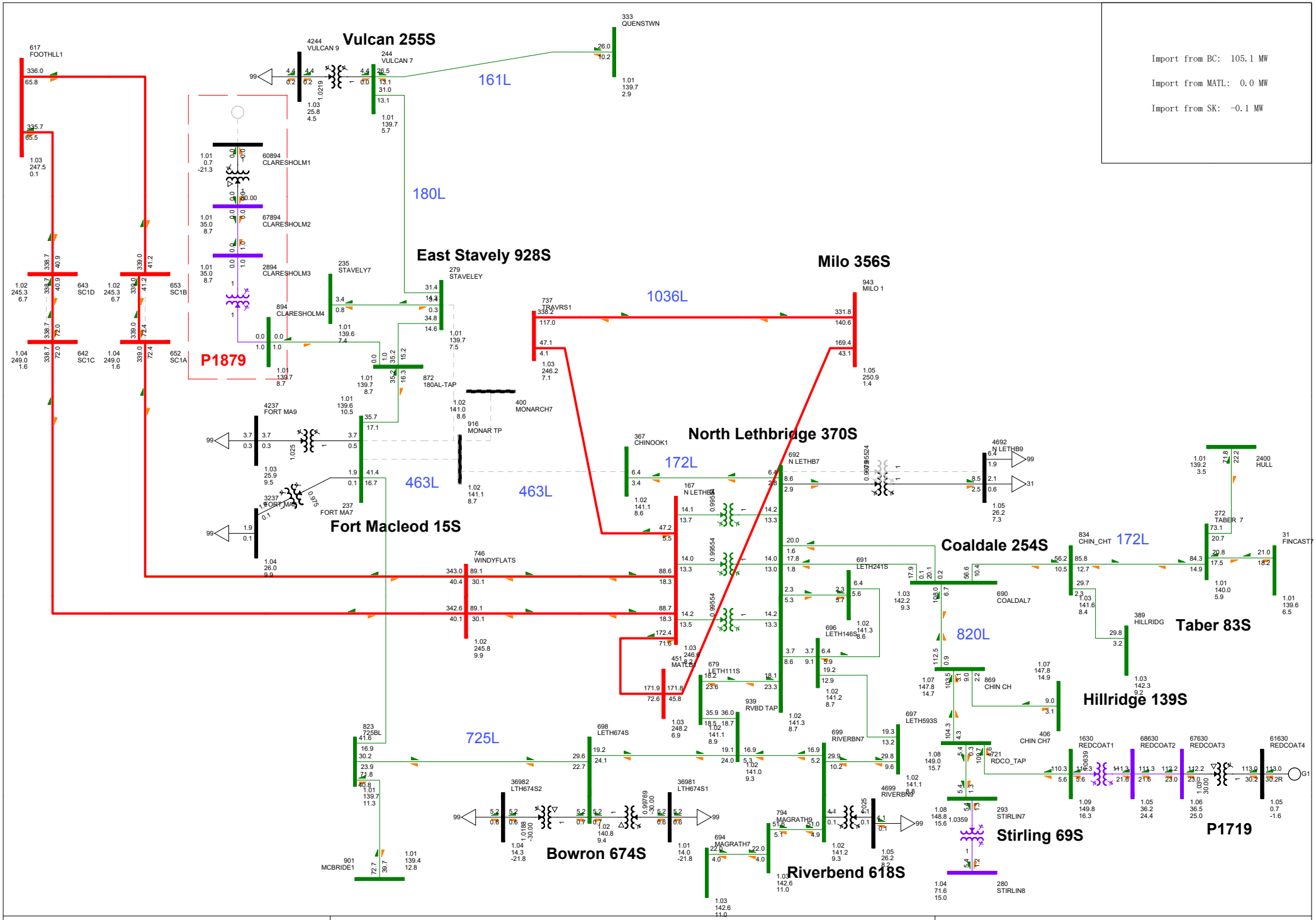


Claresholm Solar Project

AESO Project Number: P1879

FIGURE B-3-6: P1879_SL_POSTRAS
CATEGORY B - N LETHBRIDGE 370S TRANSFORMER T1
THU, APR 11 2019 11:10

Bus - Voltage (kV/pu)/Angle
Branch - MW/Mvar
Equipment - MW/Mvar
100.0%Rate A
1.100OV 0.900UV
kV: <=25.000 <=69.000 <=138.000 <=240.000 <=500.000 >500.000

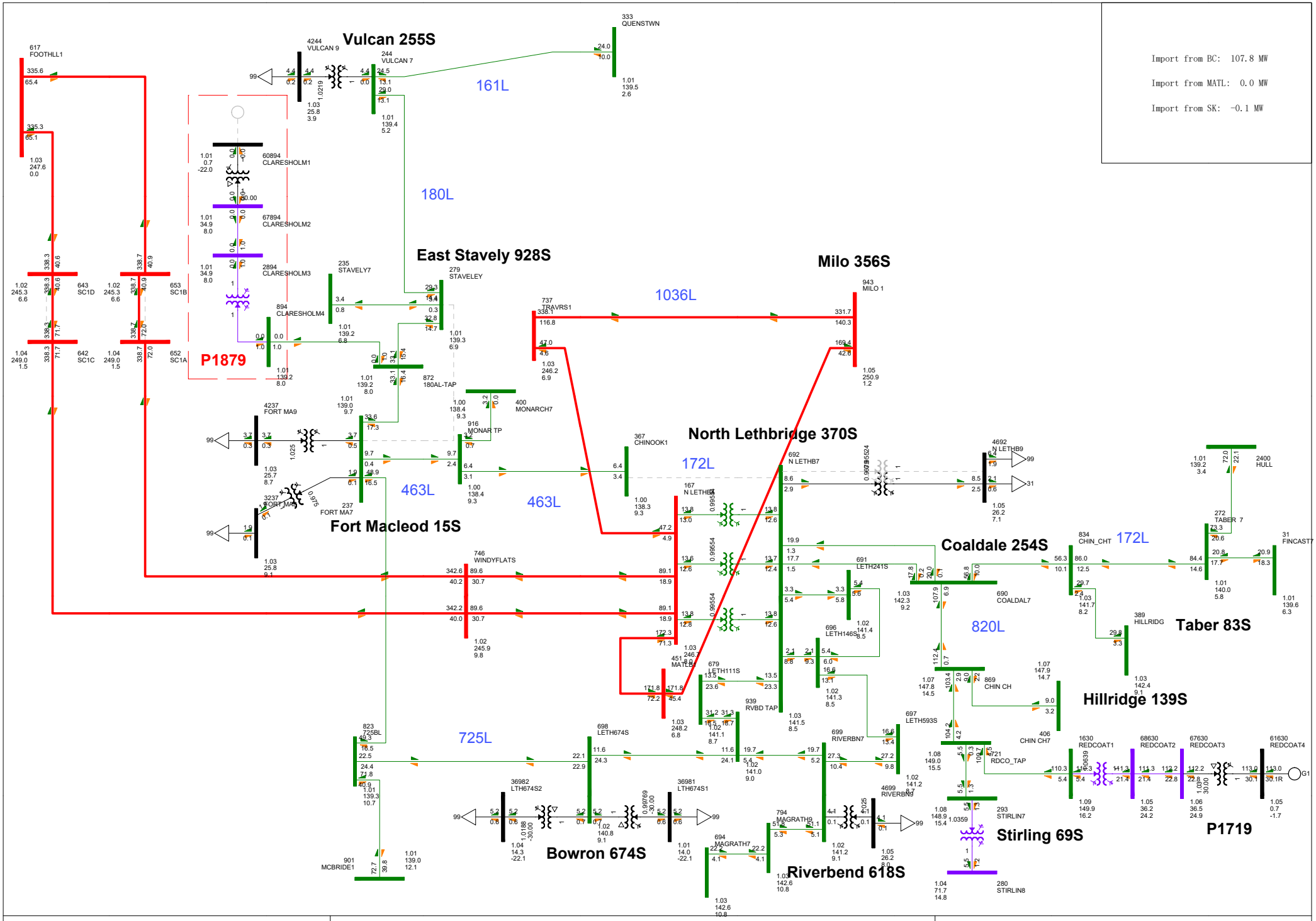


Claresholm Solar Project

AESO Project Number: P1879

FIGURE B-3-7: P1879_SL_POSTRAS
CATEGORY B - 463L (15S - 492S/181S)
WED, APR 10 2019 13:09

Bus - Voltage (kV/pu)/Angle
Branch - MW/Mvar
Equipment - MW/Mvar
100.0%Rate A
1.000OV 0.900UV
kV: <=25.000 <=69.000 <=138.000 <=240.000 <=500.000 >500.000

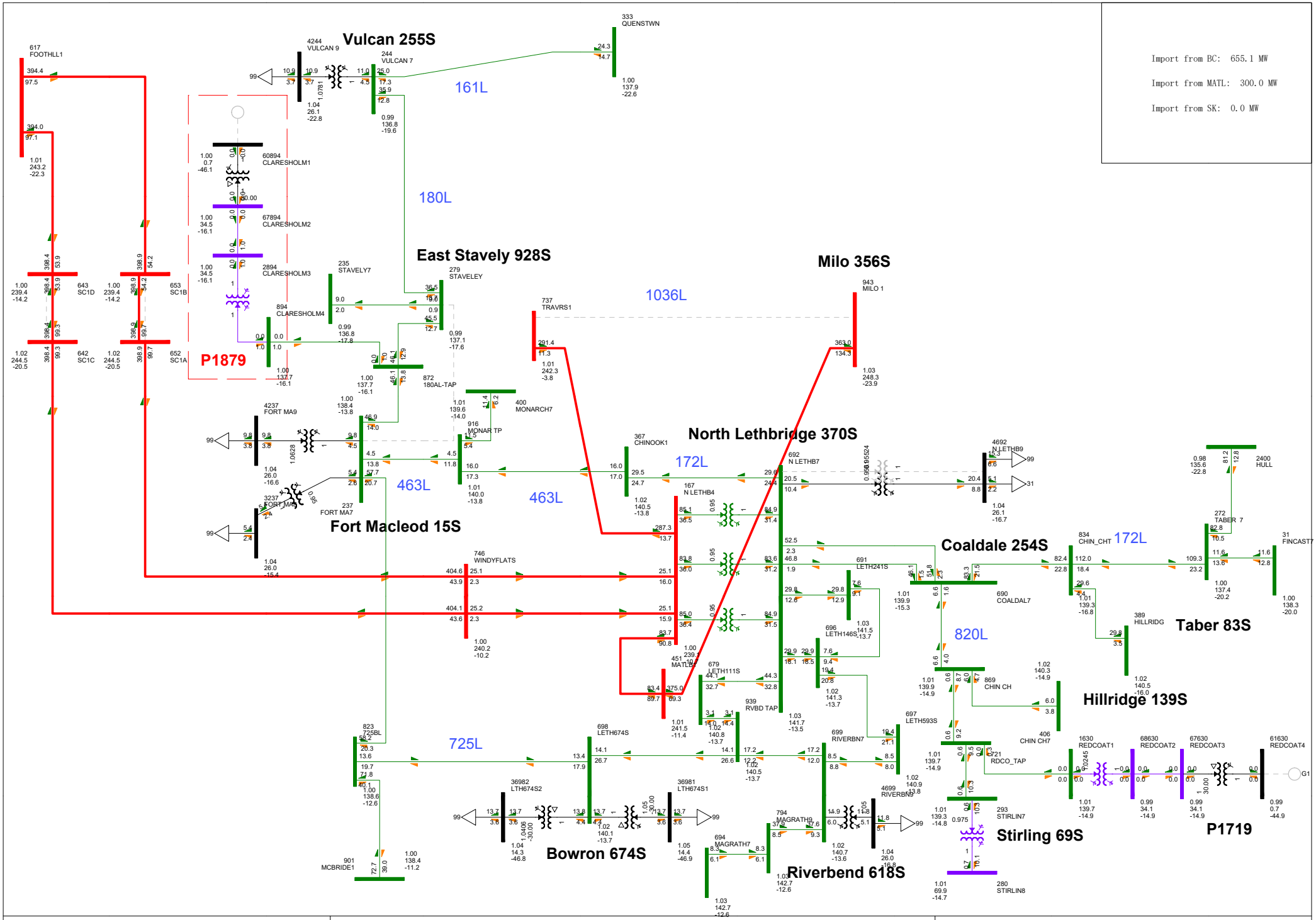


Claresholm Solar Project

AESO Project Number: P1879

FIGURE B-3-8: P1879_SL_POSTRAS
CATEGORY B - 172L (181S - 370S)
WED, APR 10 2019 13:10

Bus - Voltage (kV/pu)/Angle
Branch - MW/Mvar
Equipment - MW/Mvar
100.0%Rate A
1.000UV 0.900UV
kV: <=25.000 <=69.000 <=138.000 <=240.000 <=500.000 >500.000

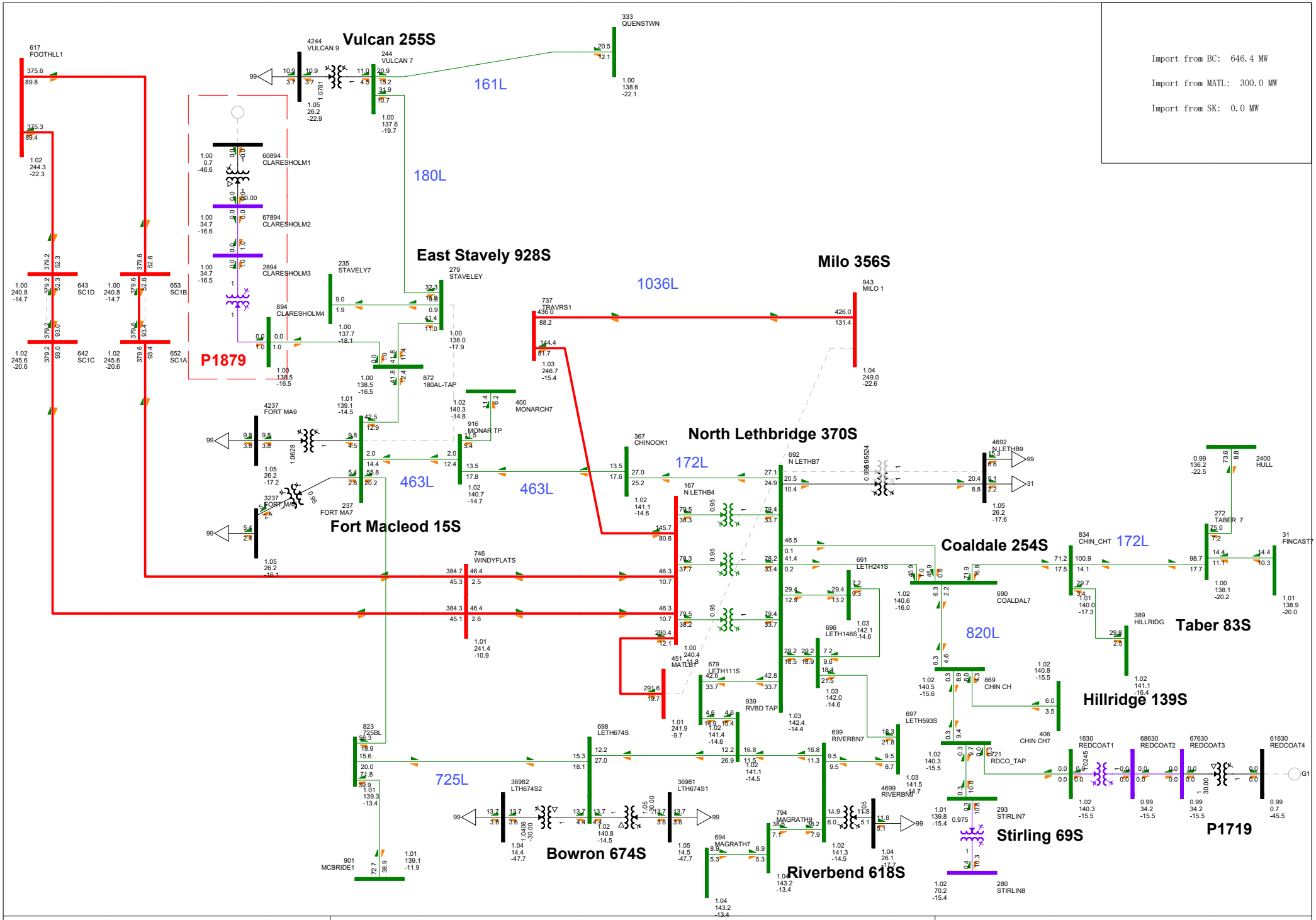


Claresholm Solar Project

AESO Project Number: P1879

FIGURE B-4-1: P1879_SP_POSTRAS
CATEGORY B - 1036L (356S - 554S)
WED, APR 10 2019 13:50

Bus - Voltage (kV/pu)/Angle
Branch - MW/Mvar
Equipment - MW/Mvar
100.0%Rate A
1.100UV 0.900UV
kV: <=25.000 <=69.000 <=138.000 <=240.000 <=500.000 >500.000

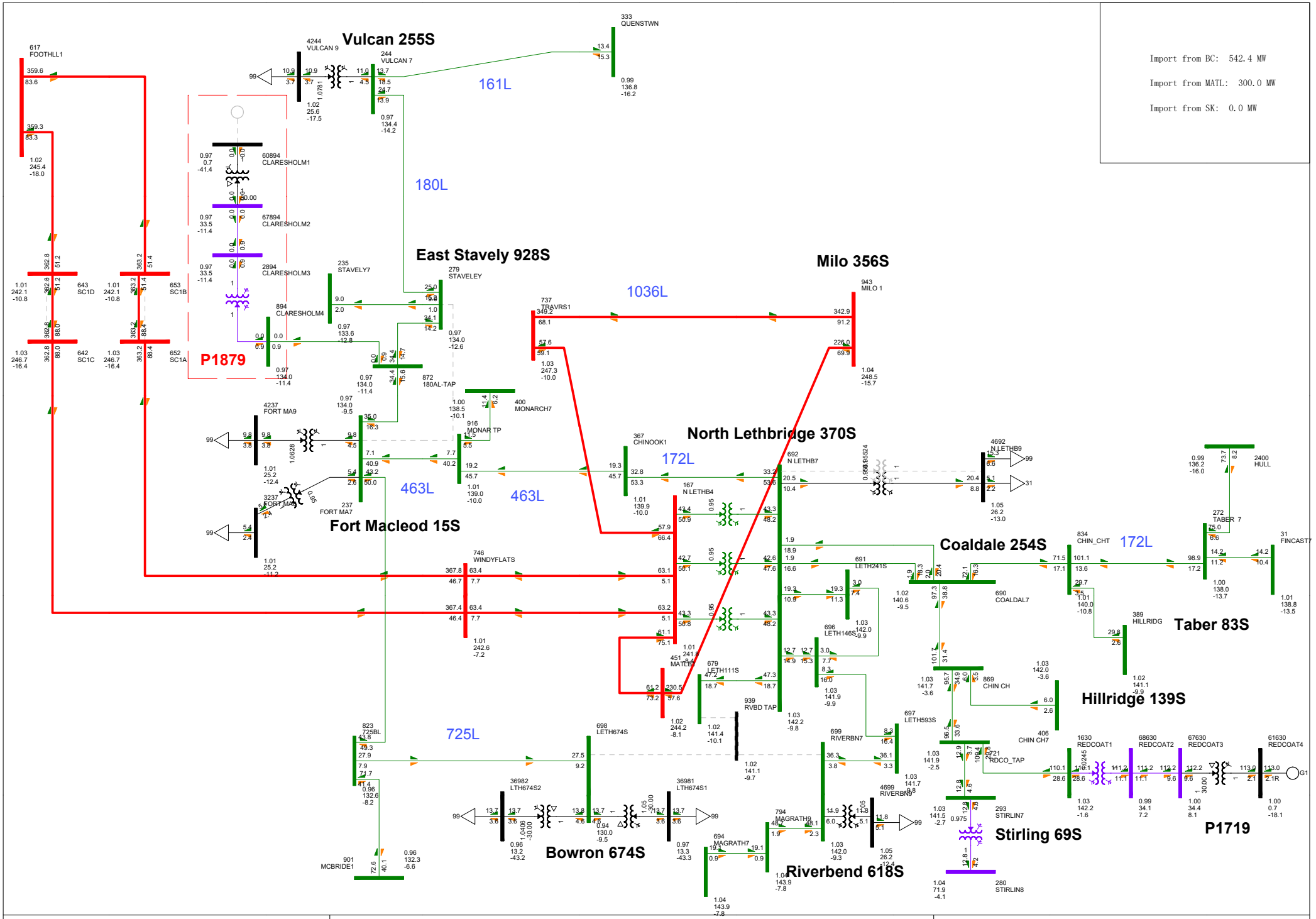


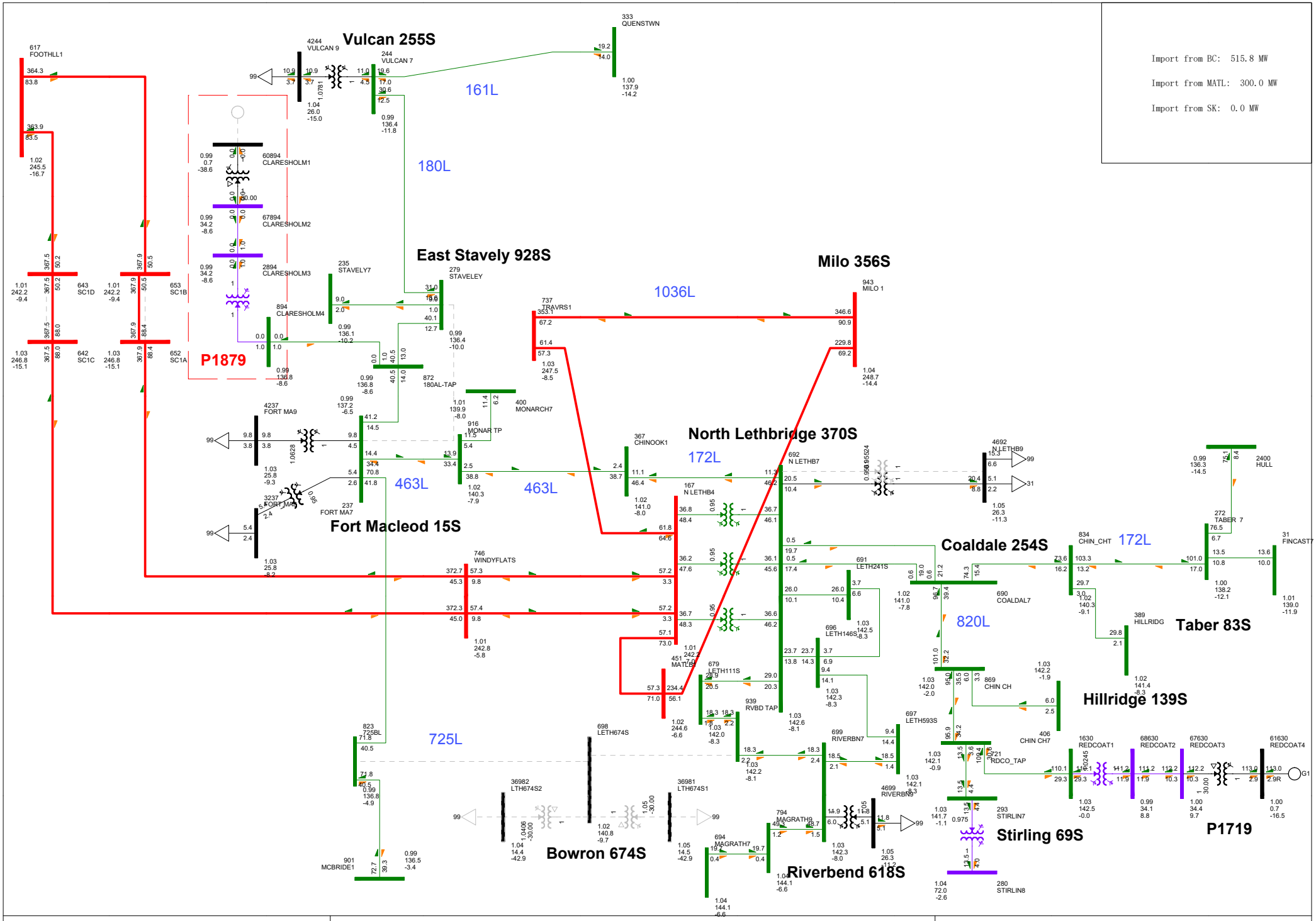
Claresholm Solar Project

AESO Project Number: P1879

FIGURE B-4-2: P1879_SP_POSTRAS
CATEGORY B - 1005L (356S - 120S)
WED, APR 10 2019 13:51

Bus - Voltage (kV/pu)/Angle
Branch - MW/Mvar
Equipment - MW/Mvar
100.0%Rate A
1.100UV 0.900UV
kV: <=25.000 <=69.000 <=138.000 <=240.000 <=500.000 >500.000


Import from BC: 542.4 MW
Import from MATL: 300.0 MW
Import from SK: 0.0 MW
Vulcan 255S
East Stavely 928S
Milo 356S
North Lethbridge 370S
Fort Macleod 15S
Coaldale 254S
Taber 83S
Hillridge 139S
Bowron 674S
Riverbend 618S
Stirling 69S
P1719
P1879
161L
180L
1036L
172L
463L
725L
Claresholm Solar Project
AESO Project Number: P1879
FIGURE B-4-3: P1879_SP_POSTRAS
CATEGORY B - 725L (674S - 111S/618S)
WED, APR 10 2019 13:51
Bus - Voltage (kV/pu)/Angle
Branch - MW/Mvar
Equipment - MW/Mvar
100.0%Rate A
1.100OV 0.900UV
kV: <=25.000 <=69.000 <=138.000 <=240.000 <=500.000 >500.000

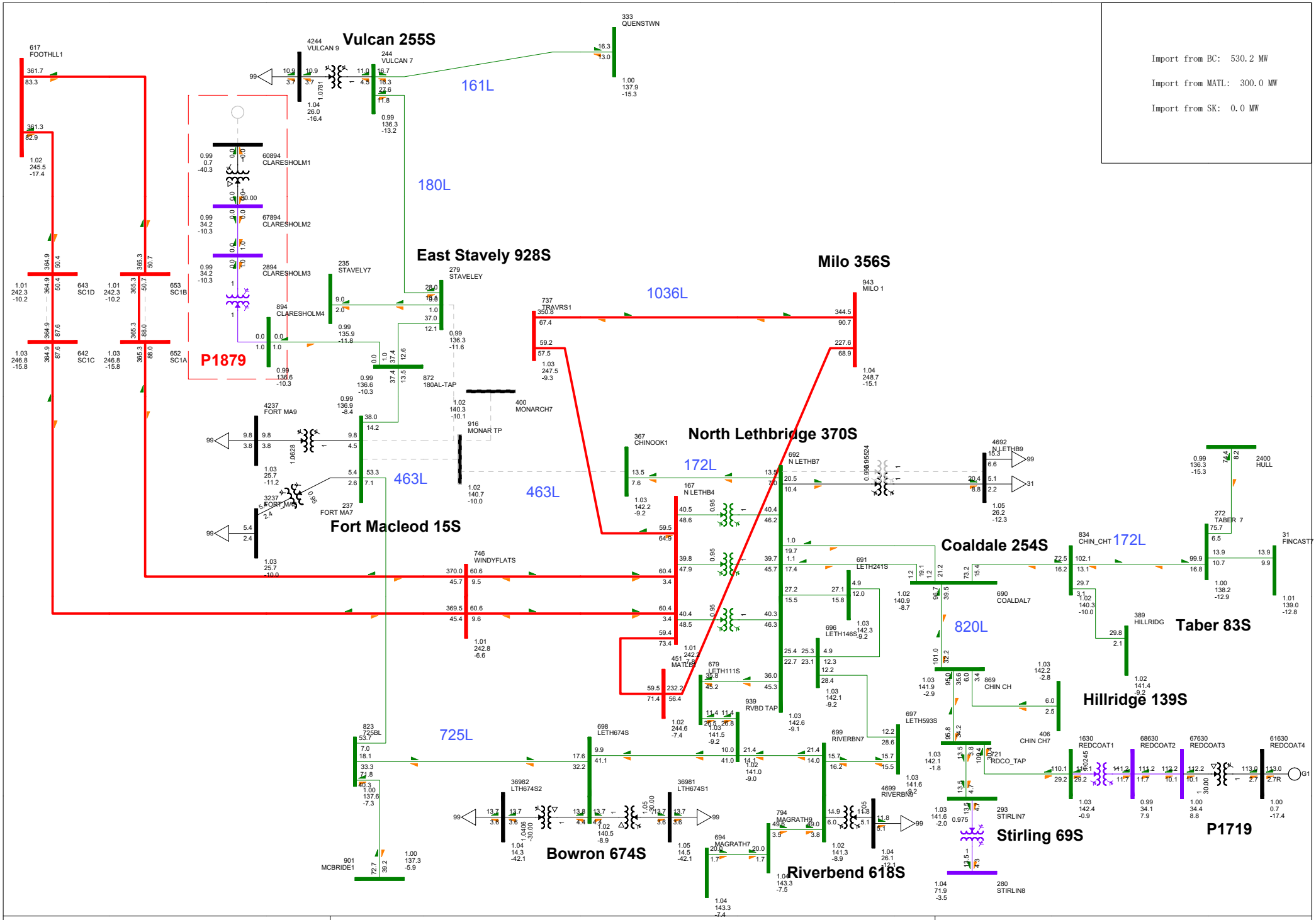


Claresholm Solar Project

AESO Project Number: P1879

FIGURE B-4-4: P1879_SP_POSTRAS
CATEGORY B - BOWRON 674S TRANSFORMER T1
WED, APR 10 2019 13:52

Bus - Voltage (kV/pu)/Angle
Branch - MW/Mvar
Equipment - MW/Mvar
100.0%Rate A
1.1000V 0.900UV
kV: <=25.000 <=69.000 <=138.000 <=240.000 <=500.000 >500.000



Claresholm Solar Project

AESO Project Number: P1879

FIGURE B-4-5: P1879_SP_POSTRAS
CATEGORY B - 463L (15S - 492S/181S)
WED, APR 10 2019 13:52

Bus - Voltage (kV/pu)/Angle
Branch - MW/Mvar
Equipment - MW/Mvar
100.0%Rate A
1.100UV 0.900UV
kV: <=25.000 <=69.000 <=138.000 <=240.000 <=500.000 >500.000

Attachment A7
Constraint Effective Factors Table

Table G-1: Generator Type

Generating Facility Name and Unit Number	P1879	AltaGas Parkland	McBride #3	McBride #2	McBride #1	Suncor Magrath	Stirling WAGF (P1719)	Chin Chute	Suncor Chin Chute	Taber Wind #1	Taber Wind #2	TransAlta Windrise (P2041)
Type	Solar	Gas	Wind	Wind	Wind	Wind	Wind	Wind	Wind	Wind	Wind	Wind

Note:

The effectiveness factors calculated for Suncor Chin Chute facility can be used for Coaldale Lethbridge gas facility (ME04) as both facilities are electrically close to each other.

Table G-2: Effectiveness Factor (post-Project Scenario#3 and Scenario#4)

Scenario and Case Name	Contingency (System Element Lost)	Details of Violation (Violation Observed On)	Generating Facility Name and Unit Number											
			P1879	AltaGas parkland	McBride #3	McBride #2	McBride #1	Suncor Magrath	Stirling WAGF (P1719)	Chin Chute	Suncor Chin Chute	Taber Wind #1	Taber Wind #2	TransAlta Windrise (P2041)
P1879_SL_V1D3_post.sav	618ST1 (Transformer T1 at Riverbend 618S)	820L (Stirling Wind Project Tap Point - 820AL Tap Point)	-1%	-1%	-1%	-1%	-1%	46%	89%	-5%	-2%	-1%	-1%	0%

Scenario and Case Name	Contingency (System Element Lost)	Details of Violation (Violation Observed On)	Generating Facility Name and Unit Number											
			P1879	AltaGas parkland	McBride #3	McBride #2	McBride #1	Suncor Magrath	Stirling WAGF (P1719)	Chin Chute	Suncor Chin Chute	Taber Wind #1	Taber Wind #2	TransAlta Windrise (P2041)
	618ST1 (Transformer T1 at Riverbend 618S)	820L (Coaldale 254S - 820AL Tap Point)	-1%	-1%	-1%	-1%	-1%	45%	88%	95%	-2%	-1%	-1%	0%
	161L (Vulcan 255S - Queenstown 504S)	463L (Fort Macleod 15S - 463AL Tap Point)	52%	52%	43%	42%	43%	5%	0%	0%	0%	0%	0%	0%
	161L (Vulcan 255S - Queenstown 504S)	180L (Fort Macleod 15S - P1879 Tap Point)	94%	95%	-1%	-1%	-1%	-1%	-1%	-1%	0%	0%	0%	0%
	161L (Vulcan 255S - Queenstown 504S)	172L (Chinook 181S - North Lethbridge 370S)	54%	50%	42%	41%	42%	5%	0%	0%	0%	0%	0%	0%
	161L (Vulcan 255S - Queenstown 504S)	725L (Bowron 674S - 725BL Tap Point)	44%	42%	56%	55%	56%	-6%	-1%	-1%	0%	0%	0%	0%

Scenario and Case Name	Contingency (System Element Lost)	Details of Violation (Violation Observed On)	Generating Facility Name and Unit Number											
			P1879	AltaGas parkland	McBride #3	McBride #2	McBride #1	Suncor Magrath	Stirling WAGF (P1719)	Chin Chute	Suncor Chin Chute	Taber Wind #1	Taber Wind #2	TransAlta Windrise (P2041)
	161L (Vulcan 255S - Queenstown 504S)	463L (Chinook 181S - 463AL Tap Point)	53%	51%	42%	41%	42%	5%	0%	0%	0%	0%	0%	0%
	725L (Bowron 674S - Coalbanks 111S/Riverbend 618S)	463L (Fort Macleod 15S - 463AL Tap Point)	68%	60%	0%	0%	0%	-4%	-3%	-3%	-2%	-1%	-1%	-2%
	725L (Bowron 674S - Coalbanks 111S/Riverbend 618S)	463L (Chinook 181S - 463AL Tap Point)	67%	59%	0%	0%	0%	-4%	-3%	-3%	-2%	-1%	-1%	-2%
	725L (Bowron 674S - Coalbanks 111S/Riverbend 618S)	172L (Chinook 181S - North Lethbridge 370S)	69%	58%	0%	0%	0%	-4%	-4%	-3%	-2%	-1%	-1%	-2%
	674ST1 (Transformer T1 in Bowron 674S)	463L (Fort Macleod 15S - 463AL Tap Point)	69%	58%	79%	78%	79%	-4%	-4%	-3%	-2%	-1%	-1%	-2%

Scenario and Case Name	Contingency (System Element Lost)	Details of Violation (Violation Observed On)	Generating Facility Name and Unit Number											
			P1879	AltaGas parkland	McBride #3	McBride #2	McBride #1	Suncor Magrath	Stirling WAGF (P1719)	Chin Chute	Suncor Chin Chute	Taber Wind #1	Taber Wind #2	TransAlta Windrise (P2041)
	674ST1 (Transformer T1 in Bowron 674S)	463L (Chinook 181S - 463AL Tap Point)	70%	57%	80%	78%	79%	-4%	-4%	-4%	-2%	-1%	-1%	-2%
	674ST1 (Transformer T1 in Bowron 674S)	172L (Chinook 181S - North Lethbridge 370S)	71%	56%	80%	78%	80%	-4%	-4%	-4%	-3%	-1%	-1%	-2%
	255ST1 (Transformer T1 in Vulcan 255S)	463L (Fort Macleod 15S - 463AL Tap Point)	52%	51%	43%	42%	43%	5%	0%	0%	0%	0%	0%	0%
	255ST1 (Transformer T1 in Vulcan 255S)	463L (Chinook 181S - 463AL Tap Point)	53%	51%	42%	41%	42%	5%	0%	0%	0%	0%	0%	0%
	255ST1 (Transformer T1 in Vulcan 255S)	725L (Bowron 674S - 725BL Tap Point)	44%	42%	56%	55%	56%	-6%	-1%	-1%	0%	0%	0%	0%

Scenario and Case Name	Contingency (System Element Lost)	Details of Violation (Violation Observed On)	Generating Facility Name and Unit Number											
			P1879	AltaGas parkland	McBride #3	McBride #2	McBride #1	Suncor Magrath	Stirling WAGF (P1719)	Chin Chute	Suncor Chin Chute	Taber Wind #1	Taber Wind #2	TransAlta Windrise (P2041)
	255ST1 (Transformer T1 in Vulcan 255S)	180L (Fort Macleod 15S - P1879 Tap Point)	94%	95%	-1%	-1%	-1%	-1%	-1%	-1%	0%	0%	0%	0%
	255ST1 (Transformer T1 in Vulcan 255S)	172L (Chinook 181S - North Lethbridge 370S)	54%	50%	42%	41%	42%	5%	0%	0%	0%	0%	0%	0%
	15ST1 (Transformer T1 in Fort Macleod 15S)	180L (Vulcan 255S - East Stavely 928S)	82%	90%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	15ST1 (Transformer T1 in Fort Macleod 15S)	180L (East Stavely 928S - P1879 Tap Point)	86%	-1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	370ST1 (Transformer T1 at North Lethbridge 370S)	725L (Bowron 674S - 725BL Tap Point)	64%	52%	77%	75%	77%	-9%	-4%	-4%	-2%	-1%	-1%	-2%

Scenario and Case Name	Contingency (System Element Lost)	Details of Violation (Violation Observed On)	Generating Facility Name and Unit Number											
			P1879	AltaGas parkland	McBride #3	McBride #2	McBride #1	Suncor Magrath	Stirling WAGF (P1719)	Chin Chute	Suncor Chin Chute	Taber Wind #1	Taber Wind #2	TransAlta Windrise (P2041)
	463L (Fort Macleod 15S - Monarch 492S/Chinook 181S)	725L (Bowron 674S - 725BL Tap Point)	67%	55%	81%	79%	80%	-6%	-4%	-4%	-2%	-1%	-1%	-2%
	172L (Chinook 181S - North Lethbridge 370S)	725L (Bowron 674S - 725BL Tap Point)	68%	55%	81%	79%	80%	-6%	-4%	-4%	-2%	-1%	-1%	-2%
	1036L (Milo 356S - Travers 554S)	172L (Taber 83S - 172EL Tap Point)	6%	5%	10%	10%	10%	12%	20%	21%	34%	-49%	-49%	5%
P1879_SP_V1D3_post.sav	618ST1 (Transformer T1 at Riverbend 618S)	820L (Stirling Wind Project Tap Point - 820AL Tap Point)	-2%	-1%	-2%	-2%	-2%	50%	90%	-5%	-2%	-2%	-2%	-1%
	618ST1 (Transformer T1 at Riverbend 618S)	820L (Coaldale 254S - 820AL Tap Point)	-2%	-1%	-2%	-2%	-2%	49%	89%	92%	-2%	-2%	-2%	-1%

Scenario and Case Name	Contingency (System Element Lost)	Details of Violation (Violation Observed On)	Generating Facility Name and Unit Number											
			P1879	AltaGas parkland	McBride #3	McBride #2	McBride #1	Suncor Magrath	Stirling WAGF (P1719)	Chin Chute	Suncor Chin Chute	Taber Wind #1	Taber Wind #2	TransAlta Windrise (P2041)
	1036L (Milo 356S - Travers 554S)	172L (Taber 83S - 172EL Tap Point)	6%	5%	10%	10%	10%	12%	18%	20%	34%	-49%	-49%	5%
	1005L (Picture Butte 120S - Milo 356S)	172L (Taber 83S - 172EL Tap Point)	6%	5%	9%	10%	9%	12%	18%	20%	33%	-49%	-49%	5%
	1005L (Picture Butte 120S - Milo 356S)	1036L (Milo 356S - Travers 554S)	18%	15%	24%	24%	24%	27%	22%	23%	19%	10%	10%	22%
	161L (Vulcan 255S - Queenstown 504S)	463L (Fort Macleod 15S - 463AL Tap Point)	53%	51%	42%	41%	42%	5%	-1%	0%	0%	0%	0%	0%
	725L (Bowron 674S - Coalbanks 111S/Riverbend 618S)	172L (Chinook 181S - North Lethbridge 370S)	57%	41%	0%	0%	0%	-4%	-5%	-4%	-2%	-1%	-1%	-2%

Scenario and Case Name	Contingency (System Element Lost)	Details of Violation (Violation Observed On)	Generating Facility Name and Unit Number											
			P1879	AltaGas parkland	McBride #3	McBride #2	McBride #1	Suncor Magrath	Stirling WAGF (P1719)	Chin Chute	Suncor Chin Chute	Taber Wind #1	Taber Wind #2	TransAlta Windrise (P2041)
	725L (Bowron 674S - Coalbanks 111S/Riverbend 618S)	463L (Fort Macleod 15S - 463AL Tap Point)	69%	60%	0%	0%	0%	-4%	-4%	-3%	-2%	-1%	-1%	-2%
	725L (Bowron 674S - Coalbanks 111S/Riverbend 618S)	463L (Chinook 181S - 463AL Tap Point)	68%	56%	0%	0%	0%	-4%	-4%	-4%	-2%	-1%	-1%	-2%
	674ST1 (Transformer T1 in Bowron 674S)	172L (Chinook 181S - North Lethbridge 370S)	72%	49%	77%	73%	76%	-4%	-4%	-3%	-2%	-1%	-1%	-2%
	674ST1 (Transformer T1 in Bowron 674S)	463L (Fort Macleod 15S - 463AL Tap Point)	69%	55%	78%	77%	78%	-4%	-4%	-3%	-2%	-1%	-1%	-2%
	674ST1 (Transformer T1 in Bowron 674S)	463L (Chinook 181S - 463AL Tap Point)	71%	52%	78%	76%	78%	-4%	-4%	-3%	-2%	-1%	-1%	-2%

Scenario and Case Name	Contingency (System Element Lost)	Details of Violation (Violation Observed On)	Generating Facility Name and Unit Number											
			P1879	AltaGas parkland	McBride #3	McBride #2	McBride #1	Suncor Magrath	Stirling WAGF (P1719)	Chin Chute	Suncor Chin Chute	Taber Wind #1	Taber Wind #2	TransAlta Windrise (P2041)
	255ST1 (Transformer T1 in Vulcan 255S)	463L (Fort Macleod 15S - 463AL Tap Point)	52%	52%	42%	41%	42%	5%	0%	0%	0%	0%	0%	0%
	255ST1 (Transformer T1 in Vulcan 255S)	725L (Bowron 674S - 725BL Tap Point)	44%	43%	56%	54%	55%	-6%	-1%	-1%	0%	0%	0%	0%
	255ST1 (Transformer T1 in Vulcan 255S)	180L (Fort Macleod 15S - P1879 Tap Point)	94%	97%	-1%	0%	-1%	-1%	-1%	-1%	0%	0%	0%	-1%
	15ST1 (Transformer T1 in Fort Macleod 15S)	180L (Vulcan 255S - East Stavely 928S)	82%	91%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	15ST1 (Transformer T1 in Fort Macleod 15S)	180L (East Stavely 928S - P1879 Tap Point)	87%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Scenario and Case Name	Contingency (System Element Lost)	Details of Violation (Violation Observed On)	Generating Facility Name and Unit Number											
			P1879	AltaGas parkland	McBride #3	McBride #2	McBride #1	Suncor Magrath	Stirling WAGF (P1719)	Chin Chute	Suncor Chin Chute	Taber Wind #1	Taber Wind #2	TransAlta Windrise (P2041)
	370ST1 (Transformer T1 at North Lethbridge 370S)	725L (Bowron 674S - 725BL Tap Point)	65%	48%	76%	73%	75%	-9%	-4%	-4%	-2%	-1%	-1%	-2%
	463L (Fort Macleod 15S - Monarch 492S/Chinook 181S)	725L (Bowron 674S - 725BL Tap Point)	68%	53%	80%	78%	80%	-6%	-4%	-4%	-2%	-1%	-1%	-2%
	172L (Chinook 181S - North Lethbridge 370S)	725L (Bowron 674S - 725BL Tap Point)	68%	50%	78%	75%	77%	-6%	-4%	-4%	-2%	-1%	-1%	-2%
	1037L (Foothills 237S - Windy Flats 183S)	172L (Taber 83S - 172EL Tap Point)	5%	5%	9%	9%	9%	11%	17%	19%	33%	-49%	-49%	4%
	1038L (Foothills 237S - Windy Flats 183S)	172L (Taber 83S - 172EL Tap Point)	5%	5%	9%	9%	9%	11%	17%	19%	33%	-49%	-49%	4%