APPENDIX A CONNECTION ASSESSMENT

Engineering Connection Assessment

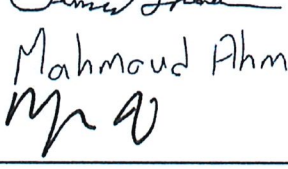
P1898 Lanfine North Wind Power Project Connection

Pattern Development Lanfine Wind ULC

Date: December 14, 2020

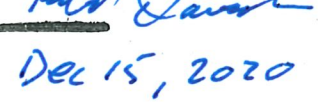
Version: V1

Classification: Public

Role	Name	Date	Signature
Prepared	Omid Ghoreishi, P.Eng. Mahmoud Ahmed, P.Eng. Myron Jin-Li, P.Eng.	Dec. 14, 2020 Dec. 14th, 2020 Dec 15, 2020	
Reviewed	Maz Mazadi, Ph. D., P.Eng.	Dec 15 2020	
Approved	Robert Davidson, P. Eng	Dec 15 2020	



APEGA
Permit-to-Practice
P-8200



Alberta Electric System Operator

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

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

www.aeso.ca

@theaeso

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.

Contents

1 Introduction 1
1.1 Project Overview 1
2 Assessment Scope 2
2.1 Objectives 2
2.2 Existing System 2
2.3 Study Area 4
3 Connection Alternatives 5
3.1 Overview 5
3.2 Connection Alternatives Examined 5
3.3 Connection Alternatives Selected for Further Study 13
3.4 Connection Alternatives Not Selected for Further Study 13
4 Assessment Approach 14
4.1 Standards, Criteria and Assumptions 14
4.2 Studies Performed 14
4.2.1 Power Flow Studies 15
4.2.2 Transient Stability Studies 15
4.2.3 Short-Circuit Current Level Studies 16
4.3 Mitigation Measure Development and Evaluation 16
4.3.1 Post-Mitigation Studies 16
4.3.2 Constraint Effective Factor Studies 16
5 Interpretation of Results 17
5.1 Results Overview 17
5.2 Pre-Project Study Results 25
5.2.1 Category A Conditions 25
5.2.2 Category B Conditions 25
5.3 Post-Project Base Scenario Study Results 25
5.3.1 Category A Conditions 25
5.3.2 Category B Conditions 25
5.4 Post-Project Sensitivity Study Results 25
5.4.1 Category A Conditions 25
5.4.2 Category B Conditions 25
5.5 Mitigation Measures 26
5.5.1 Pre-Project 26
5.5.2 Post-Project 26
5.5.2.1 Post-Project Base Scenarios 26
5.5.2.2 Post-Project Sensitivity Scenarios 26
5.5.2.3 Notable Study Assumptions 26
5.5.3 Post-Project Mitigation Study Results 27
6 Project Dependencies 28
7 Conclusions and Recommendations 29

Tables

Table 4-1: Connection Study Scenarios 14
Table 5-1: Summary of Reliability Criteria Violations, Project Impact and Mitigation Measures based on the Base Study Scenarios (Scenarios 1 - 6) 18
Table 5-2: Summary of Reliability Criteria Violations and Mitigation Measures based on the Post-Project Sensitivity Scenarios (Scenarios 4a, 4b, 4c) 21

Figures

Figure 2-1: Existing transmission system in the Study Area 3
Figure 3-1: Connection Alternative 1 6
Figure 3-2: Connection Alternative 2 8
Figure 3-3: Connection Alternative 3 10
Figure 3-4: Connection Alternative 4 12

Attachments

Attachment A: Engineering Connection Assessment Results

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

Pattern Development Lanfine Wind ULC (Market Participant) has submitted a request for system access service to the Alberta Electric System Operator (AESO) to connect its approved Lanfine North Wind Power Project (Facility) to the AIES. The Facility includes an approved collector station, designated as the Buffalo Bird 601S substation. The Facility is planned to be located in the Oyen area, in the AESO planning area of Hanna (Area 42).

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 145 MW and a Rate DTS, *Demand Transmission Service*, contract capacity of 1.5 MW; and a request for transmission development (collectively, the Project).

The scheduled in-service date (ISD) for the Project is September 30, 2022.

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 transmission facility (TFO) projects or AESO plans to expand or enhance the transmission system that must be completed prior to connection.

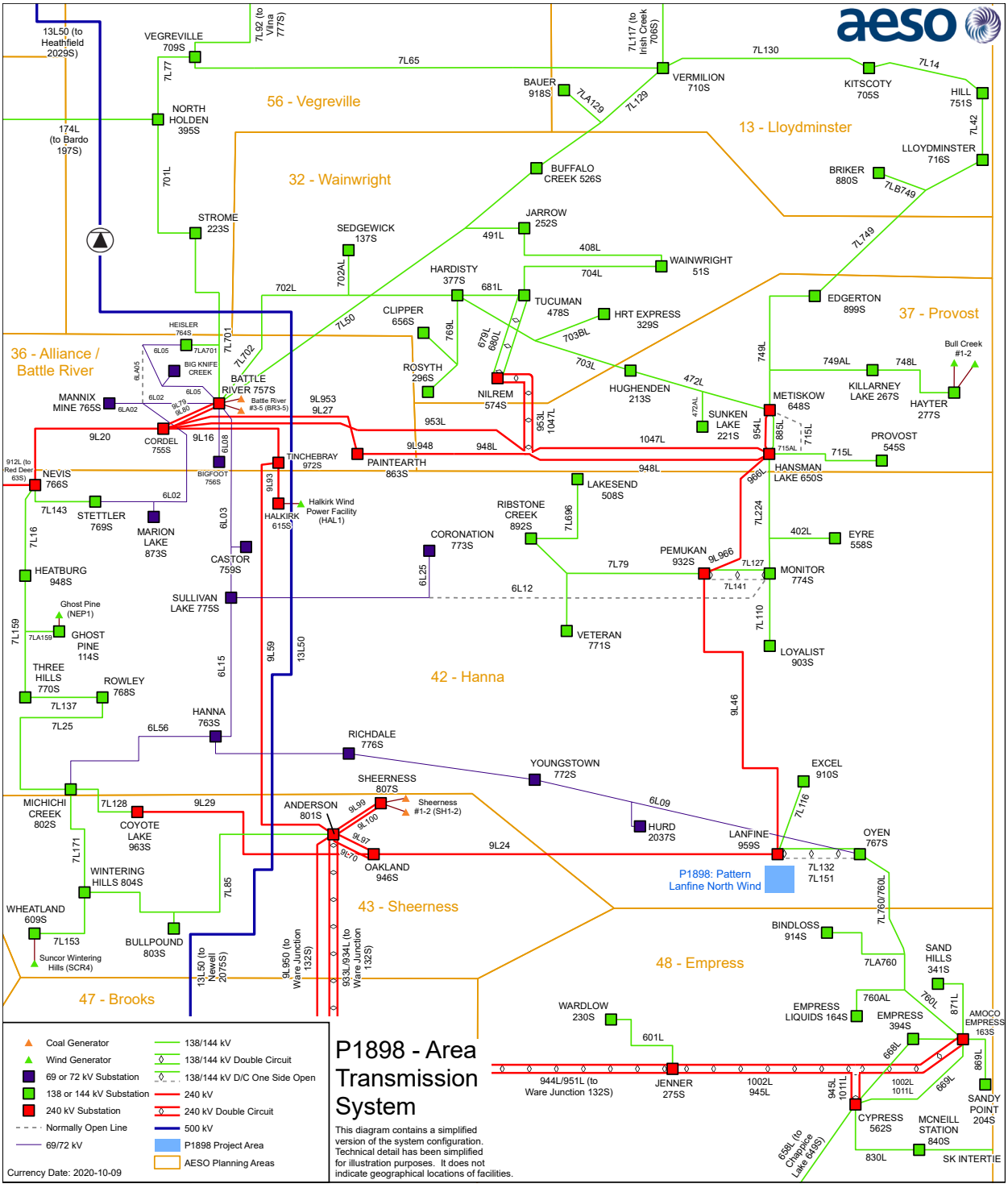
2.2 Existing System

Geographically, the Project is located in the AESO planning area of Hanna (Area 42), which is part of the AESO's Central planning region. Hanna (Area 42) is surrounded by the planning areas of Alliance/Battle River (36), Provost (37), Sheerness (43) and Empress (48). Figure 2-1 presents a map of the planning areas in the vicinity of the Project.

From a transmission system perspective, Hanna (Area 42) consists primarily of 240 kV, 138/144kV and 69/72kV transmission system. Hanna (Area 42) is connected to the Alliance/Battle River (Area 36), Provost (Area 37), Wainwright (Area 32), Sheerness (Area 43), Red Deer (Area 35), and Empress (Area 48) planning areas.

The existing transmission system in the Study Area is shown in Figure 2-1.

Figure 2-1: Existing transmission system in the Study Area



2.3 Study Area

The Study Area for the Project consists of the AESO Planning areas of Hanna (Area 42), Sheerness (Area 43), Empress (Area 48), Battle River (Area 36), Provost (Area 37), and Wainwright (Area 32), including the tie lines connecting these planning areas to the rest of the AIES. All transmission facilities within the Study Area were 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 MP, examined four transmission alternatives to meet the MP's request for system access service, as detailed in Section 3.2.

3.2 Connection Alternatives Examined

Below is a description of the developments associated with the transmission alternatives that were examined for the Project.

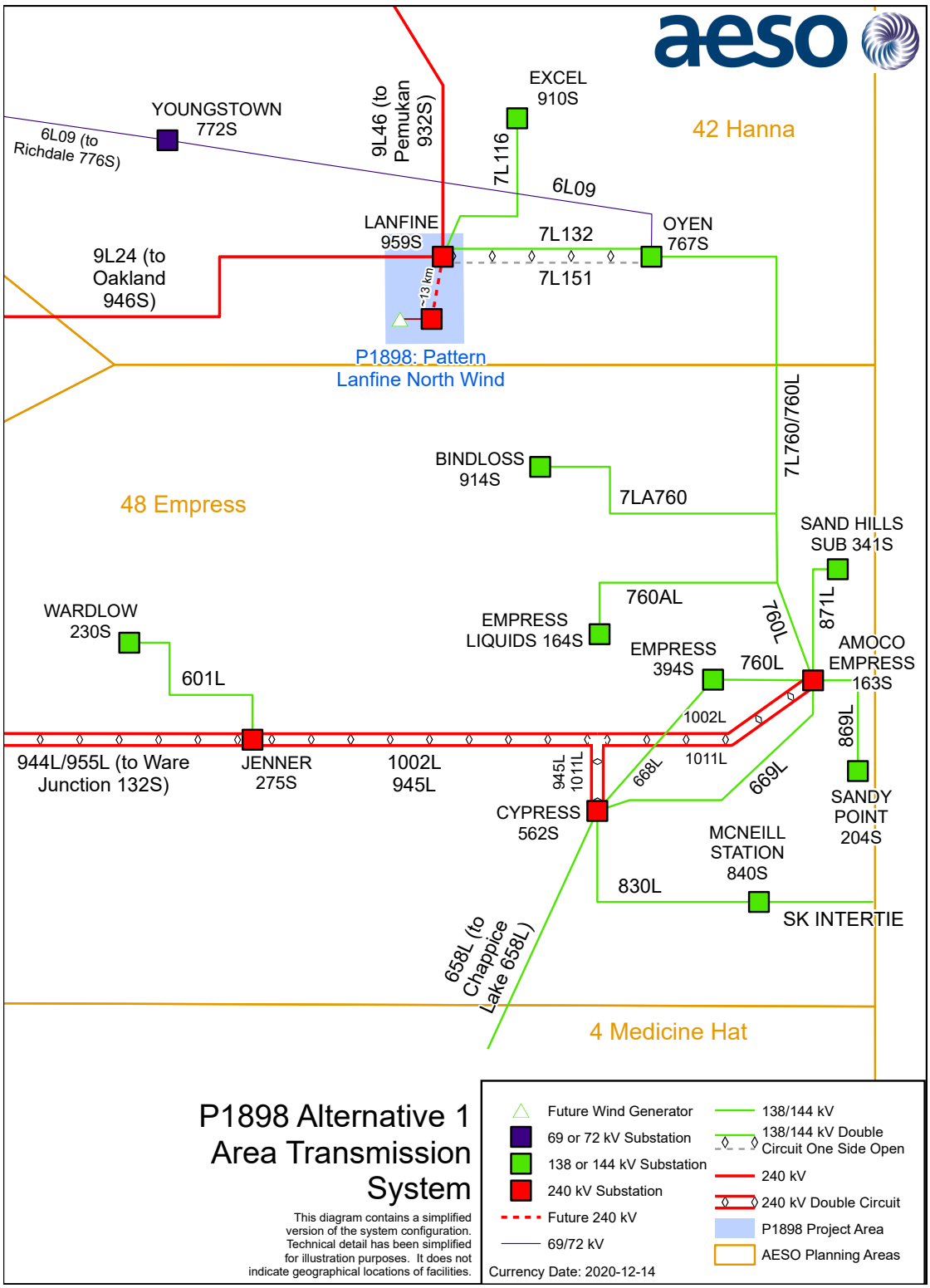
Alternative 1 – Radial 240 kV Connection to Lanfine 959S Substation

This alternative includes the following developments:

- Add a 240 kV circuit, approximately 13 km in length, to connect the Facility to the existing Lanfine 959S substation in a radial configuration;
- Modify Lanfine 959S substation, including adding one 240 kV circuit breaker; and
- Add or modify associated equipment as required for the above transmission developments.

The proposed connection configuration is shown in Figure 3-1.

Figure 3-1: Connection Alternative 1



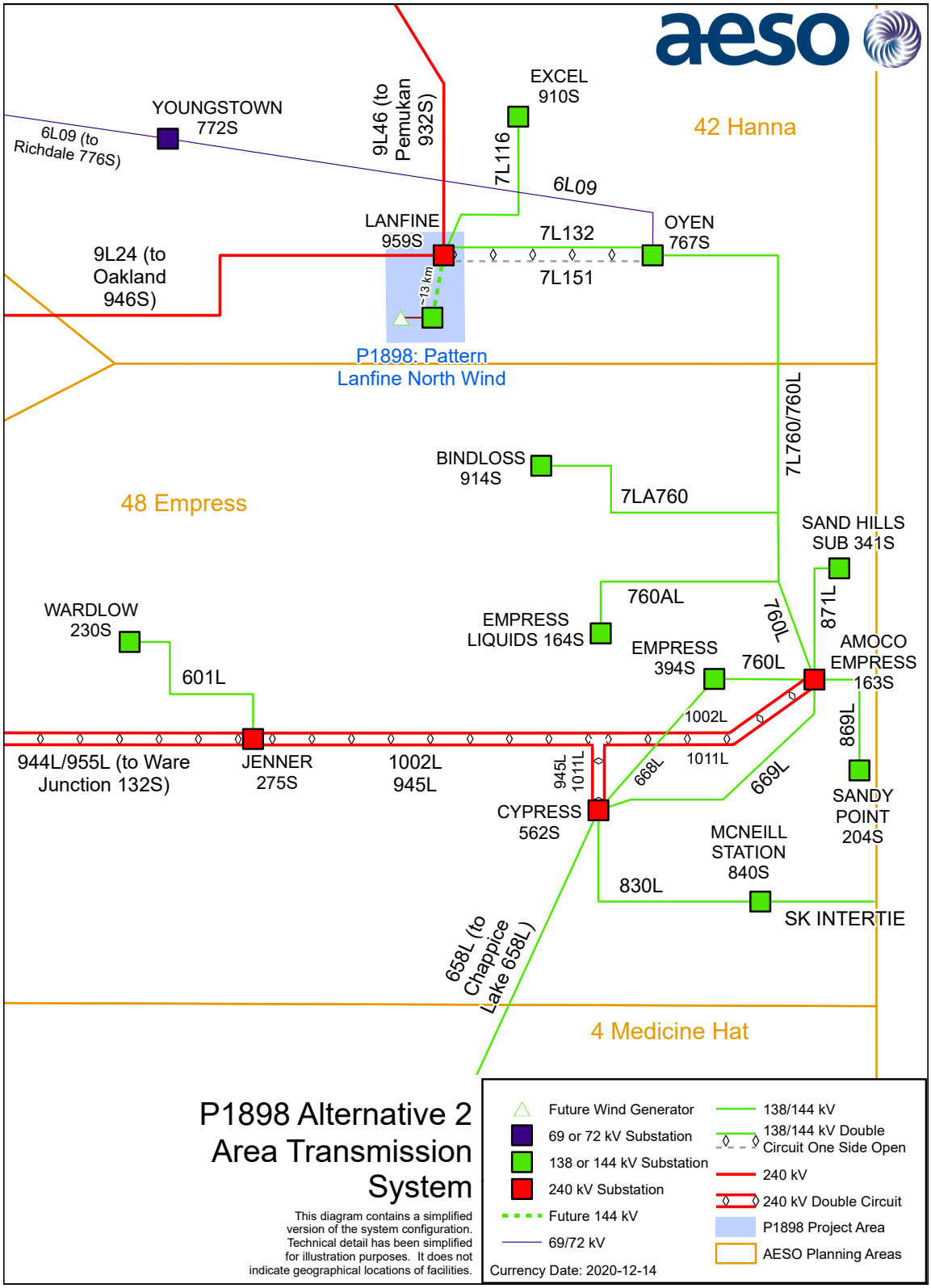
Alternative 2 – Radial 144 kV Connection to Lanfine 959S Substation

This alternative includes the following developments:

- Add a 144 kV circuit, approximately 13 km in length, to connect the Facility to the existing Lanfine 959S substation in a radial configuration;
- Modify Lanfine 959S substation, including adding one 144 kV circuit breaker; and
- Add or modify associated equipment as required for the above transmission developments.

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

Figure 3-2: Connection Alternative 2



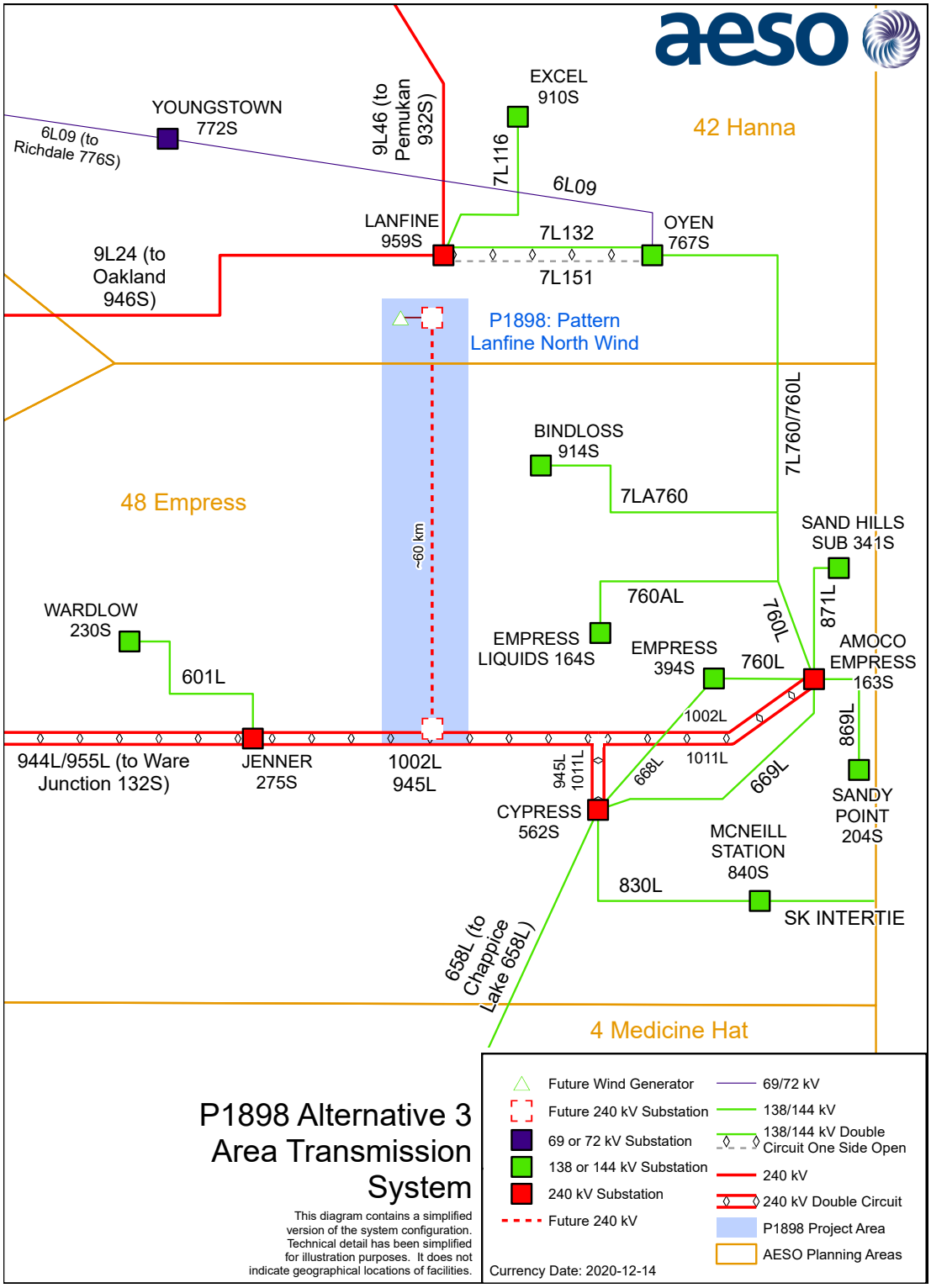
Alternative 3 – In-and-out Connection to the existing 240 kV transmission line 1002L

This alternative includes the following developments:

- Add a 240 kV switching station, including three circuit breakers and connect the 240 kV switching station to the existing transmission line 1002L (between Jenner 275S and Amoco Empress 163S) using an in-and-out configuration;
- Add one 240 kV circuit, approximately 60 km in length, to connect the Market Participant's approved Buffalo Bird 601S substation to the 240 kV switching station using a radial configuration; and
- Add or modify associated equipment as required for the above transmission developments.

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

Figure 3-3: Connection Alternative 3



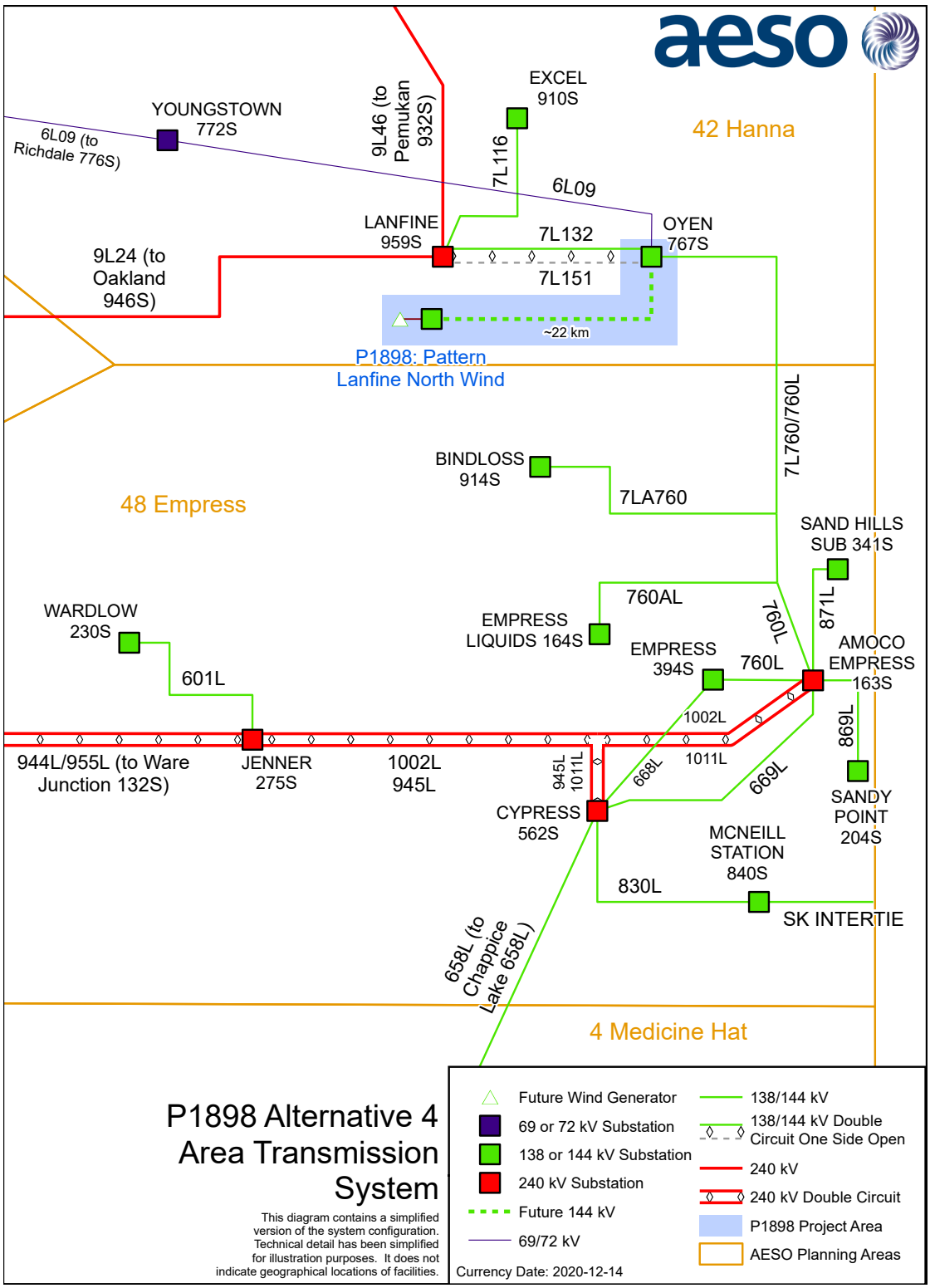
Alternative 4 – Radial 144 kV Connection to Oyen 767S Substation

This alternative includes the following developments:

- Add one 144-kV circuit, approximately 22 km in length, to connect the Facility to the existing Oyen 767S substation in a radial configuration;
- Modify Oyen 767S substation, including adding one 144 kV circuit breaker; and
- Add or modify associated equipment as required for the above transmission developments.

The proposed connection configuration is shown in Figure 3-4.

Figure 3-4: Connection Alternative 4



3.3 Connection Alternatives Selected for Further Study

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

3.4 Connection Alternatives Not Selected for Further Study

Alternative 1, Alternative 3, and Alternative 4 would involve increased transmission development and hence, increased cost, compared to Alternative 2. Therefore Alternatives 1, 3, 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 September 20, 2022. Therefore, studies were performed using scenarios for 2022 Summer Light (SL), Summer Peak (SP), and Winter Peak (WP).

After the base scenario studies were completed, several renewable (solar) generation projects were included in the renewable dispatch. To assess whether the mitigations assigned in the base scenarios (Scenarios 1 to 6) would still be effective, post-project sensitivity studies were added to study these project additions and the impacts of the Provost to Edgerton and Nilrem to Vermilion (PENV) Transmission Development system project and the Central East Transfer-out (CETO) Transmission Development system project (Scenarios 4a to 4c). As pre-Project to post-Project comparisons were already conducted in the base scenarios (to determine required mitigation), SP was the only season studied due to the most severe constraints being observed during SP.

Scenario 4a is intended as a “worst-case” scenario was assessed to understand the impact of both additional generation and PENV not being in-service prior to the Project.

Short-circuit studies were performed using the 2022 WP and 2028 WP scenarios (Scenarios 3, 6 and 7).

Table 4-1 lists the study scenarios. Post-Project scenarios reflect the requested Rate STS contract capacity at the Buffalo Bird 601S substation.

Table 4-1: Connection Study Scenarios

Scenario No.	Year/Season	System Generation Dispatch Conditions	Scenario Name	Project Generation (MW)
Pre-Project				
1	2022 Summer Peak (SP)	High Wind, Economic Coal	2022 SP Pre-Project	0
2	2022 Summer Light (SL)		2022 SL Pre-Project	0
3	2022 Winter Peak (WP)		2022 WP Pre-Project	0
Post-Project				
4	2022 SP	High Wind, Economic Coal	2022 SP Post-Project	145
5	2022 SL		2022 SL Post-Project	145
6	2022 WP		2022 WP Post-Project	145
7	2028 WP	All generation in the Study Area online	2028 WP Post-Project	145

Scenario No.	Year/Season	System Generation Dispatch Conditions	Scenario Name	Project Generation (MW)
Post-Project Sensitivity				
4a	2022 SP	High Renewable, Economic Coal	2022 SP Post-Project with additional connection projects	145
4b	2022 SP	High Renewable, Economic Coal	2022 SP Post-Project with additional connection projects and PENV	145
4c	2022 SP	High Renewable, Economic Coal	2022 SP Post-Project with additional connection projects, PENV and CETO	145

The AESO Planning Region load forecasts used for the base connection study scenarios (Scenarios 1 to 7) were based on the *2017 Long-Term Outlook* (2017 LTO).

The AESO has updated its regional forecasts since the base connection studies were performed. The AESO has determined that the use of the current AESO forecast would not materially alter the connection study results (in terms of alternative selection) or affect the conclusions and recommendations in this report. Following the completion of the base connection studies, the AESO determined that post-Project sensitivities were required, as explained above. The updated 2019 LTO was available when the new studies were scoped, therefore the 2019 LTO was used for the sensitivity studies (Scenarios 4a, 4b, 4c).

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.[1]

Power flow studies were performed for the 2022 SL, 2022 SP, and 2022 WP pre-Project scenarios, and for the 2022 SL, 2022 SP, and 2022 WP post-Project and post-Project sensitivity 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 the 2022 SL, 2022 SP, and 2022 WP post-Project scenarios.

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

4.2.3 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 2022 WP pre-Project scenario and for 2022 WP and 2028 WP 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, transient stability, and short-circuit current level studies were performed to assess the impact of the Project on the performance of the AIES following implementation of the AESO's proposed mitigation measures.

4.3.2 Constraint Effective Factor Studies

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

5 Interpretation of Results

5.1 Results Overview

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

- Section 5.2 includes an overview of the pre-Project studies results.
- Section 5.3 includes an overview of the post-Project studies results.
- Section 5.4 includes 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 based on the Base Study Scenarios (Scenarios 1 - 6)

Scenario	Type of Reliability Criteria Violation		Project Impact	Contingency (System Element Lost)	Details of Violation (Violation Observed On)	Pre-Project Mitigation Measures	Post-Project Mitigation Measures
	Pre-Project	Post-Project					
2022 SL	Thermal - above normal rating	Thermal - above emergency rating	Materially increased violation	9L20 (Cordel 755S-Nevis 766S)	Nevis 766S 901T	Planned RAS 139	Modified RAS 139
2022 SL	None	Thermal - above normal rating	New violation	EATL	Nevis 766S 901T	None	Modified RAS 139
2022 SP	Thermal - above normal rating	Thermal - above emergency rating	Marginally increased violation	395ST1 (N.Holden 395S 138kV/25kV transformer)	7L50 (Buffalo Crk 526S-Jarrow tap point)	Planned RAS 138	Modified RAS 138
2022 SP	Thermal - above normal rating	Thermal - above normal rating	Materially increased violation	526ST1/526ST2 (Buffalo Crk. 526S 138kV/25kV transformer)	749L (Edgerton 899S-Kilarney tap point)	Real-time operational practices	Real-time operational practices
2022 SP	Thermal - above normal rating	Thermal - above normal rating	Materially increased violation	526ST1/526ST2 (Buffalo Crk. 526S 138kV/25kV transformer)	7L749 (Edgerton 899S-Briker tap point)	Real-time operational practices	Real-time operational practices
2022 SP	None	Thermal - above normal rating	New violation	648ST1 (Metiskow 648S 138kV/25kV transformer)	704L (51S Wainwright to 478S Tucuman)	Planned RAS 138	Modified RAS 138
2022 SP	Thermal - above normal rating	Thermal - above normal rating	Materially increased violation	648ST1 (Metiskow 648S 138kV/25kV transformer)	7L129 (Buffalo Crk. 526S-Bauer tap point)	Planned RAS 138	Modified RAS 138
2022 SP	Thermal - above emergency rating	Thermal - above emergency rating	Materially increased violation	648ST1 (Metiskow 648S 138kV/25kV transformer)	7L50 (Buffalo Crk 526S-Jarrow tap point)	Planned RAS 138	Modified RAS 138
2022 SP	Thermal - above normal rating	Thermal - above normal rating	Materially increased violation	749L \ 749AL (Metiskow 648S-Edgerton 899S)	704L (51S Wainwright to 478S Tucuman)	Planned RAS 138	Modified RAS 138
2022 SP	Thermal - above normal rating	Thermal - above normal rating	Marginally decreased violation	749L \ 749AL (Metiskow 648S-Edgerton 899S)	7L129 (Buffalo Crk. 526S-Bauer tap point)	Planned RAS 138	Modified RAS 138
2022 SP	Thermal - above emergency rating	Thermal - above emergency rating	Materially increased violation	749L \ 749AL (Metiskow 648S-Edgerton 899S)	7L50 (Buffalo Crk 526S-Jarrow tap point)	Planned RAS 138	Modified RAS 138
2022 SP	None	Thermal - above normal rating	New violation	757S912T (Battle River 757S transformer)	704L (51S Wainwright to 478S Tucuman)	None	Real-time operational practices
2022 SP	Thermal - above normal rating	Thermal - above normal rating	Materially increased violation	766S901T (Nevis 766S 240kV/138kV transformer)	174L (Bardo 197S-N.Holden 395S)	Planned RAS 134, 138	Modified RAS 134, 138
2022 SP	Thermal - above emergency rating	Thermal - above emergency rating	Materially increased violation	766S901T (Nevis 766S 240kV/138kV transformer)	701L/7L701 (Strome 223S-N.Holden 395S)	Planned RAS 134, 138	Modified RAS 134, 138
2022 SP	None	Thermal - above normal rating	New violation	766S901T (Nevis 766S 240kV/138kV transformer)	704L (51S Wainwright to 478S Tucuman)	Planned RAS 134, 138	Modified RAS 134, 138
2022 SP	Thermal - above normal rating	Thermal - above normal rating	Marginally decreased violation	766S901T (Nevis 766S 240kV/138kV transformer)	7L129 (Buffalo Crk. 526S-Bauer tap point)	Planned RAS 134, 138	Modified RAS 134, 138
2022 SP	None	Thermal - above normal rating	New violation	766S901T (Nevis 766S 240kV/138kV transformer)	704L (51S Wainwright to 478S Tucuman)	Planned RAS 134, 138	Modified RAS 134, 138
2022 SP	Thermal - above normal rating	Thermal - above normal rating	Marginally decreased violation	766S901T (Nevis 766S 240kV/138kV transformer)	7L129 (Buffalo Crk. 526S-Bauer tap point)	Planned RAS 134, 138	Modified RAS 134, 138
2022 SP	Thermal - above emergency rating	Thermal - above emergency rating	Materially increased violation	766S901T (Nevis 766S 240kV/138kV transformer)	7L50 (Buffalo Crk 526S-Jarrow tap point)	Planned RAS 134, 138	Modified RAS 134, 138
2022 SP	Thermal - above normal rating	Thermal - above normal rating	Materially increased violation	766S901T (Nevis 766S 240kV/138kV transformer)	7L701 (Battle River 757S-7LA701)	Planned RAS 134, 138	Modified RAS 134, 138
2022 SP	Thermal - above normal rating	Thermal - above emergency rating	Materially increased violation	766S901T (Nevis 766S 240kV/138kV transformer)	7L701(Strome 233S-7LA701)	Planned RAS 134, 138	Modified RAS 134, 138
2022 SP	Thermal - above normal rating	Thermal - above normal rating	Materially increased violation	7L129 \ 7LA129 (Buffalo Crk. 526S-Vermilion 710S)	749L (Edgerton 899S-Kilarney tap point)	Real-time operational practices	Real-time operational practices
2022 SP	Thermal - above normal rating	Thermal - above emergency rating	Materially increased violation	7L42 (Lloydminster 716S-Hill 751S)	7L50 (Buffalo Crk 526S-Jarrow tap point)	Planned RAS 138	Modified RAS 138
2022 SP	Thermal - above normal rating	Thermal - above normal rating	Materially increased violation	7L50 (Buffalo Crk. 526S-Battle River 757S)	749L (Edgerton 899S-Kilarney tap point)	Real-time operational practices	Real-time operational practices
2022 SP	None	Thermal - above normal rating	New violation	7L50 (Buffalo Crk. 526S-Battle River 757S)	749L (Metiskow 648S-Kilarney tap point)	None	Real-time operational practices
2022 SP	Thermal - above normal rating	Thermal - above normal rating	Materially increased violation	7L50 (Buffalo Crk. 526S-Battle River 757S)	7L749 (Edgerton 899S-Briker tap point)	Real-time operational practices	Real-time operational practices
2022 SP	Thermal - above emergency rating	Thermal - above emergency rating	Materially increased violation	7L701 \ 7LA701 \ 701L (Strome 223S-Battle River 757S)	7L50 (Buffalo Crk 526S-Jarrow tap point)	Planned RAS 138	Modified RAS 138
2022 SP	None	Thermal - above normal rating	New violation	7L749 \ 749L \ 7LB749 Lloydminster 716S-Edgerton 899S)	704L (51S Wainwright to 478S Tucuman)	Planned RAS 138	Modified RAS 138
2022 SP	None	Thermal - above normal rating	New violation	7L749 \ 749L \ 7LB749 Lloydminster 716S-Edgerton 899S)	7L129 (Buffalo Crk. 526S-Bauer tap point)	Planned RAS 138	Modified RAS 138
2022 SP	Thermal - above emergency rating	Thermal - above emergency rating	Materially increased violation	7L749 \ 749L \ 7LB749 Lloydminster 716S-Edgerton 899S)	7L50 (Buffalo Crk 526S-Jarrow tap point)	Planned RAS 138	Modified RAS 138
2022 SP	None	Thermal - above normal rating	New violation	899ST3a (Edgerton 899S 138kV/25kV transformer)	704L (51S Wainwright to 478S Tucuman)	Planned RAS 138	Modified RAS 138
2022 SP	Thermal - above normal rating	Thermal - above normal rating	Marginally decreased violation	899ST3a (Edgerton 899S 138kV/25kV transformer)	7L129 (Buffalo Crk. 526S-Bauer tap point)	Planned RAS 138	Modified RAS 138
2022 SP	Thermal - above emergency rating	Thermal - above emergency rating	Materially increased violation	899ST3a (Edgerton 899S 138kV/25kV transformer)	7L50 (Buffalo Crk 526S-Jarrow tap point)	Planned RAS 138	Modified RAS 138
2022 SP	Thermal - above normal rating	Thermal - above normal rating	Materially increased violation	912L \ 9L912 (Red Deer 63S-Nevis 766S)	174L (Bardo 197S-N.Holden 395S)	Planned RAS 134, 138	Modified RAS 134, 138
2022 SP	Thermal - above emergency rating	Thermal - above emergency rating	Materially increased violation	912L \ 9L912 (Red Deer 63S-Nevis 766S)	701L/7L701 (Strome 223S-N.Holden 395S)	Planned RAS 134, 138	Modified RAS 134, 138
2022 SP	None	Thermal - above normal rating	New violation	912L \ 9L912 (Red Deer 63S-Nevis 766S)	704L (51S Wainwright to 478S Tucuman)	Planned RAS 134, 138	Modified RAS 134, 138
2022 SP	Thermal - above normal rating	Thermal - above normal rating	Marginally decreased violation	912L \ 9L912 (Red Deer 63S-Nevis 766S)	7L129 (Buffalo Crk. 526S-Bauer tap point)	Planned RAS 134, 138	Modified RAS 134, 138

Scenario	Type of Reliability Criteria Violation		Project Impact	Contingency (System Element Lost)	Details of Violation (Violation Observed On)	Pre-Project Mitigation Measures	Post-Project Mitigation Measures
	Pre-Project	Post-Project					
2022 SP	Thermal - above emergency rating	Thermal - above emergency rating	Materially increased violation	912L \ 9L912 (Red Deer 63S-Nevis 766S)	7L50 (Buffalo Crk 526S-Jarrow tap point)	Planned RAS 134, 138	Modified RAS 134, 138
2022 SP	Thermal - above normal rating	Thermal - above normal rating	Materially increased violation	912L \ 9L912 (Red Deer 63S-Nevis 766S)	7L701 (Battle River 757S-7LA701)	Planned RAS 134, 138	Modified RAS 134, 138
2022 SP	Thermal - above normal rating	Thermal - above emergency rating	Materially increased violation	912L \ 9L912 (Red Deer 63S-Nevis 766S)	7L701(Strome 233S-7LA701)	Planned RAS 134, 138	Modified RAS 134, 138
2022 SP	None	Thermal - above normal rating	New violation	966L \ 9L966 (Hansman Lk. 650S-Pemukan 932S)	7L127 (Monitor 7774S-Pemukan 932S)	None	Real-time operational practices
2022 SP	Thermal - above emergency rating[2]	Thermal - above emergency rating	Materially increased violation	966L \ 9L966 (Hansman Lk. 650S-Pemukan 932S)	7L224 (Hansman Lake 650S-Monitor 774S)	Real-time operational practices	New 7L224 RAS
2022 SP	Thermal - above normal rating	Thermal - above normal rating	Materially increased violation	9L20 (Cordel 755S-Nevis 766S)	701L/7L701 (Strome 223S-N.Holden 395S)	Planned RAS 139	Modified RAS 139
2022 SP	Thermal - above normal rating	Thermal - above normal rating	Materially increased violation	9L20 (Cordel 755S-Nevis 766S)	7L159 (Heatburg 948S-7LA159)	Planned RAS 139	Modified RAS 139
2022 SP	Thermal - above normal rating	Thermal - above normal rating	Materially increased violation	9L20 (Cordel 755S-Nevis 766S)	7L16 (Nevis 766S-Heatburg 948S)	Planned RAS 139	Modified RAS 139
2022 SP	Thermal - above emergency rating	Thermal - above emergency rating	Materially increased violation	9L20 (Cordel 755S-Nevis 766S)	7L50 (Buffalo Crk 526S-Jarrow tap point)	Planned RAS 139	Modified RAS 139
2022 SP	None	Thermal - above normal rating	New violation	9L20 (Cordel 755S-Nevis 766S)	7L701 (Battle River 757S-7LA701)	Planned RAS 139	Modified RAS 139
2022 SP	None	Thermal - above normal rating	New violation	9L20 (Cordel 755S-Nevis 766S)	7L701(Strome 233S-7LA701)	Planned RAS 139	Modified RAS 139
2022 SP	Thermal - above emergency rating	Thermal - above emergency rating	Materially increased violation	9L20 (Cordel 755S-Nevis 766S)	Nevis 766S 901T	Planned RAS 139	Modified RAS 139
2022 SP	None	Thermal - above normal rating	New violation	9L80 (Cordel 755S-Battle River 757S)	704L (51S Wainwright to 478S Tucuman)	Planned RAS 139	Modified RAS 139
2022 SP	Thermal - above normal rating	Thermal - above normal rating	Materially increased violation	EATL	174L (Bardo 197S-N.Holden 395S)	Planned RAS 134, 138, 139	Modified RAS 134, 138, 139 and real-time operational practices
2022 SP	Thermal - above emergency rating	Thermal - above emergency rating	Materially increased violation	EATL	701L/7L701 (Strome 223S-N.Holden 395S)	Planned RAS 134, 138, 139	Modified RAS 134, 138, 139 and real-time operational practices
2022 SP	Thermal - above normal rating	Thermal - above emergency rating	Materially increased violation	EATL	704L (51S Wainwright to 478S Tucuman)	Planned RAS 134, 138, 139	Modified RAS 134, 138, 139 and real-time operational practices
2022 SP	Thermal - above normal rating	Thermal - above normal rating	Marginally increased violation	EATL	749L (Edgerton 899S-Kilarney tap point)	Planned RAS 134, 138, 139	Modified RAS 134, 138, 139 and real-time operational practices
2022 SP	Thermal - above normal rating	Thermal - above normal rating	Marginally increased violation	EATL	7L129 (Buffalo Crk. 526S-Bauer tap point)	Planned RAS 134, 138, 139	Modified RAS 134, 138, 139 and real-time operational practices
2022 SP	Thermal - above normal rating	Thermal - above normal rating	Marginally decreased violation	EATL	7L159 (Heatburg 948S-7LA159)	Planned RAS 134, 138, 139	Modified RAS 134, 138, 139 and real-time operational practices
2022 SP	Thermal - above normal rating	Thermal - above normal rating	Marginally decreased violation	EATL	7L16 (Nevis 766S-Heatburg 948S)	Planned RAS 134, 138, 139	Modified RAS 134, 138, 139 and real-time operational practices
2022 SP	Thermal - above emergency rating	Thermal - above emergency rating	Marginally increased violation	EATL	7L50 (Buffalo Crk 526S-Jarrow tap point)	Planned RAS 134, 138, 139	Modified RAS 134, 138, 139 and real-time operational practices
2022 SP	Thermal - above normal rating	Thermal - above normal rating	Marginally increased violation	EATL	7L701 (Battle River 757S-7LA701)	Planned RAS 134, 138, 139	Modified RAS 134, 138, 139 and real-time operational practices
2022 SP	Thermal - above normal rating	Thermal - above emergency rating	Marginally increased violation	EATL	7L701(Strome 233S-7LA701)	Planned RAS 134, 138, 139	Modified RAS 134, 138, 139 and real-time operational practices
2022 SP	Thermal - above normal rating	Thermal - above normal rating	Marginally increased violation	EATL	7L749 (Edgerton 899S-Briker tap point)	Planned RAS 134, 138, 139	Modified RAS 134, 138, 139 and real-time operational practices
2022 SP	Thermal - above normal rating	Thermal - above emergency rating	Materially increased violation	EATL	912L (Red Deer 63S-Nevis 766S)	Planned RAS 134, 138, 139	Modified RAS 134, 138, 139 and real-time operational practices
2022 SP	None	Thermal - above normal rating	New violation	EATL	Nevis 766S 901T	Planned RAS 134, 138, 139	Modified RAS 134, 138, 139 and real-time operational practices
2022 WP	Thermal - above normal rating	Thermal - above normal rating	Materially increased violation	526ST1/526ST2 (Buffalo Crk. 526S 138kV/25kV transformer)	749L (Edgerton 899S-Kilarney tap point)	Real-time operational practices	Real-time operational practices
2022 WP	Thermal - above normal rating	Thermal - above normal rating	Materially increased violation	526ST1/526ST2 (Buffalo Crk. 526S 138kV/25kV transformer)	7L749 (Edgerton 899S-Briker tap point)	Real-time operational practices	Real-time operational practices
2022 WP	Thermal - above normal rating	Thermal - above emergency rating	Materially increased violation	648ST1 (Metiskow 648S 138kV/25kV transformer)	704L (51S Wainwright to 478S Tucuman)	Planned RAS 138	Modified RAS 138
2022 WP	Thermal - above emergency rating	Thermal - above emergency rating	Marginally decreased violation	648ST1 (Metiskow 648S 138kV/25kV transformer)	7L50 (Buffalo Crk 526S-Jarrow tap point)	Planned RAS 138	Modified RAS 138

[2] Based on updated ratings submitted by the TFO in November 2020 – at the time the base study scenarios were completed the observed violation was below the emergency rating.

Scenario	Type of Reliability Criteria Violation		Project Impact	Contingency (System Element Lost)	Details of Violation (Violation Observed On)	Pre-Project Mitigation Measures	Post-Project Mitigation Measures
	Pre-Project	Post-Project					
2022 WP	Thermal - above normal rating	Thermal - above emergency rating	Materially increased violation	749L \ 749AL (Metiskow 648S-Edgerton 899S)	704L (51S Wainwright to 478S Tucuman)	Planned RAS 138	Modified RAS 138
2022 WP	Thermal - above emergency rating	Thermal - above emergency rating	Marginally decreased violation	749L \ 749AL (Metiskow 648S-Edgerton 899S)	7L50 (Buffalo Crk 526S-Jarrow tap point)	Planned RAS 138	Modified RAS 138
2022 WP	Thermal - above normal rating	Thermal - above normal rating	Materially increased violation	757S912T (Battle River 757S transformer)	704L (51S Wainwright to 478S Tucuman)	Real-time operational practices	Real-time operational practices
2022 WP	Thermal - above emergency rating	Thermal - above emergency rating	Materially increased violation	766S901T (Nevis 766S 240kV/138kV transformer)	174L (Bardo 197S-N.Holden 395S)	Planned RAS 134, 138	Modified RAS 134, 138
2022 WP	Thermal - above emergency rating	Thermal - above emergency rating	Materially increased violation	766S901T (Nevis 766S 240kV/138kV transformer)	701L/7L701 (Strome 223S-N.Holden 395S)	Planned RAS 134, 138	Modified RAS 134, 138
2022 WP	Thermal - above normal rating	Thermal - above emergency rating	Materially increased violation	766S901T (Nevis 766S 240kV/138kV transformer)	704L (51S Wainwright to 478S Tucuman)	Planned RAS 134, 138	Modified RAS 134, 138
2022 WP	Thermal - above normal rating	Thermal - above normal rating	Materially increased violation	766S901T (Nevis 766S 240kV/138kV transformer)	749L (Edgerton 899S-Kilarney tap point)	Planned RAS 134, 138	Modified RAS 134, 138
2022 WP	Thermal - above emergency rating	Thermal - above emergency rating	Marginally increased violation	766S901T (Nevis 766S 240kV/138kV transformer)	7L50 (Buffalo Crk 526S-Jarrow tap point)	Planned RAS 134, 138	Modified RAS 134, 138
2022 WP	None	Thermal - above normal rating	New violation	766S901T (Nevis 766S 240kV/138kV transformer)	7L701(Strome 233S-7LA701)	Planned RAS 134, 138	Modified RAS 134, 138
2022 WP	Thermal - above normal rating	Thermal - above normal rating	Materially increased violation	766S901T (Nevis 766S 240kV/138kV transformer)	7L749 (Edgerton 899S-Briker tap point)	Planned RAS 134, 138	Modified RAS 134, 138
2022 WP	Thermal - above emergency rating	Thermal - above emergency rating	Marginally increased violation	766S901T (Nevis 766S 240kV/138kV transformer)	Sheerness 807S 2T	Planned RAS 134, 138	Modified RAS 134, 138
2022 WP	Thermal - above normal rating	Thermal - above normal rating	Materially increased violation	7L129 \ 7LA129 (Buffalo Crk. 526S-Vermilion 710S)	749L (Edgerton 899S-Kilarney tap point)	Real-time operational practices	Real-time operational practices
2022 WP	Thermal - above normal rating	Thermal - above normal rating	Materially increased violation	7L129 \ 7LA129 (Buffalo Crk. 526S-Vermilion 710S)	7L749 (Edgerton 899S-Briker tap point)	Real-time operational practices	Real-time operational practices
2022 WP	Thermal - above normal rating	Thermal - above normal rating	Materially increased violation	7L50 (Buffalo Crk. 526S-Battle River 757S)	749L (Edgerton 899S-Kilarney tap point)	Real-time operational practices	Real-time operational practices
2022 WP	Thermal - above normal rating	Thermal - above normal rating	Materially increased violation	7L50 (Buffalo Crk. 526S-Battle River 757S)	7L749 (Edgerton 899S-Briker tap point)	Real-time operational practices	Real-time operational practices
2022 WP	Thermal - above normal rating	Thermal - above normal rating	Materially increased violation	7L749 \ 749L \ 7LB749 Lloydminster 716S-Edgerton 899S)	704L (51S Wainwright to 478S Tucuman)	Planned RAS 138	Modified RAS 138
2022 WP	Thermal - above emergency rating	Thermal - above emergency rating	Marginally decreased violation	7L749 \ 749L \ 7LB749 Lloydminster 716S-Edgerton 899S)	7L50 (Buffalo Crk 526S-Jarrow tap point)	Planned RAS 138	Modified RAS 138
2022 WP	Thermal - above normal rating	Thermal - above normal rating	Materially increased violation	899ST3a (Edgerton 899S 138kV/25kV transformer)	704L (51S Wainwright to 478S Tucuman)	Planned RAS 138	Modified RAS 138
2022 WP	Thermal - above emergency rating	Thermal - above emergency rating	Marginally decreased violation	899ST3a (Edgerton 899S 138kV/25kV transformer)	7L50 (Buffalo Crk 526S-Jarrow tap point)	Planned RAS 138	Modified RAS 138
2022 WP	Thermal - above emergency rating	Thermal - above emergency rating	Materially increased violation	912L \ 9L912 (Red Deer 63S-Nevis 766S)	174L (Bardo 197S-N.Holden 395S)	Planned RAS 134, 138	Modified RAS 134, 138
2022 WP	Thermal - above emergency rating	Thermal - above emergency rating	Materially increased violation	912L \ 9L912 (Red Deer 63S-Nevis 766S)	701L/7L701 (Strome 223S-N.Holden 395S)	Planned RAS 134, 138	Modified RAS 134, 138
2022 WP	Thermal - above normal rating	Thermal - above emergency rating	Materially increased violation	912L \ 9L912 (Red Deer 63S-Nevis 766S)	704L (51S Wainwright to 478S Tucuman)	Planned RAS 134, 138	Modified RAS 134, 138
2022 WP	Thermal - above normal rating	Thermal - above normal rating	Materially increased violation	912L \ 9L912 (Red Deer 63S-Nevis 766S)	749L (Edgerton 899S-Kilarney tap point)	Planned RAS 134, 138	Modified RAS 134, 138
2022 WP	Thermal - above emergency rating	Thermal - above emergency rating	Marginally increased violation	912L \ 9L912 (Red Deer 63S-Nevis 766S)	7L50 (Buffalo Crk 526S-Jarrow tap point)	Planned RAS 134, 138	Modified RAS 134, 138
2022 WP	None	Thermal - above normal rating	New violation	912L \ 9L912 (Red Deer 63S-Nevis 766S)	7L701(Strome 233S-7LA701)	Planned RAS 134, 138	Modified RAS 134, 138
2022 WP	Thermal - above normal rating	Thermal - above normal rating	Materially increased violation	912L \ 9L912 (Red Deer 63S-Nevis 766S)	7L749 (Edgerton 899S-Briker tap point)	Planned RAS 134, 138	Modified RAS 134, 138
2022 WP	None	Thermal - above emergency rating	New violation	912L \ 9L912 (Red Deer 63S-Nevis 766S)	Sheerness 807S 2T	Planned RAS 134, 138	Modified RAS 134, 138
2022 WP	Thermal - above normal rating	Thermal - above emergency rating	Materially increased violation	9L20 (Cordel 755S-Nevis 766S)	174L (Bardo 197S-N.Holden 395S)	Planned RAS 134, 138, 139	Modified RAS 134, 138, 139 and real-time operational practices
2022 WP	Thermal - above normal rating	Thermal - above normal rating	Materially increased violation	9L20 (Cordel 755S-Nevis 766S)	701L/7L701 (Strome 223S-N.Holden 395S)	Planned RAS 134, 138, 139	Modified RAS 134, 138, 139 and real-time operational practices
2022 WP	Thermal - above normal rating	Thermal - above normal rating	Materially increased violation	9L20 (Cordel 755S-Nevis 766S)	704L (51S Wainwright to 478S Tucuman)	Planned RAS 134, 138, 139	Modified RAS 134, 138, 139 and real-time operational practices
2022 WP	Thermal - above normal rating	Thermal - above normal rating	Materially increased violation	9L20 (Cordel 755S-Nevis 766S)	749L (Edgerton 899S-Kilarney tap point)	Planned RAS 134, 138, 139	Modified RAS 134, 138, 139 and real-time operational practices
2022 WP	Thermal - above emergency rating	Thermal - above emergency rating	Marginally increased violation	9L20 (Cordel 755S-Nevis 766S)	7L50 (Buffalo Crk 526S-Jarrow tap point)	Planned RAS 134, 138, 139	Modified RAS 134, 138, 139 and real-time operational practices
2022 WP	Thermal - above normal rating	Thermal - above normal rating	Materially increased violation	9L20 (Cordel 755S-Nevis 766S)	7L749 (Edgerton 899S-Briker tap point)	Planned RAS 134, 138, 139	Modified RAS 134, 138, 139 and real-time operational practices
2022 WP	Thermal - above emergency rating	Thermal - above emergency rating	Marginally increased violation	9L20 (Cordel 755S-Nevis 766S)	Nevis 766S 901T	Planned RAS 134, 138, 139	Modified RAS 134, 138, 139 and real-time operational practices
2022 WP	Thermal - above normal rating	Thermal - above normal rating	Materially increased violation	9L80 (Cordel 755S-Battle River 757S)	704L (51S Wainwright to 478S Tucuman)	Real-time operational practices	Real-time operational practices

Scenario	Type of Reliability Criteria Violation		Project Impact	Contingency (System Element Lost)	Details of Violation (Violation Observed On)	Pre-Project Mitigation Measures	Post-Project Mitigation Measures
	Pre-Project	Post-Project					
2022 WP	Thermal - above normal rating	Thermal - above emergency rating	Materially increased violation	EATL	174L (Bardo 197S-N.Holden 395S)	Planned RAS 134, 138	Modified RAS 134, 138 and real-time operational practices
2022 WP	Thermal - above normal rating	Thermal - above emergency rating	Marginally increased violation	EATL	701L/7L701 (Strome 223S-N.Holden 395S)	Planned RAS 134, 138	Modified RAS 134, 138 and real-time operational practices
2022 WP	Thermal - above emergency rating	Thermal - above emergency rating	Materially increased violation	EATL	704L (51S Wainwright to 478S Tucuman)	Planned RAS 134, 138	Modified RAS 134, 138 and real-time operational practices
2022 WP	Thermal - above normal rating	Thermal - above normal rating	Marginally increased violation	EATL	749L (Edgerton 899S-Kilarney tap point)	Planned RAS 134, 138	Modified RAS 134, 138 and real-time operational practices
2022 WP	Thermal - above emergency rating	Thermal - above emergency rating	Marginally increased violation	EATL	7L50 (Buffalo Crk 526S-Jarrow tap point)	Planned RAS 134, 138	Modified RAS 134, 138 and real-time operational practices
2022 WP	Thermal - above normal rating	Thermal - above normal rating	Marginally increased violation	EATL	7L749 (Edgerton 899S-Briker tap point)	Planned RAS 134, 138	Modified RAS 134, 138 and real-time operational practices
2022 WP	Thermal - above emergency rating	Thermal - above emergency rating	Materially increased violation	EATL	912L (Red Deer 63S-Nevis 766S)	Planned RAS 134, 138	Modified RAS 134, 138 and real-time operational practices
2022 WP	Thermal - above emergency rating	Thermal - above emergency rating	Marginally increased violation	EATL	Battle River 757S 4T	Planned RAS 134, 138	Modified RAS 134, 138 and real-time operational practices

- Marginally increased (or marginally decreased) refers to a percent loading difference (post-Project percent loading minus pre-Project percent loading) between 0% and 3% (or -3%).
- Materially increased (or materially decreased) refers to a percent loading difference (post-Project percent loading minus pre-Project percent loading) above or equal to 3% (or below or equal to -3%).
- RAS 134, 138, and 139 are existing RASs (see Section 1.2.2 of Attachment A1). Modifications to existing RAS 134, 138 and 139 were proposed for the approved Sharp Hills Wind Facility in the *Sharp Hills Wind Farm Connection NID*. These modified versions of RAS 134, 138 and 139 are referred to herein as “Planned RAS 134,” “Planned RAS 138”, and “Planned RAS 139.”
- In this table, “Modified” refers to adding the Project to the logic of the respective RAS

Table 5-2: Summary of Reliability Criteria Violations and Mitigation Measures based on the Post-Project Sensitivity Scenarios (Scenarios 4a, 4b, 4c)

Scenario	Type of Reliability Criteria Violation	Contingency (System Element Lost)	Details of Violation (Violation Observed On)	Post-Project Mitigation Measures
	Post-Project			
2022 SP with additional connection projects	Thermal - above emergency rating	395ST1 (N.Holden 395S 138kV/25kV transformer)	7L50 (Buffalo Crk 526S-Jarrow tap point)	Modified RAS 138
2022 SP with additional connection projects	Thermal - above normal rating	395ST1 (N.Holden 395S 138kV/25kV transformer)	912L (Red Deer 63S-Nevis 766S)	Modified RAS 138
2022 SP with additional connection projects	Thermal - above normal rating	526ST1/526ST2 (Buffalo Crk. 526S 138kV/25kV transformer)	749L (Edgerton 899S-Kilarney tap point)	Real-time operational practices
2022 SP with additional connection projects	Thermal - above normal rating	526ST1/526ST2 (Buffalo Crk. 526S 138kV/25kV transformer)	7L749 (Edgerton 899S-Briker tap point)	Real-time operational practices
2022 SP with additional connection projects	Thermal - above normal rating	526ST1/526ST2 (Buffalo Crk. 526S 138kV/25kV transformer)	912L (Red Deer 63S-Nevis 766S)	Real-time operational practices
2022 SP with additional connection projects	Thermal - above normal rating	648ST1 (Metiskow 648S 138kV/25kV transformer)	7L50 (Buffalo Crk 526S-Jarrow tap point)	Modified RAS 138
2022 SP with additional connection projects	Thermal - above normal rating	749L \ 749AL (Metiskow 648S-Edgerton 899S)	7L129 (Buffalo Crk. 526S-Bauer tap point)	Modified RAS 138
2022 SP with additional connection projects	Thermal - above emergency rating	749L \ 749AL (Metiskow 648S-Edgerton 899S)	7L50 (Buffalo Crk 526S-Jarrow tap point)	Modified RAS 138
2022 SP with additional connection projects	Thermal - above emergency rating	766S901T (Nevis 766S 240kV/138kV transformer)	174L (Bardo 197S-N.Holden 395S)	Modified RAS 134, 138
2022 SP with additional connection projects	Thermal - above emergency rating	766S901T (Nevis 766S 240kV/138kV transformer)	701L/7L701 (Strome 223S-N.Holden 395S)	Modified RAS 134, 138
2022 SP with additional connection projects	Thermal - above normal rating	766S901T (Nevis 766S 240kV/138kV transformer)	704L (51S Wainwright to 478S Tucuman)	Modified RAS 134, 138
2022 SP with additional connection projects	Thermal - above normal rating	766S901T (Nevis 766S 240kV/138kV transformer)	749L (Edgerton 899S-Kilarney tap point)	Modified RAS 134, 138
2022 SP with additional connection projects	Thermal - above emergency rating	766S901T (Nevis 766S 240kV/138kV transformer)	7L129 (Buffalo Crk. 526S-Bauer tap point)	Modified RAS 134, 138
2022 SP with additional connection projects	Thermal - above emergency rating	766S901T (Nevis 766S 240kV/138kV transformer)	7L50 (Buffalo Crk 526S-Jarrow tap point)	Modified RAS 134, 138
2022 SP with additional connection projects	Thermal - above emergency rating	766S901T (Nevis 766S 240kV/138kV transformer)	7L701 (Battle River 757S-7LA701)	Modified RAS 134, 138
2022 SP with additional connection projects	Thermal - above emergency rating	766S901T (Nevis 766S 240kV/138kV transformer)	7L701(Strome 233S-7LA701)	Modified RAS 134, 138

Scenario	Type of Reliability Criteria Violation	Contingency (System Element Lost)	Details of Violation (Violation Observed On)	Post-Project Mitigation Measures
	Post-Project			
2022 SP with additional connection projects	Thermal - above normal rating	766S901T (Nevis 766S 240kV/138kV transformer)	7L749 (Edgerton 899S-Briker tap point)	Modified RAS 134, 138
2022 SP with additional connection projects	Thermal - above normal rating	7L129 \ 7LA129 (Buffalo Crk. 526S-Vermilion 710S)	749L (Edgerton 899S-Kilarney tap point)	Real-time operational practices
2022 SP with additional connection projects	Thermal - above normal rating	7L129 \ 7LA129 (Buffalo Crk. 526S-Vermilion 710S)	7L749 (Edgerton 899S-Briker tap point)	Real-time operational practices
2022 SP with additional connection projects	Thermal - above emergency rating	7L42 (Lloydminster 716S-Hill 751S)	7L50 (Buffalo Crk 526S-Jarrow tap point)	Modified RAS 138
2022 SP with additional connection projects	Thermal - above normal rating	7L50 (Buffalo Crk. 526S-Battle River 757S)	701L/7L701 (Strome 223S-N.Holden 395S)	Modified RAS 134
2022 SP with additional connection projects	Thermal - above normal rating	7L50 (Buffalo Crk. 526S-Battle River 757S)	749L (Edgerton 899S-Kilarney tap point)	Modified RAS 134
2022 SP with additional connection projects	Thermal - above normal rating	7L50 (Buffalo Crk. 526S-Battle River 757S)	7L749 (Edgerton 899S-Briker tap point)	Modified RAS 134
2022 SP with additional connection projects	Thermal - above normal rating	7L50 (Buffalo Crk. 526S-Battle River 757S)	912L (Red Deer 63S-Nevis 766S)	Modified RAS 134
2022 SP with additional connection projects	Thermal - above emergency rating	7L701 \ 7LA701 \ 701L (Strome 223S-Battle River 757S)	7L50 (Buffalo Crk 526S-Jarrow tap point)	Modified RAS 138
2022 SP with additional connection projects	Thermal - above normal rating	7L701 \ 7LA701 \ 701L (Strome 223S-Battle River 757S)	912L (Red Deer 63S-Nevis 766S)	Modified RAS 138
2022 SP with additional connection projects	Thermal - above normal rating	7L749 \ 749L \ 7LB749 Lloydminster 716S-Edgerton 899S)	7L129 (Buffalo Crk. 526S-Bauer tap point)	Modified RAS 138
2022 SP with additional connection projects	Thermal - above emergency rating	7L749 \ 749L \ 7LB749 Lloydminster 716S-Edgerton 899S)	7L50 (Buffalo Crk 526S-Jarrow tap point)	Modified RAS 138
2022 SP with additional connection projects	Thermal - above normal rating	899ST3a (Edgerton 899S 138kV/25kV transformer)	7L129 (Buffalo Crk. 526S-Bauer tap point)	Modified RAS 138
2022 SP with additional connection projects	Thermal - above emergency rating	899ST3a (Edgerton 899S 138kV/25kV transformer)	7L50 (Buffalo Crk 526S-Jarrow tap point)	Modified RAS 138
2022 SP with additional connection projects	Thermal - above emergency rating	912L \ 9L912 (Red Deer 63S-Nevis 766S)	174L (Bardo 197S-N.Holden 395S)	Modified RAS 134, 138
2022 SP with additional connection projects	Thermal - above emergency rating	912L \ 9L912 (Red Deer 63S-Nevis 766S)	701L/7L701 (Strome 223S-N.Holden 395S)	Modified RAS 134, 138
2022 SP with additional connection projects	Thermal - above normal rating	912L \ 9L912 (Red Deer 63S-Nevis 766S)	704L (51S Wainwright to 478S Tucuman)	Modified RAS 134, 138
2022 SP with additional connection projects	Thermal - above normal rating	912L \ 9L912 (Red Deer 63S-Nevis 766S)	749L (Edgerton 899S-Kilarney tap point)	Modified RAS 134, 138
2022 SP with additional connection projects	Thermal - above emergency rating	912L \ 9L912 (Red Deer 63S-Nevis 766S)	7L129 (Buffalo Crk. 526S-Bauer tap point)	Modified RAS 134, 138
2022 SP with additional connection projects	Thermal - above emergency rating	912L \ 9L912 (Red Deer 63S-Nevis 766S)	7L50 (Buffalo Crk 526S-Jarrow tap point)	Modified RAS 134, 138
2022 SP with additional connection projects	Thermal - above emergency rating	912L \ 9L912 (Red Deer 63S-Nevis 766S)	7L701 (Battle River 757S-7LA701)	Modified RAS 134, 138
2022 SP with additional connection projects	Thermal - above emergency rating	912L \ 9L912 (Red Deer 63S-Nevis 766S)	7L701(Strome 233S-7LA701)	Modified RAS 134, 138
2022 SP with additional connection projects	Thermal - above normal rating	912L \ 9L912 (Red Deer 63S-Nevis 766S)	7L749 (Edgerton 899S-Briker tap point)	Modified RAS 134, 138
2022 SP with additional connection projects	Thermal - above normal rating	966L \ 9L966 (Hansman Lk. 650S-Pemukan 932S)	7L127 (Monitor 7774S-Pemukan 932S)	New 7L224 RAS
2022 SP with additional connection projects	Thermal - above emergency rating	966L \ 9L966 (Hansman Lk. 650S-Pemukan 932S)	7L224 (Hansman Lake 650S-Monitor 774S)	New 7L224 RAS
2022 SP with additional connection projects	Thermal - above emergency rating	9L20 (Cordel 755S-Nevis 766S)	174L (Bardo 197S-N.Holden 395S)	Modified RAS 134, 138, 139 and real-time operational practices
2022 SP with additional connection projects	Thermal - above emergency rating	9L20 (Cordel 755S-Nevis 766S)	701L/7L701 (Strome 223S-N.Holden 395S)	Modified RAS 134, 138, 139 and real-time operational practices
2022 SP with additional connection projects	Thermal - above normal rating	9L20 (Cordel 755S-Nevis 766S)	749L (Edgerton 899S-Kilarney tap point)	Modified RAS 134, 138, 139 and real-time operational practices
2022 SP with additional connection projects	Thermal - above normal rating	9L20 (Cordel 755S-Nevis 766S)	7L129 (Buffalo Crk. 526S-Bauer tap point)	Modified RAS 134, 138, 139 and real-time operational practices
2022 SP with additional connection projects	Thermal - above emergency rating	9L20 (Cordel 755S-Nevis 766S)	7L159 (Heatburg 948S-7LA159)	Modified RAS 134, 138, 139 and real-time operational practices
2022 SP with additional connection projects	Thermal - above normal rating	9L20 (Cordel 755S-Nevis 766S)	7L16 (Nevis 766S-Heatburg 948S)	Modified RAS 134, 138, 139 and real-time operational practices
2022 SP with additional connection projects	Thermal - above emergency rating	9L20 (Cordel 755S-Nevis 766S)	7L50 (Buffalo Crk 526S-Jarrow tap point)	Modified RAS 134, 138, 139 and real-time operational practices
2022 SP with additional connection projects	Thermal - above emergency rating	9L20 (Cordel 755S-Nevis 766S)	7L701 (Battle River 757S-7LA701)	Modified RAS 134, 138, 139 and real-time operational practices
2022 SP with additional connection projects	Thermal - above emergency rating	9L20 (Cordel 755S-Nevis 766S)	7L701(Strome 233S-7LA701)	Modified RAS 134, 138, 139 and real-time operational practices

Scenario	Type of Reliability Criteria Violation	Contingency (System Element Lost)	Details of Violation (Violation Observed On)	Post-Project Mitigation Measures
	Post-Project			
2022 SP with additional connection projects	Thermal - above emergency rating	9L20 (Cordel 755S-Nevis 766S)	Nevis 766S 901T	Modified RAS 134, 138, 139 and real-time operational practices
2022 SP with additional connection projects	Thermal - above emergency rating	EATL	174L (Bardo 197S-N.Holden 395S)	Modified RAS 134, 138 and real-time operational practices
2022 SP with additional connection projects	Thermal - above emergency rating	EATL	701L/7L701 (Strome 223S-N.Holden 395S)	Modified RAS 134, 138 and real-time operational practices
2022 SP with additional connection projects	Thermal - above normal rating	EATL	704L (51S Wainwright to 478S Tucuman)	Modified RAS 134, 138 and real-time operational practices
2022 SP with additional connection projects	Thermal - above normal rating	EATL	749L (Edgerton 899S-Kilarney tap point)	Modified RAS 134, 138 and real-time operational practices
2022 SP with additional connection projects	Thermal - above normal rating	EATL	7L129 (Buffalo Crk. 526S-Bauer tap point)	Modified RAS 134, 138 and real-time operational practices
2022 SP with additional connection projects	Thermal - above emergency rating	EATL	7L50 (Buffalo Crk 526S-Jarrow tap point)	Modified RAS 134, 138 and real-time operational practices
2022 SP with additional connection projects	Thermal - above emergency rating	EATL	7L701 (Battle River 757S-7LA701)	Modified RAS 134, 138 and real-time operational practices
2022 SP with additional connection projects	Thermal - above emergency rating	EATL	7L701(Strome 233S-7LA701)	Modified RAS 134, 138 and real-time operational practices
2022 SP with additional connection projects	Thermal - above normal rating	EATL	7L749 (Edgerton 899S-Briker tap point)	Modified RAS 134, 138 and real-time operational practices
2022 SP with additional connection projects	Thermal - above emergency rating	EATL	912L (Red Deer 63S-Nevis 766S)	Modified RAS 134, 138 and real-time operational practices
2022 SP with additional connection projects	Thermal - above emergency rating	EATL	9L20 (Cordel 755S-Nevis 768S)	Modified RAS 134, 138 and real-time operational practices
2022 SP with additional connection projects and PENV	Thermal - above emergency rating	766S901T (Nevis 766S 240kV/138kV transformer)	174L (Bardo 197S-N.Holden 395S)	Modified RAS 134
2022 SP with additional connection projects and PENV	Thermal - above emergency rating	766S901T (Nevis 766S 240kV/138kV transformer)	701L/7L701 (Strome 223S-N.Holden 395S)	Modified RAS 134
2022 SP with additional connection projects and PENV	Thermal - above normal rating	766S901T (Nevis 766S 240kV/138kV transformer)	7L701 (Battle River 757S-7LA701)	Modified RAS 134
2022 SP with additional connection projects and PENV	Thermal - above normal rating	766S901T (Nevis 766S 240kV/138kV transformer)	7L701(Strome 233S-7LA701)	Modified RAS 134
2022 SP with additional connection projects and PENV	Thermal - above emergency rating	912L \ 9L912 (Red Deer 63S-Nevis 766S)	174L (Bardo 197S-N.Holden 395S)	Modified RAS 134
2022 SP with additional connection projects and PENV	Thermal - above emergency rating	912L \ 9L912 (Red Deer 63S-Nevis 766S)	701L/7L701 (Strome 223S-N.Holden 395S)	Modified RAS 134
2022 SP with additional connection projects and PENV	Thermal - above normal rating	912L \ 9L912 (Red Deer 63S-Nevis 766S)	7L701 (Battle River 757S-7LA701)	Modified RAS 134
2022 SP with additional connection projects and PENV	Thermal - above normal rating	912L \ 9L912 (Red Deer 63S-Nevis 766S)	7L701(Strome 233S-7LA701)	Modified RAS 134
2022 SP with additional connection projects and PENV	Thermal - above normal rating	966L \ 9L966 (Hansman Lk. 650S-Pemukan 932S)	7L127 (Monitor 7774S-Pemukan 932S)	New 7L224 RAS
2022 SP with additional connection projects and PENV	Thermal - above emergency rating	966L \ 9L966 (Hansman Lk. 650S-Pemukan 932S)	7L224 (Hansman Lake 650S-Monitor 774S)	New 7L224 RAS
2022 SP with additional connection projects and PENV	Thermal - above emergency rating	9L20 (Cordel 755S-Nevis 766S)	174L (Bardo 197S-N.Holden 395S)	Modified RAS 134
2022 SP with additional connection projects and PENV	Thermal - above normal rating	9L20 (Cordel 755S-Nevis 766S)	701L/7L701 (Strome 223S-N.Holden 395S)	Modified RAS 134
2022 SP with additional connection projects and PENV	Thermal - above normal rating	9L20 (Cordel 755S-Nevis 766S)	7L159 (Heatburg 948S-7LA159)	Modified RAS 134
2022 SP with additional connection projects and PENV	Thermal - above normal rating	9L20 (Cordel 755S-Nevis 766S)	7L701 (Battle River 757S-7LA701)	Modified RAS 134
2022 SP with additional connection projects and PENV	Thermal - above emergency rating	9L20 (Cordel 755S-Nevis 766S)	Nevis 766S 901T	Modified RAS 134
2022 SP with additional connection projects and PENV	Thermal - above emergency rating	EATL	174L (Bardo 197S-N.Holden 395S)	Modified RAS 134
2022 SP with additional connection projects and PENV	Thermal - above normal rating	EATL	701L/7L701 (Strome 223S-N.Holden 395S)	Modified RAS 134
2022 SP with additional connection projects and PENV	Thermal - above emergency rating	EATL	912L (Red Deer 63S-Nevis 766S)	Modified RAS 134
2022 SP with additional connection projects and PENV	Thermal - above normal rating	EATL	9L20 (Cordel 755S-Nevis 768S)	Modified RAS 134
2022 SP with additional connection projects, PENV and CETO	Thermal - above normal rating	966L \ 9L966 (Hansman Lk. 650S-Pemukan 932S)	7L127 (Monitor 7774S-Pemukan 932S)	New 7L224 RAS
2022 SP with additional connection projects, PENV and CETO	Thermal - above emergency rating	966L \ 9L966 (Hansman Lk. 650S-Pemukan 932S)	7L224 (Hansman Lake 650S-Monitor 774S)	New 7L224 RAS

Notes:

- RAS 134, 138, and 139 are existing RASs (see Section 1.2.2 of Attachment A1). Modifications to existing RAS 134, 138 and 139 were proposed for the approved Sharp Hills Wind Facility in the *Sharp Hills Wind Farm Connection NID*. These modified versions of RAS 134, 138 and 139 are referred to herein as “Planned RAS 134,” “Planned RAS 138”, and “Planned RAS 139.”
- In this table, “Modified” 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 Reliability Criteria violations or 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 Base Scenario Study Results

5.3.1 Category A Conditions

No Reliability Criteria violations were observed under Category A conditions for any post-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 system performance issues under Category B conditions; namely, thermal criteria violations.

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

5.4 Post-Project Sensitivity Study Results

5.4.1 Category A Conditions

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

5.4.2 Category B Conditions

The Post-Project sensitivity scenarios are intended to study what changes to mitigations or additional mitigations would be required in the event that additional renewable (solar) connection projects materialize ahead of the Project. These other renewable connection projects are outside of the Study Area, however contribute to power outflow (i.e. transmission lines 9L912/912L/9L20) constraints in the Central East subregion as well as constraints on the 138/144 kV paths connecting the Southeast and Central East subregions. The Summer Peak scenario was chosen as it is the most stressed scenario, with these solar projects dispatched to 100% of their capacity to create the credible worst case.

Post-Project power flow studies identified numerous thermal criteria violations under Category B conditions. With additional renewable generation, the same thermal criteria violations that were identified in the post-Project base scenarios, and additional thermal criteria violations were observed. Overall, the number of thermal criteria violations is reduced once PENV and CETO come into service.

5.5 Mitigation Measures

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

5.5.1 Pre-Project

Prior to connection of the Project, some of the observed thermal criteria violations can be managed by using real-time operational practices. The remaining thermal criteria violations can be mitigated with the planned RASs 134, 138 and 139.

5.5.2 Post-Project

5.5.2.1 Post-Project Base Scenarios

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

The remaining thermal criteria violations can be mitigated by modification of planned RASs 134, 138 and 139, by including the Project in the RAS logic, in combination with real-time operational practices as required. In addition, a new RAS for 144 kV transmission line 7L224 is required as part of the Project, referred to as "new 7L224 RAS".

5.5.2.2 Post-Project Sensitivity Scenarios

In general mitigation measures are similar to those applied to base scenarios. Thermal criteria violations observed can be mitigated by using real-time operational practices or modification of planned RASs 134, 138 and 139 and new 7L224 RAS, alone or in combination. With PENV and with both PENV and CETO (scenarios 4b and 4c), real-time operational practices are not required in addition to RAS action to mitigate any thermal criteria violations.

5.5.2.3 Notable Study Assumptions

Currently, the 240 kV transmission line 912L is temporarily derated, affecting the overall rating of 912L/9L912. As this is a temporary derate which is expected to end prior to the ISD of the Project, the studies assumed that the rating of the 240 kV transmission line 912L would be restored prior to the ISD of the Project. If the rating of the 240 kV transmission line 912L is not restored prior to the ISD of the Project and CETO is not in service, modifications to the planned mitigation measures or new mitigation measures may be required as this would result in Category A and Category B thermal violations based on the studies.

The studied ratings for the 240 kV transmission line 9L20 are based on post clearance mitigation information communicated by the TFO. The TFO currently has no planned date for the work to be completed, as it is not required until planned generation projects materialize in the area. If other

generation projects materialize as planned, the clearance mitigation work is not completed prior to the ISD of the Project, and CETO is not in service, modifications to the planned mitigation measures or new mitigations may be required as this would result in Category A and Category B thermal violations based on the studies.

The AESO will monitor changes related to these constraints and update, add, or remove mitigations as required.

5.5.3 Post-Project Mitigation Study Results

With the addition of the Project, the total amount of generation tied to RAS 134, 138 and 139 exceeds the Most Severe Single Contingency (MSSC) limit of 466 MW. The post-Project studies indicate that in order to mitigate the thermal violations following certain major contingencies (EATL, 912L/9L912, 9L20) the combined actions of RAS 134, 138 and 139 may result in generation curtailment in excess of the MSSC limit. Pre-contingency generation curtailment under normal conditions may be required using real-time operational practices to prevent generation curtailment by RAS action above the MSSC level. The probability of pre-curtailment being required would be dependent on generation profiles and operating conditions.

Most of the thermal criteria violations observed under Category B conditions can be alleviated by modified planned RASs 134, 138 and 139 and the new 7L224 RAS. If additional renewable generation materializes, as studied in Scenarios 4a, 4b and 4c, then in combination with RAS actions, real-time operational practices would be required to fully alleviate the thermal criteria violations observed on transmission lines 7L50 and 9L912/912L under certain Category B conditions. The probability of these post-RAS thermal violations would be dependent on generation profiles and operating conditions.

Scenario 4c, for which the EATL contingency was the only Category B condition studied, indicates that after CETO is in service real-time operational practices are not required in addition to RAS action to mitigate the resulting thermal criteria violations.

.

6 Project Dependencies

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

7 Conclusions and Recommendations

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

These issues can be mitigated by modifying RAS 134, 138 and 139, implementing a new RAS for 7L224, 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.

If the ratings of 9L912/912L and 9L20 are not restored prior to the ISD of the Project, in addition to generation projects materializing as forecasted, system performance issues could arise during Category A conditions.

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

Alternative 2 involves adding one 144 kV circuit to connect the Facility to the existing Lanfine 959S substation in a radial configuration and modifying the Lanfine 959S substation, including adding one 144 kV circuit breaker.

The conductor to be used for the 144 kV circuit should have a minimum thermal rating of 161 MVA to meet the market participant's requested STS contract capacity.

Attachment A:
Engineering Connection Assessment Results

Stage 3 Engineering Connection Assessment: Study Results

P1898 Pattern Lanfine North Wind

Pattern Development Lanfine Wind ULC

Date: December 14, 2020
Version: V7.2
Classification: Public

Role	Name	Date	Signature
Prepared and Approved	Dragan Brankovich, P.Eng.	Dec. 14 , 2020	

PERMIT TO PRACTICE
POWEREN CORPORATION
RM SIGNATURE:
RM APEGA ID #: 90666
DATE: Dec. 14/2020
PERMIT NUMBER: P009891
The Association of Professional Engineers and Geoscientists of Alberta (APEGA)

PROFESSIONAL ENGINEER
DRAGAN V. BRANKOVICH
ALBERTA
Dec. 14/2020

NOTICE TO USER

The base cases used for this study were three seasonal base cases provided by the AESO under a Non-Disclosure Agreement. These base cases were augmented by additional data and instructions received from the AESO, which were collectively used to customize these base cases for the purposes of this particular study.

The short-circuit current studies were based on modelling information provided to the AESO by third parties. The authenticity of the modelling information has not been validated by the AESO. Fault levels presented in this report could change as a result of system developments, new customer connections, or additional generation in the area.

PowerEN has relied on its expertise and used due diligence when preparing the study cases for this project. Since PowerEN Corporation has relied on the AESO's information for the purposes of this study, PowerEN Corporation cannot and does not make any warranty nor representations regarding the reliability and accuracy of the information received from the AESO, nor the assumptions used by the AESO to generate the data from these sources. Therefore, PowerEN Corporation assumes no liability for the accuracy and reliability of the data received from the AESO.

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. Nothing described in this report is suitable for construction.

Contents

1 INTRODUCTION 1

1.1 PROJECT OVERVIEW 1

2 PRE-PROJECT STUDY RESULTS 2

2.1 POWER FLOW STUDIES 2
2.1.1 Scenario 1: 2022 Summer Peak Scenario (2022SP) 2
2.1.2 Scenario 2: 2022 Summer Light Scenario (2022SL) 5
2.1.3 Scenario 3: 2022 Winter Peak Scenario (2022WP) 5

3 POST-PROJECT STUDY RESULTS 9

3.1 POWER FLOW STUDIES 9
3.1.1 Scenario 4: 2022 Summer Peak Scenario (2022SP) 9
3.1.2 Scenario 5: 2022 Summer Light Scenario (2022SL) 13
3.1.3 Scenario 6: 2022 Winter Peak Scenario (2022WP) 14
3.1.4 Sensitivity Scenario 4a: 2022 Summer Peak Scenario with additional connection projects in service (2022SP) 17
3.1.5 Sensitivity Scenario 4b: 2022 Summer Peak Scenario with additional connection projects and PENV in service (2022SP) 20
3.1.6 Sensitivity Scenario 4c: 2022 Summer Peak Scenario with additional connection projects, PENV and CETO in service (2022SP) 21
3.2 TRANSIENT STABILITY STUDY 22

4 SHORT-CIRCUIT STUDIES 24

4.1 SCENARIO 3, 2022WP PRE-PROJECT 24
4.2 SCENARIO 6: 2022WP POST-PROJECT 25
4.3 SCENARIO 7: 2028WP POST-PROJECT 26

5 MITIGATION MEASURE DEVELOPMENT AND EVALUATION 27

5.1 PRE-PROJECT STUDY SCENARIOS 27
5.2 POST-PROJECT STUDY SCENARIOS 27
5.2.1 Scenario 4: 2022 Summer Peak (2022SP) 27
5.2.2 Scenario 5: 2022 Summer Light (2022SL) 30
5.2.3 Scenario 6: 2022 Winter Peak (2022WP) 30
5.2.4 Sensitivity Scenario 4a: 2022 Summer Peak Scenario with additional connection projects in service (2022SP) 31
5.2.5 Sensitivity Scenario 4b: 2022 Summer Peak Scenario with additional connection projects and PENV in service (2022SP) 34
5.2.6 Sensitivity Scenario 4c: 2022 Summer Peak Scenario with additional connection projects, PENV and CETO in service (2022SP) 35
5.3 EVALUATION OF MITIGATION MEASURES 35
5.3.1 Scenario 4: 2022 Summer Peak (2022SP) 37
5.3.2 Scenario 5: 2022 Summer Light Scenario (2022SL) 39
5.3.3 Scenario 6: 2022 Winter Peak Scenario (2022WP) 39
5.3.4 Sensitivity Scenario 4a: 2022 Summer Peak Scenario with additional connection projects in service (2022SP) 42
5.3.5 Sensitivity Scenario 4b: 2022 Summer Peak Scenario with additional connection projects and PENV in service (2022SP) 45

5.3.6 Sensitivity Scenario 4c: 2022 Summer Peak Scenario with additional connection projects, PENV and CETO in service (2022SP) 46
5.4 CONSTRAINT EFFECTIVE FACTOR STUDIES 47

Tables

Table 2-1: Thermal Criteria Violations under Category B Conditions, Scenario 1 (2022SP) 2
Table 2-2: Thermal Criteria Violations under Category B Conditions, Scenario 2 (2022SL) 5
Table 2-3: Thermal Criteria Violations under Category B Conditions, Scenario 3 (2022WP) 6
Table 3-1: Thermal Criteria Violations under Category B Conditions, Scenario 4 (2022SP) 9
Table 3-2: Thermal Criteria Violations under Category B Conditions, Scenario 5 (2022SL) 14
Table 3-3: Thermal Criteria Violations under Category B Conditions, Scenario 6 (2022WP) 14
Table 3-4: Thermal Criteria Violations under Category B Conditions, Scenario 4a (2022SP) 17
Table 3-5: Thermal Criteria Violations under Category B Conditions, Scenario 4b (2020SP) 21
Table 3-6: Thermal Criteria Violations under Category B Conditions, Scenario 4c (2020SP) 22
Table 3-7: Transient Stability Study Results for Cat. B Conditions, Scenarios 4, 5, 6 23
Table 4-1: Pre-Project Short-Circuit Current Levels for 2022WP Scenario 3 24
Table 4-2: Post-Project Short-Circuit Current Levels for 2022WP Study Scenario 6 25
Table 4-3: Post-Project Short-Circuit Current Levels for 2028WP Study Scenario 7 26
Table 5-1: Pre-Project Mitigation Measures 27
Table 5-2: Post-Project Mitigation Measures, Scenario 4 (2022SP) 27
Table 5-3: Post-Project Mitigation Measures, Scenario 5 (2022SL) 30
Table 5-4: Post-Project Mitigation Measures, Scenario 6 (2022WP) 30
Table 5-6: Post-Project Mitigation Measures, Scenario 4a (2022SP) 32
Table 5-7: Post-Project Mitigation Measures, Scenario 4b (2022SP) 34
Table 5-8: Post-Project Mitigation Measures, Scenario 4c (2022SP) 35
Table 5-9: Summary of Proposed RAS Actions 35
Table 5-10: Post-RAS Power Flow Study Results, Scenario 4 (2022SP) 37
Table 5-11: Post-RAS Power Flow Study Results, Scenario 5 (2022SL) 39
Table 5-12: Post-RAS Power Flow Study Results, Scenario 6 (2022WP) 39
Table 5-13: Post-RAS Power Flow Study Results, Scenario 4a (2022SP) 42
Table 5-14: Post-RAS Power Flow Study Results, Scenario 4b (2022SP) 45
Table 5-15: Post-RAS Power Flow Study Results, Scenario 4c (2022SP) 47

Attachments

ATTACHMENT A1 ENGINEERING CONNECTION ASSESSMENT: STUDY SCOPE

ATTACHMENT A2 PRE-PROJECT POWER FLOW DIAGRAMS

ATTACHMENT A3 POST-PROJECT POWER FLOW DIAGRAMS

ATTACHMENT A4 POST-PROJECT TRANSIENT STABILITY DIAGRAMS

ATTACHMENT A5 MODEL DATA AND ASSUMPTIONS

ATTACHMENT A6 POST-MITIGATION POWER FLOW DIAGRAMS

ATTACHMENT A7 CONSTRAINT EFFECTIVENESS FACTORS TABLE

1 Introduction

This report presents the results of the engineering studies completed by PowerEN Corporation in Stage 3 of the AESO Connection Process. These studies were performed in order to assess the impact of the Project on the performance of the Alberta Interconnected Electric System (AIES). The Connection Proposal for this project identified the connection to Lanfine 959S, with an approximately 22 km long 144 kV transmission line, with the connection made within Lanfine 959S, as the only connection alternative meeting Patttern's needs. The studies carried out in Stage 3 are an update of the studies carried out in Stage 2.

1.1 Project Overview

Pattern Development Lanfine Wind ULC ("Pattern") has submitted a System Access Service Request (SASR) to the Alberta Electric System Operator (AESO) for 145 MW of Supply Transmission Service at Section 5, Township 26, Range 5 West of the 4th Meridian, in the Hanna Planning Area #42 (the Project).

The requested In-Service Date (ISD) for the Project is September 30, 2022.

Load Component

- Demand Transmission Service (DTS) of up to 1.5 MW is requested.
- Load Type: Station service

This is a new DTS contract capacity. Currently there is no plan for future expansion.

Generation Component

- Supply Transmission Service (STS): 145 MW
- Rated Nameplate Capacity: 148.5 MW
- Maximum Authorized Real Power (MARP): 145 MW
- Maximum Capability (MC): 145 MW
- Reactive Power Capability (preliminary) at MARP:
    - 75.8 MVAr (0.9 pf lagging)
    - 57.5 MVAr (0.95 pf leading)

No future expansion is planned.

The studies were performed in accordance with the study scope prepared by the AESO for project P1898 and applied to the connection configuration considered for this project. The scope document is provided in Attachment 1.

The power system network analysis tool that was used for the studies in this connection assessment was PowerWorld Simulator V.21.

2 Pre-Project Study Results

This section describes the results of power flow analysis for the pre-Project state. The results show instances of any violations of the Thermal and Voltage Reliability Criteria (as specified in the Connection Study Scope document in Attachment 1) detected during the course of the 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: 2022 Summer Peak Scenario (2022SP)

Category A Conditions

No Thermal or Voltage Reliability Criteria violations were observed under Category A conditions.

Category B Conditions

Thermal Reliability Criteria violations were observed under certain Category B conditions as shown in Table 2-1. No Voltage Reliability Criteria violations were observed under Category B conditions.

Table 2-1: Thermal Criteria Violations under Category B Conditions, Scenario 1 (2022SP)

Contingency (System Element Lost)	Violation Location Details	Thermal Ratings		Pre-Project Results	
		Normal Rating (MVA)	Emergency Rating (MVA)	Power Flow (MVA)	% Loading[a]
Violations Above Emergency Rating					
749L \ 749AL (Metiskow 648S-Edgerton 899S)	7L50 (Buffalo Crk 526S-Jarrow tap point)	109	124	139.0	127.2
766S901T (Nevis 766S 240kV/138kV transformer)	174L (Bardo 197S-N.Holden 395S)	85	94	134.7	158.4
	701L/7L701 (Strome 223S-N.Holden 395S)	119	131	178.0	149.6
	7L129 (Buffalo Crk. 526S-Bauer tap point)	120	124	138.2	115.2
	7L50 (Buffalo Crk 526S-Jarrow tap point)	109	124	153.6	140.6
	7L701 (Battle River 757S-7LA701)	139	160	185.6	133.5
	7L701(Strome 223S-7LA701)	139	162	192.0	138.0
7L42 (Lloydminster 716S-Hill 751S)	7L50 (Buffalo Crk 526S-Jarrow tap point)	109	124	124.5	113.9
7L701 \ 7LA701 \ 701L (Strome 223S-Battle River 757S)	7L50 (Buffalo Crk 526S-Jarrow tap point)	109	124	126.7	115.9

7L749 \ 749L \ 7LB749 Lloydminster 716S-Edgerton 899S)	7L50 (Buffalo Crk 526S-Jarrow tap point)	109	124	136.1	124.5
899ST3a (Edgerton 899S 138kV/25kV transformer)	7L50 (Buffalo Crk 526S-Jarrow tap point)	109	124	138.5	126.7
912L \ 9L912 (Red Deer 63S-Nevis 766S)	174L (Bardo 197S-N.Holden 395S)	85	94	134.3	157.8
	701L/7L701 (Strome 223S-N.Holden 395S)	119	131	177.8	149.3
	7L129 (Buffalo Crk. 526S-Bauer tap point)	120	124	137.9	114.9
	7L50 (Buffalo Crk 526S-Jarrow tap point)	109	124	153.3	140.3
	7L701 (Battle River 757S-7LA701)	139	160	183.8	132.2
	7L701(Strome 223S-7LA701)	139	162	191.7	137.8
9L20 (Cordel 755S-Nevis 766S)	174L (Bardo 197S-N.Holden 395S)	85	94	114.6	134.7
	701L/7L701 (Strome 223S-N.Holden 395S)	119	131	156.1	131.1
	7L129 (Buffalo Crk. 526S-Bauer tap point)	120	124	125.2	104.3
	7L50 (Buffalo Crk 526S-Jarrow tap point)	109	124	140.8	128.9
	7L701 (Battle River 757S-7LA701)	139	160	173.7	124.9
	7L701(Strome 223S-7LA701)	139	162	169.7	122.0
	Nevis 766S 901T	100	110	145.4	145.4
EATL	174L (Bardo 197S-N.Holden 395S)	85	94	116.3	136.7
	701L/7L701 (Strome 223S-N.Holden 395S)	119	131	163.5	137.4
	7L129 (Buffalo Crk. 526S-Bauer tap point)	120	124	132.5	110.4
	7L50 (Buffalo Crk 526S-Jarrow tap point)	109	124	148.1	135.5
	7L701(Strome 223S-7LA701)	139	162	177.4	127.5
	912L (Red Deer 63S-Nevis 766S)	507	654	708.3	139.7
	9L20 (Cordel 755S-Nevis 768S)	488	501	623.7	127.8
Violations Below Emergency Rating					
526ST1/526ST2 (Buffalo Crk. 526S 138kV/25kV transformer)	701L/7L701 (Strome 223S-N.Holden 395S)	119	131	119.7	100.53
	749L (Edgerton 899S-Kilarney tap point)	96	134	110.8	115.4
	7L749 (Edgerton 899S-Briker tap point)	96	125	103.8	108.1
	912L (Red Deer 63S-Nevis 766S)	507	654	502.2	99.1

648ST1 (Metiskow 648S 138kV/25kV transformer)	7L50 (Buffalo Crk 526S-Jarrow tap point)	109	124	110.6	101.2
749L \ 749AL (Metiskow 648S-Edgerton 899S)	7L129 (Buffalo Crk. 526S-Bauer tap point)	120	124	123.2	102.7
766S901T (Nevis 766S 240kV/138kV transformer)	704L (51S Wainwright to 478S Tucuman)	75	83	75.8	101.1
	749L (Edgerton 899S-Kilarney tap point)	96	134	107.0	111.5
	7L749 (Edgerton 899S-Briker tap point)	96	125	99.7	103.8
7L129 \ 7LA129 (Buffalo Crk. 526S-Vermilion 710S)	749L (Edgerton 899S-Kilarney tap point)	96	134	110.1	114.7
	7L749 (Edgerton 899S-Briker tap point)	96	125	103.1	107.4
	912L (Red Deer 63S-Nevis 766S)	507	654	496.6	98.0
7L50 (Buffalo Crk. 526S-Battle River 757S)	701L/7L701 (Strome 223S-N.Holden 395S)	119	131	122.6	103.0
	749L (Edgerton 899S-Kilarney tap point)	96	134	115.3	120.1
	7L749 (Edgerton 899S-Briker tap point)	96	125	108.3	112.9
	912L (Red Deer 63S-Nevis 766S)	507	654	499.3	98.5
7L701 \ 7LA701 \ 701L (Strome 223S-Battle River 757S)	912L (Red Deer 63S-Nevis 766S)	507	654	521.2	102.8
7L749 \ 749L \ 7LB749 Lloydminster 716S-Edgerton 899S)	7L129 (Buffalo Crk. 526S-Bauer tap point)	120	124	120.0	100.01
899ST3a (Edgerton 899S 138kV/25kV transformer)	7L129 (Buffalo Crk. 526S-Bauer tap point)	120	124	122.5	102.1
912L \ 9L912 (Red Deer 63S-Nevis 766S)	704L (51S Wainwright to 478S Tucuman)	75	83	75.4	100.5
	749L (Edgerton 899S-Kilarney tap point)	96	134	106.8	111.2
	7L749 (Edgerton 899S-Briker tap point)	96	125	99.4	103.6
966L \ 9L966 (Hansman Lk. 650S-Pemukan 932S)	7L224 (Hansman Lake 650S-Monitor 774S)	109	124	122.7	112.5
9L20 (Cordel 755S-Nevis 766S)	749L (Edgerton 899S-Kilarney tap point)	96	134	102.0	106.3
	7L159 (Heatburg 948S-7LA159)	109	124	120.0	109.9
	7L16 (Nevis 766S-Heatburg 948S)	109	124	115.2	105.4
EATL	704L (51S Wainwright to 478S Tucuman)	75	83	80.3	107.1
	749L (Edgerton 899S-Kilarney tap point)	96	134	113.0	117.7
	7L701 (Battle River 757S-7LA701)	139	160	147.1	105.9

Public

	7L749 (Edgerton 899S-Briker tap point)	96	125	105.6	110.0

Notes:

[a] Reported as a percentage of the observed current flow expressed in MVA, relative to the transmission line's Normal Rating, also in MVA (as shown in Attachment A1).

2.1.2 Scenario 2: 2022 Summer Light Scenario (2022SL)

Category A Conditions

No Thermal or Voltage Reliability Criteria violations were observed under Category A conditions.

Category B Conditions

Thermal Reliability Criteria violations observed under certain Category B conditions are shown in Table 2-2. No Voltage Reliability Criteria violations were observed under Category B conditions.

Table 2-2: Thermal Criteria Violations under Category B Conditions, Scenario 2 (2022SL)

Contingency	Violation Location Details	Thermal Ratings		Pre-Project Results	
		Normal Rating (MVA)	Emergency Rating (MVA)	Power Flow (MVA)	% Loading[a]
Violations Below Emergency Rating					
9L20 (Cordel 755S-Nevis 766S)	Nevis 766S 901T	109	124	108.4	108.4

Notes:

[a] Reported as a percentage of the observed current flow expressed in MVA relative to the transmission line's Normal Rating, also in MVA (as shown in Attachment A1).

2.1.3 Scenario 3: 2022 Winter Peak Scenario (2022WP)

Category A Conditions

No Thermal or Voltage Criteria violations were observed under Category A conditions.

Category B Conditions

Thermal Reliability Criteria violations were observed under certain Category B conditions as shown in Table 2-3. No Voltage Reliability Criteria violations were observed under Category B conditions.

Table 2-3: Thermal Criteria Violations under Category B Conditions, Scenario 3 (2022WP)

Contingency (System Element Lost)	Violation Location Details	Thermal Ratings		Pre-Project Results	
		Normal Rating (MVA)	Emergency Rating (MVA)	Power Flow (MVA)	% Loading[a]
Violations Above Emergency Rating					
648ST1 (Metiskow 648S 138kV/25kV transformer)	7L50 (Buffalo Crk 526S-Jarrow tap point)	**139**	**150**	159.0	114.4
749L \ 749AL (Metiskow 648S-Edgerton 899S)	7L50 (Buffalo Crk 526S-Jarrow tap point)	**139**	**150**	152.9	110.0
766S901T (Nevis 766S 240kV/138kV transformer)	174L (Bardo 197S-N.Holden 395S)	**90**	**99**	110.4	122.7
766S901T (Nevis 766S 240kV/138kV transformer)	701L/7L701 (Strome 223S-N.Holden 395S)	**146**	**161**	171.2	117.3
766S901T (Nevis 766S 240kV/138kV transformer)	7L50 (Buffalo Crk 526S-Jarrow tap point)	**139**	**150**	157.7	113.5
766S901T (Nevis 766S 240kV/138kV transformer)	7L701(Strome 223S-7LA701)	**169**	**162**	187.8	111.1
766S901T (Nevis 766S 240kV/138kV transformer)	Sheerness 807S 2T	**400**	400	400.4	100.1
912L \ 9L912 (Red Deer 63S-Nevis 766S)	174L (Bardo 197S-N.Holden 395S)	**90**	**99**	110.2	122.4
912L \ 9L912 (Red Deer 63S-Nevis 766S)	701L/7L701 (Strome 223S-N.Holden 395S)	**146**	**161**	171.1	117.2
912L \ 9L912 (Red Deer 63S-Nevis 766S)	7L50 (Buffalo Crk 526S-Jarrow tap point)	**139**	**150**	157.3	113.2
912L \ 9L912 (Red Deer 63S-Nevis 766S)	7L701(Strome 223S-7LA701)	**169**	**162**	187.6	111.0
912L \ 9L912 (Red Deer 63S-Nevis 766S)	Sheerness 807S 2T	**400**	400	400.0	100.0
9L20 (Cordel 755S-Nevis 766S)	7L701(Strome 223S-7LA701)	**169**	**162**	167.1	98.9
9L20 (Cordel 755S-Nevis 766S)	Nevis 766S 901T	**100**	**110**	136.5	136.5
EATL	704L (51S Wainwright to 478S Tucuman)	**79**	**87**	88.3	111.8
EATL	7L50 (Buffalo Crk 526S-Jarrow tap point)	**139**	**150**	153.9	110.7
EATL	7L701(Strome 223S-7LA701)	**169**	**162**	177.2	104.8
EATL	Battle River 757S 4T	**166**	**166**	169.5	102.1
Violations Below Emergency Rating					
478ST1 or 478ST2 (Tucuman 478S 138kV/25kV transformer)	749L (Edgerton 899S-Killarney tap point)	**96**	**143**	86.6	90.3
526ST1/526ST2 (Buffalo Crk. 526S 138kV/25kV transformer)	749L (Edgerton 899S-Killarney tap point)	**96**	**143**	112.1	116.8
526ST1/526ST2 (Buffalo Crk. 526S 138kV/25kV transformer)	7L749 (Edgerton 899S-Briker tap point)	**96**	**134**	105.3	109.7
648ST1 (Metiskow 648S 138kV/25kV transformer)	704L (51S Wainwright to 478S Tucuman)	**79**	**87**	85.0	107.6

Contingency (System Element Lost)	Violation Location Details	Thermal Ratings		Pre-Project Results	
		Normal Rating (MVA)	Emergency Rating (MVA)	Power Flow (MVA)	% Loading[a]
648ST1 (Metiskow 648S 138kV/25kV transformer)	7L129 (Buffalo Crk. 526S-Bauer tap point)	**139**	**143**	138.2	99.4
704L (Wainwright 51S-Tucuman 478S)	749L (Edgerton 899S-Killarney tap point)	**96**	**143**	93.1	97.0
749L \ 749AL (Metiskow 648S-Edgerton 899S)	704L (51S Wainwright to 478S Tucuman)	**79**	**87**	85.1	107.7
757S912T (Battle River 757S transformer)	704L (51S Wainwright to 478S Tucuman)	**79**	**87**	79.5	100.6
766S901T (Nevis 766S 240kV/138kV transformer)	704L (51S Wainwright to 478S Tucuman)	**79**	**87**	84.4	106.9
766S901T (Nevis 766S 240kV/138kV transformer)	749L (Edgerton 899S-Killarney tap point)	**96**	**143**	104.3	108.6
766S901T (Nevis 766S 240kV/138kV transformer)	7L129 (Buffalo Crk. 526S-Bauer tap point)	**139**	**143**	136.9	98.5
766S901T (Nevis 766S 240kV/138kV transformer)	7L701 (Battle River 757S-7LA701)	**179**	**194**	181.1	101.2
766S901T (Nevis 766S 240kV/138kV transformer)	7L749 (Edgerton 899S-Briker tap point)	**96**	**134**	97.0	101.1
7L129 \ 7LA129 (Buffalo Crk. 526S-Vermilion 710S)	749L (Edgerton 899S-Kilarney tap point)	**96**	**143**	109.4	114.0
7L129 \ 7LA129 (Buffalo Crk. 526S-Vermilion 710S)	7L749 (Edgerton 899S-Briker tap point)	**96**	**134**	102.8	107.1
7L50 (Buffalo Crk. 526S-Battle River 757S)	749L (Edgerton 899S-Killarney tap point)	**96**	**143**	116.9	121.8
7L50 (Buffalo Crk. 526S-Battle River 757S)	7L749 (Edgerton 899S-Briker tap point)	**96**	**134**	110.0	114.6
7L701 \ 7LA701 \ 701L (Strome 223S-Battle River 757S)	7L50 (Buffalo Crk 526S-Jarrow tap point)	**139**	**150**	138.1	99.4
7L749 \ 749L \ 7LB749 Lloydminster 716S-Edgerton 899S)	704L (51S Wainwright to 478S Tucuman)	**79**	**87**	81.0	102.6
7L749 \ 749L \ 7LB749 Lloydminster 716S-Edgerton 899S)	7L50 (Buffalo Crk 526S-Jarrow tap point)	**139**	**150**	146.5	105.4
899ST3a (Edgerton 899S 138kV/25kV transformer)	704L (51S Wainwright to 478S Tucuman)	**79**	**87**	82.6	104.6
899ST3a (Edgerton 899S 138kV/25kV transformer)	7L50 (Buffalo Crk 526S-Jarrow tap point)	**139**	**150**	149.2	107.3
912L \ 9L912 (Red Deer 63S-Nevis 766S)	704L (51S Wainwright to 478S Tucuman)	**79**	**87**	84.0	106.3
912L \ 9L912 (Red Deer 63S-Nevis 766S)	749L (Edgerton 899S-Killarney tap point)	**96**	**143**	104.0	108.4
912L \ 9L912 (Red Deer 63S-Nevis 766S)	7L129 (Buffalo Crk. 526S-Bauer tap point)	**139**	**143**	136.5	98.2
912L \ 9L912 (Red Deer 63S-Nevis 766S)	7L701 (Battle River 757S-7LA701)	**179**	**194**	179.3	100.2

Public

Contingency (System Element Lost)	Violation Location Details	Thermal Ratings		Pre-Project Results	
		Normal Rating (MVA)	Emergency Rating (MVA)	Power Flow (MVA)	% Loading[a]
912L \ 9L912 (Red Deer 63S-Nevis 766S)	7L749 (Edgerton 899S-Briker tap point)	**96**	**134**	96.8	100.9
9L20 (Cordel 755S-Nevis 766S)	174L (Bardo 197S-N.Holden 395S)	**90**	**99**	91.9	102.1
9L20 (Cordel 755S-Nevis 766S)	701L/7L701 (Strome 223S-N.Holden 395S)	**146**	**161**	150.9	103.4
9L20 (Cordel 755S-Nevis 766S)	704L (51S Wainwright to 478S Tucuman)	**79**	**87**	80.9	102.4
9L20 (Cordel 755S-Nevis 766S)	749L (Edgerton 899S-Killarney tap point)	**96**	**143**	99.8	104.0
9L20 (Cordel 755S-Nevis 766S)	7L50 (Buffalo Crk 526S-Jarrow tap point)	**139**	**150**	145.7	104.8
9L20 (Cordel 755S-Nevis 766S)	7L701 (Battle River 757S-7LA701)	**179**	**194**	171.9	96.0
9L20 (Cordel 755S-Nevis 766S)	7L749 (Edgerton 899S-Briker tap point)	**96**	**134**	92.7	96.6
9L80 (Cordel 755S-Battle River 757S)	704L (51S Wainwright to 478S Tucuman)	**79**	**87**	79.5	100.6
EATL	174L (Bardo 197S-N.Holden 395S)	**90**	**99**	95.8	106.4
EATL	701L/7L701 (Strome 223S-N.Holden 395S)	**146**	**161**	160.6	110.0
EATL	749L (Edgerton 899S-Killarney tap point)	**96**	**143**	109.8	114.4
EATL	7L749 (Edgerton 899S-Briker tap point)	**96**	**134**	102.6	106.8
EATL	912L (Red Deer 63S-Nevis 766S)	**623**	**773**	643.4	103.3

Notes:

[a] Reported as a percentage of the observed current flow expressed in MVA, relative to the transmission line's Normal Rating, also in MVA (as shown in Attachment A1.

3 Post-Project Study Results

This section describes the results of the power flow and transient stability studies performed for the post-Project system configuration, for 2022 summer light (2022SL), 2022 summer peak (2022SP) and 2022 winter peak (2022WP) study scenarios.

3.1 Power Flow Studies

Power flow diagrams illustrating the post-Project power flow study results for Category A and Category B conditions are found in [Attachment A3].

3.1.1 Scenario 4: 2022 Summer Peak Scenario (2022SP)

Category A Conditions

No Thermal or Voltage Reliability Criteria violations were observed under Category A conditions.

Category B Conditions

Thermal Reliability Criteria violations were observed under certain Category B conditions as shown in Table 3-1. No Voltage Reliability Criteria violations were observed under Category B conditions.

Table 3-1: Thermal Criteria Violations under Category B Conditions, Scenario 4 (2022SP)

Details of Violation (Violation Observed On)	Normal Rating (MVA)	Normal Rating (MVA)	Emerg. Rating (MVA	Pre-Project Results		Post-Project Results		% Loading Difference (Post-Pre)
				Power Flow (MVA)	% Loading	Power Flow (MVA)	% Loading	
Violations Above Emergency Rating								
395ST1 (N.Holden 395S 138kV/25kV transformer)	7L50 (Buffalo Crk 526S-Jarrow tap point)	109	117	114.7	104.9	117.7	108.0	3.0
648ST1 (Metiskow 648S 138kV/25kV transformer)	7L50 (Buffalo Crk 526S-Jarrow tap point)	109	117	137.2	125.9	141.3	129.6	3.7
749L \ 749AL (Metiskow 648S-Edgerton 899S)	7L50 (Buffalo Crk 526S-Jarrow tap point)	109	117	132.3	121.0	136.5	125.2	4.2
766S901T (Nevis 766S 240kV/138kV transformer)	701L/7L701 (Strome 223S-N.Holden 395S)	119	131	137.6	115.6	145.7	122.4	6.8
	7L50 (Buffalo Crk 526S-Jarrow tap point)	109	117	130.7	119.6	136.5	125.2	5.6

Details of Violation (Violation Observed On)	Normal Rating (MVA)	Normal Rating (MVA)	Emerg. Rating (MVA	Pre-Project Results		Post-Project Results		% Loading Difference (Post-Pre)
				Power Flow (MVA)	% Loading	Power Flow (MVA)	% Loading	
	7L701(Strome 233S-7LA701)	142	159	155.4	111.0	163.6	115.4	4.3
7L42 (Lloydminster 716S-Hill 751S)	7L50 (Buffalo Crk 526S-Jarrow tap point)	109	117	115.8	106.0	120.1	110.2	4.2
7L701 \ 7LA701 \ 701L (Strome 223S-Battle River 757S)	7L50 (Buffalo Crk 526S-Jarrow tap point)	109	117	117.2	107.3	121.1	111.1	3.8
7L749 \ 749L \ 7LB749 Lloydminster 716S-Edgerton 899S)	7L50 (Buffalo Crk 526S-Jarrow tap point)	109	117	126.5	115.8	130.8	120.0	4.2
899ST3a (Edgerton 899S 138kV/25kV transformer)	7L50 (Buffalo Crk 526S-Jarrow tap point)	109	117	129.1	118.1	133.3	122.3	4.2
912L \ 9L912 (Red Deer 63S-Nevis 766S)	174L (Bardo 197S-N.Holden 395S)	84	94	85.7	100.8	94.0	110.6	9.8
	701L/7L701 (Strome 223S-N.Holden 395S)	119	131	137.7	115.7	145.8	122.6	6.9
	7L50 (Buffalo Crk 526S-Jarrow tap point)	109	117	130.8	119.7	136.5	125.2	5.5
	7L701(Strome 233S-7LA701)	142	159	155.5	111.1	163.8	115.5	4.4
966L \ 9L966 (Hansman Lk. 650S-Pemukan 932S)	7L224 (Hansman Lake 650S-Monitor 774S)	108	120	122.8	112.3	145.1	134.0	21.7
9L20 (Cordel 755S-Nevis 766S)	7L50 (Buffalo Crk 526S-Jarrow tap point)	109	117	120.4	110.2	125.4	115.0	4.9
	Nevis 766S 901T	100	110	122.4	122.4	131.3	131.3	8.9
EATL	701L/7L701 (Strome 223S-N.Holden 395S)	119	131	140.3	117.9	144.2	121.1	3.3
	704L (51S WAINWRIGHT to 478S Tucuman)	75	83	80.6	107.5	83.2	110.9	3.4
	7L50 (Buffalo Crk 526S-Jarrow tap point)	109	117	136.8	125.5	139.6	128.1	2.6
	7L701(Strome 233S-7LA701)	142	159	158.4	111.6	162.3	114.4	2.8

Public

Details of Violation (Violation Observed On)	Normal Rating (MVA)	Normal Rating (MVA)	Emerg. Rating (MVA	Pre-Project Results		Post-Project Results		% Loading Difference (Post-Pre)
				Power Flow (MVA)	% Loading	Power Flow (MVA)	% Loading	
	912L (Red Deer 63S-Nevis 766S)	507	553	547.0	107.9	575.0	113.4	5.5
Violations Below Emergency Rating								
526ST1/526ST2 (Buffalo Crk. 526S 138kV/25kV transformer)	749L (Edgerton 899S-Kilarney tap point)	96	134	100.5	104.7	104.2	108.6	3.8
	7L749 (Edgerton 899S-Briker tap point)	92	125	95.3	103.5	98.9	107.5	3.9
648ST1 (Metiskow 648S 138kV/25kV transformer)	704L (51S WAINWRIGHT to 478S Tucuman)	75	83	75.0	100.0	78.1	104.2	4.2
	7L129 (Buffalo Crk. 526S-Bauer tap point)	116	132	122.8	105.9	126.8	109.4	3.4
749L \ 749AL (Metiskow 648S-Edgerton 899S)	704L (51S WAINWRIGHT to 478S Tucuman)	75	83	75.3	100.4	78.7	104.9	4.5
	7L129 (Buffalo Crk. 526S-Bauer tap point)	116	132	119.4	109.3	123.5	106.5	-2.7
757S912T (Battle River 757S transformer)	704L (51S WAINWRIGHT to 478S Tucuman)	75	83	73.2	97.5	76.2	101.5	4.0
766S901T (Nevis 766S 240kV/138kV transformer)	174L (Bardo 197S-N.Holden 395S)	84	94	85.6	100.7	93.9	110.5	9.8
	704L (51S WAINWRIGHT to 478S Tucuman)	75	83	71.2	94.9	75.2	100.2	5.3
	7L129 (Buffalo Crk. 526S-Bauer tap point)	116	132	116.9	107.0	122.4	105.6	-1.4
	7L701 (Battle River 757S-7LA701)	142	159	145.7	104.0	154.6	109.0	5.0
7L129 \ 7LA129 (Buffalo Crk. 526S-Vermilion 710S)	749L (Edgerton 899S-Kilarney tap point)	96	134	97.4	101.4	101.0	105.2	3.8
7L50 (Buffalo Crk. 526S-Battle River 757S)	749L (Edgerton 899S-Kilarney tap point)	96	134	102.8	107.1	106.5	111.0	3.9
	749L (Metiskow 648S-Kilarney tap point)	122	134	119.5	97.9	123.2	101.0	3.1

Public

Details of Violation (Violation Observed On)	Normal Rating (MVA)	Normal Rating (MVA)	Emerg. Rating (MVA	Pre-Project Results		Post-Project Results		% Loading Difference (Post-Pre)
				Power Flow (MVA)	% Loading	Power Flow (MVA)	% Loading	
	7L749 (Edgerton 899S-Briker tap point)	92	125	97.3	101.4	101.0	109.8	8.4
7L749 \ 749L \ 7LB749 Lloydminster 716S-Edgerton 899S)	704L (51S WAINWRIGHT to 478S Tucuman)	75	83	71.9	95.8	75.3	100.4	4.6
	7L129 (Buffalo Crk. 526S-Bauer tap point)	116	132	114.3	104.6	118.4	102.1	-2.5
899ST3a (Edgerton 899S 138kV/25kV transformer)	704L (51S WAINWRIGHT to 478S Tucuman)	75	83	73.3	97.7	76.7	102.3	4.6
	7L129 (Buffalo Crk. 526S-Bauer tap point)	116	132	116.7	106.8	120.8	104.2	-2.6
912L \ 9L912 (Red Deer 63S-Nevis 766S)	704L (51S WAINWRIGHT to 478S Tucuman)	75	83	71.3	95.1	75.3	100.4	5.3
	7L129 (Buffalo Crk. 526S-Bauer tap point)	116	132	117.0	107.0	122.4	105.6	-1.5
	7L701 (Battle River 757S-7LA701)	142	159	145.8	104.2	153.3	108.1	4.0
966L \ 9L966 (Hansman Lk. 650S-Pemukan 932S)	7L127 (Monitor 7774S-Pemukan 932S)	145	194	127.0	87.8	165.5	114.3	26.6
9L20 (Cordel 755S-Nevis 766S)	701L/7L701 (Strome 223S-N.Holden 395S)	119	131	120.1	100.9	127.1	106.8	6.0
	7L129 (Buffalo Crk. 526S-Bauer tap point)	116	132	107.0	92.2	111.7	96.4	4.1
	7L159 (Heatburg 948S-7LA159)	107	119	114.9	105.1	117.8	109.8	4.7
	7L16 (Nevis 766S-Heatburg 948S)	107	120	111.4	101.9	114.4	106.6	4.6
	7L701 (Battle River 757S-7LA701)	142	159	138.7	97.8	146.0	102.9	5.1
	7L701(Strome 233S-7LA701)	142	159	137.6	97.0	144.8	102.1	5.0

Public

Details of Violation (Violation Observed On)	Normal Rating (MVA)	Normal Rating (MVA)	Emerg. Rating (MVA	Pre-Project Results		Post-Project Results		% Loading Difference (Post-Pre)
				Power Flow (MVA)	% Loading	Power Flow (MVA)	% Loading	
9L80 (Cordel 755S-Battle River 757S)	704L (51S WAINWRIGHT to 478S Tucuman)	75	83	73.2	97.5	76.2	101.5	4.0
EATL	174L (Bardo 197S-N.Holden 395S)	84	94	84.2	100.3	88.4	104.0	3.7
	749L (Edgerton 899S-Kilarney tap point)	96	134	100.8	105.0	103.5	107.8	2.8
	7L129 (Buffalo Crk. 526S-Bauer tap point)	116	132	122.5	105.6	125.2	107.9	2.3
	7L159 (Heatburg 948S-7LA159)	107	119	116.3	108.4	116.2	108.3	-0.1
	7L16 (Nevis 766S-Heatburg 948S)	107	120	112.8	105.1	112.8	105.1	-0.1
	7L701 (Battle River 757S-7LA701)	142	159	152.3	107.3	156.5	110.3	3.0
	7L749 (Edgerton 899S-Briker tap point)	92	125	95.1	103.4	97.7	106.2	2.9
	Nevis 766S 901T	100	110	98.5	98.5	100.1	100.1	1.6

Notes:

[a] Reported as a percentage of the observed current flow expressed in MVA relative to the transmission line's Normal Rating, also in MVA (as shown in Attachment A1).

3.1.2 Scenario 5: 2022 Summer Light Scenario (2022SL)

Category A Conditions

No Thermal or Voltage Reliability Criteria violations were observed under Category A conditions.

Category B Conditions

Thermal Reliability Criteria violations observed under certain Category B conditions are shown in Table 3-2. No Voltage Reliability Criteria violations were observed under Category B conditions.

Table 3-2: Thermal Criteria Violations under Category B Conditions, Scenario 5 (2022SL)

Contingency (System Element Lost)	Details of Violation (Violation Observed On)	Normal Rating (MVA)	Emerg. Rating (MVA)	Pre-Project Results		Post-Project Results		% Loading Difference (Post-Pre)
				Power Flow (MVA)	% Loading	Power Flow (MVA)	% Loading	
Violations Above Emergency Rating								
9L20 (Cordel 755S-Nevis 766S)	Nevis 766S 901T	100	110	108.4	108.4	116.0	116.0	7.6
Violations Below Emergency Rating								
EATL	Nevis 766S 901T	100	110	99.0	99.0	102.0	102.0	3.0

Notes:

Per cent loading reported as a percentage of the observed current flow expressed in MVA relative to the transmission line's Normal Rating.

3.1.3 Scenario 6: 2022 Winter Peak Scenario (2022WP)

Category A Conditions

No Thermal or Voltage Reliability Criteria violations were observed under Category A conditions.

Category B Conditions

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

Table 3-3: Thermal Criteria Violations under Category B Conditions, Scenario 6 (2022WP)

Contingency (System Element Lost)	Details of Violation (Violation Observed On)	Normal Rating (MVA)	Emerg. Rating (MVA)	Pre-Project Results		Post-Project Results		% Loading Difference (Post-Pre)
				Power Flow (MVA)	% Loading	Power Flow (MVA)	% Loading	
Violations Above Emergency Rating								
648ST1 (Metiskow 648S 138kV/25kV transformer)	704L (51S WAINWRIGHT to 478S Tucuman)	**79**	**87**	85.0	108	87.6	110.9	3.33
	7L50 (Buffalo Crk 526S-Jarrow tap point)	**144**	**144**	159.0	110	162.4	112.8	-1.57
749L \ 749AL (Metiskow 648S-Edgerton 899S)	704L (51S WAINWRIGHT to 478S Tucuman)	**79**	**87**	85.1	108	88.0	111.4	3.65

Contingency (System Element Lost)	Details of Violation (Violation Observed On)	Normal Rating (MVA)	Emerg. Rating (MVA)	Pre-Project Results		Post-Project Results		% Loading Difference (Post-Pre)
				Power Flow (MVA)	% Loading	Power Flow (MVA)	% Loading	
	7L50 (Buffalo Crk 526S-Jarrow tap point)	**144**	**144**	152.9	106	156.4	108.6	-1.44
766S901T (Nevis 766S 240kV/138kV transformer)	174L (Bardo 197S-N.Holden 395S)	**90**	**99**	110.4	123	116.6	129.6	6.86
	701L/7L701 (Strome 223S-N.Holden 395S)	**146**	**161**	171.2	117	177.6	121.6	4.34
	704L (51S WAINWRIGHT to 478S Tucuman)	**79**	**87**	84.4	107	87.8	111.1	4.21
	7L50 (Buffalo Crk 526S-Jarrow tap point)	**144**	**144**	157.7	110	162.2	112.6	-0.84
	Sheerness 807S 2T	**400**	**400**	400.4	100	400.9	100.2	0.13
7L749 \ 749L \ 7LB749 Lloydminster 716S-Edgerton 899S)	7L50 (Buffalo Crk 526S-Jarrow tap point)	**144**	**144**	146.5	102	149.9	104.1	-1.29
899ST3a (Edgerton 899S 138kV/25kV transformer)	7L50 (Buffalo Crk 526S-Jarrow tap point)	**144**	**144**	149.2	104	152.6	106.0	-1.35
912L \ 9L912 (Red Deer 63S-Nevis 766S)	174L (Bardo 197S-N.Holden 395S)	**90**	**99**	110.2	122	116.4	129.3	6.88
	701L/7L701 (Strome 223S-N.Holden 395S)	**146**	**161**	171.1	117	177.3	121.5	4.26
	704L (51S WAINWRIGHT to 478S Tucuman)	**79**	**87**	84.0	106	87.3	110.5	4.12
	7L50 (Buffalo Crk 526S-Jarrow tap point)	**139**	**144**	157.3	113	161.7	112.3	-0.91
	7L749 (Edgerton 899S-Briker tap point)	**96**	**134**	96.8	101	418.6	108.7	7.89
9L20 (Cordel 755S-Nevis 766S)	7L50 (Buffalo Crk 526S-Jarrow tap point)	**139**	**144**	145.7	105	149.7	104.0	-0.85
EATL	174L (Bardo 197S-N.Holden 395S)	**90**	**99**	95.8	106	100.7	111.8	111.84
	701L/7L701 (Strome 223S-N.Holden 395S)	**146**	**161**	160.7	110	164.9	113.0	112.97
	704L (51S WAINWRIGHT to 478S Tucuman)	**79**	**87**	88.3	112	91.0	115.1	115.14
	7L50 (Buffalo Crk 526S-Jarrow tap point)	**144**	**144**	153.9	107	156.8	108.9	108.91
	912L (Red Deer 63S-Nevis 766S)	**623**	**624**	643.4	103	663.1	106.4	106.43
Violations Below Emergency Rating								
	749L (Edgerton 899S-Kilarney tap point)	**96**	**143**	112.1	117	115.2	120.01	3.25

Public

Contingency (System Element Lost)	Details of Violation (Violation Observed On)	Normal Rating (MVA)	Emerg. Rating (MVA)	Pre-Project Results		Post-Project Results		% Loading Difference (Post-Pre)
				Power Flow (MVA)	% Loading	Power Flow (MVA)	% Loading	
526ST1/526ST2 (Buffalo Crk. 526S 138kV/25kV transformer)	7L749 (Edgerton 899S-Briker tap point)	**96**	**134**	105.3	110	108.4	117.81	8.08
757S912T (Battle River 757S transformer)	704L (51S WAINWRIGHT to 478S Tucuman)	**79**	**87**	79.5	101	82.1	103.98	3.4
766S901T (Nevis 766S 240kV/138kV transformer)	749L (Edgerton 899S-Kilarney tap point)	**96**	**143**	104.3	109	107.7	112.2	3.57
	7L701(Strome 233S-7LA701)	**192**	**229**	187.8	98	194.2	101.2	-9.96
	7L749 (Edgerton 899S-Briker tap point)	**96**	**134**	97.0	101	100.4	109.1	8.05
7L129 \ 7LA129 (Buffalo Crk. 526S-Vermilion 710S)	749L (Edgerton 899S-Kilarney tap point)	**96**	**143**	109.4	114	112.3	117	3.02
	7L749 (Edgerton 899S-Briker tap point)	**96**	**134**	102.8	107	105.6	114.83	7.71
7L50 (Buffalo Crk. 526S-Battle River 757S)	749L (Edgerton 899S-Kilarney tap point)	**96**	**143**	116.9	122	120.1	125.05	3.3
	7L749 (Edgerton 899S-Briker tap point)	**96**	**134**	110.0	115	113.1	122.95	8.35
7L749 \ 749L \ 7LB749 Lloydminster 716S-Edgerton 899S)	704L (51S WAINWRIGHT to 478S Tucuman)	**79**	**87**	81.0	103	83.9	106.3	3.68
899ST3a (Edgerton 899S 138kV/25kV transformer)	704L (51S WAINWRIGHT to 478S Tucuman)	**79**	**87**	82.6	105	85.5	108.2	3.68
912L \ 9L912 (Red Deer 63S-Nevis 766S)	749L (Edgerton 899S-Kilarney tap point)	**96**	**143**	104.0	108	107.4	111.8	3.46
	7L701(Strome 233S-7LA701)	**192**	**229**	187.6	98	194.0	101.0	-9.98
	Sheerness 807S 2T	**400**	**400**	400.0	100	166.5	100.1	0.1
9L20 (Cordel 755S-Nevis 766S)	174L (Bardo 197S-N.Holden 395S)	**90**	**99**	91.9	102	97.6	108.5	6.35
	701L/7L701 (Strome 223S-N.Holden 395S)	**146**	**161**	150.9	103	156.5	107.2	3.81
	704L (51S WAINWRIGHT to 478S Tucuman)	**79**	**87**	80.9	102	84.1	106.5	4.05
	749L (Edgerton 899S-Kilarney tap point)	**96**	**143**	99.8	104	103.0	107.3	3.35
	7L749 (Edgerton 899S-Briker tap point)	**92**	**134**	92.7	101	95.9	104.2	104.21
	Nevis 766S 901T	**100**	**110**	56.7	57	58.5	140.8	4.24
9L80 (Cordel 755S-Battle River 757S)	704L (51S WAINWRIGHT to 478S Tucuman)	**79**	**87**	79.5	101	82.1	103.99	103.99

Public

Contingency (System Element Lost)	Details of Violation (Violation Observed On)	Normal Rating (MVA)	Emerg. Rating (MVA)	Pre-Project Results		Post-Project Results		% Loading Difference (Post-Pre)
				Power Flow (MVA)	% Loading	Power Flow (MVA)	% Loading	
EATL	749L (Edgerton 899S-Kilarney tap point)	**96**	**143**	109.8	114	112.4	117.1	117.08
	7L749 (Edgerton 899S-Briker tap point)	**92**	**134**	102.6	111	105.1	114.3	114.27

Notes:

Per cent loading reported as a percentage of the observed current flow expressed in MVA relative to the transmission line's Normal Rating.

3.1.4 Sensitivity Scenario 4a: 2022 Summer Peak Scenario with additional connection projects in service (2022SP)

Category A Conditions

No Thermal or Voltage Reliability Criteria violations were observed under Category A conditions.

Category B Conditions

Thermal Reliability Criteria violations observed under certain Category B conditions are shown in Table 3-4. No Voltage Reliability Criteria violations were observed under Category B conditions.

Table 3-4: Thermal Criteria Violations under Category B Conditions, Scenario 4a (2022SP)

Contingency (System Element Lost)	Details of Violation (Violation Observed On)	Normal Rating (MVA)	Emerg. Rating (MVA)	Post-Project Results	
				Power Flow (MVA)	% Loading
Violations Above Emergency Rating					
395ST1 (N.Holden 395S 138kV/25kV transformer)	7L50 (Buffalo Crk 526S-Jarrow tap point)	**109**	**117**	119.9	110.0
749L \ 749AL (Metiskow 648S-Edgerton 899S)	7L50 (Buffalo Crk 526S-Jarrow tap point)	**109**	**117**	135.0	123.8
766S901T (Nevis 766S 240kV/138kV transformer)	174L (Bardo 197S-N.Holden 395S)	**84**	**94**	134.6	160.3
	701L/7L701 (Strome 223S-N.Holden 395S)	**119**	**131**	176.4	148.2
	7L129 (Buffalo Crk. 526S-Bauer tap point)	**116**	**132**	137.3	118.4

Contingency (System Element Lost)	Details of Violation (Violation Observed On)	Normal Rating (MVA)	Emerg. Rating (MVA)	Post-Project Results	
				Power Flow (MVA)	% Loading
	7L50 (Buffalo Crk 526S-Jarrow tap point)	109	117	152.8	140.2
	7L701 (Battle River 757S-7LA701)	142	159	184.7	130.2
	7L701(Strome 233S-7LA701)	142	159	190.3	134.2
7L42 (Lloydminster 716S-Hill 751S)	7L50 (Buffalo Crk 526S-Jarrow tap point)	109	117	123.6	113.4
7L701 \ 7LA701 \ 701L (Strome 223S-Battle River 757S)	7L50 (Buffalo Crk 526S-Jarrow tap point)	109	117	125.3	114.9
7L749 \ 749L \ 7LB749 Lloydminster 716S-Edgerton 899S)	7L50 (Buffalo Crk 526S-Jarrow tap point)	109	117	135.1	124.0
899ST3a (Edgerton 899S 138kV/25kV transformer)	7L50 (Buffalo Crk 526S-Jarrow tap point)	109	117	137.5	126.1
912L \ 9L912 (Red Deer 63S-Nevis 766S)	174L (Bardo 197S-N.Holden 395S)	84	94	133.9	159.4
	701L/7L701 (Strome 223S-N.Holden 395S)	119	131	176.6	148.4
	7L129 (Buffalo Crk. 526S-Bauer tap point)	116	132	136.7	117.9
	7L50 (Buffalo Crk 526S-Jarrow tap point)	109	117	151.8	139.3
	7L701 (Battle River 757S-7LA701)	142	159	182.2	128.5
	7L701(Strome 233S-7LA701)	142	159	190.5	134.3
966L \ 9L966 (Hansman Lk. 650S-Pemukan 932S)	7L224 (Hansman Lake 650S-Monitor 774S)	108	120	137.3	126.8
9L20 (Cordel 755S-Nevis 766S)	174L (Bardo 197S-N.Holden 395S)	84	94	114.3	136.1
	701L/7L701 (Strome 223S-N.Holden 395S)	119	131	154.7	130.0
	7L159 (Heatburg 948S-7LA159)	107	119	119.3	111.2
	7L50 (Buffalo Crk 526S-Jarrow tap point)	109	117	139.7	128.2
	7L701 (Battle River 757S-7LA701)	142	159	172.6	121.7
	7L701(Strome 233S-7LA701)	142	159	169.1	119.2
	Nevis 766S 901T	100	110	146.1	146.1
EATL	174L (Bardo 197S-N.Holden 395S)	84	94	111.2	132.4
	701L/7L701 (Strome 223S-N.Holden 395S)	119	131	156.9	131.8
	7L50 (Buffalo Crk 526S-Jarrow tap point)	109	117	143.2	131.4
	7L701 (Battle River 757S-7LA701)	142	159	165.0	116.3

Public

Contingency (System Element Lost)	Details of Violation (Violation Observed On)	Normal Rating (MVA)	Emerg. Rating (MVA)	Post-Project Results	
				Power Flow (MVA)	% Loading
	7L701(Strome 233S-7LA701)	142	159	170.6	120.3
	912L (Red Deer 63S-Nevis 766S)	507	553	699.4	137.9
	9L20 (Cordel 755S-Nevis 768S)	488	588	615.8	126.2
Violations Below Emergency Rating					
395ST1 (N.Holden 395S 138kV/25kV transformer)	912L (Red Deer 63S-Nevis 766S)	507	553	527.7	104.1
526ST1/526ST2 (Buffalo Crk. 526S 138kV/25kV transformer)	749L (Edgerton 899S-Kilarney tap point)	96	134	110.8	115.4
	7L749 (Edgerton 899S-Briker tap point)	92	125	104.0	113.0
	912L (Red Deer 63S-Nevis 766S)	507	553	513.0	101.2
648ST1 (Metiskow 648S 138kV/25kV transformer)	7L50 (Buffalo Crk 526S-Jarrow tap point)	109	117	109.7	100.6
749L \ 749AL (Metiskow 648S-Edgerton 899S)	7L129 (Buffalo Crk. 526S-Bauer tap point)	116	132	118.9	102.5
766S901T (Nevis 766S 240kV/138kV transformer)	704L (51S WAINWRIGHT to 478S Tucuman)	75	83	76.1	101.4
	749L (Edgerton 899S-Kilarney tap point)	96	134	107.3	111.8
	7L749 (Edgerton 899S-Briker tap point)	92	125	100.2	108.9
7L129 \ 7LA129 (Buffalo Crk. 526S-Vermilion 710S)	749L (Edgerton 899S-Kilarney tap point)	96	134	110.2	114.8
	7L749 (Edgerton 899S-Briker tap point)	92	125	103.2	112.2
	912L (Red Deer 63S-Nevis 766S)	507	553	506.0	99.8
7L50 (Buffalo Crk. 526S-Battle River 757S)	701L/7L701 (Strome 223S-N.Holden 395S)	119	131	120.7	101.4
	749L (Edgerton 899S-Kilarney tap point)	96	134	115.5	120.3
	7L749 (Edgerton 899S-Briker tap point)	92	125	108.5	118.0
	912L (Red Deer 63S-Nevis 766S)	507	553	508.6	100.3
7L701 \ 7LA701 \ 701L (Strome 223S-Battle River 757S)	912L (Red Deer 63S-Nevis 766S)	507	553	531.6	104.8
7L749 \ 749L \ 7LB749 Lloydminster 716S-Edgerton 899S)	7L129 (Buffalo Crk. 526S-Bauer tap point)	116	132	118.9	102.5
899ST3a (Edgerton 899S 138kV/25kV transformer)	7L129 (Buffalo Crk. 526S-Bauer tap point)	116	132	121.5	104.8

Public

Contingency (System Element Lost)	Details of Violation (Violation Observed On)	Normal Rating (MVA)	Emerg. Rating (MVA)	Post-Project Results	
				Power Flow (MVA)	% Loading
912L \ 9L912 (Red Deer 63S-Nevis 766S)	704L (51S WAINWRIGHT to 478S Tucuman)	75	83	75.6	100.8
	749L (Edgerton 899S-Kilarney tap point)	96	134	106.9	111.3
	7L749 (Edgerton 899S-Briker tap point)	92	125	99.6	108.2
966L \ 9L966 (Hansman Lk. 650S-Pemukan 932S)	7L127 (Monitor 7774S-Pemukan 932S)	145	194	156.0	107.8
9L20 (Cordel 755S-Nevis 766S)	749L (Edgerton 899S-Kilarney tap point)	96	134	102.7	107.0
	7L129 (Buffalo Crk. 526S-Bauer tap point)	116	132	124.1	107.0
	7L16 (Nevis 766S-Heatburg 948S)	107	120	114.5	106.7
EATL	704L (51S WAINWRIGHT to 478S Tucuman)	75	83	78.3	104.4
	749L (Edgerton 899S-Kilarney tap point)	96	134	111.0	115.6
	7L129 (Buffalo Crk. 526S-Bauer tap point)	116	132	127.6	110.1
	7L749 (Edgerton 899S-Briker tap point)	92	125	103.6	112.6

Notes:

Per cent loading reported as a percentage of the observed current flow expressed in MVA relative to the transmission line's Normal Rating.

3.1.5 Sensitivity Scenario 4b: 2022 Summer Peak Scenario with additional connection projects and PENV in service (2022SP)

Category A Conditions

No Thermal or Voltage Reliability Criteria violations were observed under Category A conditions.

Category B Conditions

Thermal Reliability Criteria violations were observed under certain Category B conditions as shown in Table 3-5. No Voltage Reliability Criteria violations were observed under Category B conditions.

Table 3-5: Thermal Criteria Violations under Category B Conditions, Scenario 4b (2022SP)

Details of Violation (Violation Observed On)	Normal Rating (MVA)	Normal Rating (MVA)	Emerg. Rating (MVA	Post-Project Results	
				Power Flow (MVA)	% Loading
Violations Above Emergency Rating					
766S901T (Nevis 766S 240kV/138kV transformer)	174L (Bardo 197S-N.Holden 395S)	84	94	126.1	150.1
	701L/7L701 (Strome 223S-N.Holden 395S)	119	131	143.1	120.2
912L \ 9L912 (Red Deer 63S-Nevis 766S)	174L (Bardo 197S-N.Holden 395S)	84	94	125.6	149.5
	701L/7L701 (Strome 223S-N.Holden 395S)	119	131	142.9	120.1
966L \ 9L966 (Hansman Lk. 650S-Pemukan 932S)	7L224 (Hansman Lake 650S-Monitor 774S)	108	120	132.8	122.7
9L20 (Cordel 755S-Nevis 766S)	174L (Bardo 197S-N.Holden 395S)	84	94	108.4	129.1
	Nevis 766S 901T	100	110	134.9	134.9
EATL	174L (Bardo 197S-N.Holden 395S)	84	94	99.9	119.0
	912L (Red Deer 63S-Nevis 766S)	507	553	630.9	124.4
Violations Below Emergency Rating					
766S901T (Nevis 766S 240kV/138kV transformer)	7L701 (Battle River 757S-7LA701)	142	159	151.2	106.5
	7L701(Strome 233S-7LA701)	142	159	156.7	110.3
912L \ 9L912 (Red Deer 63S-Nevis 766S)	7L701 (Battle River 757S-7LA701)	142	159	148.8	104.9
	7L701(Strome 233S-7LA701)	142	159	156.5	110.3
966L \ 9L966 (Hansman Lk. 650S-Pemukan 932S)	7L127 (Monitor 7774S-Pemukan 932S)	145	194	150.1	103.7
9L20 (Cordel 755S-Nevis 766S)	701L/7L701 (Strome 223S-N.Holden 395S)	119	131	125.2	105.2
	7L159 (Heatburg 948S-7LA159)	107	119	110.2	102.7
	7L701 (Battle River 757S-7LA701)	142	159	145.2	102.4
EATL	701L/7L701 (Strome 223S-N.Holden 395S)	119	131	121.0	101.7
	9L20 (Cordel 755S-Nevis 768S)	488	588	557.1	114.2

Notes:

Per cent loading reported as a percentage of the observed current flow expressed in MVA relative to the transmission line's Normal Rating.

3.1.6 Sensitivity Scenario 4c: 2022 Summer Peak Scenario with additional connection projects, PENV and CETO in service (2022SP)

Category A Conditions

No Thermal or Voltage Reliability Criteria violations were observed under Category A conditions.

Category B Conditions

Thermal Reliability Criteria violations were observed under certain Category B conditions as shown in Table 3-6. No Voltage Reliability Criteria violations were observed under Category B conditions.

Table 3-6: Thermal Criteria Violations under Category B Conditions, Scenario 4c (2022SP)

Details of Violation (Violation Observed On)	Normal Rating (MVA)	Normal Rating (MVA)	Emerg. Rating (MVA	Post-Project Results	
				Power Flow (MVA)	% Loading
Violations Above Emergency Rating					
966L \ 9L966 (Hansman Lk. 650S-Pemukan 932S)	7L224 (Hansman Lake 650S-Monitor 774S)	108	120	145.7	134.5
Violations Below Emergency Rating					
966L \ 9L966 (Hansman Lk. 650S-Pemukan 932S)	7L127 (Monitor 7774S-Pemukan 932S)	145	194	162.3	112.2

Notes:

Per cent loading reported as a percentage of the observed current flow expressed in MVA relative to the transmission line's Normal Rating.

3.2 Transient Stability Study

A transient stability study was completed[1] for post-Project Study Scenarios 4 (2022SL), 5 (2022SP), and 6 (2022WP). The study investigated system performance under Category B contingency conditions for a set of contingencies deemed critical for Project interconnection, as shown in Table 3-7. The simulated contingencies consisted of a 3-phase bolted fault applied to each end of the transmission lines under consideration and clearing the fault after the specified times for the near end and the far end of the line.

The study did not find any transient stability concerns in any of the scenarios studied, and the system showed acceptable dynamic response to the simulated contingencies.

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].

[1] Transient stability simulations were performed with the Project dynamic model provided in Stage 3 PDUP of December 4, 2020.

Table 3-7: Transient Stability Study Results for Cat. B Conditions, Scenarios 4, 5, 6

Studied Contingency	Type of fault	Fault Location	Performance
9L24 Oakland 946S to Lanfine 959S	3-phase bolted	Oakland 946S	stable
9L24 Lanfine 959S to Oakland 946S	3-phase bolted	Lanfine 959S	stable
9L46 Lanfine 959S to Bridgeden 2088S	3-phase bolted	Lanfine 959S	stable
9L46 Bridgeden 2088S Lanfine 959S	3-phase bolted	Bridgeden 2088S	stable
9L51 Bridgeden 2088S Pemukan 932S	3-phase bolted	Bridgeden 2088S	stable
9L51 Pemukan 932S to Bridgeden 2088S	3-phase bolted	Pemukan 932S	stable
9L29 Oakland 946S to Coyote Lake 963S	3-phase bolted	Oakland 946S	stable
9L29 Coyote Lake 963S to Oakland 946S	3-phase bolted	Coyote Lake 963S	stable
9L20 Cordel 755S to Nevis 766S	3-phase bolted	Cordel 755S	stable
9L20 Nevis 766S to Cordel 755S	3-phase bolted	Nevis 766S	stable
9L16/9L49 Tinchebray 972S to Cordel 755S	3-phase bolted	Tinchebray 972S	stable
9L16/9L49 Cordel 755S to Tinchebray 972S	3-phase bolted	Cordel 755S	stable
9L59 Anderson 801S to Tinchebray 972S	3-phase bolted	Anderson 801S	stable
9L59 Tinchebray 972S to Anderson 801S	3-phase bolted	Tinchebray 972S	stable
9L966 Pemukan 932S to Hansman Lake 650S	3-phase bolted	Pemukan 932S	stable
9L966 Hansman Lake 650S to Pemukan 932S	3-phase bolted	Hansman Lake 650S	stable
912L/9L912 Nevis 766S to Red Deer 63S	3-phase bolted	Nevis 766S	stable
912L/9L912 Red Deer 63S to Nevis 766S	3-phase bolted	Red Deer 63S	stable

4 Short-Circuit Studies

Short-circuit study results showed that post-Project short-circuit levels were marginally increased compared to the pre-Project state, but were well within the standard equipment rating of 31.5 kA RMS.

The short-circuit results are shown in *Table 4-1*, *Table 4-2* and *Table 4-3* in the following subsections.

4.1 Scenario 3, 2022WP Pre-Project

Pre-Project short-circuit current levels are provided in *Table 4-1*[2].

Table 4-1: Pre-Project Short-Circuit Current Levels for 2022WP Scenario 3

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)
Anderson 801S	240	256.8	12.8	0.00301+j0.02001	13.1	0.00194+j0.01890
Anderson 801S	138	147.7	4.5	0.01021+j0.09836	4.3	0.00577+j0.11731
Sheerness 1 807S	240	256.8	12.3	0.00307+j0.02070	12.8	0.00179+j0.01934
Sheerness 2 807S	240	256.8	12.4	0.00304+j0.02055	12.7	0.00204+j0.01979
Oakland 946S	240	256.8	11.5	0.00333+j0.02224	10.0	0.00645+j0.03190
Hansman Lake 650S	240	256.8	5.6	0.01195+j0.04447	5.0	0.01686+j0.06028
Hansman Lake 650S	138	143.0	7.4	0.01658+j0.05624	6.5	0.02163+j0.07938
Lanfine 959S	240	256.8	5.3	0.00882+j0.04794	2.7	0.05842+j0.18429
Lanfine 959S	138	146.3	5.8	0.01292+j0.07485	1.0	0.44138+j1.12320
Excel 910S	138	146.3	5.2	0.01545+j0.08421	1.0	0.44985+j1.14950
Monitor 774S	138	146.3	5.6	0.01933+j0.07768	1.8	0.19510+j0.53117
Monitor 774S	69	73.1	1.0	0.06245+j0.87438	0.9	0.21409+j1.32720
Pemukan 923S	240	255.4	4.8	0.01175+j0.05177	3.0	0.03968+j0.14853
Pemukan 923S	138	147.5	5.7	0.01840+j0.07659	1.8	0.20063+j0.54408
Oyen 767S	138	146.3	5.0	0.01885+j0.08575	1.1	0.38884+j1.01618
Oyen 767S	69	73.8	2.0	0.10414+j0.44805	0.1	24.4016-j2.97692
Bindloss 914S	138	142.1	3.3	0.04449+j0.12245	1.8	0.13589+j0.45339

[2] 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 Scenario 6: 2022WP Post-Project

Post-Project short-circuit current levels for the 2022WP study scenario are provided in *Table 4-2*.

Table 4-2: Post-Project Short-Circuit Current Levels for 2022WP Study Scenario 6

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)
Anderson 801S	240	256.8	13.1	0.00282+j0.01944	13.3	0.00194+j0.01887
Anderson 801S	138	147.7	4.5	0.01001+j0.09783	4.3	0.00577+j0.11728
Sheerness 1 807S	240	256.8	12.5	0.00288+j0.02014	13.0	0.00179+j0.01932
Sheerness 2 807S	240	256.8	12.8	0.00285+j0.02000	12.9	0.00204+j0.01977
Oakland 946S	240	256.8	11.9	0.00309+j0.02157	10.2	0.00646+j0.03187
Hansman Lake 650S	240	256.8	5.7	0.01144+j0.04367	5.0	0.01818+j0.06103
Hansman Lake 650S	138	142.9	7.5	0.01601+j0.05527	6.5	0.02384+j0.08091
Lanfine 959S	240	256.8	5.9	0.00697+j0.04280	2.8	0.05891+j0.18446
Lanfine 959S	138	146.3	6.8	0.00952+j0.06410	4.7	0.01880+j0.15006
Excel 910S	138	146.3	6.0	0.01203+j0.07349	4.1	0.02725+j0.17632
Monitor 774S	138	146.3	5.7	0.01828+j0.07600	1.9	0.19865+j0.53300
Monitor 774S	69	72.3	1.0	0.06144+j0.87277	0.8	0.21756+j1.32900
Pemukan 923S	240	255.3	5.0	0.01072+j0.04966	3.0	0.04580+j0.14897
Pemukan 923S	138	147.6	5.8	0.01735+j0.07487	1.8	0.20420+j0.54592
Oyen 767S	138	146.3	5.7	0.01570+j0.07663	3.8	0.03576+j0.19150
Oyen 767S	69	74.5	2.0	0.09980+j0.44167	0.1	24.08892-j3.46028
Bindloss 914S	138	142.1	3.3	0.04402+j0.12043	2.0	0.10706+j0.38494
Buffalo Bird 601S	138	146.3	5.8	0.01148+j0.07561	4.9	0.00949+j0.11946
Buffalo Bird 601S	34.5	35.5	14.6	0.00831+j0.11882	19.0	0.00441+j0.03563

4.3 Scenario 7: 2028WP Post-Project

Post-Project short-circuit current levels for 2027WP are provided in Table 4-3.

Table 4-3: Post-Project Short-Circuit Current Levels for 2028WP Study Scenario 7

Substation Name and Number	Base Voltage (kV)	Pre-Fault Voltage (kV)	3-Φ Fault (kA)	Positive Sequence Thevenin Source Impedance (R1+jX1) (pu)	1-Φ Fault (kA)	Zero Sequence Thevenin Source Impedance (R0+jX0) (pu)
Anderson 801S	240	257.0	13.9	0.00241+j0.01834	14.9	0.00154+j0.01531
Anderson 801S	138	147.7	4.6	0.00961+j0.09667	4.9	0.00374+j0.08032
Sheernes 1 807S	240	257.0	13.2	0.00257+j0.01937	13.4	0.00248+j0.01898
Sheerness 2 807S	240	257.0	13.2	0.00258+j0.01937	13.4	0.00252+j0.01898
Oakland 946S	240	257.0	12.7	0.00258+j0.02003	12.9	0.00288+j0.01974
Hansman Lake 650S	240	256.8	6.7	0.00830+j0.03761	6.9	0.00535+j0.03525
Hansman Lake 650S	138	142.6	8.5	0.01245+j0.04943	8.5	0.00673+j0.05138
Lanfine 959S	240	256.8	6.3	0.00593+j0.04044	6.6	0.00382+j0.03475
Lanfine 959S	138	146.3	7.0	0.00926+j0.06385	10.5	0.00032+j0.00002
Excel 910S	138	149.0	6.1	0.01179+j0.07322	7.7	0.00812+j0.02628
Monitor 774S	138	146.3	6.3	0.01476+j0.06952	7.2	0.00556+j0.04227
Monitor 774S	69	72.5	1.0	0.05862+j0.86807	1.0	0.02895+j0.85318
Pemukan 923S	240	252.0	5.8	0.00764+j0.04269	6.4	0.00326+j0.03200
Pemukan 923S	138	146.3	6.4	0.01384+j0.06835	7.7	0.00257+j0.03381
Oyen 767S	138	147.7	5.8	0.01557+j0.07604	6.1	0.02017+j0.06407
Oyen 767S	69	75.2	2.0	0.10091+j0.43896	2.0	0.05184+j0.48901
Bindloss 914S	138	142.1	3.4	0.04470+j0.11721	2.0	0.10571+j0.37397
Buffalo Bird 601S	138	149.0	5.9	0.01126+j0.07537	7.4	0.00536+j0.03042
Buffalo Bird 601S	34.5	35.1	14.7	0.00817+j0.011780	14.4	0.00977+j0.12403

5 Mitigation Measure Development and Evaluation

The Studies Consultant, in consultation with the AESO, developed mitigation measures to address the system performance issues identified in the post-Project scenarios. Existing Remedial Action Schemes (RAS) are described in Section 1.2.2 of Attachment A1.

5.1 Pre-Project Study Scenarios

A list of the Remedial Action Schemes (RAS) considered in this study is shown *Table 5-1*.

Table 5-1: Pre-Project Mitigation Measures

Mitigation Measure	System Elements Affected
Planned RAS #134	174L (Bardo 197S-N.Holden 395S)
	7L701 (Battle River 757S-7LA701)
	7L701(Strome 223S-7LA701)
	701L/7L701 (Strome 223S-N.Holden 395S)
Planned RAS #138	7L50 (Buffalo Crk 526S-Jarrow tap point)
Planned RAS #139	Nevis 766S 901T

5.2 Post-Project Study Scenarios

Table 5-5 shows all instances found in the post-Project state which require mitigation either by RAS or by Real Time Operating Procedures (RTOP). The mitigation analysis of the post-Project scenarios indicated that the planned RAS 134, RAS 138 and RAS 139 would need to be modified to include the Project. The analysis also showed that in several instances these modified RAS did not fully mitigate the overloads and that post-RAS Real Time Operating Procedures (RTOP) need to be relied upon to mitigate the residual overloads after the RAS was executed.

5.2.1 Scenario 4: 2022 Summer Peak (2022SP)

Table 5-2: Post-Project Mitigation Measures, Scenario 4 (2022SP)

Mitigation Measure	System Elements Affected	Contingency
Modified RAS 134	174L (Bardo 197S-N.Holden 395S)	• 766S901T (Nevis 766S 240kV/138kV transformer) • 912L \ 9L912 (Red Deer 63S-Nevis 766S) • EATL
	701L/7L701 (Strome 223S-N.Holden 395S)	

Public

Mitigation Measure	System Elements Affected	Contingency
	704L (51S WAINWRIGHT to 478S Tucuman)	• 766S901T (Nevis 766S 240kV/138kV transformer)
	749L (Edgerton 899S-Kilarney tap point)	
	7L129 (Buffalo Crk. 526S-Bauer tap point)	
	7L159 (Heatburg 948S-7LA159)	
	7L16 (Nevis 766S-Heatburg 948S)	
	7L50 (Buffalo Crk 526S-Jarrow tap point)	
	7L701 (Battle River 757S-7LA701)	
	7L701(Strome 233S-7LA701)	
	7L749 (Edgerton 899S-Briker tap point)	
	912L (Red Deer 63S-Nevis 766S)	
Modified RAS 138	704L (51S WAINWRIGHT to 478S Tucuman)	• 648ST1 (Metiskow 648S 138kV/25kV transformer) • 749L \ 749AL (Metiskow 648S-Edgerton 899S) • 766S901T (Nevis 766S 240kV/138kV transformer) • 7L749 \ 749L \ 7LB749 Lloydminster 716S-Edgerton 899S) • 899ST3a (Edgerton 899S 138kV/25kV transformer) • 912L \ 9L912 (Red Deer 63S-Nevis 766S) • 9L20 (Cordel 755S-Nevis 766S) • EATL
	174L (Bardo 197S-N.Holden 395S)	
	701L/7L701 (Strome 223S-N.Holden 395S)	
	749L (Edgerton 899S-Kilarney tap point)	
	7L129 (Buffalo Crk. 526S-Bauer tap point)	
	7L159 (Heatburg 948S-7LA159)	
	7L16 (Nevis 766S-Heatburg 948S)	
	7L50 (Buffalo Crk 526S-Jarrow tap point)	
	7L701 (Battle River 757S-7LA701)	
	7L701(Strome 233S-7LA701)	
	7L749 (Edgerton 899S-Briker tap point)	
	912L (Red Deer 63S-Nevis 766S)	
	Nevis 766S 901T	
Modified RAS 139	701L/7L701 (Strome 223S-N.Holden 395S)	• 9L20 (Cordel 755S-Nevis 766S)
	7L129 (Buffalo Crk. 526S-Bauer tap point)	
	7L159 (Heatburg 948S-7LA159)	
	7L16 (Nevis 766S-Heatburg 948S)	
	7L50 (Buffalo Crk 526S-Jarrow tap point)	

Mitigation Measure	System Elements Affected	Contingency
	7L701 (Battle River 757S-7LA701)	
	7L701(Strome 233S-7LA701)	
	Nevis 766S 901T	
New RAS 7L224	7L224 (Hansman Lake 650S-Monitor 774S)	• 966L \ 9L966 (Hansman Lk. 650S-Pemukan 932S)
	7L127 (Monitor 7774S-Pemukan 932S)	
Post-RAS RTOP	174L (Bardo 197S-N.Holden 395S)	• EATL
	701L/7L701 (Strome 223S-N.Holden 395S)	
	704L (51S WAINWRIGHT to 478S Tucuman)	
	749L (Edgerton 899S-Kilarney tap point)	
	7L129 (Buffalo Crk. 526S-Bauer tap point)	
	7L159 (Heatburg 948S-7LA159)	
	7L16 (Nevis 766S-Heatburg 948S)	
	7L50 (Buffalo Crk 526S-Jarrow tap point)	
	7L701 (Battle River 757S-7LA701)	
	7L701(Strome 233S-7LA701)	
	7L749 (Edgerton 899S-Briker tap point)	
	912L (Red Deer 63S-Nevis 766S)	
RTOP	7L50 (Buffalo Crk 526S-Jarrow tap point)	• 395ST1 (N.Holden 395S 138kV/25kV transformer) • 526ST1/526ST2 (Buffalo Crk. 526S 138kV/25kV transformer) • 757S912T (Battle River 757S transformer) • 7L129 \ 7LA129 (Buffalo Crk. 526S-Vermilion 710S) • 7L42 (Lloydminster 716S-Hill 751S) • 7L50 (Buffalo Crk. 526S-Battle River 757S) • 7L701 \ 7LA701 \ 701L (Strome 223S-Battle River 757S) • 9L80 (Cordel 755S-Battle River 757S) • EATL
	704L (51S WAINWRIGHT to 478S Tucuman)	
	749L (Edgerton 899S-Kilarney tap point)	
	749L (Metiskow 648S-Kilarney tap point)	
	7L749 (Edgerton 899S-Briker tap point)	
	Nevis 766S 901T	

Public

5.2.2 Scenario 5: 2022 Summer Light (2022SL)

Table 5-3: Post-Project Mitigation Measures, Scenario 5 (2022SL)

Mitigation Measure	System Elements Affected	Contingency
Modified RAS 139	Nevis 766S 901T	• 9L20 (Cordel 755S-Nevis 766S)
RTOP	Nevis 766S 901T	• EATL

5.2.3 Scenario 6: 2022 Winter Peak (2022WP)

Table 5-4: Post-Project Mitigation Measures, Scenario 6 (2022WP)

Mitigation Measure	System Elements Affected	Contingency
Modified RAS 134	174L (Bardo 197S-N.Holden 395S)	• 766S901T (Nevis 766S 240kV/138kV transformer) • 912L \ 9L912 (Red Deer 63S-Nevis 766S) • 9L20 (Cordel 755S-Nevis 766S) • EATL
	701L/7L701 (Strome 223S-N.Holden 395S)	
	704L (51S WAINWRIGHT to 478S Tucuman)	
	749L (Edgerton 899S-Kilarney tap point)	
	7L50 (Buffalo Crk 526S-Jarrow tap point)	
	7L701(Strome 233S-7LA701)	
	7L749 (Edgerton 899S-Briker tap point)	
	912L (Red Deer 63S-Nevis 766S)	
	Nevis 766S 901T	
	Sheerness 807S 2T	
Modified RAS 138	174L (Bardo 197S-N.Holden 395S)	• 648ST1 (Metiskow 648S 138kV/25kV transformer) • 749L \ 749AL (Metiskow 648S-Edgerton 899S) • 766S901T (Nevis 766S 240kV/138kV transformer) • 7L749 \ 749L \ 7LB749 Lloydminster 716S-Edgerton 899S) • 899ST3a (Edgerton 899S 138kV/25kV transformer) • 912L \ 9L912 (Red Deer 63S-Nevis 766S) • 9L20 (Cordel 755S-Nevis 766S) • EATL
	701L/7L701 (Strome 223S-N.Holden 395S)	
	704L (51S WAINWRIGHT to 478S Tucuman)	
	749L (Edgerton 899S-Kilarney tap point)	
	7L50 (Buffalo Crk 526S-Jarrow tap point)	

Mitigation Measure	System Elements Affected	Contingency
	7L701(Strome 233S-7LA701)	
	7L749 (Edgerton 899S-Briker tap point)	
	912L (Red Deer 63S-Nevis 766S)	
	Nevis 766S 901T	
	Sheerness 807S 2T	
Modified RAS 139	174L (Bardo 197S-N.Holden 395S)	9L20 (Cordel 755S-Nevis 766S)
	701L/7L701 (Strome 223S-N.Holden 395S)	
	704L (51S WAINWRIGHT to 478S Tucuman)	
	749L (Edgerton 899S-Kilarney tap point)	
	7L50 (Buffalo Crk 526S-Jarrow tap point)	
	7L749 (Edgerton 899S-Briker tap point)	
	Nevis 766S 901T	
Post-RAS RTOP	174L (Bardo 197S-N.Holden 395S)	• EATL
	701L/7L701 (Strome 223S-N.Holden 395S)	
	704L (51S WAINWRIGHT to 478S Tucuman)	
	749L (Edgerton 899S-Kilarney tap point)	
	7L50 (Buffalo Crk 526S-Jarrow tap point)	
	7L749 (Edgerton 899S-Briker tap point)	
	912L (Red Deer 63S-Nevis 766S)	
RTOP	749L (Edgerton 899S-Kilarney tap point)	• 526ST1/526ST2 (Buffalo Crk. 526S 138kV/25kV transformer) • 757S912T (Battle River 757S transformer) • 7L129 \ 7LA129 (Buffalo Crk. 526S-Vermilion 710S) • 7L50 (Buffalo Crk. 526S-Battle River 757S) • 9L80 (Cordel 755S-Battle River 757S)
	7L749 (Edgerton 899S-Briker tap point)	
	704L (51S WAINWRIGHT to 478S Tucuman)	

5.2.4 Sensitivity Scenario 4a: 2022 Summer Peak Scenario with additional connection projects in service (2022SP)

Table 5-5: Post-Project Mitigation Measures, Scenario 4a (2022SP)

Mitigation Measure	System Elements Affected	Contingency
Modified RAS 134	174L (Bardo 197S-N.Holden 395S)	• 766S901T (Nevis 766S 240kV/138kV transformer) • 912L \ 9L912 (Red Deer 63S-Nevis 766S) • 9L20 (Cordel 755S-Nevis 766S) • EATL
	701L/7L701 (Strome 223S-N.Holden 395S)	
	704L (51S WAINWRIGHT to 478S Tucuman)	
	749L (Edgerton 899S-Kilarney tap point)	
	7L129 (Buffalo Crk. 526S-Bauer tap point)	
	7L159 (Heatburg 948S-7LA159)	
	7L16 (Nevis 766S-Heatburg 948S)	
	7L50 (Buffalo Crk 526S-Jarrow tap point)	
	7L701 (Battle River 757S-7LA701)	
	7L701(Strome 233S-7LA701)	
	7L749 (Edgerton 899S-Briker tap point)	
	912L (Red Deer 63S-Nevis 766S)	
	9L20 (Cordel 755S-Nevis 768S)	
	Nevis 766S 901T	
Modified RAS 138	7L129 (Buffalo Crk. 526S-Bauer tap point)	• 899ST3a (Edgerton 899S 138kV/25kV transformer) • 912L \ 9L912 (Red Deer 63S-Nevis 766S) • 9L20 (Cordel 755S-Nevis 766S) • EATL • 899ST3a (Edgerton 899S 138kV/25kV transformer) • 912L \ 9L912 (Red Deer 63S-Nevis 766S) • 9L20 (Cordel 755S-Nevis 766S) • EATL • 899ST3a (Edgerton 899S 138kV/25kV transformer)
	174L (Bardo 197S-N.Holden 395S)	
	701L/7L701 (Strome 223S-N.Holden 395S)	
	704L (51S WAINWRIGHT to 478S Tucuman)	
	749L (Edgerton 899S-Kilarney tap point)	
	7L159 (Heatburg 948S-7LA159)	
	7L16 (Nevis 766S-Heatburg 948S)	
	7L50 (Buffalo Crk 526S-Jarrow tap point)	
	7L701 (Battle River 757S-7LA701)	
	7L701(Strome 233S-7LA701)	
	7L749 (Edgerton 899S-Briker tap point)	
	912L (Red Deer 63S-Nevis 766S)	
	9L20 (Cordel 755S-Nevis 768S)	

Mitigation Measure	System Elements Affected	Contingency
	Nevis 766S 901T	
Modified RAS 139	174L (Bardo 197S-N.Holden 395S)	• 9L20 (Cordel 755S-Nevis 766S)
	701L/7L701 (Strome 223S-N.Holden 395S)	
	749L (Edgerton 899S-Kilarney tap point)	
	7L129 (Buffalo Crk. 526S-Bauer tap point)	
	7L159 (Heatburg 948S-7LA159)	
	7L16 (Nevis 766S-Heatburg 948S)	
	7L50 (Buffalo Crk 526S-Jarrow tap point)	
	7L701 (Battle River 757S-7LA701)	
	7L701(Strome 233S-7LA701)	
	Nevis 766S 901T	
New RAS 7L224	7L224 (Hansman Lake 650S-Monitor 774S)	• 966L \ 9L966 (Hansman Lk. 650S-Pemukan 932S)
	7L127 (Monitor 7774S-Pemukan 932S)	
Post-RAS RTOP	174L (Bardo 197S-N.Holden 395S)	• 749L \ 749AL (Metiskow 648S-Edgerton 899S) • 766S901T (Nevis 766S 240kV/138kV transformer) • 7L749 \ 749L \ 7LB749 Lloydminster 716S-Edgerton 899S) • 899ST3a (Edgerton 899S 138kV/25kV transformer) • 912L \ 9L912 (Red Deer 63S-Nevis 766S) • EATL
	701L/7L701 (Strome 223S-N.Holden 395S)	
	704L (51S Wainwright to 478S Tucuman)	
	749L (Edgerton 899S-Killarney tap point)	
	7L129 (Buffalo Crk. 526S-Bauer tap point)	
	7L50 (Buffalo Crk 526S-Jarrow tap point)	
	7L701 (Battle River 757S-7LA701)	
	7L701(Strome 223S-7LA701)	
	7L749 (Edgerton 899S-Briker tap point)	
	912L (Red Deer 63S-Nevis 766S)	
	9L20 (Cordel 755S-Nevis 768S)	
RTOP	7L50 (Buffalo Crk 526S-Jarrow tap point)	• 395ST1 (N.Holden 395S 138kV/25kV transformer) • 526ST1/526ST2 (Buffalo Crk. 526S 138kV/25kV transformer) • 648ST1 (Metiskow 648S 138kV/25kV transformer) • 7L129 \ 7LA129 (Buffalo Crk. 526S-Vermilion 710S) • 7L42 (Lloydminster 716S-Hill 751S)
	701L/7L701 (Strome 223S-N.Holden 395S)	
	749L (Edgerton 899S-Kilarney tap point)	
	7L749 (Edgerton 899S-Briker tap point)	

Public

Mitigation Measure	System Elements Affected	Contingency
	912L (Red Deer 63S-Nevis 766S)	• 7L50 (Buffalo Crk. 526S-Battle River 757S)

5.2.5 Sensitivity Scenario 4b: 2022 Summer Peak Scenario with additional connection projects and PENV in service (2022SP)

Table 5-6: Post-Project Mitigation Measures, Scenario 4b (2022SP)

Mitigation Measure	System Elements Affected	Contingency
Modified RAS 134	174L (Bardo 197S-N.Holden 395S)	• 766S901T (Nevis 766S 240kV/138kV transformer) • 912L \ 9L912 (Red Deer 63S-Nevis 766S) • 9L20 (Cordel 755S-Nevis 766S) • EATL
	701L/7L701 (Strome 223S-N.Holden 395S)	
	7L159 (Heatburg 948S-7LA159)	
	7L701 (Battle River 757S-7LA701)	
	7L701(Strome 233S-7LA701)	
	912L (Red Deer 63S-Nevis 766S)	
	9L20 (Cordel 755S-Nevis 768S)	
	Nevis 766S 901T	
Modified RAS 139	174L (Bardo 197S-N.Holden 395S)	• 9L20 (Cordel 755S-Nevis 766S)
	701L/7L701 (Strome 223S-N.Holden 395S)	
	7L159 (Heatburg 948S-7LA159)	
	7L701 (Battle River 757S-7LA701)	
	Nevis 766S 901T	
New 7L224 RAS	7L224 (Hansman Lake 650S-Monitor 774S)	• 966L \ 9L966 (Hansman Lk. 650S-Pemukan 932S)
	7L127 (Monitor 7774S-Pemukan 932S)	

5.2.6 Sensitivity Scenario 4c: 2022 Summer Peak Scenario with additional connection projects, PENV and CETO in service (2022SP)

Table 5-7: Post-Project Mitigation Measures, Scenario 4c (2022SP)

Mitigation Measure	System Elements Affected	Contingency
New 7L224 RAS	7L224 (Hansman Lake 650S-Monitor 774S)	• 966L \ 9L966 (Hansman Lk. 650S-Pemukan 932S)
	7L127 (Monitor 7774S-Pemukan 932S)	

5.3 Evaluation of Mitigation Measures

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

The post-mitigation measures studies were performed under Category B conditions for all four post-Project scenarios using Alternative 1 and the proposed RASs which are summarized in Table 5-8.

Table 5-8: Summary of Proposed RAS Actions

Mitigation Measure	Mitigation Measure Description	Mitigation Measure Action
Modified RAS 134[3]	Mitigates overload above the emergency rating on 701L or 174L	Trip generation in the following sequence until the overload on 7L50 is mitigated: 1. P1898 Pattern Lanfine North 2. P1567 Sharp Hills Project 3. Existing Halkirk 1 4. If overloading on 701L or 174L remains, open 174L.
Modified RAS 138	Mitigates overload above the emergency rating on 7L50	Trip generation in the following sequence until the overload on 7L50 is mitigated:

[3] RAS #134 and #138 may receive overload signals at the same time. In those instances, it was assumed that the transfer trip to 174L or 491L would be initiated at the same time, after all generation is tripped.

Mitigation Measure	Mitigation Measure Description	Mitigation Measure Action
		1. P1898 Pattern Lanfine North 2. P1567 Sharp Hills Project 3. Existing Halkirk 1 4. If overloading on 7L50 remains, open 491L
Modified RAS 139	Mitigates overload above the emergency rating (110MVA) on Nevis 766S901T Transformer	Trip generation in the following sequence until the overload on Nevis 766S901T is mitigated: 1. P1898 Pattern Lanfine North 2. P1567 Sharp Hills Project 3. Existing Halkirk 1
Modified RAS 134 and RAS 138	Mitigates simultaneous overloads above the emergency rating on 701L or 174L and on 7L50	Trip generation in the following sequence until the overloads on either of 701L, 174L and 7L50 are mitigated: 1. P1898 Pattern Lanfine North 2. P1567 Sharp Hills Project 3. Existing Halkirk 1 4. If overloading on 701L or 174L remains, open 174L. 5. If overloading on 7L50 remains, open 491L.
New 7L224 RAS	Mitigates overload above the emergency rating on 7L224	1. Open 7L224

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 were not simulated.

5.3.1 Scenario 4: 2022 Summer Peak (2022SP)

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 5-9.

Table 5-9: Post-RAS Power Flow Study Results, Scenario 4 (2022SP)

Contingency	Limiting Branch	Normal Rating (MVA)	Post-Project Results		Post-RAS Action Results		Mitigation Action
			Power Flow (MVA)	%	Power Flow (MVA)	%	
648ST1 (Metiskow 648S 138kV/25kV transformer)	704L (51S WAINWRIGHT to 478S Tucuman)	75	78.1	104.2	23.5	31.4	1) Trip P1898; 2) Trip Sharp Hills; 3)Trip Halkirk 1; 4) Open 491L
	7L129 (Buffalo Crk. 526S-Bauer tap point)	116	126.8	109.4	90.1	77.7	
749L \ 749AL (Metiskow 648S-Edgerton 899S)	704L (51S WAINWRIGHT to 478S Tucuman)	75	78.7	104.9	23.6	31.5	1) trip P1898; 2) trip Sharp Hills; 3) trip Halkirk 1; 4) open 491L
	7L129 (Buffalo Crk. 526S-Bauer tap point)	116	123.5	106.5	86.7	74.8	
766S901T (Nevis 766S 240kV/138kV transformer)	174L (Bardo 197S-N.Holden 395S)	84	93.9	110.5	40.8	48.5	1) trip P1898; 2) trip Sharp Hills; 3) trip Halkirk 1
	704L (51S WAINWRIGHT to 478S Tucuman)	75	75.2	100.2	52.9	70.6	
	7L129 (Buffalo Crk. 526S-Bauer tap point)	116	122.4	105.6	87.7	75.6	
	7L701 (Battle River 757S-7LA701)	142	154.6	109.0	104.2	73.5	
7L749 \ 749L \ 7LB749 Lloydminster 716S-Edgerton 899S)	704L (51S WAINWRIGHT to 478S Tucuman)	75	75.3	100.4	56.2	75.0	1) trip P1898; 2) trip Sharp Hills; 3) trip Halkirk 1
	7L129 (Buffalo Crk. 526S-Bauer tap point)	116	118.4	102.1	88.6	76.4	
899ST3a (Edgerton 899S 138kV/25kV transformer)	704L (51S WAINWRIGHT to 478S Tucuman)	75	76.7	102.3	58.0	77.3	1) trip P1898; 2) trip Sharp Hills; 3) trip Halkirk 1
	7L129 (Buffalo Crk. 526S-Bauer tap point)	116	120.8	104.2	92.3	79.6	

Contingency	Limiting Branch	Normal Rating (MVA)	Post-Project Results		Post-RAS Action Results		Mitigation Action
			Power Flow (MVA)	%	Power Flow (MVA)	%	
912L \ 9L912 (Red Deer 63S-Nevis 766S)	704L (51S WAINWRIGHT to 478S Tucuman)	75	75.3	100.4	53.4	71.2	1) trip P1898; 2) trip Sharp Hills; 3) trip Halkirk 1
	7L129 (Buffalo Crk. 526S-Bauer tap point)	116	122.4	105.6	88.1	76.0	
	7L701 (Battle River 757S-7LA701)	142	153.3	108.1	105.4	74.3	
966L \ 9L966 (Hansman Lk. 650S-Pemukan 932S)	7L127 (Monitor 7774S-Pemukan 932S)	145	165.5	114.3	0.0	0.0	1) Open 7L224
	7L127 (Monitor 7774S-Pemukan 932S)	145	165.5	114.3	0	0	
9L20 (Cordel 755S-Nevis 766S)	701L/7L701 (Strome 223S-N.Holden 395S)	119	127.1	106.8	97.3	81.8	1) trip P1898; 2) trip Sharp Hills
	7L129 (Buffalo Crk. 526S-Bauer tap point)	116	111.7	96.4	92.0	79.3	
	7L159 (Heatburg 948S-7LA159)	107	117.8	109.8	99.0	92.2	
	7L16 (Nevis 766S-Heatburg 948S)	107	114.4	106.6	95.6	89.0	
	7L701 (Battle River 757S-7LA701)	142	146.0	102.9	115.3	81.3	
	7L701(Strome 233S-7LA701)	142	144.8	102.1	114.6	80.8	
EATL	174L (Bardo 197S-N.Holden 395S)	84	88.4	104.0	23.6	28.1	1) trip P1898; 2) trip Sharp Hills; 3) trip Halkirk 1; 4) open 491L and 174L; 5) RTOP
	749L (Edgerton 899S-Kilarney tap point)	96	103.5	107.8	90.3	94.1	
	7L129 (Buffalo Crk. 526S-Bauer tap point)	116	125.2	107.9	86.4	74.5	
	7L159 (Heatburg 948S-7LA159)	107	116.2	108.3	109.1	101.6	
	7L16 (Nevis 766S-Heatburg 948S)	107	112.8	105.1	105.6	98.4	
	7L701 (Battle River 757S-7LA701)	142	156.5	110.3	107.0	75.5	
	7L749 (Edgerton 899S-Briker tap point)	92	97.7	106.2	84.8	92.2	

Public

5.3.2 Scenario 5: 2022 Summer Light Scenario (2022SL)

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 5-10*.

Table 5-10: Post-RAS Power Flow Study Results, Scenario 5 (2022SL)

Contingency	Limiting Branch	Normal Rating (MVA)	Post-Project Results		Post-RAS Action Results		Mitigation Action
			Power Flow (MVA)	%	Power Flow (MVA)	%	
9L20 (Cordel 755S-Nevis 766S)	Nevis 766S 901T	100	116.0	116.0	84.7	84.7	1) trip P1898; 2) trip Sharp Hills

5.3.3 Scenario 6: 2022 Winter Peak Scenario (2022WP)

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 5-11.

Table 5-11: Post-RAS Power Flow Study Results, Scenario 6 (2022WP)

Contingency	Limiting Branch	Normal Rating (MVA)	Post-Project Results		Post-RAS Action Results		Mitigation Action
			Power Flow (MVA)	%	Power Flow (MVA)	%	
648ST1 (Metiskow 648S 138kV/25kV transformer)	704L (51S WAINWRIGHT to 478S Tucuman)	**79**	87.6	110.9	72.3	93.6	1) trip P1898; 2) trip Sharp Hills; 3) curtail Halkirk 1 by 74 MW
	7L50 (Buffalo Crk 526S-Jarrow tap point)	**144**	162.4	112.8	140.2	99.4	

Contingency	Limiting Branch	Normal Rating (MVA)	Post-Project Results		Post-RAS Action Results		Mitigation Action
			Power Flow (MVA)	%	Power Flow (MVA)	%	
749L \ 749AL (Metiskow 648S-Edgerton 899S)	704L (51S WAINWRIGHT to 478S Tucuman)	**79**	88.0	111.4	134.2	94.5	1) trip P1898; 2) trip Sharp Hills
	7L50 (Buffalo Crk 526S-Jarrow tap point)	**144**	156.4	108.6	134.2	97.5	
766S901T (Nevis 766S 240kV/138kV transformer)	174L (Bardo 197S-N.Holden 395S)	**90**	116.6	129.6	81.0	90.0	1) trip P1898; 2) trip Sharp Hills
	701L/7L701 (Strome 223S-N.Holden 395S)	**146**	177.6	121.6	142.5	97.6	
	704L (51S WAINWRIGHT to 478S Tucuman)	**79**	87.8	111.1	70.8	89.6	
	749L (Edgerton 899S-Kilarney tap point)	**96**	107.7	112.2	91.0	94.8	
	7L50 (Buffalo Crk 526S-Jarrow tap point)	**144**	162.2	112.6	129.9	90.2	
	7L701(Strome 233S-7LA701)	**192**	194.2	101.2	158.4	82.5	
	7L749 (Edgerton 899S-Briker tap point)	**96**	100.4	109.1	84.2	91.5	
	Sheerness 807S 2T	**400**	400.9	100.2	391.3	97.8	
7L749 \ 749L \ 7LB749 Lloydminster 716S-Edgerton 899S)	704L (51S WAINWRIGHT to 478S Tucuman)	**79**	83.9	106.3	68.6	86.9	1) trip P1898; 2) trip Sharp Hills
	7L50 (Buffalo Crk 526S-Jarrow tap point)	**144**	149.9	104.1	129.1	89.7	
899ST3a (Edgerton 899S 138kV/25kV transformer)	704L (51S WAINWRIGHT to 478S Tucuman)	**79**	85.5	108.2	72.1	91.3	1) trip P1898; 2) trip Sharp Hills
	7L50 (Buffalo Crk 526S-Jarrow tap point)	**144**	152.6	106.0	136.7	94.9	
912L \ 9L912 (Red Deer 63S-Nevis 766S)	174L (Bardo 197S-N.Holden 395S)	**90**	116.4	129.3	80.7	89.7	1) trip P1898; 2) trip Sharp Hills
	701L/7L701 (Strome 223S-N.Holden 395S)	**146**	177.3	121.5	142.3	97.4	
	704L (51S WAINWRIGHT to 478S Tucuman)	**79**	87.3	110.5	70.5	89.3	
	749L (Edgerton 899S-Kilarney tap point)	**96**	107.4	111.8	90.7	94.5	

Public

Contingency	Limiting Branch	Normal Rating (MVA)	Post-Project Results		Post-RAS Action Results		Mitigation Action
			Power Flow (MVA)	%	Power Flow (MVA)	%	
	7L50 (Buffalo Crk 526S-Jarrow tap point)	**139**	161.7	112.3	138.3	99.5	
	7L701(Strome 233S-7LA701)	**192**	194.0	101.0	158.2	82.4	
	7L749 (Edgerton 899S-Briker tap point)	**96**	418.6	108.7	83.9	91.2	
	Sheerness 807S 2T	**400**	166.5	100.1	391.0	97.8	
9L20 (Cordel 755S-Nevis 766S)	174L (Bardo 197S-N.Holden 395S)	**90**	97.6	108.5	51.2	56.9	1) trip P1898; 2) trip Sharp Hills; 3) trip Halkirk 1
	701L/7L701 (Strome 223S-N.Holden 395S)	**146**	156.5	107.2	111.1	76.1	
	704L (51S WAINWRIGHT to 478S Tucuman)	**79**	84.1	106.5	62.8	79.5	
	749L (Edgerton 899S-Kilarney tap point)	**96**	103.0	107.3	83.0	86.5	
	7L50 (Buffalo Crk 526S-Jarrow tap point)	**139**	149.7	104.0	118.7	85.4	
	7L749 (Edgerton 899S-Briker tap point)	**92**	95.9	104.2	76.5	83.1	
	Nevis 766S 901T	**100**	58.5	140.8	95.1	95.1	
EATL	174L (Bardo 197S-N.Holden 395S)	**90**	100.7	111.8	74.0	82.2	1) trip P1898; 2) trip Sharp Hills; 3) trip Halkirk 1; 4) RTOP
	701L/7L701 (Strome 223S-N.Holden 395S)	**146**	164.9	113.0	139.2	95.4	
	704L (51S WAINWRIGHT to 478S Tucuman)	**79**	91.0	115.1	77.1	97.5	
	749L (Edgerton 899S-Kilarney tap point)	**96**	112.4	117.1	98.8	102.9	
	7L50 (Buffalo Crk 526S-Jarrow tap point)	**144**	156.8	108.9	138.9	96.6	
	7L749 (Edgerton 899S-Briker tap point)	**92**	105.1	114.3	91.9	99.9	
	912L (Red Deer 63S-Nevis 766S)	**623**	663.1	106.4	483.6	77.6	

Public

5.3.4 Sensitivity Scenario 4a: 2022 Summer Peak Scenario with additional connection projects in service (2022SP)

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 5-12*.

Table 5-12: Post-RAS Power Flow Study Results, Scenario 4a (2022SP)

Contingency	Limiting Branch	Normal Rating (MVA)	Post-Project Results		Post-RAS Action Results		Mitigation Action
			Power Flow (MVA)	%	Power Flow (MVA)	%	
749L \ 749AL (Metiskow 648S-Edgerton 899S)	7L129 (Buffalo Crk. 526S-Bauer tap point)	116	132	118.9	86.0	74.1	1) Trip P1898; 2) Trip Sharp Hills; 3) Trip Halkirk 1; 4) Open 491L
	7L50 (Buffalo Crk 526S-Jarrow tap point)	109	117	135.0	101.9	93.5	
766S901T (Nevis 766S 240kV/138kV transformer)	174L (Bardo 197S-N.Holden 395S)	84	94	134.6	0.0	0.0	1) Trip P1898; 2) Trip Sharp Hills; 3) Trip Halkirk 1; 4) Open 491L and 174L
	701L/7L701 (Strome 223S-N.Holden 395S)	119	131	176.4	88.4	74.2	
	704L (51S WAINWRIGHT to 478S Tucuman)	75	83	76.1	20.7	27.6	
	749L (Edgerton 899S-Kilarney tap point)	96	134	107.3	86.0	89.6	
	7L129 (Buffalo Crk. 526S-Bauer tap point)	116	132	137.3	83.9	72.4	
	7L50 (Buffalo Crk 526S-Jarrow tap point)	109	117	152.8	99.7	91.5	
	7L701 (Battle River 757S-7LA701)	142	159	184.7	100.2	70.7	
	7L701(Strome 233S-7LA701)	142	159	190.3	101.3	71.4	
	7L749 (Edgerton 899S-Briker tap point)	92	125	100.2	79.4	86.3	

Public

Contingency	Limiting Branch	Normal Rating (MVA)	Post-Project Results		Post-RAS Action Results		Mitigation Action
			Power Flow (MVA)	%	Power Flow (MVA)	%	
7L701 \ 7LA701 \ 701L (Strome 223S-Battle River 757S)	7L50 (Buffalo Crk 526S-Jarrow tap point)	**109**	117	125.3	102.2	93.7	1) Trip P1898; 2) Trip Sharp Hills; 3) Trip Halkirk 1
	912L (Red Deer 63S-Nevis 766S)	**507**	553	531.6	339.4	66.9	
7L749 \ 749L \ 7LB749 Lloydminster 716S-Edgerton 899S)	7L50 (Buffalo Crk 526S-Jarrow tap point)	**109**	117	135.1	94.7	86.8	1) Trip P1898; 2) Trip Sharp Hills; 3) Trip Halkirk 1; 4) Open 491L
899ST3a (Edgerton 899S 138kV/25kV transformer)	7L129 (Buffalo Crk. 526S-Bauer tap point)	**116**	132	121.5	84.7	73.0	1) Trip P1898; 2) Trip Sharp Hills; 3) Trip Halkirk 1; 4) Open 491L
	7L50 (Buffalo Crk 526S-Jarrow tap point)	**109**	117	137.5	100.8	92.5	
912L \ 9L912 (Red Deer 63S-Nevis 766S)	174L (Bardo 197S-N.Holden 395S)	**84**	94	133.9	0.0	0.0	1) Trip P1898; 2) Trip Sharp Hills; 3) Trip Halkirk 1; 4) Open 491L and 174L
	701L/7L701 (Strome 223S-N.Holden 395S)	**119**	131	176.6	88.3	74.2	
	704L (51S WAINWRIGHT to 478S Tucuman)	**75**	83	75.6	20.7	27.6	
	749L (Edgerton 899S-Kilarney tap point)	**96**	134	106.9	85.7	89.3	
	7L129 (Buffalo Crk. 526S-Bauer tap point)	**116**	132	136.7	83.6	72.1	
	7L50 (Buffalo Crk 526S-Jarrow tap point)	**109**	117	151.8	99.4	91.2	
	7L701 (Battle River 757S-7LA701)	**142**	159	182.2	98.0	69.1	
	7L701(Strome 233S-7LA701)	**142**	159	190.5	101.3	71.4	
	7L749 (Edgerton 899S-Briker tap point)	**92**	125	99.6	79.0	85.9	
966L \ 9L966 (Hansman Lk. 650S-Pemukan 932S)	7L127 (Monitor 7774S-Pemukan 932S)	**145**	194	156.0	0	0	1) Open 7L224
	7L224 (Hansman Lake 650S-Monitor 774S)	**108**	120	137.3	0	0	

Public

Contingency	Limiting Branch	Normal Rating (MVA)	Post-Project Results		Post-RAS Action Results		Mitigation Action
			Power Flow (MVA)	%	Power Flow (MVA)	%	
9L20 (Cordel 755S-Nevis 766S)	174L (Bardo 197S-N.Holden 395S)	84	94	114.3	66.1	78.7	1) Trip P1898; 2) Trip Sharp Hills; 3) Trip Halkirk 1; 4) post-RAS RTOP
	701L/7L701 (Strome 223S-N.Holden 395S)	119	131	154.7	106.6	89.5	
	749L (Edgerton 899S-Kilarney tap point)	96	134	102.7	81.7	85.1	
	7L129 (Buffalo Crk. 526S-Bauer tap point)	116	132	124.1	91.7	79.1	
	7L159 (Heatburg 948S-7LA159)	107	119	119.3	94.1	87.6	
	7L16 (Nevis 766S-Heatburg 948S)	107	120	114.5	89.3	83.2	
	7L50 (Buffalo Crk 526S-Jarrow tap point)	109	117	139.7	107.8	98.9	
	7L701 (Battle River 757S-7LA701)	142	159	172.6	123.7	87.2	
	7L701(Strome 233S-7LA701)	142	159	169.1	119.7	84.4	
	Nevis 766S 901T	100	110	146.1	100.6	100.6	
EATL	174L (Bardo 197S-N.Holden 395S)	84	94	111.2	0.0	0.0	1) Trip P1898; 2) Trip Sharp Hills; 3) Trip Halkirk 1; 4) Open 491L and 174L 5) post-RAS RTOP
	701L/7L701 (Strome 223S-N.Holden 395S)	119	131	156.9	93.0	78.2	
	704L (51S WAINWRIGHT to 478S Tucuman)	75	83	78.3	20.7	27.6	
	749L (Edgerton 899S-Kilarney tap point)	96	134	111.0	97.6	101.7	
	7L129 (Buffalo Crk. 526S-Bauer tap point)	116	132	127.6	86.5	74.6	
	7L50 (Buffalo Crk 526S-Jarrow tap point)	109	117	143.2	102.3	93.9	
	7L701 (Battle River 757S-7LA701)	142	159	165.0	105.3	74.2	
	7L701(Strome 233S-7LA701)	142	159	170.6	106.2	74.9	
	7L749 (Edgerton 899S-Briker tap point)	92	125	103.6	90.6	98.5	
	912L (Red Deer 63S-Nevis 766S)	507	553	699.4	549.1	108.3	

Public

Contingency	Limiting Branch	Normal Rating (MVA)	Post-Project Results		Post-RAS Action Results		Mitigation Action
			Power Flow (MVA)	%	Power Flow (MVA)	%	
	9L20 (Cordel 755S-Nevis 768S)	488	588	615.8	477.6	97.9	

5.3.5 Sensitivity Scenario 4b: 2022 Summer Peak Scenario with additional connection projects and PENV in service (2022SP)

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 5-13.

Table 5-13: Post-RAS Power Flow Study Results, Scenario 4b (2022SP)

Contingency	Limiting Branch	Normal Rating (MVA)	Post-Project Results		Post-RAS Action Results		Mitigation Action
			Power Flow (MVA)	%	Power Flow (MVA)	%	
766S901T (Nevis 766S 240kV/138kV transformer)	174L (Bardo 197S-N.Holden 395S)	84	94	126.1	69.0	82.1	1) Trip P1898; 2) Trip Sharp Hills; 3) Trip Halkirk 1
	701L/7L701 (Strome 223S-N.Holden 395S)	119	131	143.1	92.8	78.0	
	7L701 (Battle River 757S-7LA701)	142	159	151.2	103.8	73.1	
	7L701(Strome 233S-7LA701)	142	159	156.7	105.8	74.5	
912L \ 9L912 (Red Deer 63S-Nevis 766S)	174L (Bardo 197S-N.Holden 395S)	84	94	125.6	68.7	81.8	1) Trip P1898; 2) Trip Sharp Hills; 3) Trip Halkirk 1
	701L/7L701 (Strome 223S-N.Holden 395S)	119	131	142.9	92.7	77.9	
	7L701 (Battle River 757S-7LA701)	142	159	148.8	102.6	72.3	
	7L701(Strome 233S-7LA701)	142	159	156.5	105.7	74.6	
966L \ 9L966 (Hansman Lk.	7L127 (Monitor 7774S-Pemukan 932S)	145	194	150.1	0	0	1) Open 7L224

Public

Contingency	Limiting Branch	Normal Rating (MVA)	Post-Project Results		Post-RAS Action Results		Mitigation Action
			Power Flow (MVA)	%	Power Flow (MVA)	%	
650S-Pemukan 932S)	7L224 (Hansman Lake 650S-Monitor 774S)	108	120	132.8	0	0	
9L20 (Cordel 755S-Nevis 766S)	174L (Bardo 197S-N.Holden 395S)	84	94	108.4	58.8	70.0	1) Trip P1898; 2) Trip Sharp Hills; 3) Trip Halkirk 1
	701L/7L701 (Strome 223S-N.Holden 395S)	119	131	125.2	82.3	69.2	
	7L159 (Heatburg 948S-7LA159)	107	119	110.2	86.1	80.2	
	7L701 (Battle River 757S-7LA701)	142	159	145.2	100.9	71.1	
	Nevis 766S 901T	100	110	134.9	90.8	90.8	
EATL	174L (Bardo 197S-N.Holden 395S)	84	94	99.9	69.1	82.3	1) Trip P1898; 2) Trip Sharp Hills; 3) Trip Halkirk 1
	701L/7L701 (Strome 223S-N.Holden 395S)	119	131	121.0	95.2	80.0	
	912L (Red Deer 63S-Nevis 766S)	507	553	630.9	443.7	87.5	
	9L20 (Cordel 755S-Nevis 768S)	488	588	557.1	388.7	79.6	

5.3.6 Sensitivity Scenario 4c: 2022 Summer Peak Scenario with additional connection projects, PENV and CETO in service (2022SP)

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 5-14.

Table 5-14: Post-RAS Power Flow Study Results, Scenario 4c (2022SP)

Contingency	Limiting Branch	Normal Rating (MVA)	Post-Project Results		Post-RAS Action Results		Mitigation Action
			Power Flow (MVA)	%	Power Flow (MVA)	%	
966L \ 9L966 (Hansman Lk. 650S-Pemukan 932S)	7L127 (Monitor 7774S-Pemukan 932S)	145	194	162.3	0	0	1) Open 7L224
966L \ 9L966 (Hansman Lk. 650S-Pemukan 932S)	7L224 (Hansman Lake 650S-Monitor 774S)	108	120	145.7	0	0	

5.4 Constraint Effective Factor Studies

Constraint effective factor studies were conducted for all post-Project scenarios. The constraint effective factors were calculated for all Category B conditions when the loadings of the monitored transmission elements in the Study Area exceeded 100% (i.e., for all of the contingencies that resulted in thermal criteria violations). The results of the constraint effective factor studies are provided in Attachment A7.

Attachment A1
Engineering Connection Assessment: Study Scope

Engineering Connection Assessment: Study Scope

P1898 Lanfine North Wind Power Project Connection

Pattern Development Lanfine Wind ULC

Date: December 5, 2020

Version: V9

Classification: Public

Company Name	Name and Credentials	Date	Signature
PowerEN Corporation (Studies Consultant)	Dragan Brankovich, P. Eng	Dec 14, 2020	
AESO	Myron Jin-Li, P. Eng	Dec. 14, 2020	
Transmission Facility Owner (ATCO)	Rachel Liu, P. Eng	Dec. 14, 2020	Rachel Liu
Market Participant	Pat Bowes	Dec 14 2020	

Alberta Electric System Operator

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

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

www.aeso.ca

@theaeso

Contents

1 Introduction 1
1.1 Project Overview 1
1.2 Existing System Overview 2
1.2.1 Study Area 2
1.2.2 Existing Constraints 2
2 Connection Alternative to be Studied 4
2.1 Alternative 2 – Radial 144 kV Connection to Lanfine 959S Substation 4
3 Criteria, Standards and Requirements 7
3.1 AESO Reliability Criteria 7
3.2 ISO Rules and Information Documents 8
4 Scenarios and Assumptions 9
4.1 Scenarios 9
4.2 Assumptions 10
4.2.1 System Project Assumptions 10
4.2.2 Connection Project Assumptions 10
**Only in the sensitivity scenarios 11*
4.2.3 Load Assumptions 11
4.2.4 Generation Assumptions 12
4.2.4.1 Non-renewable Generation Assumptions 12
4.2.4.2 Base Scenario Renewable Generation Assumptions 13
4.2.4.3 Sensitivity Scenario Renewable Generation Assumptions 15
4.2.5 Intertie Flow Assumptions 19
4.2.6 HVDC Power Order Assumptions 20
4.2.7 Transmission Facility Ratings 20
4.2.8 Protection Fault Clearing Times 26
4.2.9 Project Dynamic Data 27
4.2.10 Voltage Profile Assumption 27
5 Study Methodology 28
5.1 Power Flow Studies 29
5.1.1 Contingencies to be Studied 29
5.2 Transient Stability Studies 29
5.2.1 Contingencies to be Studied 29
5.3 Short-Circuit Current Level Studies 29
6 Mitigation Measures 31
6.1 Development 31
6.2 Evaluation 31
6.2.1 Post-Mitigation Studies 31
6.2.2 Constraint Effective Factor Studies 31
7 Changes to Study Assumptions 32

Tables

Table 1-1: Project Load and Generation Details 1
Table 3-1: Post-Contingency Voltage Deviation Guidelines for Low Voltage Busses 8
Table 4-1: Connection Study Scenarios 9
Table 4-2: Planned System Transmission Projects to be Included in the Sensitivity Studies 10
Table 4-3: Planned Connection Projects Included in the Studies 10
Table 4-4: Forecast Area Peak Load (2017 LTO at AESO Central Planning Region Peak) 12
Table 4-5: Forecast Area Peak Load for 2022 Sensitivity (2019 LTO at AESO Central Planning Region Peak) 12
Table 4-6: Existing Generation Non-Renewable Generation Dispatch Conditions for Scenarios 1-6 12
Table 4-8: Dispatch Conditions for Existing and Under Construction Wind and Solar Aggregated Generation Facilities 13
Table 4-9: Dispatch Conditions for Planned Wind and Solar Generation Projects 14
Table 4-10: Sensitivity Scenario Dispatch Conditions for Existing and Under Construction Wind and Solar Aggregated Generation Facilities 16
Table 4-11: Sensitivity Scenario Dispatch Conditions for Existing and Under Construction Solar Generation Facilities 17
Table 4-12: Sensitivity Scenario Dispatch Conditions for Planned Wind Generation Projects 17
Table 4-13: Dispatch Conditions for Planned Solar Generation Projects 18
Table 4-14: Intertie Flows by Scenario 19
Table 4-15: HVDC Power Order by Scenario 20
Table 4-16: HVDC to Adjacent AC System MVAr Exchange Limits 20
Table 4-17: Thermal Rating Assumptions for Key Transmission Lines in the Study Area 21
The TFOs provided the details of the substation transformers in the Study Area. The key transformers in the Study Area are shown in Table 4-18. 25
Table 4-18: Summary of Key Transformer Ratings in the Study Area 25
Table 4-19: Summary of Key Shunt Elements in the Study Area 25
Table 4-20: Protection Fault Clearing Times 26
Table 5-1: Summary of the Studies to be Performed 28

Figures

Figure 1-1: Transmission System in the Study Area 3
Figure 2-1: Connection Alternative 2 5

Attachments

Attachment A: Transmission Planning Criteria – Basis and Assumptions

1 Introduction

This Study Scope provides an overview of the engineering studies to be completed by PowerEn Corporation (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

Pattern Development Lanfine Wind ULC (Market Participant) has submitted a request for system access service to the Alberta Electric System Operator (AESO) to connect its approved Lanfine North Wind Facility (Facility) to the AIES. The Facility includes an approved collector substation, designated as the Buffalo Bird 601S substation. The Facility is planned to be located in the Oyen area, in the AESO planning area of Hanna (Area 42).

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 145 MW and a Rate DTS, *Demand Transmission Service*, contract capacity of 1.5 MW; and a request for transmission development (collectively, the Project).

The Project in-service date (ISD) used for the purpose of the studies is September 30, 2022.

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

Table 1-1: Project Load and Generation Details

Project Component		Description
Load	Existing Rate DTS, *Demand Transmission Service,* contract capacity	No existing contract
	Requested Rate DTS	1.5 MW
	Type	Industrial
	Motors (number and size)	Not applicable
	Power factor	Not applicable
	Future load expansion plans	No
Generation	Generation type	Wind
	Existing Rate STS, *Supply Transmission Service,* contract capacity	Not applicable
	Requested Rate STS	150 MW
	Number and size of generating units	40 turbines at 3.6MW each
	Maximum authorized real power (MARP)	145 MW
	Maximum capability (MC)	145 MW
	Reactive power capability	47.65 MVAr (0.95 pf absorbing)

Project Component		Description
		70.22 MVAr (0.9 pf reducing)
	Future generation expansion plans	No

Note:

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

1.2 Existing System Overview

1.2.1 Study Area

Geographically, the Project is located in the AESO planning area of Hanna (Area 42).

The Study Area consists of the AESO planning areas of Hanna (Area 42), Sheerness (Area 43), Empress (Area 48), Battle River (Area 36), Provost (Area 37), Wainwright (Area 32) and the tie-lines from these areas to the AIES.

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

1.2.2 Existing Constraints

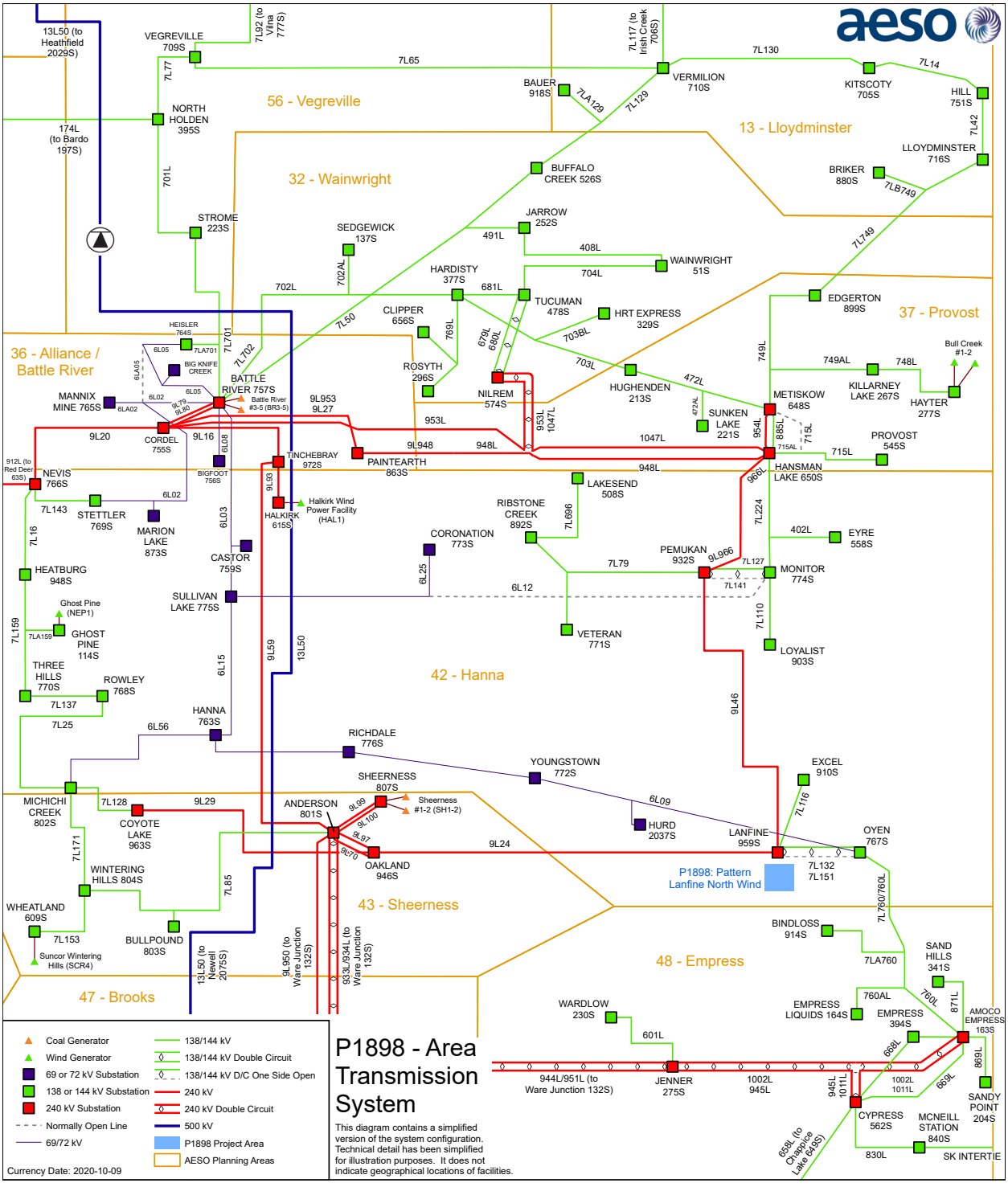
Existing constraints in the Study Area are managed in accordance with the procedures set out in Section 302.1 of the ISO rules, *Real Time Transmission Constraint Management* (TCM Rule).

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 schemes are used to manage constraints in the area:

- RAS 32: Battle River 757S 7L50 and 7L701 thermal protection scheme
- RAS 134: 174L-395S North Holden overload mitigation scheme
- RAS 138: 7L50-526S Buffalo Creek overload mitigation scheme
- RAS 139: 901T-766S Nevis overload mitigation scheme
- RAS 149: Eastern Alberta Transmission Line (EATL) HVDC

Figure 1-1: Transmission System in the Study Area



2 Connection Alternative to be Studied

The following alternative will be studied:

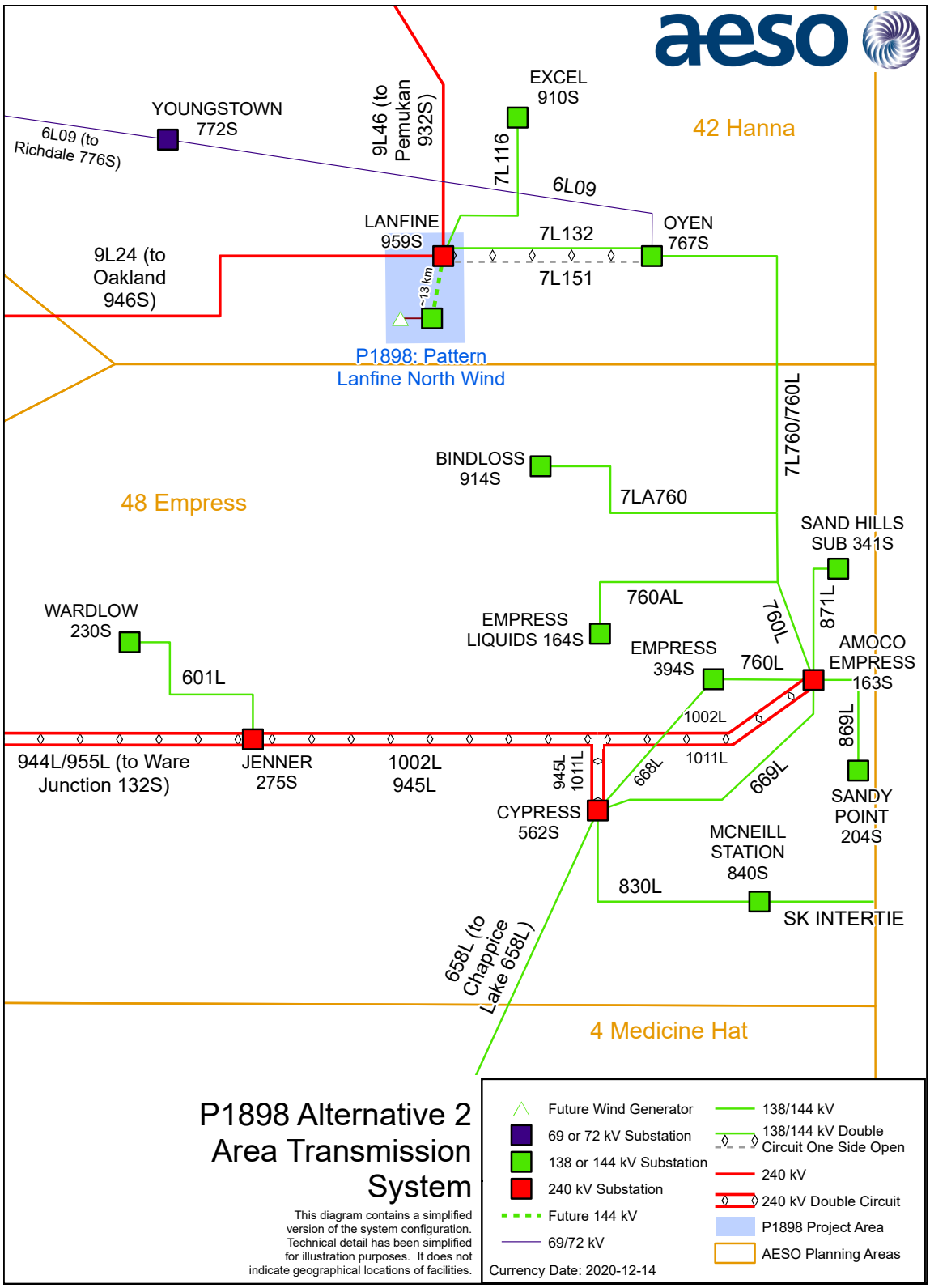
2.1 Alternative 2 – Radial 144 kV Connection to Lanfine 959S Substation

This alternative includes the following developments:

- Add a 144 kV circuit, approximately 13 km in length, to connect the Facility and the existing Lanfine 959S substation in a radial configuration;
- Modify Lanfine 959S substation, including adding one 144 kV circuit breaker; and
- Add or modify associated equipment as required for the above transmission developments.

The proposed connection configuration is shown in Figure 2-1

Figure 2-1: Connection Alternative 2



3 Criteria, Standards and Requirements

3.1 AESO Reliability Criteria

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

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

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

The TPL standards, TPL-001-AB-0 and TPL-002-AB1-0, have referenced Applicable Ratings when specifying the required system performance under Category A and Category B 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; and*
- Desired post-contingency voltage deviation limits for three defined post-event timeframes as provided in Table 3-1.

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

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

3.2 ISO Rules and Information Documents

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

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

- The AESO's *Connection Study Requirements*;
- Section 502.1 of the ISO rules, *Aggregated Generating Facilities Technical Requirements*;
- Section 502.16 of the ISO rules, *Aggregated Generating Facilities Operating Requirements*;
- Section 502.5 of the ISO rules *Generating Unit Technical Requirements*; and
- Section 502.6 of the ISO rules *Generating Unit Operating Requirements*;

4 Scenarios and Assumptions

4.1 Scenarios

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

The AESO has updated its regional forecasts since the base connection studies were performed. The AESO determined that the use of the current AESO forecast would not materially alter the connection study results (in terms of alternative selection) or affect the conclusions and recommendations in this report. After the base scenario studies were completed, several renewable (solar) generation facilities were added. To assess whether the mitigations assigned in the base scenarios (Scenarios 1 to 6) would still be effective, post-project sensitivity studies were added to study these project additions and the impacts of the Provost to Edgerton and Nilrem to Vermilion (PENV) Transmission Development system project and the Central East Transfer-out (CETO) Transmission Development system project (Scenarios 4a to 4c). As pre-Project to post-Project comparisons were already conducted in the base scenarios (to determine required mitigation), Summer Peak (SP) was the only season studied for sensitivities as it is the most stressed scenario, with these solar generation facilities dispatched to 100% of their capacity to create the credible worst case..

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 Generation (MW)
Pre-Project				
1	2022 Summer Peak (SP)	High Wind, Economic Coal	2022 SP Pre-Project	0
2	2022 Summer Light (SL)		2022 SL Pre-Project	0
3	2022 Winter Peak (WP)		2022 WP Pre-Project	0
Post-Project				
4	2022 SP	High Wind, Economic Coal	2022 SP Post-Project	145
5	2022 SL		2022 SL Post-Project	145
6	2022 WP		2022 WP Post-Project	145
7	2028 WP	All generation in the Study Area online	2028 WP Post-Project	145
Post-Project Sensitivity				
4a	2022 SP	High Renewable, Economic Coal	2022 SP Post-Project with additional connection projects	145

Scenario No.	Year/Season	System Generation Dispatch Conditions	Scenario Name	Project Generation (MW)
4b	2022 SP	High Renewable, Economic Coal	2022 SP Post-Project with additional connection projects and PENV	145
4c	2022 SP	High Renewable, Economic Coal	2022 SP Post-Project with additional connection projects, PENV and CETO	145

4.2 Assumptions

4.2.1 System Project Assumptions

Table 4-2 lists the system transmission projects that will be included in the sensitivity scenarios.

Table 4-2: Planned System Transmission Projects to be Included in the Sensitivity Studies

AESO Project No.	Project Name/Description	Scheduled ISD	AUC NID Decision No.
P1781	Provost to Edgerton & Nilrem to Vermilion Transmission Development	Dec. 31, 2022 (Stage 1)	23429-D01-2019
P7001	Central East Transfer-out Transmission Development	2023 (Stage 1)	N/A

4.2.2 Connection Project Assumptions

Table 4-3 summarizes the connection projects in the Study Area that should be included in the studies.

Table 4-3: Planned Connection Projects Included in the Studies

AESO Project No.	AESO Project Name	AESO Planning Area No.	Generation (MW)	Load (MW)	Scheduled ISD	AUC Decision No.
851	TransCanada Keystone KXL Pumpstation #2-Eyre	37	0.0	0.0	Nov 1, 2020	2011-104
851	TransCanada Keystone KXL Pumpstation #2-Eyre	37	0.0	25.0	Nov 1, 2020	2011-104
863	TransCanada Keystone KXL Pumpstation #3-Current	42	0.0	25.0	Nov 1, 2020	2011-372
864	TransCanada Keystone KXL Pumpstation #4-Armitage	42	0.0	25.0	Nov 1, 2020	2011-372

AESO Project No.	AESO Project Name	AESO Planning Area No.	Generation (MW)	Load (MW)	Scheduled ISD	AUC Decision No.
1250	E.ON Grizzly Bear Wind	13	120.0	1.5	Dec 15, 2020	21643-D01-2016
1410	ATCO Heartland Pump Station Connection	56	0.0	20.0	Nov 1, 2020	21166-D01-2016
1567	EDPR Sharp Hills Wind Farm New Facility Generator Capacity	42	248.4	1.0	Jun 1, 2020	23066-D01-2018
1567	EDPR Sharp Hills Wind Farm New Facility Generator Capacity	42	51.6	0.0	Jun 1, 2020	23066-D01-2018
1718	Wheatland WAGF Project	43	120.0	0.0	Sep 30, 2022	24040-D01-2019
1782	Fortis Provost Reliability	37	0.0	0.0	May 1, 2020	23339-D01-2019
1812*	Suncor Forty Mile Granlea WAGF	4	200.0	0.3	Nov 16, 2021	Decision 24120-D01-2019
1879*	Claresholm Solar Connection	49	130.0	0.6	Dec 18, 2020	Decision 24679-D01-2019
2009*	Greengate Travers MPC Solar	49	400.0	0.5	Sep 30, 2021	Decision 24848-D01-2019

*Only in the sensitivity scenarios

4.2.3 Load Assumptions

The load forecast to be used for the base scenario studies is shown in Table 4-4 and is a forecast for the AESO Central Planning Region peak based on the *AESO 2017 Long-Term Outlook* (2017 LTO)[1].

As the *AESO 2019 Long-Term Outlook* (2019 LTO[2]) was available when the sensitivity studies were scoped, the 2019 LTO was used for the sensitivity studies. Therefore, the load forecast to be used for the post-Project sensitivity scenario studies is shown in Table 4-5 and is a forecast for the AESO Central Planning Region peak based on the 2019 LTO.

For all studies, when loads for the Alberta Internal Load (AIL) are modified to align with the load forecast in the 2017 LTO, the active power to reactive power ratio in the base case scenarios shall be maintained.

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

[2] The 2019 LTO is available on the AESO website.

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

AESO Planning Region Name	Forecast Peak Load by Year/Season (MW)		
	2022 SL	2022 SP	2022 WP
Central	1437	1937	2207

Note:
[1]The Central Planning Region comprises the following AESO planning areas: Vegreville (Area 56), Lloydminster (Area 13), Wainwright (Area 32), Provost (Area 37), Alliance/Battle River (Area 36), Hanna (Area 42), Red Deer (Area 35), Didsbury (Area 39), Caroline (Area 38), Drayton Valley (Area 30), Hinton/Edson (Area 29), Abraham Lake (Area 34) and Cold Lake (Area 28).

Table 4-5: Forecast Area Peak Load for 2022 Sensitivity (2019 LTO at AESO Central Planning Region Peak)

AESO Planning Region Name	Forecast Peak Load by Year/Season (MW)
	2022 SP
Central Planning Region	2,101

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

4.2.4.1 Non-renewable Generation Assumptions

The generation forecast to be used for the base scenario studies is based on the 2017 LTO. The generation forecast to be used for the 2022 sensitivity scenarios is based on the 2019 LTO. The generation assumptions for the studies will assume high renewable and economic coal. Additional studies may be required in the event of changes to the AESO's corporate forecast.

The non-renewable generation dispatch conditions for the study scenarios are described in Table 4-6 and Table 4-7.

Table 4-6: Existing Generation Non-Renewable Generation Dispatch Conditions for Scenarios 1-6

Facility Name	Unit No.	Bus No.	Pmax (MW)	AESO Planning Area No.	Unit Net Generation[a] (MW) by Scenario		
					2022 SP	2022 SL	2022 WP
Battle River	3	1495	149	36	Offline	Offline	Offline
Battle River	4	1496	155	36	83.0	60.0	153.0
Battle River	5	1497	385	36	209.8	92.6	388.8
Sheerness	1	1482	400	43	382.5	239.5	392.5

Facility Name	Unit No.	Bus No.	Pmax (MW)	AESO Planning Area No.	Unit Net Generation[a] (MW) by Scenario		
					2022 SP	2022 SL	2022 WP
Sheerness	2	1487	390	43	375.6	234.7	384.4

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

Table 4-7 Existing Non-Renewable Generation Dispatch Conditions for Scenarios 4a, 4b, 4c

Facility Name	Unit No.	Bus No.	Pmax (MW)	AESO Planning Area No.	Unit Net Generation[a] (MW) by Scenario
					2022 SP
Battle River	3	1495	149	36	Offline
Battle River	4	1496	155	36	134.8
Battle River	5	1497	385	36	356.3
Sheerness	1	1482	400	43	368.4
Sheerness	2	1487	390	43	372.7

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

4.2.4.2 Base Scenario Renewable Generation Assumptions

Per the 2017 LTO, the total forecast wind and solar electricity generation in 2022 is 2962 MW. This includes existing, under construction and planned wind and solar electricity generation facilities.

Using the 2017 LTO's 2022 wind and solar generation forecast of 2962 MW, the generation assumptions will dispatch the wind and solar electricity generation facilities in order to yield the credible worst-case power flow conditions for the Study Area. 2022 Pre-Project dispatch levels for the existing and under-construction wind and solar generation facilities are shown in Table 4-8.

Table 4-8: Dispatch Conditions for Existing and Under Construction Wind and Solar Aggregated Generation Facilities

Facility Name and Code	AESO Planning Area No.	Busses	MC (MW)	2022 Unit Net Generation (MW)
Ardenville Wind	53	4735, 4740	68	68
Blue Trail Wind	53	66328, 67328	66	66
Castle River #1 (CR1)	53	2234, 3234	39	39
Castle Rock Wind Farm (CRR1)	53	67221	77	77
Cowley Ridge (CRWD)	53	4264	20	20

Enmax Taber (TAB1)	52	15343, 16343	81	81
Kettles Hill (KHW1)	53	2402, 3402	63	63
McBride Lake Windfarm (AKE1)	53	2901, 3901, 4901	75	75
Soderglen Wind (GWW1)	53	12358, 13358	68	68
Summerview 1 (IEW1)	53	2338, 3338	66	66
Summerview 2 (IEW2)	53	4339, 5337	66	66
Suncor Chin Chute (SCR3)	54	2389	30	30
Suncor Magrath (SCR2)	53	11002	30	30
Suncor Wintering Hills (SCR4)	43	60789, 60791, 60793, 60846, 60848, 60850	88	88
Old Man River	53	61543	46	46
Blackspring Ridge (BSR1)	49	61736, 61737	300	300
Brooks Solar (BSC1)	47	553257	15	15
AESO South Planning Region Subtotal				**1198**
Ghost Pine	42	2621 to 2625	82	82
Halkirk	42	66435, 67435	150	150
Bull Creek DG	37	550003, 550004	29.5	29.5
AESO Central Planning Region Subtotal				**261.5**
Total Existing Renewable Generation				**1,459.5**

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

Table 4-9 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. Planned wind and solar generation projects not listed in Table 4-9 are not included in the study and will not be dispatched.

Table 4-9: Dispatch Conditions for Planned Wind and Solar Generation Projects

Project Number	Project Name	Project Type	Planned ISD	Bus No.	AESO Planning Area No.	MC (MW)	Unit Net Generation Dispatch[a] (MW) by Scenario
							2022 SP
South Planning Region							
462	Castle Rock Ridge Phase 2	Wind	Jun 30, 2019	550006	53	30.6	30.6
515	Heritage Wind Energy Centre	Wind	Sep 1, 2020	62536, 66536	53	300	143.2
524	Enel Riverview	Wind	Jun 30, 2019	69221	53	115	115
1800	Capital Power Whitla Wind	Wind	Sep 1, 2019	60990	4	201.6	201.6

Project Number	Project Name	Project Type	Planned ISD	Bus No.	AESO Planning Area No.	MC (MW)	Unit Net Generation Dispatch[a] (MW) by Scenario
							2022 SP
1533	Jenner Wind Power Project	Wind	Jun 28, 2019	60798, 60799	48	120	122.4
1698	Jenner Wind Power Project 2	Wind	May 1, 2019	61798, 61799	48	180	71.4
1853	Buffalo Atlee Wind Farm 1	Wind	Mar 1, 2019	552260	48	17.25	17.25
2199	Buffalo Atlee Wind Farm 2	Wind	Dec 1, 2020	990013	48	13.8	13.8
1892	Buffalo Atlee Wind Farm 3	Wind	Mar 18, 2019	553260	48	17.25	17.25
1719	Stirling Wind Project	Wind	Dec 20, 2019	61630	54	113	113
2041	Windrise Wind	Wind	Nov 2, 2020	990001, 990004	53	207	207
2122	EDF Cypress Wind	Wind	Jun 1, 2021	962122	4	450	201.6
Subtotal (Southern Alberta)							**1254.1**
Central Planning Region							
1567	Sharp Hills Wind Facility	Wind	Jun 1, 2020	60831, 60832	42	248.4	248.4
1704	Paintearth Wind Power	Wind	Jul 1, 2019	61418	42	150	0
Subtotal (Central Alberta)							**398.4**
Total Planned							**1359.3**
Total Planned, Existing and Under Construction							**2962**

The post-Project scenario renewable generation dispatch levels were identical to the pre-Project scenario dispatch levels shown in Table 4-8 and Table 4-9, except that the existing Blue Trail and McBride Lake facilities were switched off and the Cowley Ridge facility was dispatched down (to 9 MW) as these facilities are far away from the Study Area. The Facility was dispatched to 145 MW in all post-Project scenarios. This will result in a total renewable dispatch consistent with the 2017 LTO's 2022 renewable generation forecast of 2962 MW for 2022.

4.2.4.3 Sensitivity Scenario Renewable Generation Assumptions

Per the 2019 LTO, the total forecast wind electricity generation in 2022 SP is 2764.7 MW and the total forecast solar electricity generation in 2022 SP is 635.5 MW. This includes existing, under construction and planned wind and solar electricity generation facilities.

Using the 2019 LTO's 2022 SP wind and solar generation forecast of 2764.7 MW and 635.5 MW, the generation assumptions will dispatch the wind and solar electricity generation facilities in order to yield the credible worst-case power flow conditions for the Study Area. 2022 Pre-Project dispatch levels for the existing and under-construction renewable generation facilities are shown in Table 4-10 Table 4-10:and

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

Table 4-10: Sensitivity Scenario Dispatch Conditions for Existing and Under Construction Wind and Solar Aggregated Generation Facilities

Facility Name and Code	Bus No.	MC (MW)	AESO Planning Area No.	Unit Net Generation[a] (MW) by Scenario
				2022 SP
Ardenville Wind (ARD1)	4735, 4740	68	53	68
Blue Trail Wind (BTR1)	66328, 67328	66	53	66
Castle River #1 (CR1)	2234, 3234	39	53	0
Castle Rock Wind Farm (CRR1)	67221	77	53	77
Cowley Ridge (CRWD)	4264	20	53	0
Enmax Taber (TAB1)	15343, 16343	81	52	81
Kettles Hill (KHW1)	2402, 3402	63	53	63
McBride Lake Wind Farm (AKE1)	2901, 3901, 4901	73	53	73
Soderglen Wind (GWW1)	12358, 13358	71	53	71
Summerview 1 (IEW1)	2338, 3338	66	53	66
Summerview 2 (IEW2)	4339, 5337	66	53	66
Suncor Chin Chute (SCR3)	2389	30	54	30
Suncor Magrath (SCR2)	11002	30	53	30
Suncor Wintering Hills (SCR4)	60789, 60791, 60793, 60846, 60848, 60850	88	43	88
Old Man 2 Wind Farm 1 (OWF1)	61543	46	53	46
Blackspring Ridge (BSR1)	61736, 61737	300	49	300
Capital Power Whitla Wind Power Facility (WHT1)	60990	202	4	202
Riverview (RIV1)	69221	115	53	0
Castle Rock Ridge 2 (CRR2)	567221	29	53	25.1
AESO South Planning Region Subtotal				**1352.1**
Ghost Pine (NEP1)	2621, 2622, 2623, 2624, 2625	82	42	82
Halkirk (HAL1)	66435, 67435	150	42	150

Facility Name and Code	Bus No.	MC (MW)	AESO Planning Area No.	Unit Net Generationa[a] (MW) by Scenario
				2022 SP
Fortis Bull Creek 1 and 2 (BUL1 and BUL2)	550003, 550004	29	37	29
	AESO Central Planning Region Subtotal			261
	Total			**1613.1**

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

Table 4-11: Sensitivity Scenario Dispatch Conditions for Existing and Under Construction Solar Generation Facilities

Facility Name and Code	Bus No.	MC (MW)	AESO Planning Area No.	Unit Net Generation[a] (MW) by Scenario
				2022 SP
Brooks Solar (BSC1)	553257	15	47	15
AESO South Planning Region Subtotal				15
	Total			15

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

Table 4-12: Sensitivity Scenario Dispatch Conditions for Planned Wind 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
							2022 SP
South Planning Region							
P1892	Fortis Buffalo Atlee Cluster 3 WAGF DER (REP #2)	Wind	01-Sep-20	553260	17.3	47 – Brooks	17.25
P1853	Fortis Buffalo Atlee Cluster 1 WAGF (REP #2)	Wind	01-Sep-20	552260	18.3	48-Empress	17.25
P2199	FortisAlberta Buffalo Atlee Cluster 2 (REP #2)	Wind	01-Sep-20	557261	13.8	48-Empress	13.8
P1719	Stirling WAGF Project (REP #2)	Wind	20-Nov-20	61630	113	54-Lethbridge	113
P2122	Cypress Wind Project Connection (REP #2)	Wind	01-Jun-21	560003	201.6	4-Medicine Hat	201.6

Project Number	Project Name	Project Type	Planned ISD	Bus No.	MC (MW)	AESO Planning Area No.	Unit Net Generation Dispatch[a] (MW) by Scenario
							2022 SP
P1533	Joss MPC WAGF (REP #3)	Wind	15-Aug-20	60798, 60799	120	48-Empress	122.4
P1698	Joss Jenner WAGF – Phase 2 (REP #3)	Wind	15-Aug-20	61798, 61799	180	48-Empress	71.4
P2041	TransAlta Windrise MPC Wind (REP #3)	Wind	01-Nov-20	567031	220	53-Fort Macleod	146.5
P1812	Suncor Forty Mile Granlea	Wind	01-June-20	61994, 62994	200	4-Medicine Hat	200
Subtotal (Southern Alberta)							**903.2**
Central Planning Region							
P1567	Sharp Hills Wind Farm	Wind	Nov 15, 2020	60831, 60832	300	42-Hanna	248.4
Subtotal (Central Alberta)							**248.4**
Total Planned							**1151.6**
Total Planned, Existing and Under Construction							**2764.7**

Note:

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

Table 4-13: Dispatch Conditions for Planned 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
							2022 SP
South Planning Region							
P1878	Fortis 257S Hull DER Solar	Solar	23-Dec-19	552402	24.5	52-Vauxhall	24.5
P1922	FortisAlberta Vauxhall Solar DER	Solar	23-Dec-19	554273	22	52-Vauxhall	22
P1879	Claresholm Solar	Solar	01-July-20	60894	130	49-Stavely	130
P2009	Greengate Travers MPC Solar	Solar	01-Dec-20	560026, 561026, 562026	400	49-Stavely	400
P1838	Fortis 895S Suffield DG PV	Solar	30-June-20	3270	22	4-Medicine Hat	22
Subtotal (Southern Alberta)							598.5
Central Planning Region							
P2097	Innisfail Solar DER	Solar	15-Dec-19	557120	22	39-Didsbury	22

Project Number	Project Name	Project Type	Planned ISD	Bus No.	MC (MW)	AESO Planning Area No.	Unit Net Generation Dispatch[a] (MW) by Scenario
							2022 SP
Subtotal (Central Alberta)							
Total Planned							**620.5**
Total Planned, Existing and Under Construction							**635.5**

The post-Project scenario renewable generation dispatch levels will be identical to the pre-Project scenario dispatch levels shown in Table 4-10 except that the existing Castle Rock Ridge will be switched off and the existing McBride Lake will be dispatched down (to 9 MW) as these facilities are far away from the Study Area. The Facility was dispatched to 145 MW in all post-Project scenarios. This will result in a total renewable dispatch consistent with the 2019 LTO's 2022 renewable generation forecast for 2022.

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 4-14.

For the 2028 WP scenario, which is only used to perform short-circuit studies, the intertie flow values should be set to the AESO planning base cases.

Table 4-14: Intertie Flows by Scenario

Scenario Number	Scenario Name	Import (-) / Export (+) (MW) by Intertie		
		AB-BC	AB-SK	MATL
1	2022 SP Pre-Project	-280	-150	-300
2	2022 SL Pre-Project	700	150	300
3	2022 WP Pre-Project	-280	-150	-300
4	2022 SP Post-Project	-280	-150	-300
5	2022 SL Post-Project	700	150	300
6	2022 WP Post-Project	-280	-150	-300
7	2028 WP Post-Project	Per AESO base case		
4a	2023 SP Post-Project with additional connection projects	0	-150	-130
4b	2023 SP Post-Project with additional connection projects and PENV	0	-150	-130
4c	2023 SP Post-Project with additional connection projects, PENV and CETO	0	-150	-130

4.2.6 HVDC Power Order Assumptions

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

For the 2028 WP scenario, the HVDC power order should be as per the AESO base cases and will not be adjusted.

Table 4-15: HVDC Power Order by Scenario

Scenario Number	Scenario Name	WATL (MW)*	EATL (MW)*
1	2022 SP Pre-Project	-325	-1000
2	2022 SL Pre-Project	-320	-725
3	2022 WP Pre-Project	-250	-1000
4	2022 SP Post-Project	-325	-1000
5	2022 SL Post-Project	-250	-750
6	2022 WP Post-Project	-250	-1000
7	2028 WP Post-Project	Per AESO base case	
4a	2022 SP Post-Project Sensitivity	-400	-1000
4b	2022 SP Post-Project Sensitivity	-1000	-1000
4c	2022 SP Post-Project Sensitivity	-1000	-1000

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 4-16. These limits must be maintained when performing the studies.

Table 4-16: 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 4-17 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.

In June 2020 ATCO submitted updates to facility ratings, after the base studies were completed and after the sensitivity studies began. ATCO submitted further updates to facility ratings in November 2020. These updated ratings are shown in the table below, but study results were only updated for the most limiting facilities for each contingency and where the updated facility rating is lower than the previous facility rating.

Table 4-17: Thermal Rating Assumptions for Key Transmission Lines in the Study Area

Line ID	Line Description	Voltage Class (kV)	Normal Rating (MVA)		Emergency Rating (MVA)	
			Summer	Winter	Summer	Winter
174L	Bardo 197S - 395S North Holden	138	85	90	94	99
408L[a]	Jarrow 252S - Wainwright 51S	138	75	79	83	87
472L	Metiskow 648S - Sunken Lake 221S Tap	138	121	150	133	153
472L	Sunken Lake 221S Tap - Hughenden 213S	138	121	150	133	165
679L	Nilrem 574S - Tucuman 478S	138	167CT	191	184	218
680L	Nilrem 574S - Tucuman 478S	138	167CT	191	184	218
681L	Tucuman 478S - Hardisty 377S	138	143	172	184	218
701L	North Holden 395S - Strome 223S	138	119	146	131	161
6L02	Battle River 757S - Marion Lake 873S	72	59	74	67	74
6L02	Marion Lake 873S - Stettler 769S	72	59	66CT	66CT	66CT
6L03	Battle River 757S - Sullivan Lake 775S	72	49CT	49CT	49CT	49CT
6L05	Heisler 764S - Battle River 757S	72	57	72	64	74CT
6L09	Oyen 767S - Hanna 763S	72	24CT	24CT	24CT	24CT
6L12	Sulivan Lake 775S - Coronation 773S	72	24CT	24CT	24CT	24CT
6L15	Hanna 763S - Sulivan Lake 775S	72	24CT	24CT	24CT	24CT
6L56	Hanna 763S - Michichi Creek 802S	72	37CT	37CT	37CT	37CT
701L	Heisler T-Tap - Strome 223S	138	158	191	174	213
703L	Hughenden 213S - HRT Express 329S Tap	138	121	145	133	160
703L	HRT Express 329S Tap - Hardisty 377S	138	96CT	96CT	133	143
704L	Wainwright 51S - Tucuman 478S	138	75	79	83	87
704L	Jarrow 252S - Jarrow 252S Tap	138	85	90	94	99
748L	Killarney Lake 267S - Hayter 277S	138	119	146	131	161
749L	Metiskow 648S - Killarney T-Tap	138	122	150	134	163
749L	Edgerton 899S - Killarney T-Tap	138	96CT	96CT	134	143

Line ID	Line Description	Voltage Class (kV)	Normal Rating (MVA)		Emergency Rating (MVA)	
			Summer	Winter	Summer	Winter
749L/7L749	Edgerton 899S - Briker Tap	138	96CT	96CT	130	140
760L	Empress Liquid 164S tap - Bindloss 914S Tap	138	120	142	132	156
760L	Empress Liquid 164S tap - Amoco Empress 163S	138	120	148	132	163
760L	Amoco Empress 163S - Empress 394S	138	119	146	131	161
760L/7L760	Empress Liquid 164S tap - Bindloss Tap	138	109.3	139	123.6	142.8CT
769L	Hardisty 377S - Rosyth	138	86	115	95	127
7L110	Monitor 774S - Loyalist 903S	144	99CT	99CT	99CT	99CT
7L116	Excel 910S - Lanfine 959S	144	99CT	99CT	99CT	99CT
7L117	Vermilion 710S - Irish Creek 706S	144	131	166	147	189
7L127	Pemukan 932S - Monitor 774S	144	151 bus cond.	190 bus cond.	194 bus cond.	254 bus cond.
7L128	Coyote Lake 963S - Michichi Creek 802S	144	117 bus cond.	147 bus cond.	144 bus cond.	185 bus cond.
7L129	Buffalo Creek 526S - Vermilion 710S	144	129	161	138	178
7L130	Vermilion 710S - Kitscoty 705S	144	114	151	125	170
7L132	Lanfine 959S - Oyen 767S	144	117 bus cond.	147 bus cond.	144 Bus cond.	179 Prot.
7L137	Three Hills 770S - Rowley 768S	144	113	149	126	171
7L139	Whitby Lake 819S - Norberg 936S Tap	144	114	151	127	173
7L139	Norberg 936S Tap - St. Paul 707S	144	114	151	127	173
7L14	Kitscoty 705S - Hill 751S	144	114	151	125	170
7L143	Nevis 766S - Stettler 769S	144	100CT	100CT	100CT	100CT
7L153	Wintering Hils 804S - Wheatland 609S	144	185	199CT	199CT	199CT
7L159	Three Hills 770S - Ghostpine Tap	144	112	149	124	150CT
7L159	Heatburg 948S - Ghostpine Tap	144	112	149	124	167CT
7L16	Nevis 766S - Heatburg 948S	144	112	133CT	125	133CT
7L171	Michichi Creek 802S - Wintering Hills 804S	144	112	147	127	150CT

Line ID	Line Description	Voltage Class (kV)	Normal Rating (MVA)		Emergency Rating (MVA)	
			Summer	Winter	Summer	Winter
7L224	Hansman Lake 650S - Monitor 774S	144	113	150	125	171
7L25	Michichi Creek 802S - Rowley 768S	144	114	154	128	177
7L134 (Future Line)	Future Vincent 2019S - Vegreville 709S	144	114	146	127	157
7L42	Hill 751S - Lloydminster 716S	144	130	150CT	142	150CT
7L50	Battle River 757S - Jarrow 252S Tap	144	114	150GS	122	150GS
7L53	Irish Creek 706S - Lindberg 969S Tap	144	130	162	145	185
7L53	Lindberg 969S Tap - Bonnyville 700S	144	130	162	145	185
7L65	Vermilion 710S - Future Vincent 2019S	144	114	146	127	172
7L70	St. Paul 707S - Bonnyville 700S	144	115	152	128	174
7L77	North Holden 395S - Vegreville 709S	138	114	151	125	169
7L701	Battle River 757S - Strome IPL	144	148	200	166	239
7L702	Battle River 757S - Sedgewick 137S Tap	144	115	155	128	177
702L	Sedgewick 137S tap - Hardisty 377S	138	87	135	96	146
7L749	Lloydminster 716S - Briker Tap	144	114	151	126	170
7L760	Oyen 767S - Bindloss 914S Tap	144	115	153	128	175
7L79	Pemukan 932S - Ribstone Creek 892S	144	114	145	129	157
7L85	Wintering Hills 804S - Bullpound 803S Tap	144	117 bus cond.	147 bus cond.	144 bus cond.	184 bus cond.
7L85	Bullpound 803S Tap - Anderson 801S	144	145	193	173	199CT
7L92	Vegreville 709S - Whitby Lake 819S (All segments)	144	114	133CT	126	133CT
7LA159	Ghost Pine 114S - 7L159 Tap	144	114	145	129	149CT
7LA701	Heisler 764S - Heisler Tap	144	133CT	133CT	133CT	133CT
885L	Metiskow 648S - Hansman Lake 650S	138	287	287	344	373
912L/ 9L912	Nevis 766S - Red Deer 63S*	240	507	624CT (ATCO)	558	624CT (ATCO)
931L	Ware Junction 132S - West Brooks 28S	240	592	665	654	773
953L	Cordel 755S - Nilrem 574S	240	544	663CT	641	663CT

Line ID	Line Description	Voltage Class (kV)	Normal Rating (MVA)		Emergency Rating (MVA)	
			Summer	Winter	Summer	Winter
954L	Metiskow 648S - Hansman Lake 650S	240	333CT	333CT	499CT	499CT
9L16	Tinchebray 972S - Cordel 755S	240	499CT	499CT	499CT	499CT
9L20*	Nevis 766S - Cordel 755S	240	488	623.5CT	558	623.5CT
9L24	Oakland 946S - Lanfine 959S	240	740	831SG	831SG	831SG
9L27	Paintearth 863S - Cordel 755S	240	442CT	442CT	442CT	442CT
9L29	Oakland 946S - Coyote Lake 963S	240	740	831SG	831SG	831SG
9L46	Lanfine 959S - Pemukan 932S	240	755	831CT	831CT	831CT
9L51[b]	Sedalia 363S - Pemukan 932S	240	753	831	866	1049
9L59	Tinchebray 972S - Anderson 801S	240	499SG	499SG	499SG	499SG
9L70	Anderson 801S - Oakland 946S	240	499SG	499SG	499SG	499SG
9L79	Battle River 757S - Cordel 755S	240	499CT	499CT	499CT	499CT
9L80	Battle River 757S - Cordel 755S	240	499CT	499CT	499CT	499CT
9L93	Halkirk 615S - Tinchebray 972S	240	378	520	517	733
9L933	Anderson 801S - Ware Junction 132S	240	550	748	651	831SG
9L934	Anderson 801S - Ware Junction 132S	240	499SG	499SG	499SG	499SG
9L948	Paintearth 863S - Hansman Lake 650S	240	442CT	442CT	442CT	442CT
9L950	Anderson 801S - Ware Junction 132S	240	499SG	499SG	499SG	499SG
9L953	Cordel 755S - Nilrem 574S	240	544	663CT	641	663CT
9L966	Pemukan 932S - Hansman Lake 650S	240	442CT	442CT	442CT	442CT
9L97	Anderson 801S - Oakland 946S	240	499SG	499SG	499SG	499SG
9L99	Sheerness 807S - Anderson 801S	240	470	499SG	499SG	499SG
9L100	Sheerness 807S - Anderson 801S	240	470	499SG	499SG	499SG
1047L	Nilrem 574S - Hansman Lake 650S	240	499CT	499CT	680	748CT

Note:

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

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

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

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

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

The TFOs provided the details of the substation transformers in the Study Area. The key transformers in the Study Area are shown in Table 4-18.

Table 4-18: Summary of Key Transformer Ratings in the Study Area

Substation Name and Number	Transformer ID	Transformer Voltages (kV)	Transformer Rating (MVA)
Anderson 801S	901T	240/144	125CT
Battle River 757S	912T	240/144	299CT
	701T	144/72	75
Nevis 766S	901T	240/144	100CT
	701T	144/25	12/16/20
Nilrem 574S	T1	240/138	400
	T2	240/138	400
Metiskow 648S	T3	240/138	200
Hansman Lake 650S	T1	240/138	200
	T3	240/18	200

The TFOs provided the details of the shunt elements in the Study Area. The key shunt elements in the Study Area are shown in Table 4-19.

Table 4-19: Summary of Key Shunt Elements in the Study Area

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

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)
Killarney Lake 267S	138	1 x 9.10 MVAr + 2 x 10.90 MVAr	30.90	-	-
Lloydminster 716S	138	1 x 18.37 MVAr	18.37	-	-
Tucuman 478S	138	1 x 27.17 MVAr	27.17	-	-
Vermilion 710S	138	1 x 22.96 MVAr	22.96	-	-
Lanfine 959S	34.5	1 x 200 MVAr	200	1 x -100 MVAr	-100
	138	2 x 27.55 MVAr	55.10	-	-
Monitor 774S	138	1 x 18.38 MVAr + 1 x 27.55 MVAr	45.93	-	-
Pemukan 932S	138	2 x 27.55 MVAr	55.10	-	-

4.2.8 Protection Fault Clearing Times

The transient stability studies will be performed using the actual fault clearing times for the selected contingencies, as provided by the TFOs and as shown in Table 4-20. Only those contingencies shown in Table 4-20 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 4-20: Protection Fault Clearing Times

Contingency (System Element Lost)				Fault Location	Clearing Times	
Transmission Line ID	Nominal Bus Voltage (kV)	Terminal Location				
		Terminal 1	Terminal 2		Terminal 1	Terminal 2
9L24	240	Oakland 946S	Lanfine 959S	Oakland 946S	5 cycles	6 cycles
9L24	240	Lanfine 959S	Oakland 946S	Lanfine 959S	5 cycles	6 cycles
9L46	240	Lanfine 959S	Pemukan 932S	Lanfine 959S	5 cycles	6 cycles
9L46	240	Lanfine 959S	Pemukan 932S	Pemukan 932S	5 cycles	6 cycles
9L29	240	Oakland 946S	Coyote Lake 963S	Oakland 946S	5 cycles	6 cycles

9L29	240	Coyote Lake 963S	Oakland 946S	Coyote Lake 963S	5 cycles	6 cycles
9L16	240	Cordel 755S	Tinchebray 972S	Cordel 755S	5 cycles	6 cycles
9L16	240	Tinchebray 972S	Cordel 755S	Tinchebray 972S	5 cycles	6 cycles
9L966	240	Pemukan 932S	Hansman Lake 650S	Pemukan 932S	5 cycles	6 cycles
9L966	240	Hansman Lake 650S	Pemukan 932S	Hansman Lake 650S	5 cycles	6 cycles
9L20	240	Cordel 755S	Nevis 766S	Cordel 755S	5 cycles	6 cycles
9L20	240	Nevis 766S	Cordel 755S	Nevis 766S	5 cycles	6 cycles
912L	240	Red Deer 63S	Nevis 766S	Red Deer 63S	5 cycles	6 cycles
912L	240	Nevis 766S	Red Deer 63S	Nevis 766S	5 cycles	6 cycles
9L59	240	Tinchebray 972S	Anderson 801S	Tinchebray 972S	5 cycles	6 cycles
9L59	240	Anderson 801S	Tinchebray 972S	Anderson 801S	5 cycles	6 cycles

4.2.9 Project Dynamic Data

Dynamic data for the Project can be found in Attachment A7.

4.2.10 Voltage Profile Assumption

ID #2010-007RS will be used to establish system normal (i.e., pre-contingency) voltage profiles for key area busses prior to commencing any studies. Table 2-1 of the *Transmission Planning Criteria – Basis and Assumptions* applies for the busses not included in ID #2010-007RS. These voltages will be used to set the voltage profile for the study base cases prior to the power flow studies.

5 Study Methodology

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

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

Scenario No. and Name		Power Flow		Voltage Stability		Transient Stability		Motor Starting		Short Circuit
		Category		Category		Category		Category		Category A
		A	B	A	B	A	B	A	B	
Pre-Project										
1	2022 SP	X	X			X*	X*			
2	2022 SL	X	X			X*	X*			
3	2022 WP	X	X			X*	X*			X
Post-Project										
4	2022 SP	X	X			X	X			
5	2022 SL	X	X			X	X			
6	2022 WP	X	X			X	X			X
7	2028 WP									X
Post-Project Sensitivity										
4a	2022 SP with additional connection projects	X	X							
4b	2022 SP with additional connection projects and PENV	X	X							
4c	2022 SP with additional connection projects, PENV and CETO	X	X**							

*Only required if post-Project transient stability studies show potential stability issues

**Only for EATL and 9L966 contingency

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 as well as for the loss of the EATL HVDC line.

5.2 Transient Stability Studies

The Keephills Unit 3 in 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 and Battle River units. The results report must also provide the 500 kV, 240 kV and 138 kV bus voltage levels for substations near the point of connection. Other busses will be monitored and will be reported as determined by the results. The results report must also provide the key branch active and reactive power flow surrounding the Facility.

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

5.2.1 Contingencies to be Studied

Transient stability studies will be performed for the contingencies shown in Table 4-20

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.

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

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

- Anderson 801S
- Bindloss 914S
- Excel 910S
- Hansman Lake 650S
- Lanfine 959S
- Monitor 774S
- Pemukan 923S
- Oakland 946S
- Oyen 767S
- Sheerness 807S
- Buffalo Bird 601S

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 are based on the AESO's current corporate forecast (2017 LTO and 2019 LTO) with modifications to incorporate the latest forecast intelligence. Sensitivity studies or restudy may be required in the event of revisions to the AESO's corporate forecast, forecast intelligence, or other study assumptions. Additional engineering studies may also be required to assess new connection alternatives, changes to project ISD, or delays in proposed system developments. Any additional or revised study requirements shall be captured in a signed Study Scope Amendment document.

Attachment A: Transmission Planning Criteria – Basis and Assumptions

Transmission Planning Criteria – Basis and Assumptions

Date: July 9, 2019

Version: V1.2

Alberta Electric System Operator

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

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

www.aeso.ca

@theaeso

1. Introduction

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

2. Transmission Reliability Standards and Criteria[1]

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

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

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

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

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

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

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

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

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

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

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

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

2.1 Thermal Loading Criteria

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

2.2 Voltage Range and Voltage Stability Criteria

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

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

Nominal Voltage	Extreme Minimum	Normal Minimum	Normal Maximum	Extreme Maximum
500	475	500	525	550
240	216	234	252	264
260 (Northeast & Northwest)*	234	247	266	275
144	130	137	151	155
138	124	135	145	152
72	65	68.5	75.5	79
69	62	65.5	72.5	76

Table 2-2: Voltage Stability Criteria

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

2.3 Transient Stability Analysis Assumptions

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

Table 2-3: Fault Clearing Times

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

Table 2-4: Stuck Breaker Clearing Times for Lines

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

Table 2-5: Stuck Breaker Clearing Times for Transformers

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

Attachment A2

Pre-Project Power Flow Diagrams

Table of Contents

Scenario 1 (2022SP) 4

Figure A-S1-1: Category A Power Flow 5

Figure B-S1-2: Category B Power Flow, Contingency: 395ST1 (N.Holden 395S 138kV/25kV transformer) 6

Figure B-S1-2: Category B Power Flow, Contingency: 526ST1/526ST2 (Buffalo Crk. 526S 138kV/25kV transformer) 7

Figure B-S1-3: Category B Power Flow, Contingency: 648ST1 (Metiskow 648S 138kV/25kV transformer) 8

Figure B-S1-4: Category B Power Flow, Contingency: 749L\749AL (Metiskow 648S-Edgerton 899S) 9

Figure B-S1-5: Category B Power Flow, Contingency 757S912T (Battle River 757S transformer) 10

..... 10

Figure B-S1-6: Category B Power Flow, Contingency: 766S901T (Nevis 766S 240kV/138kV transformer) 11

Figure B-S1-7: Category B Power Flow, Contingency: 7L129\7LA129 (Buffalo Crk. 526S-Vermilion 710S) 12

Figure B-S1-8: Category B Power Flow, Contingency: 7L42(Lloydminster716S-Hill751S) 13

Figure B-S1-9: Category B Power Flow, Contingency: 7L50 (Buffalo Crk. 526S-Battle River 757S) 14

Figure B-S1-10: Category B Power Flow, Contingency: 7L701\7LA701\701L (Strome 223S-Battle River 757S) 15

..... 15

Figure B-S1-11: Category B Power Flow, Contingency: 7L749\749L\7LB749 (Lloydminster 716S-Edgerton 899S) 16

Figure B-S1-12: Category B Power Flow, Contingency: 899ST3a (Edgerton 899S 138kV/25kV transformer) ... 17

Figure B-S1-13: Category B Power Flow, Contingency: 912L \9L912 (Red Deer 63S-Nevis 766S) 18

Figure B-S1-14: Category B Power Flow, Contingency: 966L\9L966 (Hansman Lk. 650S-Pemukan 932S) 19

Figure B-S1-15: Category B Power Flow, Contingency: 9L20 (Cordel 755S-Nevis 766S) 20

Figure B-S1-16: Category B Power Flow, Contingency: 9L80 (Cordel 755S-Battle River 757S) 21

Figure B-S1-16: Category B Power Flow, Contingency: EATL 22

Scenario 2 (2022SL) 23

Figure A-S2-1: Category A Power Flow 24

Figure B-S2-1: Category B Power Flow, Contingency: 9L20 25

Figure B-S2-2: EATL 26

Scenario 3 (2022WP) 27

Figure A-S3-1: Category A Power Flow 28

Figure B-S3-1: Category B Power Flow, Contingency: 478ST1 or 478ST2 (Tucuman 478S 138kV/25 kV transformer) 29

Figure B-S3-2: Category B Power Flow, Contingency: 526ST1/526ST2 (Buffalo Crk. 526S 138kV/25kV transformer) 30

Figure B-S3-3: Category B Power Flow, Contingency: 648ST1 (Metiskow 648S 138kV/25kV transformer) 31

Figure B-S3-4: Category B Power Flow, Contingency: 766S901T (Nevis 766S 240kV/138kV transformer) 32

Figure B-S3-5: Category B Power Flow, Contingency: 7L129 \ 7LA129 (Buffalo Crk. 526S-Vermilion 710S) 33

Figure B-S3-6: Category B Power Flow, Contingency: 7L50 (Buffalo Crk. 526S-Battle River 757S) 34

Figure B-S3-7: Category B Power Flow, Contingency: 7L701 \ 7LA701 \ 701L (Strome 223S-Battle River 757S) 35

Figure B-S3-9: Category B Power Flow, Contingency: 899ST3a (Edgerton 899S 138kV/25kV transformer) 37

Figure B-S3-10: Category B Power Flow, Contingency: 912L \ 9L912 (Red Deer 63S-Nevis 766S) 38

Figure B-S3-11: Category B Power Flow, Contingency: 9L20 (Cordel 755S-Nevis 766S) 39

Figure B-S3-12: Category B Power Flow, Contingency: 9L80 (Cordel 755S-Battle River 757S) 40

Figure B-S3-13: Category B Power Flow, Contingency: EATL 41

A2.1

Scenario 1 (2022SP)

Figure A-S1-1: Category A Power Flow

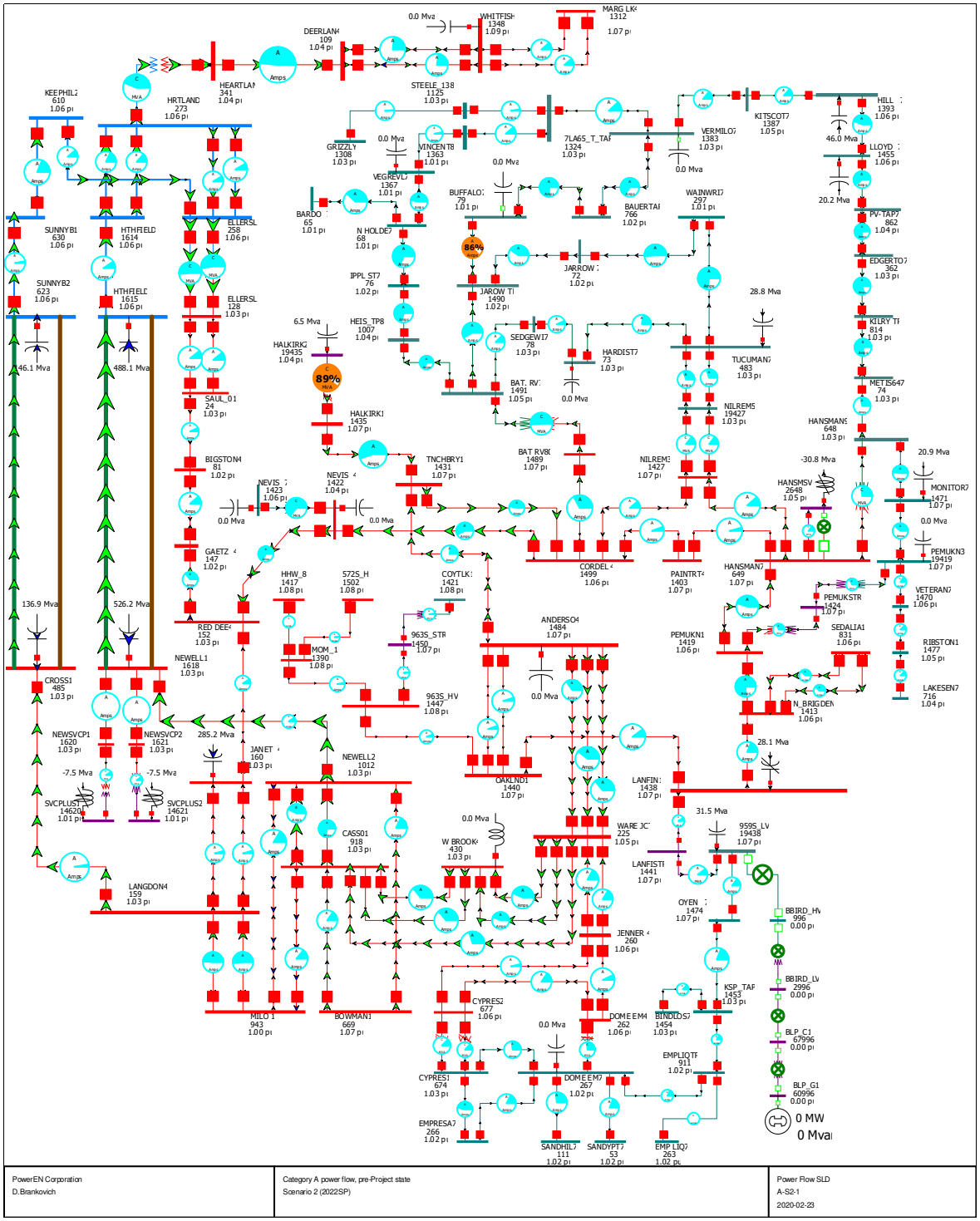


Figure B-S1-2: Category B Power Flow, Contingency: 395ST1 (N.Holden 395S 138kV/25kV transformer)

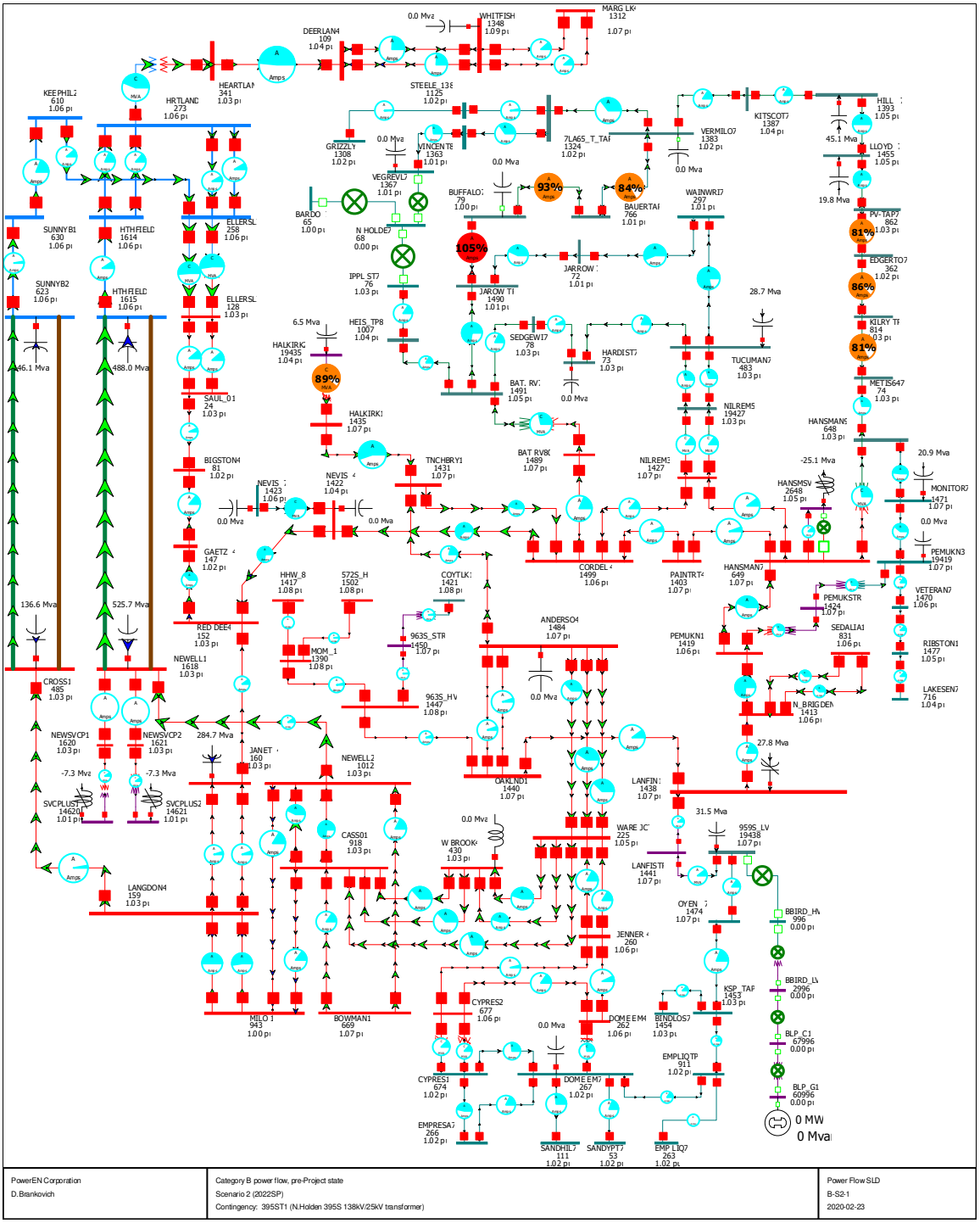


Figure B-S1-2: Category B Power Flow, Contingency: 526ST1/526ST2 (Buffalo Crk. 526S 138kV/25kV transformer)

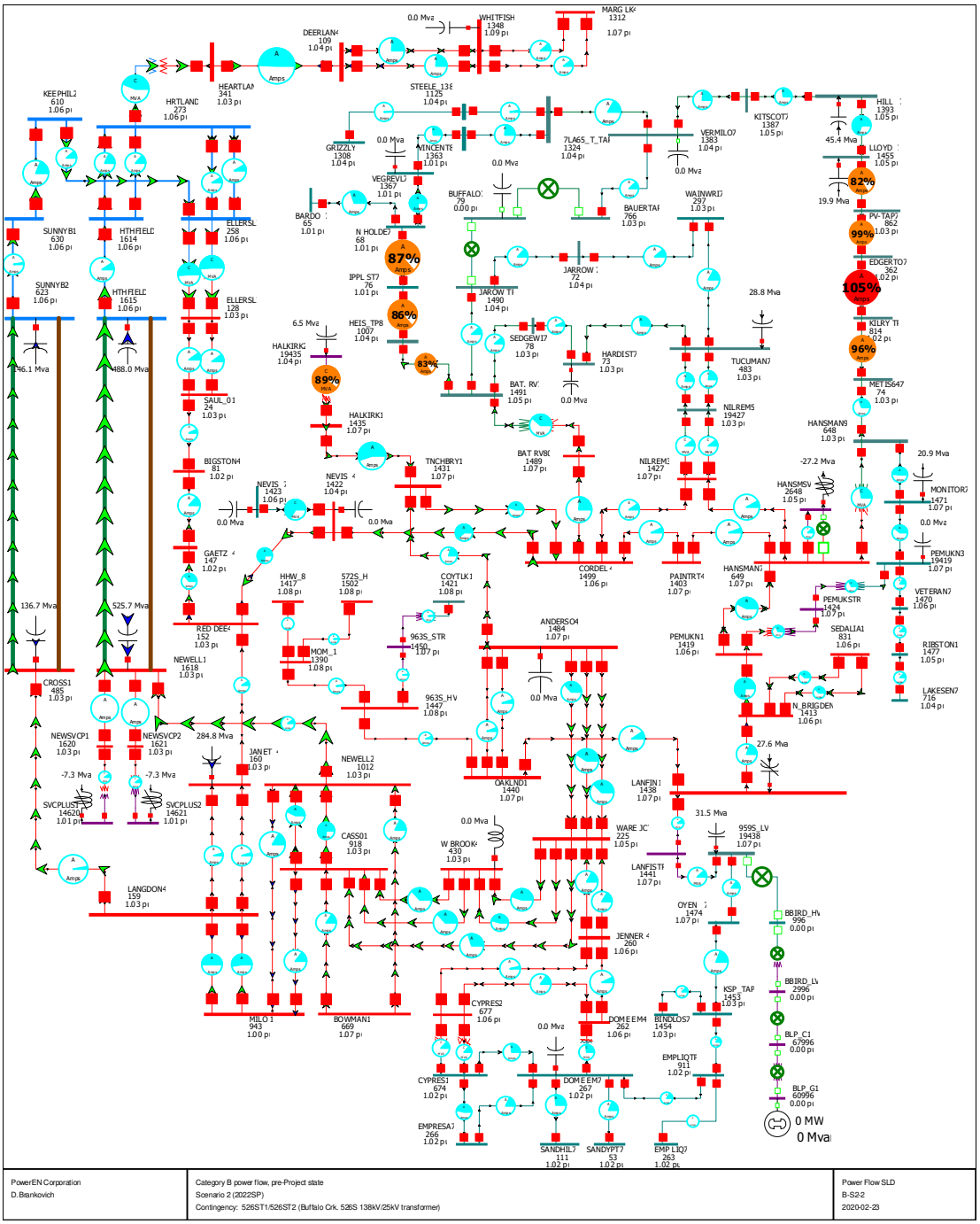


Figure B-S1-3: Category B Power Flow, Contingency: 648ST1 (Metiskow 648S 138kV/25kV transformer)

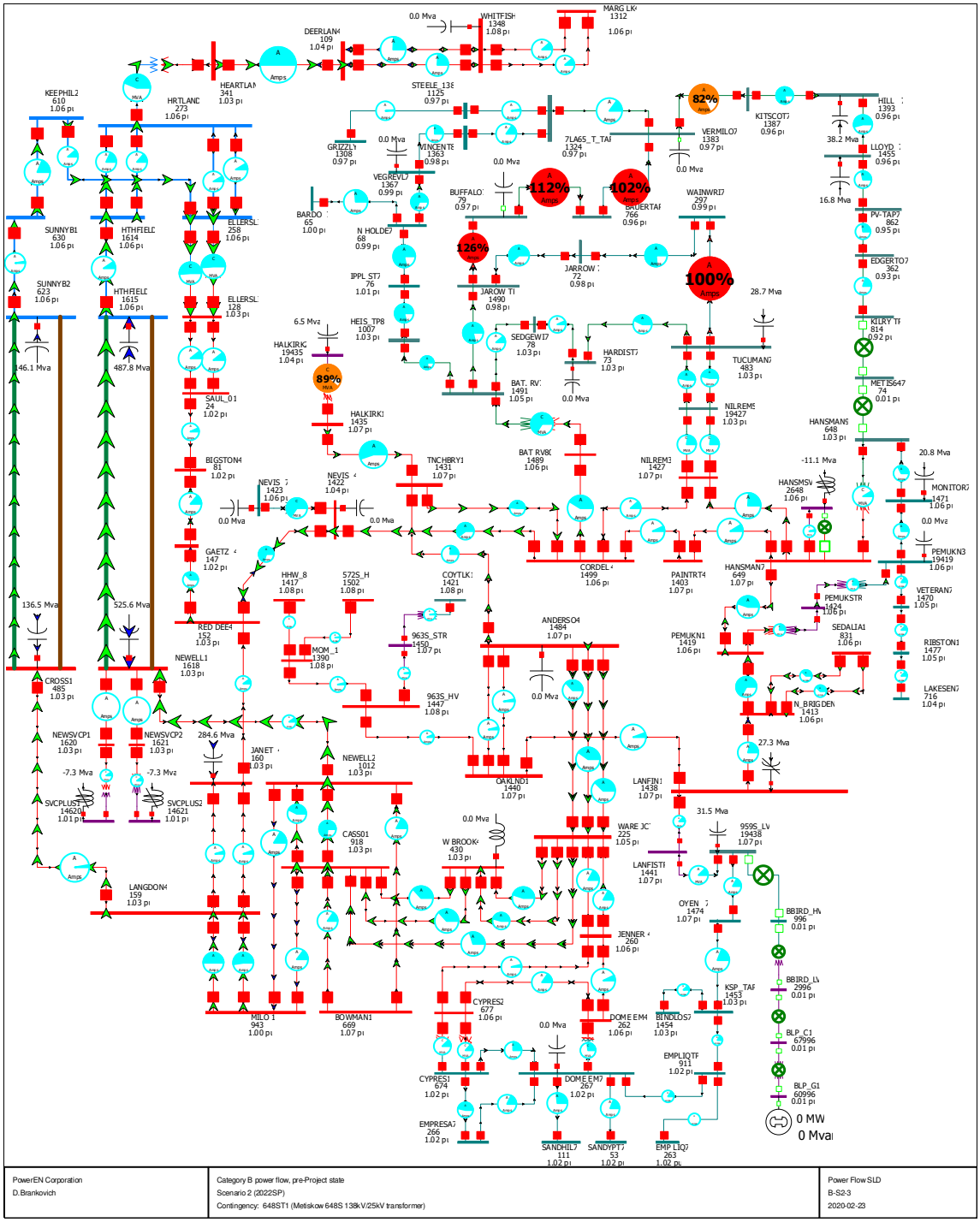


Figure B-S1-4: Category B Power Flow, Contingency: 749L\749AL (Metiskow 648S-Edgerton 899S)

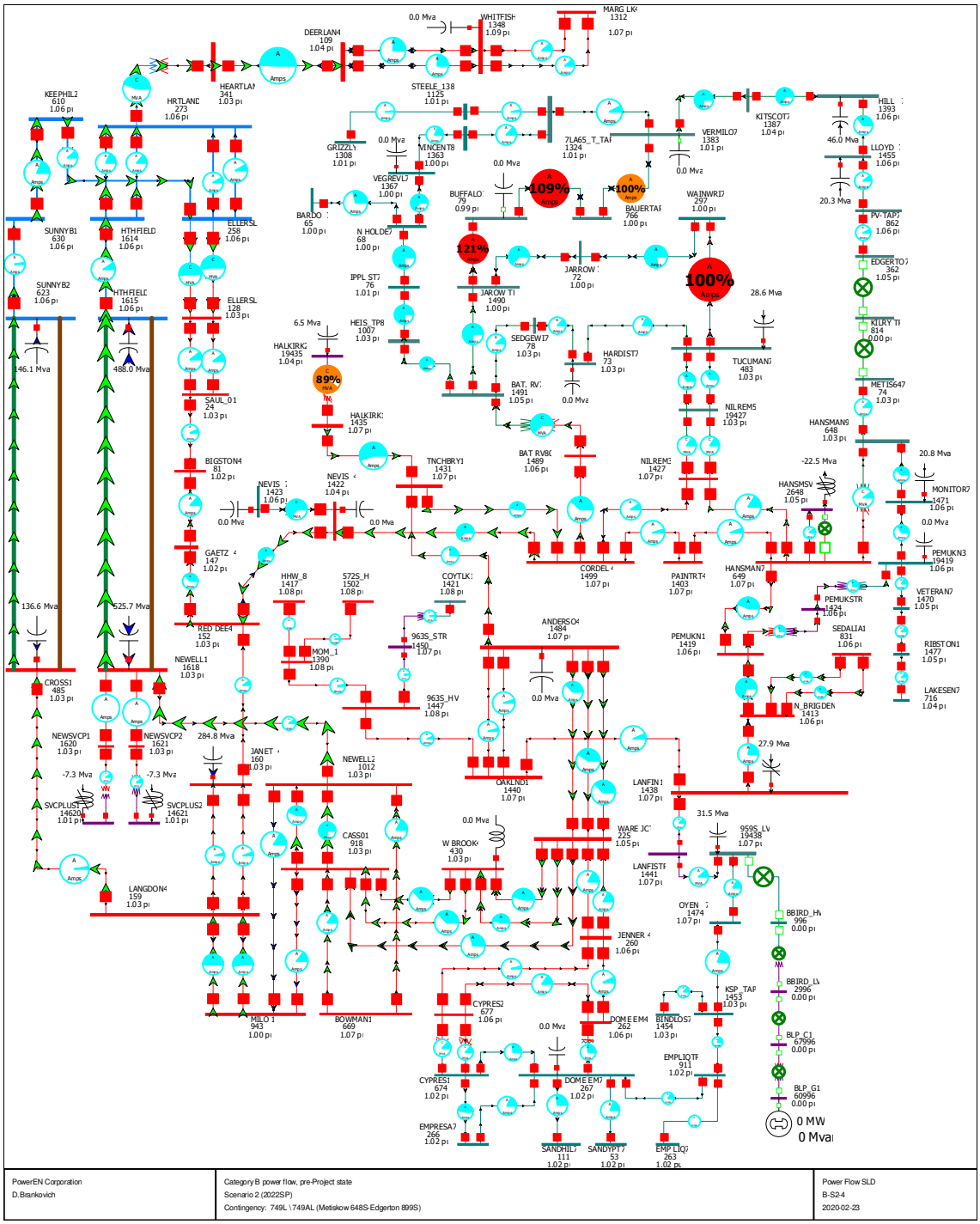


Figure B-S1-5: Category B Power Flow, Contingency 757S912T (Battle River 757S transformer)

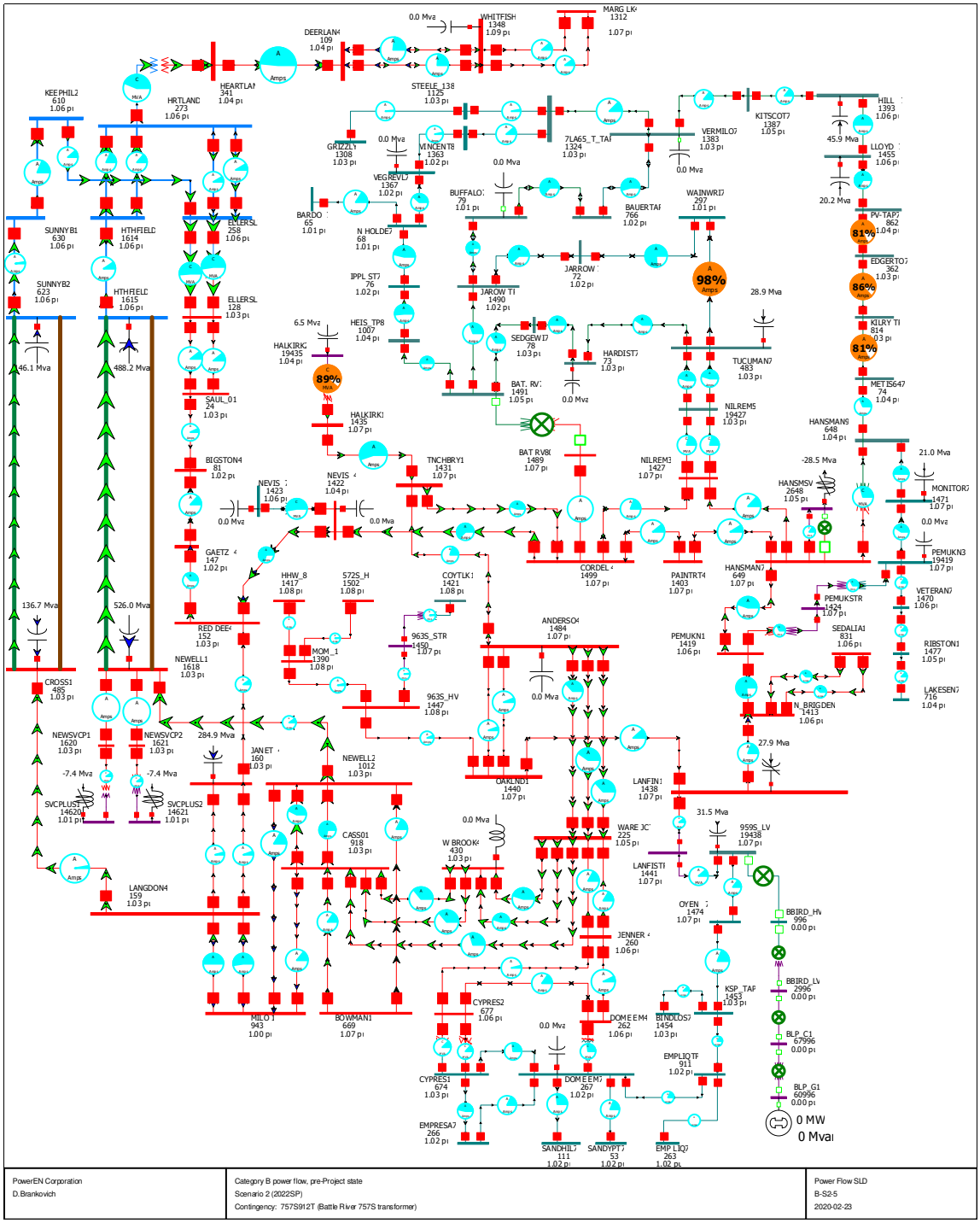


Figure B-S1-6: Category B Power Flow, Contingency: 766S901T (Nevis 766S 240kV/138kV transformer)

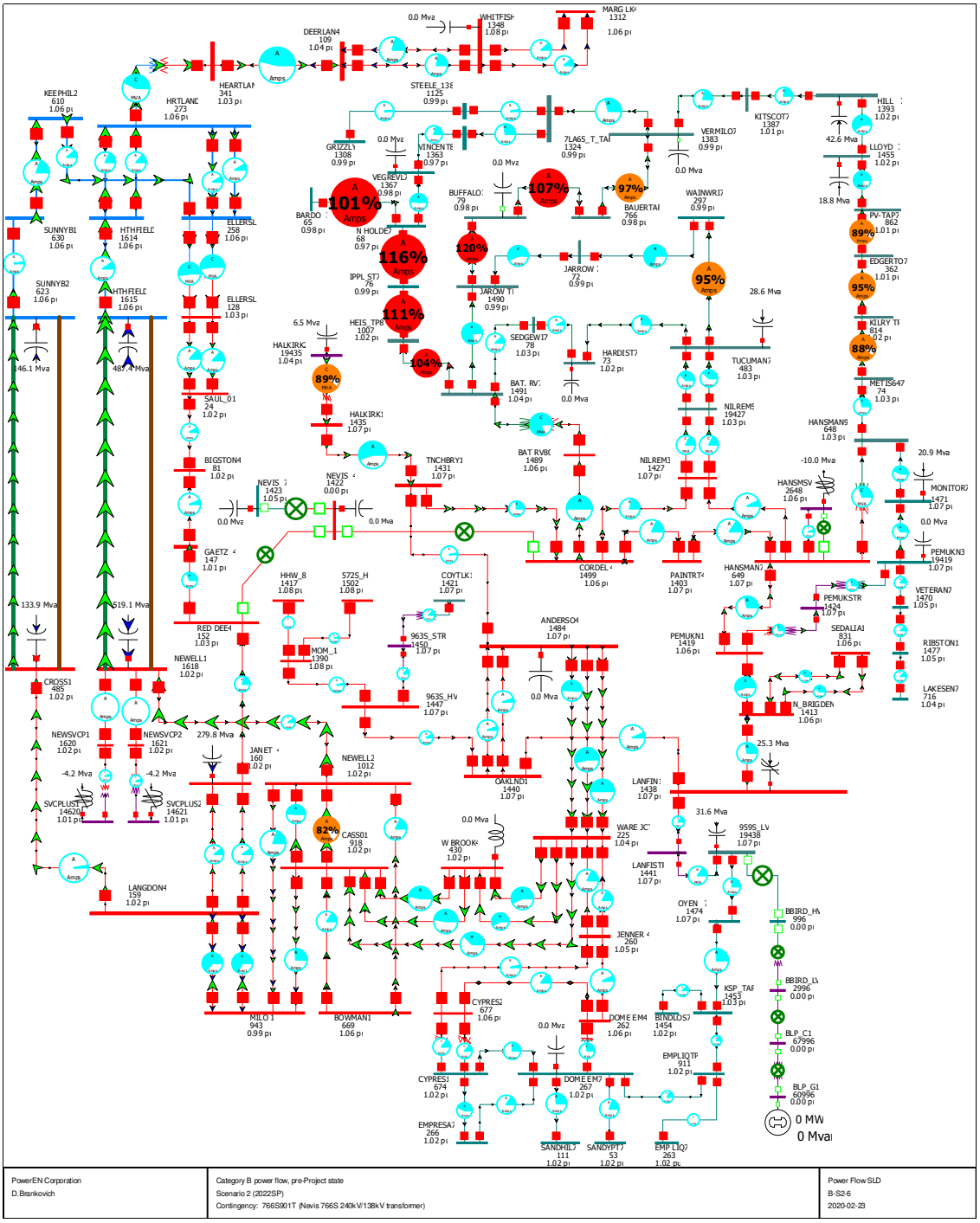


Figure B-S1-7: Category B Power Flow, Contingency: 7L129\7LA129 (Buffalo Crk. 526S-Vermilion 710S)

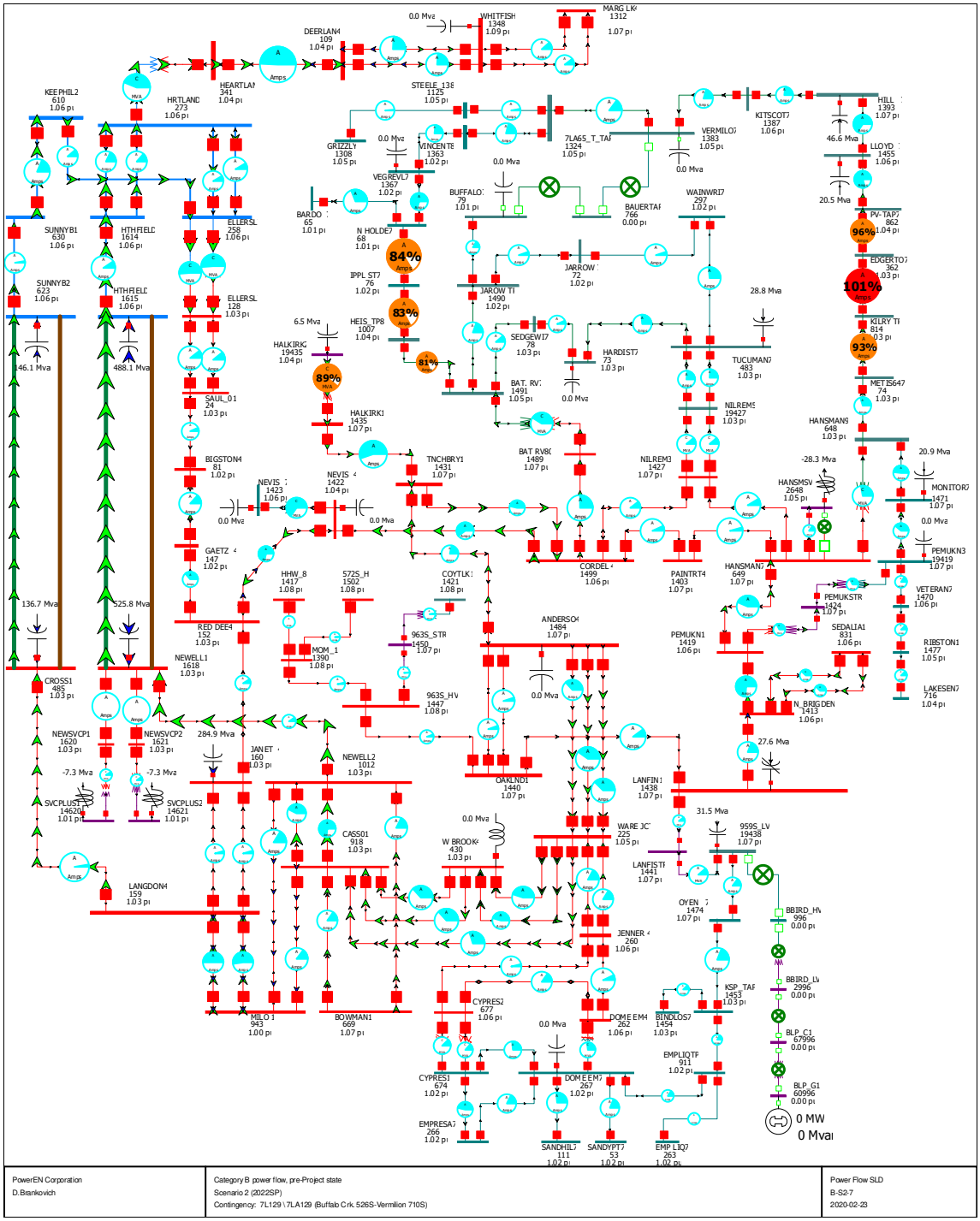


Figure B-S1-8: Category B Power Flow, Contingency: 7L42(Lloydminster716S-Hill751S)

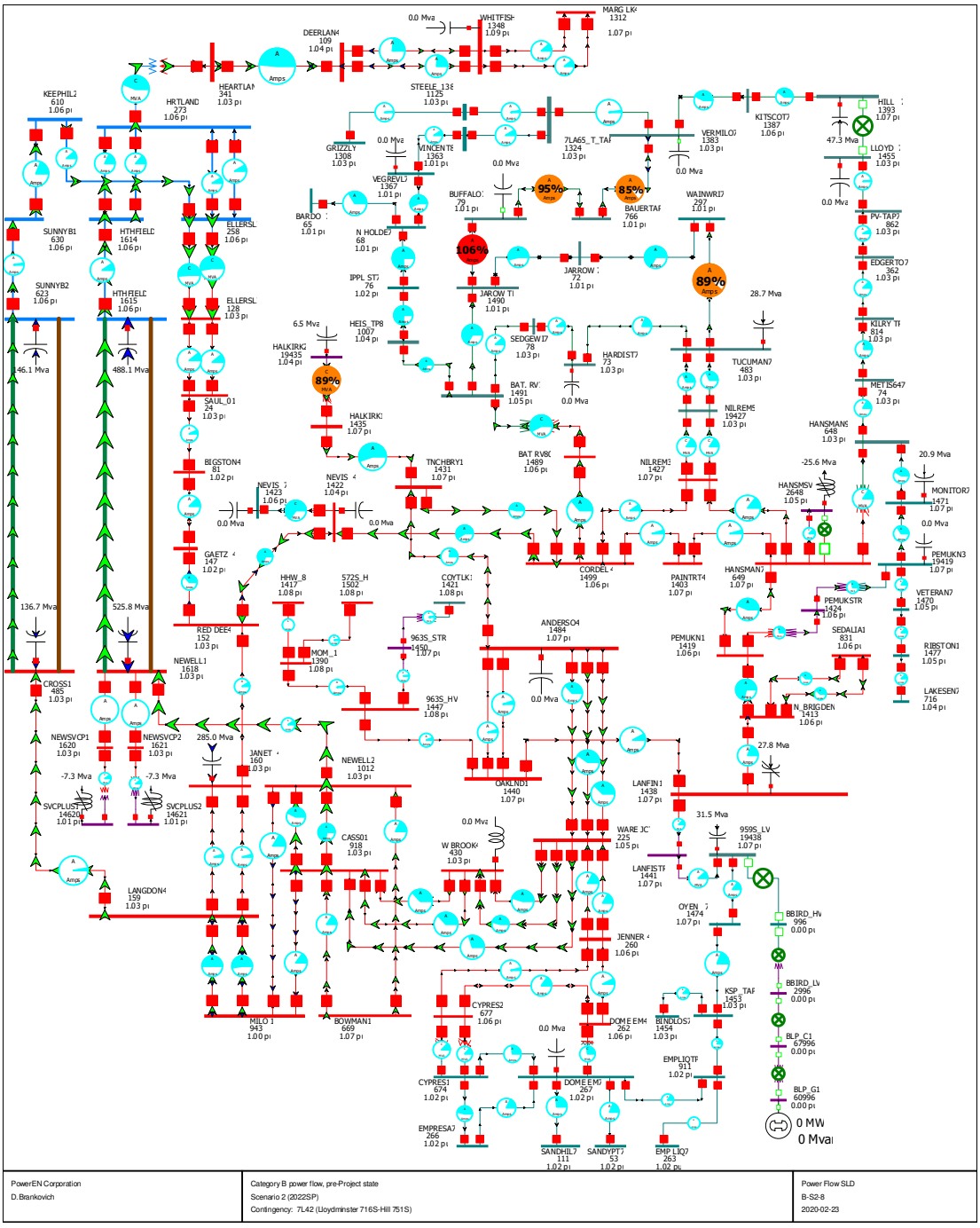


Figure B-S1-9: Category B Power Flow, Contingency: 7L50 (Buffalo Crk. 526S-Battle River 757S)

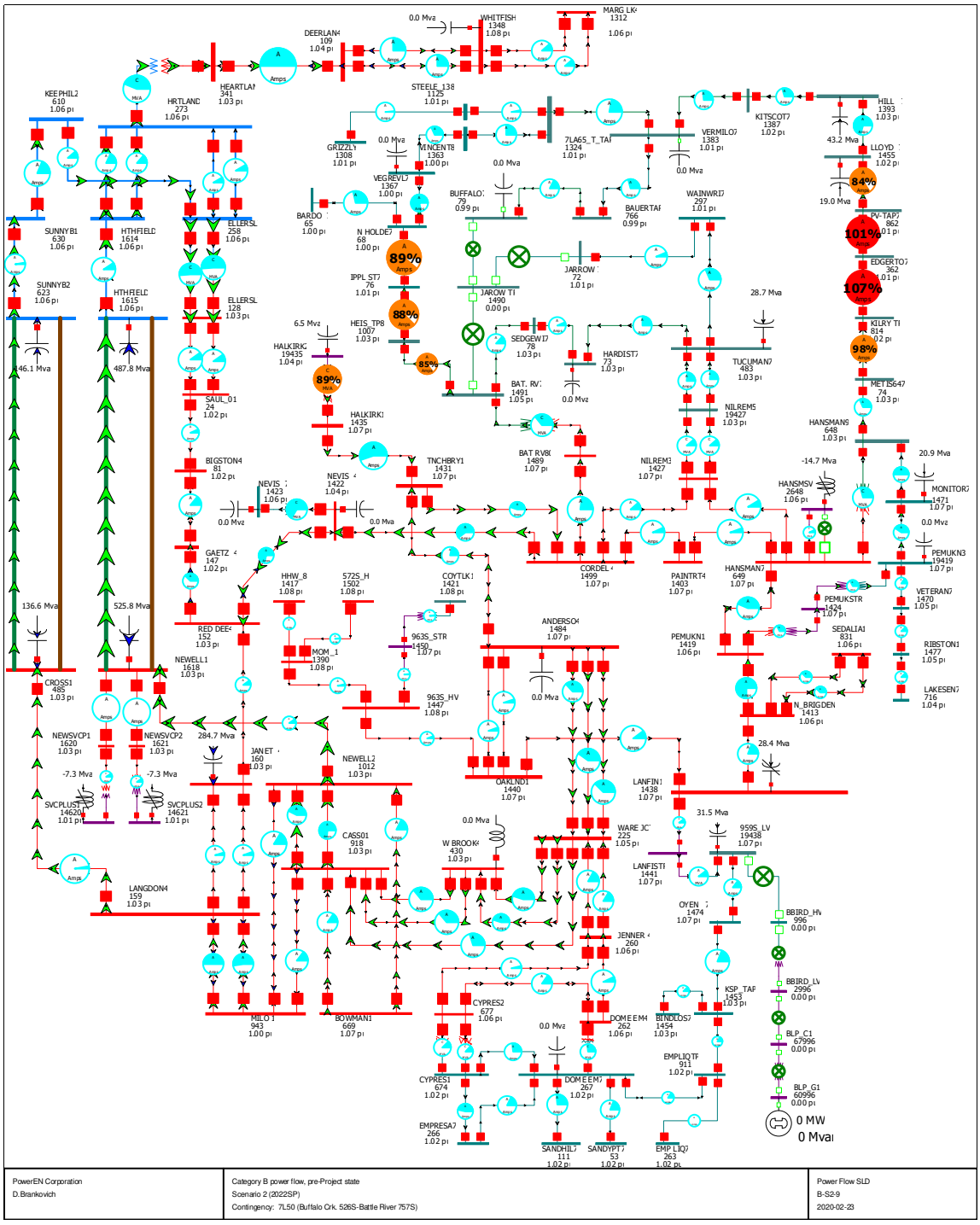


Figure B-S1-10: Category B Power Flow, Contingency: 7L701\7LA701\701L (Strome 223S-Battle River 757S)

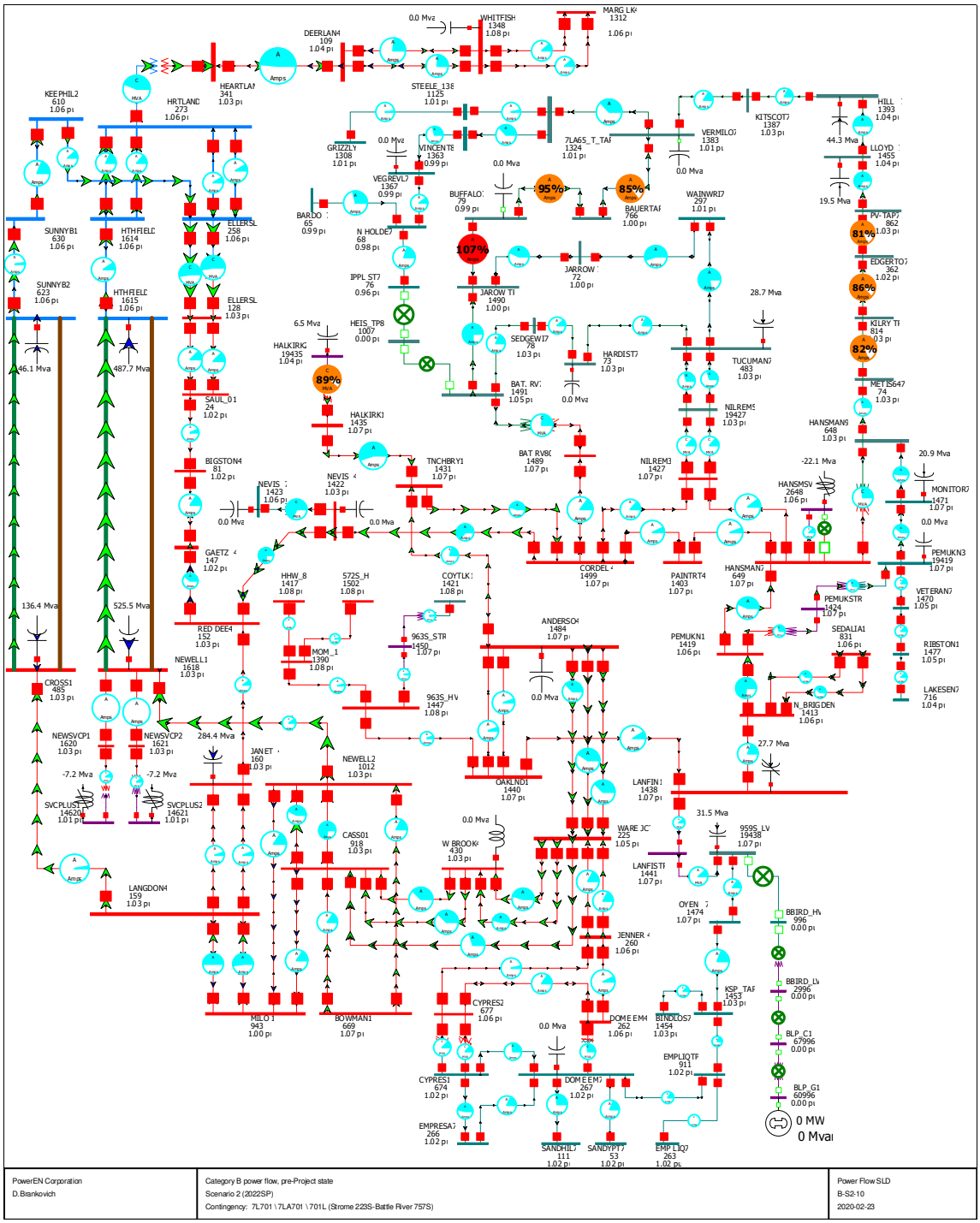


Figure B-S1-11: Category B Power Flow, Contingency: 7L749\749L\7LB749 (Lloydminster 716S-Edgerton 899S)

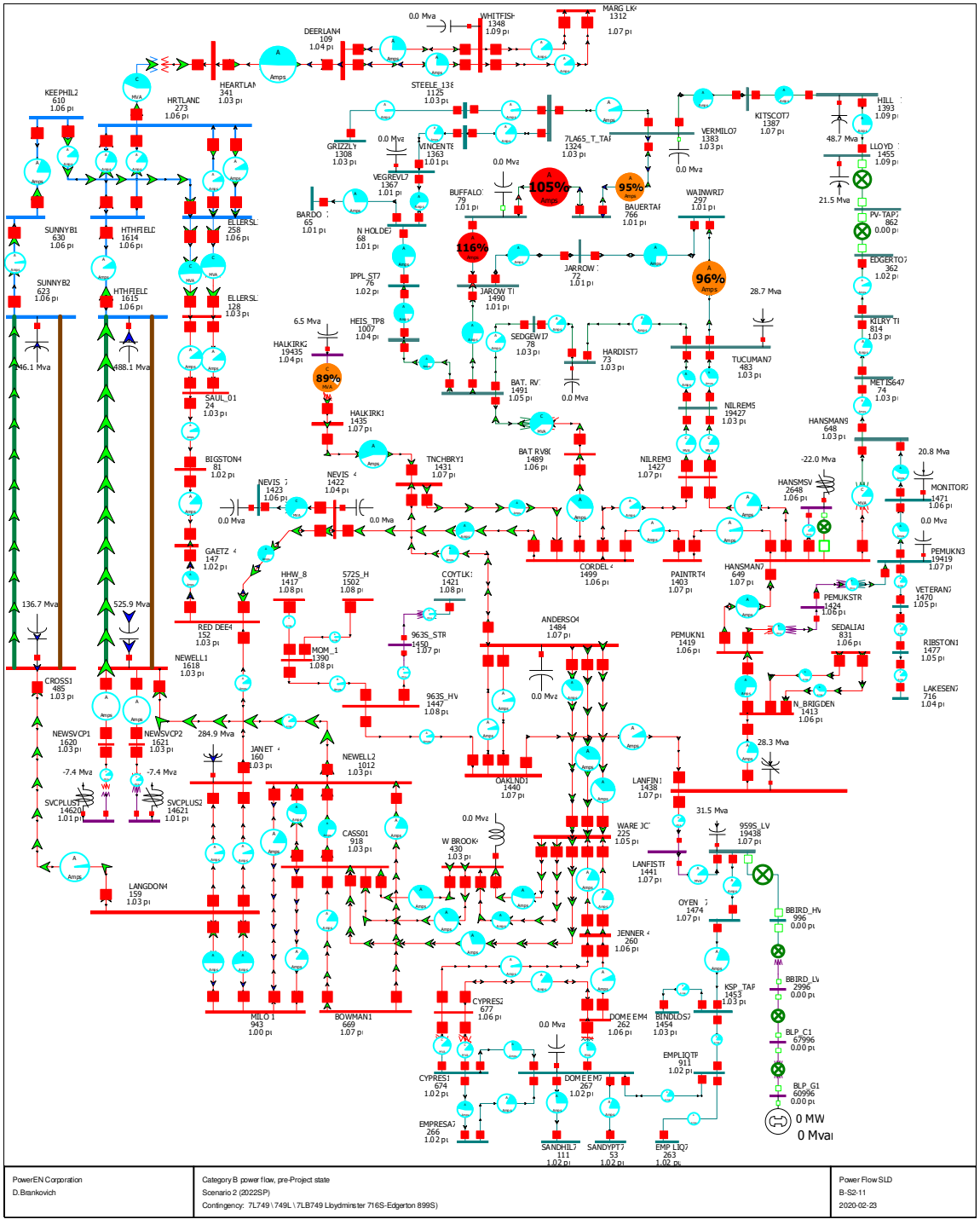


Figure B-S1-12: Category B Power Flow, Contingency: 899ST3a (Edgerton 899S 138kV/25kV transformer)

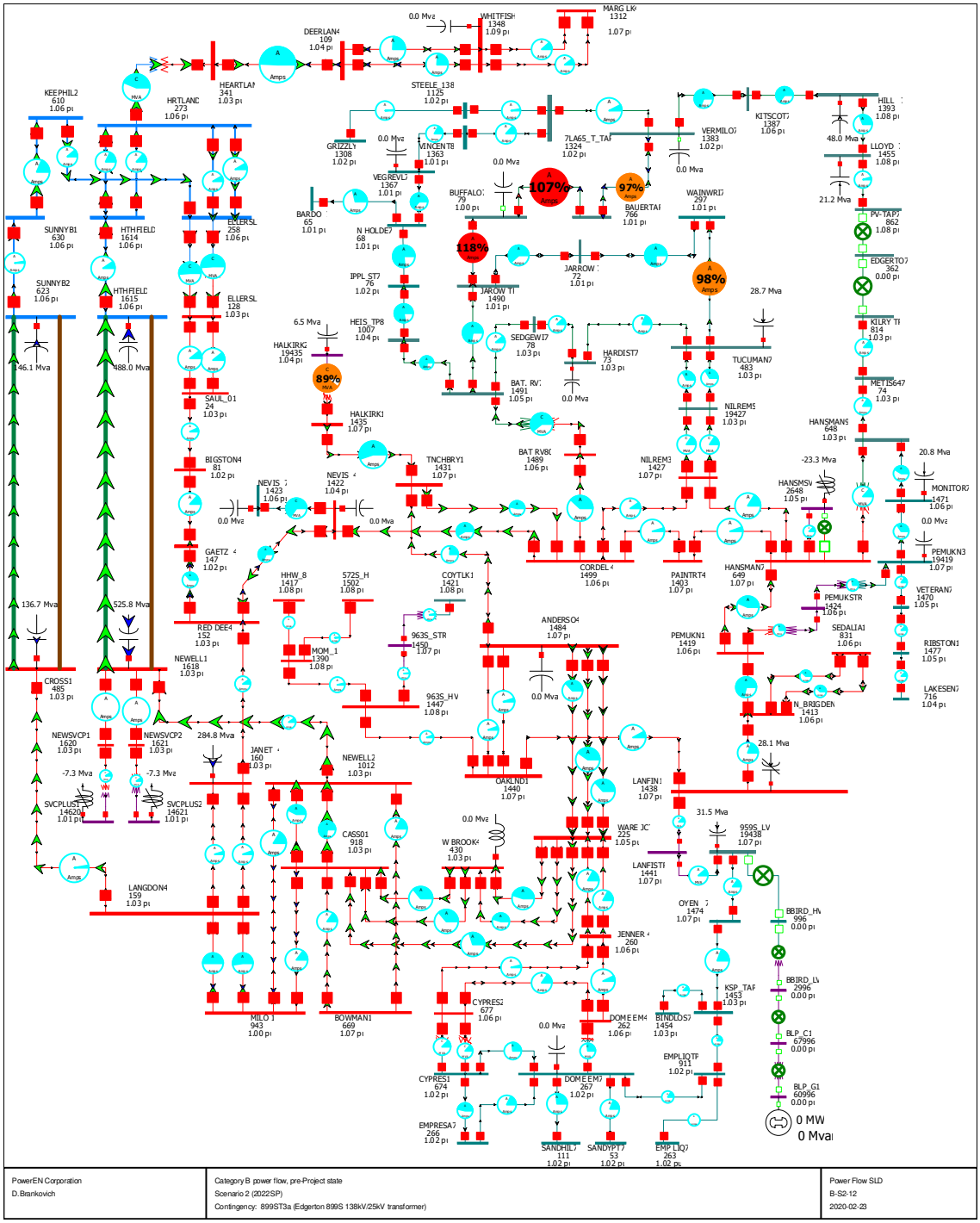


Figure B-S1-13: Category B Power Flow, Contingency: 912L \9L912 (Red Deer 63S-Nevis 766S)

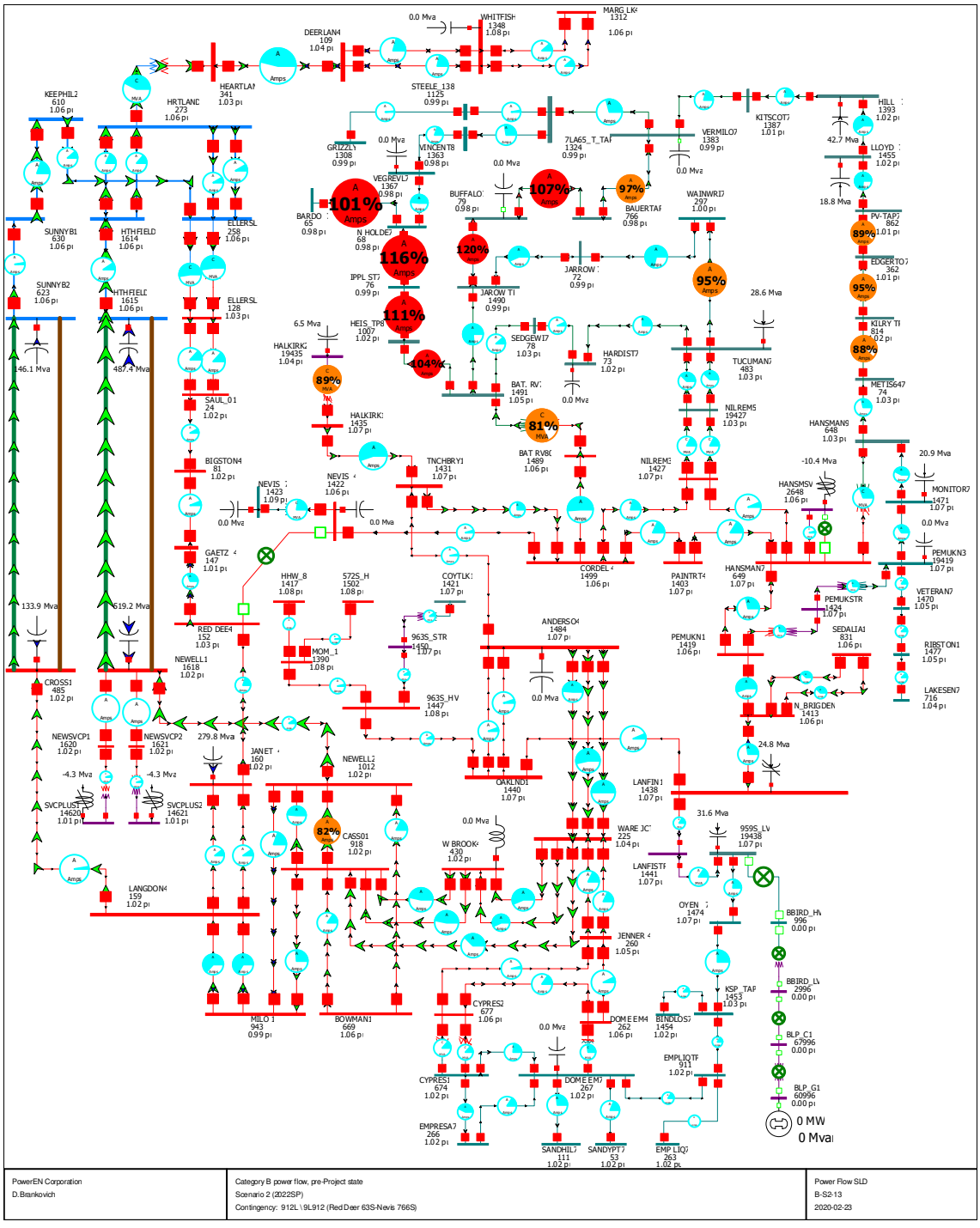


Figure B-S1-14: Category B Power Flow, Contingency: 966L\9L966 (Hansman Lk. 650S-Pemukan 932S)

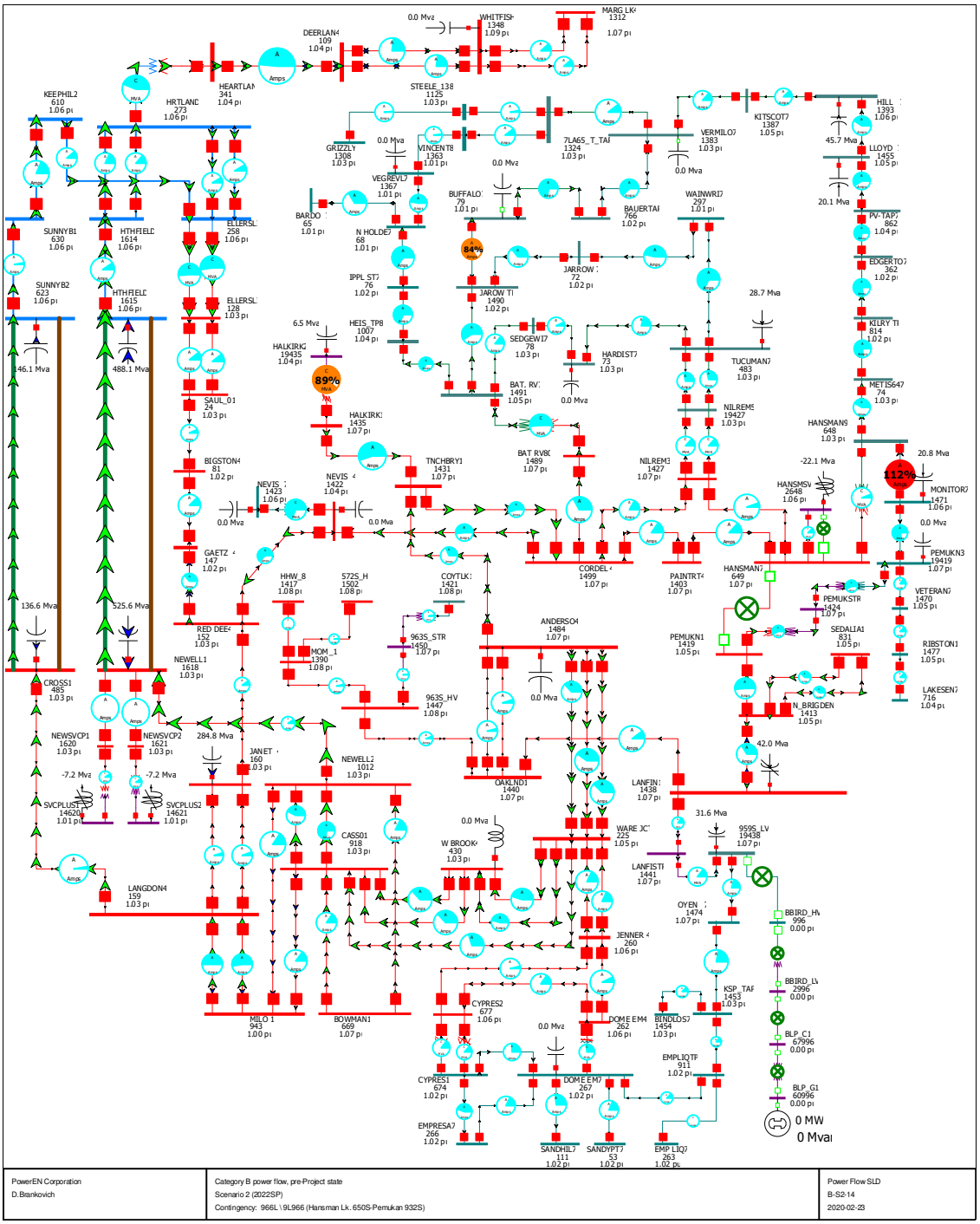


Figure B-S1-15: Category B Power Flow, Contingency: 9L20 (Cordel 755S-Nevis 766S)

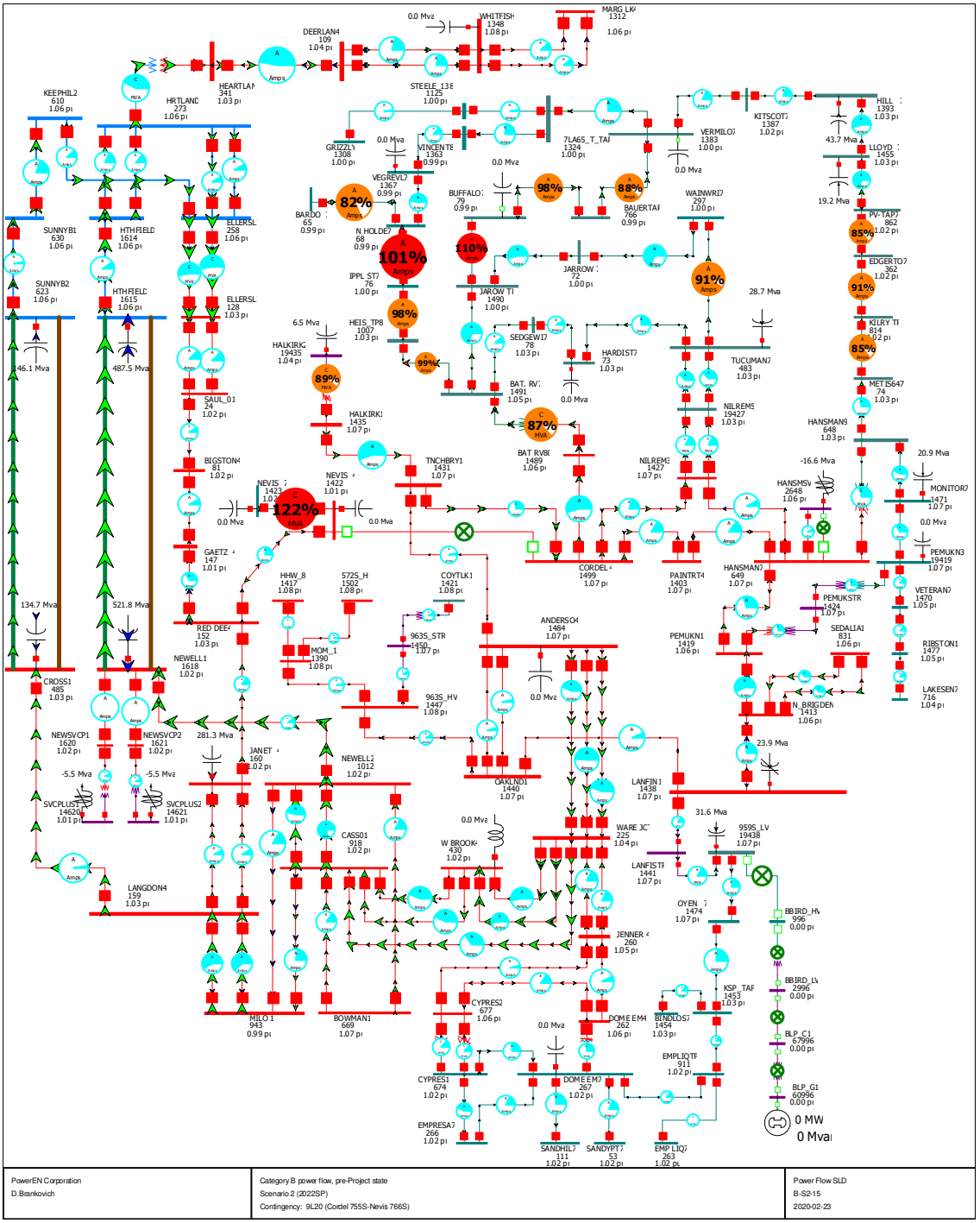


Figure B-S1-16: Category B Power Flow, Contingency: 9L80 (Cordel 755S-Battle River 757S)

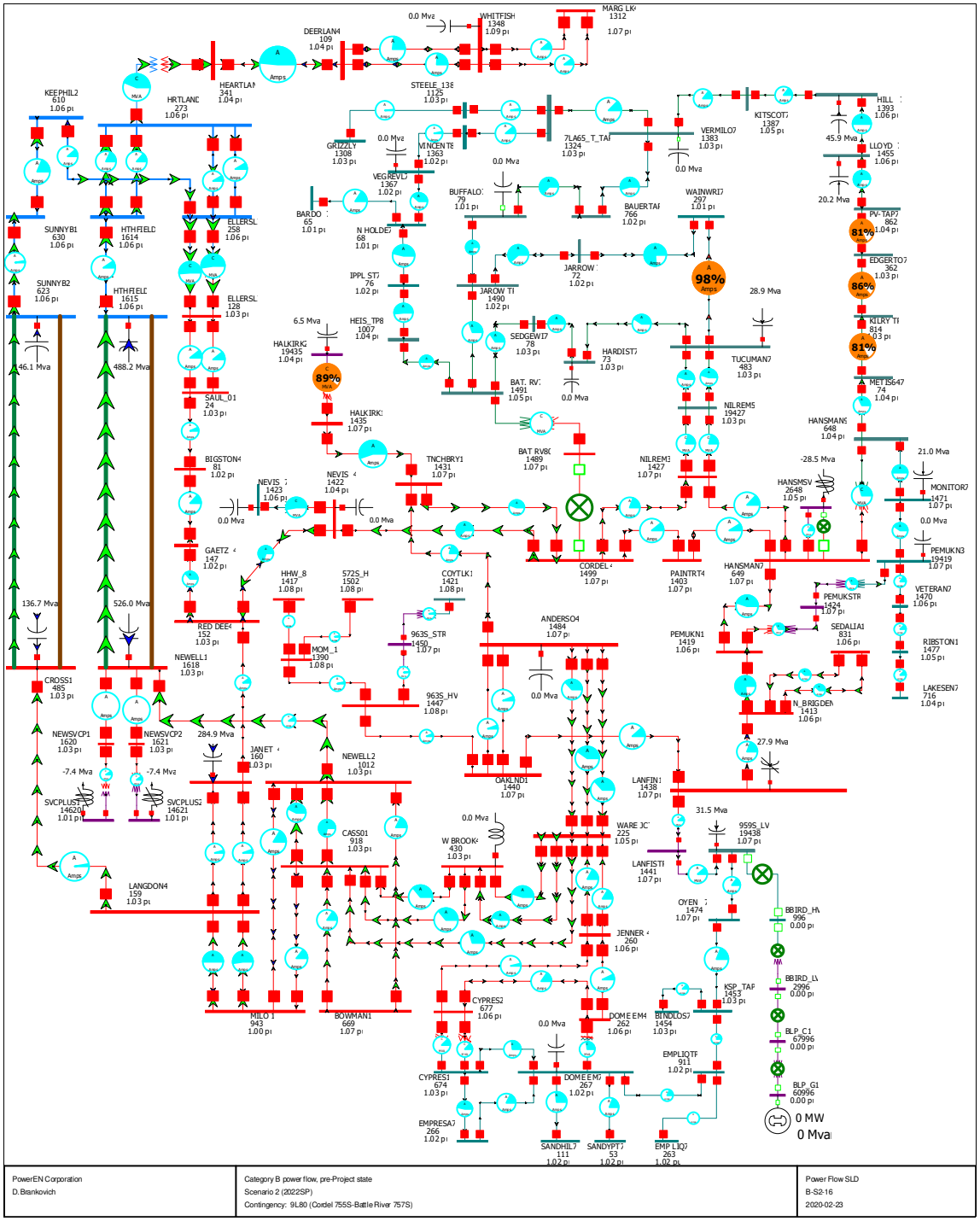
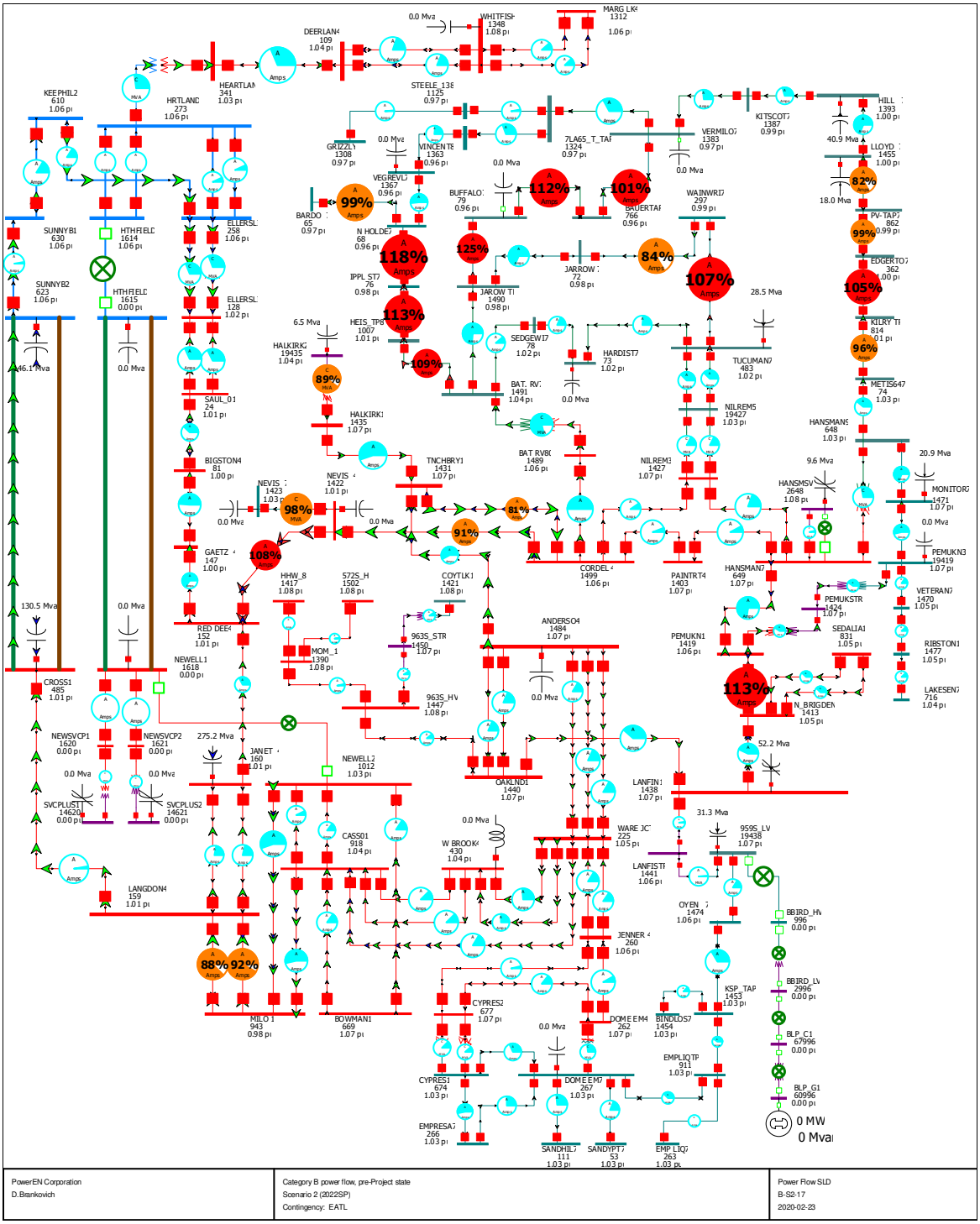


Figure B-S1-16: Category B Power Flow, Contingency: EATL



A2.2

Scenario 2 (2022SL)

Figure A-S2-1: Category A Power Flow

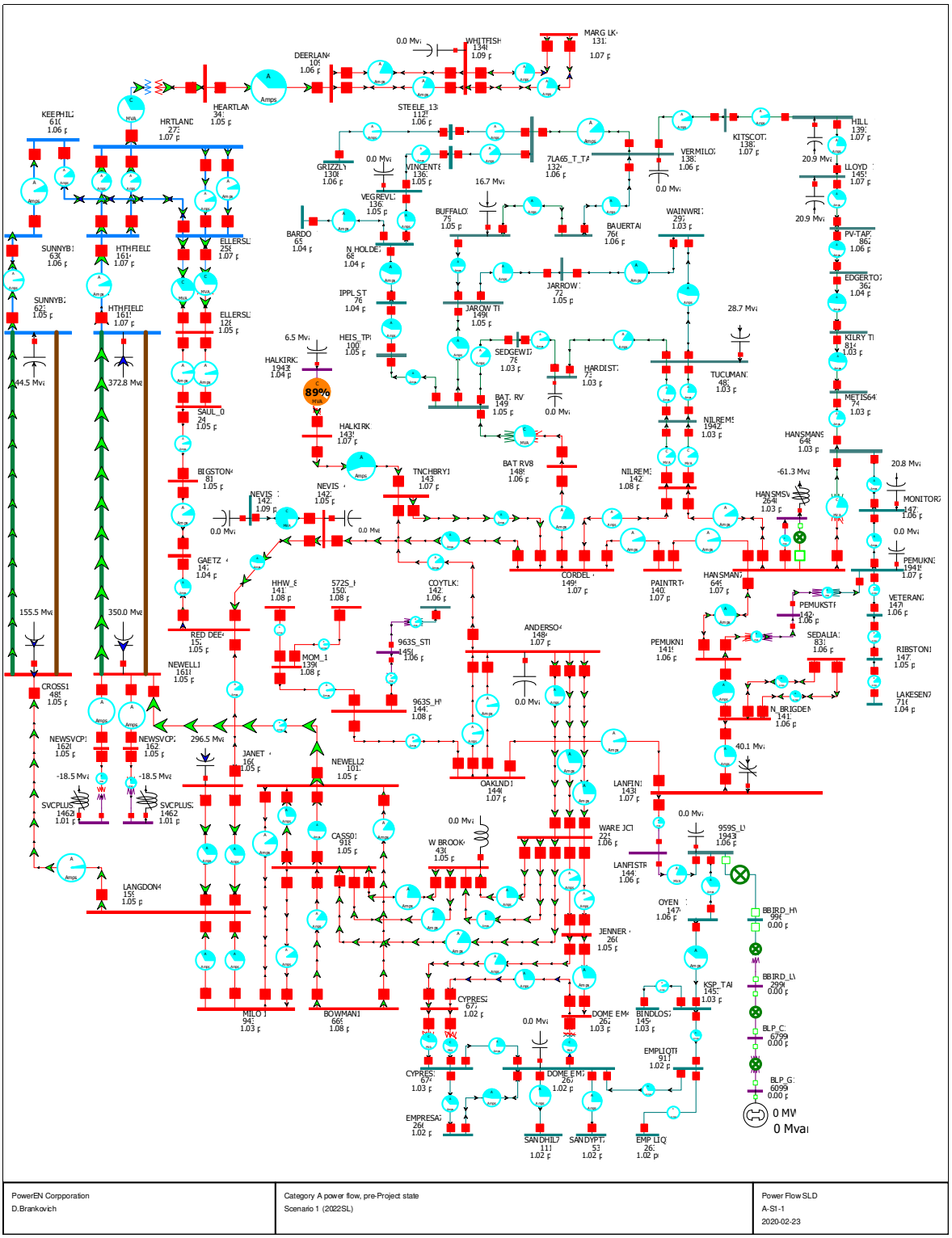


Figure B-S2-1: Category B Power Flow, Contingency: 9L20

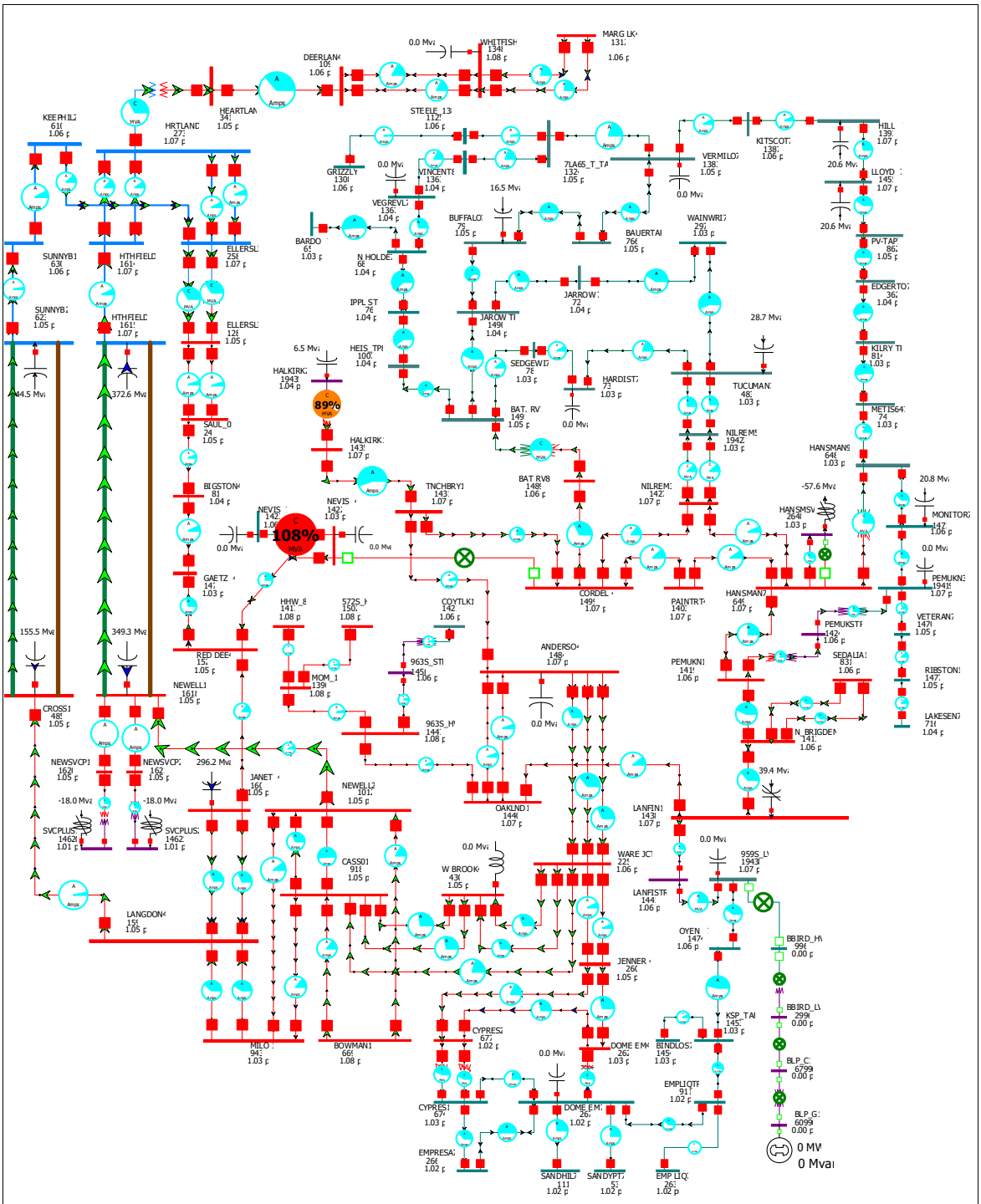
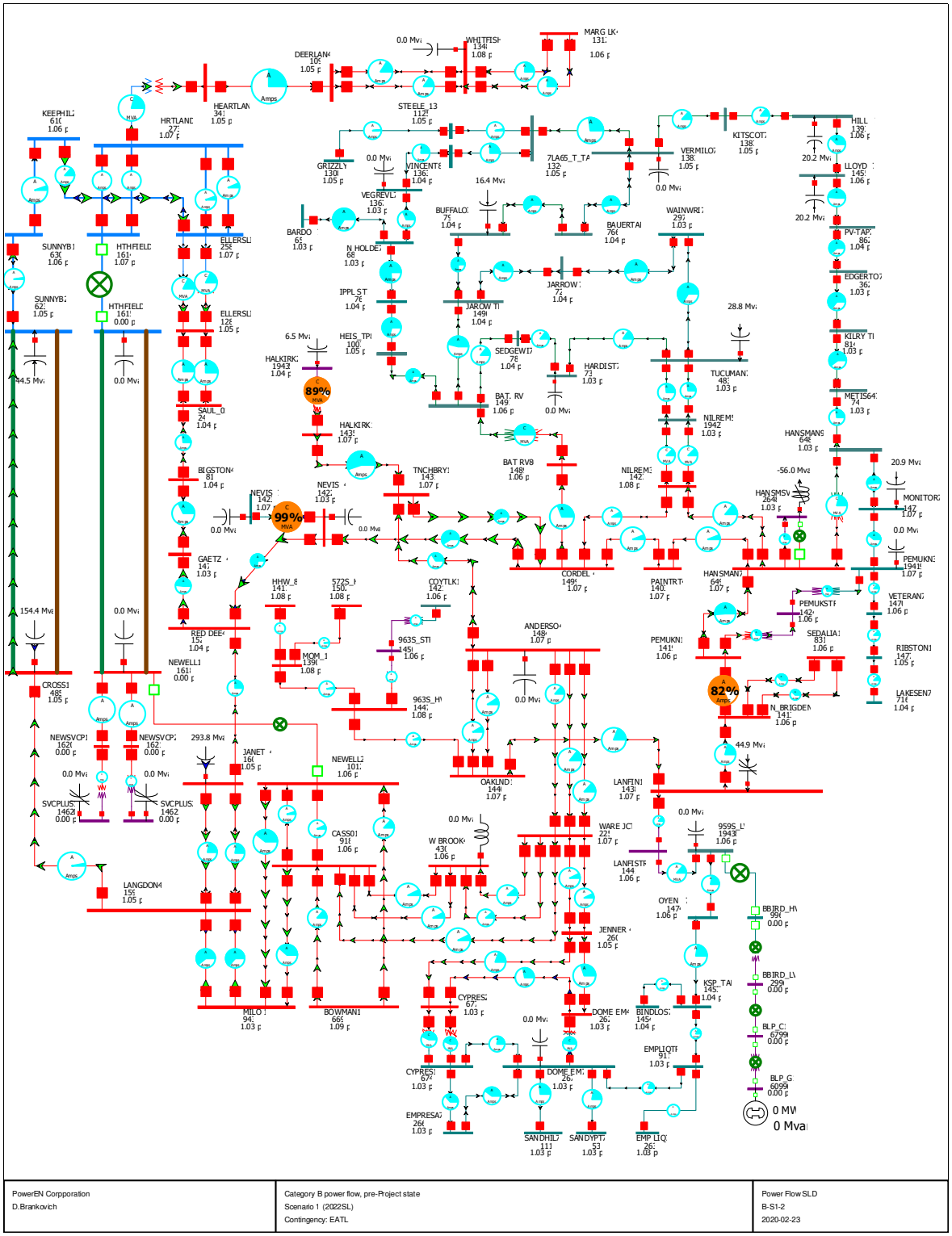


Figure B-S2-2: EATL



A2.3

Scenario 3 (2022WP)

Figure A-S3-1: Category A Power Flow

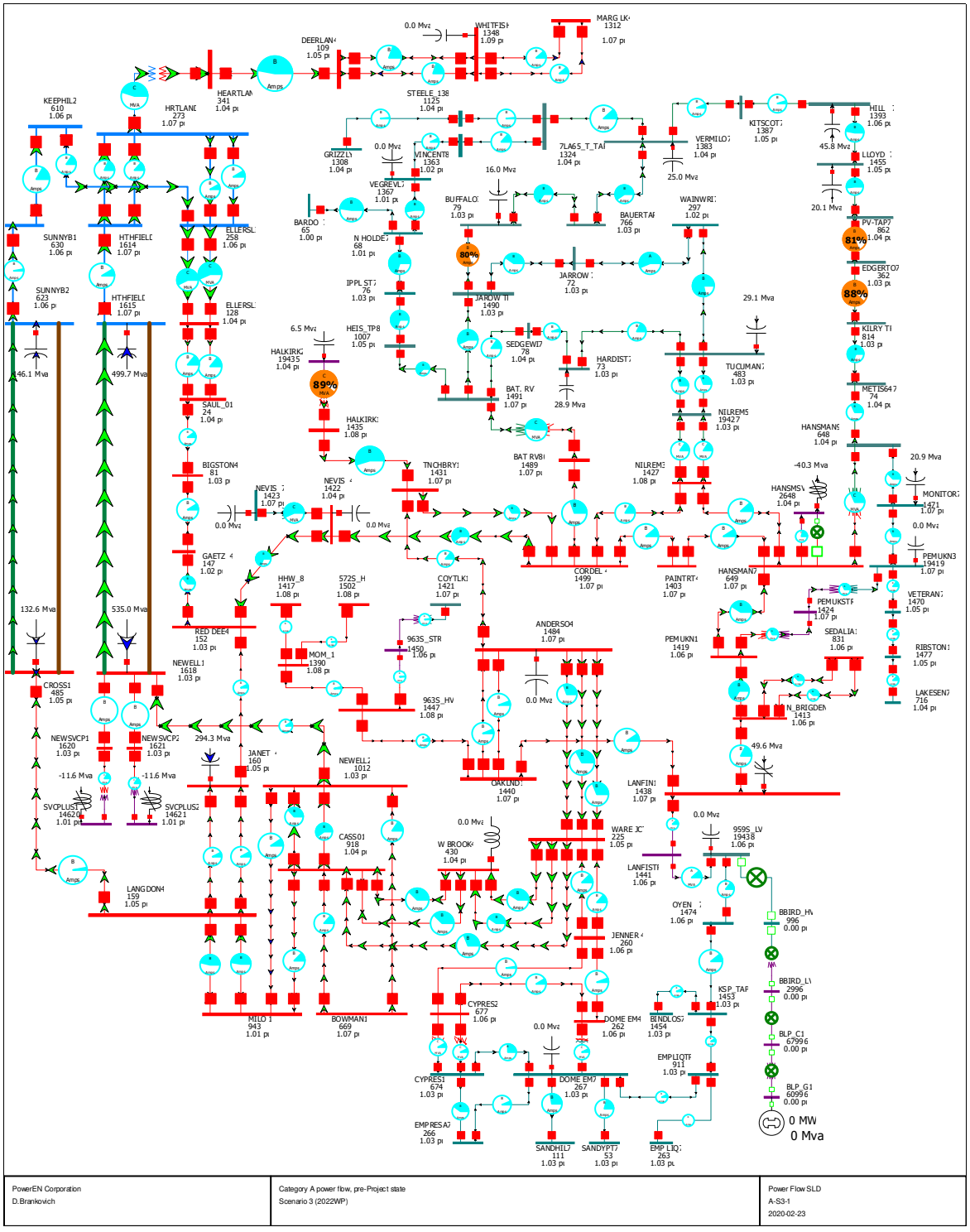


Figure B-S3-1: Category B Power Flow, Contingency: 478ST1 or 478ST2 (Tucuman 478S 138kV/25 kV transformer)

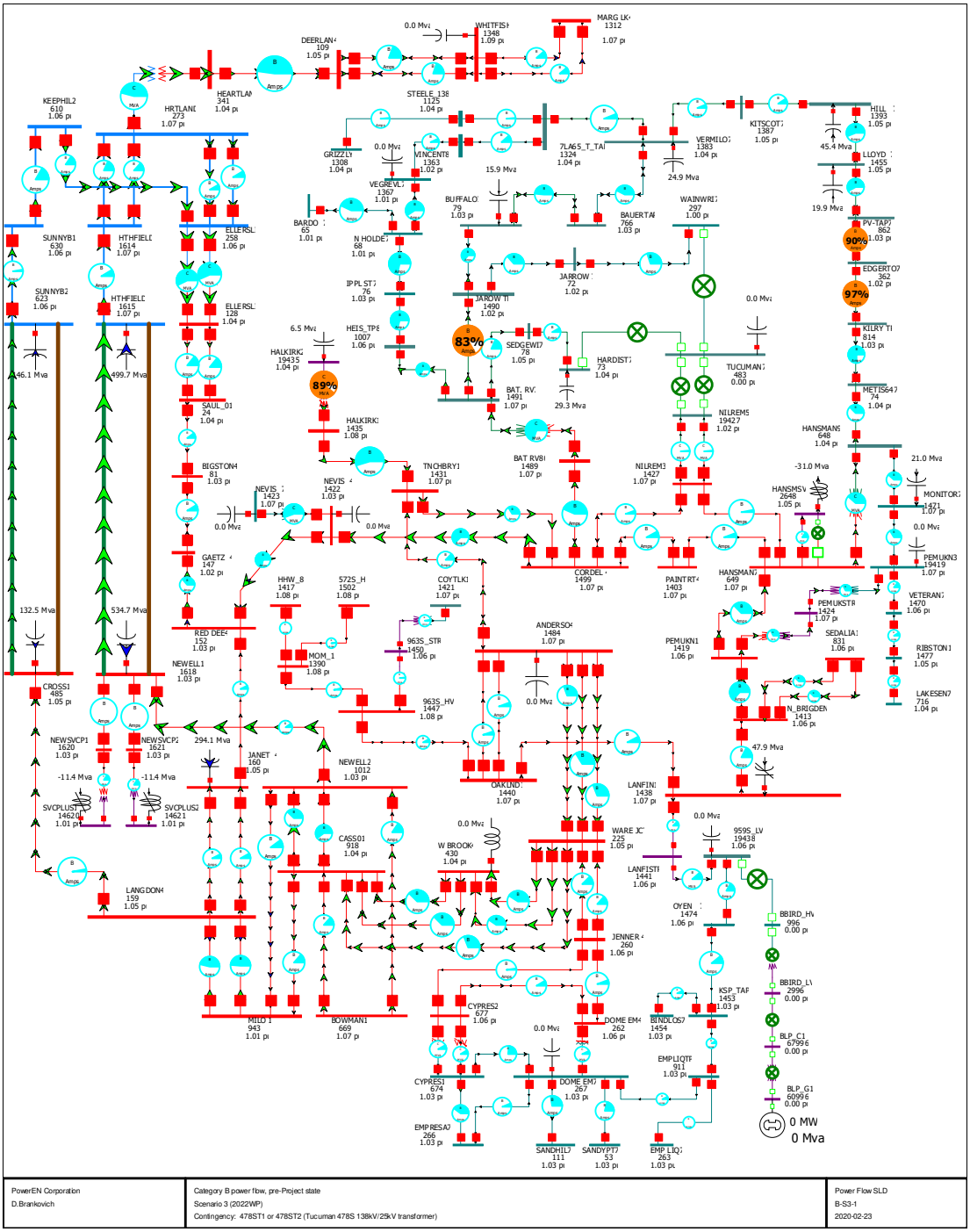


Figure B-S3-2: Category B Power Flow, Contingency: 526ST1/526ST2 (Buffalo Crk. 526S 138kV/25kV transformer)

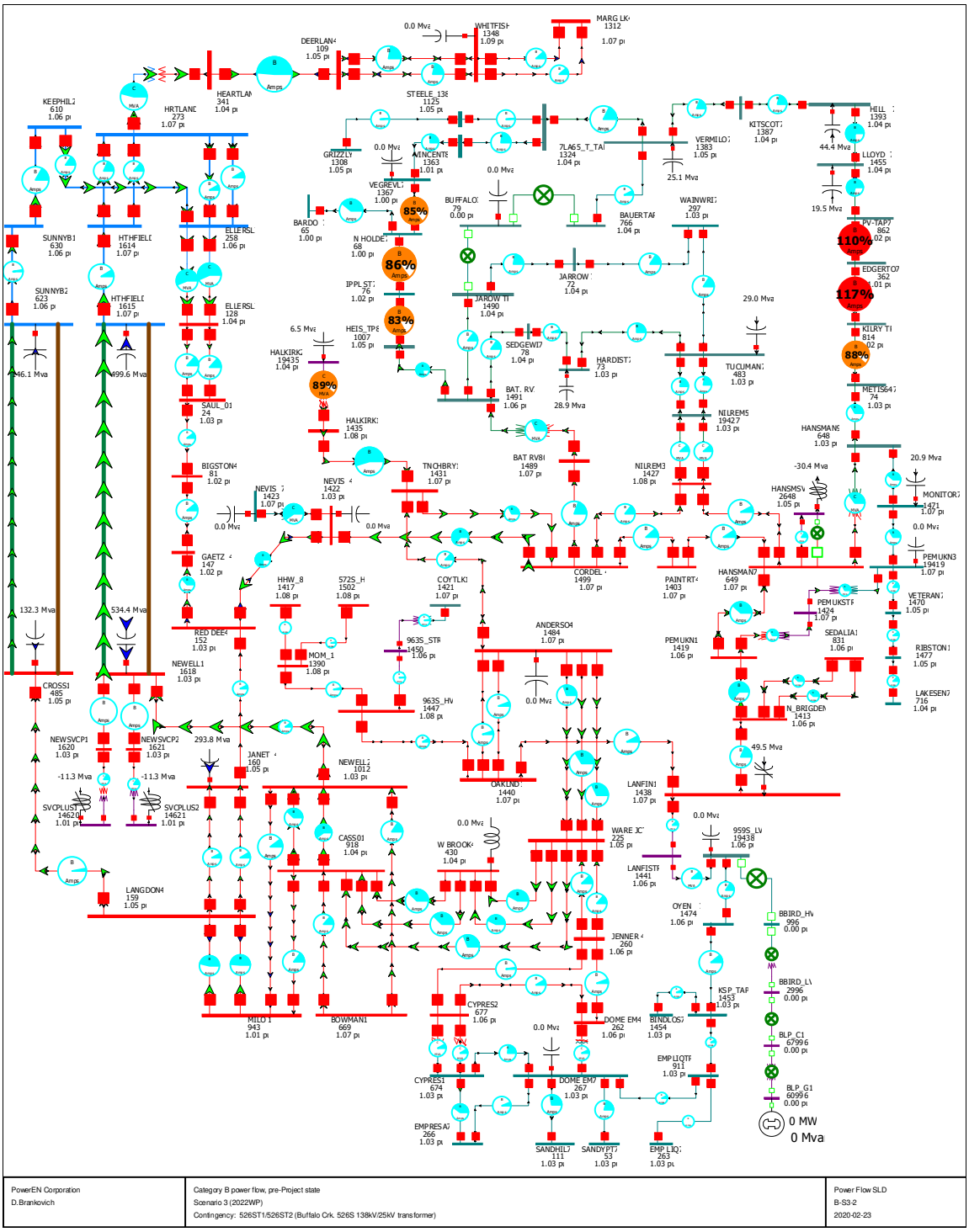


Figure B-S3-3: Category B Power Flow, Contingency: 648ST1 (Metiskow 648S 138kV/25kV transformer)

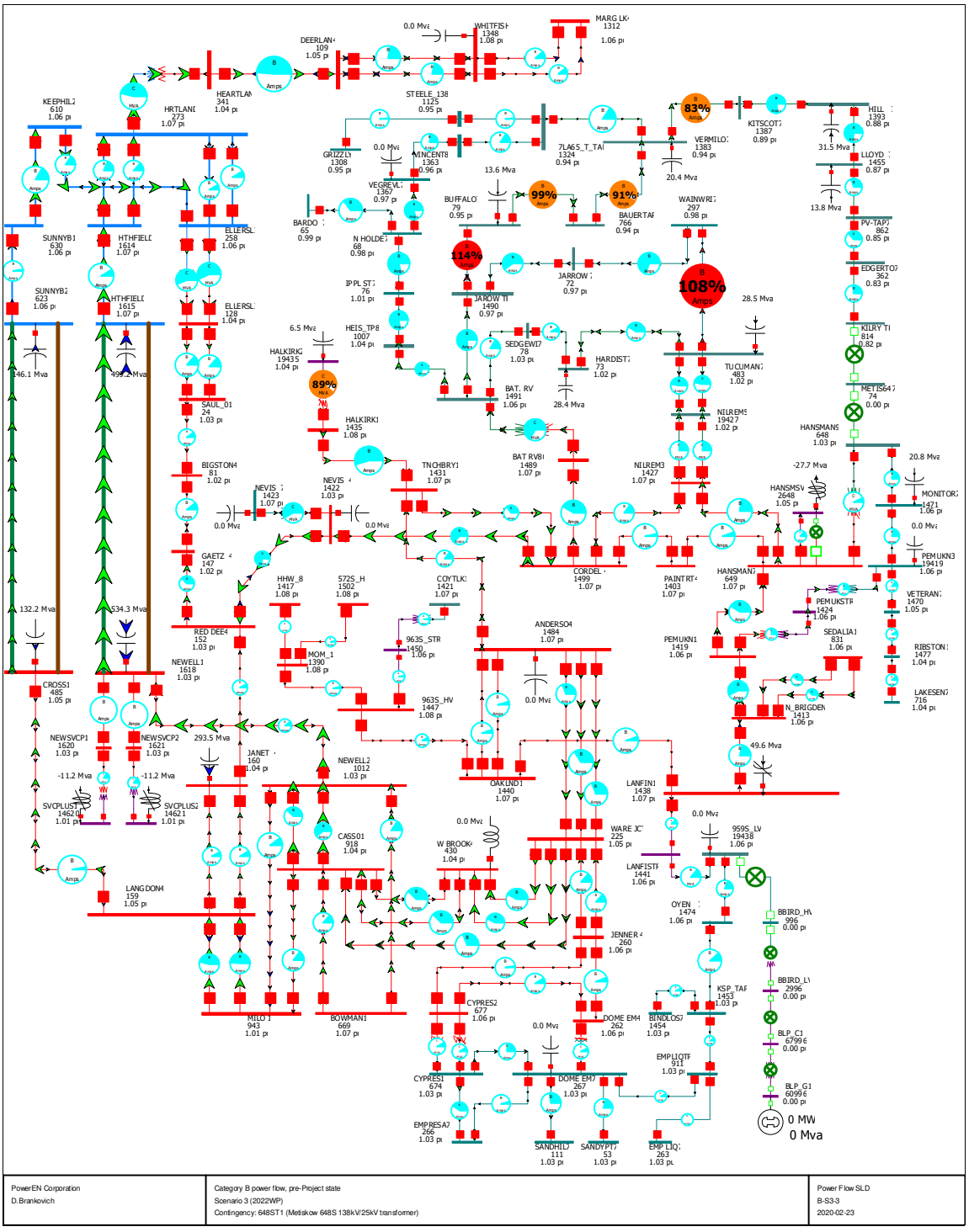


Figure B-S3-4: Category B Power Flow, Contingency: 766S901T (Nevis 766S 240kV/138kV transformer)

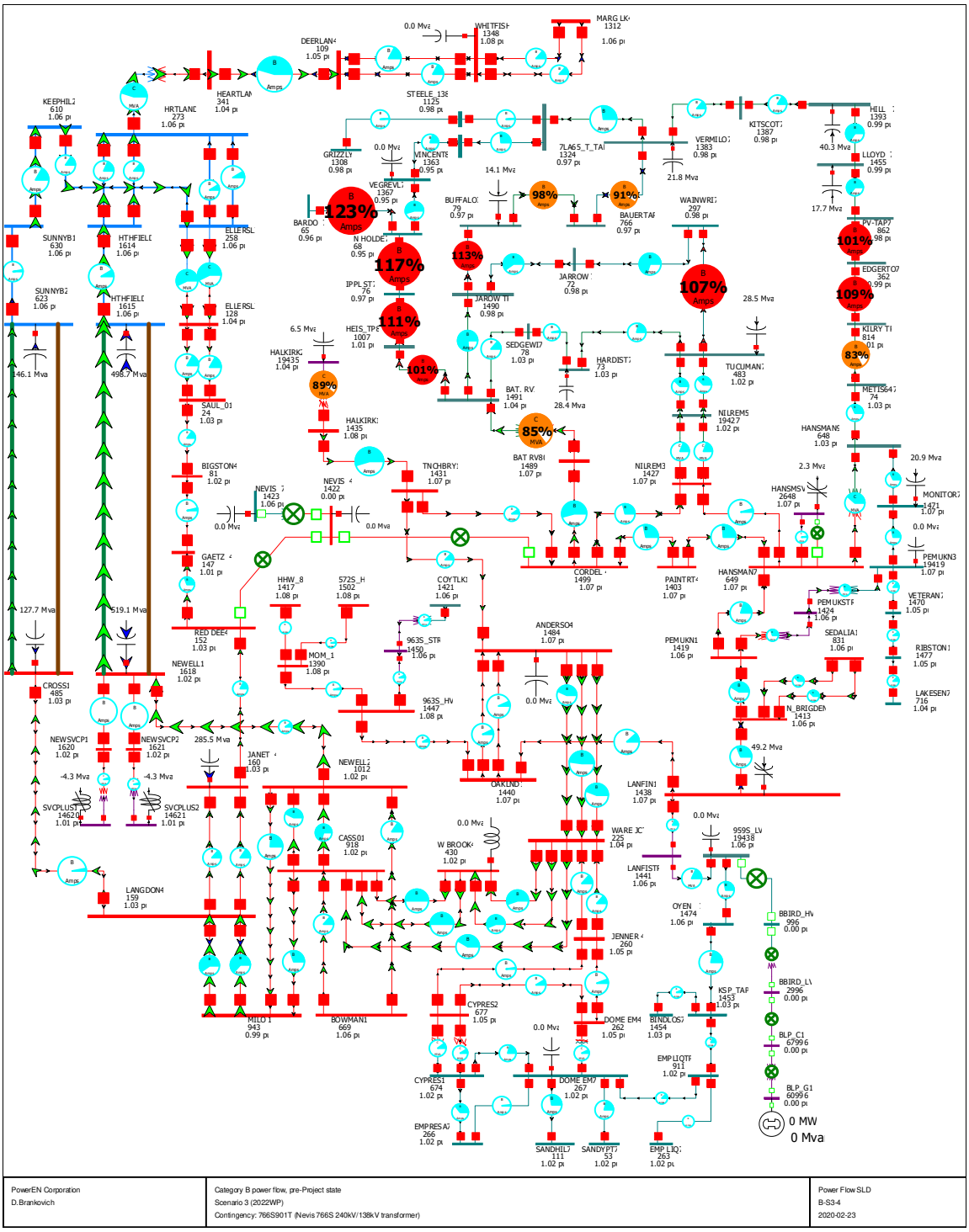


Figure B-S3-5: Category B Power Flow, Contingency: 7L129 \ 7LA129 (Buffalo Crk. 526S-Vermilion 710S)

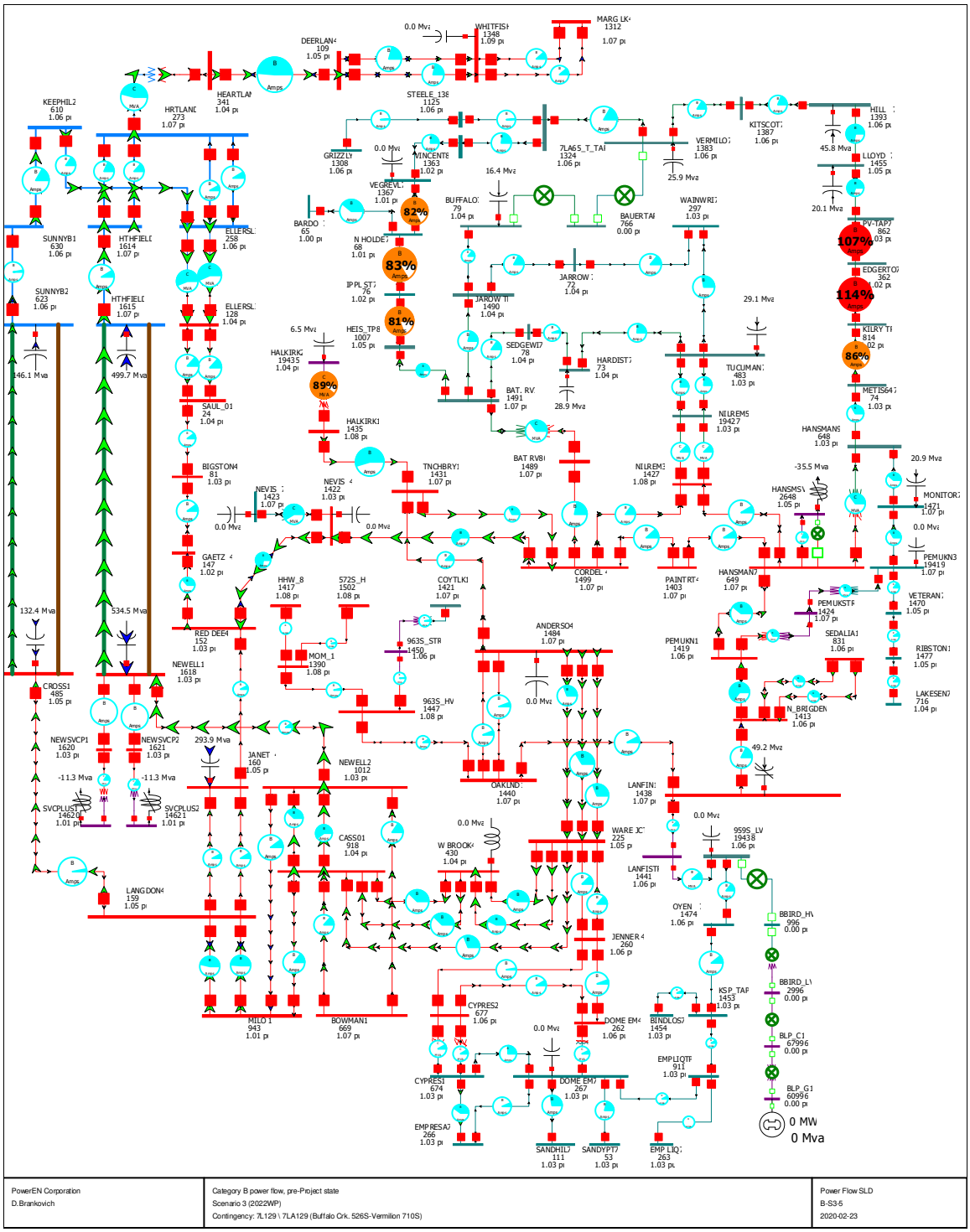


Figure B-S3-6: Category B Power Flow, Contingency: 7L50 (Buffalo Crk. 526S-Battle River 757S)

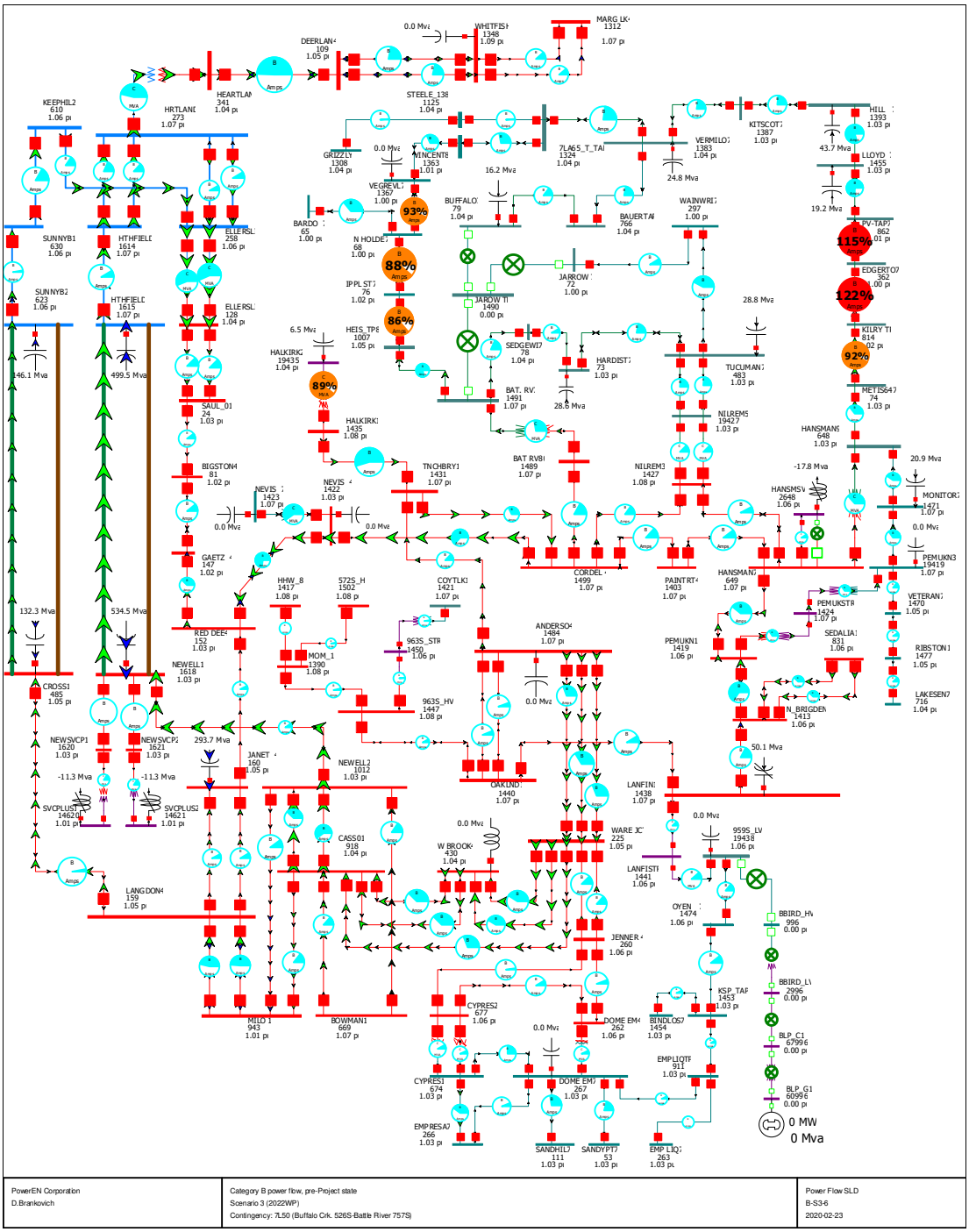


Figure B-S3-7: Category B Power Flow, Contingency: 7L701 \ 7LA701 \ 701L (Strome 223S-Battle River 757S)

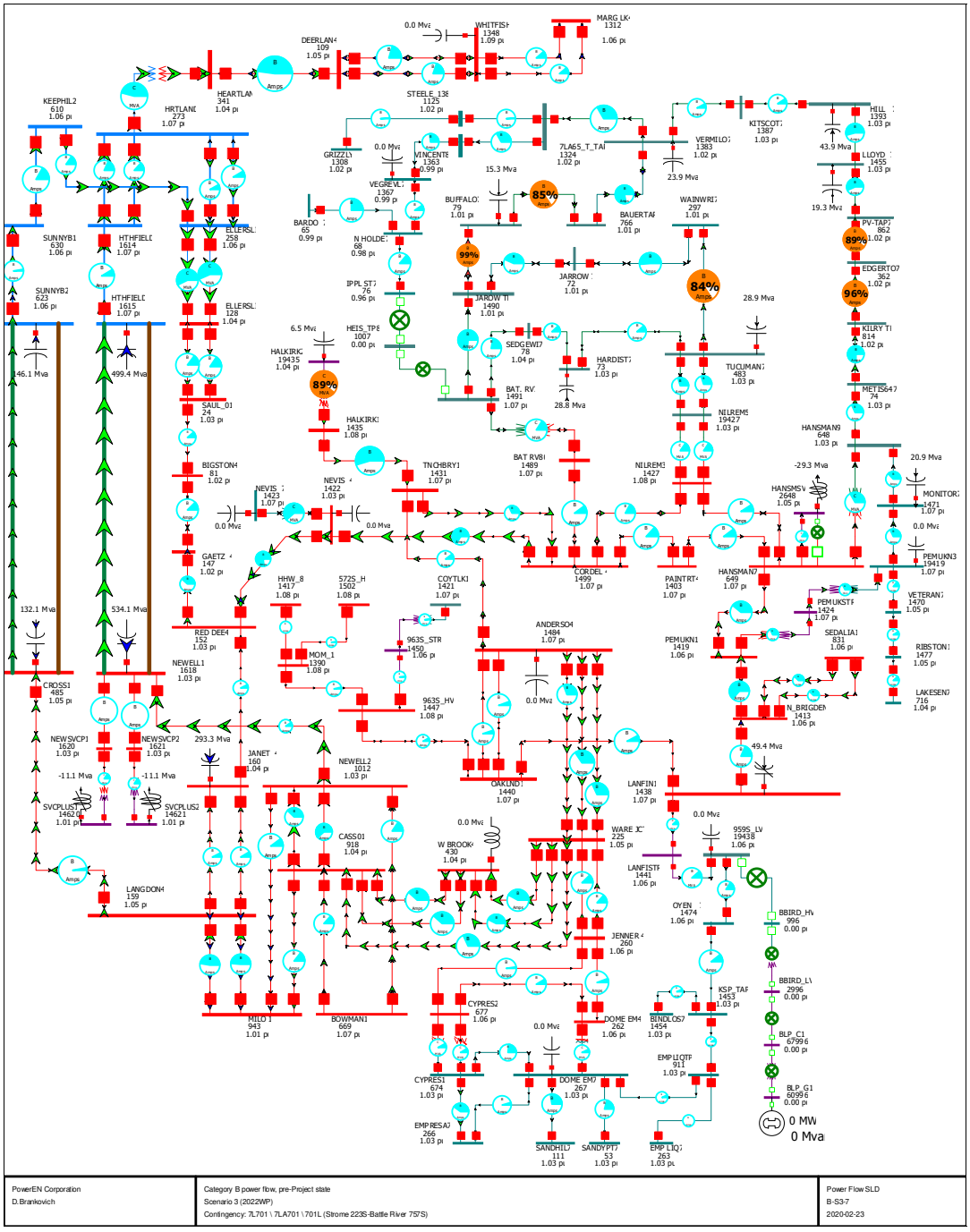


Figure B-S3-8: Category B Power Flow, Contingency: 7L749 \ 749L \ 7LB749 Lloydminster 716S-Edgerton 899S)

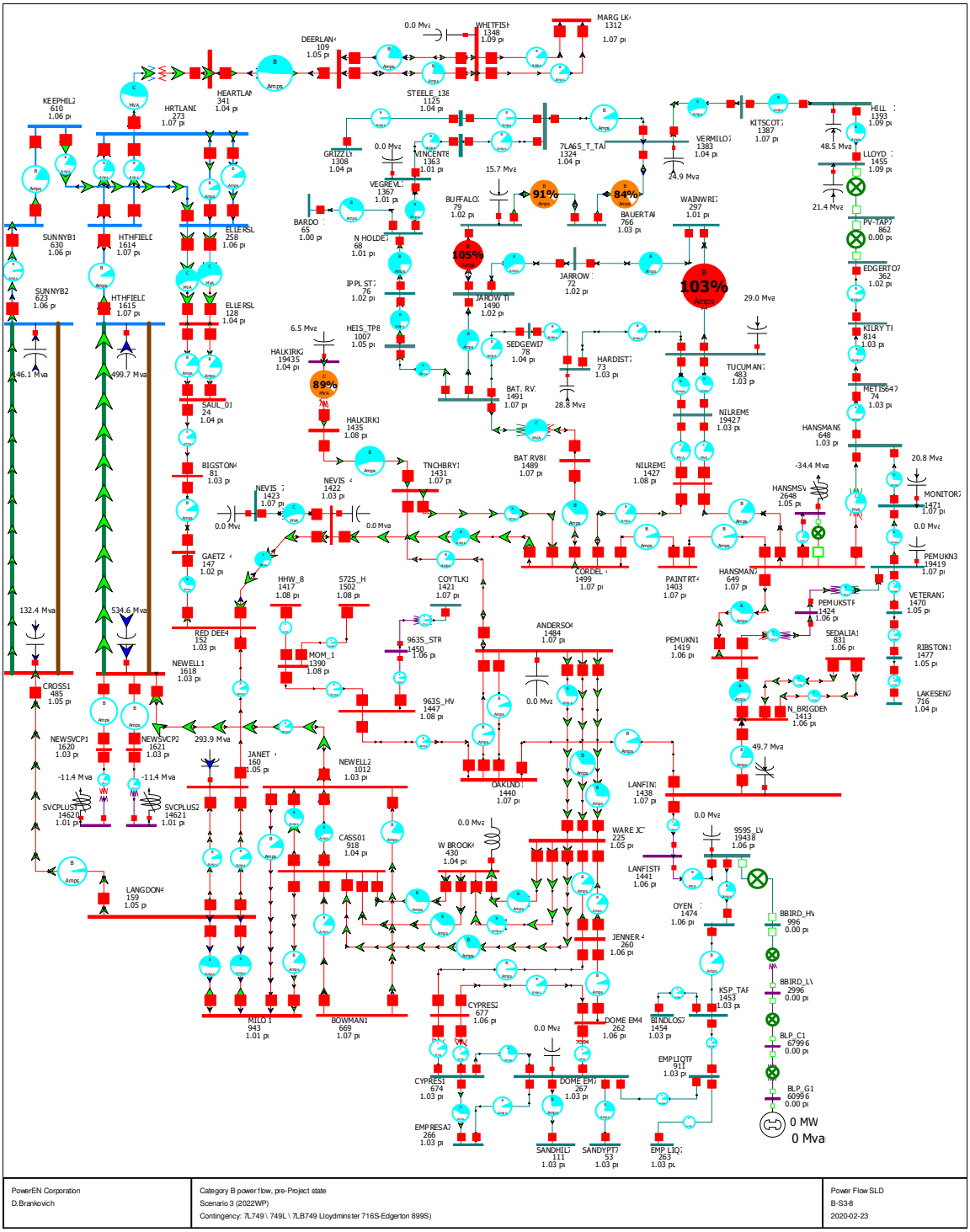


Figure B-S3-9: Category B Power Flow, Contingency: 899ST3a (Edgerton 899S 138kV/25kV transformer)

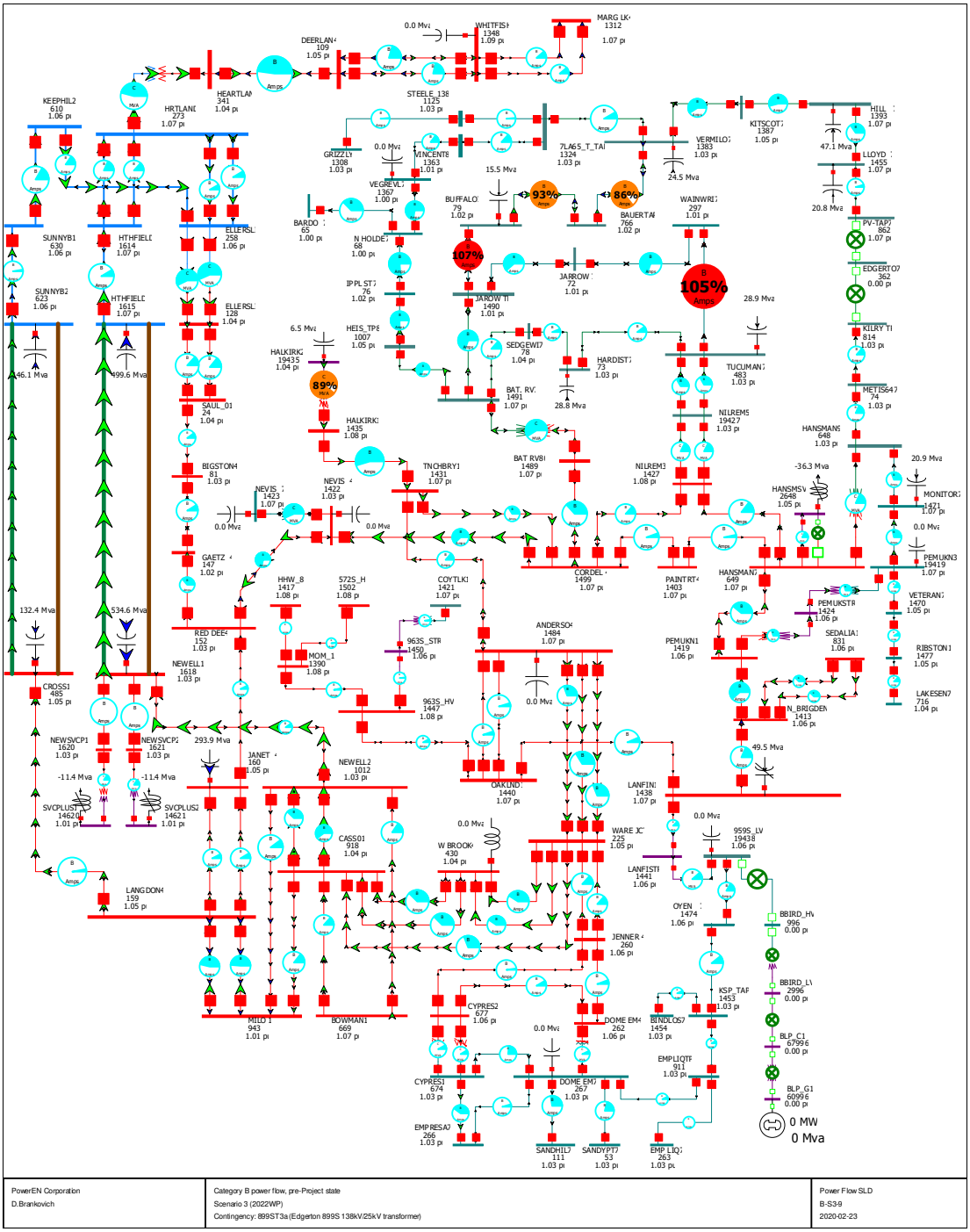


Figure B-S3-10: Category B Power Flow, Contingency: 912L \ 9L912 (Red Deer 63S-Nevis 766S)

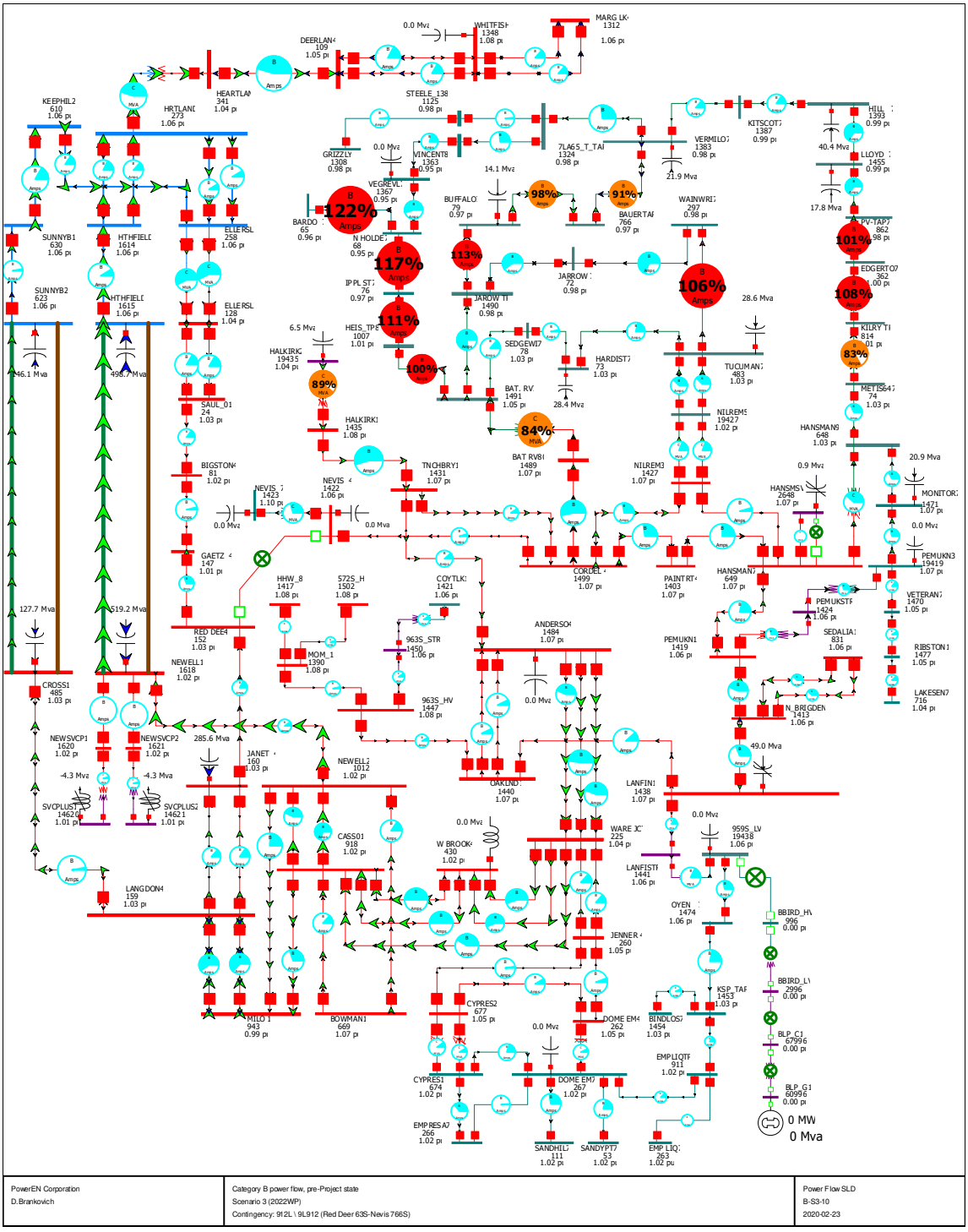


Figure B-S3-11: Category B Power Flow, Contingency: 9L20 (Cordel 755S-Nevis 766S)

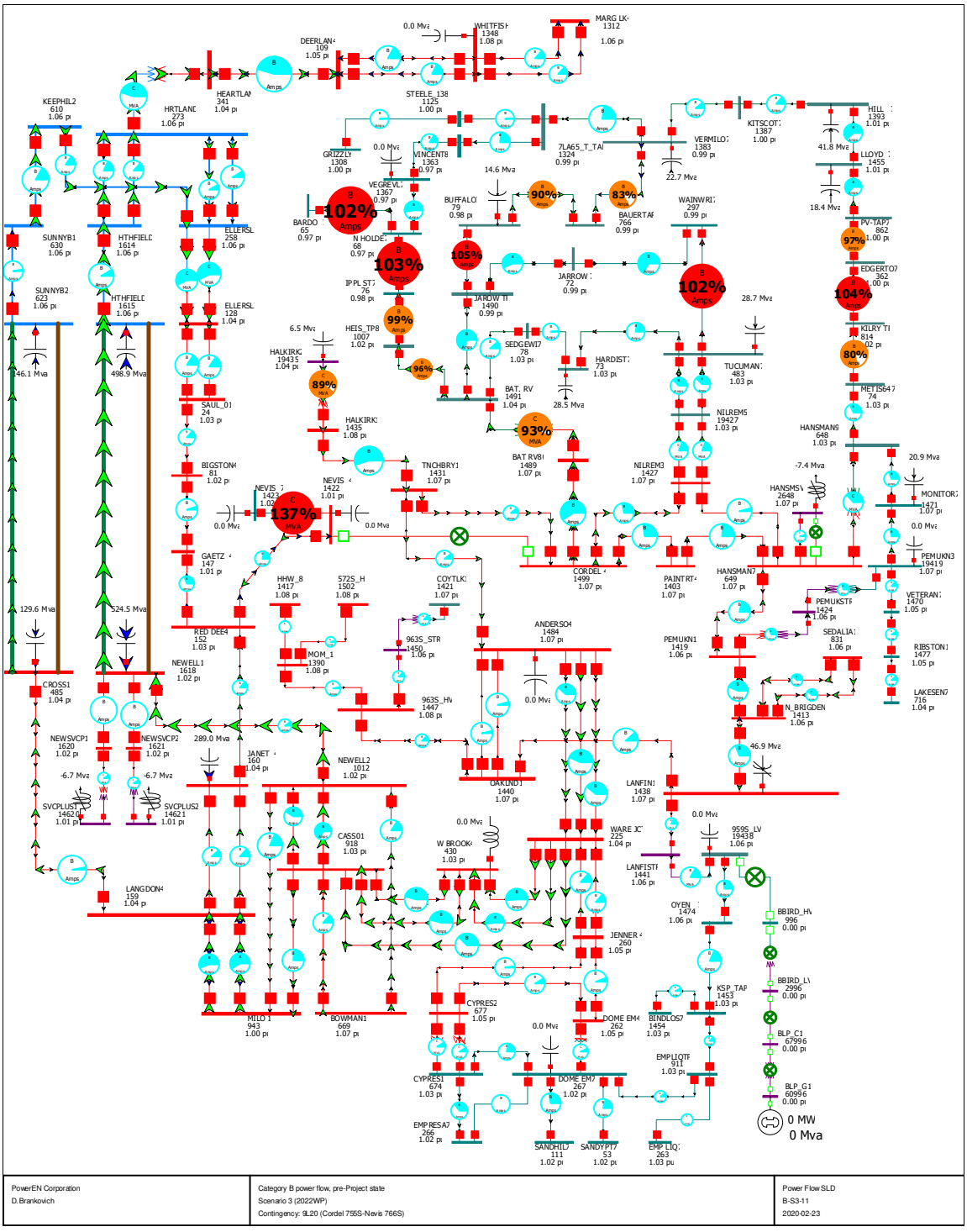


Figure B-S3-12: Category B Power Flow, Contingency: 9L80 (Cordel 755S-Battle River 757S)

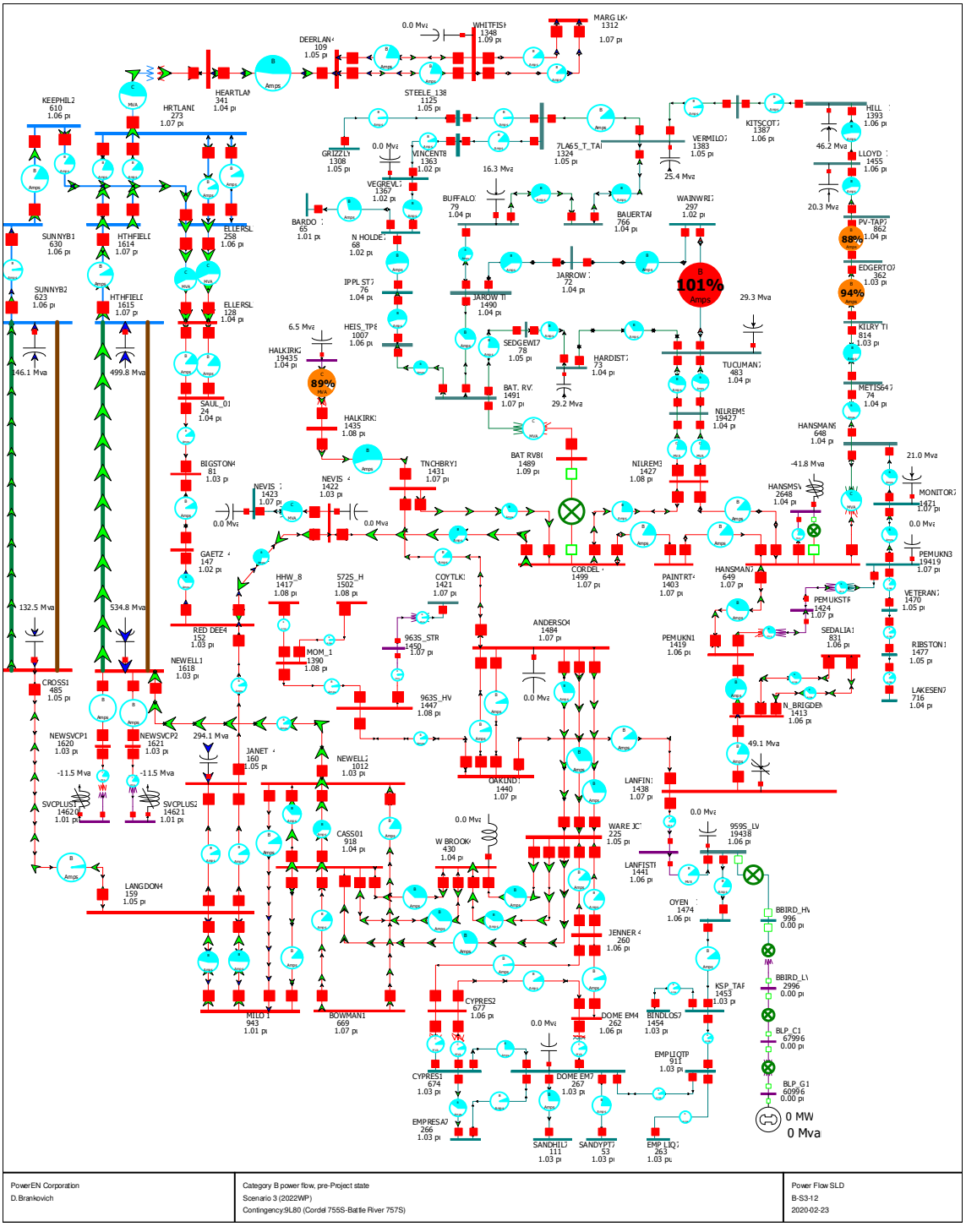
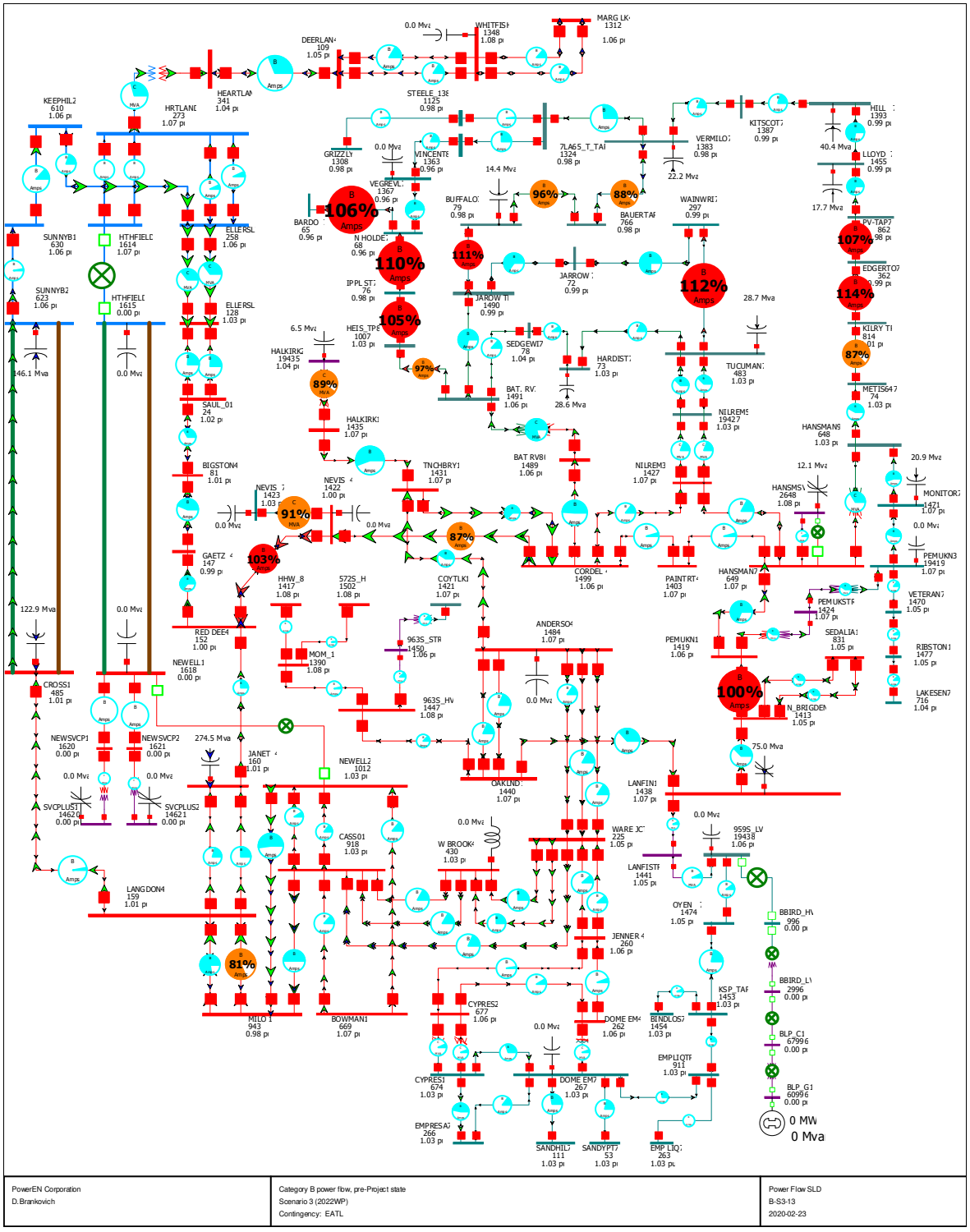


Figure B-S3-13: Category B Power Flow, Contingency: EATL



Attachment A3

Post-Project Single Line Diagrams

Table of Contents

SCENARIO 4: POST-PROJECT POWER FLOW SINGLE LINE DIAGRAMS (2022SP) 3
Figure A-S4-1: Category A Power Flow 4
Figure B-S4-1: Category B Power Flow, Contingency: 648ST1 (Metiskow 648S 138kV/25kV transformer) 5
Figure B-S4-2: Category B Power Flow, Contingency 749L \ 749AL (Metiskow 648S-Edgerton 899S) 6
Figure B-S4-3: Category B Power Flow, Contingency: 766S901T (Nevis 766S 901T transformer) 7
Figure B-S4-4: Category B Power Flow, Contingency: 7L749 \ 749L \ 7LB749 Lloydminster 716S-Edgerton 899S) 8
Figure B-S4-5: Category B Power Flow, Contingency: 899ST3a (Edgerton 899S 138kV/25kV transformer) 9
Figure B-S4-6: Category B Power Flow, Contingency: 912L \ 9L912 (Red Deer 63S-Nevis 766S) 10
Figure B-S4-7: Category B Power Flow, Contingency: 966L \ 9L966 (Hansman Lk. 650S-Pemukan 932S) 11
Figure B-S4-8: Category B Power Flow, Contingency: 9L20 (Cordel 755S-Nevis 766S) 12
Figure B-S4-9: Category B Power Flow, Contingency: EATL 13
Figure B-S4-10: Category B Power Flow, Contingency: 395ST1 (N.Holden 395S 138kV/25kV transformer) 14
Figure B-S4-11: Category B Power Flow, Contingency: 526ST1/526ST2 (Buffalo Crk. 526S 138kV/25kV transformer) 15
Figure B-S4-12: Category B Power Flow, Contingency: 757S912T (Battle River 757S transformer) 16
Figure B-S4-13: Category B Power Flow, Contingency: 7L129 \ 7LA129 (Buffalo Crk. 526S-Vermilion 710S) 17
Figure B-S4-14: Category B Power Flow, Contingency: 7L42 (Lloydminster 716S-Hill 751S) 18
Figure B-S4-15: Category B Power Flow, Contingency: 7L50 (Buffalo Crk. 526S-Battle River 757S) 19
Figure B-S4-16: Category B Power Flow, Contingency: 7L701 \ 7LA701 \ 701L (Strome 223S-Battle River 757S) 20
Figure B-S4-17: Category B Power Flow, Contingency: 9L80 (Cordel 755S-Battle River 757S) 21
SCENARIO 5: POST-PROJECT POWER FLOW SINGLE LINE DIAGRAMS (2022SL) 22
Figure A-S5-1: Category A Power Flow 23
Figure B-S5-1: Category B Power Flow, Contingency: 9L20 (Cordel 755S-Nevis 766S) 24
Figure B-S5-2: Category B Power Flow, Contingency: EATL 25
SCENARIO 6: POST-PROJECT POWER FLOW SINGLE LINE DIAGRAMS (2022WP) 26
Figure A-S6-1: Category A Power Flow 27
Figure B-S6-1: Category B Power Flow, Contingency: 648ST1 (Metiskow 648S 138kV/25kV transformer) 28
Figure B-S6-2: Category B Power Flow, Contingency: 749L \ 749AL (Metiskow 648S-Edgerton 899S) 29
Figure B-S6-3: Category B Power Flow, Contingency: 766S901T (Nevis 766S 901T transformer) 30
Figure B-S6-4: Category B Power Flow, Contingency: 7L749 \ 749L \ 7LB749 Lloydminster 716S-Edgerton 899S) 31
Figure B-S6-5: Category B Power Flow, Contingency: 899ST3a (Edgerton 899S 138kV/25kV transformer) 32
Figure B-S6-6: Category B Power Flow, Contingency: 912L \ 9L912 (Red Deer 63S-Nevis 766S) 33
Figure B-S6-7: Category B Power Flow, Contingency: 9L20 (Cordel 755S-Nevis 766S) 34
Figure B-S6-8: Category B Power Flow, Contingency: EATL 35
Figure B-S6-9: Category B Power Flow, Contingency: 526ST1/526ST2 (Buffalo Crk. 526S 138kV/25kV transformer) 36
Figure B-S6-10: Category B Power Flow, Contingency: 757S912T (Battle River 757S transformer) 37
Figure B-S6-11: Category B Power Flow, Contingency: 7L129 \ 7LA129 (Buffalo Crk. 526S-Vermilion 710S) 38
Figure B-S6-12: Category B Power Flow, Contingency: 7L50 (Buffalo Crk. 526S-Battle River 757S) 39
Figure B-S6-13: Category B Power Flow, Contingency: 9L80 (Cordel 755S-Battle River 757S) 40
SENSITIVITY SCENARIO 4A (2022SP) 41
Figure A-S4a-1: Category A Power Flow 42

Figure B-S4a-1: 749L \ 749AL (Metiskow 648S-Edgerton 899S) *43*
Figure B-S4a-2: 766S901T (Nevis 766S 901T transformer) *44*
Figure B-S4a-3: 7L701\7LA701\701L (Strome 223S-BattleRiver 757S) *45*
Figure B-S4a-4: 7L749\749L\7LB749 (Lloydminster 716S-Edgerton 899S) *46*
Figure B-S4a-5: 899ST3a (Edgerton 899S 138kV/25kV transformer) *47*
Figure B-S4a-6: 912L \ 9L912 (Red Deer 63S-Nevis 766S) *48*
Figure B-S4a-7: 966L\9L966 (Hansman Lk. 650S-Pemukan 932S) *49*
Figure B-S4a-8: 9L20 (Cordel 755S-Nevis 766S) *50*
Figure B-S4a-9: EATL *51*
Figure B-S4a-10: 395ST1 (N. Holden 395S 138 kV/25 kV transformer) *52*
Figure B-S4a-11: 526ST1/526ST2 (Buffalo Crk. 526S 138 kV/ 25kV transformer) *53*
Figure B-S4a-12: 648ST1 (Metiskow 648S 138 kV/25 kV transformer) *54*
Figure B-S4a-13: 7L129 \ 7LA129 (Buffalo Crk. 526S-Vermilion 710S) *55*
Figure B-S4a-14: 7L42 (Lloydminster 716S - Hill 751S) *56*
Figure B-S4a-15: 7L50 (Buffalo Crk. 526S-Battle River 757S) *57*
SENSITIVITY SCENARIO 4B (2022SP) 58
Figure A-S4b-1: Category A Power Flow *59*
Figure B-S4b-1: 766S901T (Nevis 766S 901T transformer) *60*
Figure B-S4b-2: 912L \ 9L912 (Red Deer 63S-Nevis 766S) *61*
Figure B-S4b-3: 966L \ 9L966 (Hansman Lk. 650S-Pemukan 932S) *62*
Figure B-S4b-4: 9L20 (Cordel 755S-Nevis 766S) *63*
Figure B-S4b-5: EATL *64*
SENSITIVITY SCENARIO 4C (2022SP) 65
Figure A-S4c-1: Category A Power Flow *66*
Figure B-S4c-1: 966L \ 9L966 (Hansman Lk. 650S-Pemukan 932S) *67*

A3.2

Scenario 4: Post-Project Power Flow Single Line Diagrams (2022SP)

Figure A-S4-1: Category A Power Flow

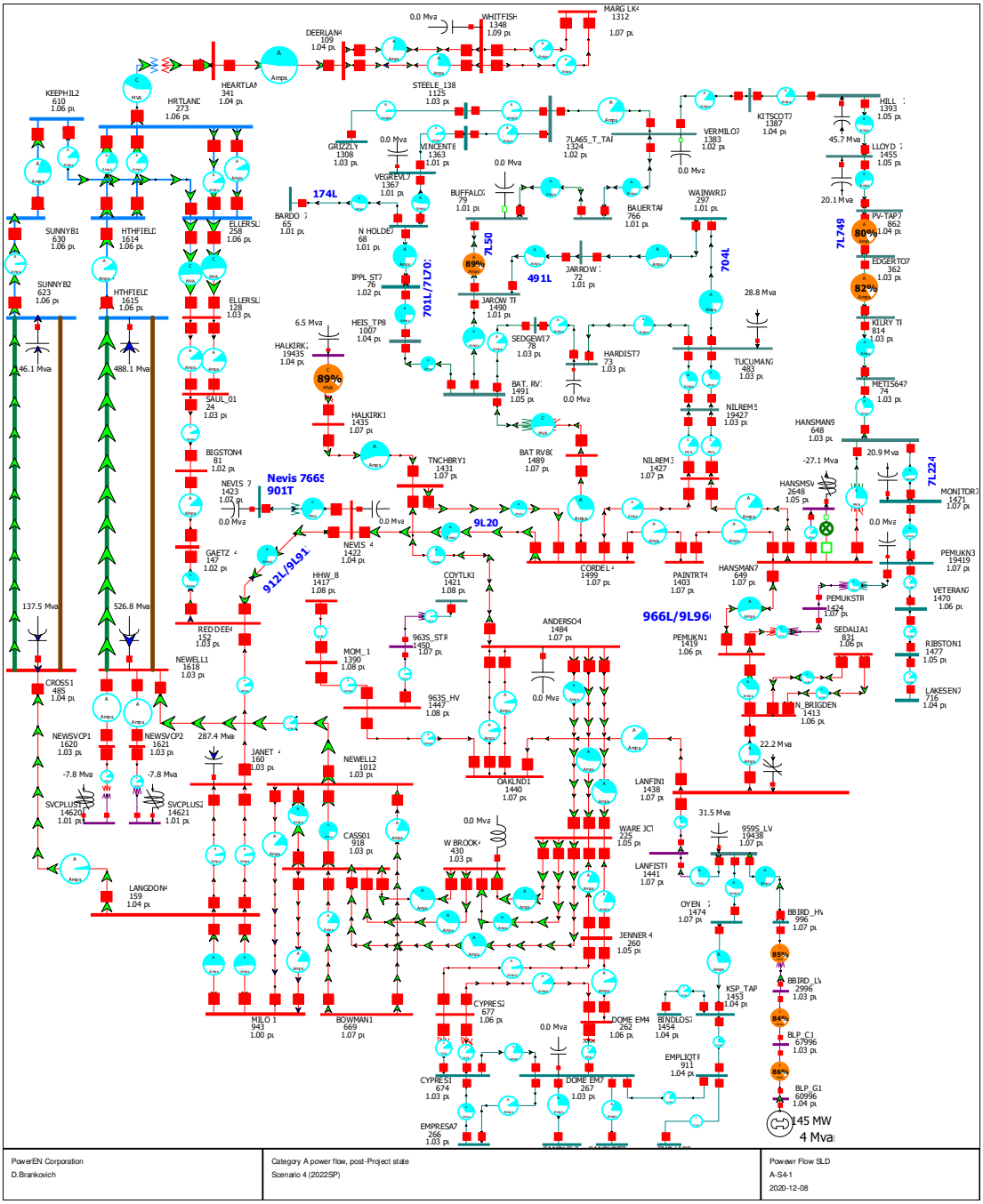


Figure B-S4-1: Category B Power Flow, Contingency: 648ST1 (Metiskow 648S 138kV/25kV transformer)

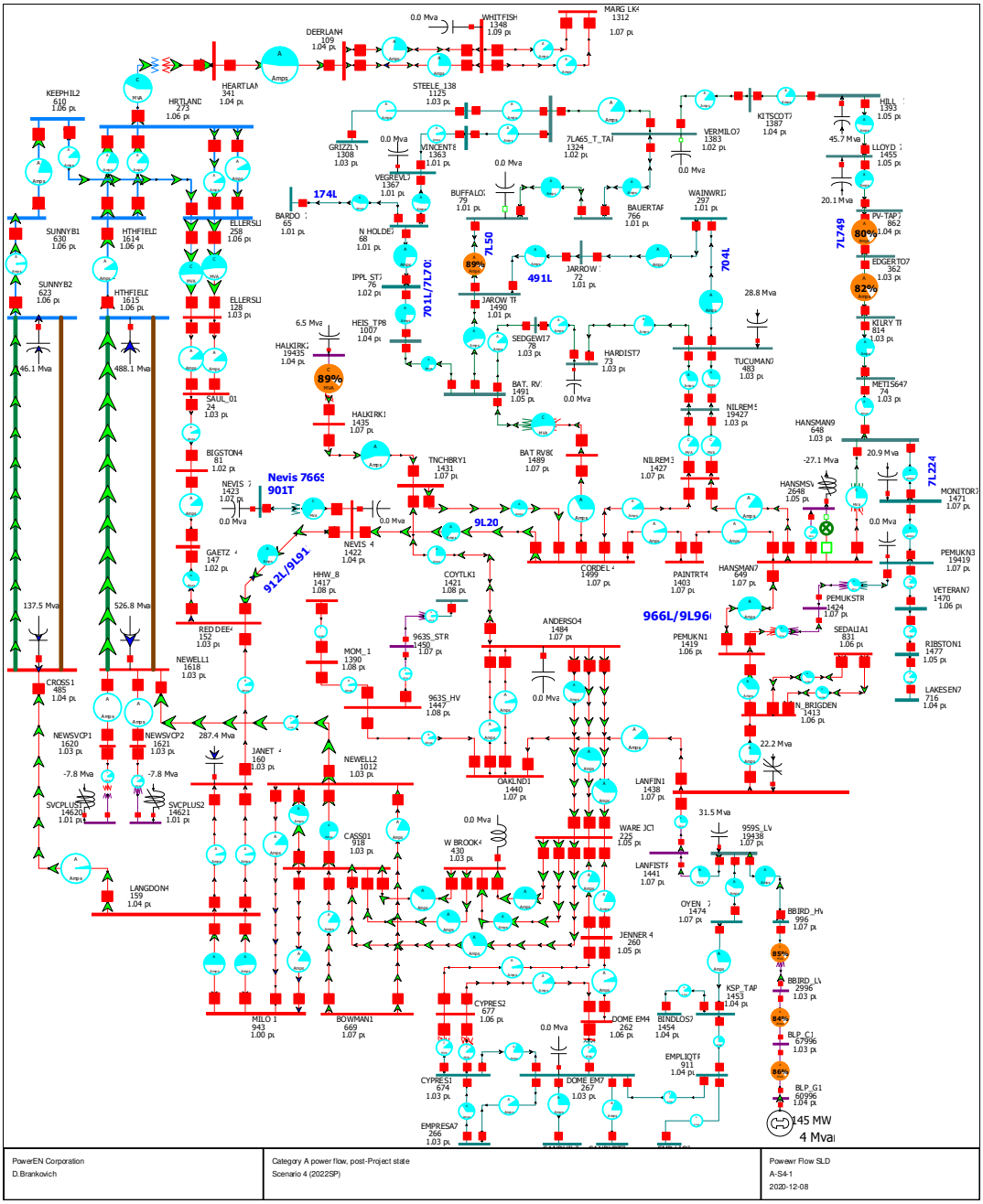


Figure B-S4-2: Category B Power Flow, Contingency 749L \ 749AL (Metiskow 648S-Edgerton 899S)

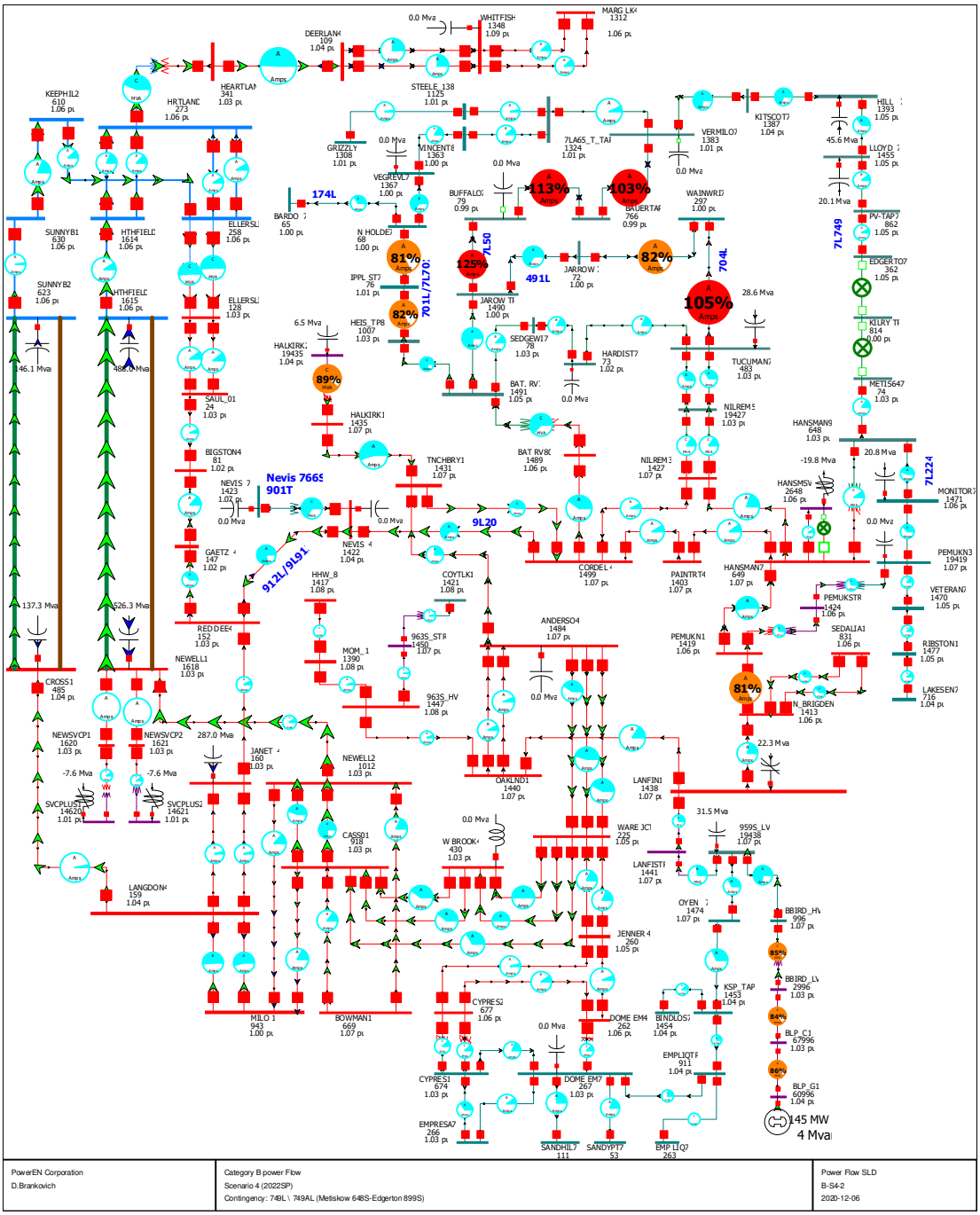


Figure B-S4-3: Category B Power Flow, Contingency: 766S901T (Nevis 766S 901T transformer)

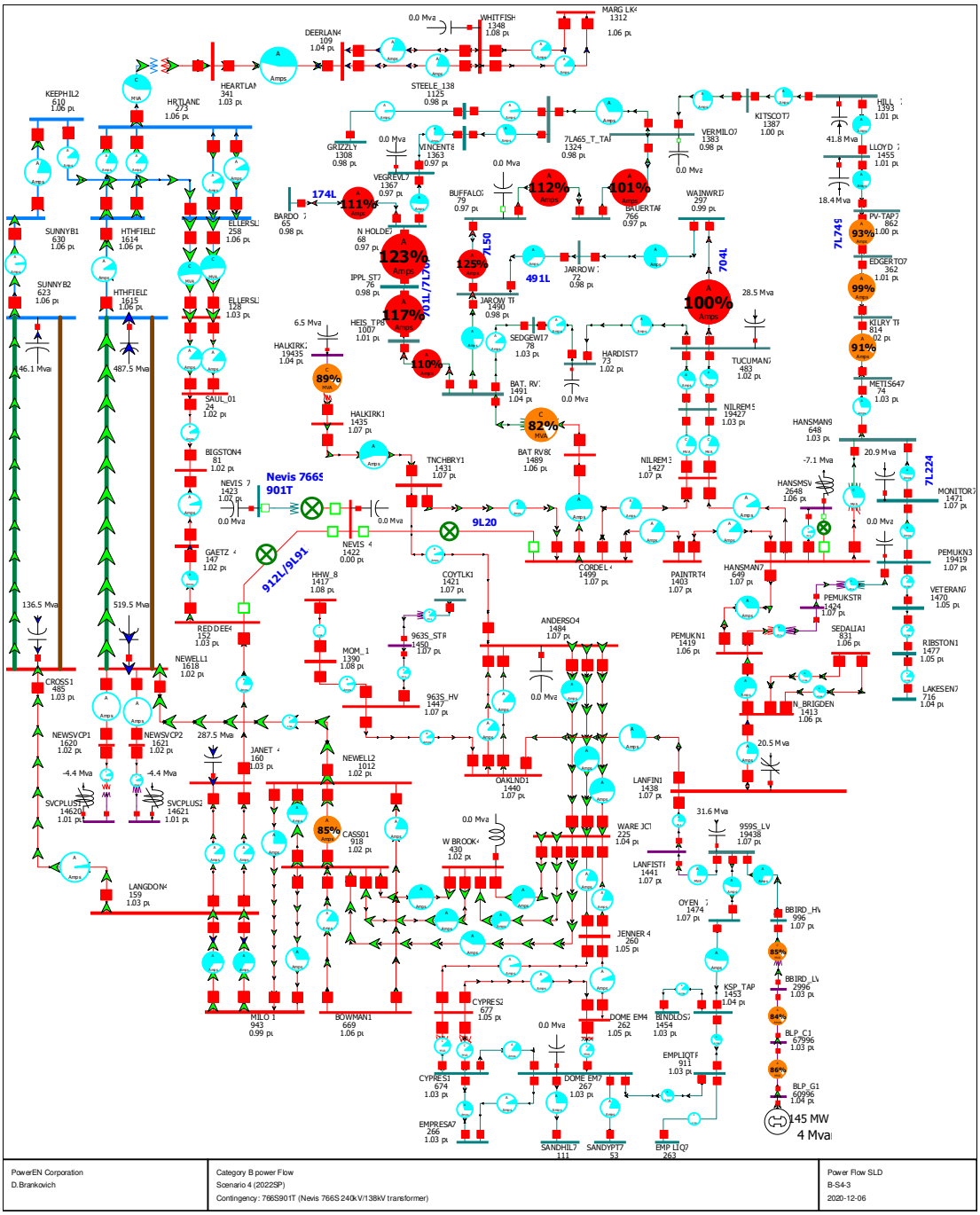


Figure B-S4-4: Category B Power Flow, Contingency: 7L749 \ 749L \ 7LB749 Lloydminster 716S-Edgerton 899S)

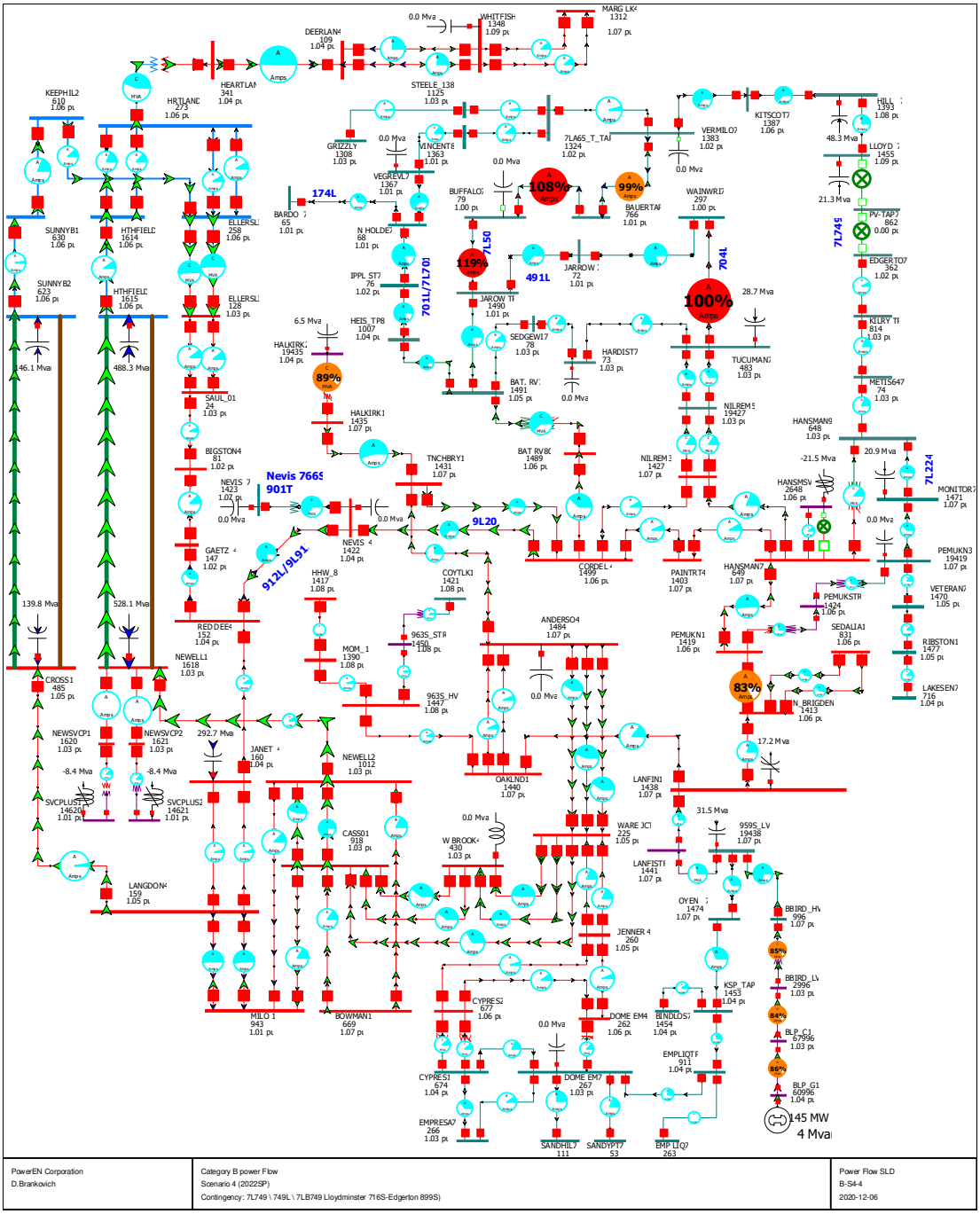


Figure B-S4-5: Category B Power Flow, Contingency: 899ST3a (Edgerton 899S 138kV/25kV transformer)

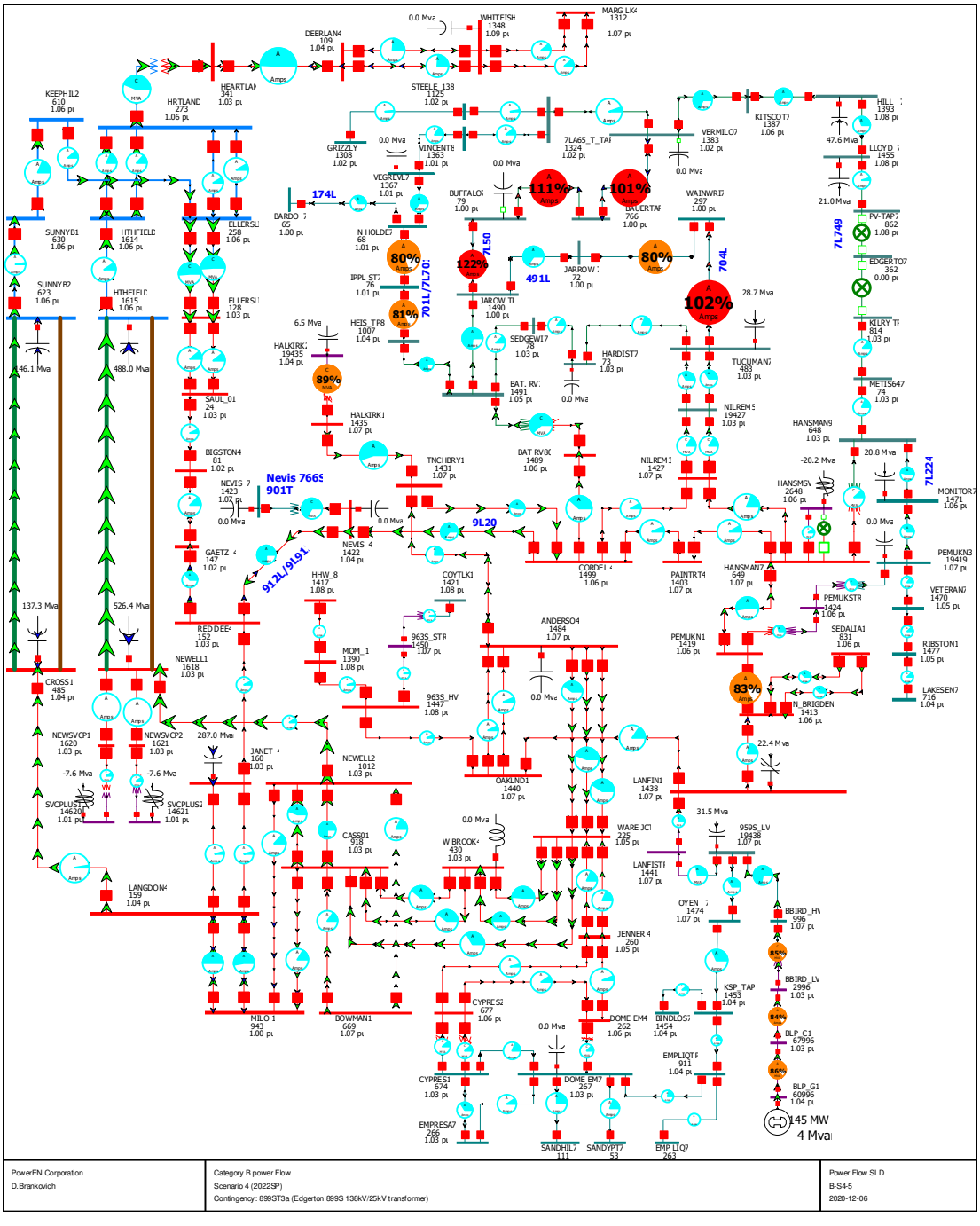


Figure B-S4-6: Category B Power Flow, Contingency: 912L \ 9L912 (Red Deer 63S-Nevis 766S)

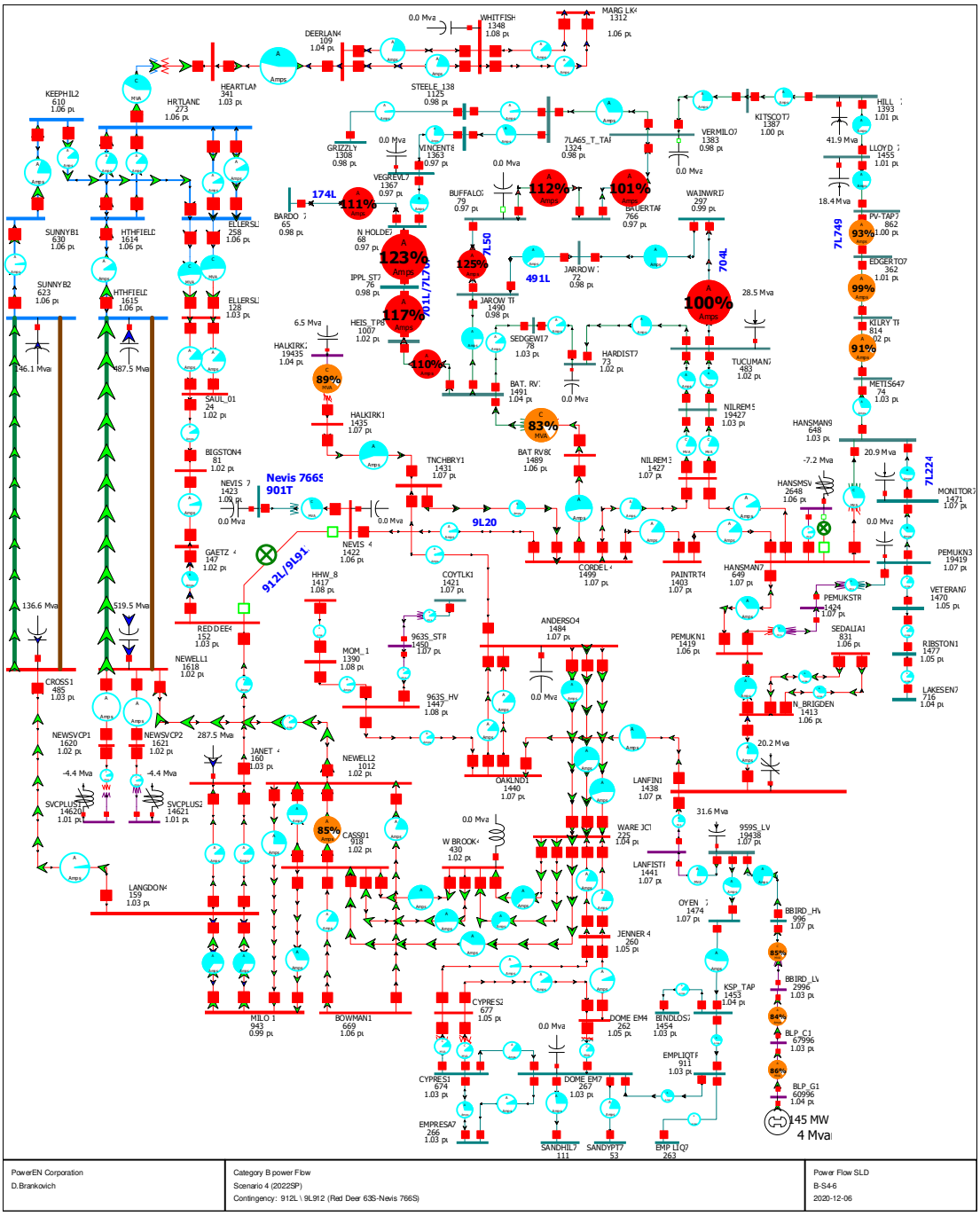


Figure B-S4-7: Category B Power Flow, Contingency: 966L \ 9L966 (Hansman Lk. 650S-Pemukan 932S)

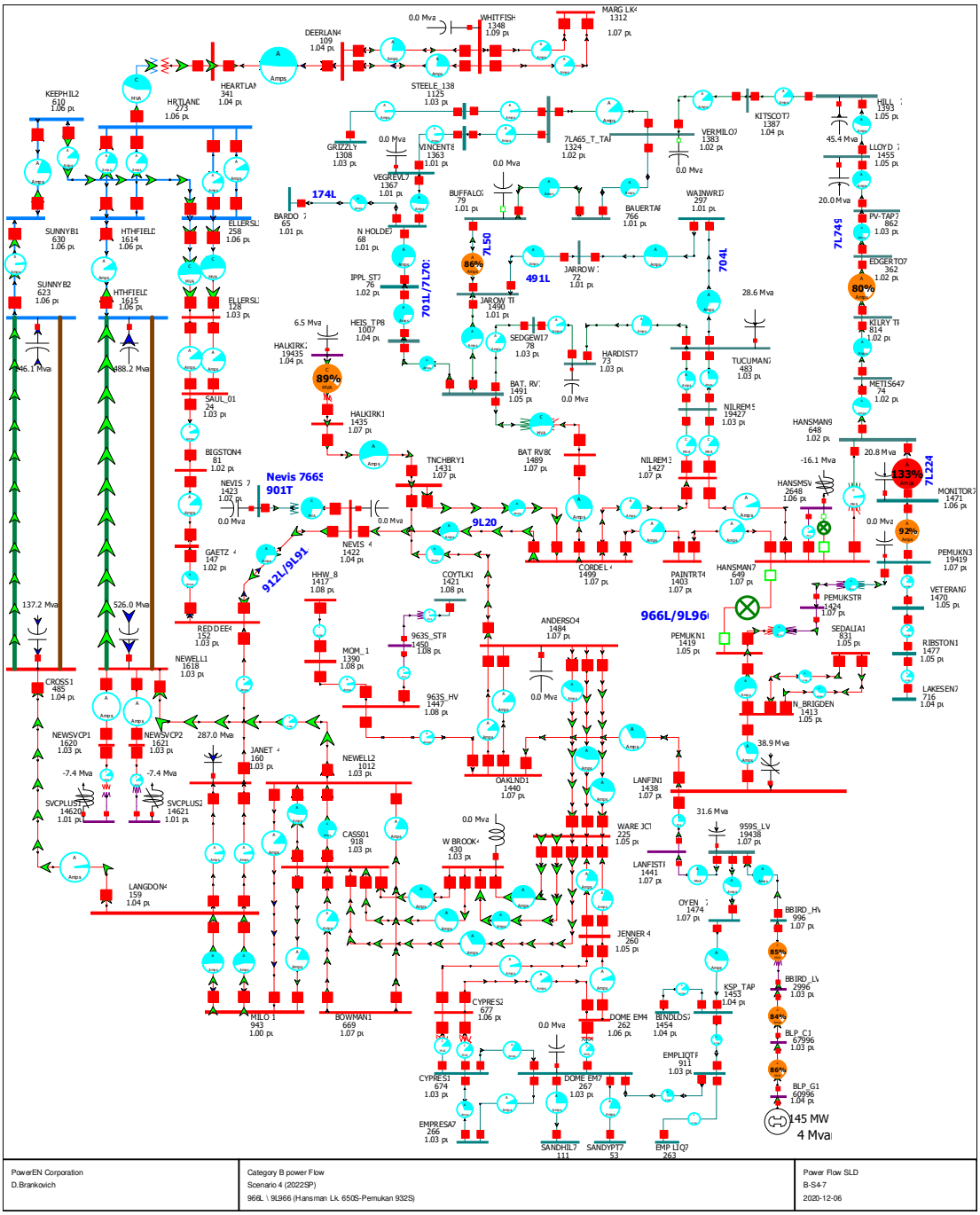


Figure B-S4-8: Category B Power Flow, Contingency: 9L20 (Cordel 755S-Nevis 766S)

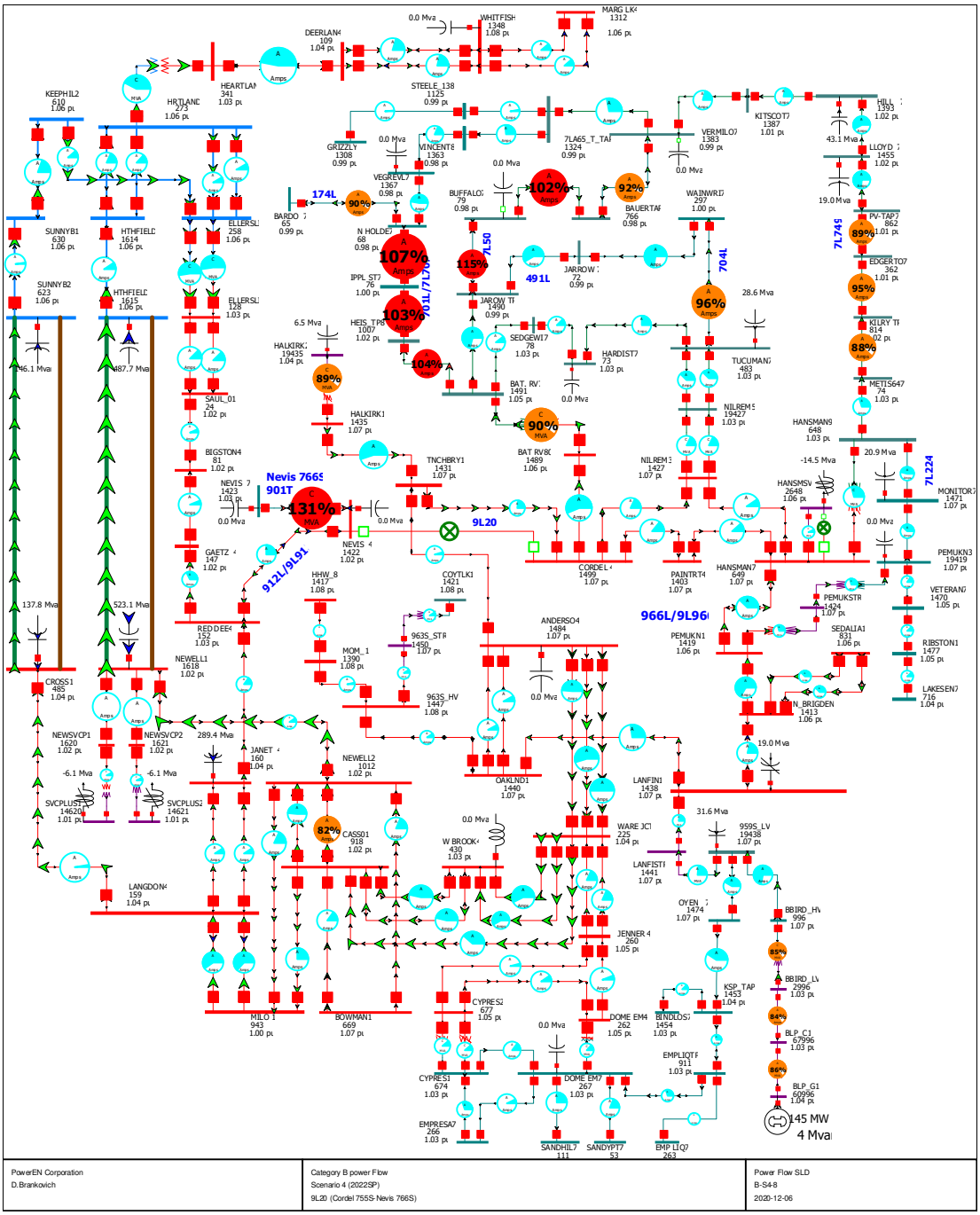


Figure B-S4-9: Category B Power Flow, Contingency: EATL

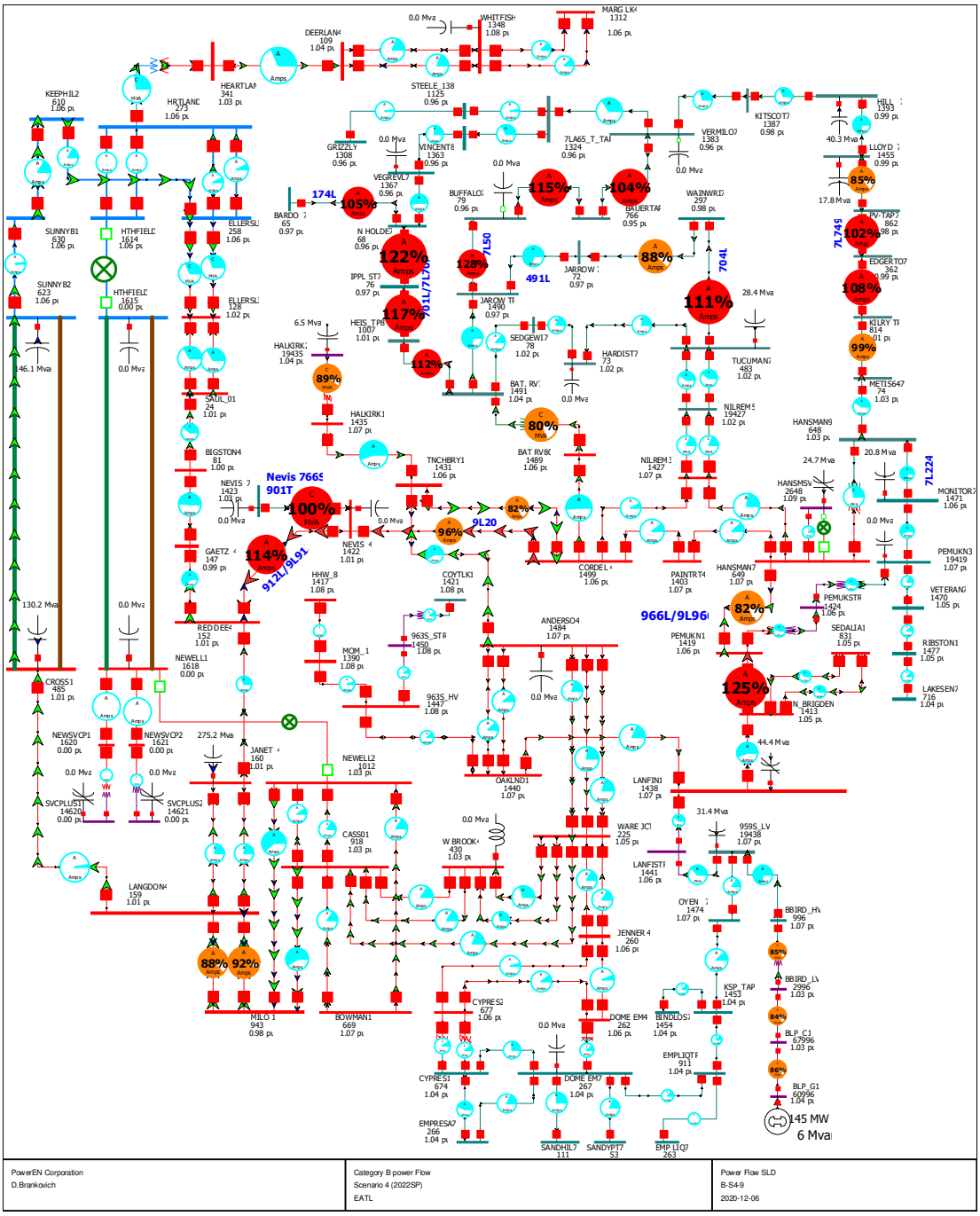


Figure B-S4-10: Category B Power Flow, Contingency: 395ST1 (N.Holden 395S 138kV/25kV transformer)

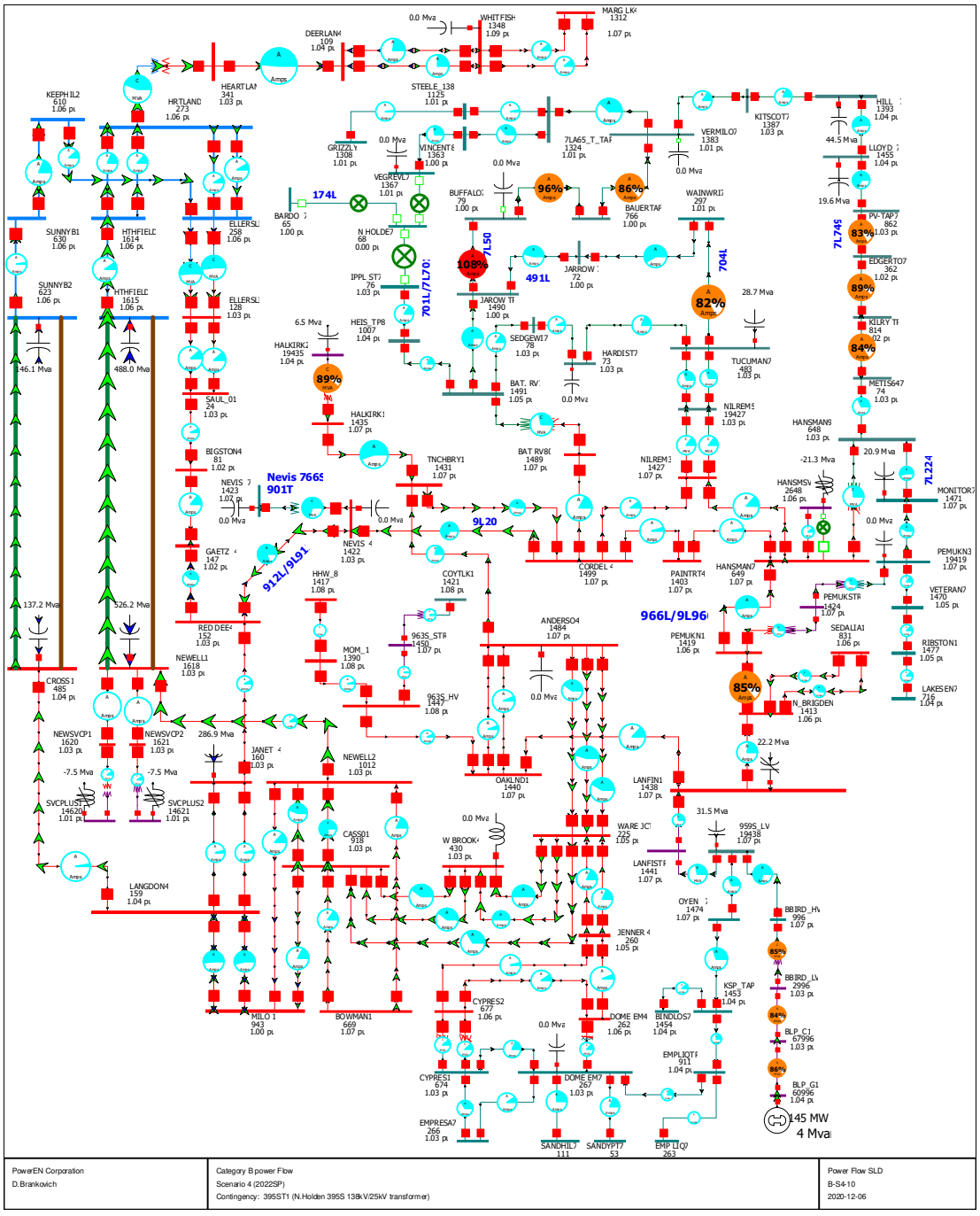


Figure B-S4-11: Category B Power Flow, Contingency: 526ST1/526ST2 (Buffalo Crk. 526S 138kV/25kV transformer)

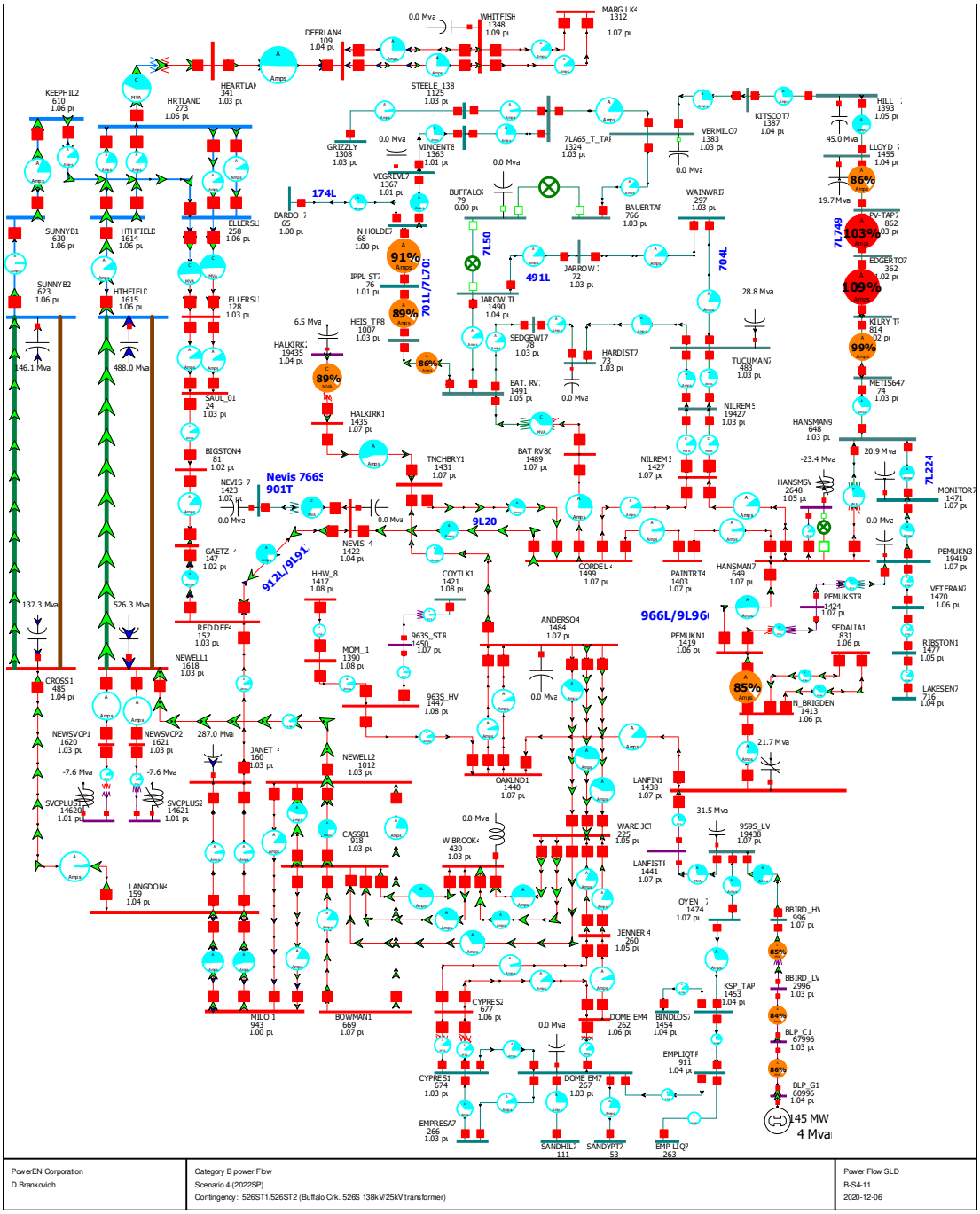


Figure B-S4-12: Category B Power Flow, Contingency: 757S912T (Battle River 757S transformer)

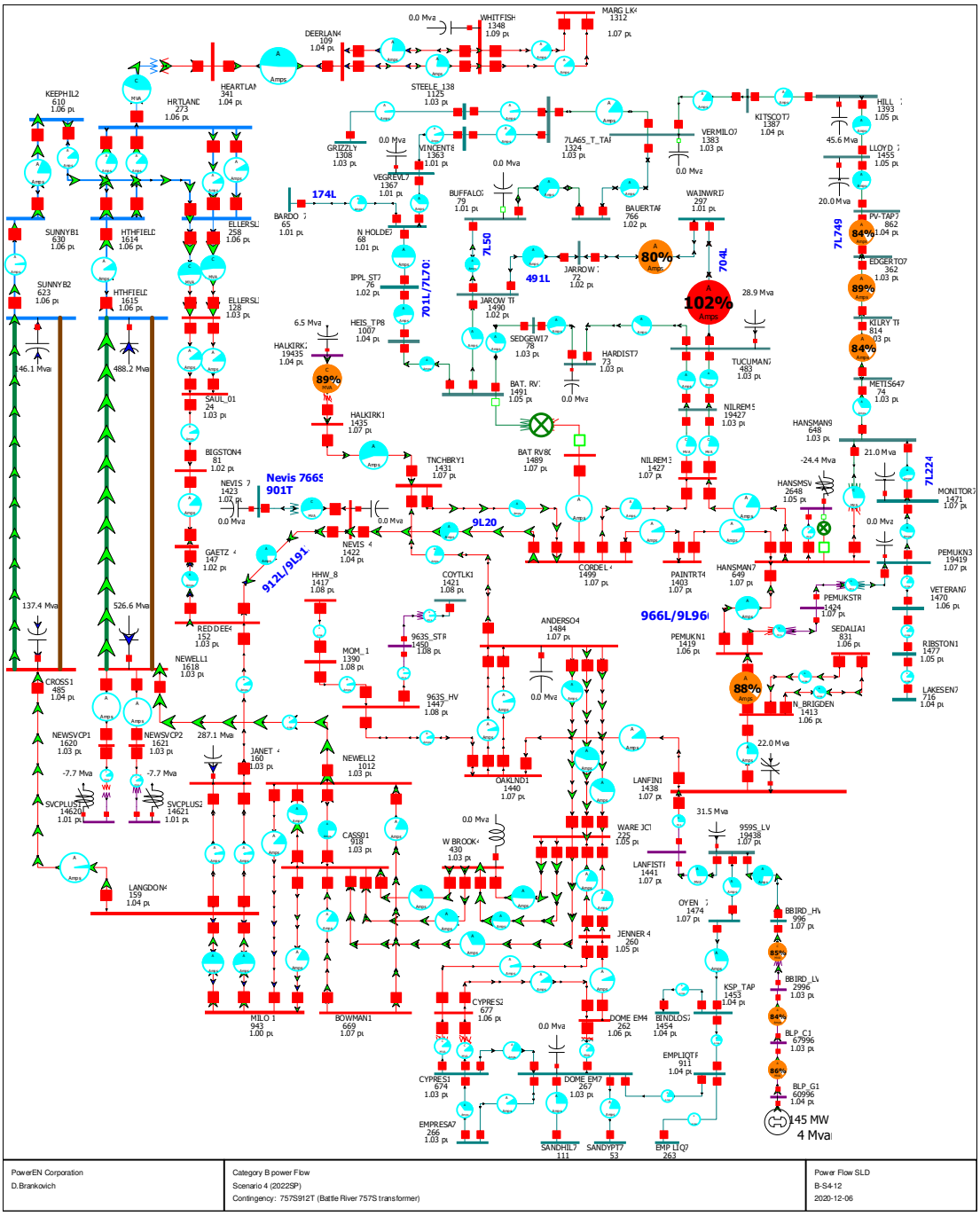


Figure B-S4-13: Category B Power Flow, Contingency: 7L129 \ 7LA129 (Buffalo Crk. 526S-Vermilion 710S)

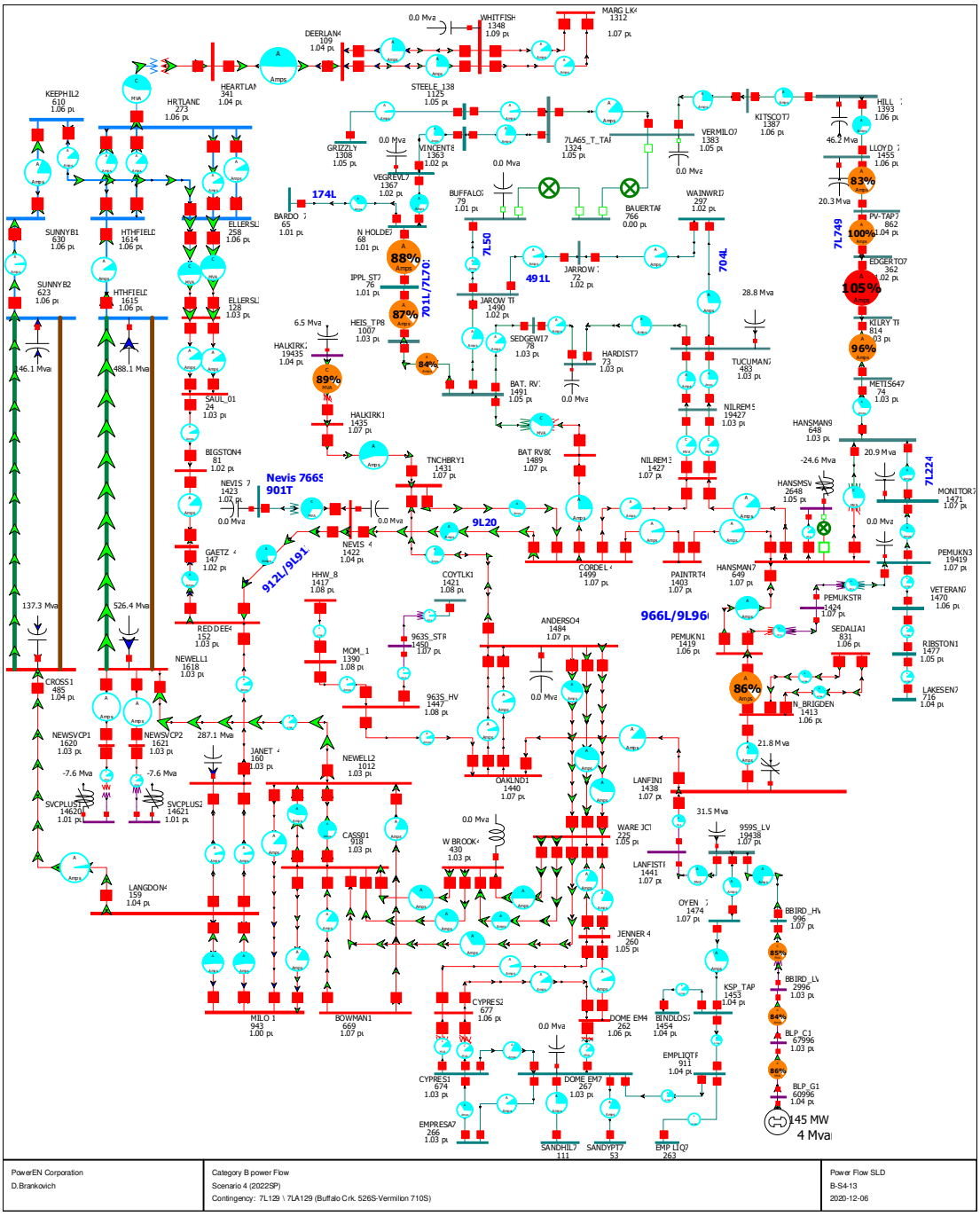


Figure B-S4-14: Category B Power Flow, Contingency: 7L42 (Lloydminster 716S-Hill 751S)

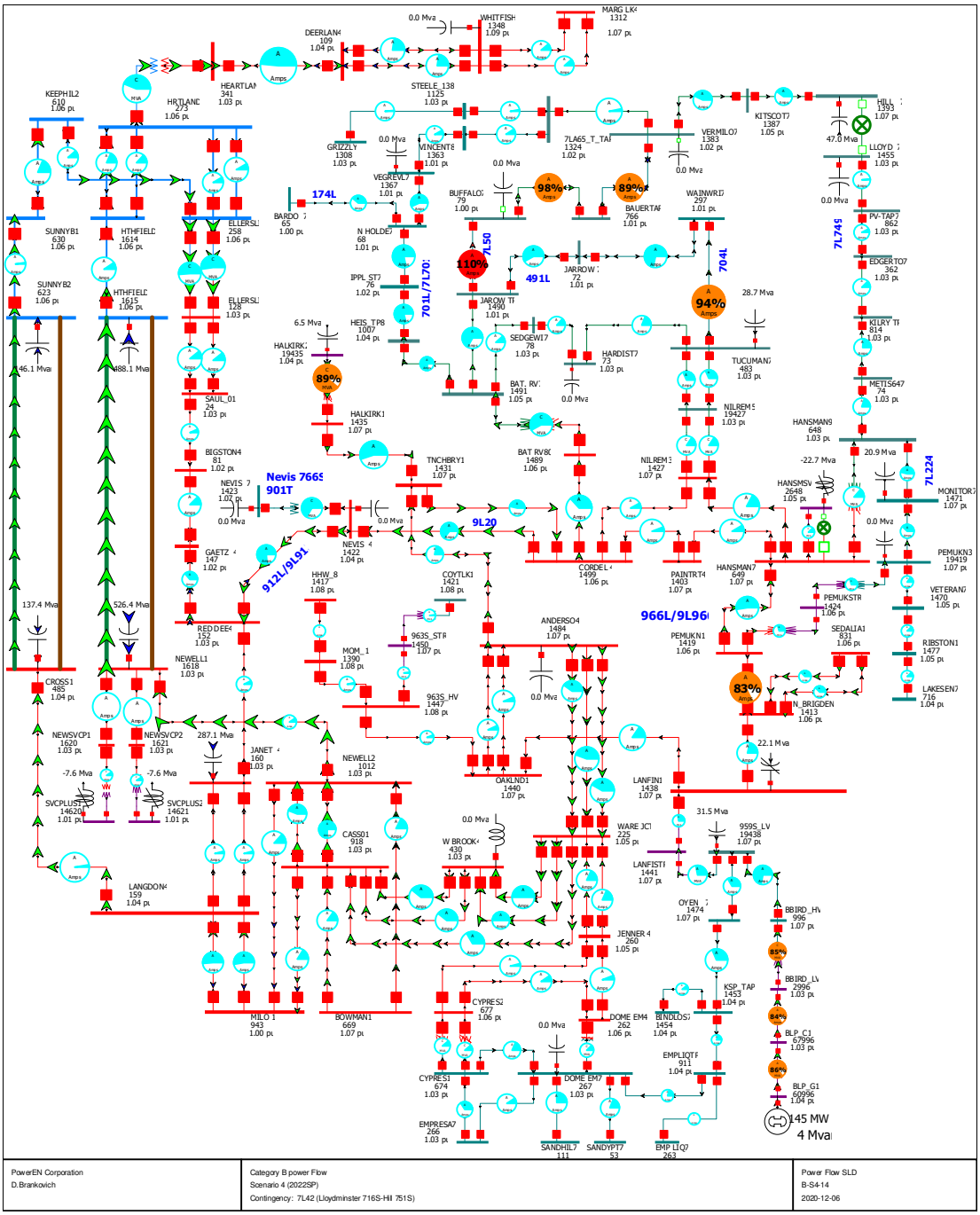


Figure B-S4-15: Category B Power Flow, Contingency: 7L50 (Buffalo Crk. 526S-Battle River 757S)

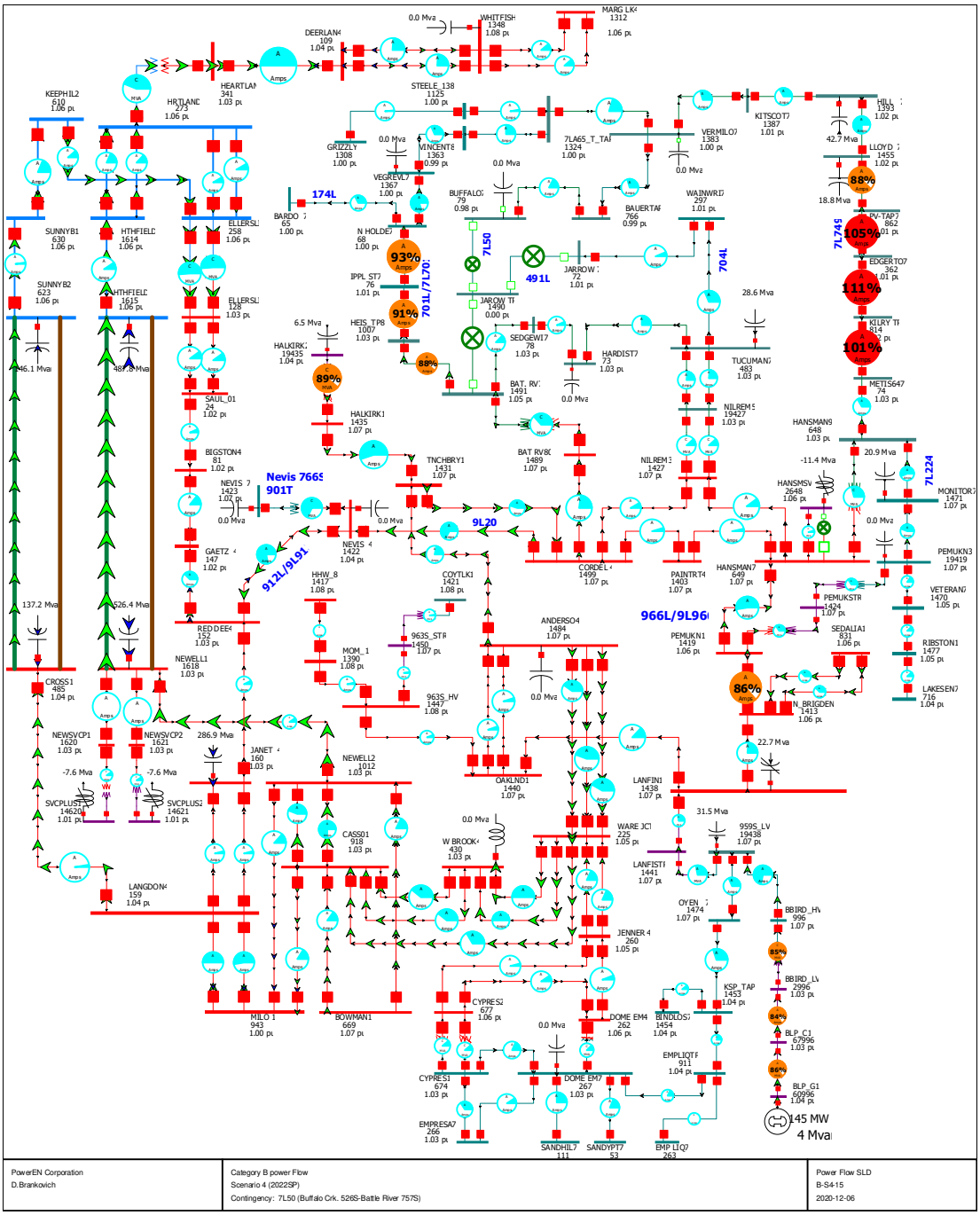


Figure B-S4-16: Category B Power Flow, Contingency: 7L701 \ 7LA701 \ 701L (Strome 223S-Battle River 757S)

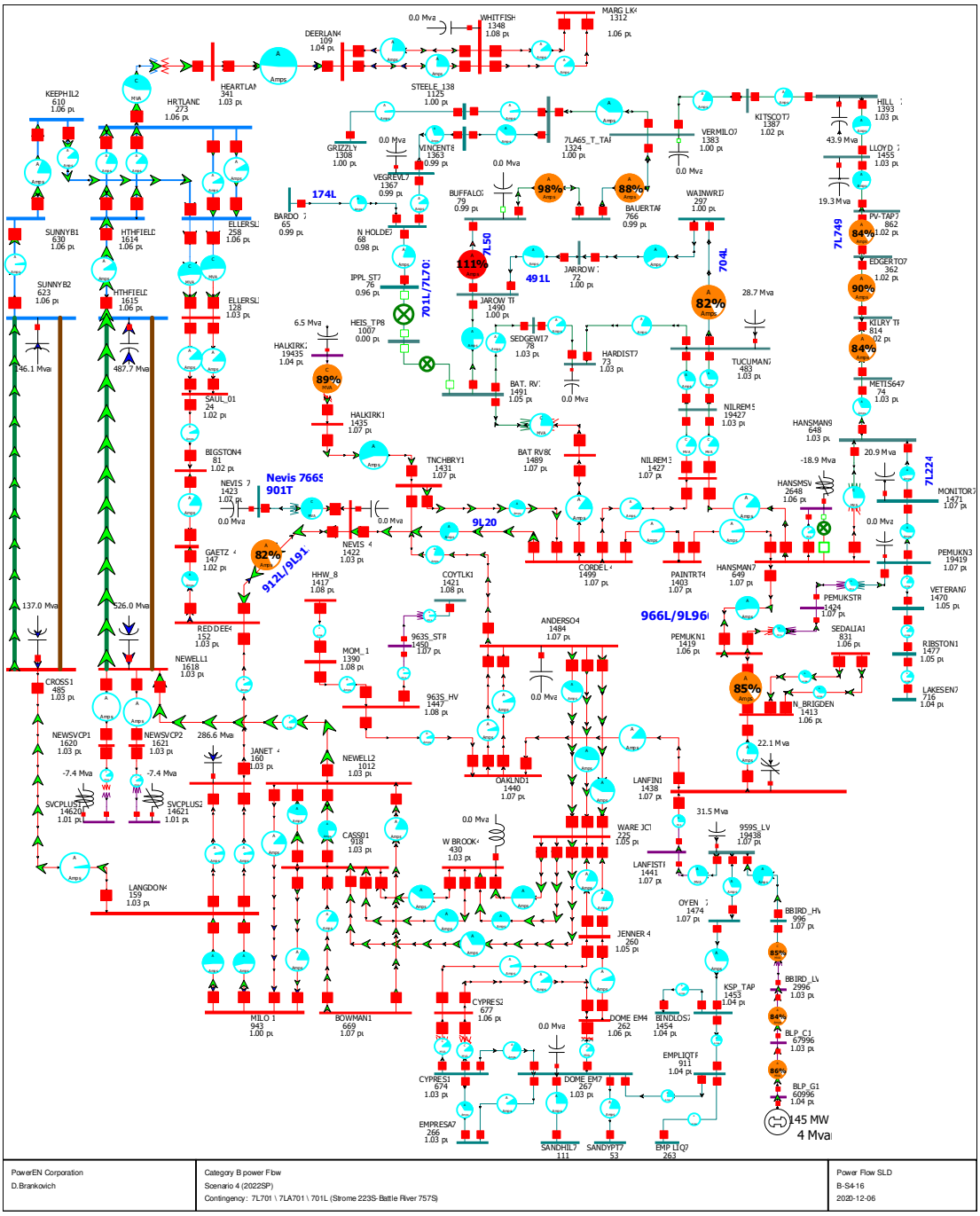
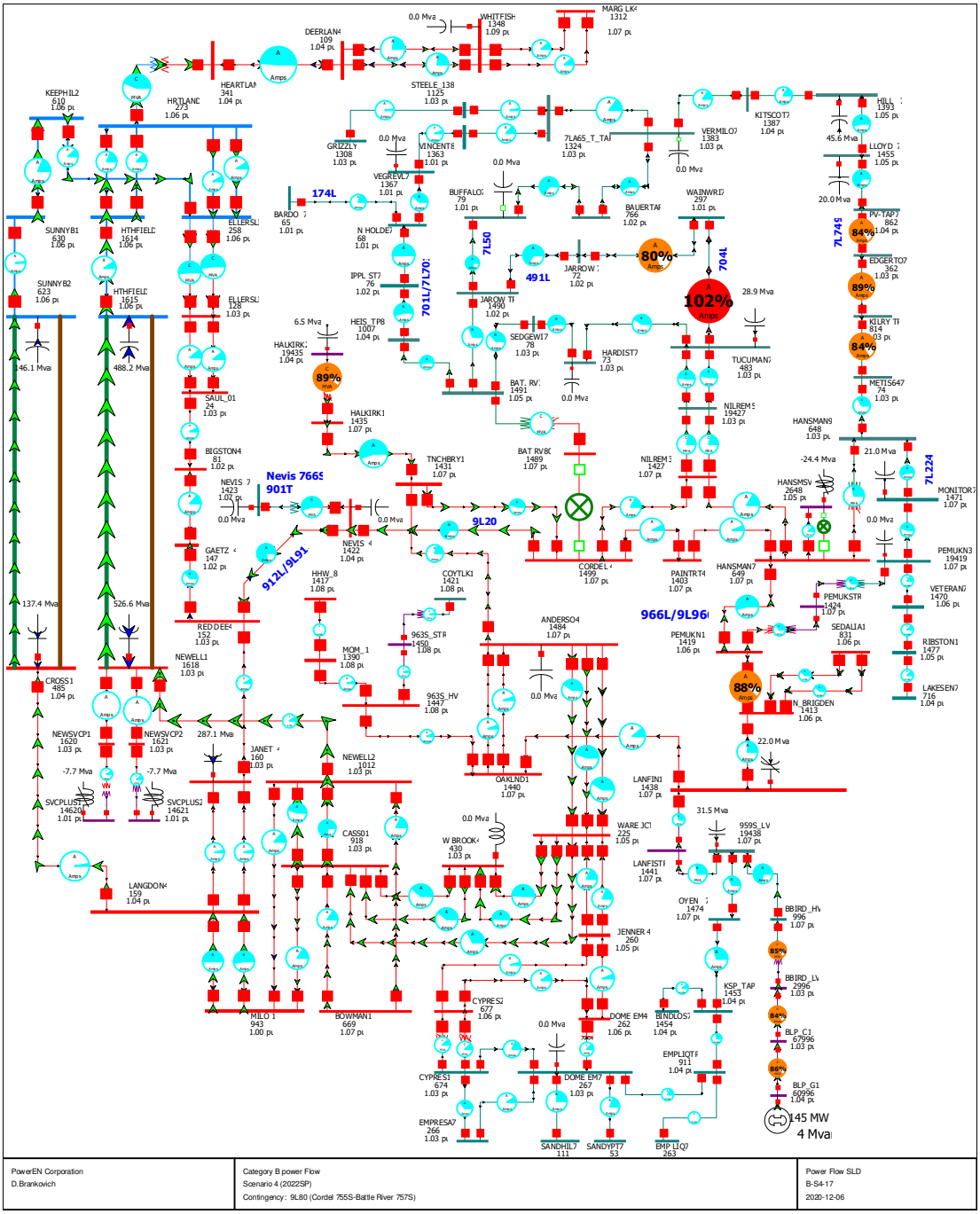


Figure B-S4-17: Category B Power Flow, Contingency: 9L80 (Cordel 755S-Battle River 757S)



A3.1

Scenario 5: Post-Project Power Flow Single Line Diagrams (2022SL)

Figure A-S5-1: Category A Power Flow

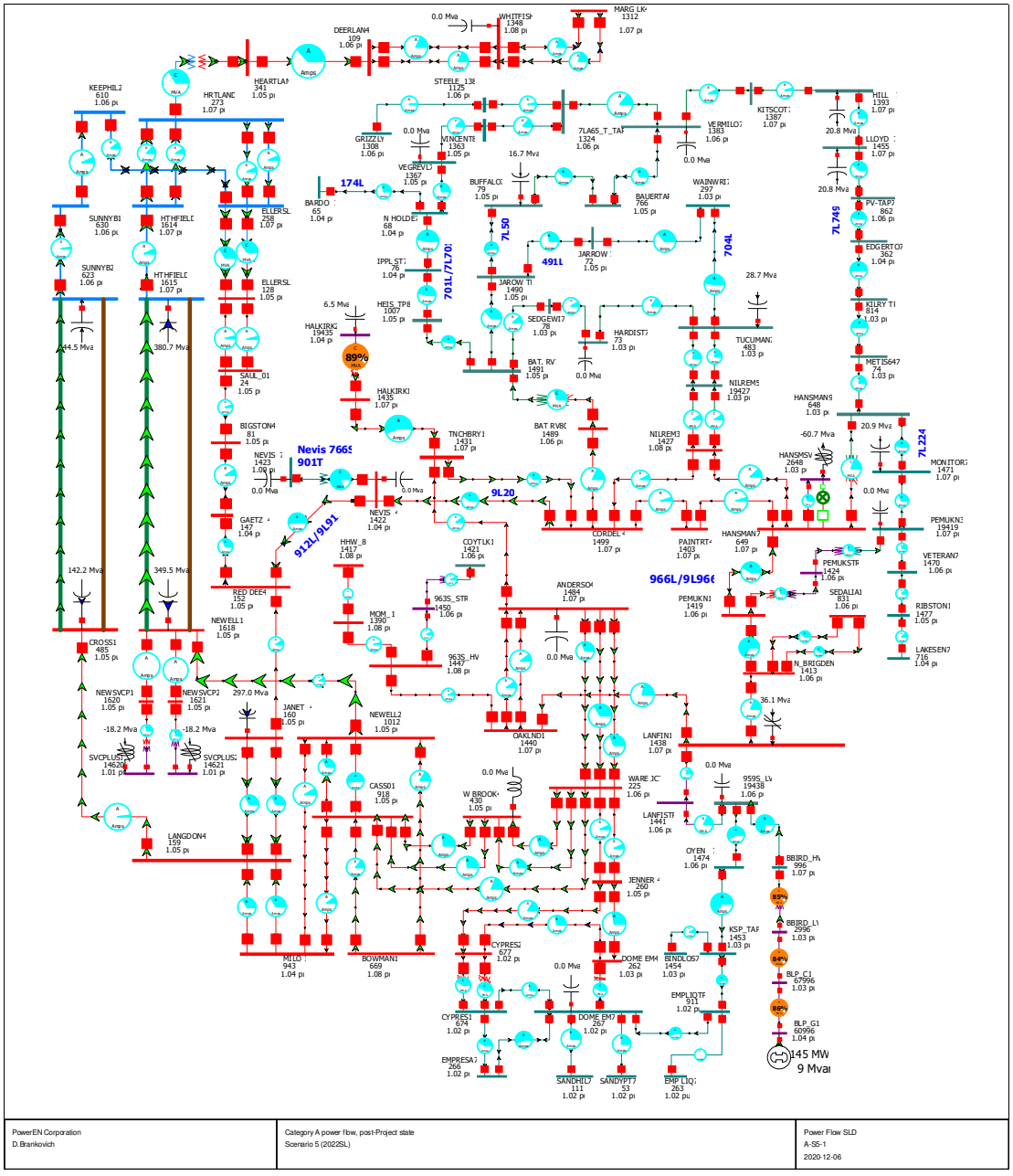


Figure B-S5-1: Category B Power Flow, Contingency: 9L20 (Cordel 755S-Nevis 766S)

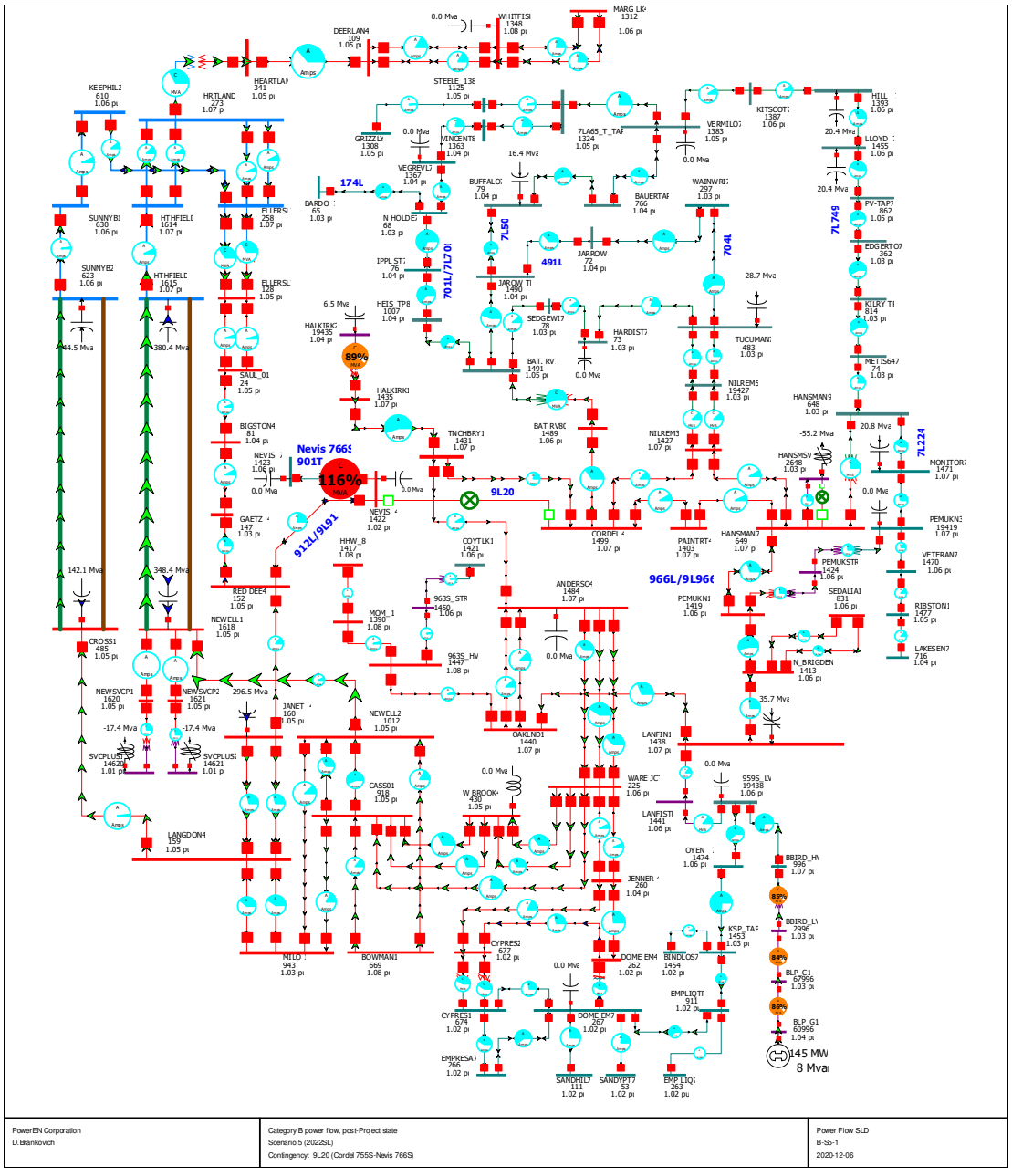
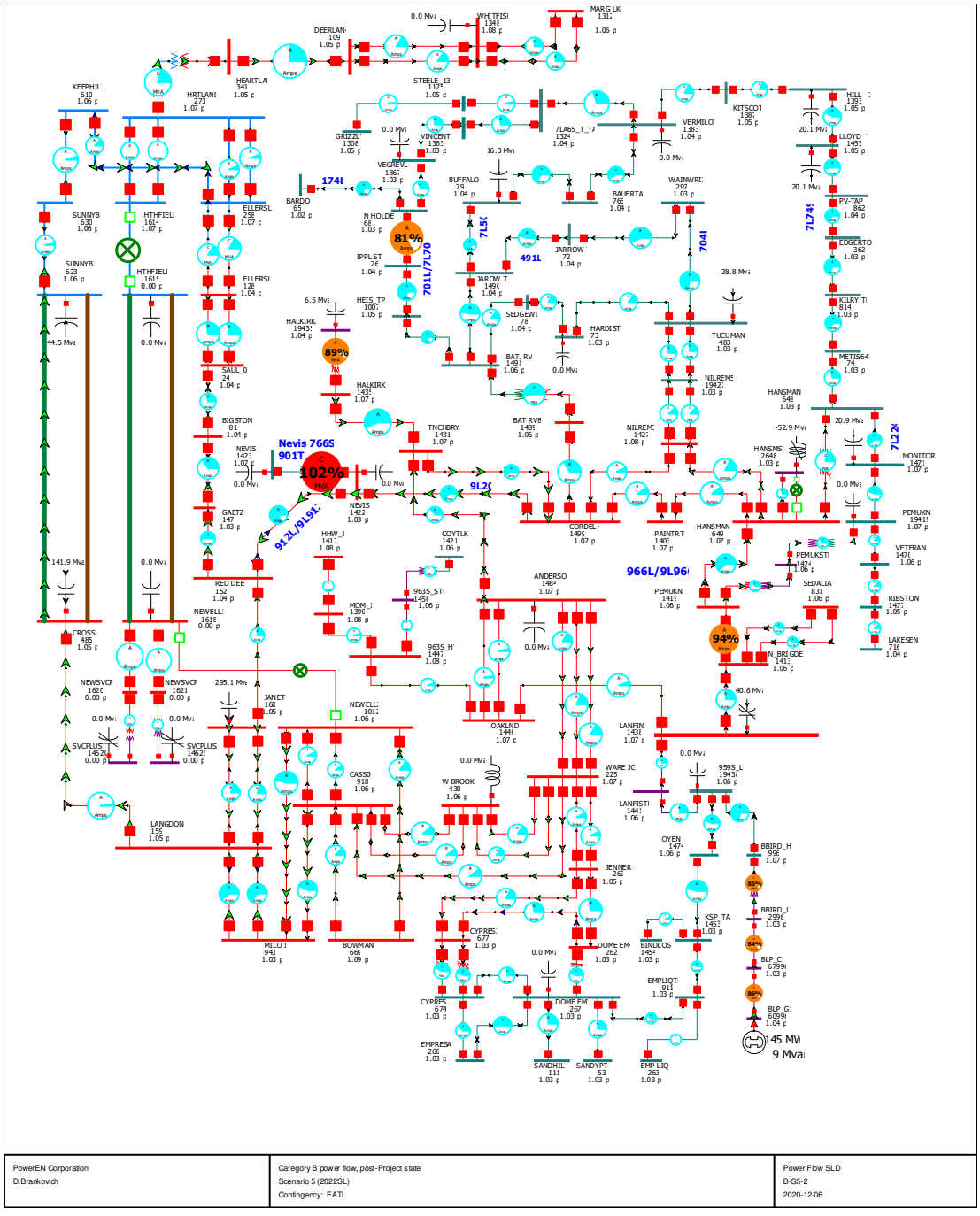


Figure B-S5-2: Category B Power Flow, Contingency: EATL



A3.3

Scenario 6: Post-Project Power Flow Single Line Diagrams (2022WP)

Figure A-S6-1: Category A Power Flow

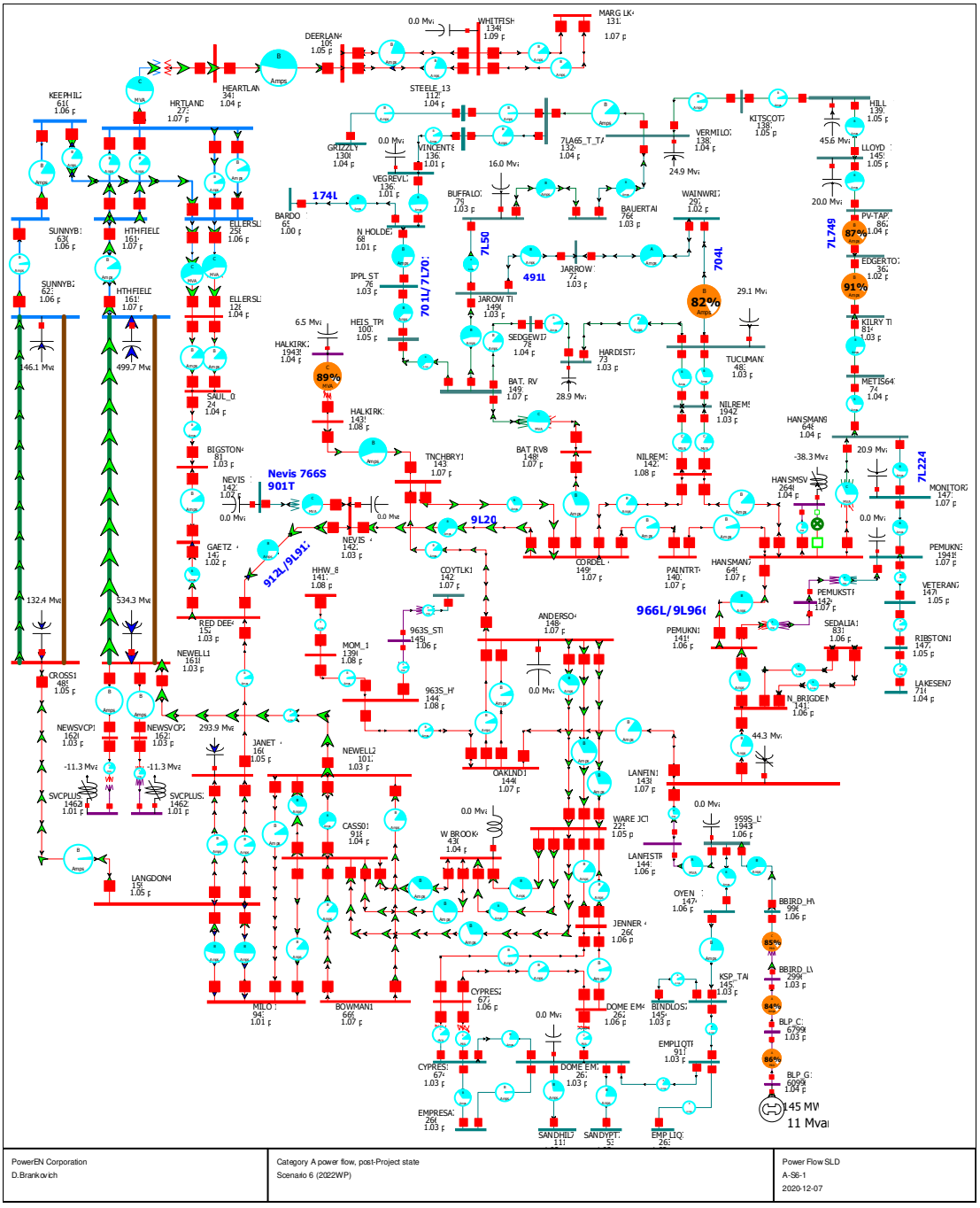


Figure B-S6-1: Category B Power Flow, Contingency: 648ST1 (Metiskow 648S 138kV/25kV transformer)

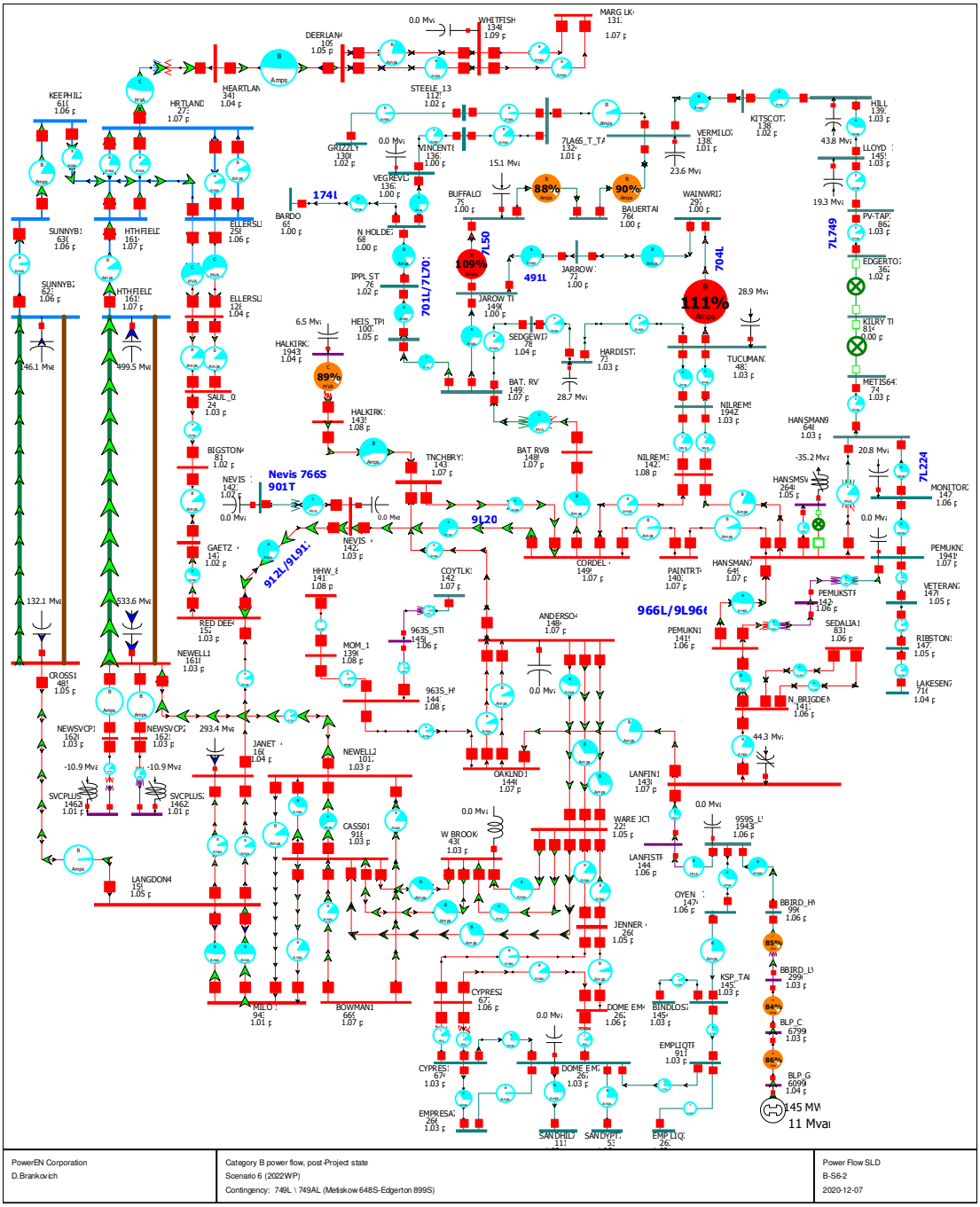


Figure B-S6-2: Category B Power Flow, Contingency: 749L \ 749AL (Metiskow 648S-Edgerton 899S)

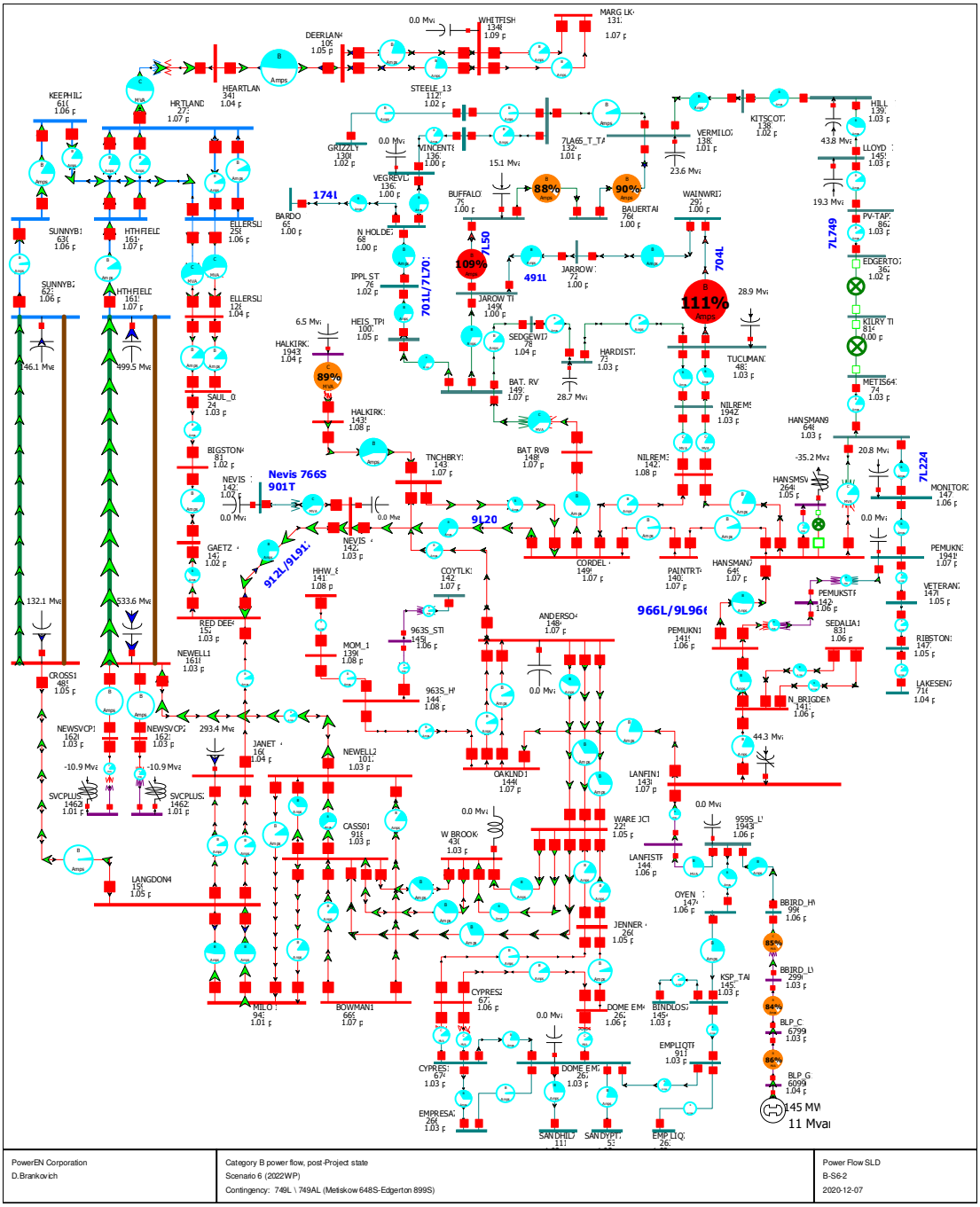


Figure B-S6-3: Category B Power Flow, Contingency: 766S901T (Nevis 766S 901T transformer)

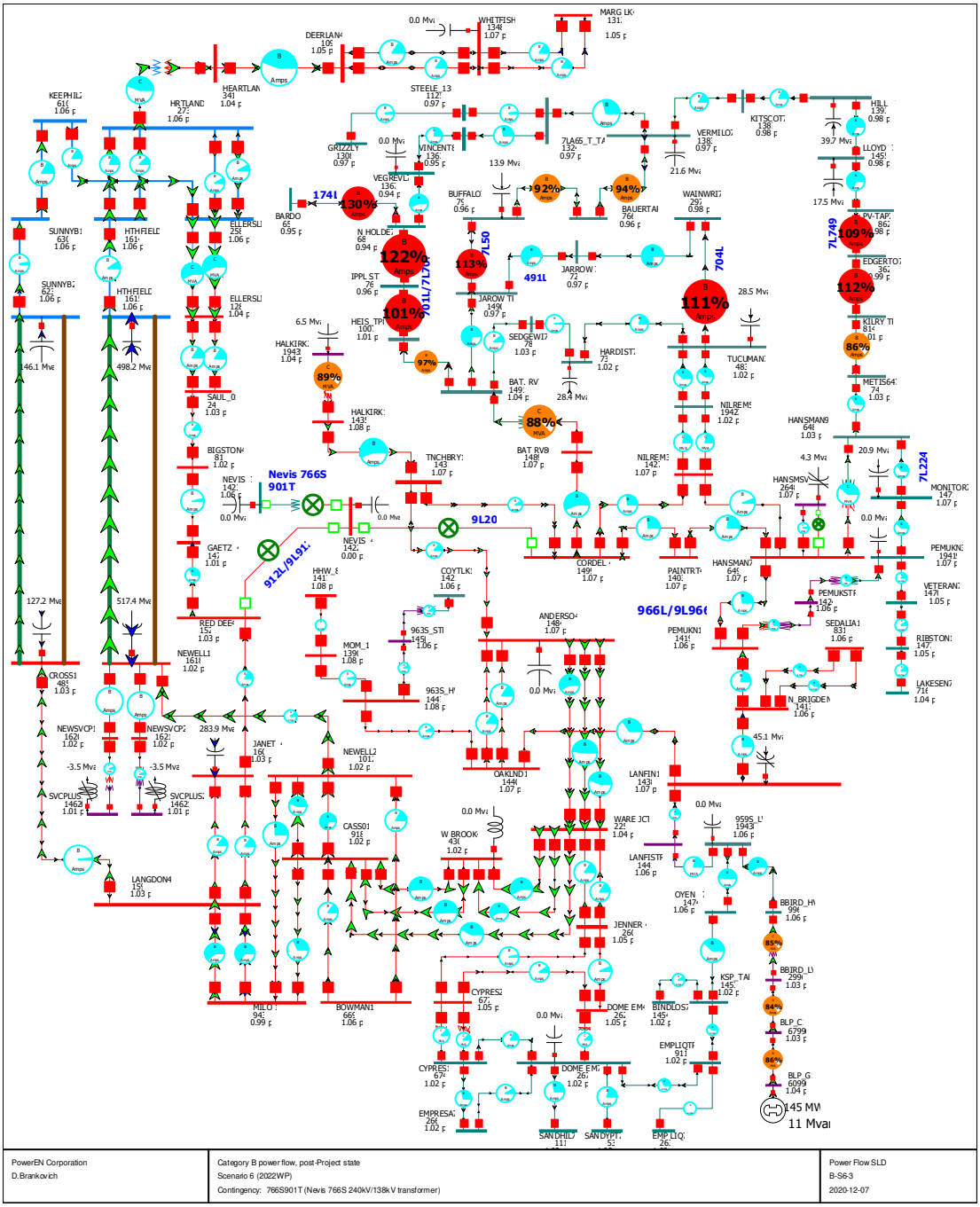


Figure B-S6-4: Category B Power Flow, Contingency: 7L749 \ 749L \ 7LB749 Lloydminster 716S-Edgerton 899S)

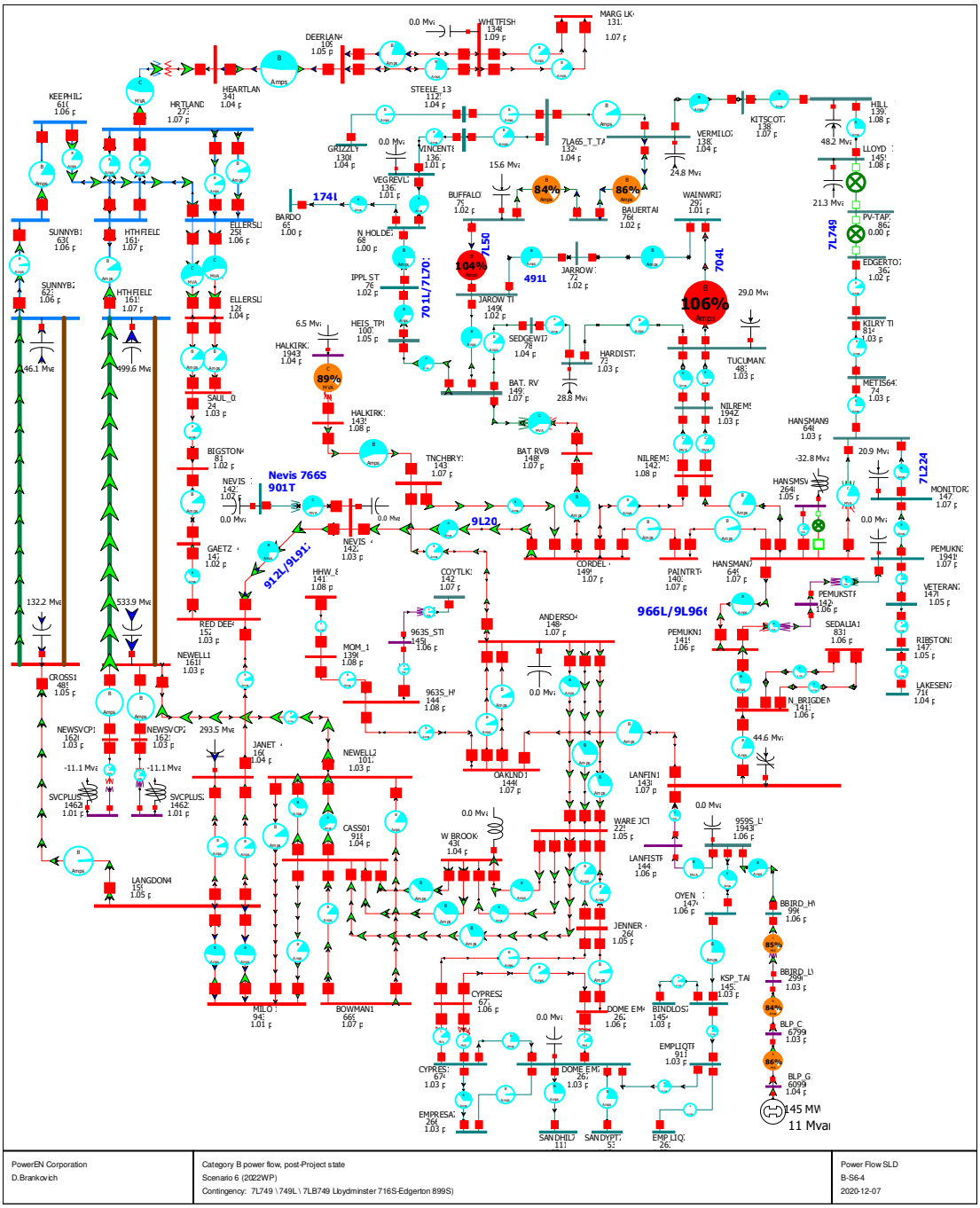


Figure B-S6-5: Category B Power Flow, Contingency: 899ST3a (Edgerton 899S 138kV/25kV transformer)

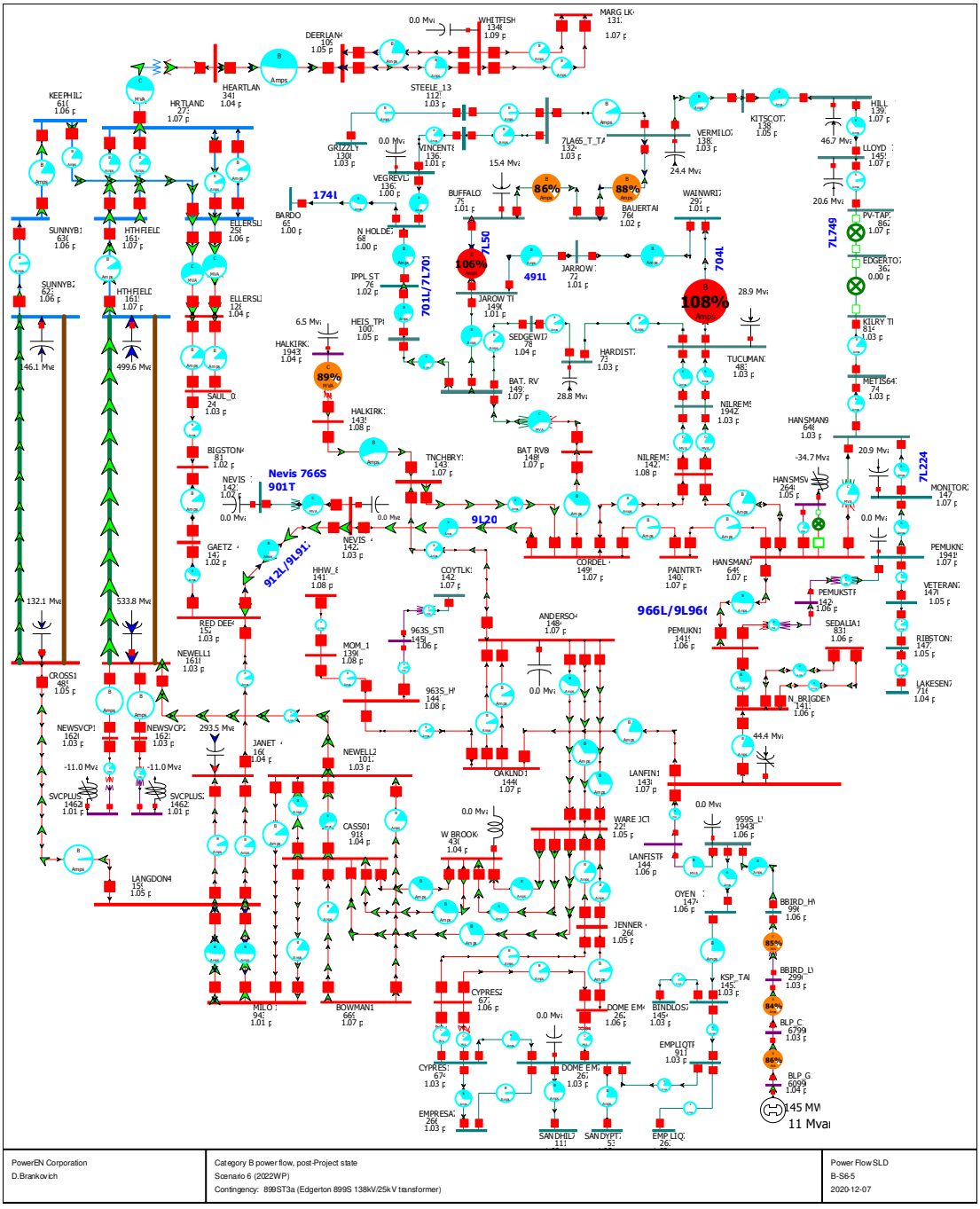


Figure B-S6-6: Category B Power Flow, Contingency: 912L \ 9L912 (Red Deer 63S-Nevis 766S)

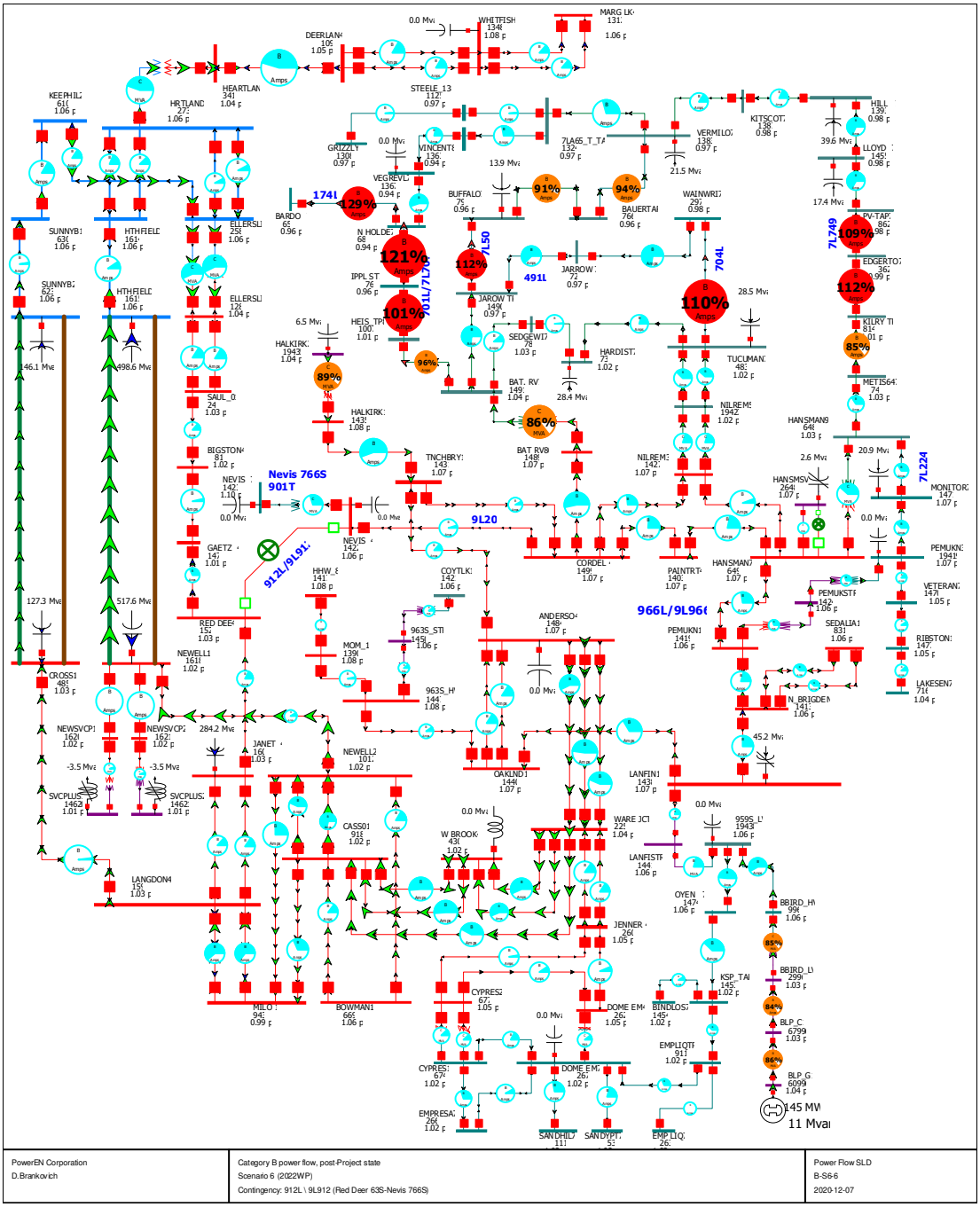


Figure B-S6-7: Category B Power Flow, Contingency: 9L20 (Cordel 755S-Nevis 766S)

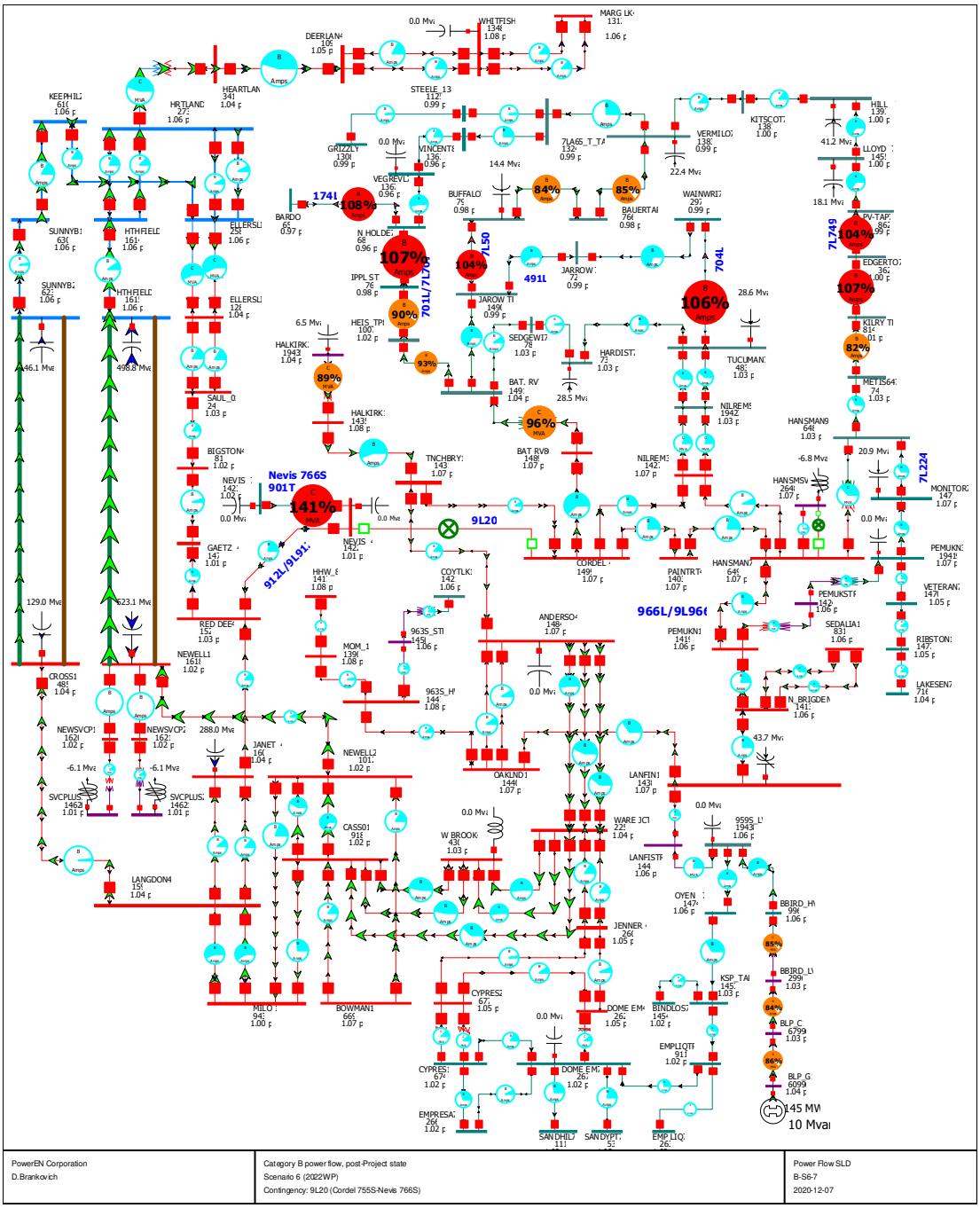


Figure B-S6-8: Category B Power Flow, Contingency: EATL

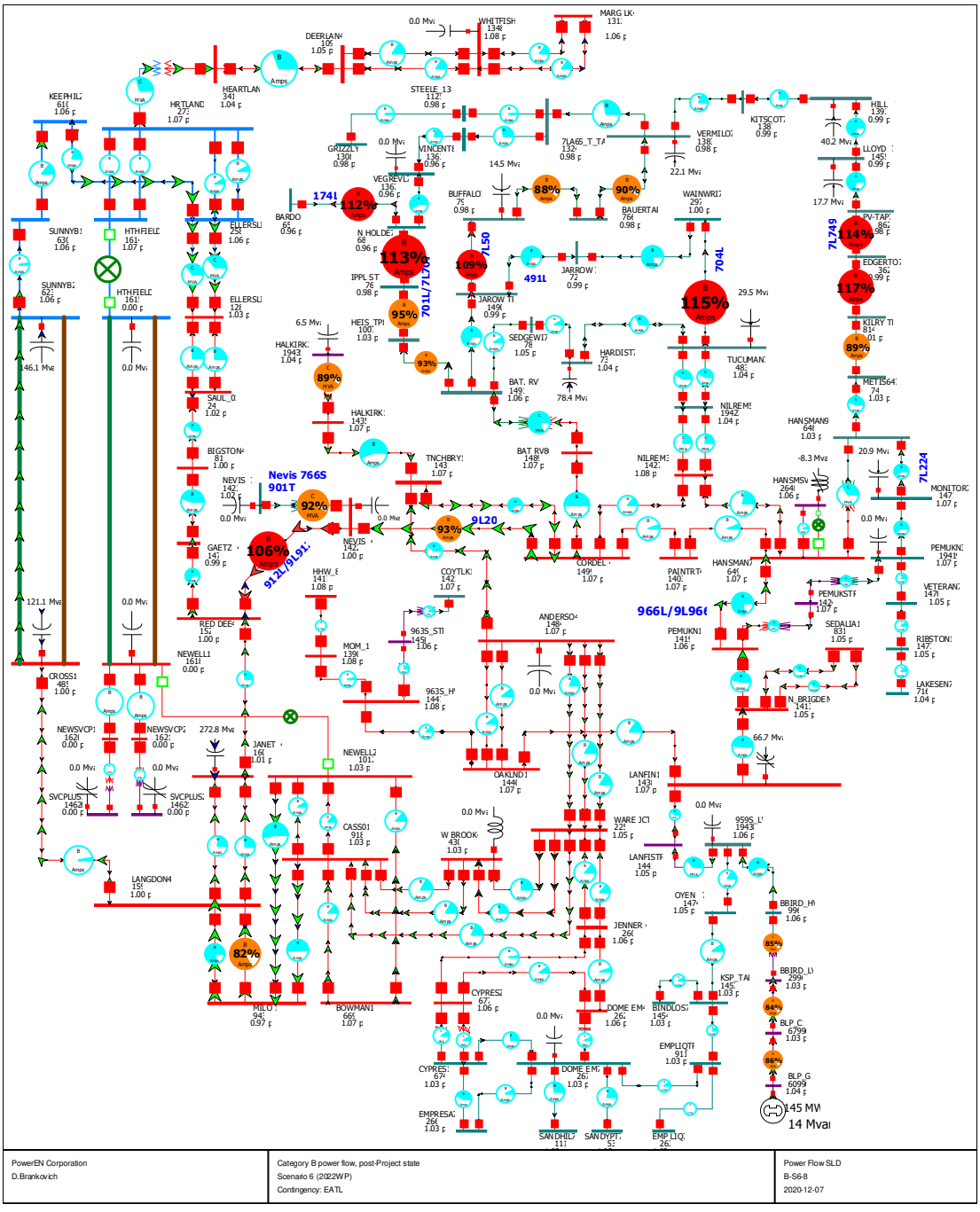


Figure B-S6-9: Category B Power Flow, Contingency: 526ST1/526ST2 (Buffalo Crk. 526S 138kV/25kV transformer)

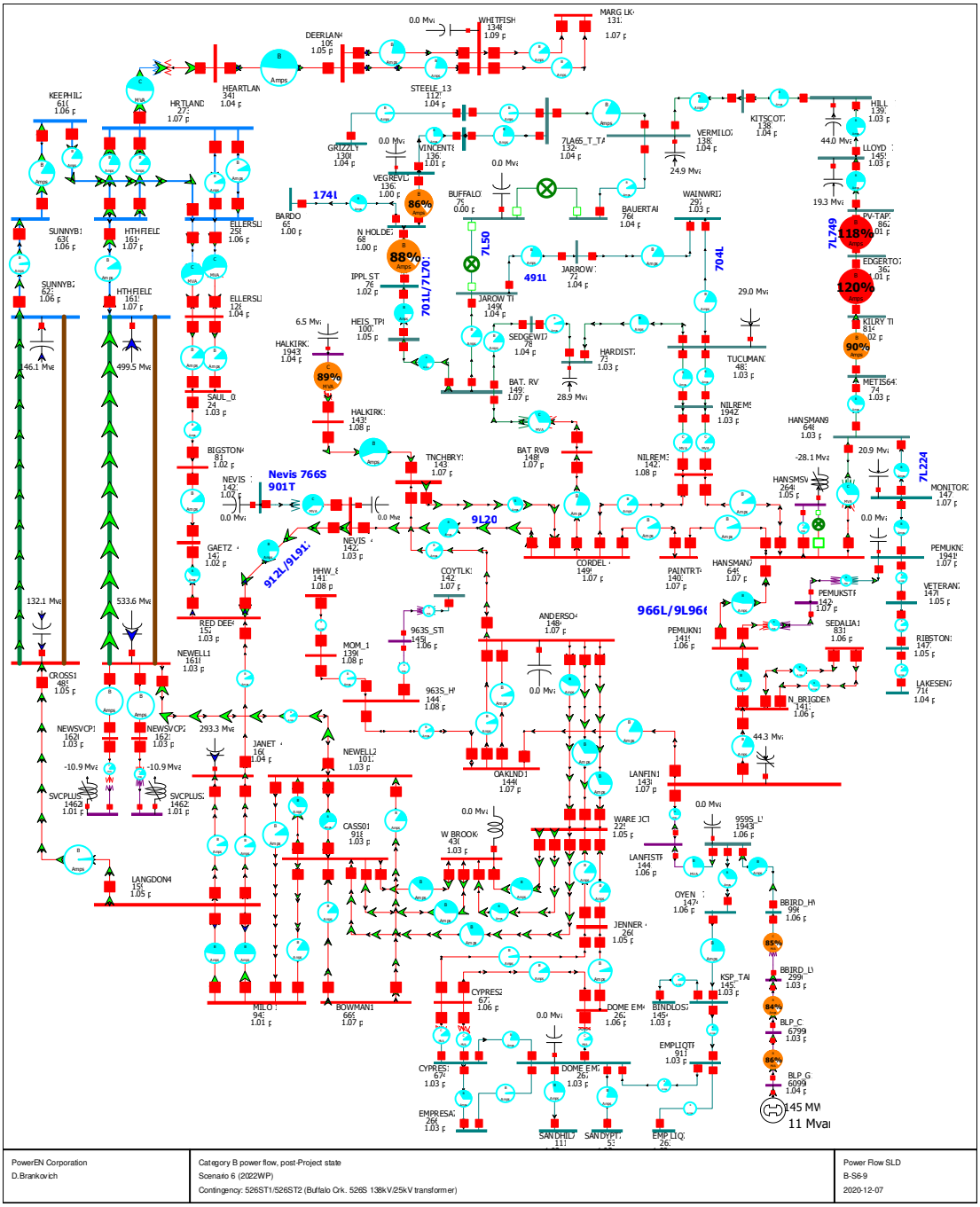


Figure B-S6-10: Category B Power Flow, Contingency: 757S912T (Battle River 757S transformer)

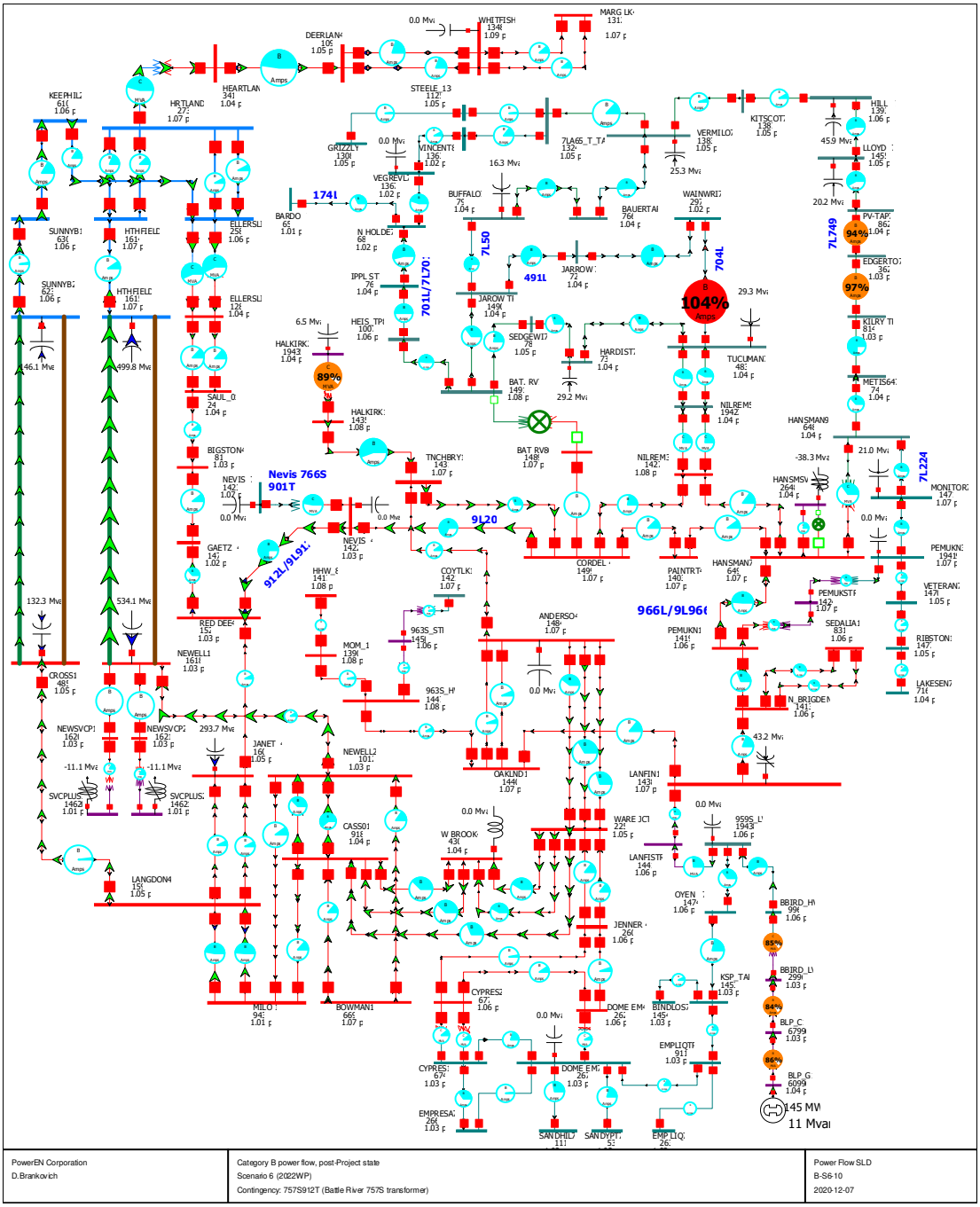


Figure B-S6-11: Category B Power Flow, Contingency: 7L129 \ 7LA129 (Buffalo Crk. 526S-Vermilion 710S)

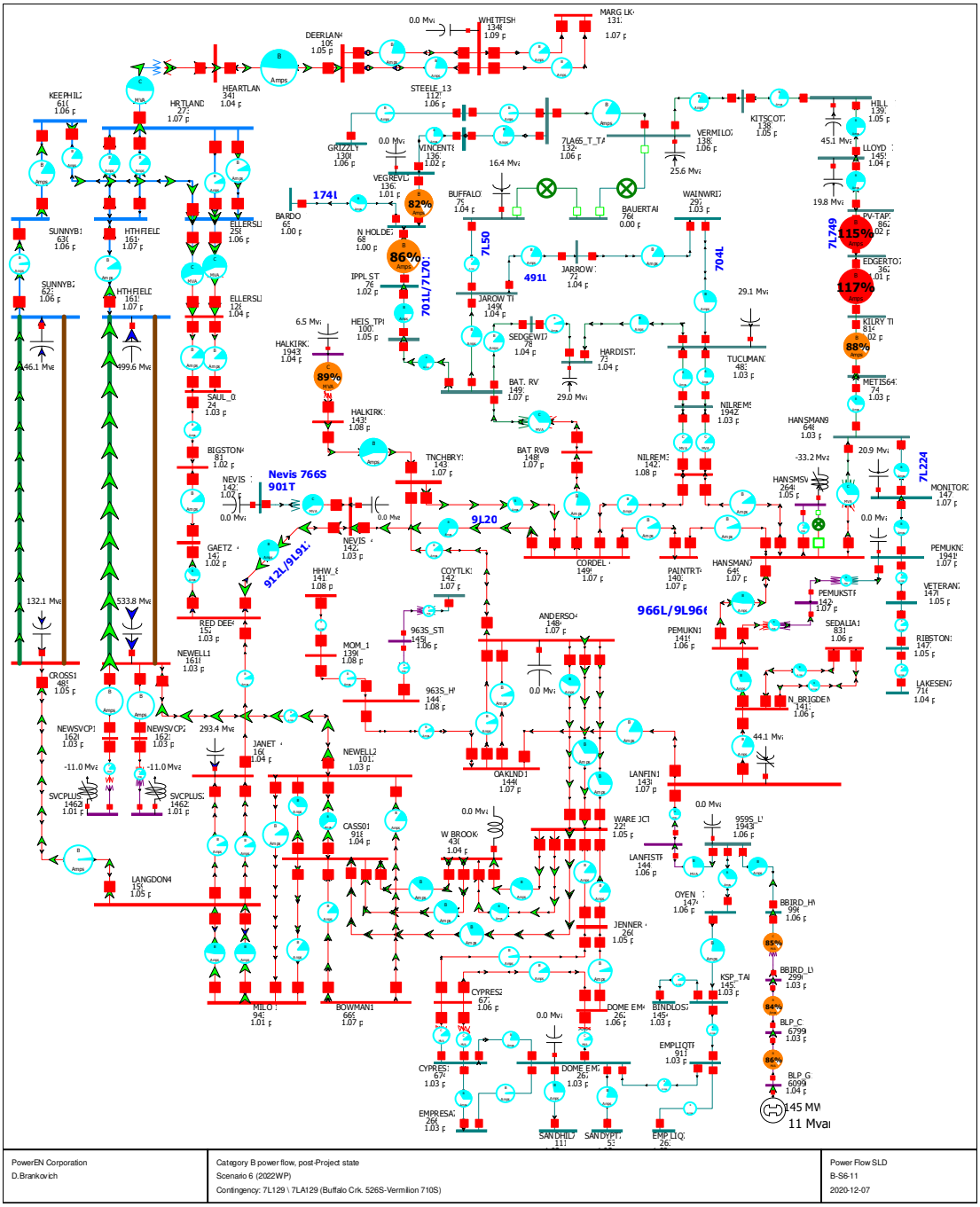


Figure B-S6-12: Category B Power Flow, Contingency: 7L50 (Buffalo Crk. 526S-Battle River 757S)

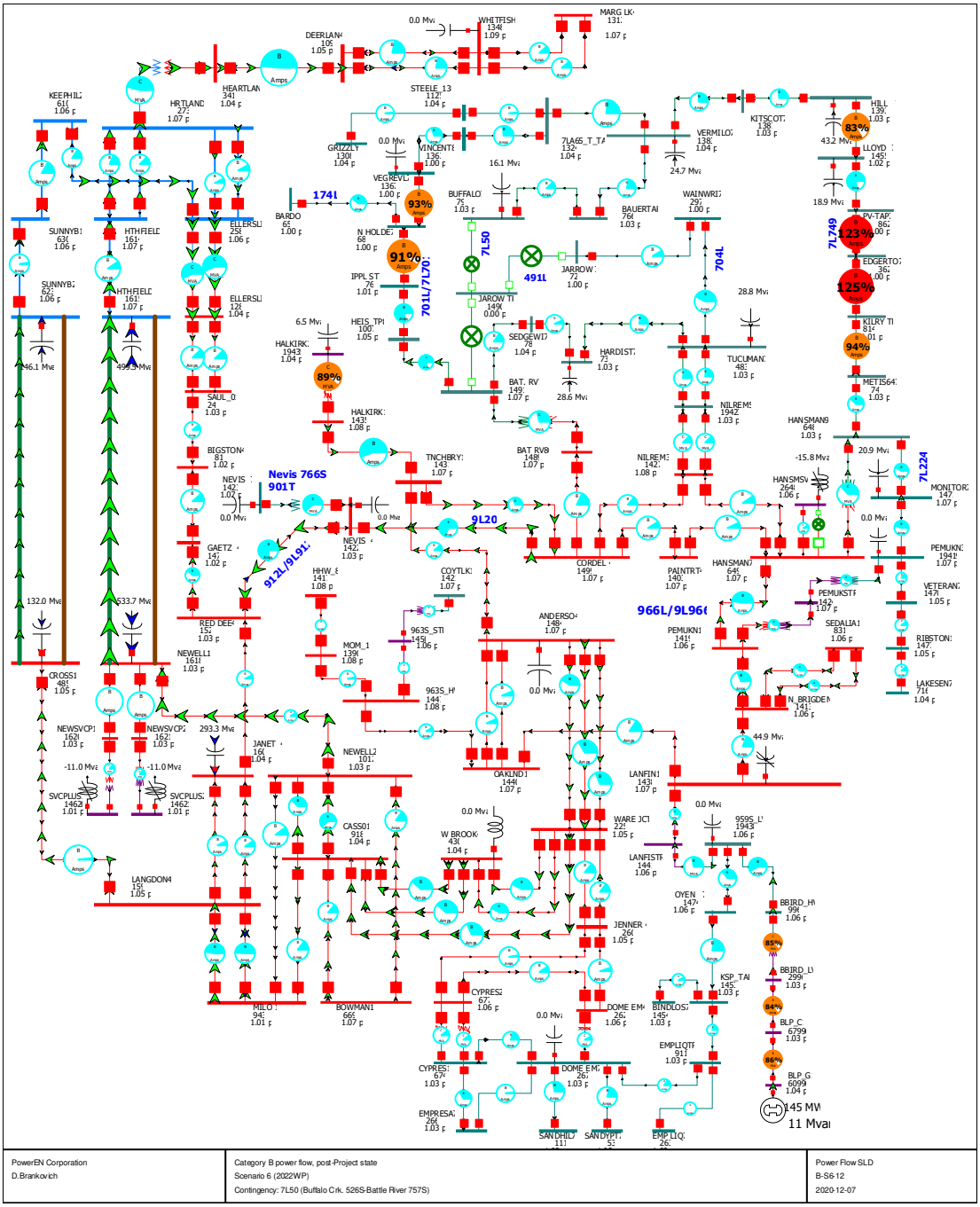
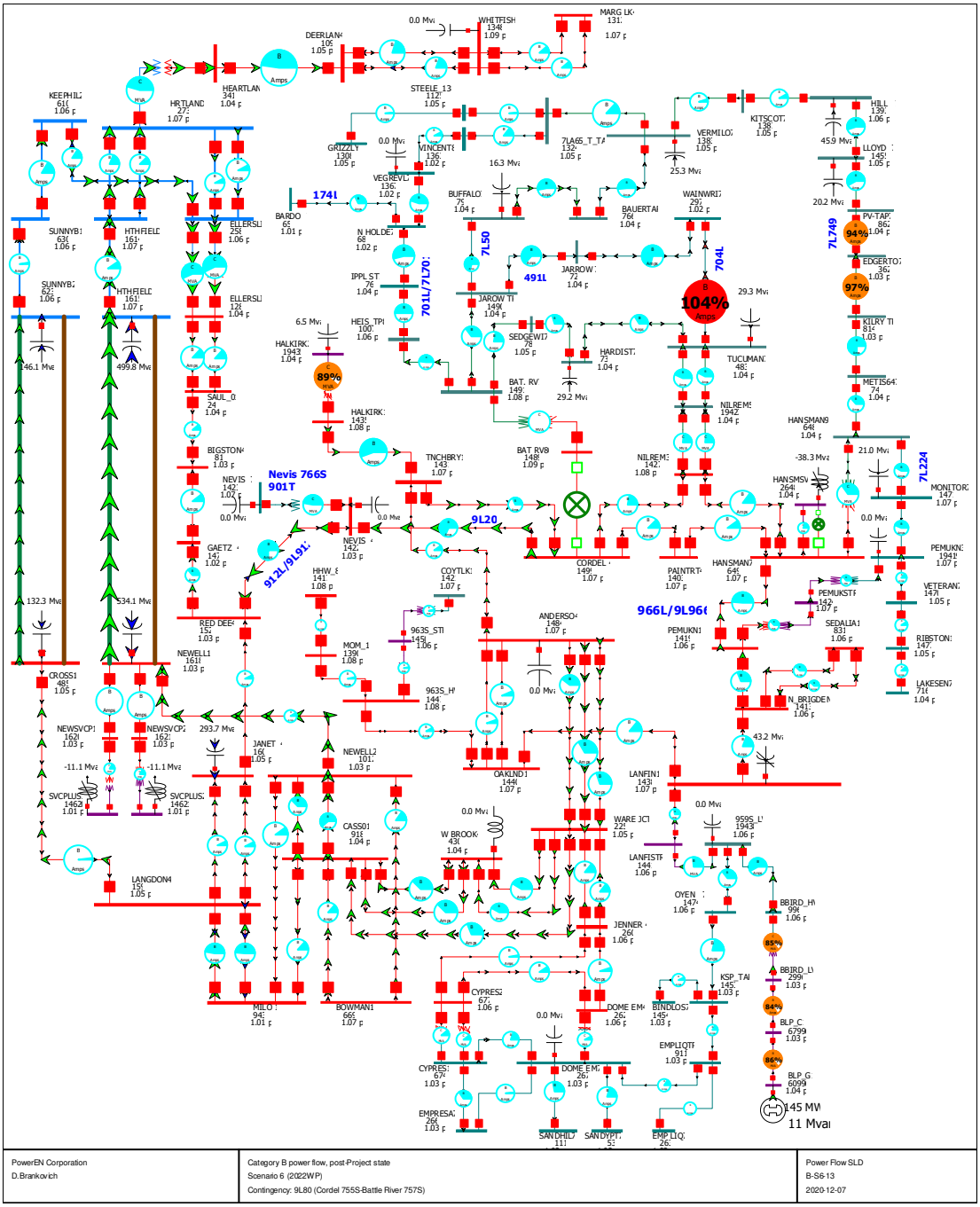


Figure B-S6-13: Category B Power Flow, Contingency: 9L80 (Cordel 755S-Battle River 757S)



A3.4

Sensitivity Scenario 4a (2022SP)

Figure A-S4a-1: Category A Power Flow

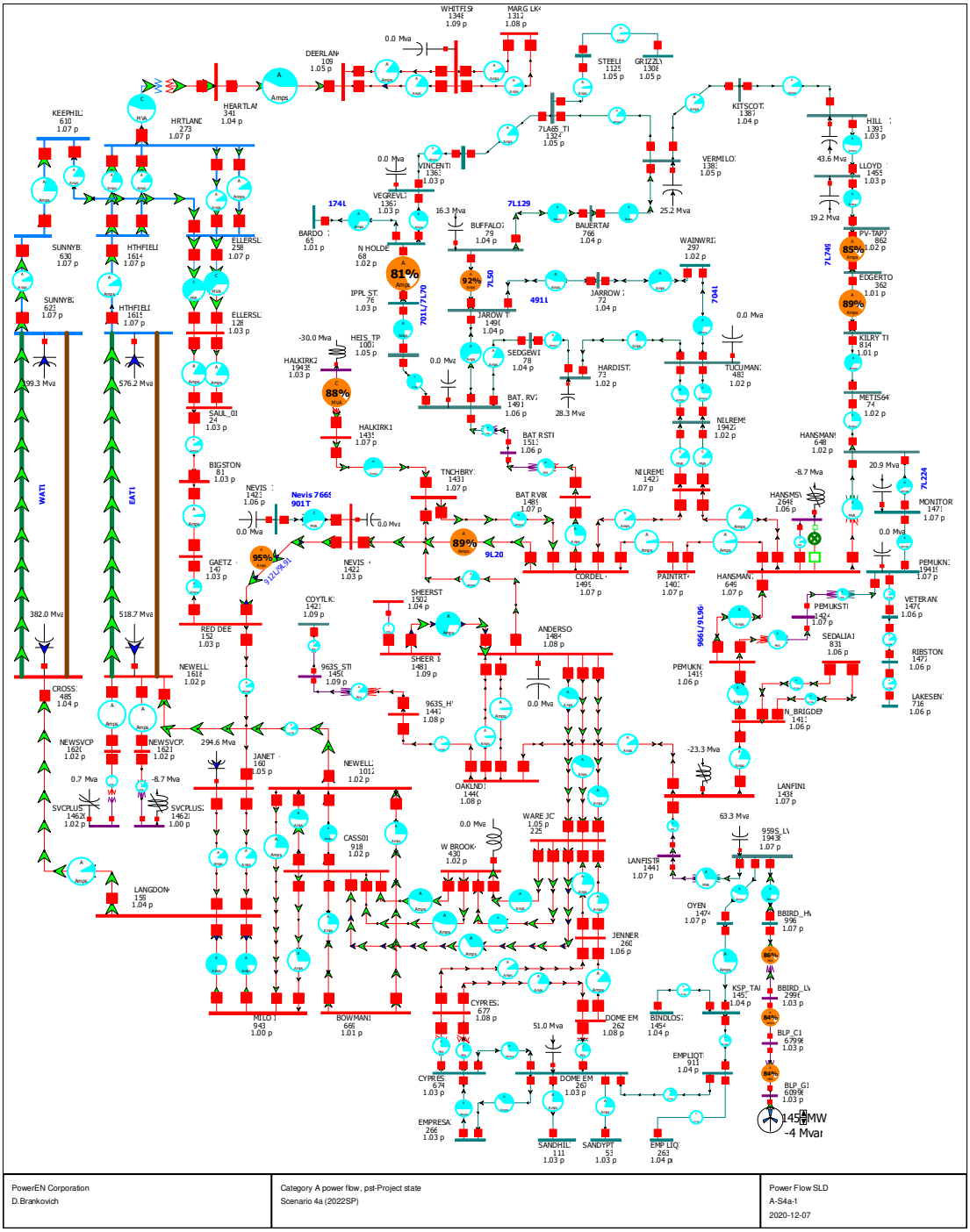


Figure B-S4a-1: 749L \ 749AL (Metiskow 648S-Edgerton 899S)

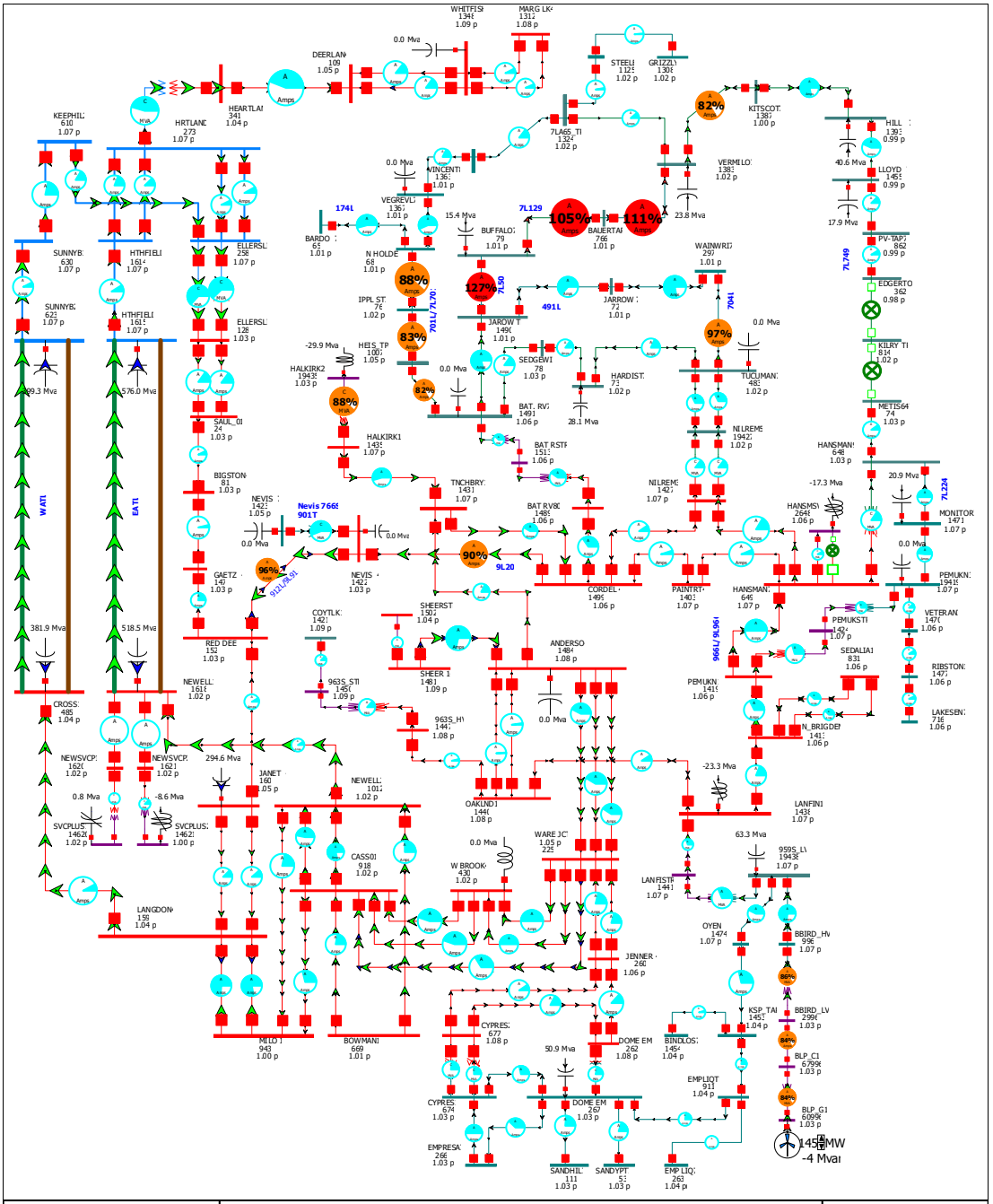


Figure B-S4a-2: 766S901T (Nevis 766S 901T transformer)

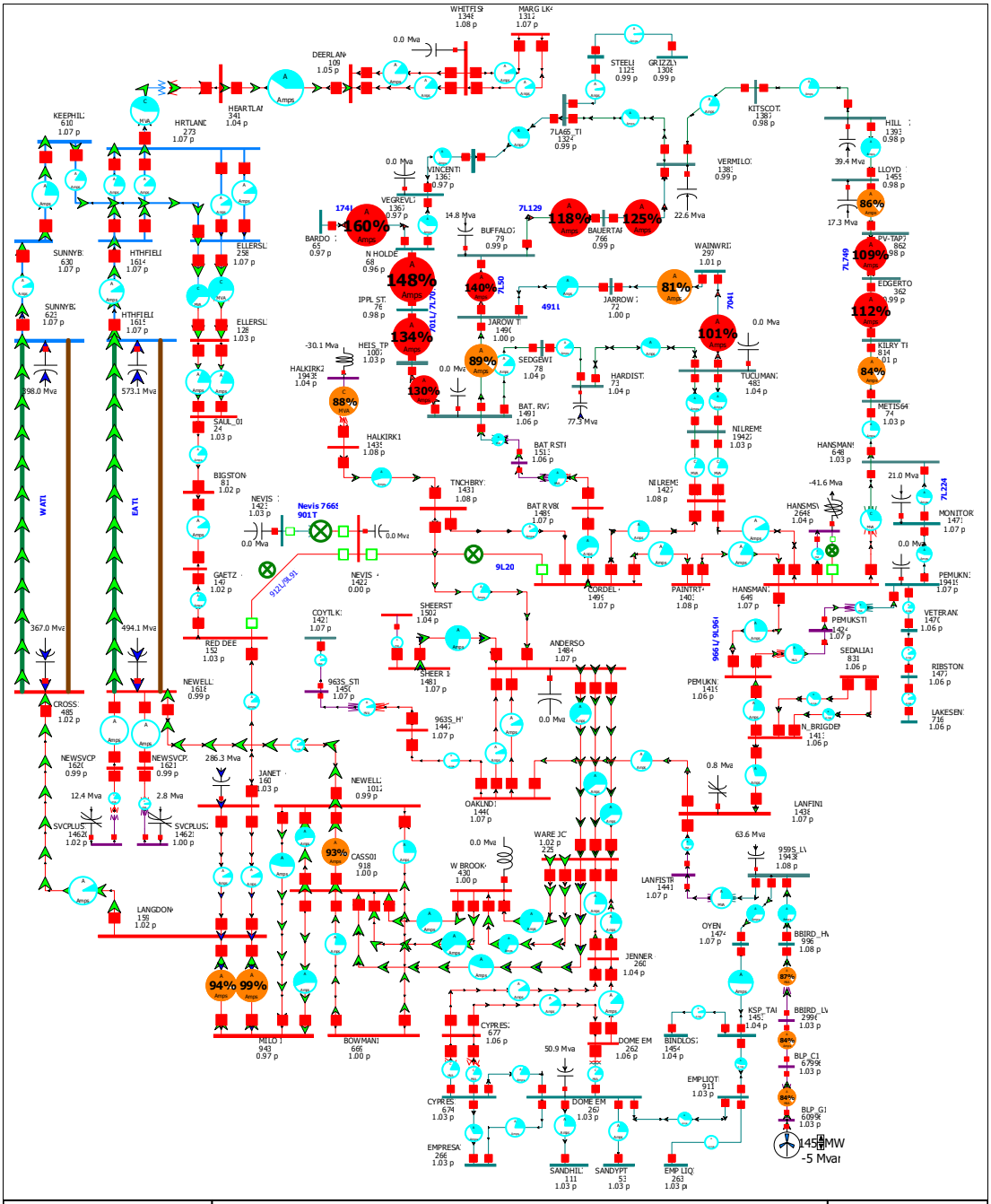


Figure B-S4a-3: 7L701\7LA701\701L (Strome 223S-BattleRiver 757S)

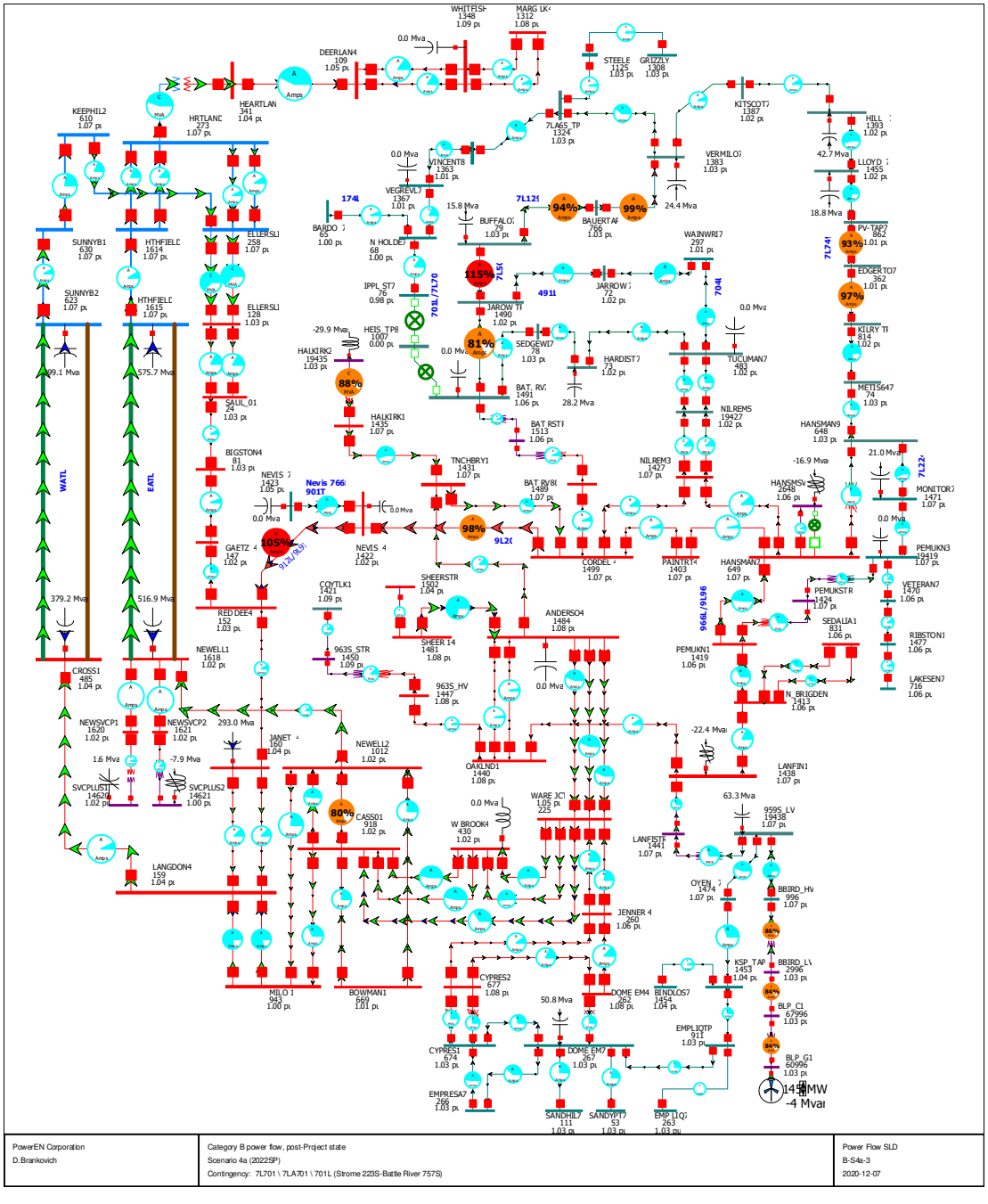


Figure B-S4a-4: 7L749\749L\7LB749 (Lloydminster 716S-Edgerton 899S)

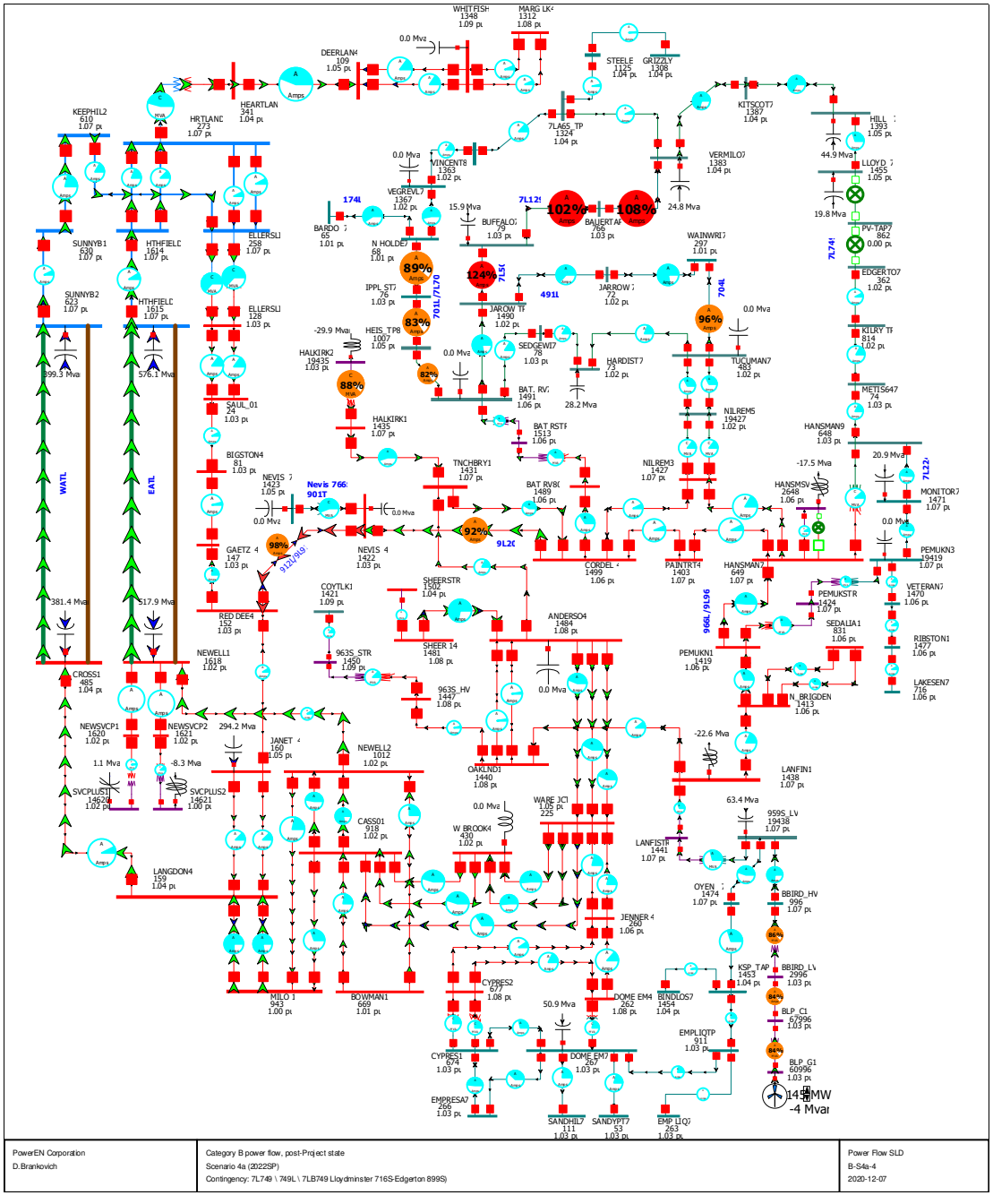


Figure B-S4a-5: 899ST3a (Edgerton 899S 138kV/25kV transformer)

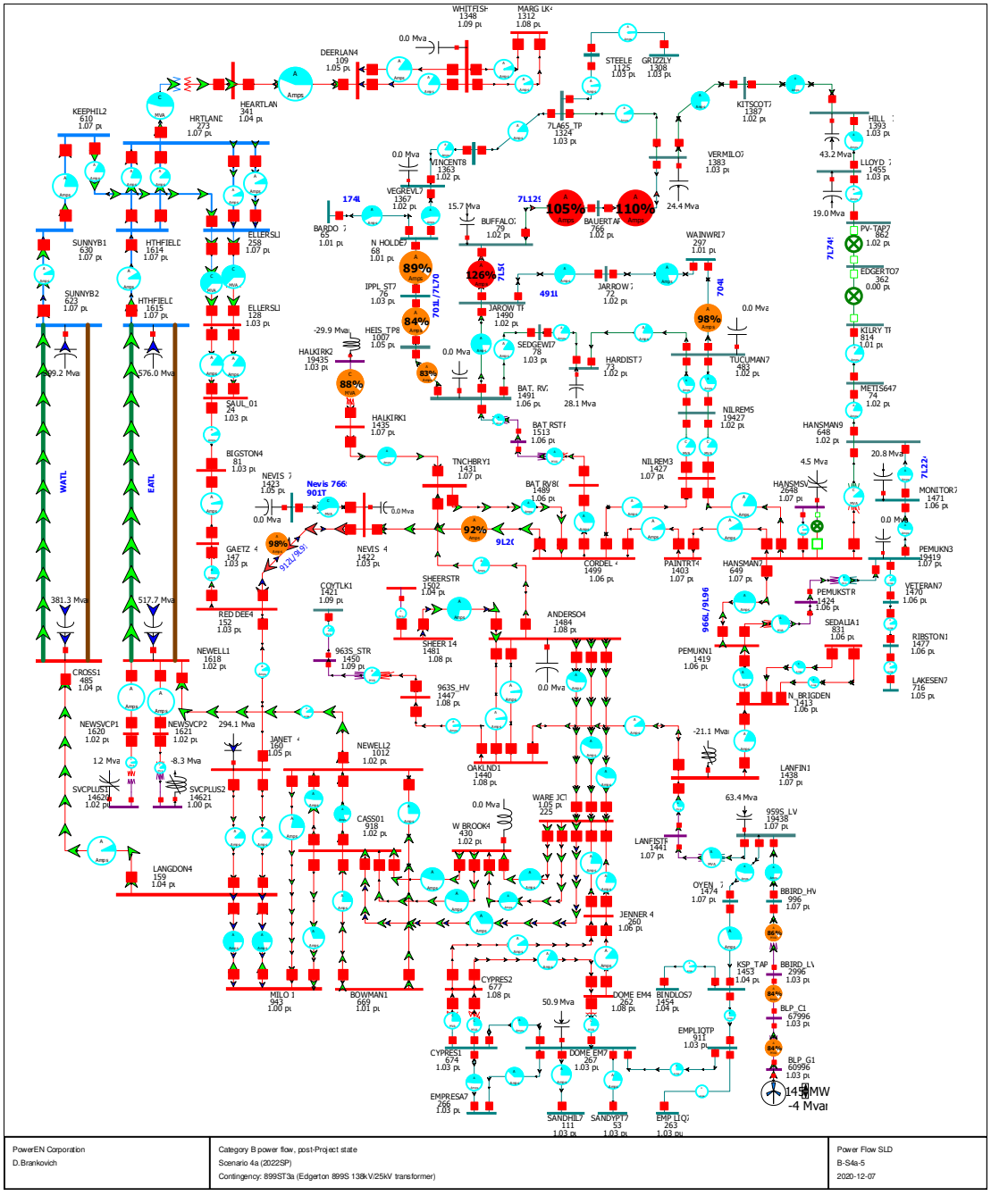


Figure B-S4a-6: 912L \ 9L912 (Red Deer 63S-Nevis 766S)

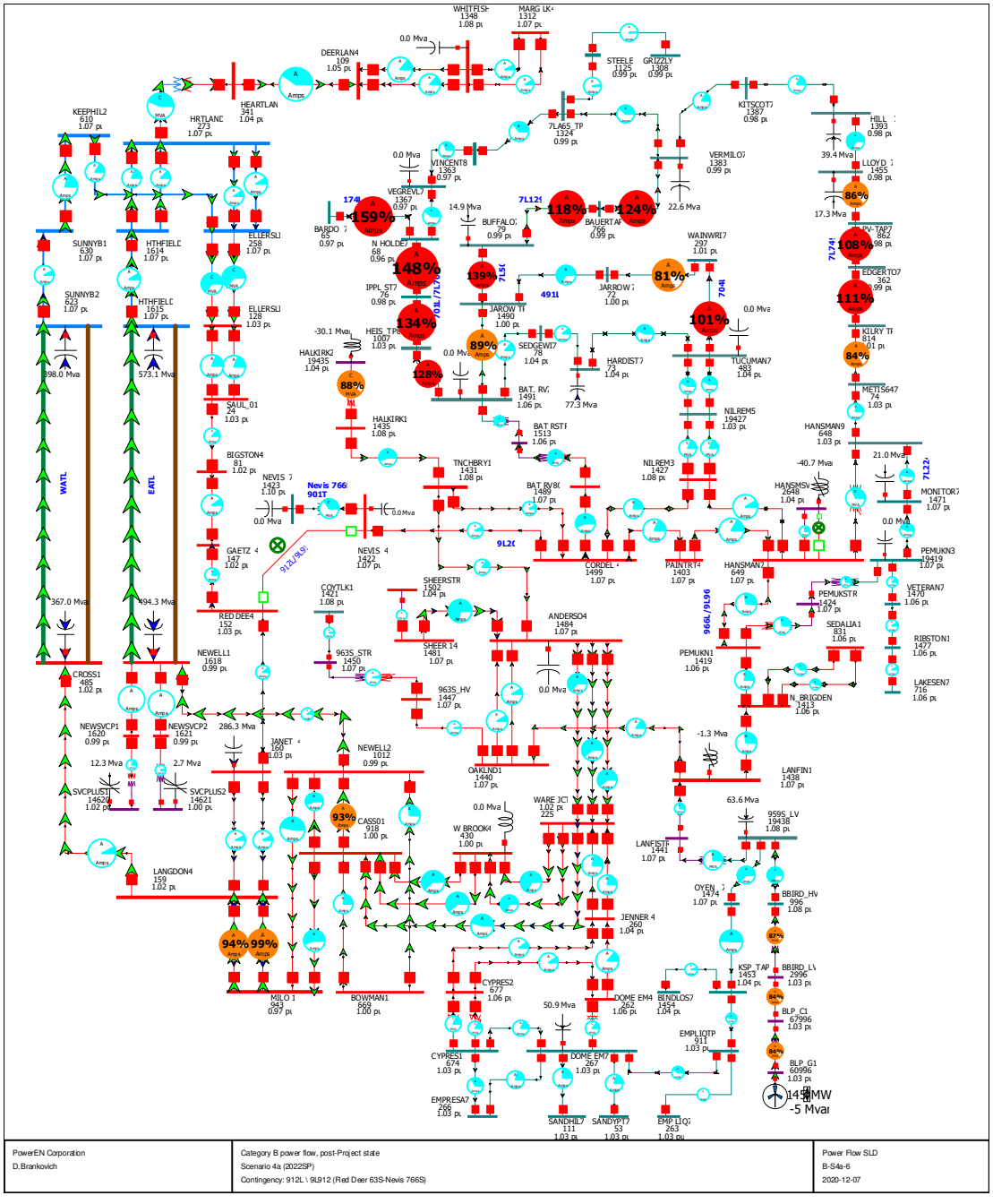


Figure B-S4a-7: 966L\9L966 (Hansman Lk. 650S-Pemukan 932S)

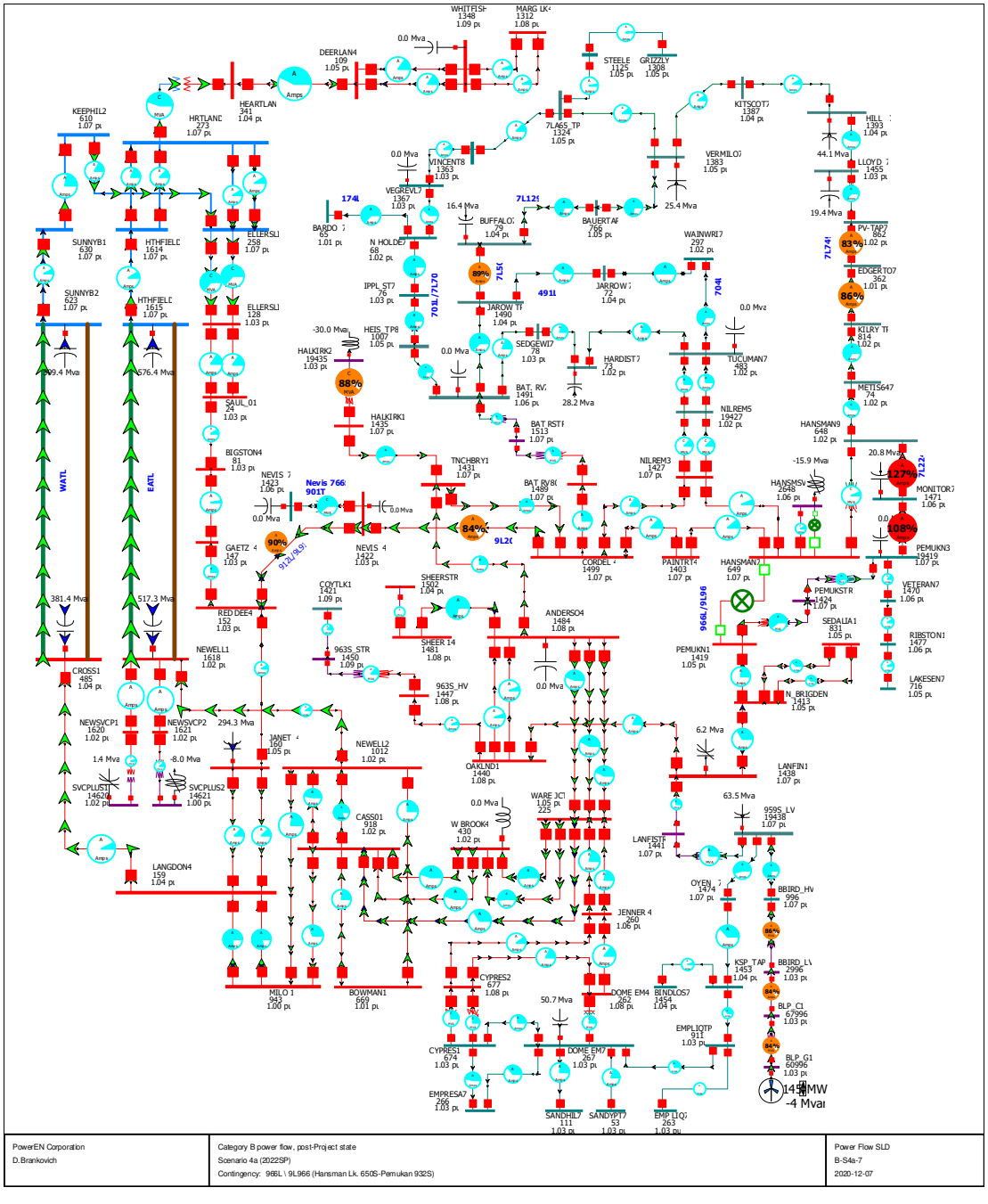


Figure B-S4a-8: 9L20 (Cordel 755S-Nevis 766S)

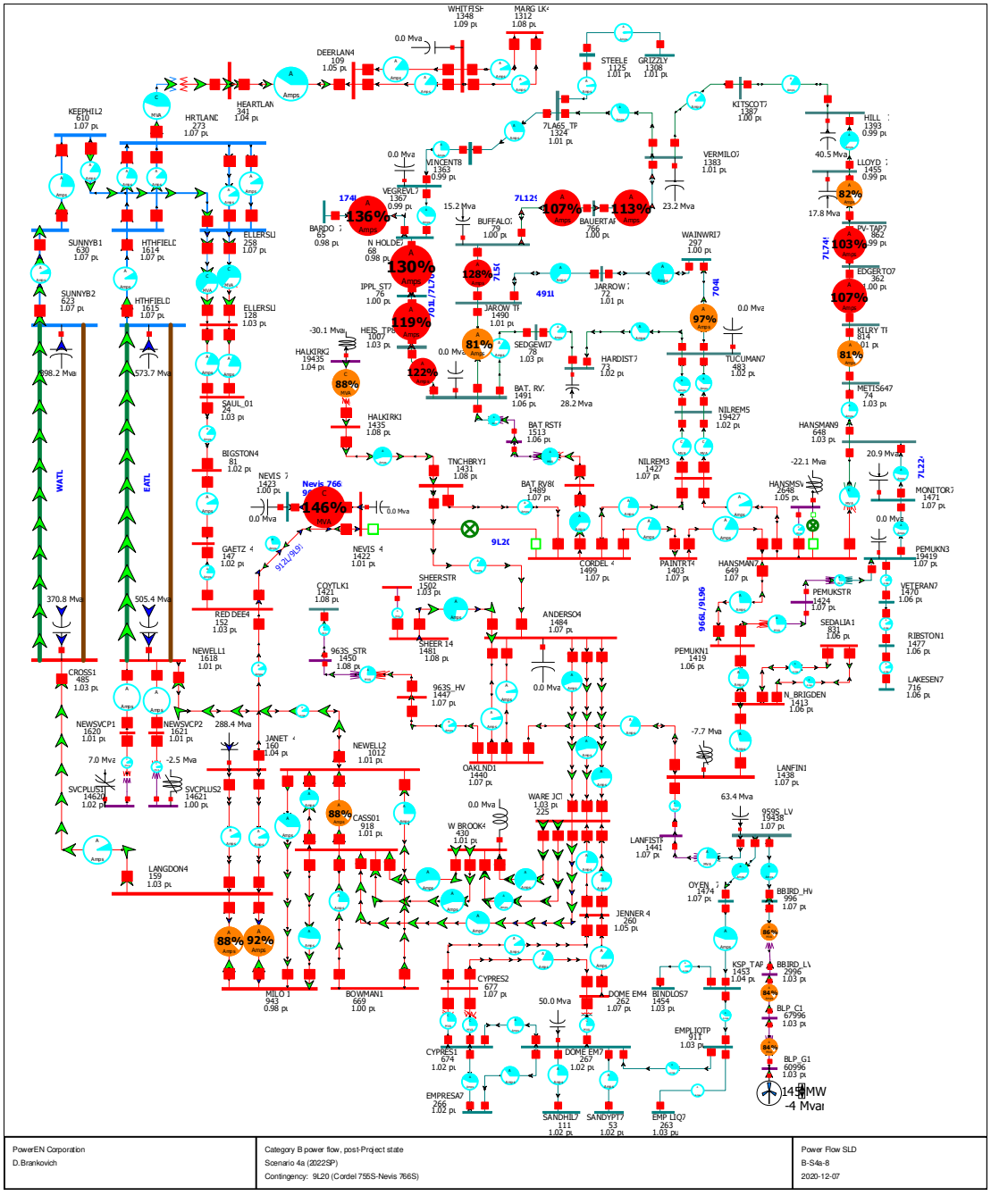


Figure B-S4a-9: EATL

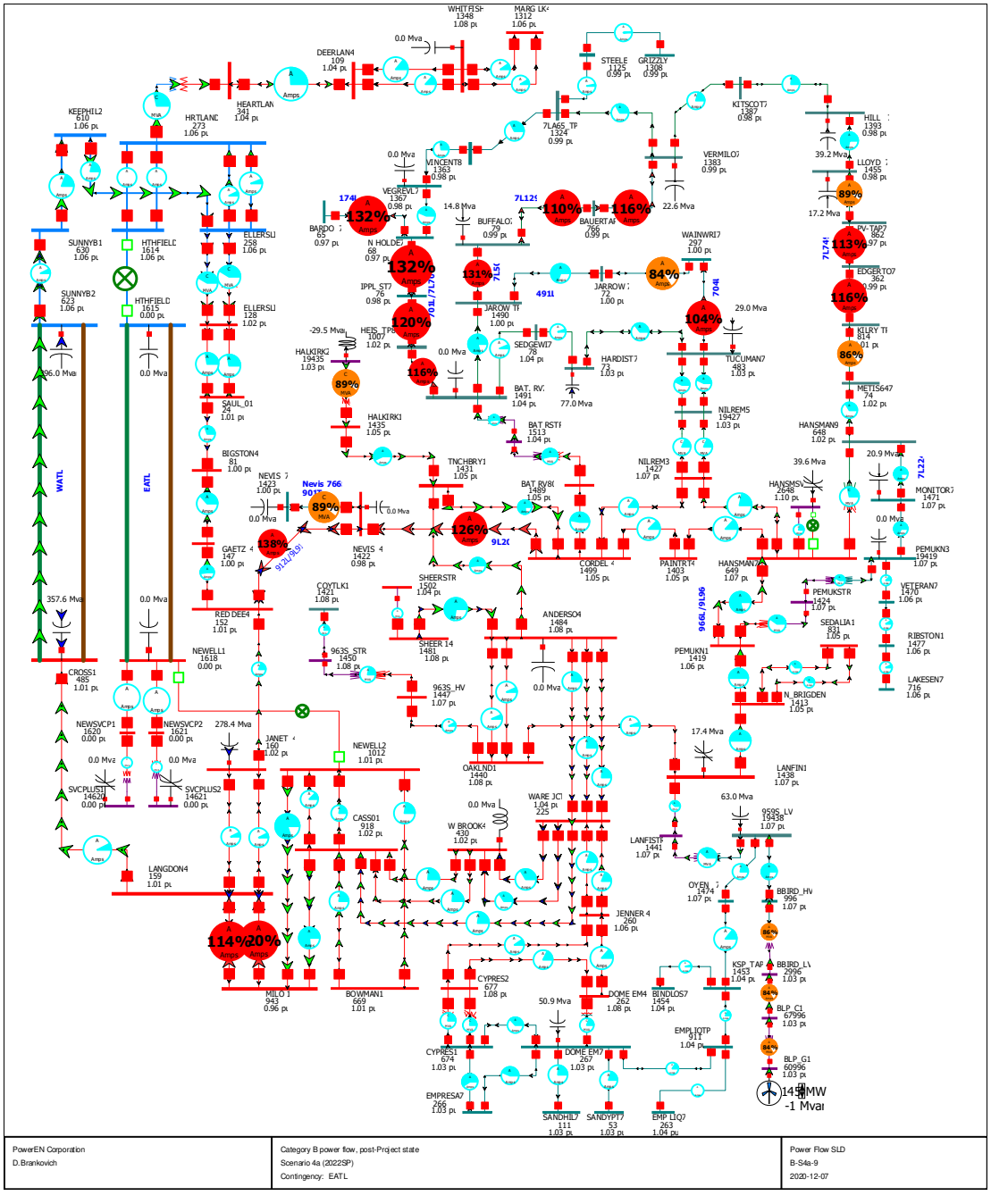


Figure B-S4a-10: 395ST1 (N. Holden 395S 138 kV/25 kV transformer)

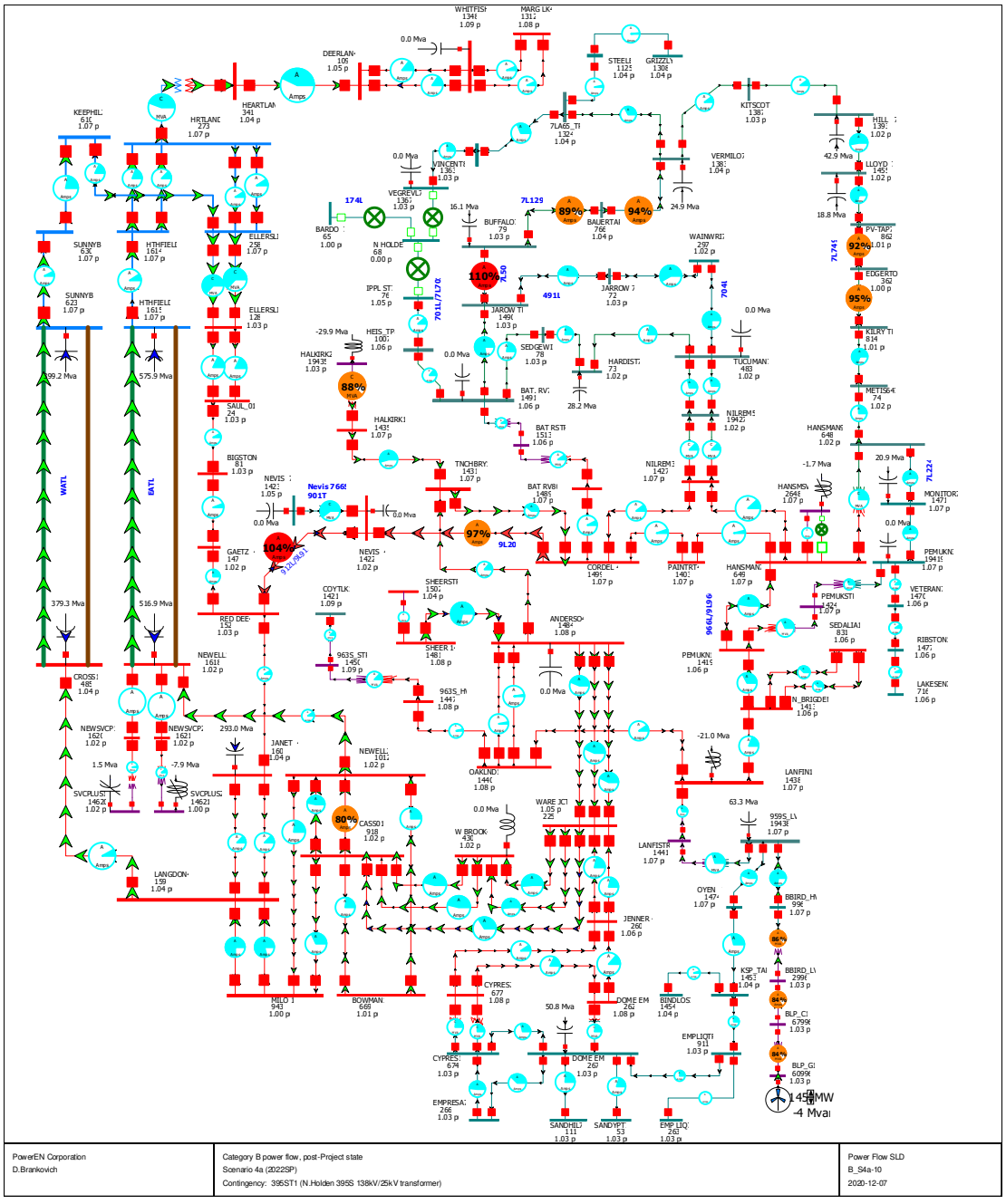


Figure B-S4a-11: 526ST1/526ST2 (Buffalo Crk. 526S 138 kV/ 25kV transformer)

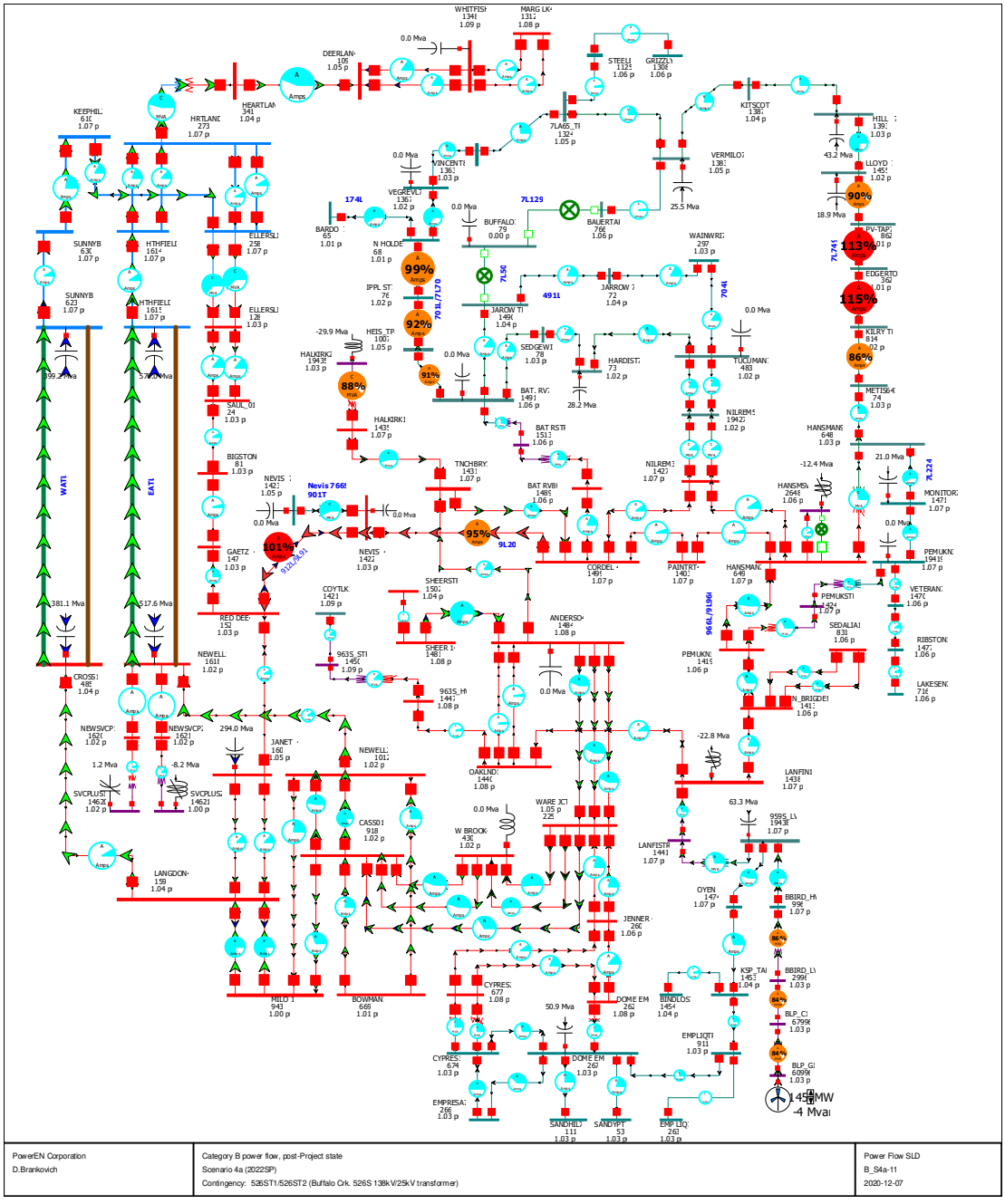


Figure B-S4a-12: 648ST1 (Metiskow 648S 138 kV/25 kV transformer)

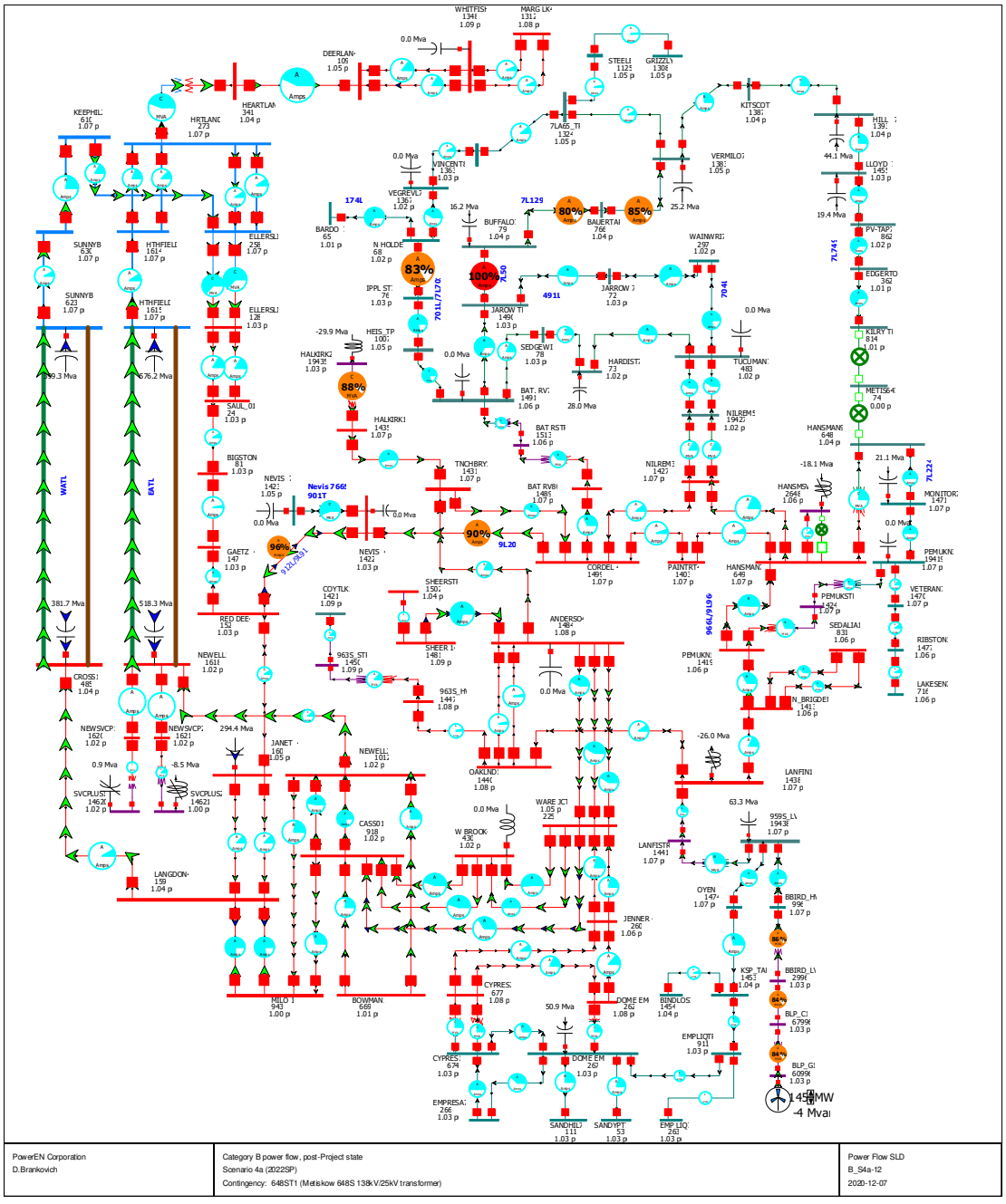


Figure B-S4a-13: 7L129 \ 7LA129 (Buffalo Crk. 526S-Vermilion 710S)

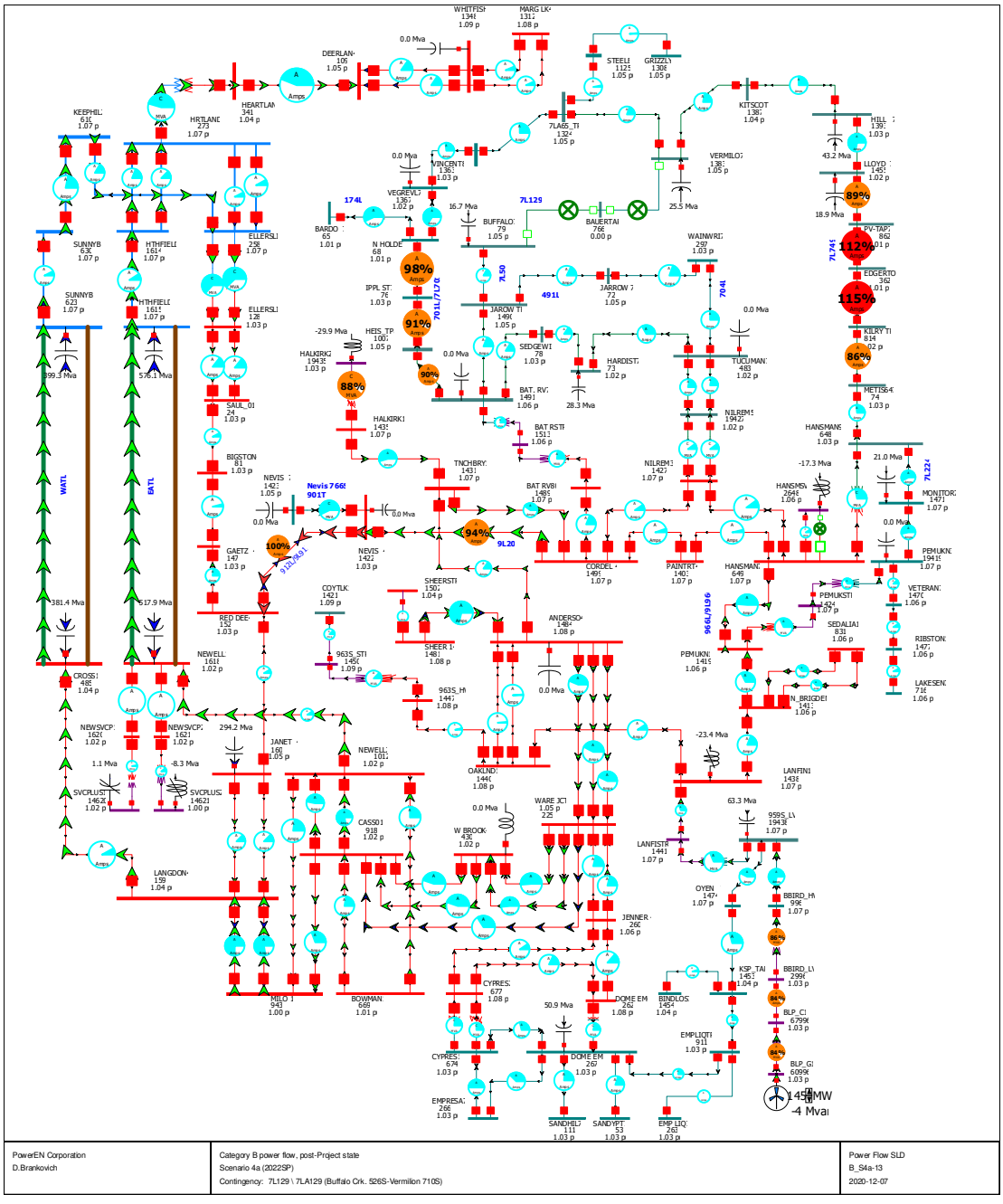


Figure B-S4a-14: 7L42 (Lloydminster 716S - Hill 751S)

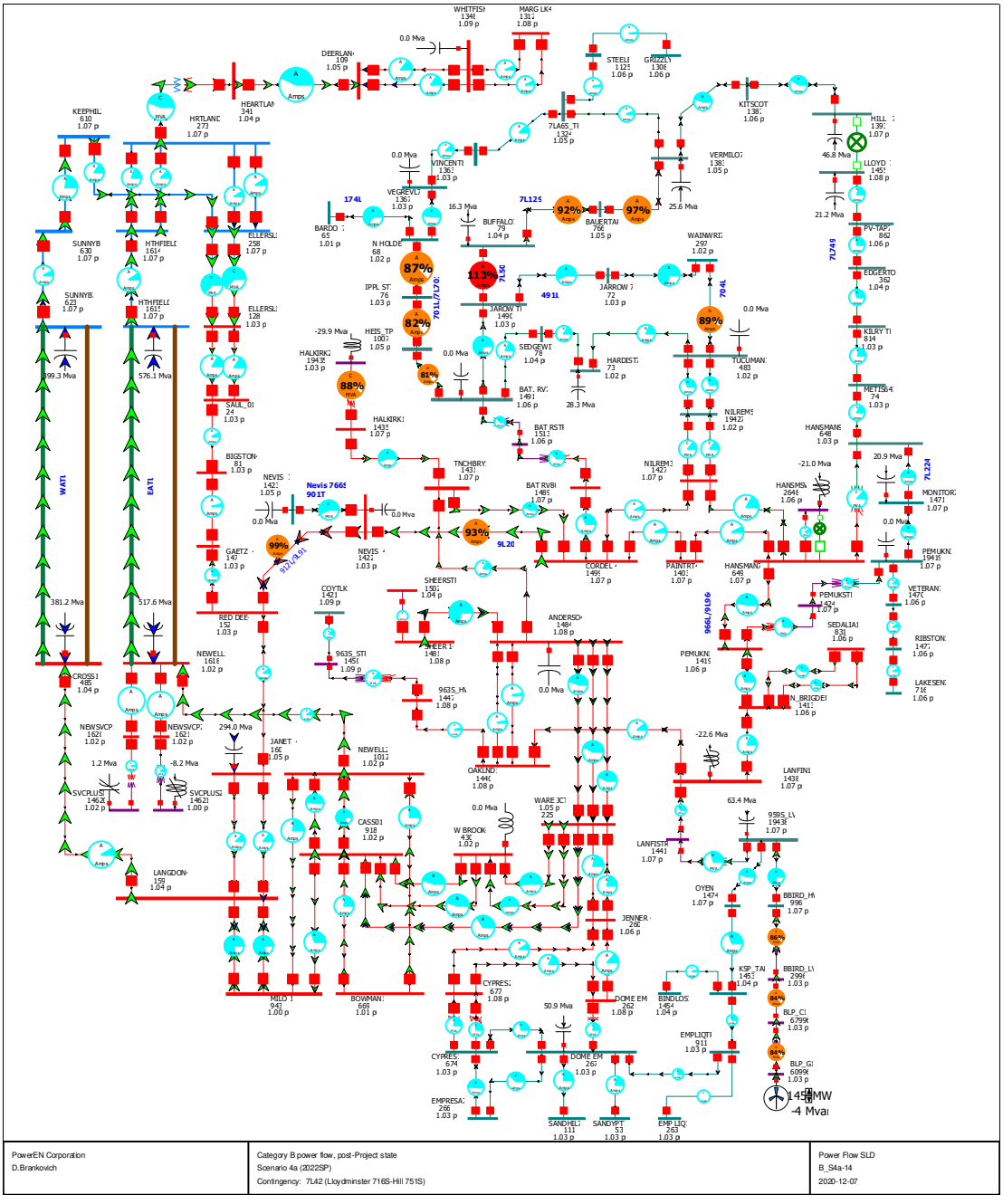
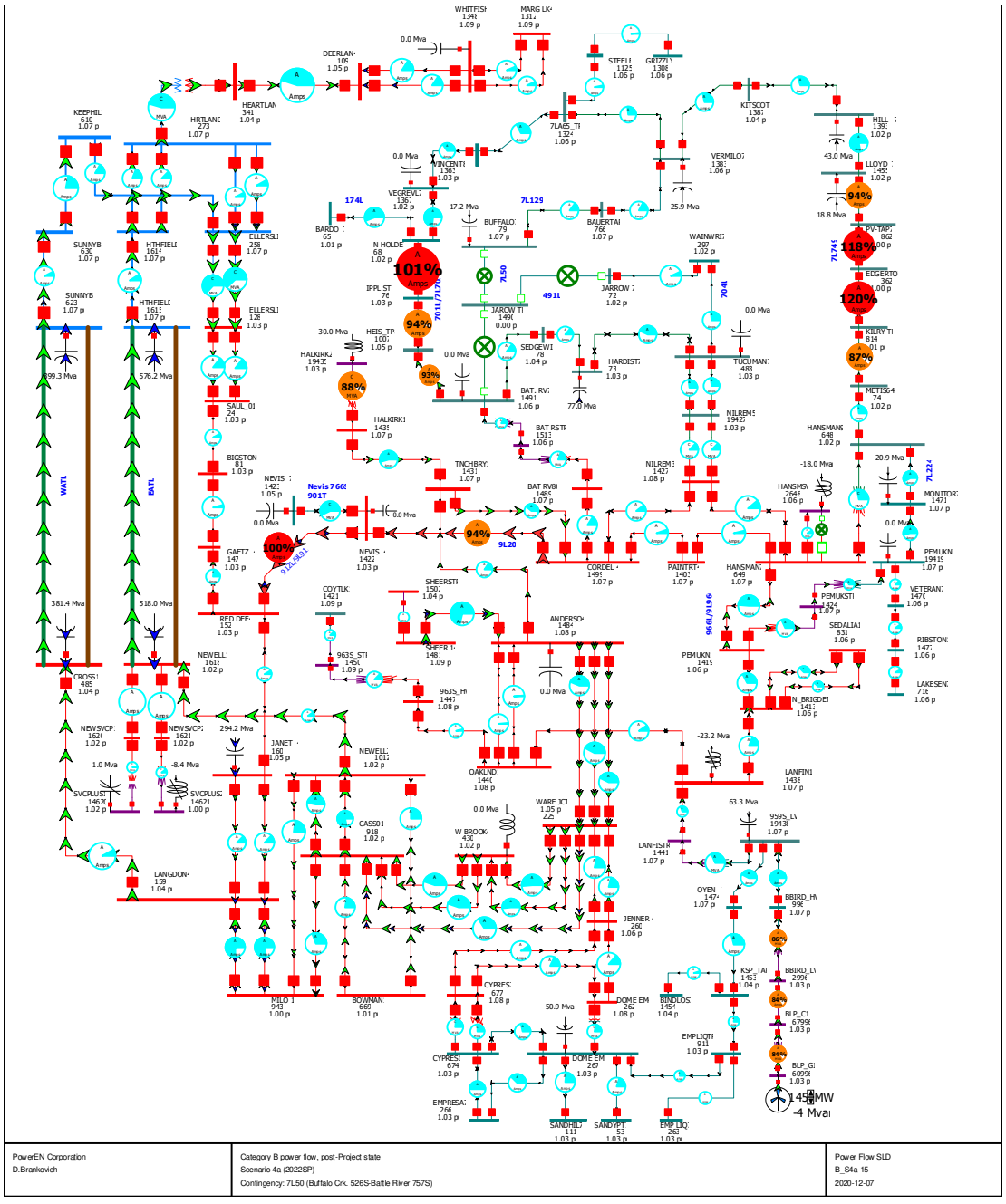


Figure B-S4a-15: 7L50 (Buffalo Crk. 526S-Battle River 757S)



A3.5

Sensitivity Scenario 4b (2022SP)

Figure A-S4b-1: Category A Power Flow

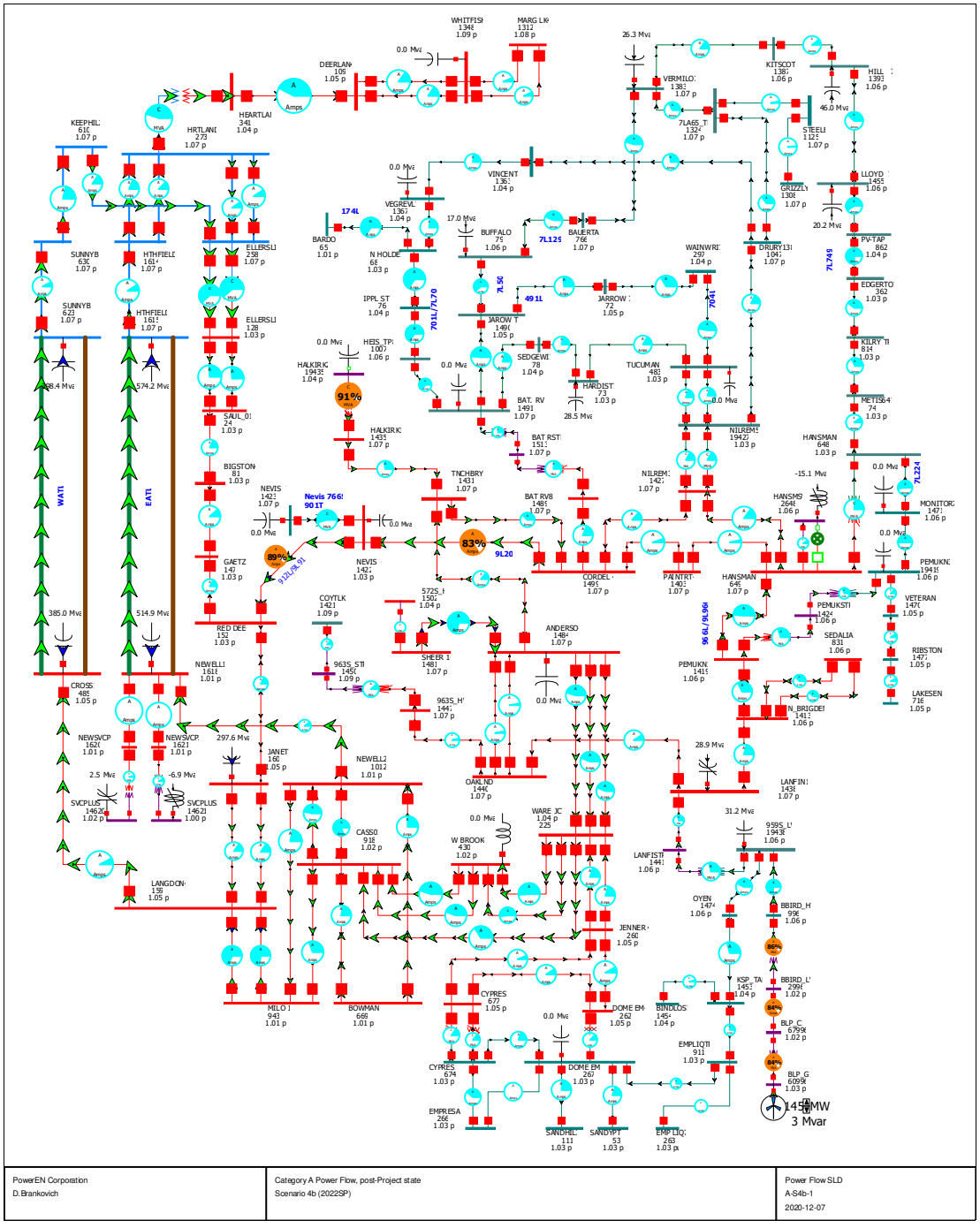


Figure B-S4b-1: 766S901T (Nevis 766S 901T transformer)

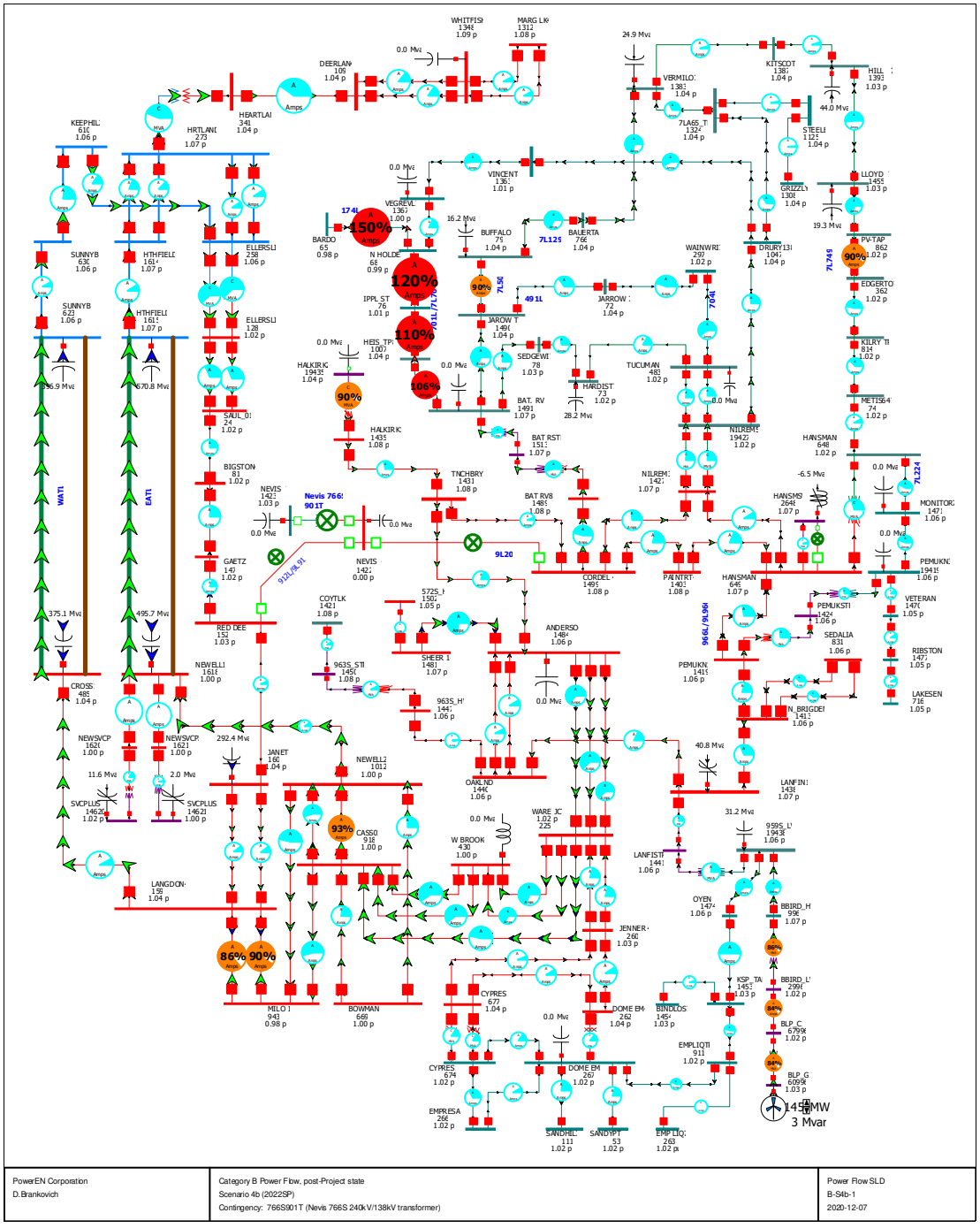


Figure B-S4b-2: 912L \ 9L912 (Red Deer 63S-Nevis 766S)

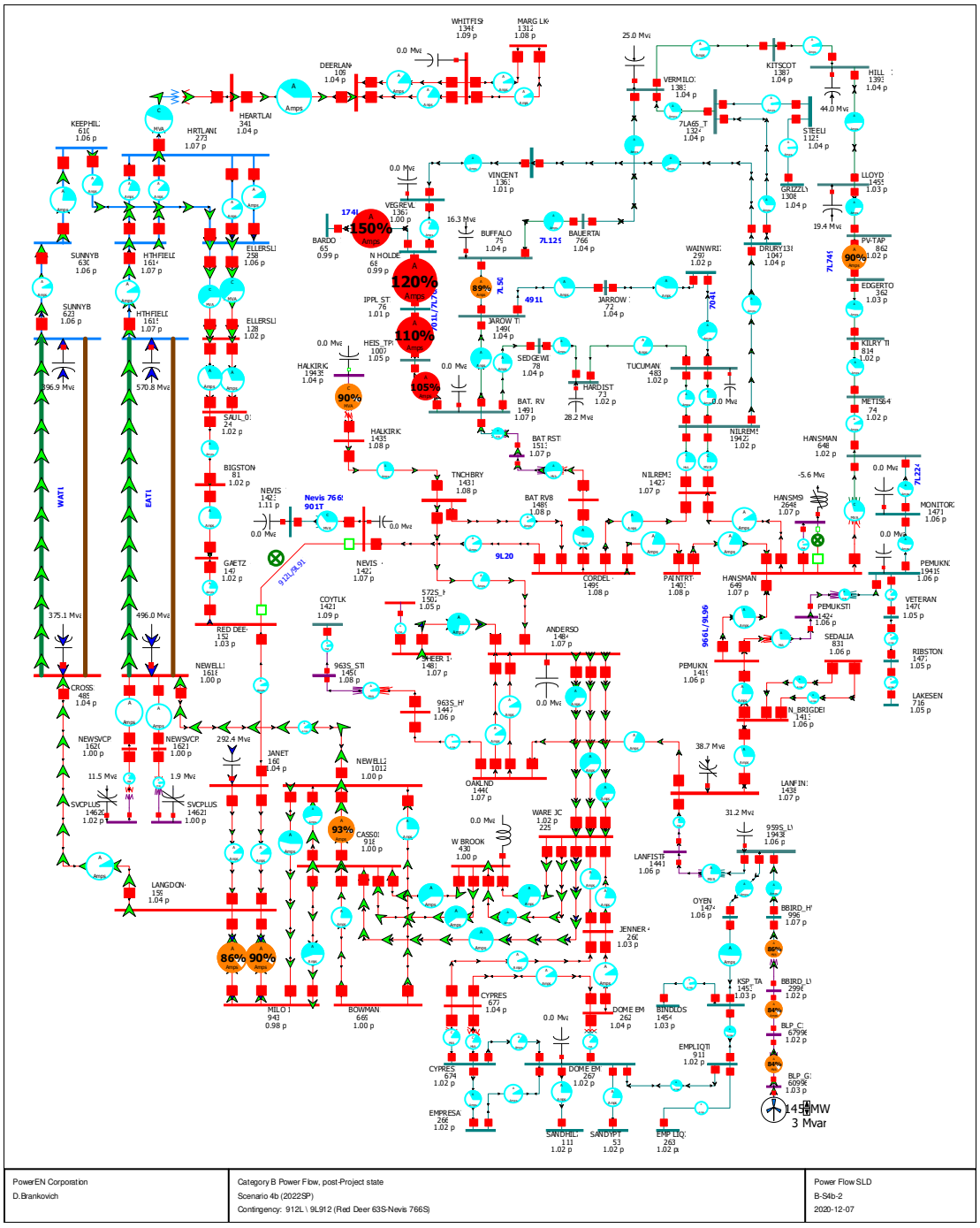


Figure B-S4b-3: 966L \ 9L966 (Hansman Lk. 650S-Pemukan 932S)

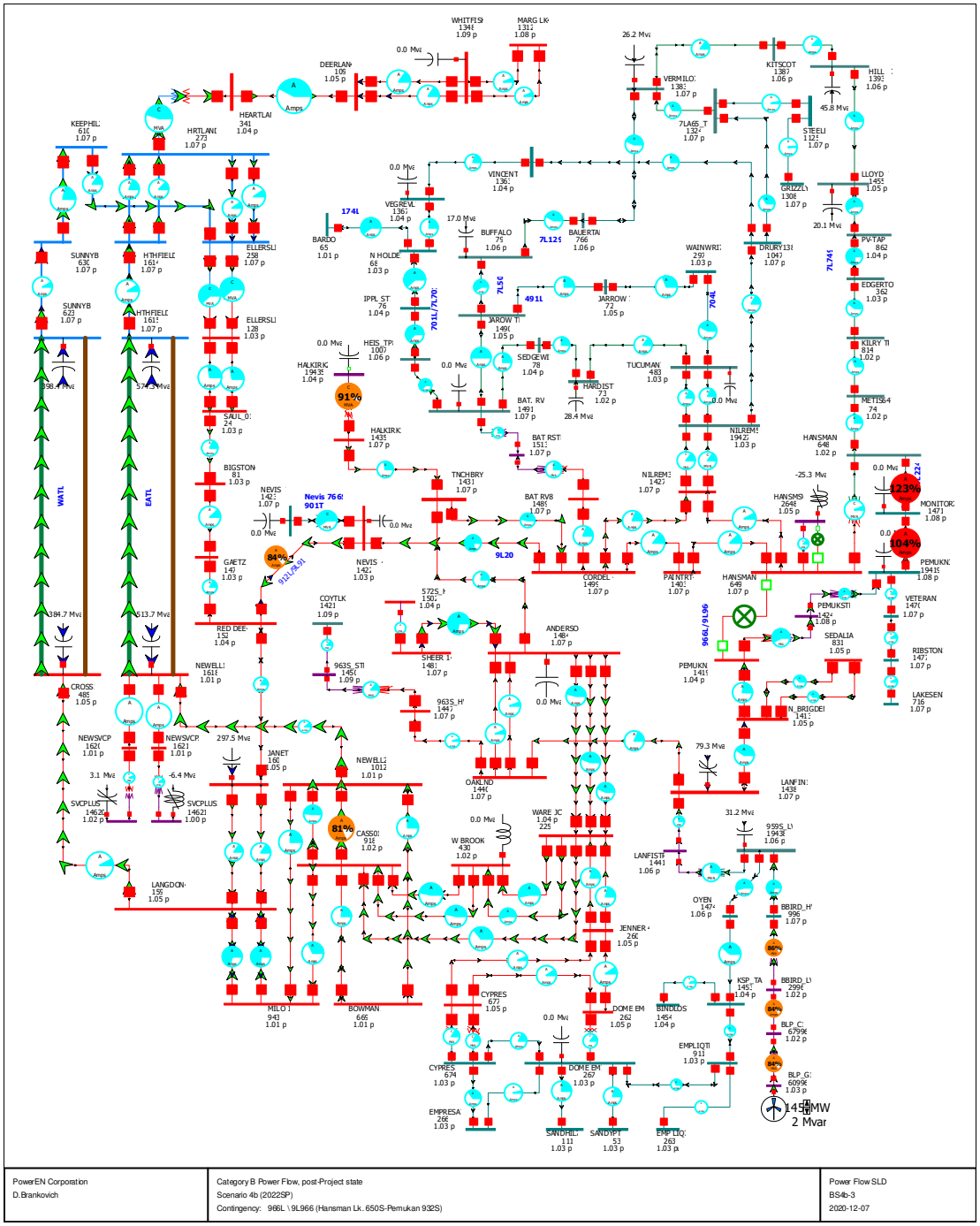


Figure B-S4b-4: 9L20 (Cordel 755S-Nevis 766S)

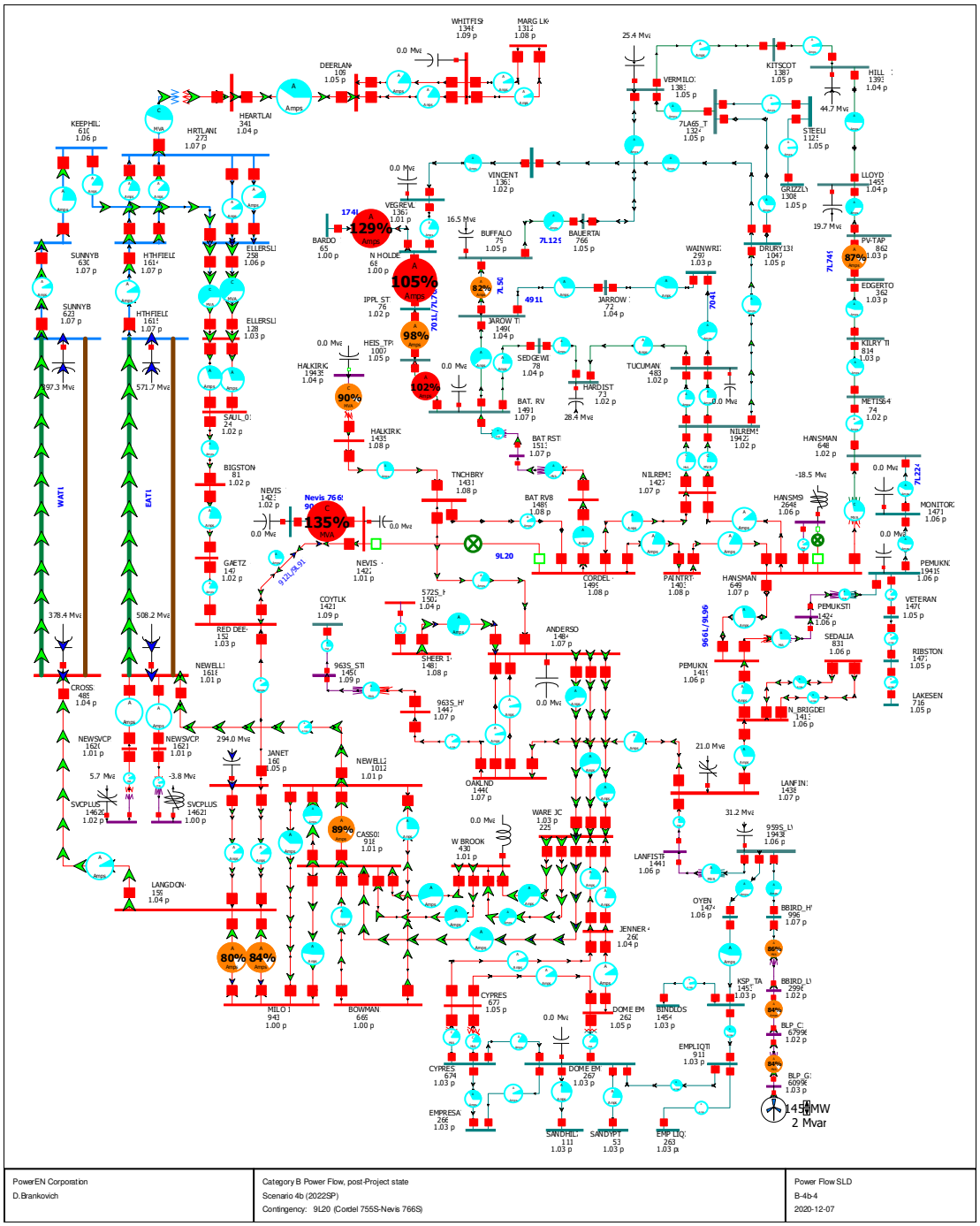
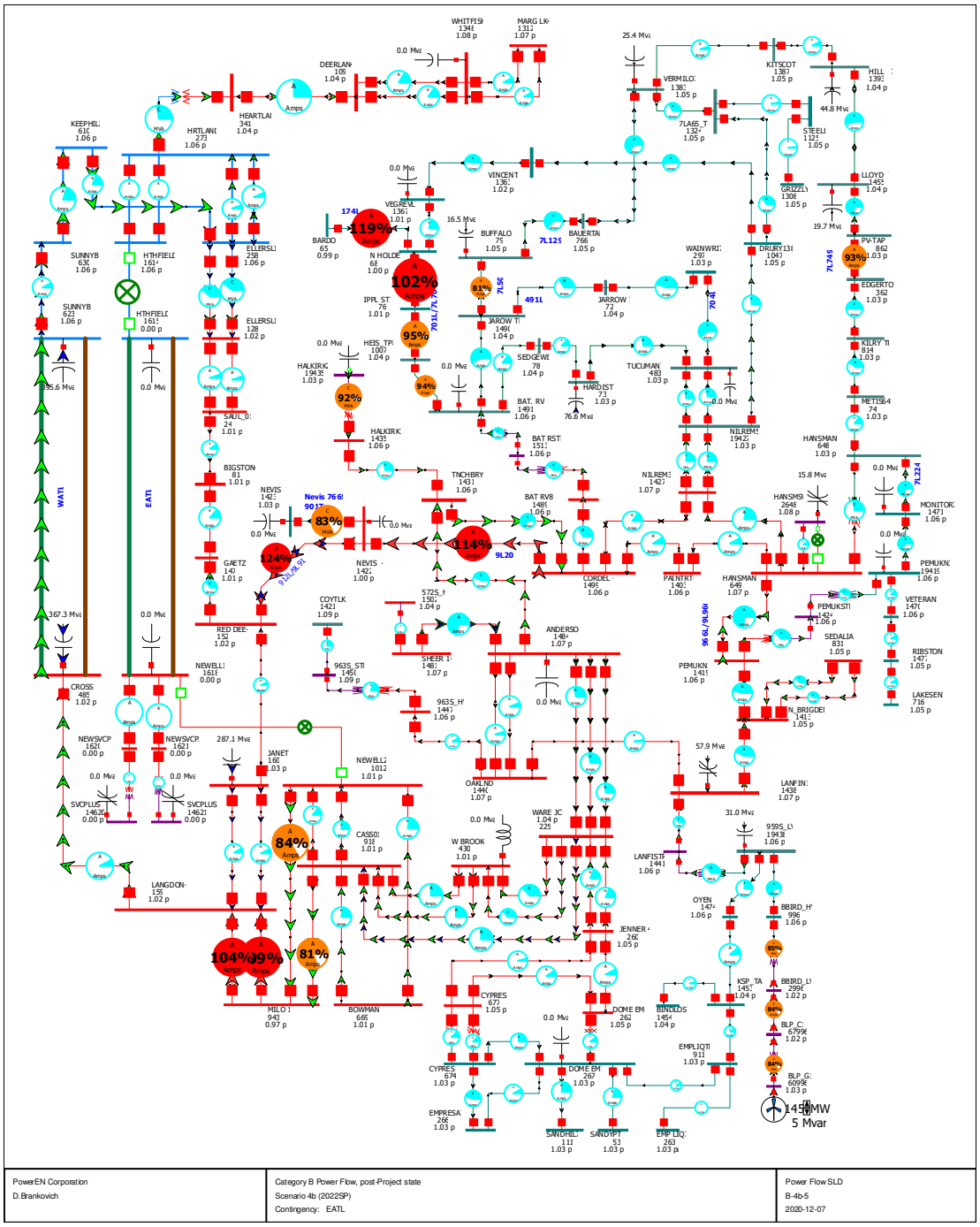


Figure B-S4b-5: EATL



A3.6

Sensitivity Scenario 4c (2022SP)

Figure A-S4c-1: Category A Power Flow

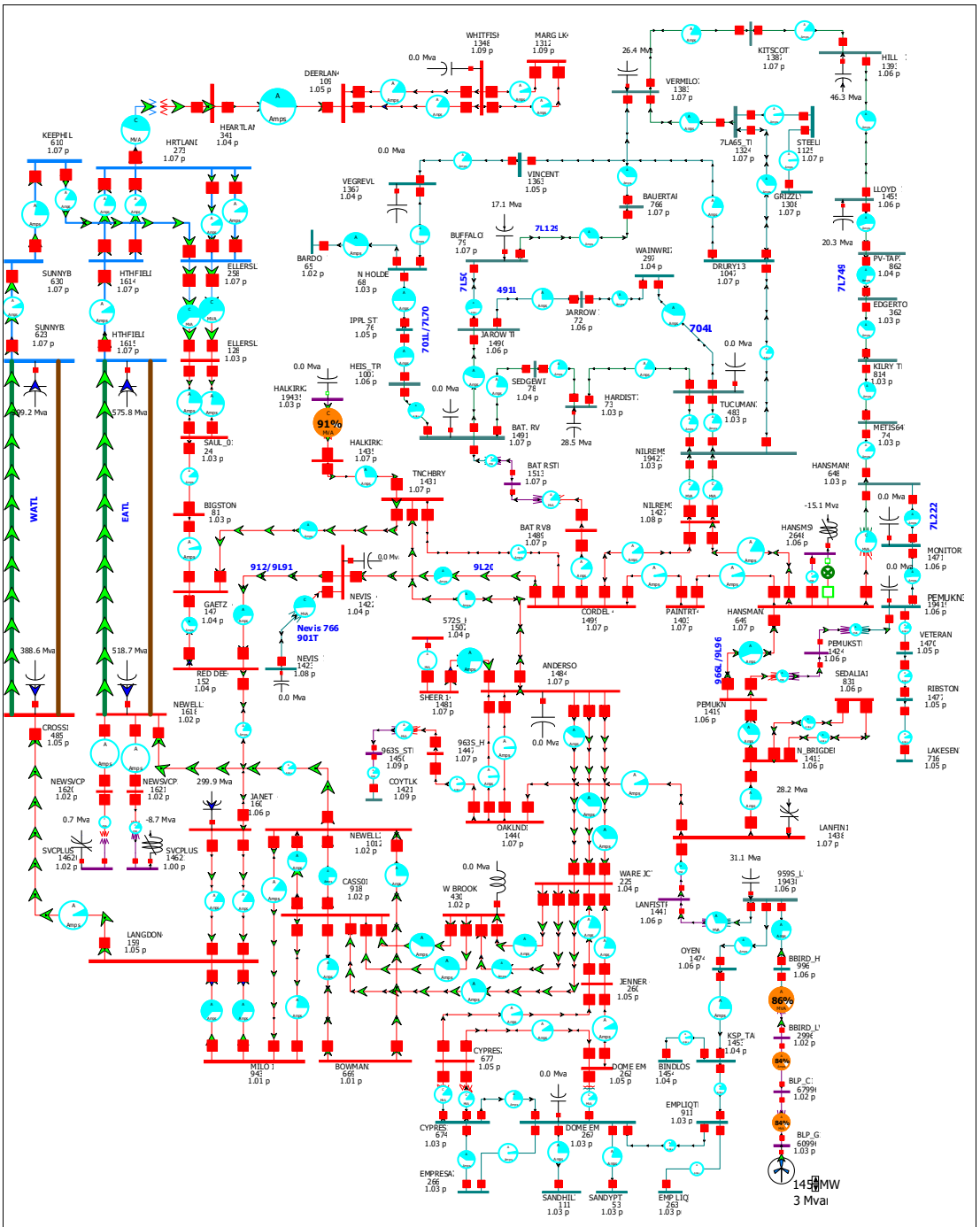
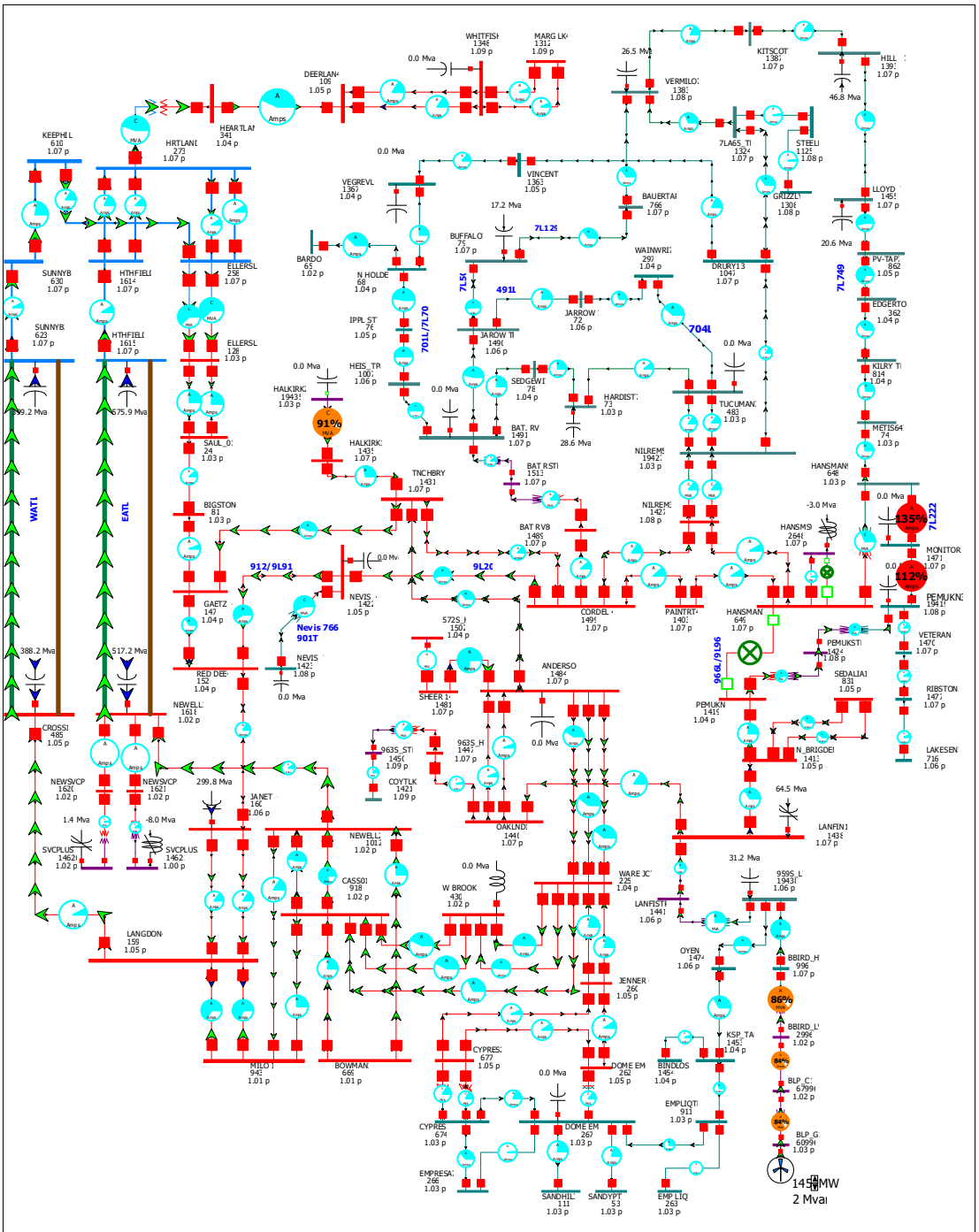


Figure B-S4c-1: 966L \ 9L966 (Hansman Lk. 650S-Pemukan 932S)



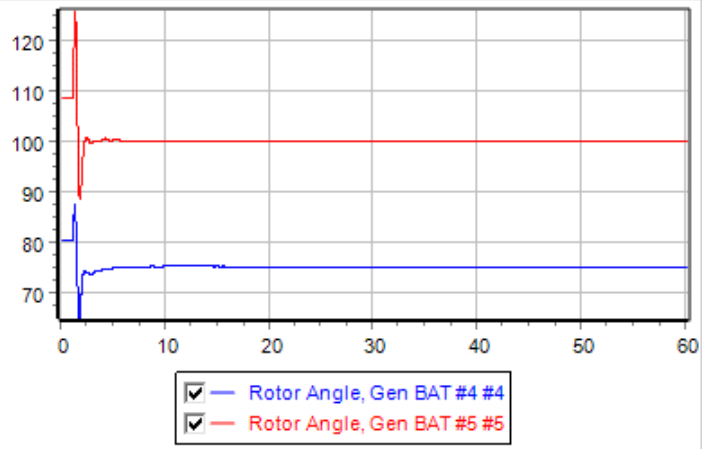
Attachment A4

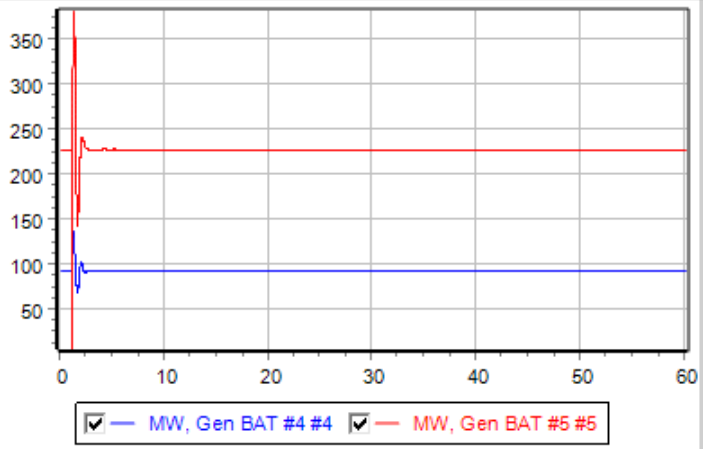
Post-Project Transient Stability Diagrams

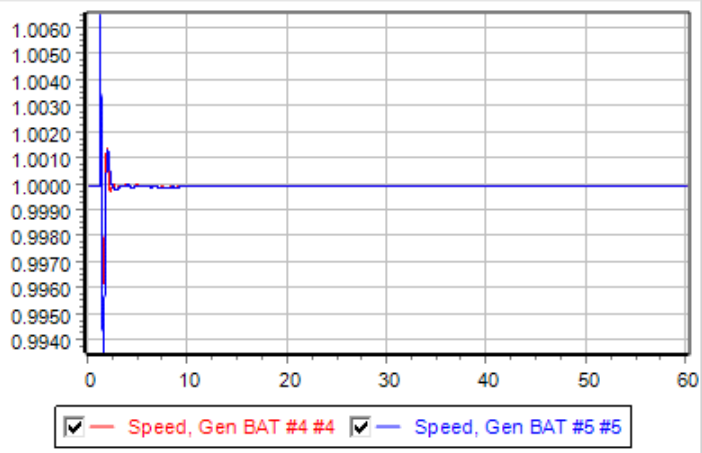
A4.1

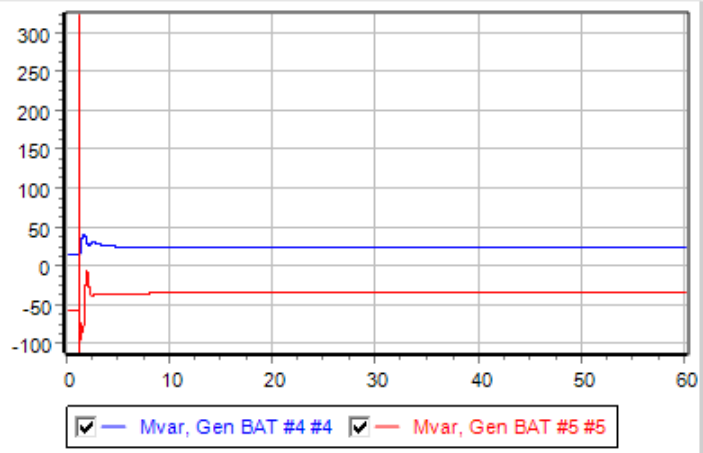
Scenario 4 (2022SP)

Battle River







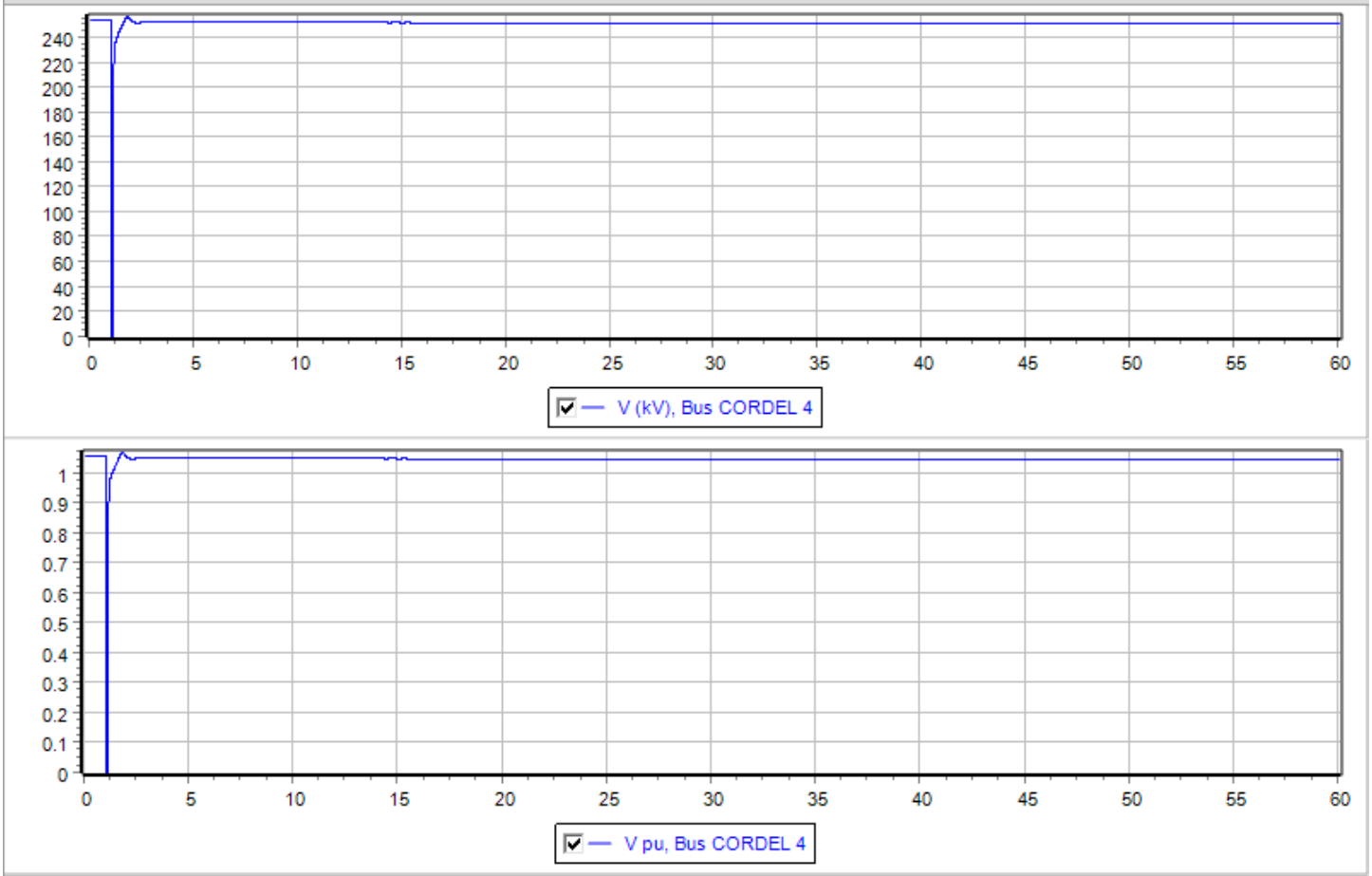


Contingency:
9L16/9L49: Cordel 755S to Tinchebray 972S

Study Case:
Scenario 4 (2022SP)

December 04, 2020 15:42:50

Cordel 755S Voltages

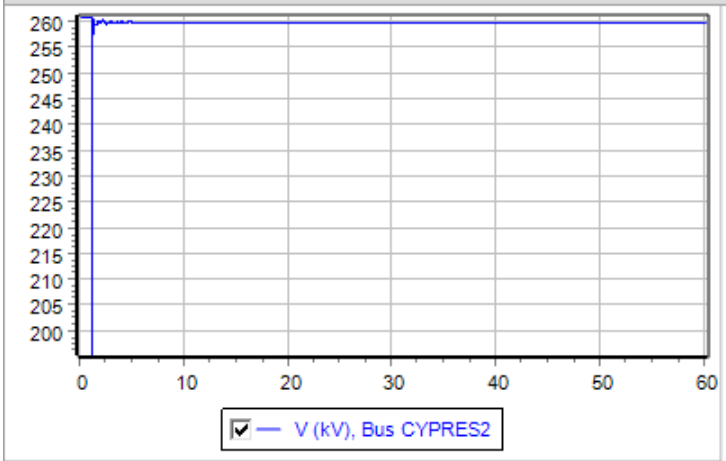


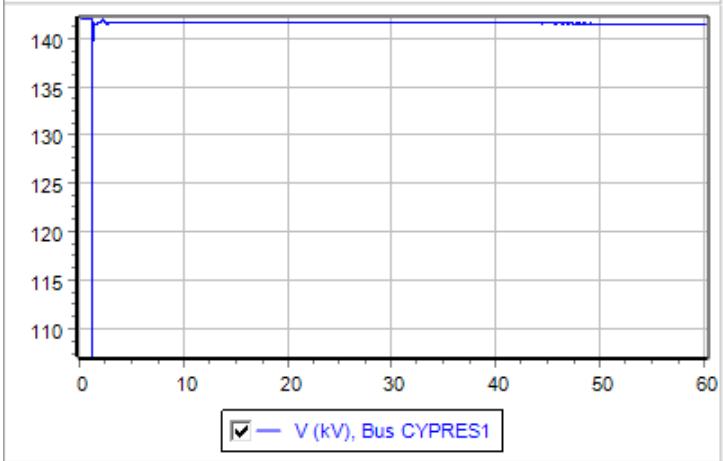
Contingency:
9L16/9L49: Cordel 755S to Tinchebray 972S

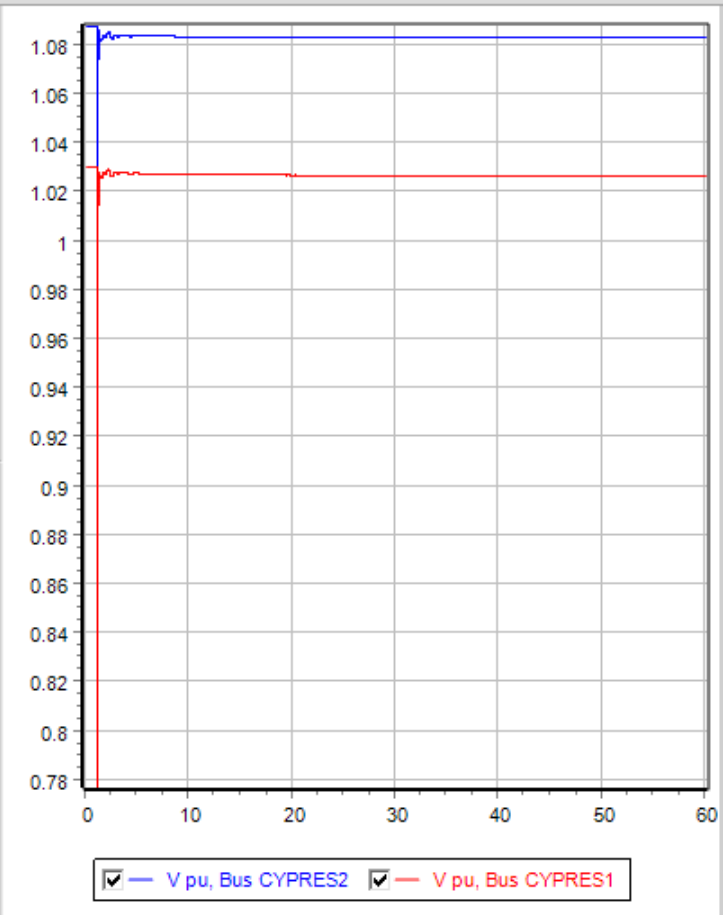
Study Case:
Scenario 4 (2022SP)

December 04, 2020 15:42:53

Cypress 562S Voltages





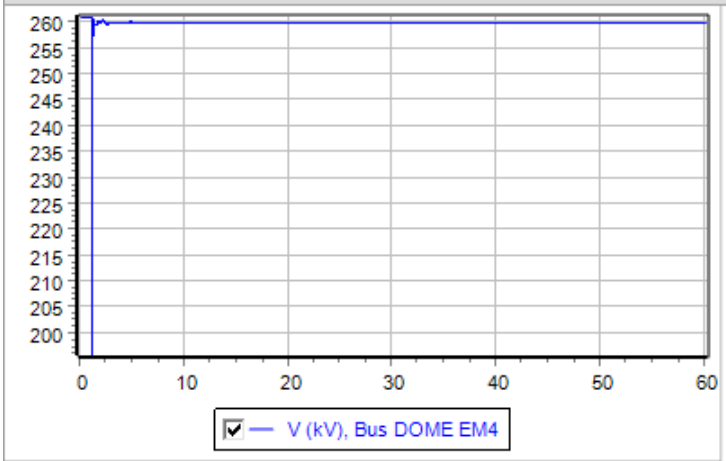


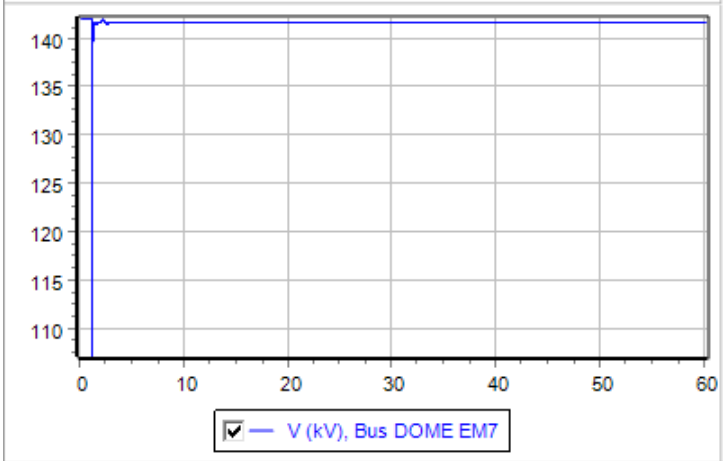
Contingency:
9L16/9L49: Cordel 755S to Tinchebray 972S

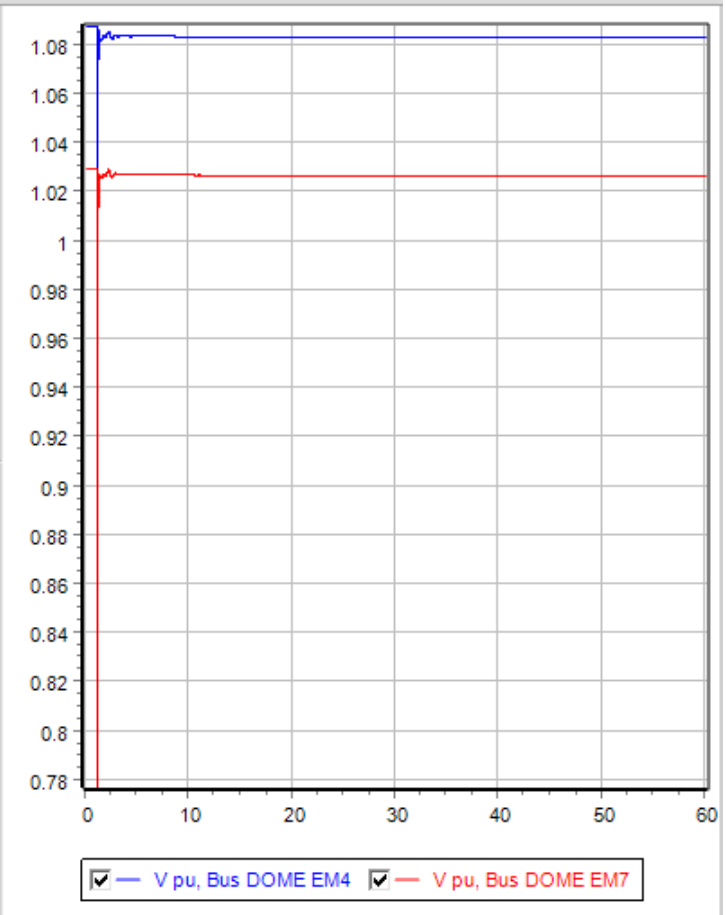
Study Case:
Scenario 4 (2022SP)

December 04, 2020 15:42:53

Dome 163S Voltages





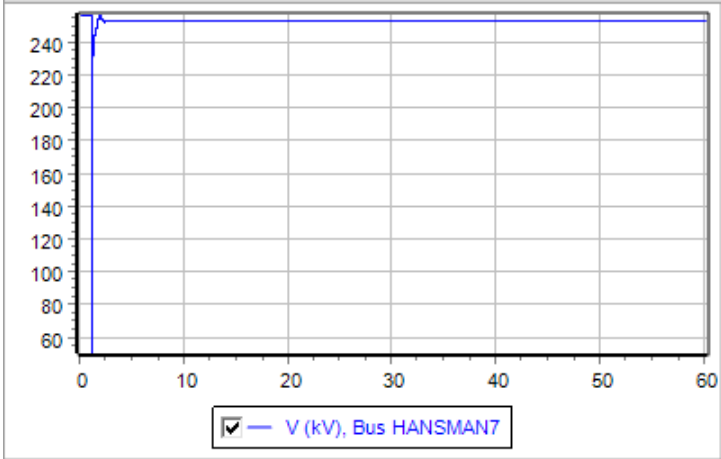


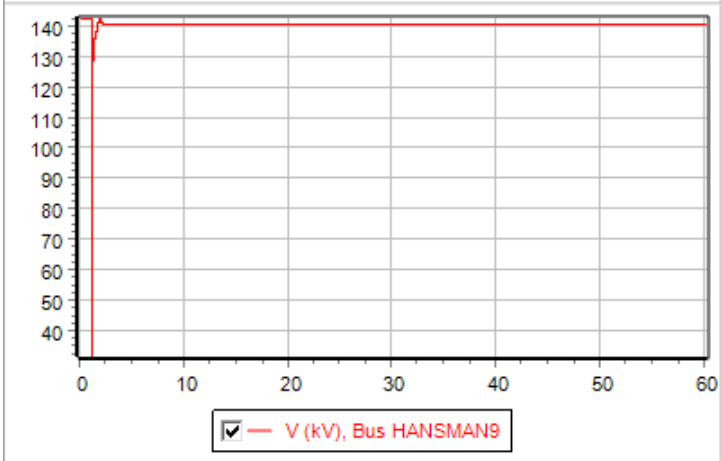
Contingency:
9L16/9L49: Cordel 755S to Tinchebray 972S

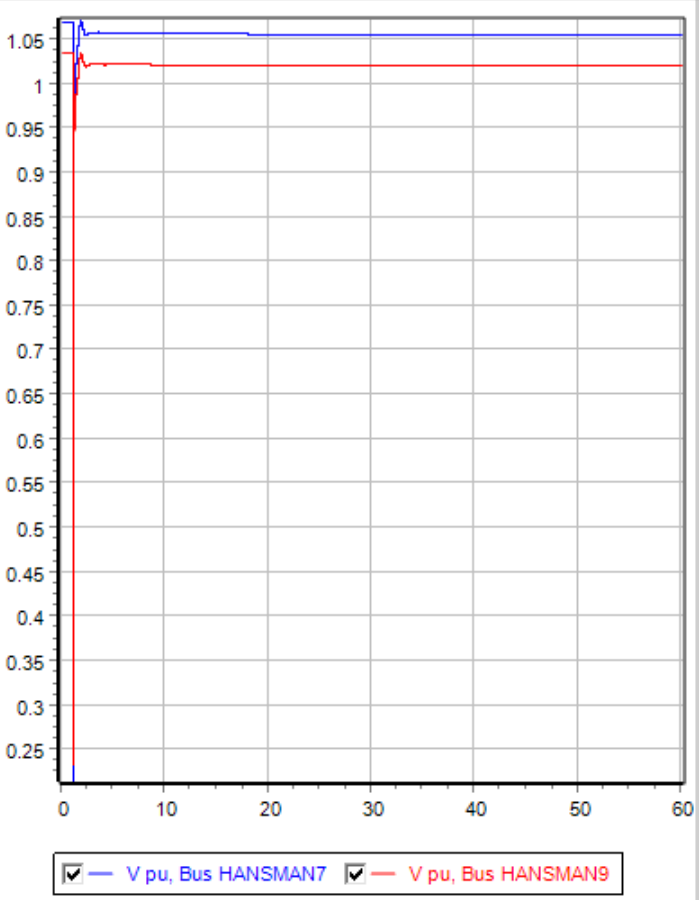
Study Case:
Scenario 4 (2022SP)

December 04, 2020 15:42:52

Hansman Lake 650S Voltages





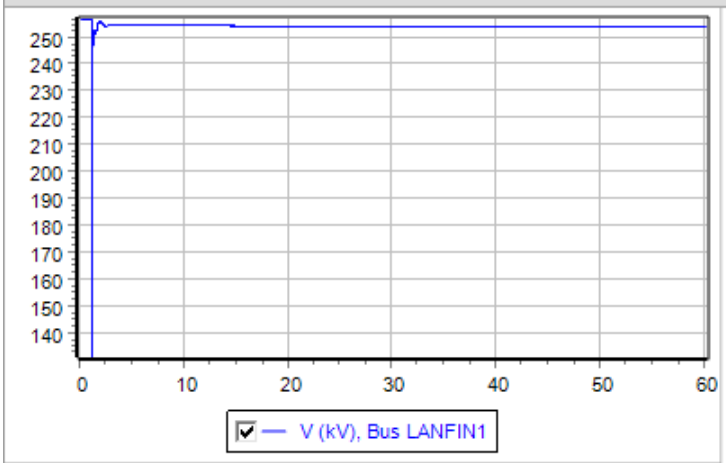


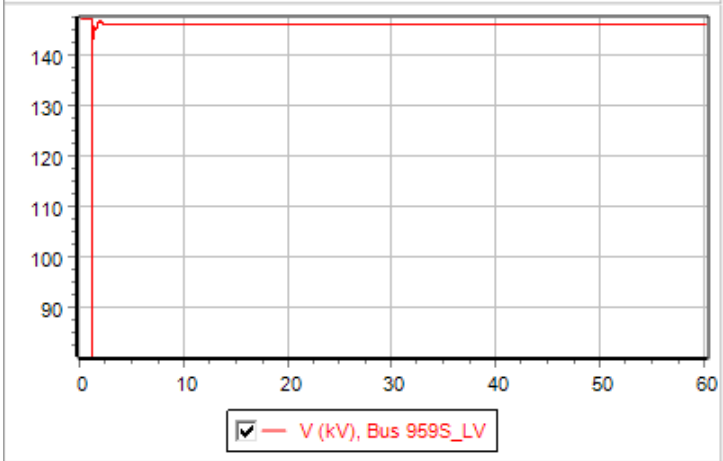
Contingency:
9L16/9L49: Cordel 755S to Tinchebray 972S

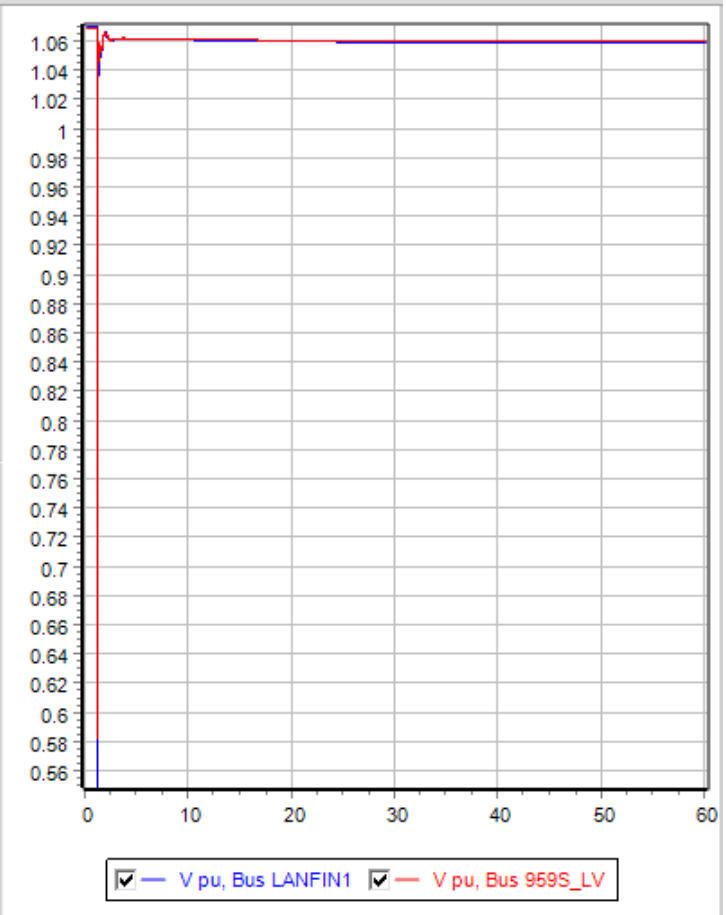
Study Case:
Scenario 4 (2022SP)

December 04, 2020 15:42:52

Lanfine 959S Voltages





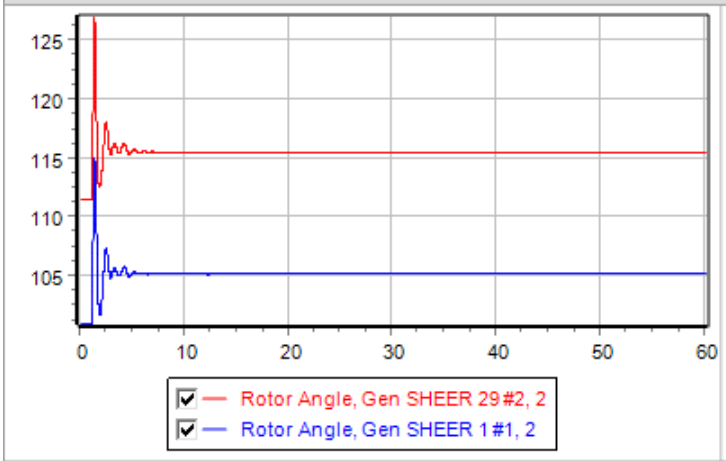


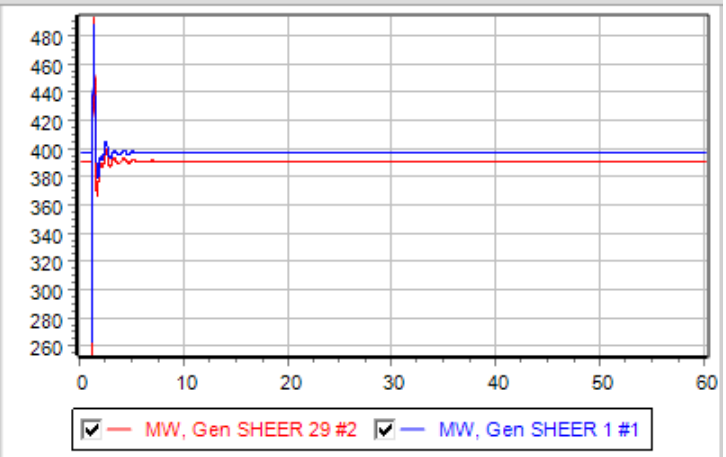
Contingency:
9L16/9L49: Cordel 755S to Tinchebray 972S

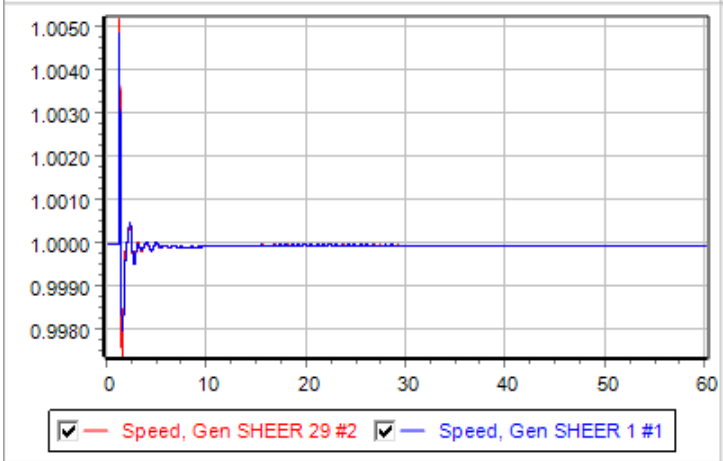
Study Case:
Scenario 4 (2022SP)

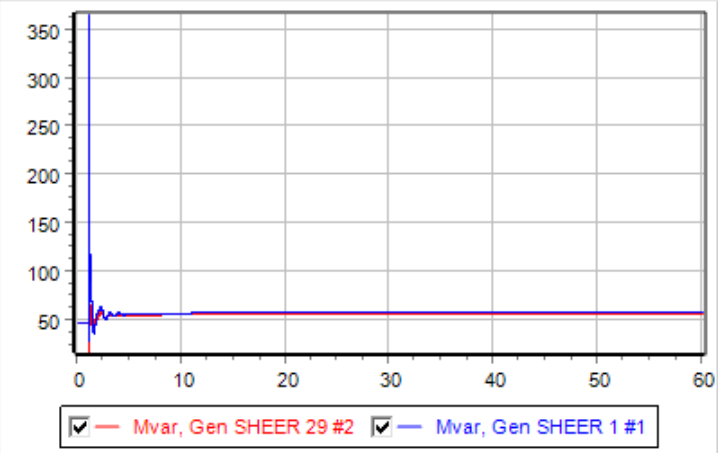
December 04, 2020 15:42:51

Sheerness







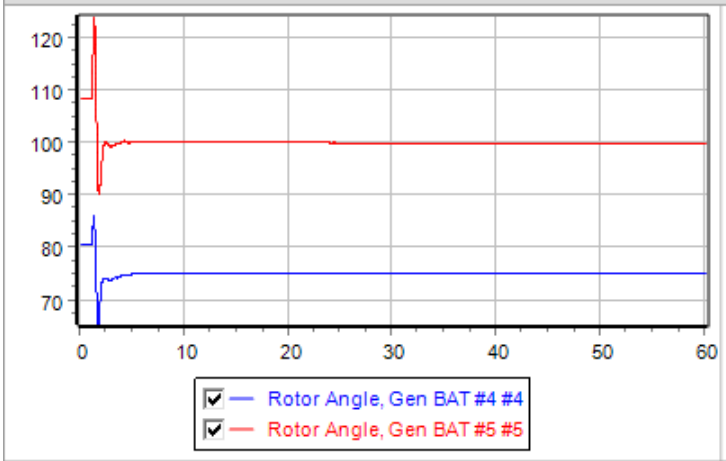


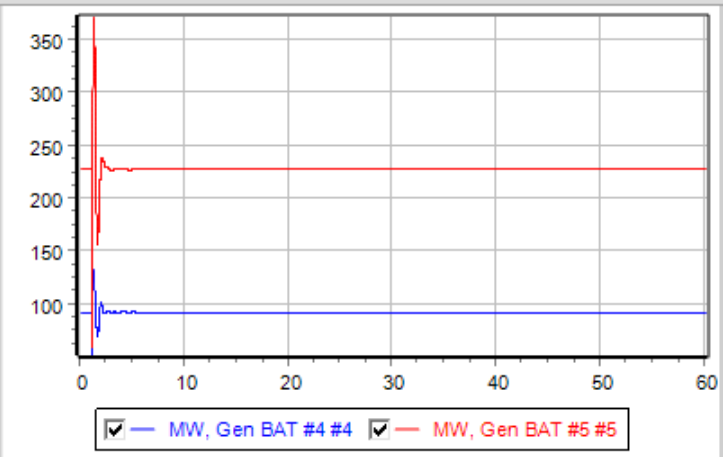
Contingency:
9L16/9L49: Cordel 755S to Tinchebray 972S

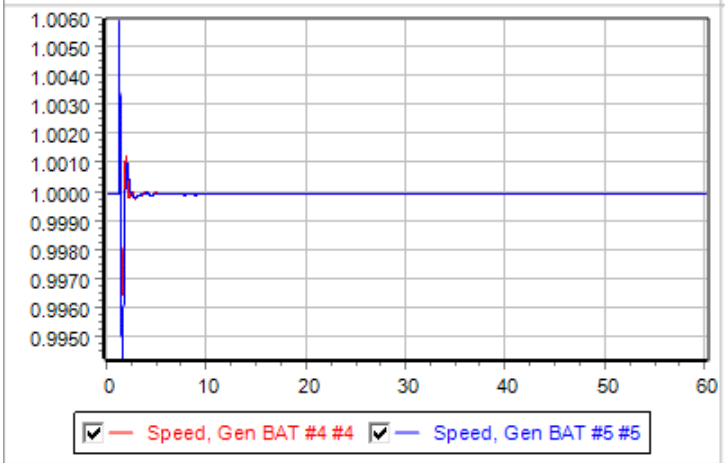
Study Case:
Scenario 4 (2022SP)

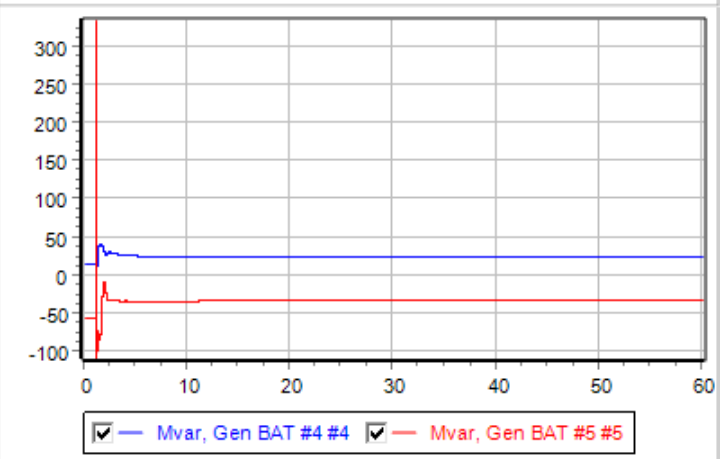
December 04, 2020 15:42:50

Battle River







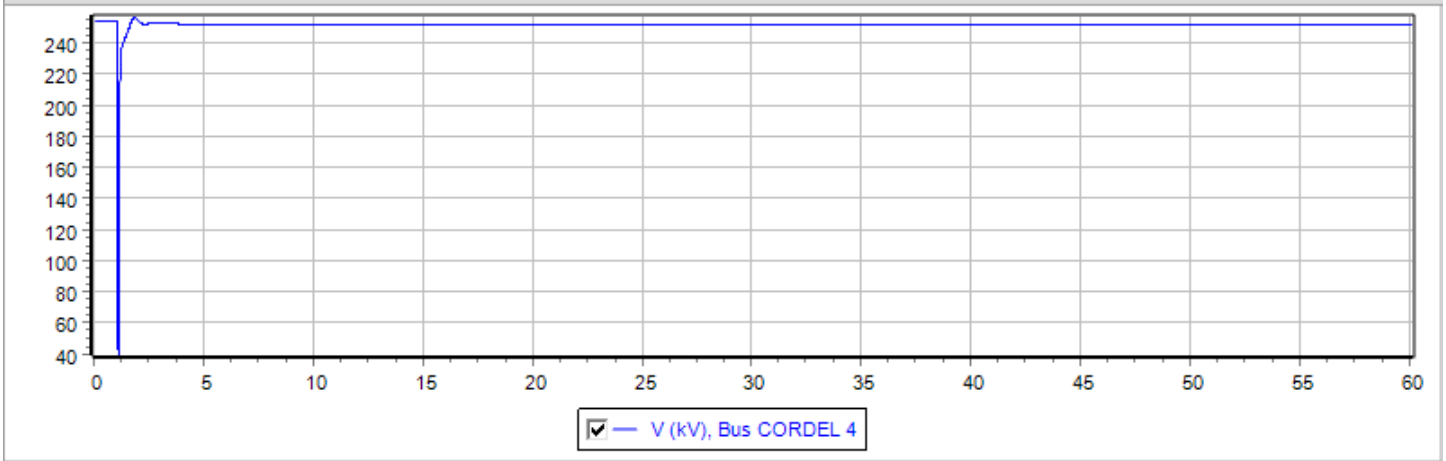


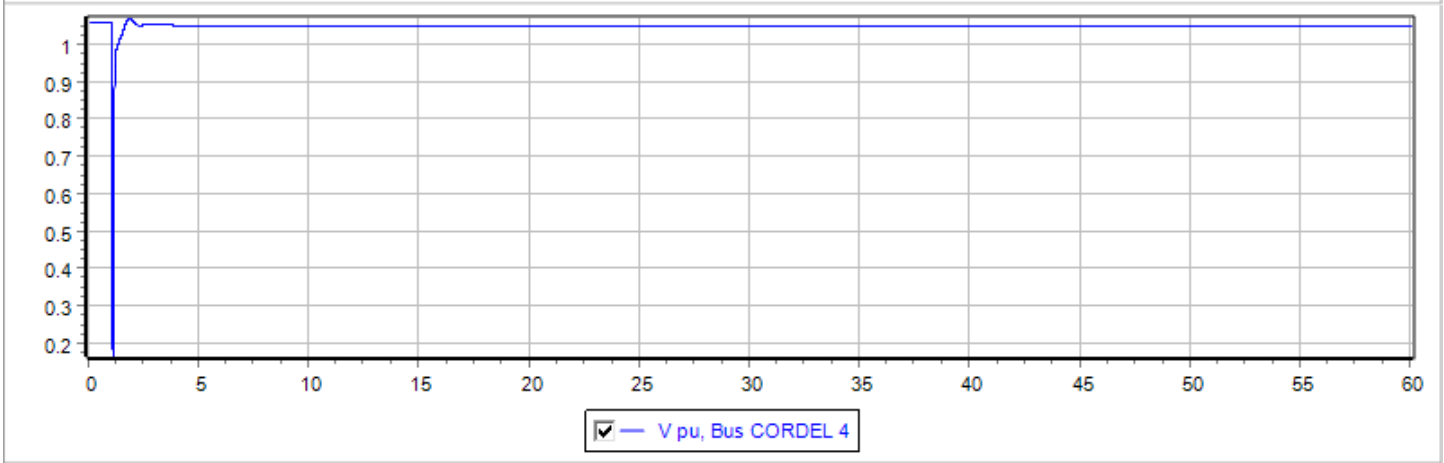
Contingency:
9L16/9L49: Tinchebray 972S to Cordel 755S

Study Case:
Scenario 4 (2022SP)

December 04, 2020 15:45:48

Cordel 755S Voltages



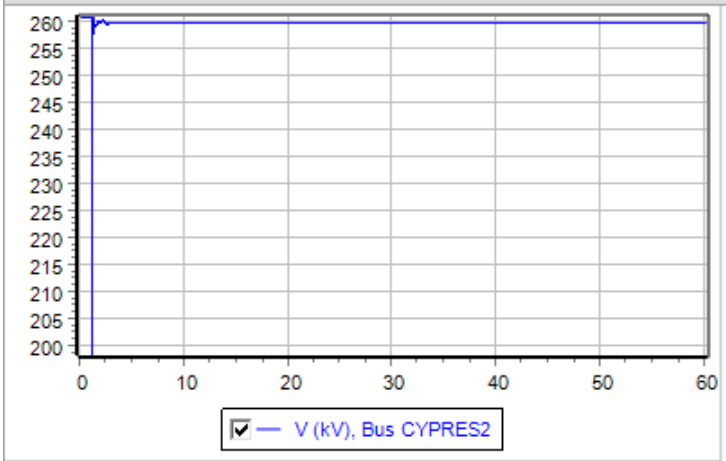


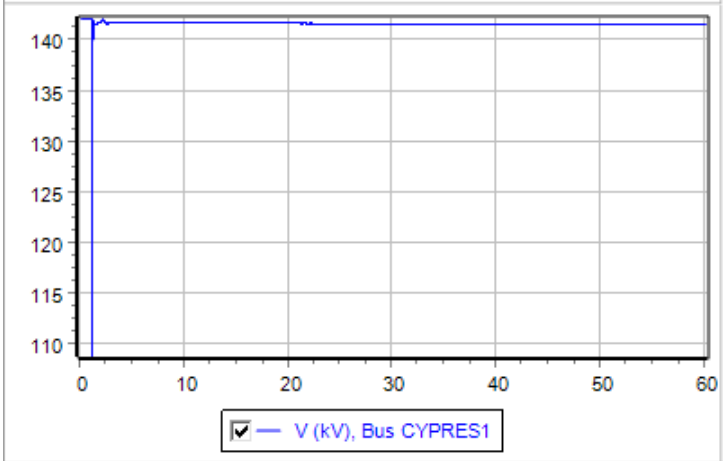
Contingency:
9L16/9L49: Tinchebray 972S to Cordel 755S

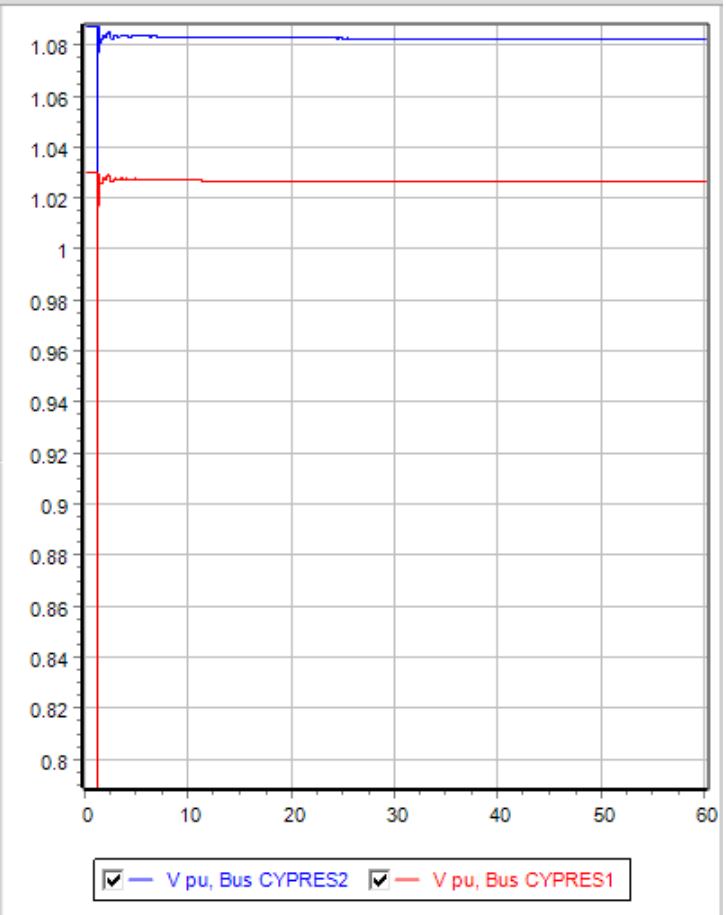
Study Case:
Scenario 4 (2022SP)

December 04, 2020 15:45:51

Cypress 562S Voltages





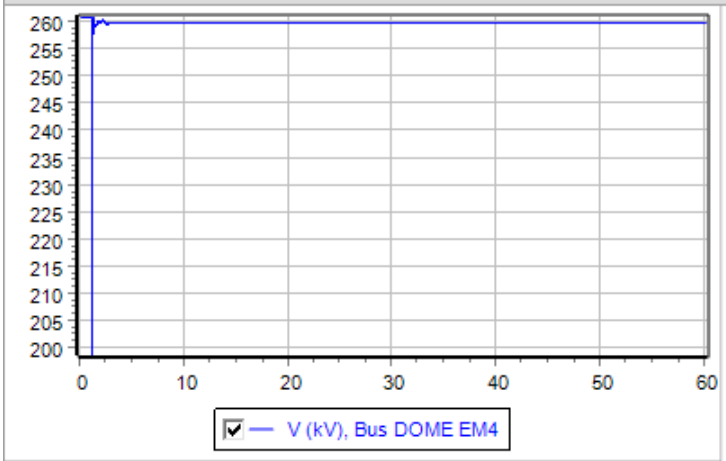


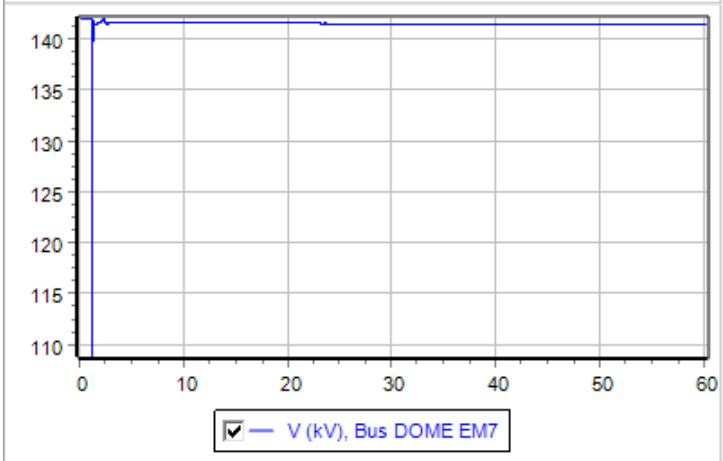
Contingency:
9L16/9L49: Tinchebray 972S to Cordel 755S

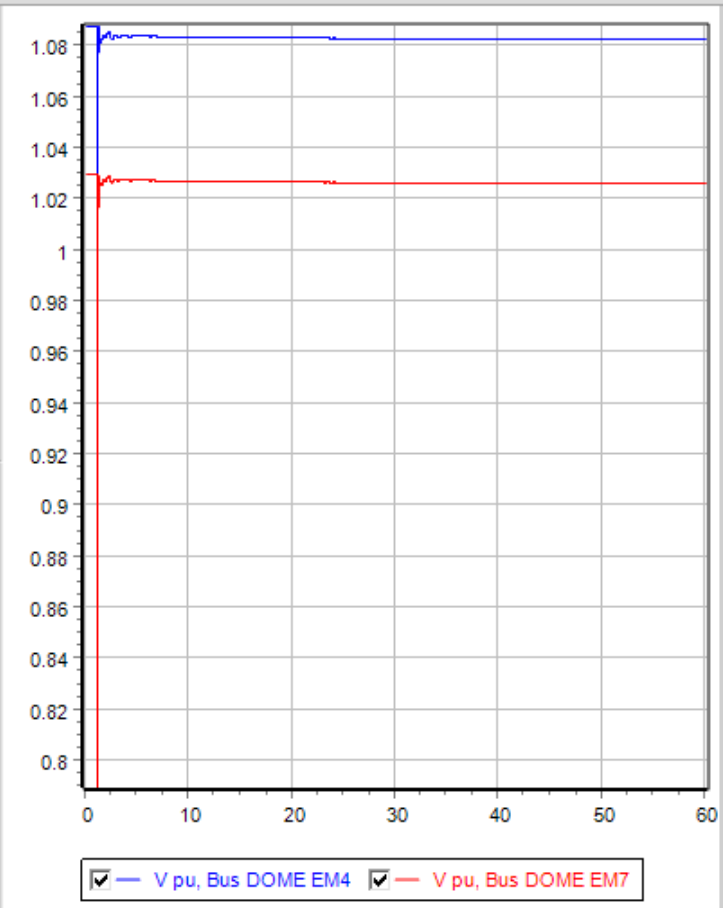
Study Case:
Scenario 4 (2022SP)

December 04, 2020 15:45:50

Dome 163S Voltages





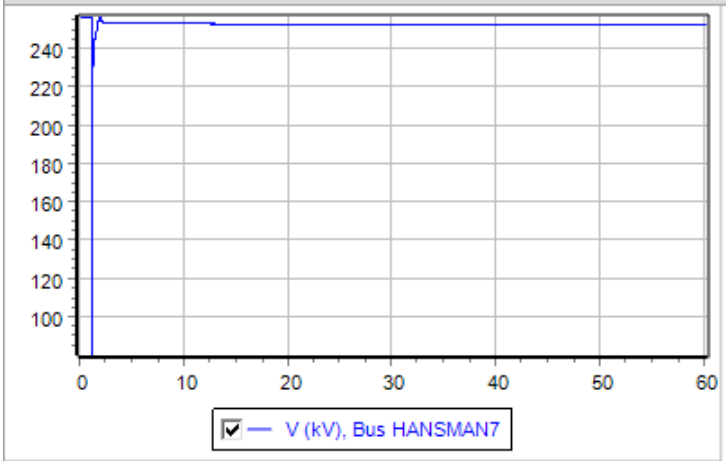


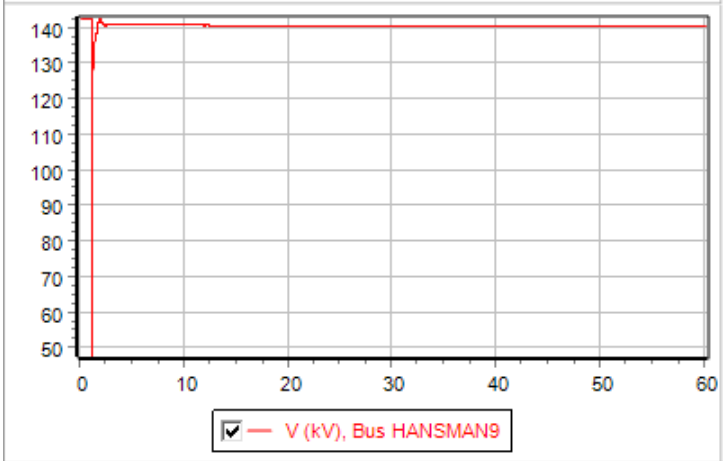
Contingency:
9L16/9L49: Tinchebray 972S to Cordel 755S

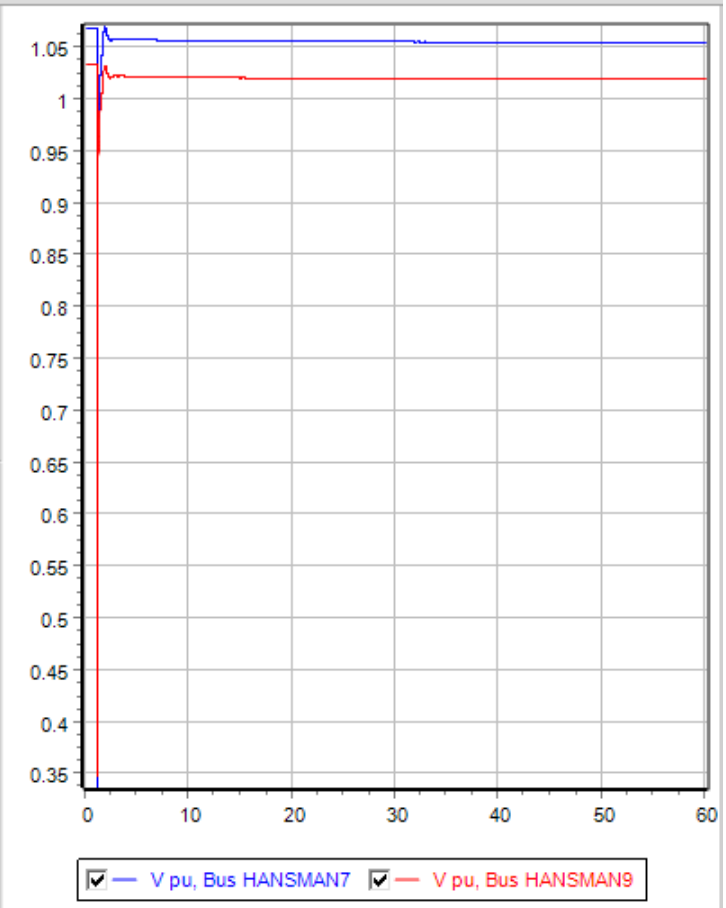
Study Case:
Scenario 4 (2022SP)

December 04, 2020 15:45:50

Hansman Lake 650S Voltages





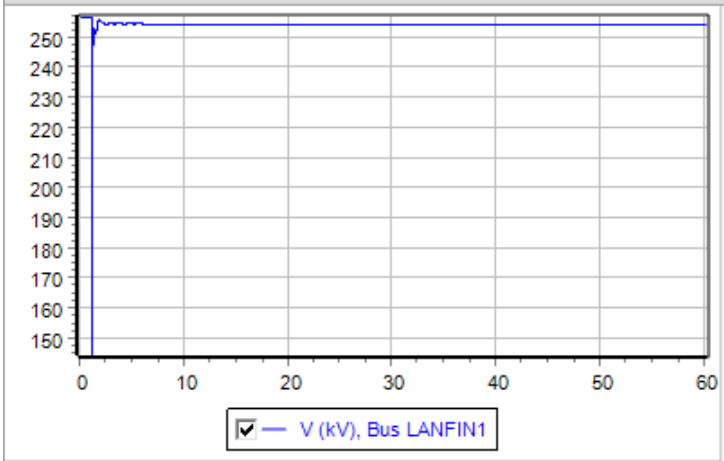


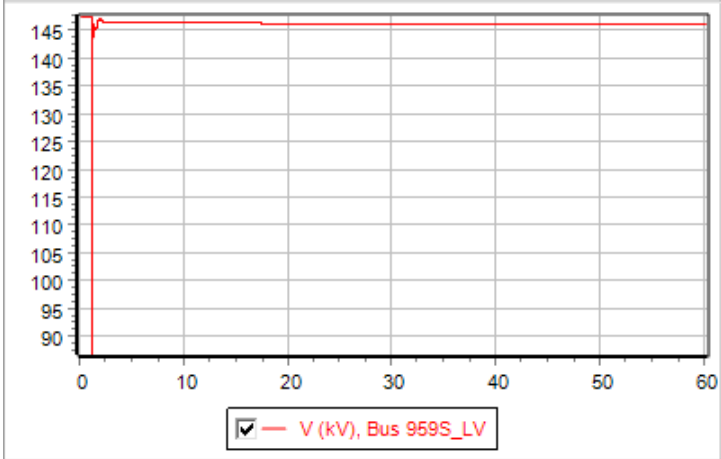
Contingency:
9L16/9L49: Tinchebray 972S to Cordel 755S

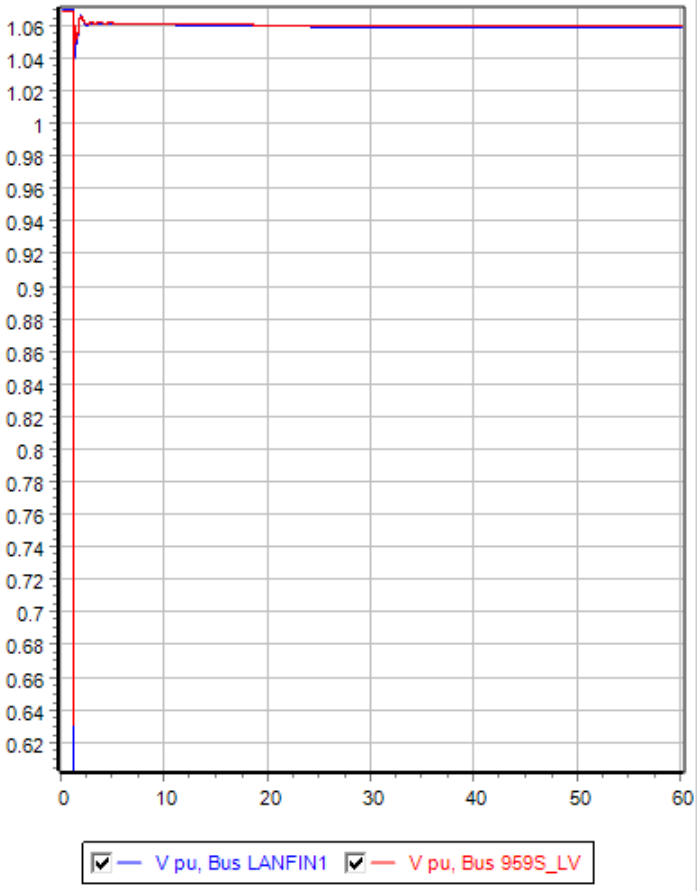
Study Case:
Scenario 4 (2022SP)

December 04, 2020 15:45:49

Lanfine 959S Voltages





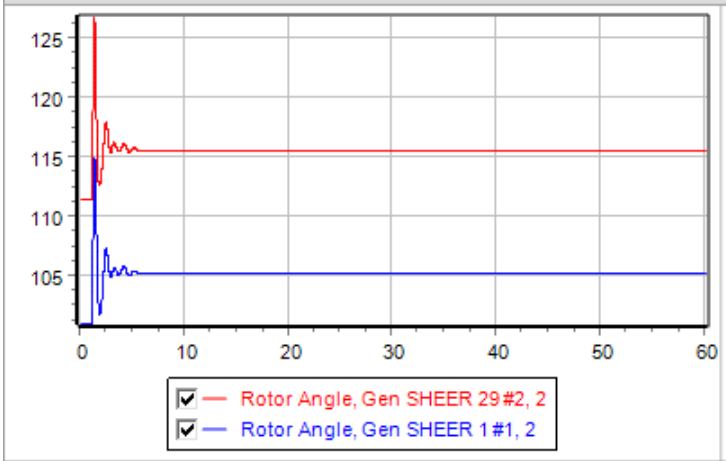


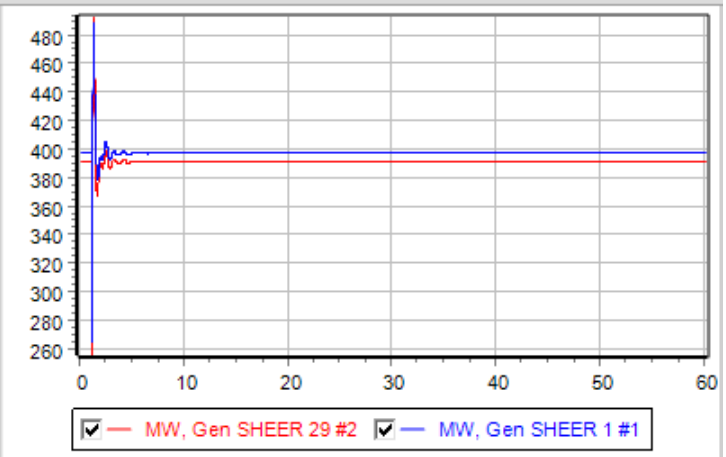
Contingency:
9L16/9L49: Tinchebray 972S to Cordel 755S

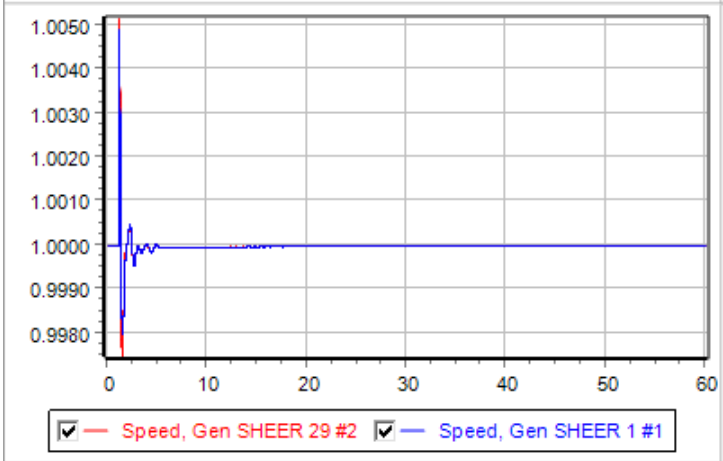
Study Case:
Scenario 4 (2022SP)

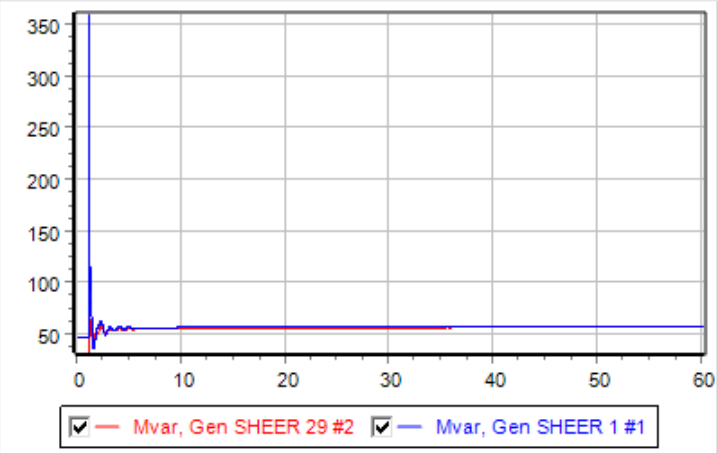
December 04, 2020 15:45:48

Sheerness







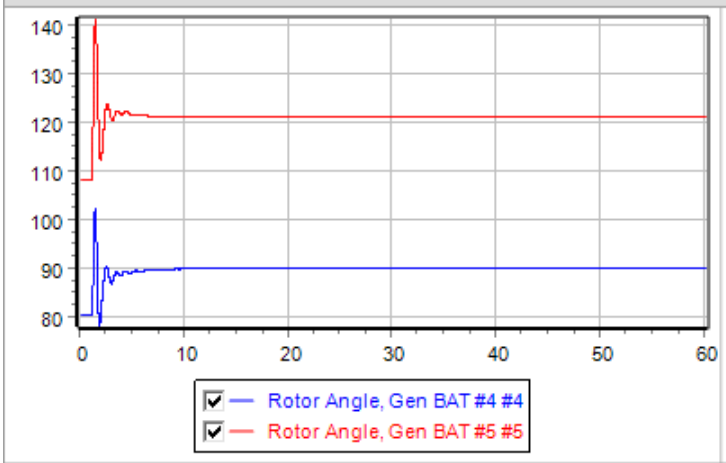


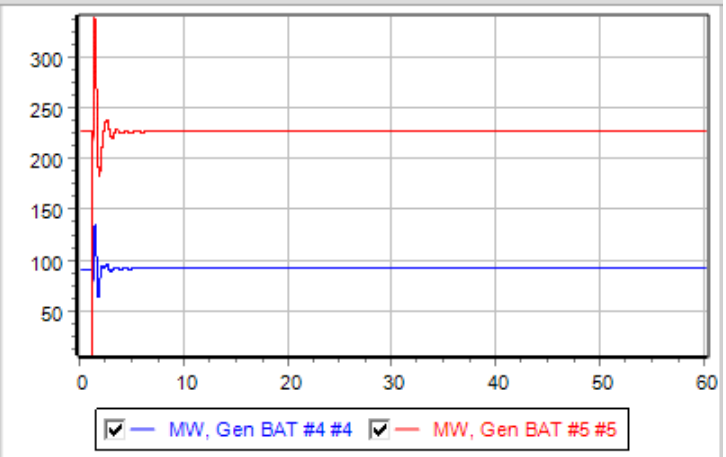
Contingency:
9L16/9L49: Tinchebray 972S to Cordel 755S

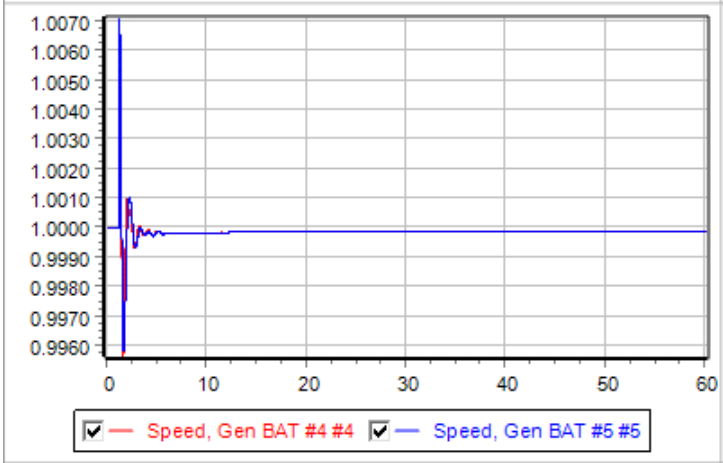
Study Case:
Scenario 4 (2022SP)

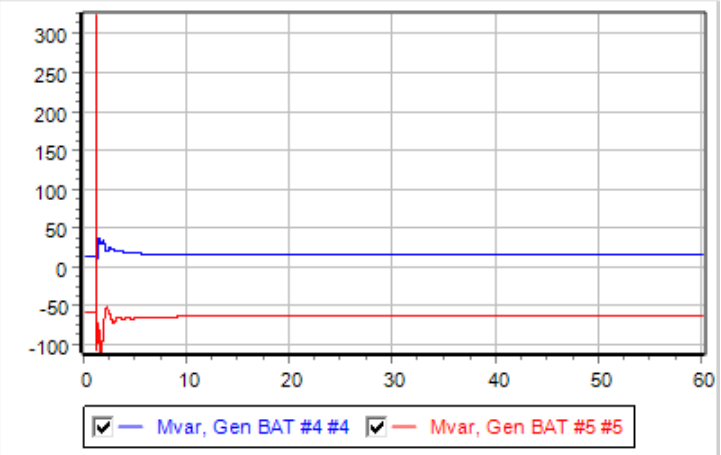
December 04, 2020 15:45:47

Battle River









Contingency:
9L20: Cordel 755S to Nevis 766S

Study Case:
Scenario 4 (2022SP)

December 04, 2020 15:48:53

Cordel 755S Voltages

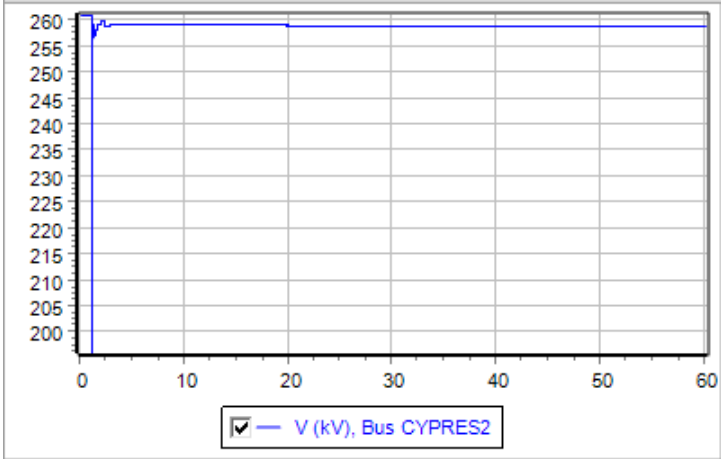


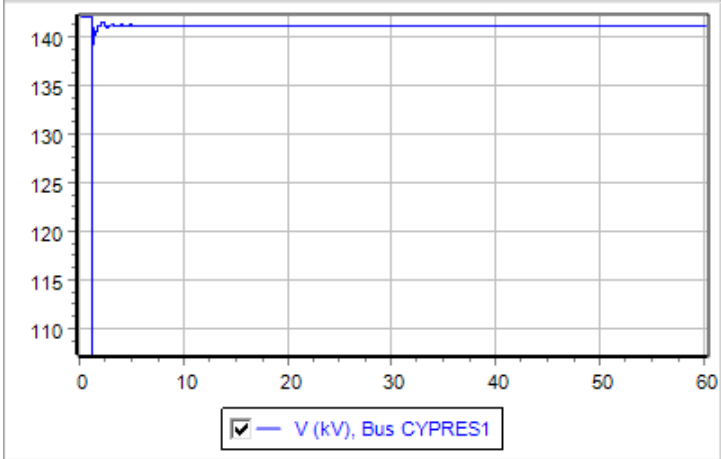
Contingency:
9L20: Cordel 755S to Nevis 766S

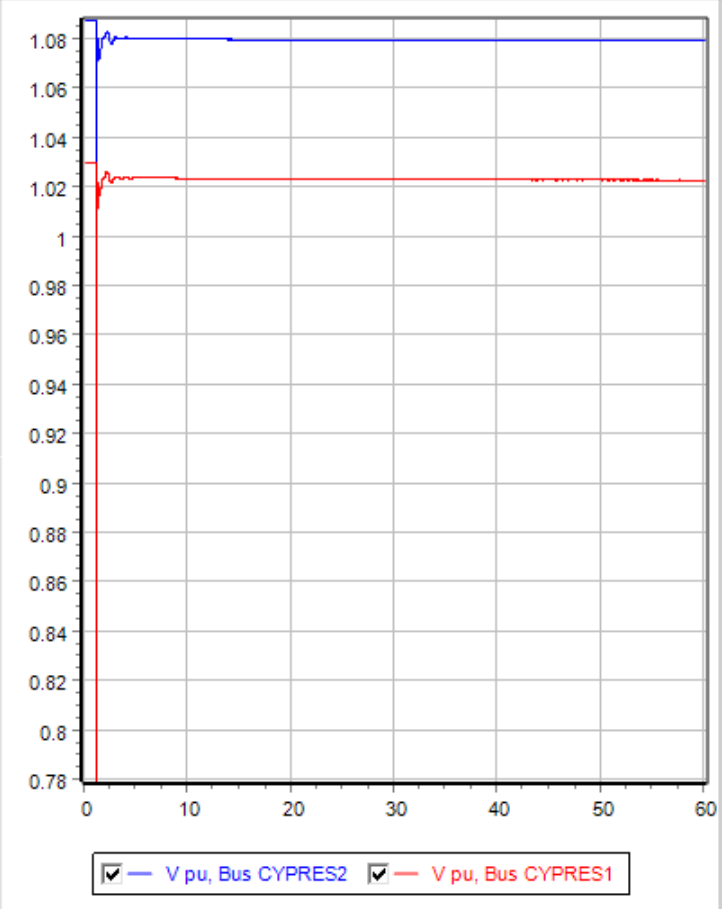
Study Case:
Scenario 4 (2022SP)

December 04, 2020 15:48:56

Cypress 562S Voltages





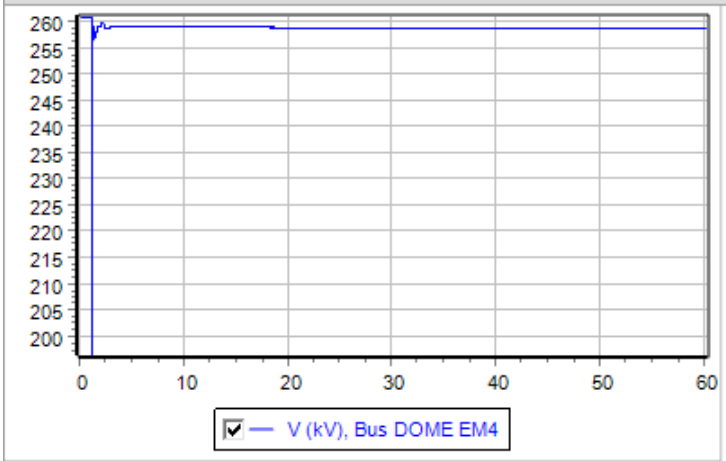


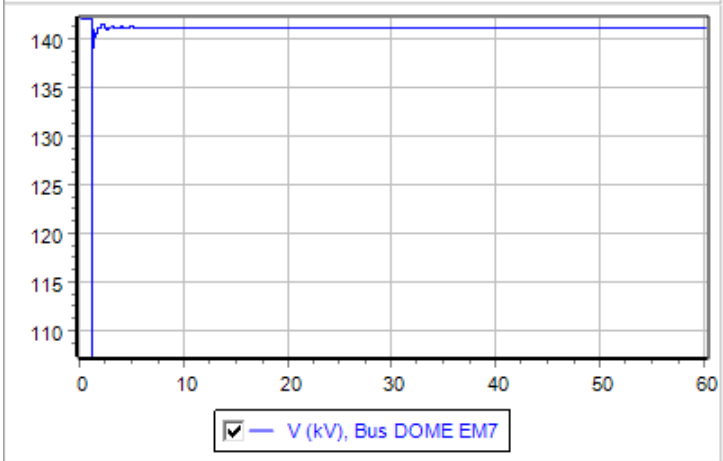
Contingency:
9L20: Cordel 755S to Nevis 766S

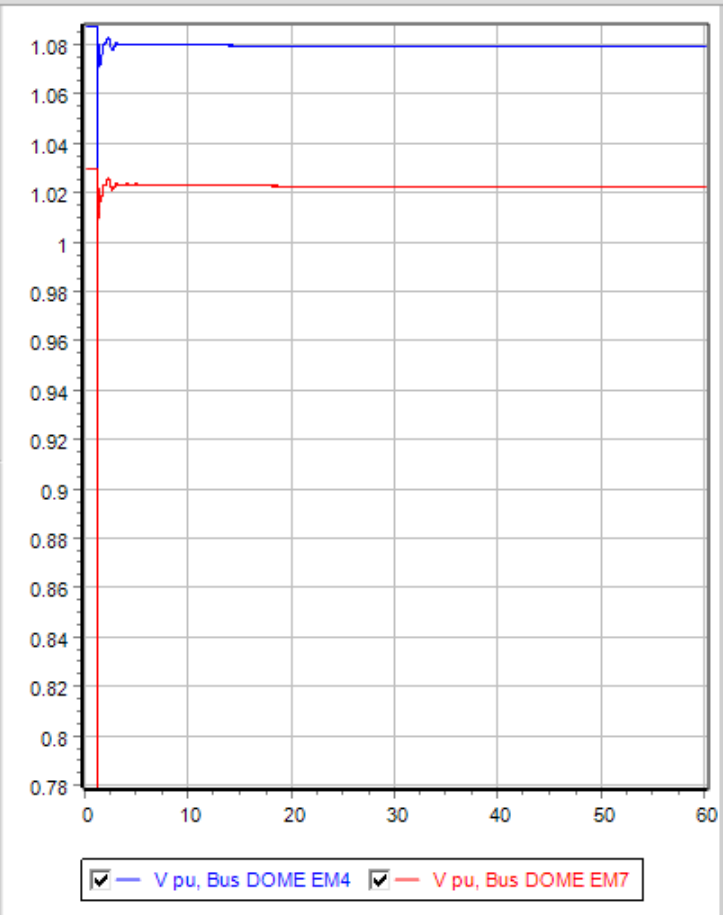
Study Case:
Scenario 4 (2022SP)

December 04, 2020 15:48:56

Dome 163S Voltages





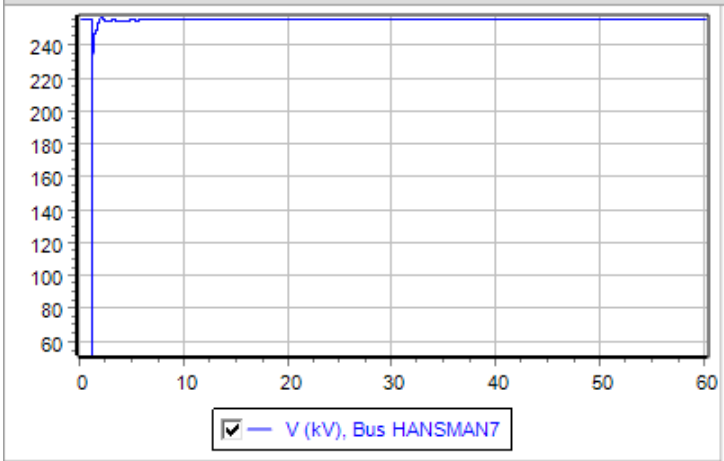


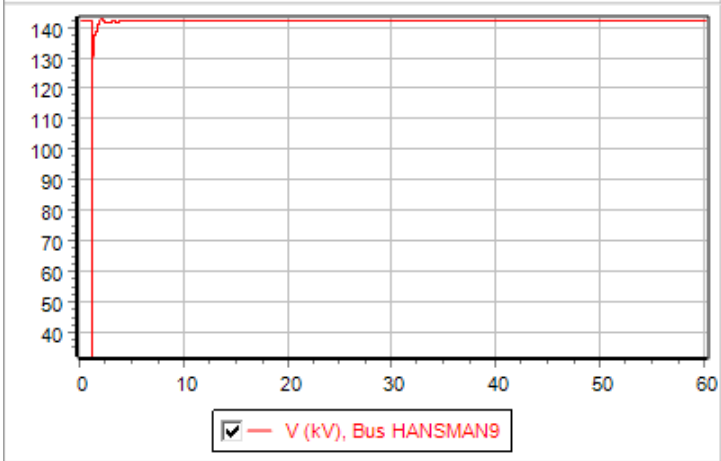
Contingency:
9L20: Cordel 755S to Nevis 766S

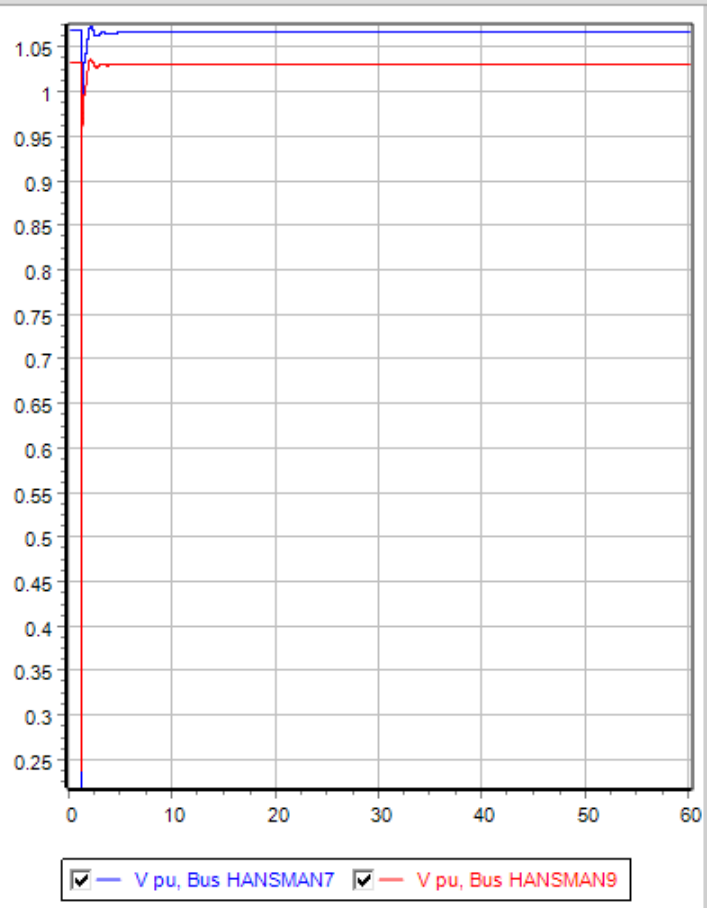
Study Case:
Scenario 4 (2022SP)

December 04, 2020 15:48:55

Hansman Lake 650S Voltages





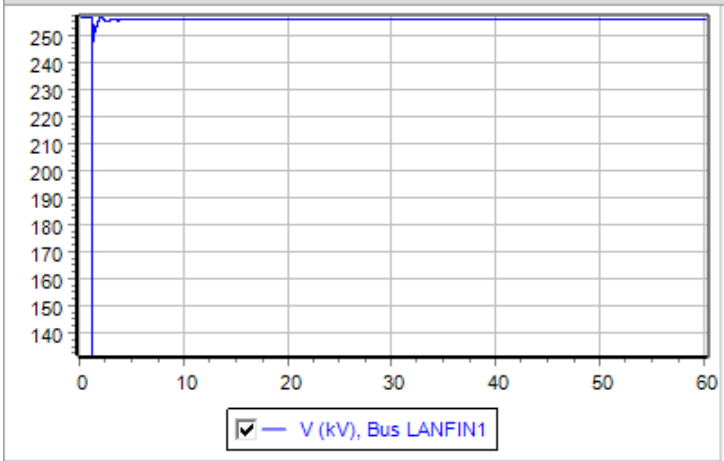


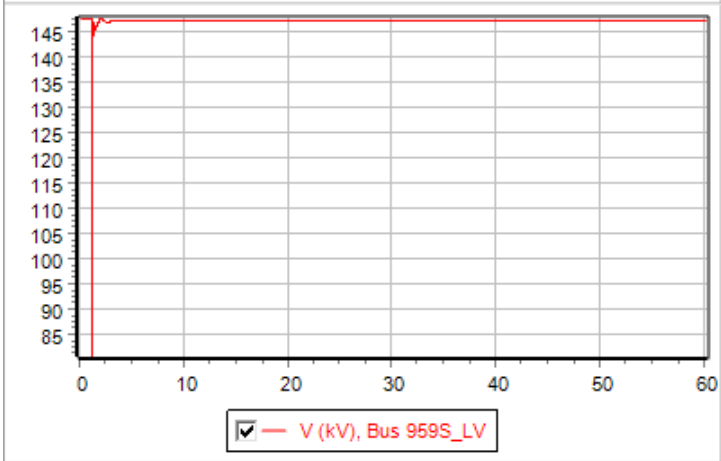
Contingency:
9L20: Cordel 755S to Nevis 766S

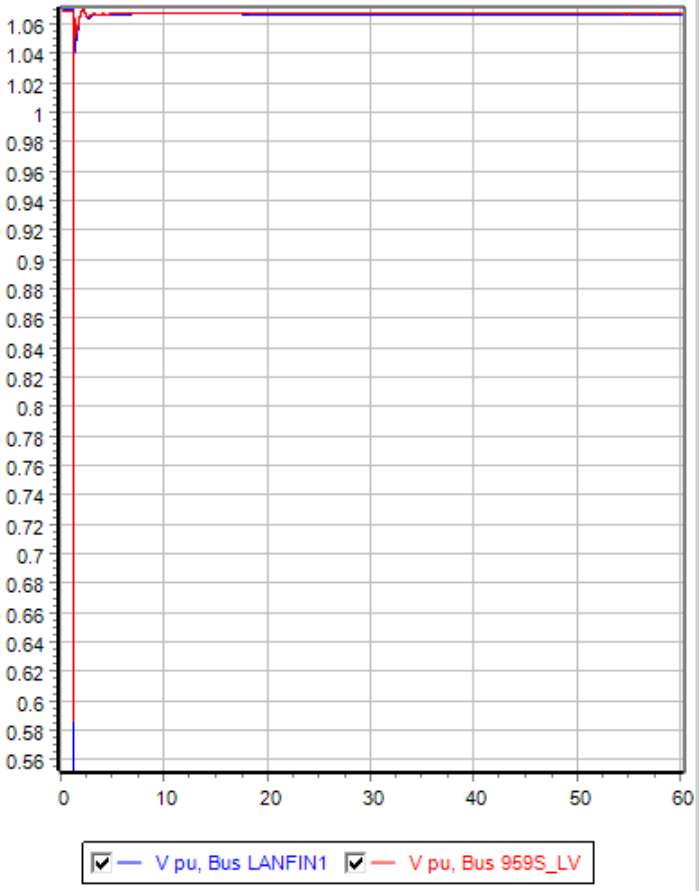
Study Case:
Scenario 4 (2022SP)

December 04, 2020 15:48:55

Lanfine 959S Voltages





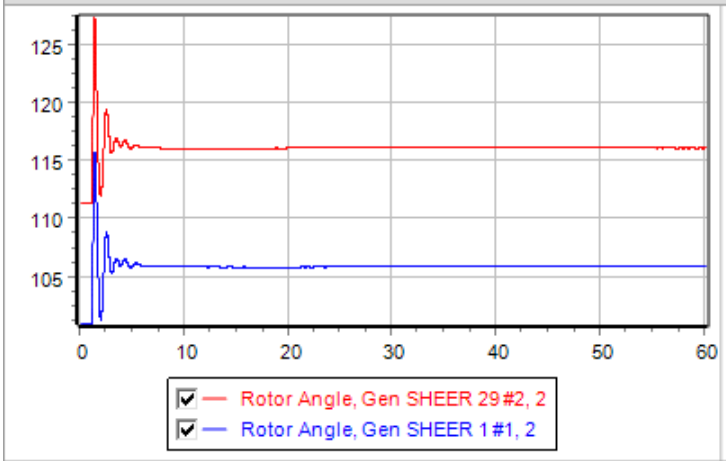


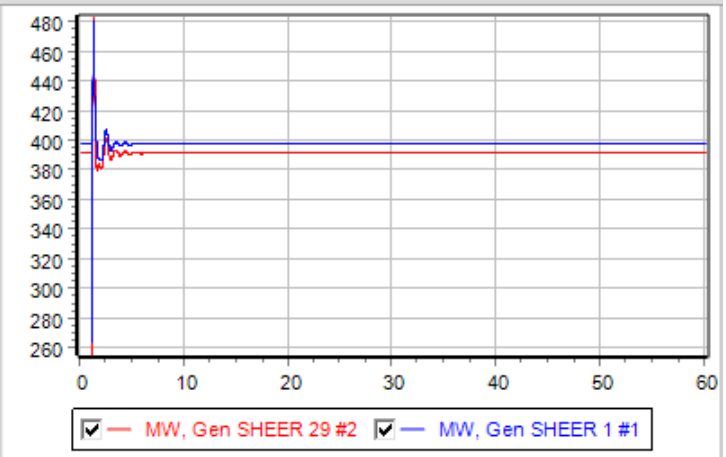
Contingency:
9L20: Cordel 755S to Nevis 766S

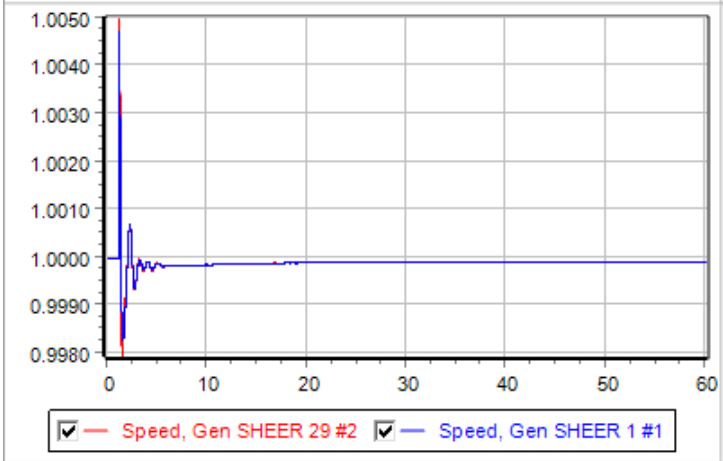
Study Case:
Scenario 4 (2022SP)

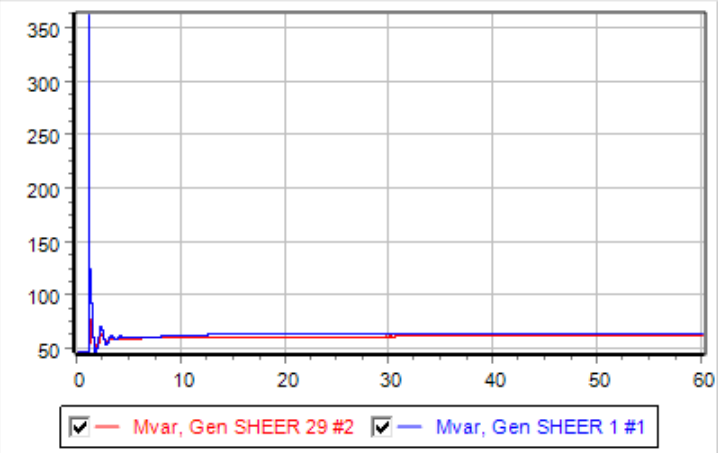
December 04, 2020 15:48:54

Sheerness







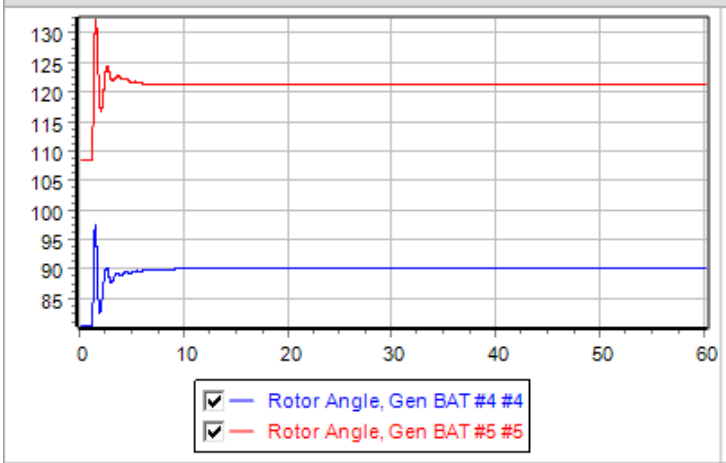


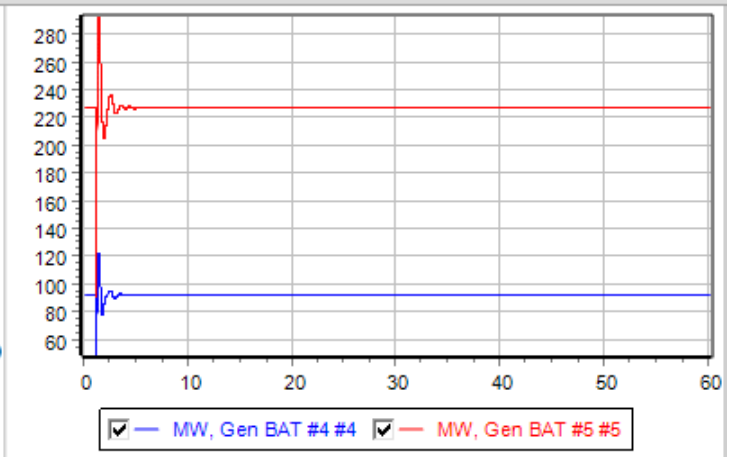
Contingency:
9L20: Cordel 755S to Nevis 766S

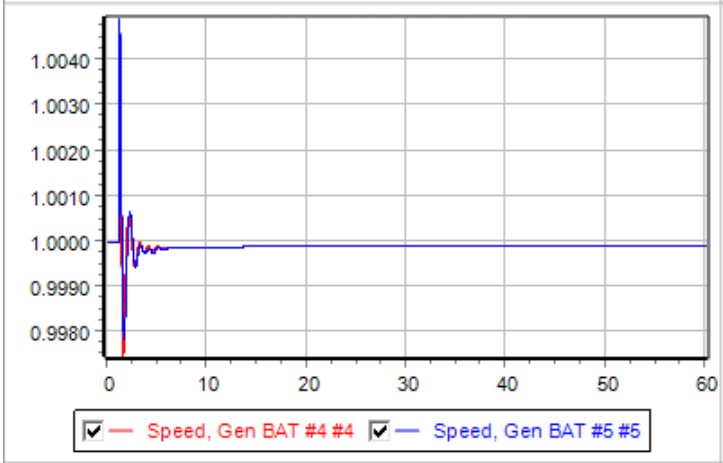
Study Case:
Scenario 4 (2022SP)

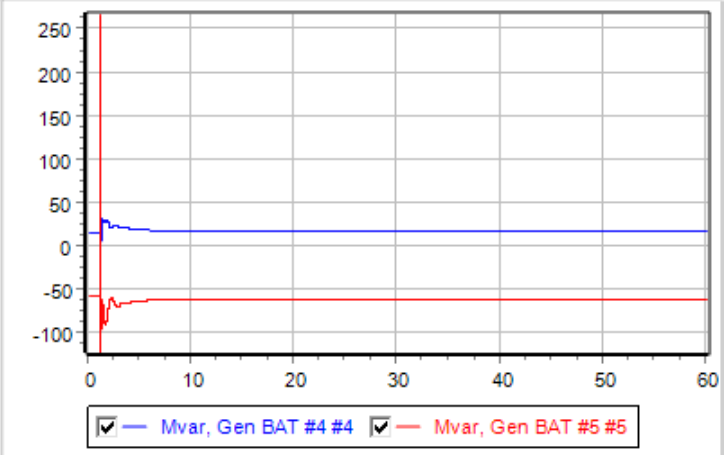
December 04, 2020 15:48:53

Battle River







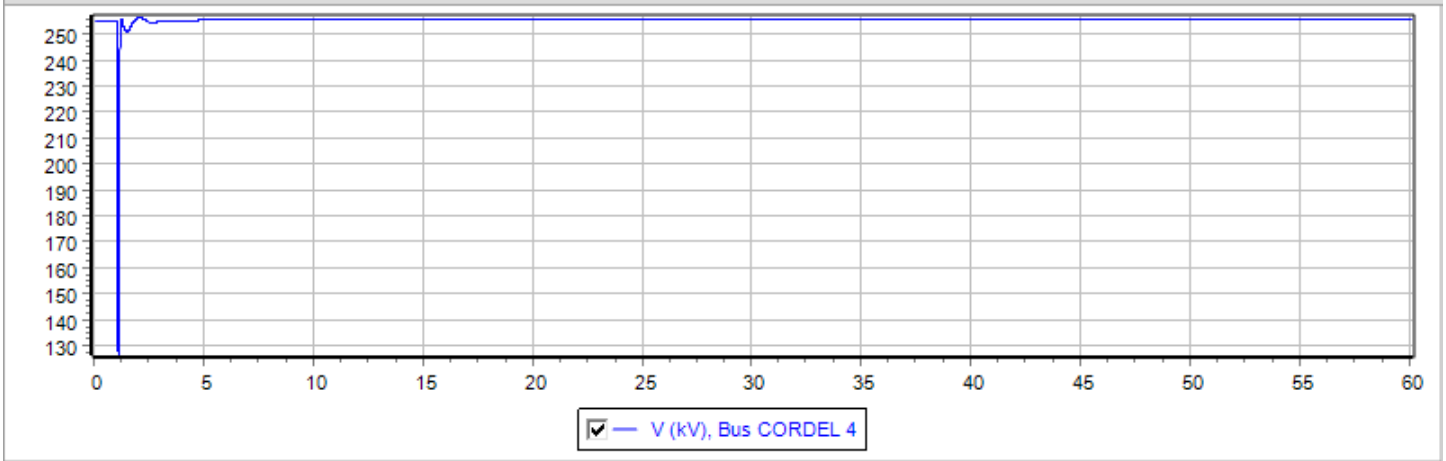


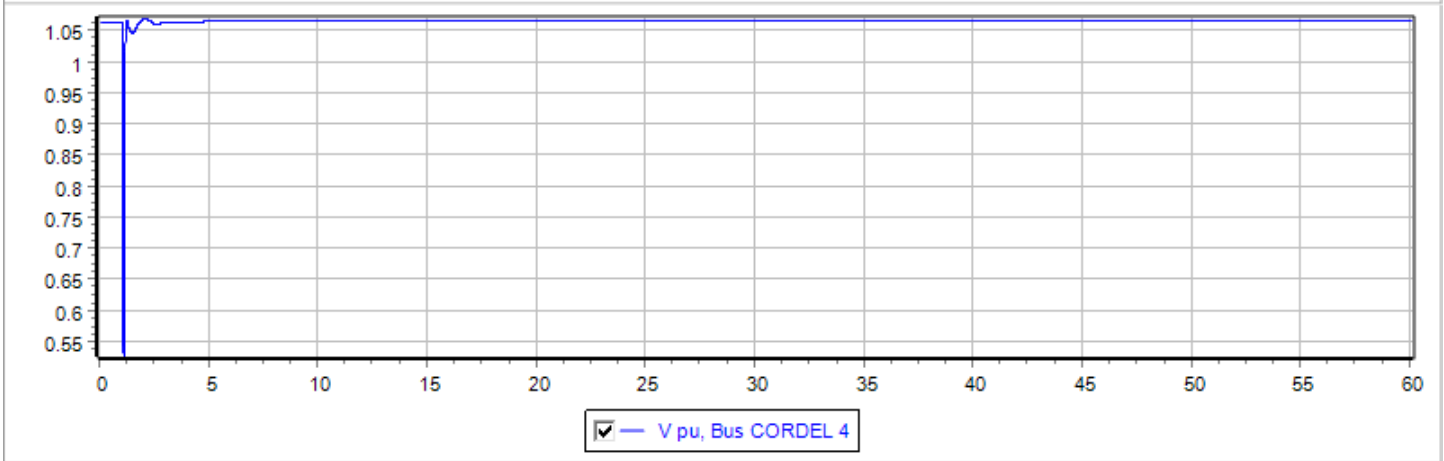
Contingency:
9L20: Nevis 766S to Cordel 755S

Study Case:
Scenario 4 (2022SP)

December 04, 2020 15:51:58

Cordel 755S Voltages



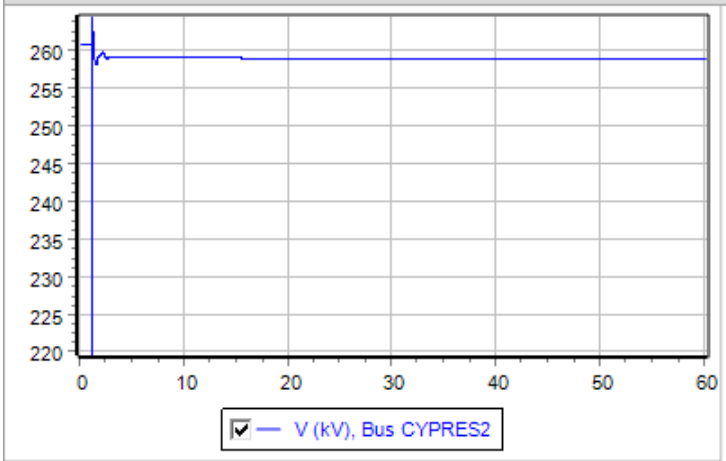


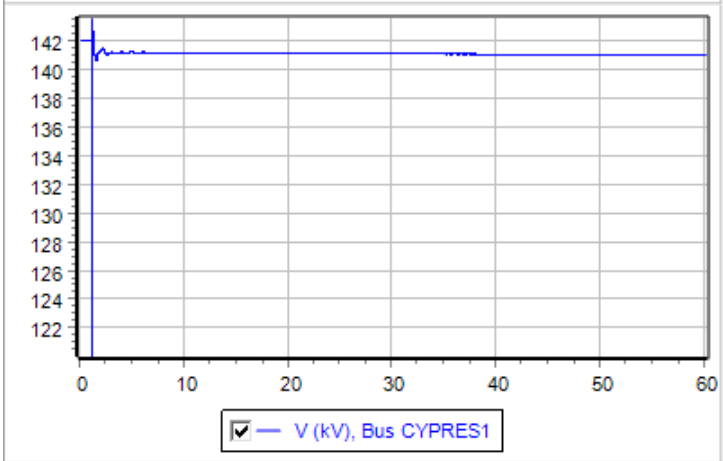
Contingency:
9L20: Nevis 766S to Cordel 755S

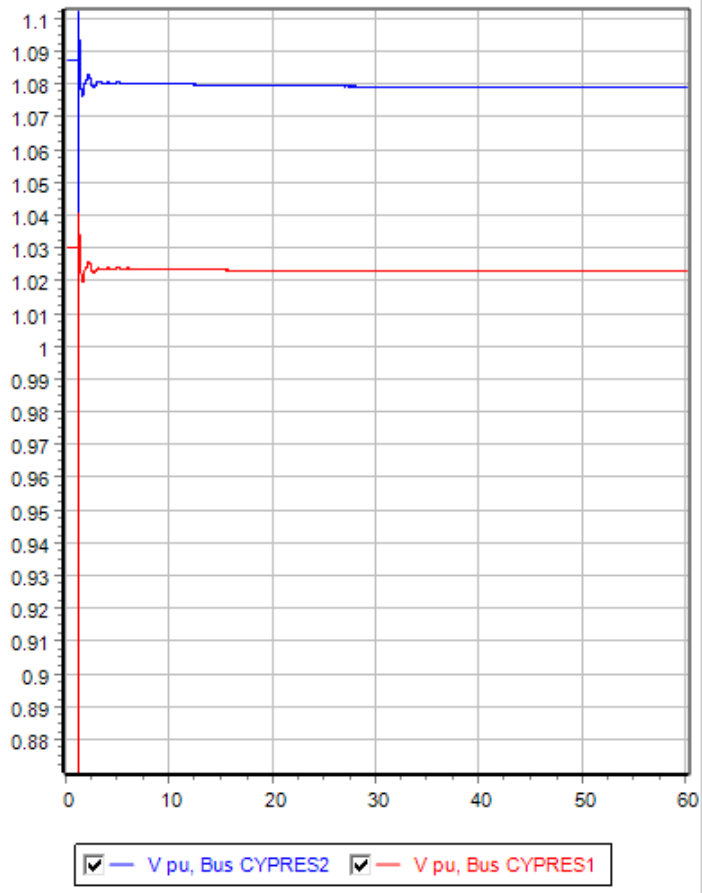
Study Case:
Scenario 4 (2022SP)

December 04, 2020 15:52:00

Cypress 562S Voltages





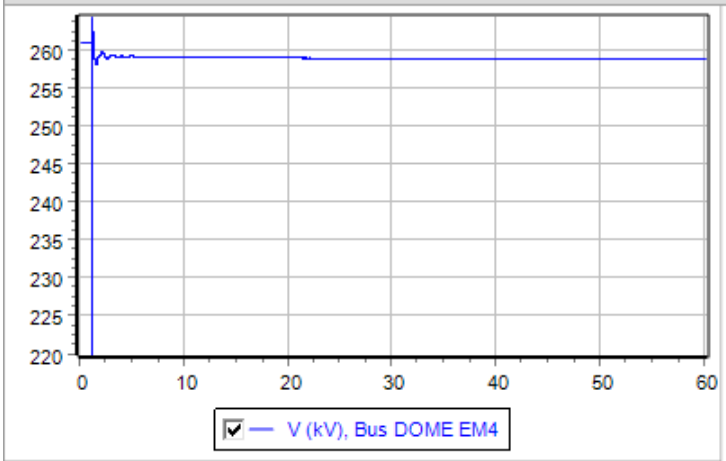


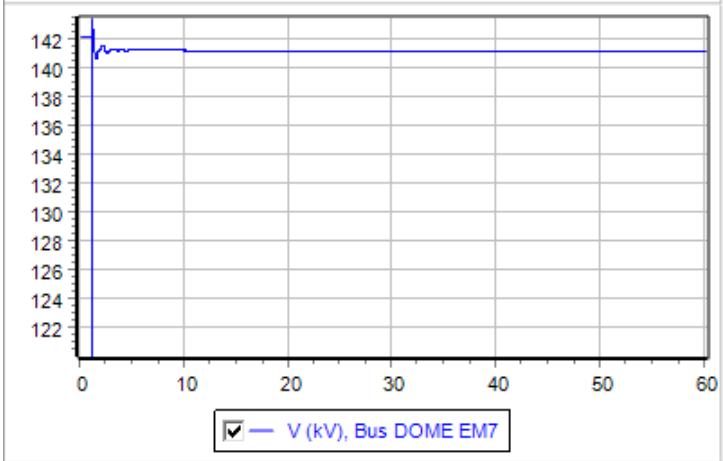
Contingency:
9L20: Nevis 766S to Cordel 755S

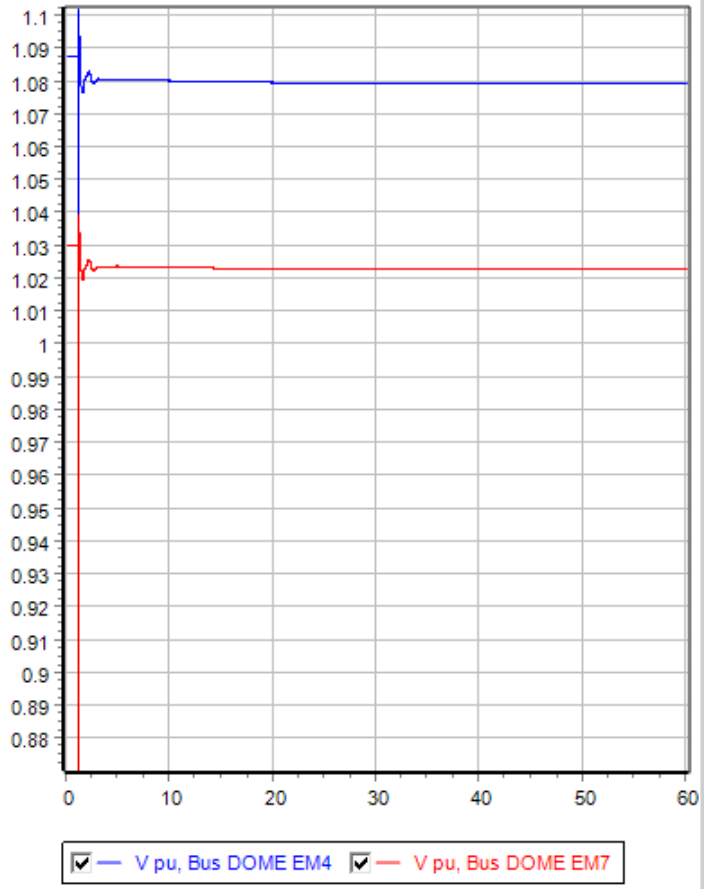
Study Case:
Scenario 4 (2022SP)

December 04, 2020 15:52:00

Dome 163S Voltages





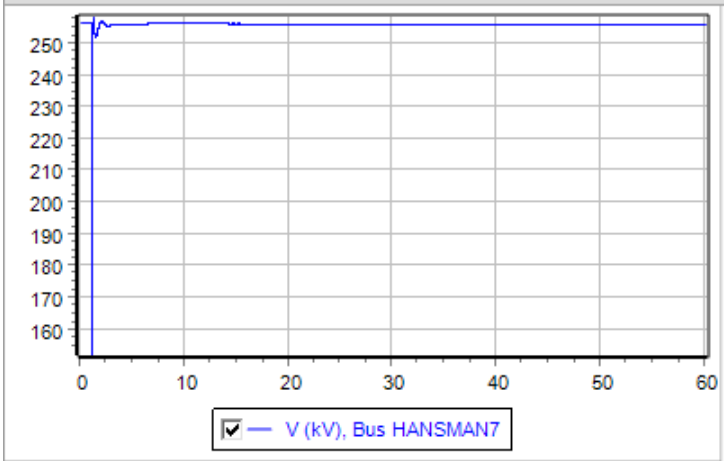


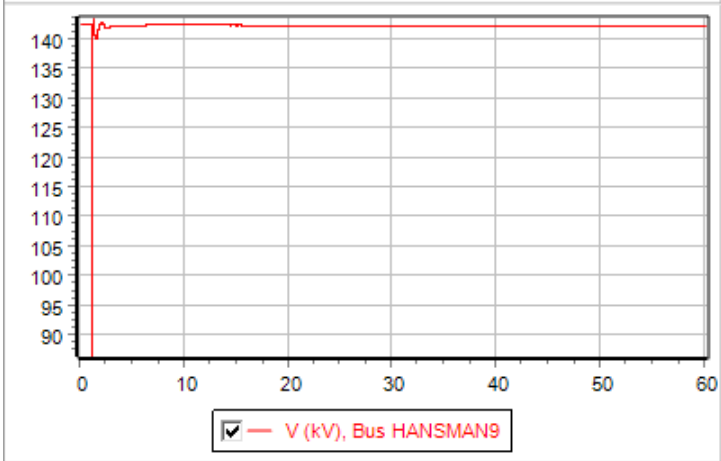
Contingency:
9L20: Nevis 766S to Cordel 755S

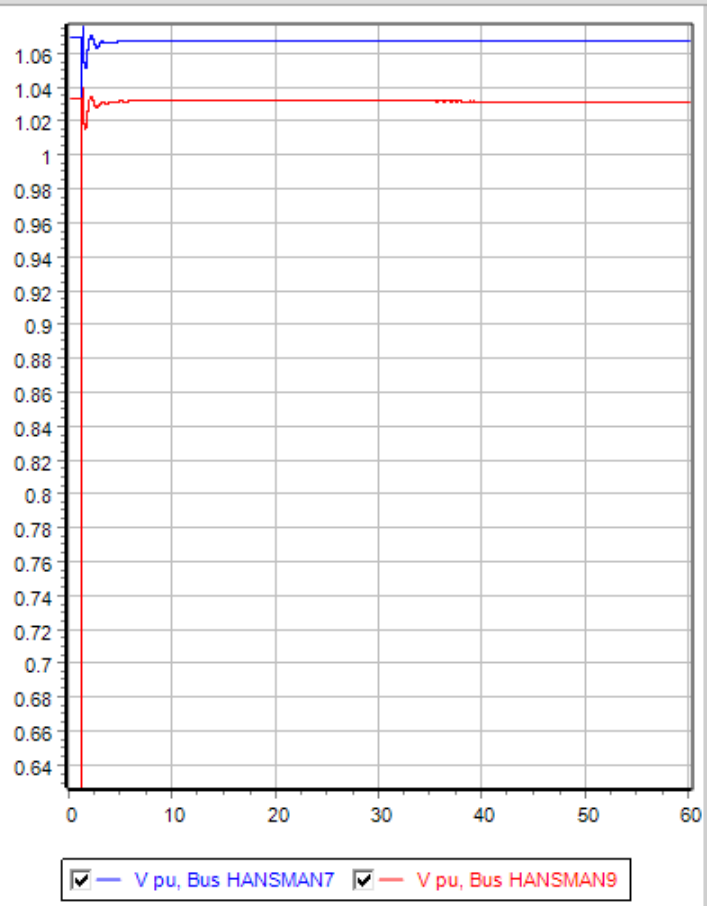
Study Case:
Scenario 4 (2022SP)

December 04, 2020 15:51:59

Hansman Lake 650S Voltages





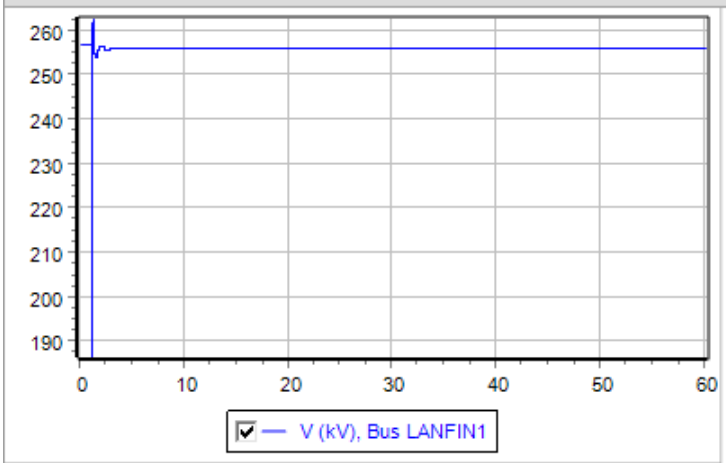


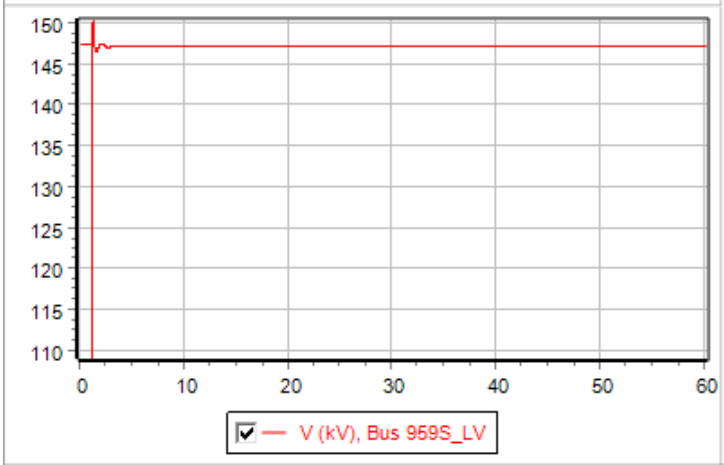
Contingency:
9L20: Nevis 766S to Cordel 755S

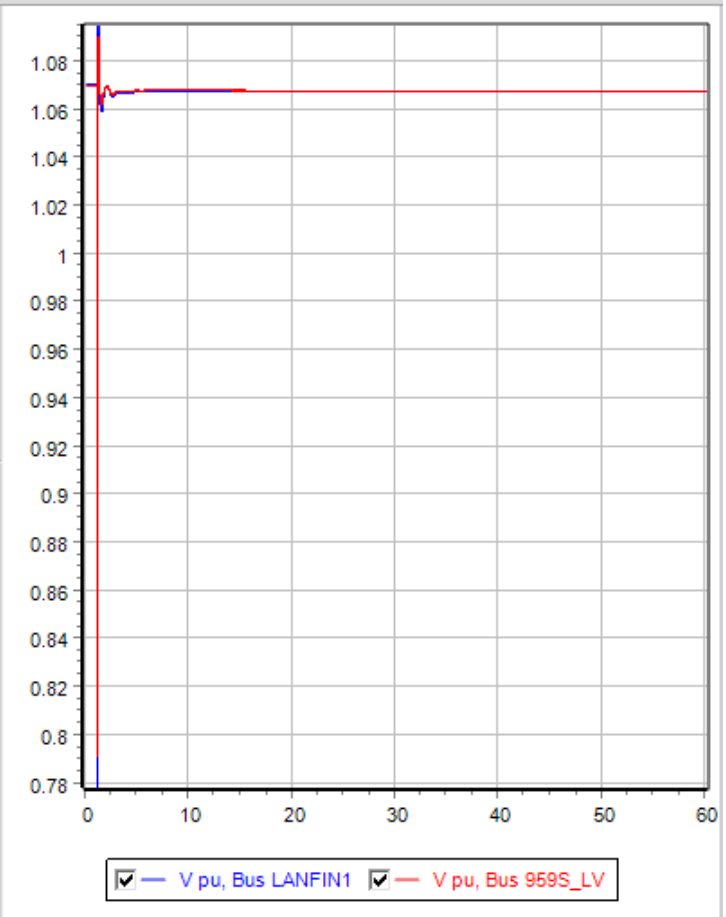
Study Case:
Scenario 4 (2022SP)

December 04, 2020 15:51:59

Lanfine 959S Voltages





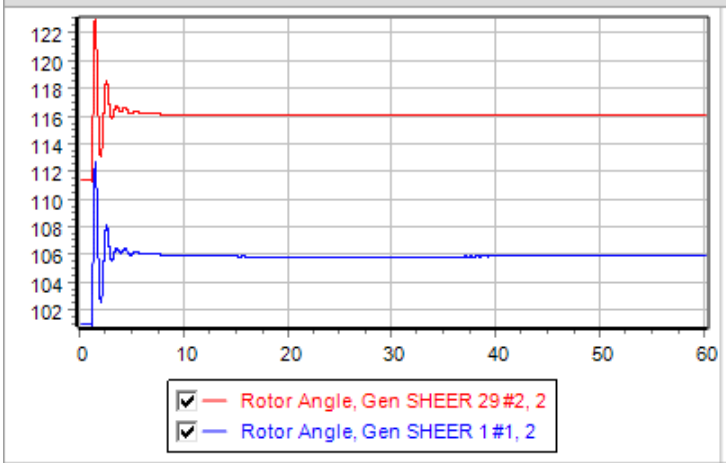


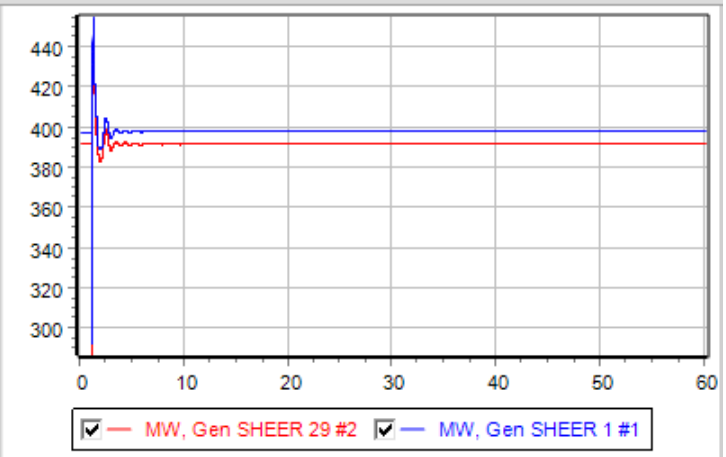
Contingency:
9L20: Nevis 766S to Cordel 755S

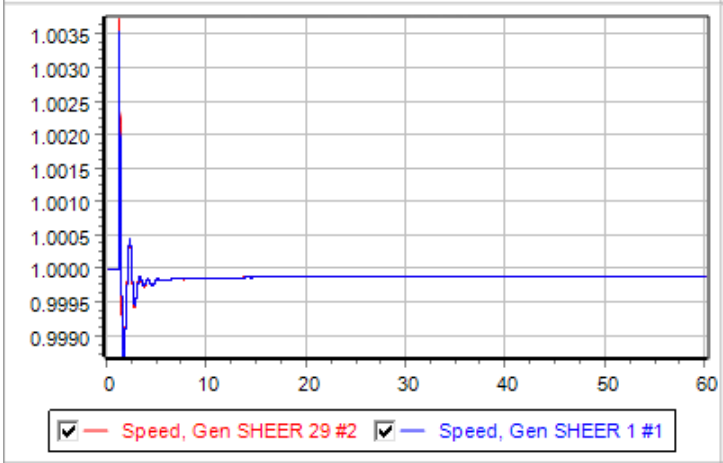
Study Case:
Scenario 4 (2022SP)

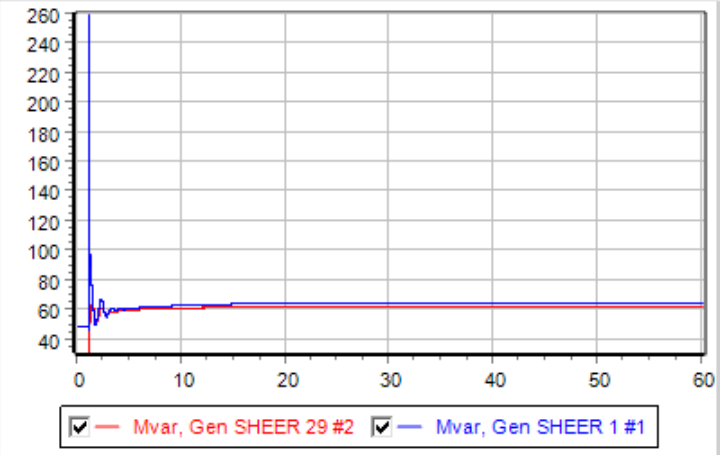
December 04, 2020 15:51:58

Sheerness







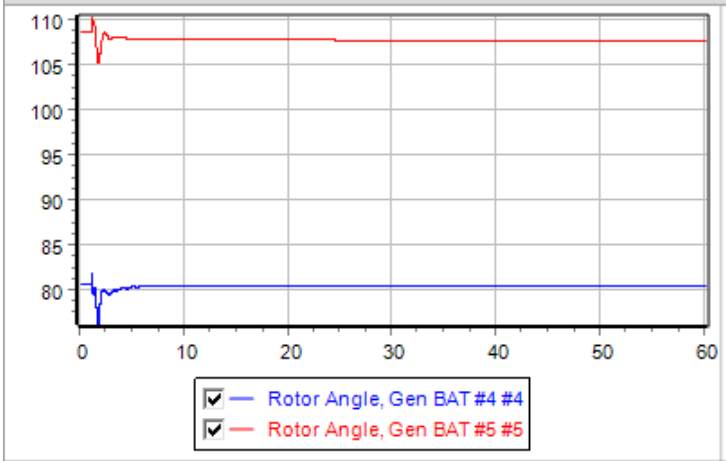


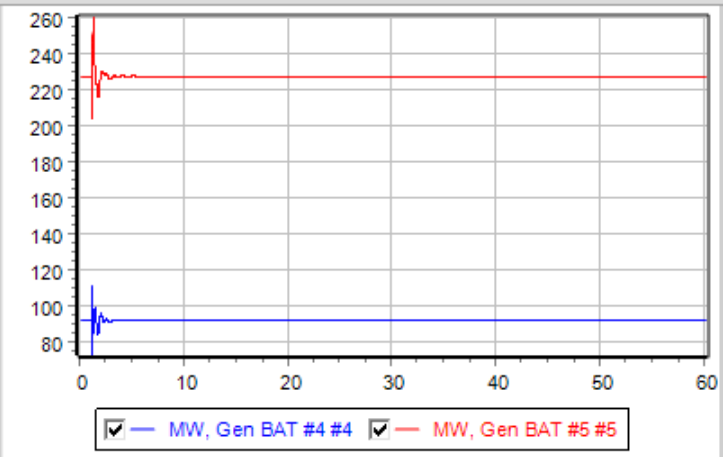
Contingency:
9L20: Nevis 766S to Cordel 755S

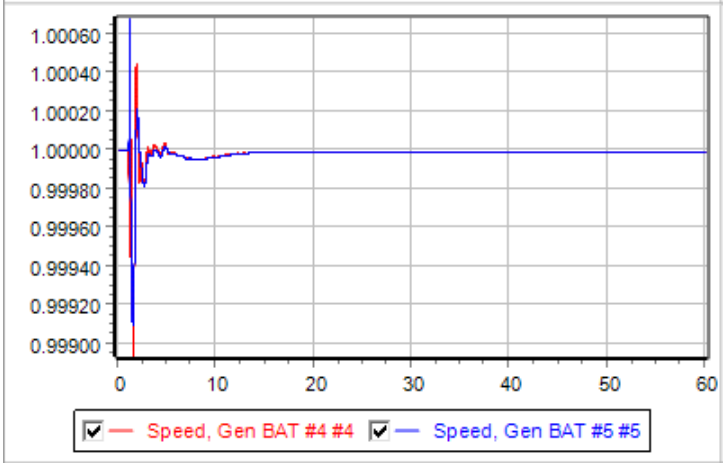
Study Case:
Scenario 4 (2022SP)

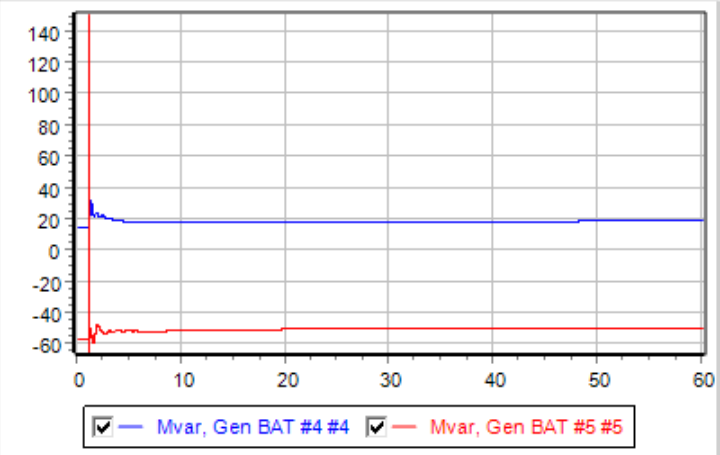
December 04, 2020 15:51:57

Battle River







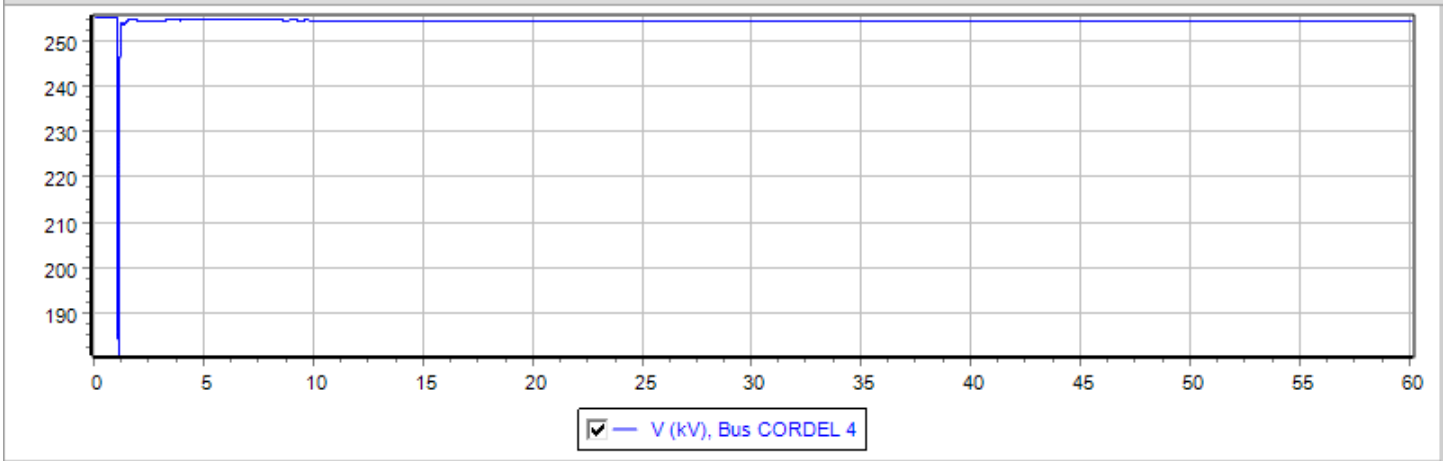


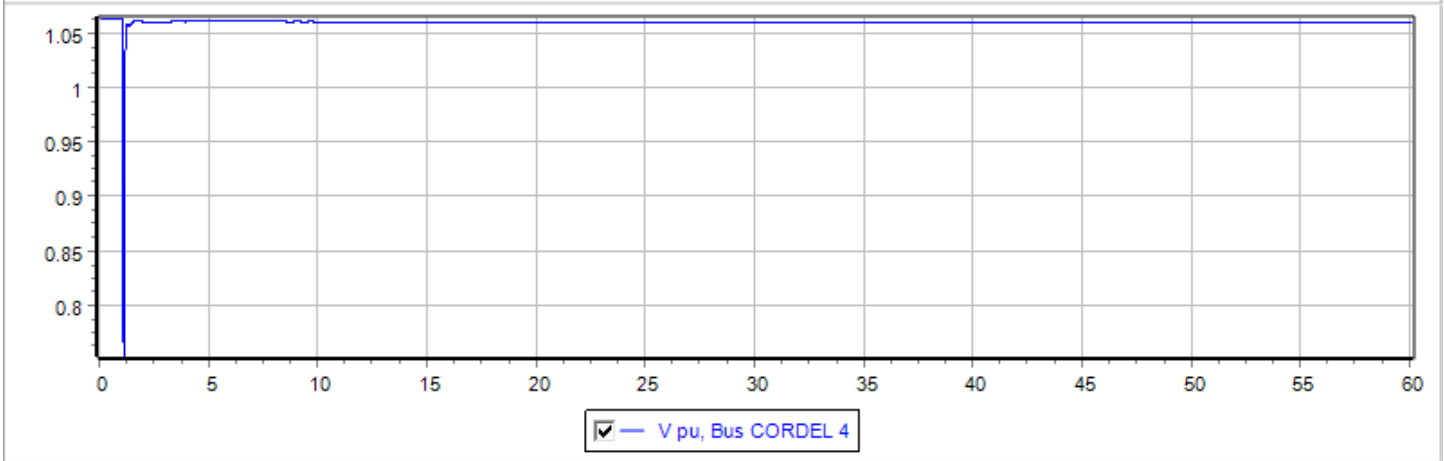
Contingency:
9L24: Lanfine 959S to Oakland 946S

Study Case:
Scenario 4 (2022SP)

December 04, 2020 15:55:29

Cordel 755S Voltages



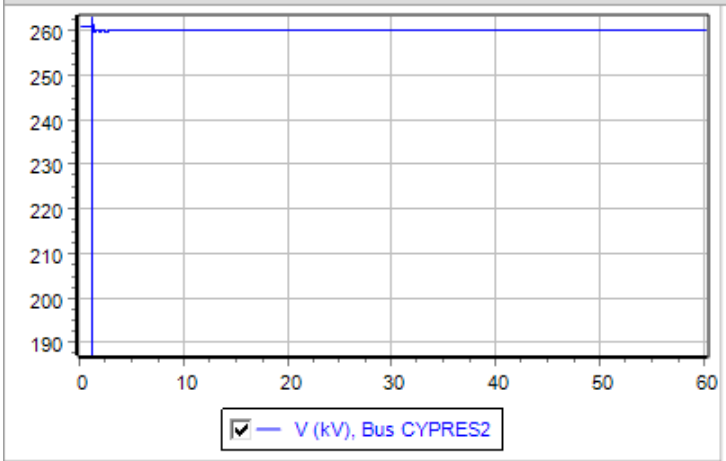


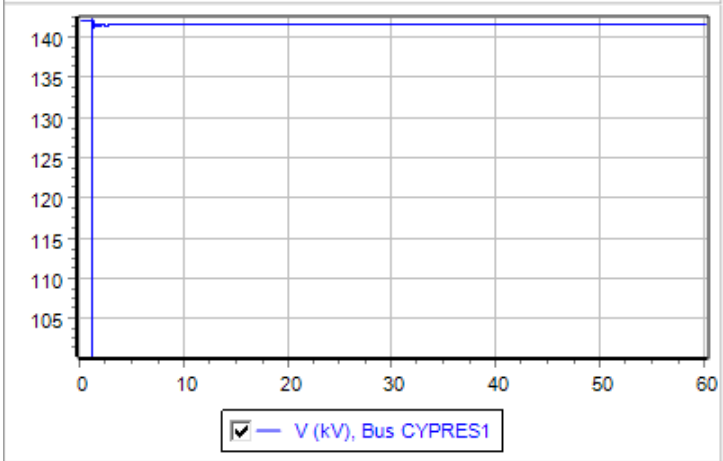
Contingency:
9L24: Lanfine 959S to Oakland 946S

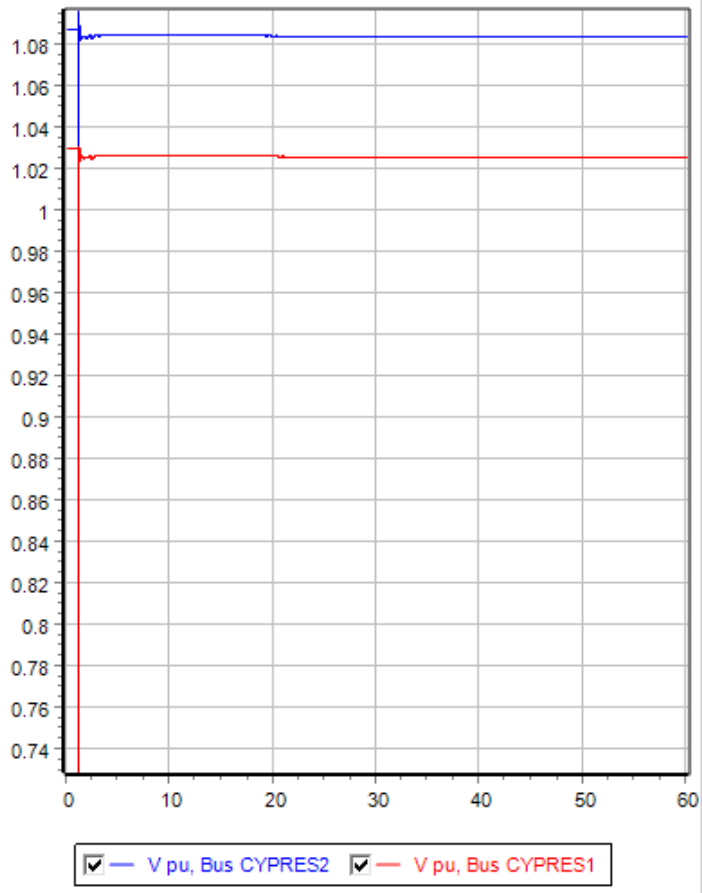
Study Case:
Scenario 4 (2022SP)

December 04, 2020 15:55:32

Cypress 562S Voltages





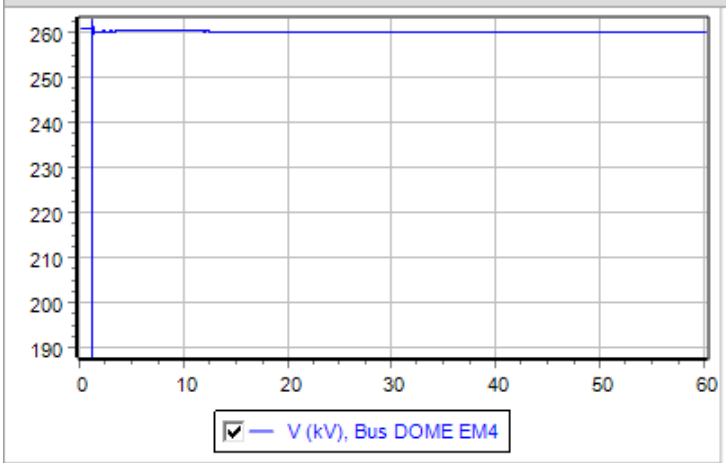


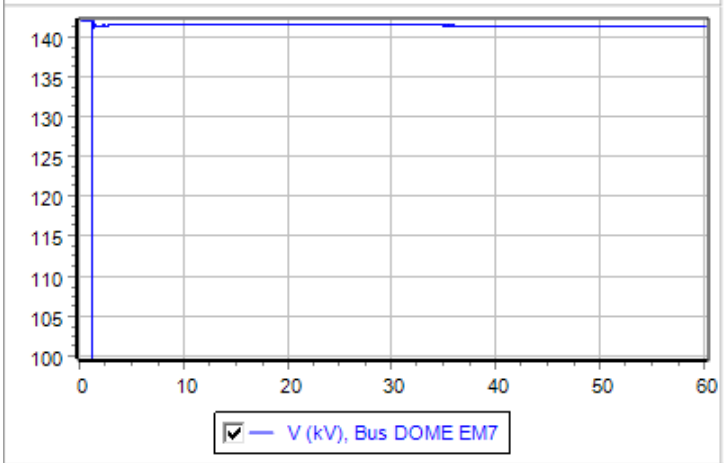
Contingency:
9L24: Lanfine 959S to Oakland 946S

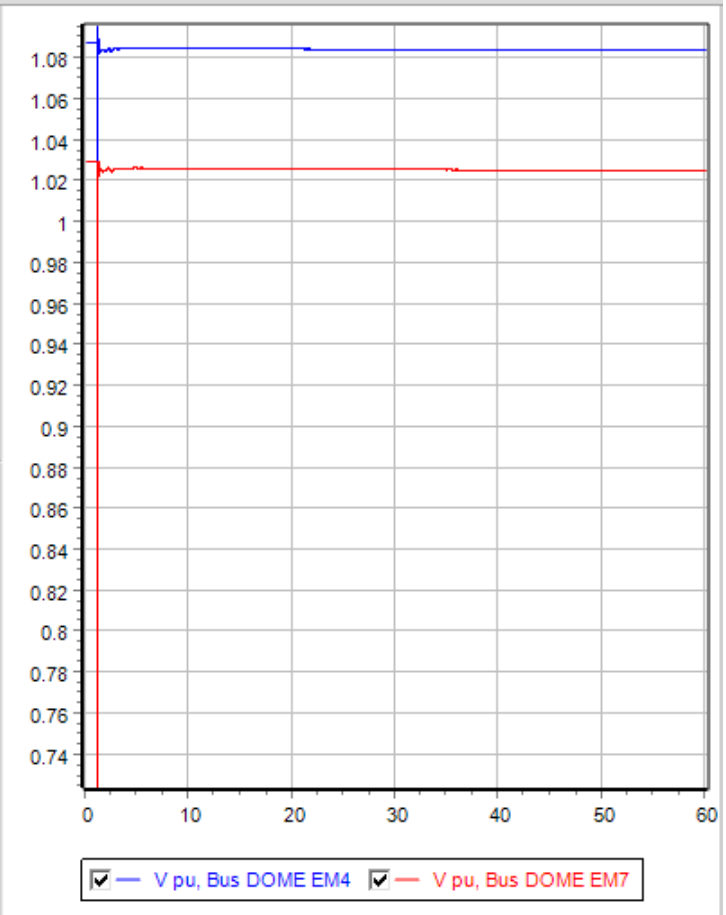
Study Case:
Scenario 4 (2022SP)

December 04, 2020 15:55:31

Dome 163S Voltages





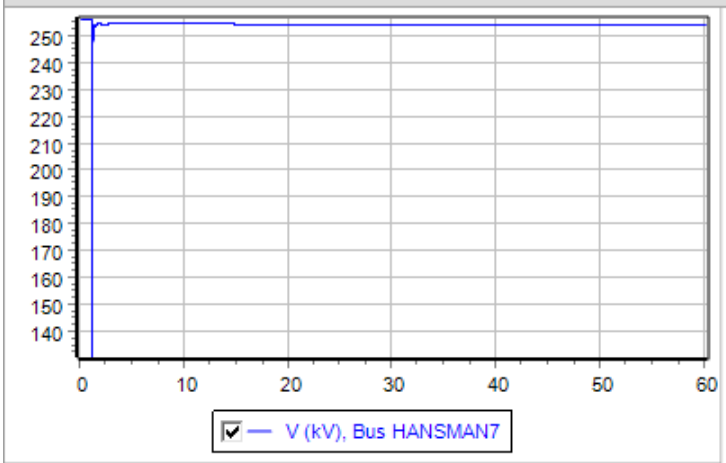


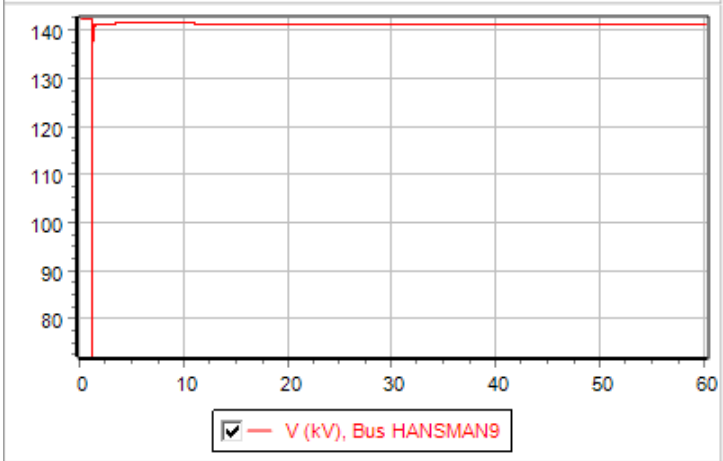
Contingency:
9L24: Lanfine 959S to Oakland 946S

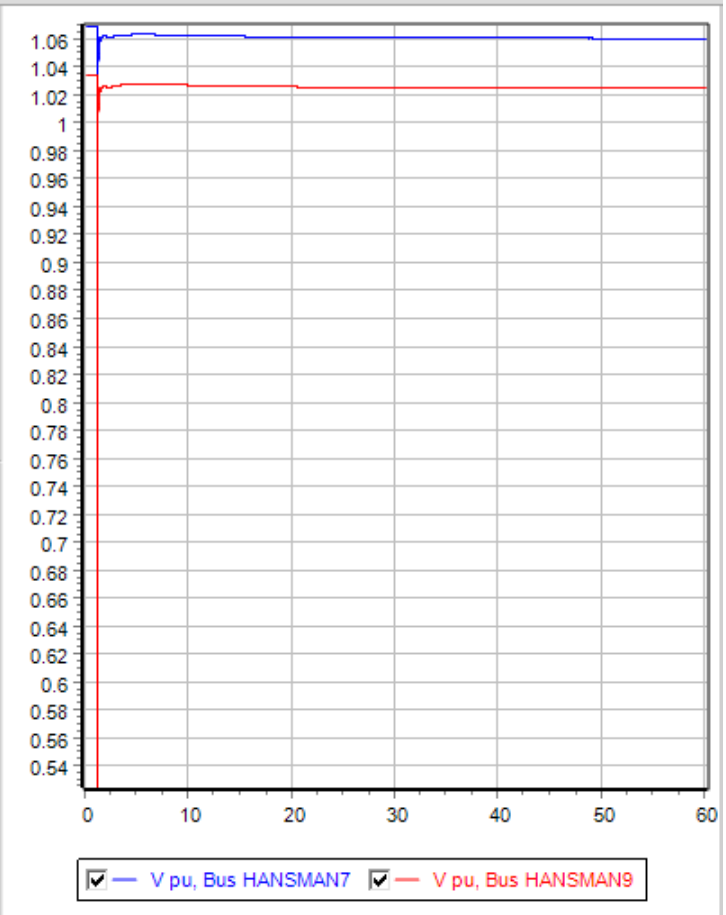
Study Case:
Scenario 4 (2022SP)

December 04, 2020 15:55:31

Hansman Lake 650S Voltages





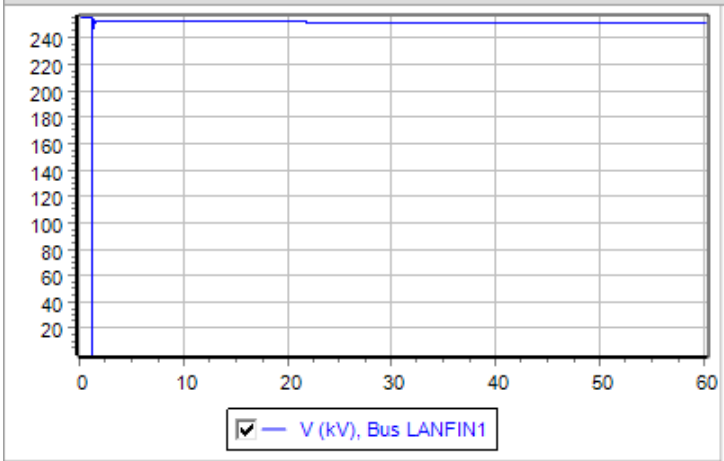


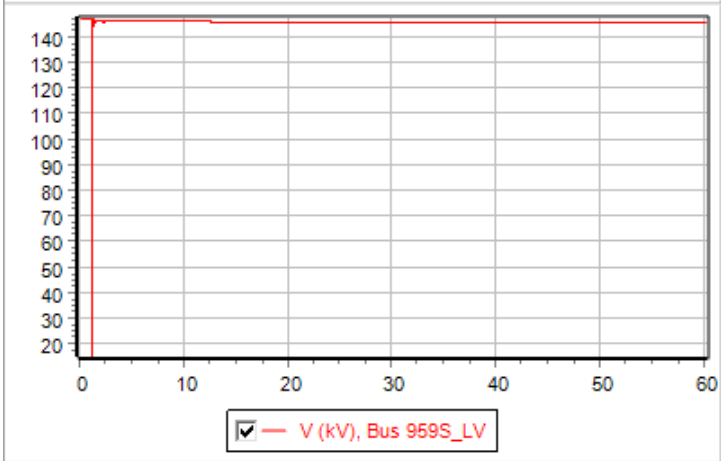
Contingency:
9L24: Lanfine 959S to Oakland 946S

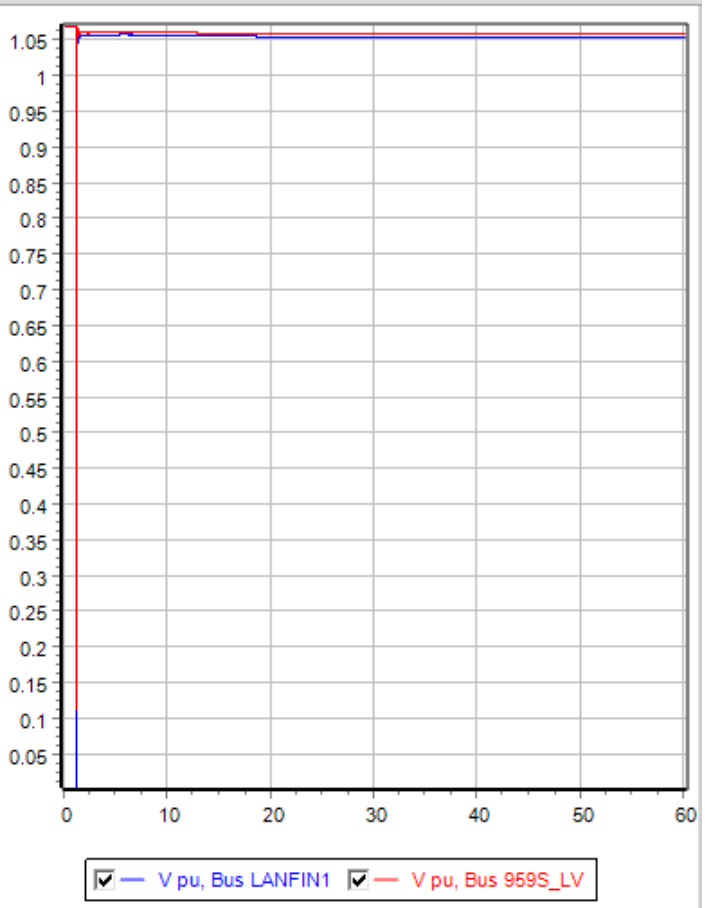
Study Case:
Scenario 4 (2022SP)

December 04, 2020 15:55:30

Lanfine 959S Voltages





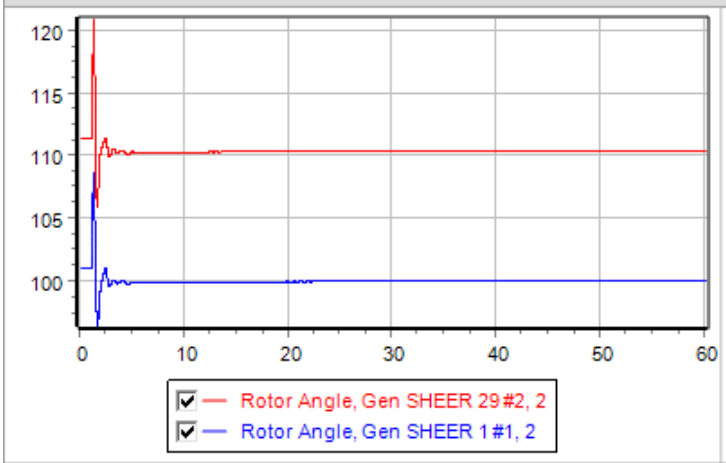


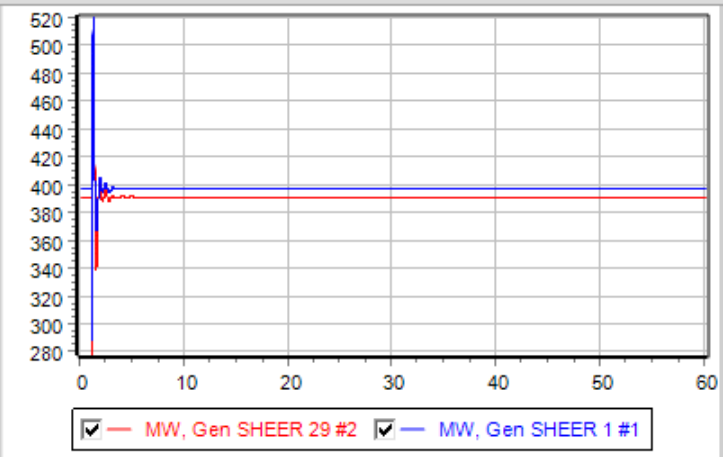
Contingency:
9L24: Lanfine 959S to Oakland 946S

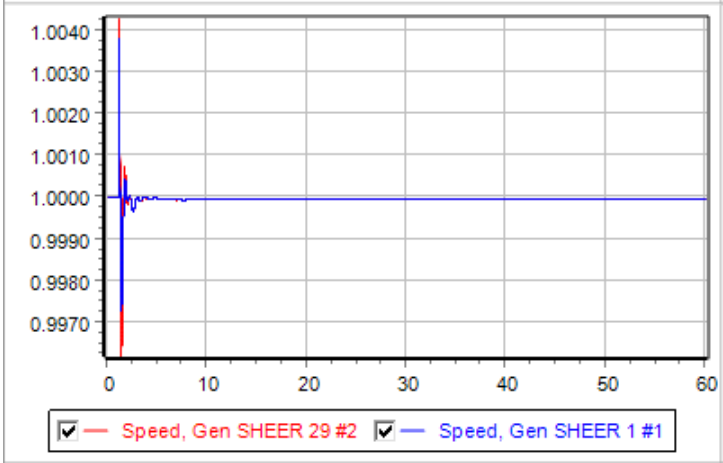
Study Case:
Scenario 4 (2022SP)

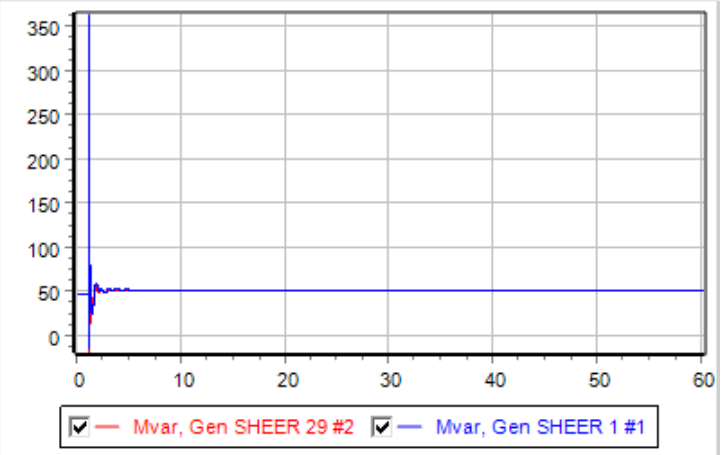
December 04, 2020 15:55:29

Sheerness







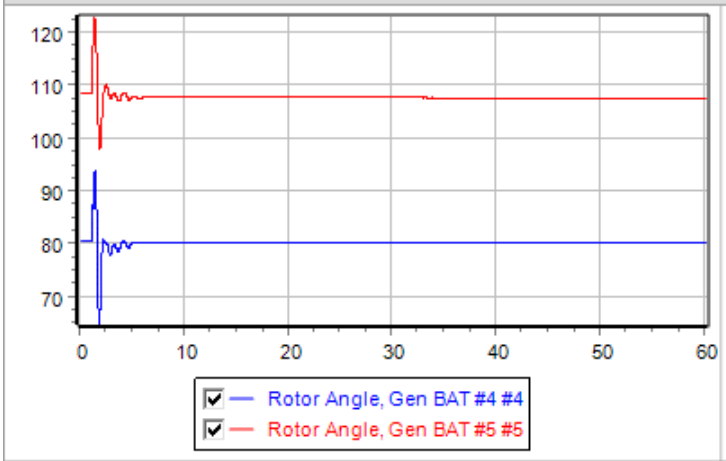


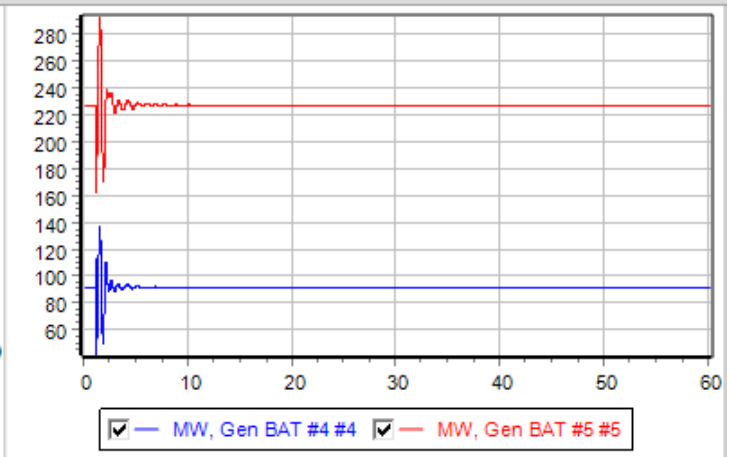
Contingency:
9L24: Lanfine 959S to Oakland 946S

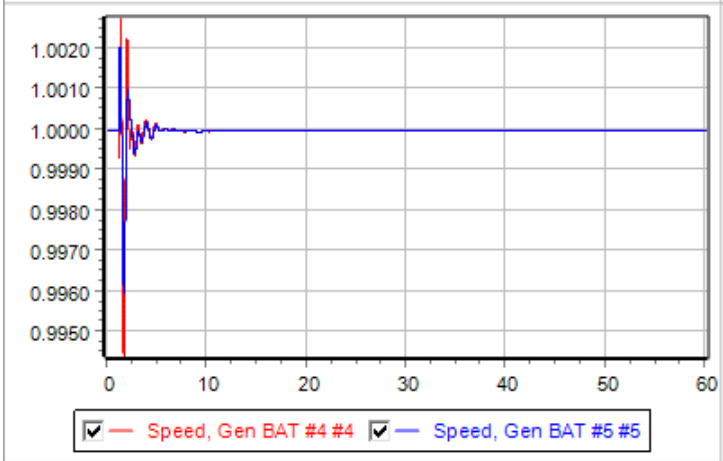
Study Case:
Scenario 4 (2022SP)

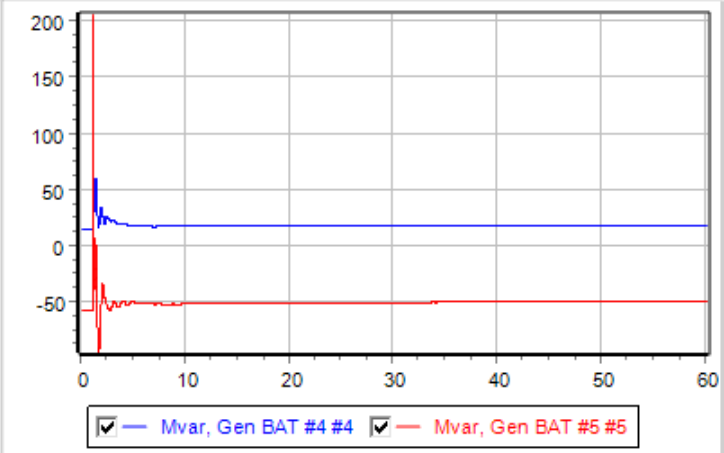
December 04, 2020 15:55:28

Battle River







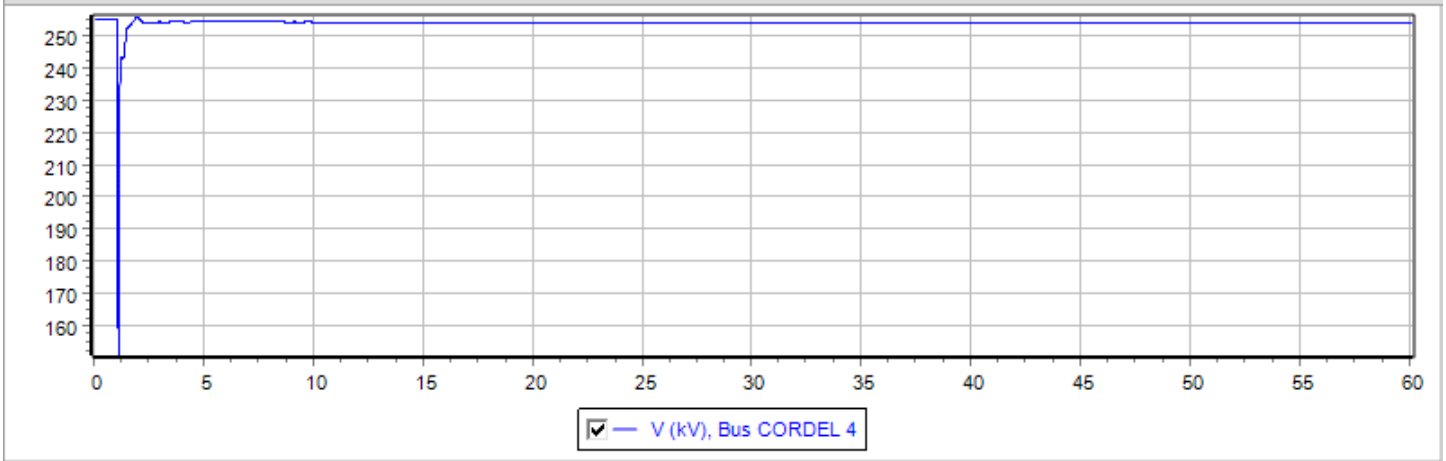


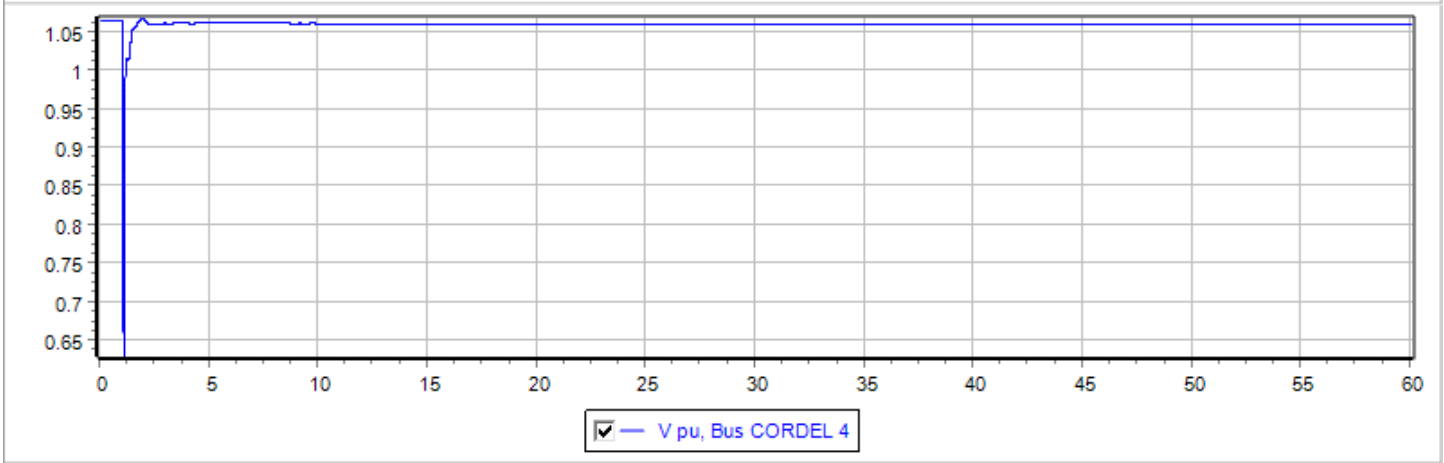
Contingency:
9L24: Oakland 946S to Lanfine 959S

Study Case:
Scenario 4 (2022SP)

December 04, 2020 15:59:15

Cordel 755S Voltages



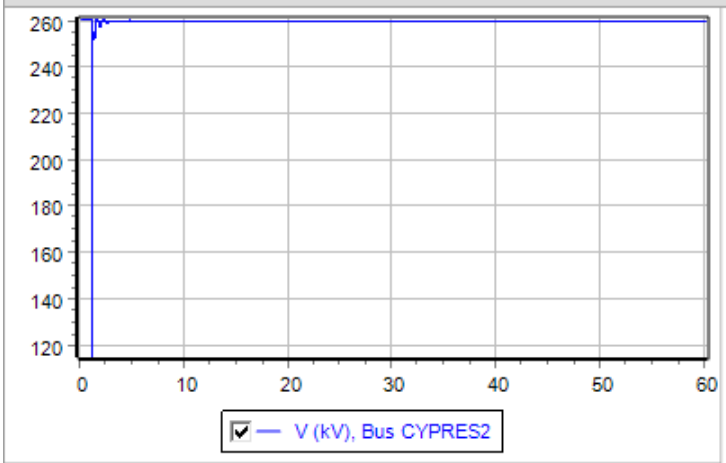


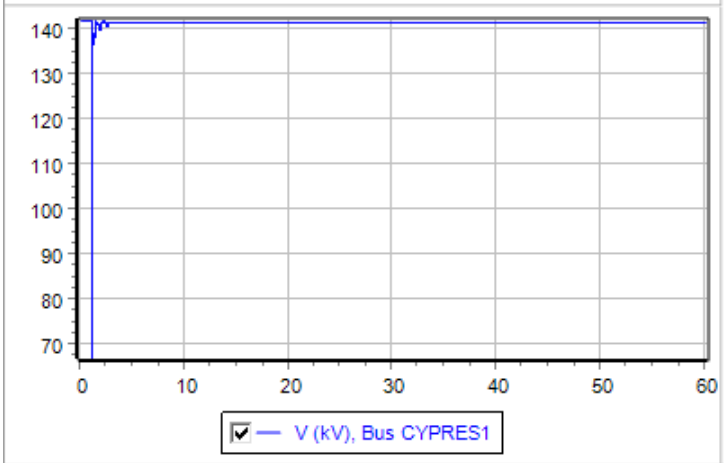
Contingency:
9L24: Oakland 946S to Lanfine 959S

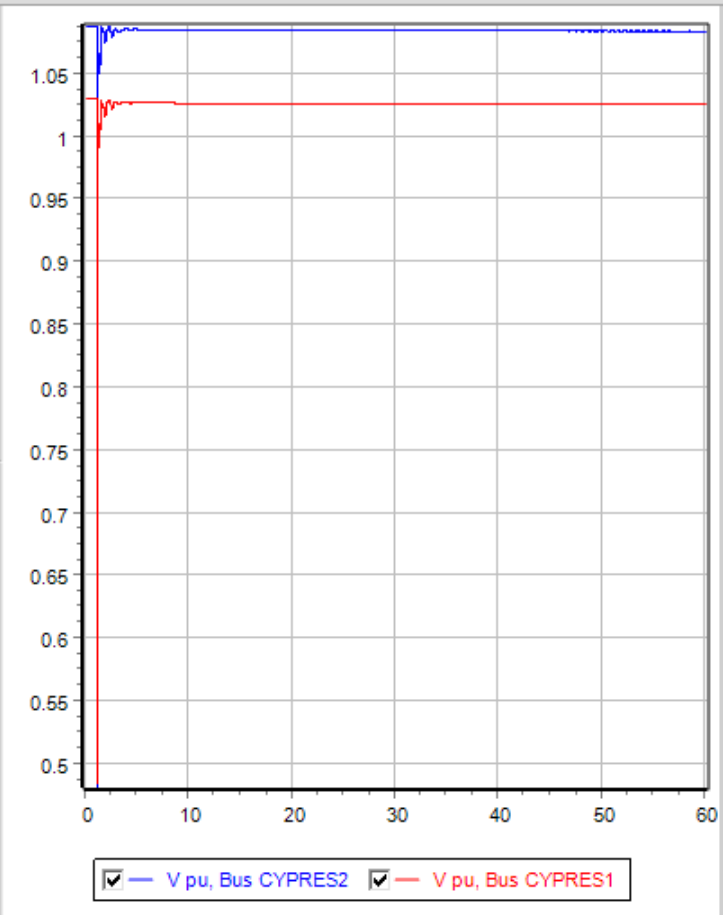
Study Case:
Scenario 4 (2022SP)

December 04, 2020 15:59:18

Cypress 562S Voltages





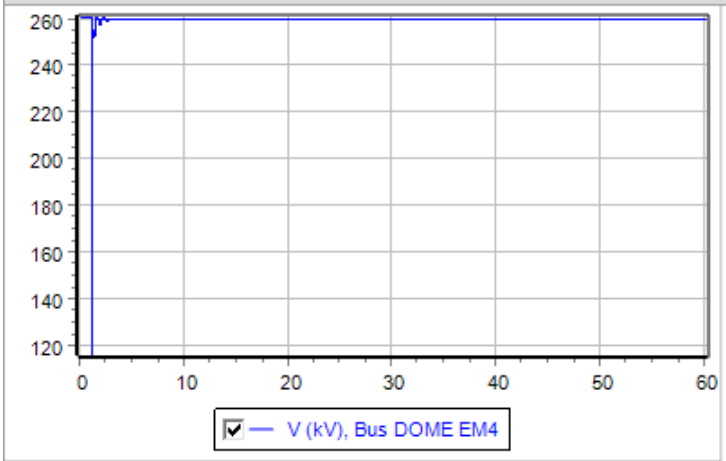


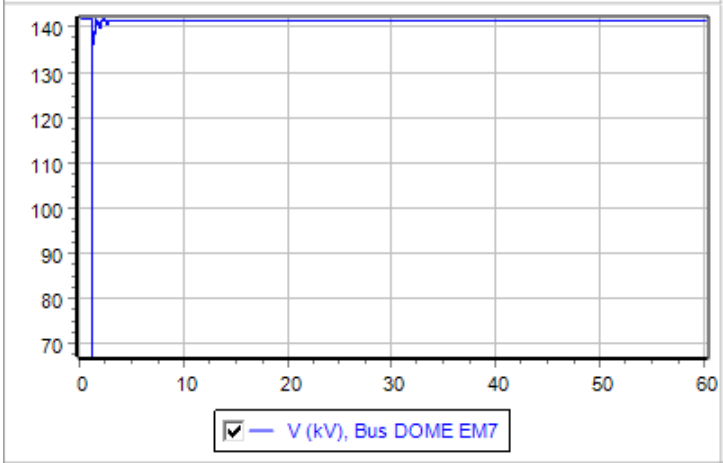
Contingency:
9L24: Oakland 946S to Lanfine 959S

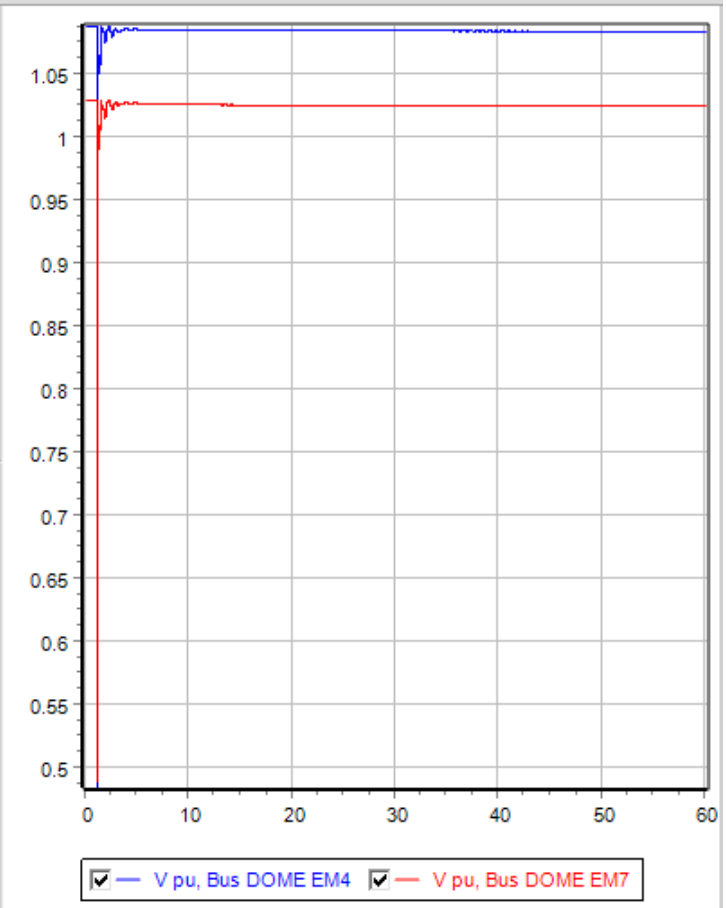
Study Case:
Scenario 4 (2022SP)

December 04, 2020 15:59:18

Dome 163S Voltages





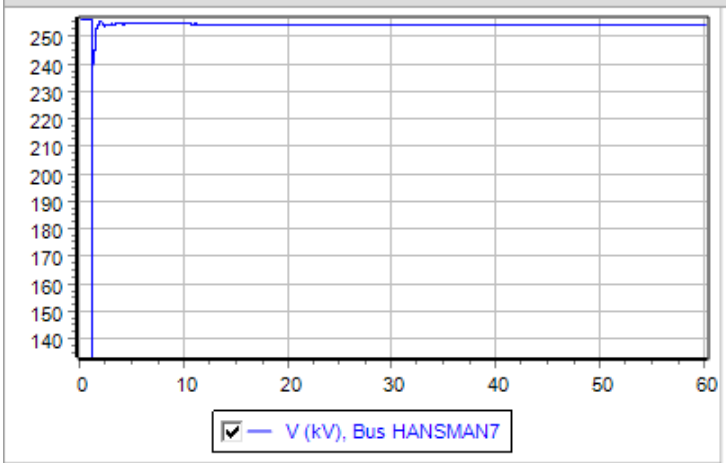


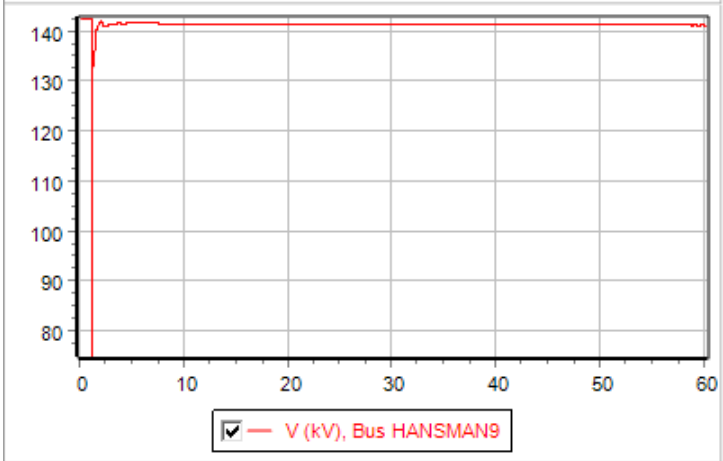
Contingency:
9L24: Oakland 946S to Lanfine 959S

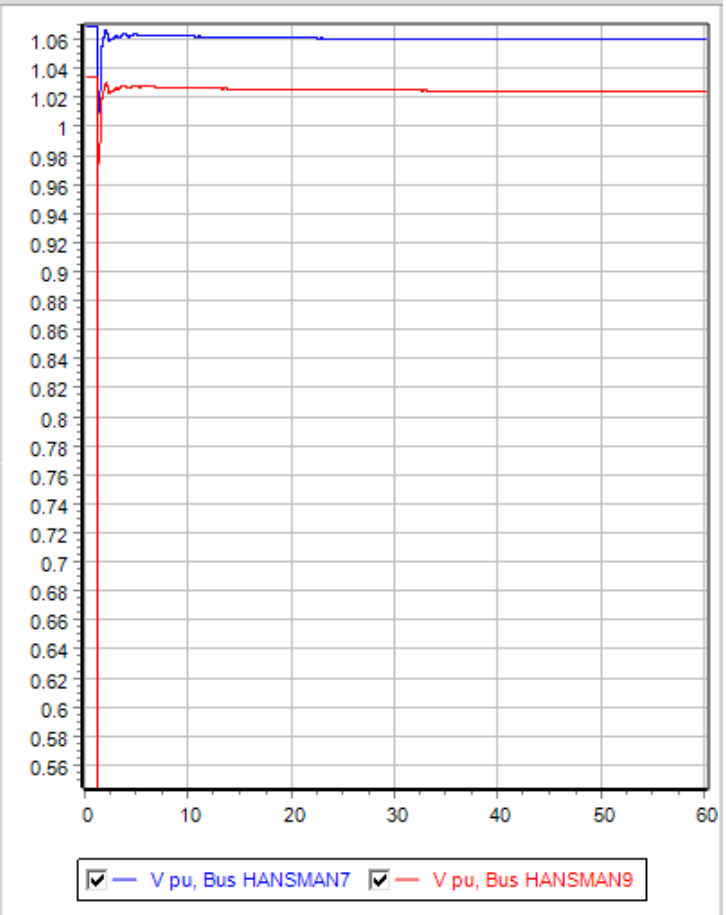
Study Case:
Scenario 4 (2022SP)

December 04, 2020 15:59:17

Hansman Lake 650S Voltages





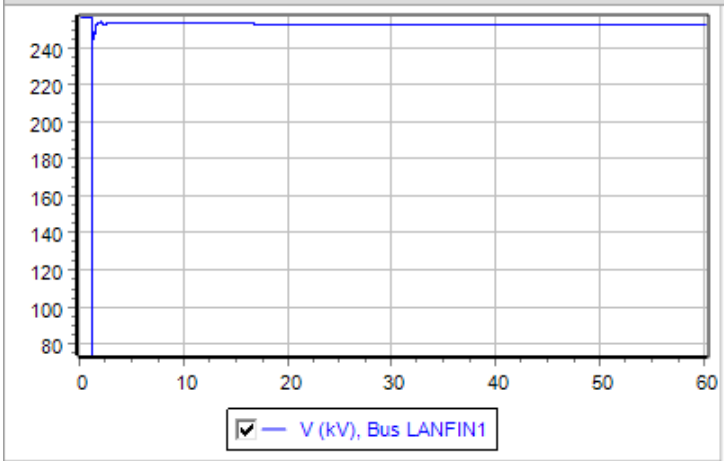


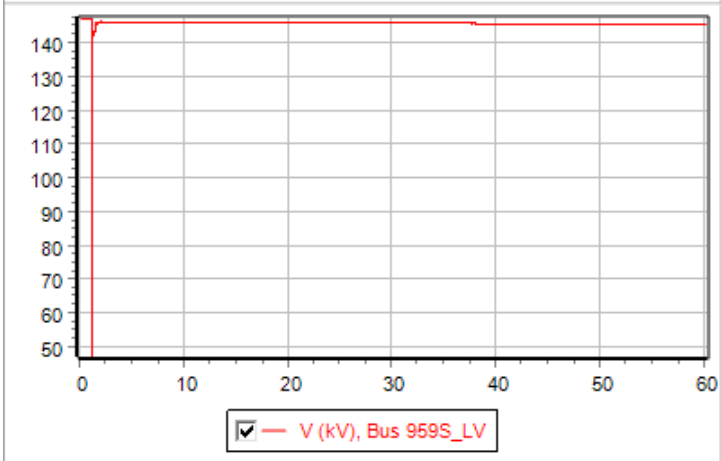
Contingency:
9L24: Oakland 946S to Lanfine 959S

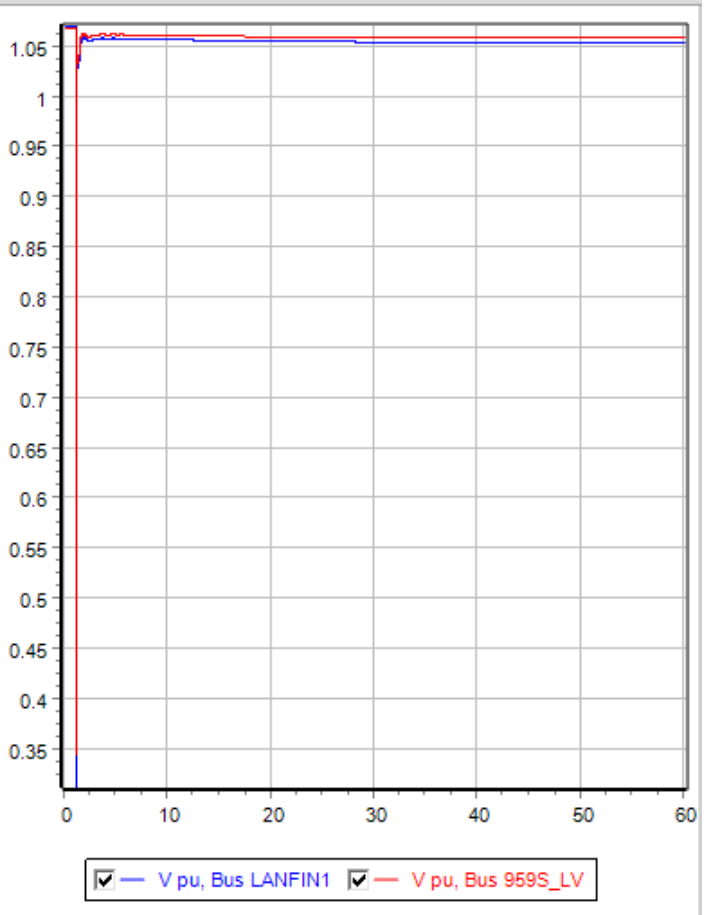
Study Case:
Scenario 4 (2022SP)

December 04, 2020 15:59:17

Lanfine 959S Voltages





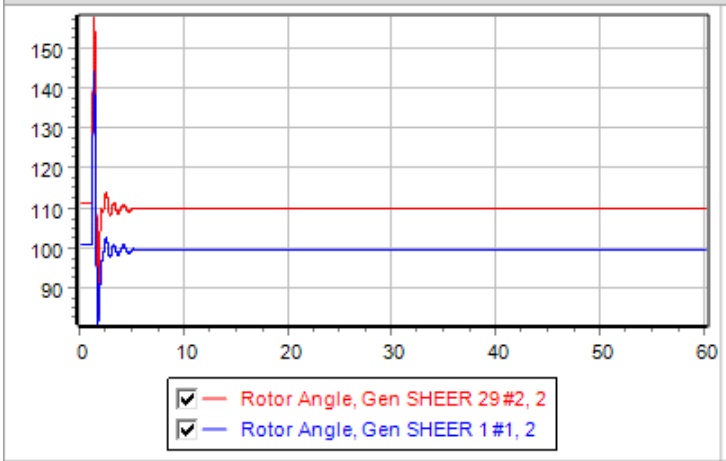


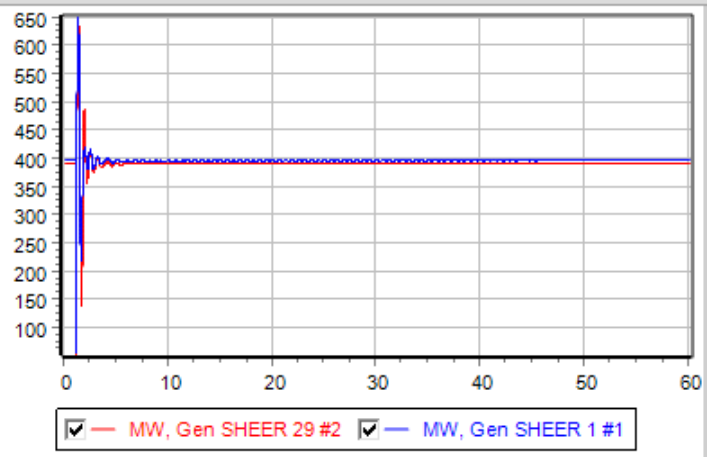
Contingency:
9L24: Oakland 946S to Lanfine 959S

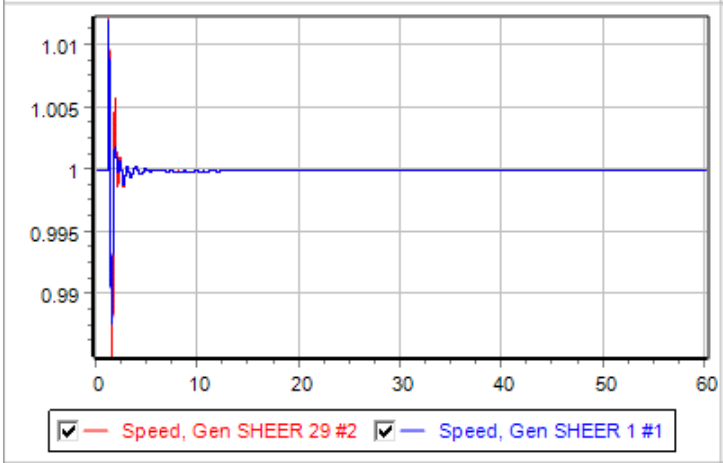
Study Case:
Scenario 4 (2022SP)

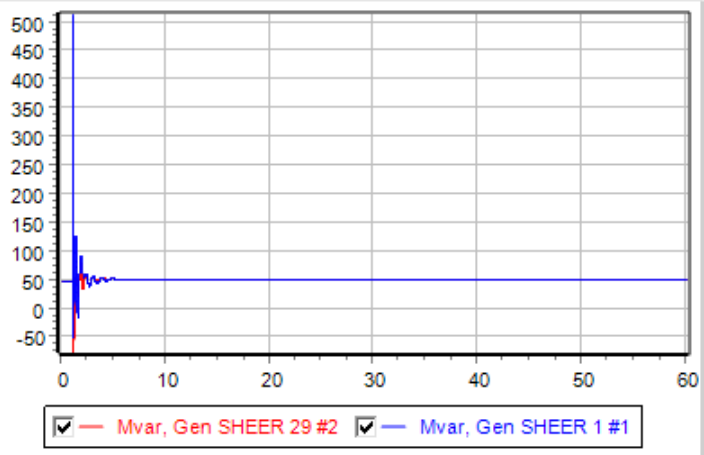
December 04, 2020 15:59:16

Sheerness







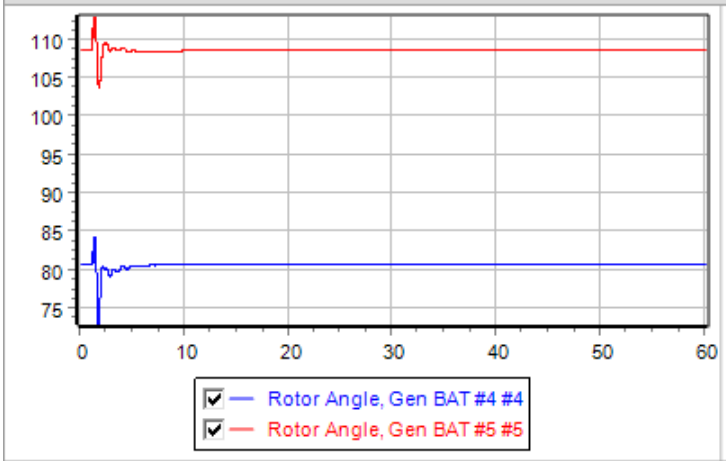


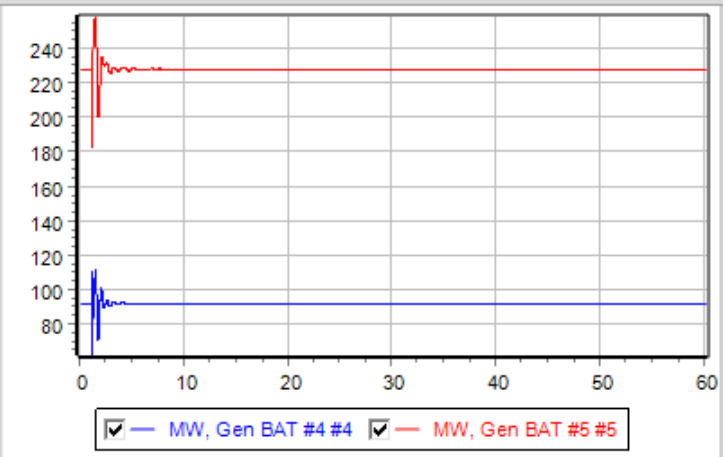
Contingency:
9L24: Oakland 946S to Lanfine 959S

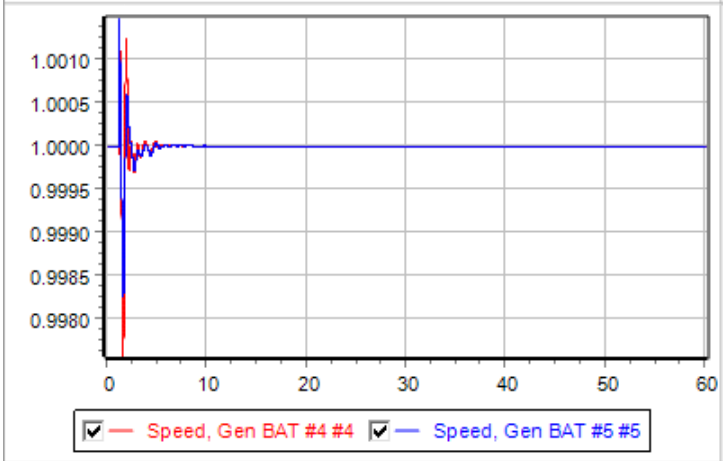
Study Case:
Scenario 4 (2022SP)

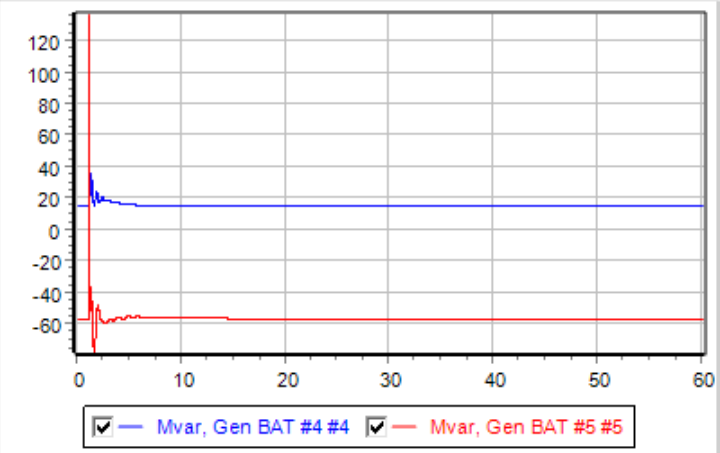
December 04, 2020 15:59:15

Battle River







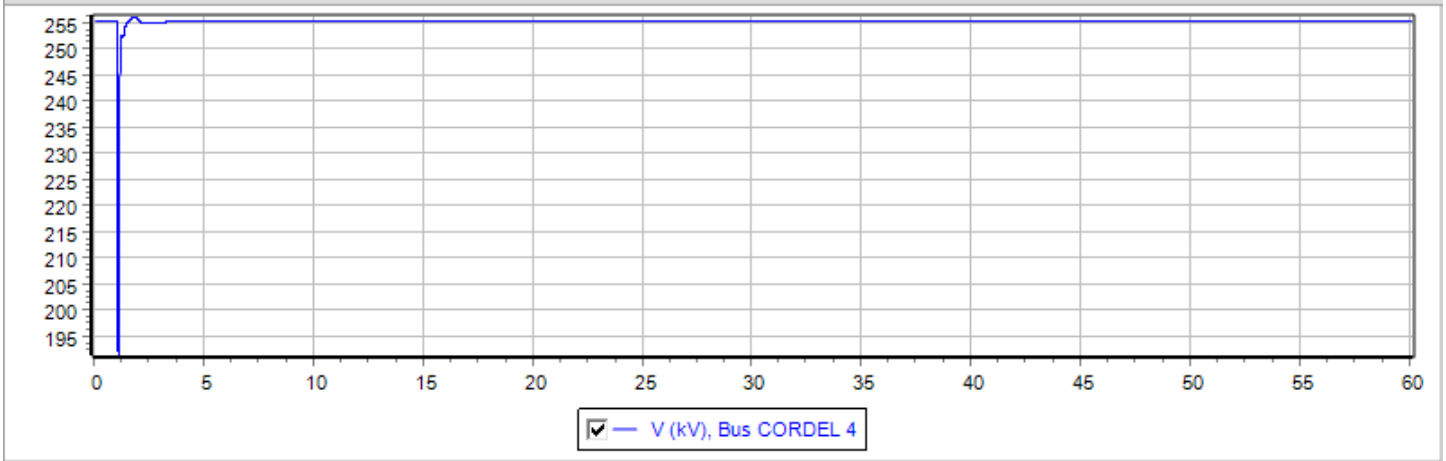


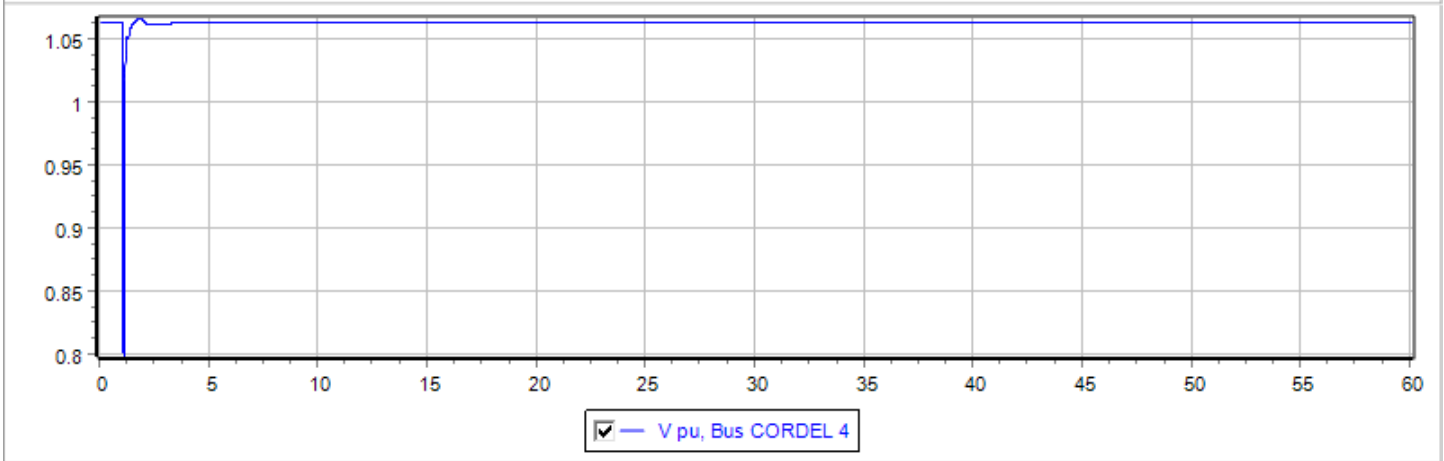
Contingency:
9L29: Coyote Lake 963S to Oakland 946S

Study Case:
Scenario 4 (2022SP)

December 04, 2020 16:02:56

Cordel 755S Voltages



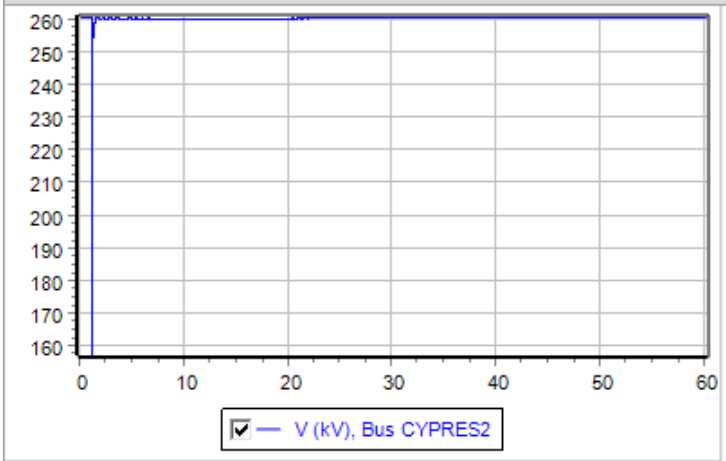


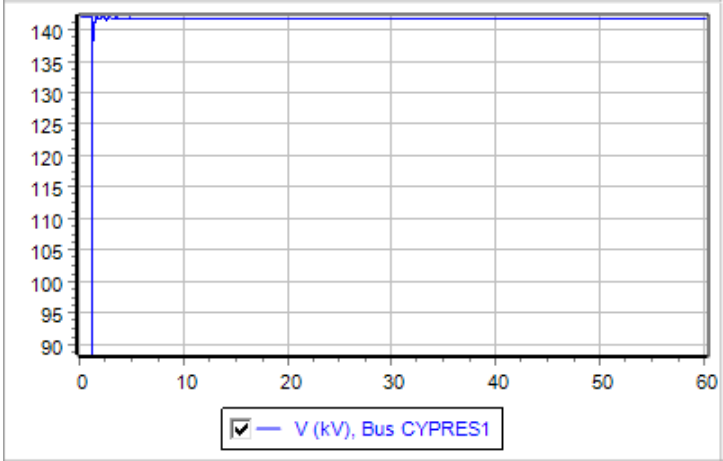
Contingency:
9L29: Coyote Lake 963S to Oakland 946S

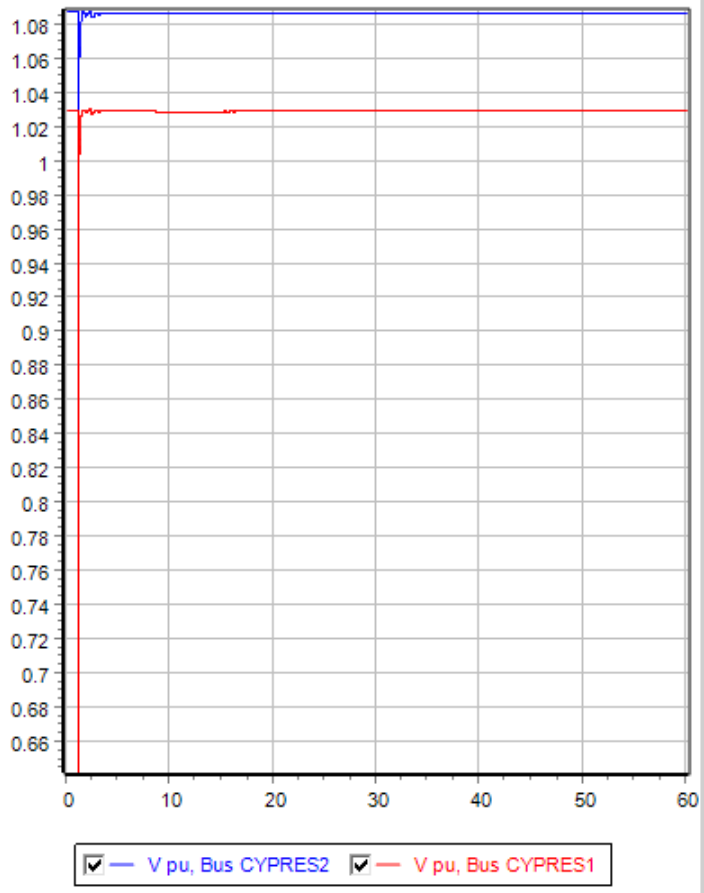
Study Case:
Scenario 4 (2022SP)

December 04, 2020 16:02:59

Cypress 562S Voltages





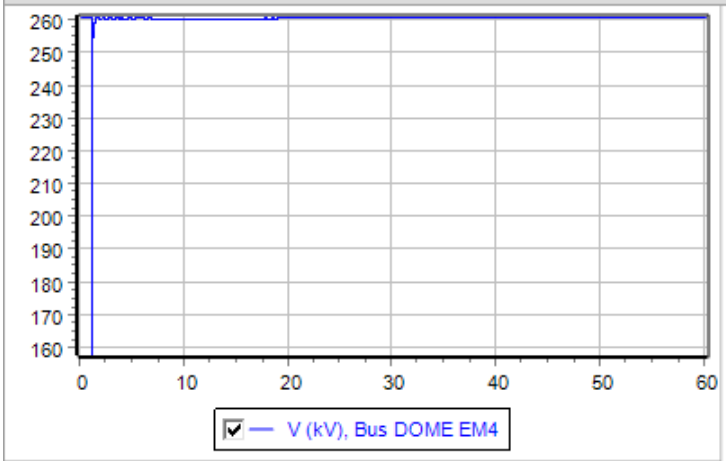


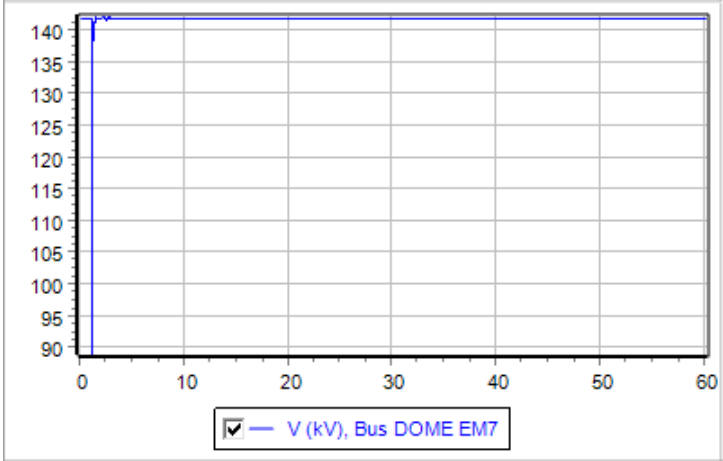
Contingency:
9L29: Coyote Lake 963S to Oakland 946S

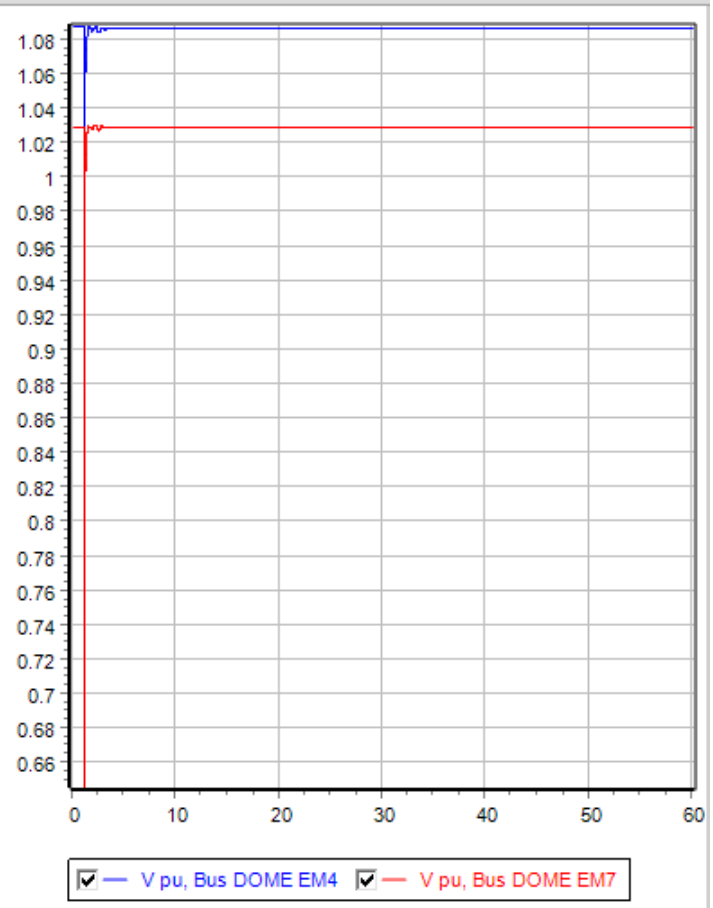
Study Case:
Scenario 4 (2022SP)

December 04, 2020 16:02:58

Dome 163S Voltages





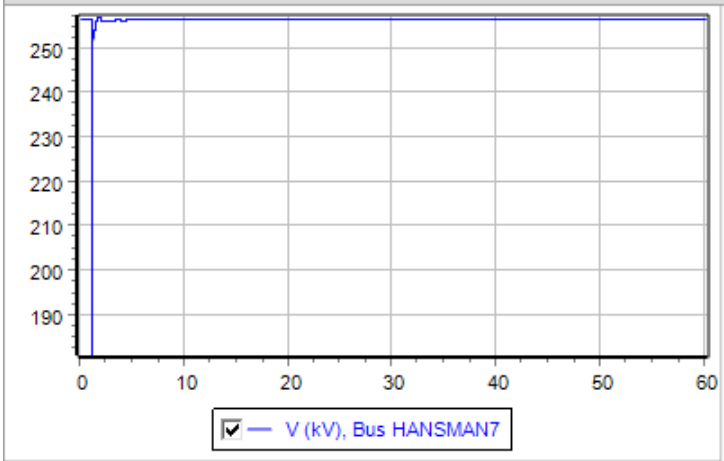


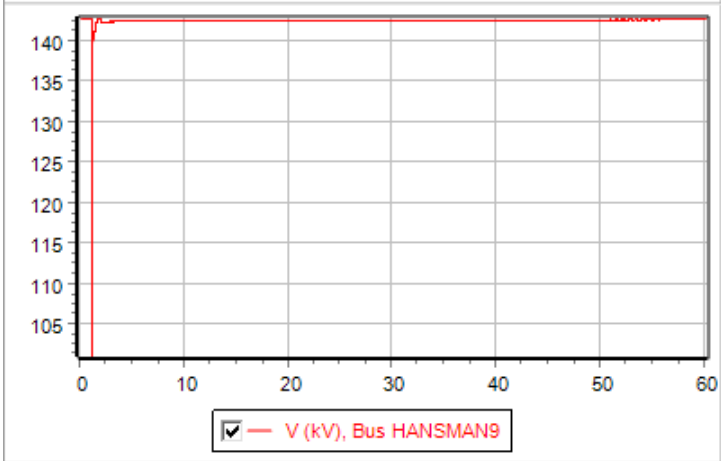
Contingency:
9L29: Coyote Lake 963S to Oakland 946S

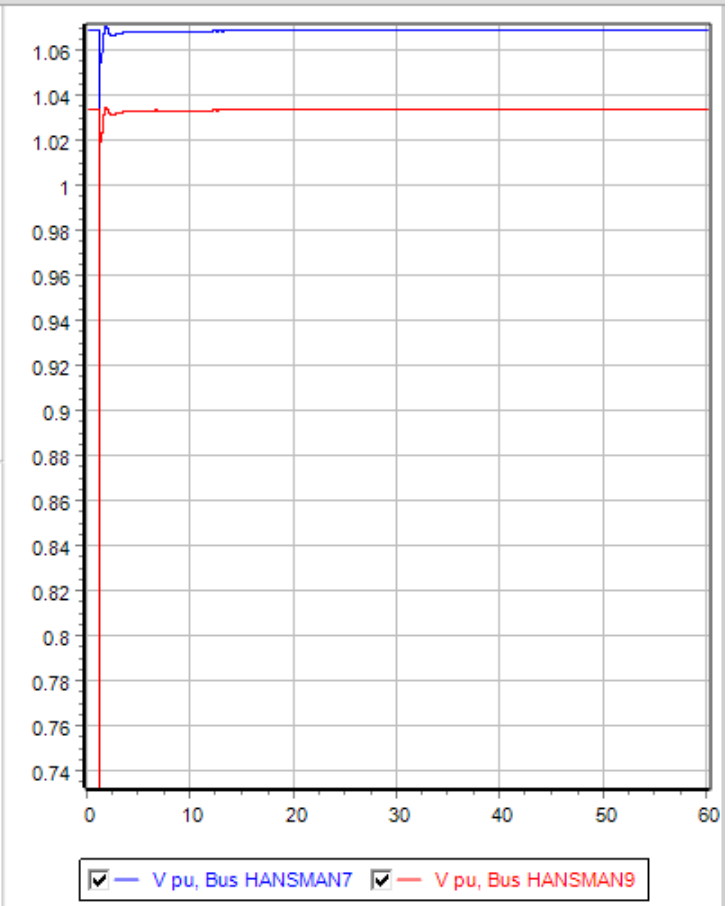
Study Case:
Scenario 4 (2022SP)

December 04, 2020 16:02:57

Hansman Lake 650S Voltages





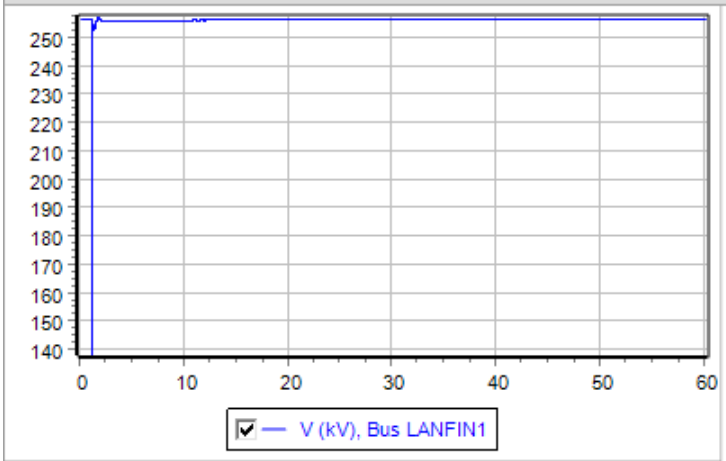


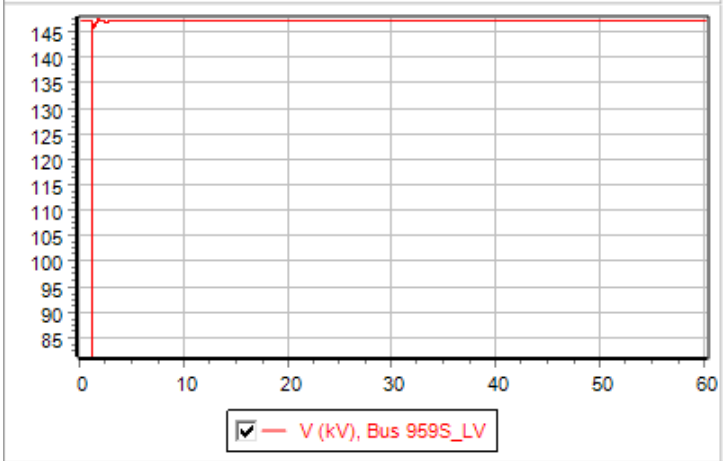
Contingency:
9L29: Coyote Lake 963S to Oakland 946S

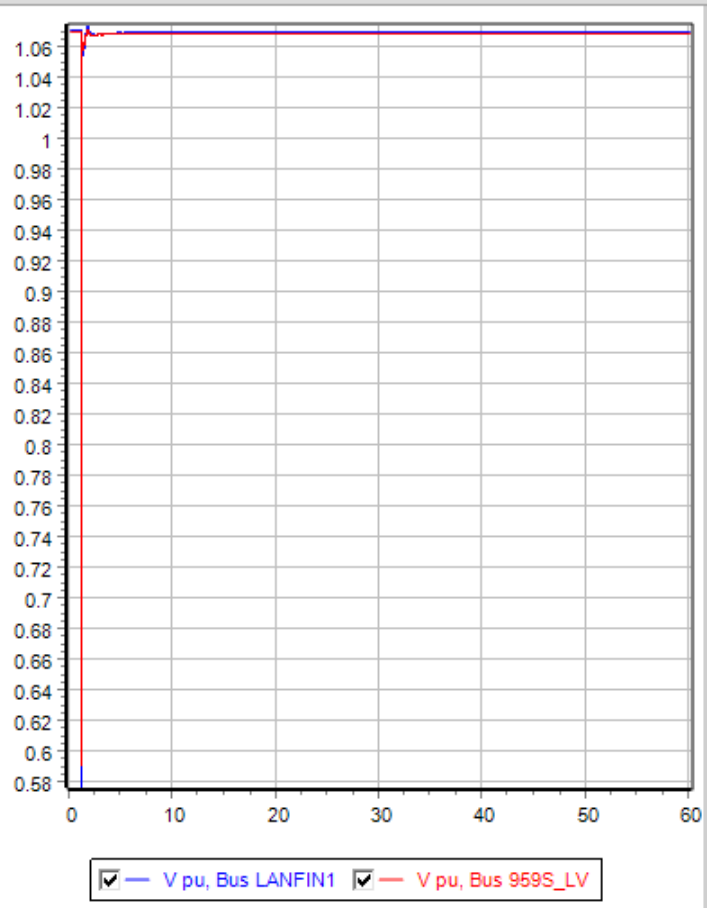
Study Case:
Scenario 4 (2022SP)

December 04, 2020 16:02:57

Lanfine 959S Voltages





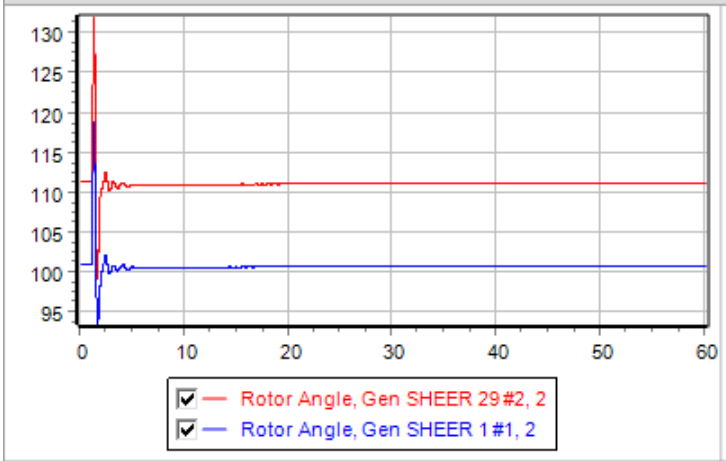


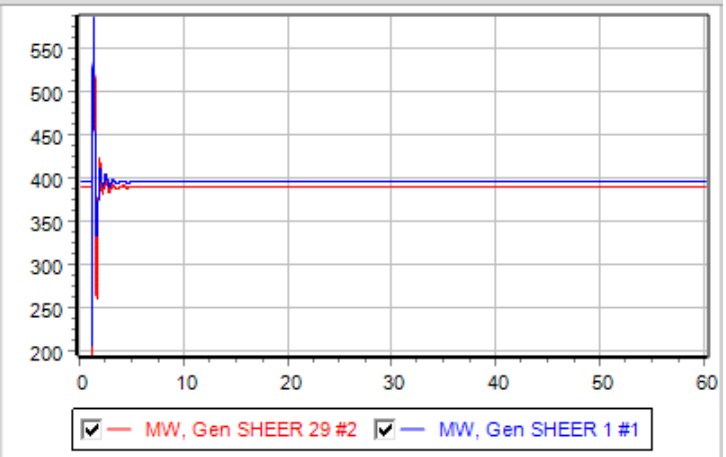
Contingency:
9L29: Coyote Lake 963S to Oakland 946S

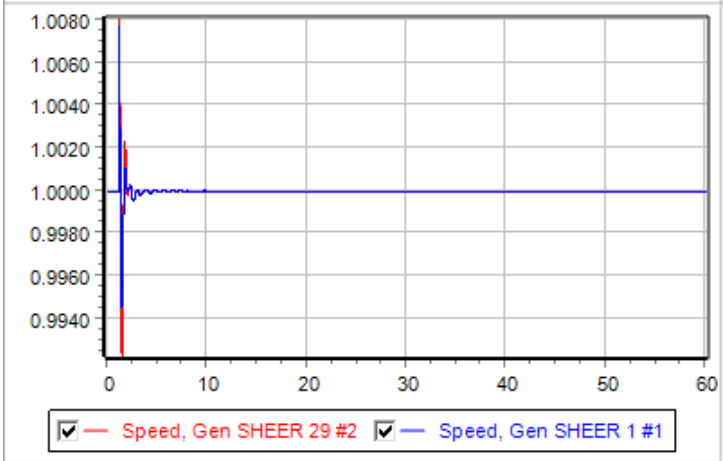
Study Case:
Scenario 4 (2022SP)

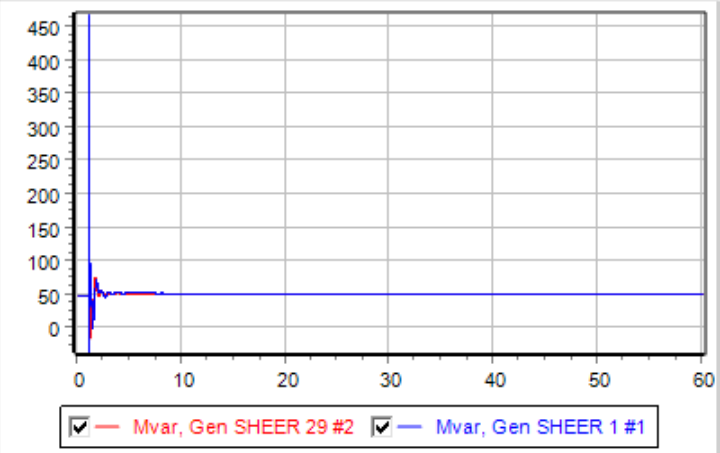
December 04, 2020 16:02:56

Sheerness







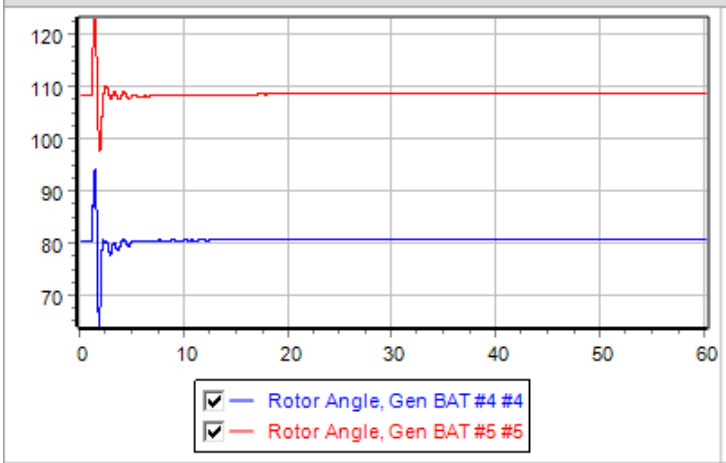


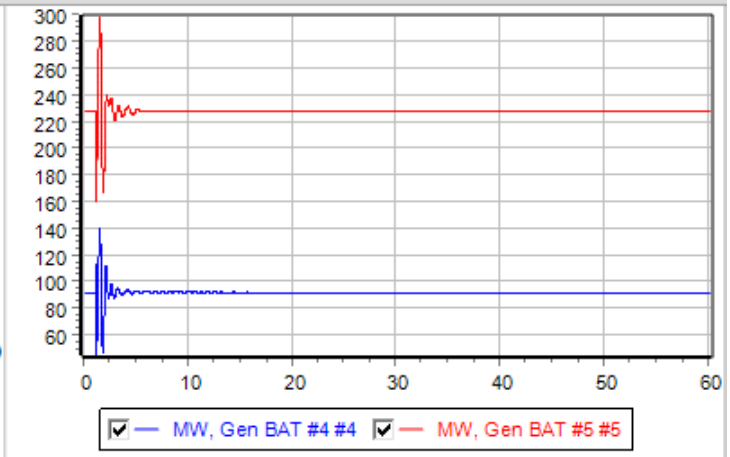
Contingency:
9L29: Coyote Lake 963S to Oakland 946S

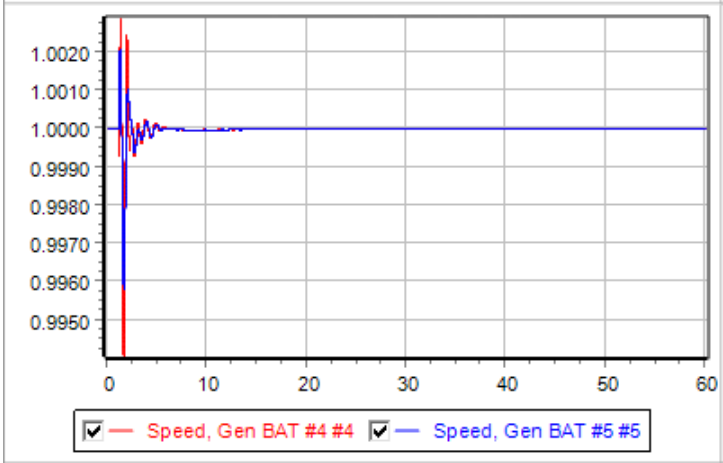
Study Case:
Scenario 4 (2022SP)

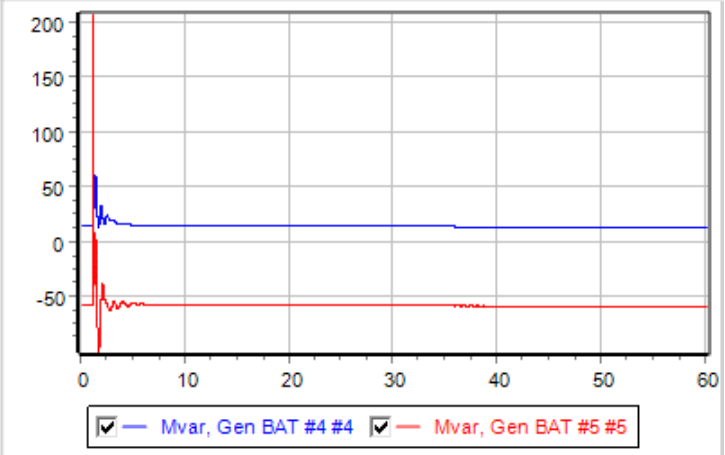
December 04, 2020 16:02:55

Battle River







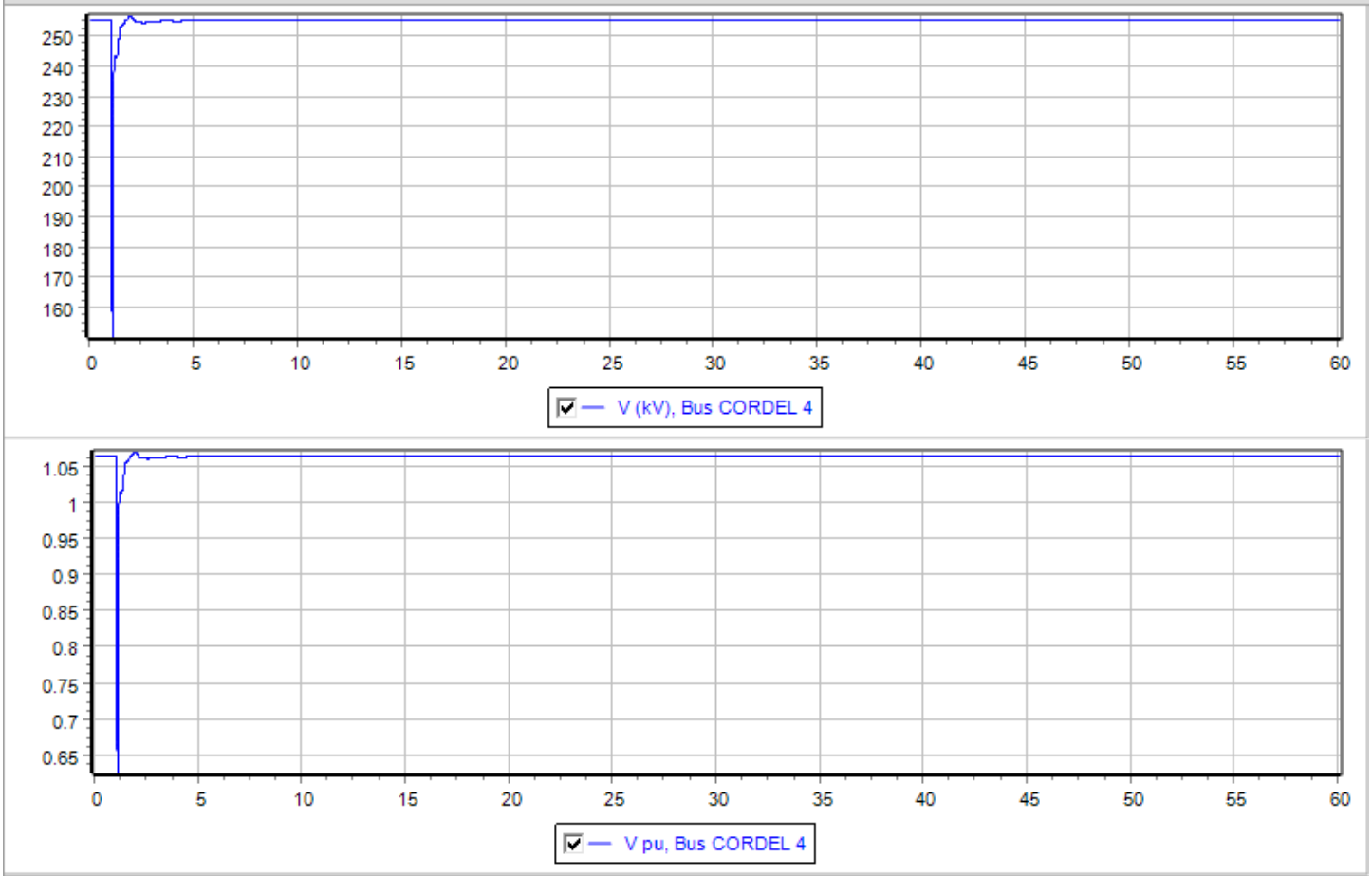


Contingency:
9L29: Oakland 946S to Coyote Lake 963S

Study Case:
Scenario 4 (2022SP)

December 04, 2020 16:06:58

Cordel 755S Voltages

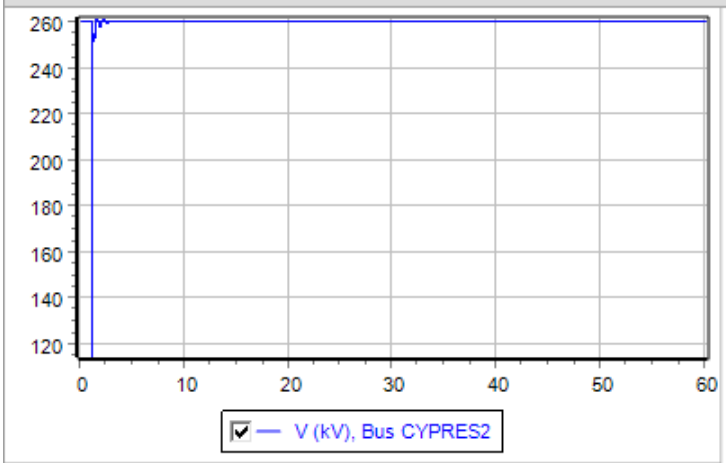


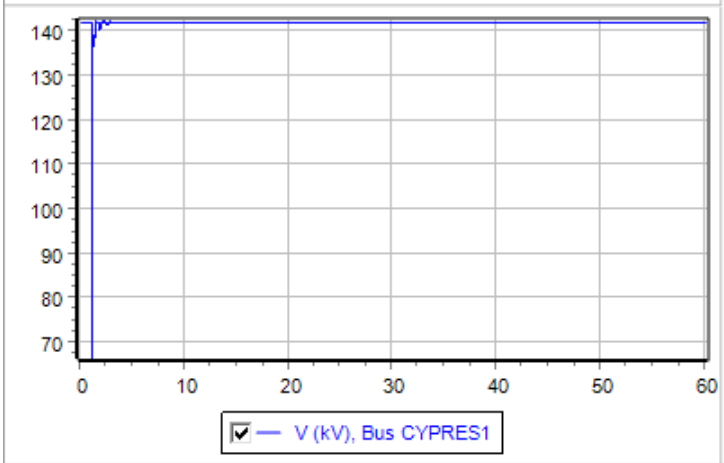
Contingency:
9L29: Oakland 946S to Coyote Lake 963S

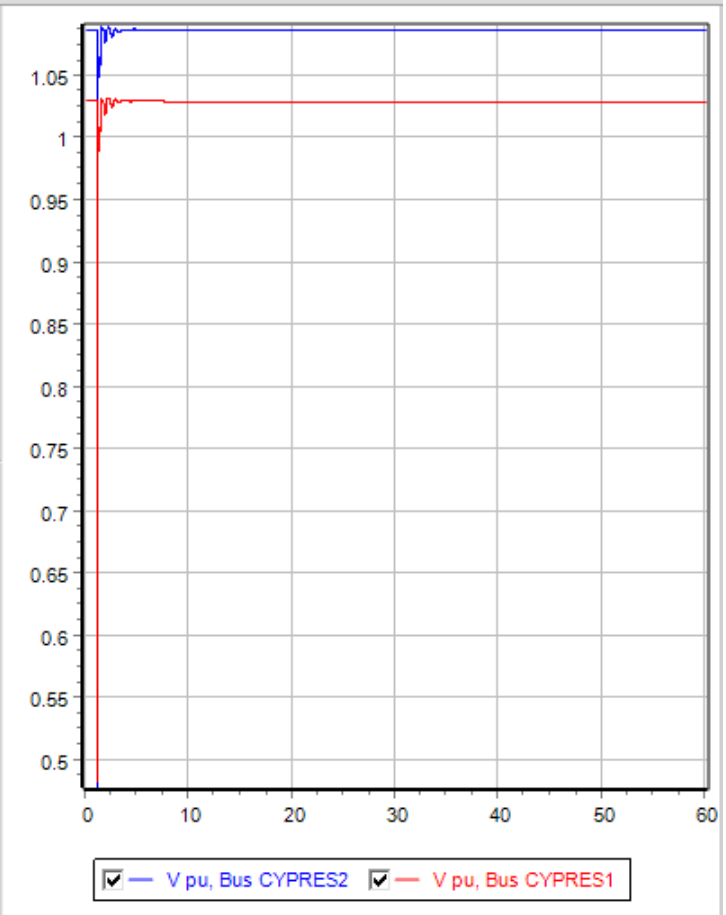
Study Case:
Scenario 4 (2022SP)

December 04, 2020 16:07:03

Cypress 562S Voltages





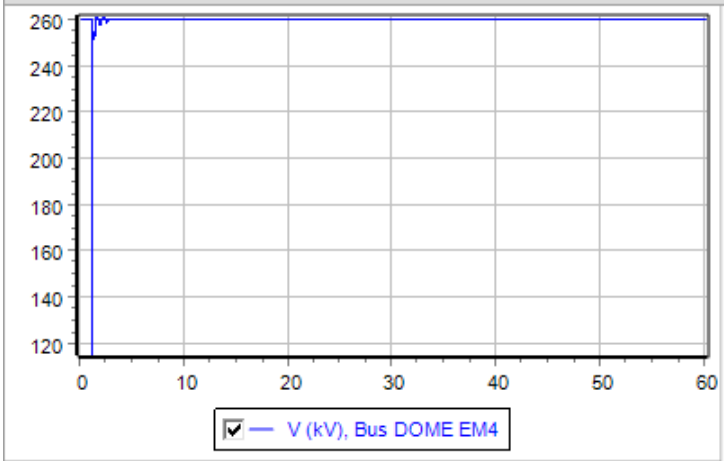


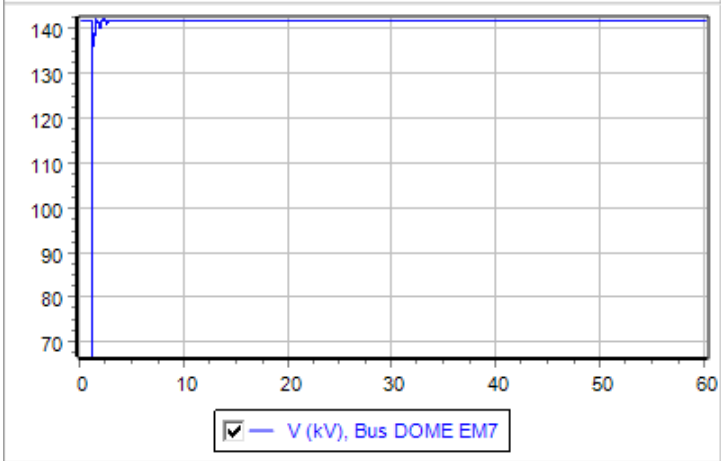
Contingency:
9L29: Oakland 946S to Coyote Lake 963S

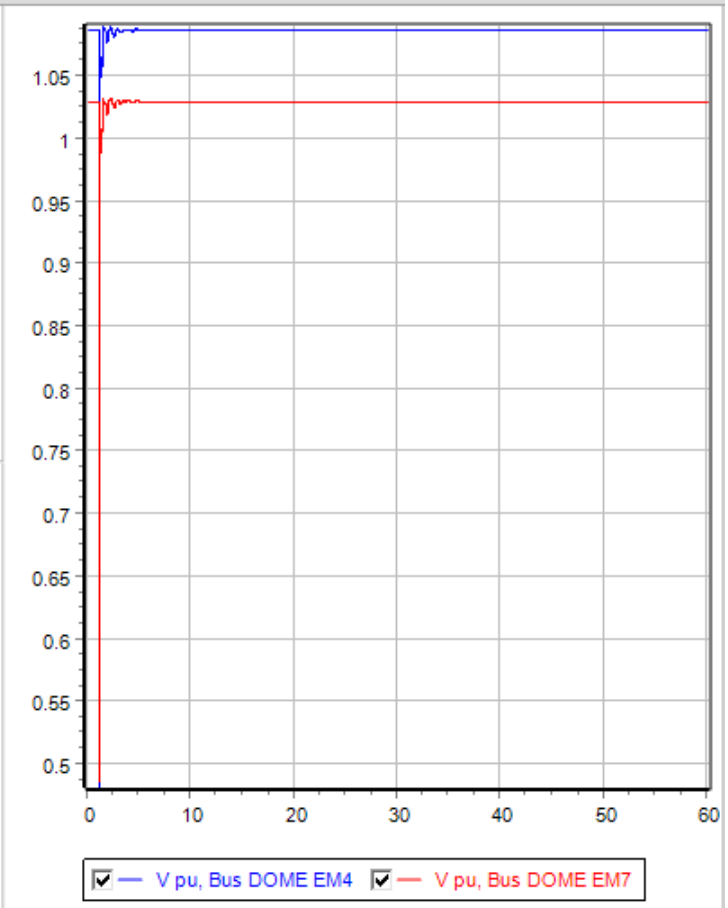
Study Case:
Scenario 4 (2022SP)

December 04, 2020 16:07:02

Dome 163S Voltages





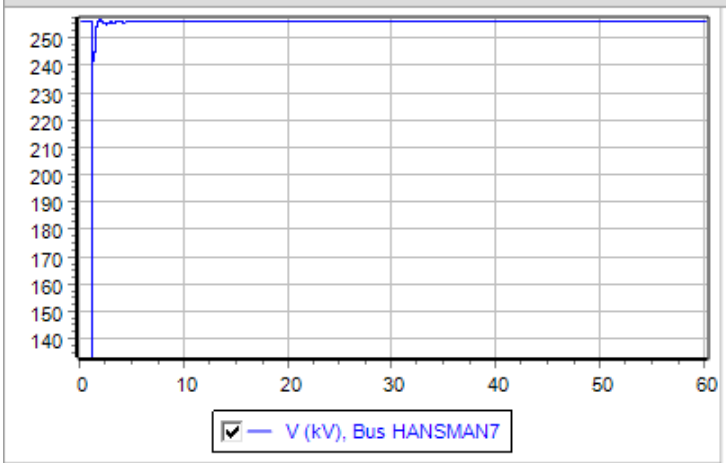


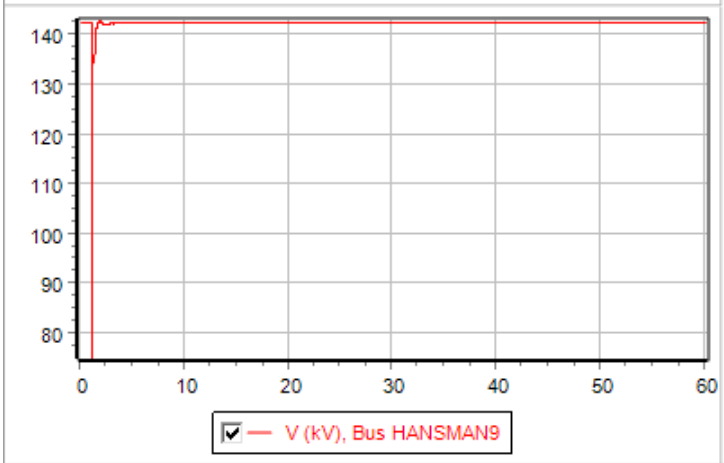
Contingency:
9L29: Oakland 946S to Coyote Lake 963S

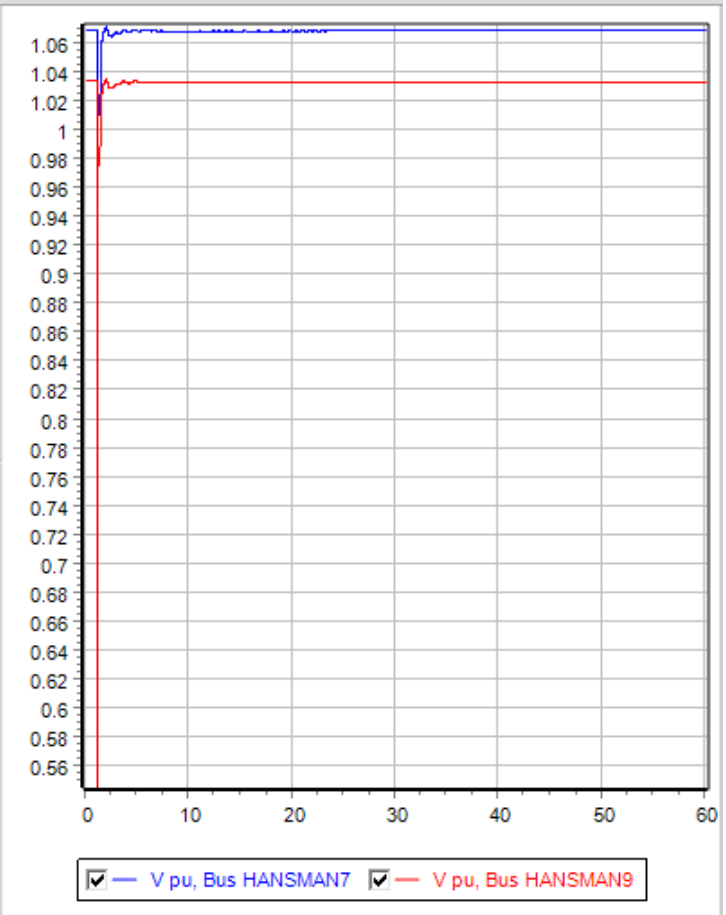
Study Case:
Scenario 4 (2022SP)

December 04, 2020 16:07:01

Hansman Lake 650S Voltages





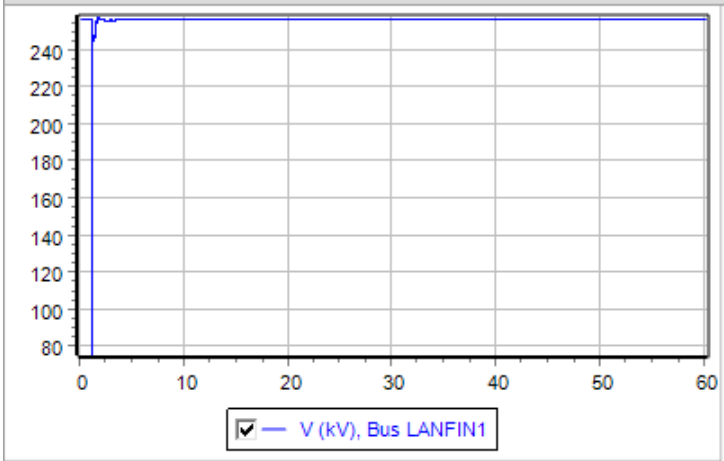


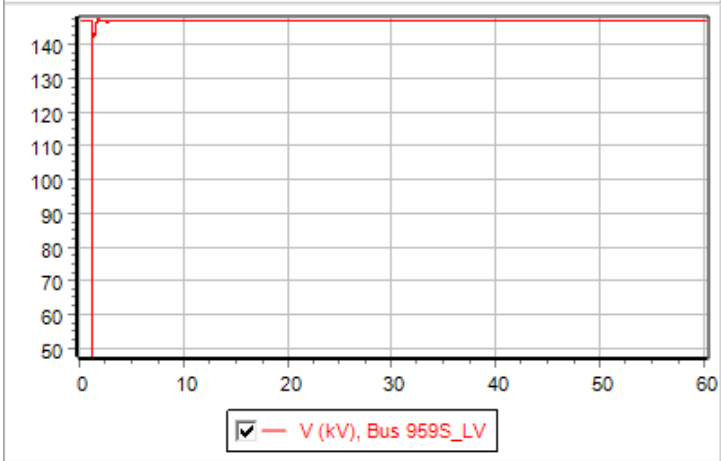
Contingency:
9L29: Oakland 946S to Coyote Lake 963S

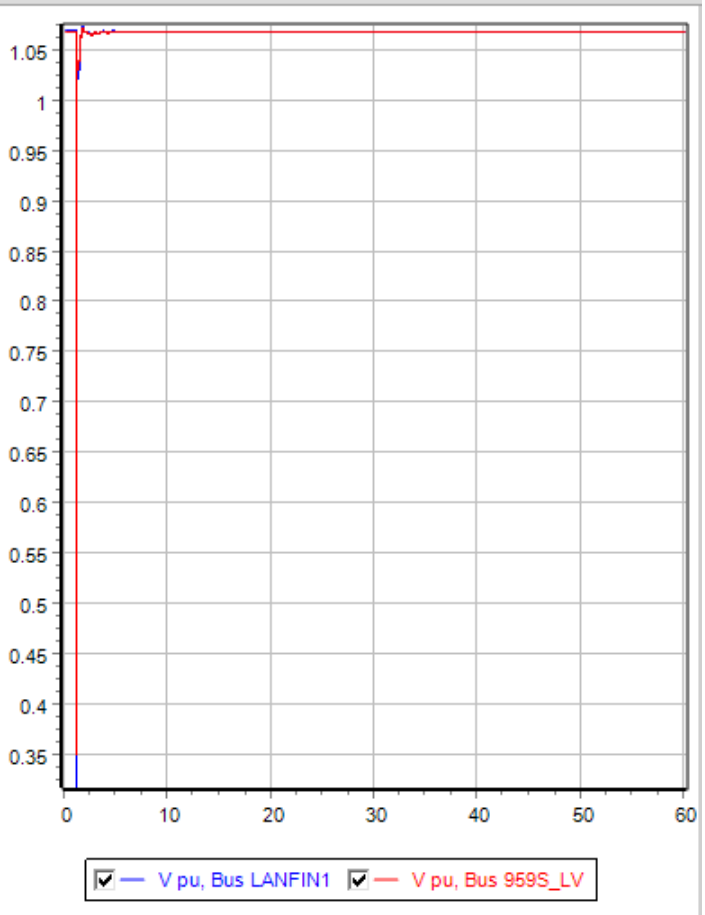
Study Case:
Scenario 4 (2022SP)

December 04, 2020 16:07:00

Lanfine 959S Voltages





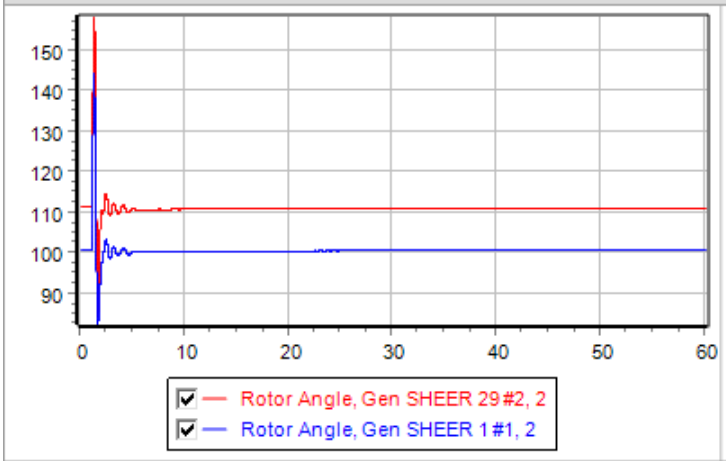


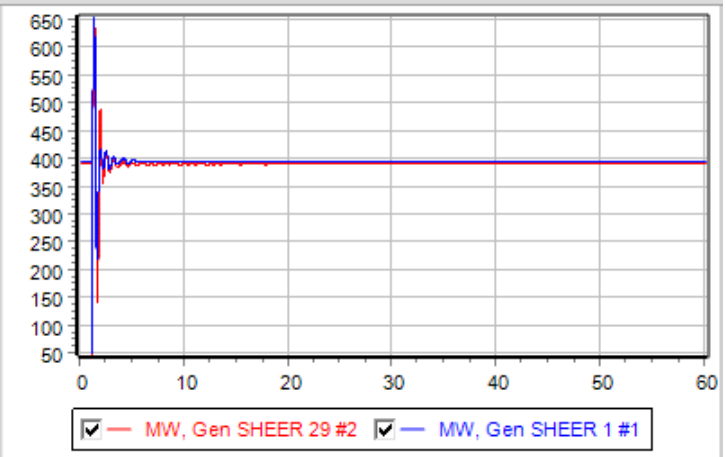
Contingency:
9L29: Oakland 946S to Coyote Lake 963S

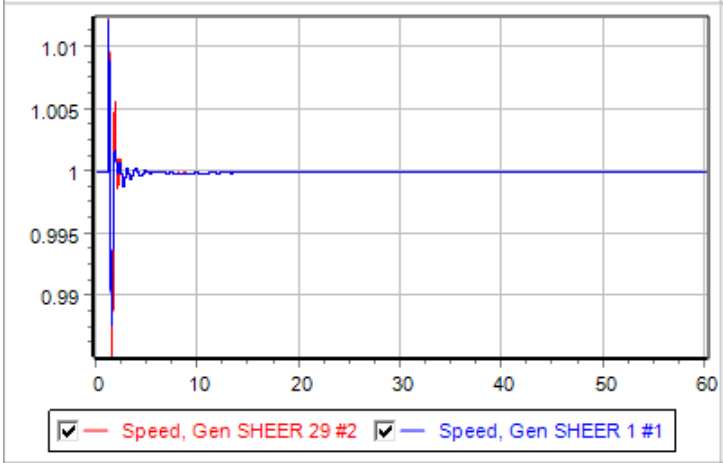
Study Case:
Scenario 4 (2022SP)

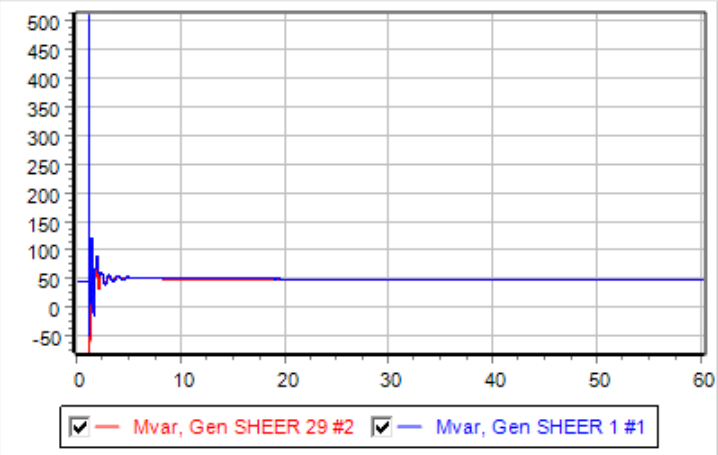
December 04, 2020 16:06:59

Sheerness







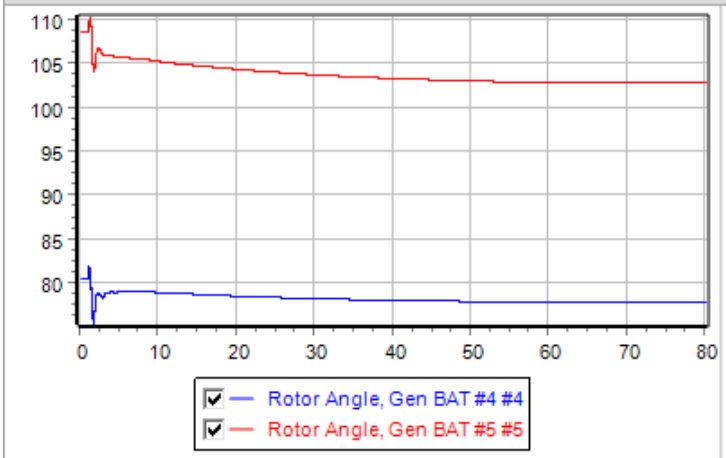


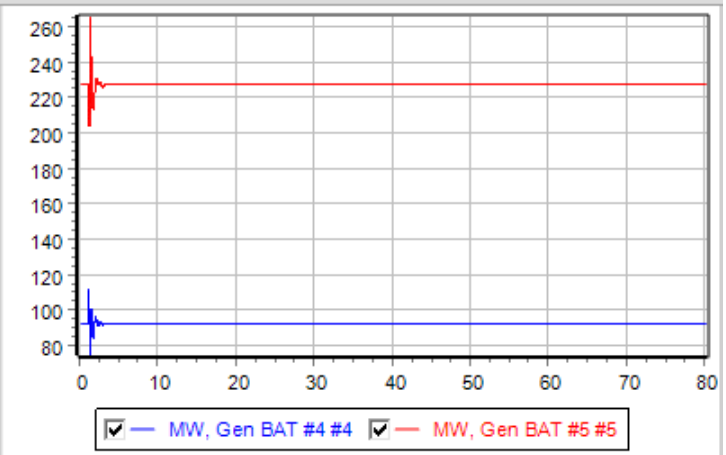
Contingency:
9L29: Oakland 946S to Coyote Lake 963S

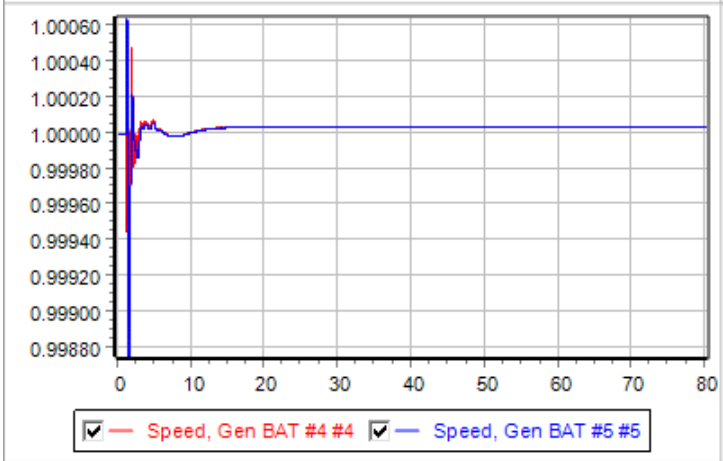
Study Case:
Scenario 4 (2022SP)

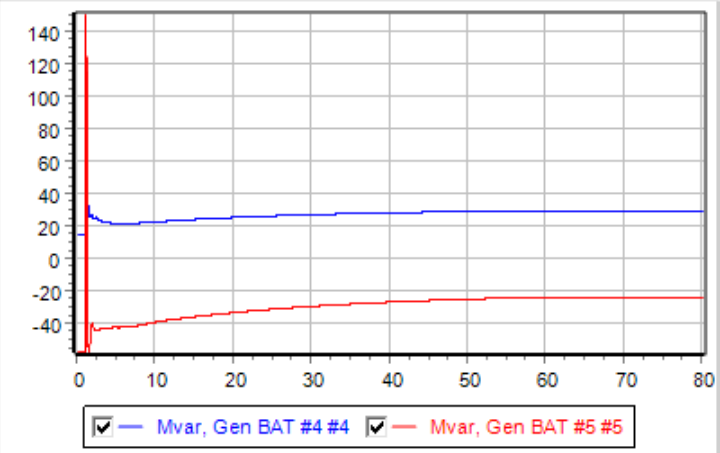
December 04, 2020 16:06:57

Battle River







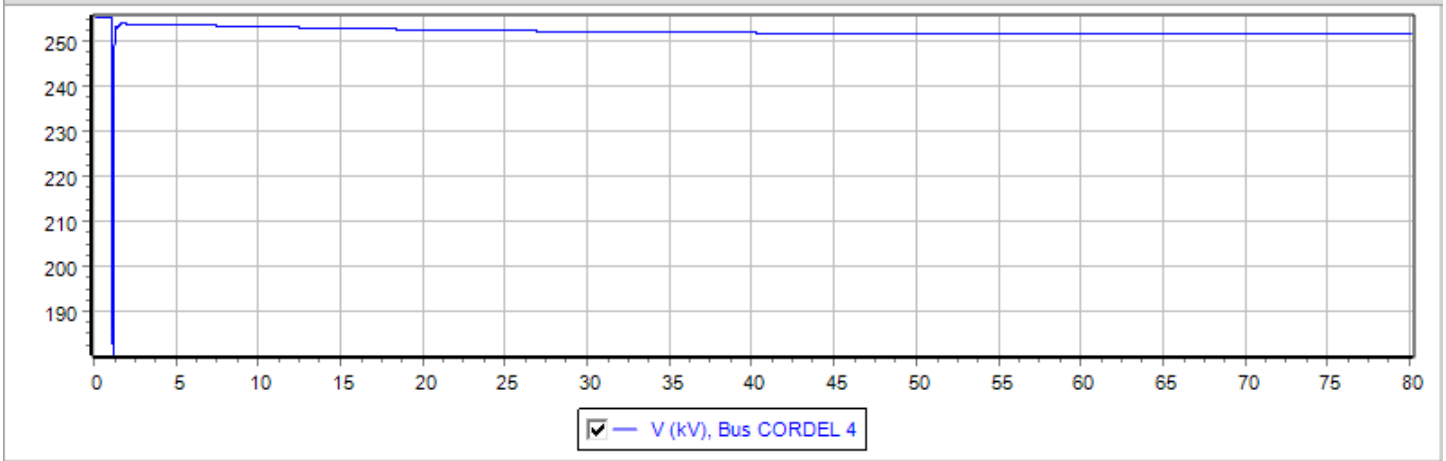


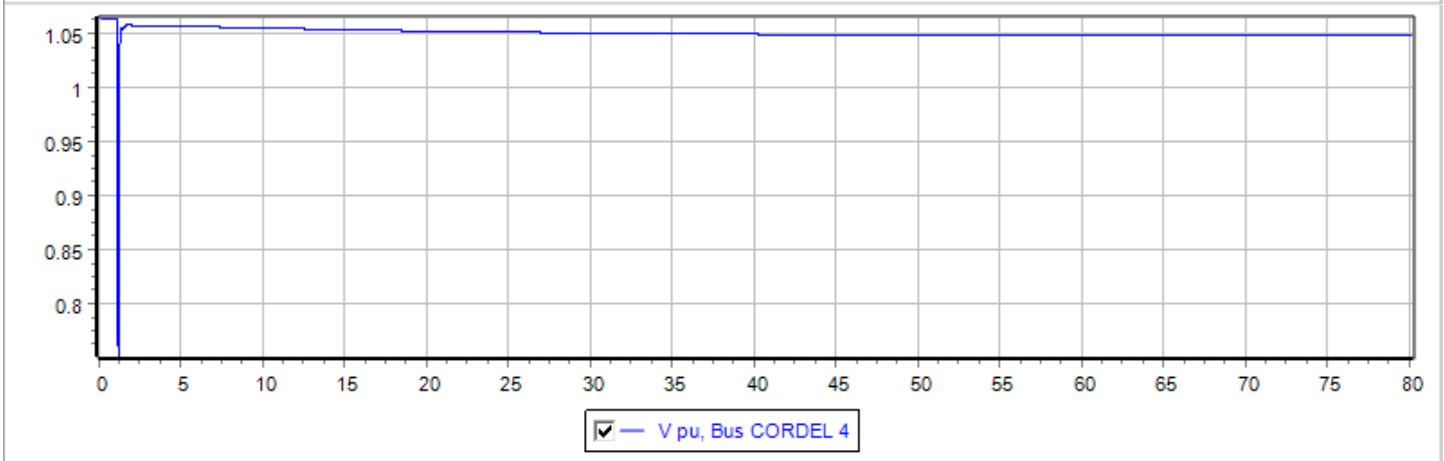
Contingency:
9L46: Lanfine 959S to N.Bridgen

Study Case:
Scenario 4 (2022SP)

December 04, 2020 16:56:47

Cordel 755S Voltages



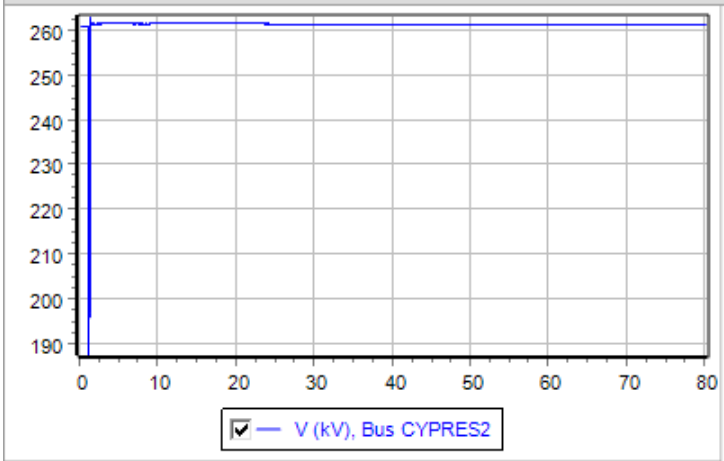


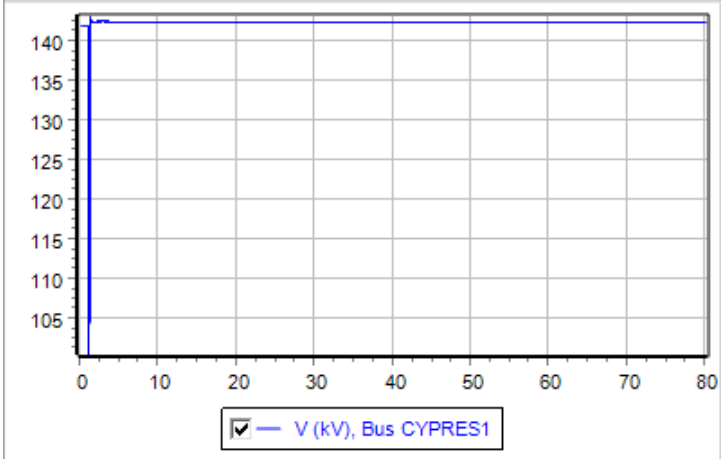
Contingency:
9L46: Lanfine 959S to N.Bridgen

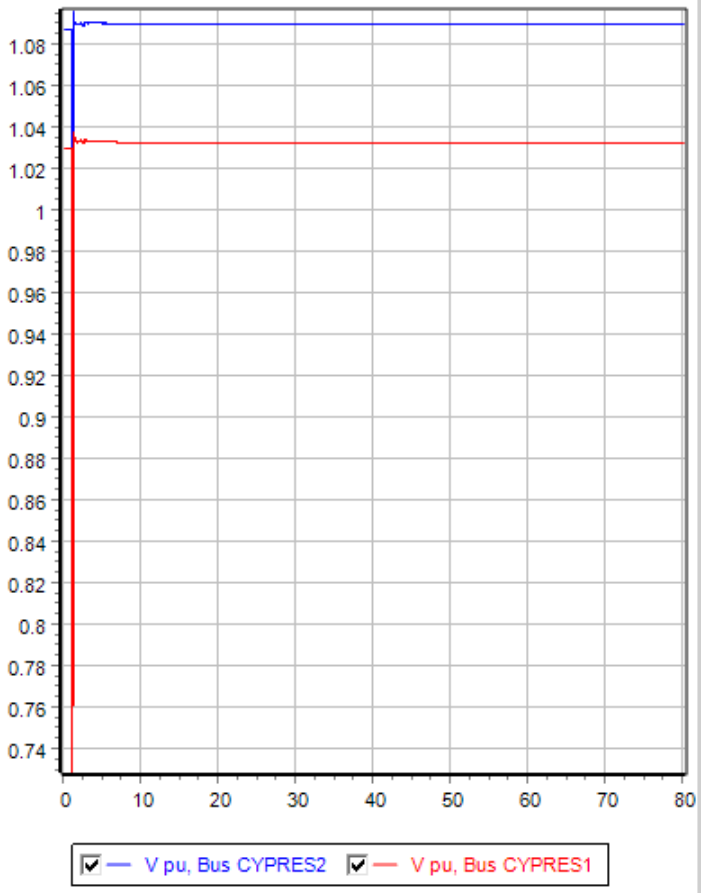
Study Case:
Scenario 4 (2022SP)

December 04, 2020 16:56:50

Cypress 562S Voltages





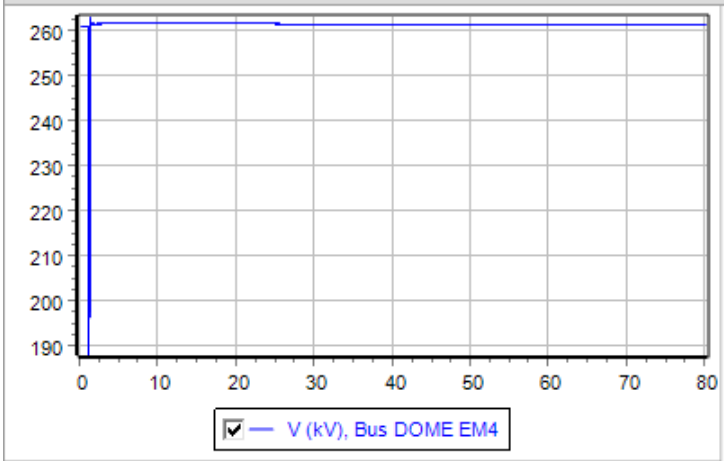


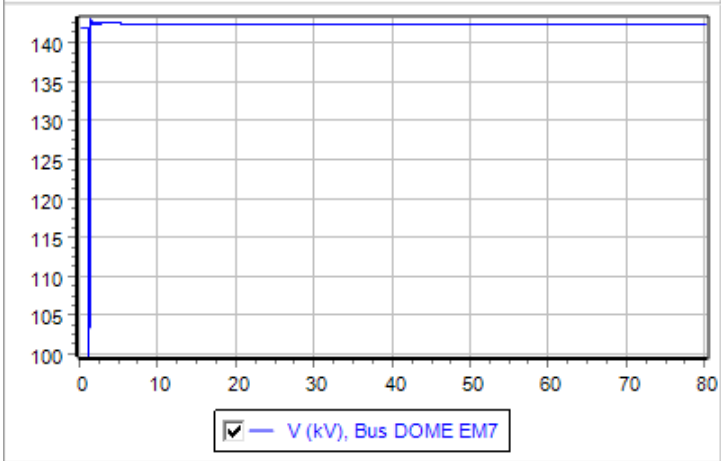
Contingency:
9L46: Lanfine 959S to N.Bridgen

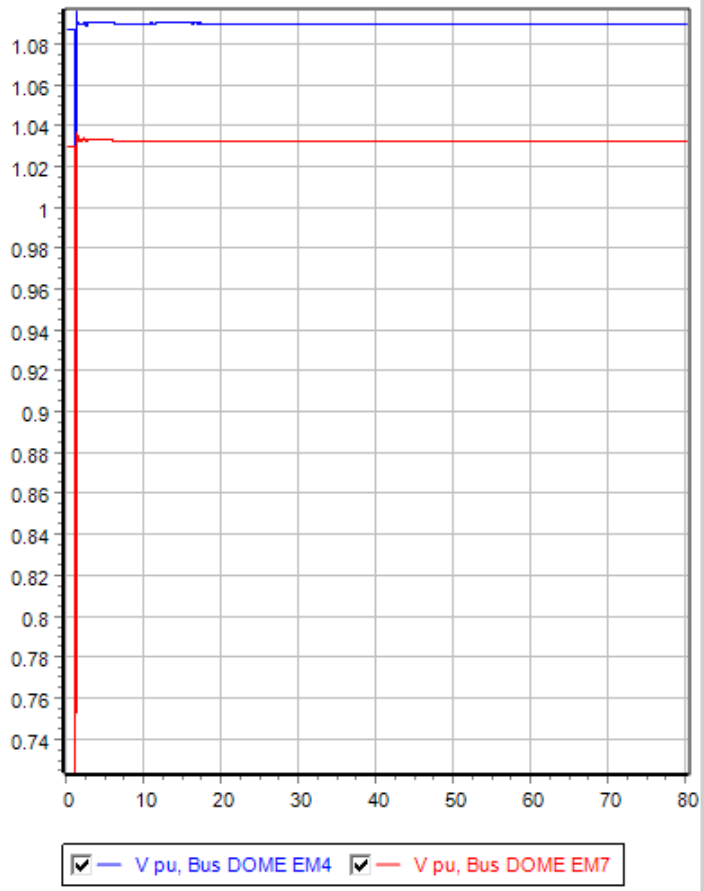
Study Case:
Scenario 4 (2022SP)

December 04, 2020 16:56:49

Dome 163S Voltages





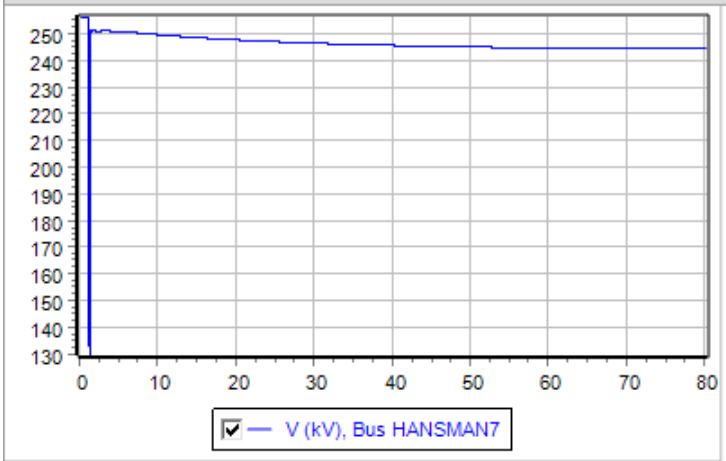


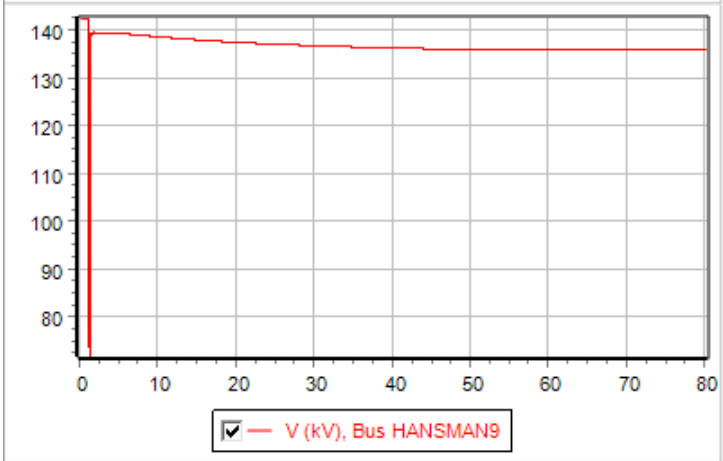
Contingency:
9L46: Lanfine 959S to N.Bridgen

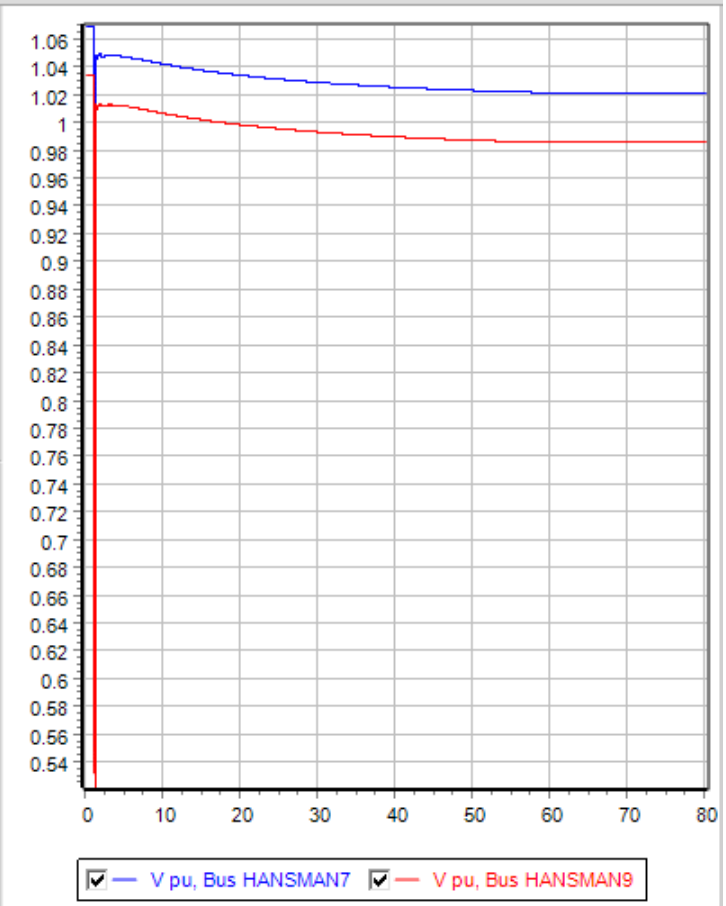
Study Case:
Scenario 4 (2022SP)

December 04, 2020 16:56:49

Hansman Lake 650S Voltages





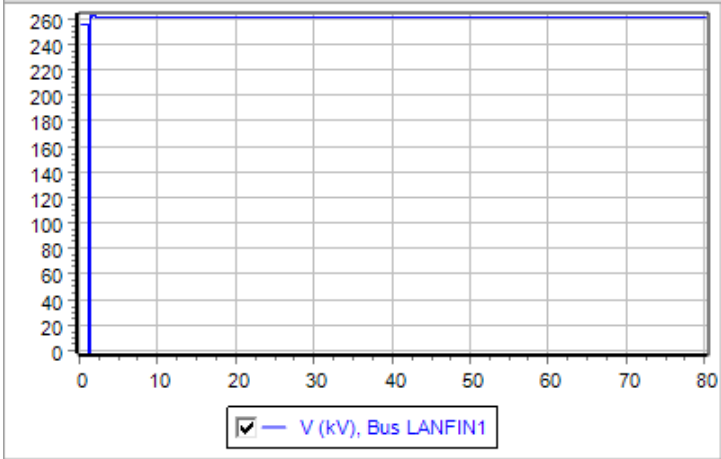


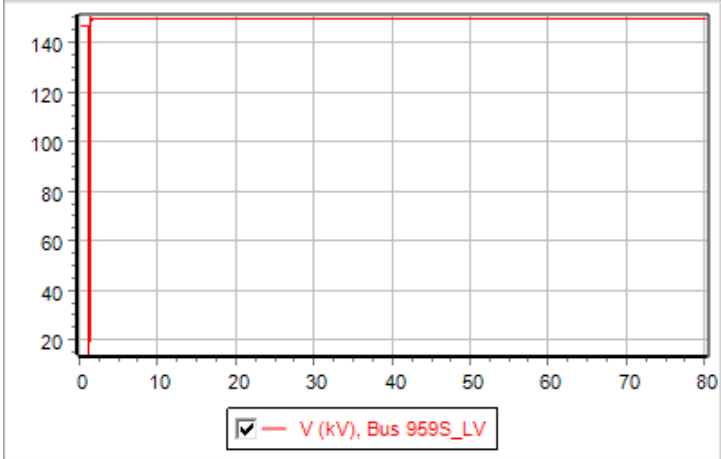
Contingency:
9L46: Lanfine 959S to N.Bridgen

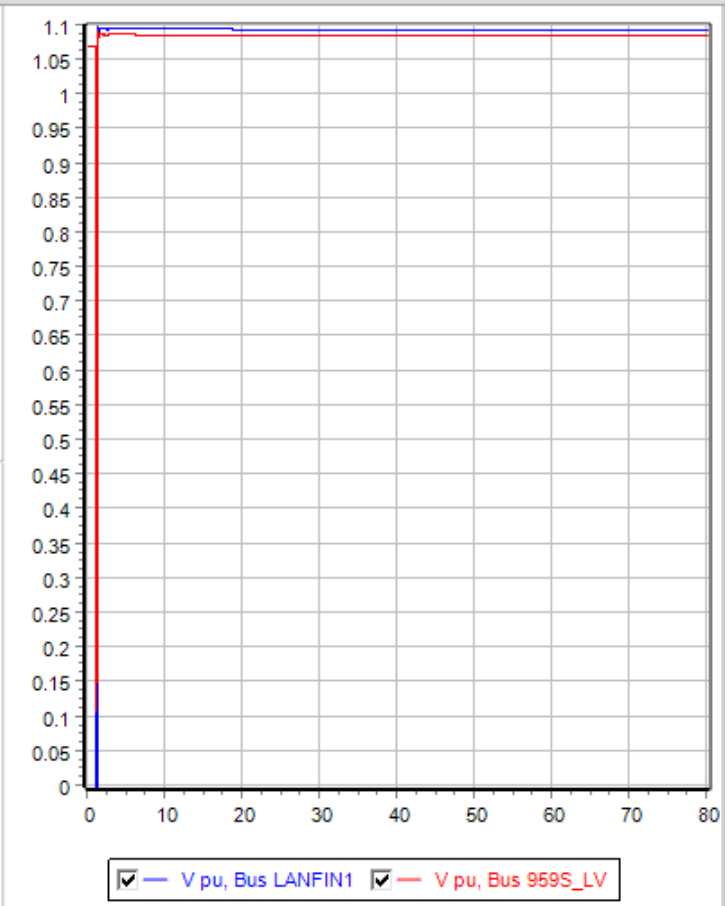
Study Case:
Scenario 4 (2022SP)

December 04, 2020 16:56:48

Lanfine 959S Voltages





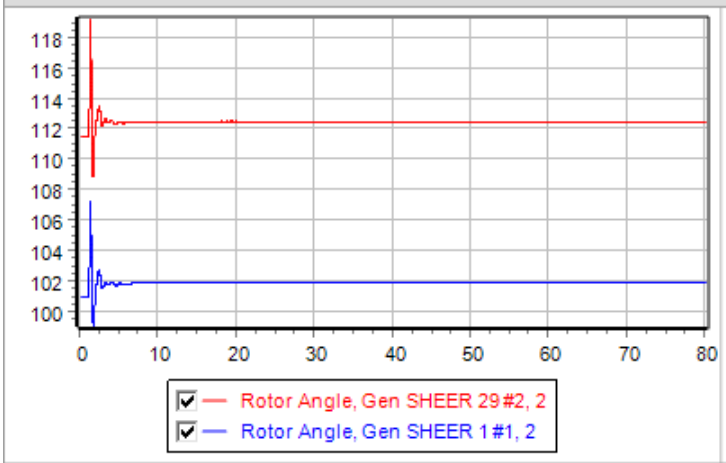


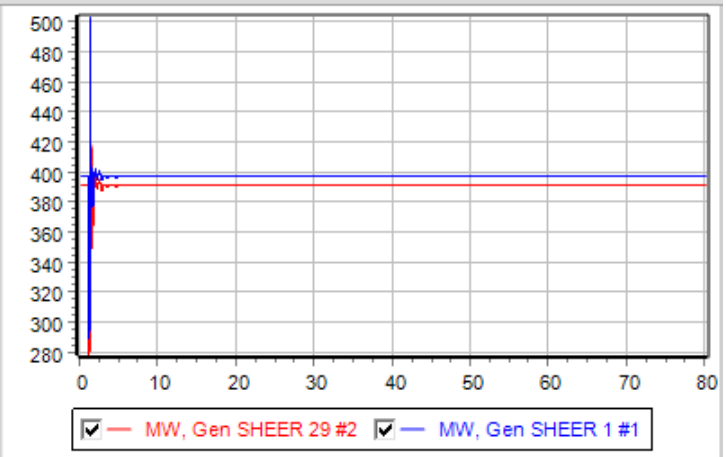
Contingency:
9L46: Lanfine 959S to N.Bridgen

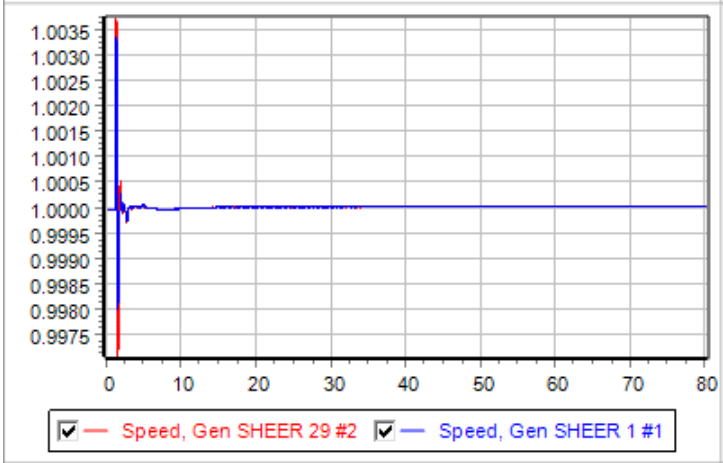
Study Case:
Scenario 4 (2022SP)

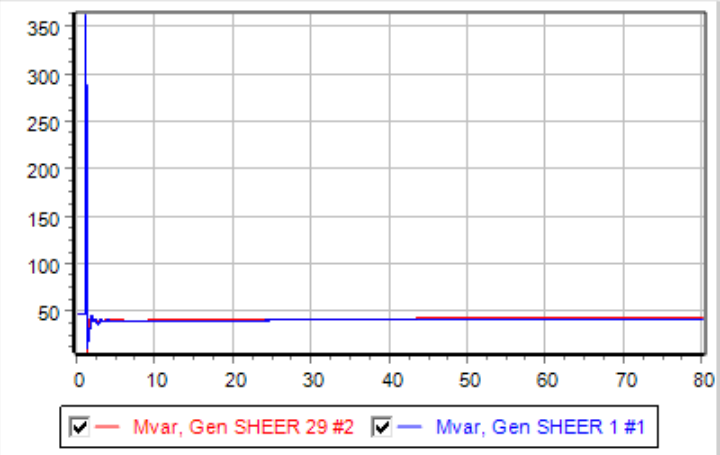
December 04, 2020 16:56:48

Sheerness







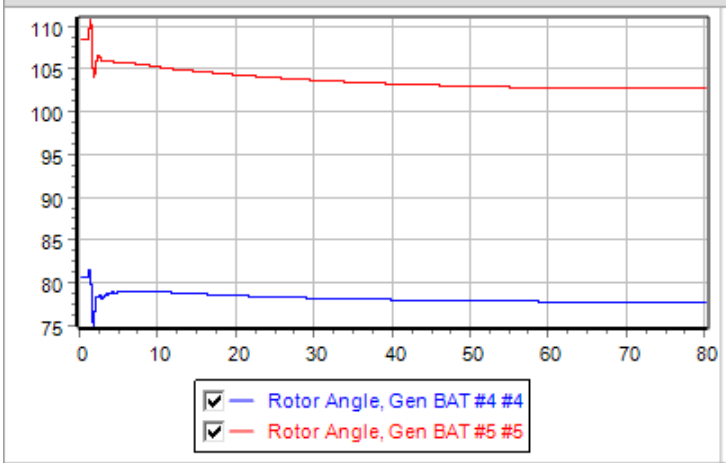


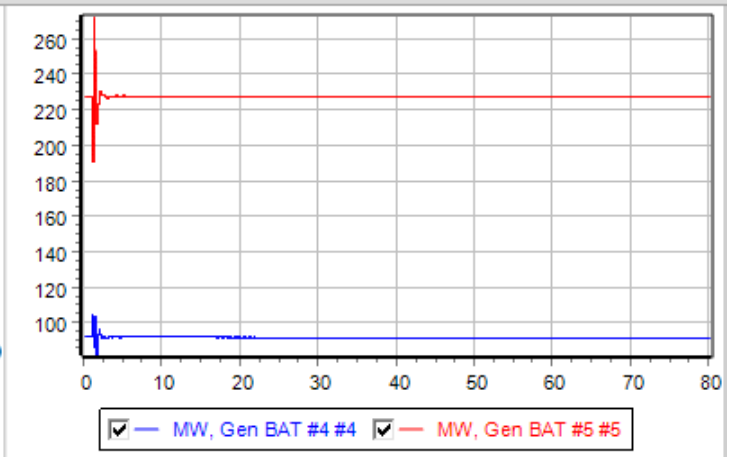
Contingency:
9L46: Lanfine 959S to N.Bridgen

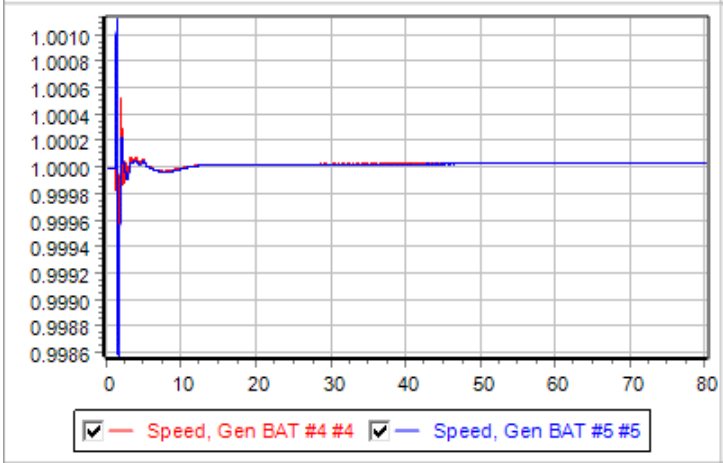
Study Case:
Scenario 4 (2022SP)

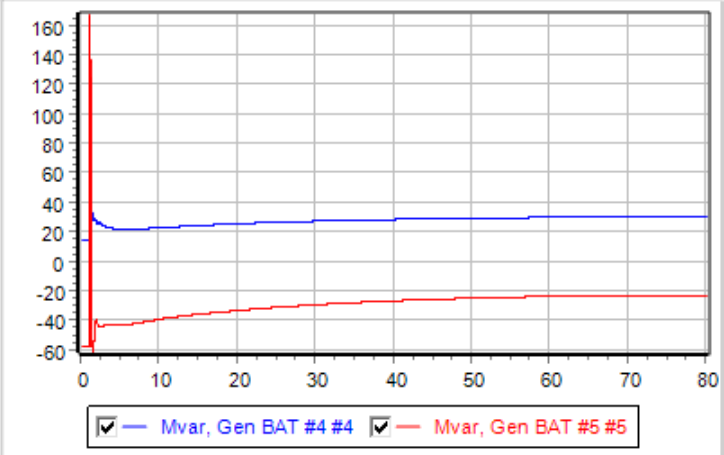
December 04, 2020 16:56:46

Battle River







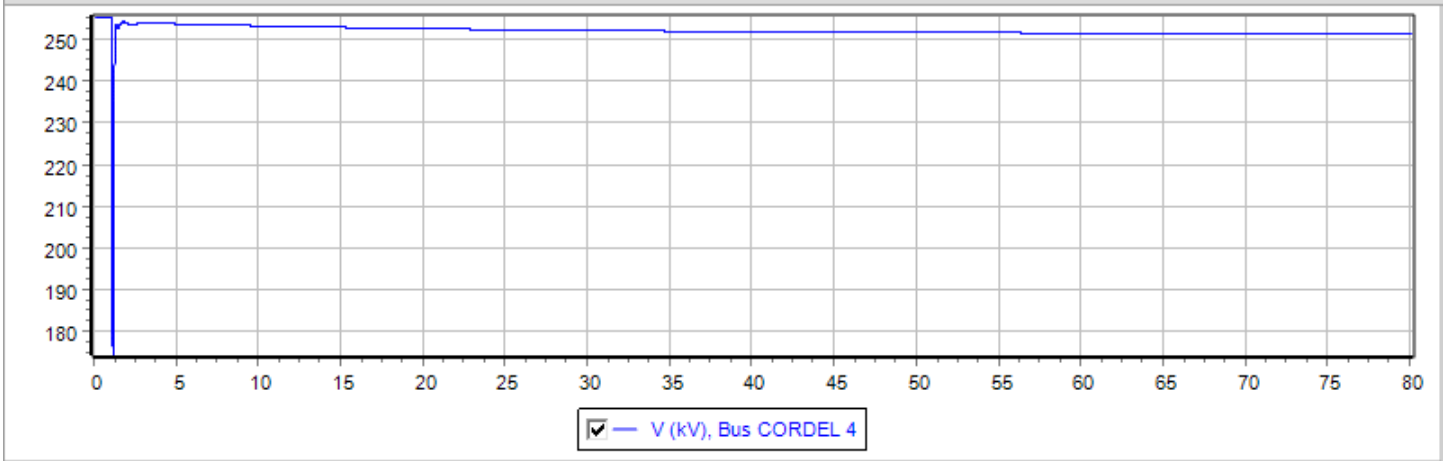


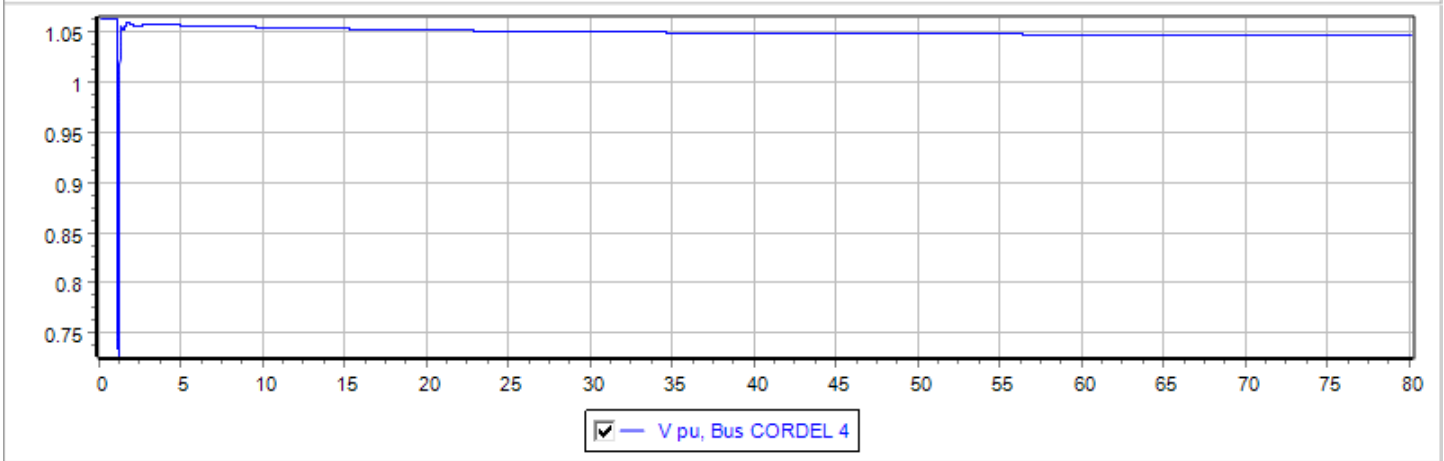
Contingency:
9L46: N.Bridgen to Lanfine 959S

Study Case:
Scenario 4 (2022SP)

December 04, 2020 17:05:59

Cordel 755S Voltages



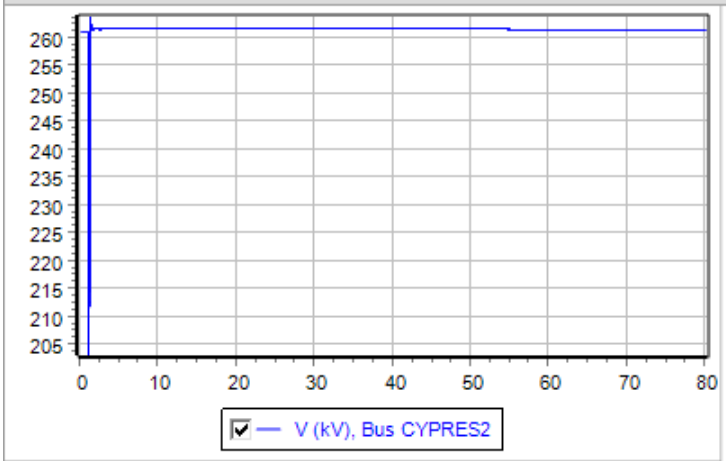


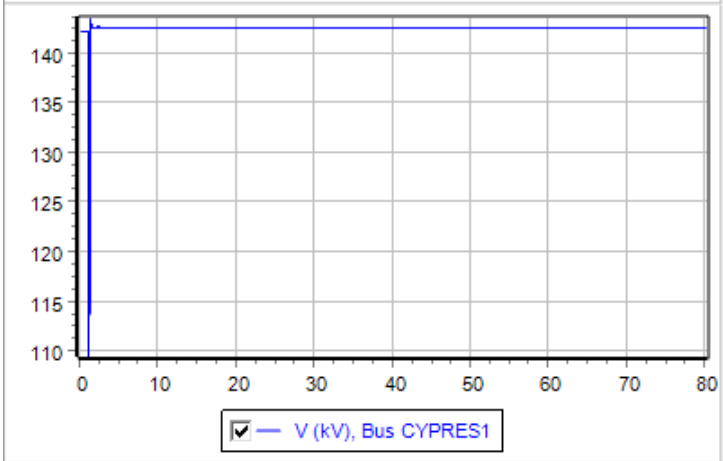
Contingency:
9L46: N.Bridgen to Lanfine 959S

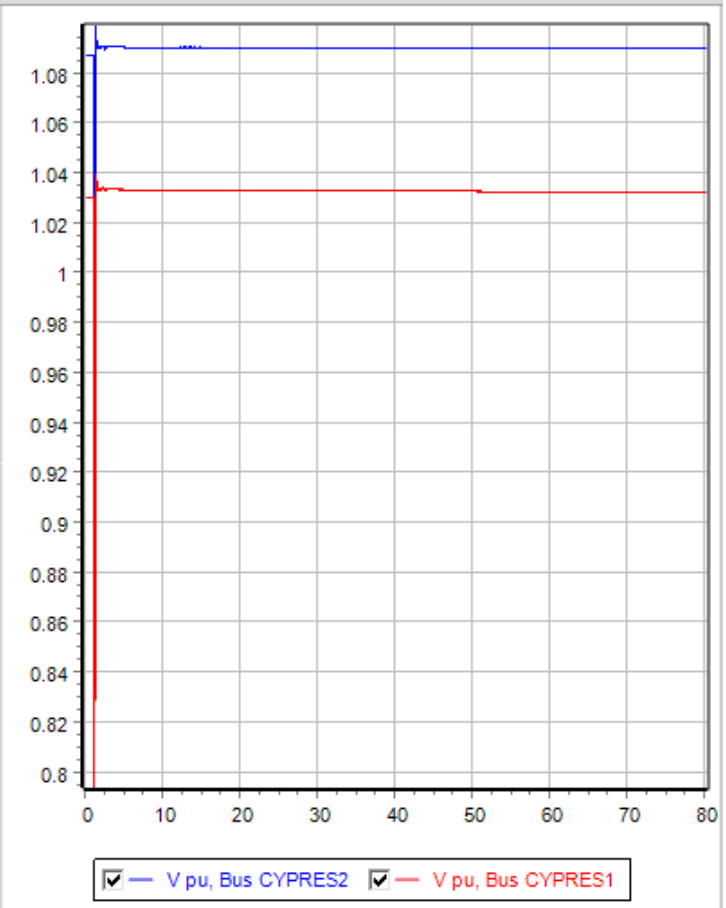
Study Case:
Scenario 4 (2022SP)

December 04, 2020 17:06:02

Cypress 562S Voltages





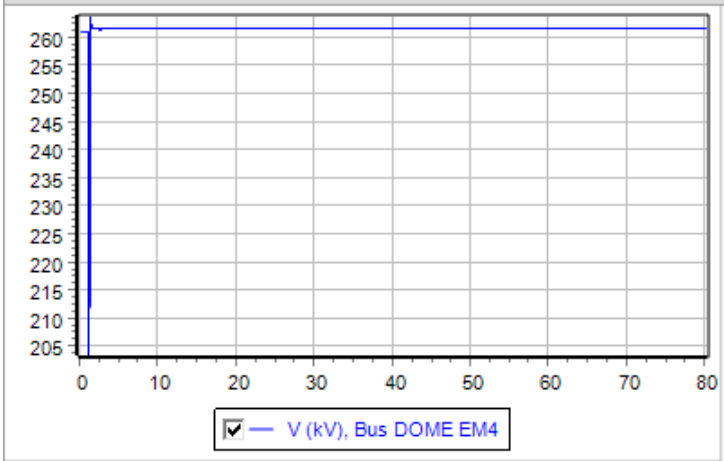


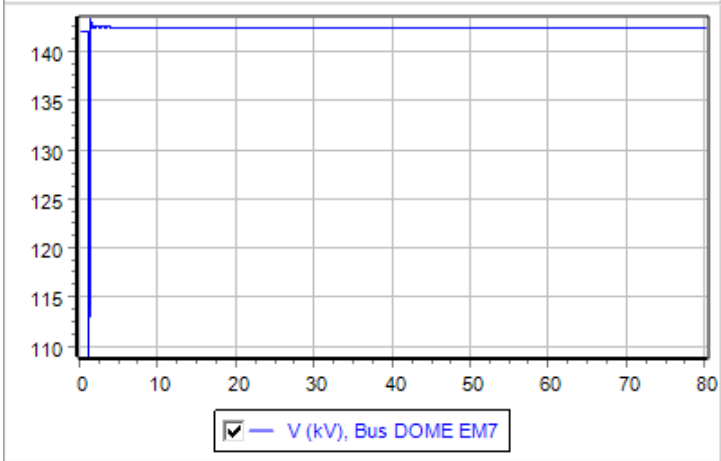
Contingency:
9L46: N.Bridgen to Lanfine 959S

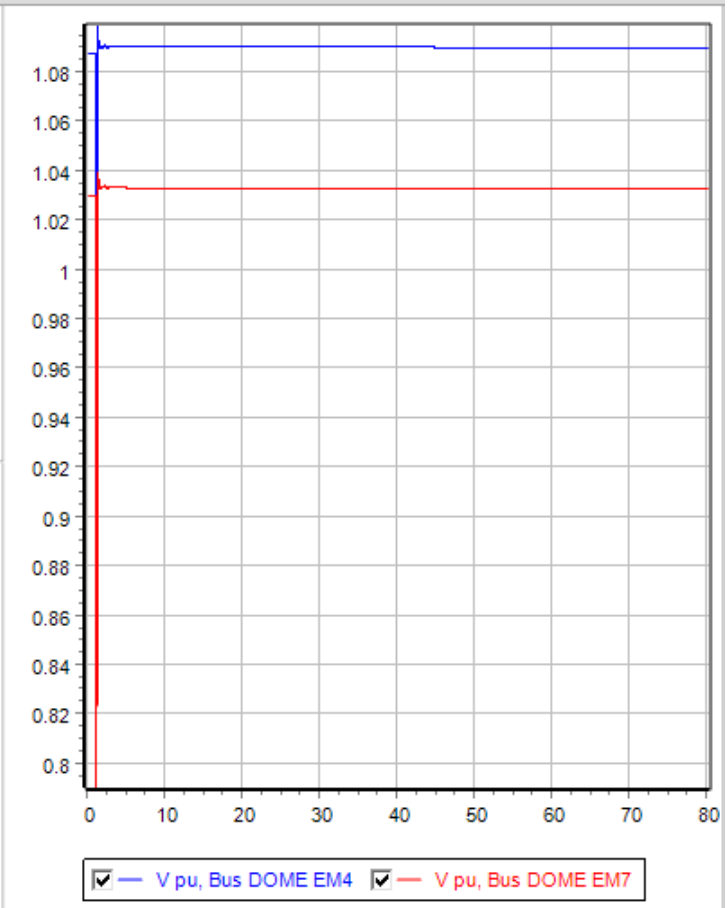
Study Case:
Scenario 4 (2022SP)

December 04, 2020 17:06:01

Dome 163S Voltages





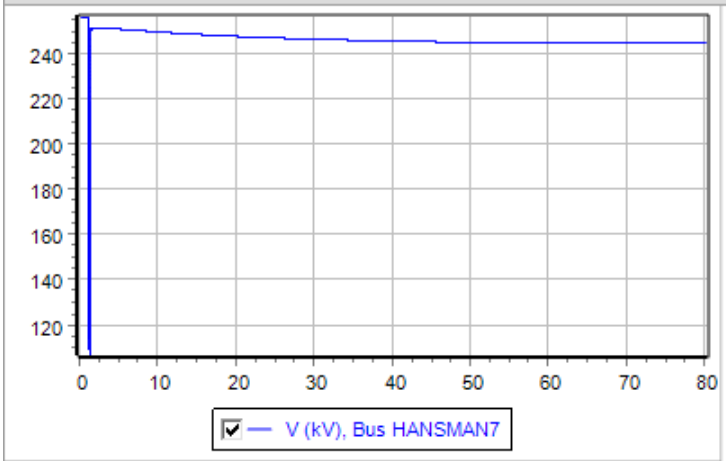


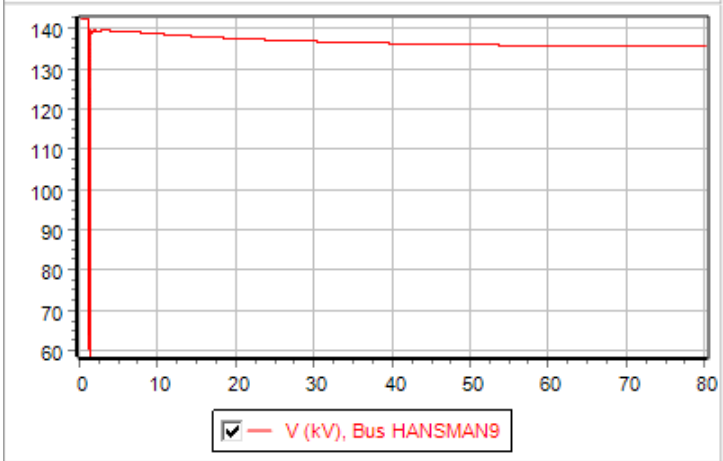
Contingency:
9L46: N.Bridgen to Lanfine 959S

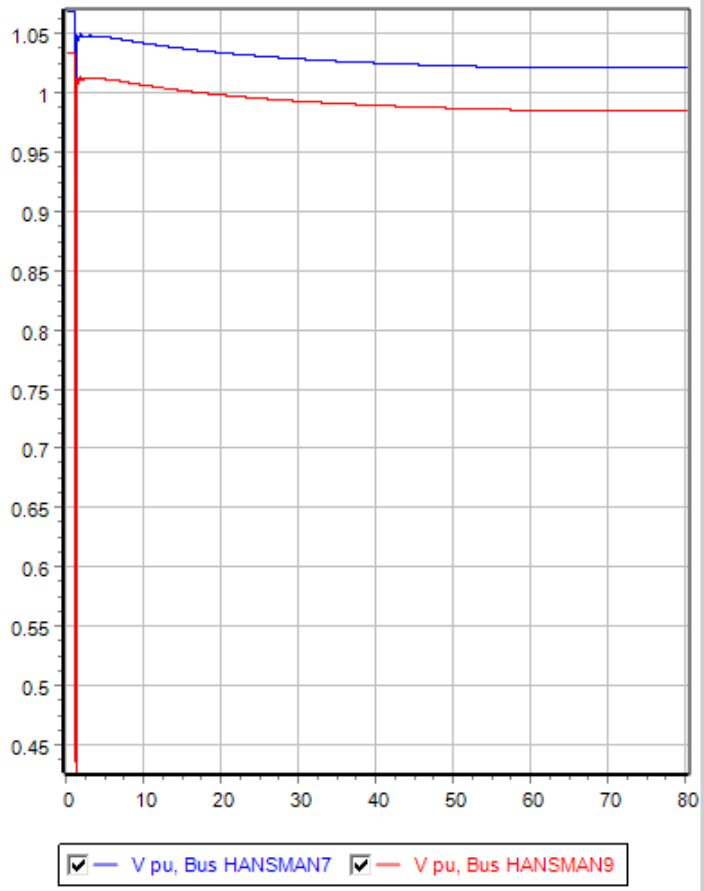
Study Case:
Scenario 4 (2022SP)

December 04, 2020 17:06:00

Hansman Lake 650S Voltages





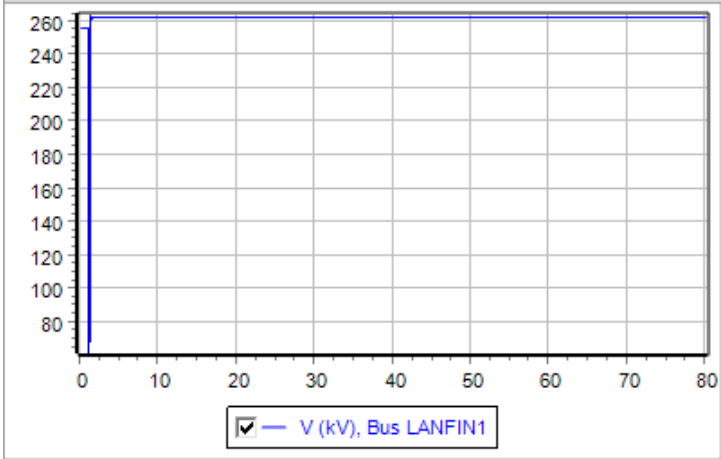


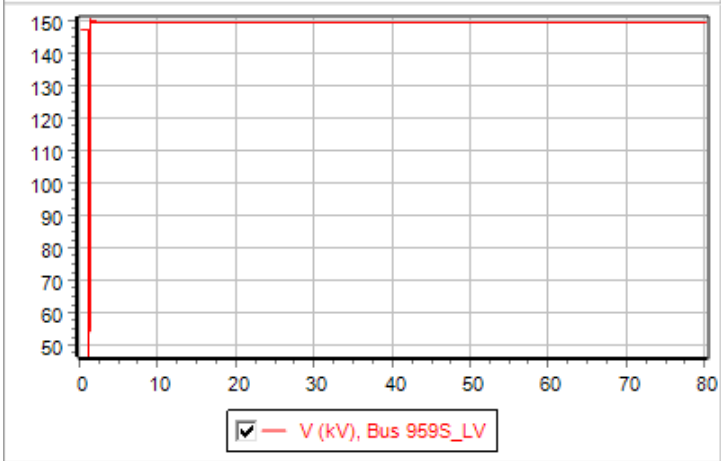
Contingency:
9L46: N.Bridgen to Lanfine 959S

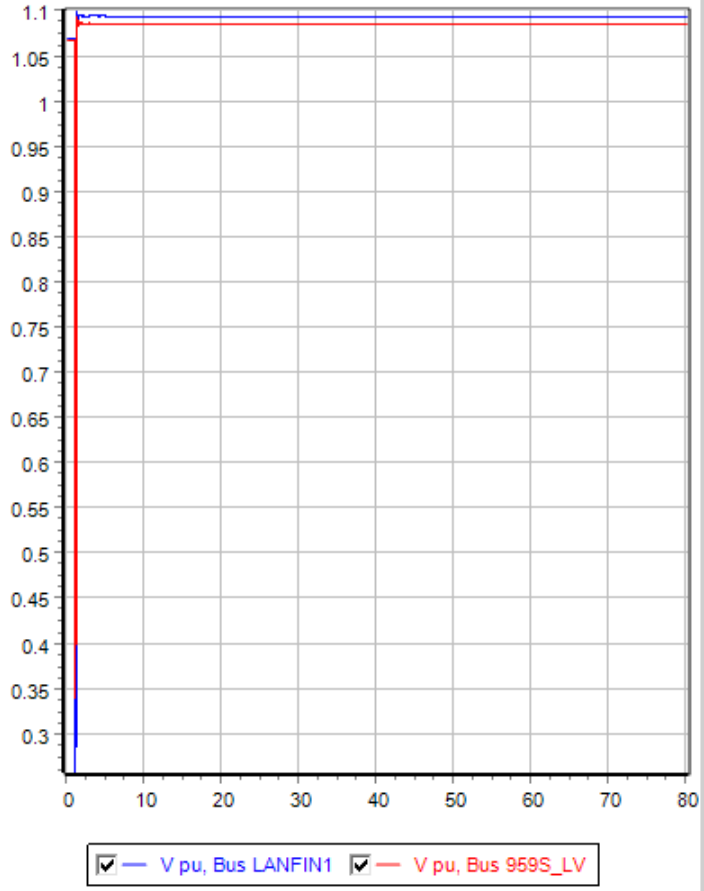
Study Case:
Scenario 4 (2022SP)

December 04, 2020 17:06:00

Lanfine 959S Voltages





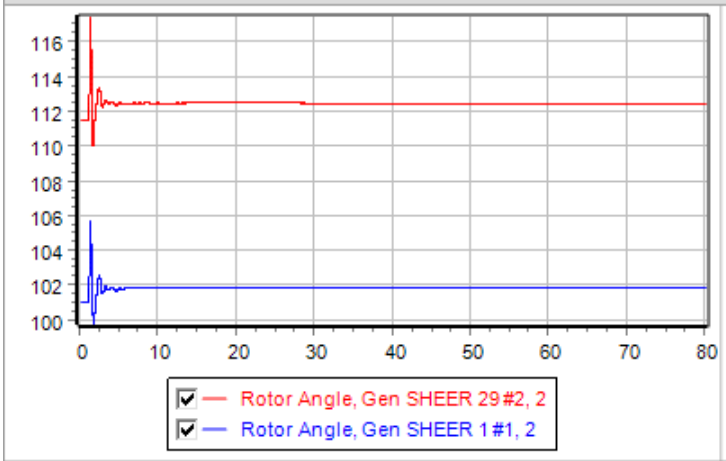


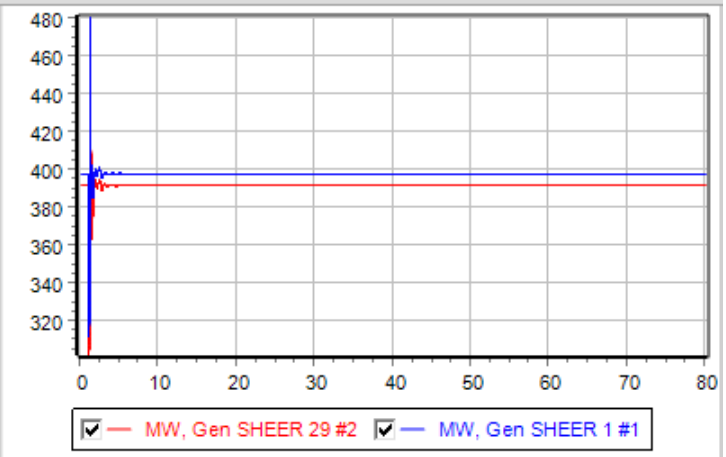
Contingency:
9L46: N.Bridgen to Lanfine 959S

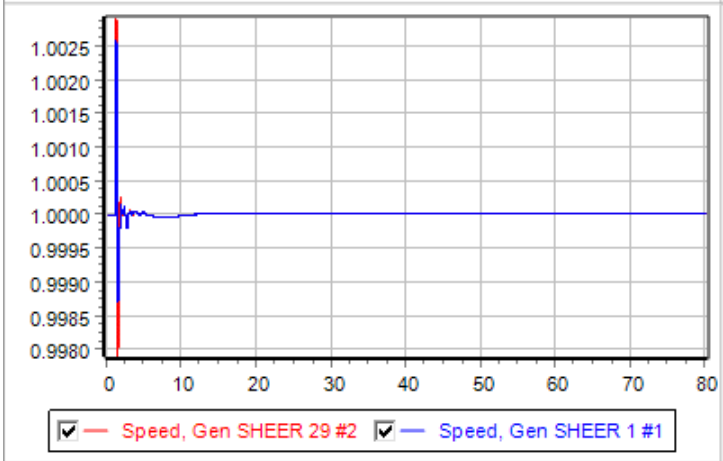
Study Case:
Scenario 4 (2022SP)

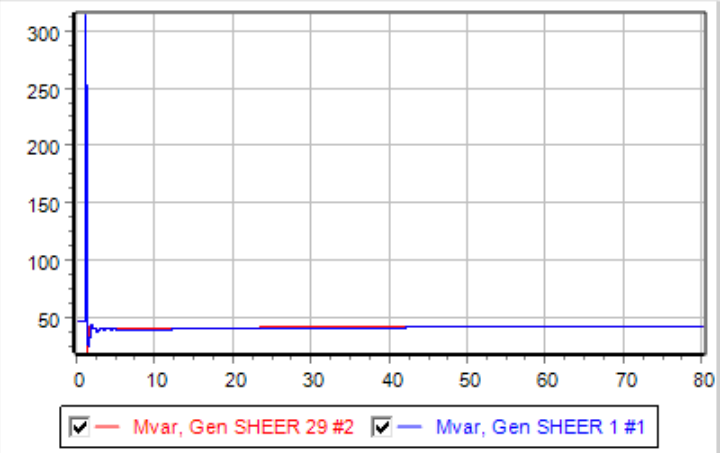
December 04, 2020 17:05:59

Sheerness







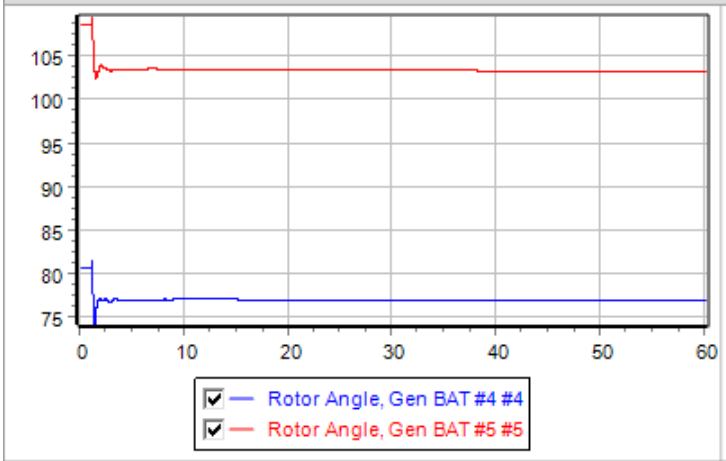


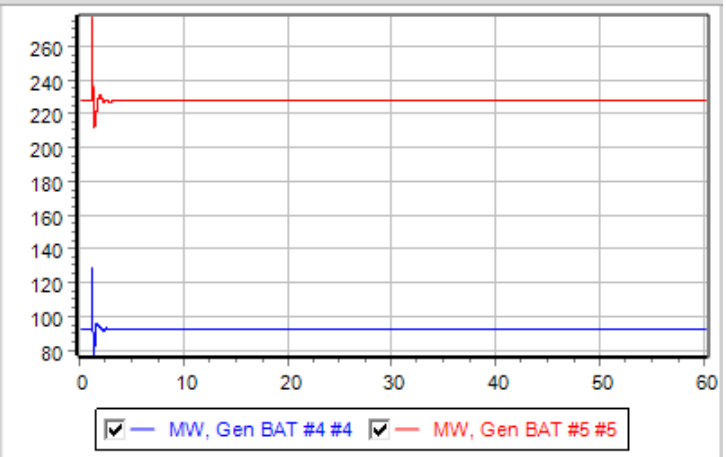
Contingency:
9L46: N.Bridgen to Lanfine 959S

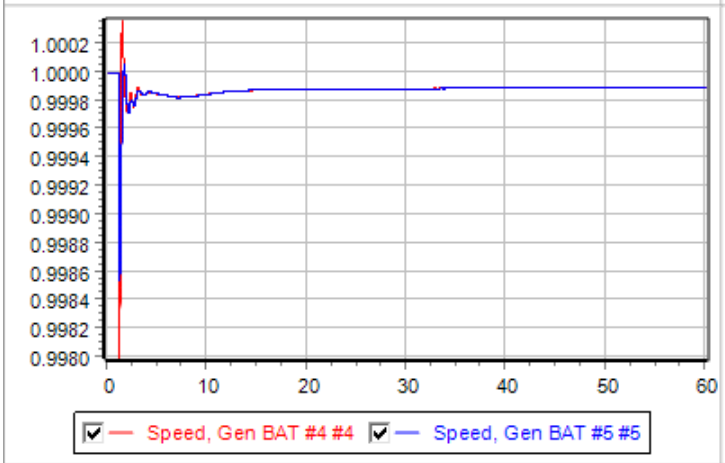
Study Case:
Scenario 4 (2022SP)

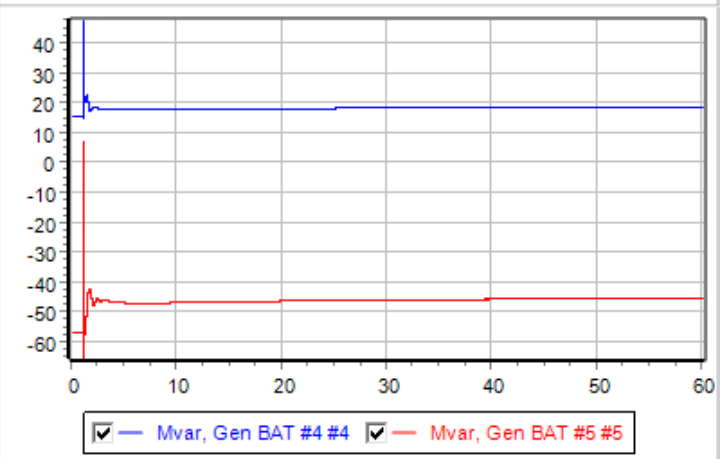
December 04, 2020 17:05:58

Battle River







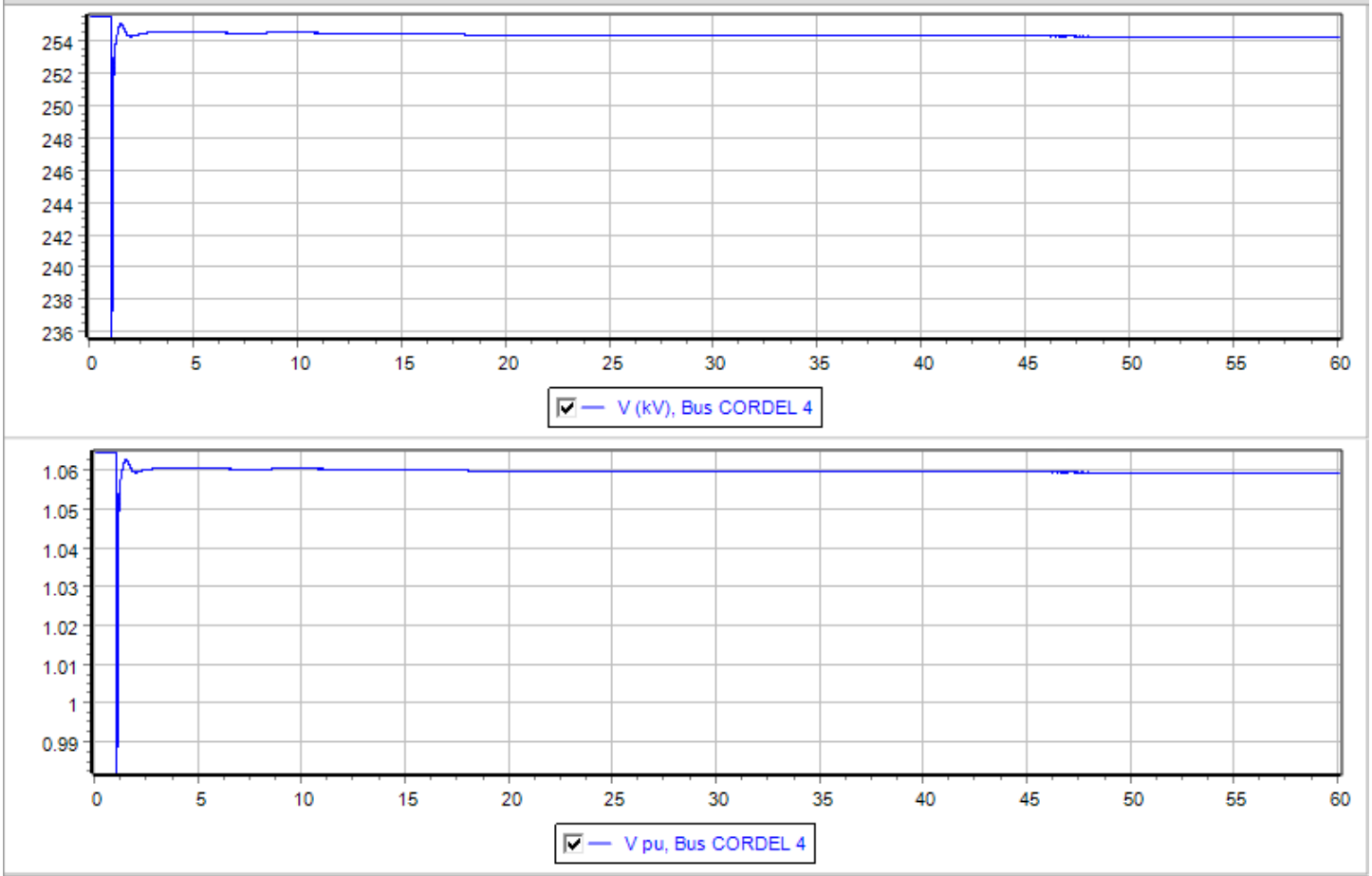


Contingency:
9L51: N.Bridgen to Pemukan 932S

Study Case:
Scenario 4 (2022SP)

December 04, 2020 16:18:12

Cordel 755S Voltages

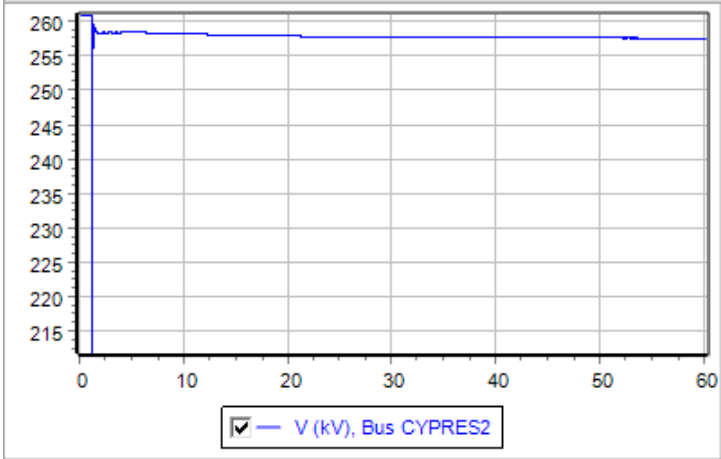


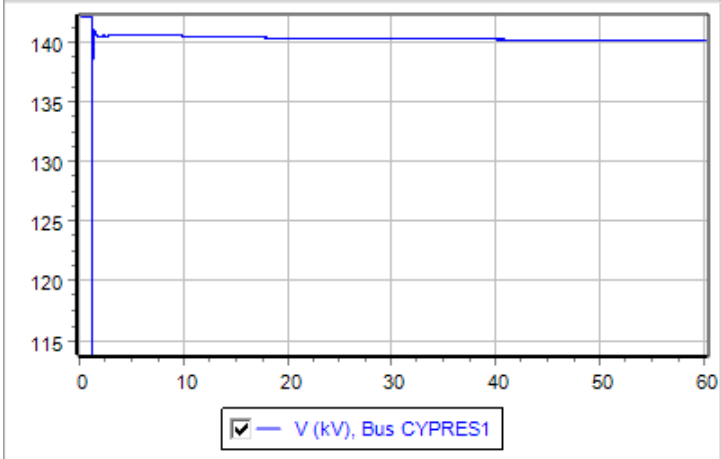
Contingency:
9L51: N.Bridgen to Pemukan 932S

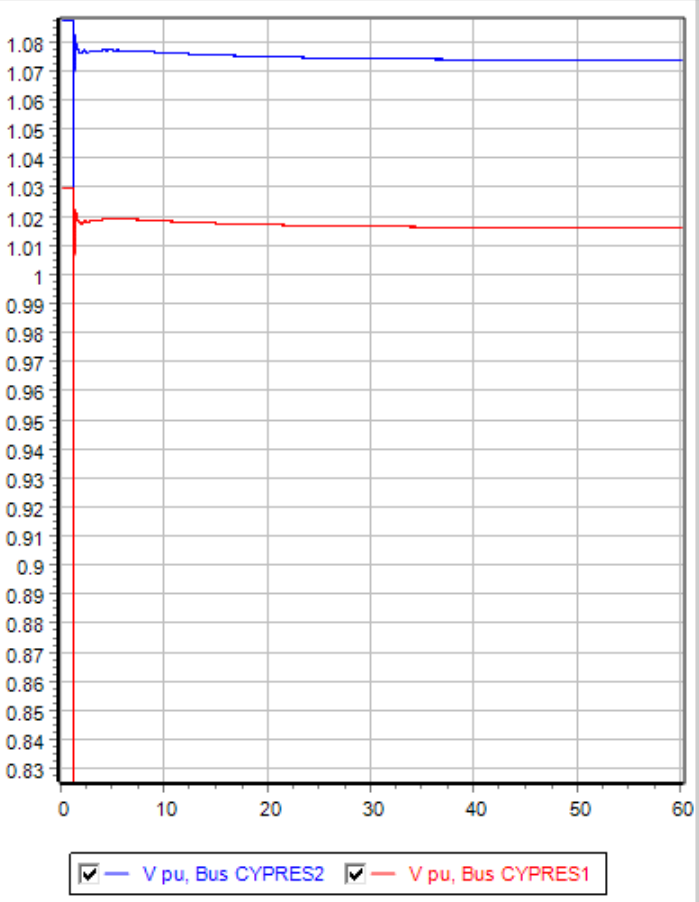
Study Case:
Scenario 4 (2022SP)

December 04, 2020 16:18:15

Cypress 562S Voltages





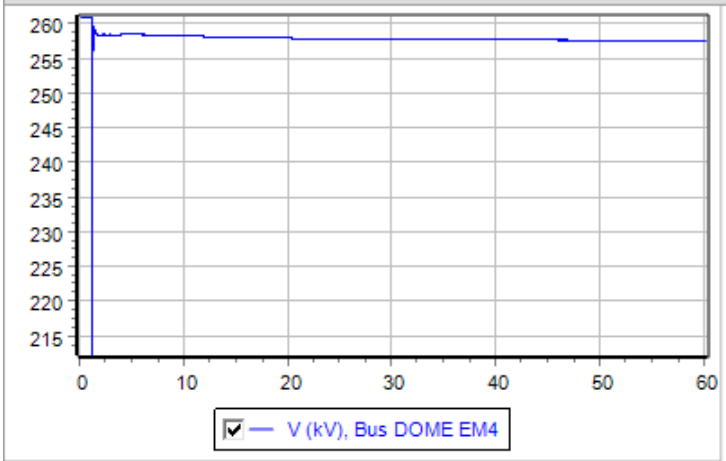


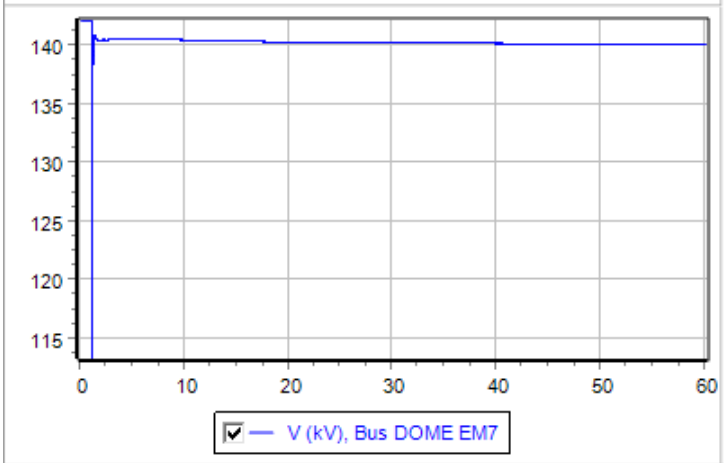
Contingency:
9L51: N.Bridgen to Pemukan 932S

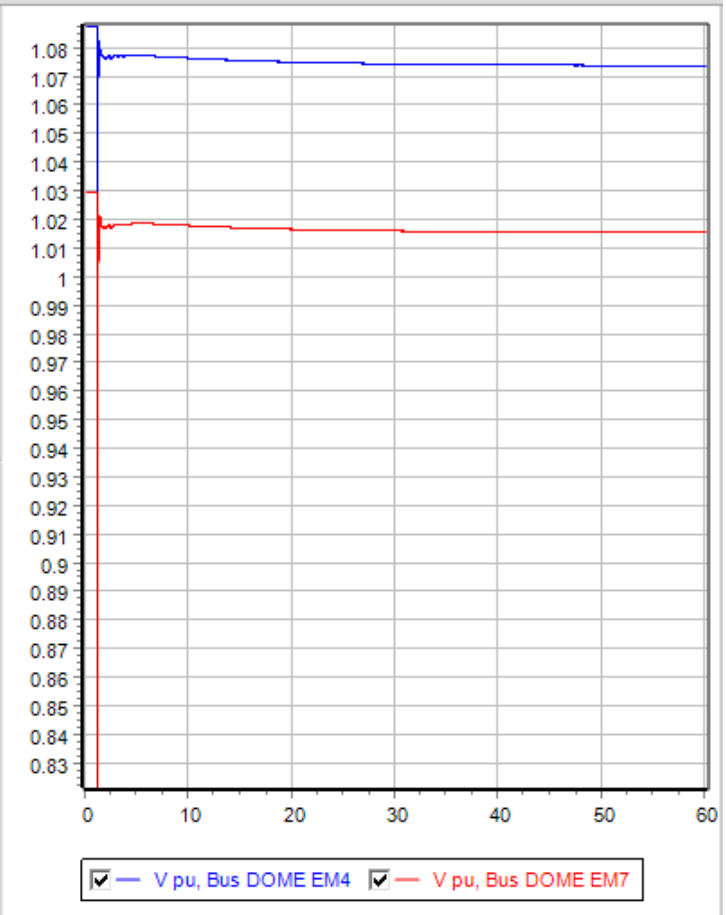
Study Case:
Scenario 4 (2022SP)

December 04, 2020 16:18:14

Dome 163S Voltages





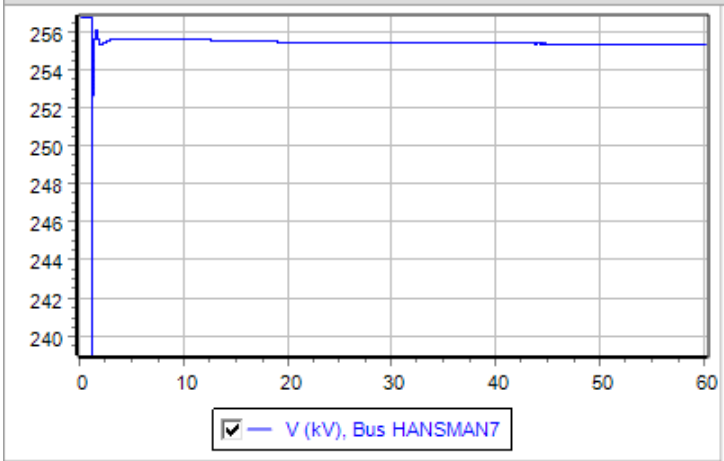


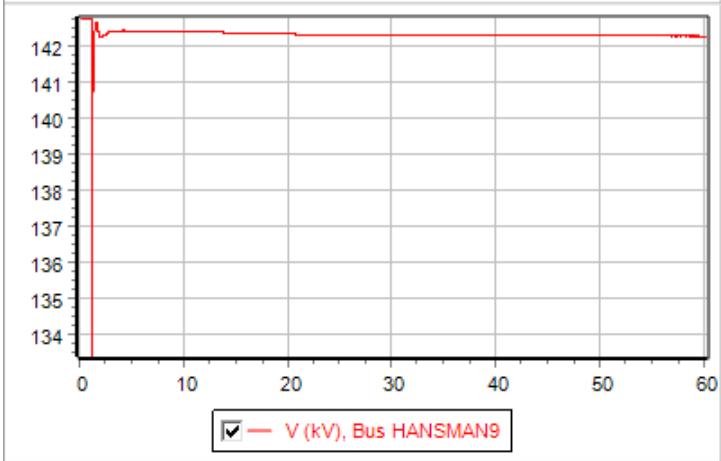
Contingency:
9L51: N.Bridgen to Pemukan 932S

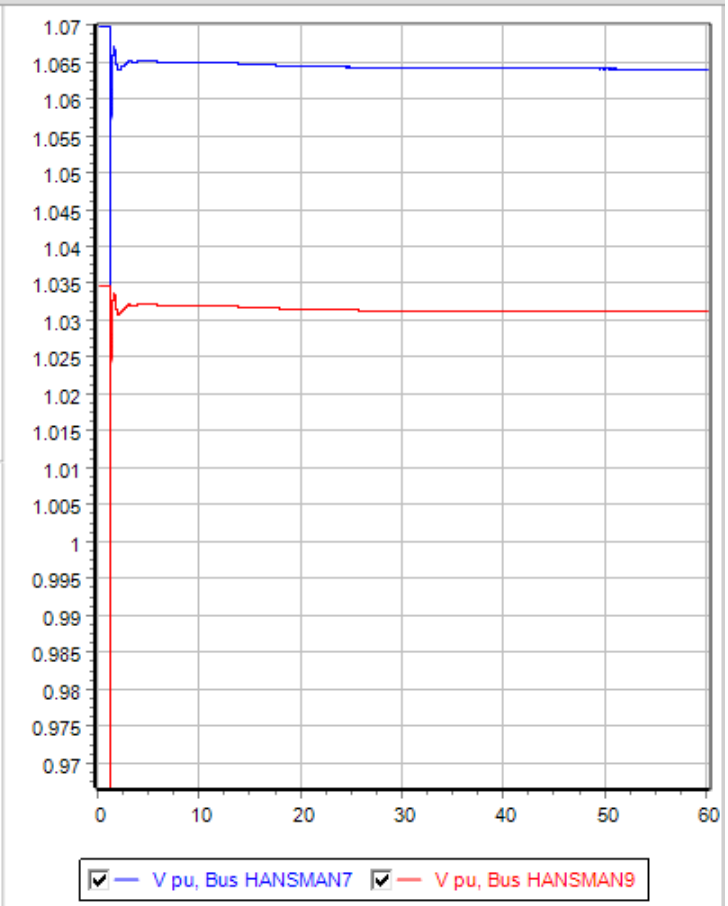
Study Case:
Scenario 4 (2022SP)

December 04, 2020 16:18:14

Hansman Lake 650S Voltages





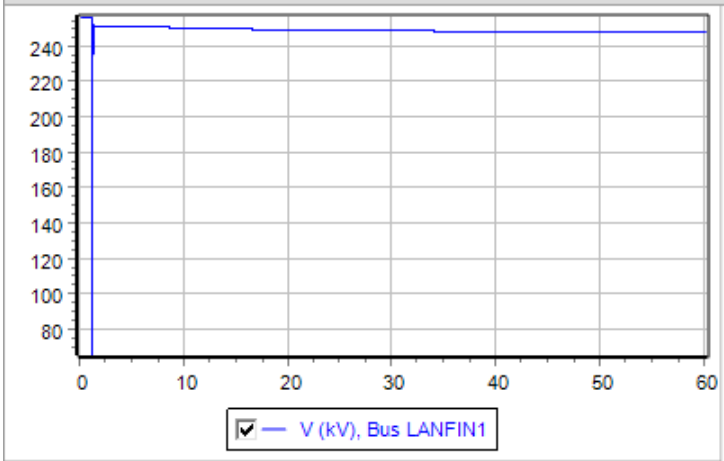


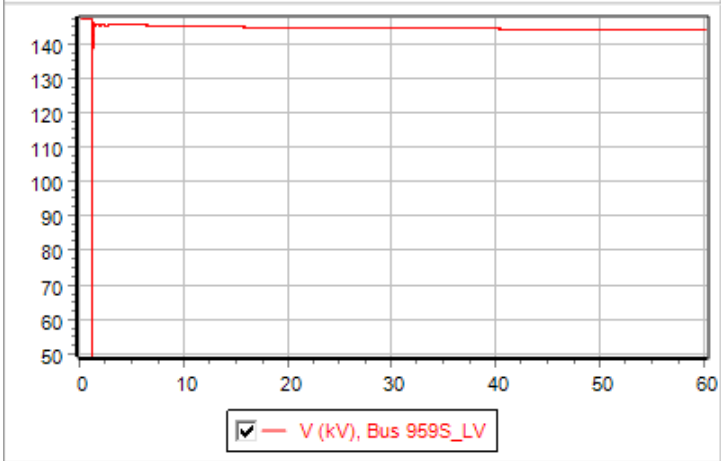
Contingency:
9L51: N.Bridgen to Pemukan 932S

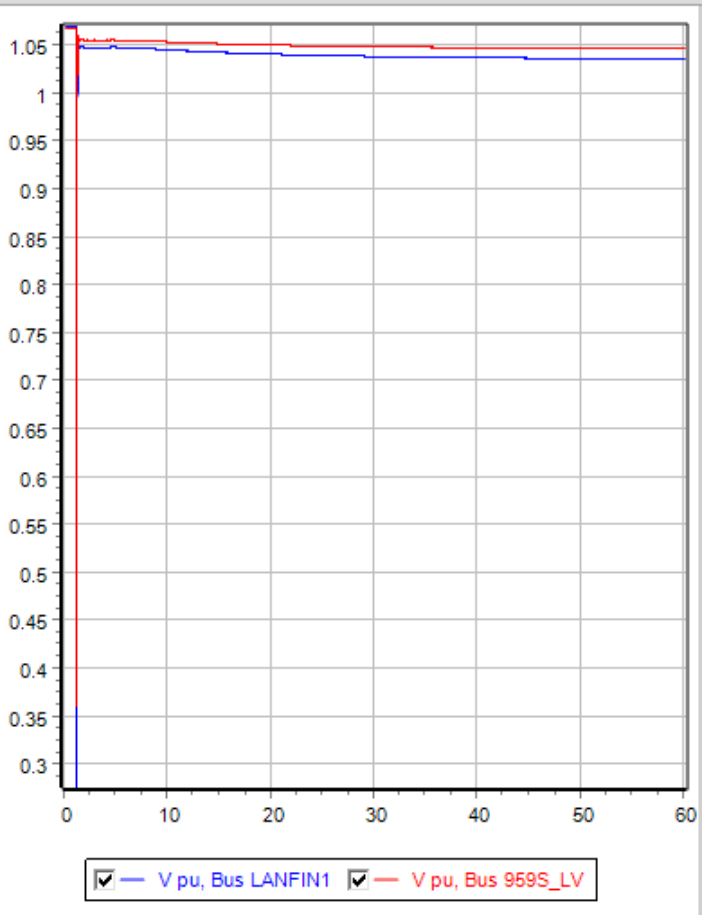
Study Case:
Scenario 4 (2022SP)

December 04, 2020 16:18:13

Lanfine 959S Voltages





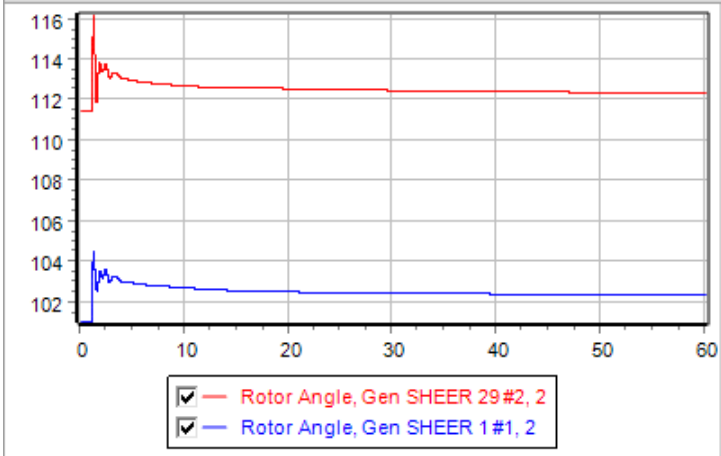


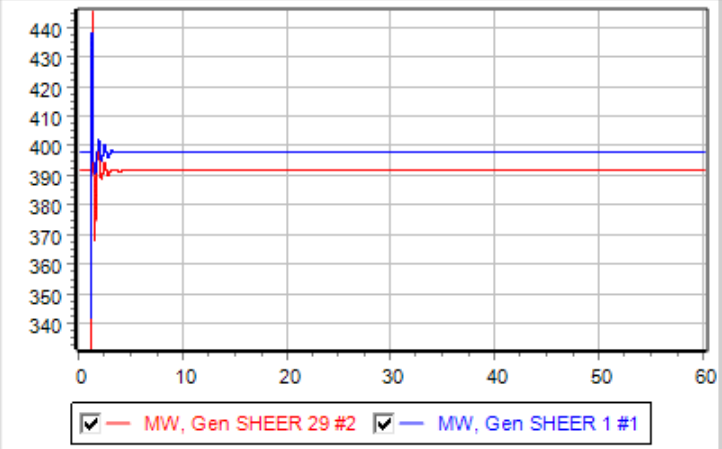
Contingency:
9L51: N.Bridgen to Pemukan 932S

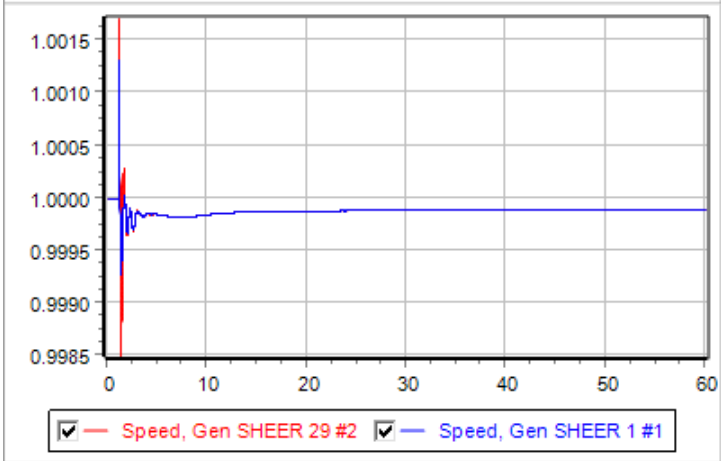
Study Case:
Scenario 4 (2022SP)

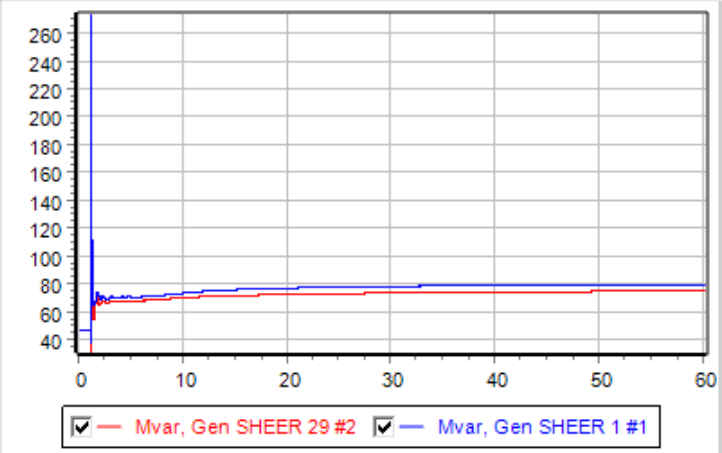
December 04, 2020 16:18:12

Sheerness







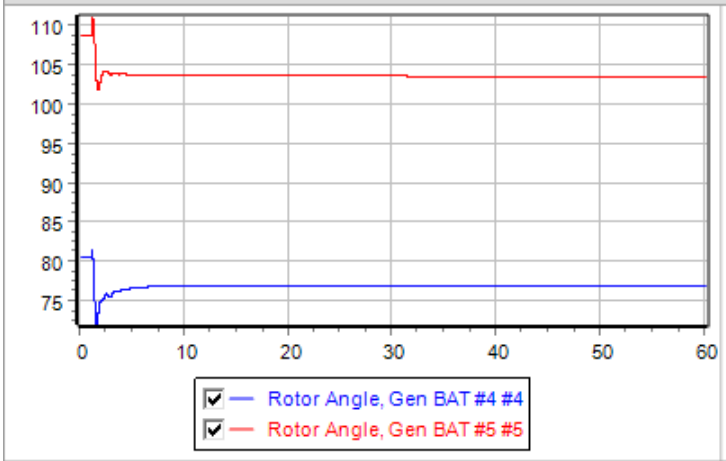


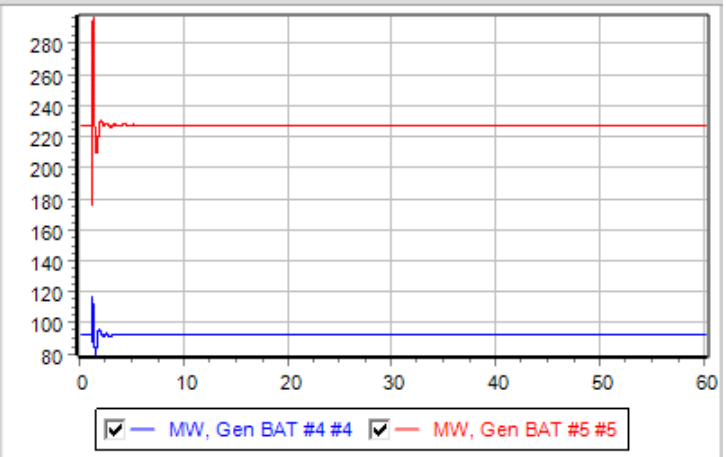
Contingency:
9L51: N.Bridgen to Pemukan 932S

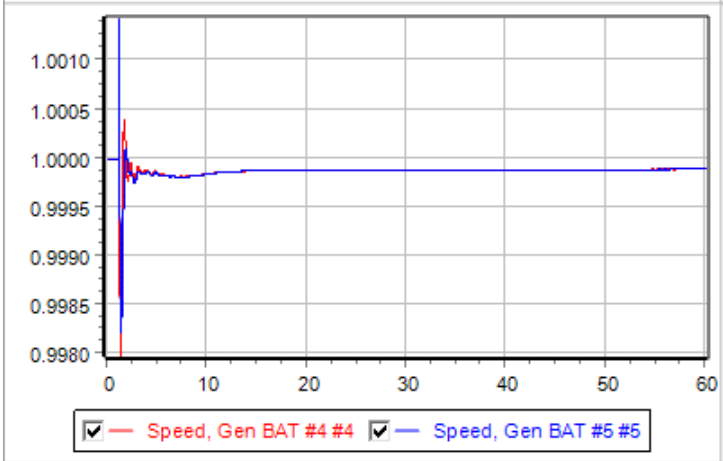
Study Case:
Scenario 4 (2022SP)

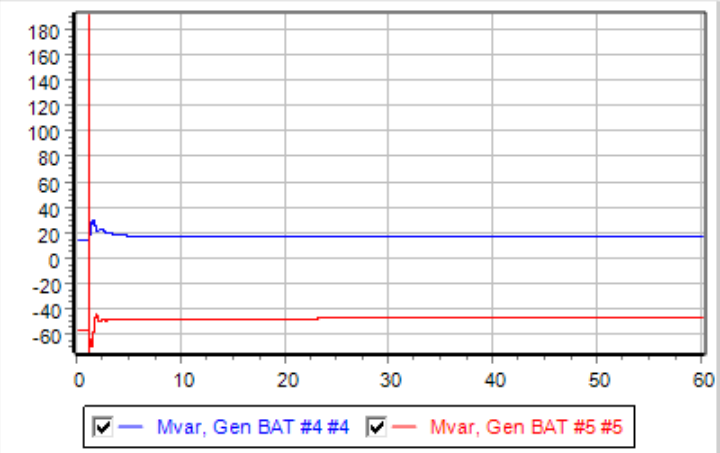
December 04, 2020 16:18:11

Battle River







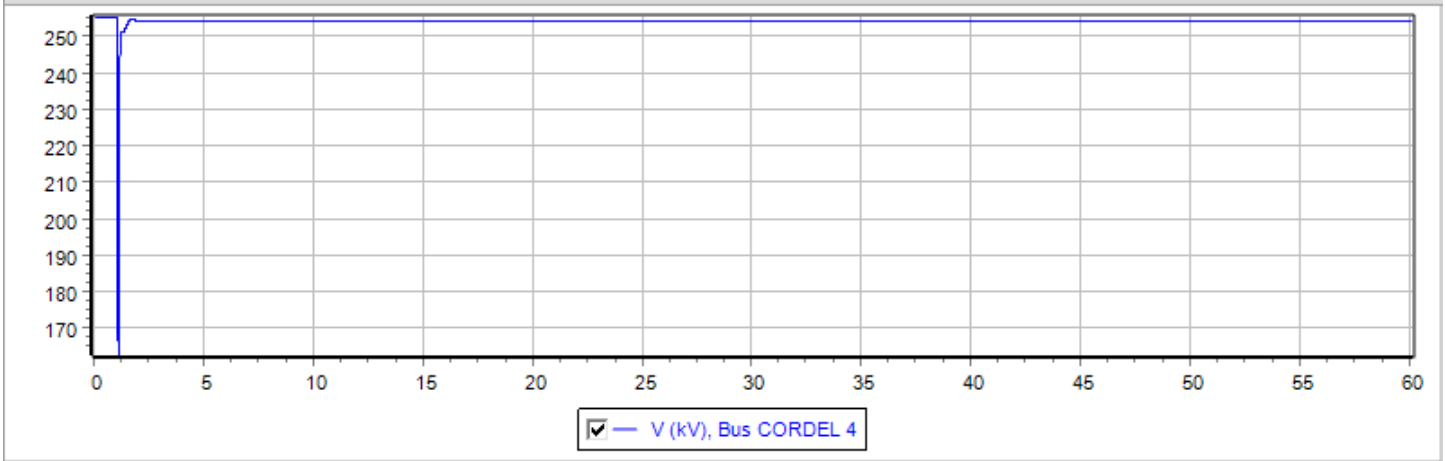


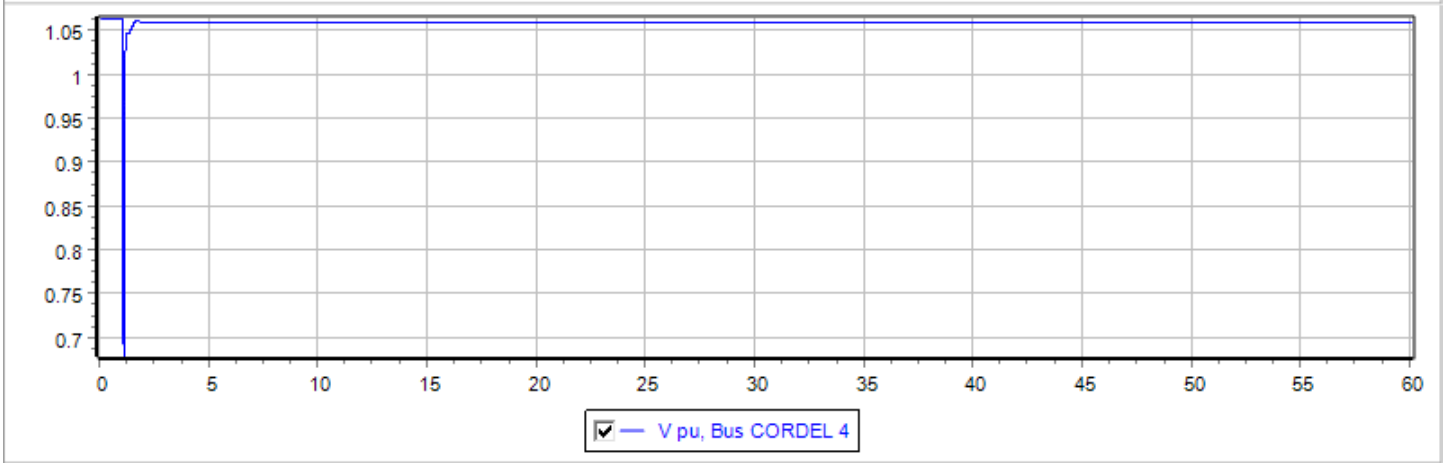
Contingency:
9L51: Pemukan 932S to N.Bridgen

Study Case:
Scenario 4 (2022SP)

December 04, 2020 16:21:38

Cordel 755S Voltages



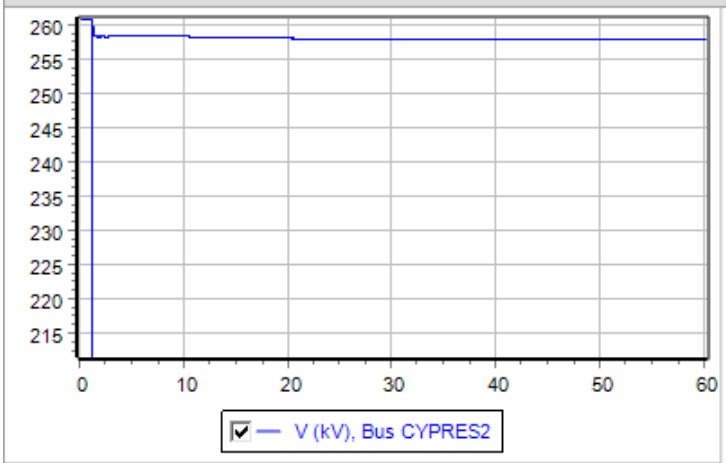


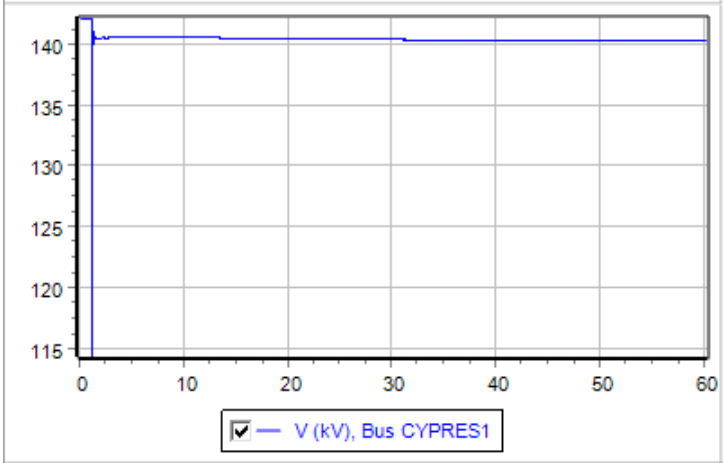
Contingency:
9L51: Pemukan 932S to N.Bridgen

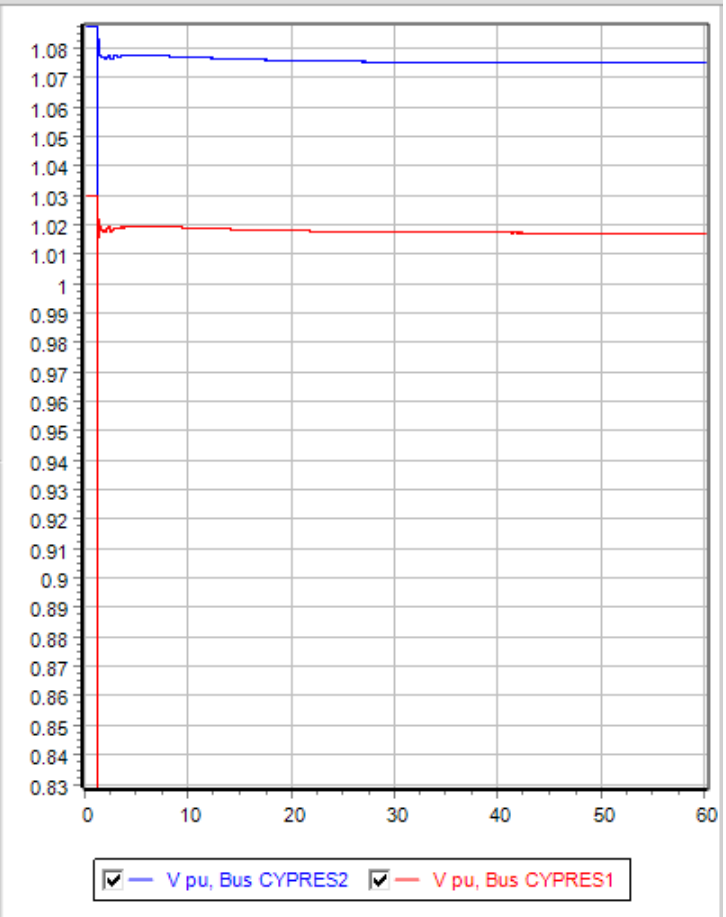
Study Case:
Scenario 4 (2022SP)

December 04, 2020 16:21:40

Cypress 562S Voltages





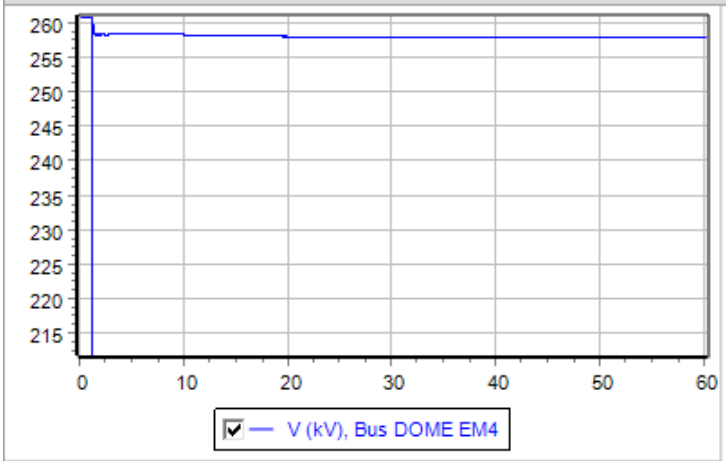


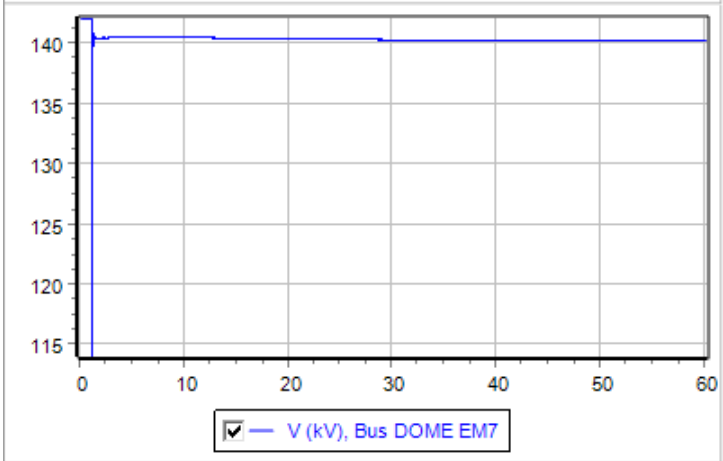
Contingency:
9L51: Pemukan 932S to N.Bridgen

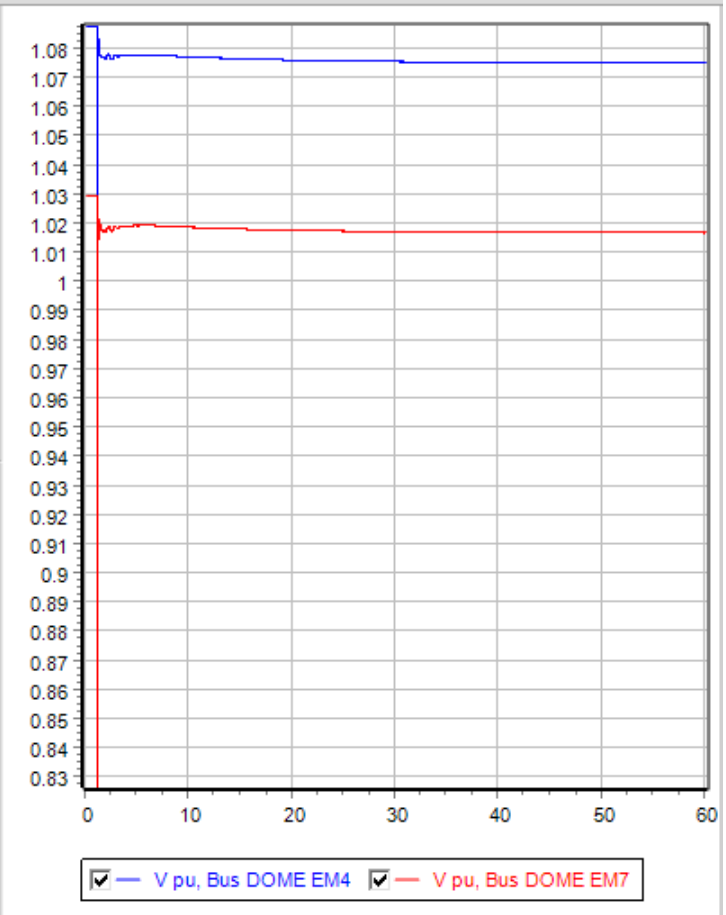
Study Case:
Scenario 4 (2022SP)

December 04, 2020 16:21:40

Dome 163S Voltages





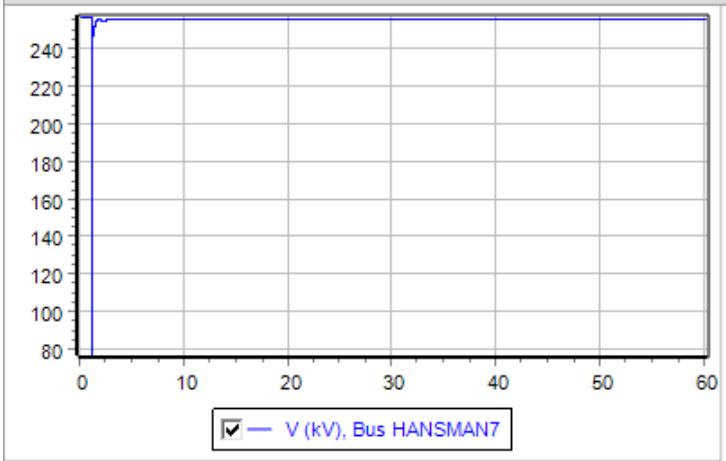


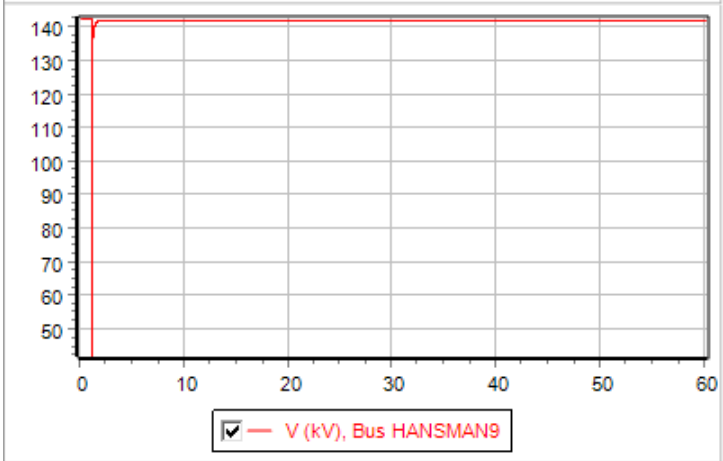
Contingency:
9L51: Pemukan 932S to N.Bridgen

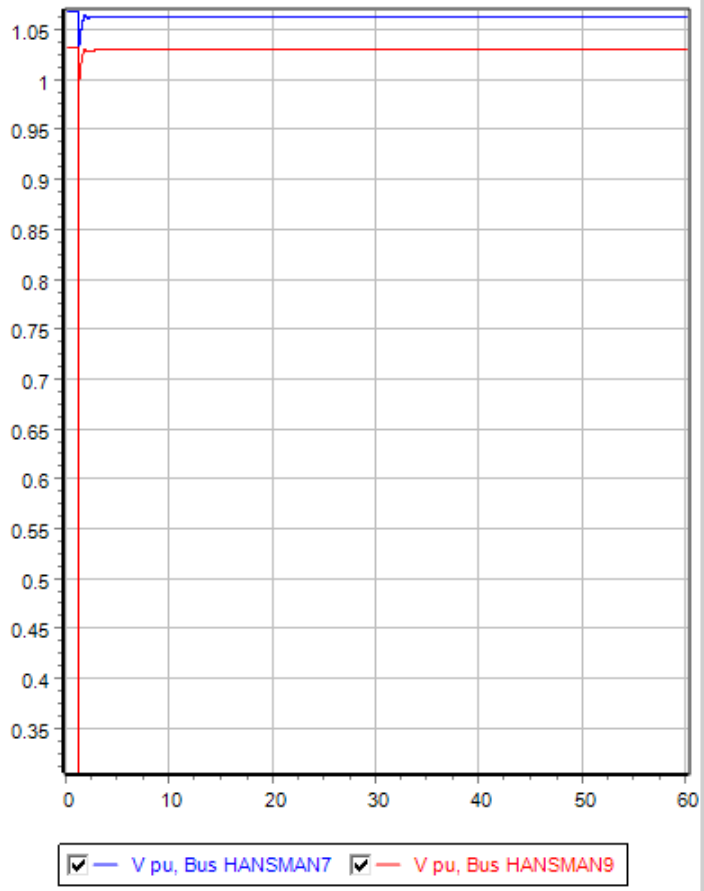
Study Case:
Scenario 4 (2022SP)

December 04, 2020 16:21:39

Hansman Lake 650S Voltages





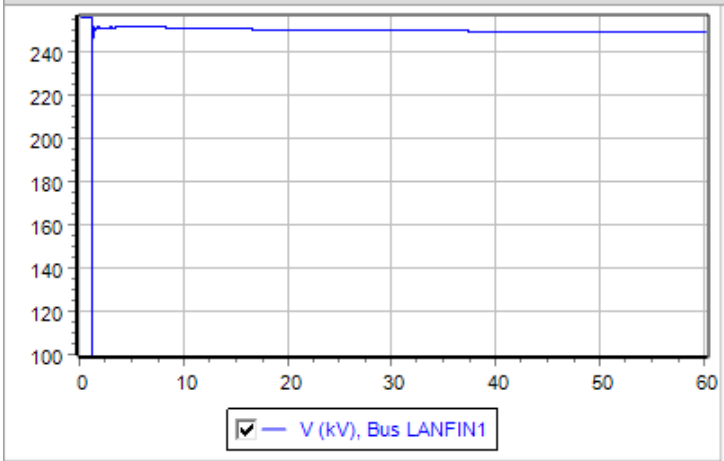


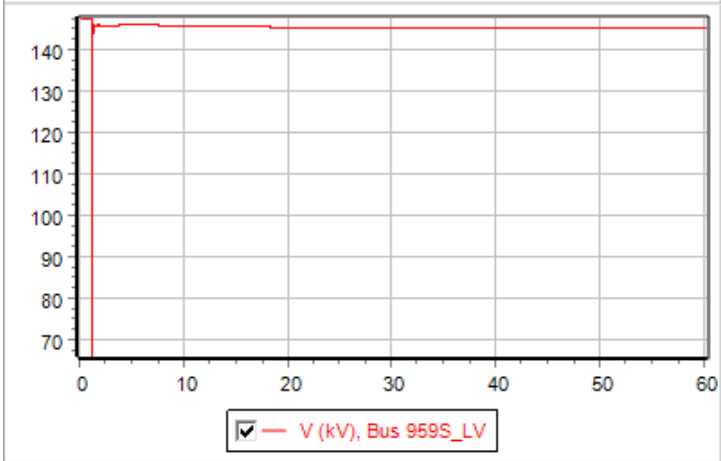
Contingency:
9L51: Pemukan 932S to N.Bridgen

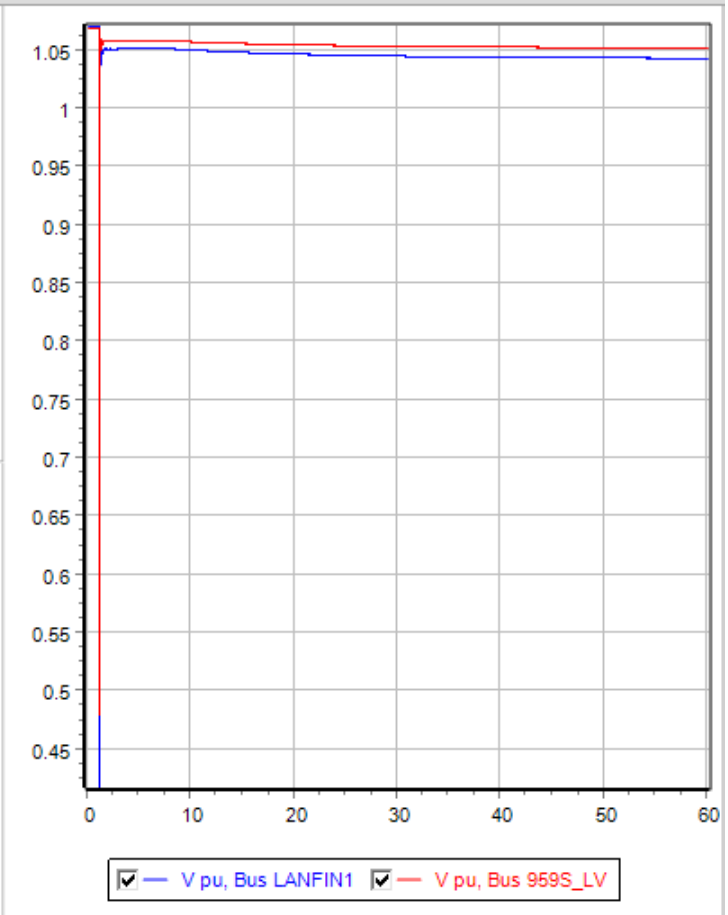
Study Case:
Scenario 4 (2022SP)

December 04, 2020 16:21:39

Lanfine 959S Voltages





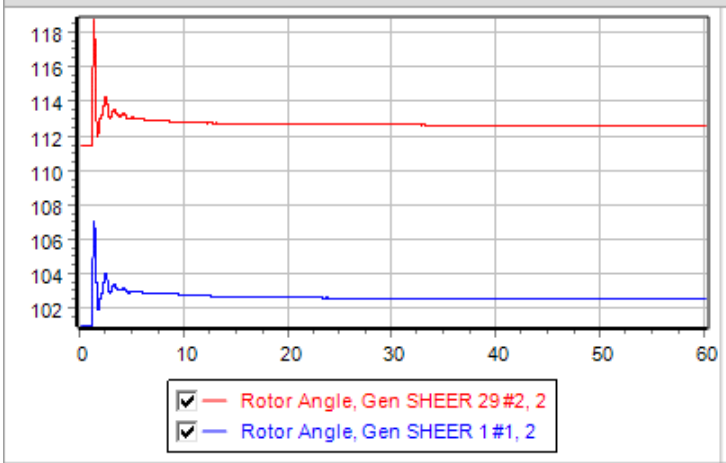


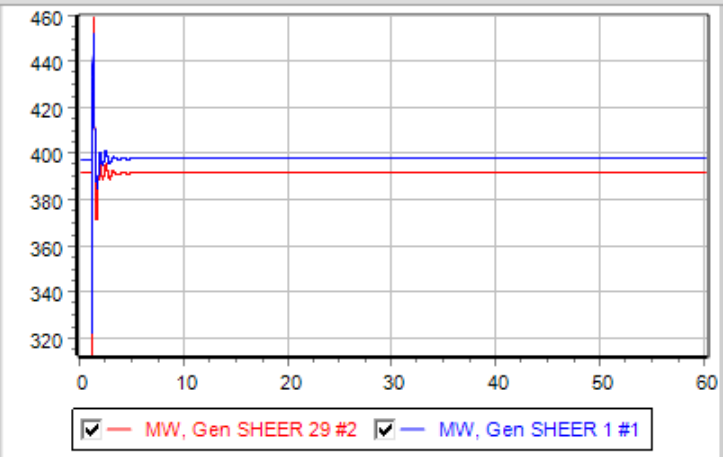
Contingency:
9L51: Pemukan 932S to N.Bridgen

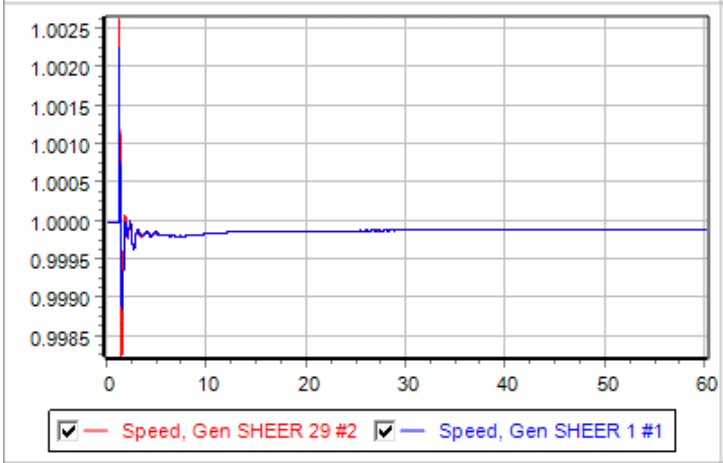
Study Case:
Scenario 4 (2022SP)

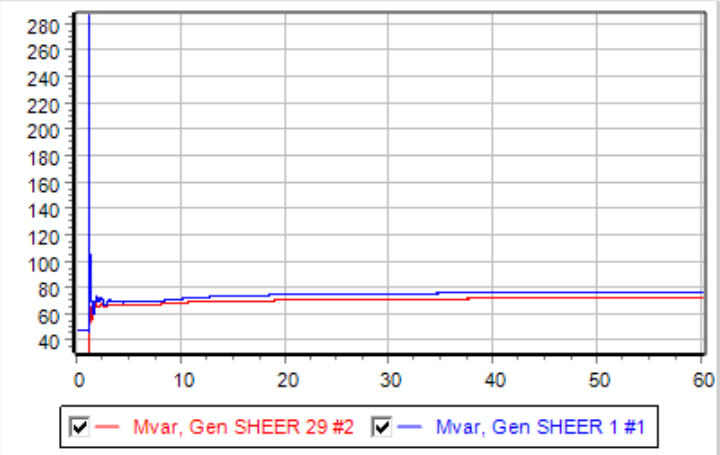
December 04, 2020 16:21:38

Sheerness







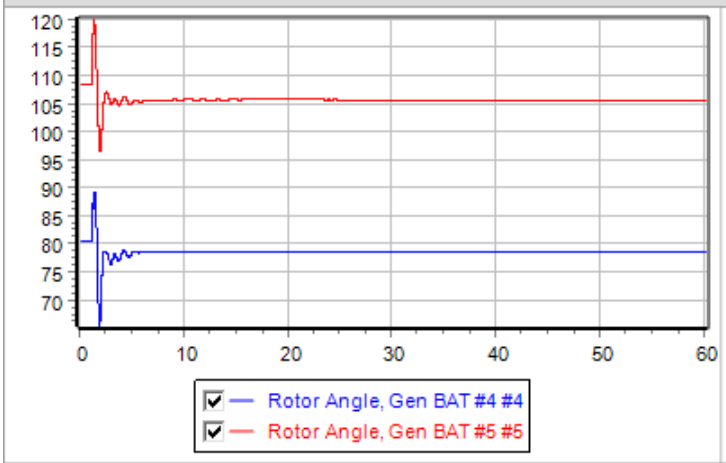


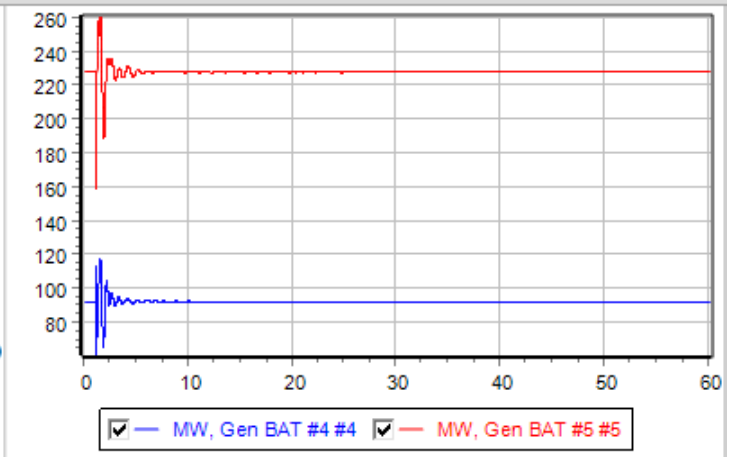
Contingency:
9L51: Pemukan 932S to N.Bridgen

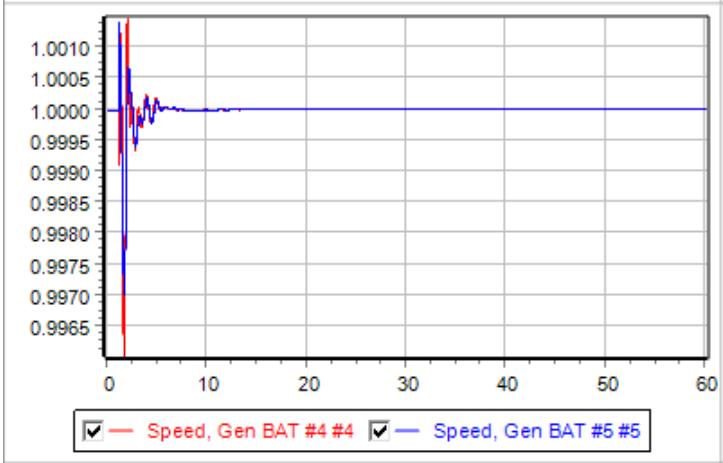
Study Case:
Scenario 4 (2022SP)

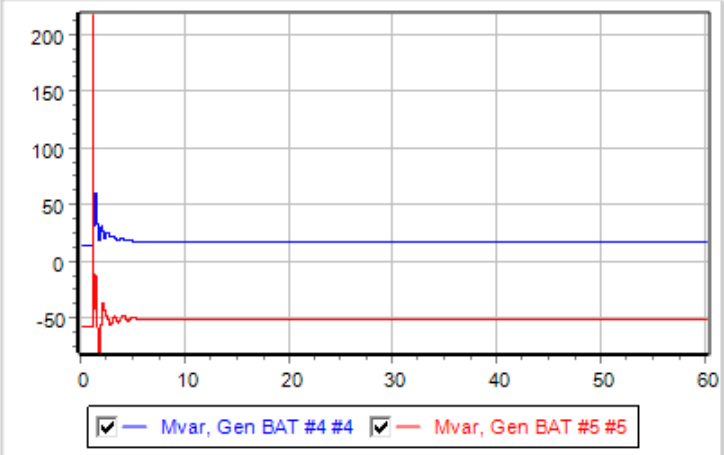
December 04, 2020 16:21:37

Battle River







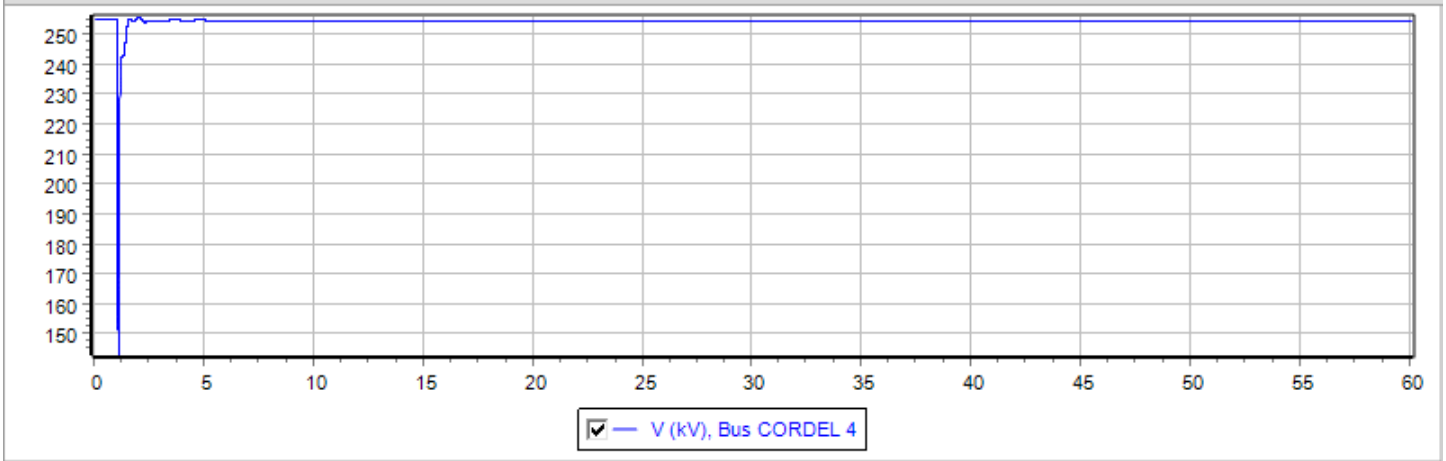


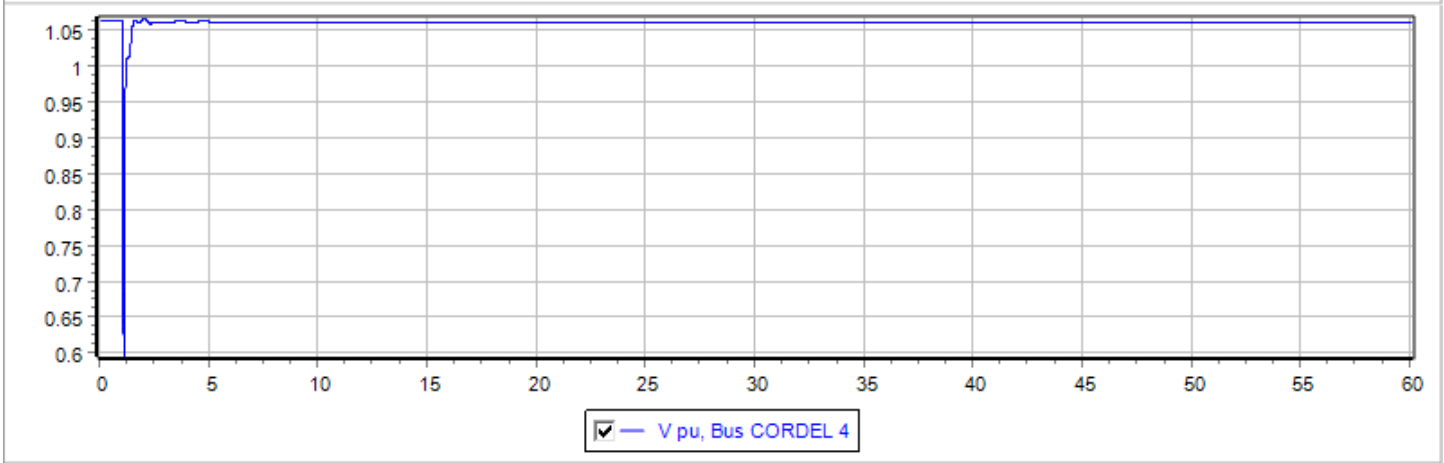
Contingency:
9L59: Anderson 801S to Tinchebray 972S

Study Case:
Scenario 4 (2022SP)

December 04, 2020 16:25:26

Cordel 755S Voltages



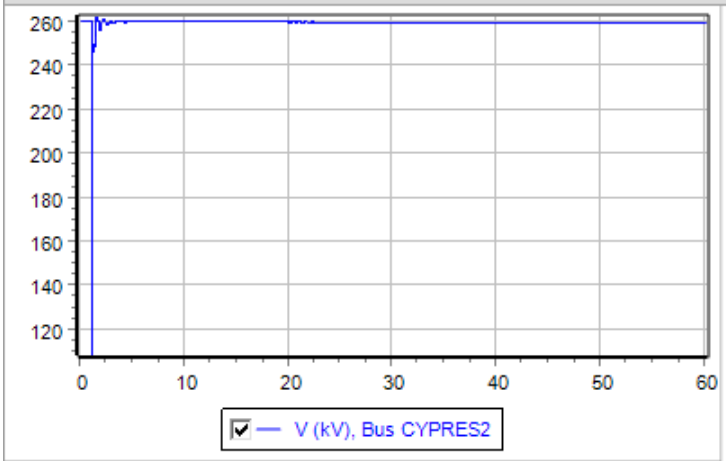


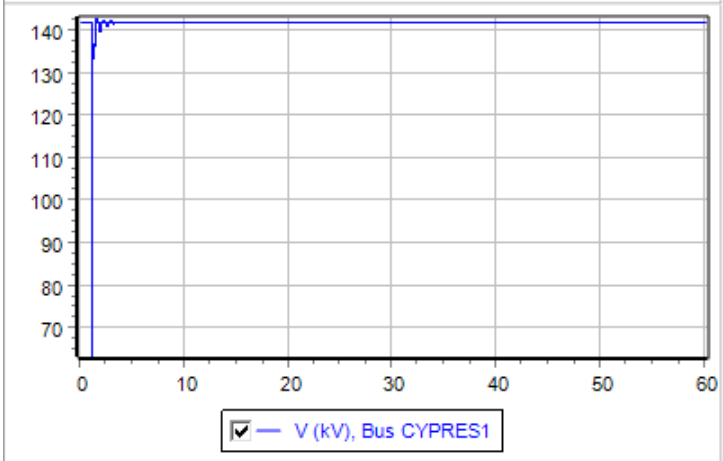
Contingency:
9L59: Anderson 801S to Tinchebray 972S

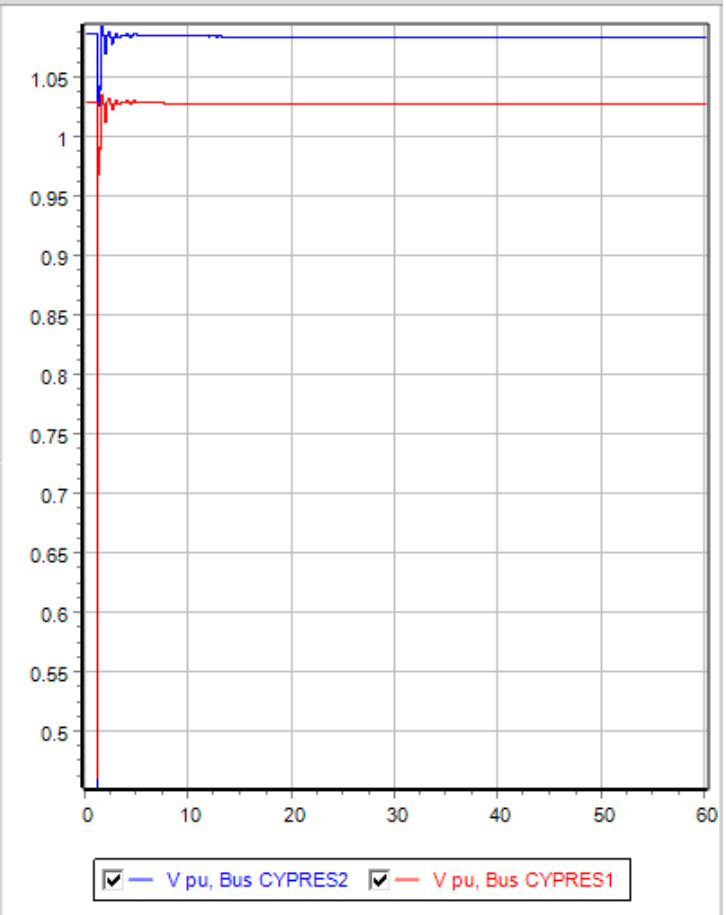
Study Case:
Scenario 4 (2022SP)

December 04, 2020 16:25:28

Cypress 562S Voltages





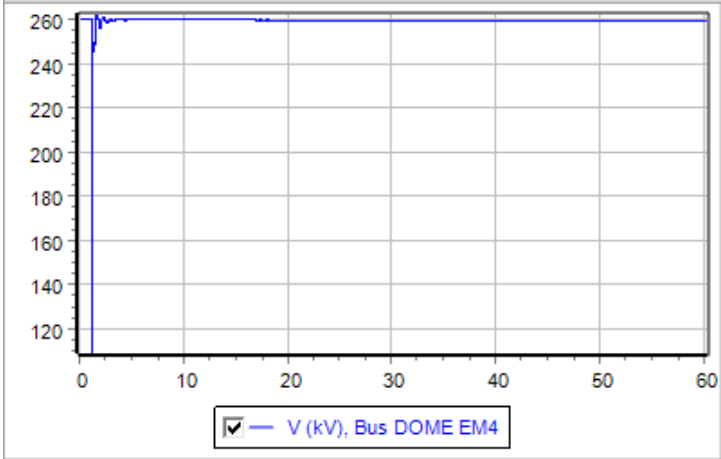


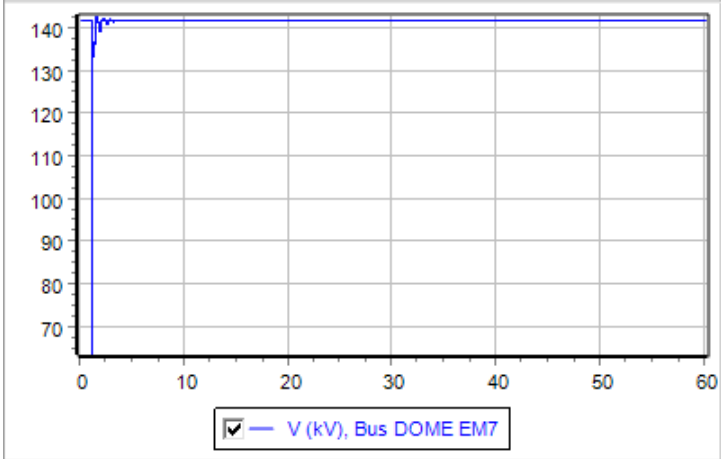
Contingency:
9L59: Anderson 801S to Tinchebray 972S

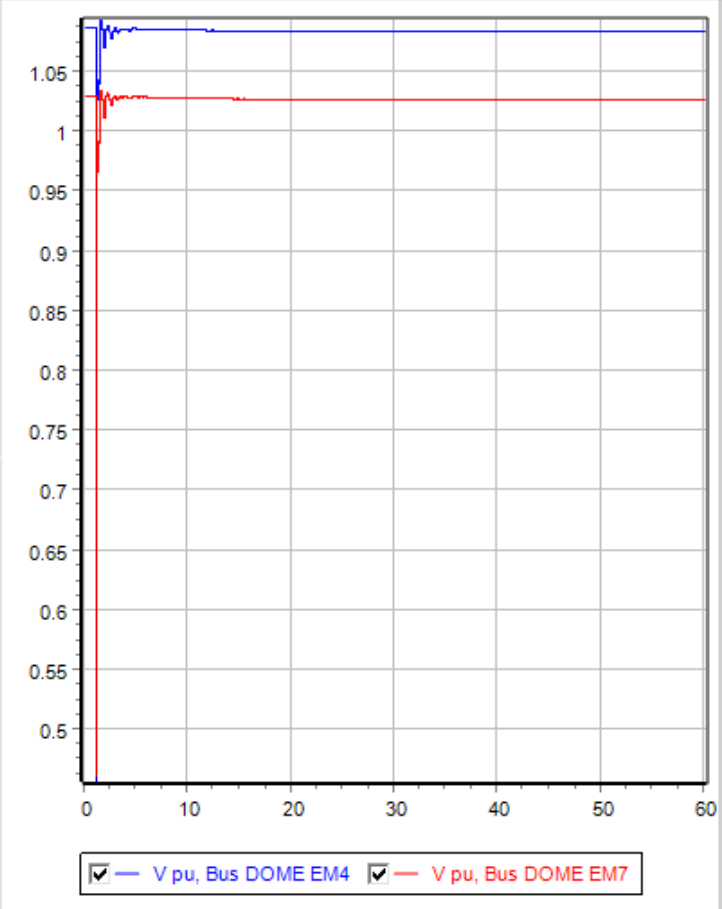
Study Case:
Scenario 4 (2022SP)

December 04, 2020 16:25:28

Dome 163S Voltages





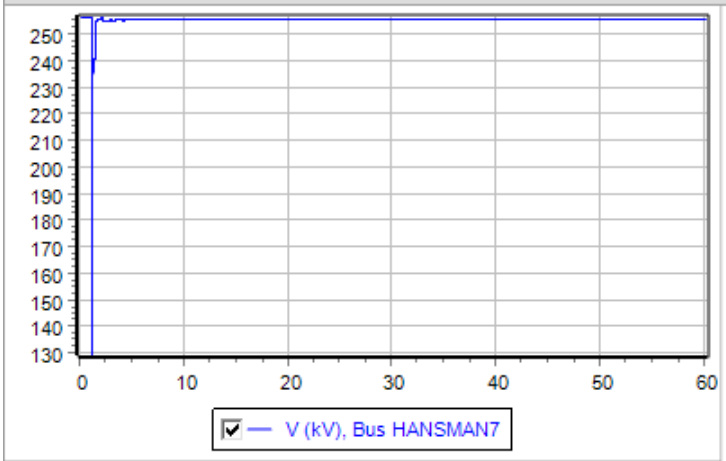


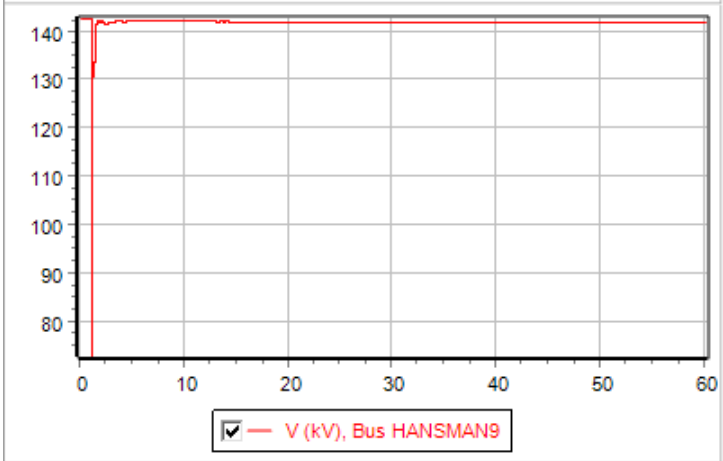
Contingency:
9L59: Anderson 801S to Tinchebray 972S

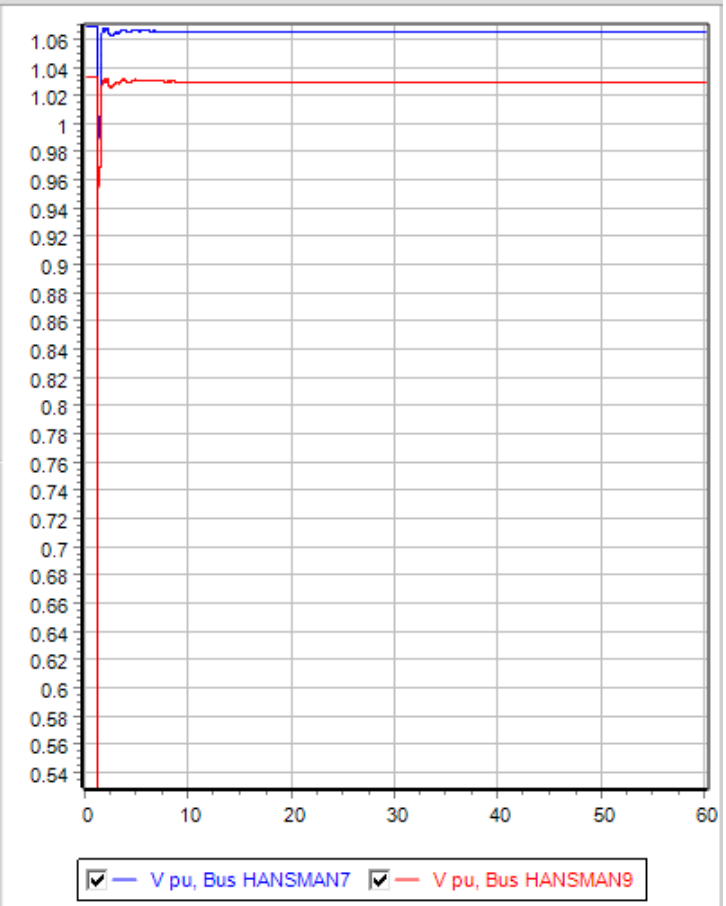
Study Case:
Scenario 4 (2022SP)

December 04, 2020 16:25:27

Hansman Lake 650S Voltages





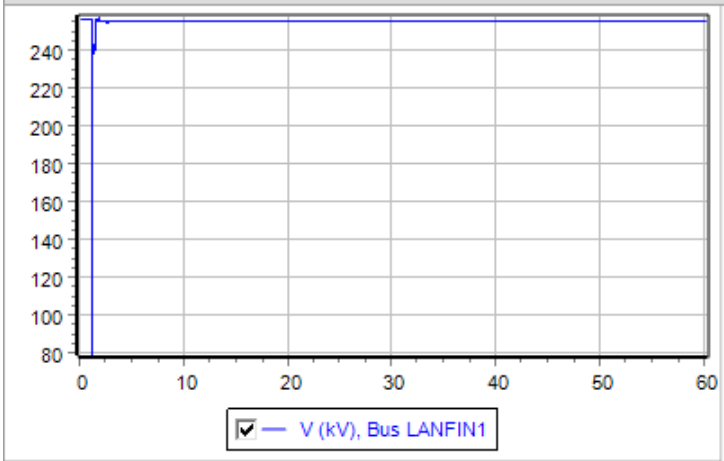


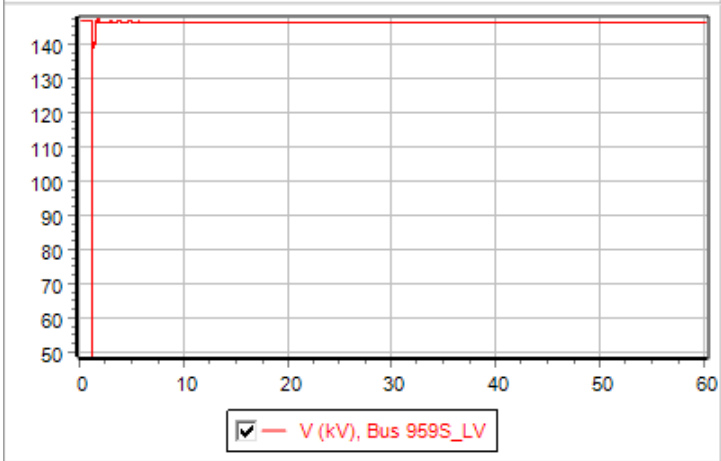
Contingency:
9L59: Anderson 801S to Tinchebray 972S

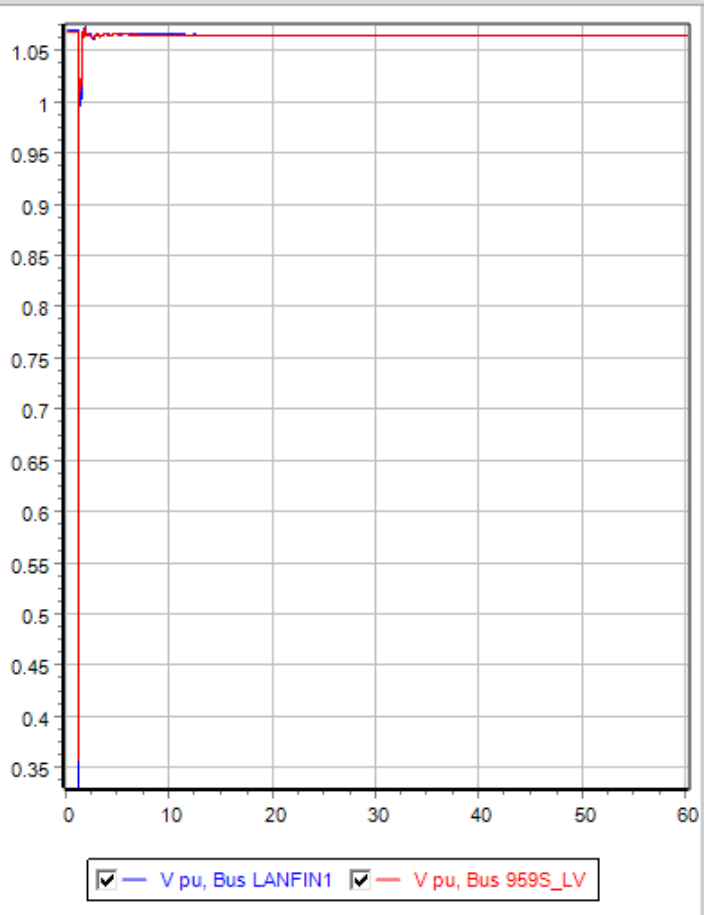
Study Case:
Scenario 4 (2022SP)

December 04, 2020 16:25:27

Lanfine 959S Voltages





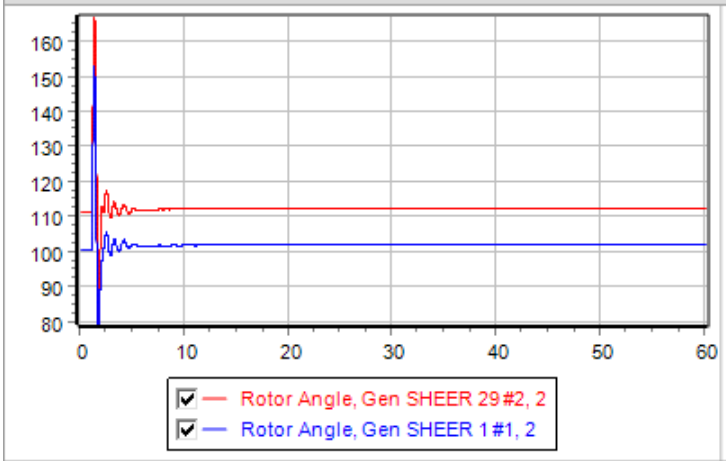


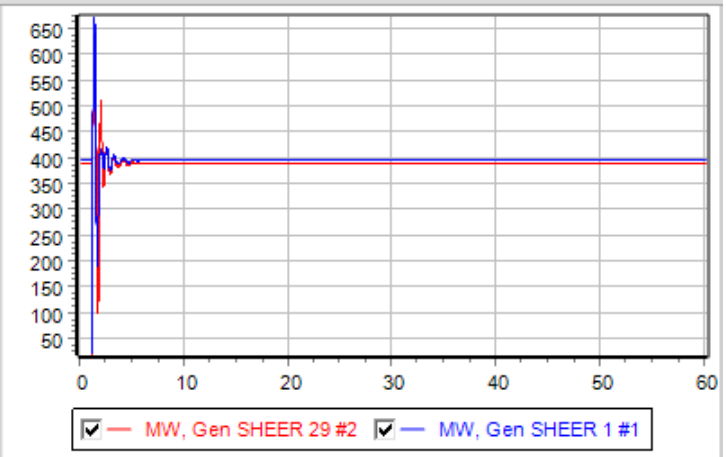
Contingency:
9L59: Anderson 801S to Tinchebray 972S

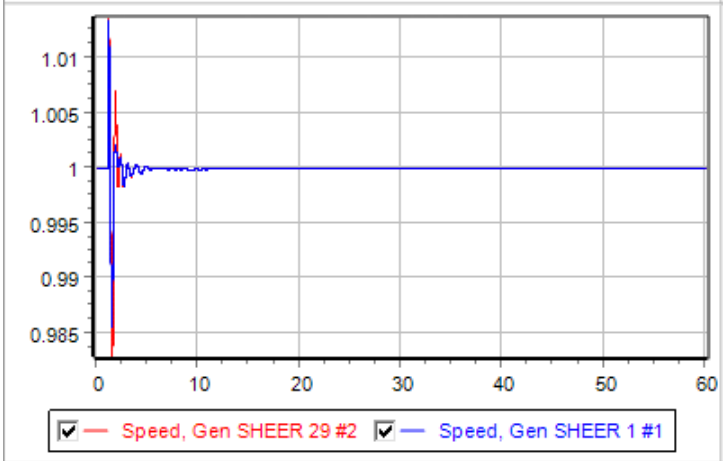
Study Case:
Scenario 4 (2022SP)

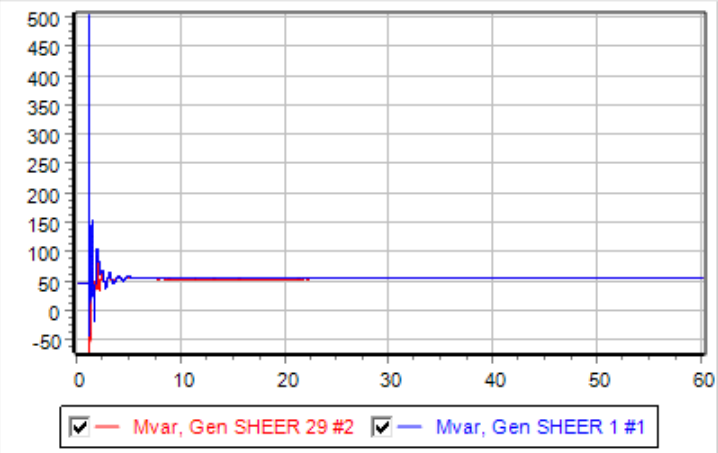
December 04, 2020 16:25:26

Sheerness







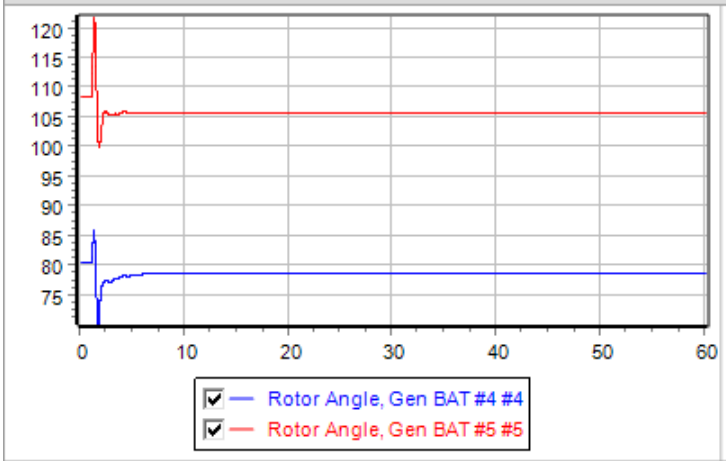


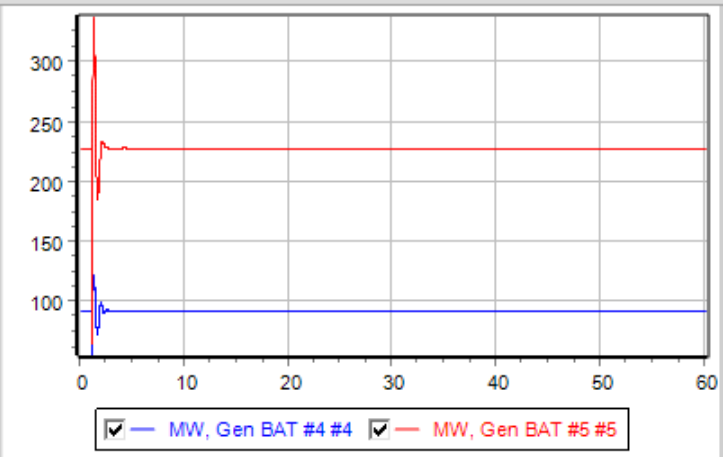
Contingency:
9L59: Anderson 801S to Tinchebray 972S

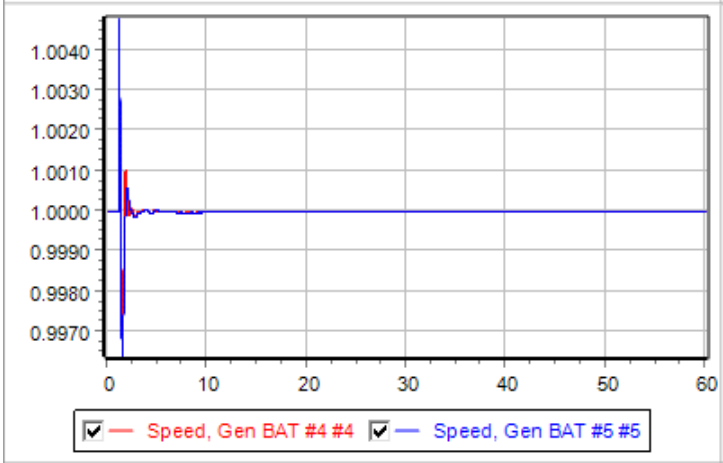
Study Case:
Scenario 4 (2022SP)

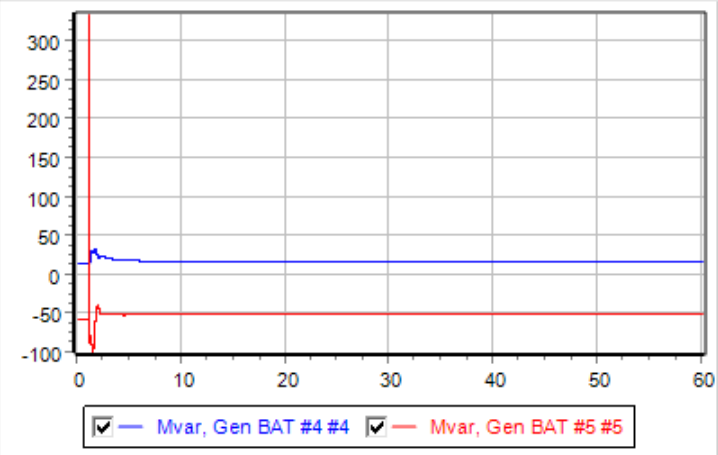
December 04, 2020 16:25:25

Battle River









Contingency:
9L59: Tinchebray 972S to Anderson 801S

Study Case:
Scenario 4 (2022SP)

December 04, 2020 16:29:05

Cordel 755S Voltages

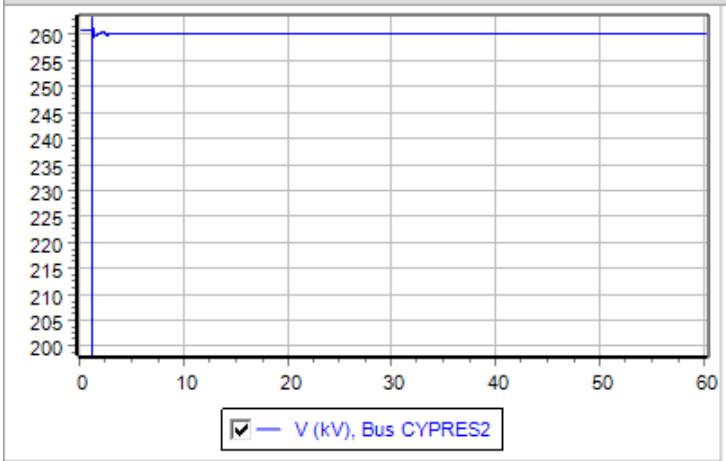


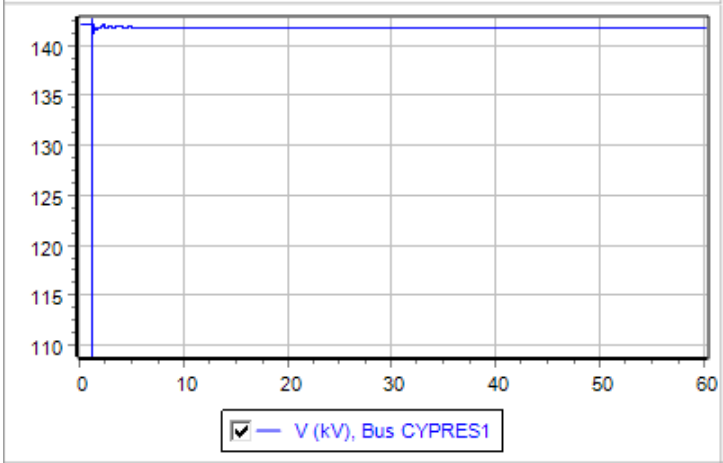
Contingency:
9L59: Tinchebray 972S to Anderson 801S

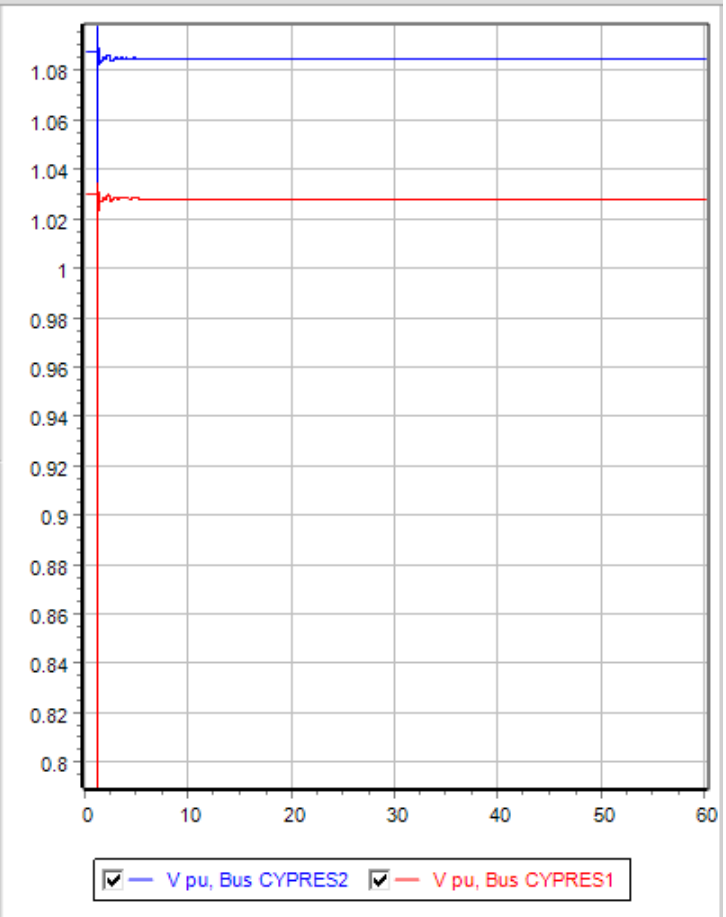
Study Case:
Scenario 4 (2022SP)

December 04, 2020 16:29:08

Cypress 562S Voltages





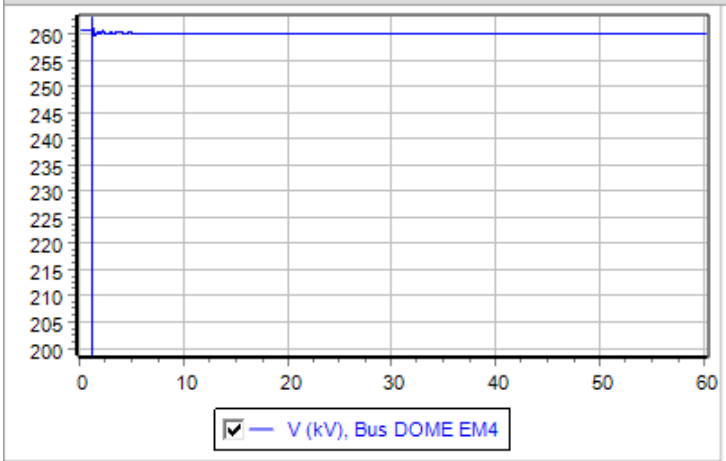


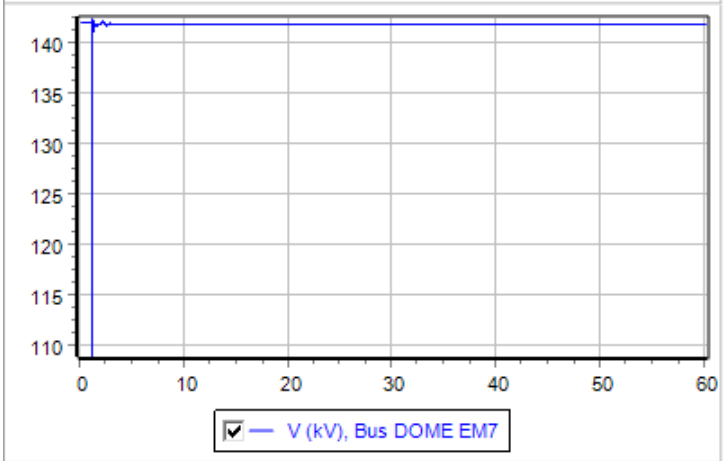
Contingency:
9L59: Tinchebray 972S to Anderson 801S

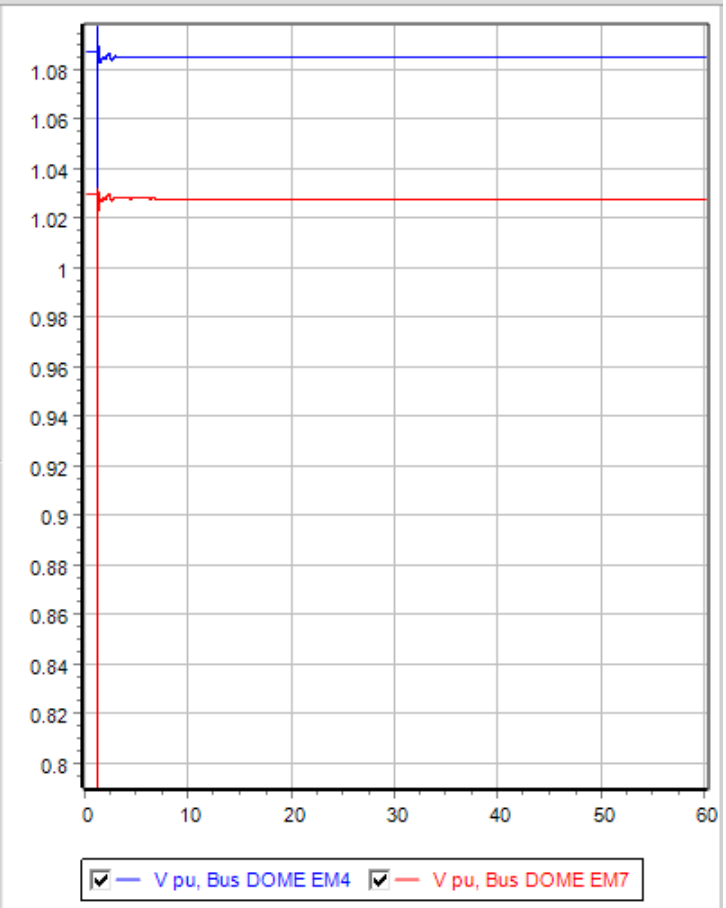
Study Case:
Scenario 4 (2022SP)

December 04, 2020 16:29:07

Dome 163S Voltages





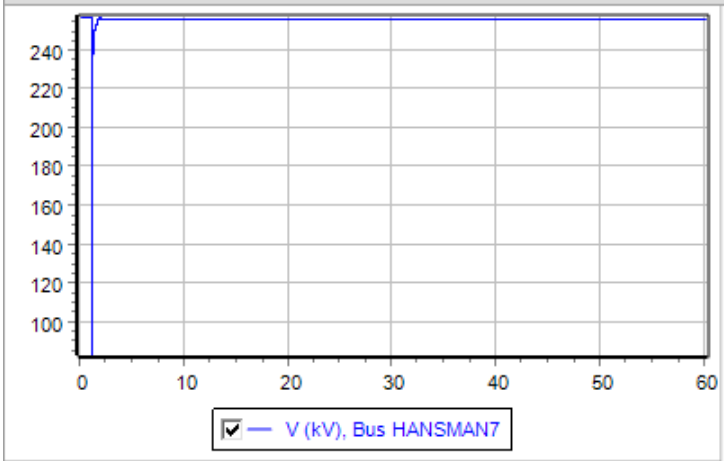


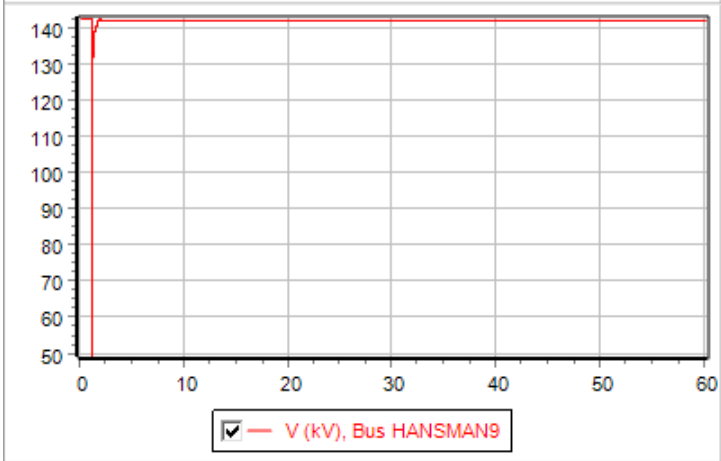
Contingency:
9L59: Tinchebray 972S to Anderson 801S

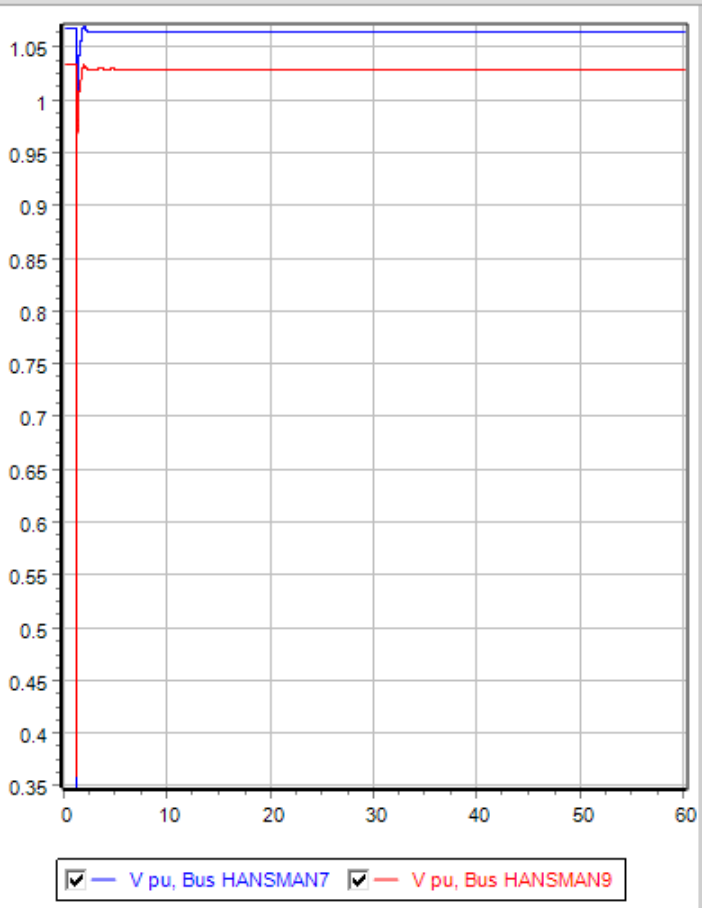
Study Case:
Scenario 4 (2022SP)

December 04, 2020 16:29:07

Hansman Lake 650S Voltages





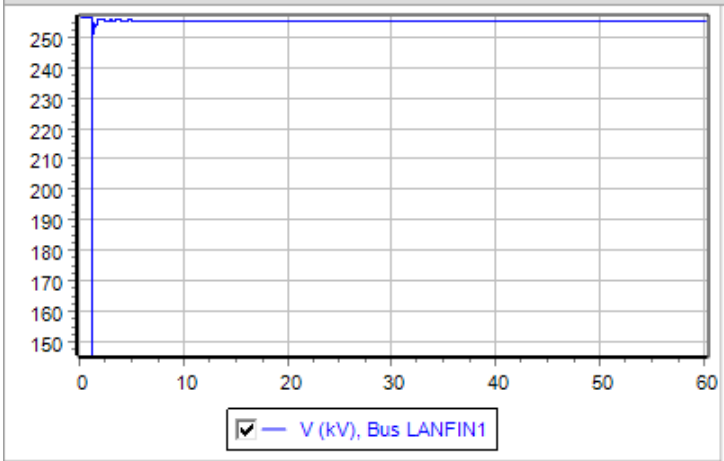


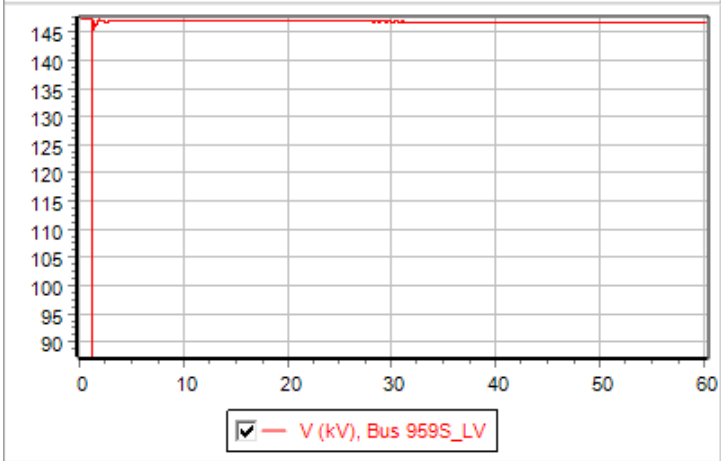
Contingency:
9L59: Tinchebray 972S to Anderson 801S

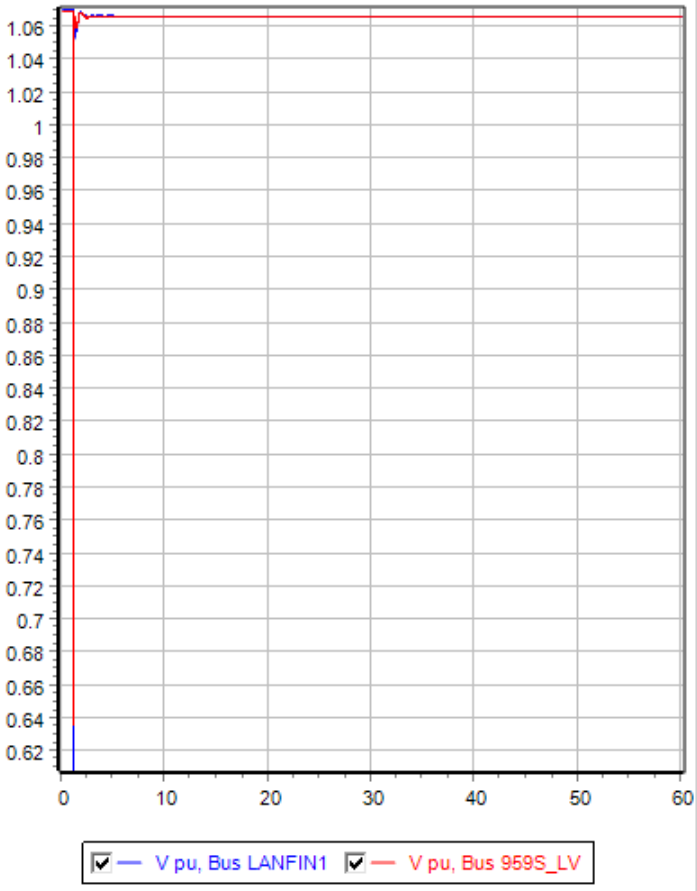
Study Case:
Scenario 4 (2022SP)

December 04, 2020 16:29:06

Lanfine 959S Voltages





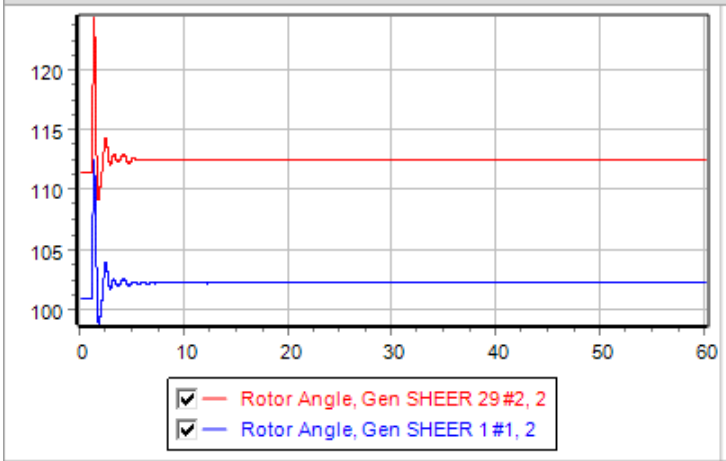


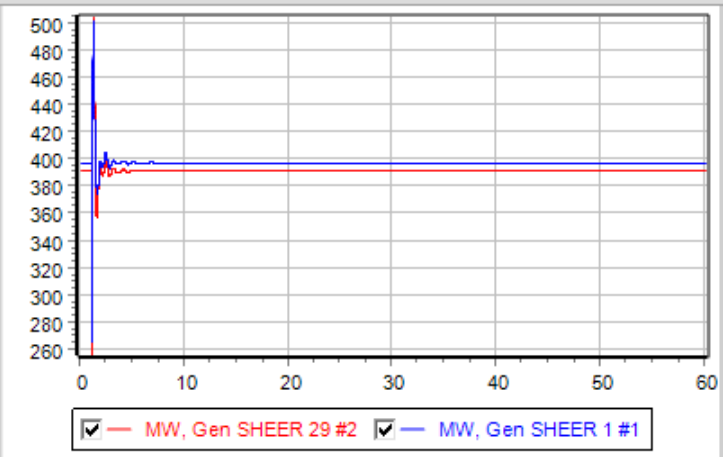
Contingency:
9L59: Tinchebray 972S to Anderson 801S

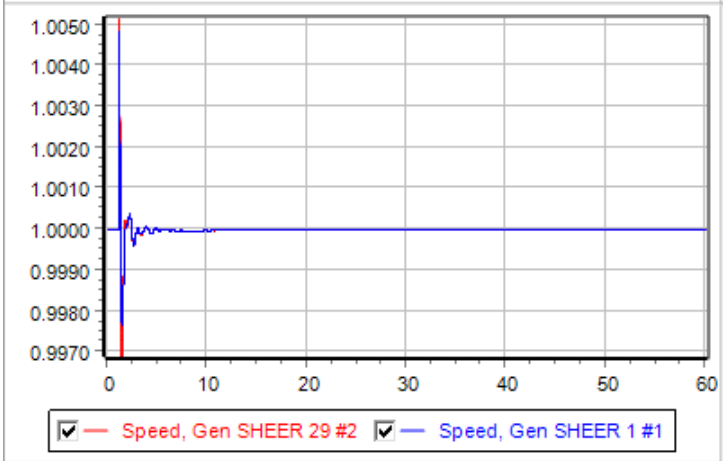
Study Case:
Scenario 4 (2022SP)

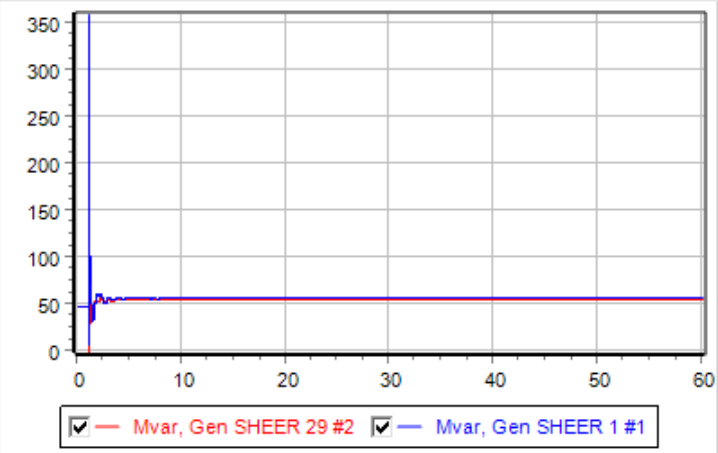
December 04, 2020 16:29:05

Sheerness







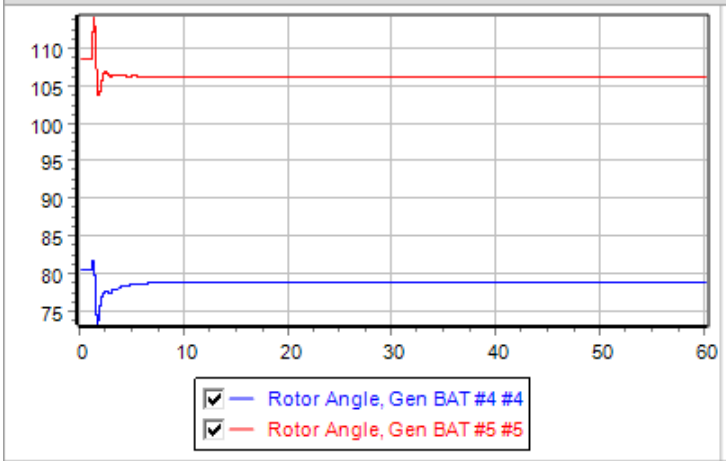


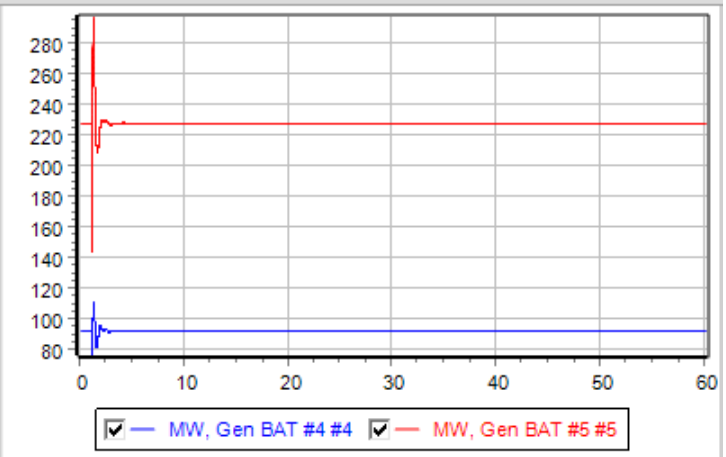
Contingency:
9L59: Tinchebray 972S to Anderson 801S

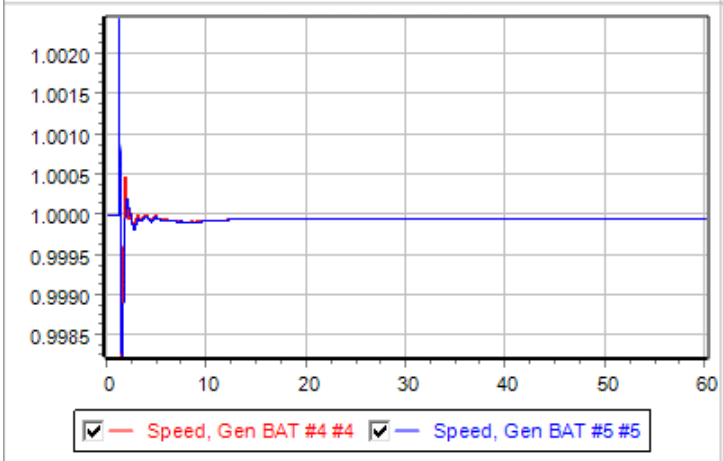
Study Case:
Scenario 4 (2022SP)

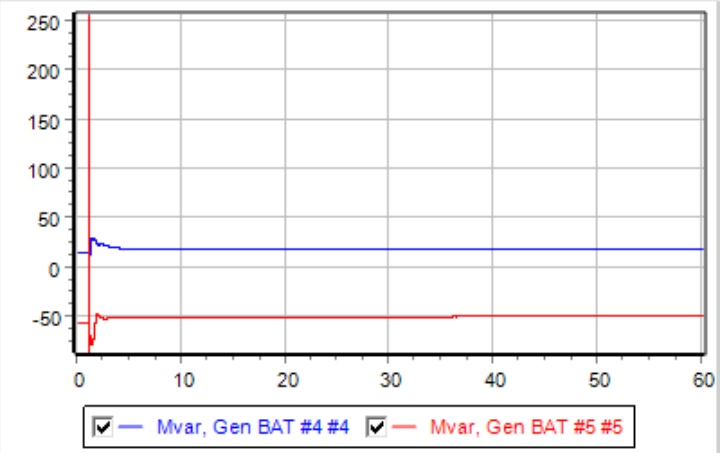
December 04, 2020 16:29:04

Battle River







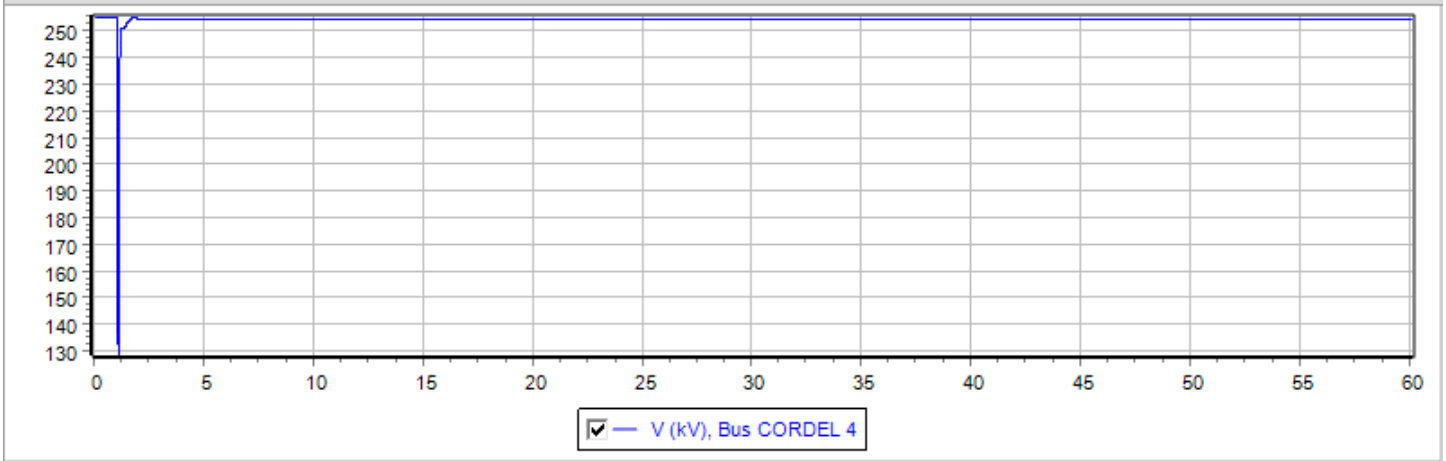


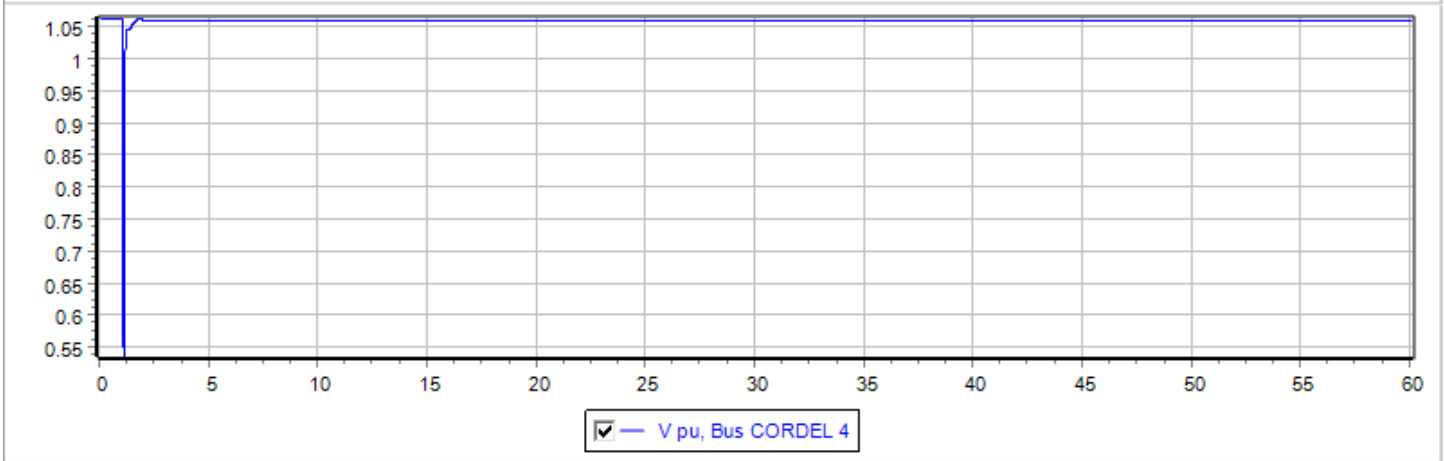
Contingency:
9L966: Hansman Lake 650S to Pemukan 932S

Study Case:
Scenario 4 (2022SP)

December 04, 2020 16:32:41

Cordel 755S Voltages



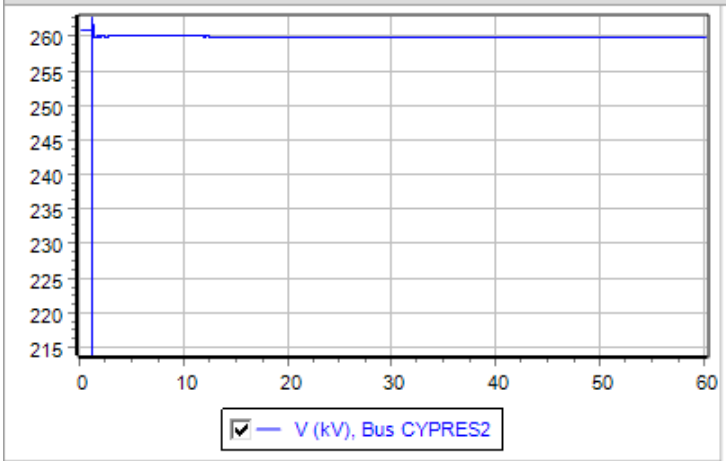


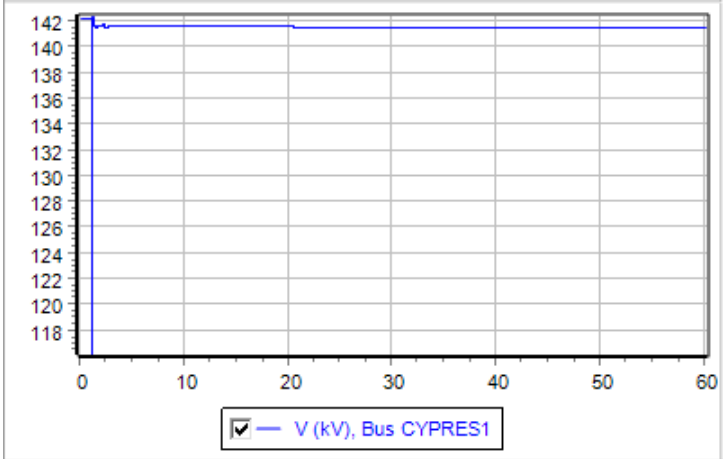
Contingency:
9L966: Hansman Lake 650S to Pemukan 932S

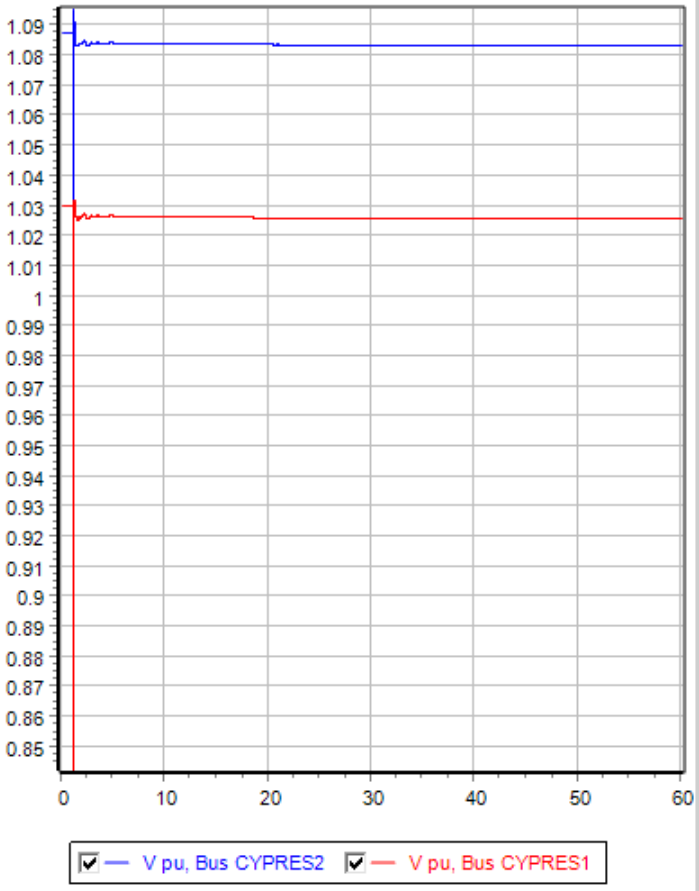
Study Case:
Scenario 4 (2022SP)

December 04, 2020 16:32:43

Cypress 562S Voltages





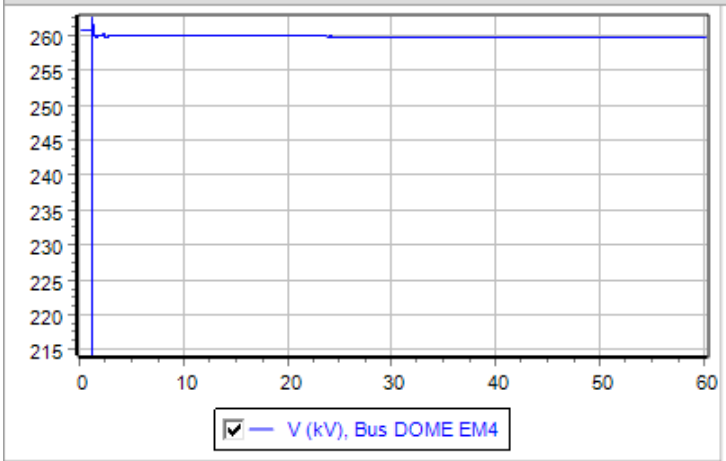


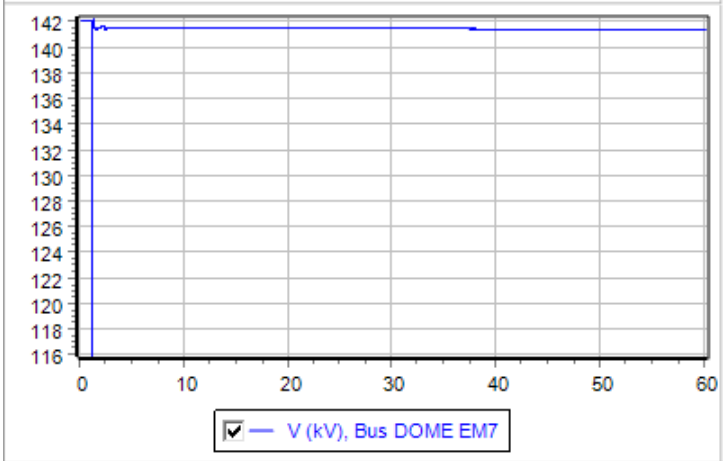
Contingency:
9L966: Hansman Lake 650S to Pemukan 932S

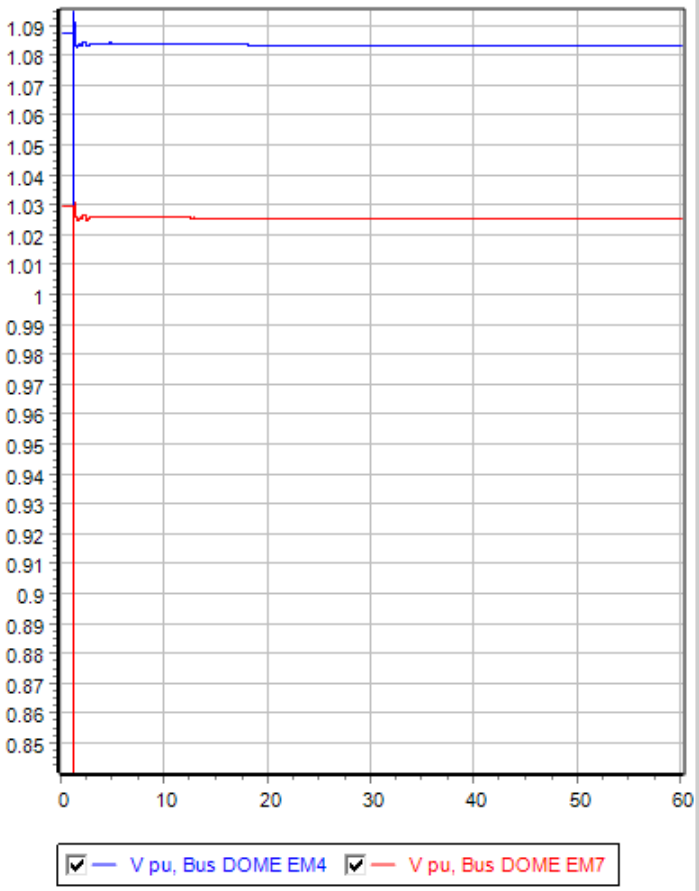
Study Case:
Scenario 4 (2022SP)

December 04, 2020 16:32:43

Dome 163S Voltages





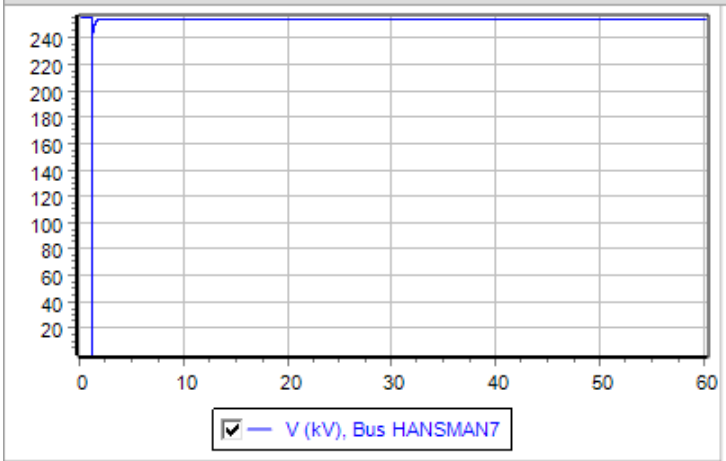


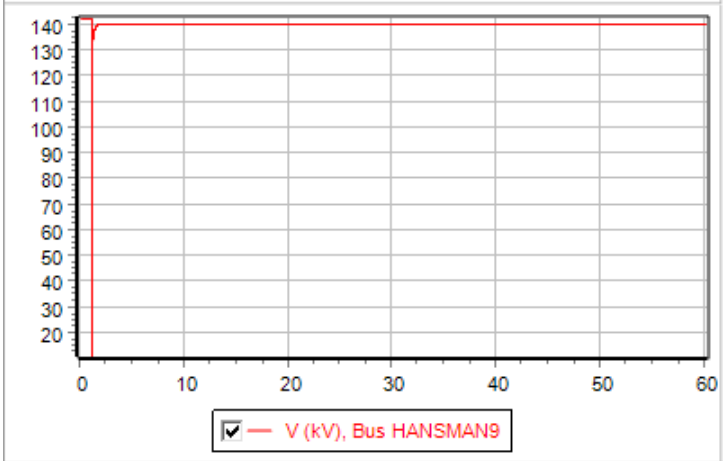
Contingency:
9L966: Hansman Lake 650S to Pemukan 932S

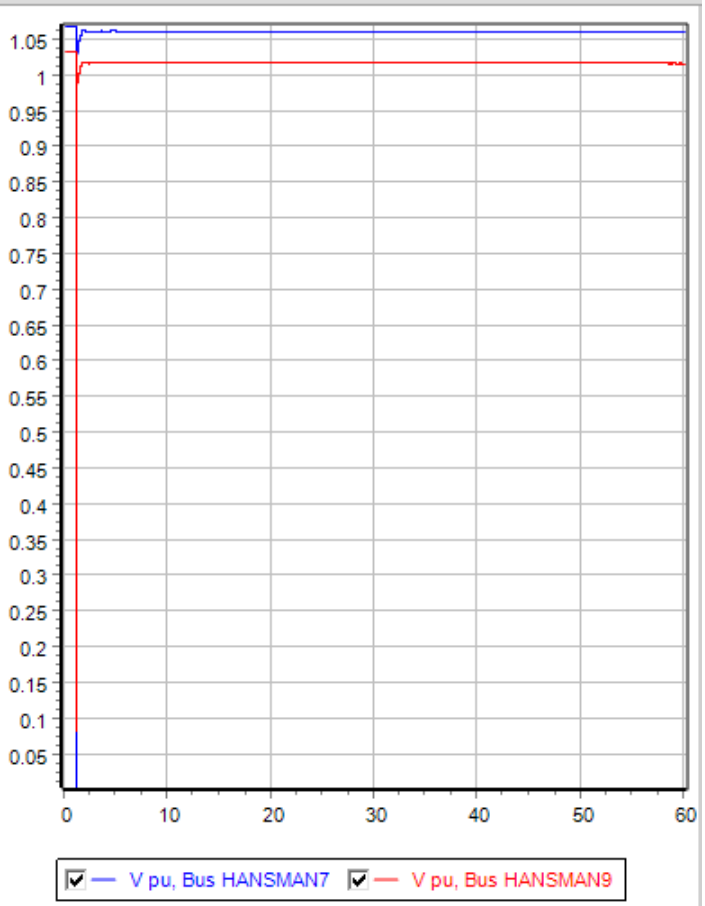
Study Case:
Scenario 4 (2022SP)

December 04, 2020 16:32:42

Hansman Lake 650S Voltages





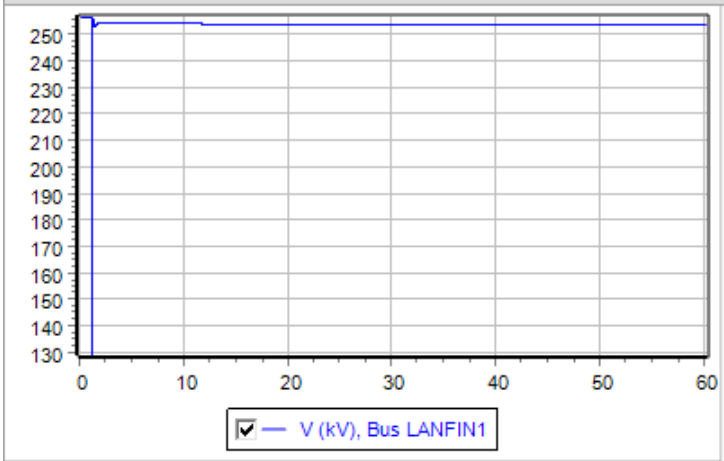


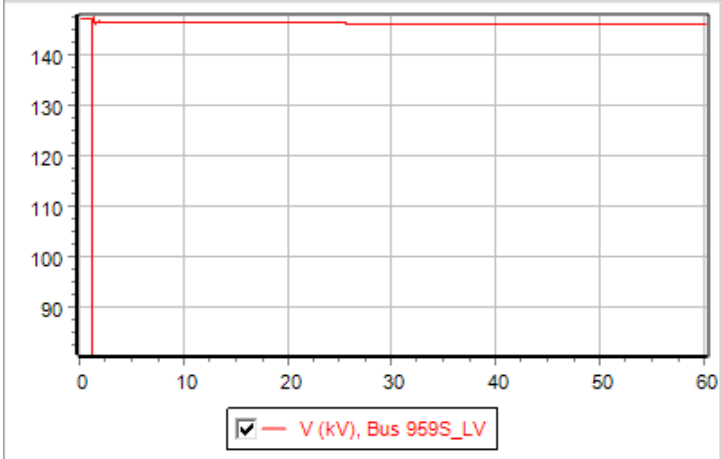
Contingency:
9L966: Hansman Lake 650S to Pemukan 932S

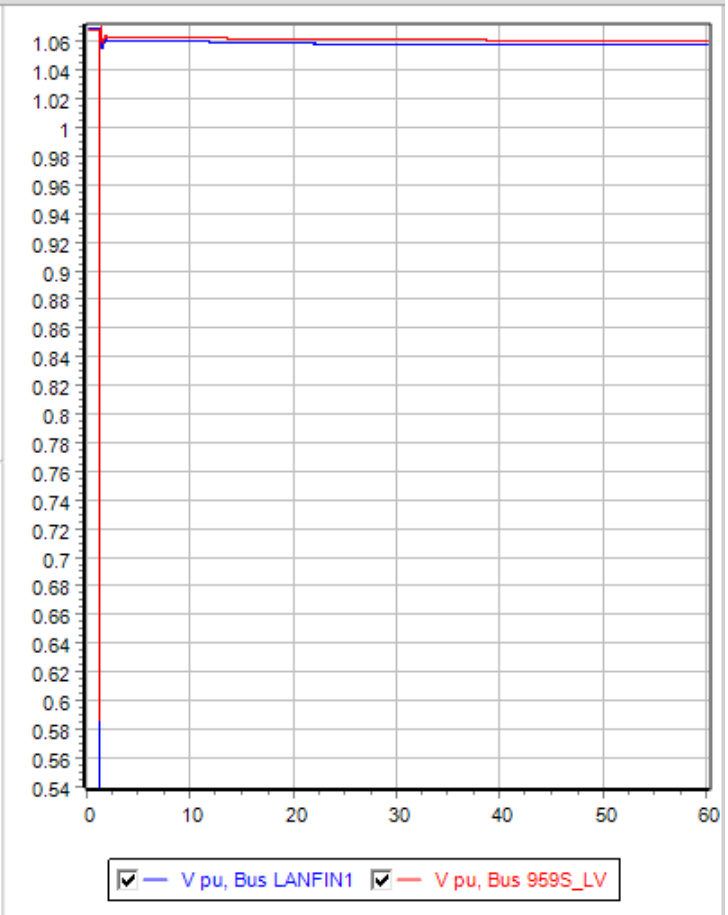
Study Case:
Scenario 4 (2022SP)

December 04, 2020 16:32:42

Lanfine 959S Voltages





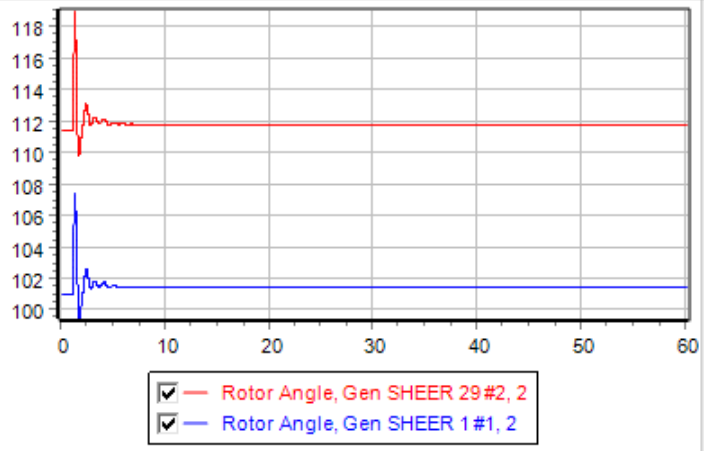


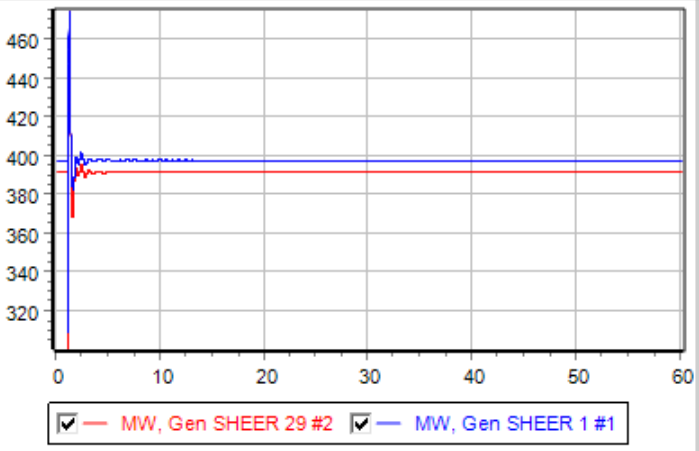
Contingency:
9L966: Hansman Lake 650S to Pemukan 932S

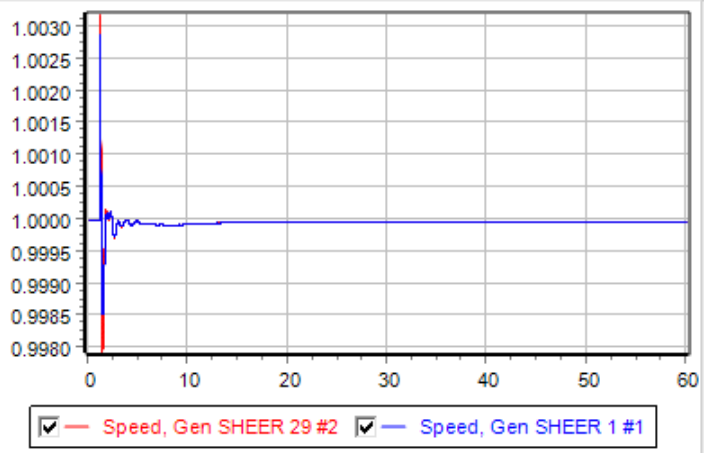
Study Case:
Scenario 4 (2022SP)

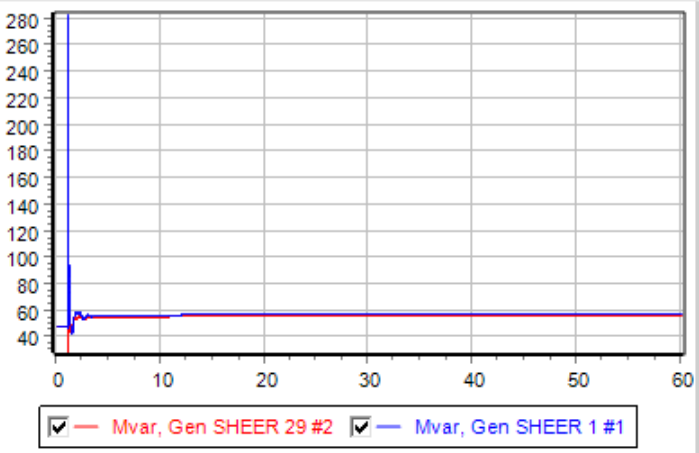
December 04, 2020 16:32:41

Sheerness







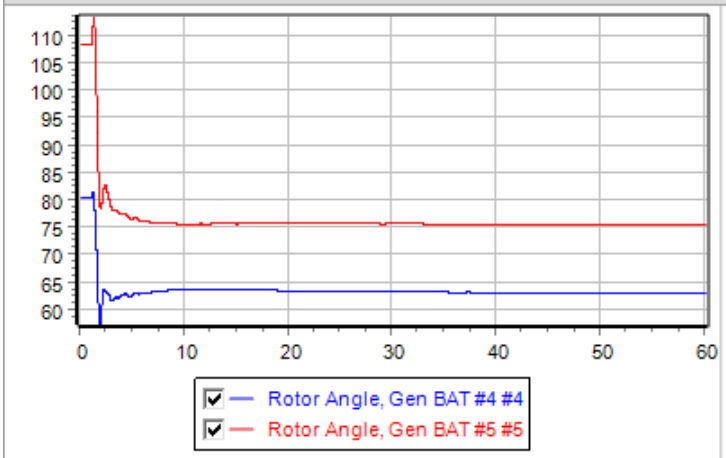


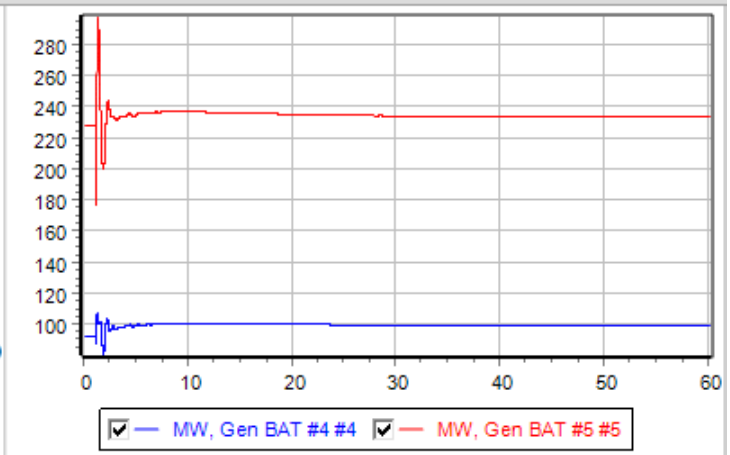
Contingency:
9L966: Hansman Lake 650S to Pemukan 932S

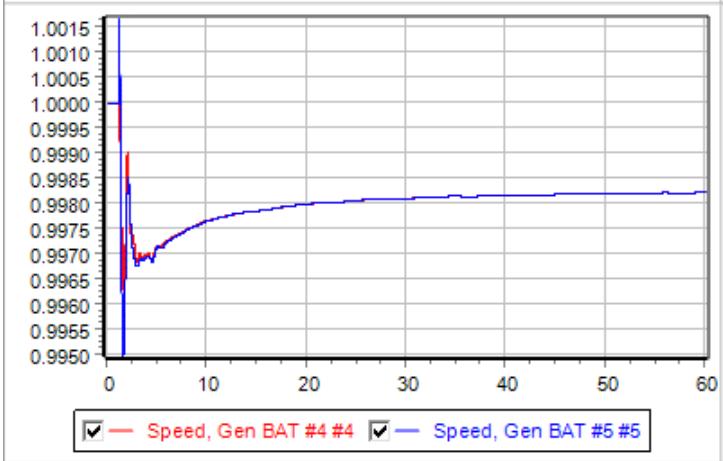
Study Case:
Scenario 4 (2022SP)

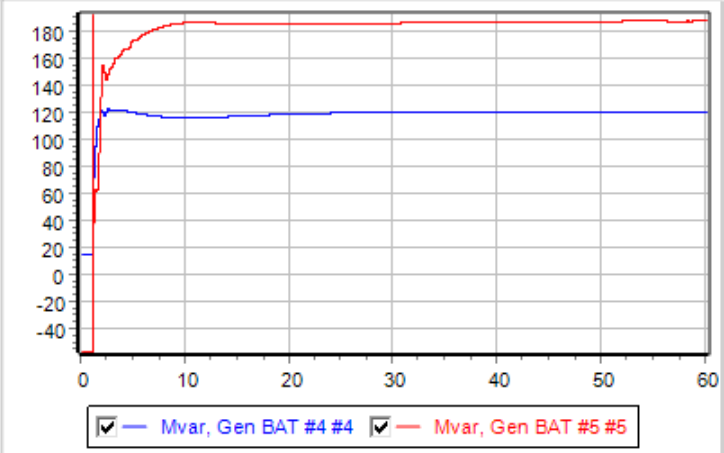
December 04, 2020 16:32:40

Battle River







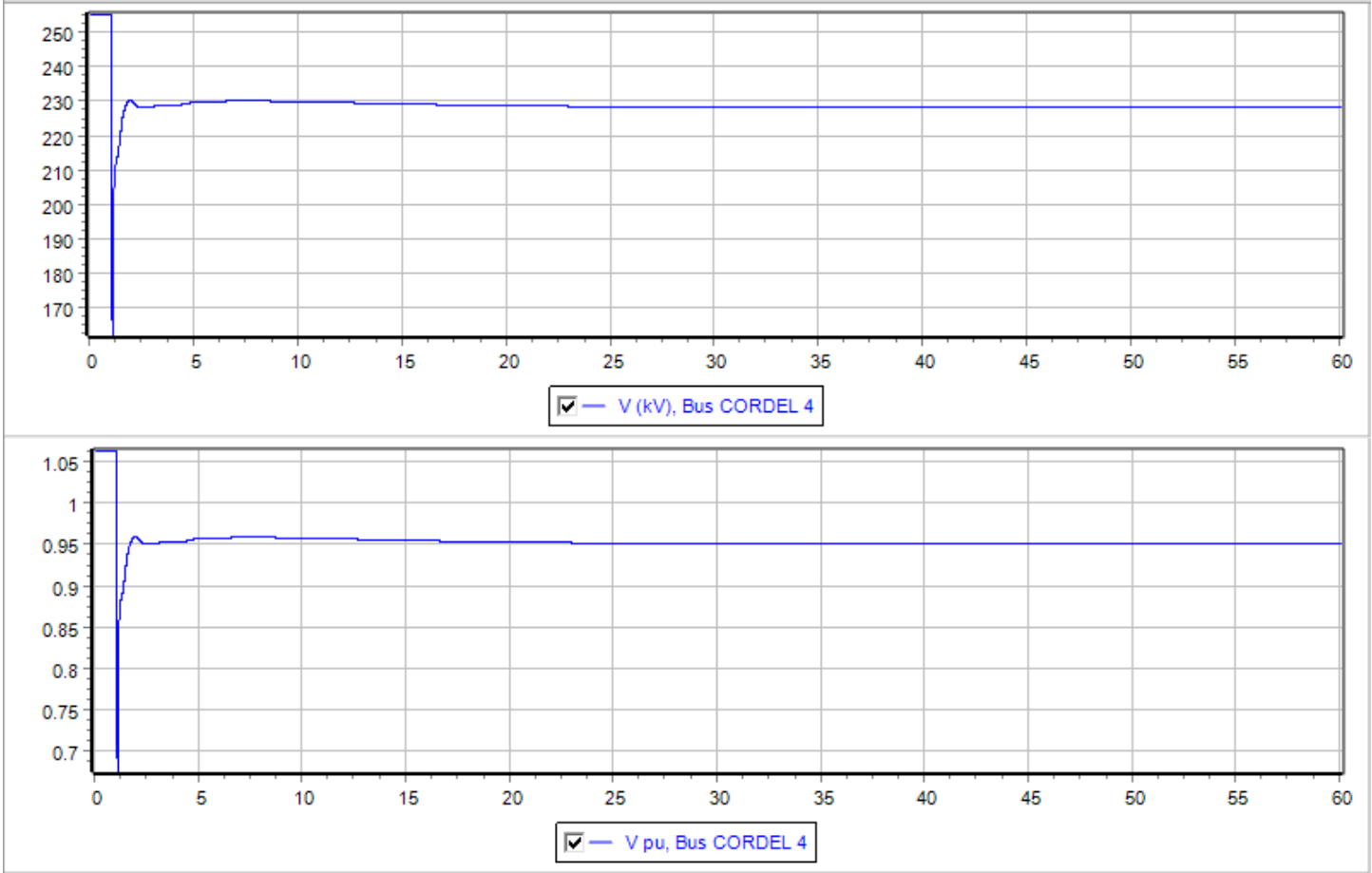


Contingency:
9L966: Pemukan 932S to Hansman Lake 650S

Study Case:
Scenario 4 (2022SP)

December 04, 2020 16:36:01

Cordel 755S Voltages

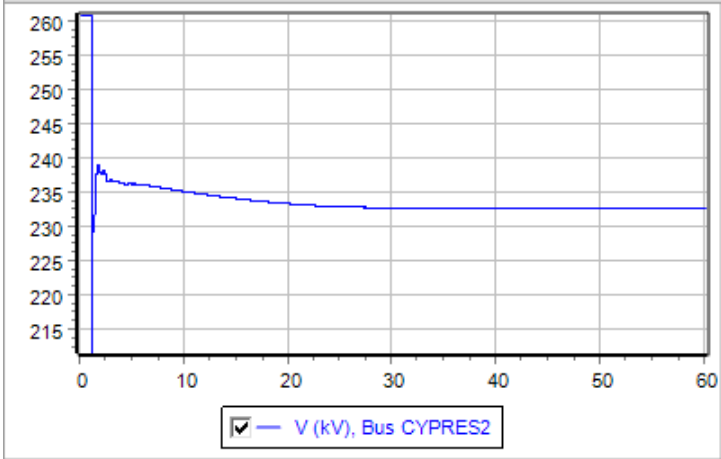


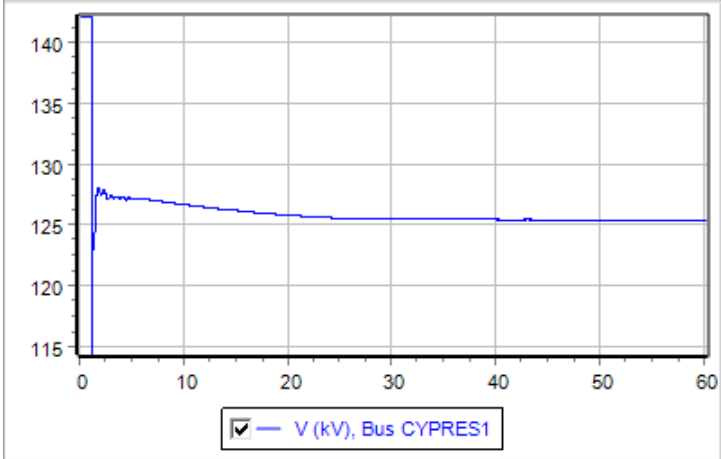
Contingency:
9L966: Pemukan 932S to Hansman Lake 650S

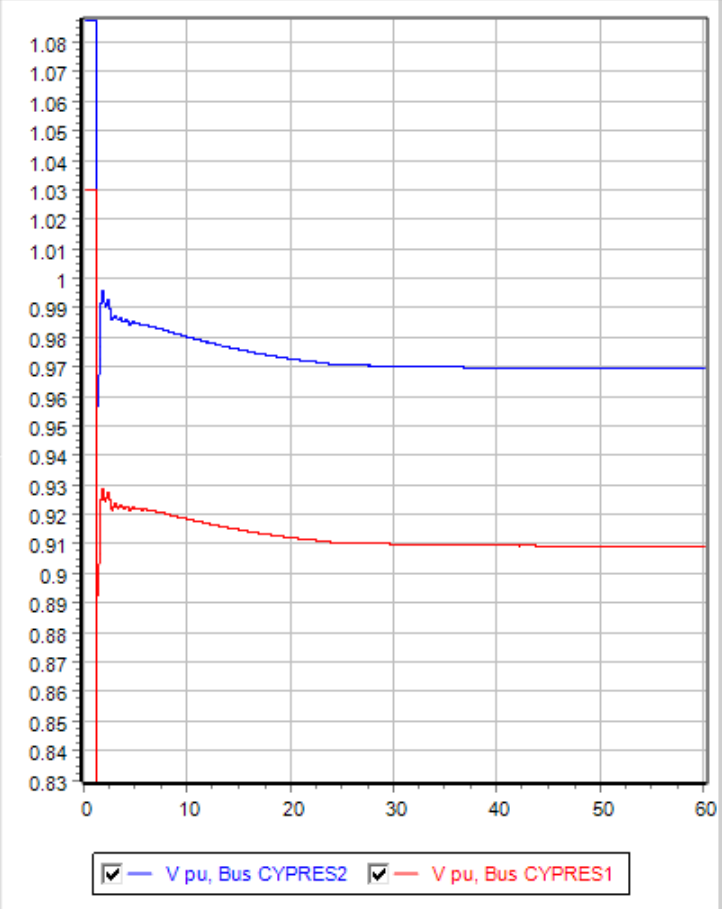
Study Case:
Scenario 4 (2022SP)

December 04, 2020 16:36:03

Cypress 562S Voltages





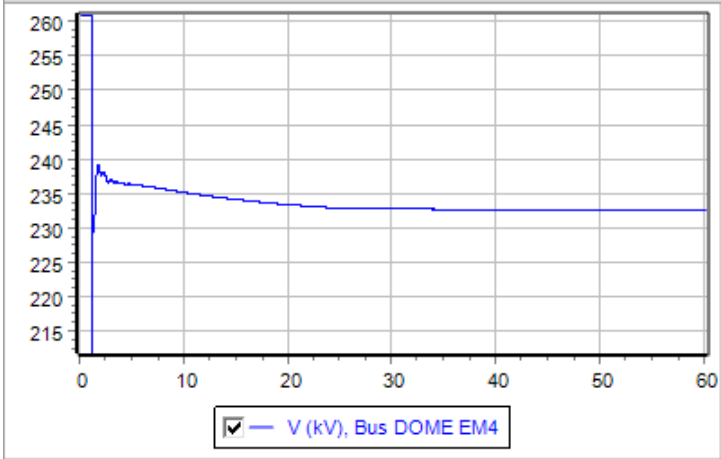


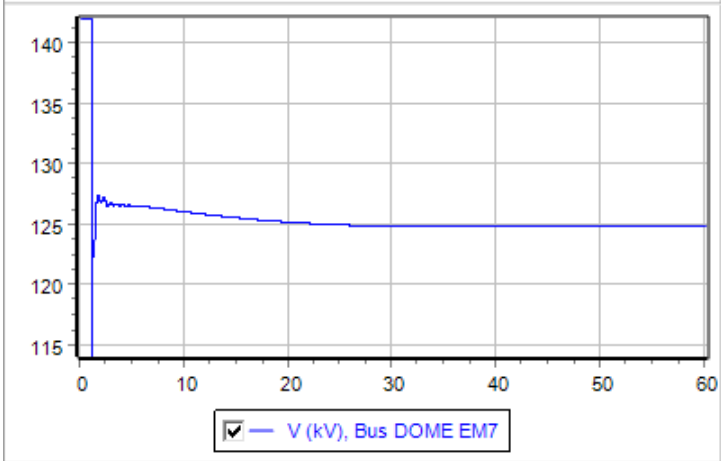
Contingency:
9L966: Pemukan 932S to Hansman Lake 650S

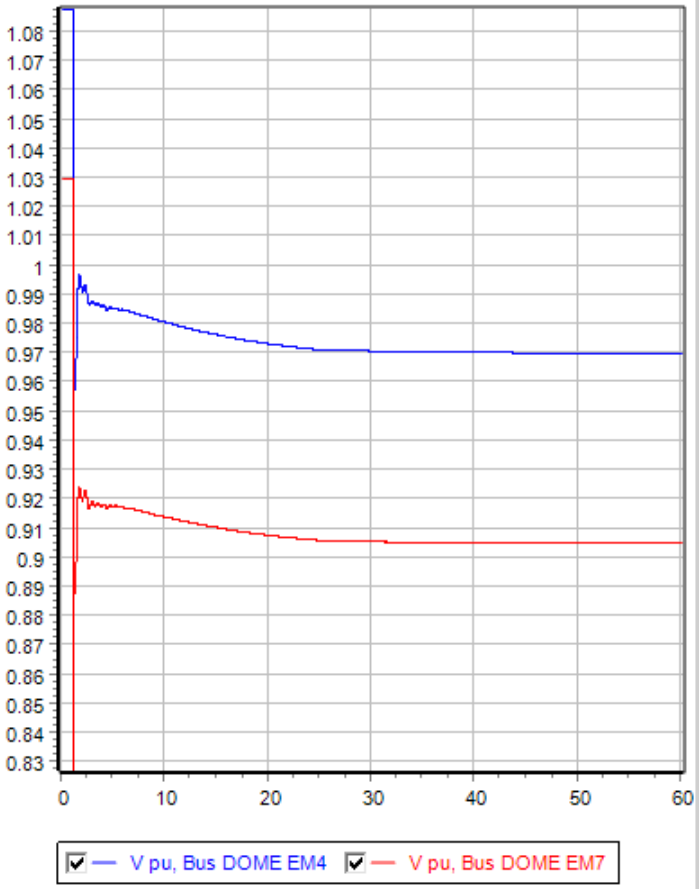
Study Case:
Scenario 4 (2022SP)

December 04, 2020 16:36:03

Dome 163S Voltages





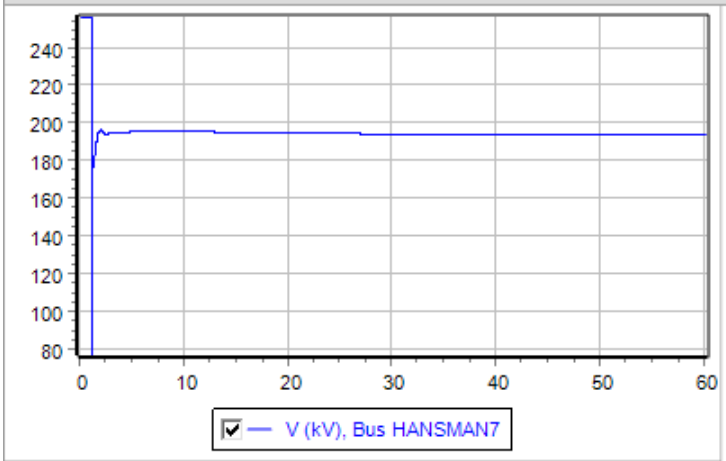


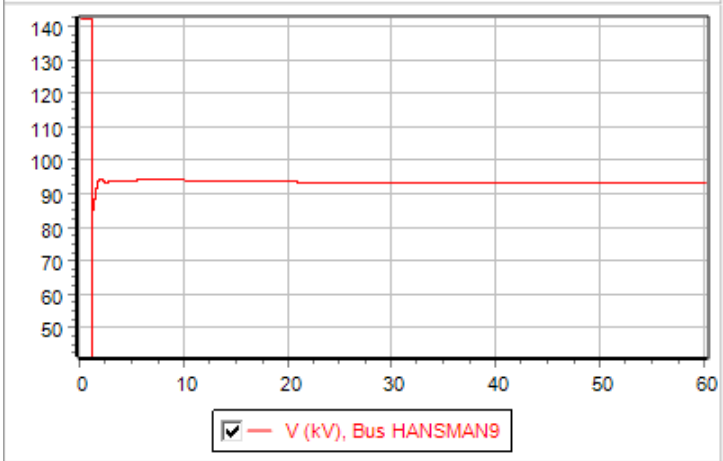
Contingency:
9L966: Pemukan 932S to Hansman Lake 650S

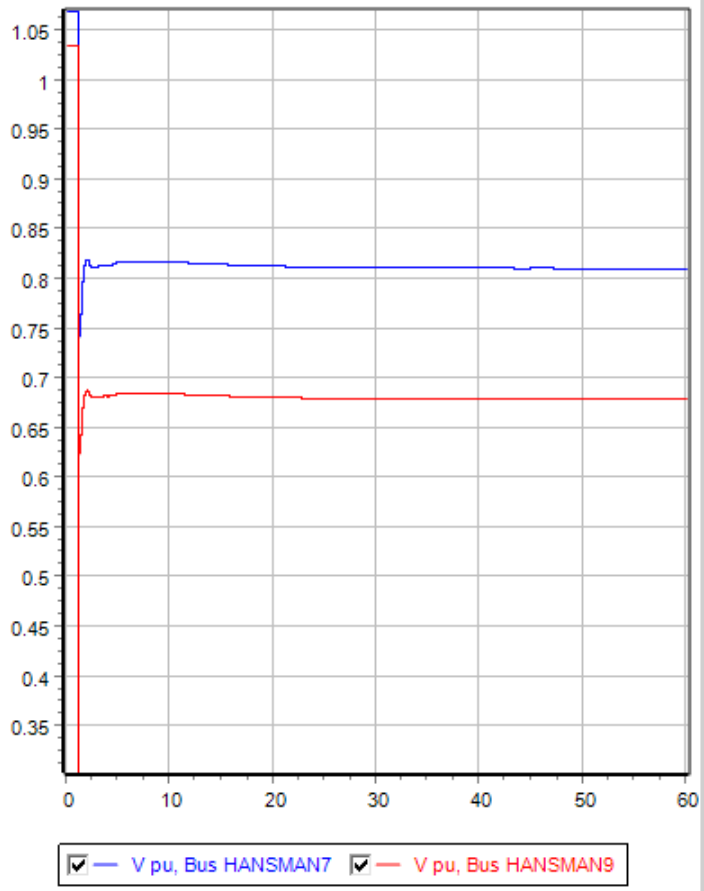
Study Case:
Scenario 4 (2022SP)

December 04, 2020 16:36:02

Hansman Lake 650S Voltages





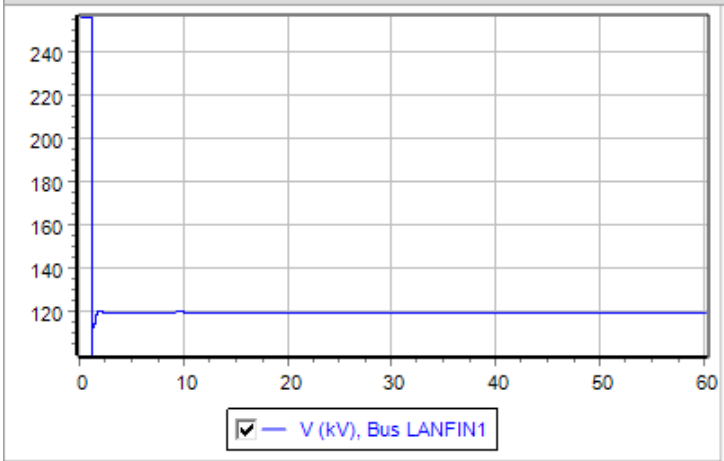


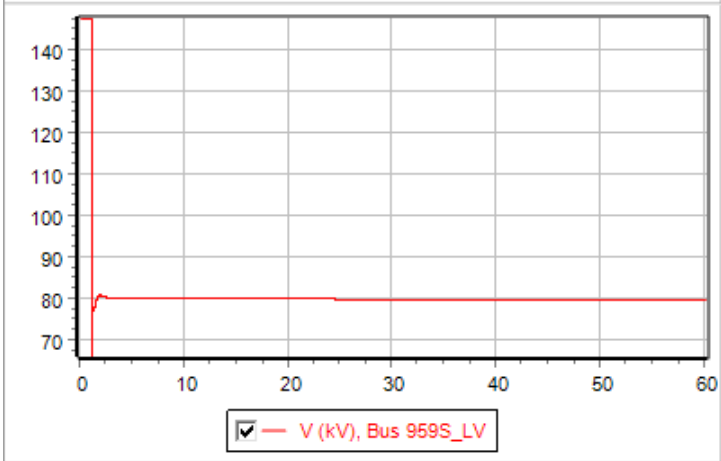
Contingency:
9L966: Pemukan 932S to Hansman Lake 650S

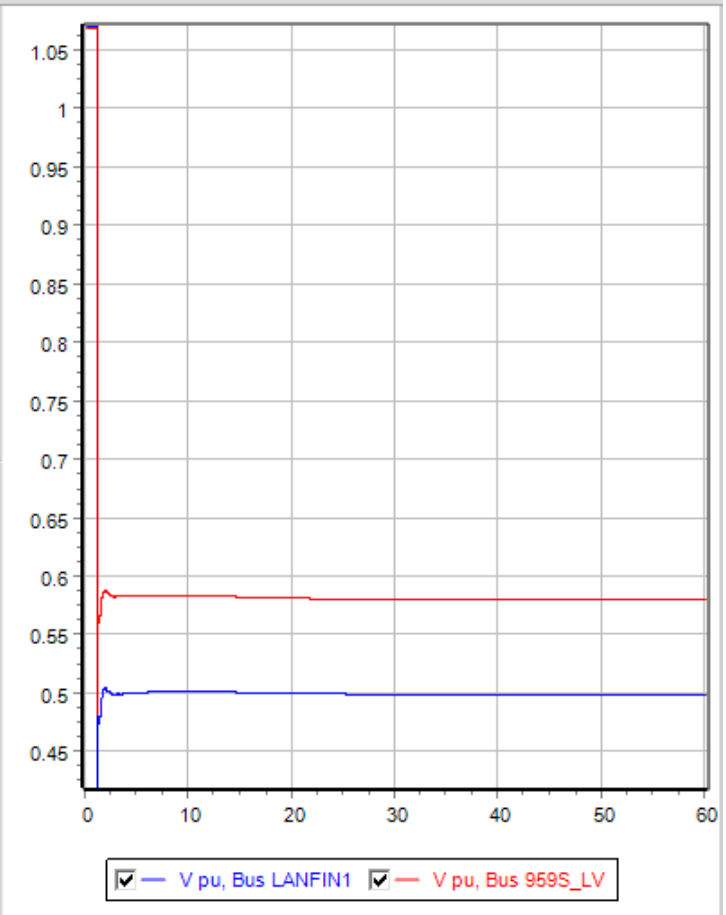
Study Case:
Scenario 4 (2022SP)

December 04, 2020 16:36:02

Lanfine 959S Voltages





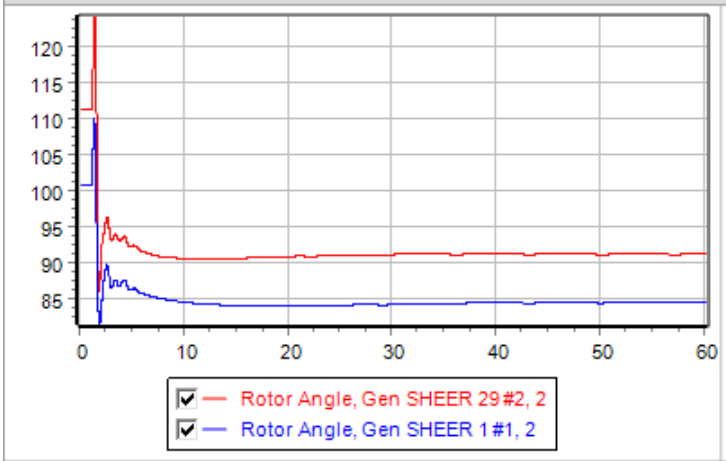


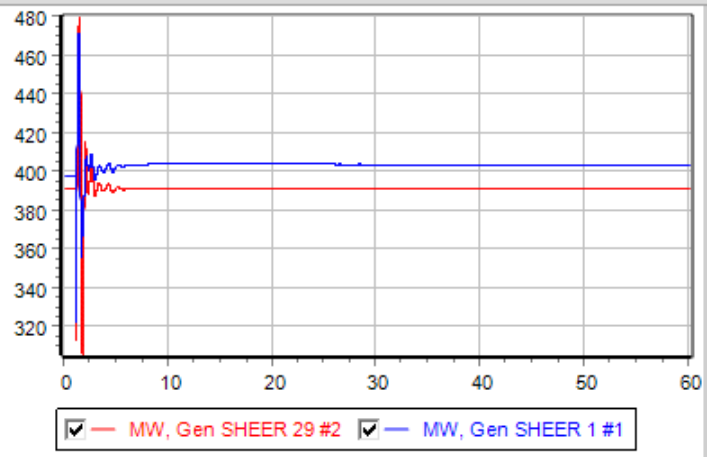
Contingency:
9L966: Pemukan 932S to Hansman Lake 650S

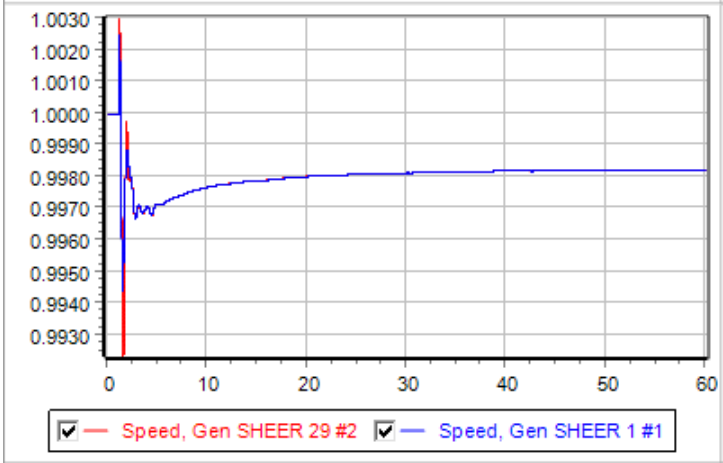
Study Case:
Scenario 4 (2022SP)

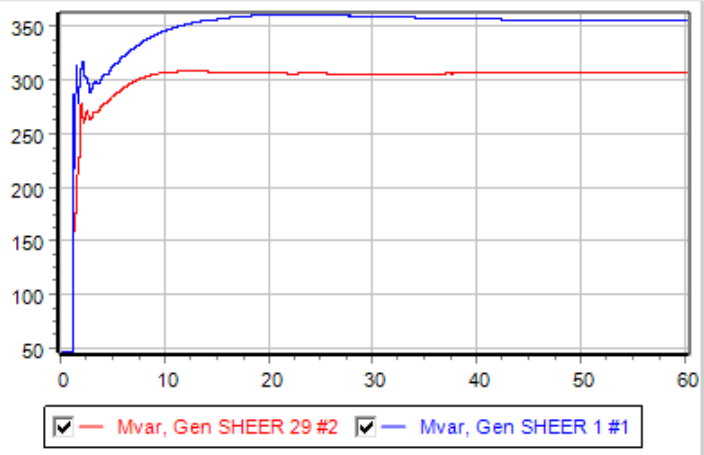
December 04, 2020 16:36:01

Sheerness







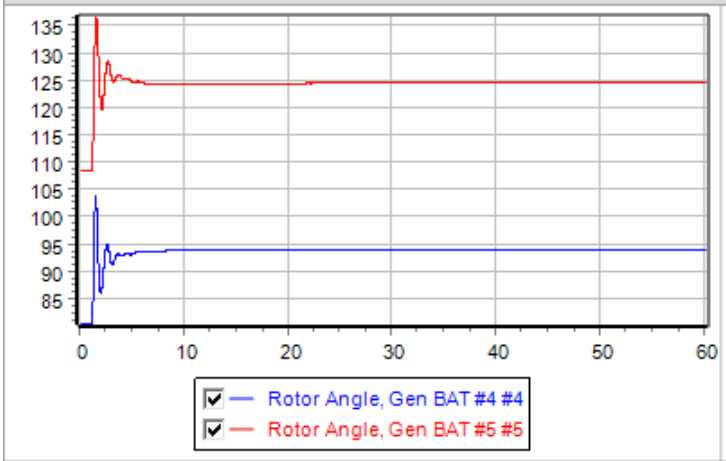


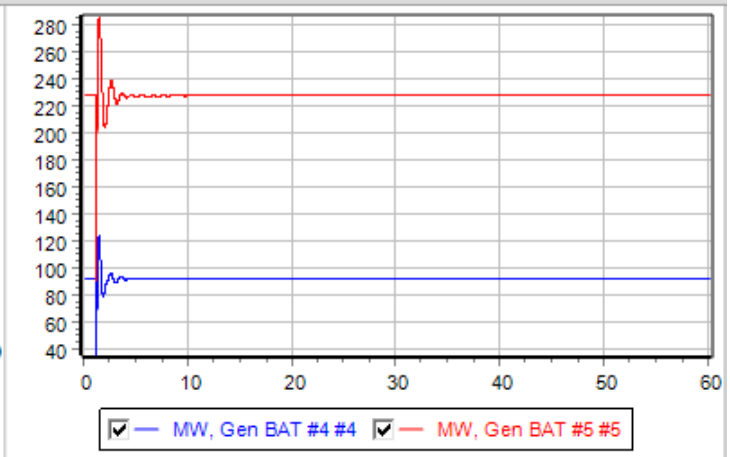
Contingency:
9L966: Pemukan 932S to Hansman Lake 650S

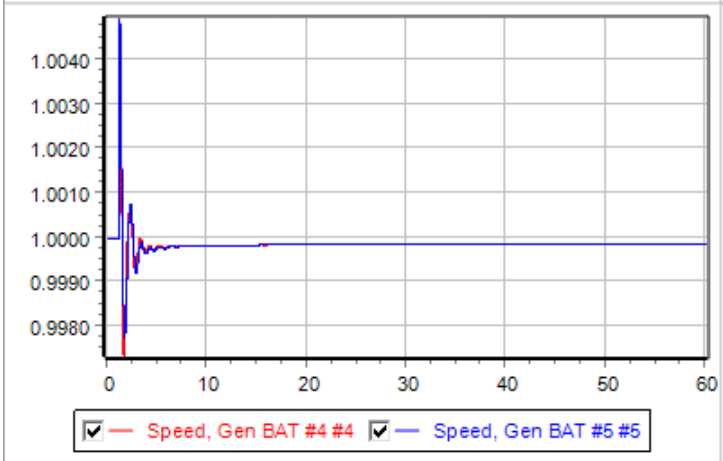
Study Case:
Scenario 4 (2022SP)

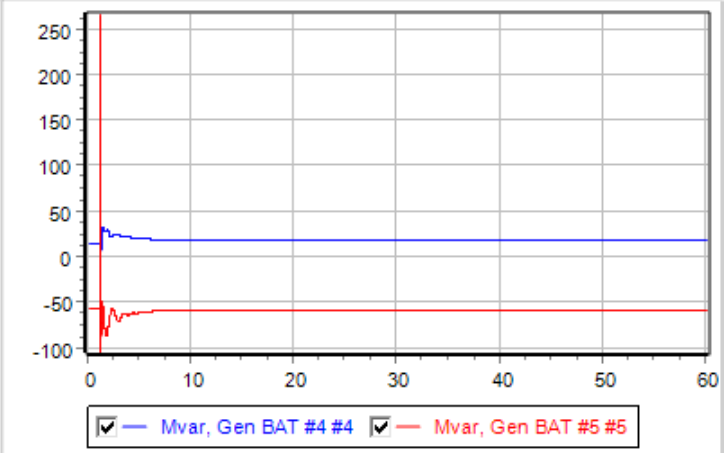
December 04, 2020 16:36:00

Battle River







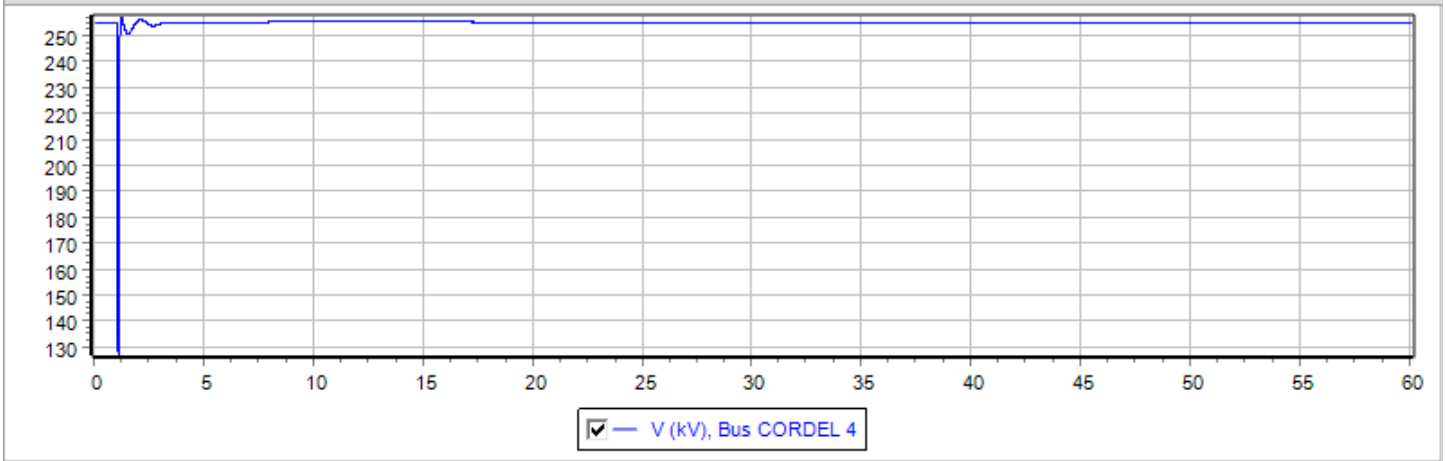


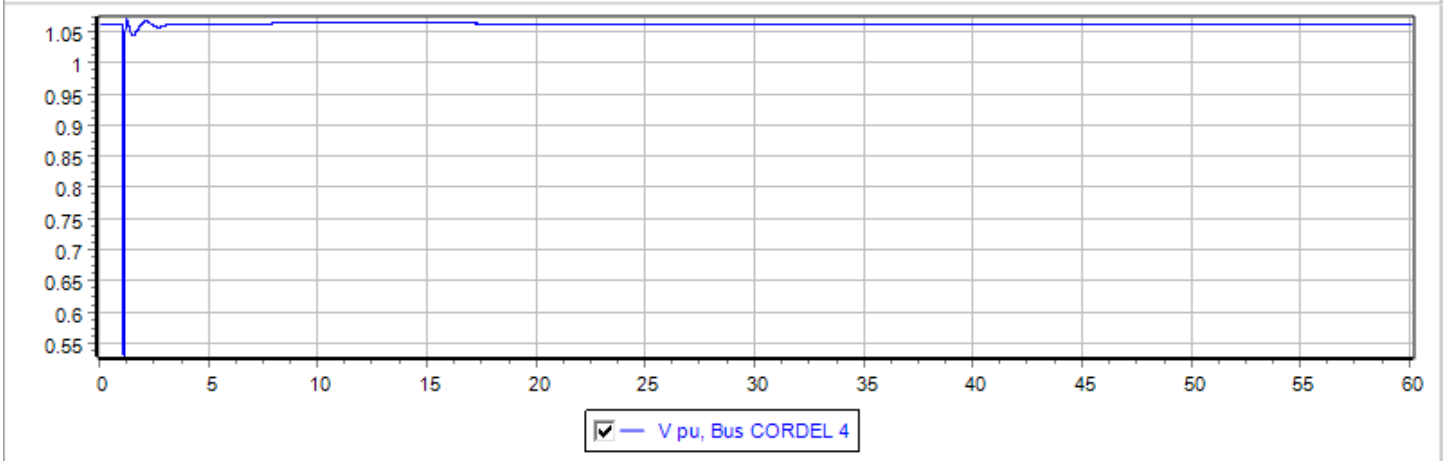
Contingency:
912L/9L912: Nevis 766S to Red Deer 63S

Study Case:
Scenario 4 (2022SP)

December 04, 2020 15:36:41

Cordel 755S Voltages



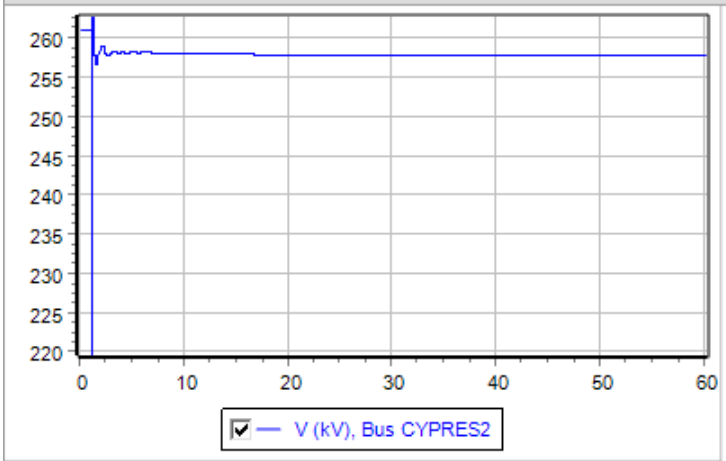


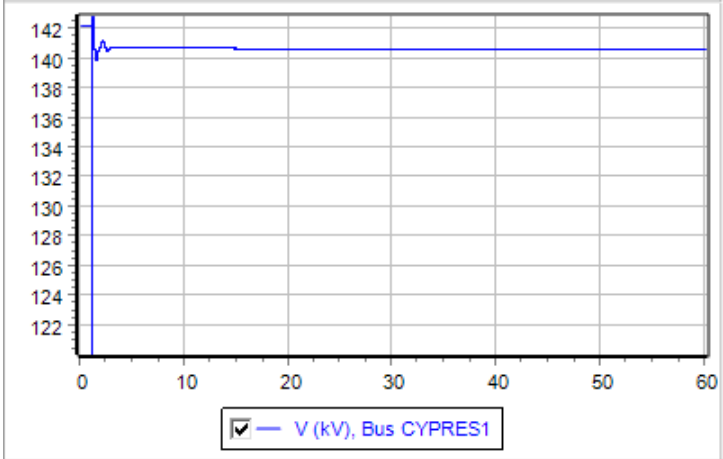
Contingency:
912L/9L912: Nevis 766S to Red Deer 63S

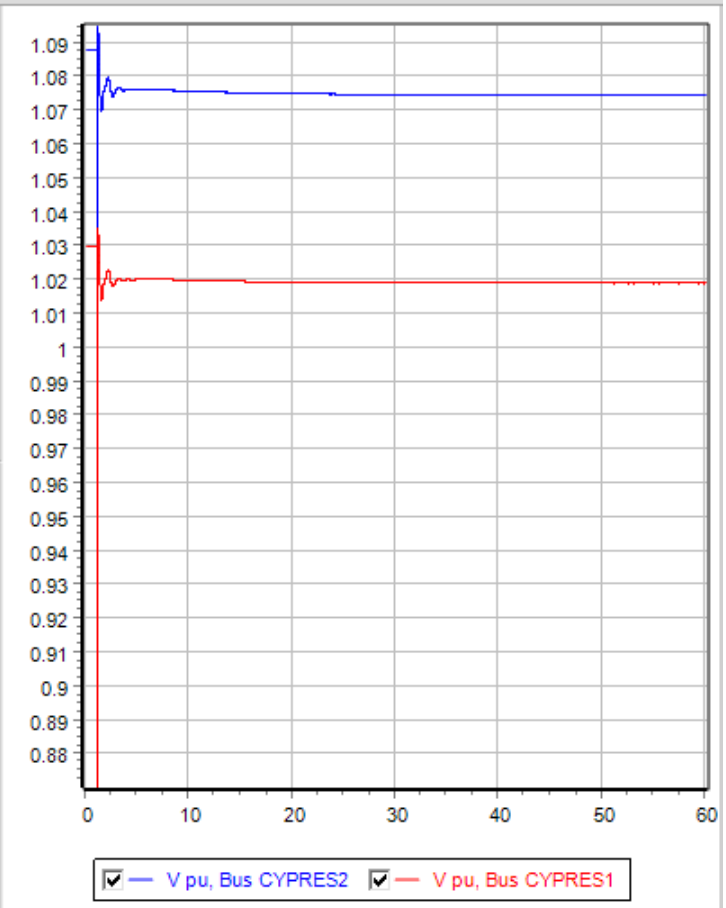
Study Case:
Scenario 4 (2022SP)

December 04, 2020 15:36:44

Cypress 562S Voltages





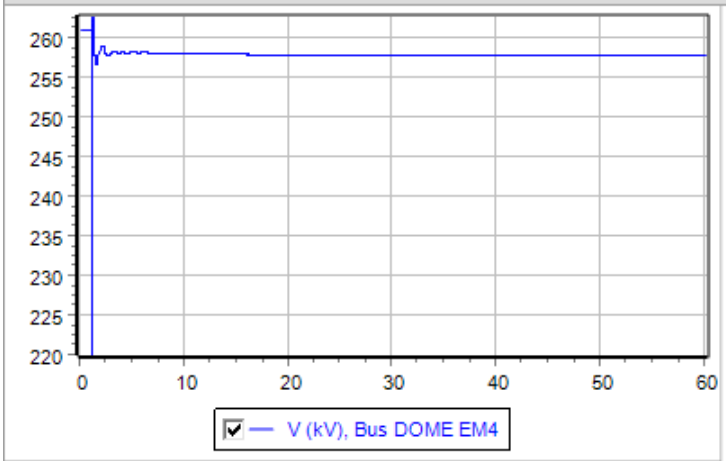


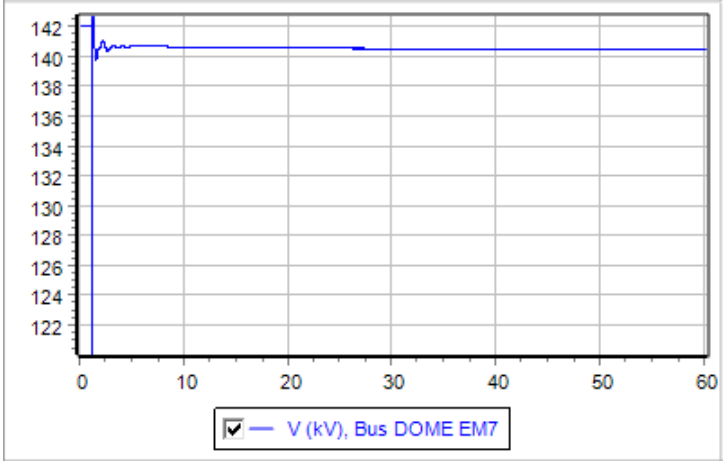
Contingency:
912L/9L912: Nevis 766S to Red Deer 63S

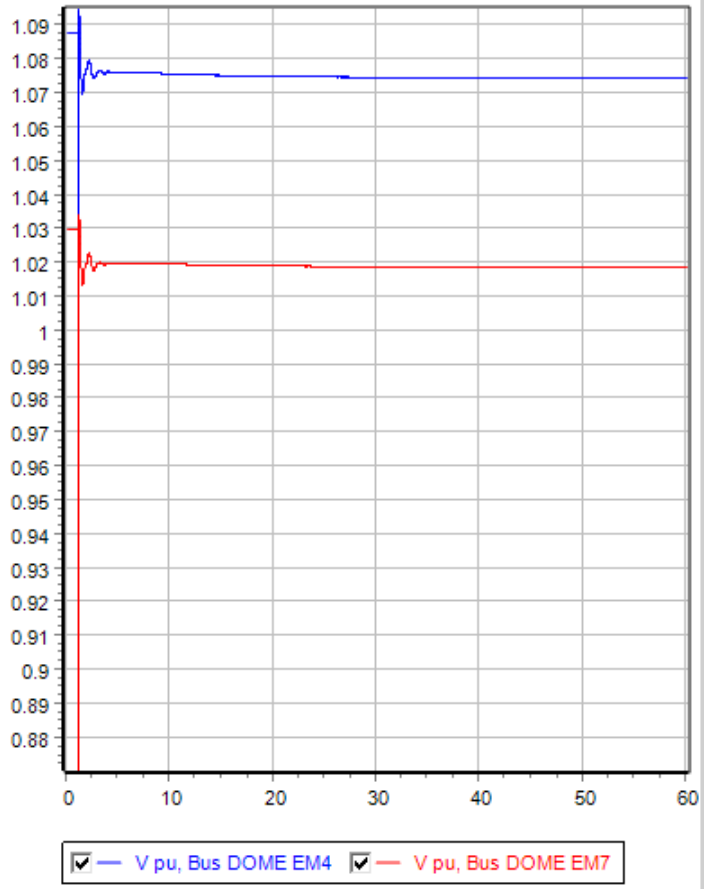
Study Case:
Scenario 4 (2022SP)

December 04, 2020 15:36:43

Dome 163S Voltages





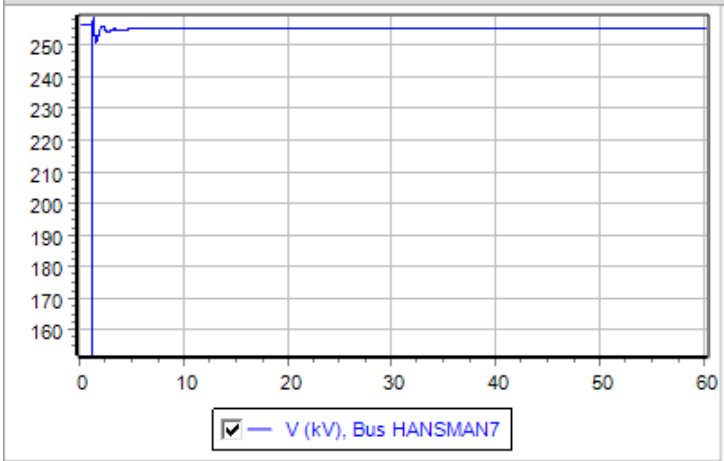


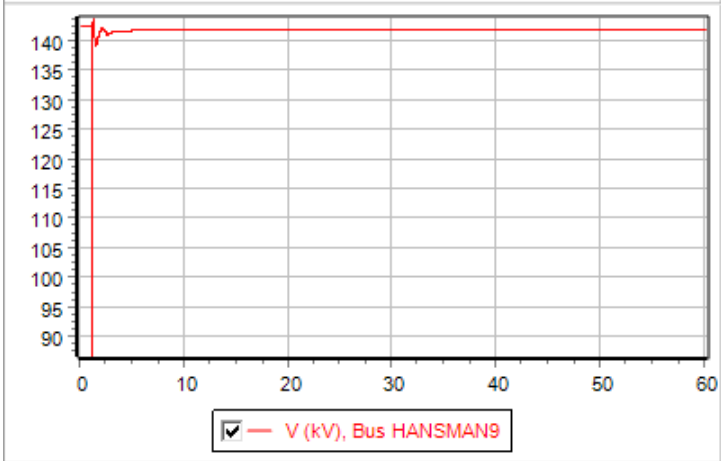
Contingency:
912L/9L912: Nevis 766S to Red Deer 63S

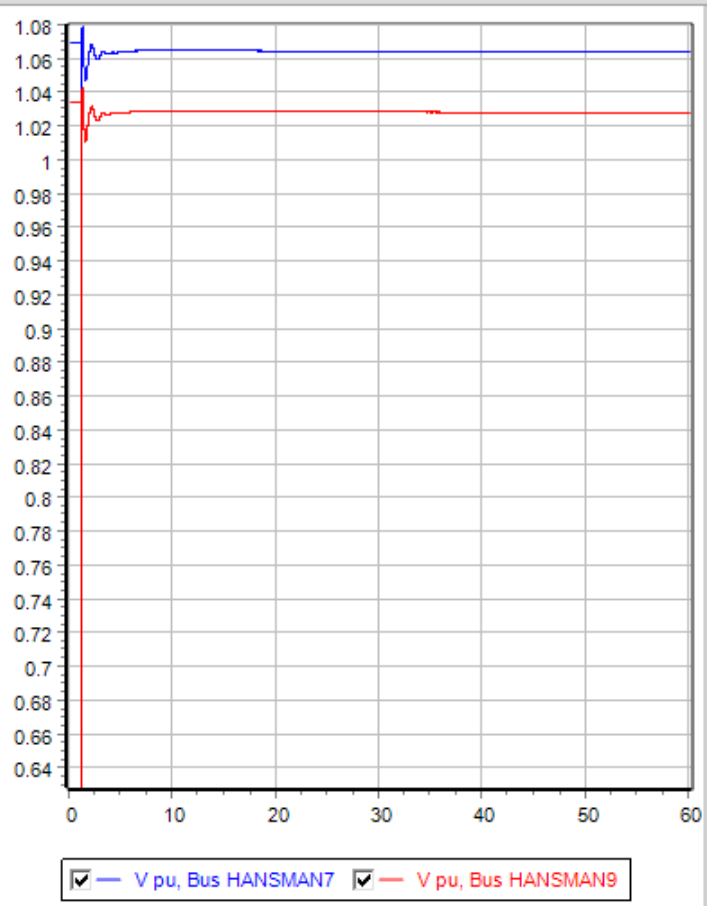
Study Case:
Scenario 4 (2022SP)

December 04, 2020 15:36:42

Hansman Lake 650S Voltages





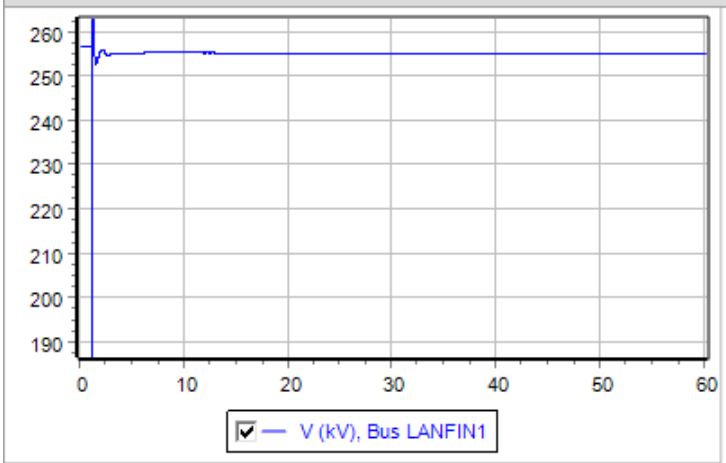


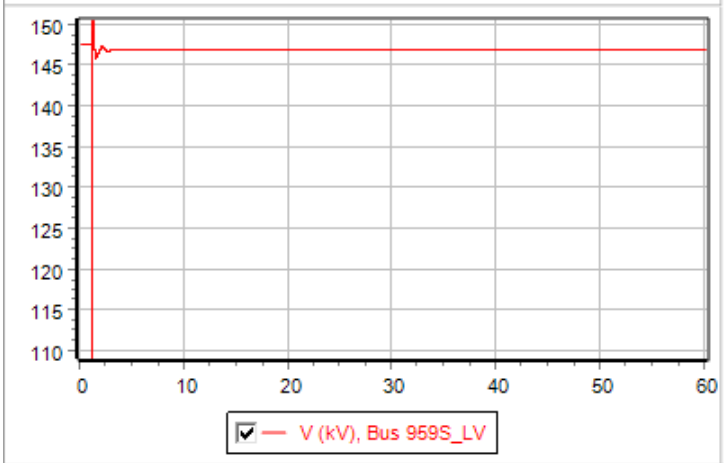
Contingency:
912L/9L912: Nevis 766S to Red Deer 63S

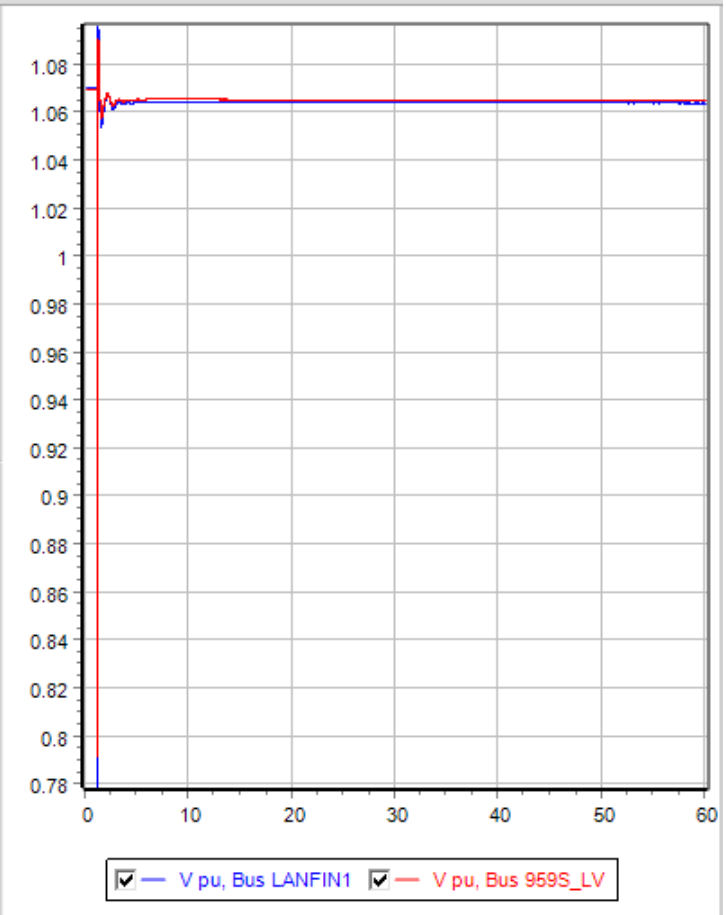
Study Case:
Scenario 4 (2022SP)

December 04, 2020 15:36:42

Lanfine 959S Voltages





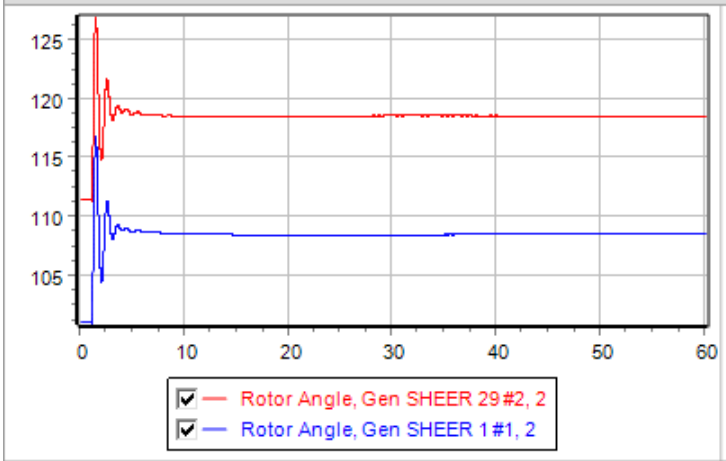


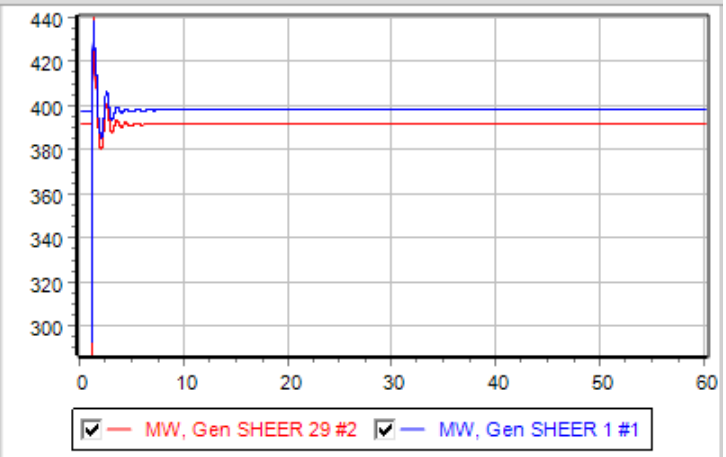
Contingency:
912L/9L912: Nevis 766S to Red Deer 63S

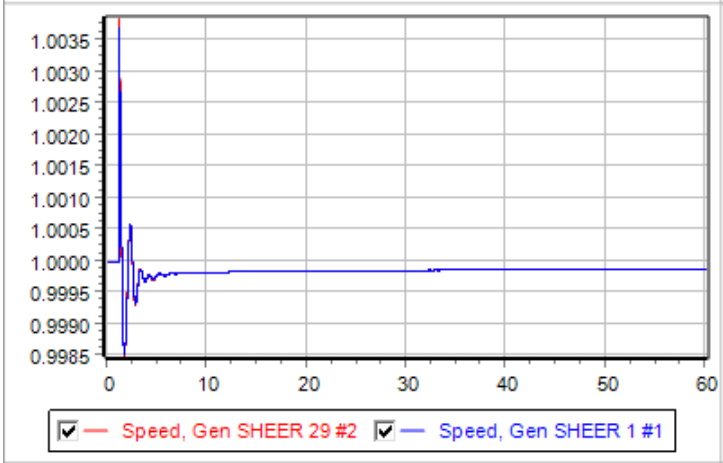
Study Case:
Scenario 4 (2022SP)

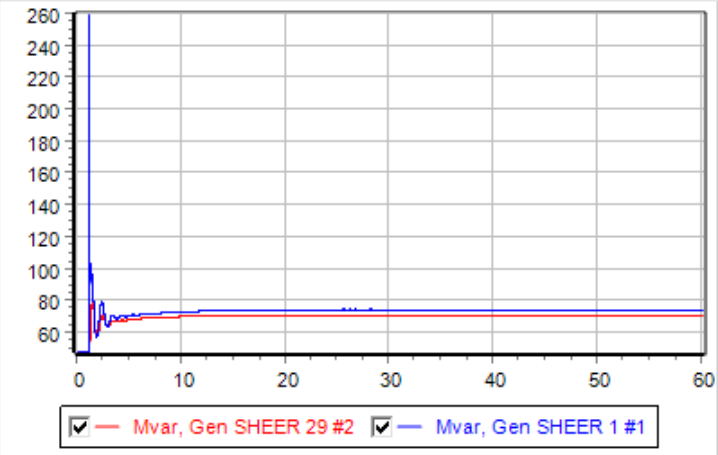
December 04, 2020 15:36:41

Sheerness







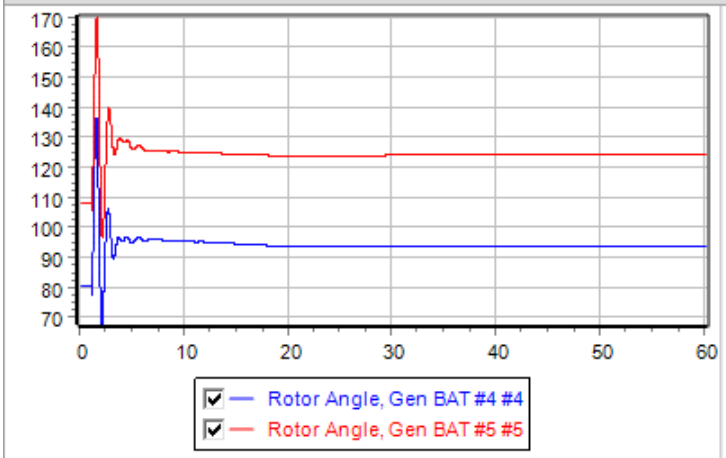


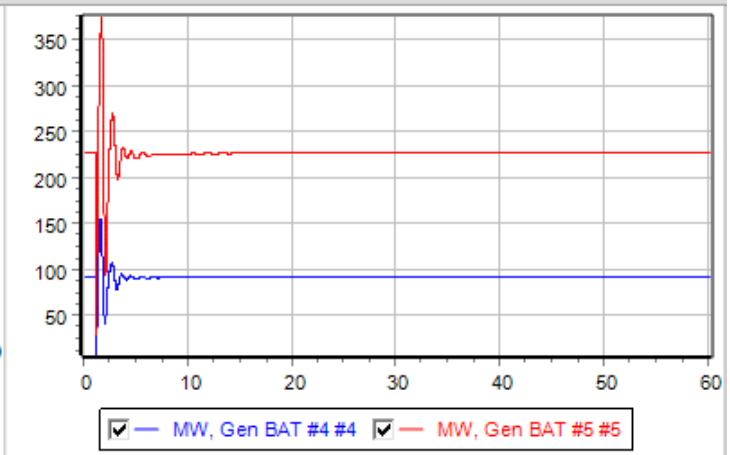
Contingency:
912L/9L912: Nevis 766S to Red Deer 63S

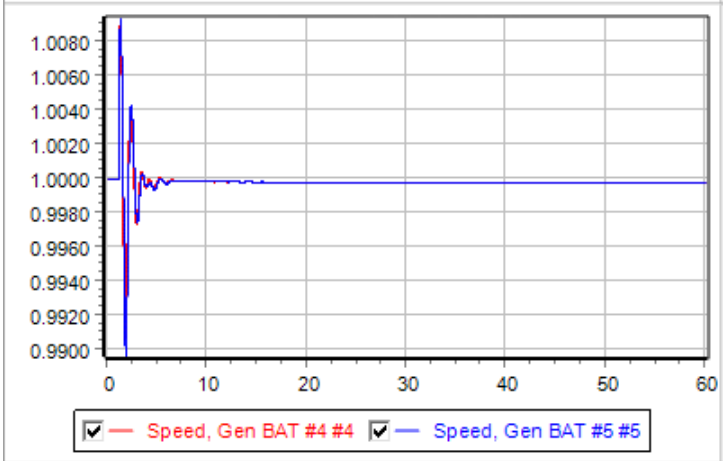
Study Case:
Scenario 4 (2022SP)

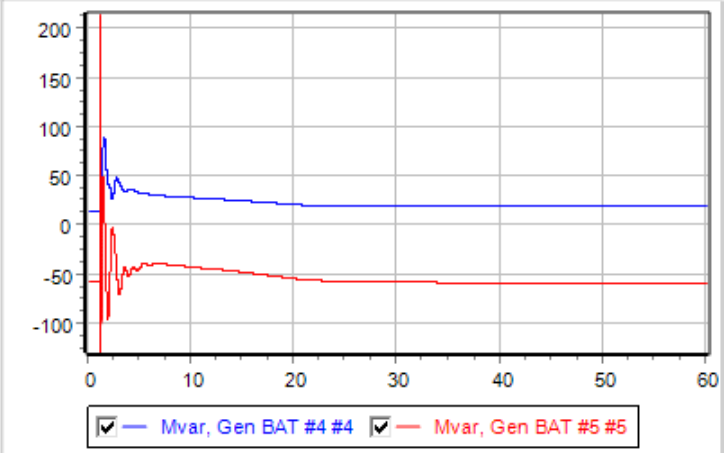
December 04, 2020 15:36:40

Battle River







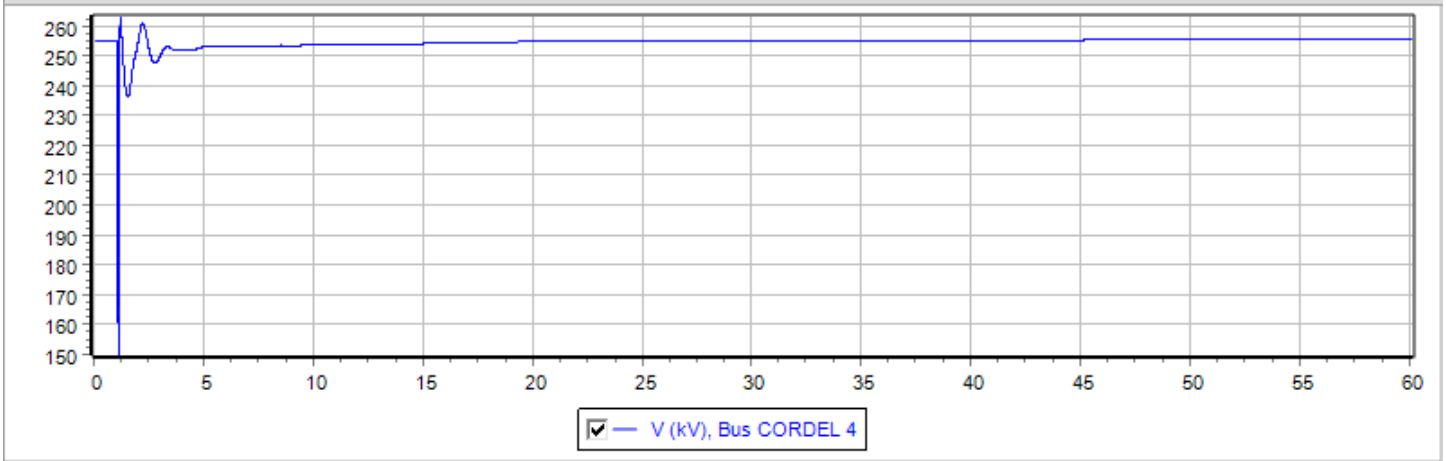


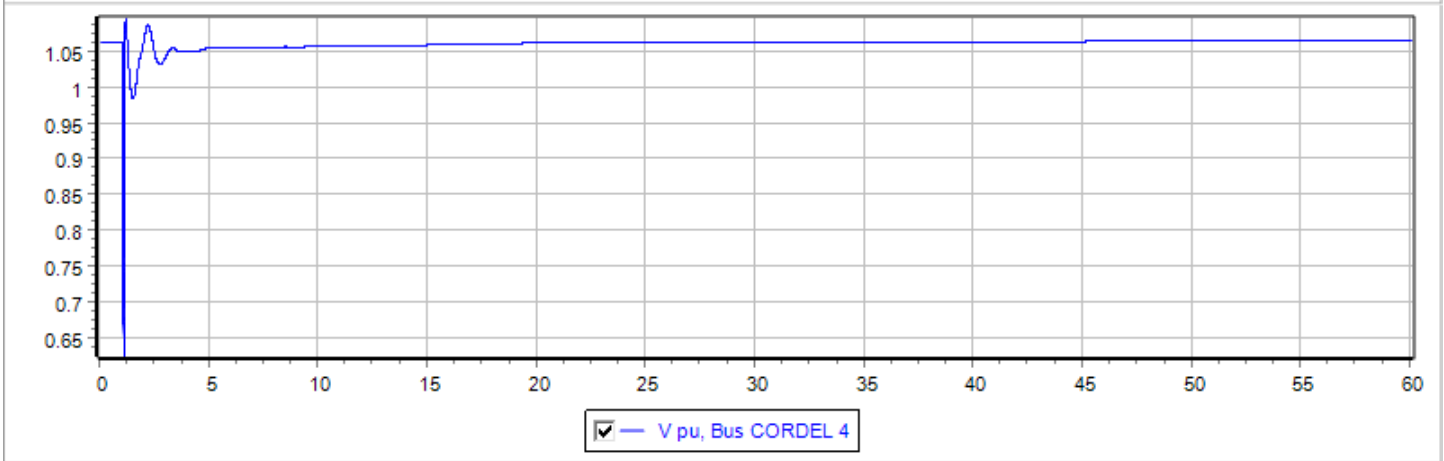
Contingency:
912L/9L912: Red Deer 63S to Nevis 766S

Study Case:
Scenario 4 (2022SP)

December 04, 2020 15:40:07

Cordel 755S Voltages



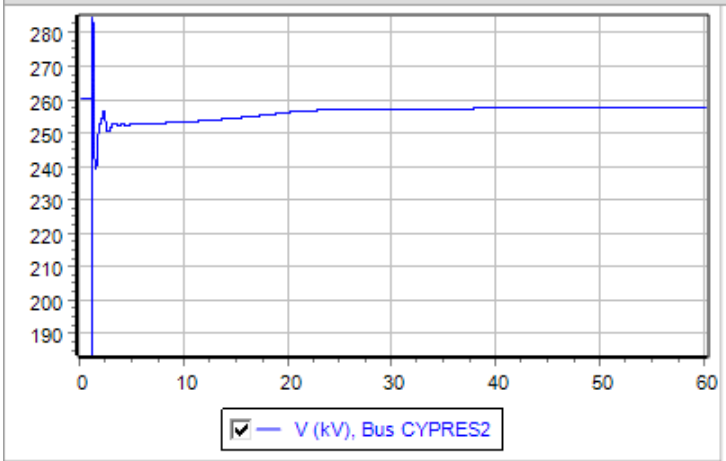


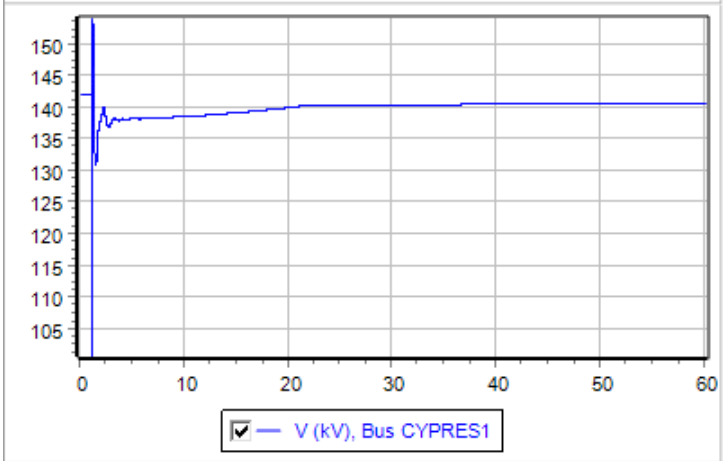
Contingency:
912L/9L912: Red Deer 63S to Nevis 766S

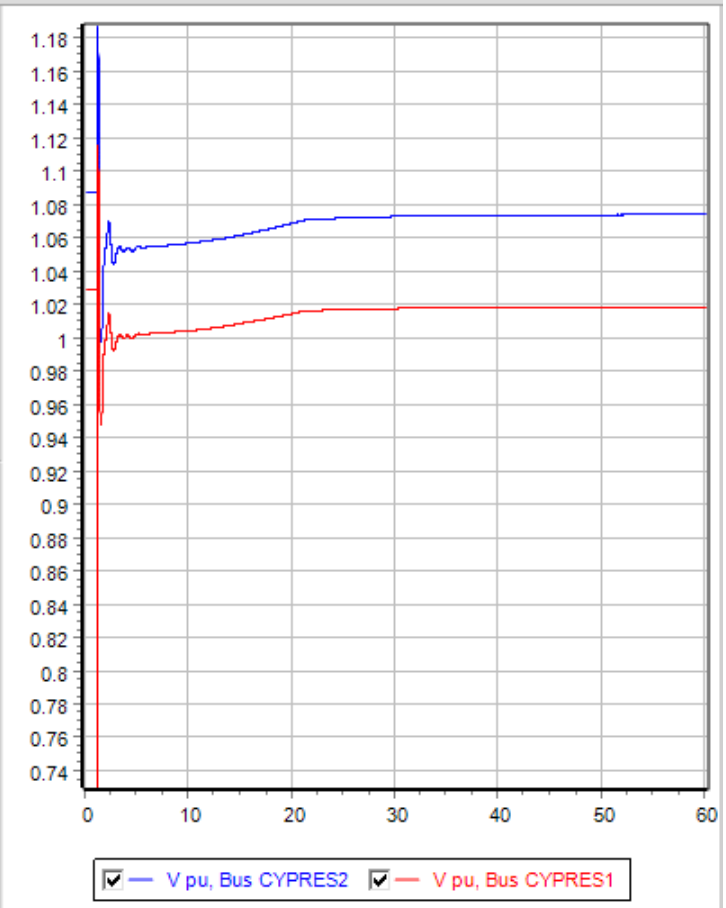
Study Case:
Scenario 4 (2022SP)

December 04, 2020 15:40:10

Cypress 562S Voltages





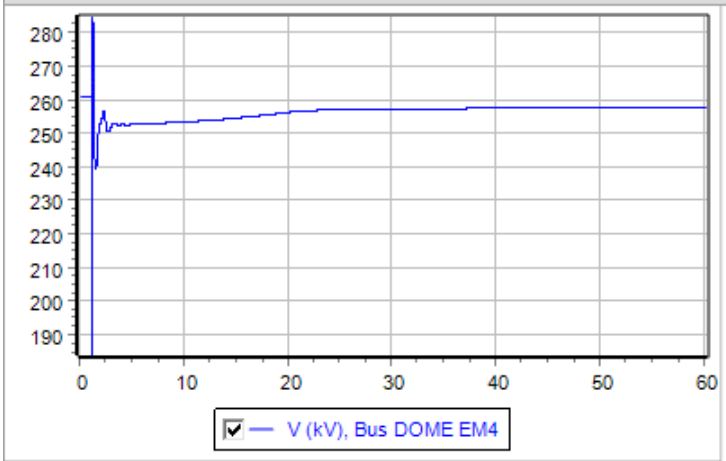


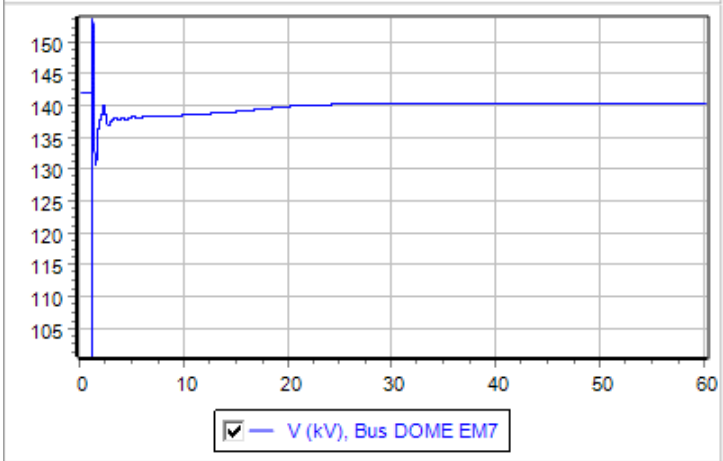
Contingency:
912L/9L912: Red Deer 63S to Nevis 766S

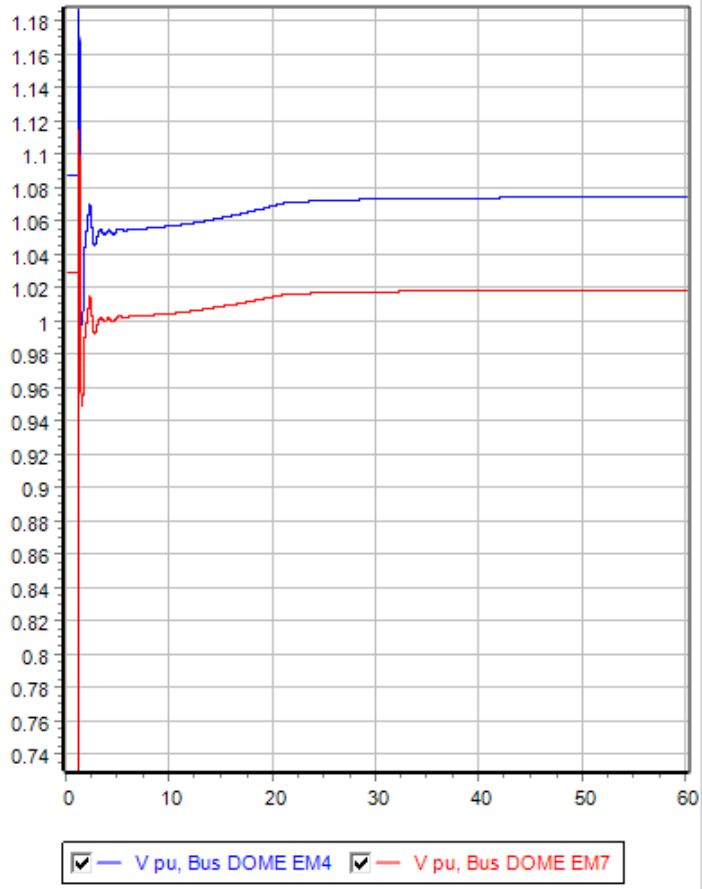
Study Case:
Scenario 4 (2022SP)

December 04, 2020 15:40:10

Dome 163S Voltages





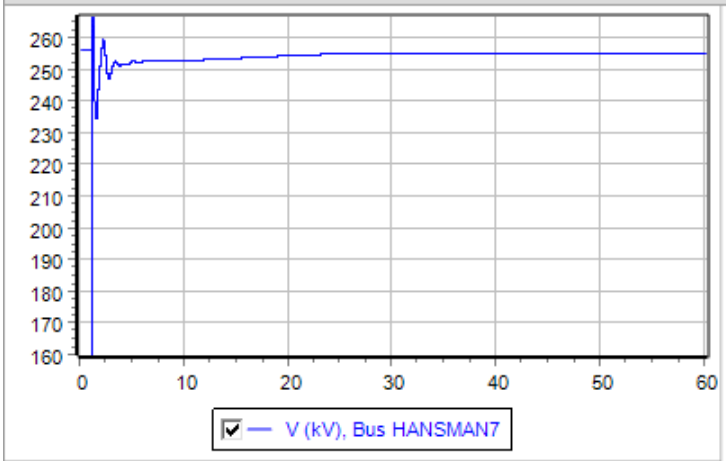


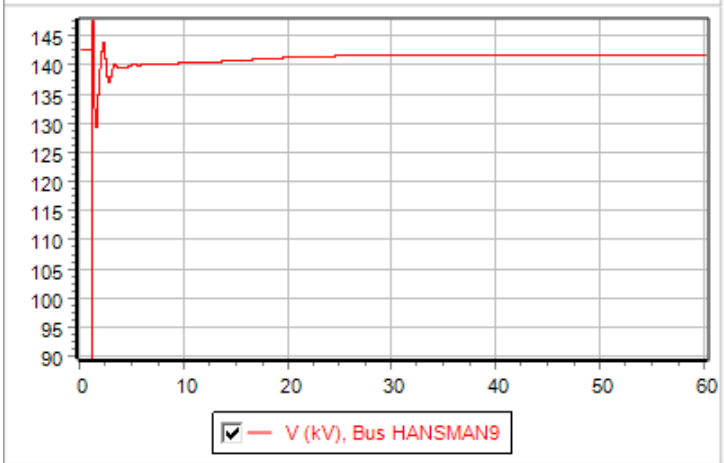
Contingency:
912L/9L912: Red Deer 63S to Nevis 766S

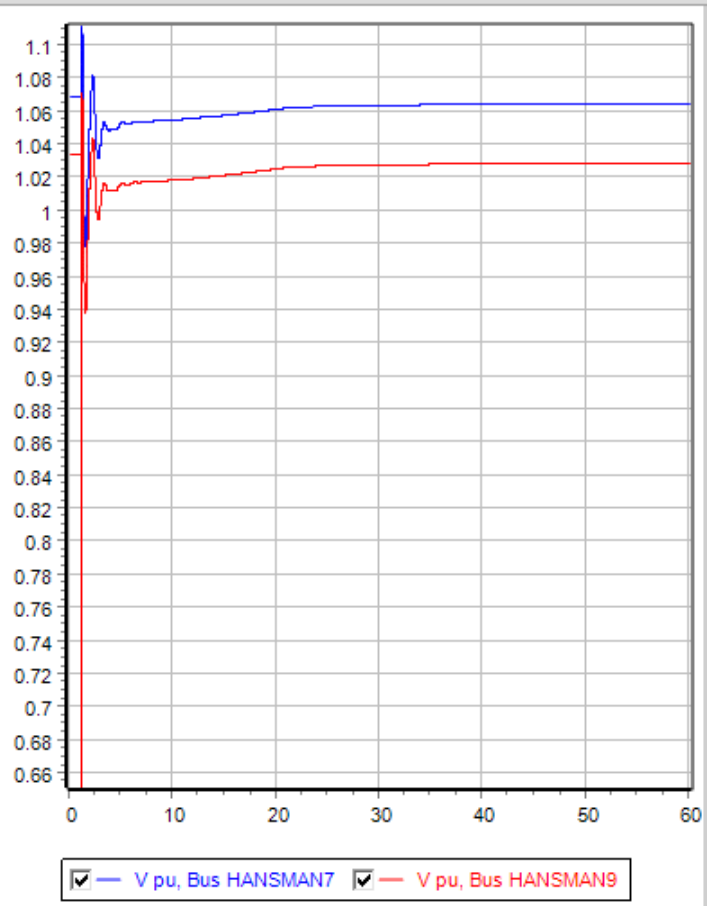
Study Case:
Scenario 4 (2022SP)

December 04, 2020 15:40:09

Hansman Lake 650S Voltages





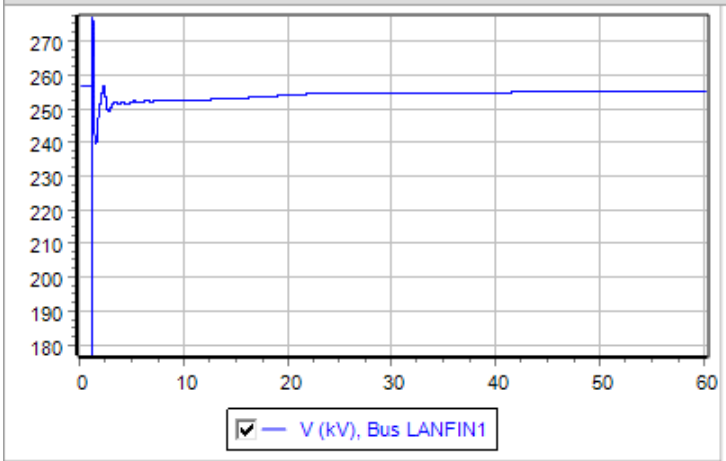


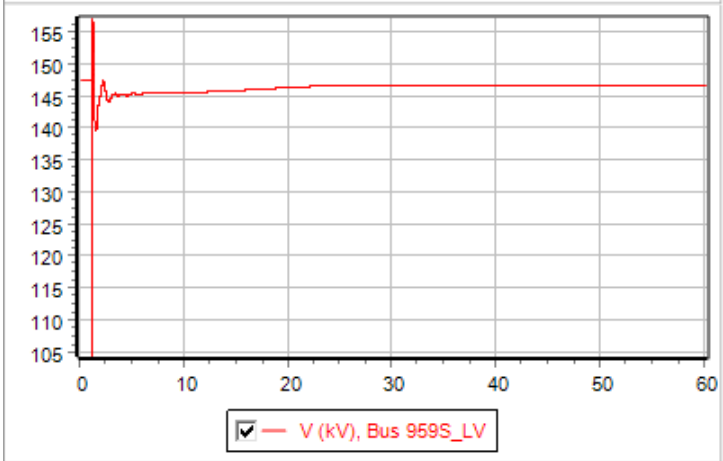
Contingency:
912L/9L912: Red Deer 63S to Nevis 766S

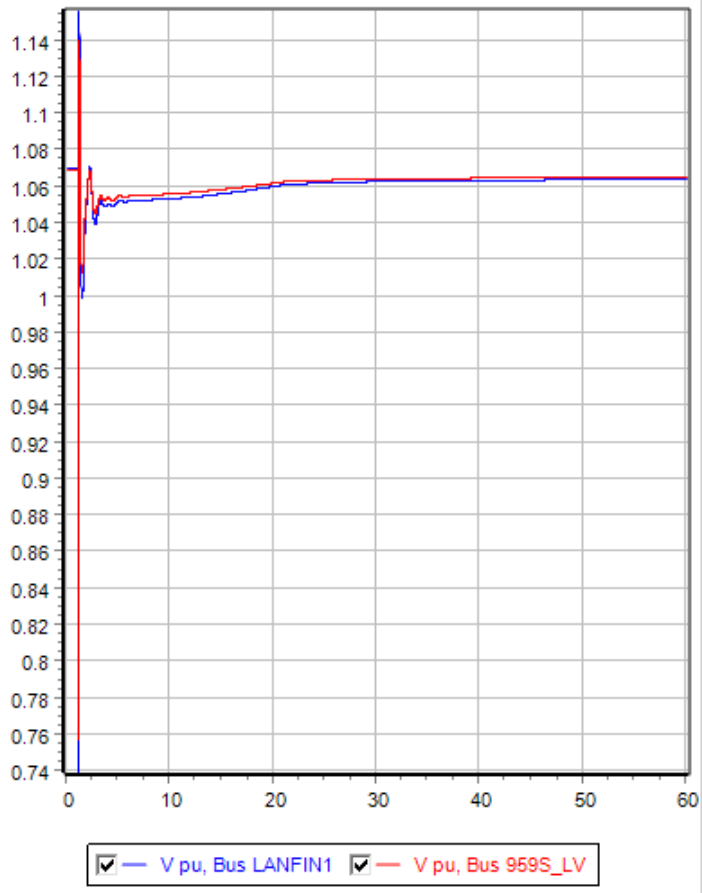
Study Case:
Scenario 4 (2022SP)

December 04, 2020 15:40:08

Lanfine 959S Voltages





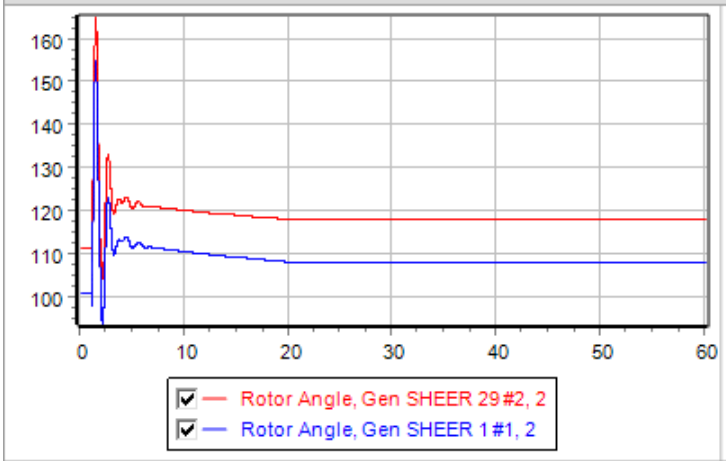


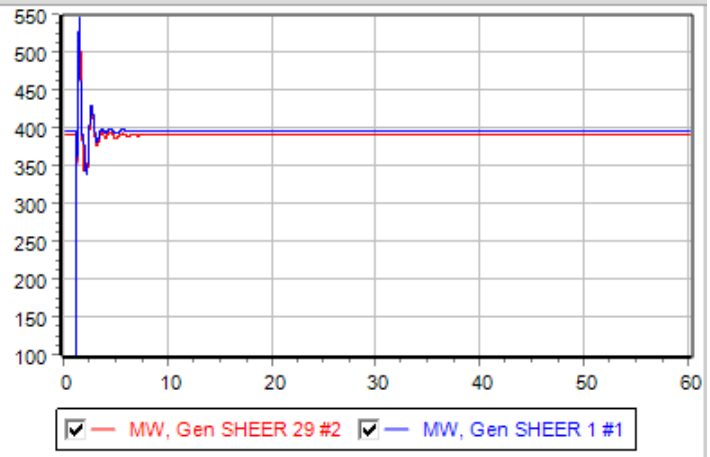
Contingency:
912L/9L912: Red Deer 63S to Nevis 766S

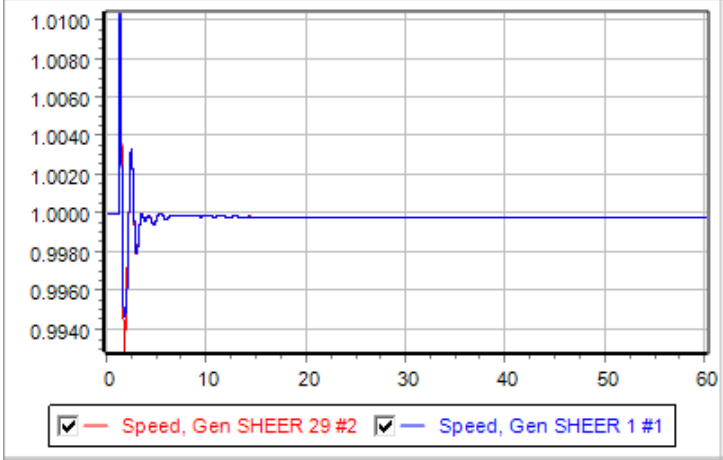
Study Case:
Scenario 4 (2022SP)

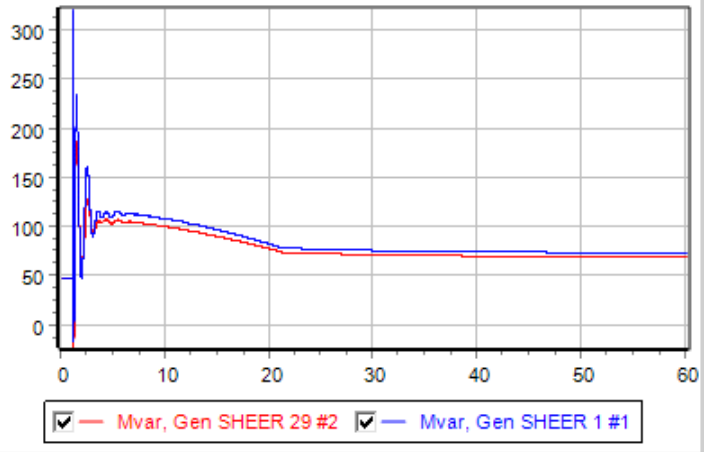
December 04, 2020 15:40:08

Sheerness









Contingency:
912L/9L912: Red Deer 63S to Nevis 766S

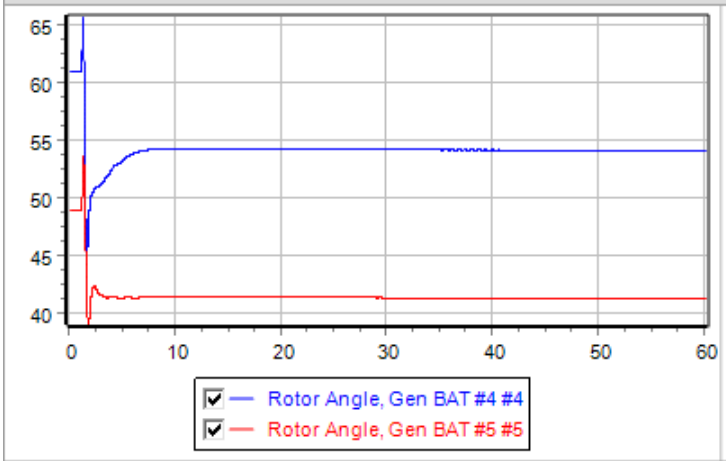
Study Case:
Scenario 4 (2022SP)

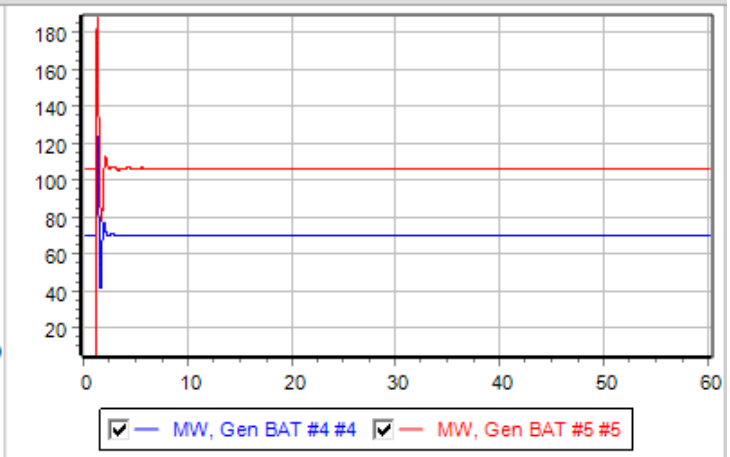
December 04, 2020 15:40:07

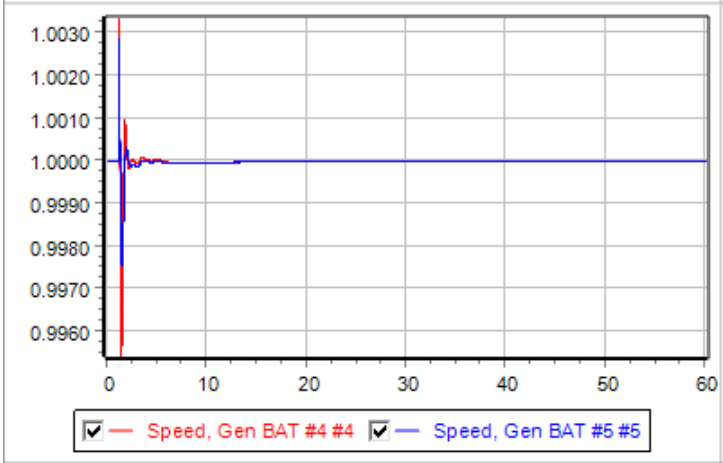
A4.2

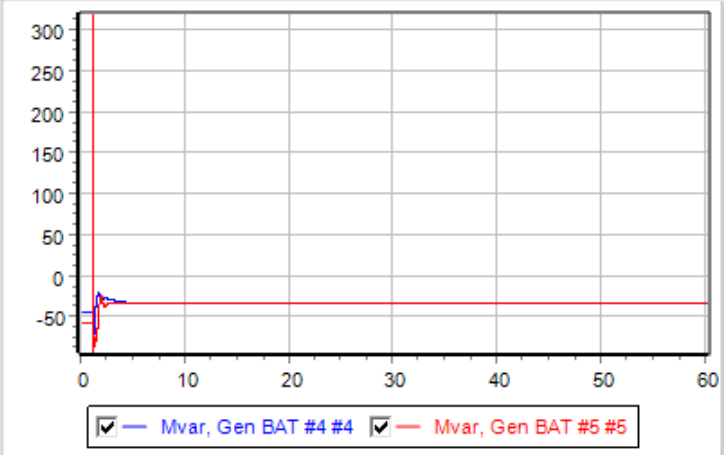
Scenario 5 (2022SL)

Battle River







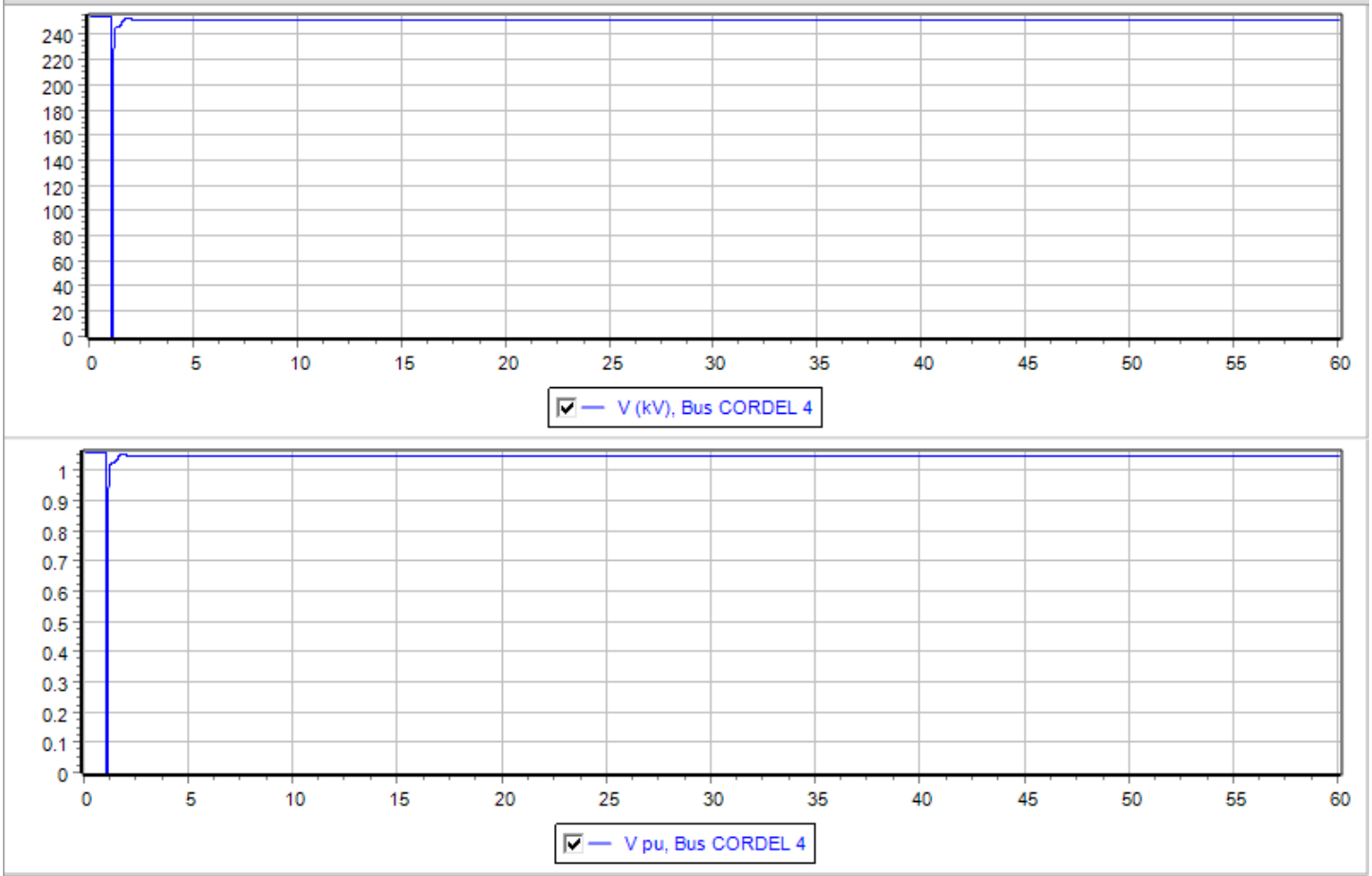


Contingency:
9L16/9L49: Cordel 755S to Tinchebray 972S

Study Case:
Scenario 5 (2022SL)

December 04, 2020 18:02:25

Cordel 755S Voltages

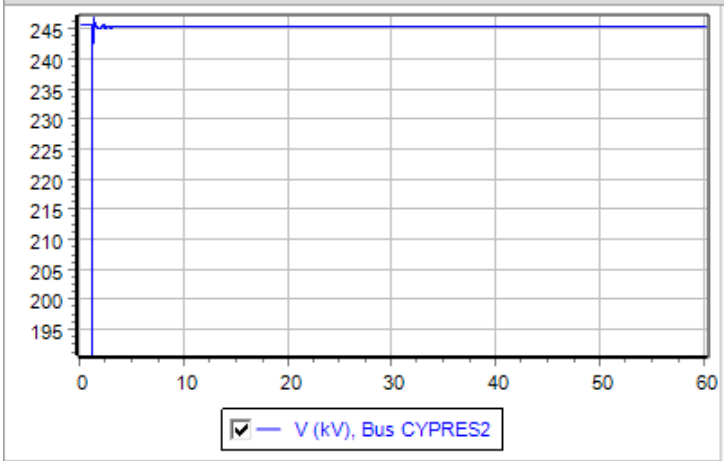


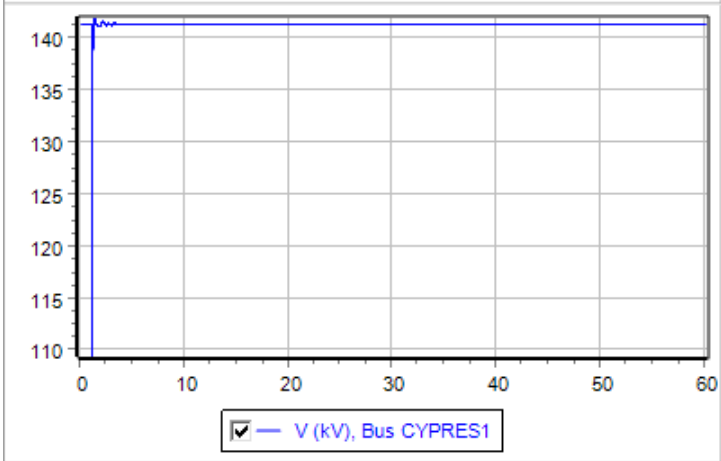
Contingency:
9L16/9L49: Cordel 755S to Tinchebray 972S

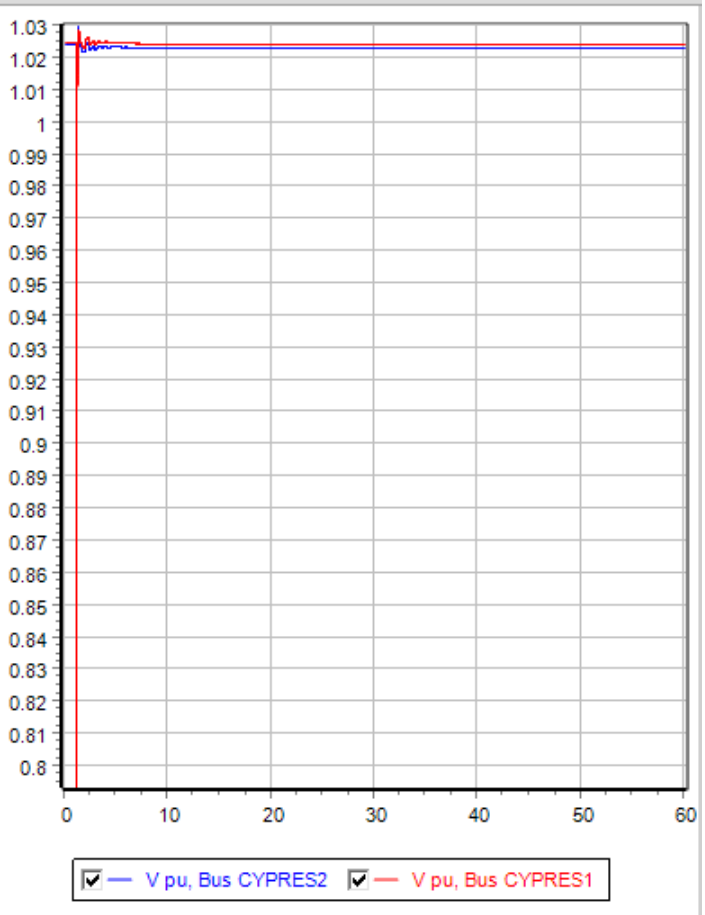
Study Case:
Scenario 5 (2022SL)

December 04, 2020 18:02:28

Cypress 562S Voltages





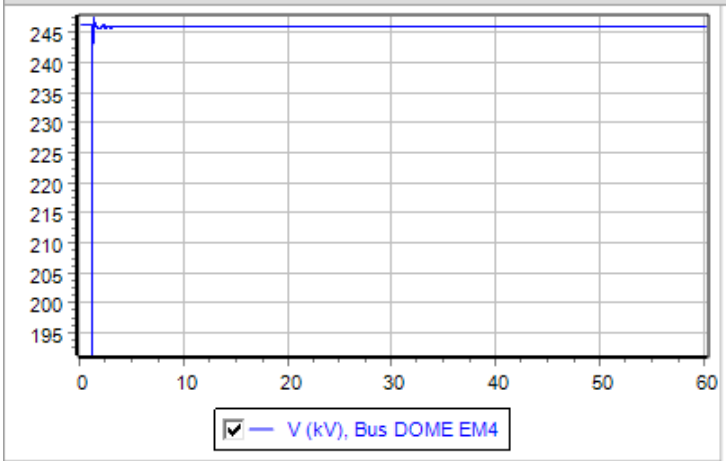


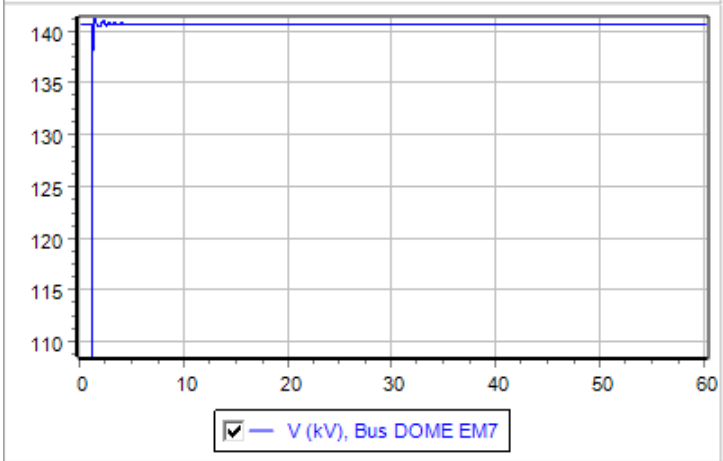
Contingency:
9L16/9L49: Cordel 755S to Tinchebray 972S

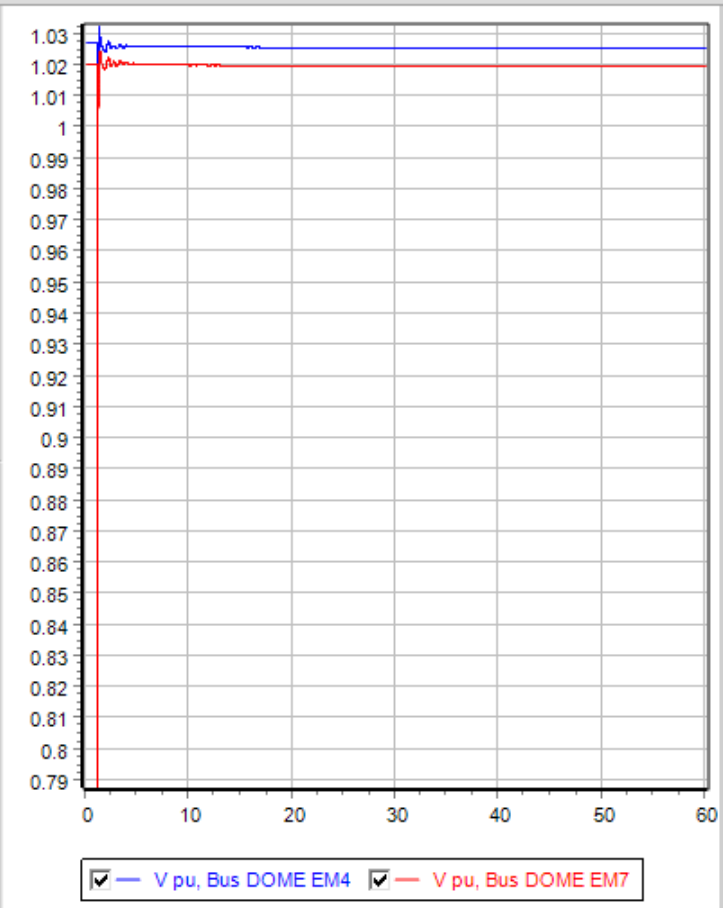
Study Case:
Scenario 5 (2022SL)

December 04, 2020 18:02:27

Dome 163S Voltages





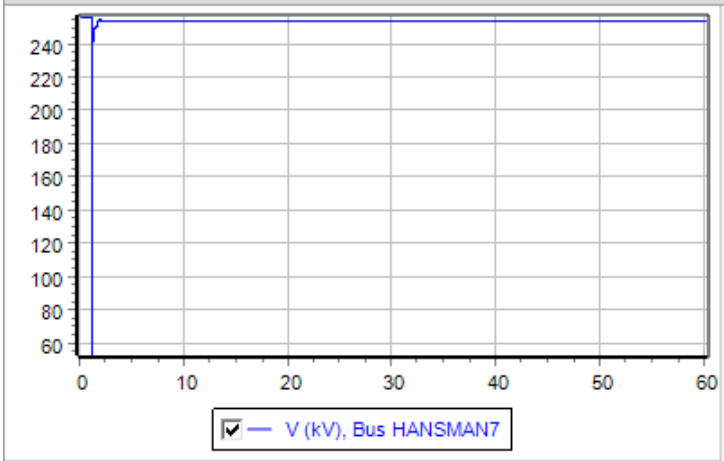


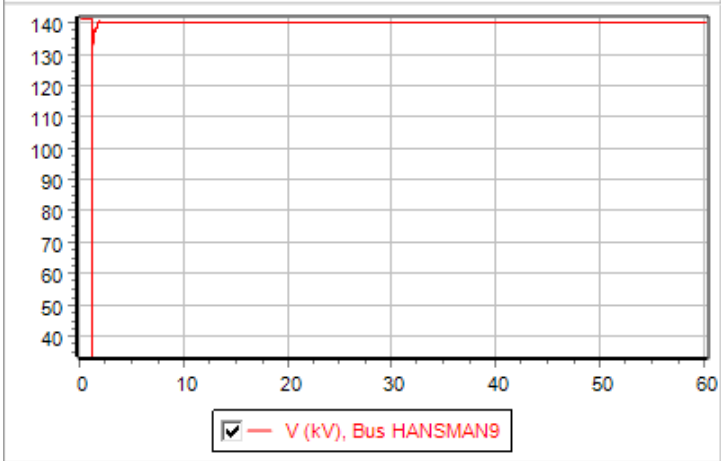
Contingency:
9L16/9L49: Cordel 755S to Tinchebray 972S

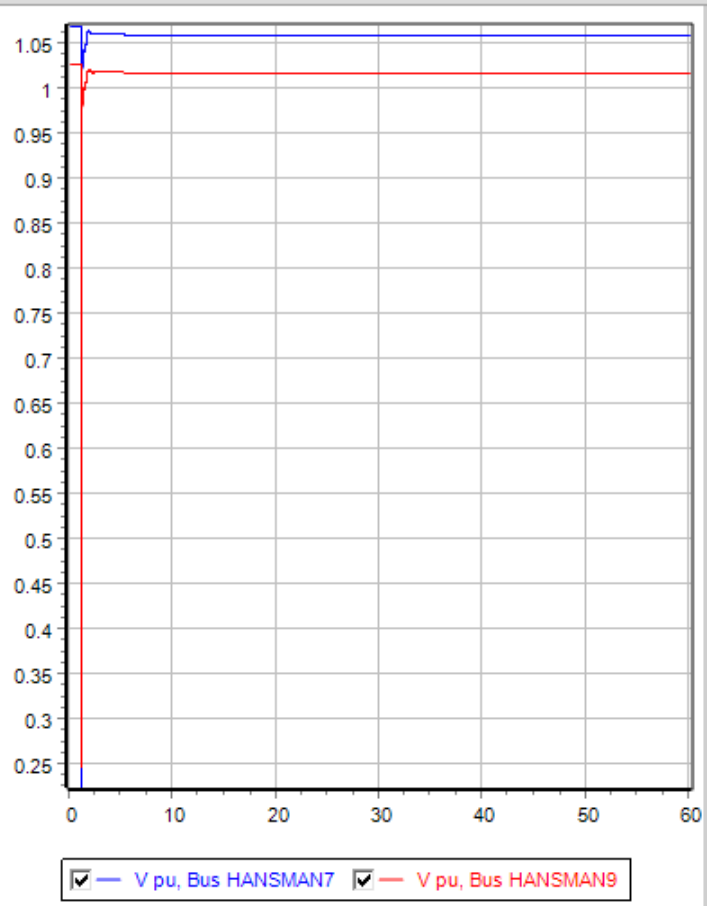
Study Case:
Scenario 5 (2022SL)

December 04, 2020 18:02:27

Hansman Lake 650S Voltages





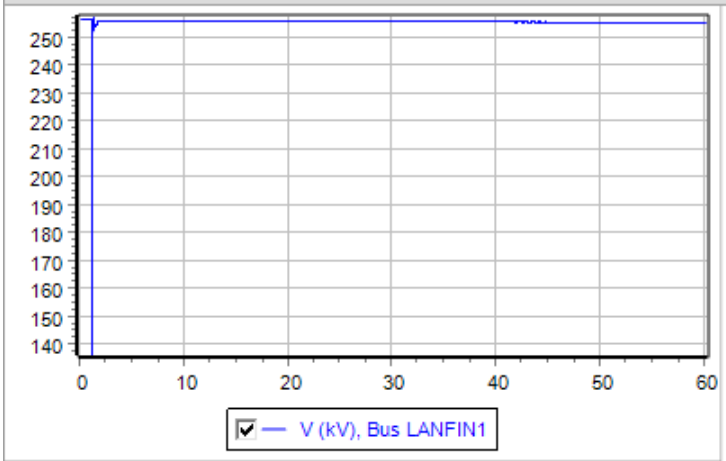


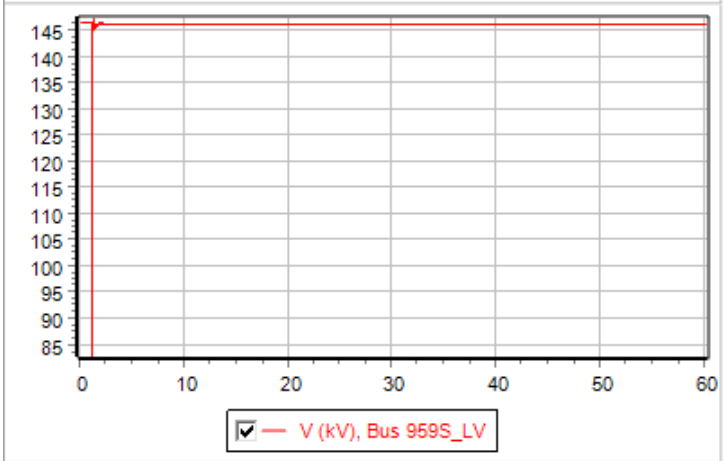
Contingency:
9L16/9L49: Cordel 755S to Tinchebray 972S

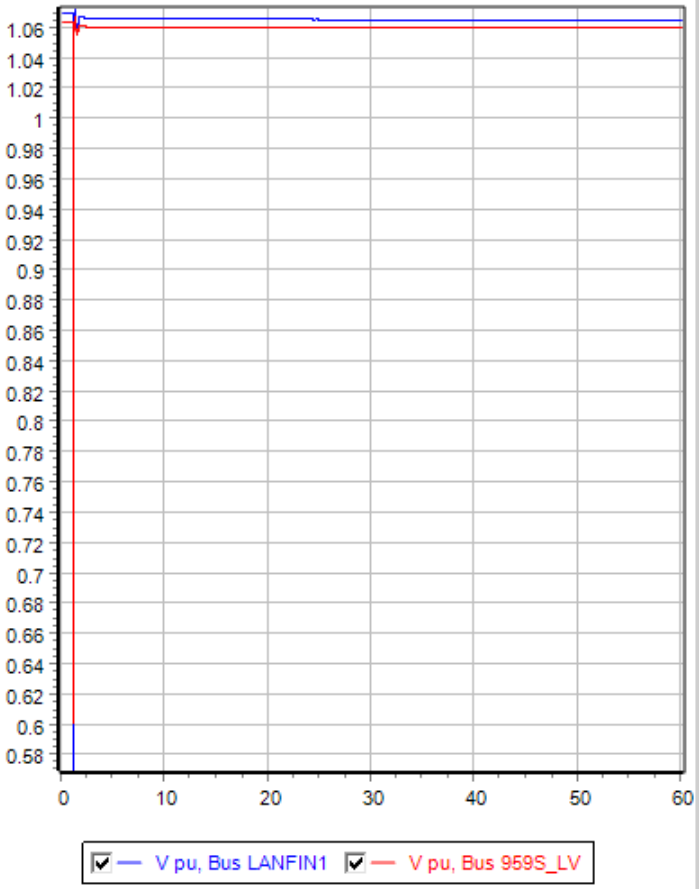
Study Case:
Scenario 5 (2022SL)

December 04, 2020 18:02:26

Lanfine 959S Voltages





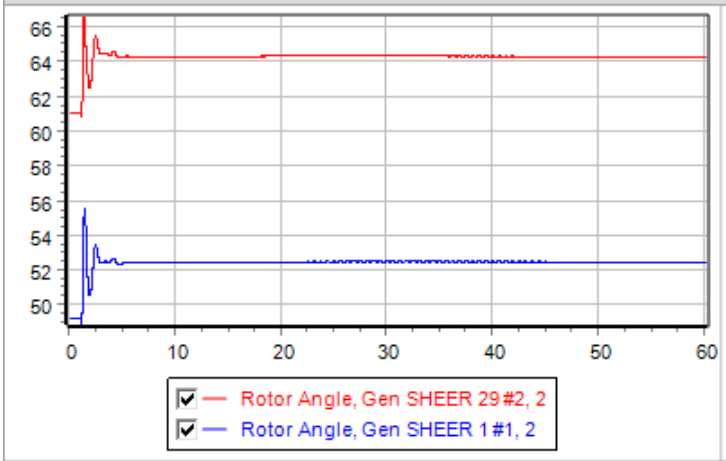


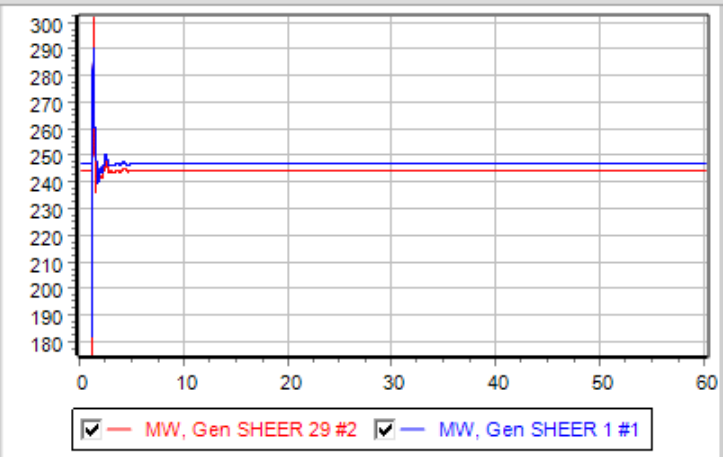
Contingency:
9L16/9L49: Cordel 755S to Tinchebray 972S

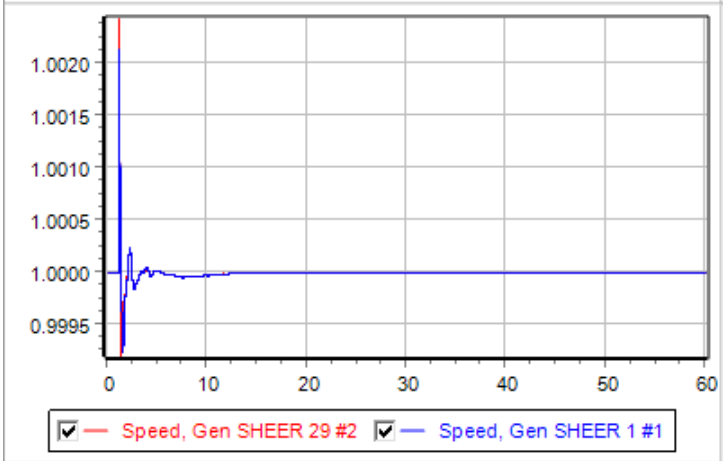
Study Case:
Scenario 5 (2022SL)

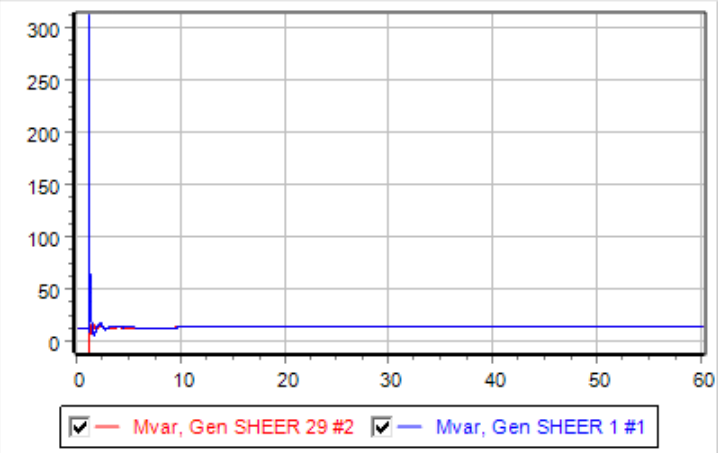
December 04, 2020 18:02:25

Sheerness







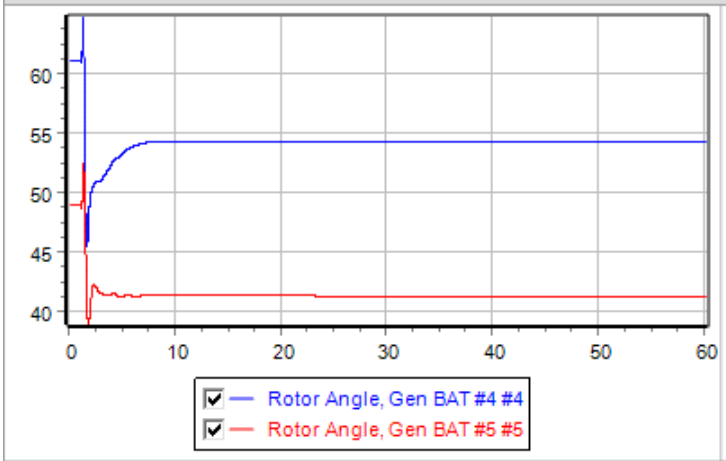


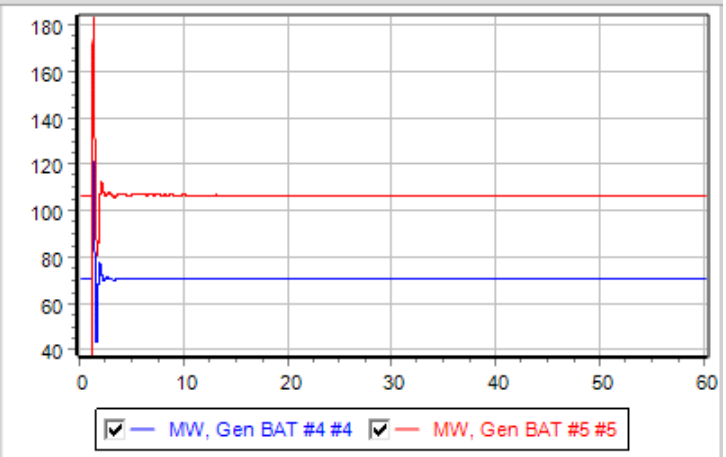
Contingency:
9L16/9L49: Cordel 755S to Tinchebray 972S

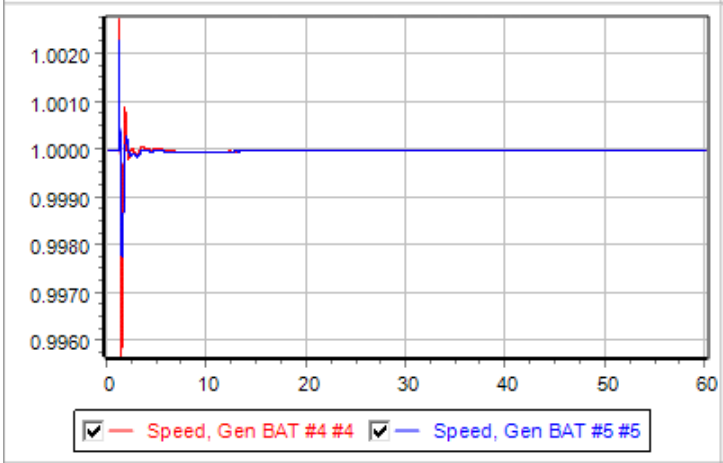
Study Case:
Scenario 5 (2022SL)

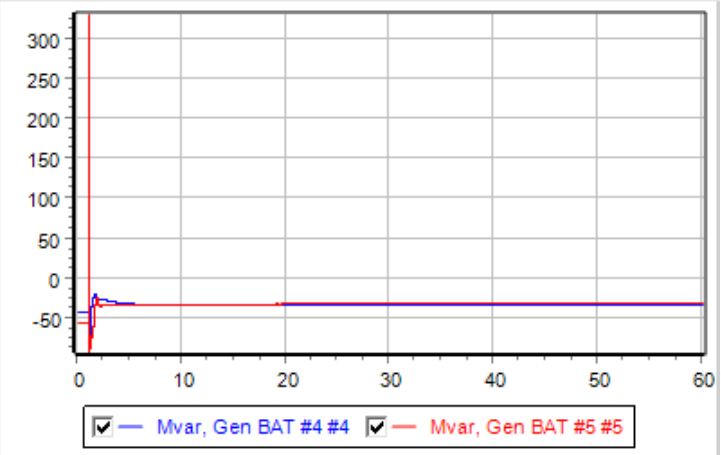
December 04, 2020 18:02:24

Battle River









Contingency:
9L16/9L49: Tinchebray 972S to Cordel 755S

Study Case:
Scenario 5 (2022SL)

December 04, 2020 18:06:01

Cordel 755S Voltages

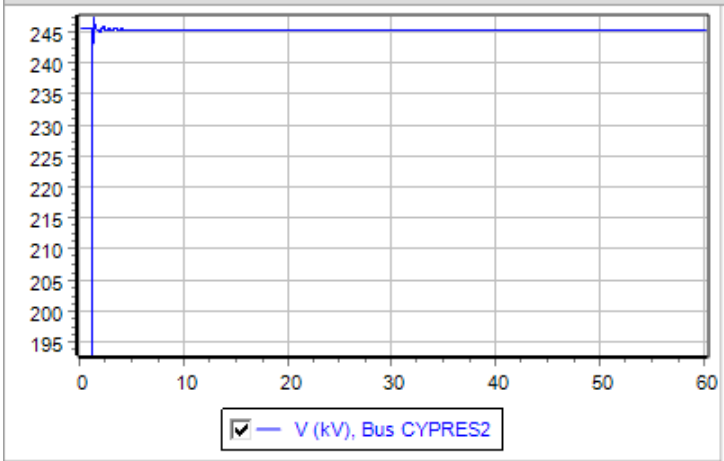


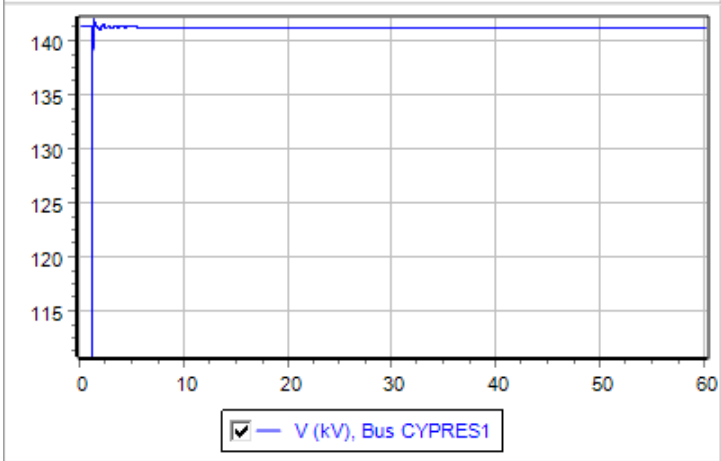
Contingency:
9L16/9L49: Tinchebray 972S to Cordel 755S

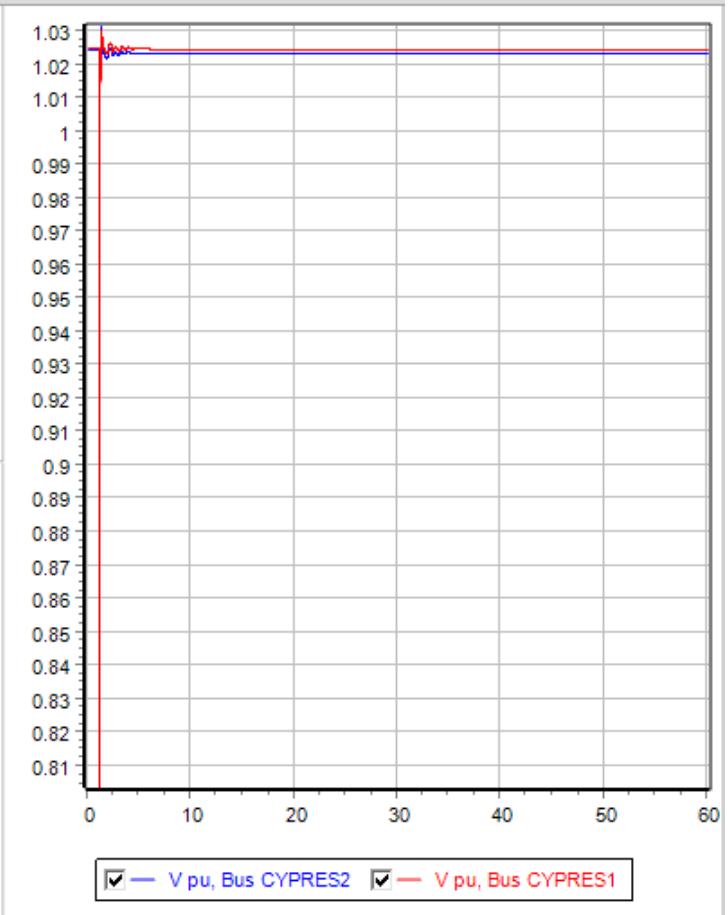
Study Case:
Scenario 5 (2022SL)

December 04, 2020 18:06:04

Cypress 562S Voltages





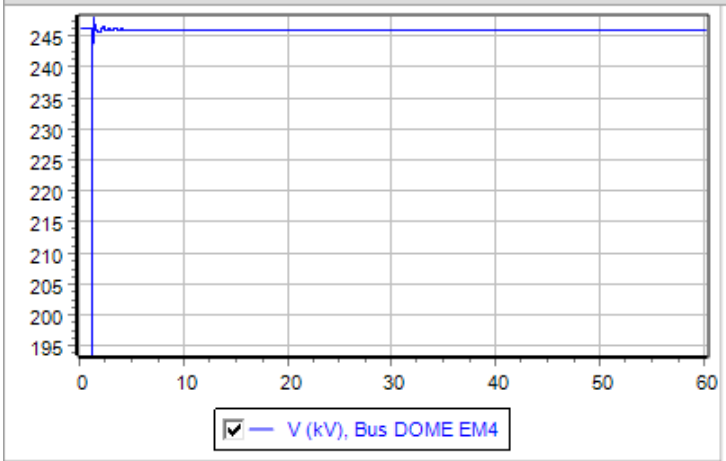


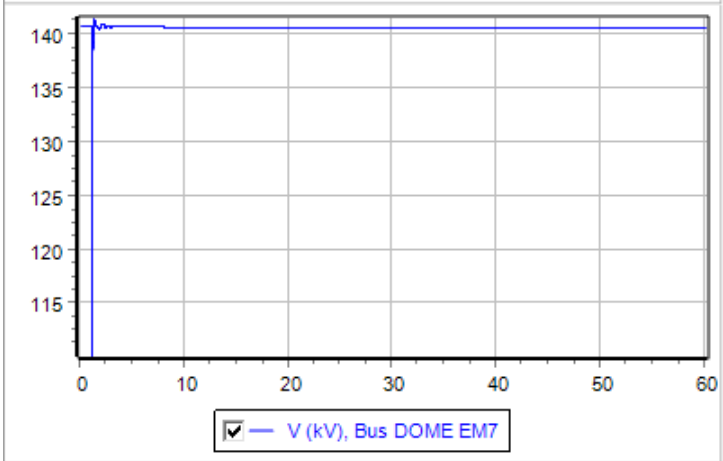
Contingency:
9L16/9L49: Tinchebray 972S to Cordel 755S

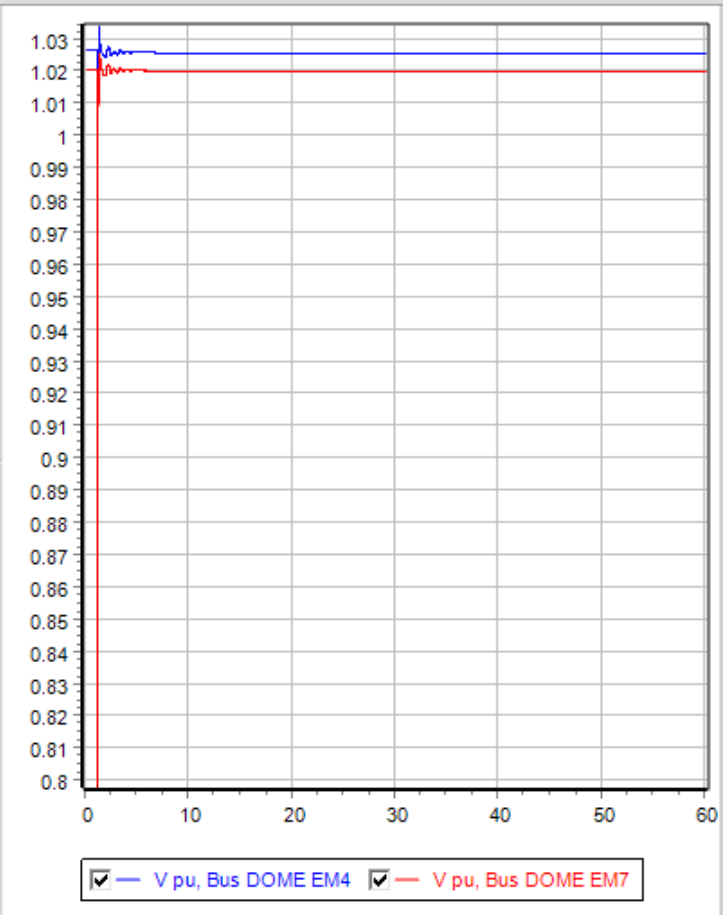
Study Case:
Scenario 5 (2022SL)

December 04, 2020 18:06:04

Dome 163S Voltages





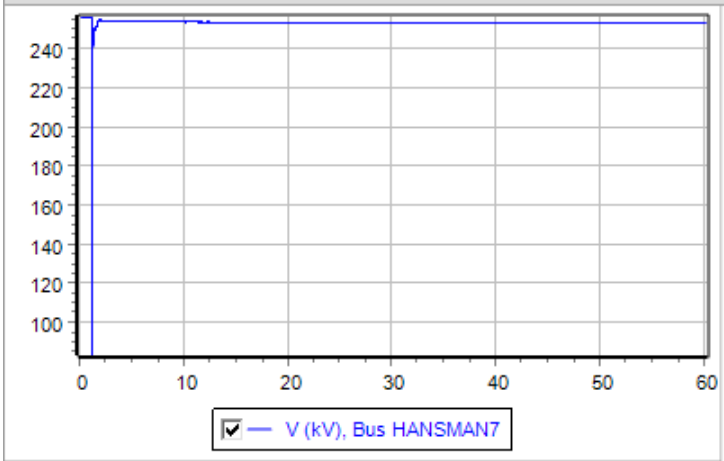


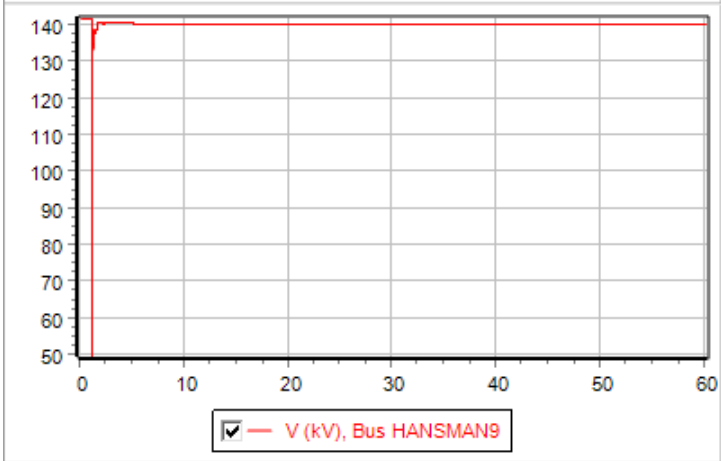
Contingency:
9L16/9L49: Tinchebray 972S to Cordel 755S

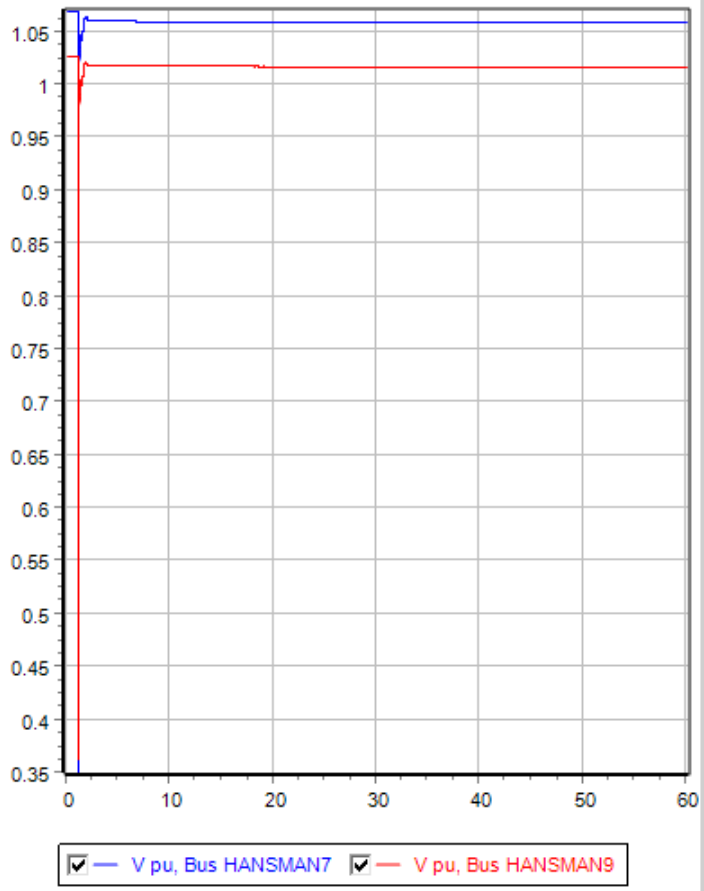
Study Case:
Scenario 5 (2022SL)

December 04, 2020 18:06:03

Hansman Lake 650S Voltages





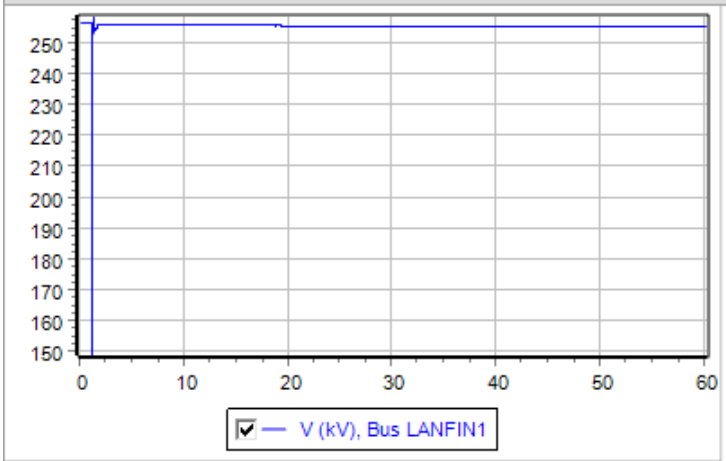


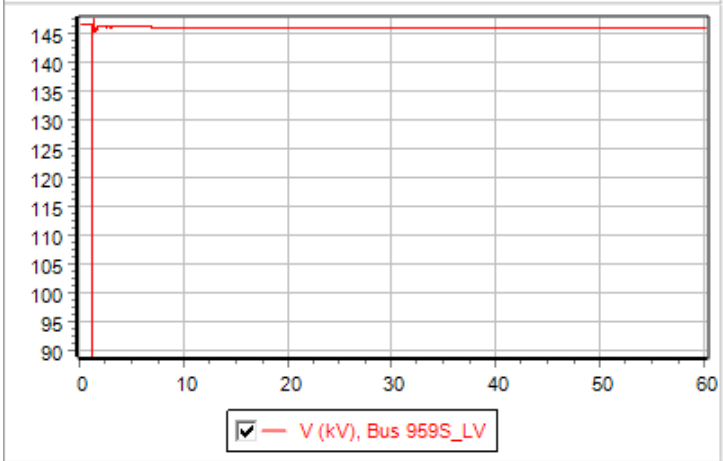
Contingency:
9L16/9L49: Tinchebray 972S to Cordel 755S

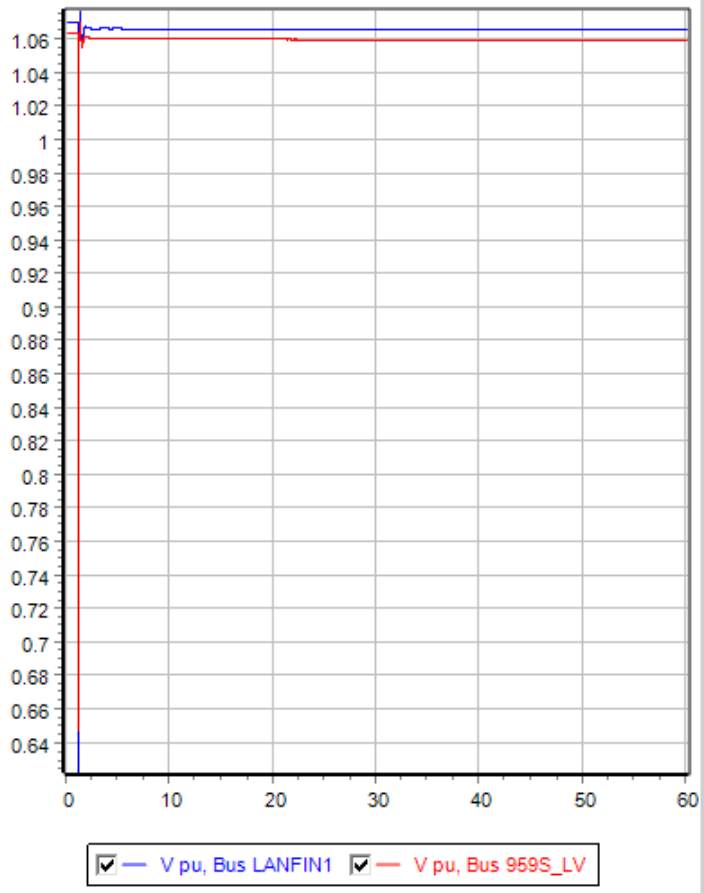
Study Case:
Scenario 5 (2022SL)

December 04, 2020 18:06:02

Lanfine 959S Voltages





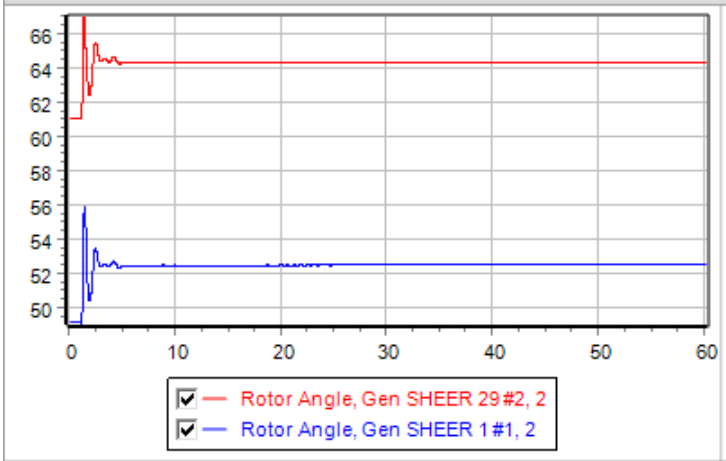


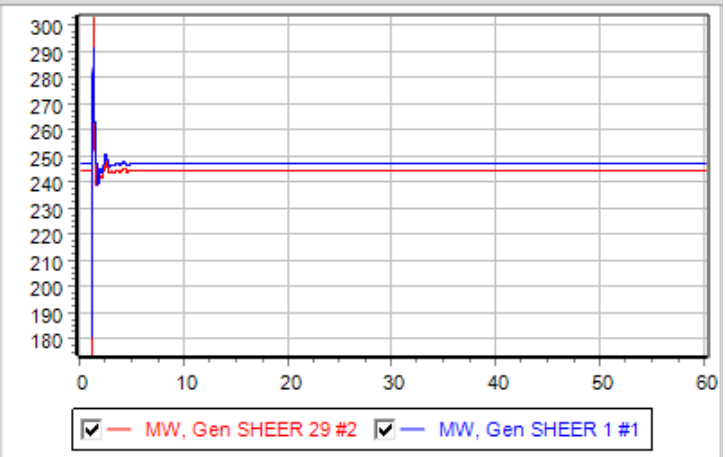
Contingency:
9L16/9L49: Tinchebray 972S to Cordel 755S

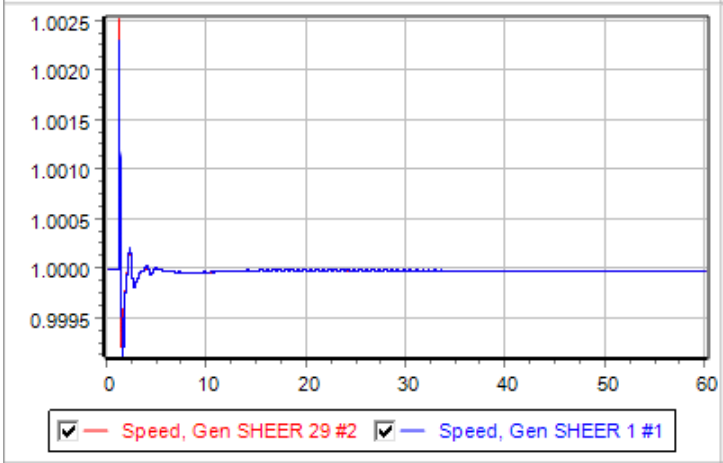
Study Case:
Scenario 5 (2022SL)

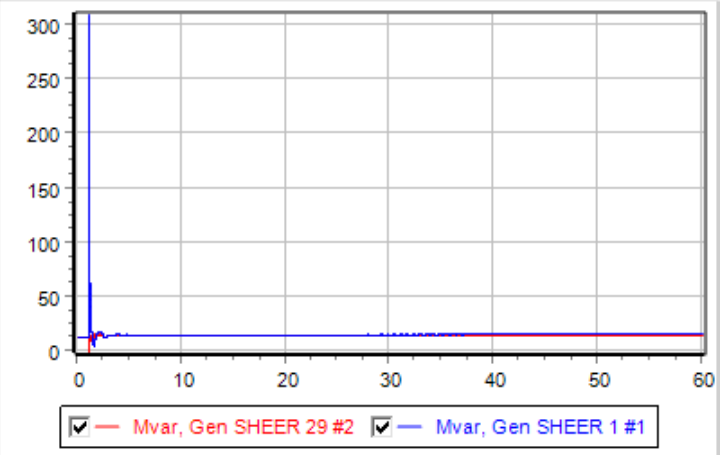
December 04, 2020 18:06:02

Sheerness







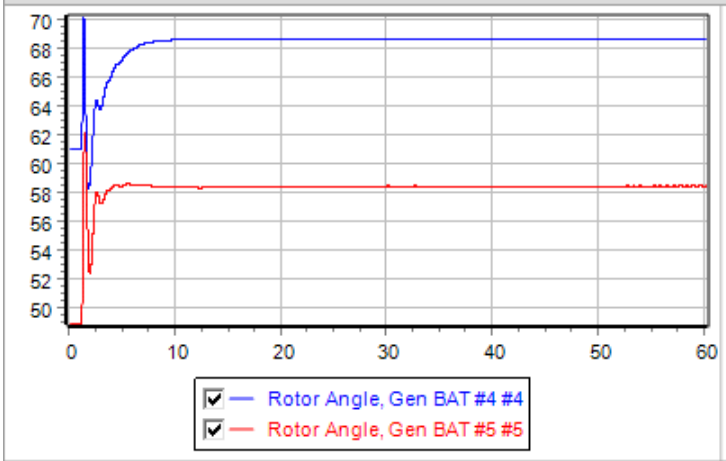


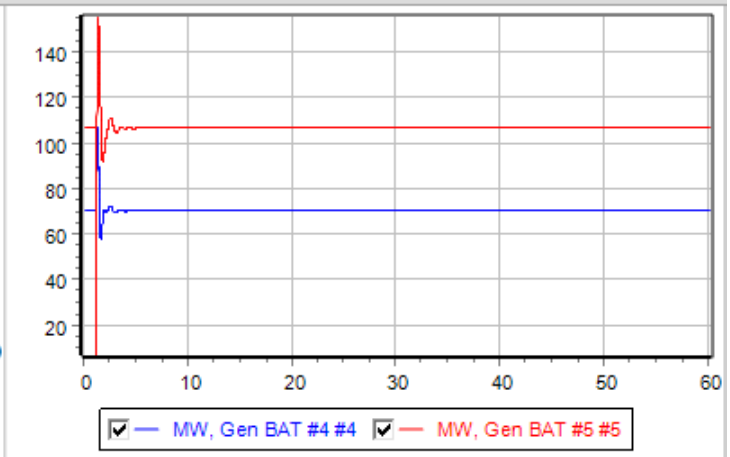
Contingency:
9L16/9L49: Tinchebray 972S to Cordel 755S

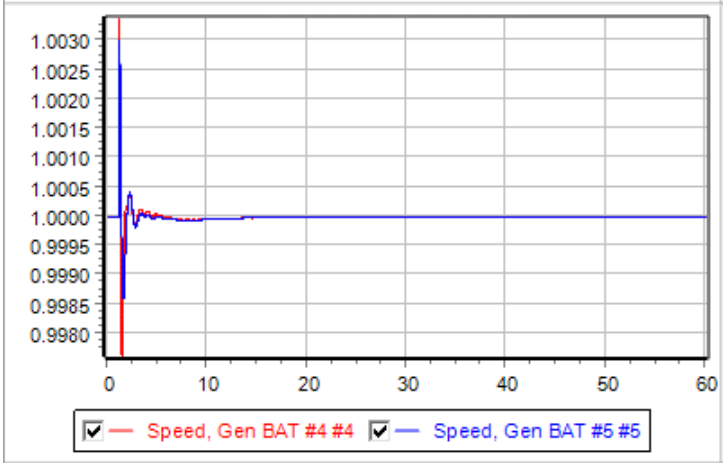
Study Case:
Scenario 5 (2022SL)

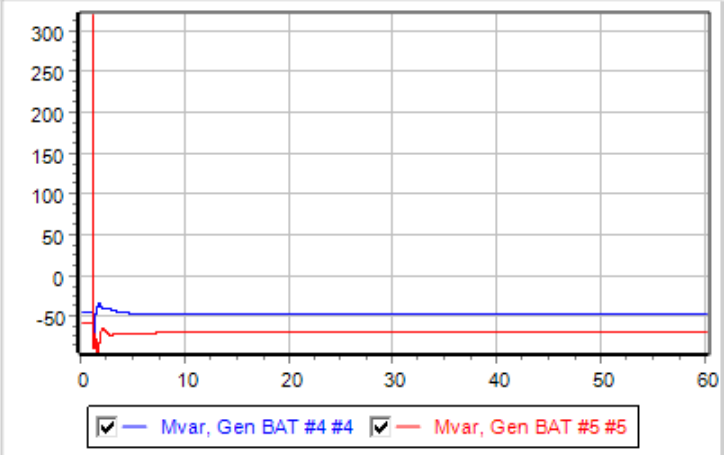
December 04, 2020 18:06:01

Battle River







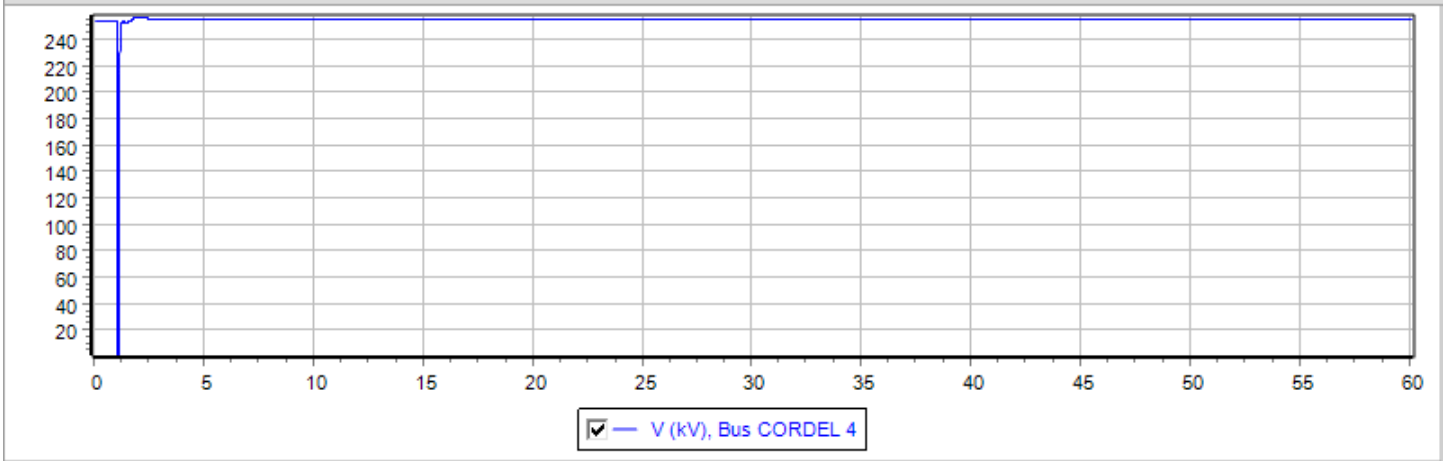


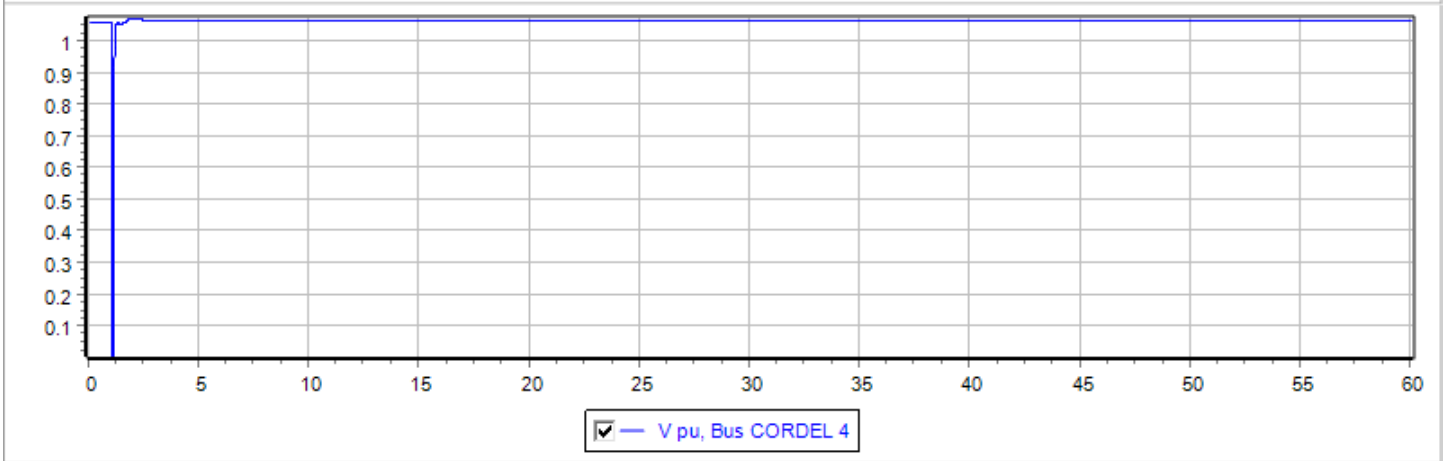
Contingency:
9L20: Cordel 755S to Nevis 766S

Study Case:
Scenario 5 (2022SL)

December 04, 2020 18:09:39

Cordel 755S Voltages



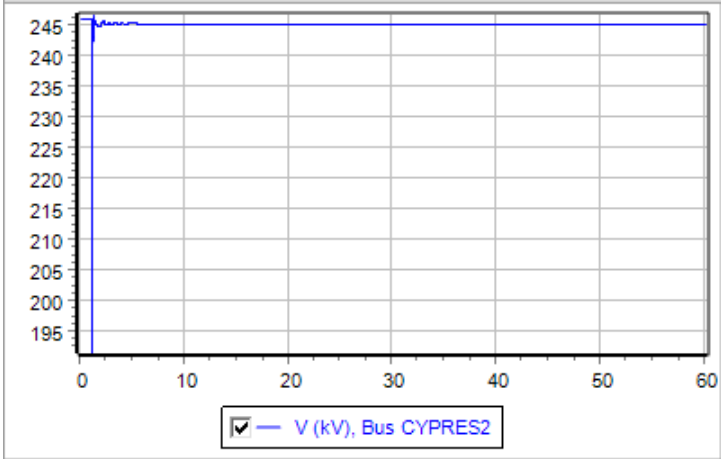


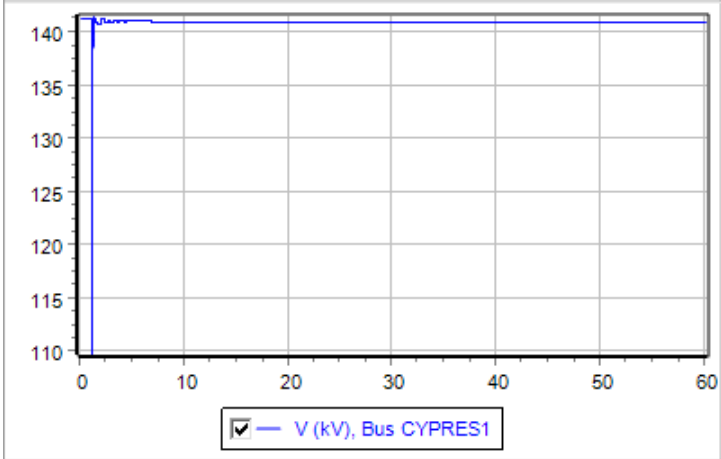
Contingency:
9L20: Cordel 755S to Nevis 766S

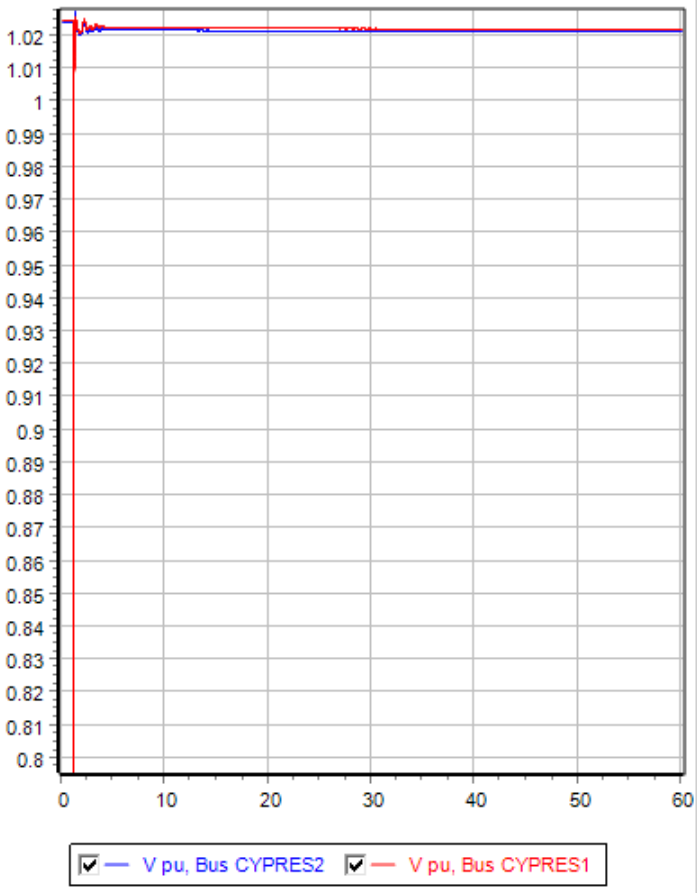
Study Case:
Scenario 5 (2022SL)

December 04, 2020 18:09:42

Cypress 562S Voltages





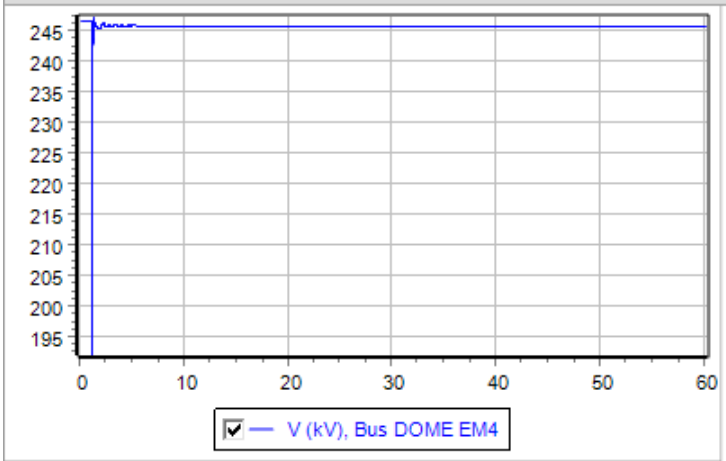


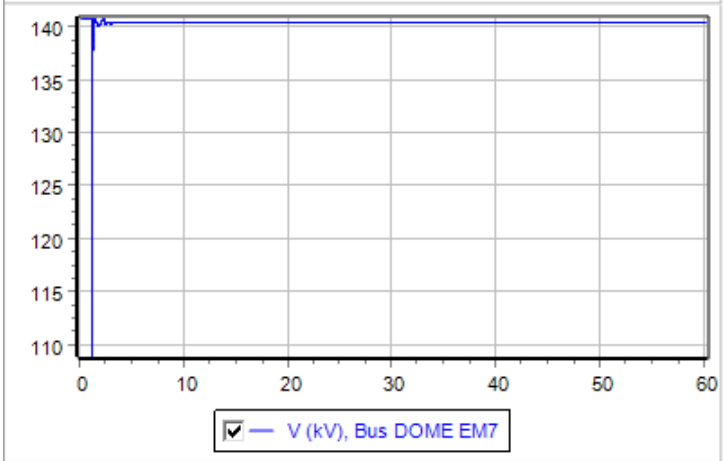
Contingency:
9L20: Cordel 755S to Nevis 766S

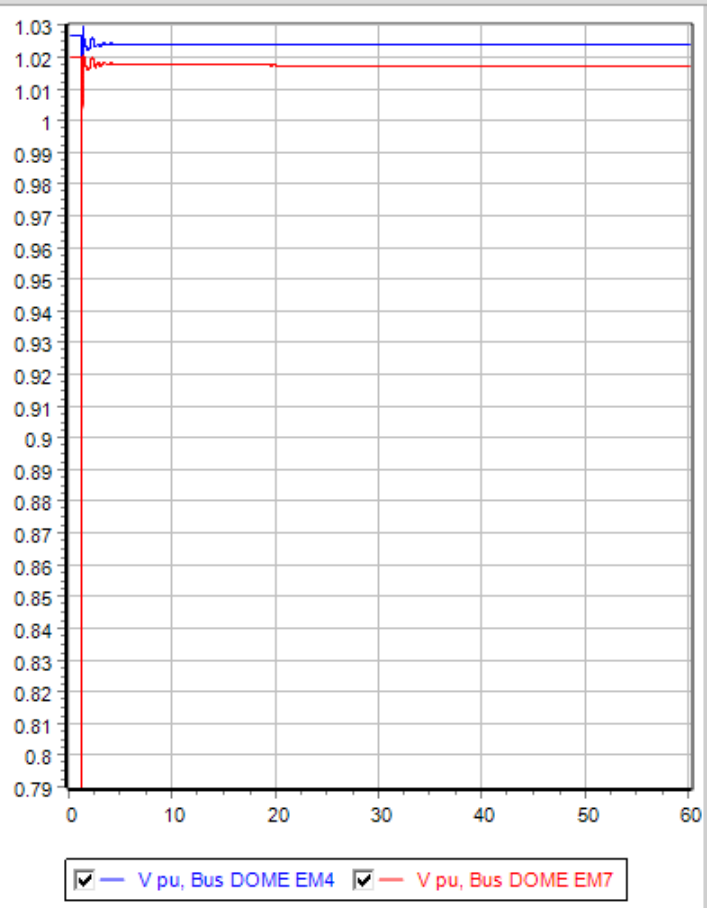
Study Case:
Scenario 5 (2022SL)

December 04, 2020 18:09:41

Dome 163S Voltages





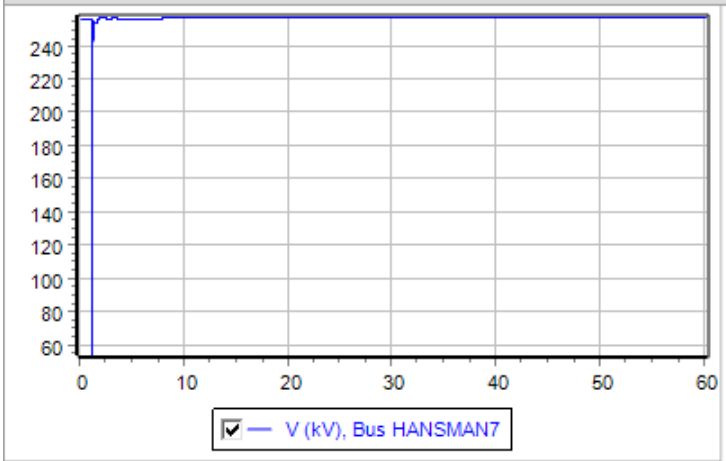


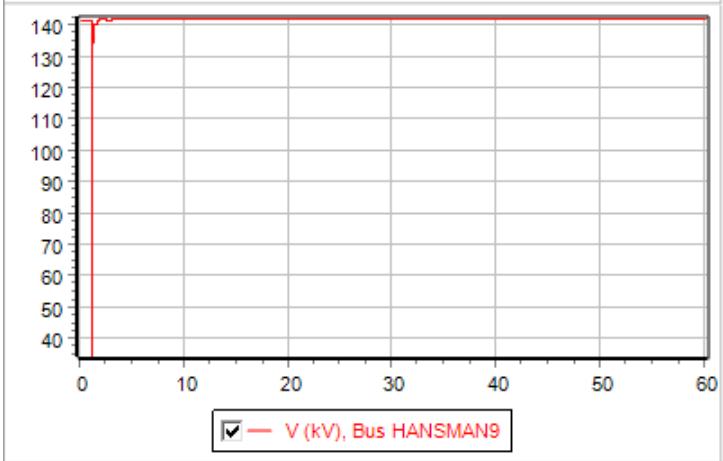
Contingency:
9L20: Cordel 755S to Nevis 766S

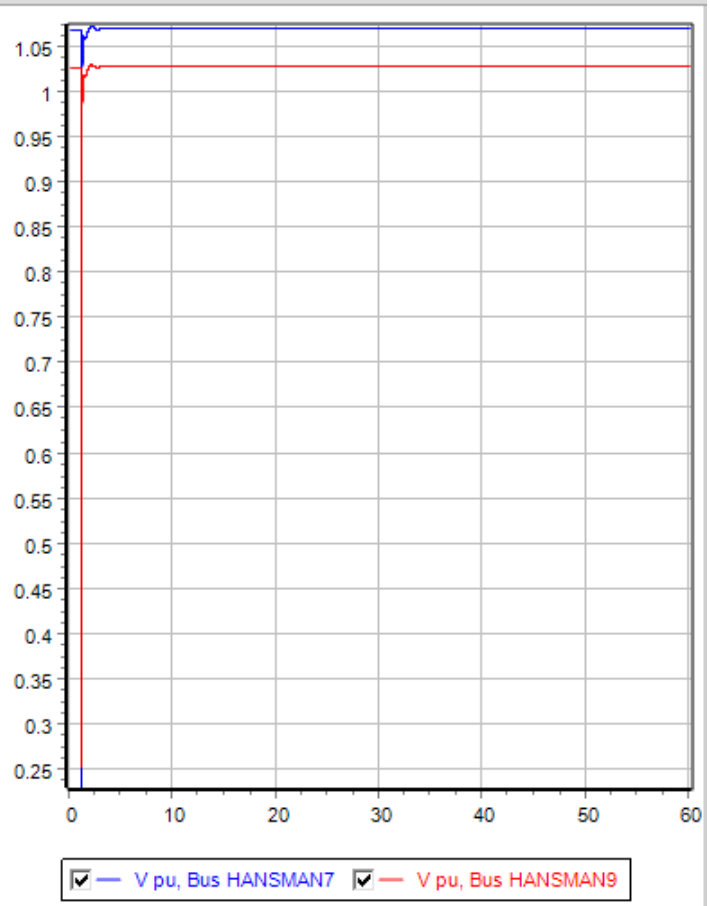
Study Case:
Scenario 5 (2022SL)

December 04, 2020 18:09:41

Hansman Lake 650S Voltages





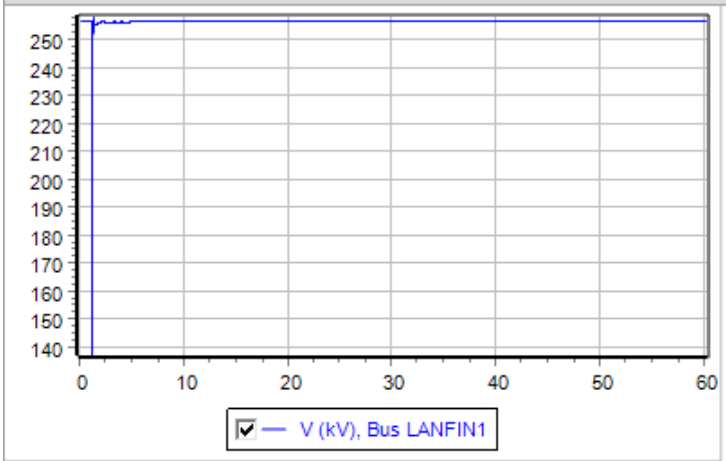


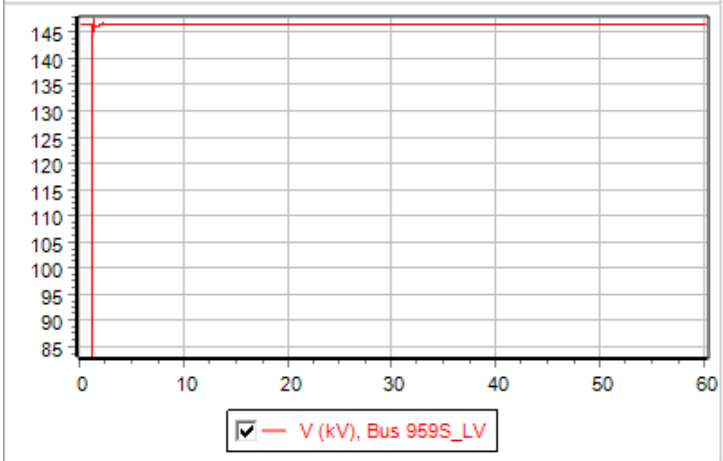
Contingency:
9L20: Cordel 755S to Nevis 766S

Study Case:
Scenario 5 (2022SL)

December 04, 2020 18:09:40

Lanfine 959S Voltages





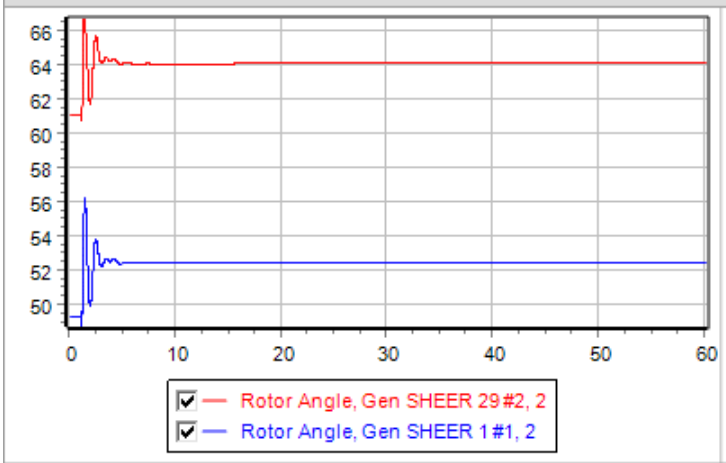


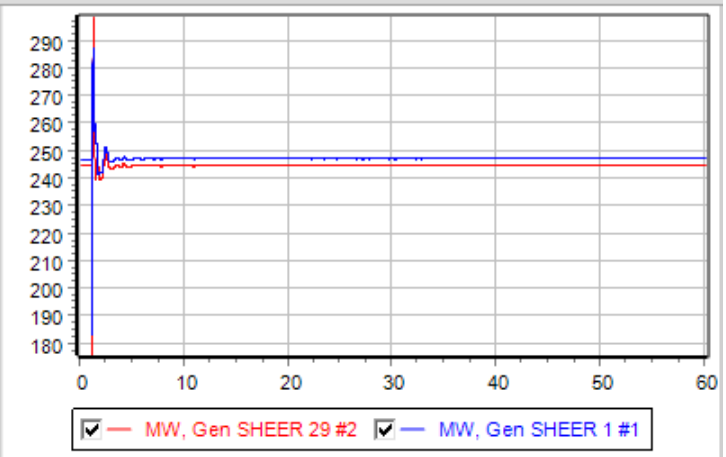
Contingency:
9L20: Cordel 755S to Nevis 766S

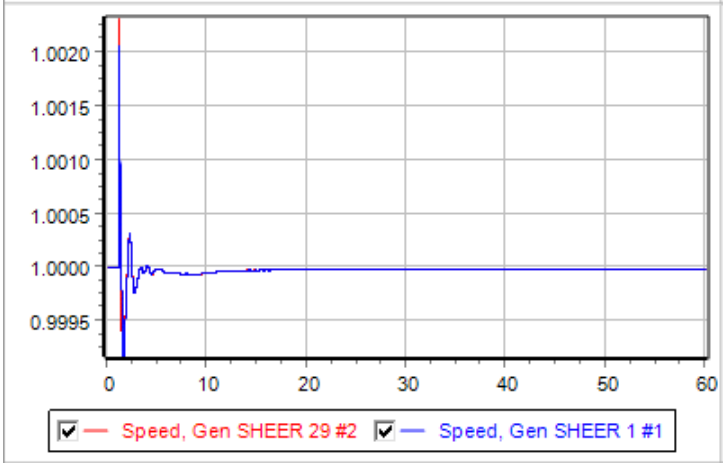
Study Case:
Scenario 5 (2022SL)

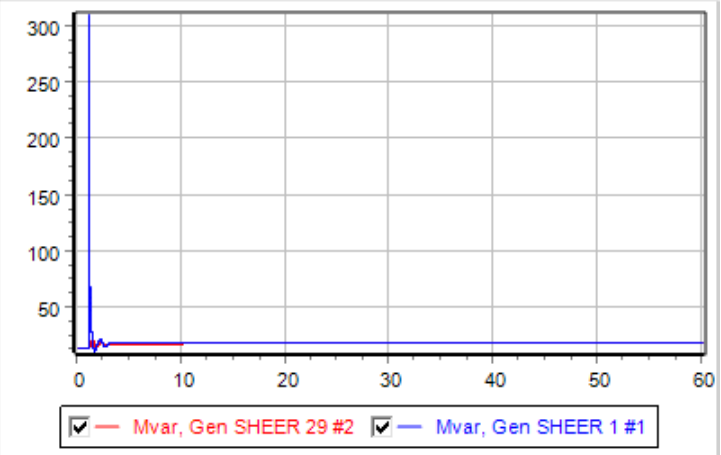
December 04, 2020 18:09:40

Sheerness







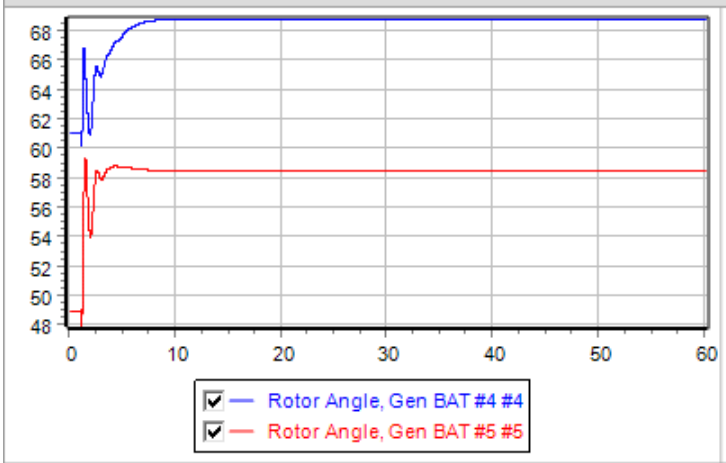


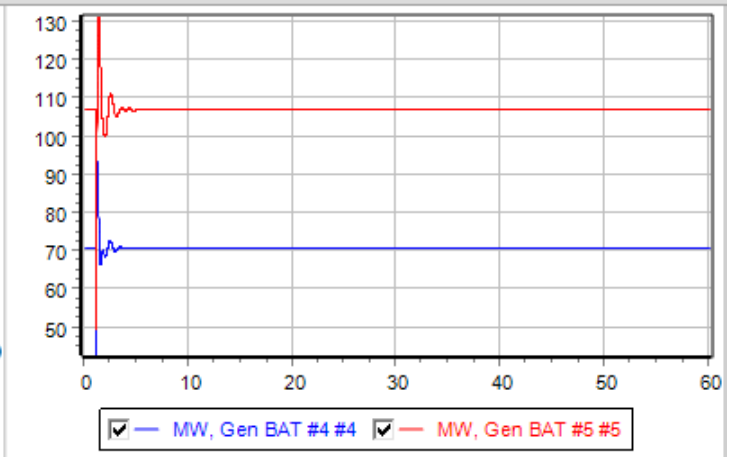
Contingency:
9L20: Cordel 755S to Nevis 766S

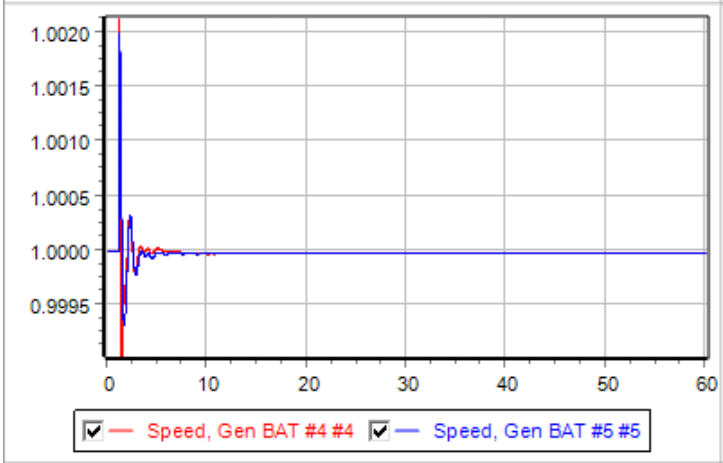
Study Case:
Scenario 5 (2022SL)

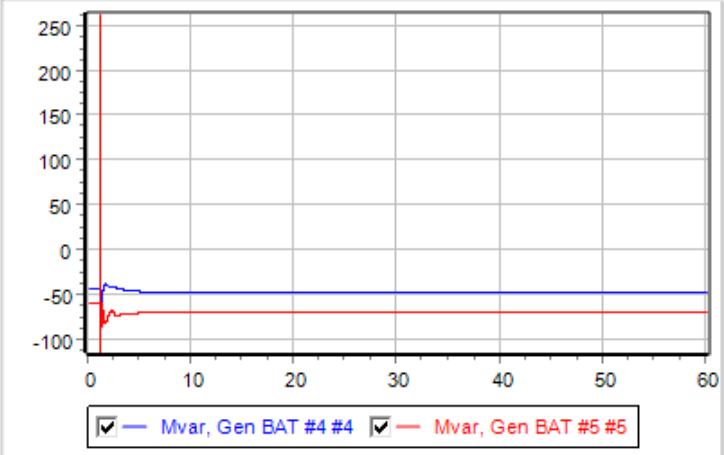
December 04, 2020 18:09:39

Battle River







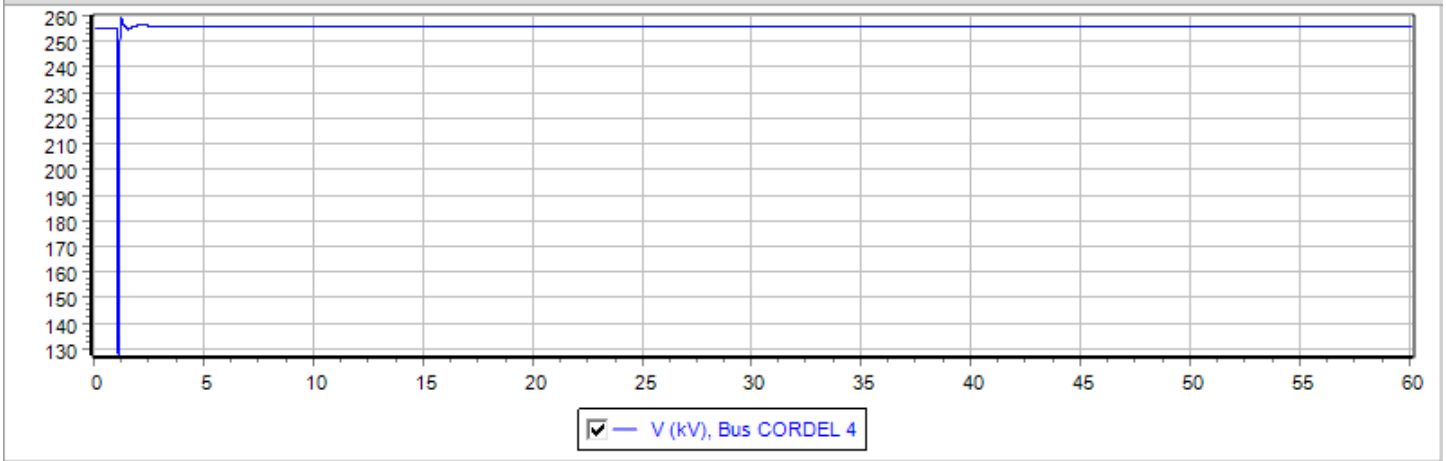


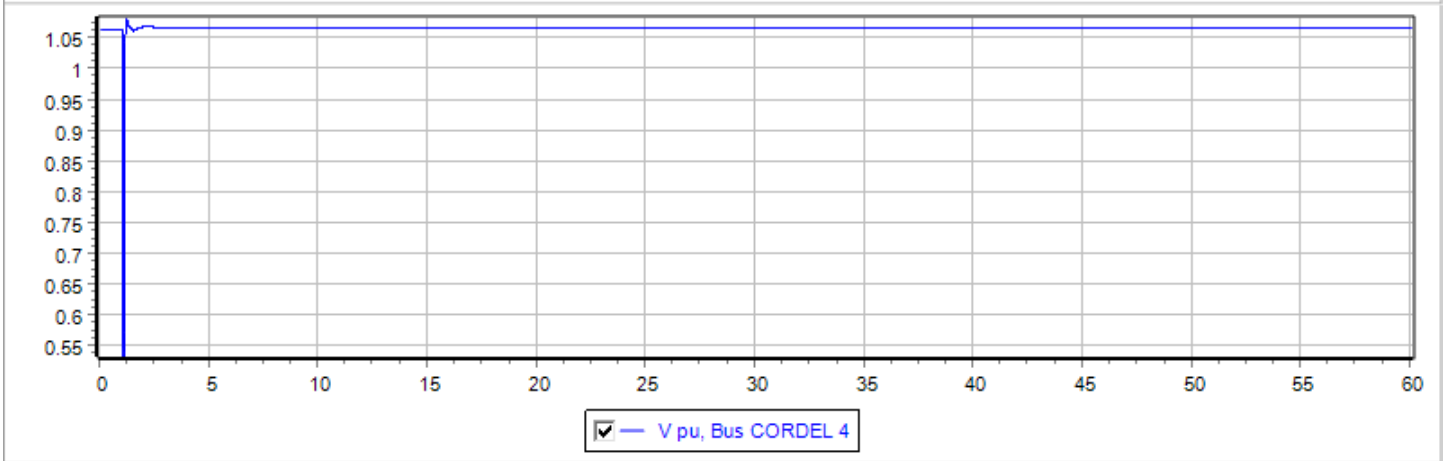
Contingency:
9L20: Nevis 766S to Cordel 755S

Study Case:
Scenario 5 (2022SL)

December 04, 2020 18:13:28

Cordel 755S Voltages



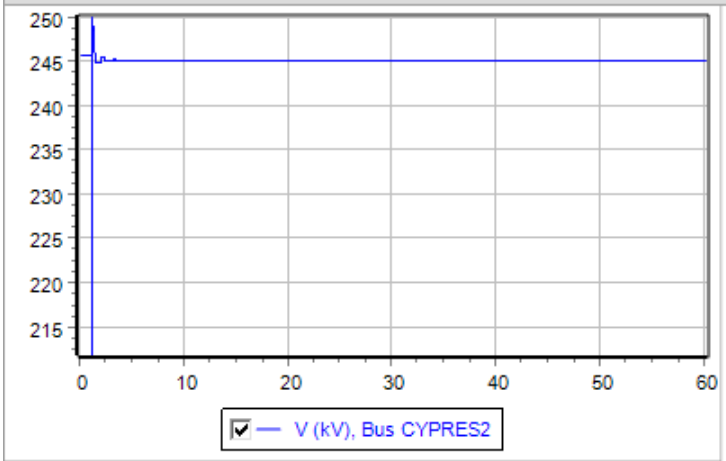


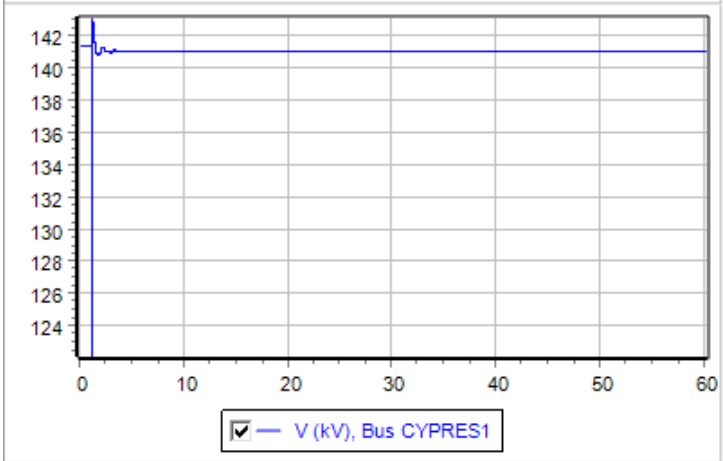
Contingency:
9L20: Nevis 766S to Cordel 755S

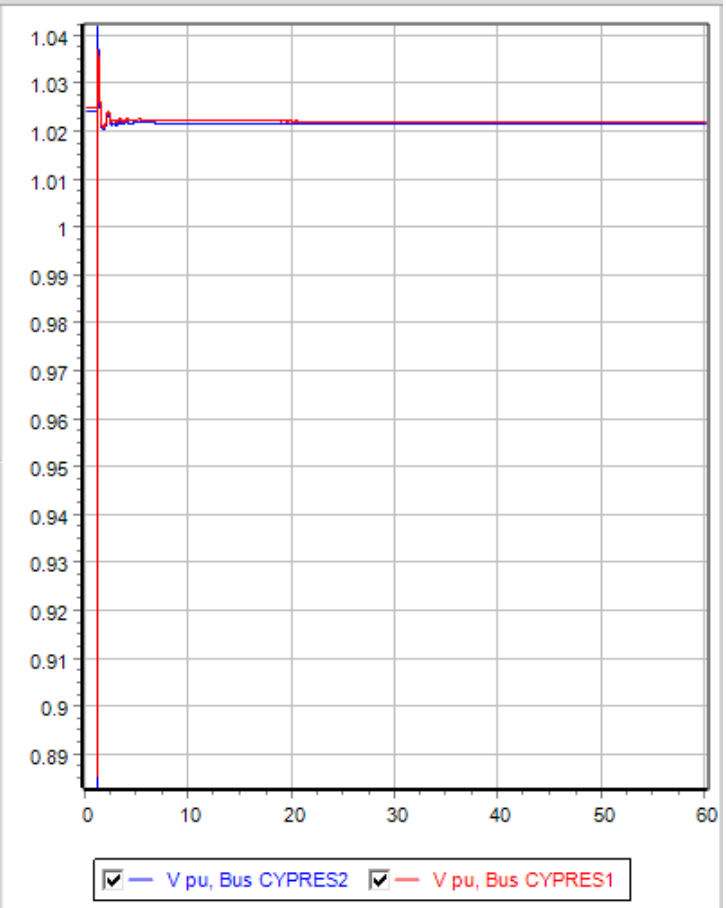
Study Case:
Scenario 5 (2022SL)

December 04, 2020 18:13:31

Cypress 562S Voltages





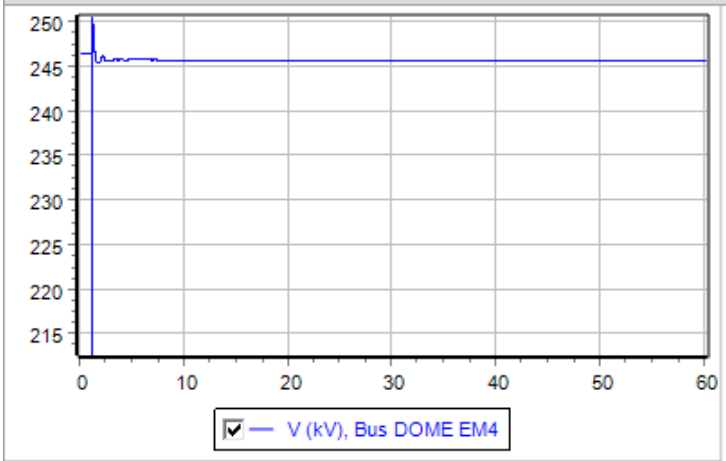


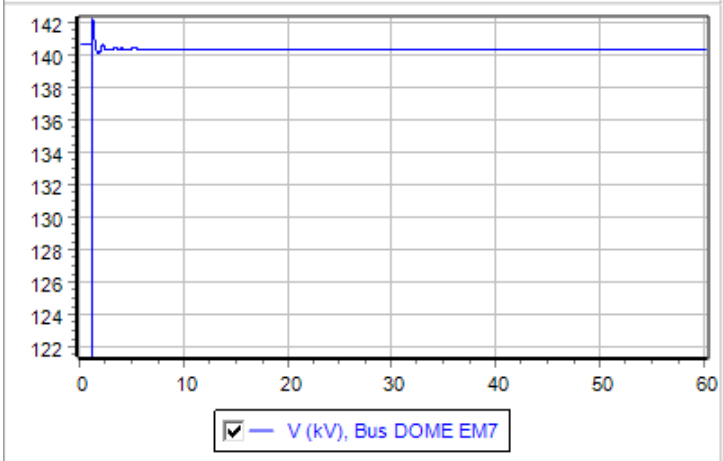
Contingency:
9L20: Nevis 766S to Cordel 755S

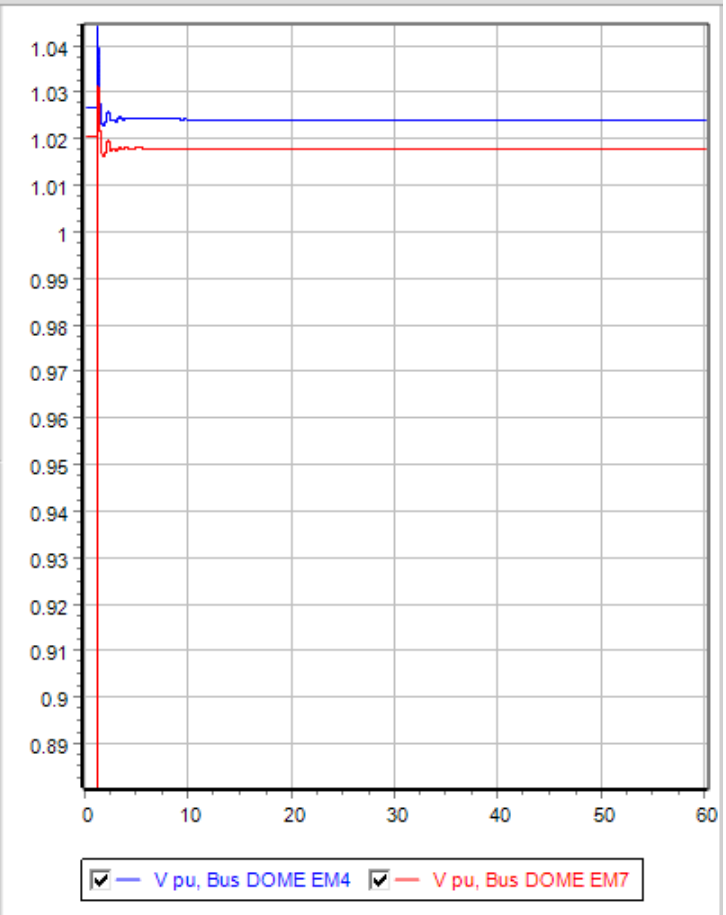
Study Case:
Scenario 5 (2022SL)

December 04, 2020 18:13:30

Dome 163S Voltages





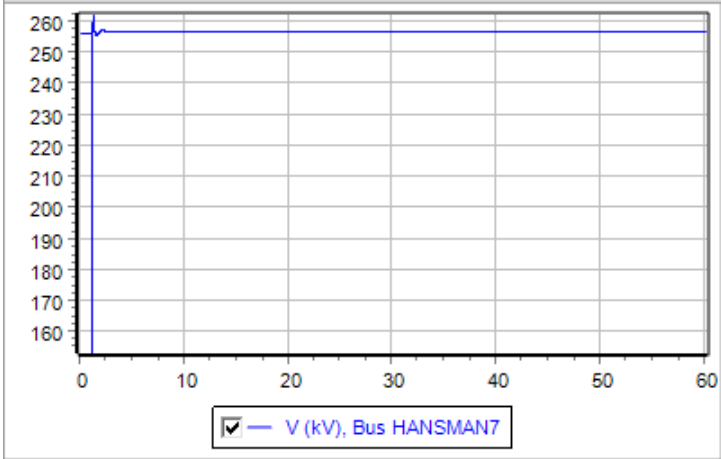


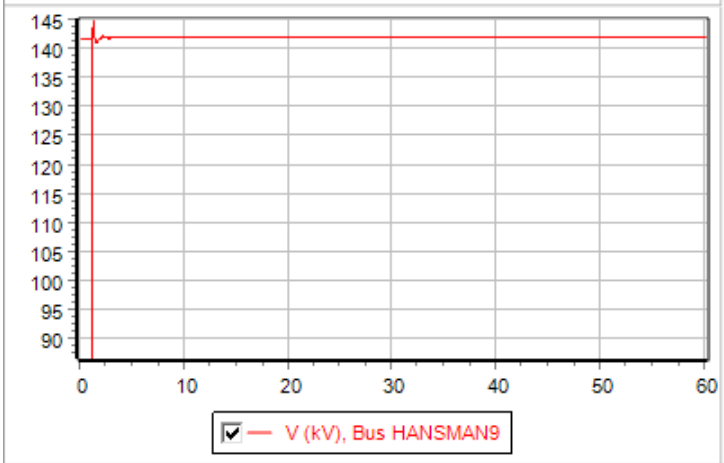
Contingency:
9L20: Nevis 766S to Cordel 755S

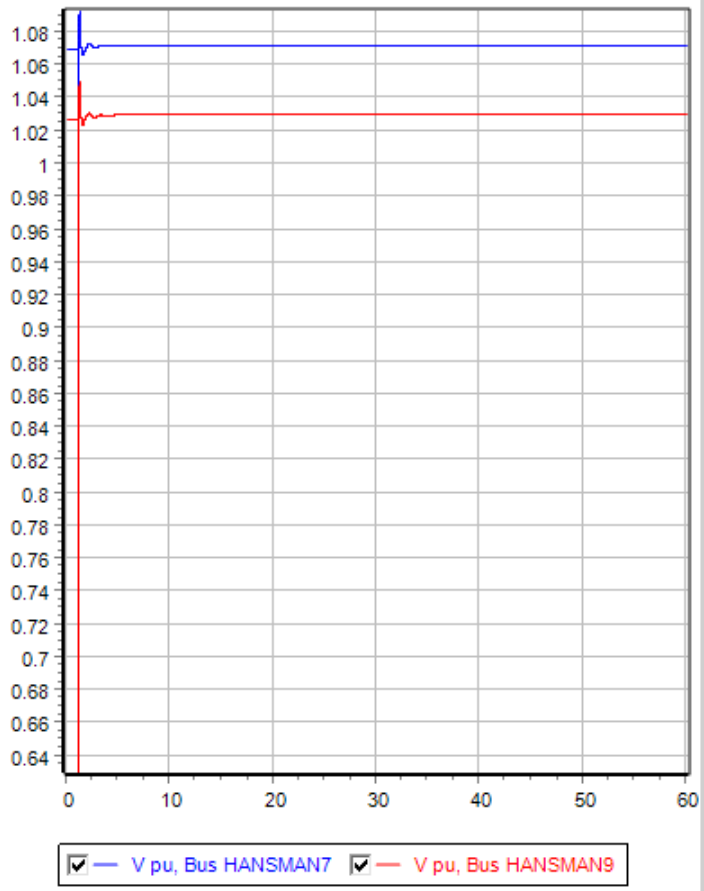
Study Case:
Scenario 5 (2022SL)

December 04, 2020 18:13:30

Hansman Lake 650S Voltages





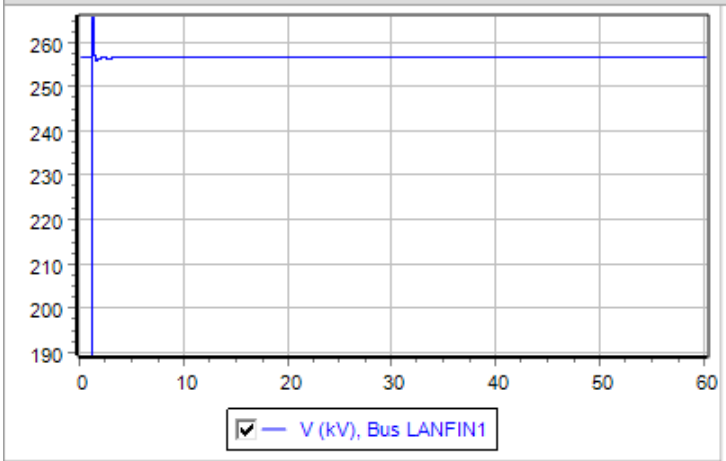


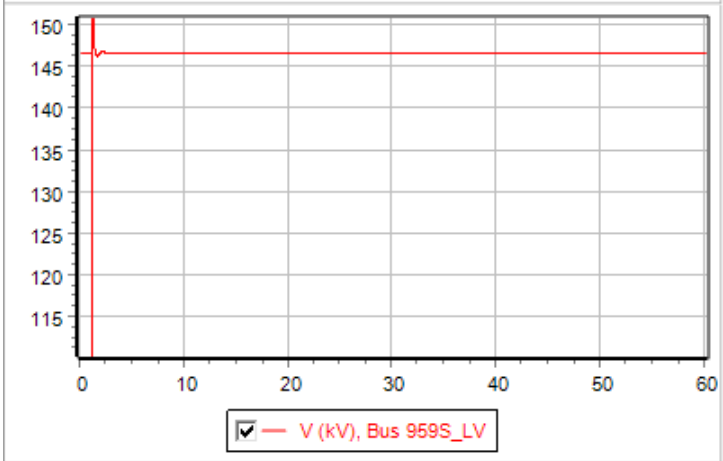
Contingency:
9L20: Nevis 766S to Cordel 755S

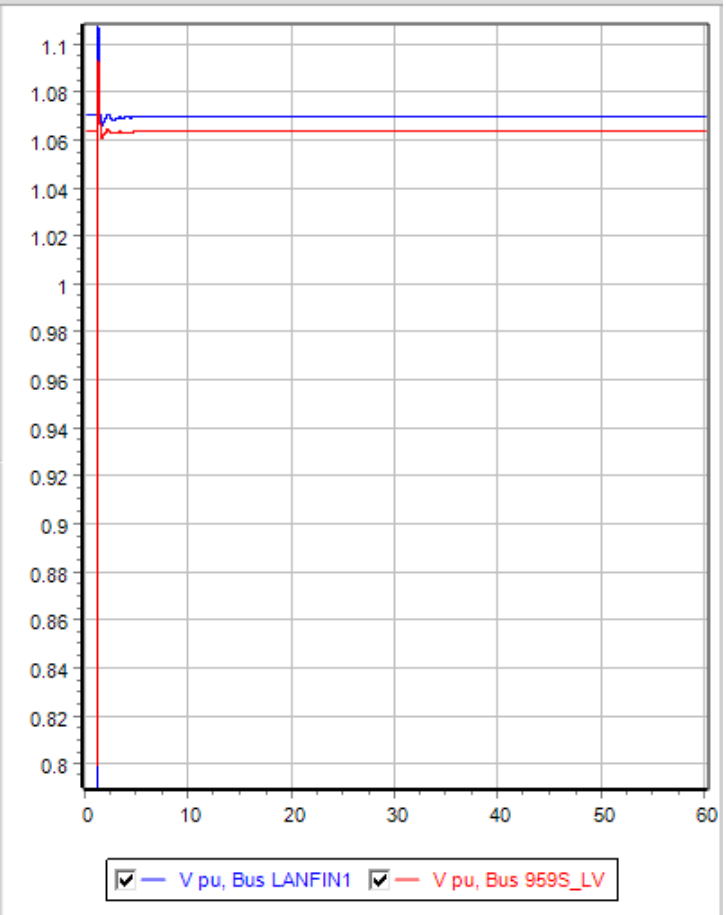
Study Case:
Scenario 5 (2022SL)

December 04, 2020 18:13:29

Lanfine 959S Voltages





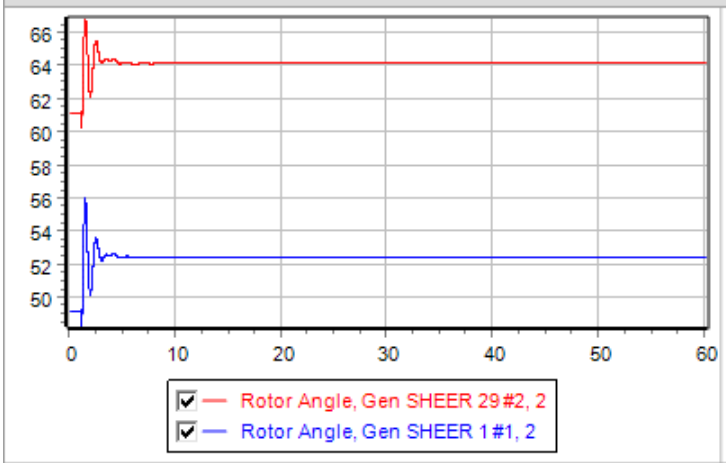


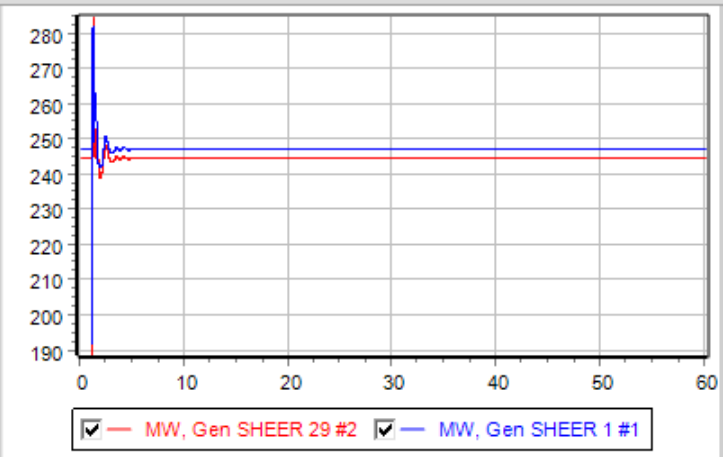
Contingency:
9L20: Nevis 766S to Cordel 755S

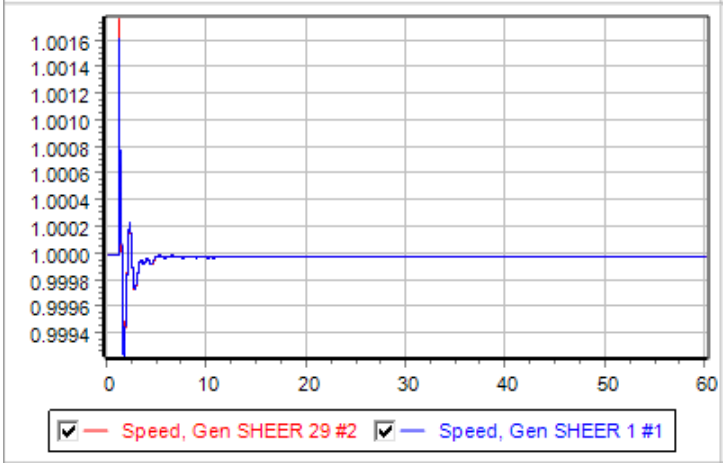
Study Case:
Scenario 5 (2022SL)

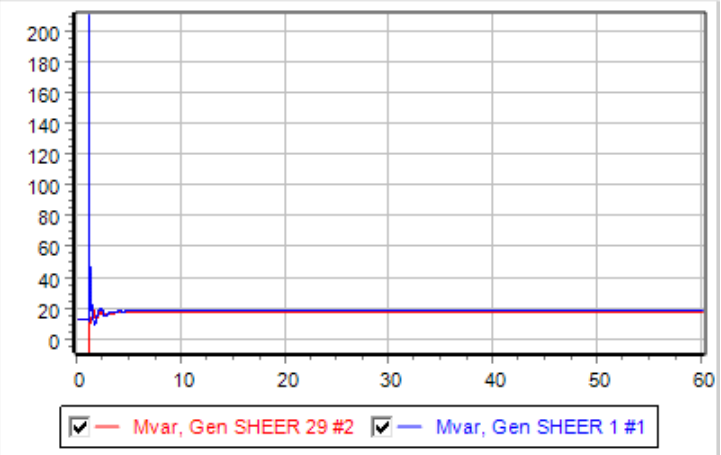
December 04, 2020 18:13:28

Sheerness







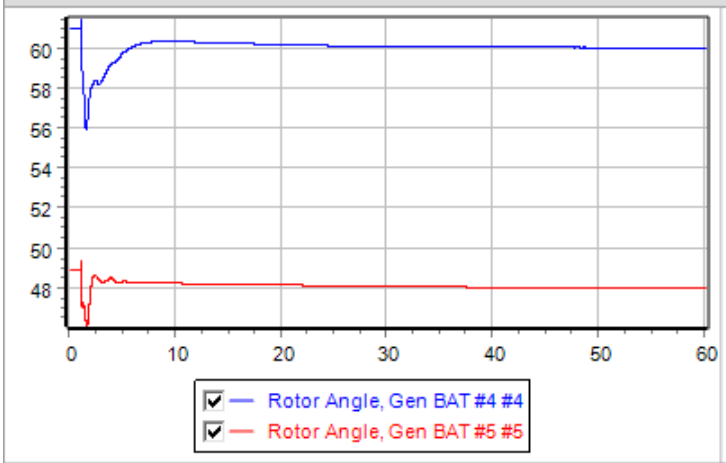


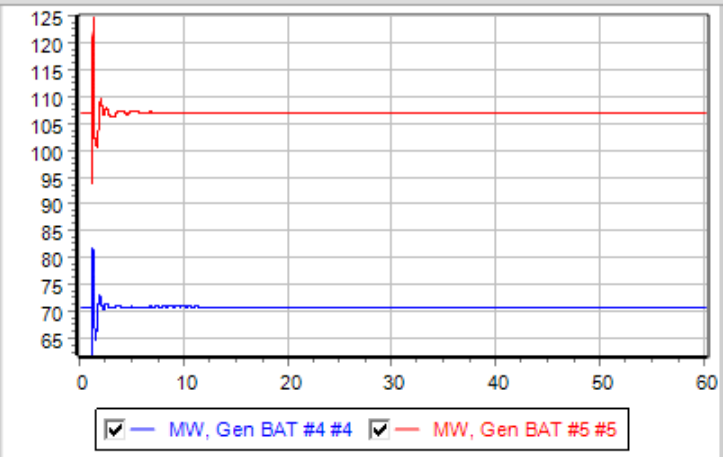
Contingency:
9L20: Nevis 766S to Cordel 755S

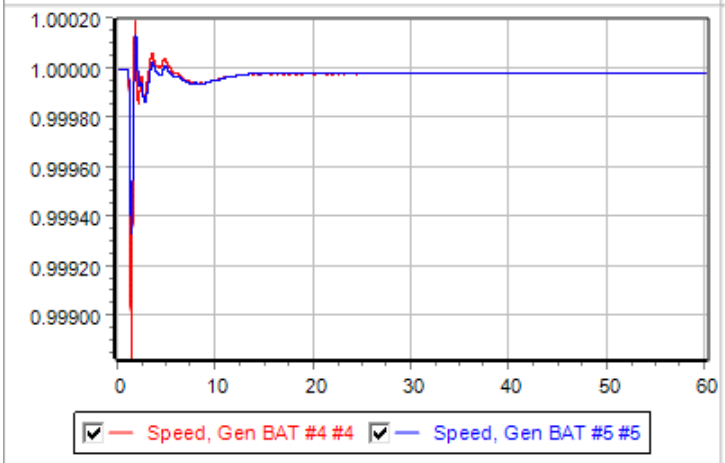
Study Case:
Scenario 5 (2022SL)

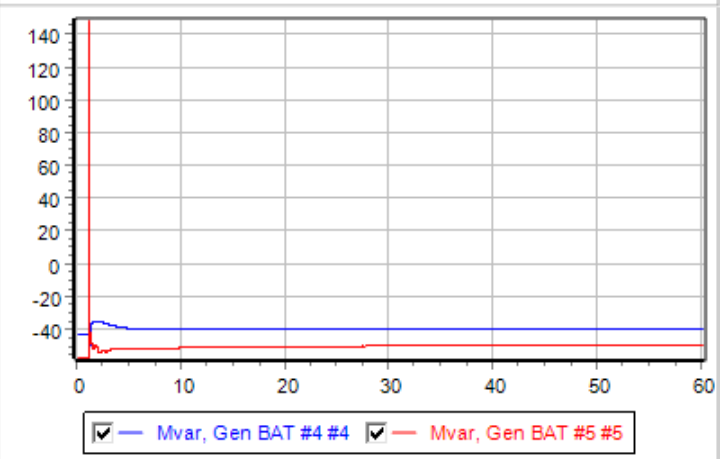
December 04, 2020 18:13:27

Battle River







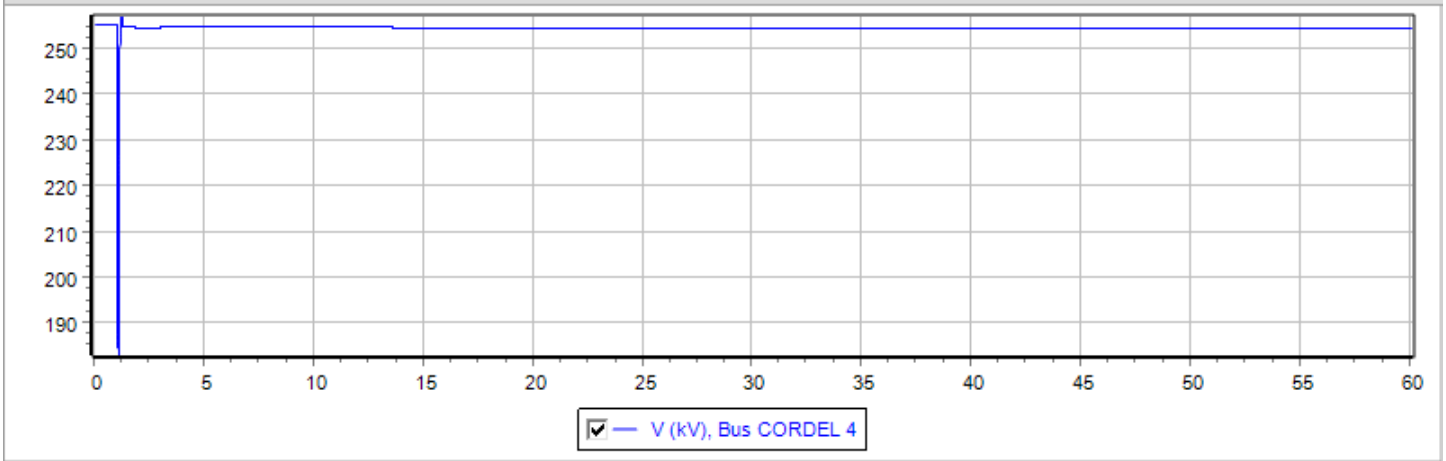


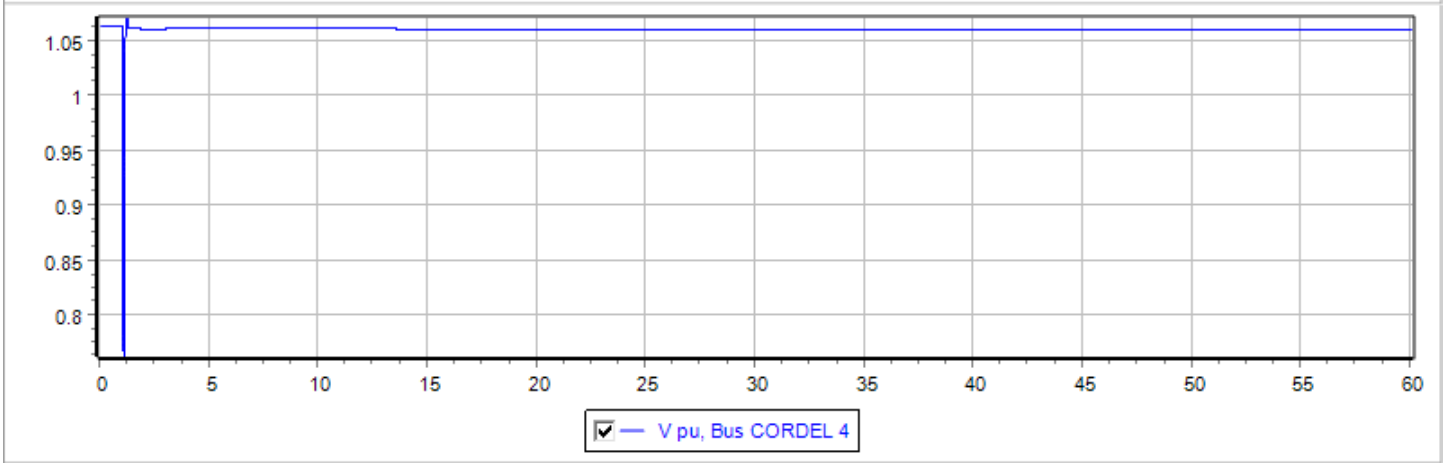
Contingency:
9L24: Lanfine 959S to Oakland 946S

Study Case:
Scenario 5 (2022SL)

December 04, 2020 18:17:28

Cordel 755S Voltages



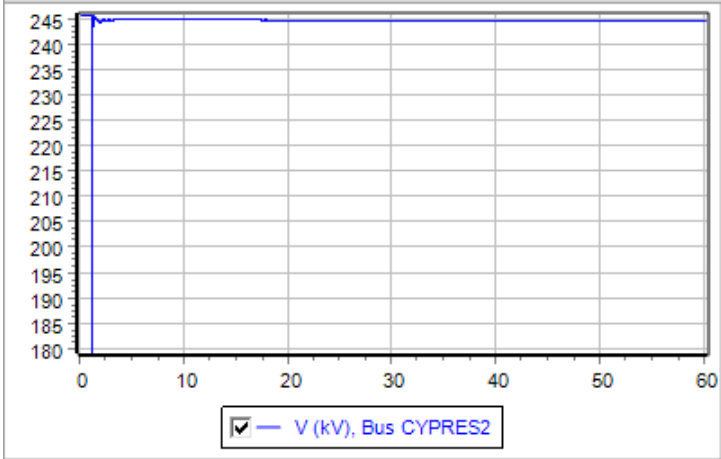


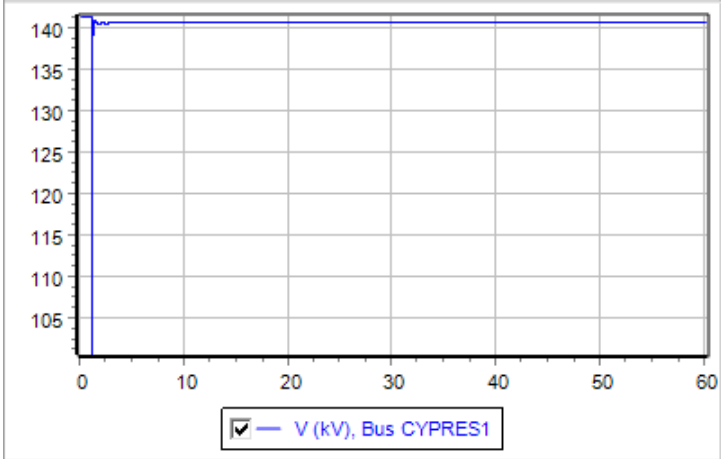
Contingency:
9L24: Lanfine 959S to Oakland 946S

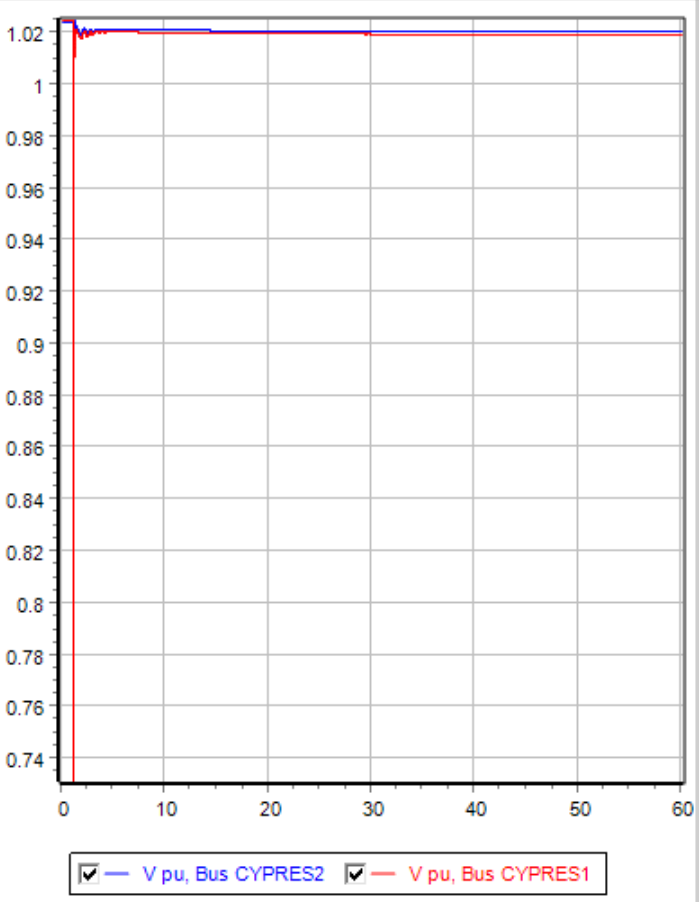
Study Case:
Scenario 5 (2022SL)

December 04, 2020 18:17:30

Cypress 562S Voltages





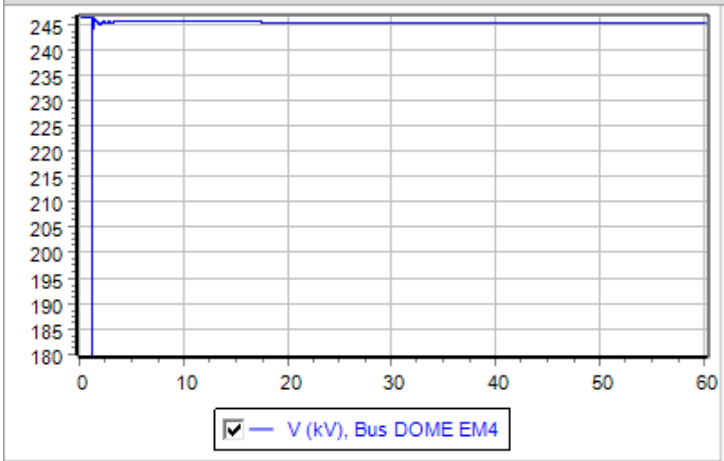


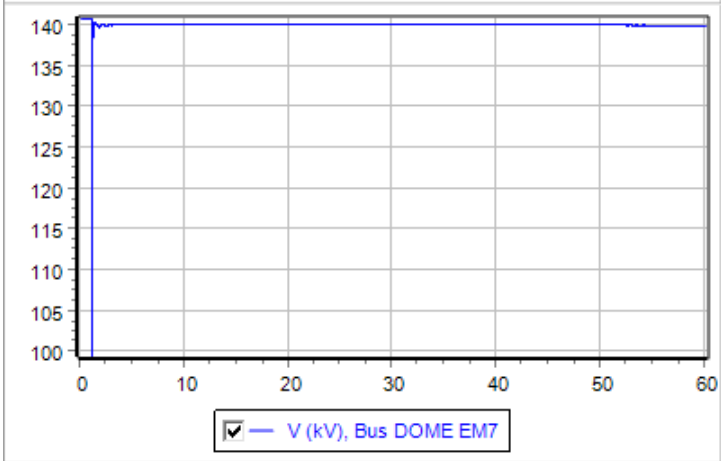
Contingency:
9L24: Lanfine 959S to Oakland 946S

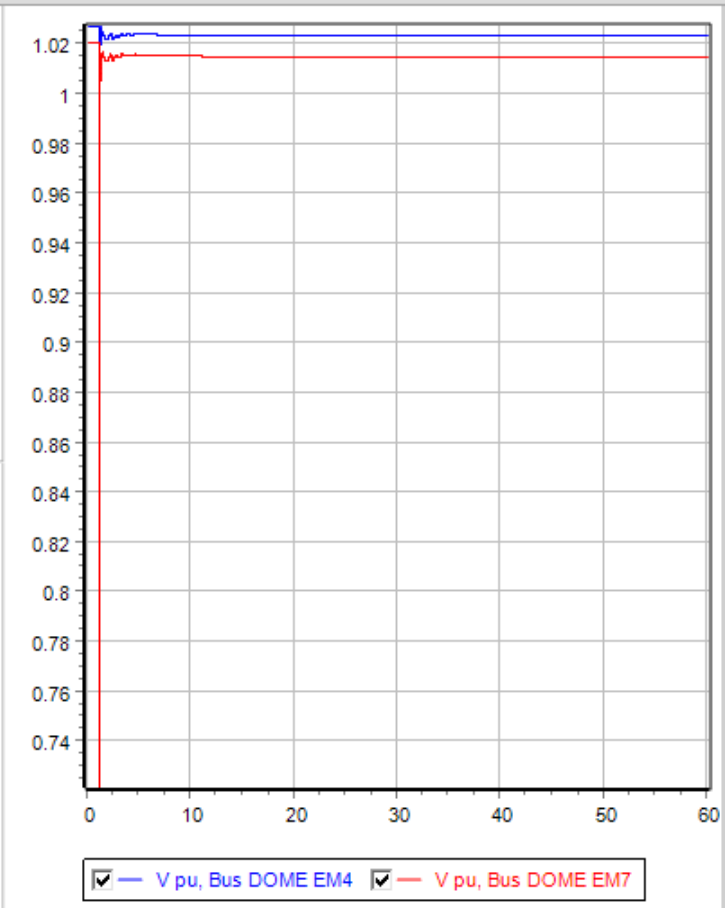
Study Case:
Scenario 5 (2022SL)

December 04, 2020 18:17:30

Dome 163S Voltages





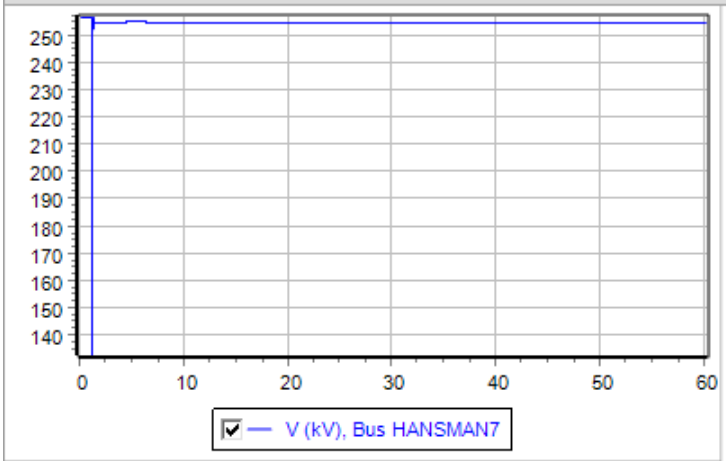


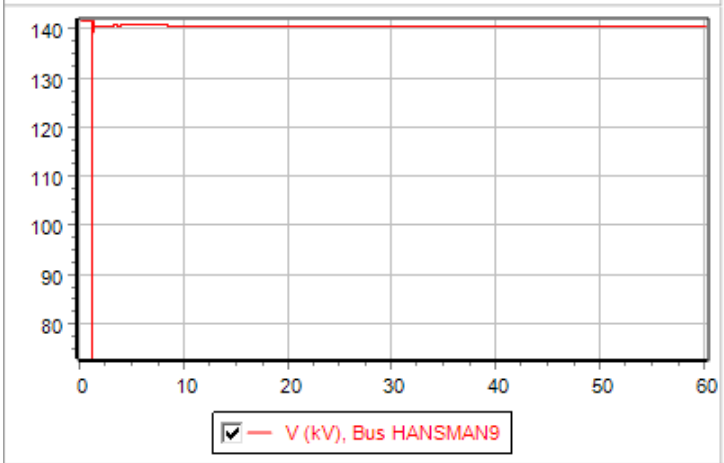
Contingency:
9L24: Lanfine 959S to Oakland 946S

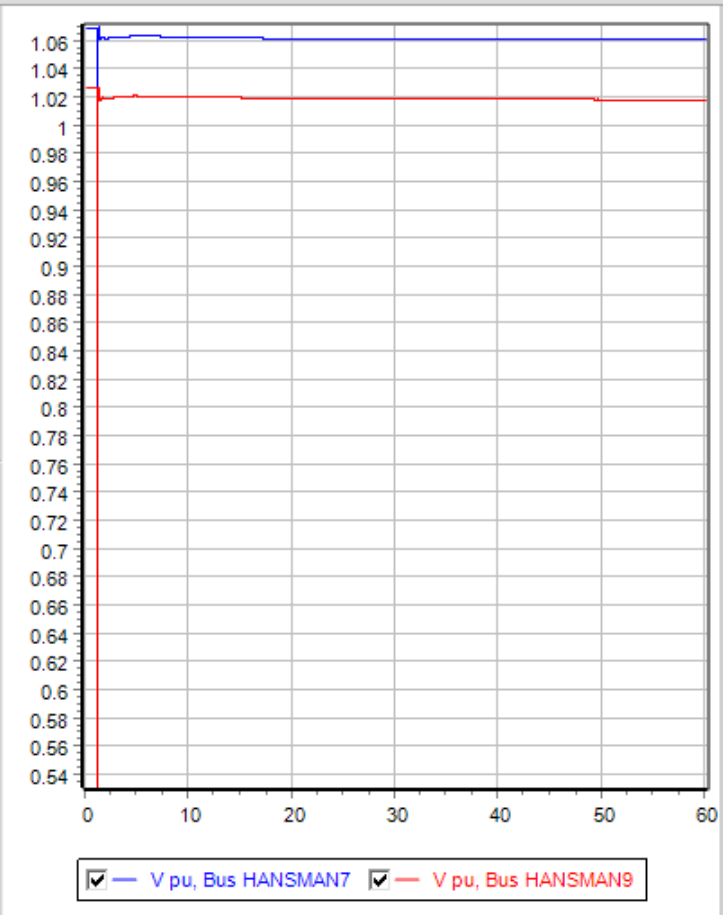
Study Case:
Scenario 5 (2022SL)

December 04, 2020 18:17:29

Hansman Lake 650S Voltages





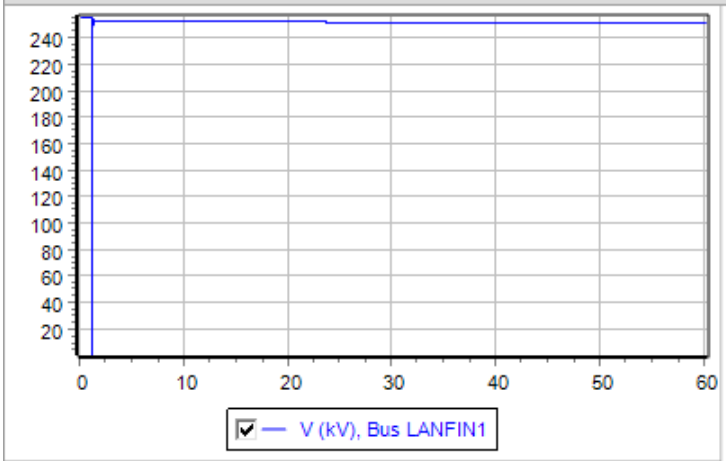


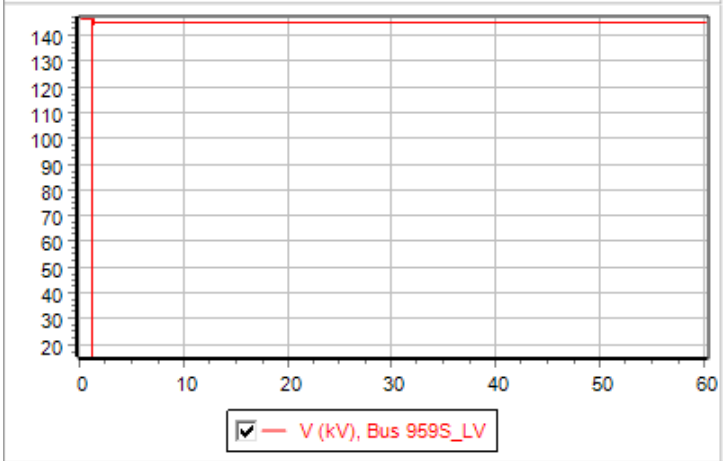
Contingency:
9L24: Lanfine 959S to Oakland 946S

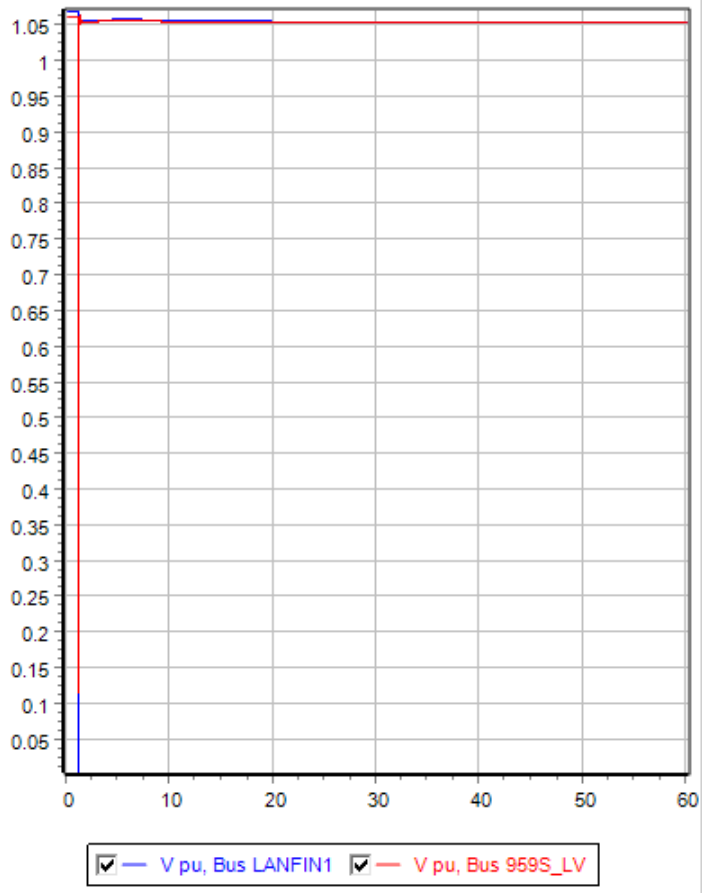
Study Case:
Scenario 5 (2022SL)

December 04, 2020 18:17:29

Lanfine 959S Voltages





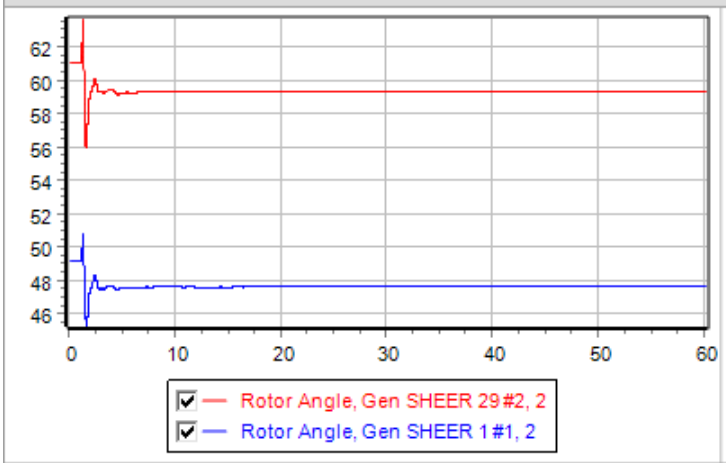


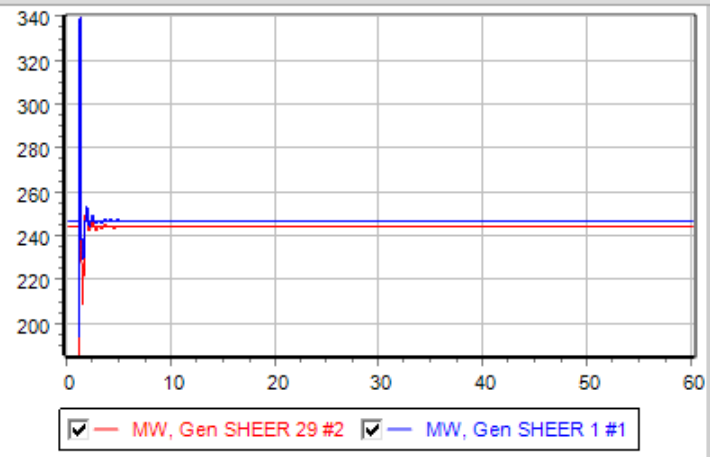
Contingency:
9L24: Lanfine 959S to Oakland 946S

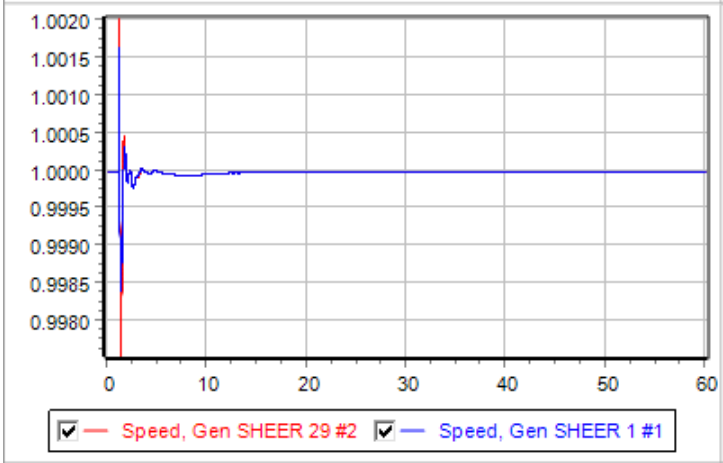
Study Case:
Scenario 5 (2022SL)

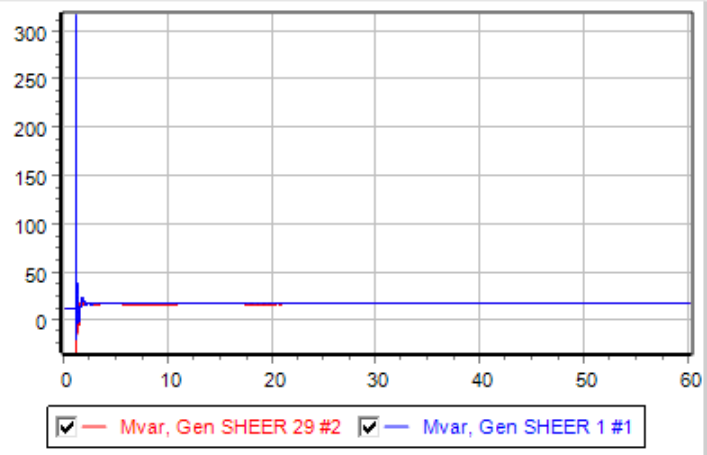
December 04, 2020 18:17:28

Sheerness







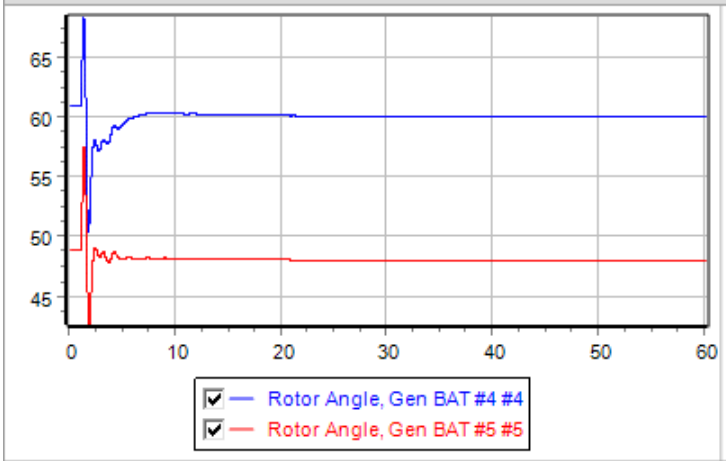


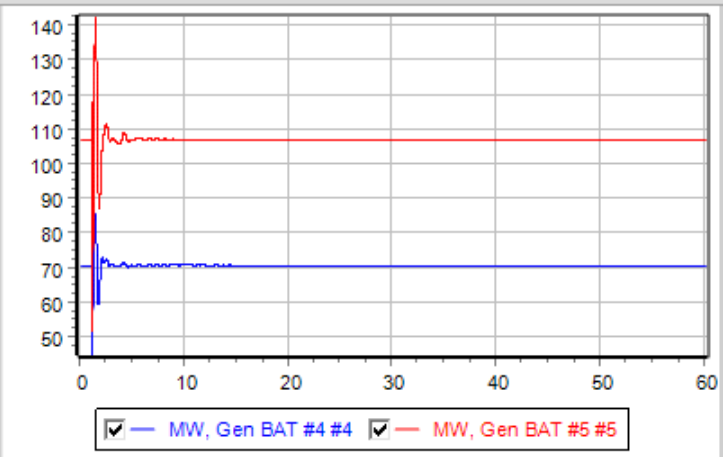
Contingency:
9L24: Lanfine 959S to Oakland 946S

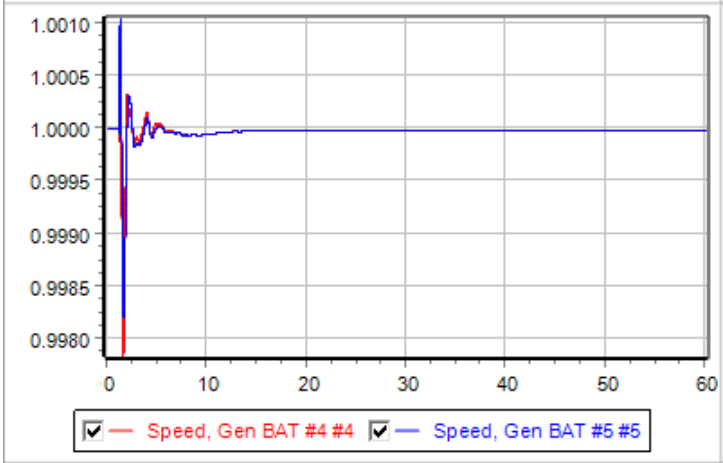
Study Case:
Scenario 5 (2022SL)

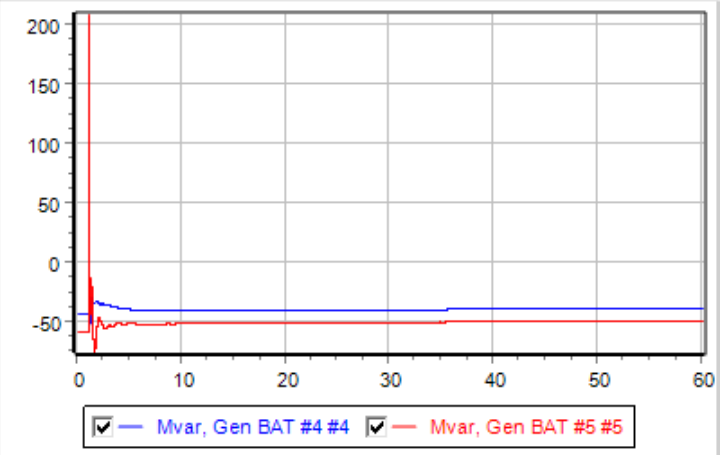
December 04, 2020 18:17:27

Battle River







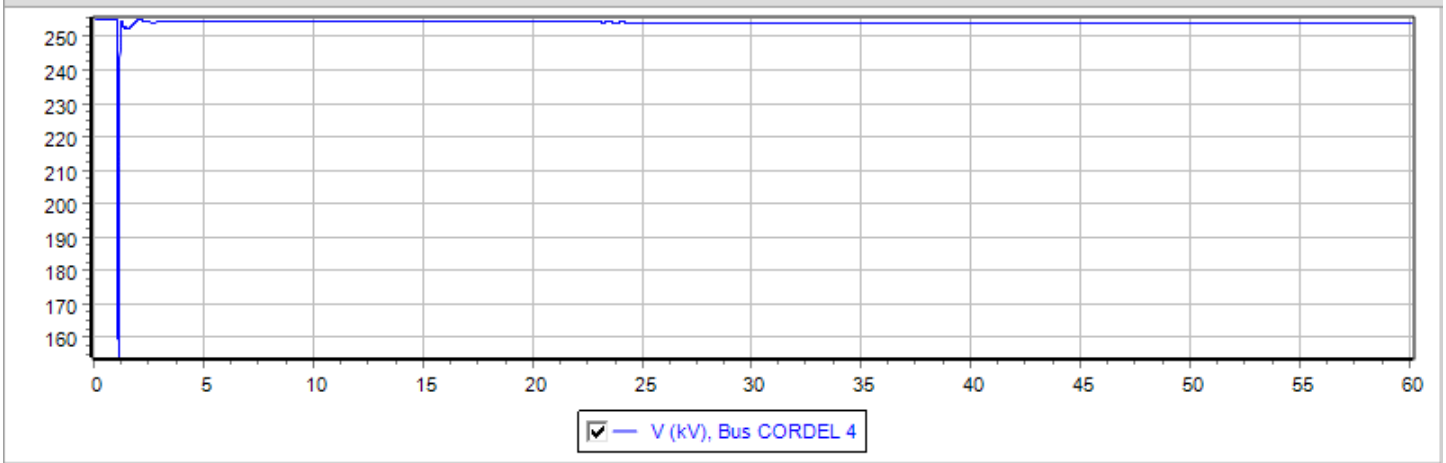


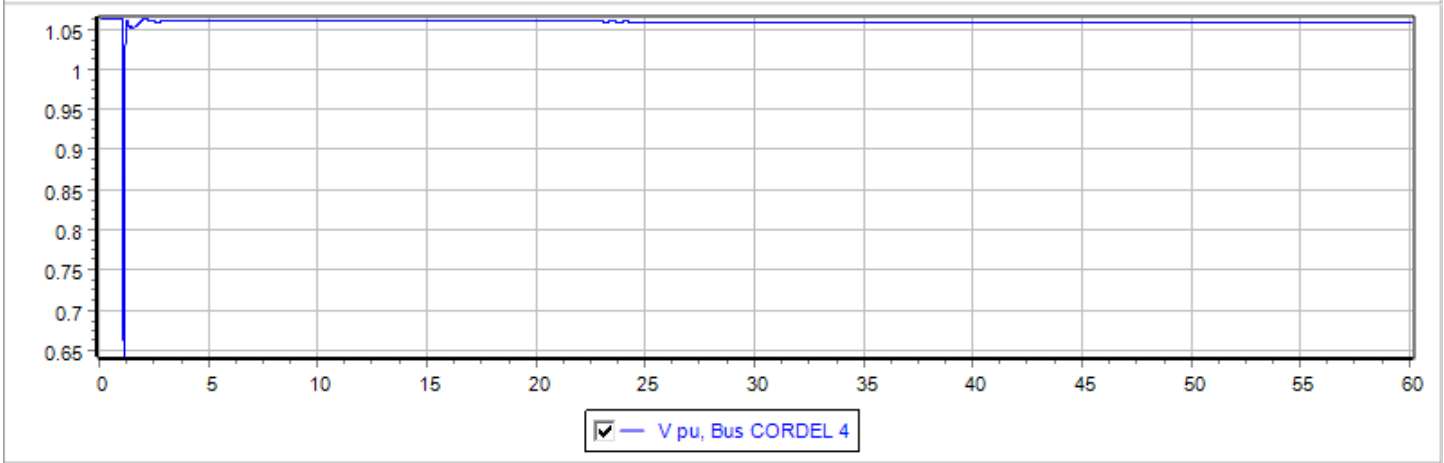
Contingency:
9L24: Oakland 946S to Lanfine 959S

Study Case:
Scenario 5 (2022SL)

December 04, 2020 18:21:09

Cordel 755S Voltages



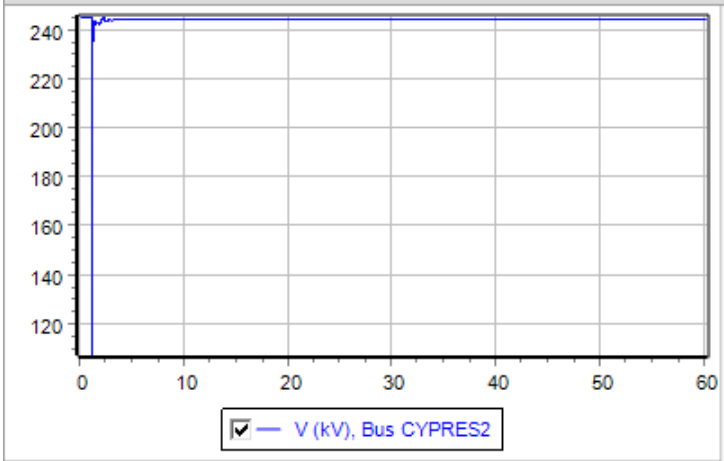


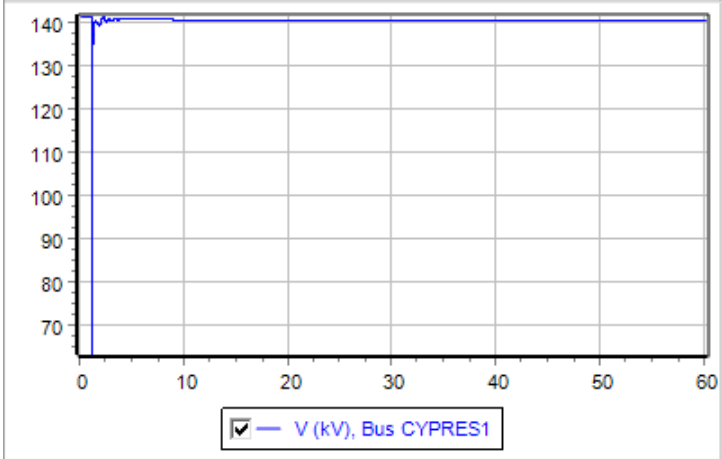
Contingency:
9L24: Oakland 946S to Lanfine 959S

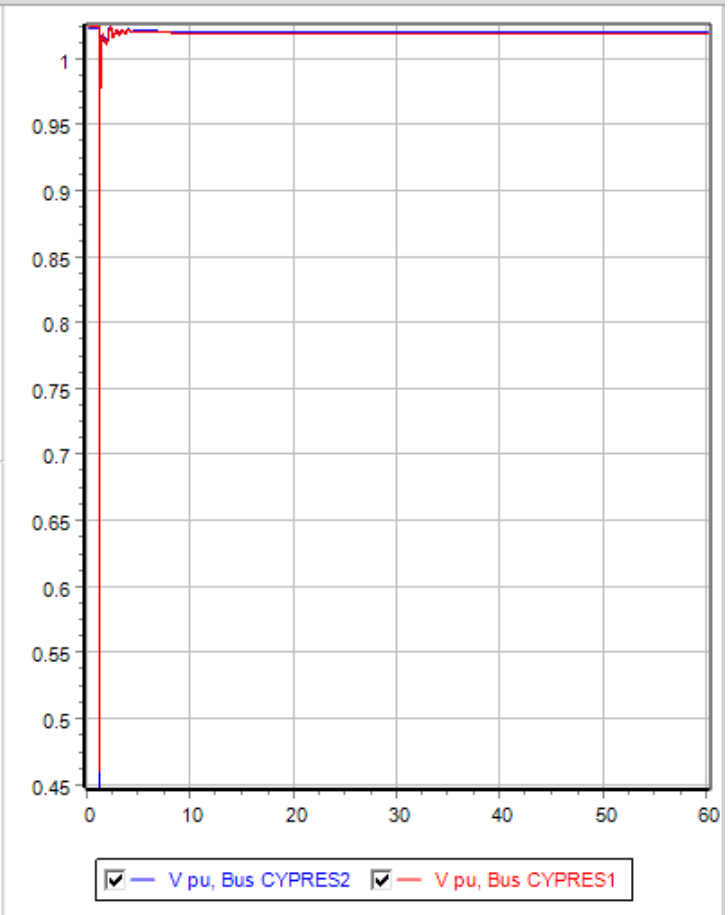
Study Case:
Scenario 5 (2022SL)

December 04, 2020 18:21:12

Cypress 562S Voltages





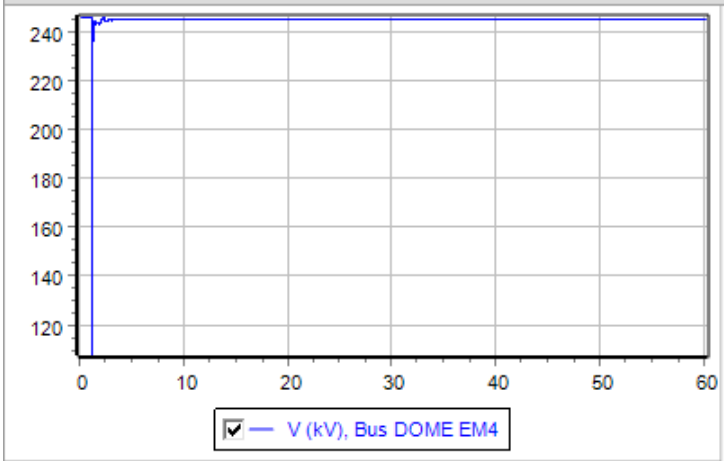


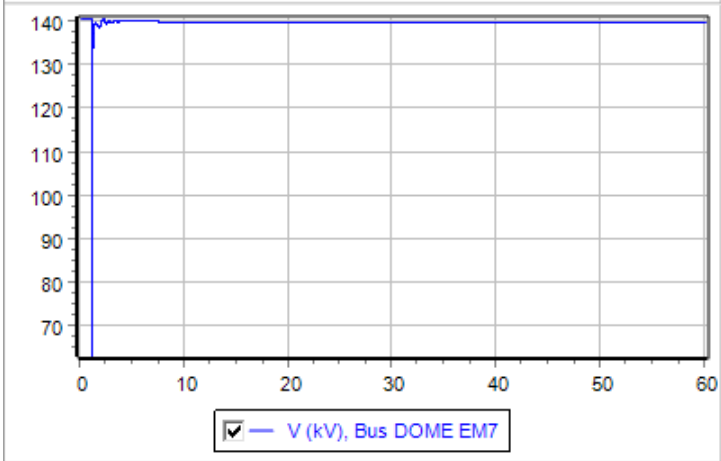
Contingency:
9L24: Oakland 946S to Lanfine 959S

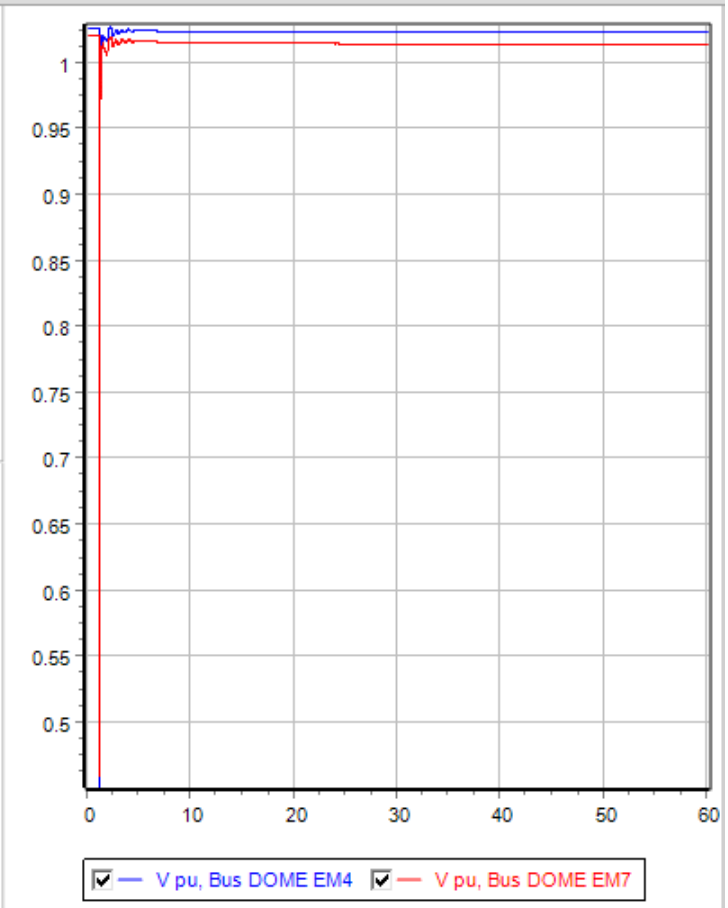
Study Case:
Scenario 5 (2022SL)

December 04, 2020 18:21:11

Dome 163S Voltages





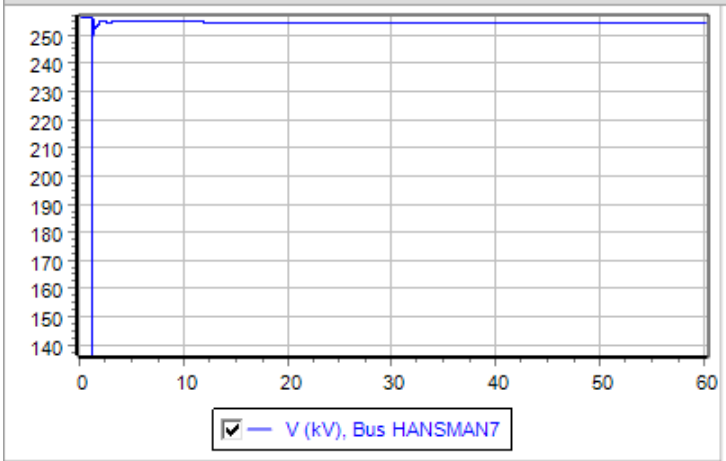


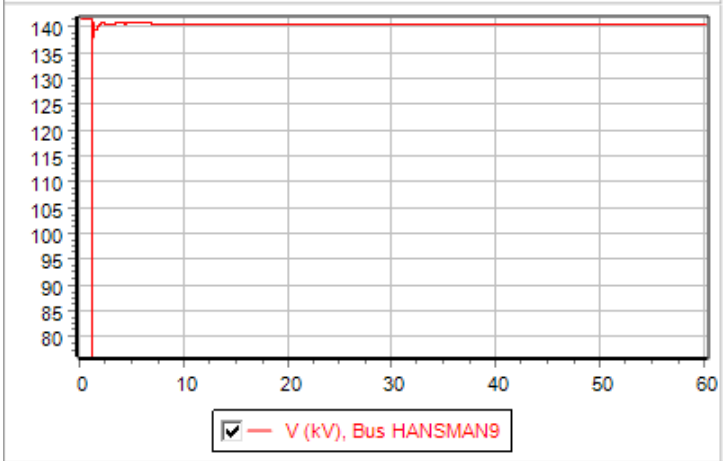
Contingency:
9L24: Oakland 946S to Lanfine 959S

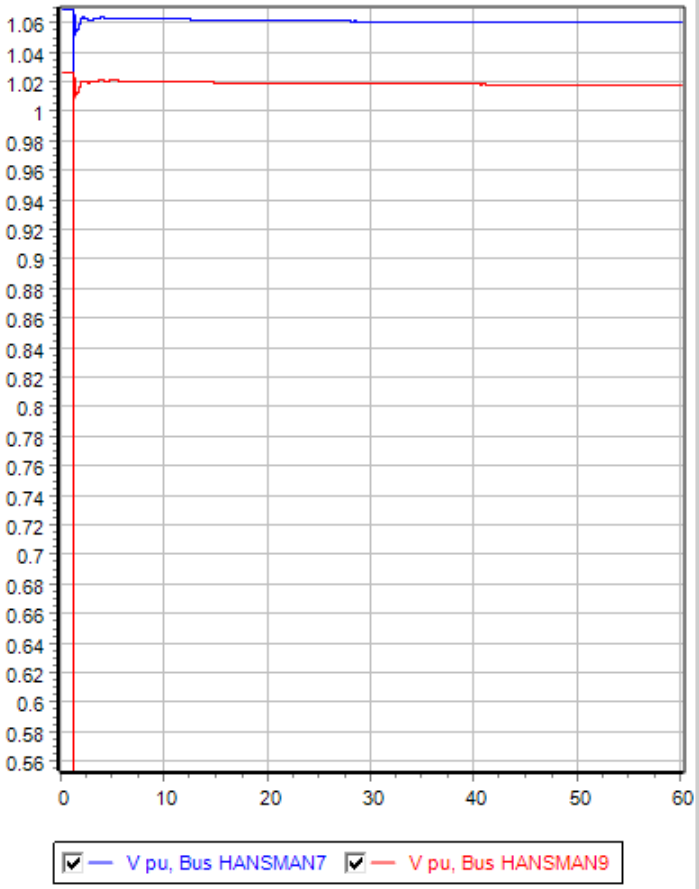
Study Case:
Scenario 5 (2022SL)

December 04, 2020 18:21:11

Hansman Lake 650S Voltages





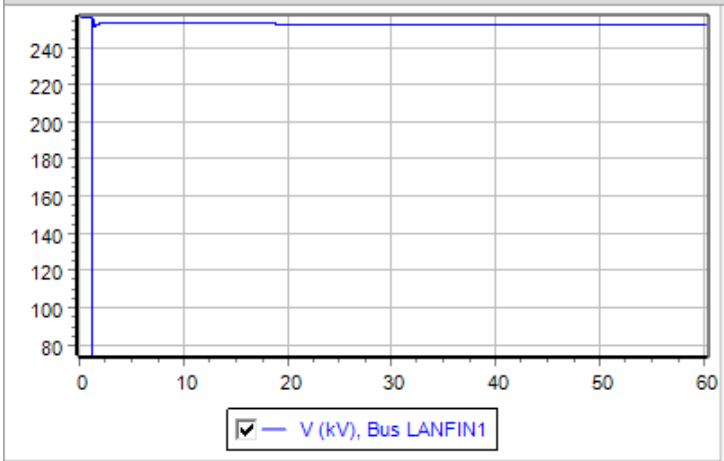


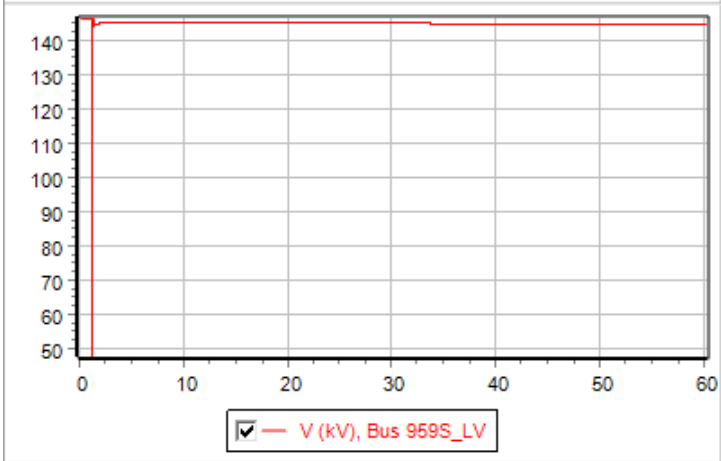
Contingency:
9L24: Oakland 946S to Lanfine 959S

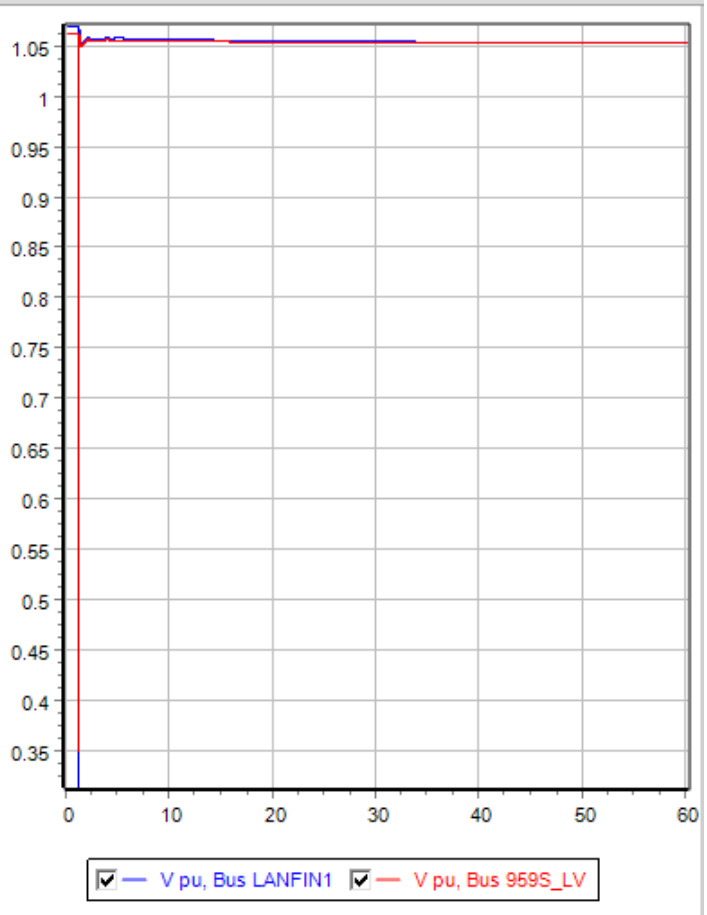
Study Case:
Scenario 5 (2022SL)

December 04, 2020 18:21:10

Lanfine 959S Voltages





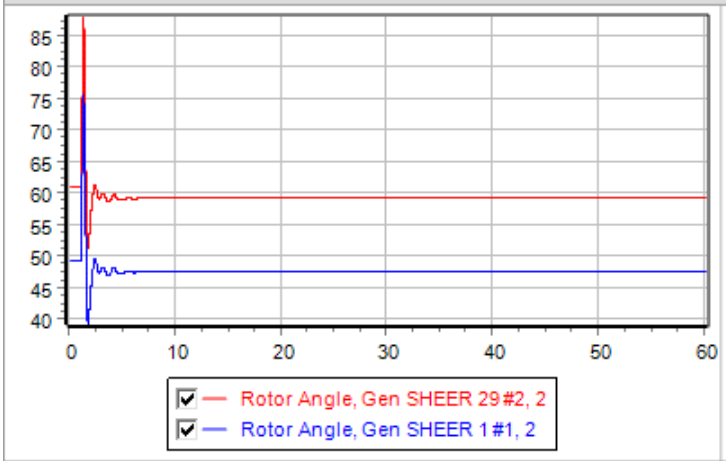


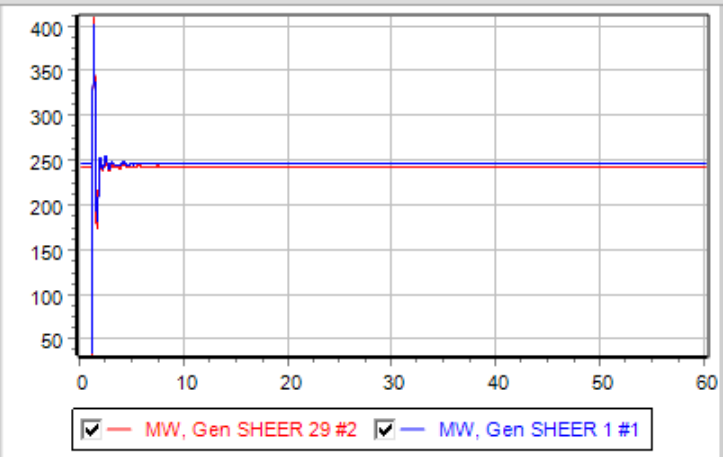
Contingency:
9L24: Oakland 946S to Lanfine 959S

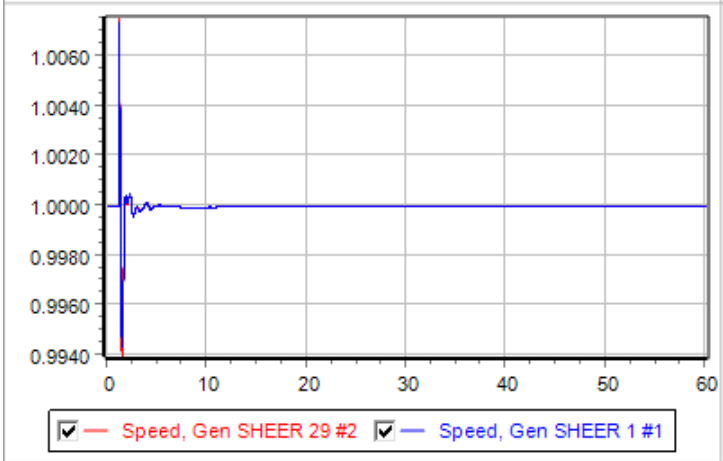
Study Case:
Scenario 5 (2022SL)

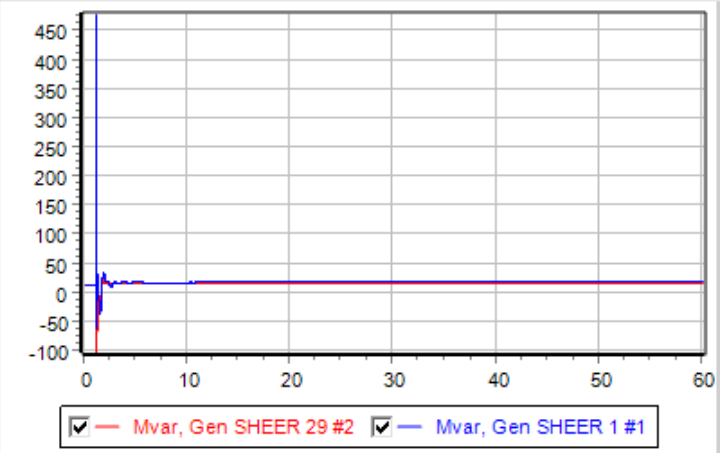
December 04, 2020 18:21:09

Sheerness







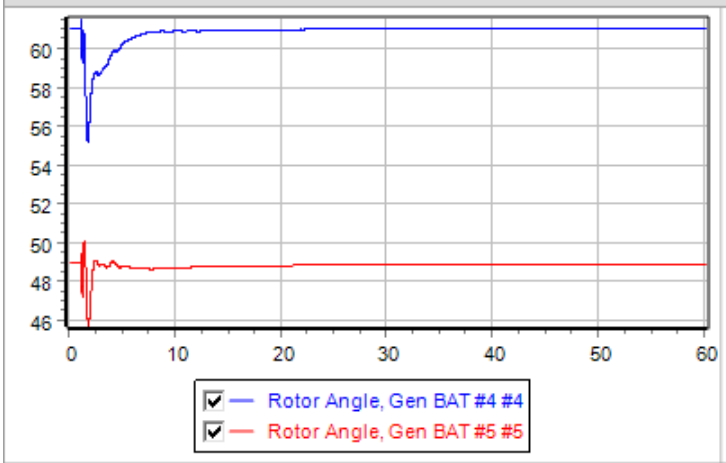


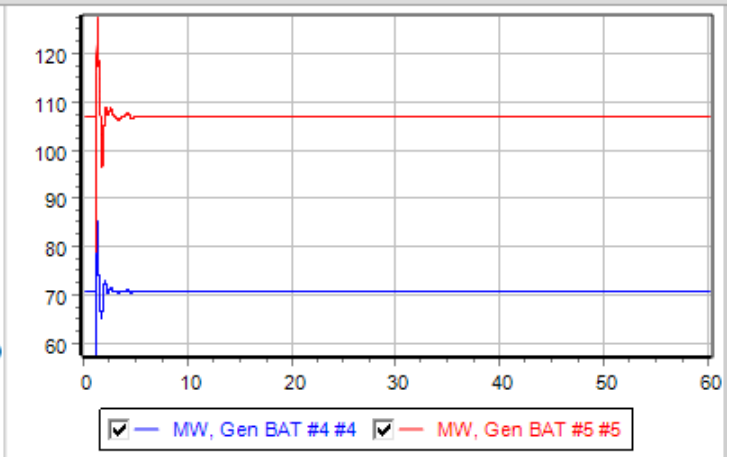
Contingency:
9L24: Oakland 946S to Lanfine 959S

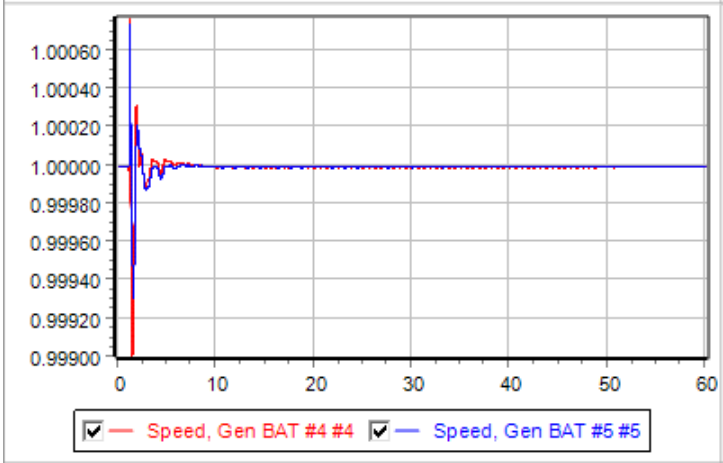
Study Case:
Scenario 5 (2022SL)

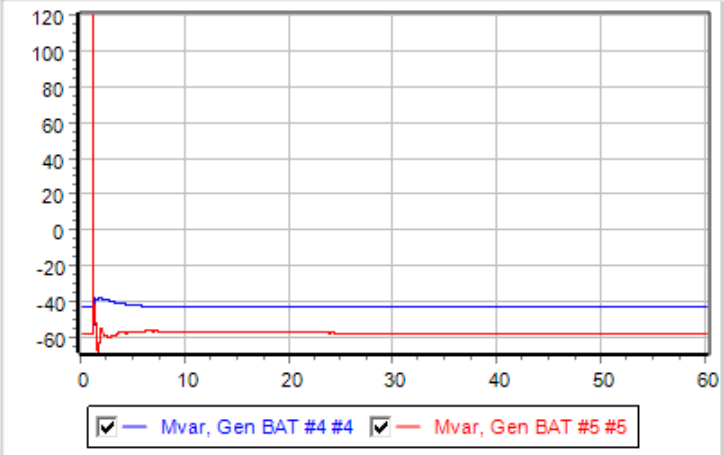
December 04, 2020 18:21:08

Battle River







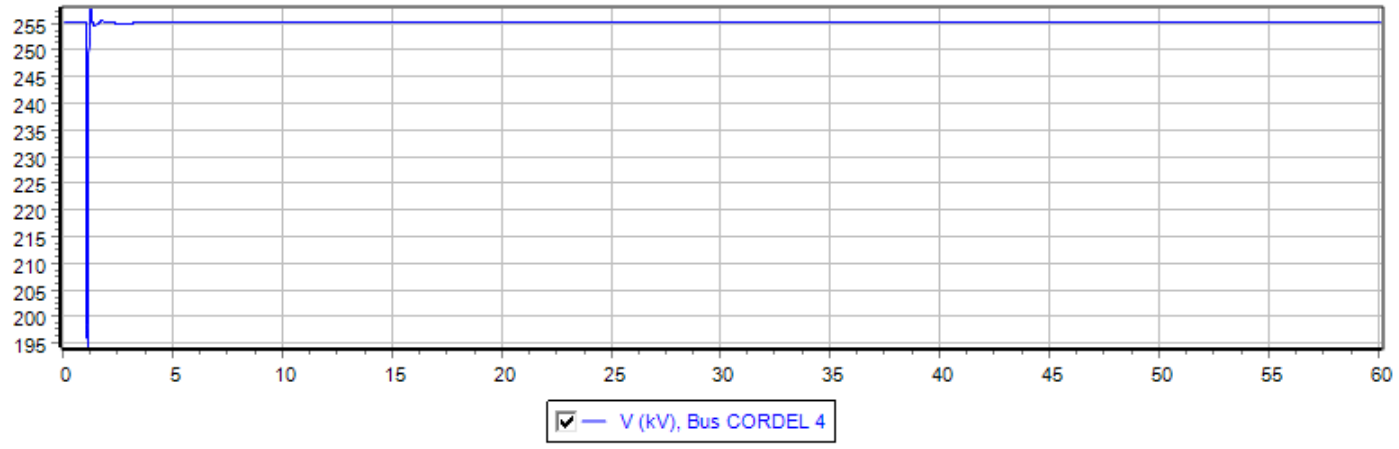


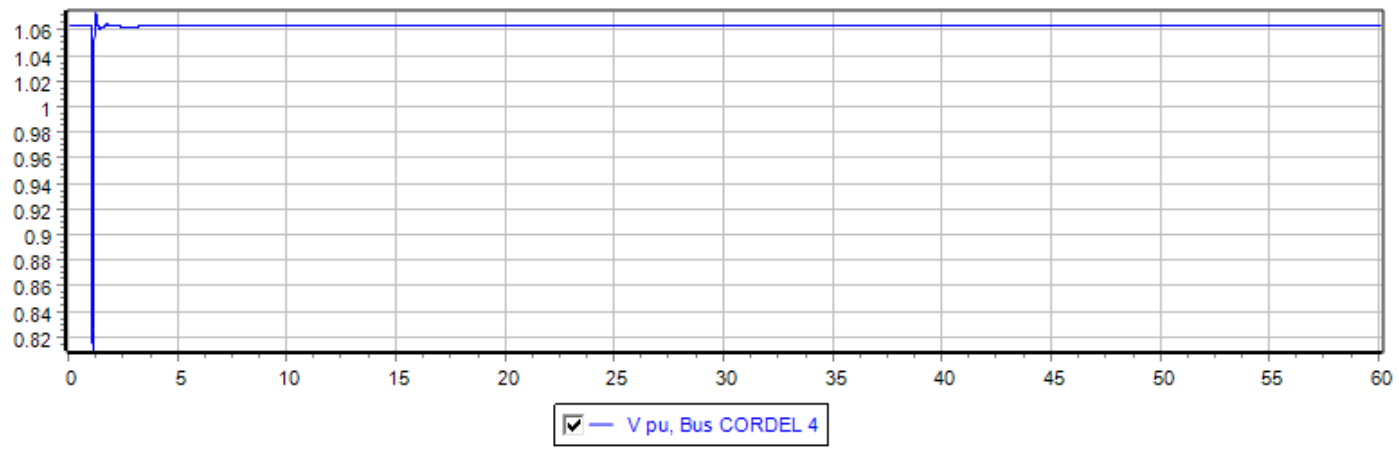
Contingency:
9L29: Coyote Lake 963S to Oakland 946S

Study Case:
Scenario 5 (2022SL)

December 04, 2020 18:24:49

Cordel 755S Voltages



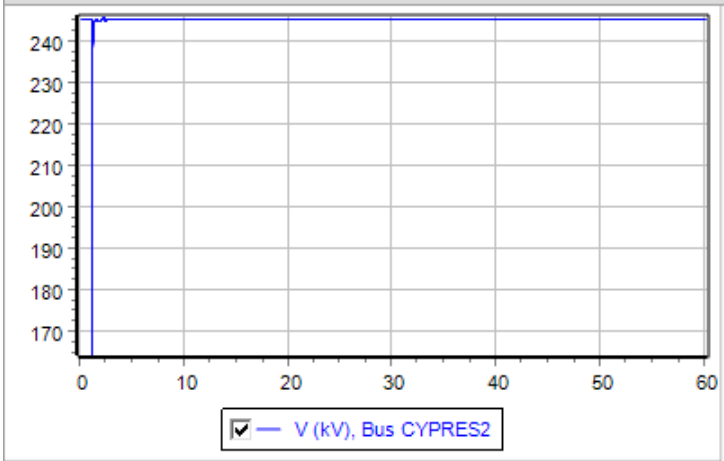


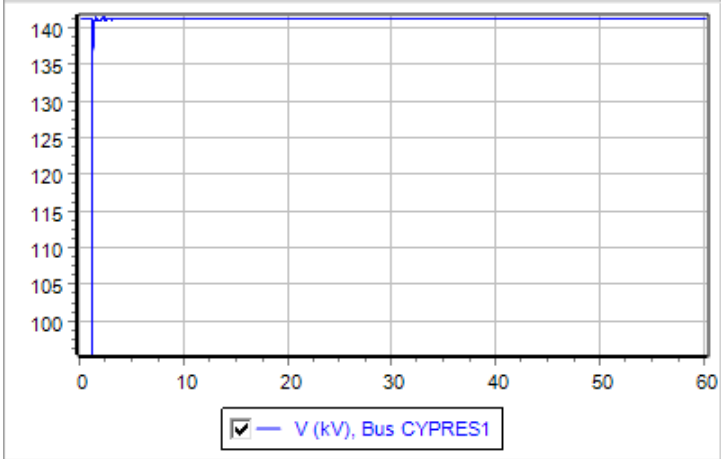
Contingency:
9L29: Coyote Lake 963S to Oakland 946S

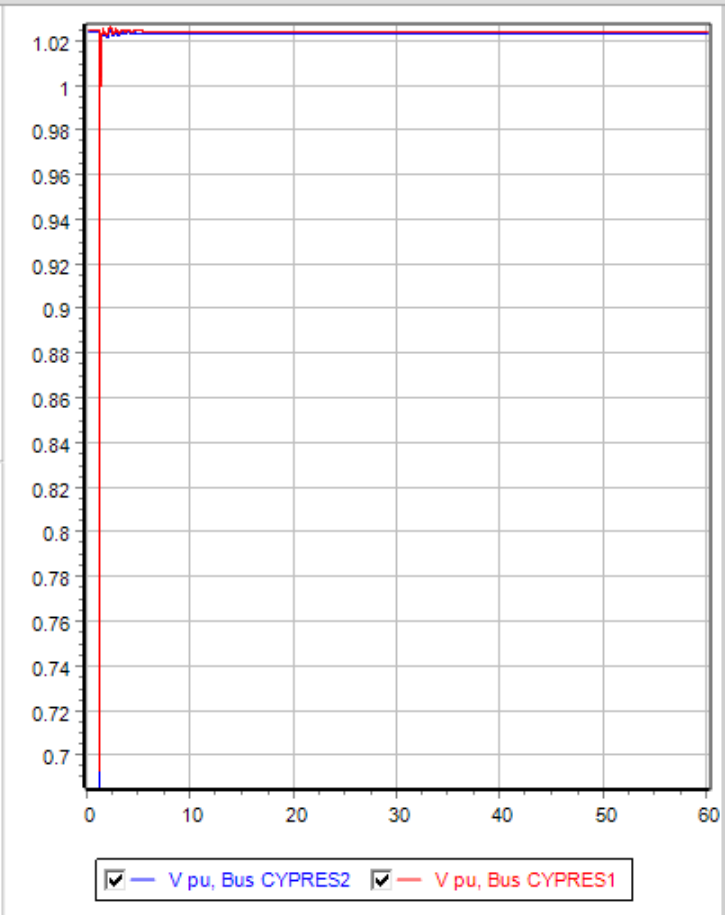
Study Case:
Scenario 5 (2022SL)

December 04, 2020 18:24:52

Cypress 562S Voltages





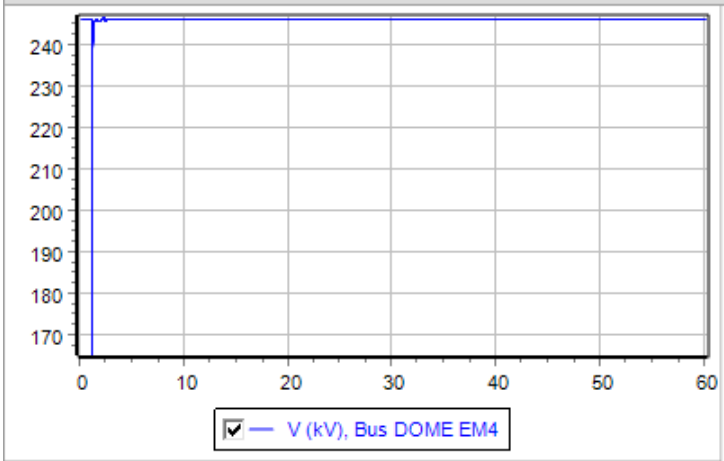


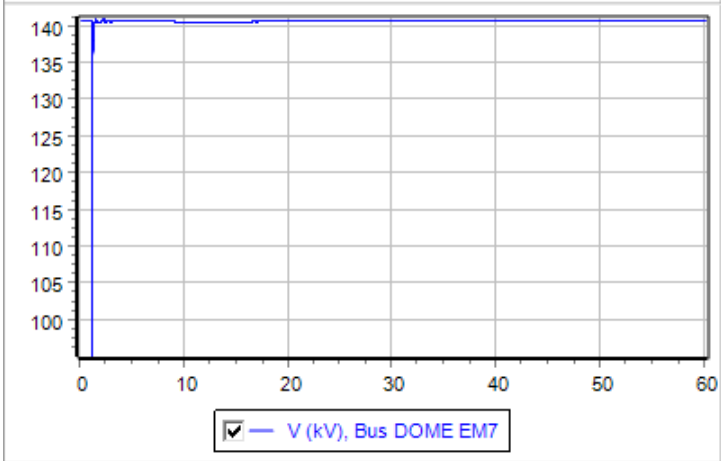
Contingency:
9L29: Coyote Lake 963S to Oakland 946S

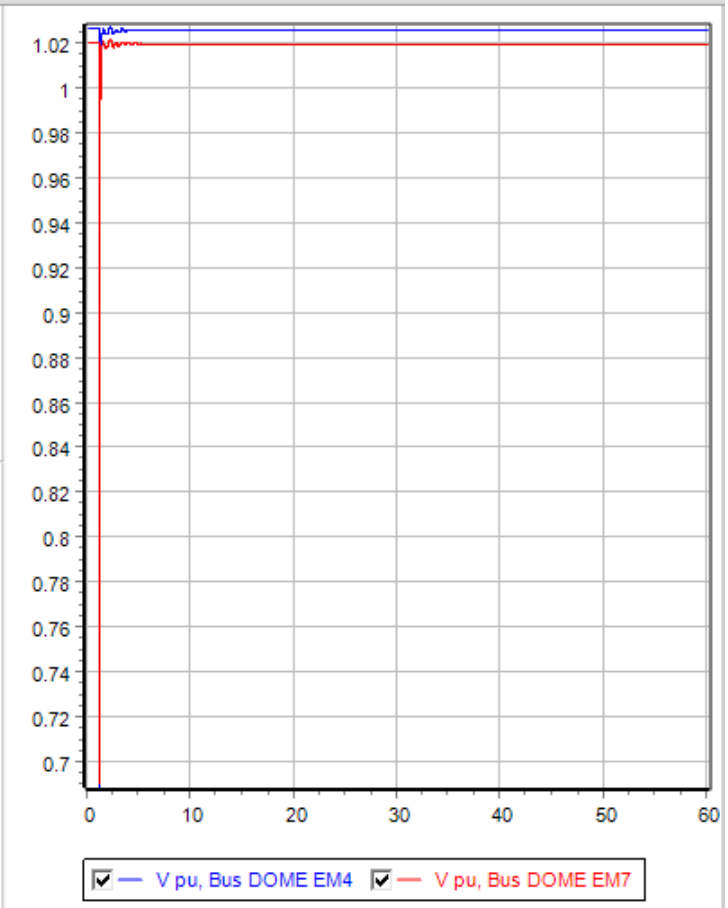
Study Case:
Scenario 5 (2022SL)

December 04, 2020 18:24:51

Dome 163S Voltages





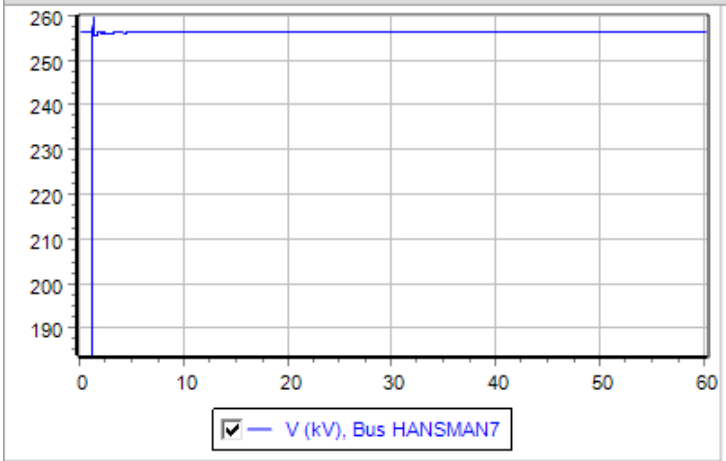


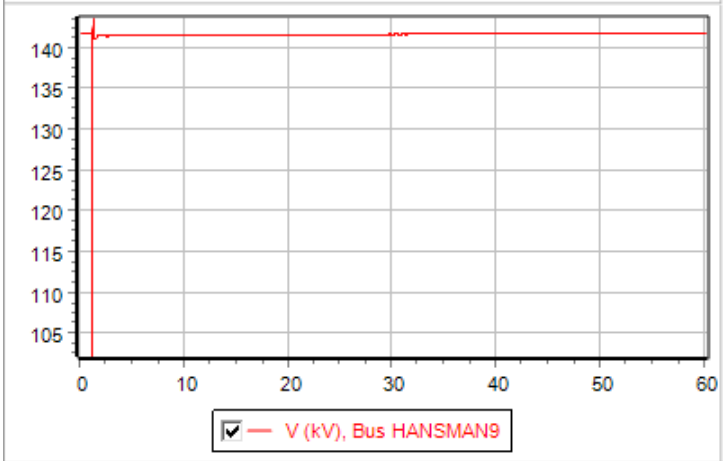
Contingency:
9L29: Coyote Lake 963S to Oakland 946S

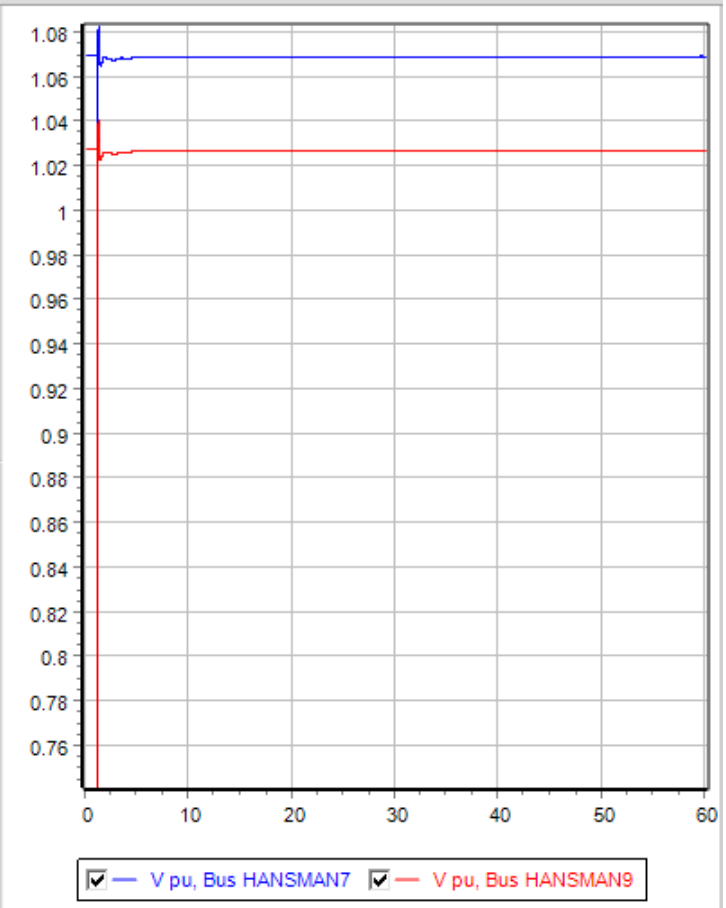
Study Case:
Scenario 5 (2022SL)

December 04, 2020 18:24:50

Hansman Lake 650S Voltages





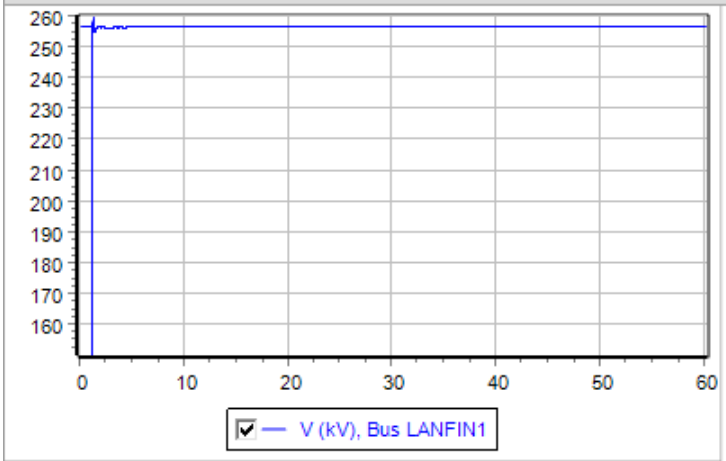


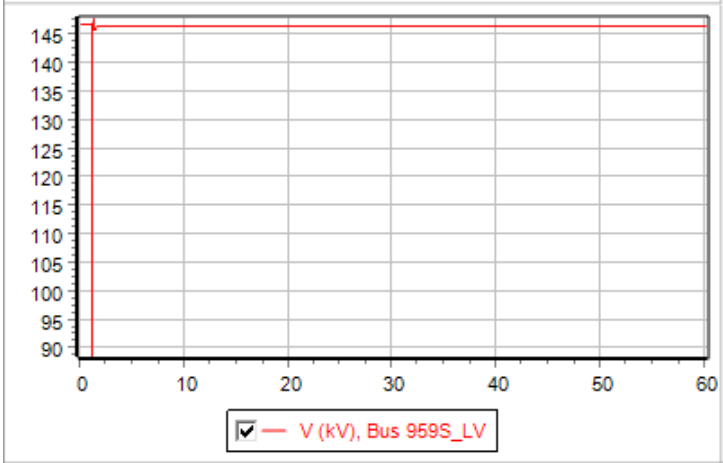
Contingency:
9L29: Coyote Lake 963S to Oakland 946S

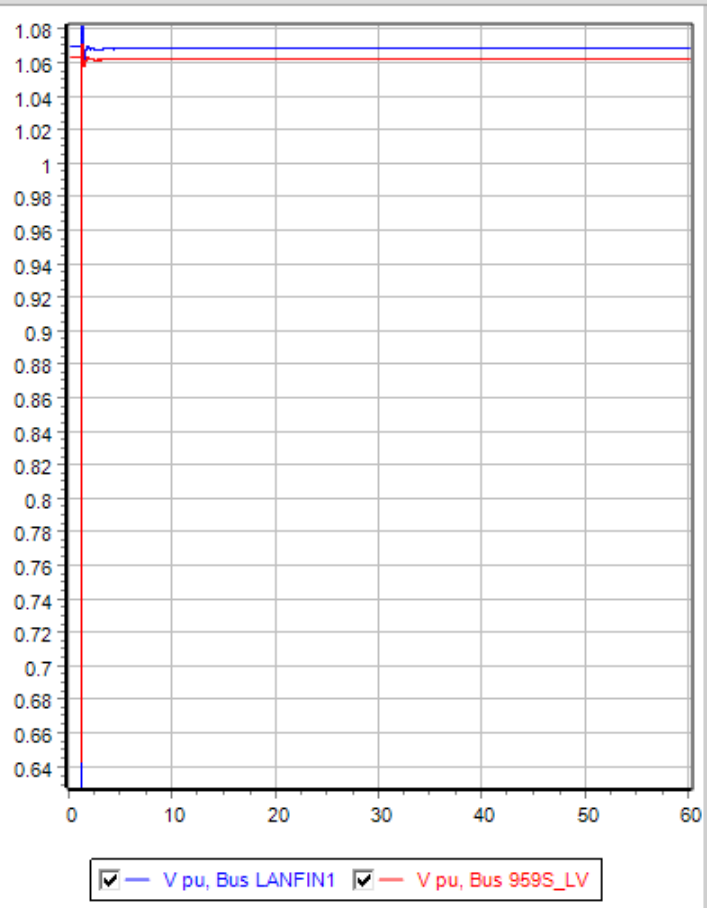
Study Case:
Scenario 5 (2022SL)

December 04, 2020 18:24:50

Lanfine 959S Voltages





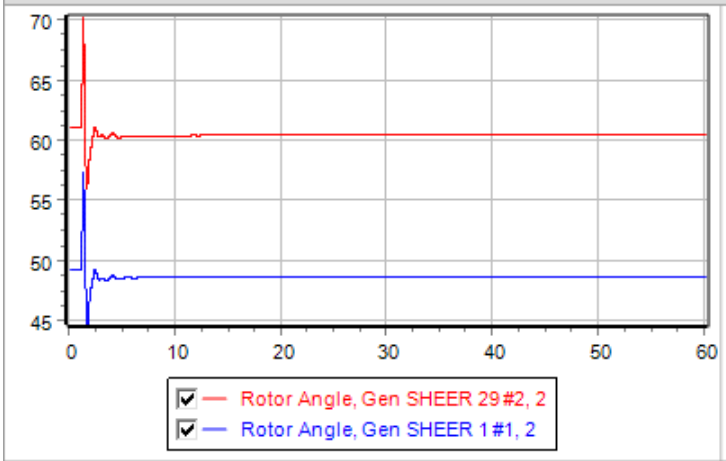


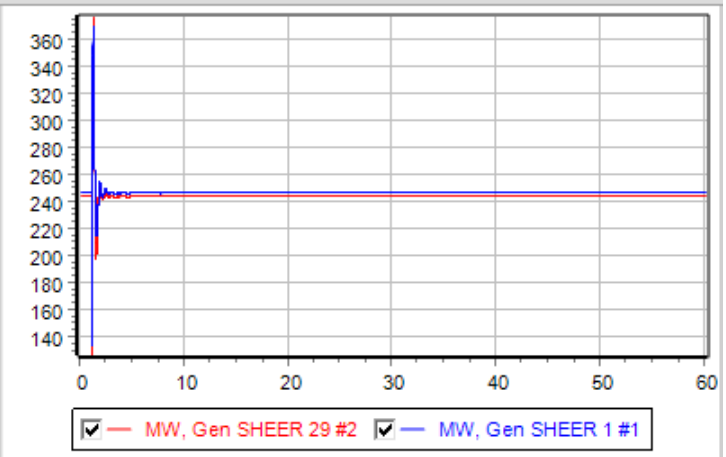
Contingency:
9L29: Coyote Lake 963S to Oakland 946S

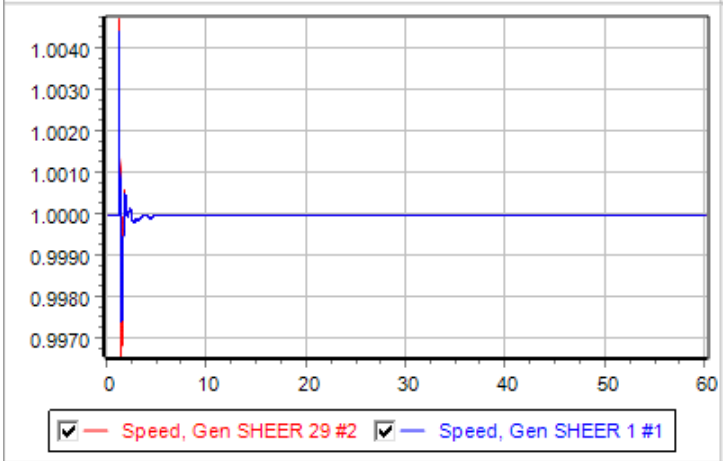
Study Case:
Scenario 5 (2022SL)

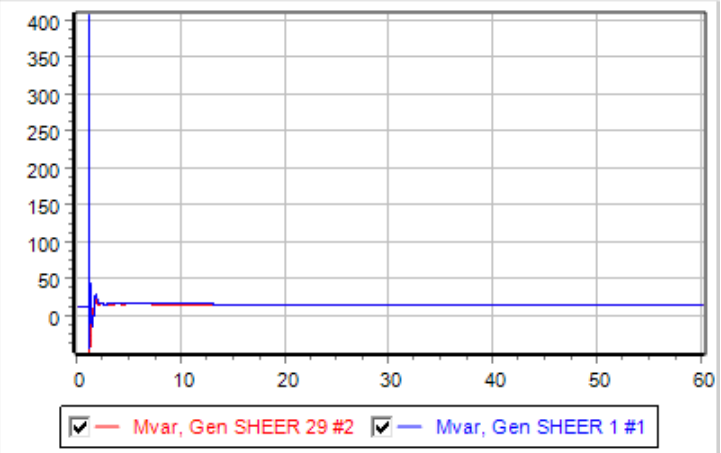
December 04, 2020 18:24:49

Sheerness







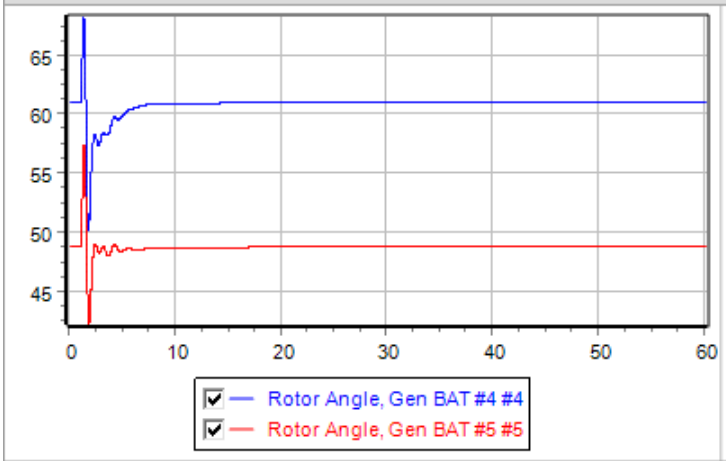


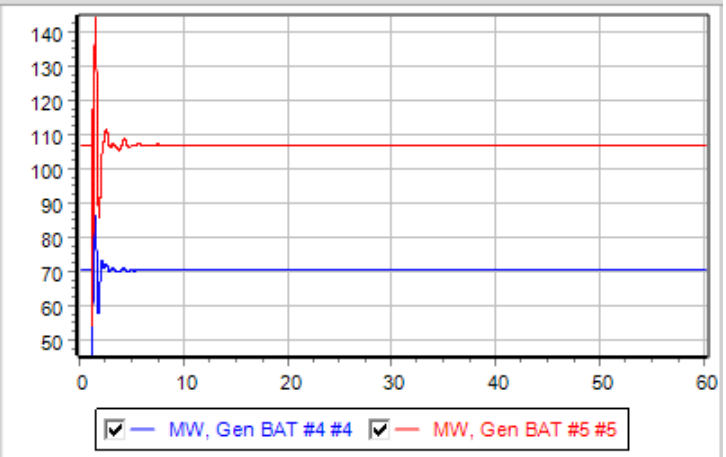
Contingency:
9L29: Coyote Lake 963S to Oakland 946S

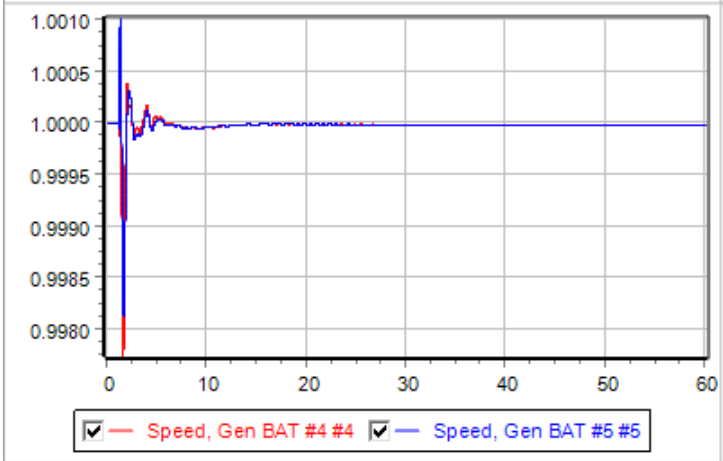
Study Case:
Scenario 5 (2022SL)

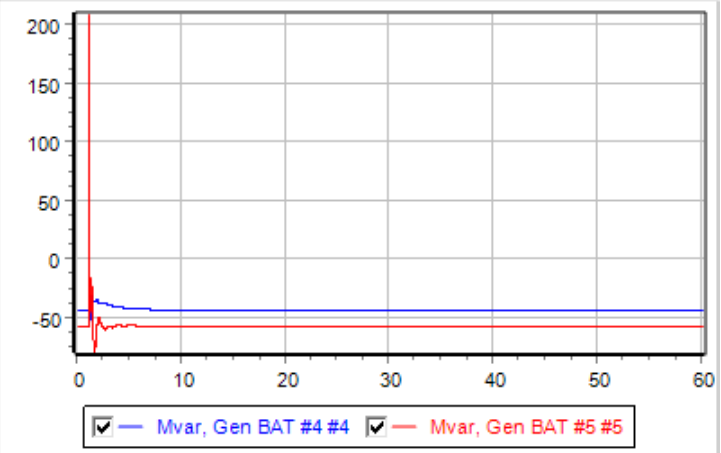
December 04, 2020 18:24:48

Battle River







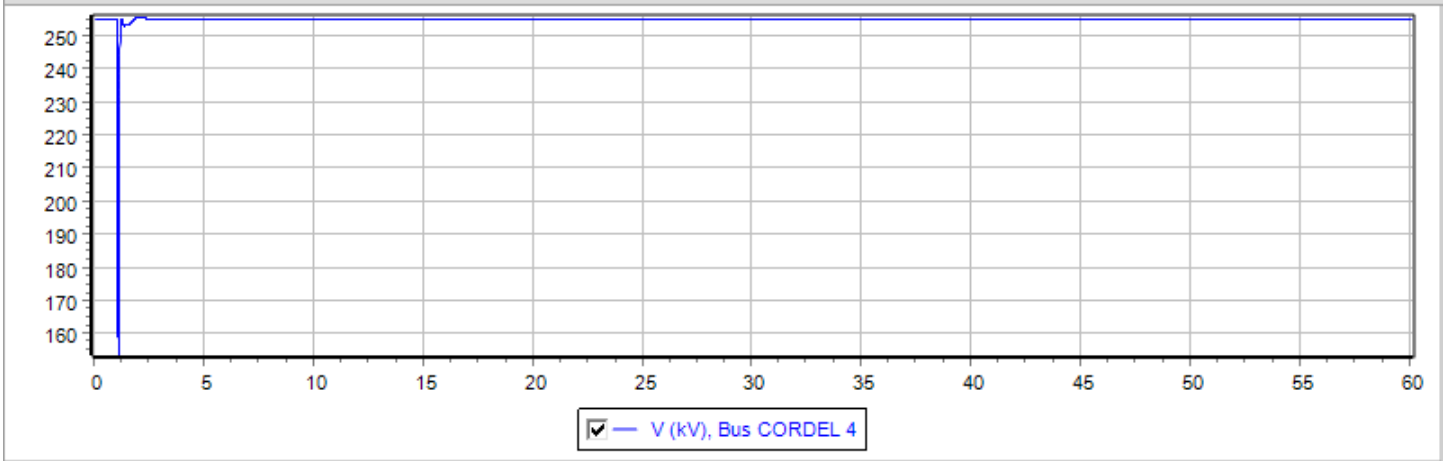


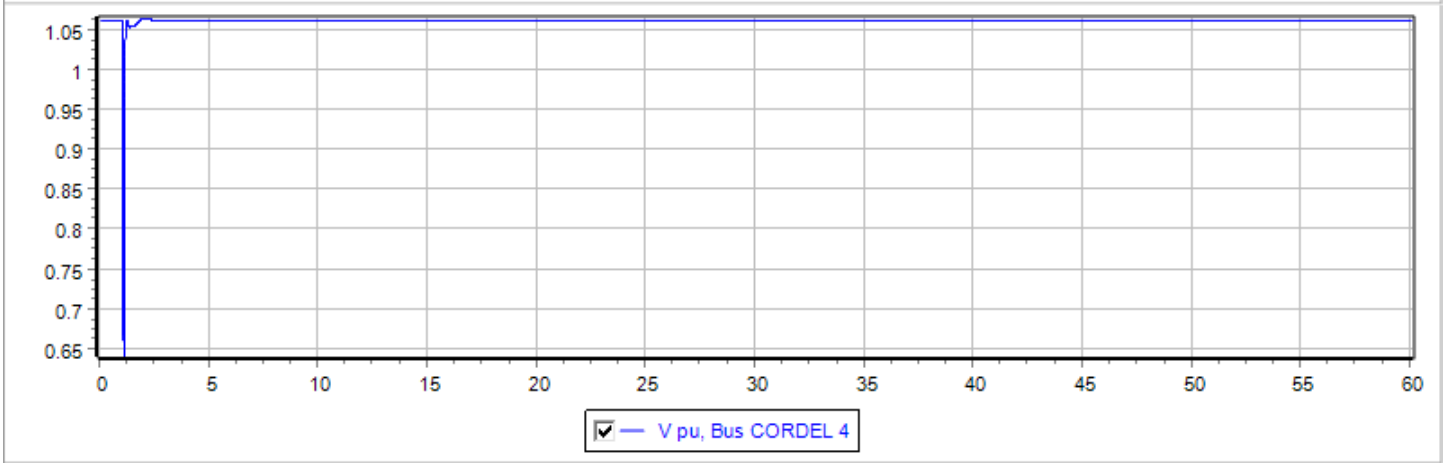
Contingency:
9L29: Oakland 946S to Coyote Lake 963S

Study Case:
Scenario 5 (2022SL)

December 04, 2020 18:28:25

Cordel 755S Voltages



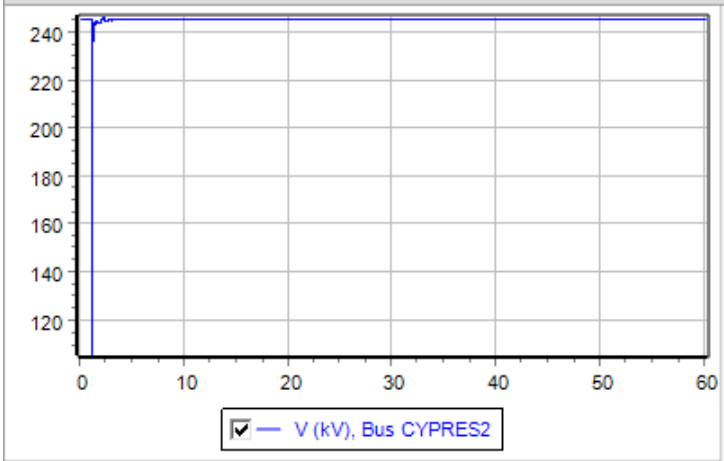


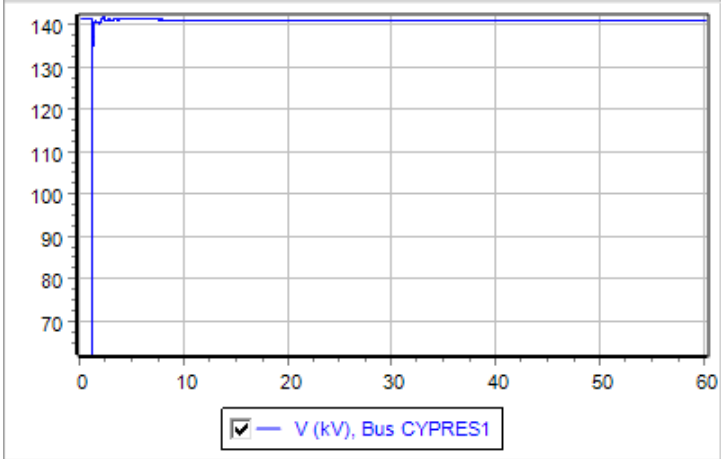
Contingency:
9L29: Oakland 946S to Coyote Lake 963S

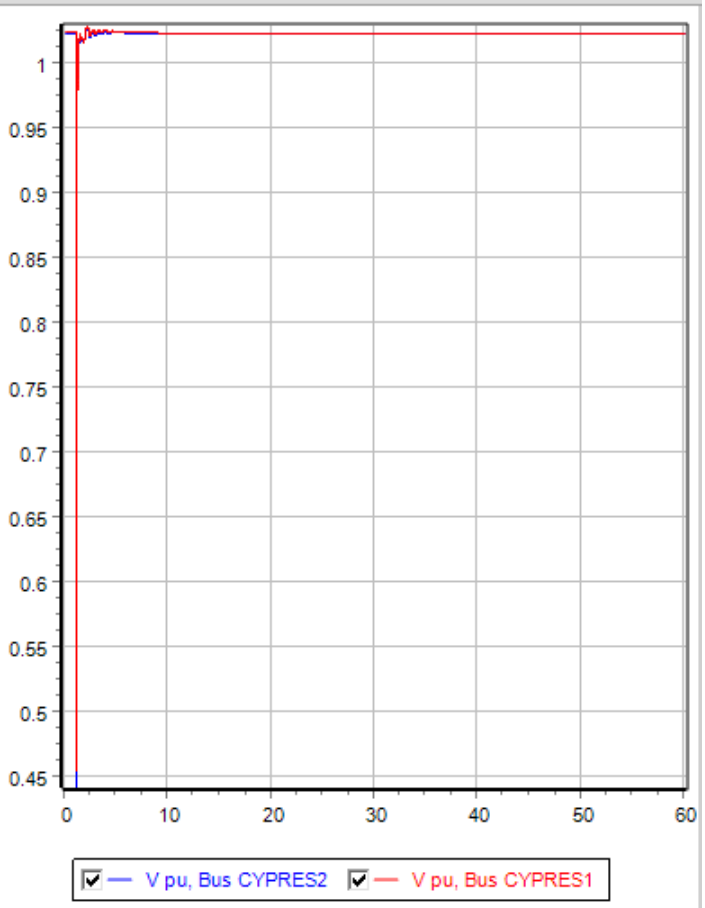
Study Case:
Scenario 5 (2022SL)

December 04, 2020 18:28:28

Cypress 562S Voltages





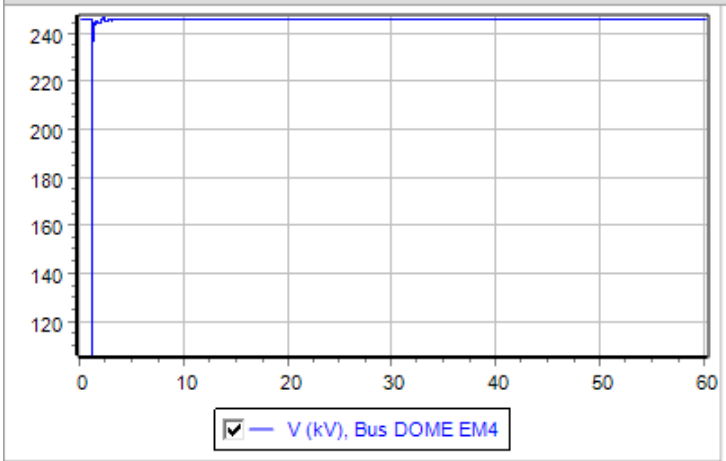


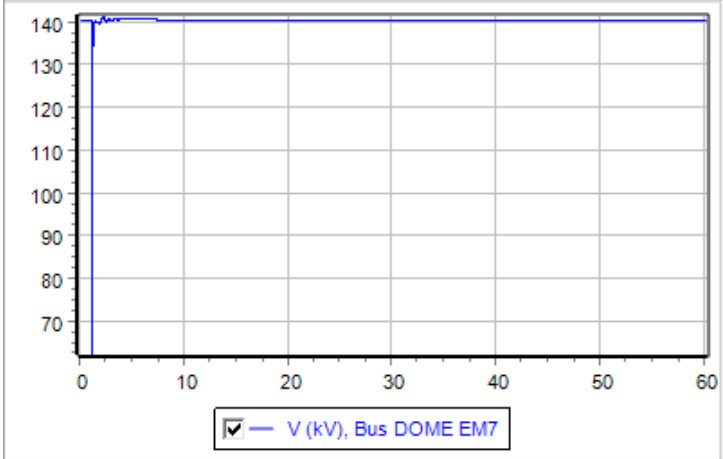
Contingency:
9L29: Oakland 946S to Coyote Lake 963S

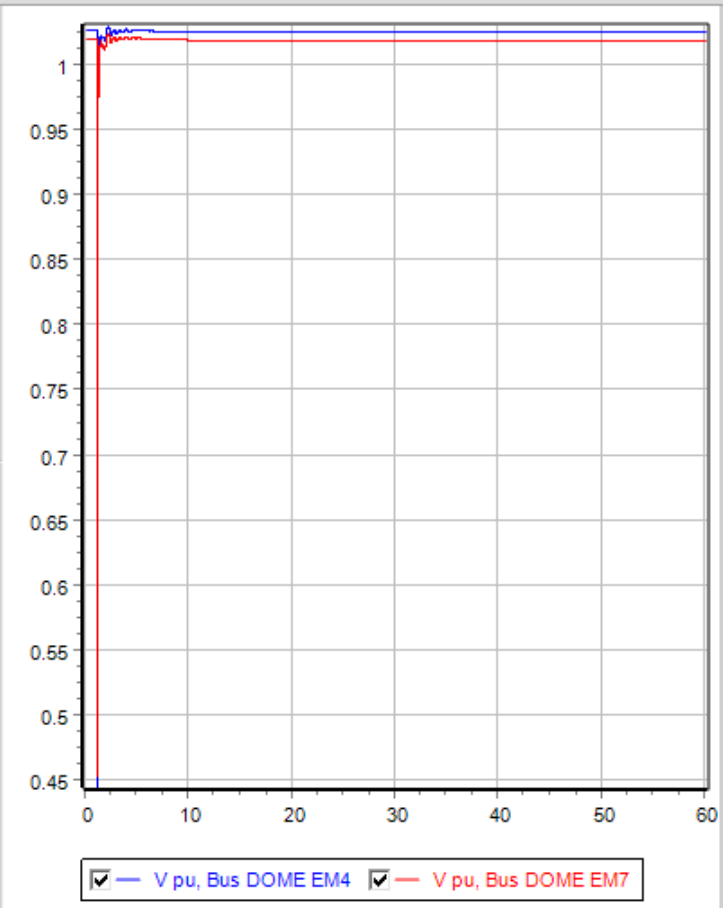
Study Case:
Scenario 5 (2022SL)

December 04, 2020 18:28:27

Dome 163S Voltages





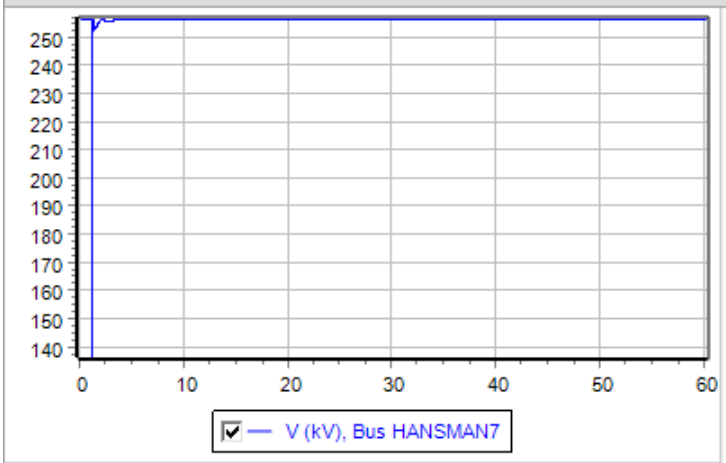


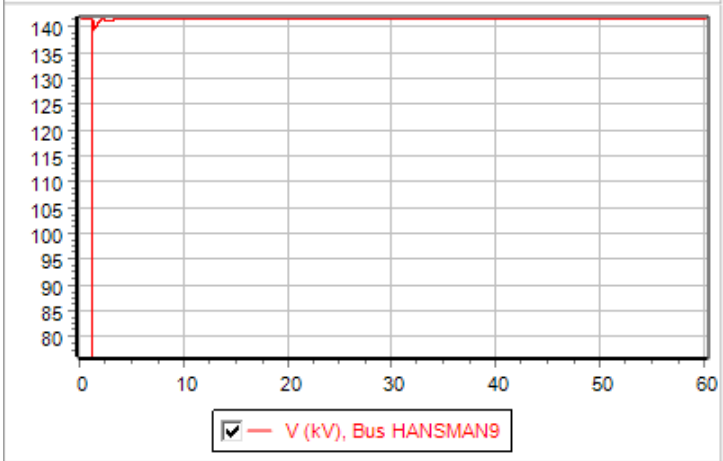
Contingency:
9L29: Oakland 946S to Coyote Lake 963S

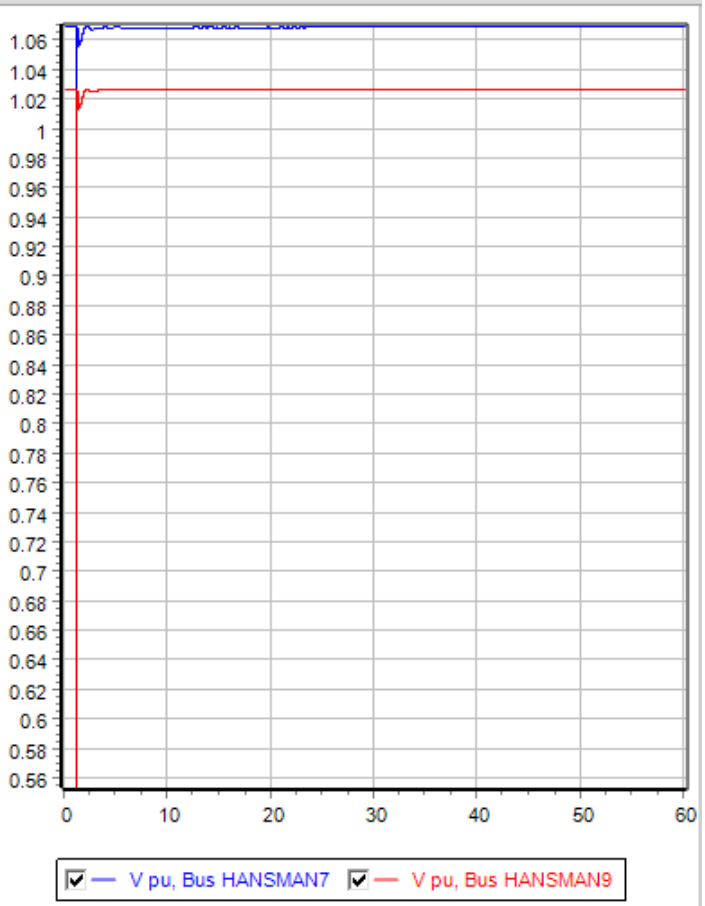
Study Case:
Scenario 5 (2022SL)

December 04, 2020 18:28:27

Hansman Lake 650S Voltages





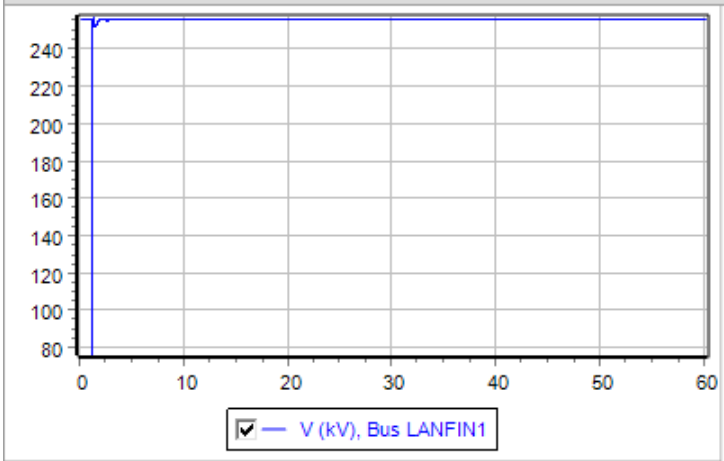


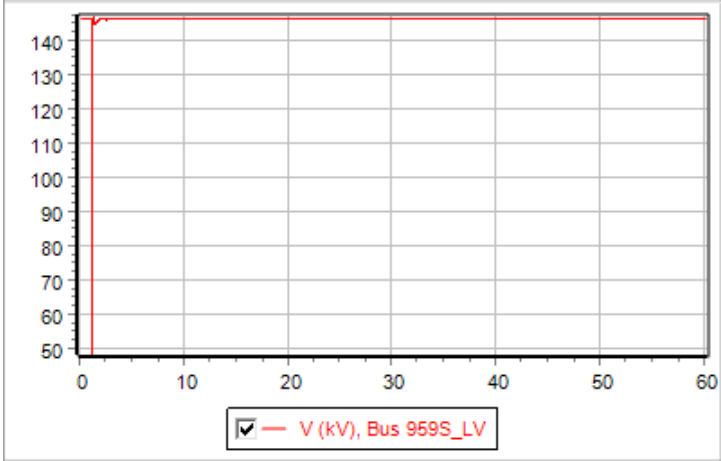
Contingency:
9L29: Oakland 946S to Coyote Lake 963S

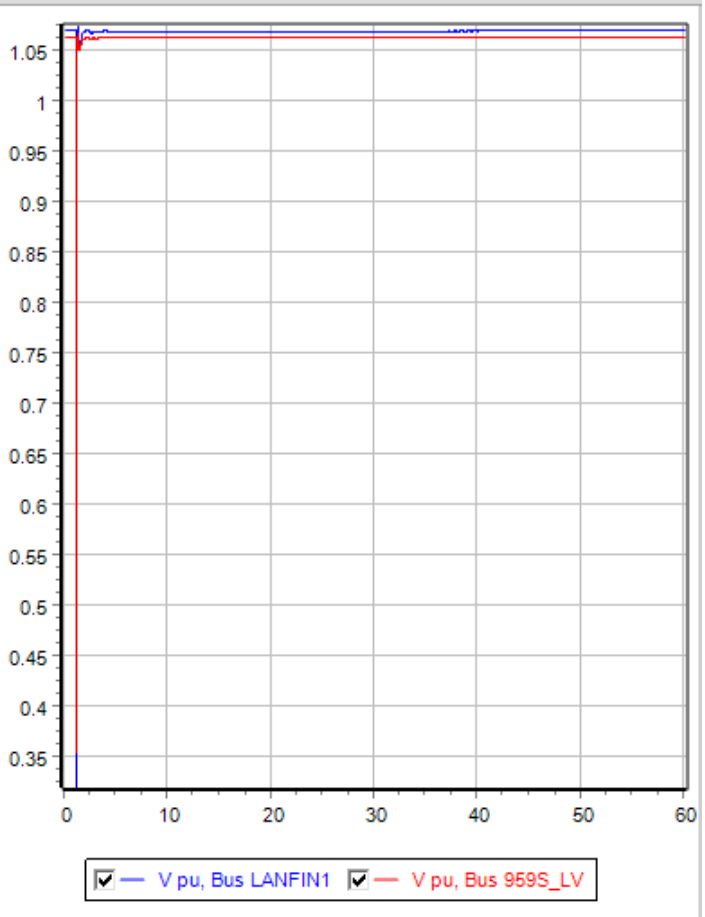
Study Case:
Scenario 5 (2022SL)

December 04, 2020 18:28:26

Lanfine 959S Voltages





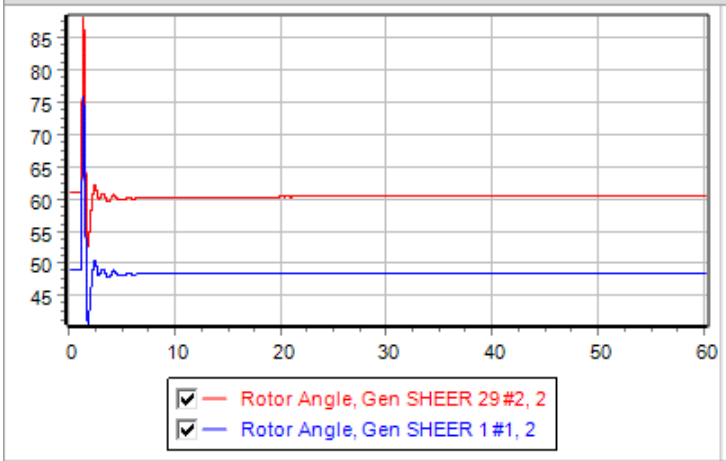


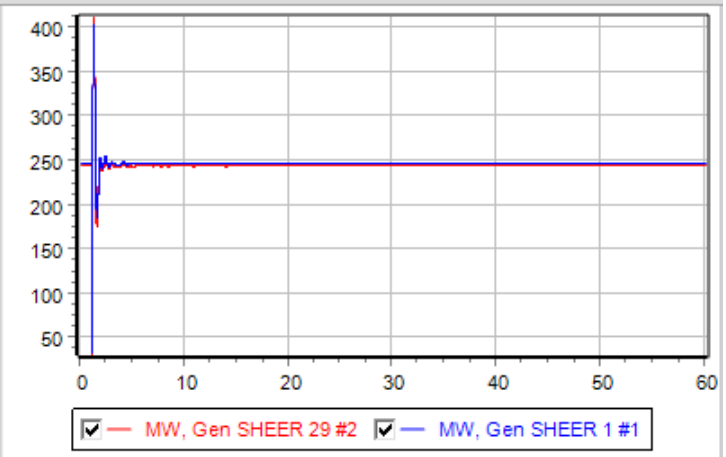
Contingency:
9L29: Oakland 946S to Coyote Lake 963S

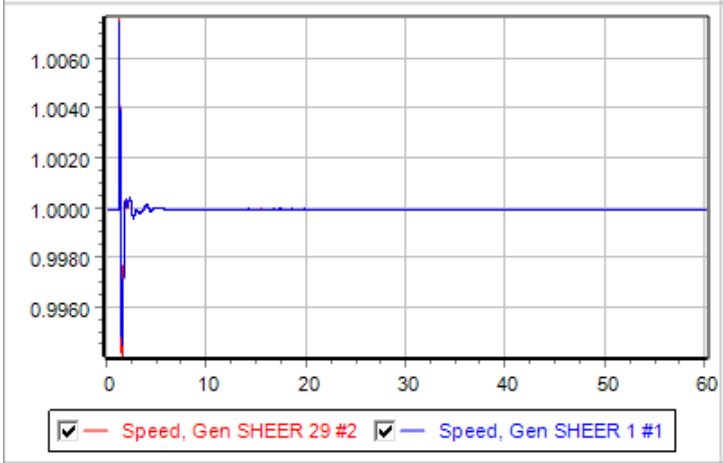
Study Case:
Scenario 5 (2022SL)

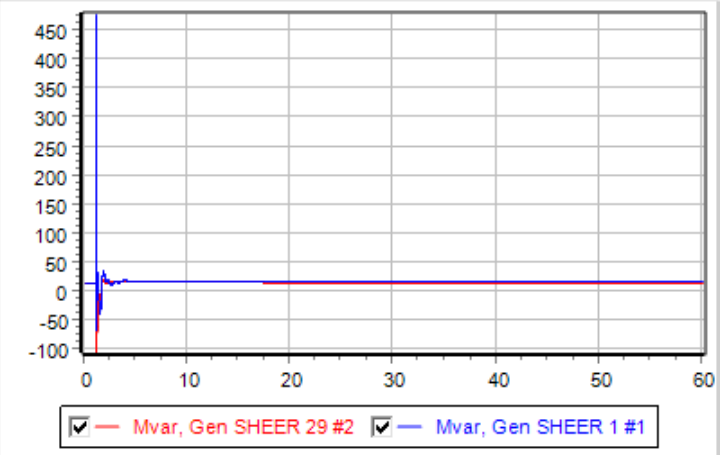
December 04, 2020 18:28:26

Sheerness







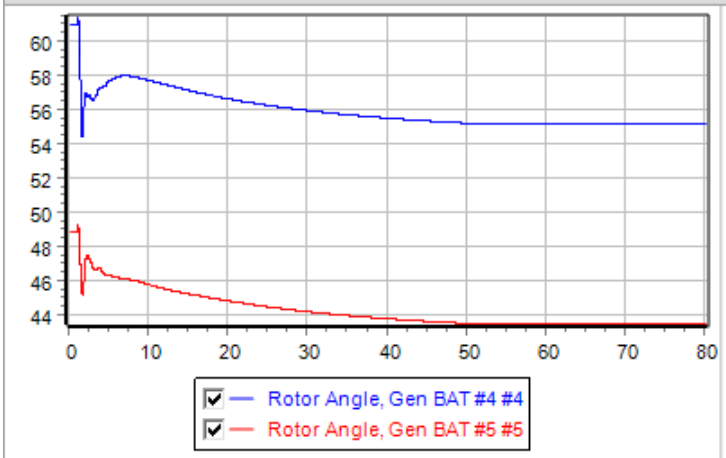


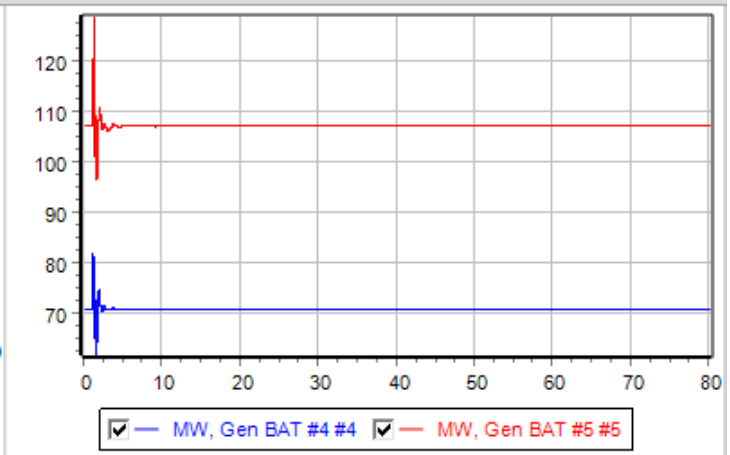
Contingency:
9L29: Oakland 946S to Coyote Lake 963S

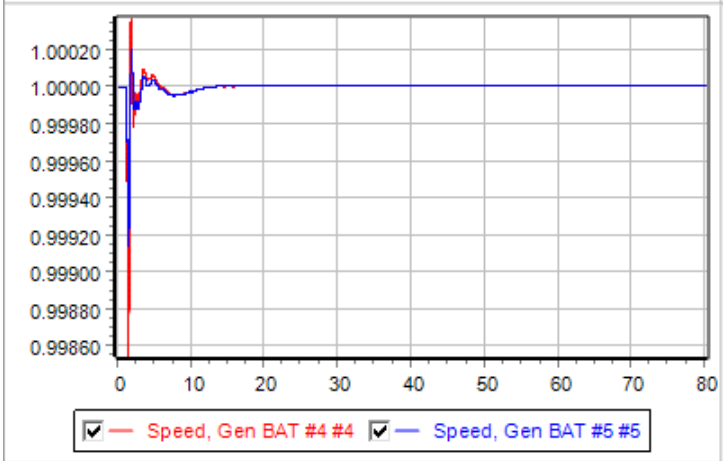
Study Case:
Scenario 5 (2022SL)

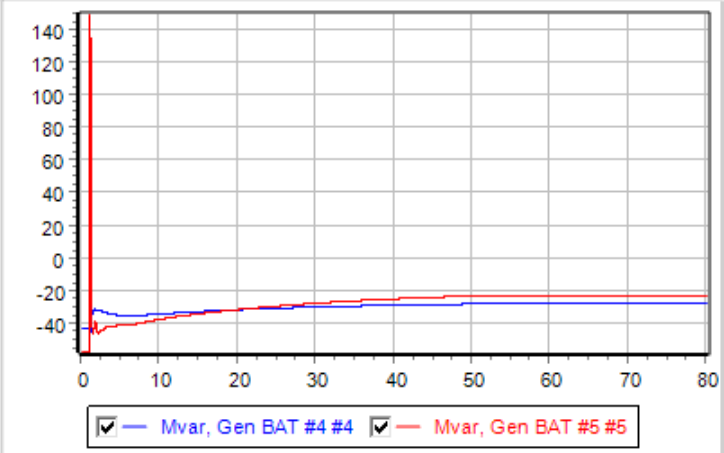
December 04, 2020 18:28:25

Battle River







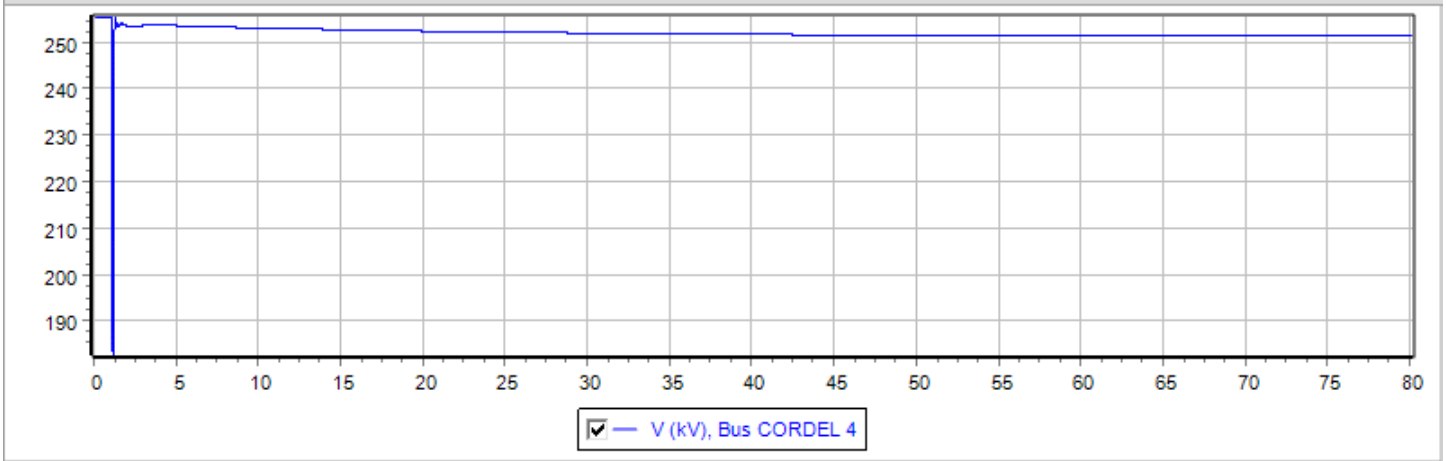


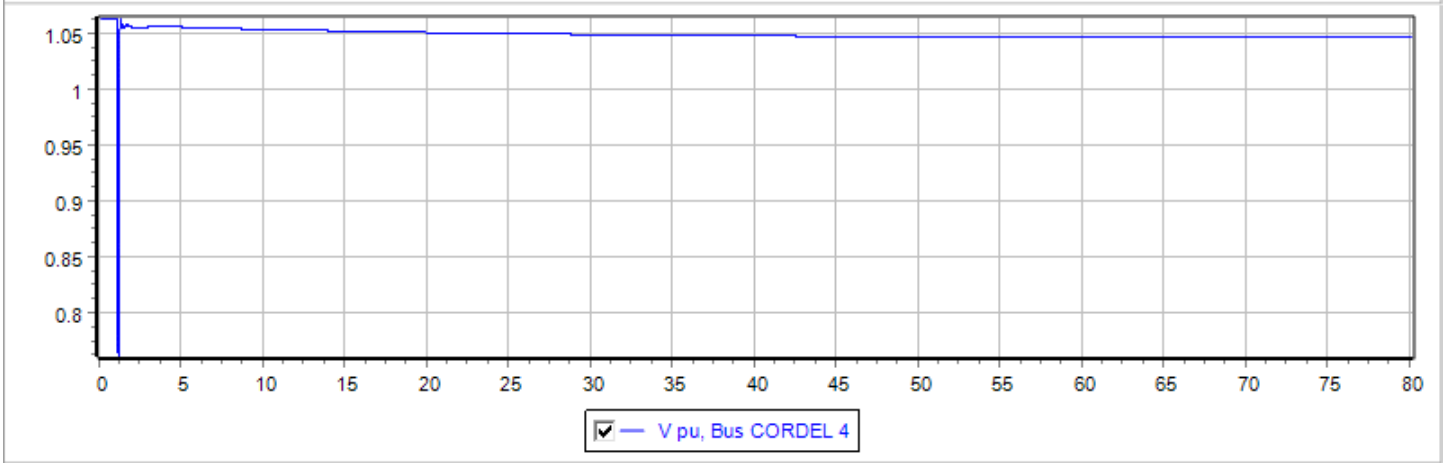
Contingency:
9L46: Lanfine 959S to N.Bridgen

Study Case:
Scenario 5 (2022SL)

December 04, 2020 19:24:32

Cordel 755S Voltages



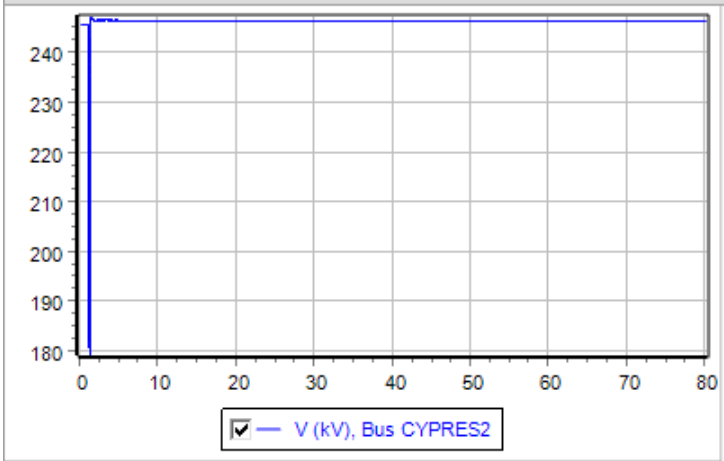


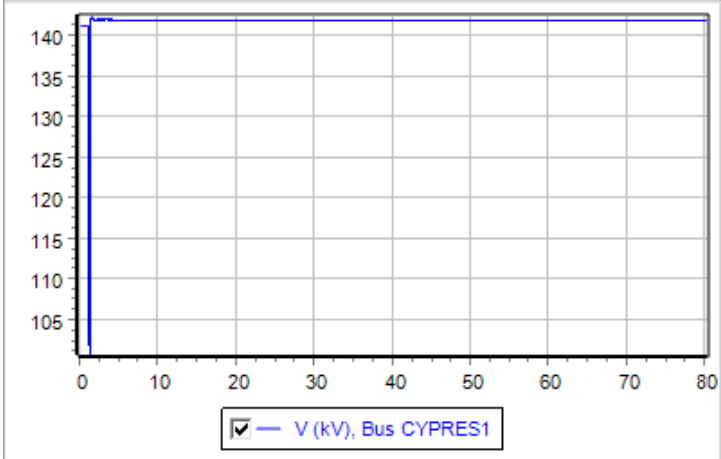
Contingency:
9L46: Lanfine 959S to N.Bridgen

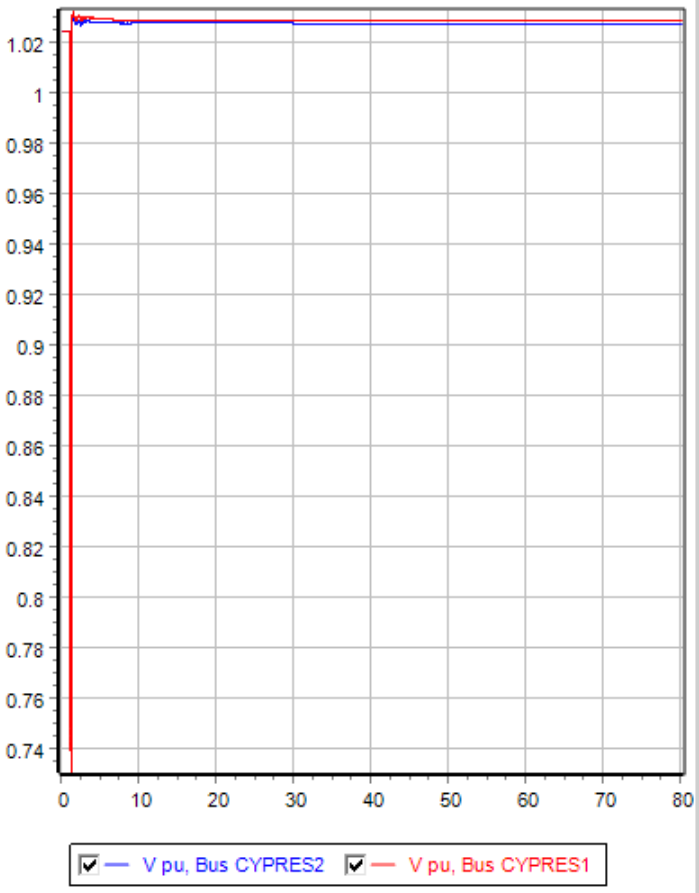
Study Case:
Scenario 5 (2022SL)

December 04, 2020 19:24:35

Cypress 562S Voltages





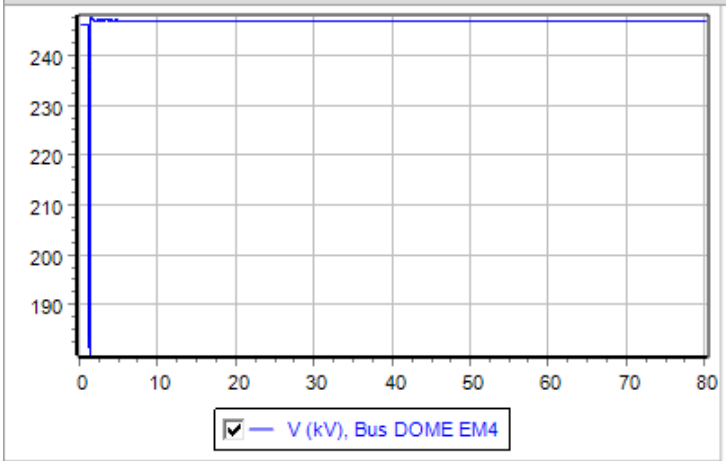


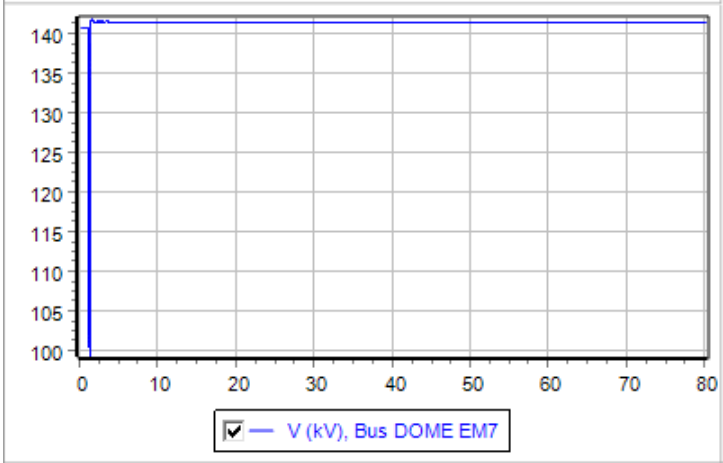
Contingency:
9L46: Lanfine 959S to N.Bridgen

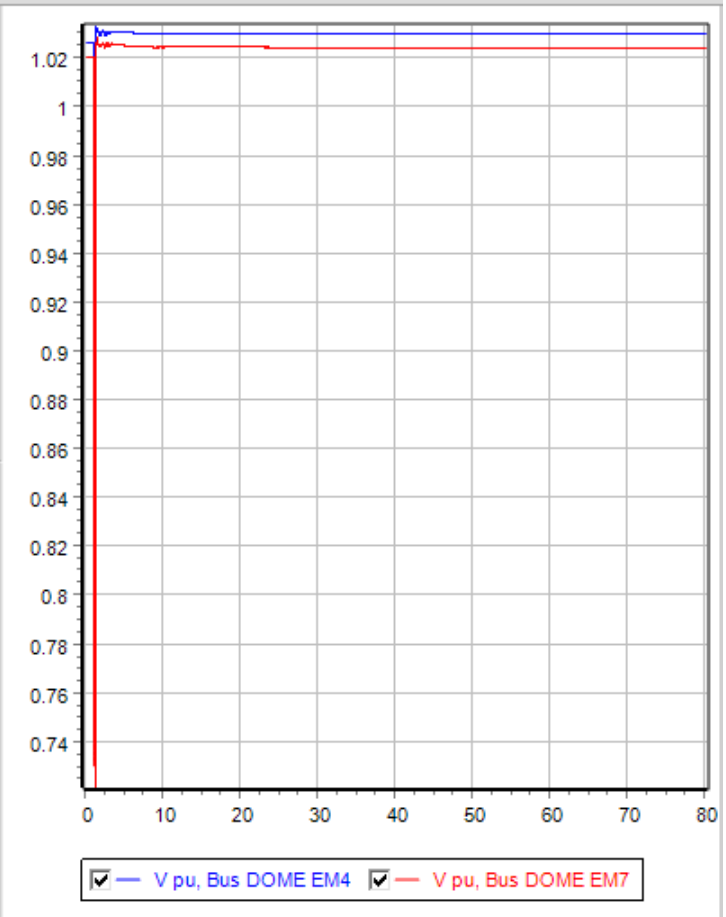
Study Case:
Scenario 5 (2022SL)

December 04, 2020 19:24:34

Dome 163S Voltages





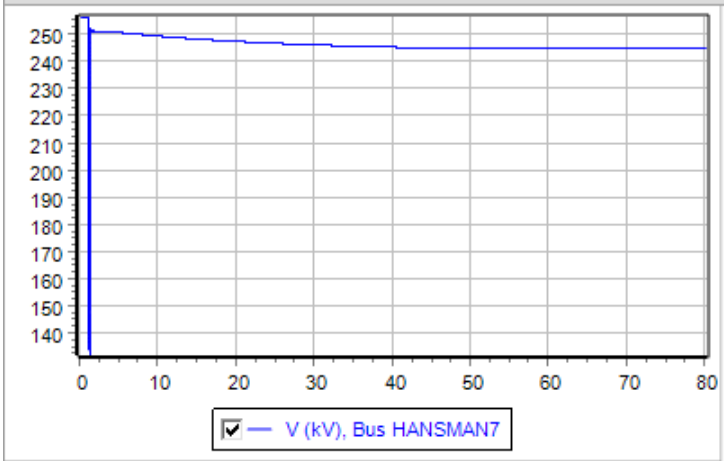


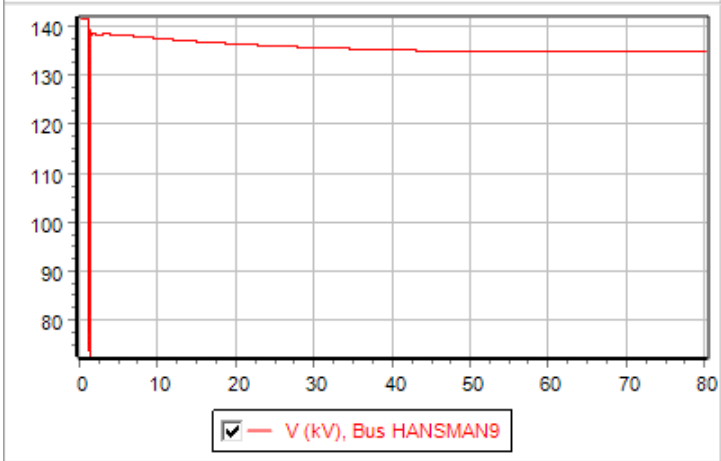
Contingency:
9L46: Lanfine 959S to N.Bridgen

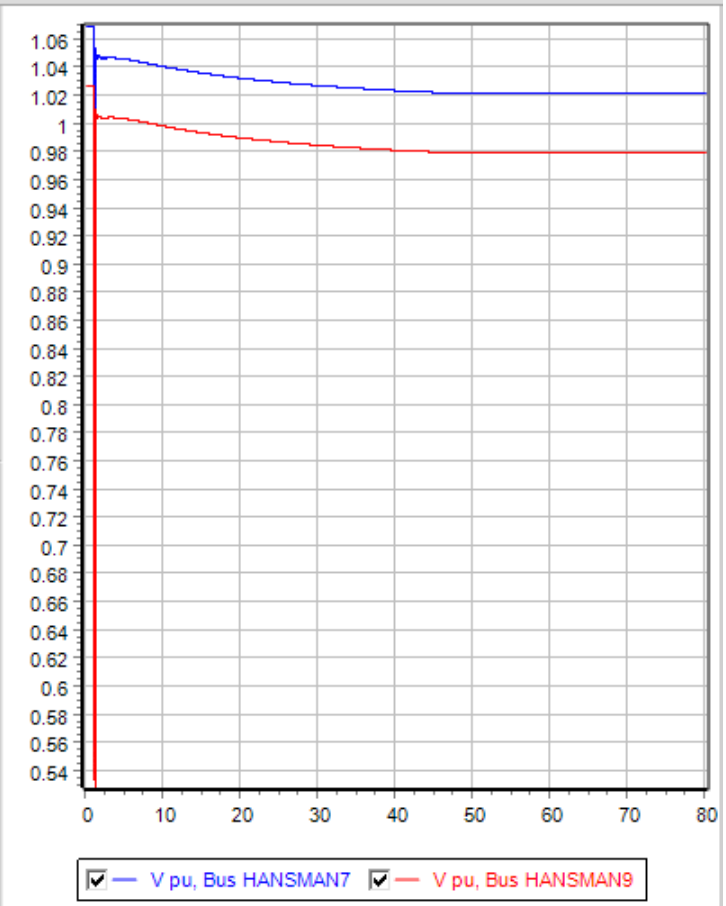
Study Case:
Scenario 5 (2022SL)

December 04, 2020 19:24:33

Hansman Lake 650S Voltages





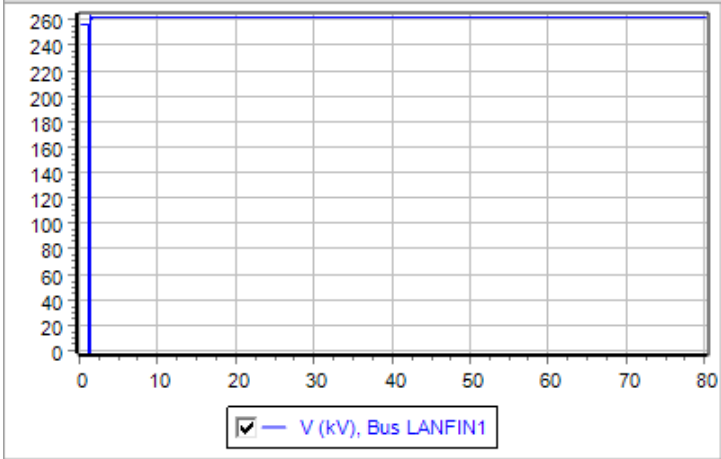


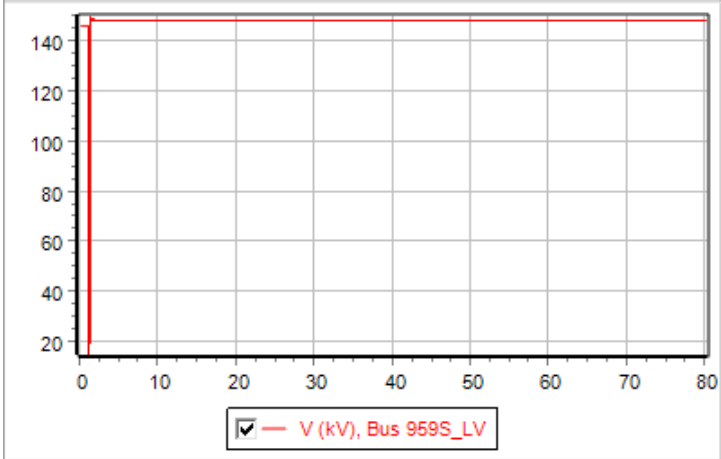
Contingency:
9L46: Lanfine 959S to N.Bridgen

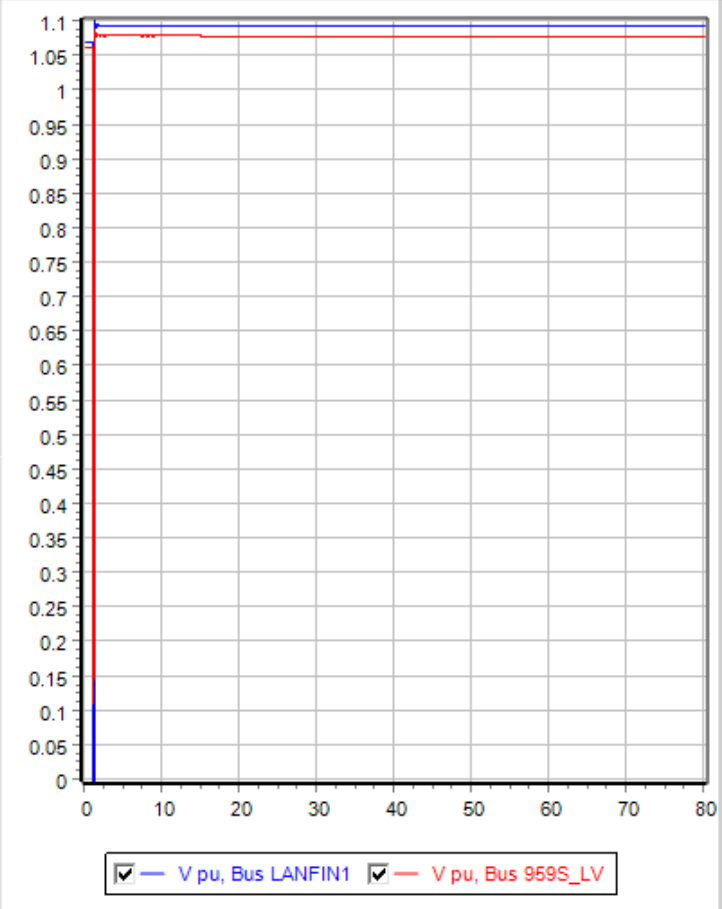
Study Case:
Scenario 5 (2022SL)

December 04, 2020 19:24:33

Lanfine 959S Voltages





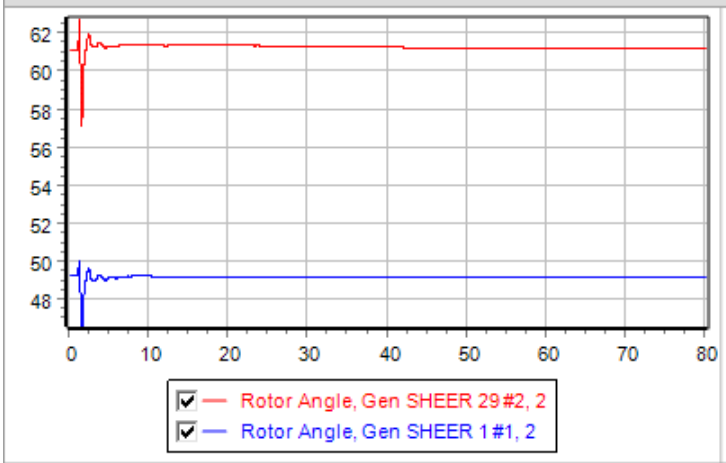


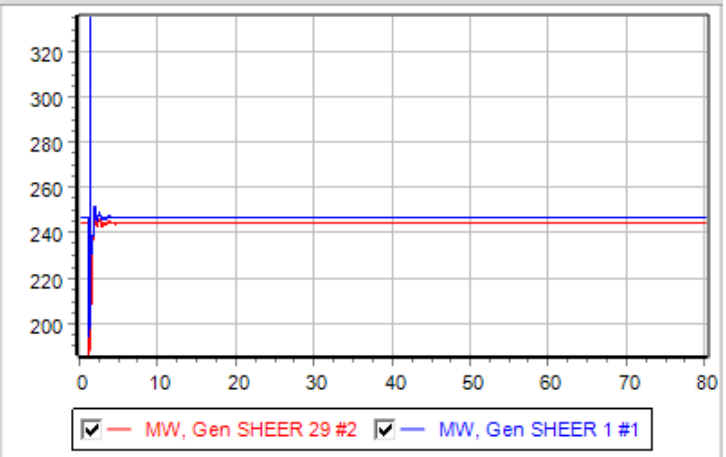
Contingency:
9L46: Lanfine 959S to N.Bridgen

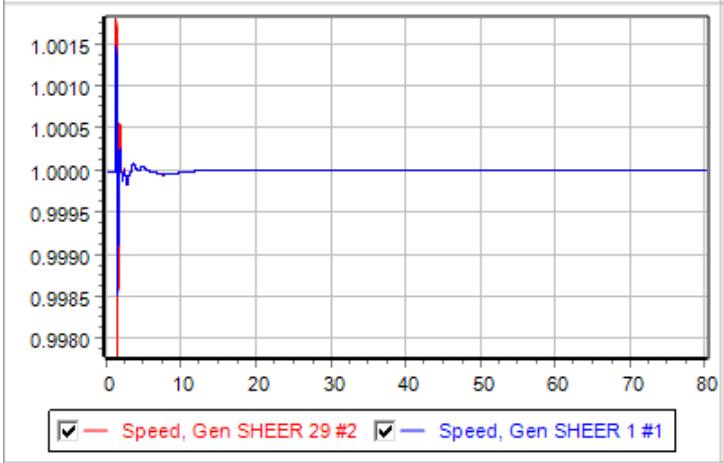
Study Case:
Scenario 5 (2022SL)

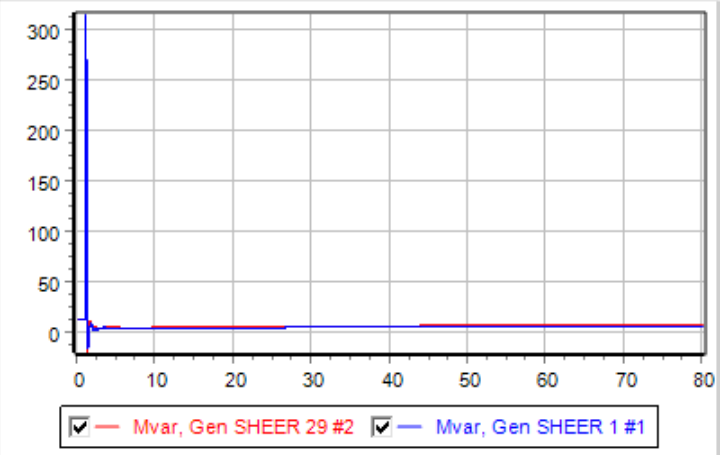
December 04, 2020 19:24:32

Sheerness







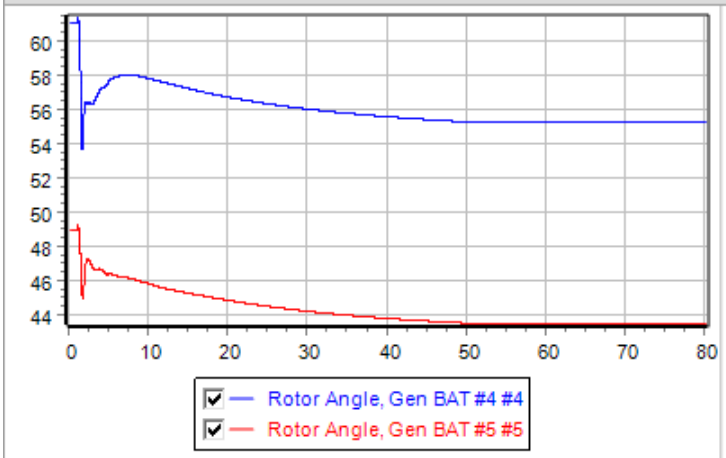


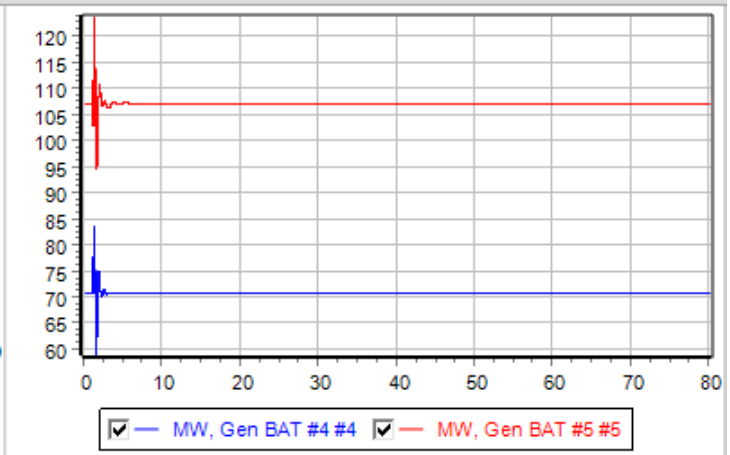
Contingency:
9L46: Lanfine 959S to N.Bridgen

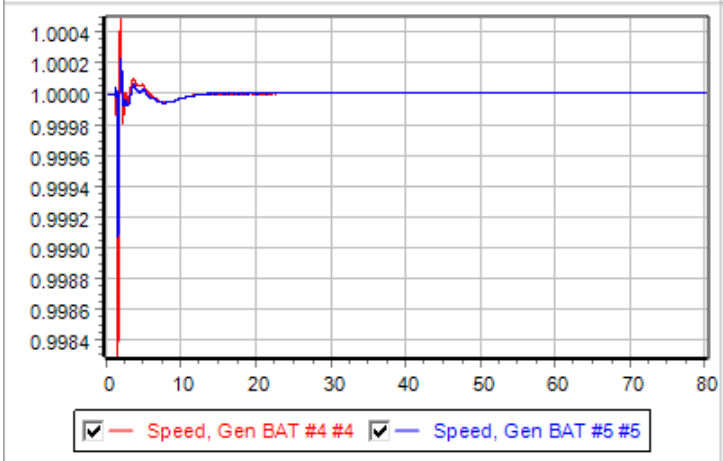
Study Case:
Scenario 5 (2022SL)

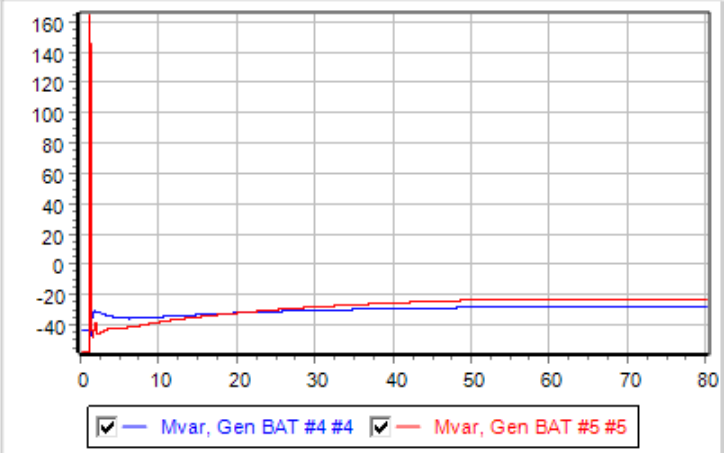
December 04, 2020 19:24:31

Battle River







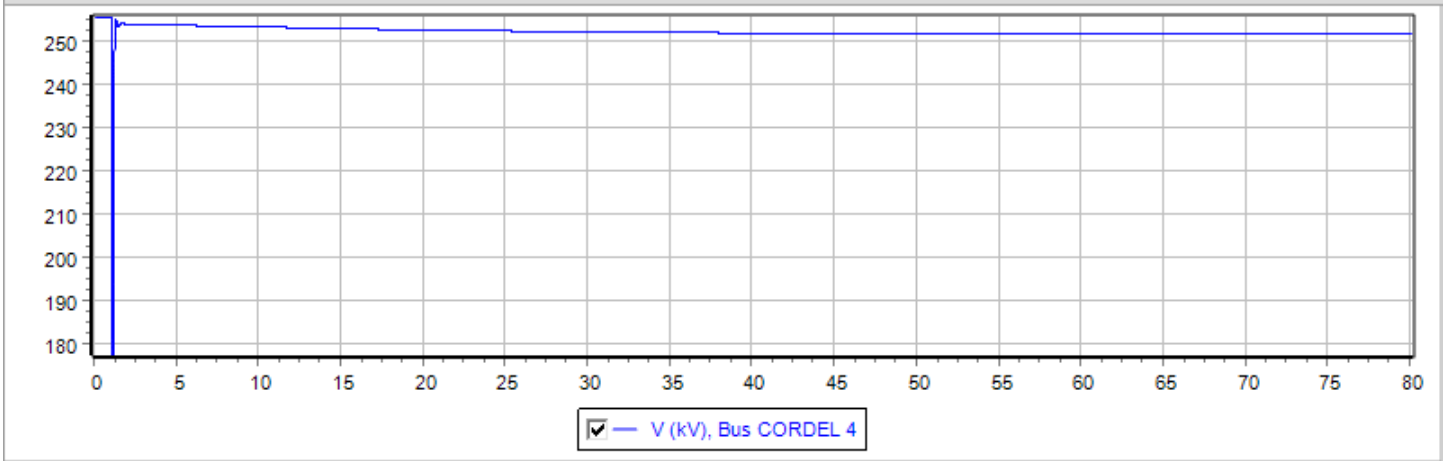


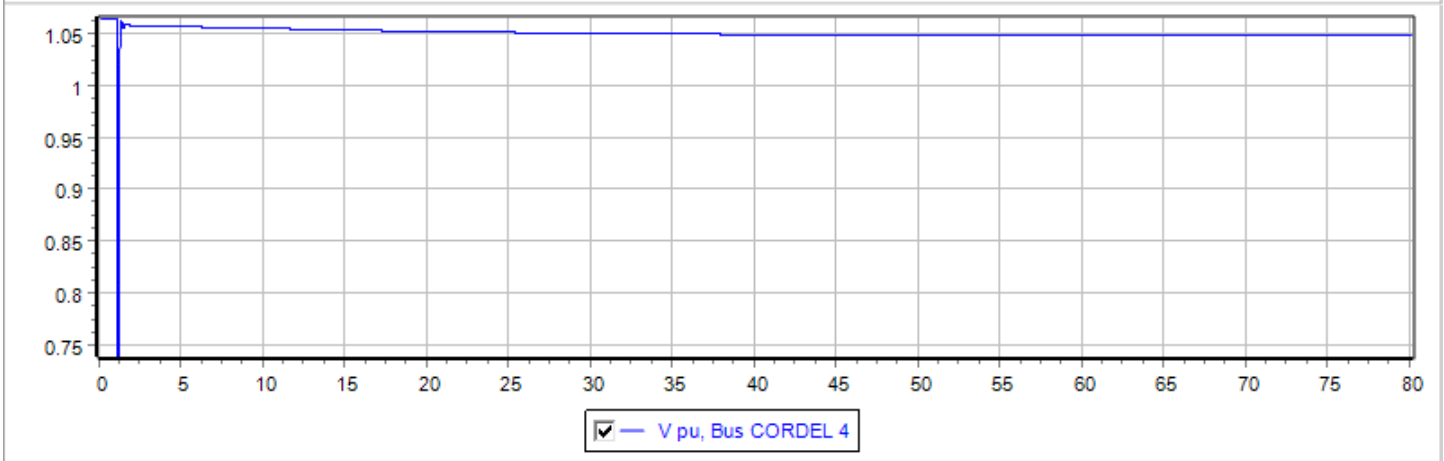
Contingency:
9L46: N.Bridgen to Lanfine 959S

Study Case:
Scenario 5 (2022SL)

December 04, 2020 19:35:36

Cordel 755S Voltages



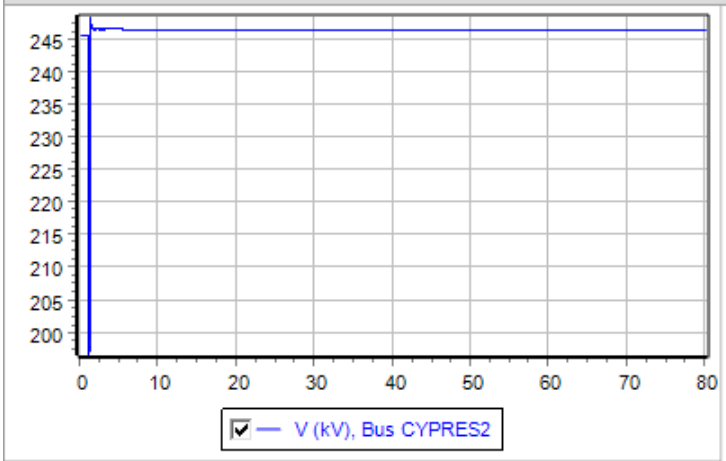


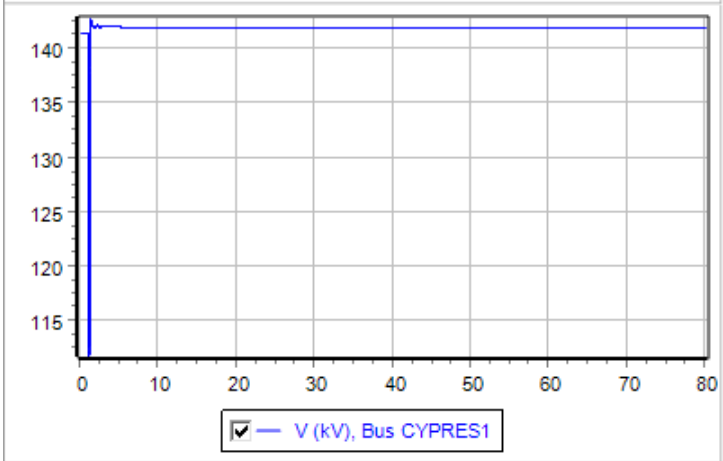
Contingency:
9L46: N.Bridgen to Lanfine 959S

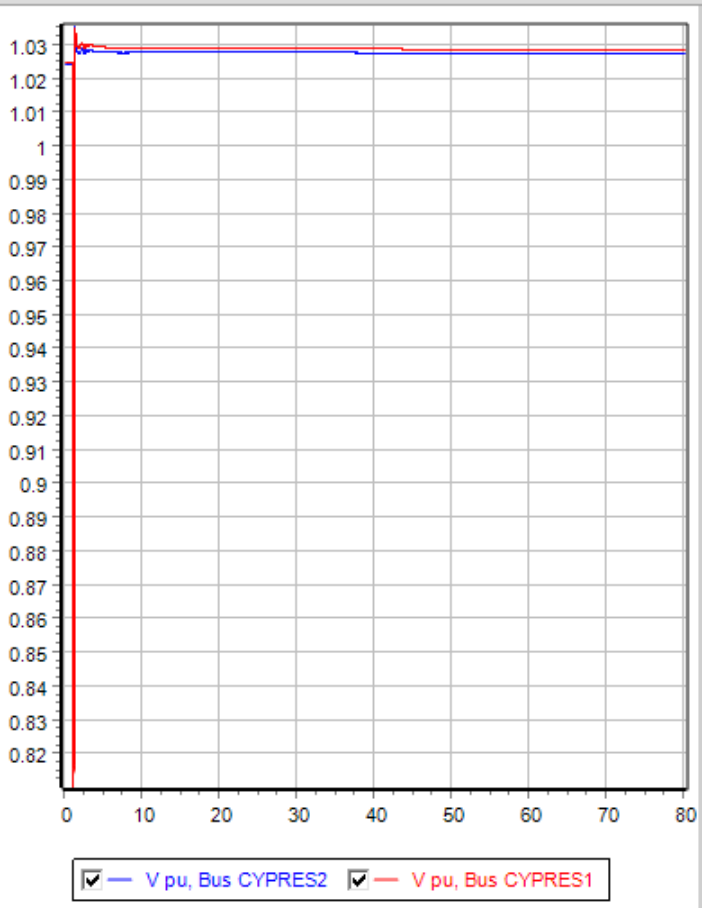
Study Case:
Scenario 5 (2022SL)

December 04, 2020 19:35:38

Cypress 562S Voltages





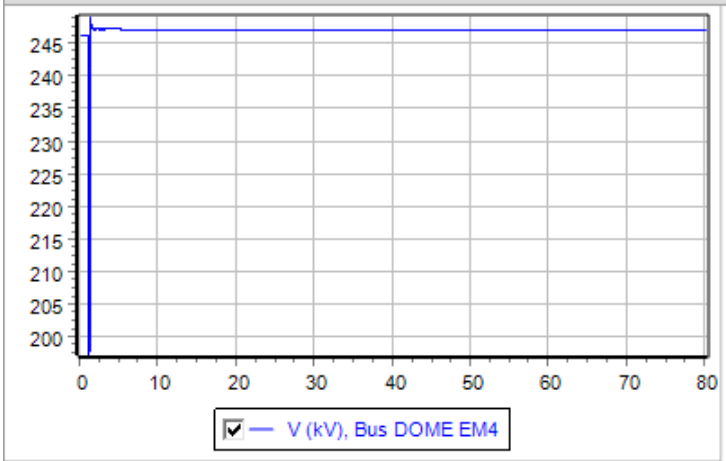


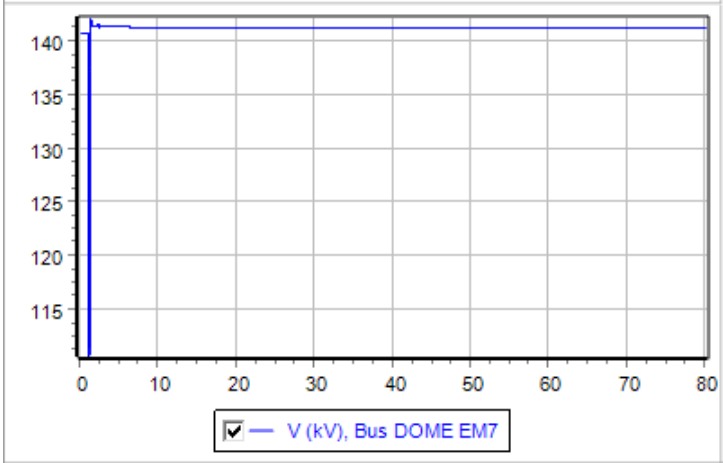
Contingency:
9L46: N.Bridgen to Lanfine 959S

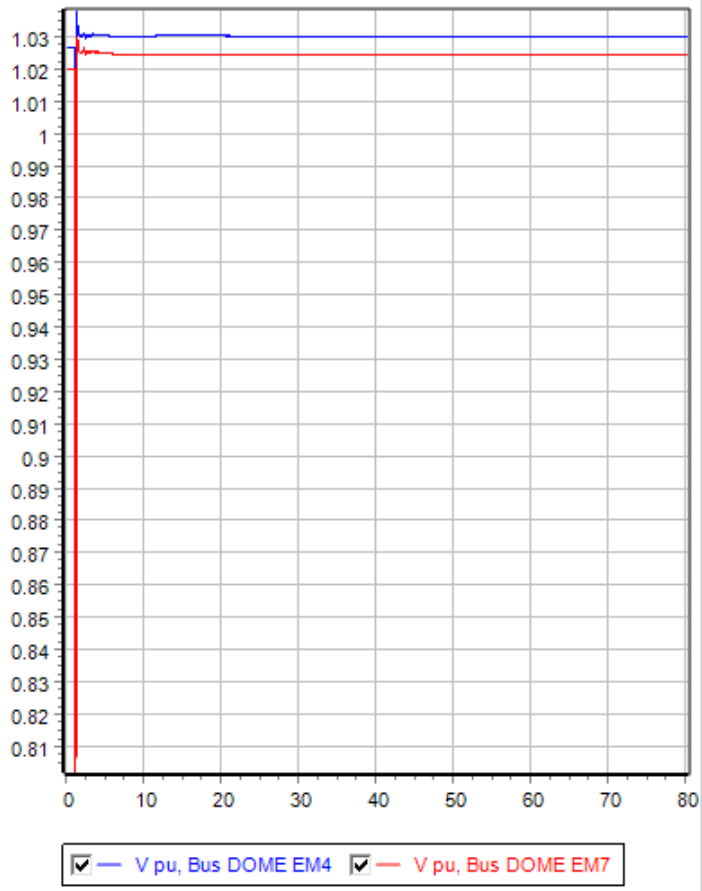
Study Case:
Scenario 5 (2022SL)

December 04, 2020 19:35:38

Dome 163S Voltages





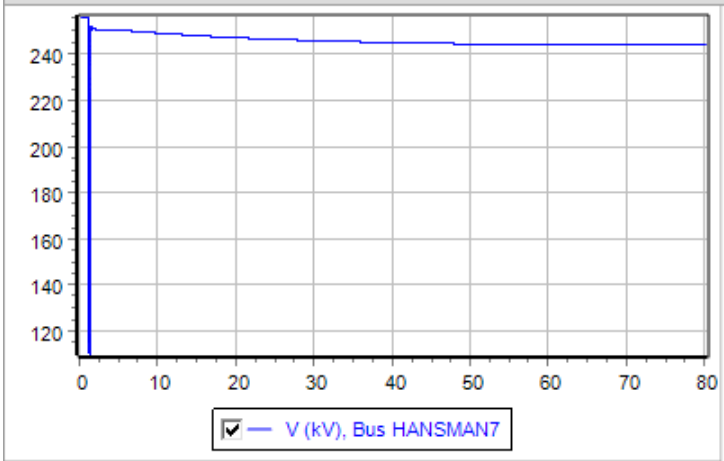


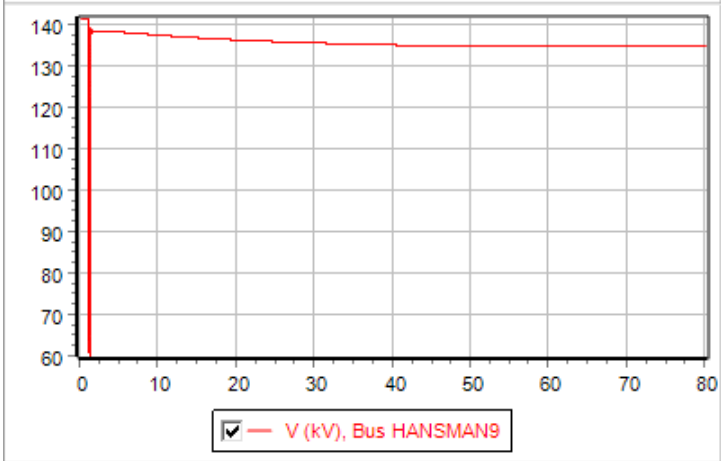
Contingency:
9L46: N.Bridgen to Lanfine 959S

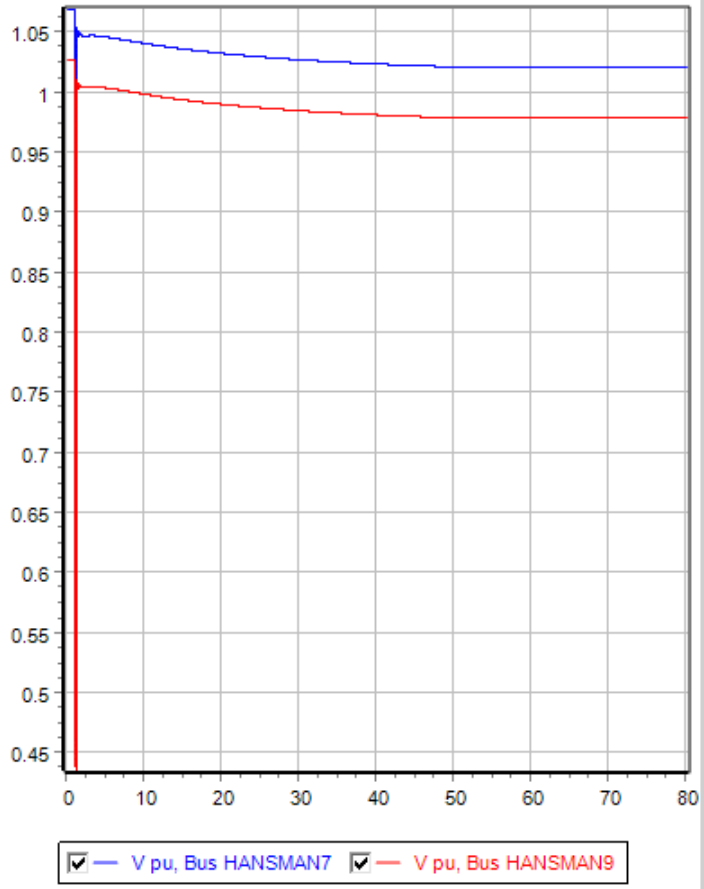
Study Case:
Scenario 5 (2022SL)

December 04, 2020 19:35:37

Hansman Lake 650S Voltages





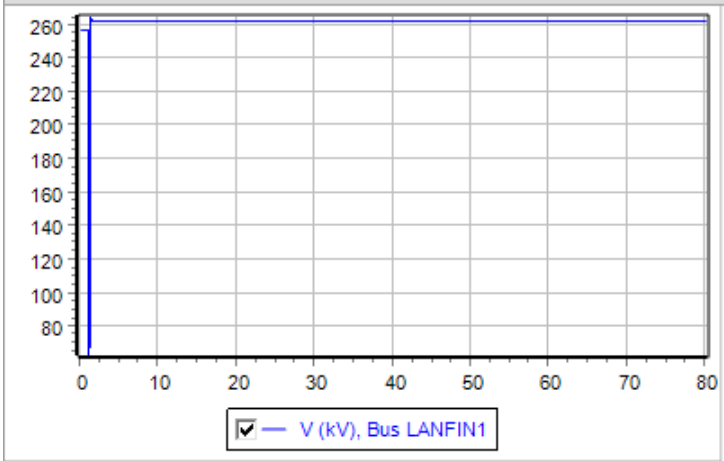


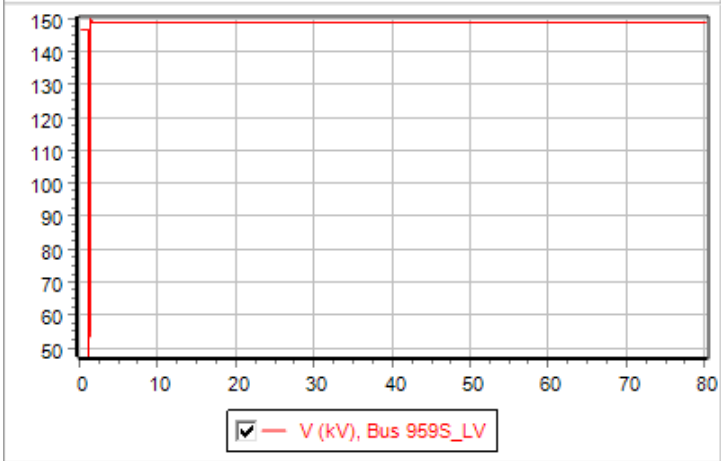
Contingency:
9L46: N.Bridgen to Lanfine 959S

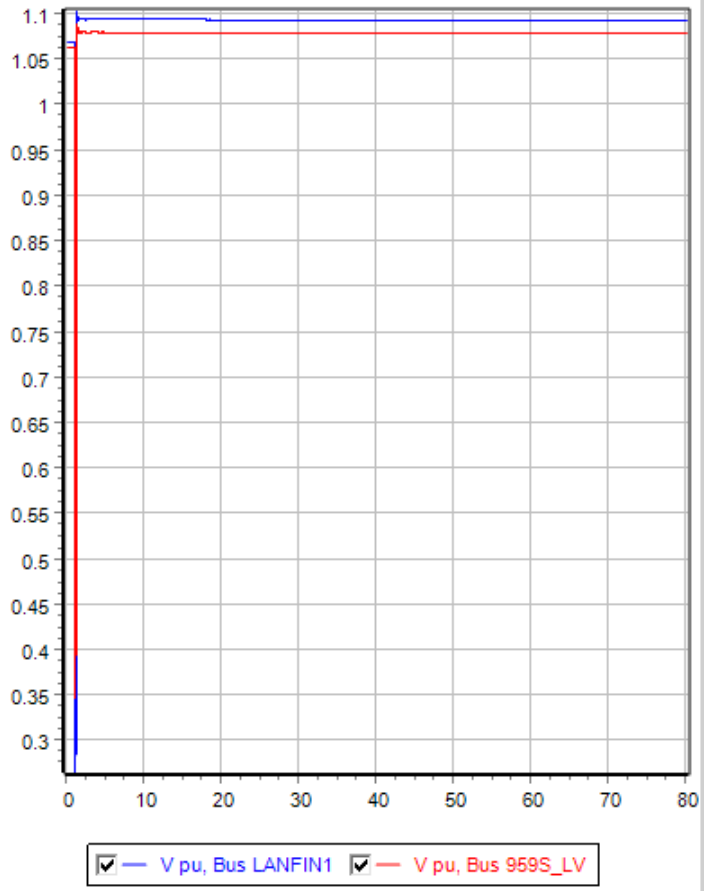
Study Case:
Scenario 5 (2022SL)

December 04, 2020 19:35:37

Lanfine 959S Voltages





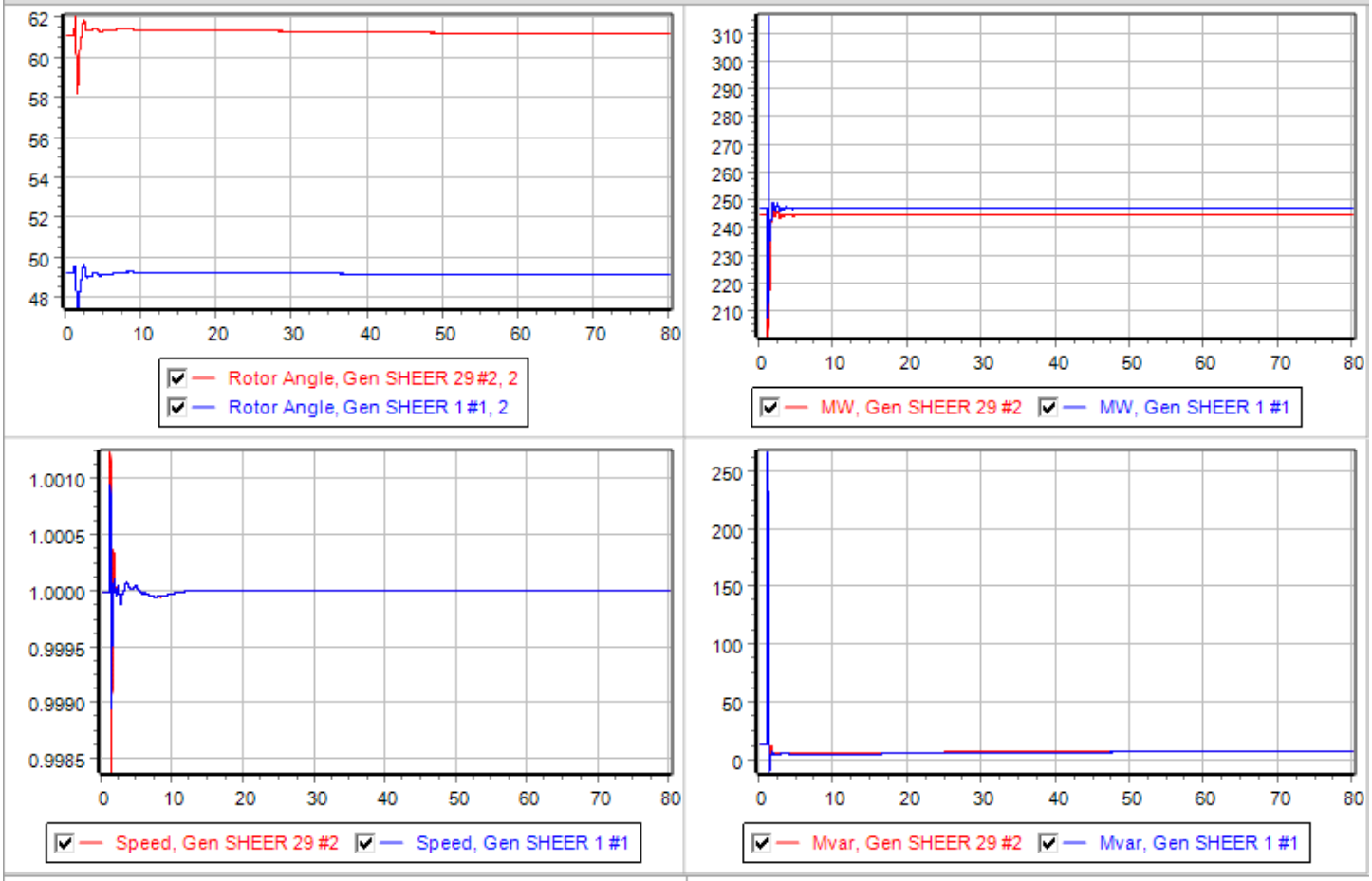


Contingency:
9L46: N.Bridgen to Lanfine 959S

Study Case:
Scenario 5 (2022SL)

December 04, 2020 19:35:36

Sheerness

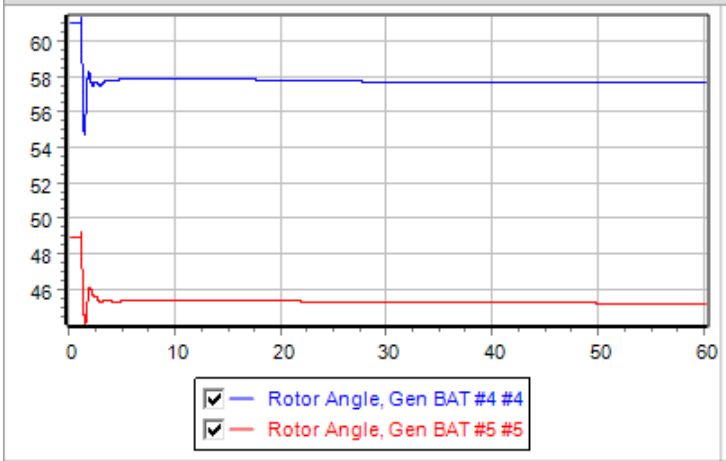


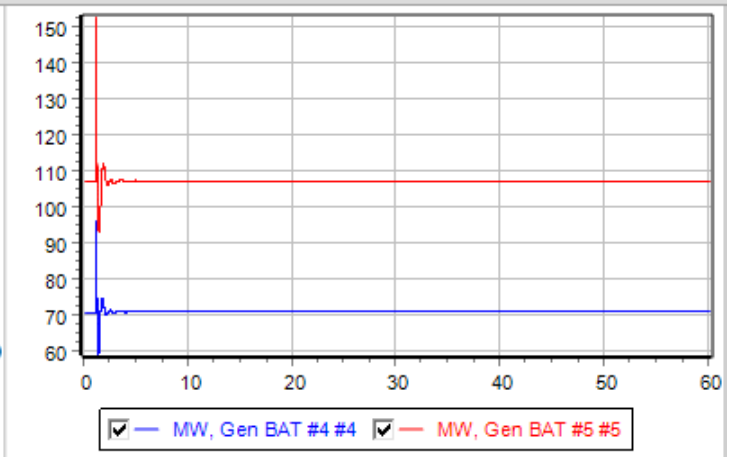
Contingency:
9L46: N.Bridgen to Lanfine 959S

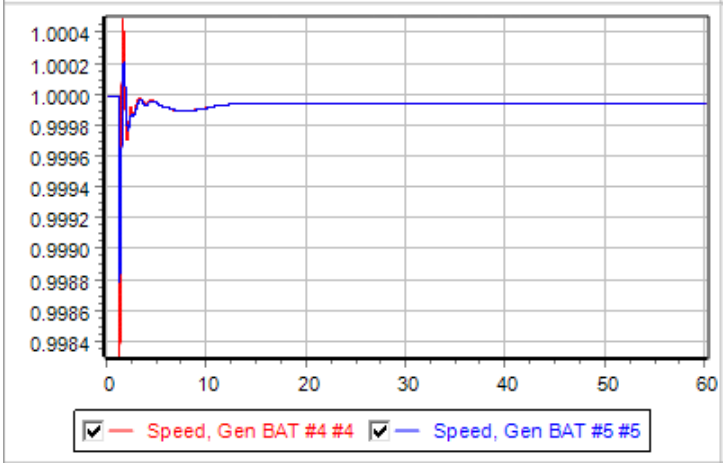
Study Case:
Scenario 5 (2022SL)

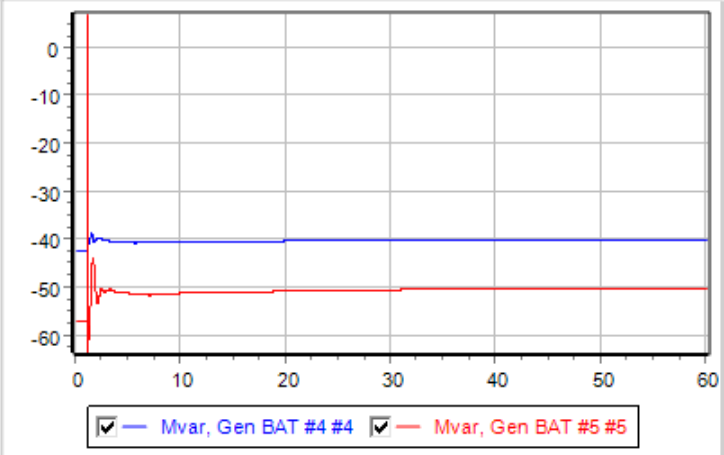
December 04, 2020 19:35:35

Battle River







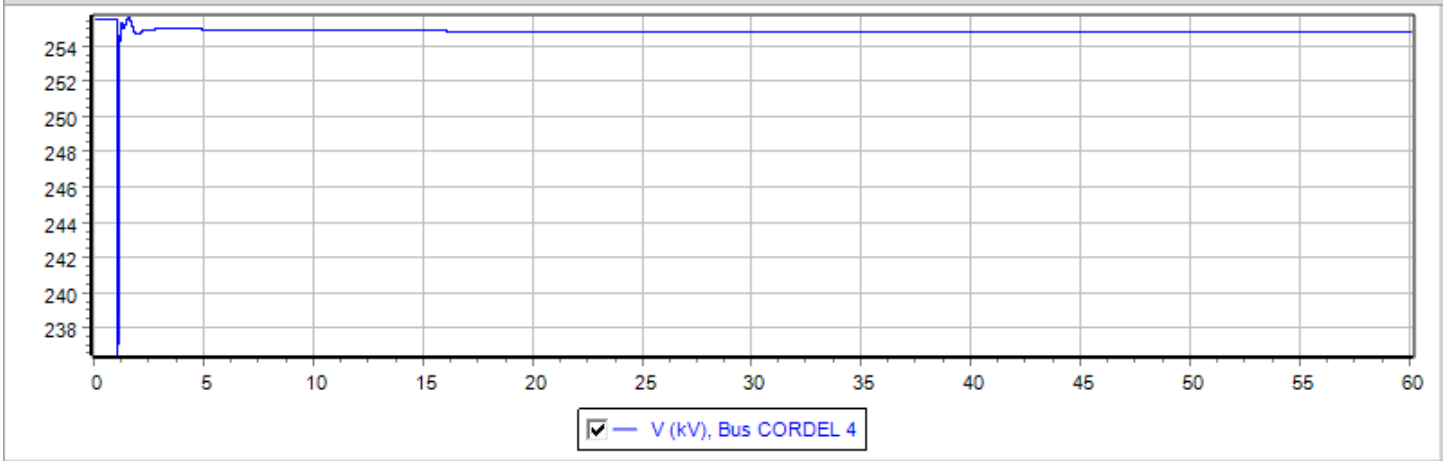


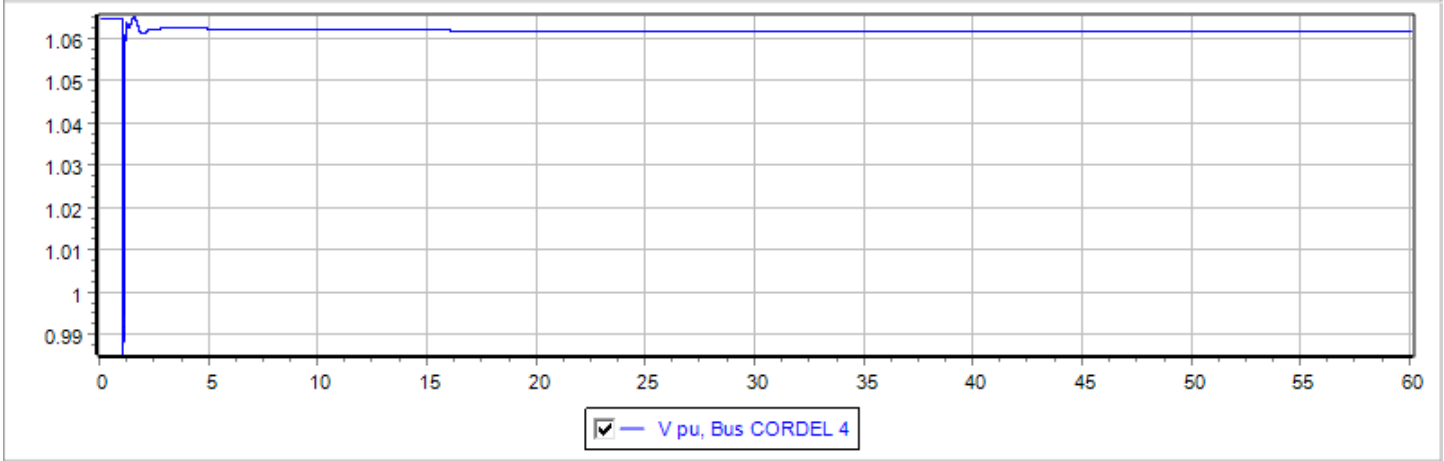
Contingency:
9L51: N.Bridgen to Pemukan 932S

Study Case:
Scenario 5 (2022SL)

December 04, 2020 18:38:57

Cordel 755S Voltages



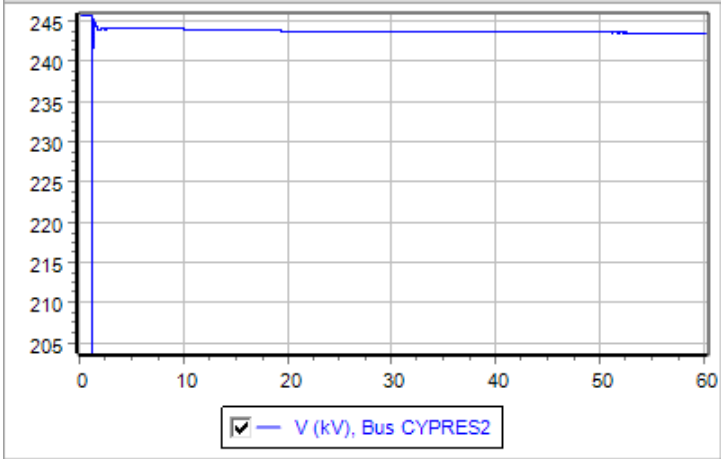


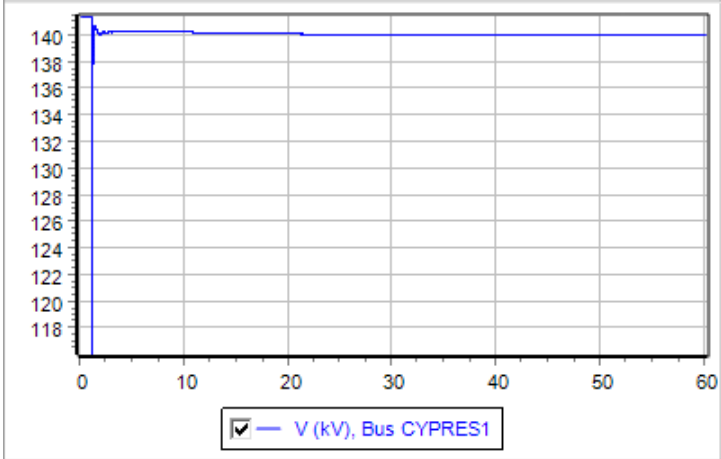
Contingency:
9L51: N.Bridgen to Pemukan 932S

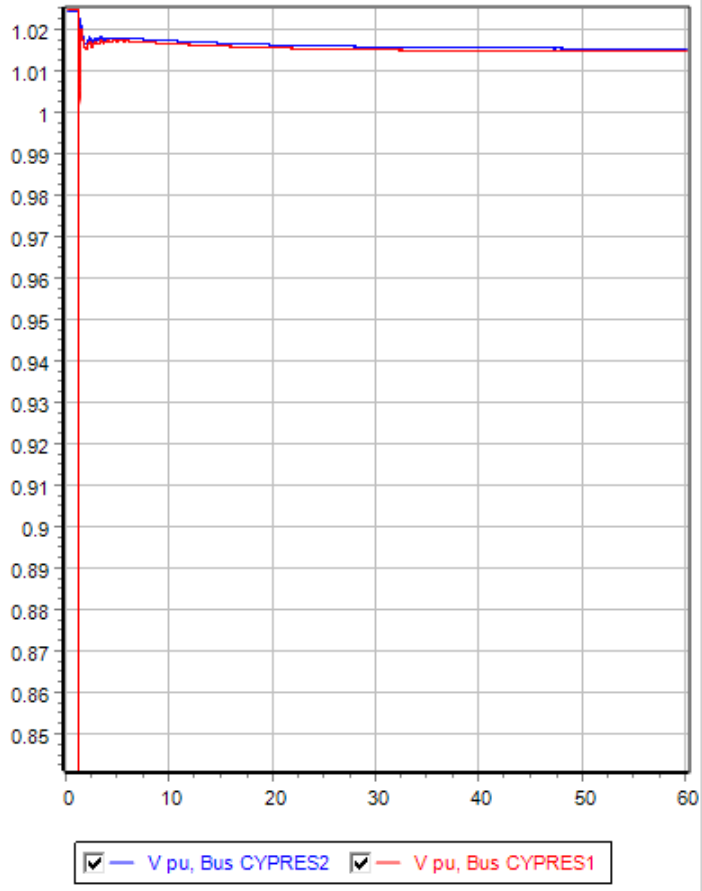
Study Case:
Scenario 5 (2022SL)

December 04, 2020 18:39:00

Cypress 562S Voltages





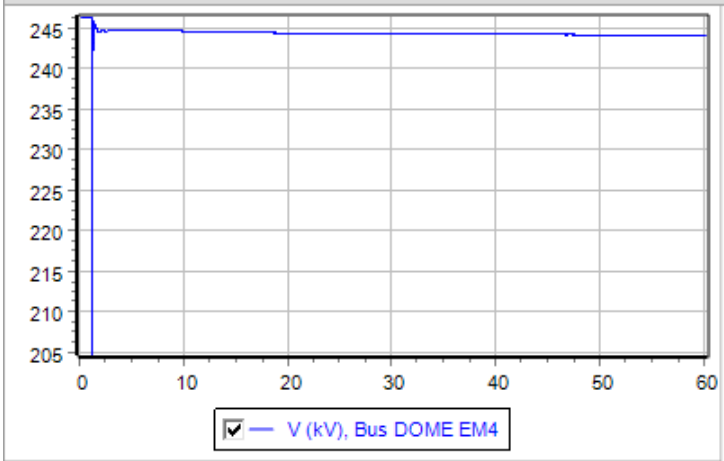


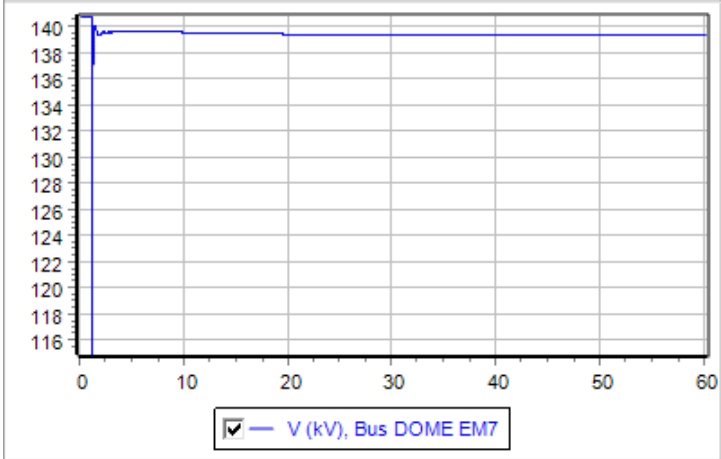
Contingency:
9L51: N.Bridgen to Pemukan 932S

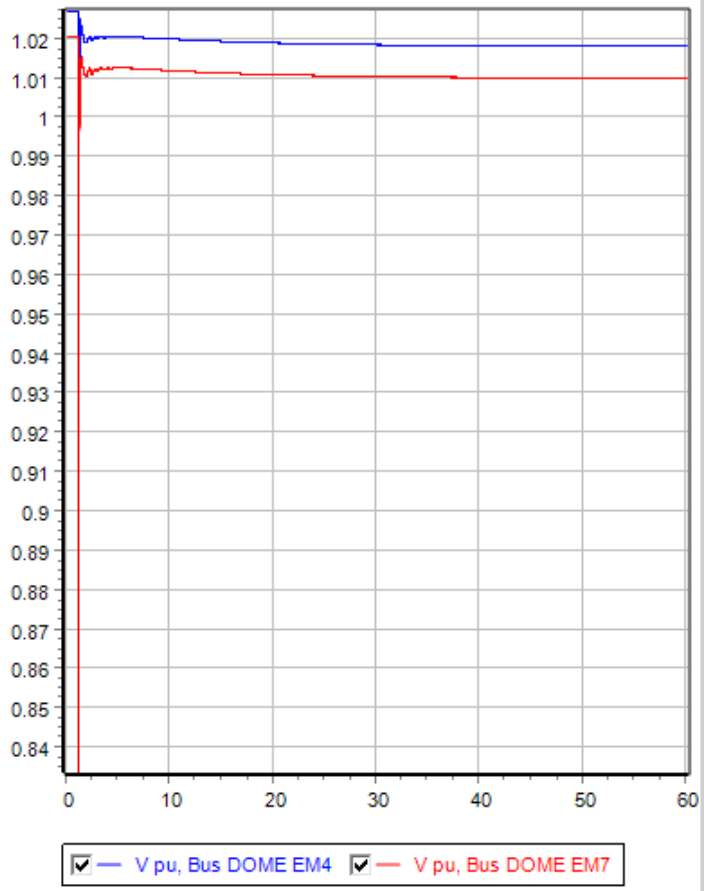
Study Case:
Scenario 5 (2022SL)

December 04, 2020 18:39:00

Dome 163S Voltages





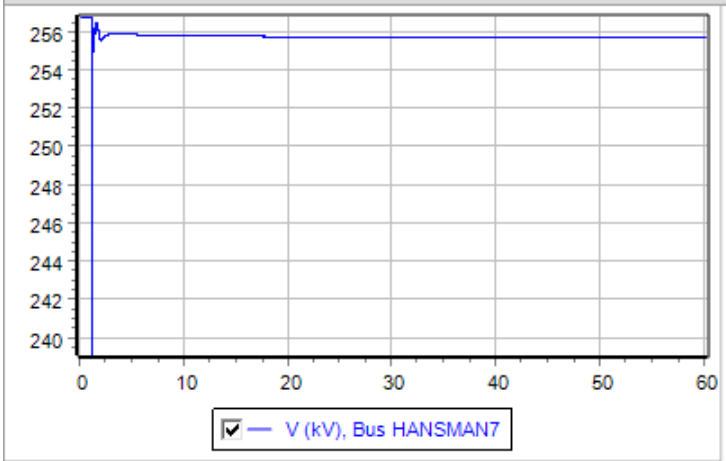


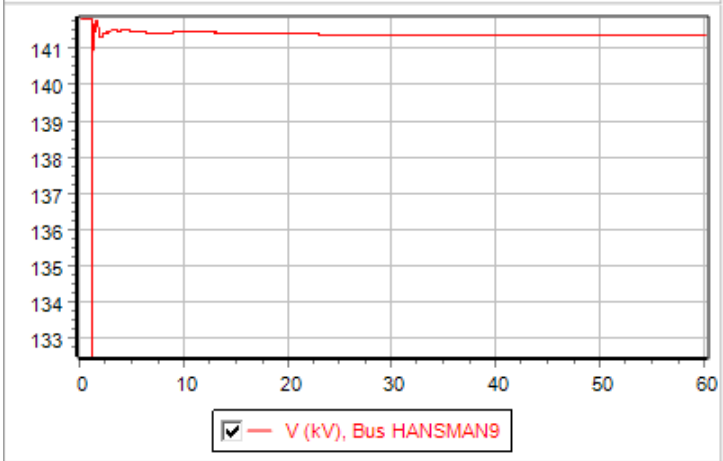
Contingency:
9L51: N.Bridgen to Pemukan 932S

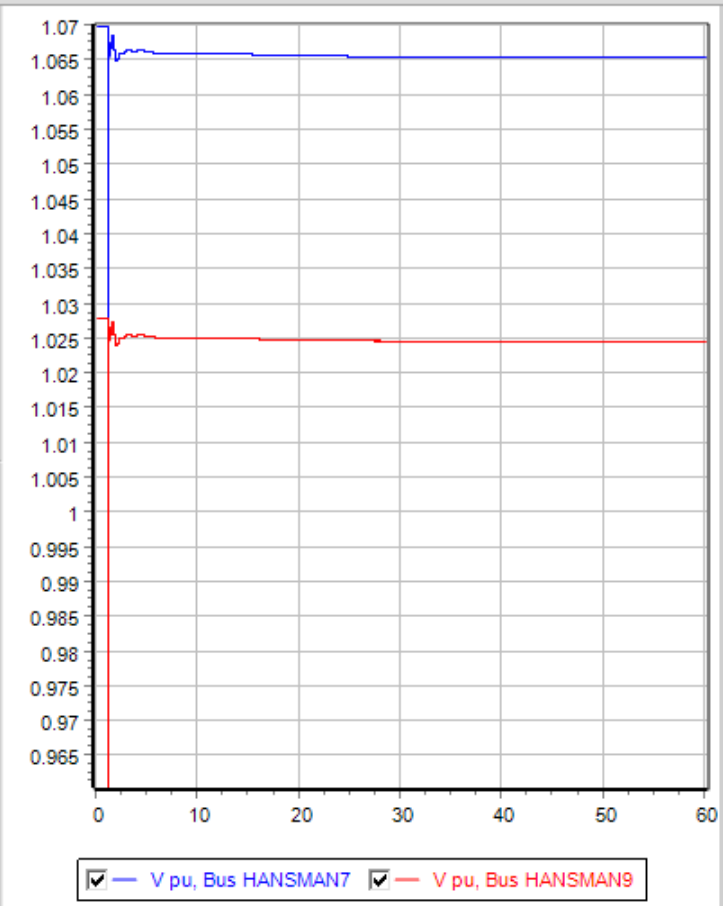
Study Case:
Scenario 5 (2022SL)

December 04, 2020 18:38:59

Hansman Lake 650S Voltages





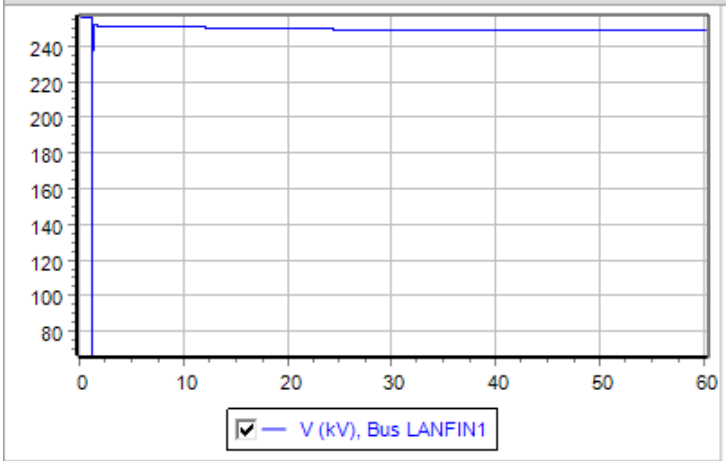


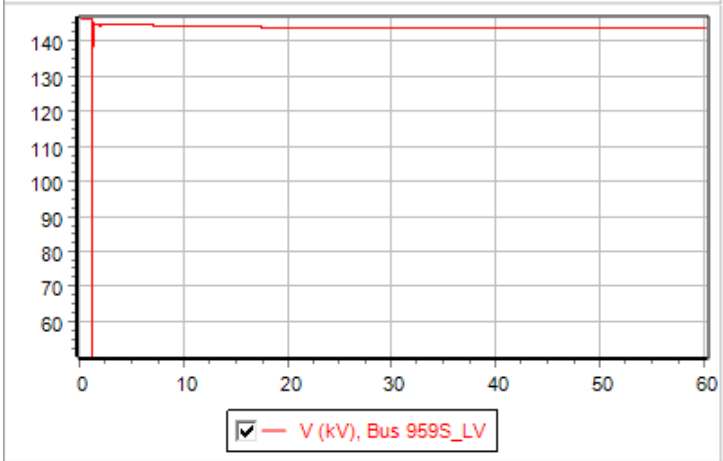
Contingency:
9L51: N.Bridgen to Pemukan 932S

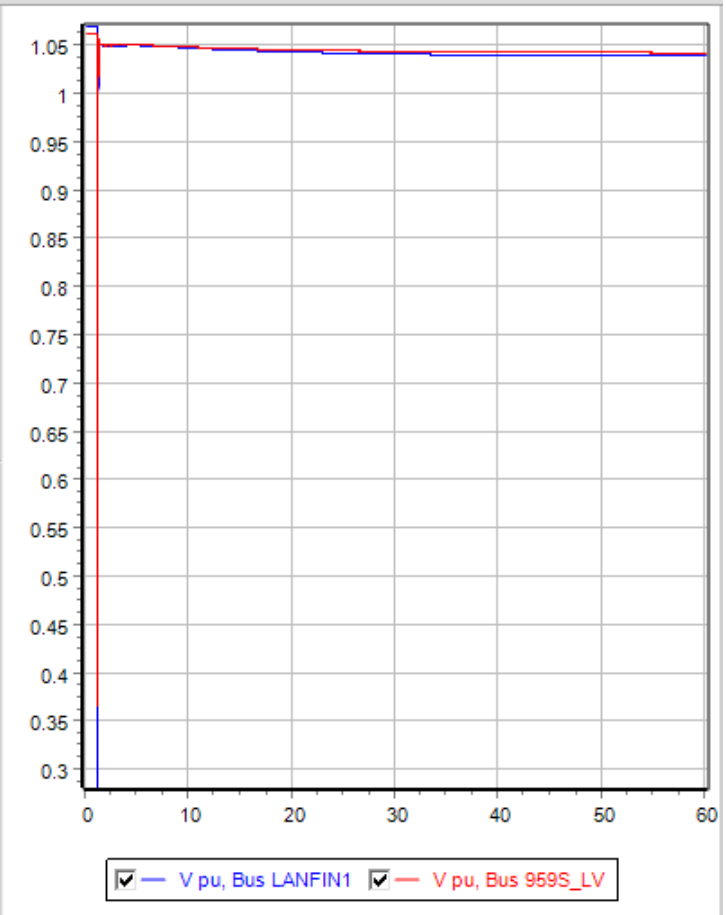
Study Case:
Scenario 5 (2022SL)

December 04, 2020 18:38:59

Lanfine 959S Voltages





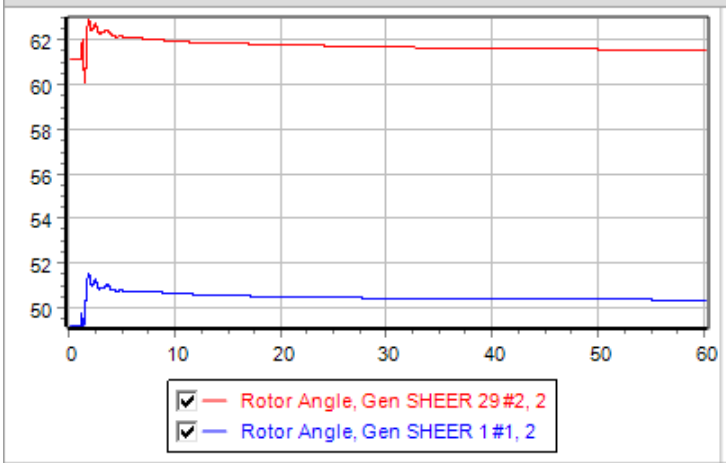


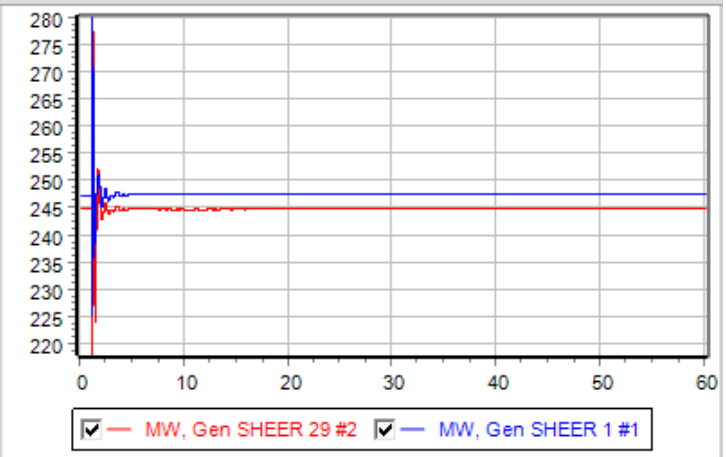
Contingency:
9L51: N.Bridgen to Pemukan 932S

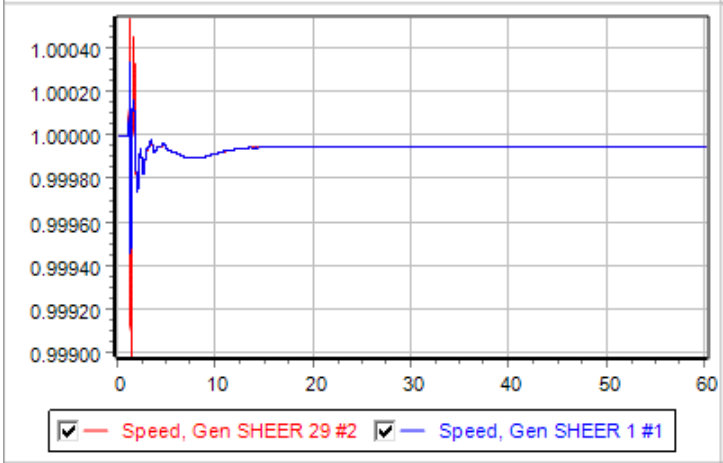
Study Case:
Scenario 5 (2022SL)

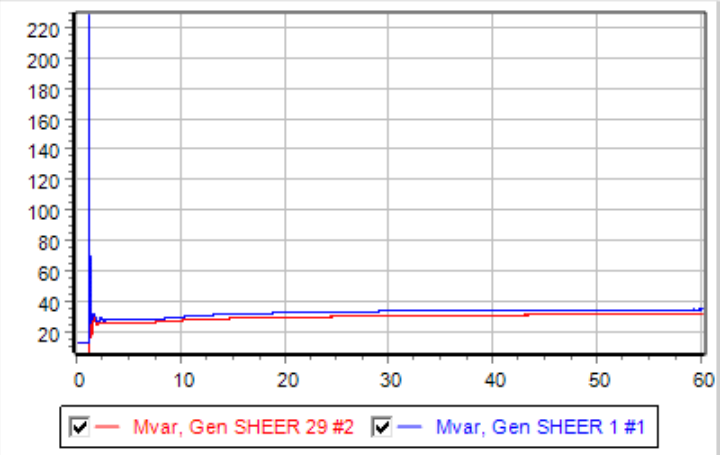
December 04, 2020 18:38:58

Sheerness







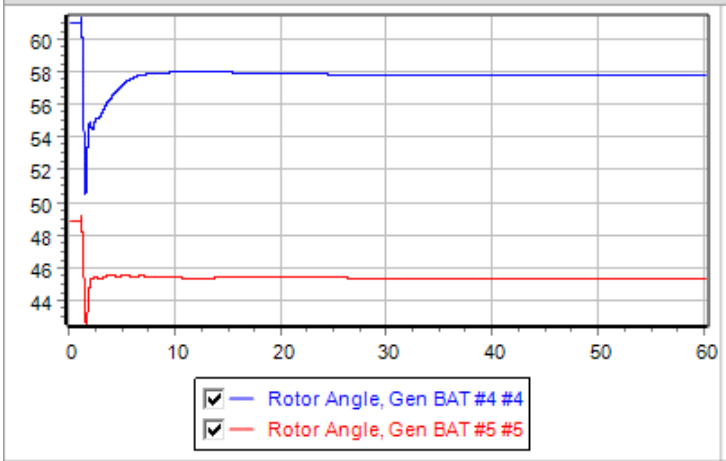


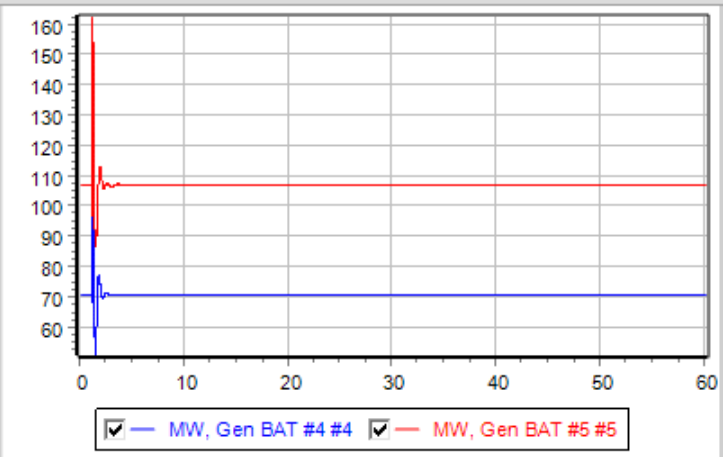
Contingency:
9L51: N.Bridgen to Pemukan 932S

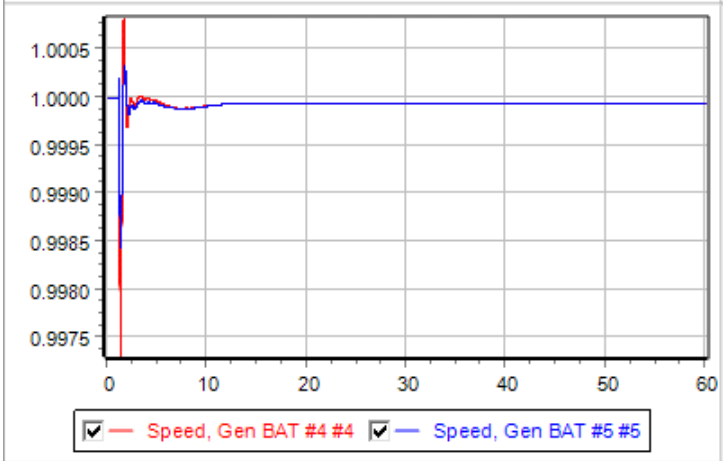
Study Case:
Scenario 5 (2022SL)

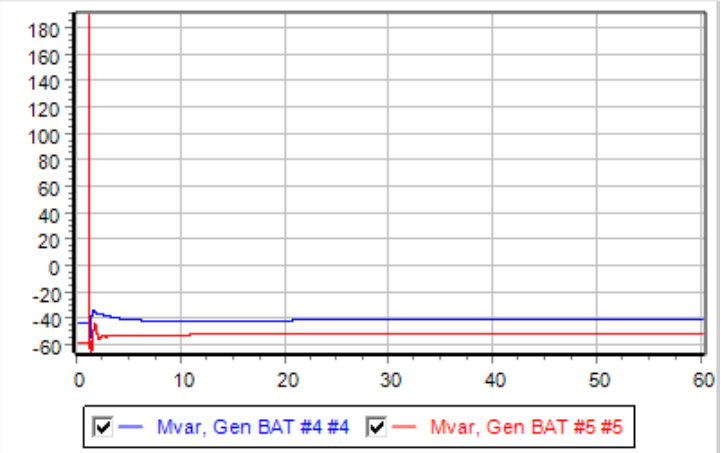
December 04, 2020 18:38:57

Battle River







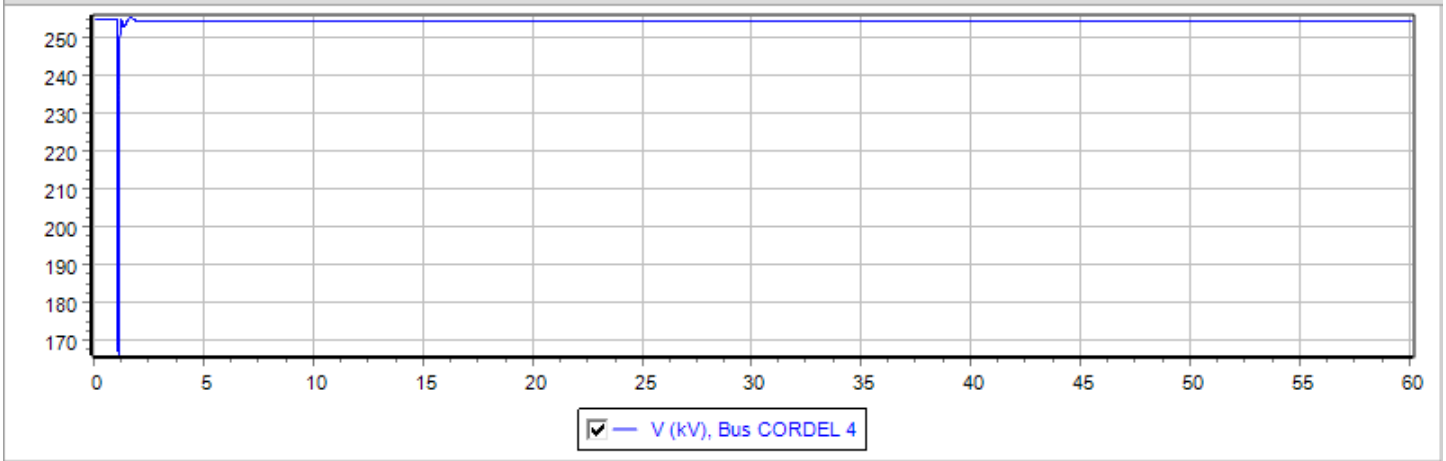


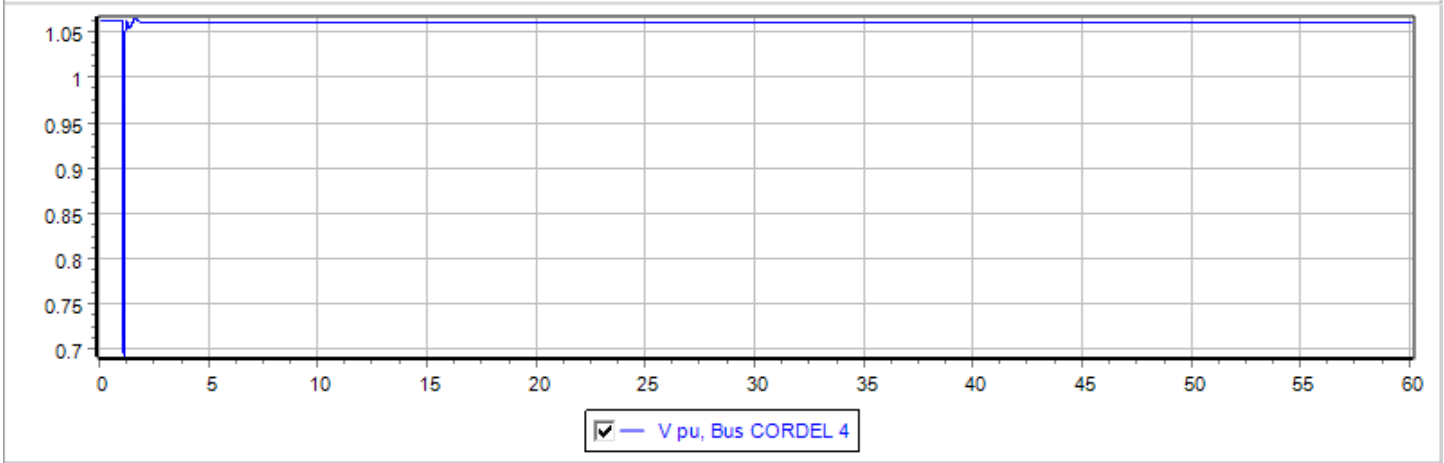
Contingency:
9L51: Pemukan 932S to N.Bridgen

Study Case:
Scenario 5 (2022SL)

December 04, 2020 18:41:46

Cordel 755S Voltages



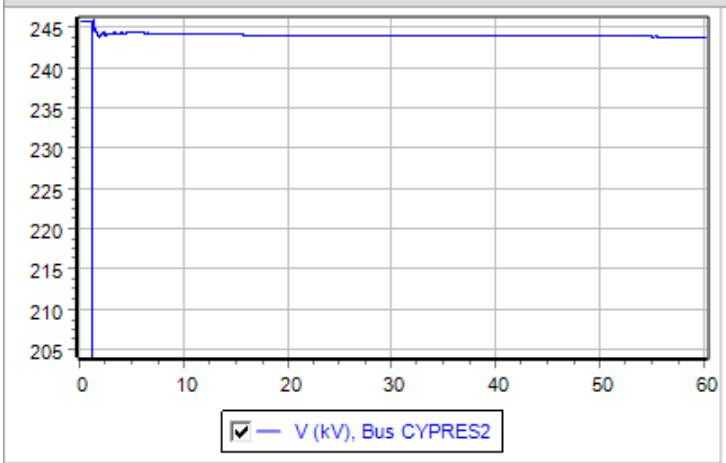


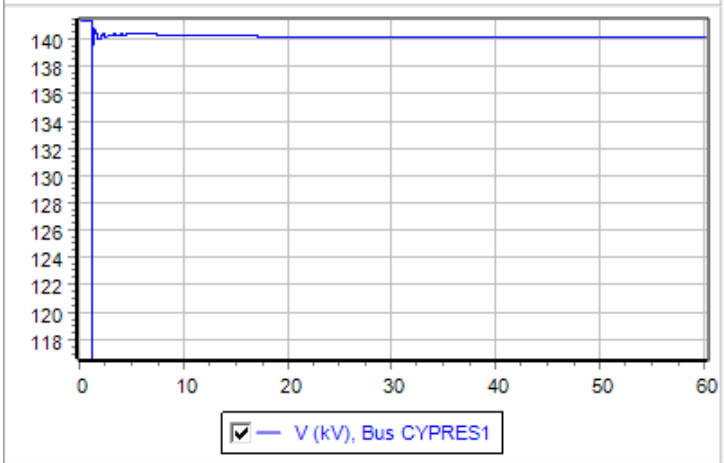
Contingency:
9L51: Pemukan 932S to N.Bridgen

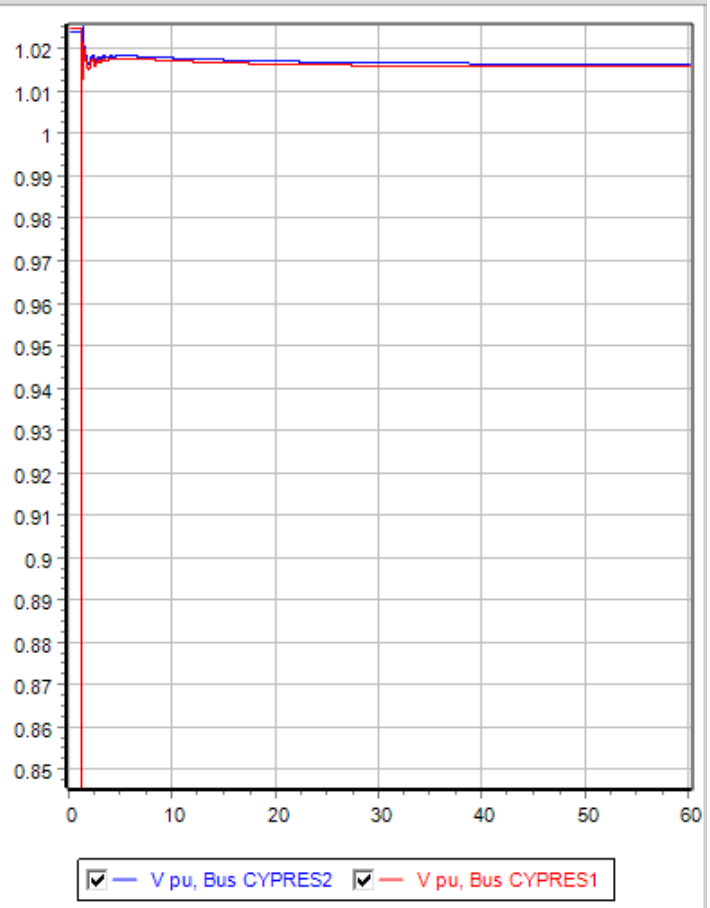
Study Case:
Scenario 5 (2022SL)

December 04, 2020 18:41:49

Cypress 562S Voltages





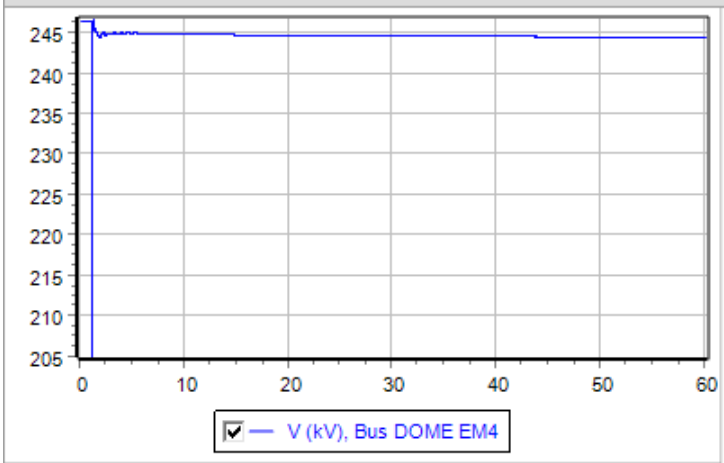


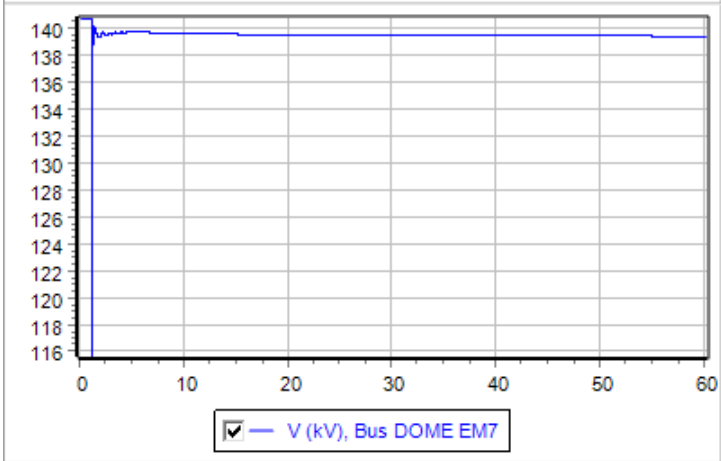
Contingency:
9L51: Pemukan 932S to N.Bridgen

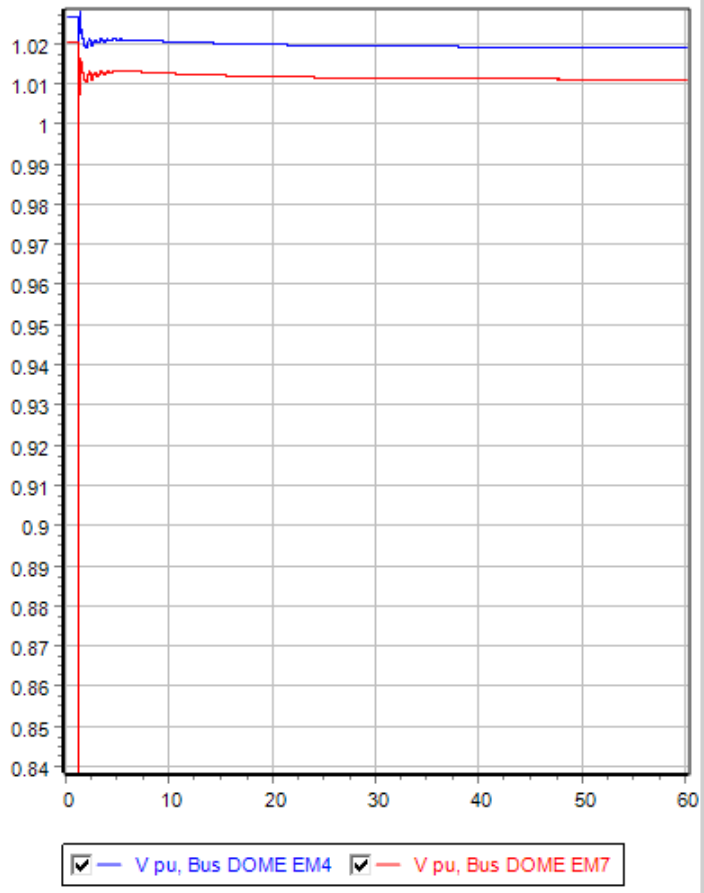
Study Case:
Scenario 5 (2022SL)

December 04, 2020 18:41:48

Dome 163S Voltages





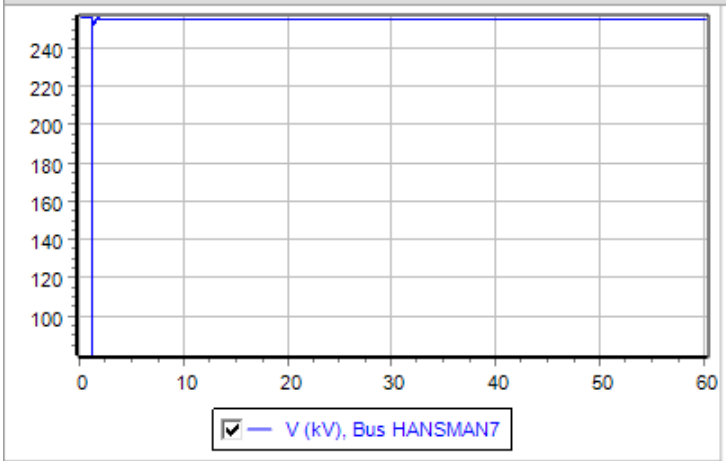


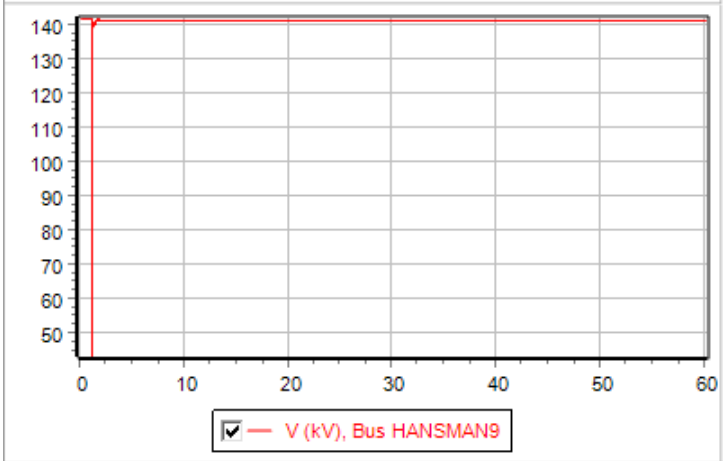
Contingency:
9L51: Pemukan 932S to N.Bridgen

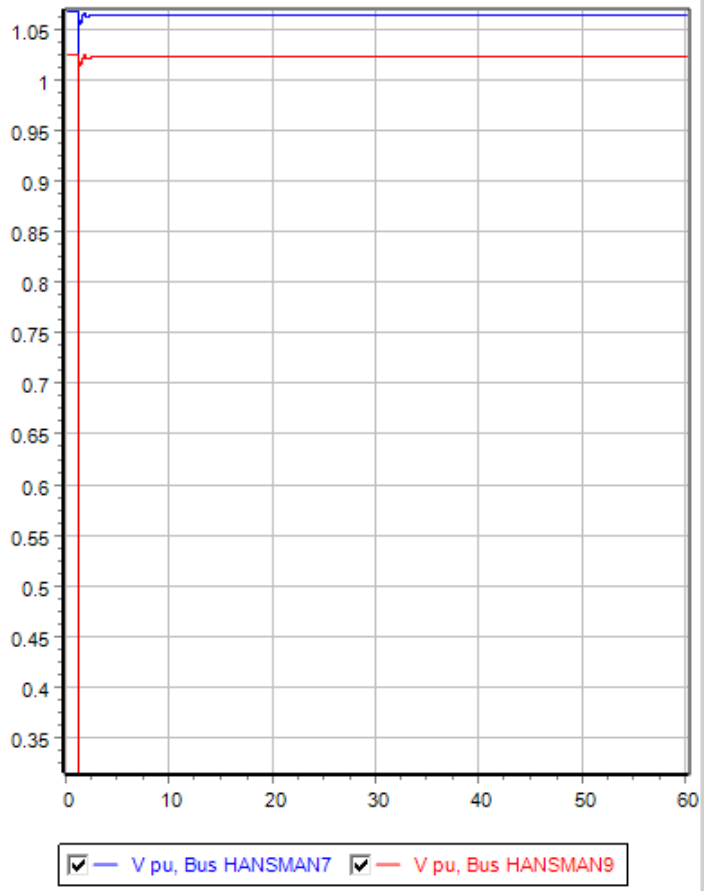
Study Case:
Scenario 5 (2022SL)

December 04, 2020 18:41:47

Hansman Lake 650S Voltages





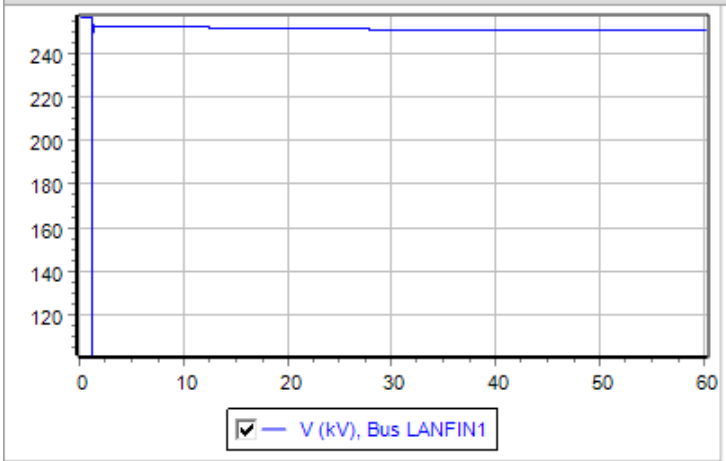


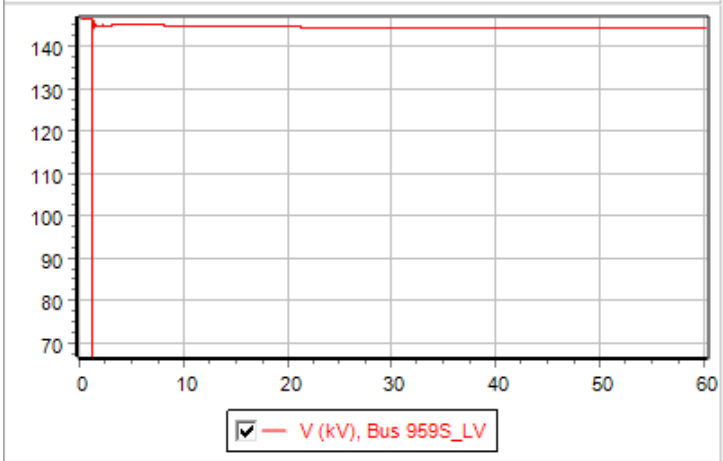
Contingency:
9L51: Pemukan 932S to N.Bridgen

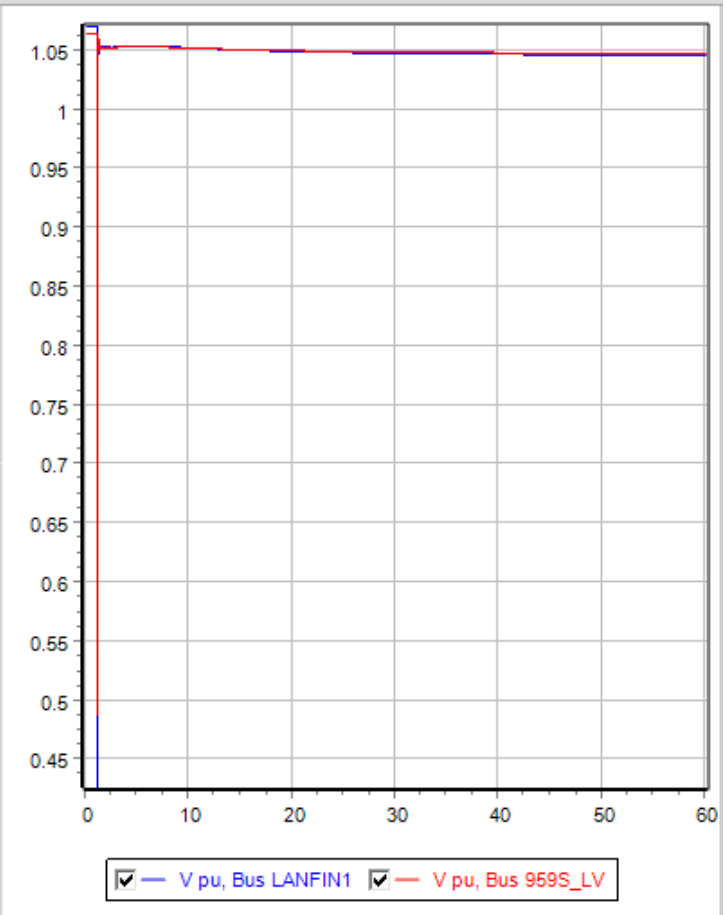
Study Case:
Scenario 5 (2022SL)

December 04, 2020 18:41:47

Lanfine 959S Voltages





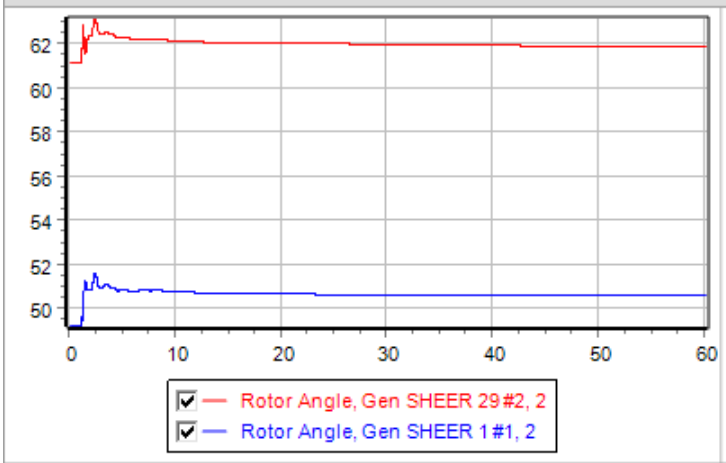


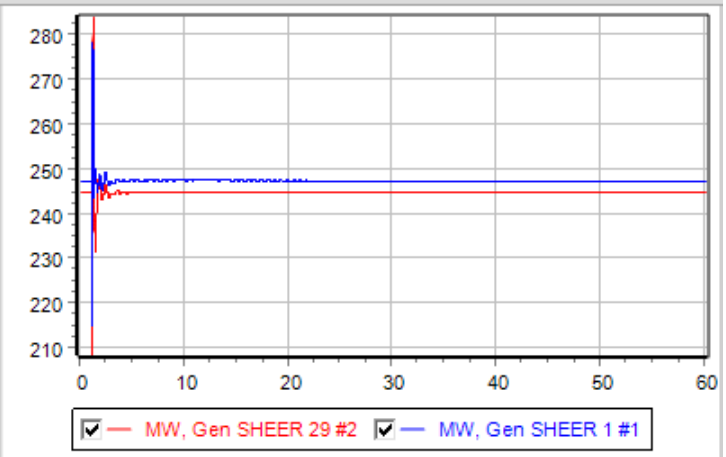
Contingency:
9L51: Pemukan 932S to N.Bridgen

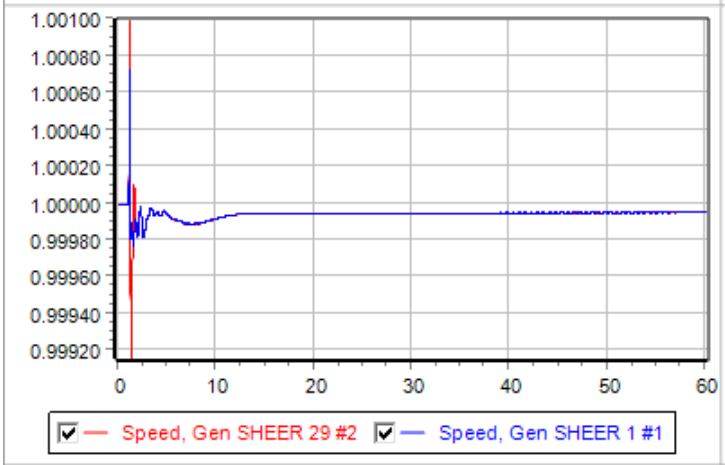
Study Case:
Scenario 5 (2022SL)

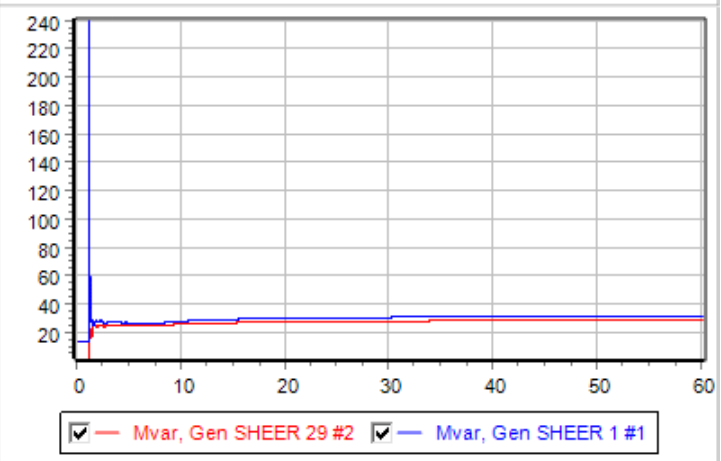
December 04, 2020 18:41:46

Sheerness







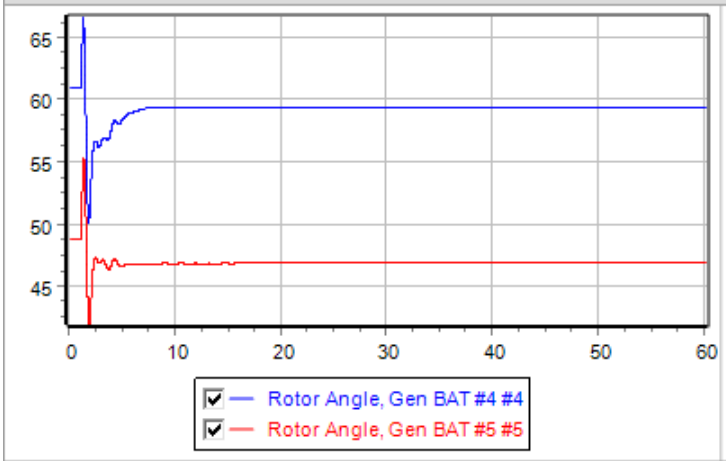


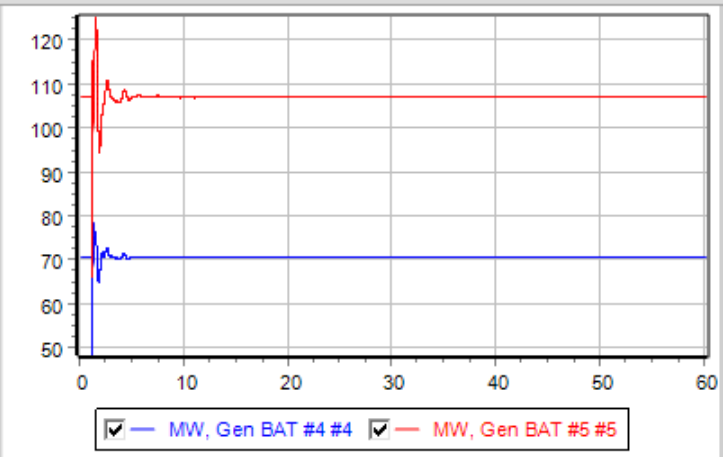
Contingency:
9L51: Pemukan 932S to N.Bridgen

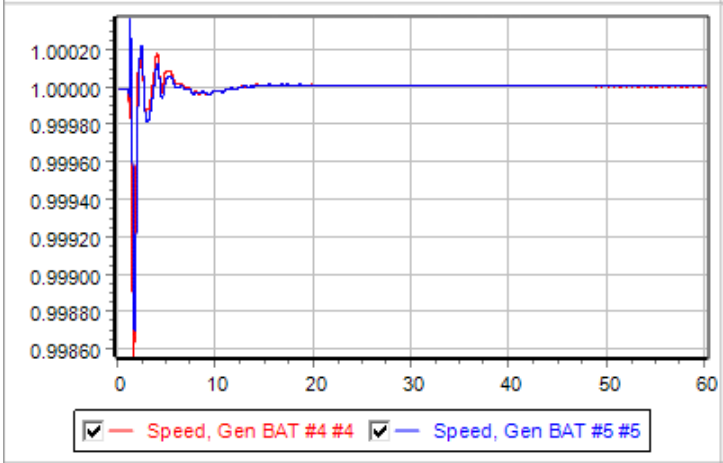
Study Case:
Scenario 5 (2022SL)

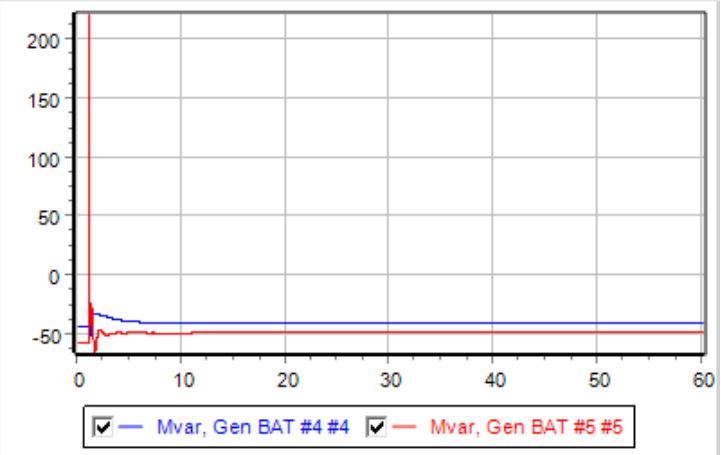
December 04, 2020 18:41:45

Battle River







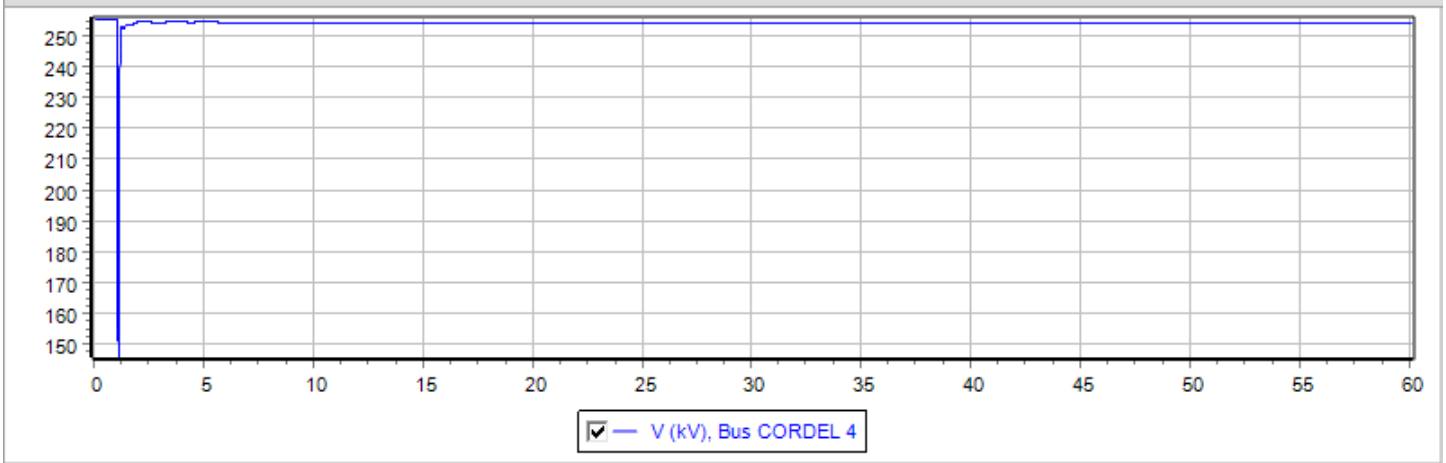


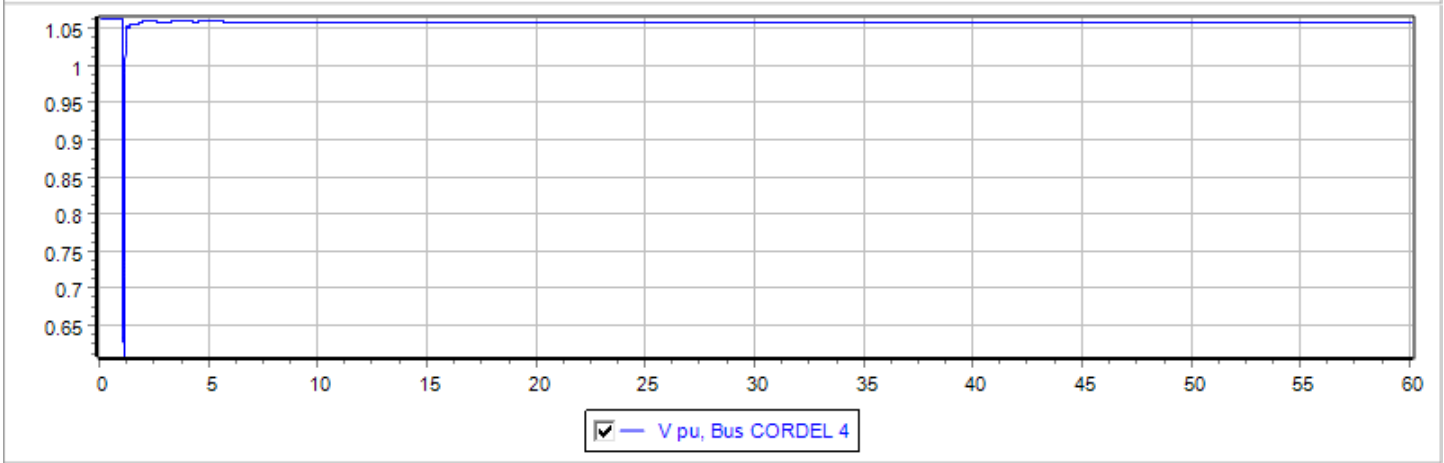
Contingency:
9L59: Anderson 801S to Tinchebray 972S

Study Case:
Scenario 5 (2022SL)

December 04, 2020 18:45:15

Cordel 755S Voltages



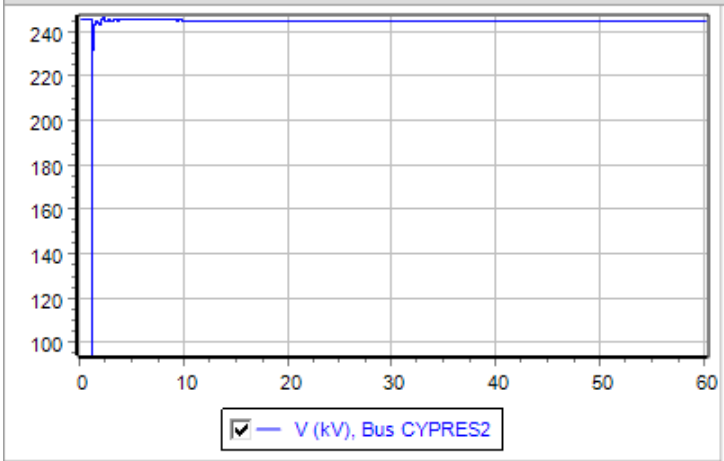


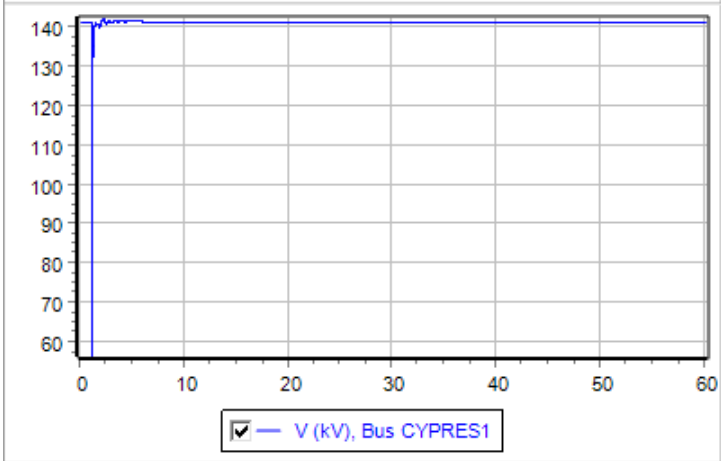
Contingency:
9L59: Anderson 801S to Tinchebray 972S

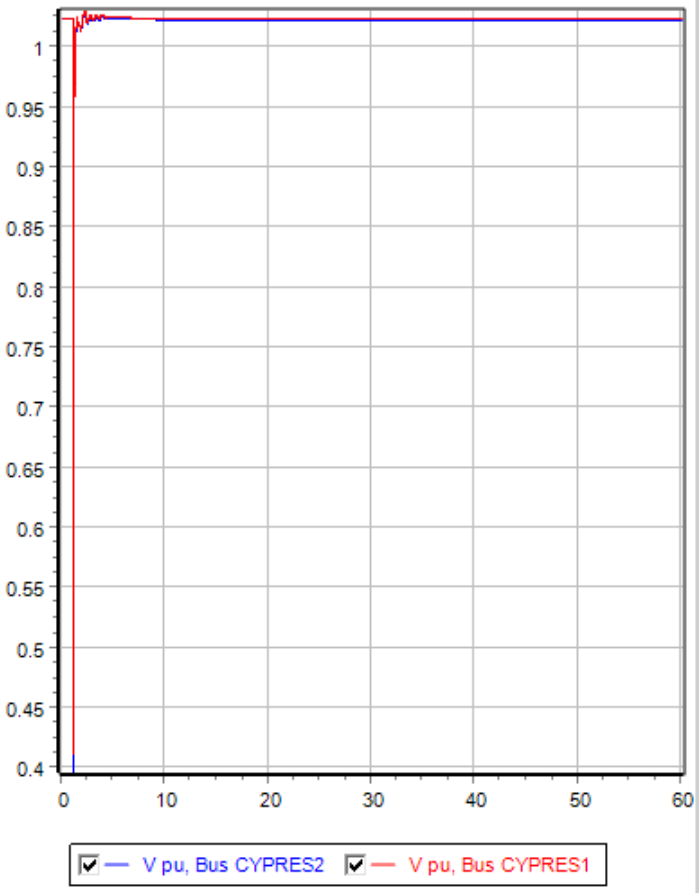
Study Case:
Scenario 5 (2022SL)

December 04, 2020 18:45:17

Cypress 562S Voltages





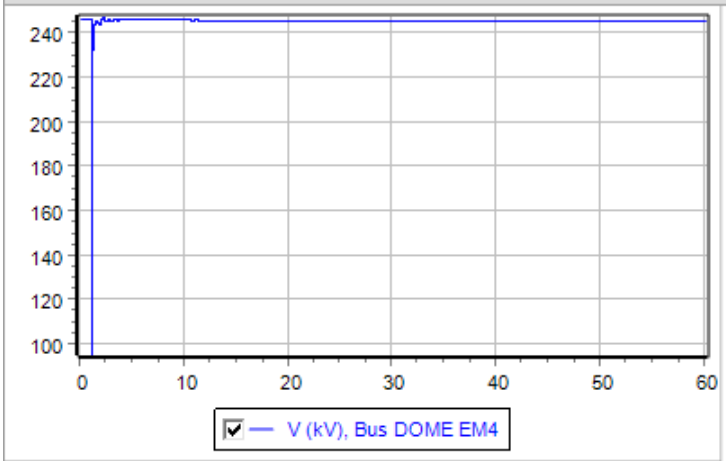


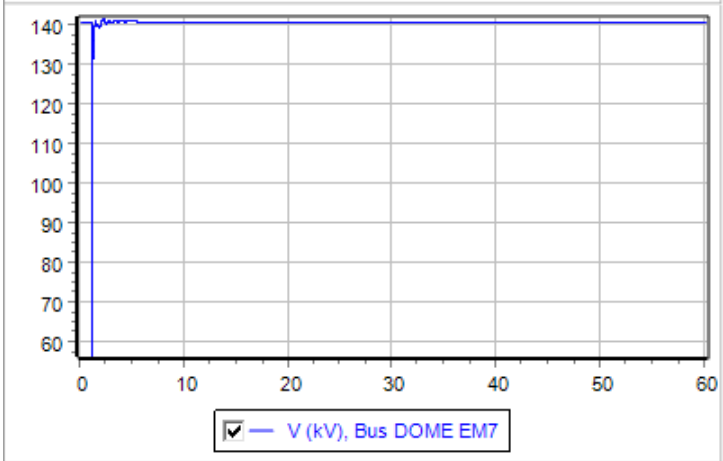
Contingency:
9L59: Anderson 801S to Tinchebray 972S

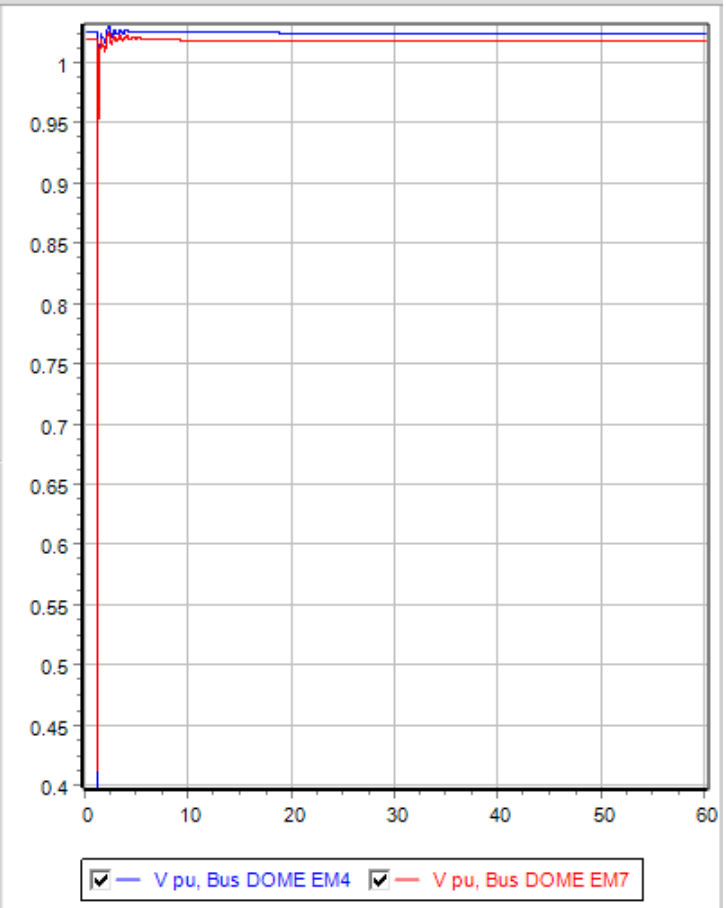
Study Case:
Scenario 5 (2022SL)

December 04, 2020 18:45:17

Dome 163S Voltages





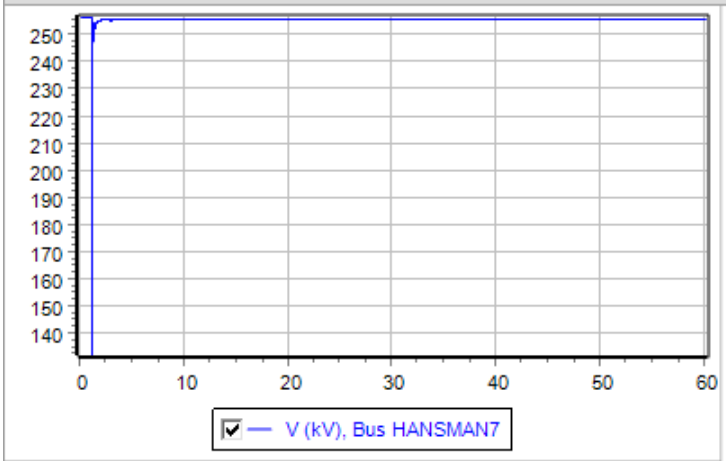


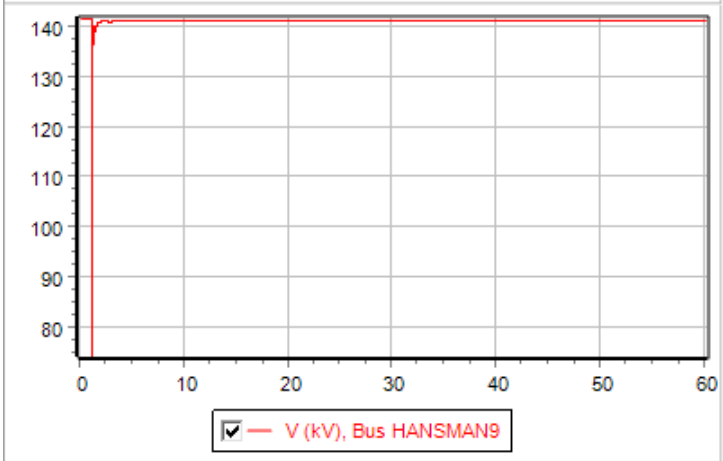
Contingency:
9L59: Anderson 801S to Tinchebray 972S

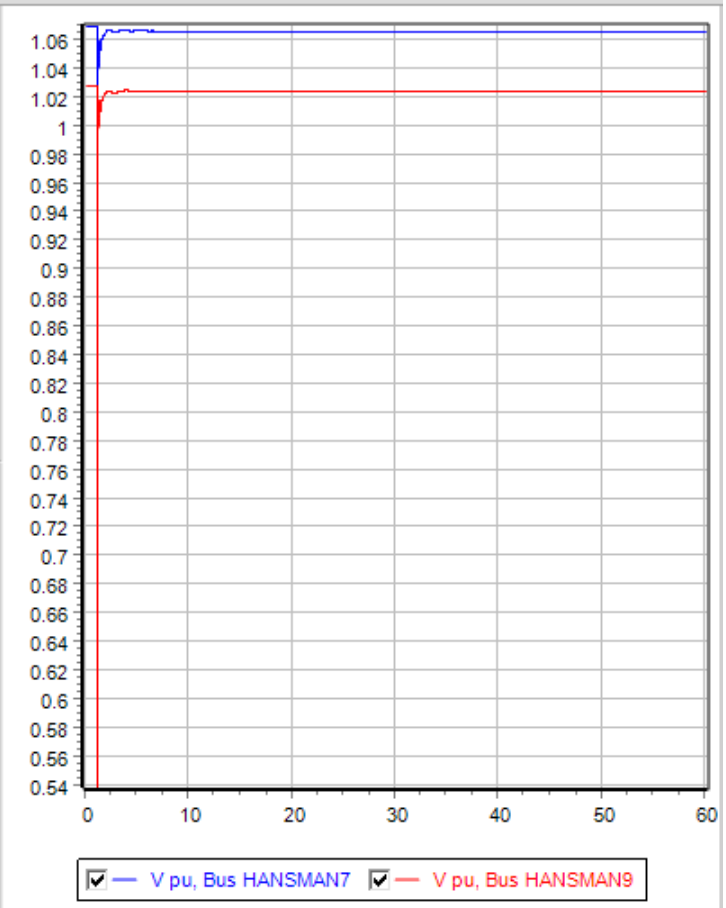
Study Case:
Scenario 5 (2022SL)

December 04, 2020 18:45:16

Hansman Lake 650S Voltages





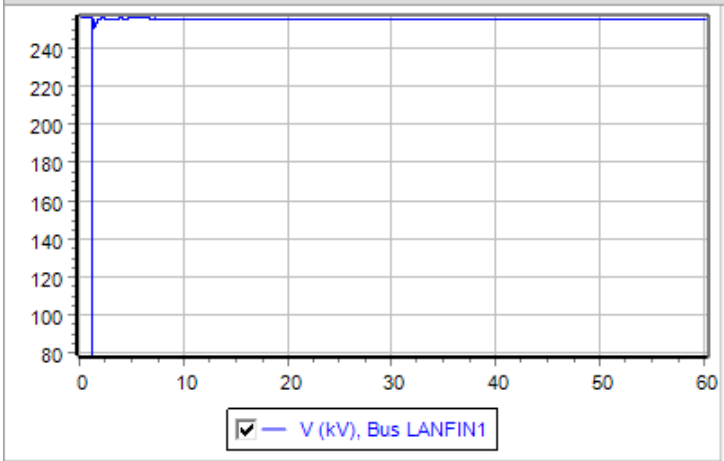


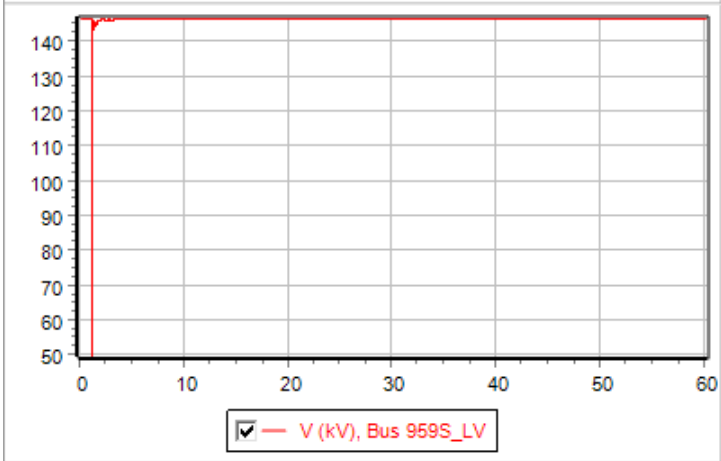
Contingency:
9L59: Anderson 801S to Tinchebray 972S

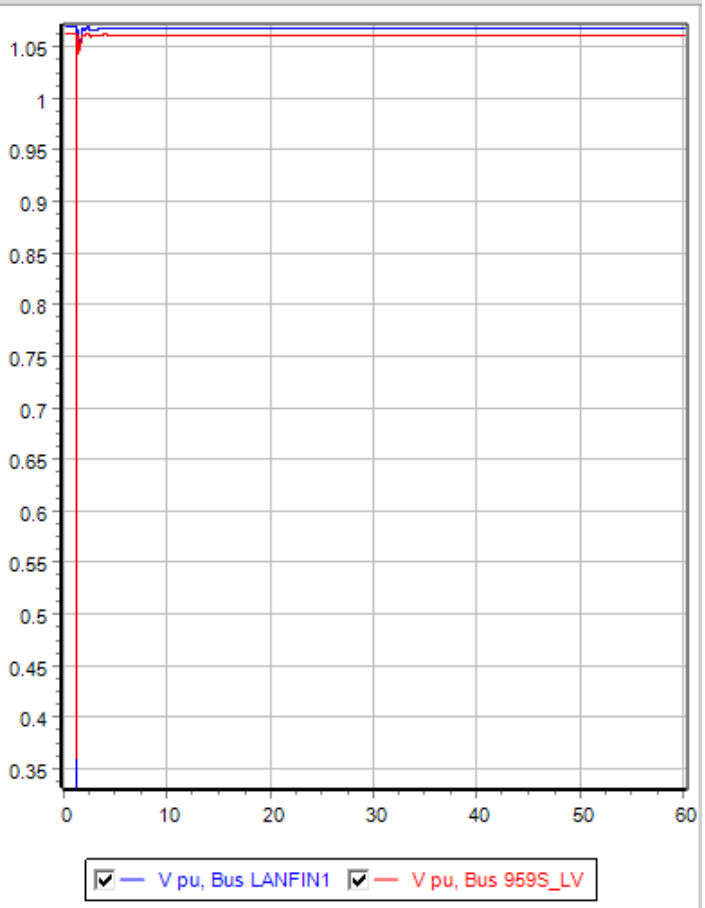
Study Case:
Scenario 5 (2022SL)

December 04, 2020 18:45:16

Lanfine 959S Voltages





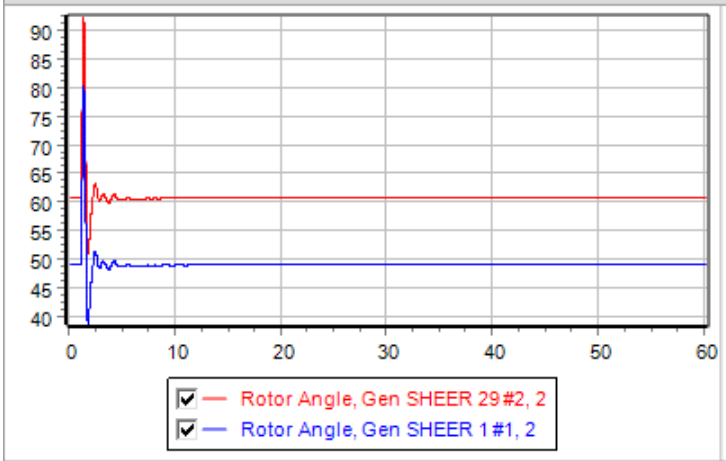


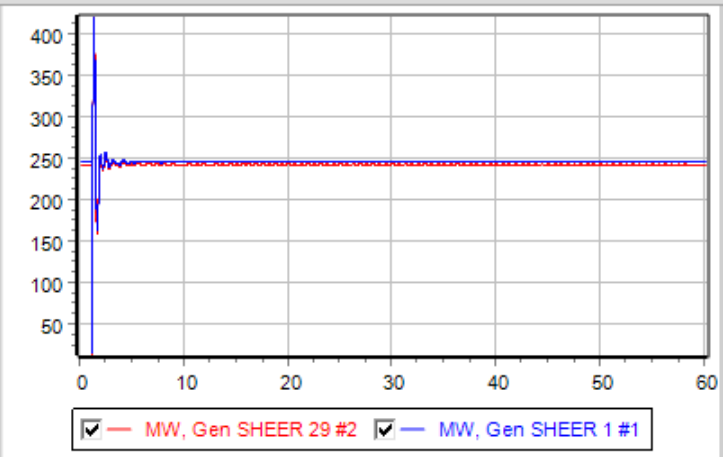
Contingency:
9L59: Anderson 801S to Tinchebray 972S

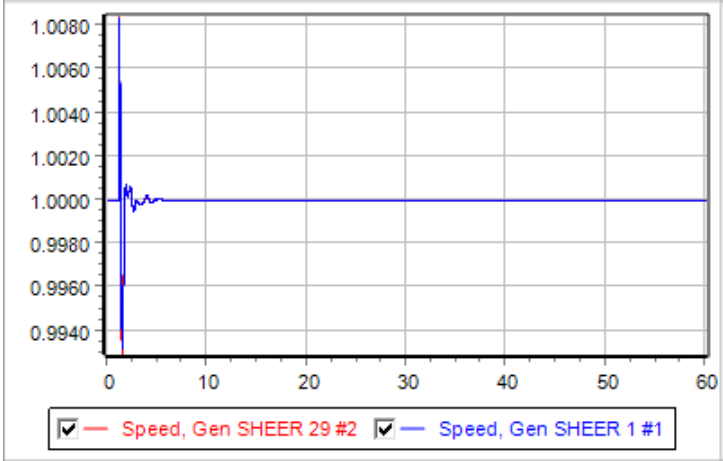
Study Case:
Scenario 5 (2022SL)

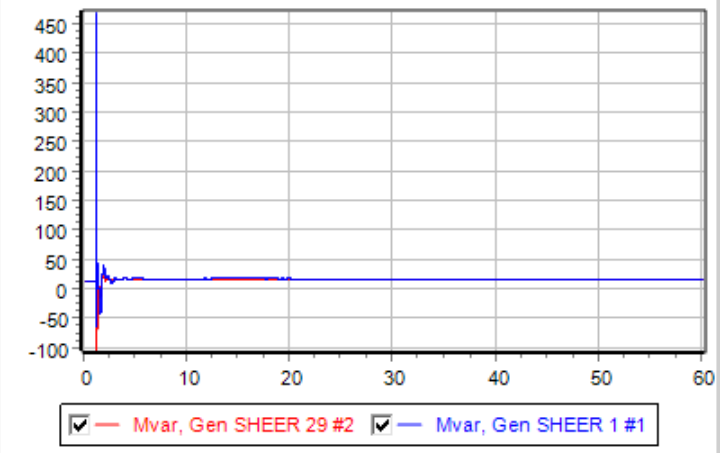
December 04, 2020 18:45:15

Sheerness







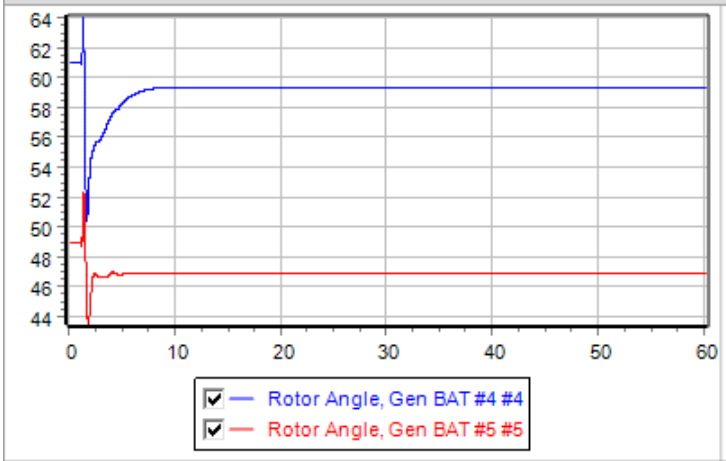


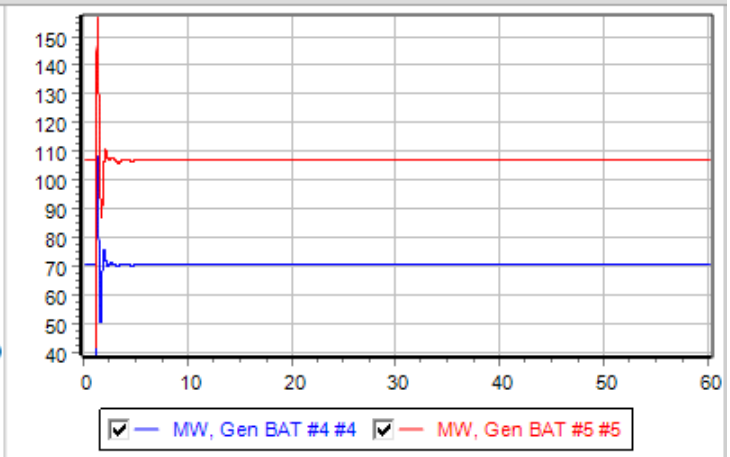
Contingency:
9L59: Anderson 801S to Tinchebray 972S

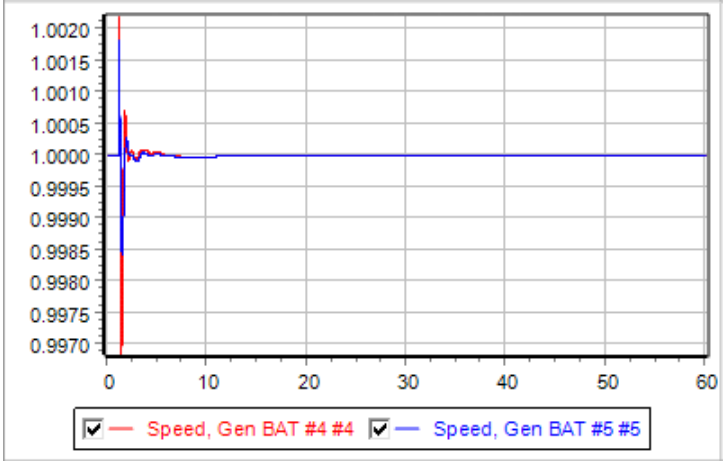
Study Case:
Scenario 5 (2022SL)

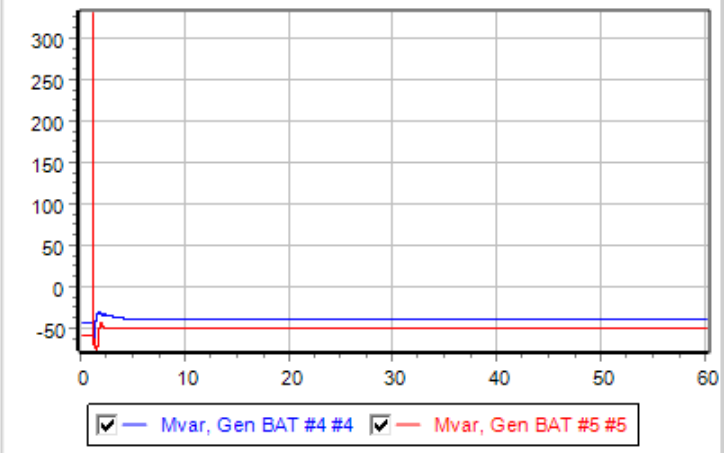
December 04, 2020 18:45:14

Battle River









Contingency:
9L59: Tinchebray 972S to Anderson 801S

Study Case:
Scenario 5 (2022SL)

December 04, 2020 18:48:53

Cordel 755S Voltages

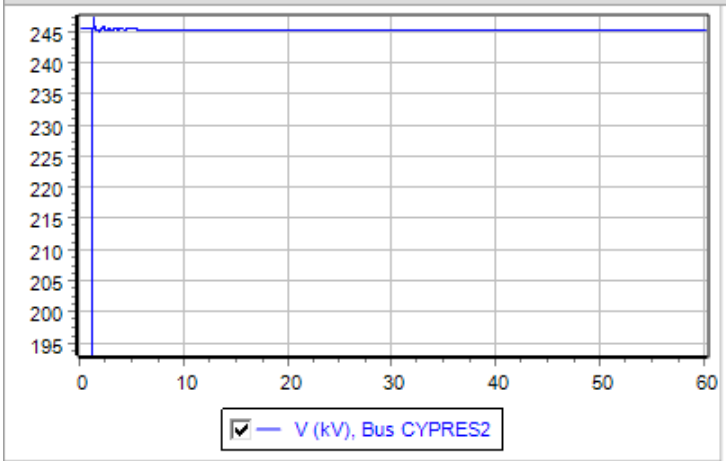


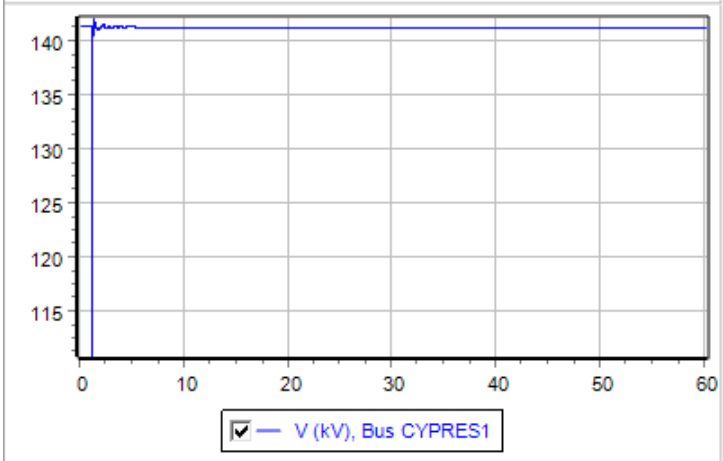
Contingency:
9L59: Tinchebray 972S to Anderson 801S

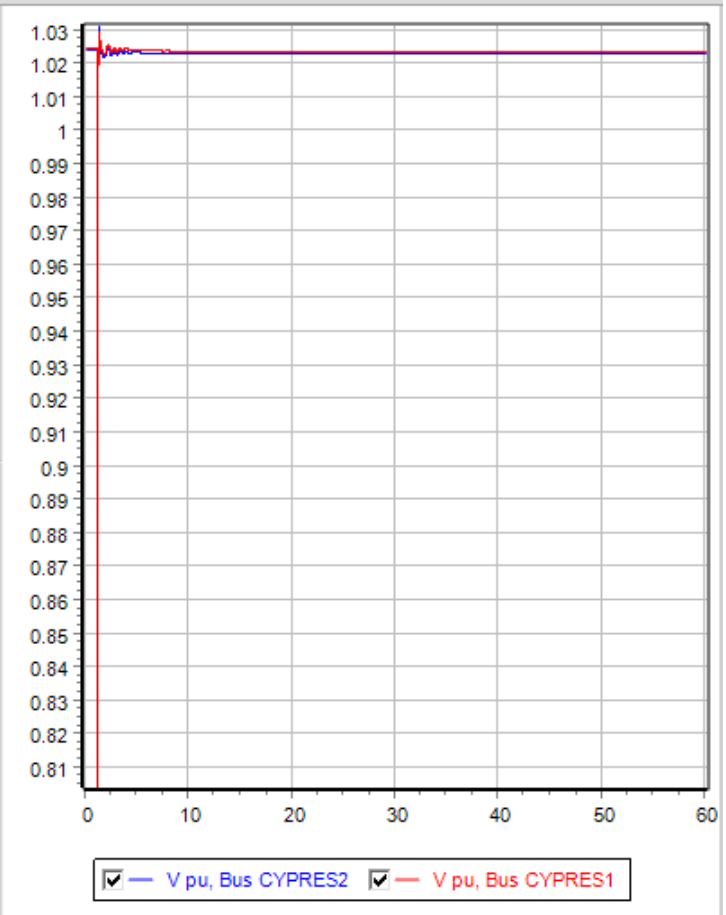
Study Case:
Scenario 5 (2022SL)

December 04, 2020 18:48:55

Cypress 562S Voltages





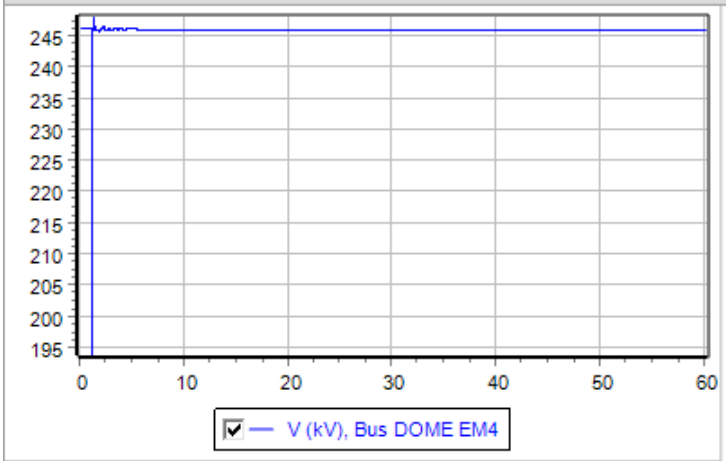


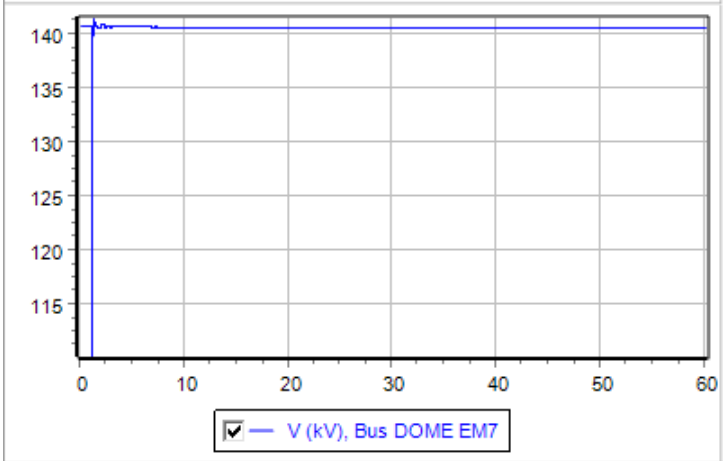
Contingency:
9L59: Tinchebray 972S to Anderson 801S

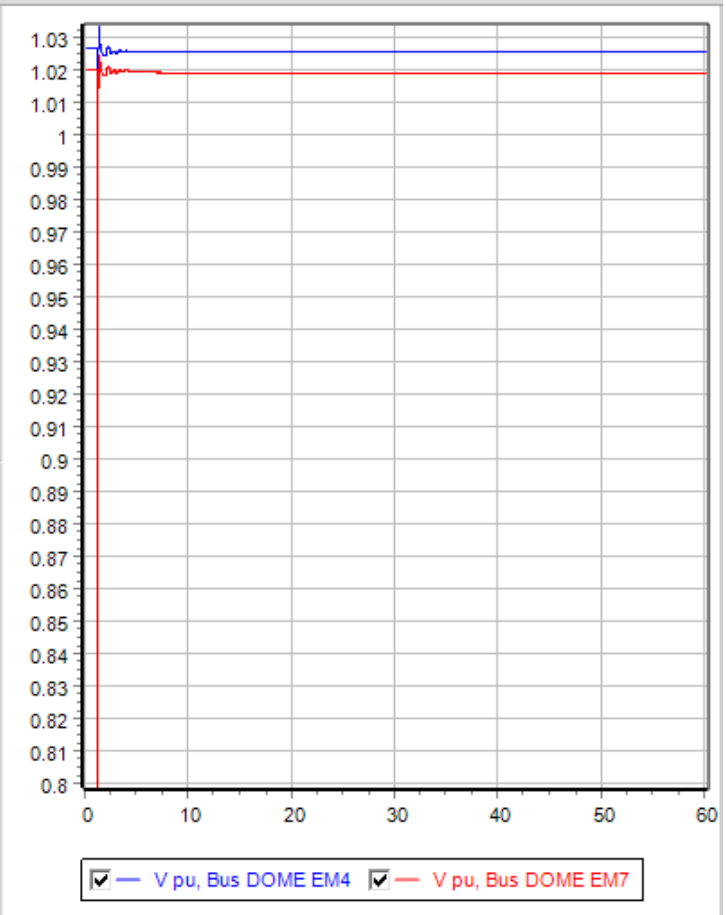
Study Case:
Scenario 5 (2022SL)

December 04, 2020 18:48:55

Dome 163S Voltages





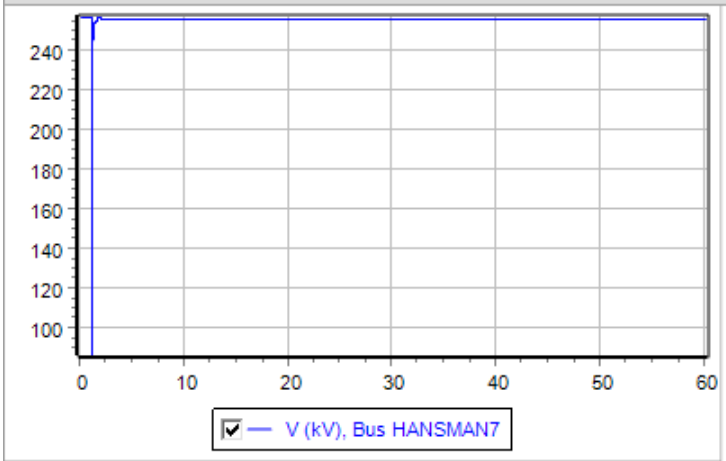


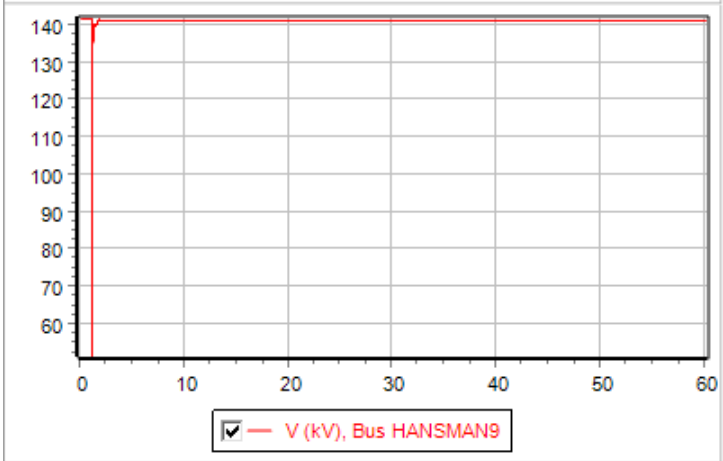
Contingency:
9L59: Tinchebray 972S to Anderson 801S

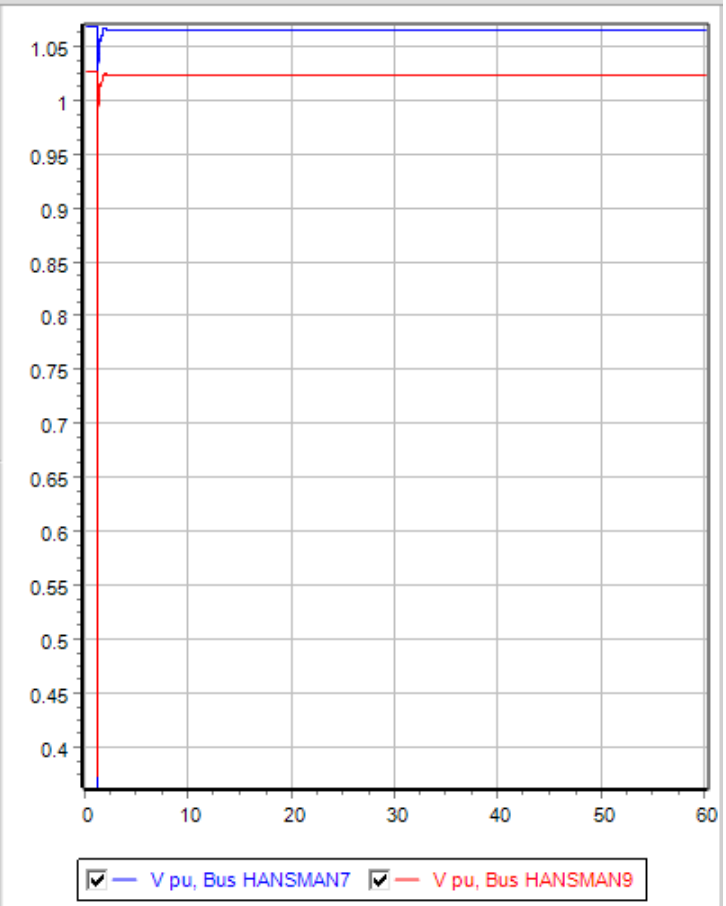
Study Case:
Scenario 5 (2022SL)

December 04, 2020 18:48:54

Hansman Lake 650S Voltages





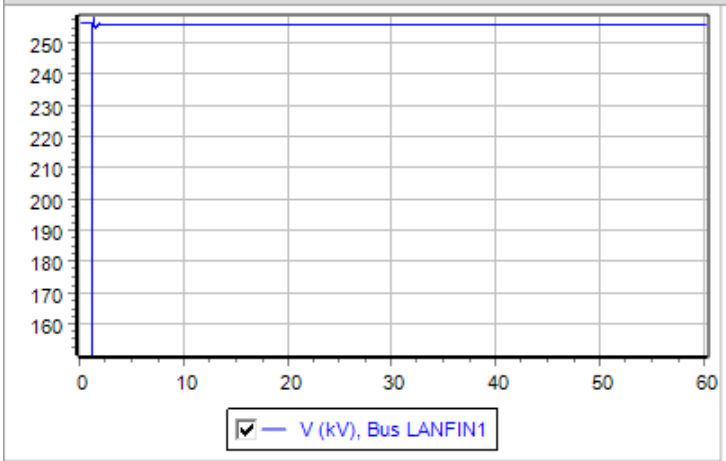


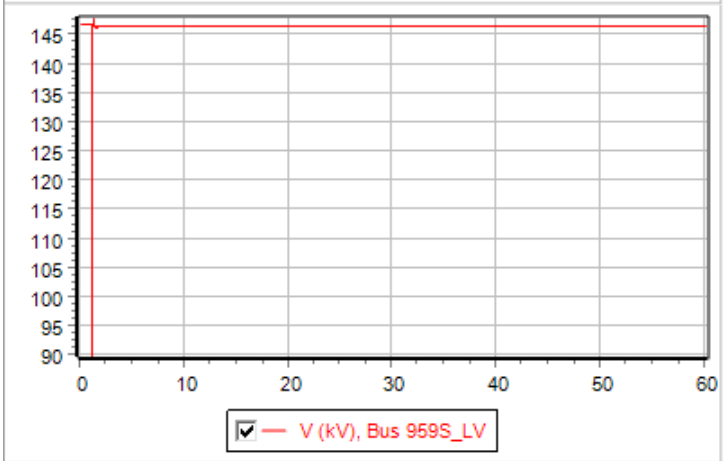
Contingency:
9L59: Tinchebray 972S to Anderson 801S

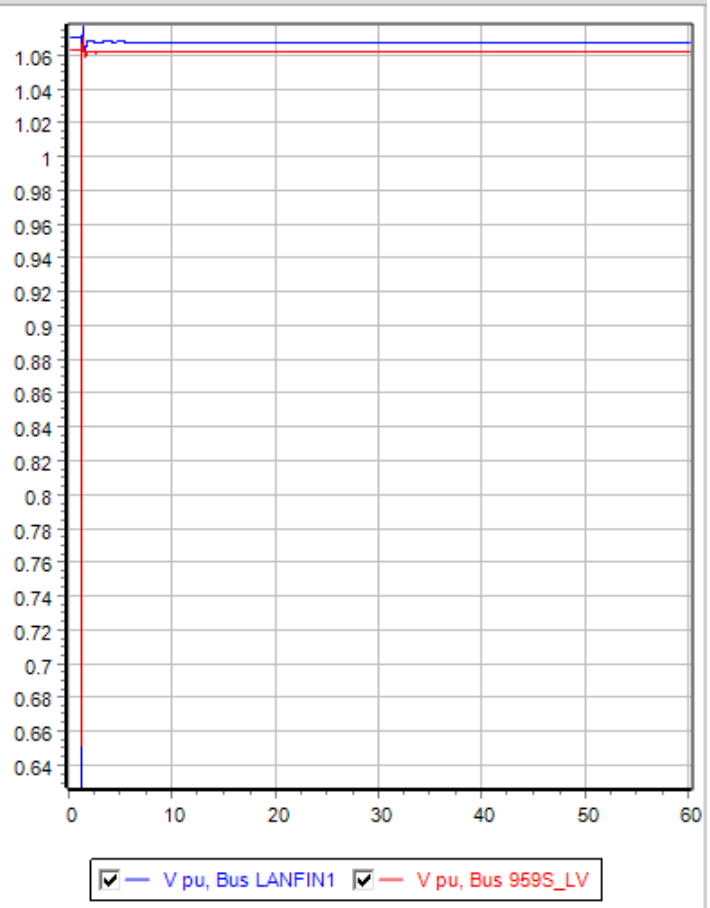
Study Case:
Scenario 5 (2022SL)

December 04, 2020 18:48:54

Lanfine 959S Voltages





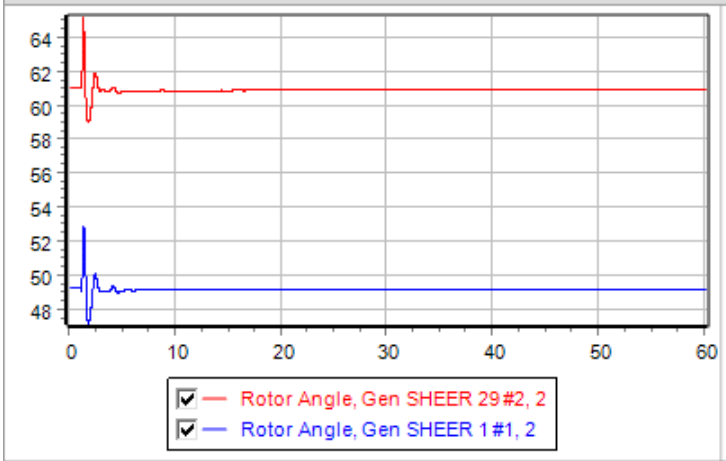


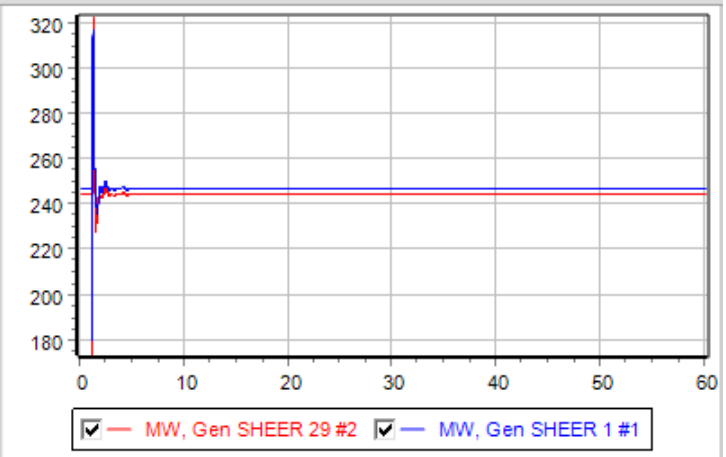
Contingency:
9L59: Tinchebray 972S to Anderson 801S

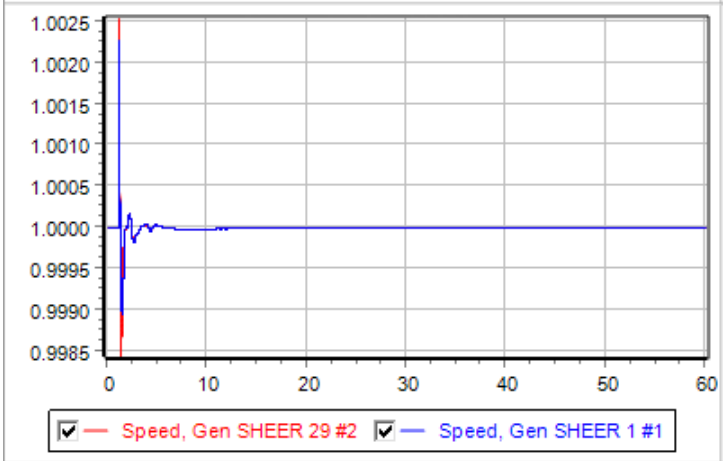
Study Case:
Scenario 5 (2022SL)

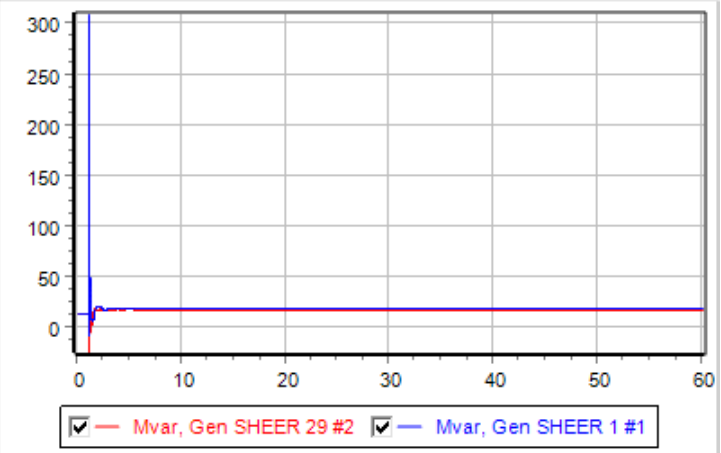
December 04, 2020 18:48:53

Sheerness







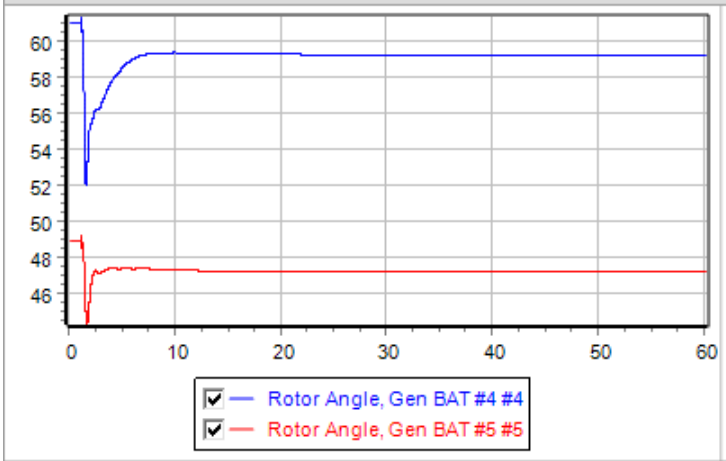


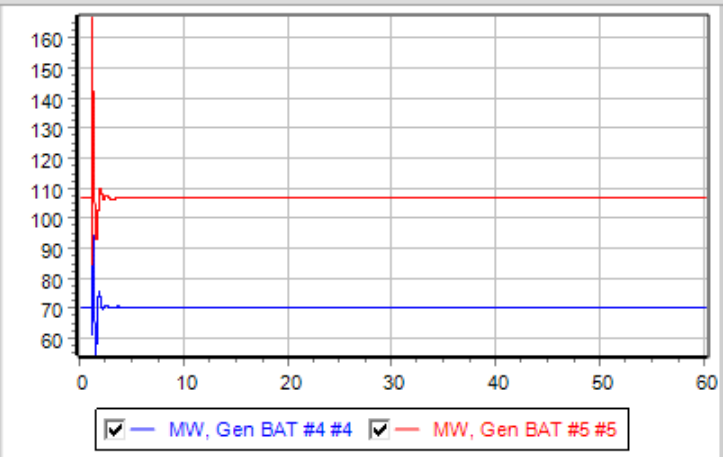
Contingency:
9L59: Tinchebray 972S to Anderson 801S

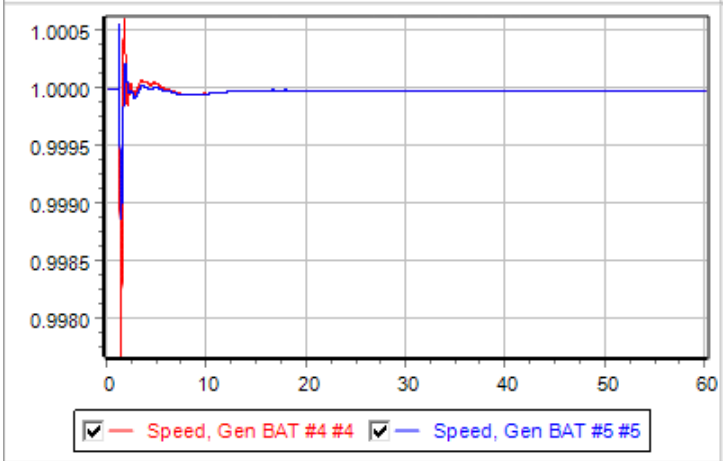
Study Case:
Scenario 5 (2022SL)

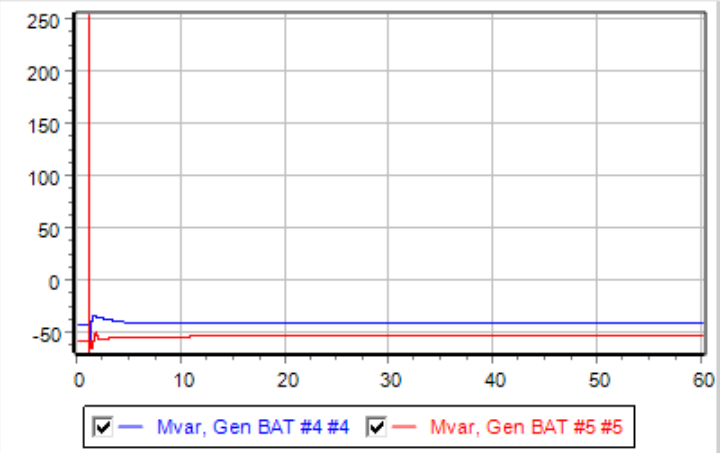
December 04, 2020 18:48:52

Battle River







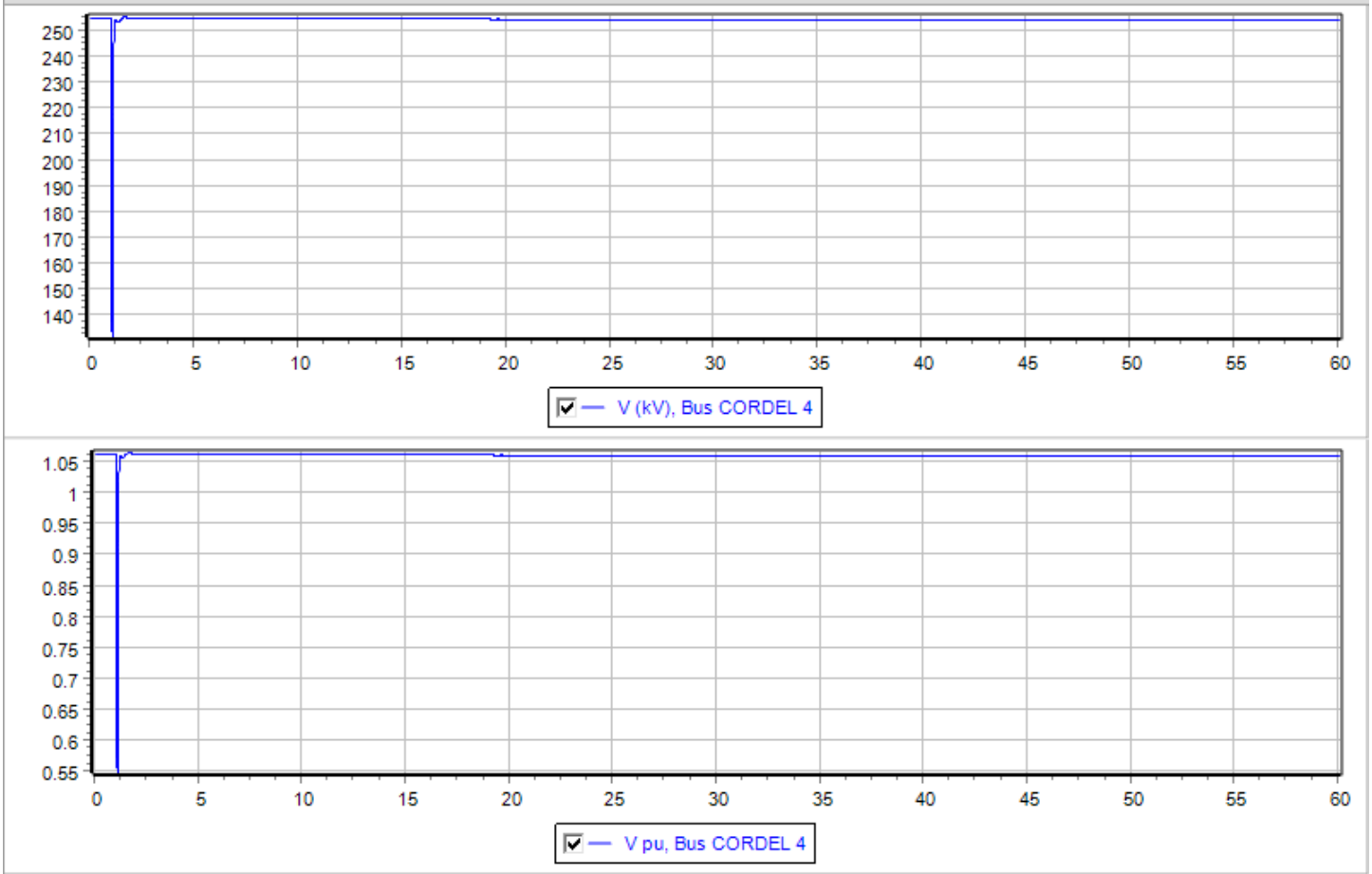


Contingency:
9L966: Hansman Lake 650S to Pemukan 932S

Study Case:
Scenario 5 (2022SL)

December 04, 2020 18:52:36

Cordel 755S Voltages

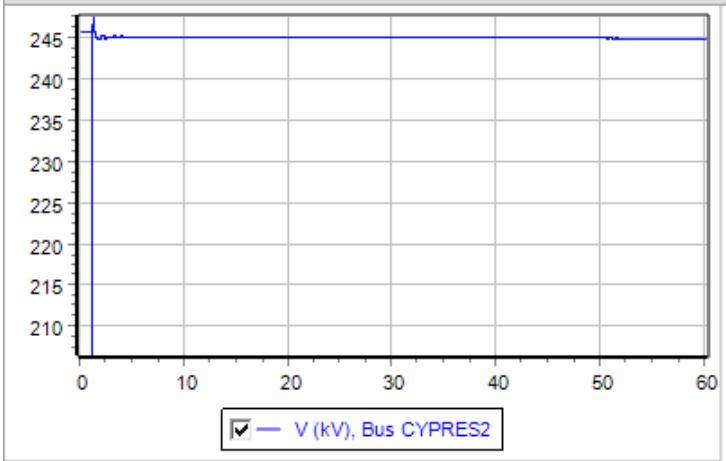


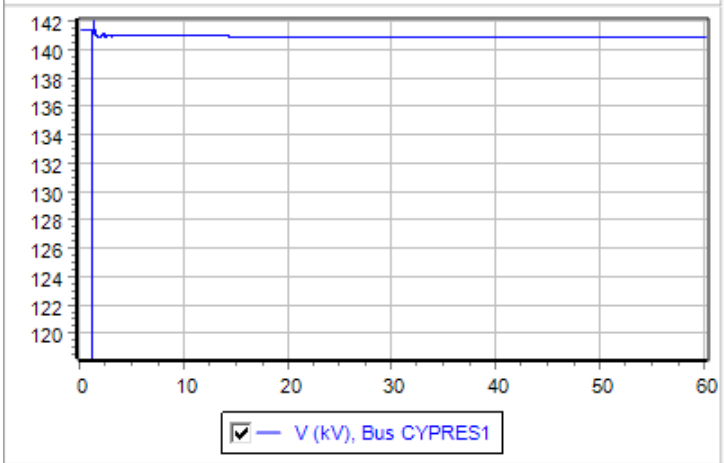
Contingency:
9L966: Hansman Lake 650S to Pemukan 932S

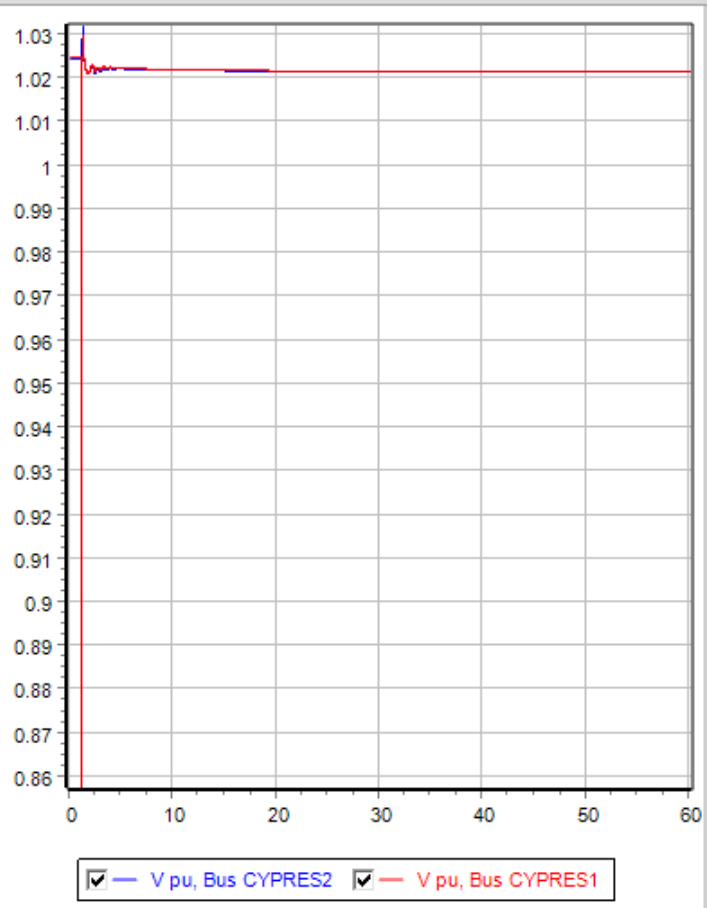
Study Case:
Scenario 5 (2022SL)

December 04, 2020 18:52:38

Cypress 562S Voltages





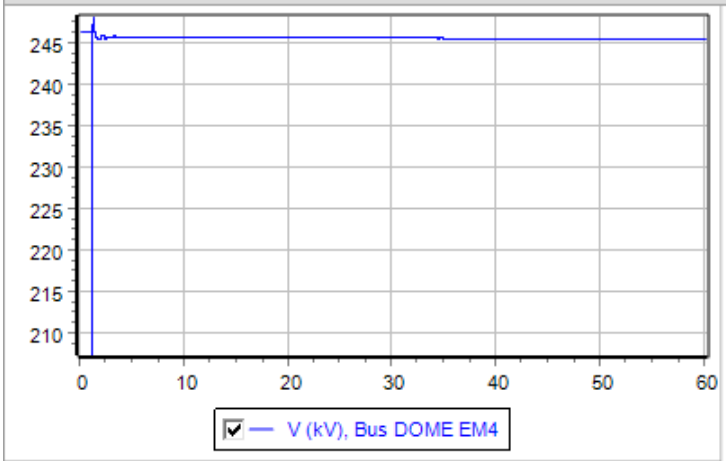


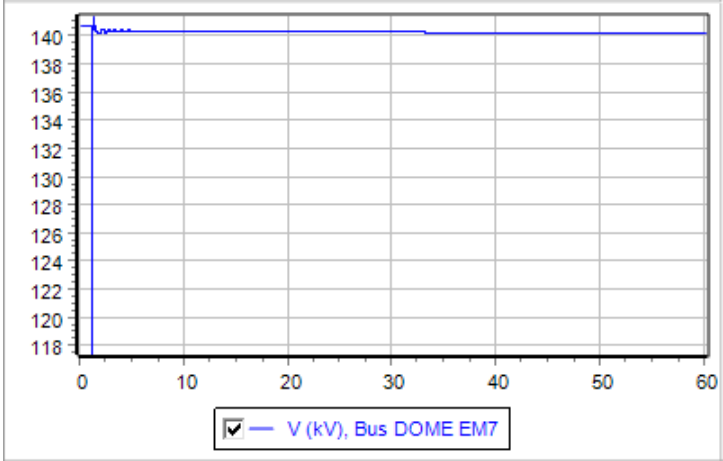
Contingency:
9L966: Hansman Lake 650S to Pemukan 932S

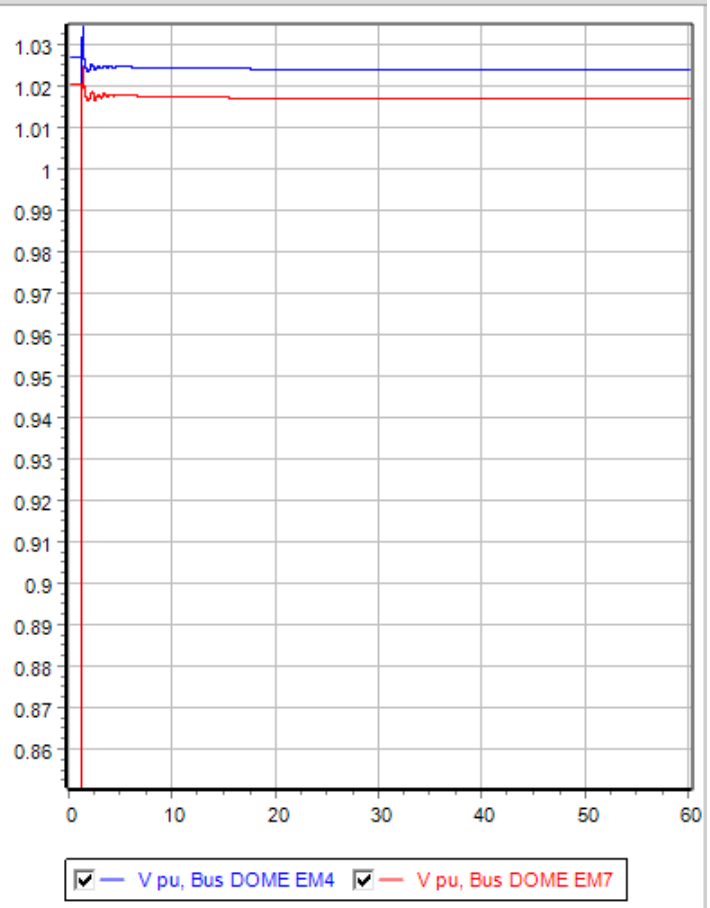
Study Case:
Scenario 5 (2022SL)

December 04, 2020 18:52:38

Dome 163S Voltages





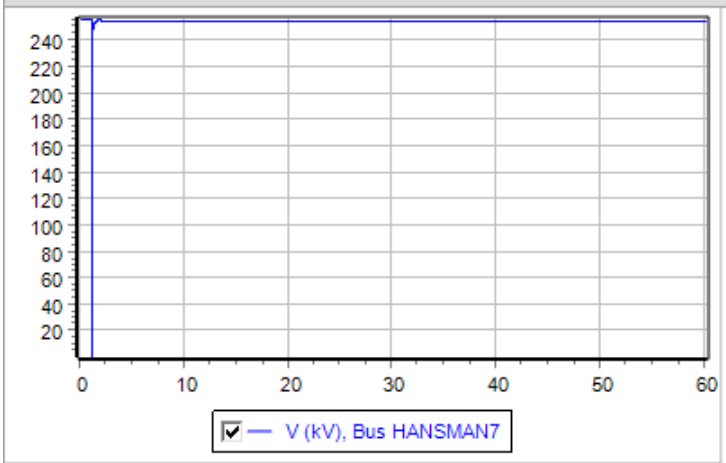


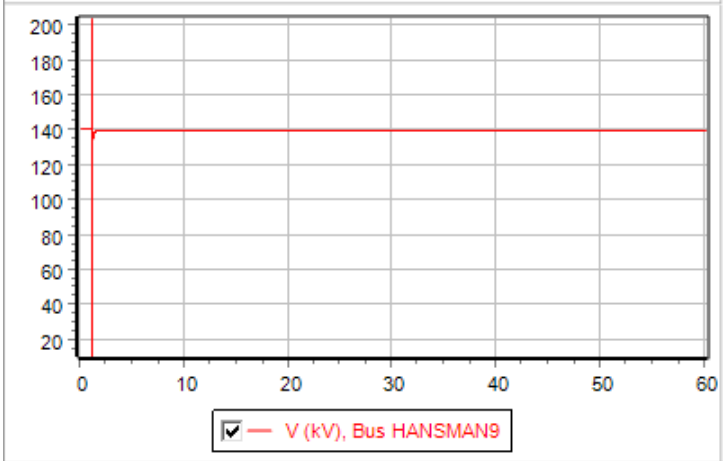
Contingency:
9L966: Hansman Lake 650S to Pemukan 932S

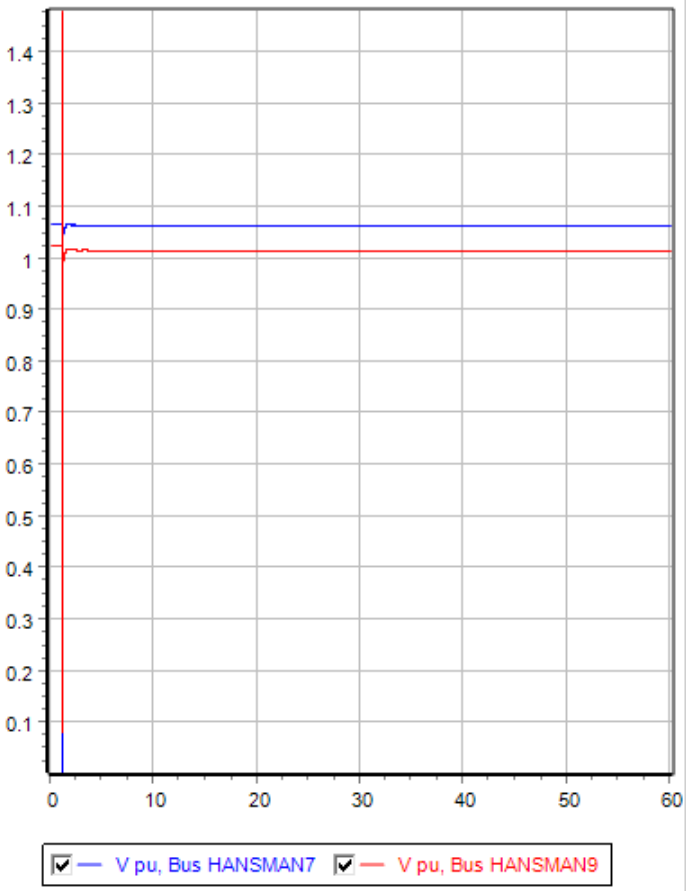
Study Case:
Scenario 5 (2022SL)

December 04, 2020 18:52:37

Hansman Lake 650S Voltages





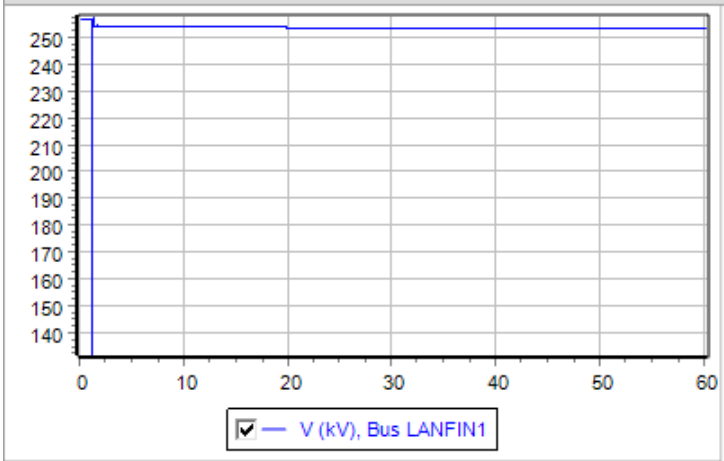


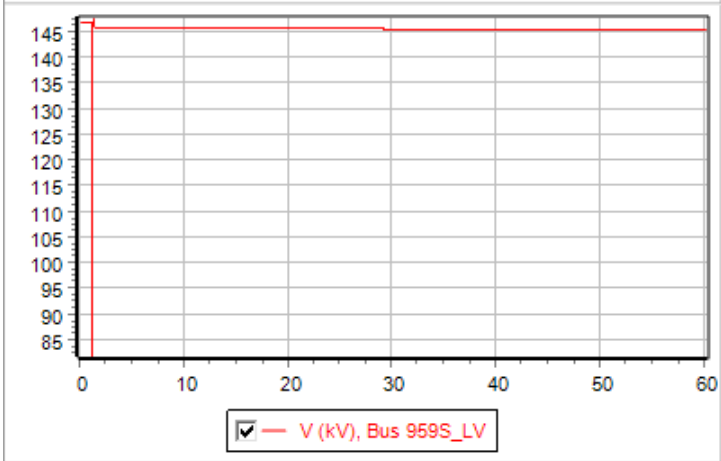
Contingency:
9L966: Hansman Lake 650S to Pemukan 932S

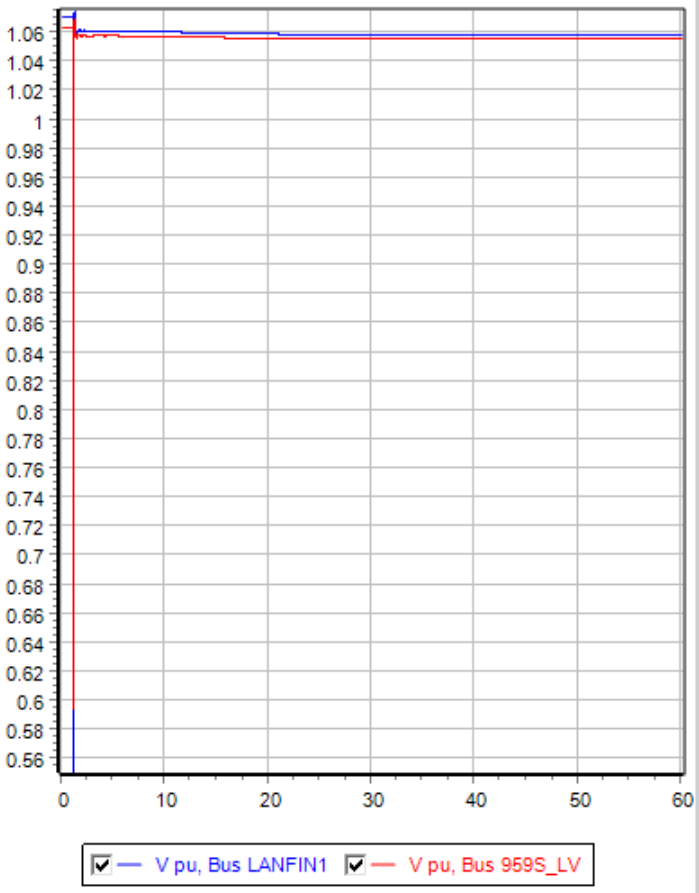
Study Case:
Scenario 5 (2022SL)

December 04, 2020 18:52:37

Lanfine 959S Voltages





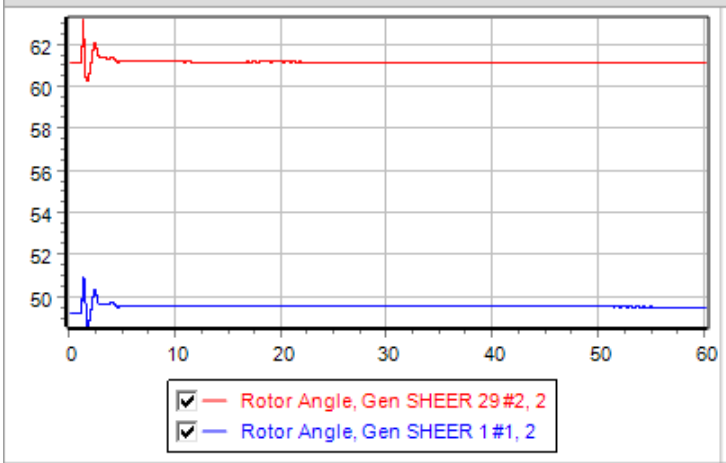


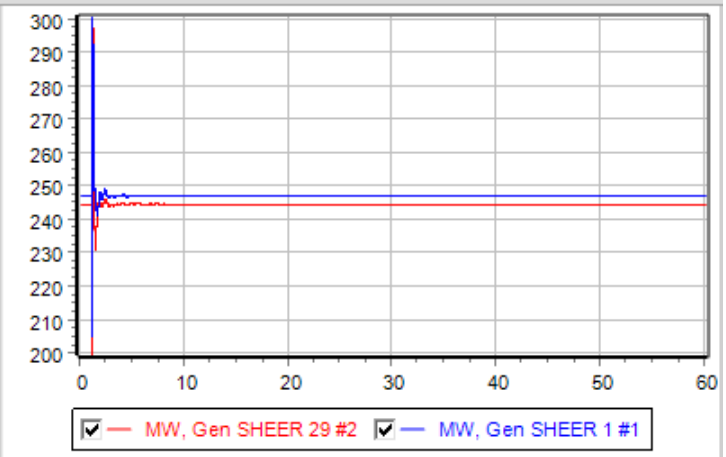
Contingency:
9L966: Hansman Lake 650S to Pemukan 932S

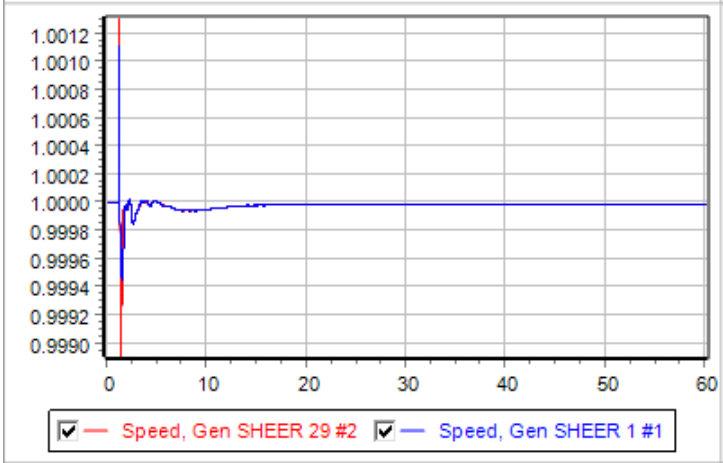
Study Case:
Scenario 5 (2022SL)

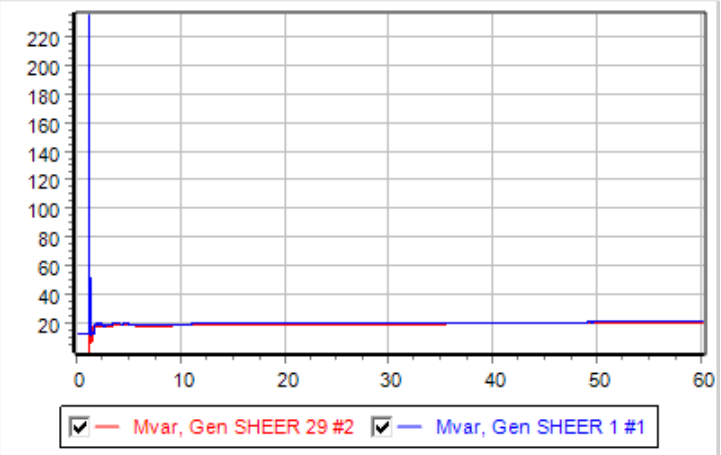
December 04, 2020 18:52:36

Sheerness







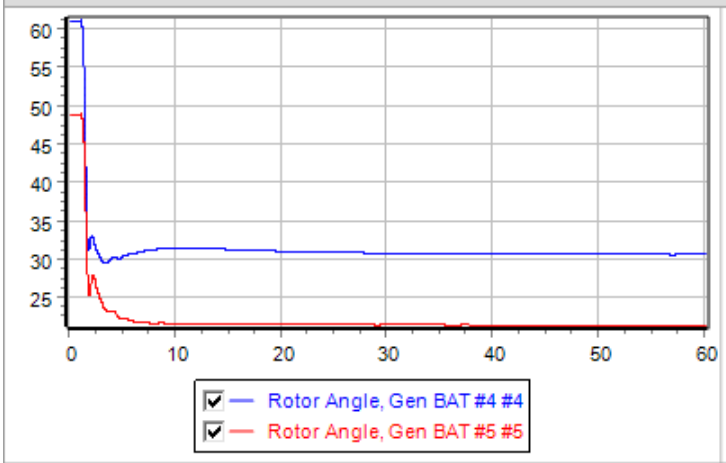


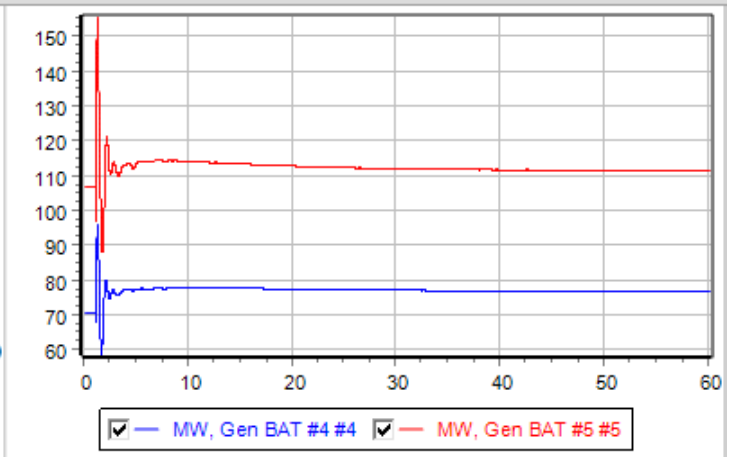
Contingency:
9L966: Hansman Lake 650S to Pemukan 932S

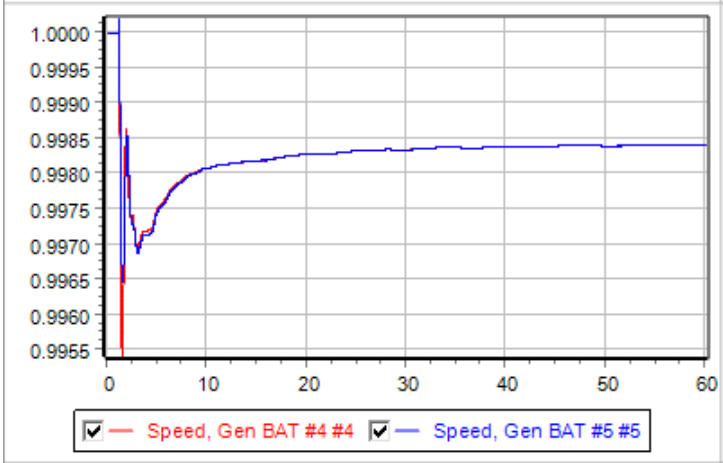
Study Case:
Scenario 5 (2022SL)

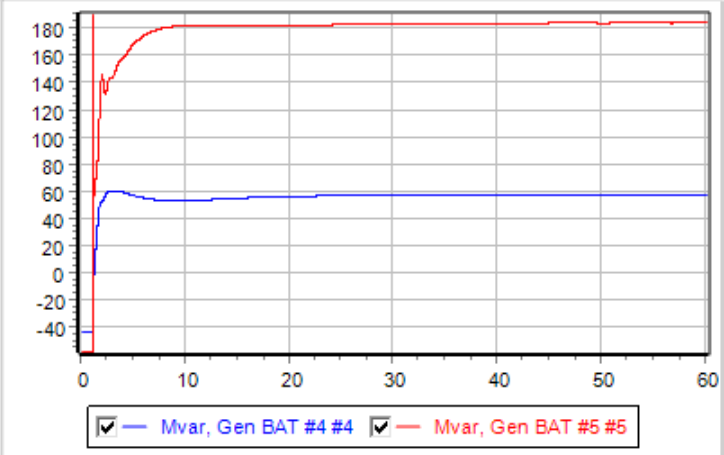
December 04, 2020 18:52:35

Battle River







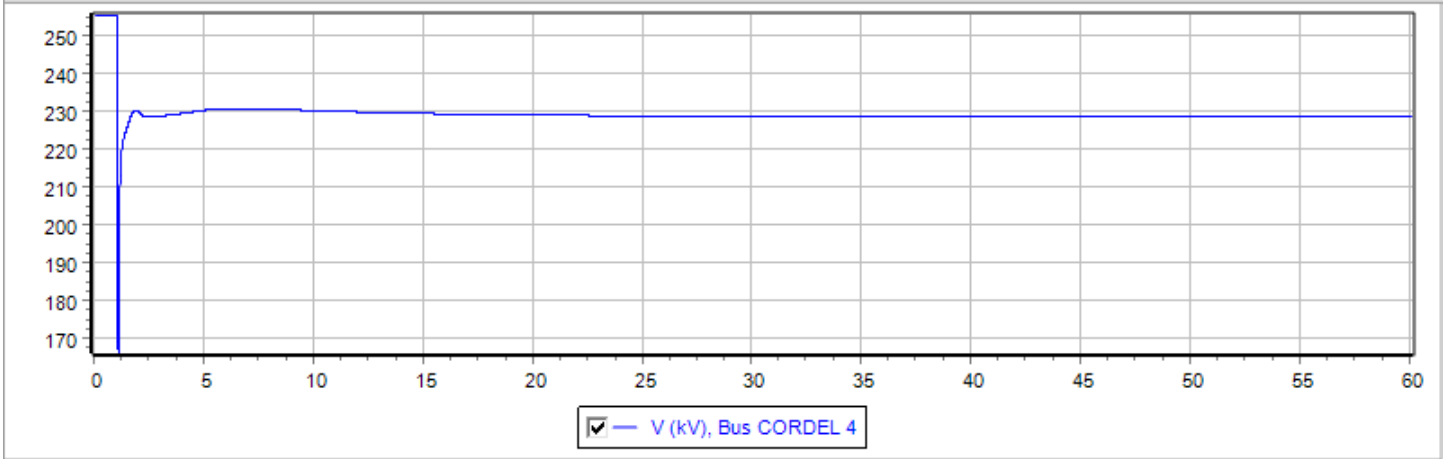


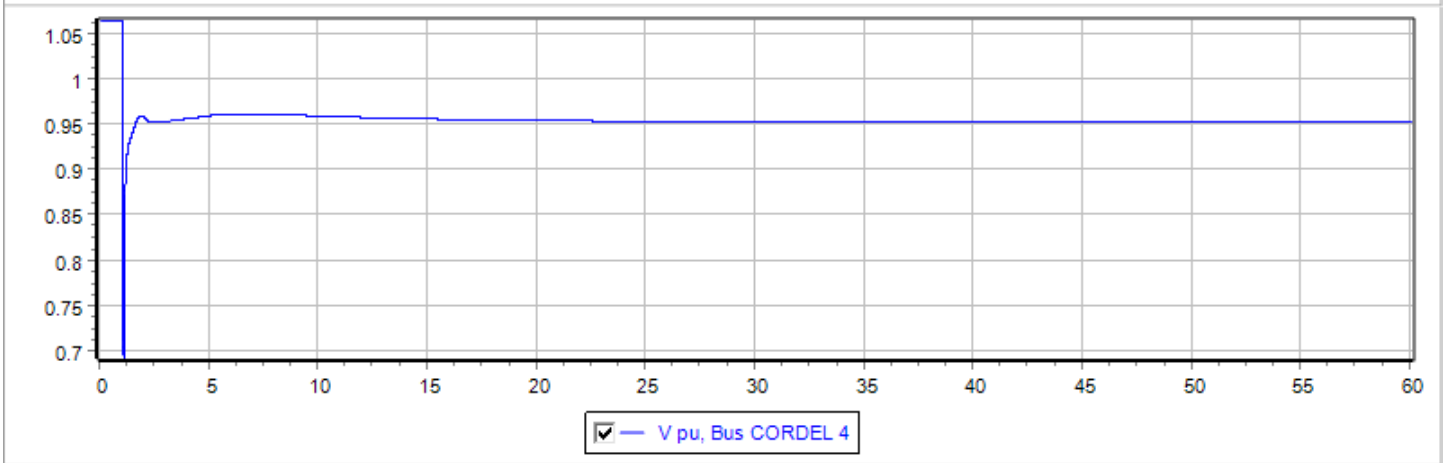
Contingency:
9L966: Pemukan 932S to Hansman Lake 650S

Study Case:
Scenario 5 (2022SL)

December 04, 2020 18:55:43

Cordel 755S Voltages



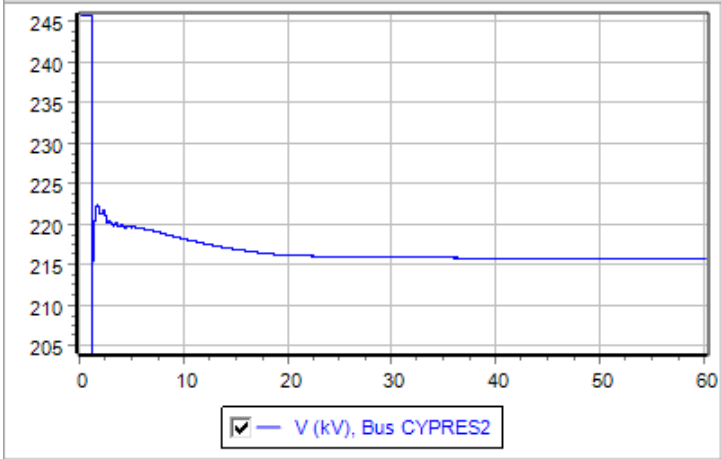


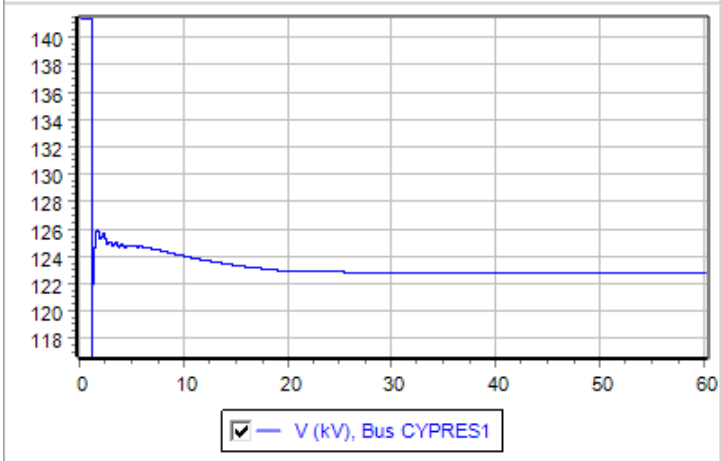
Contingency:
9L966: Pemukan 932S to Hansman Lake 650S

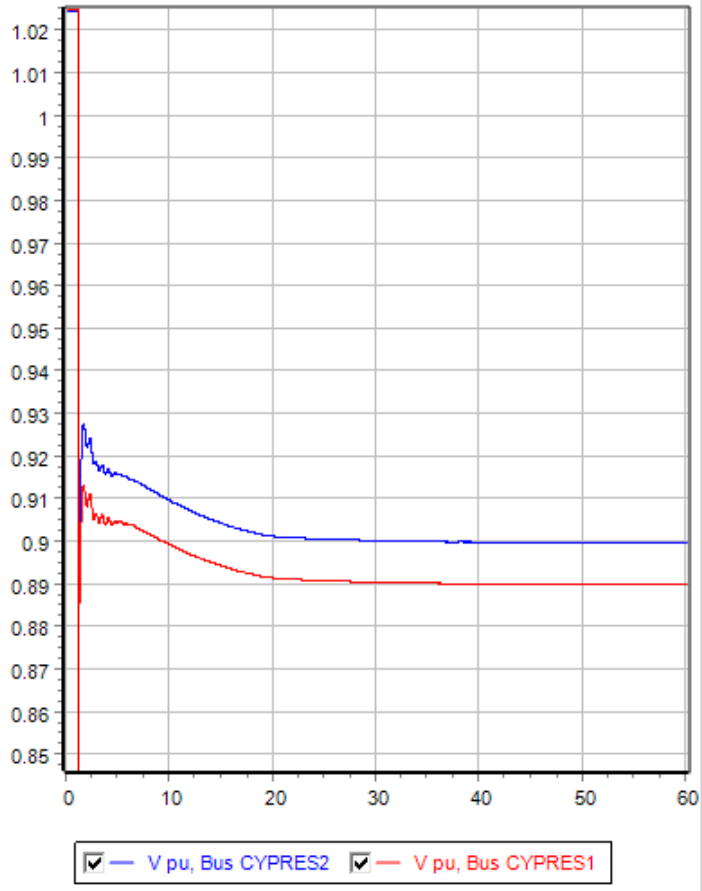
Study Case:
Scenario 5 (2022SL)

December 04, 2020 18:55:46

Cypress 562S Voltages





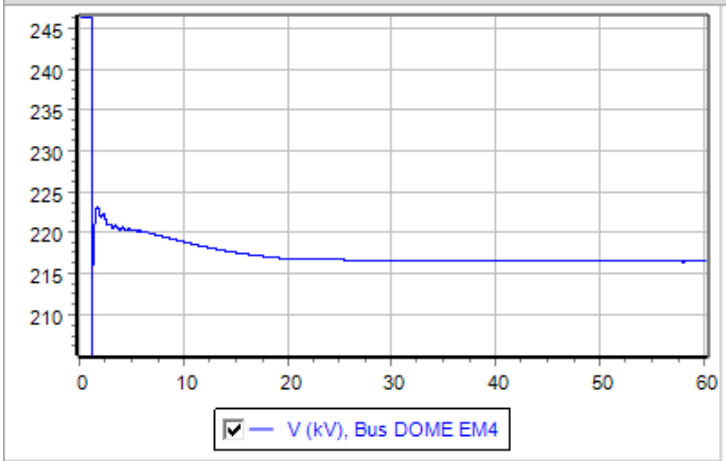


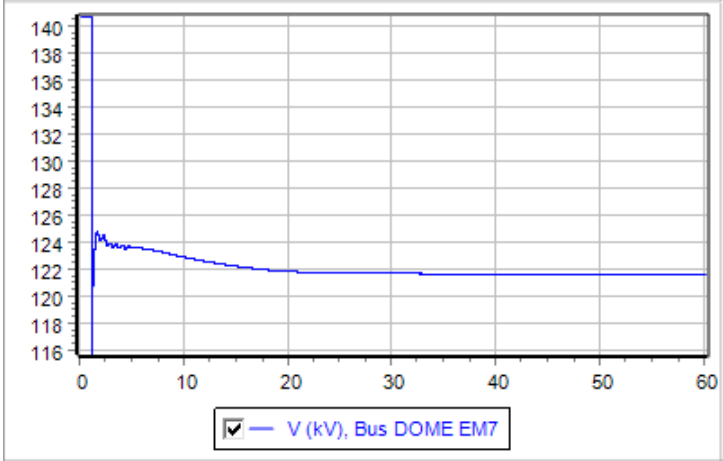
Contingency:
9L966: Pemukan 932S to Hansman Lake 650S

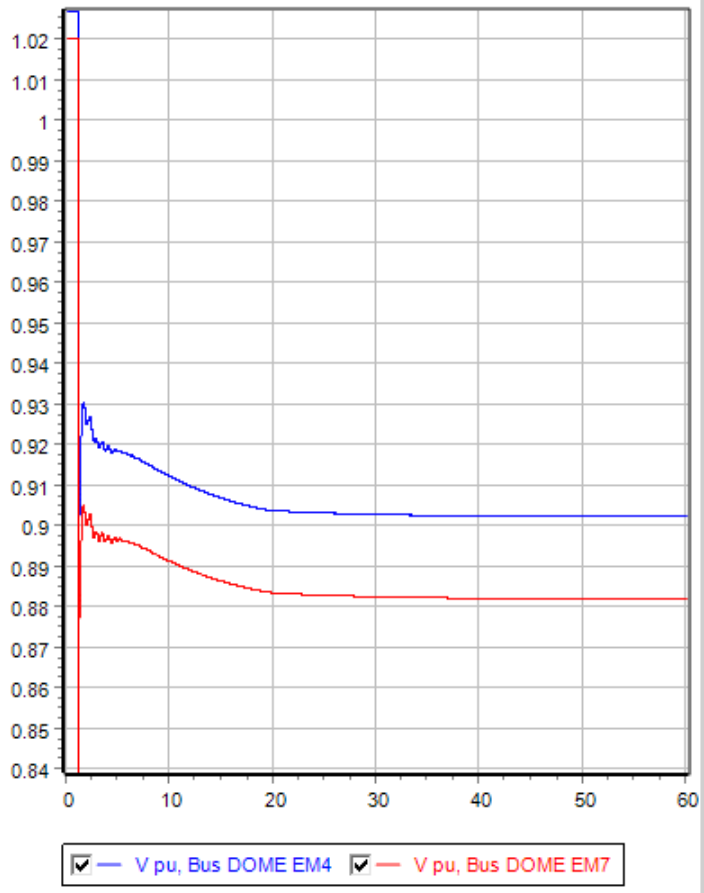
Study Case:
Scenario 5 (2022SL)

December 04, 2020 18:55:46

Dome 163S Voltages





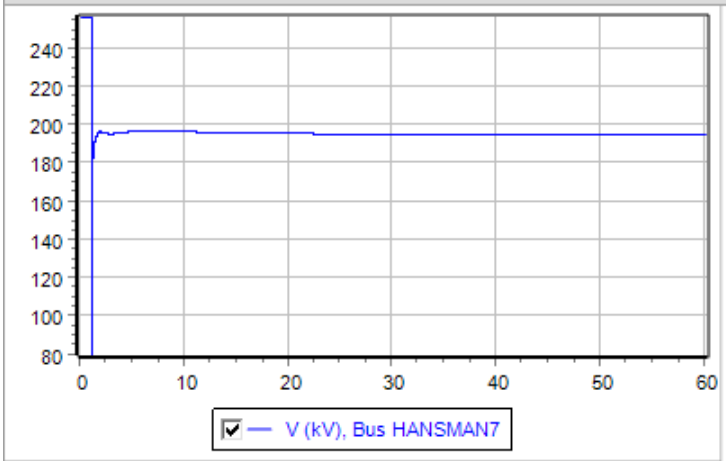


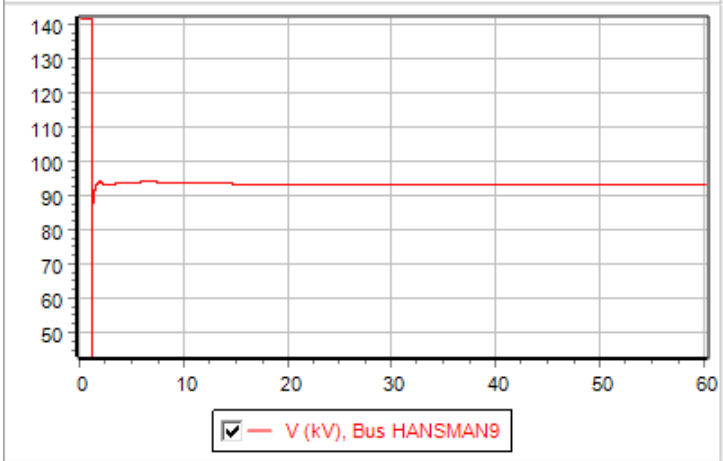
Contingency:
9L966: Pemukan 932S to Hansman Lake 650S

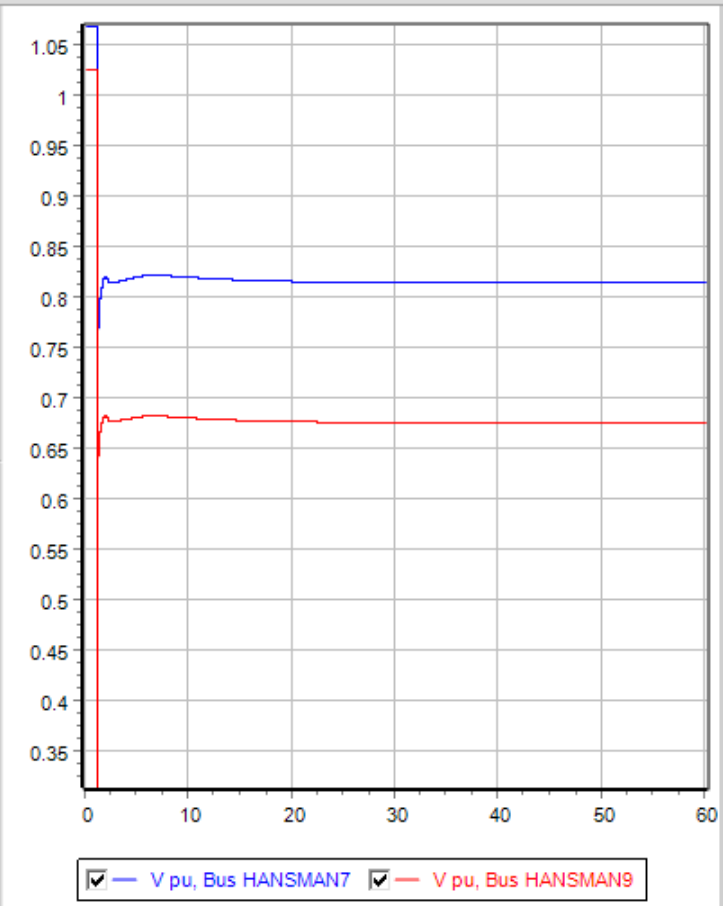
Study Case:
Scenario 5 (2022SL)

December 04, 2020 18:55:45

Hansman Lake 650S Voltages





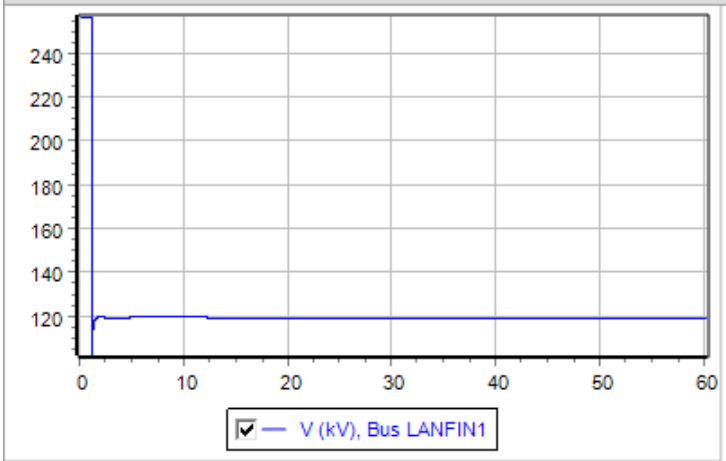


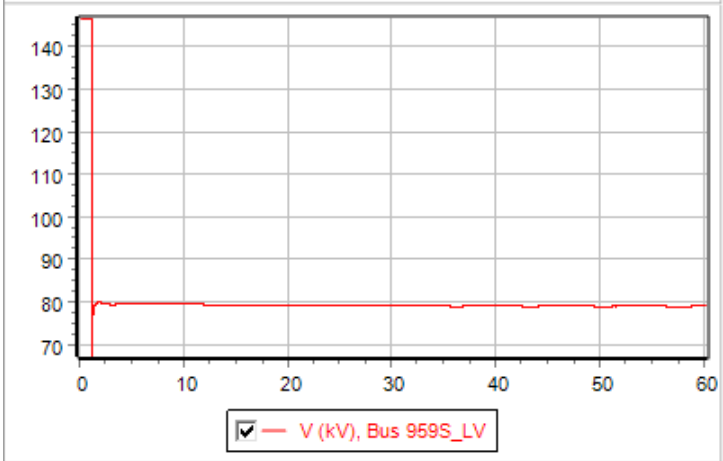
Contingency:
9L966: Pemukan 932S to Hansman Lake 650S

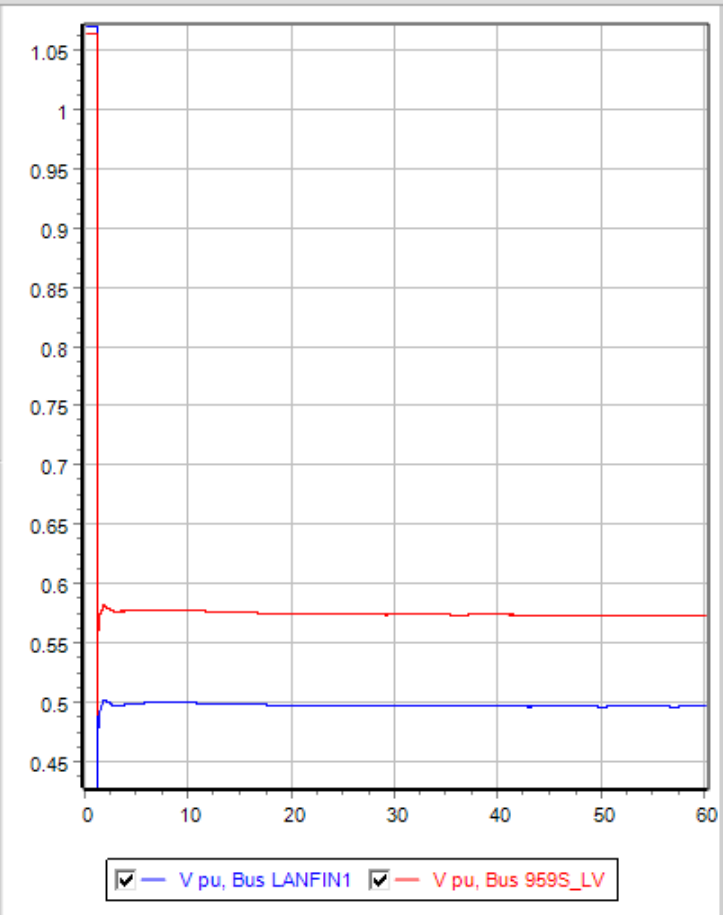
Study Case:
Scenario 5 (2022SL)

December 04, 2020 18:55:45

Lanfine 959S Voltages





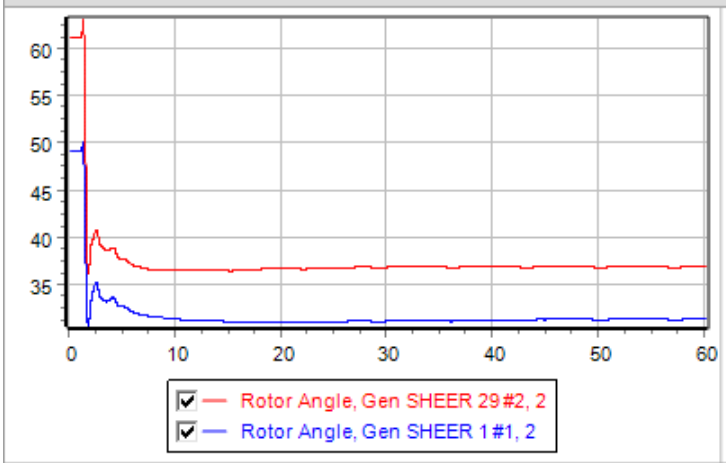


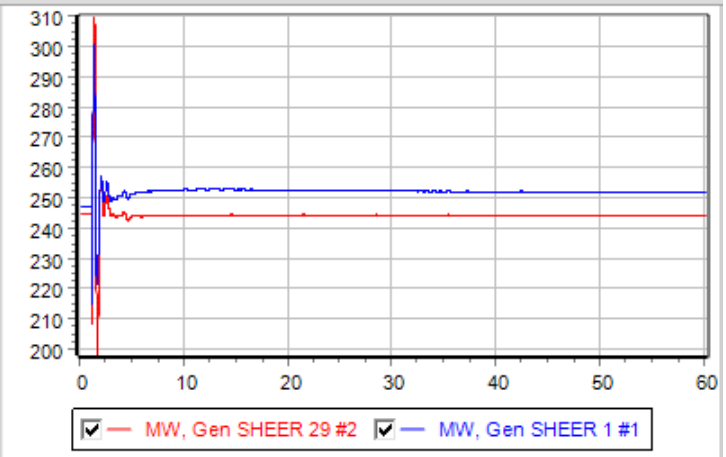
Contingency:
9L966: Pemukan 932S to Hansman Lake 650S

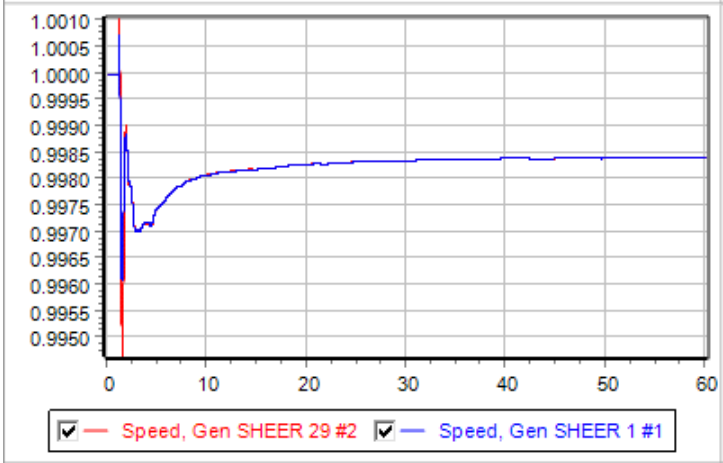
Study Case:
Scenario 5 (2022SL)

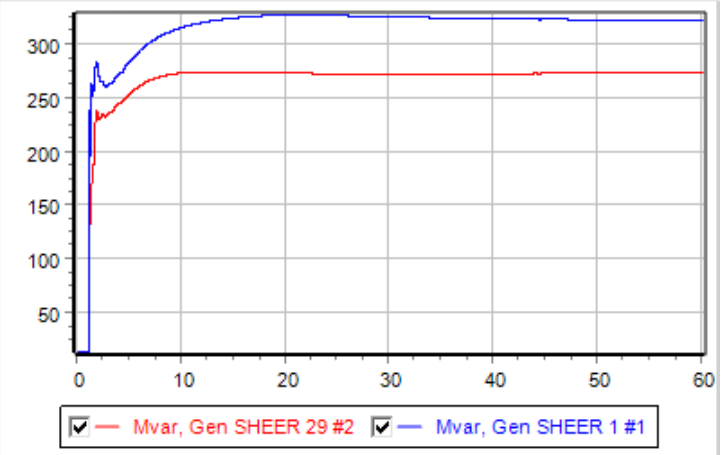
December 04, 2020 18:55:44

Sheerness







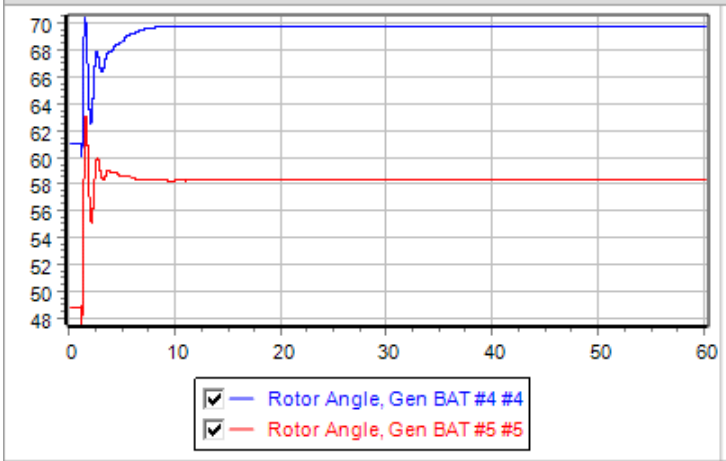


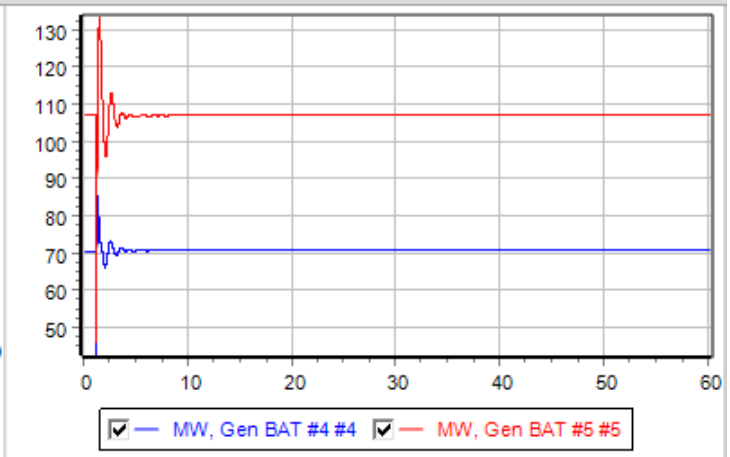
Contingency:
9L966: Pemukan 932S to Hansman Lake 650S

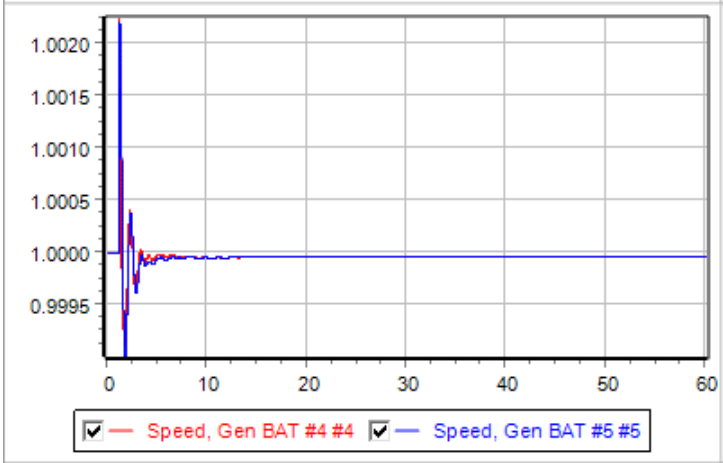
Study Case:
Scenario 5 (2022SL)

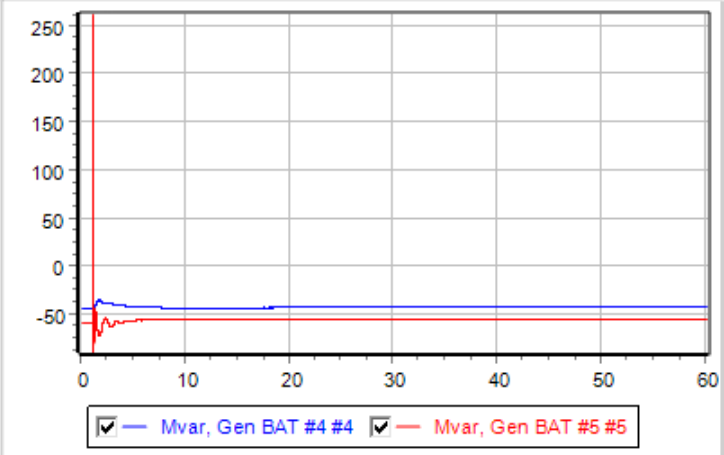
December 04, 2020 18:55:43

Battle River







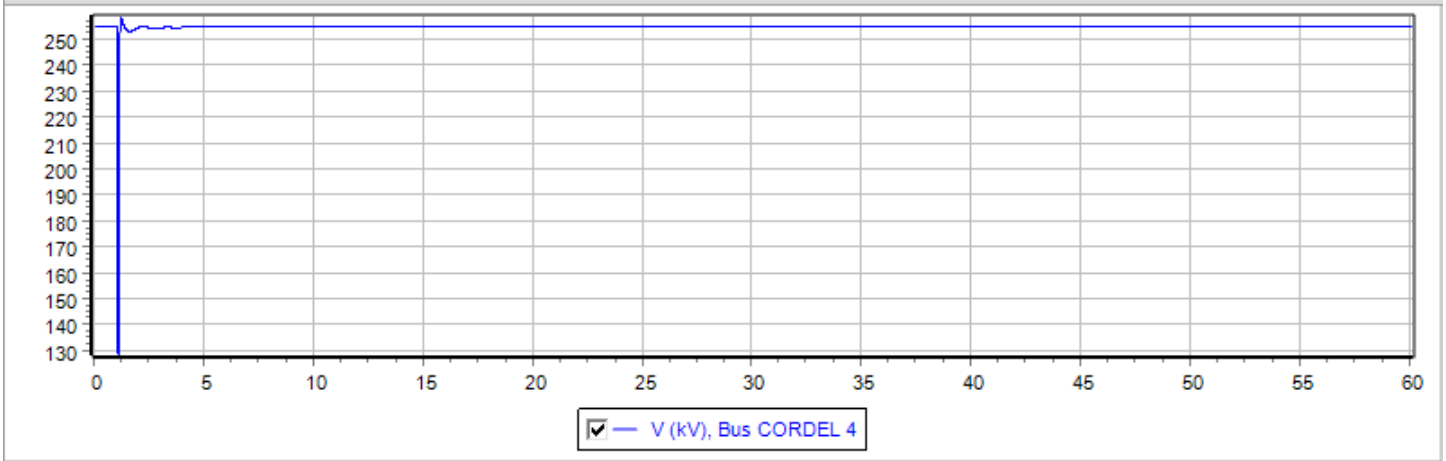


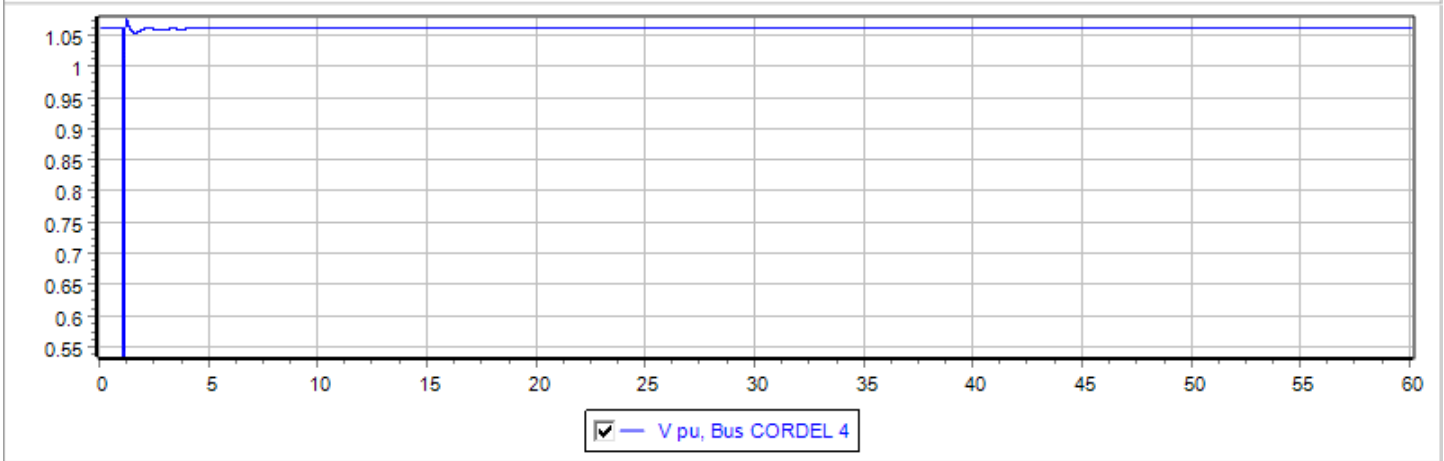
Contingency:
912L/9L912: Nevis 766S to Red Deer 63S

Study Case:
Scenario 5 (2022SL)

December 04, 2020 17:56:07

Cordel 755S Voltages



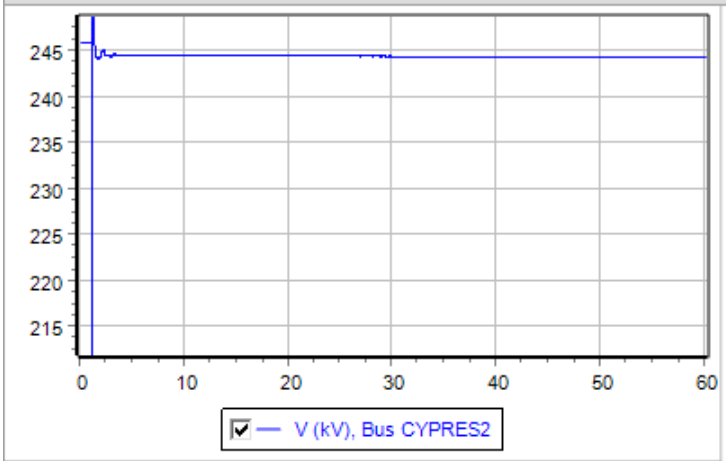


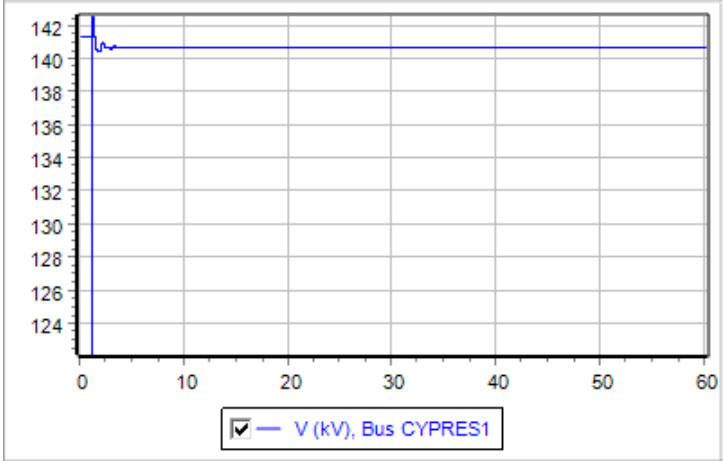
Contingency:
912L/9L912: Nevis 766S to Red Deer 63S

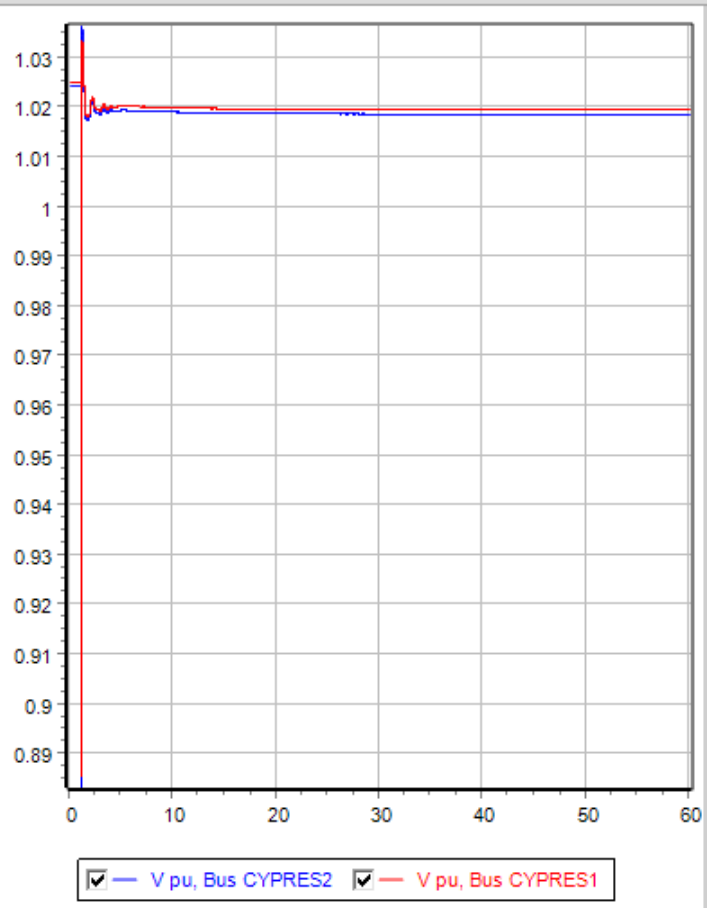
Study Case:
Scenario 5 (2022SL)

December 04, 2020 17:56:10

Cypress 562S Voltages





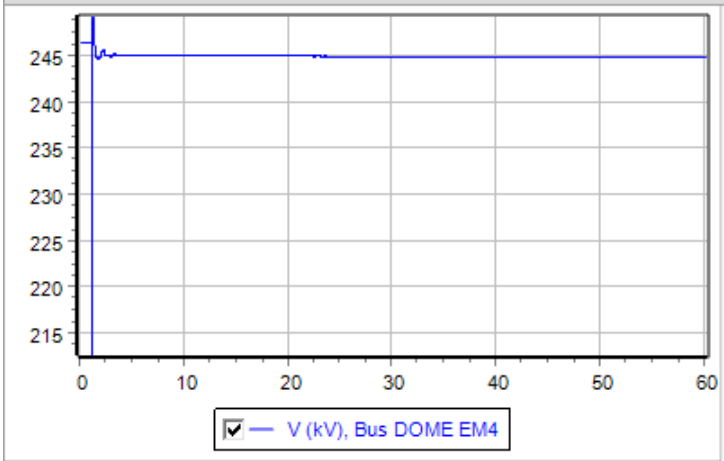


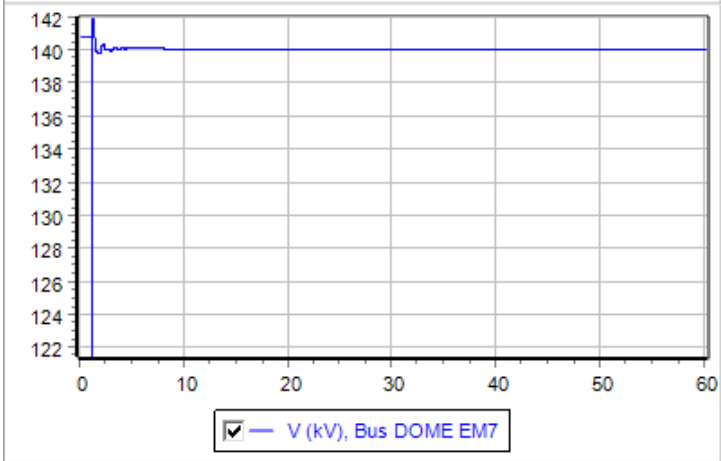
Contingency:
912L/9L912: Nevis 766S to Red Deer 63S

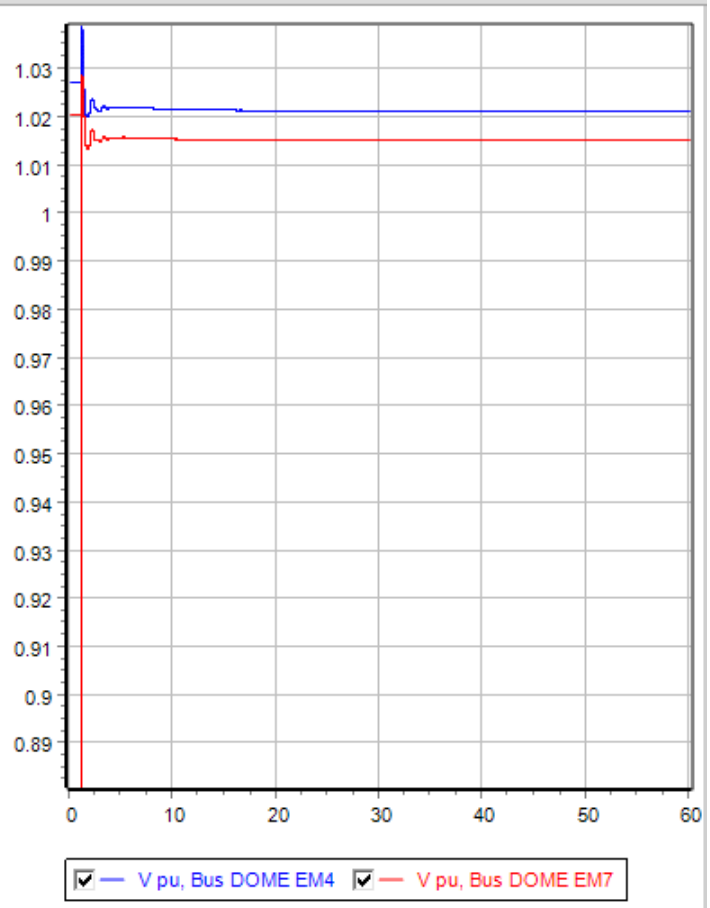
Study Case:
Scenario 5 (2022SL)

December 04, 2020 17:56:10

Dome 163S Voltages





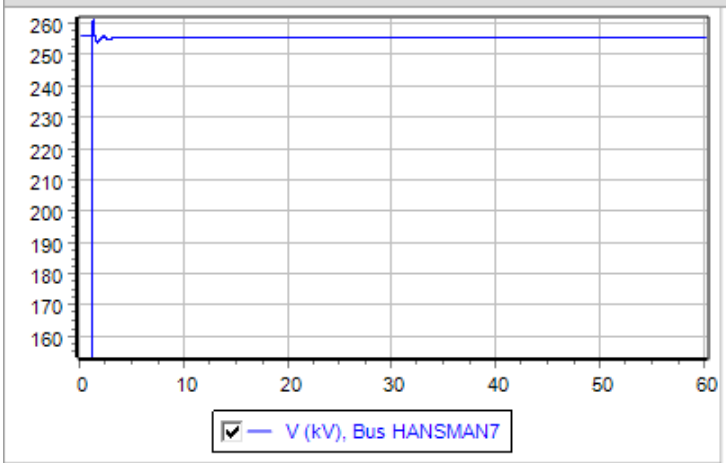


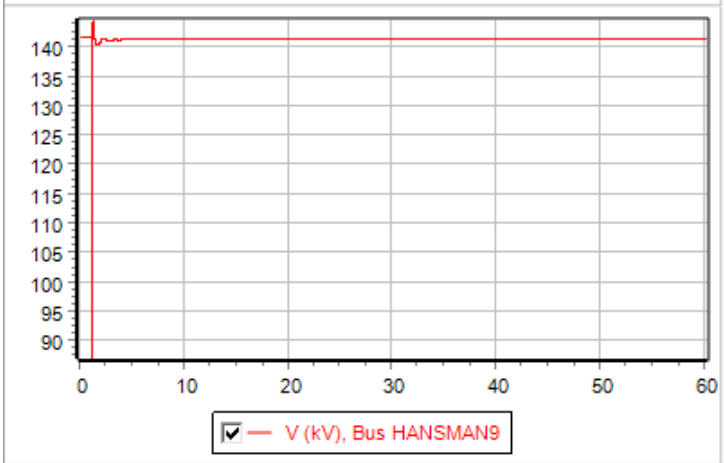
Contingency:
912L/9L912: Nevis 766S to Red Deer 63S

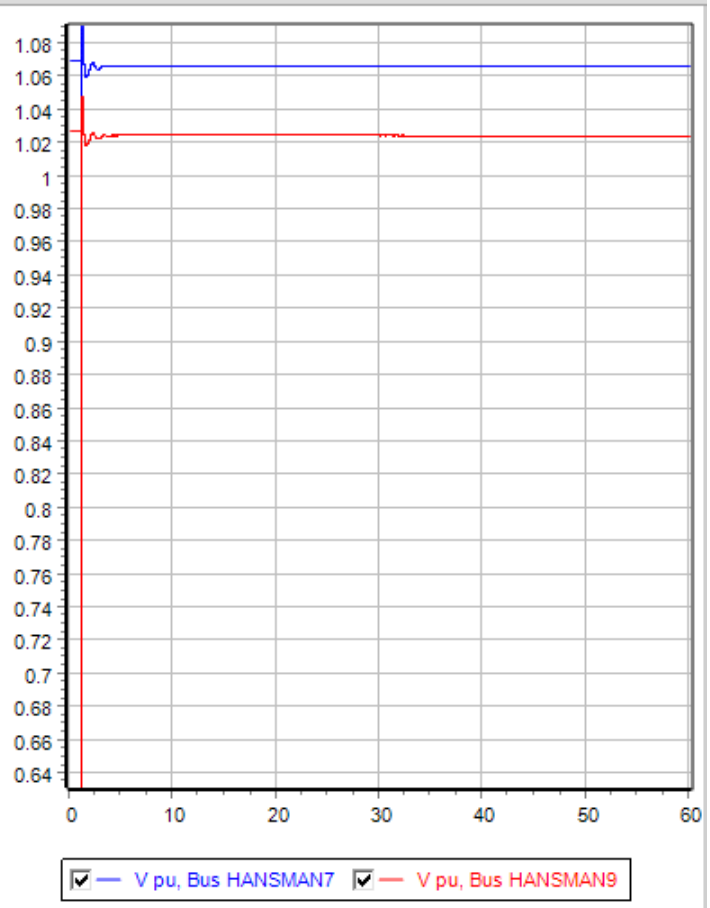
Study Case:
Scenario 5 (2022SL)

December 04, 2020 17:56:09

Hansman Lake 650S Voltages





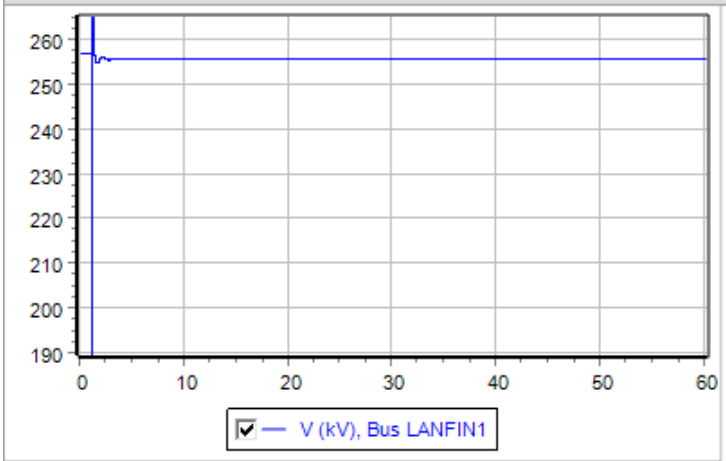


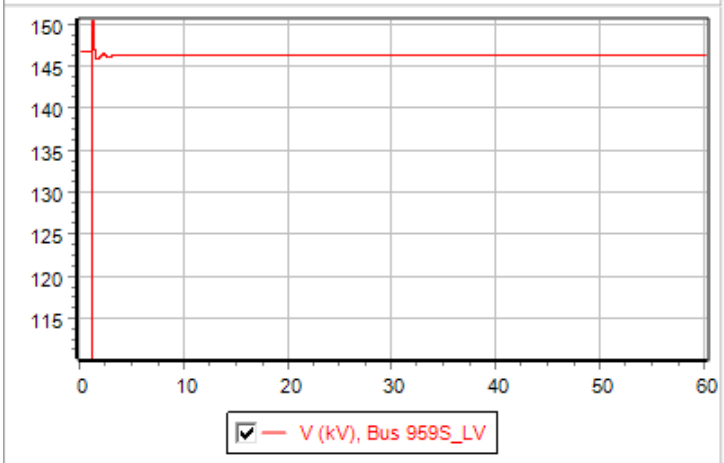
Contingency:
912L/9L912: Nevis 766S to Red Deer 63S

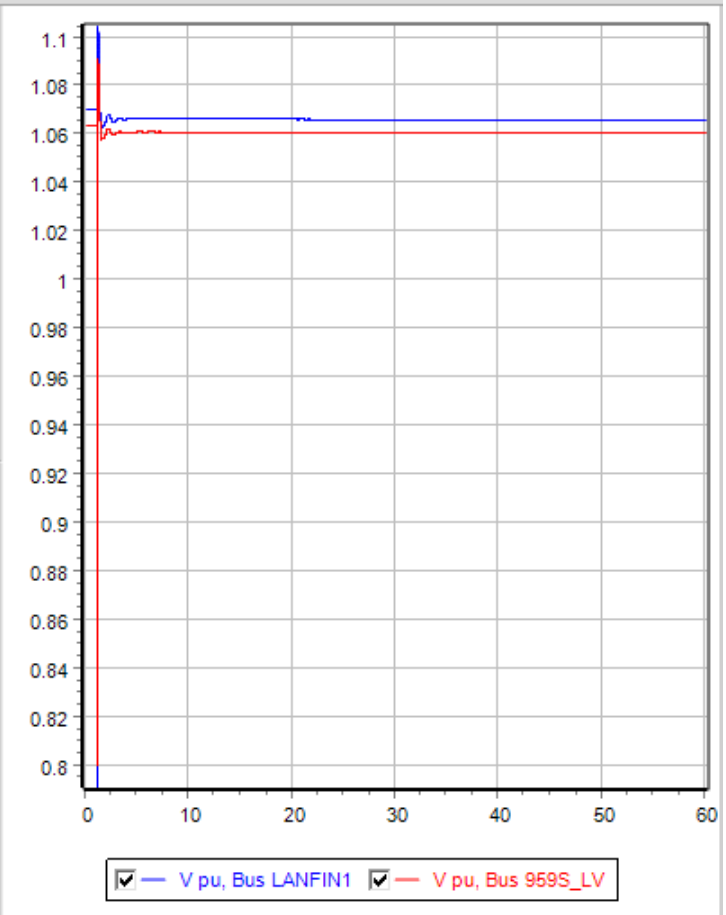
Study Case:
Scenario 5 (2022SL)

December 04, 2020 17:56:08

Lanfine 959S Voltages





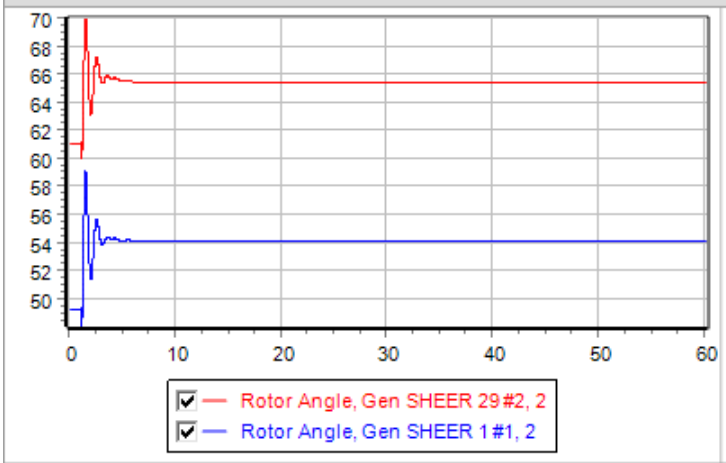


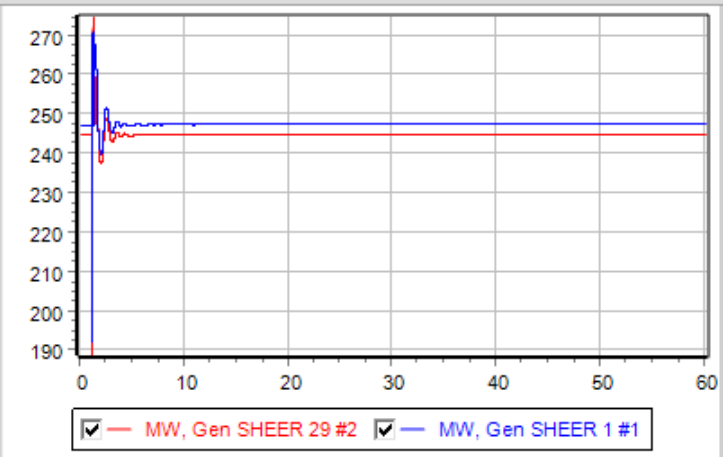
Contingency:
912L/9L912: Nevis 766S to Red Deer 63S

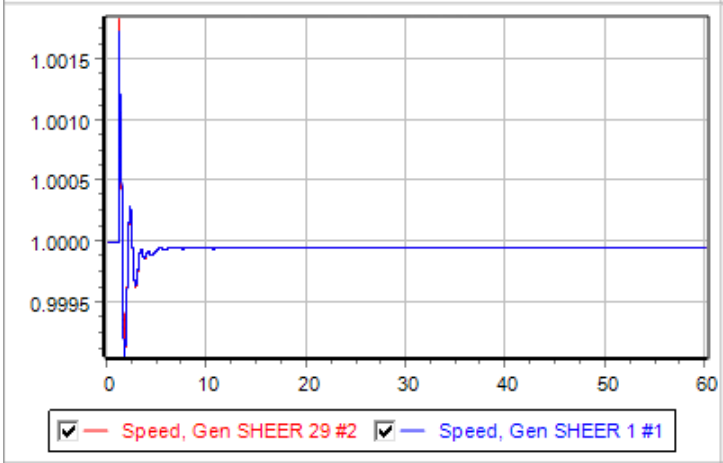
Study Case:
Scenario 5 (2022SL)

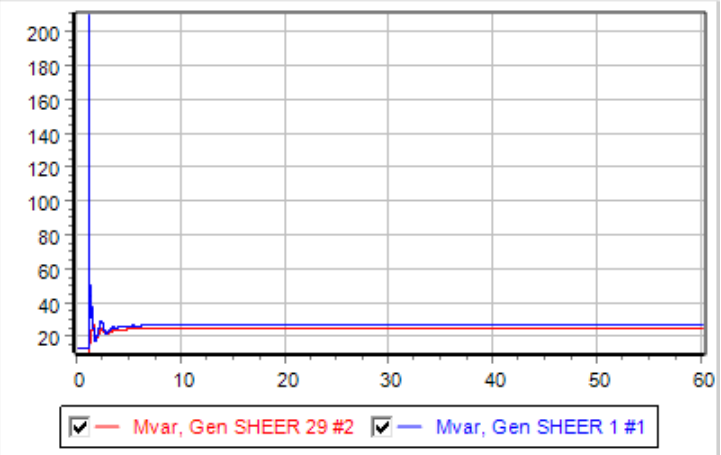
December 04, 2020 17:56:08

Sheerness







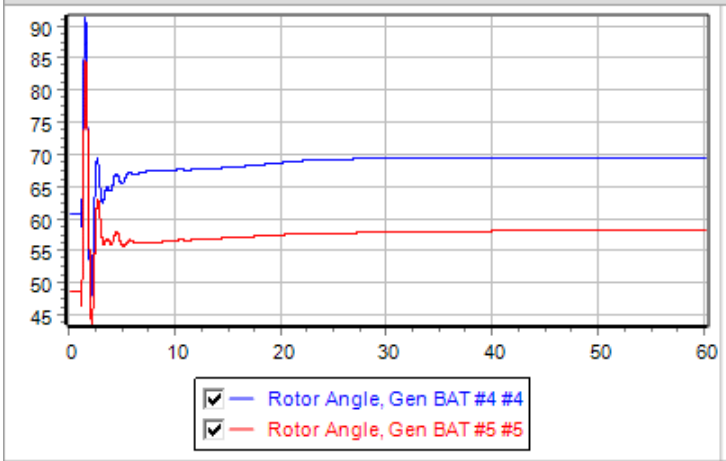


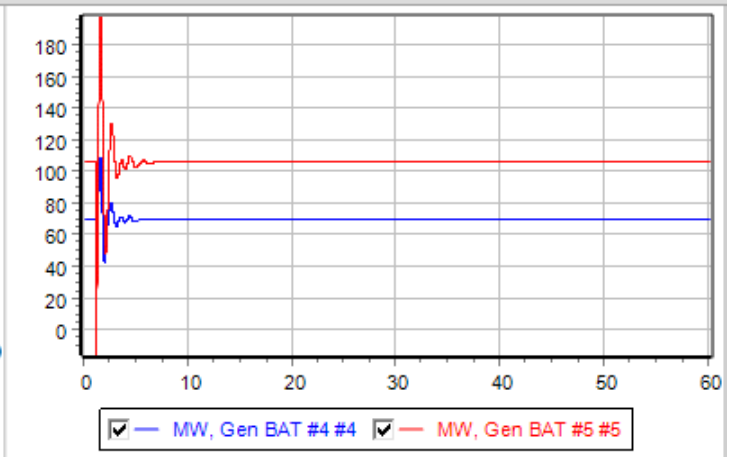
Contingency:
912L/9L912: Nevis 766S to Red Deer 63S

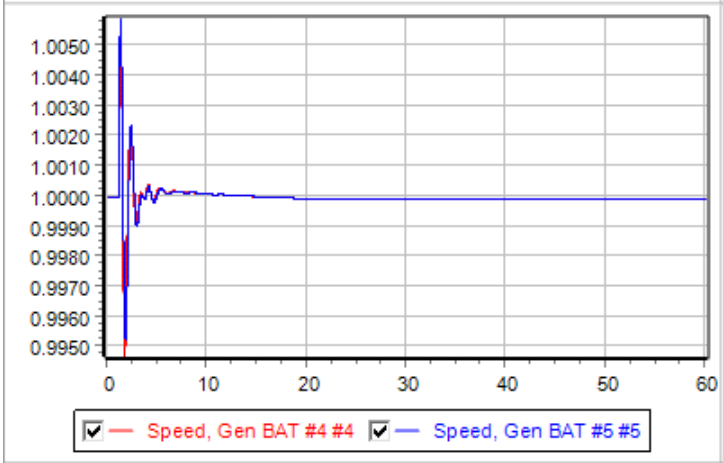
Study Case:
Scenario 5 (2022SL)

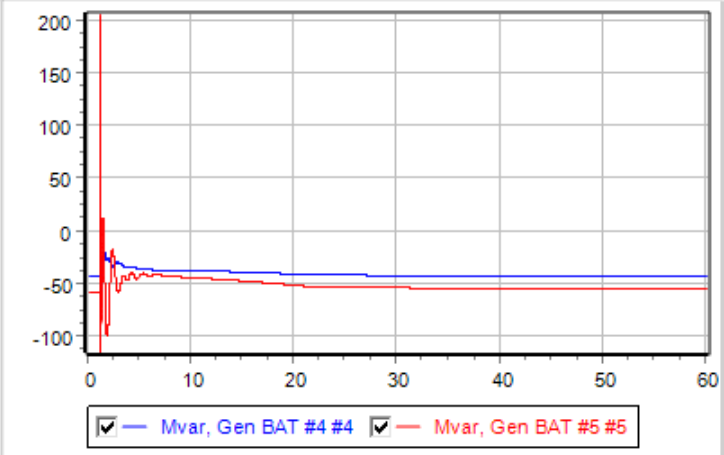
December 04, 2020 17:56:07

Battle River







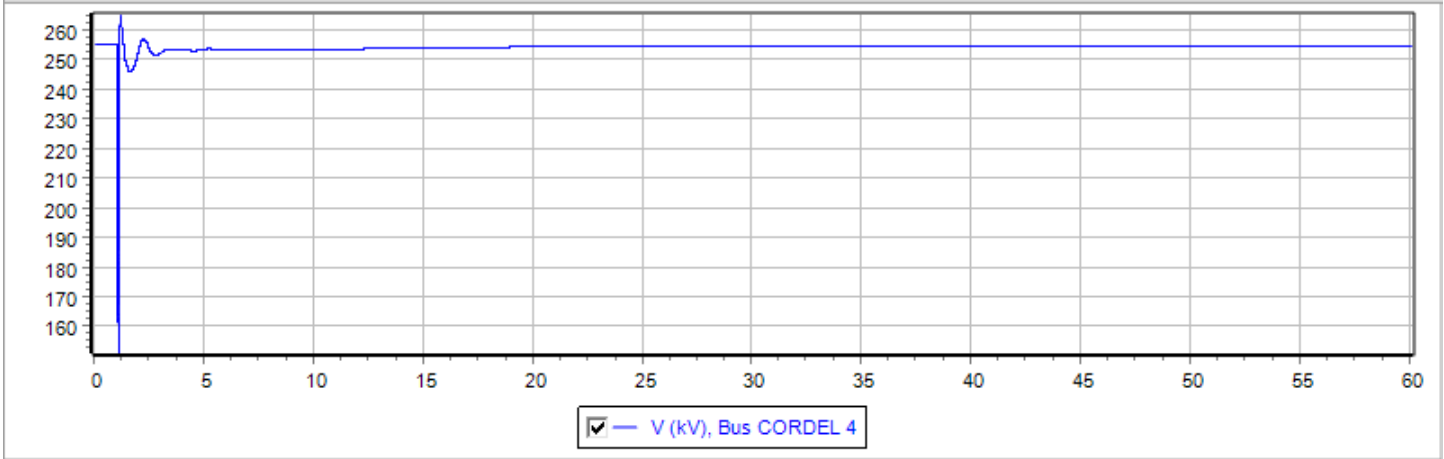


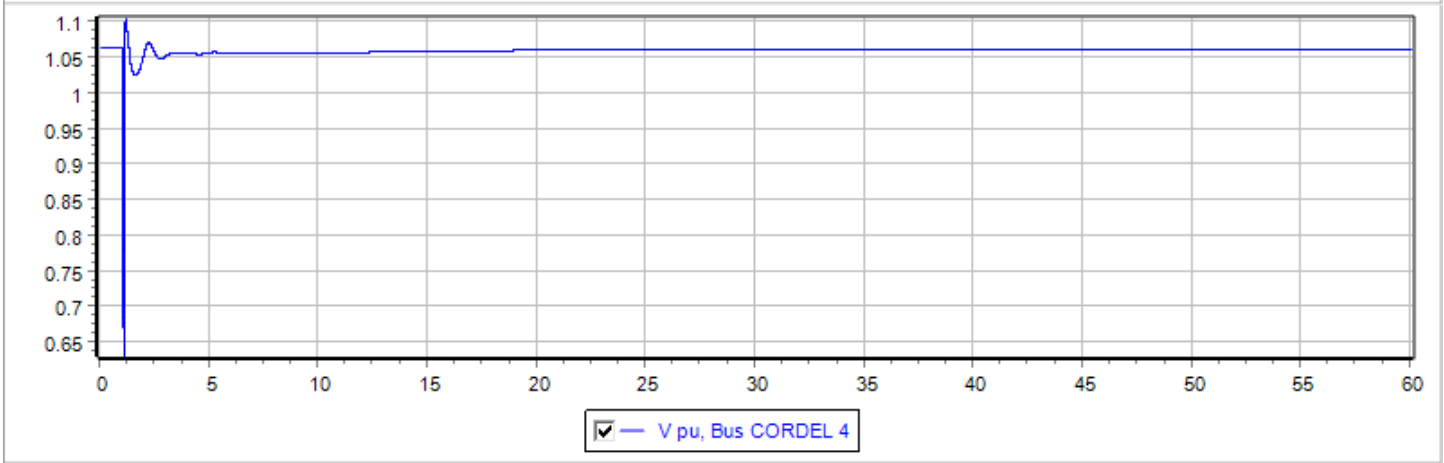
Contingency:
912L/9L912: Red Deer 63S to Nevis 766S

Study Case:
Scenario 5 (2022SL)

December 04, 2020 17:59:05

Cordel 755S Voltages



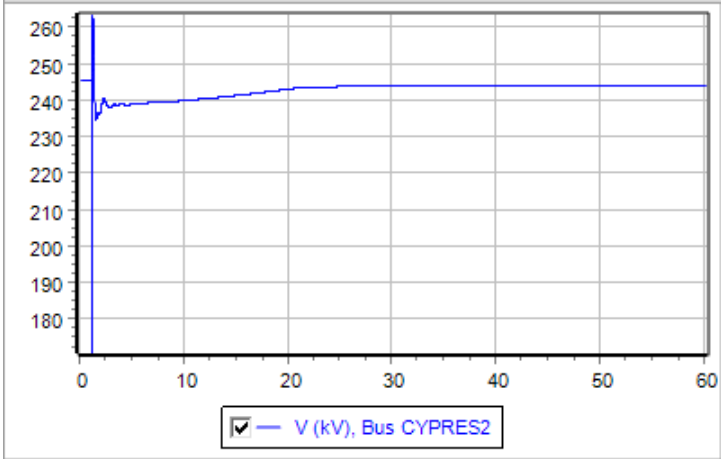


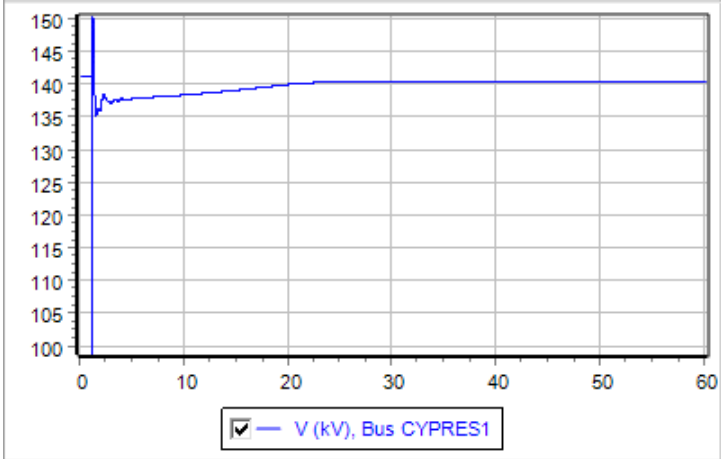
Contingency:
912L/9L912: Red Deer 63S to Nevis 766S

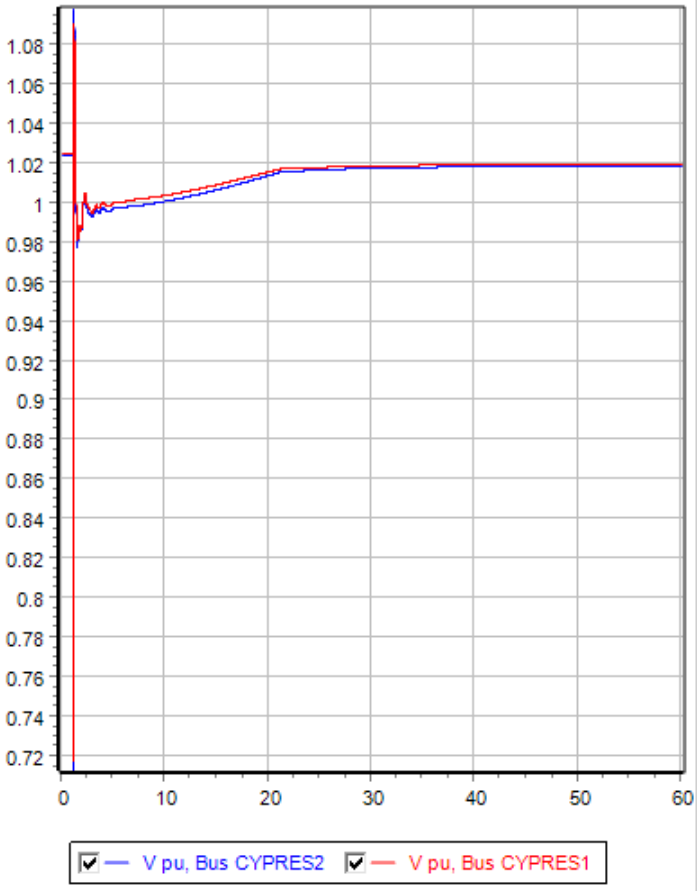
Study Case:
Scenario 5 (2022SL)

December 04, 2020 17:59:08

Cypress 562S Voltages





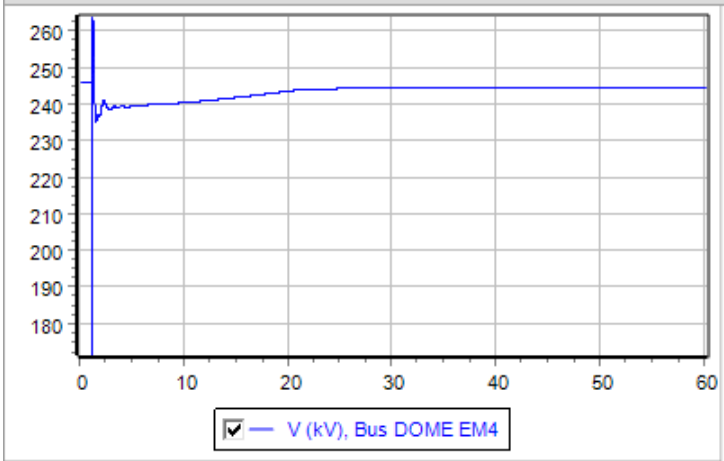


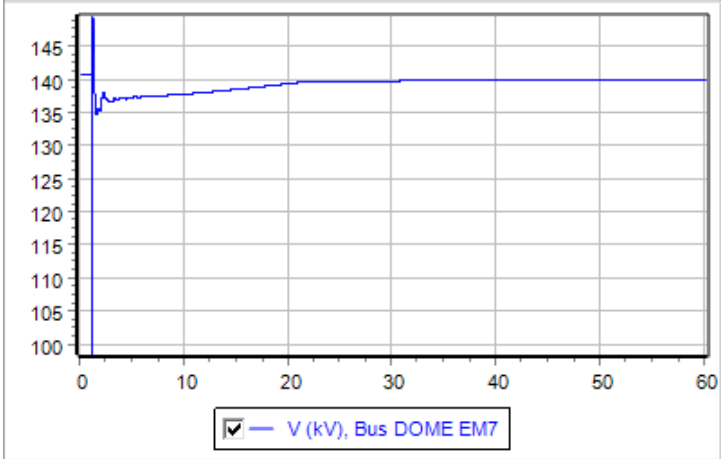
Contingency:
912L/9L912: Red Deer 63S to Nevis 766S

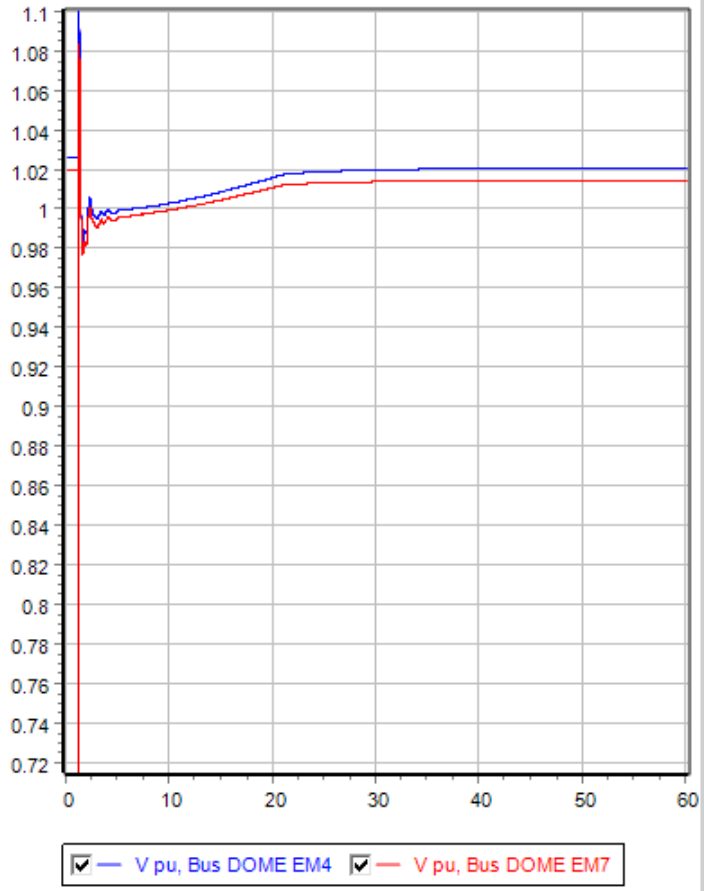
Study Case:
Scenario 5 (2022SL)

December 04, 2020 17:59:07

Dome 163S Voltages





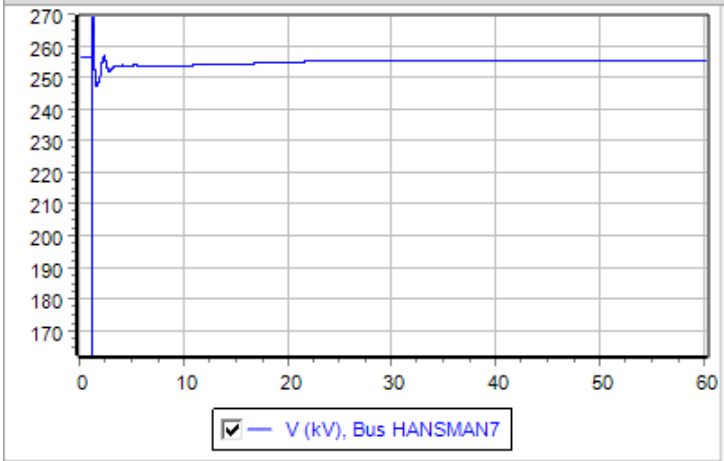


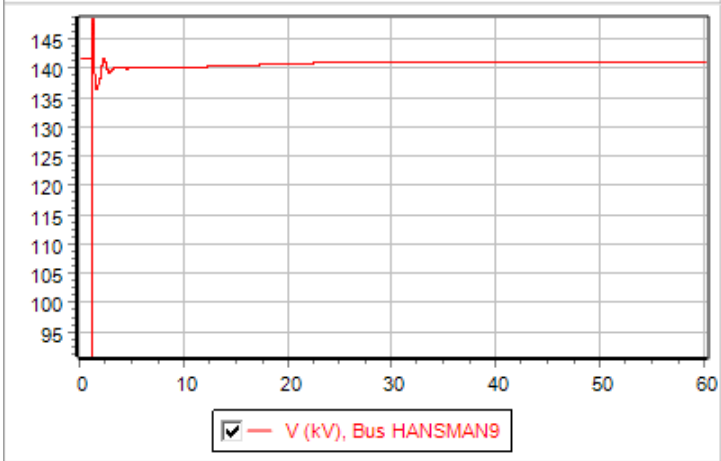
Contingency:
912L/9L912: Red Deer 63S to Nevis 766S

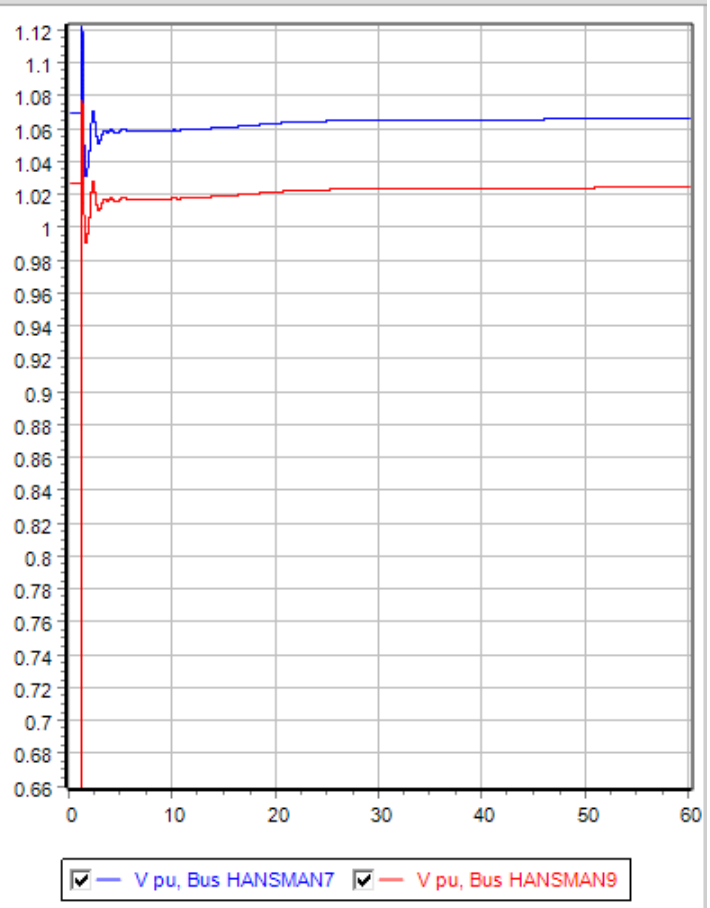
Study Case:
Scenario 5 (2022SL)

December 04, 2020 17:59:07

Hansman Lake 650S Voltages





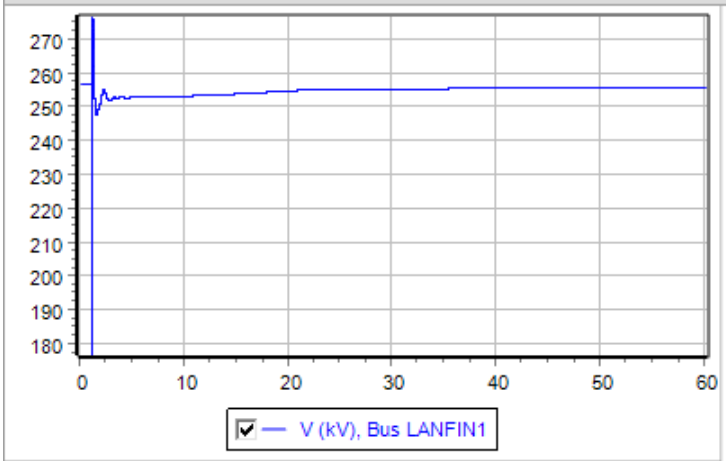


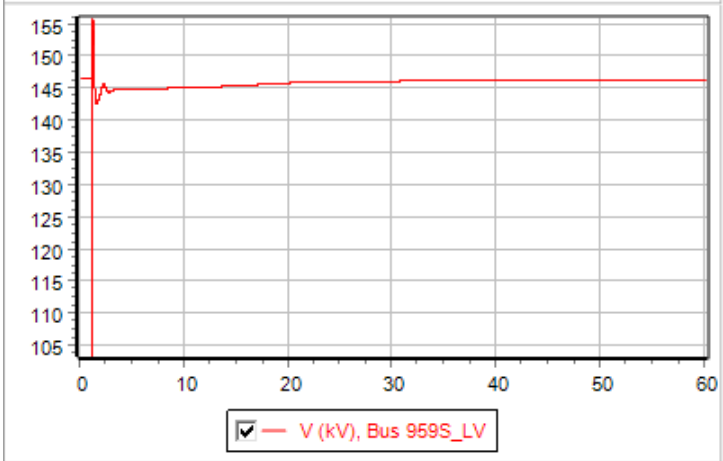
Contingency:
912L/9L912: Red Deer 63S to Nevis 766S

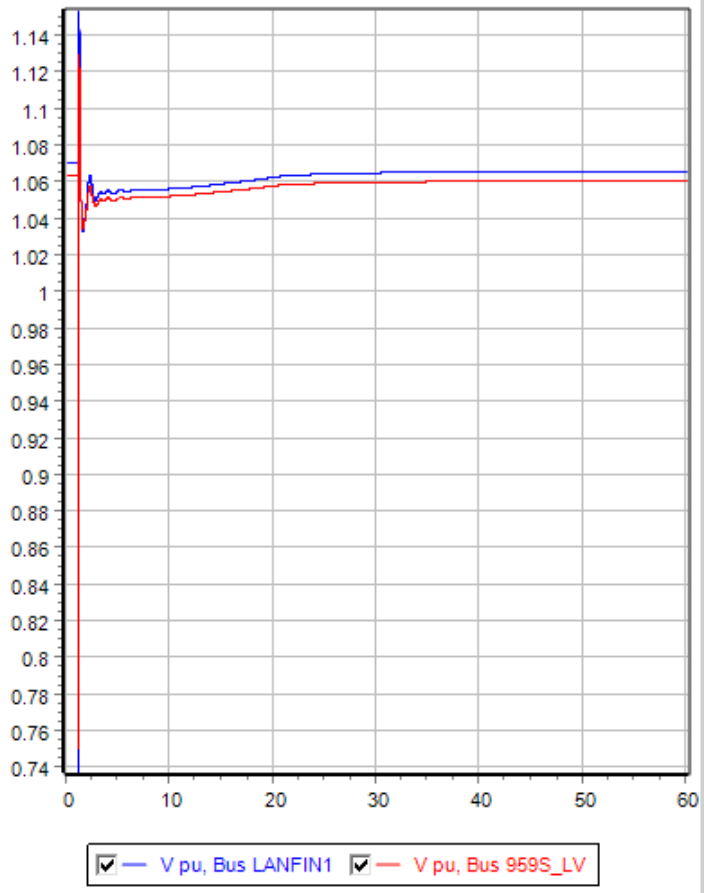
Study Case:
Scenario 5 (2022SL)

December 04, 2020 17:59:06

Lanfine 959S Voltages





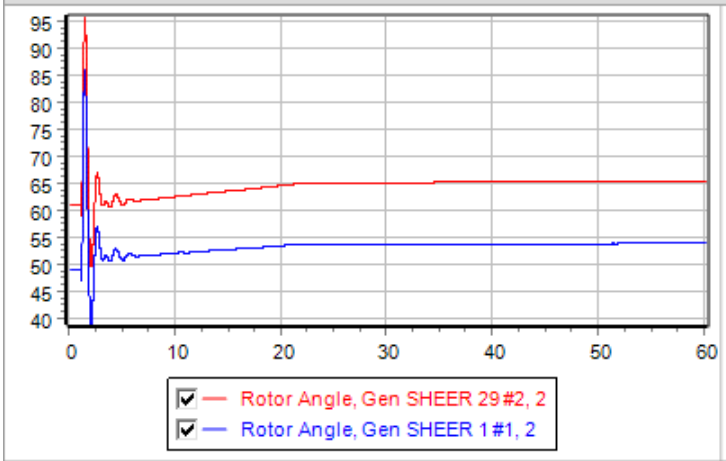


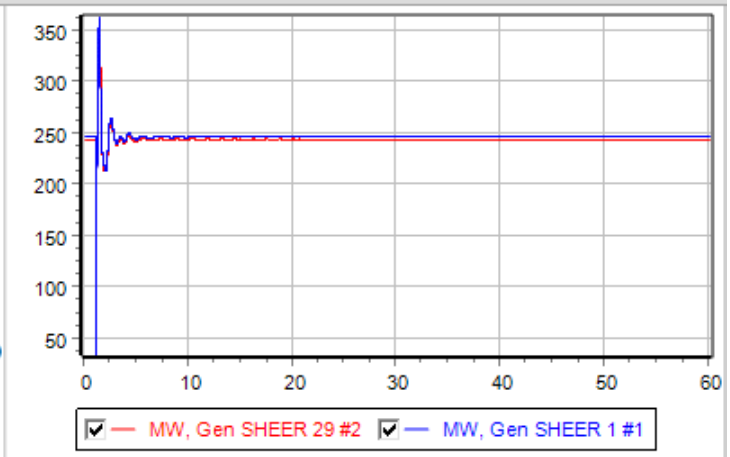
Contingency:
912L/9L912: Red Deer 63S to Nevis 766S

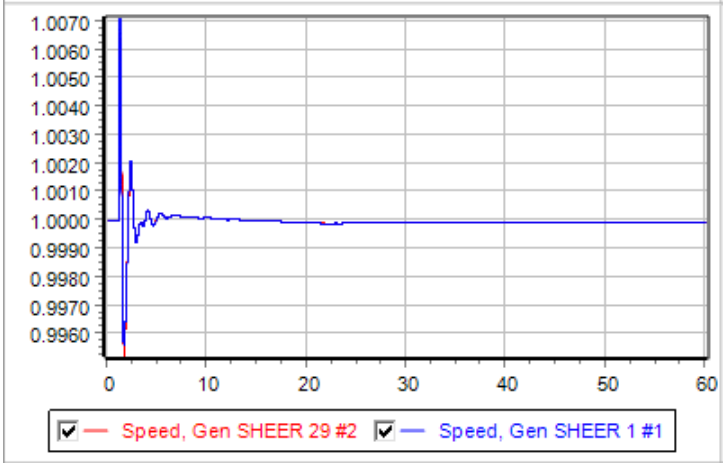
Study Case:
Scenario 5 (2022SL)

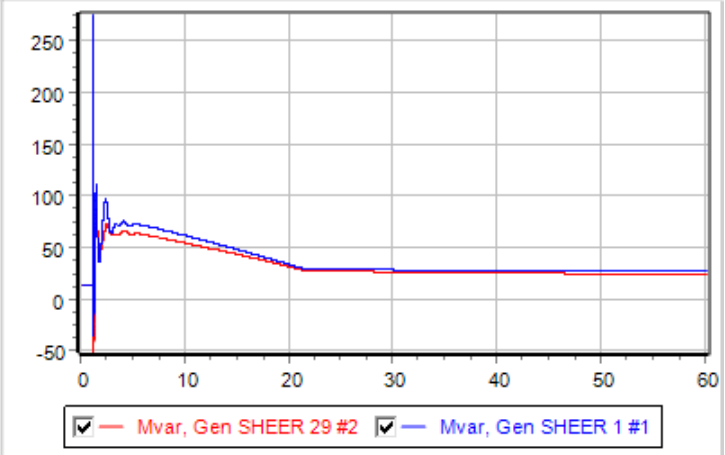
December 04, 2020 17:59:06

Sheerness









Contingency:
912L/9L912: Red Deer 63S to Nevis 766S

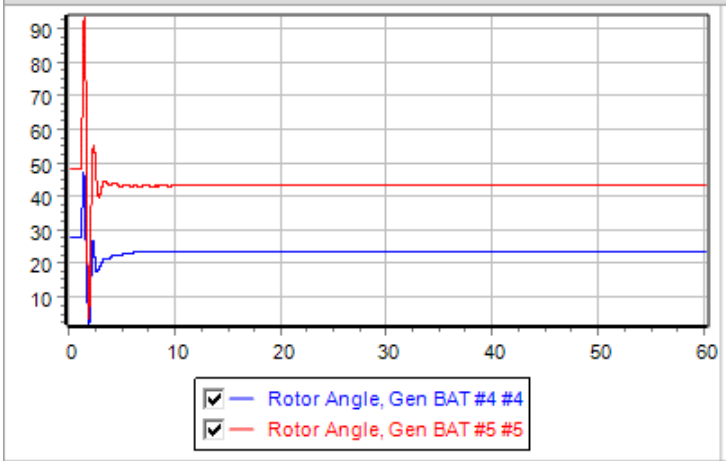
Study Case:
Scenario 5 (2022SL)

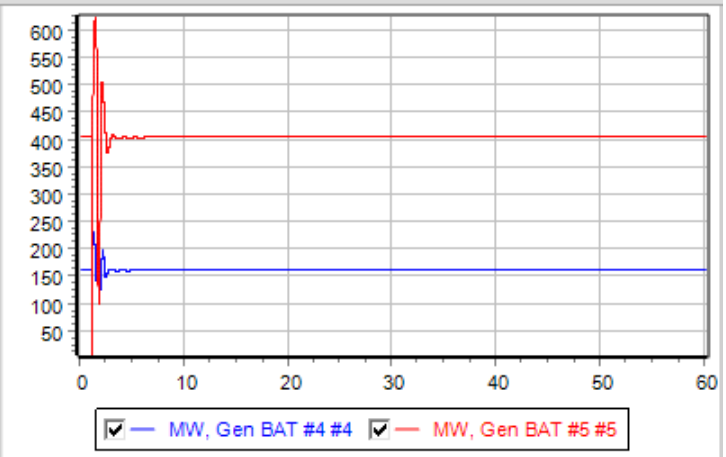
December 04, 2020 17:59:04

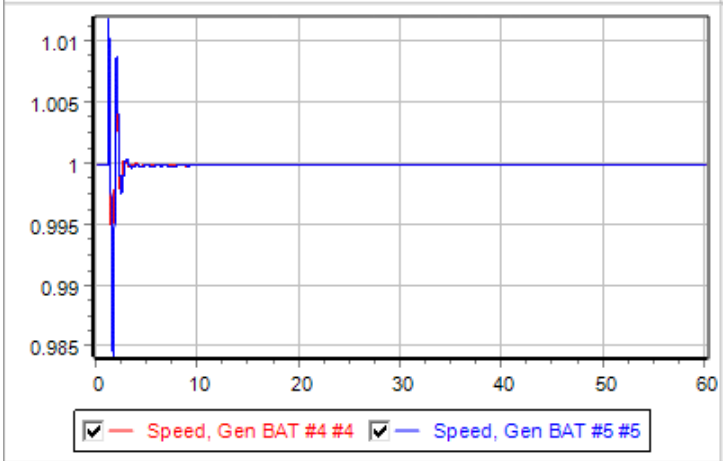
A4.3

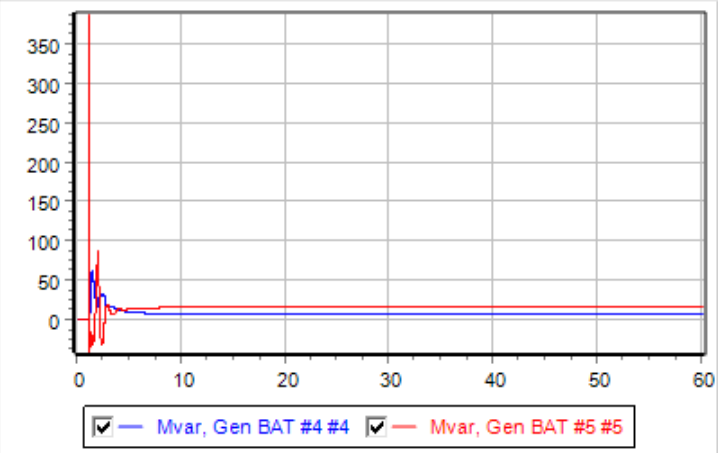
Scenario 6 (2022WP)

Battle River







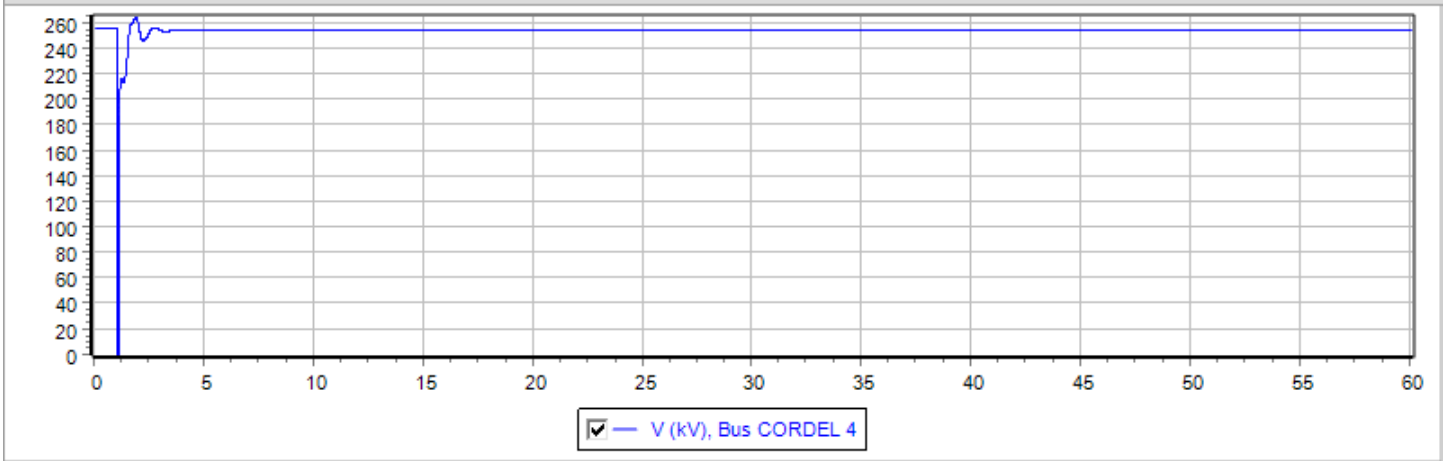


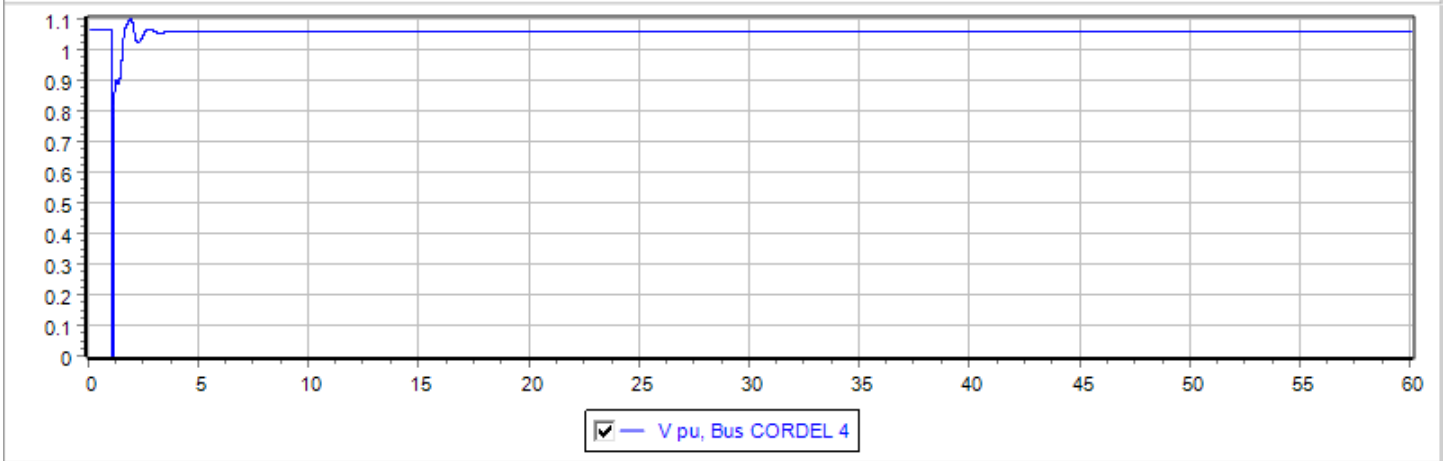
Contingency:
9L16/9L49: Cordel 755S to Tinchebray 972S

Study Case:
Scenario 6 (2022WP)

December 04, 2020 19:58:06

Cordel 755S Voltages



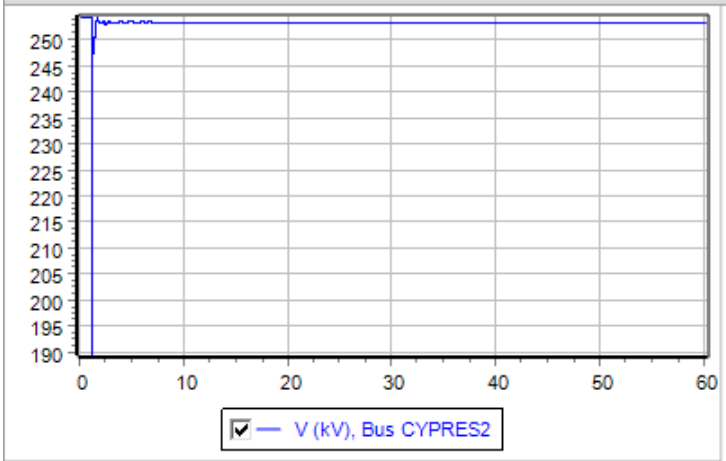


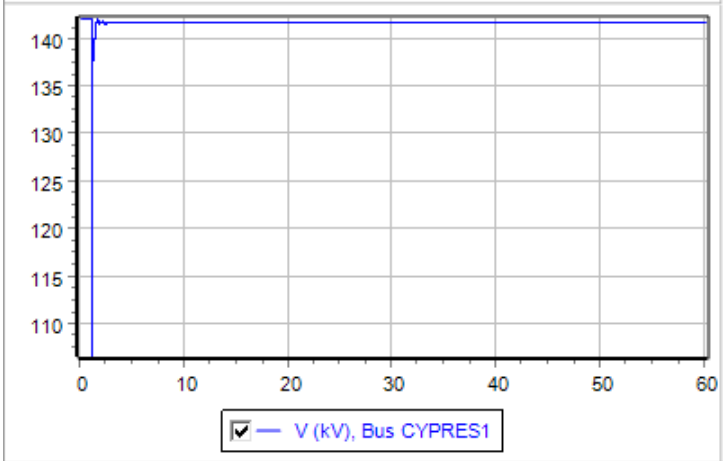
Contingency:
9L16/9L49: Cordel 755S to Tinchebray 972S

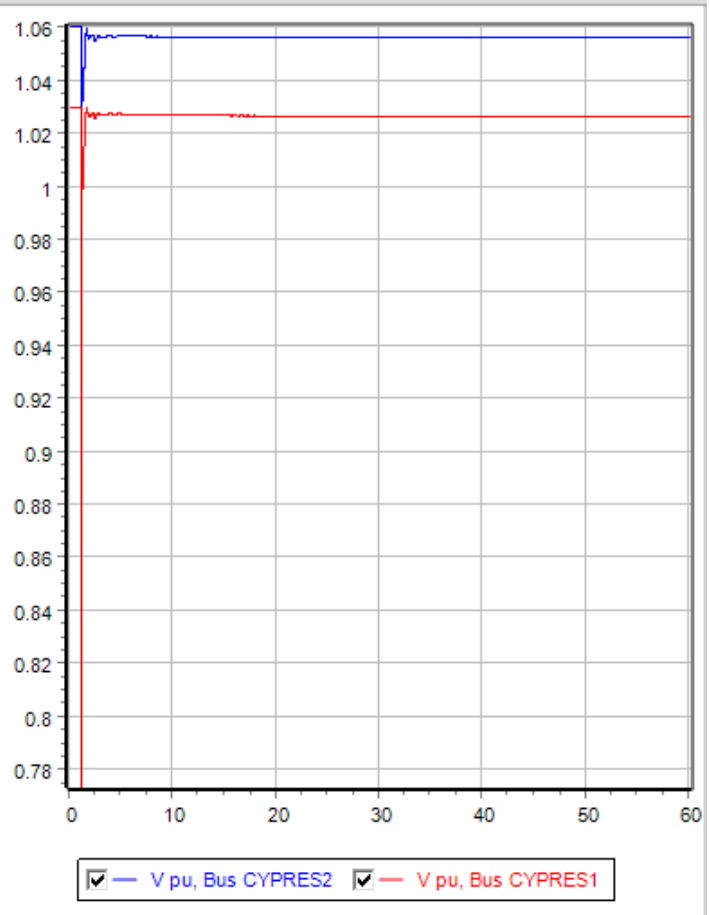
Study Case:
Scenario 6 (2022WP)

December 04, 2020 19:58:09

Cypress 562S Voltages





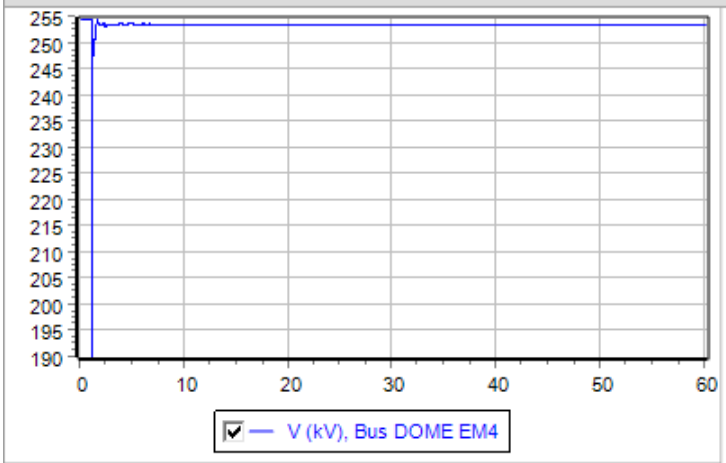


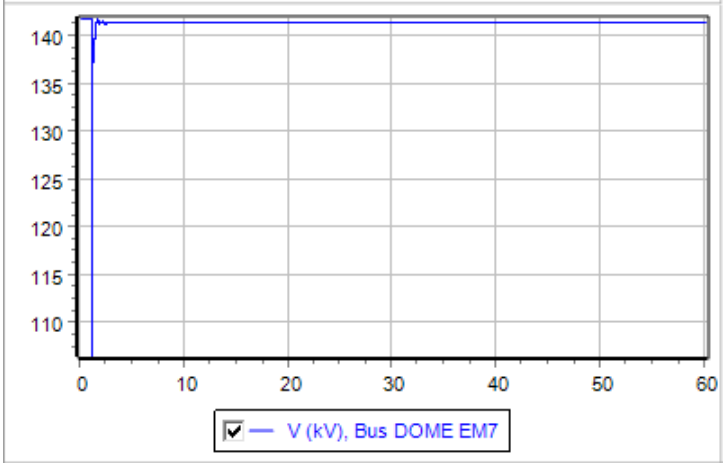
Contingency:
9L16/9L49: Cordel 755S to Tinchebray 972S

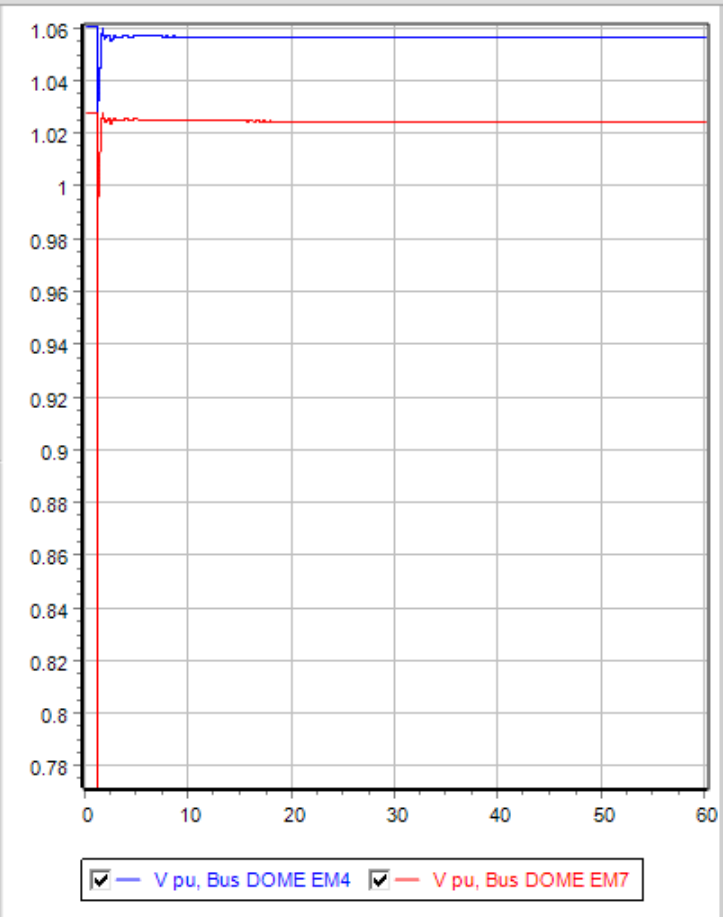
Study Case:
Scenario 6 (2022WP)

December 04, 2020 19:58:08

Dome 163S Voltages





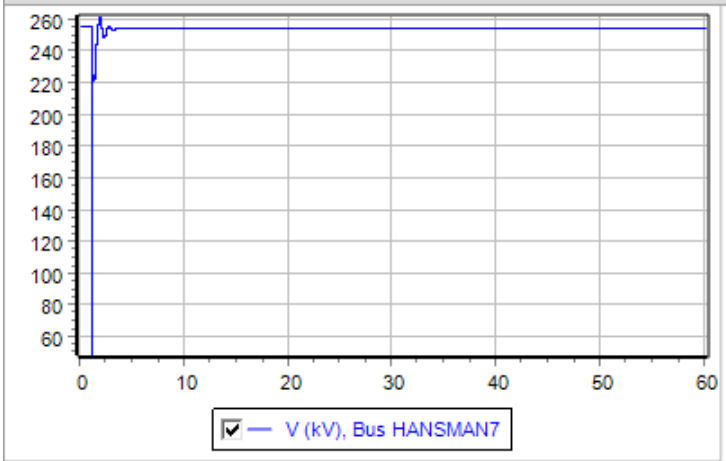


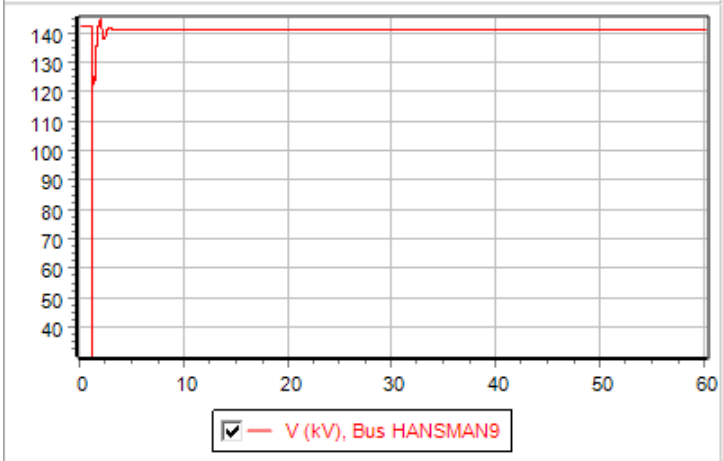
Contingency:
9L16/9L49: Cordel 755S to Tinchebray 972S

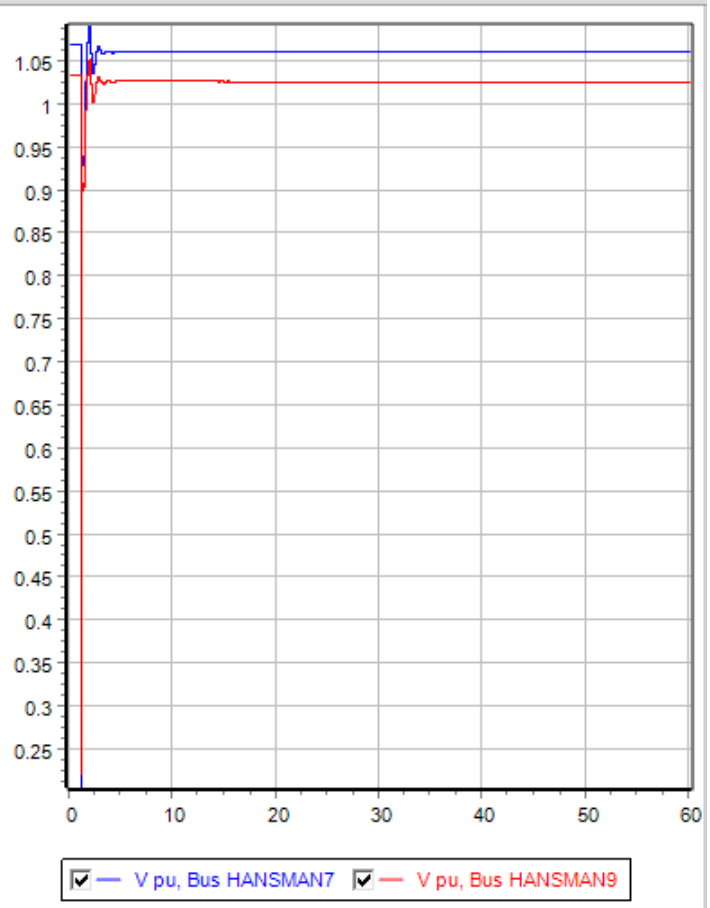
Study Case:
Scenario 6 (2022WP)

December 04, 2020 19:58:08

Hansman Lake 650S Voltages





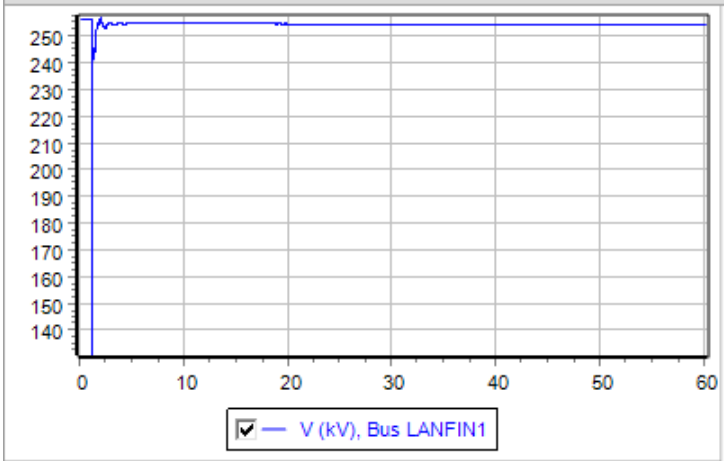


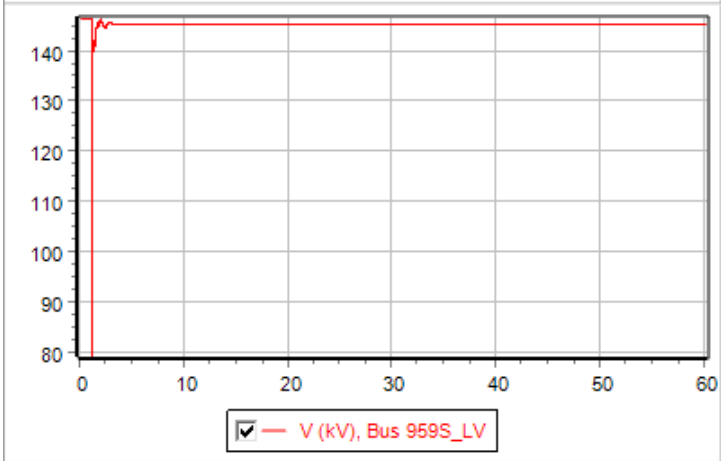
Contingency:
9L16/9L49: Cordel 755S to Tinchebray 972S

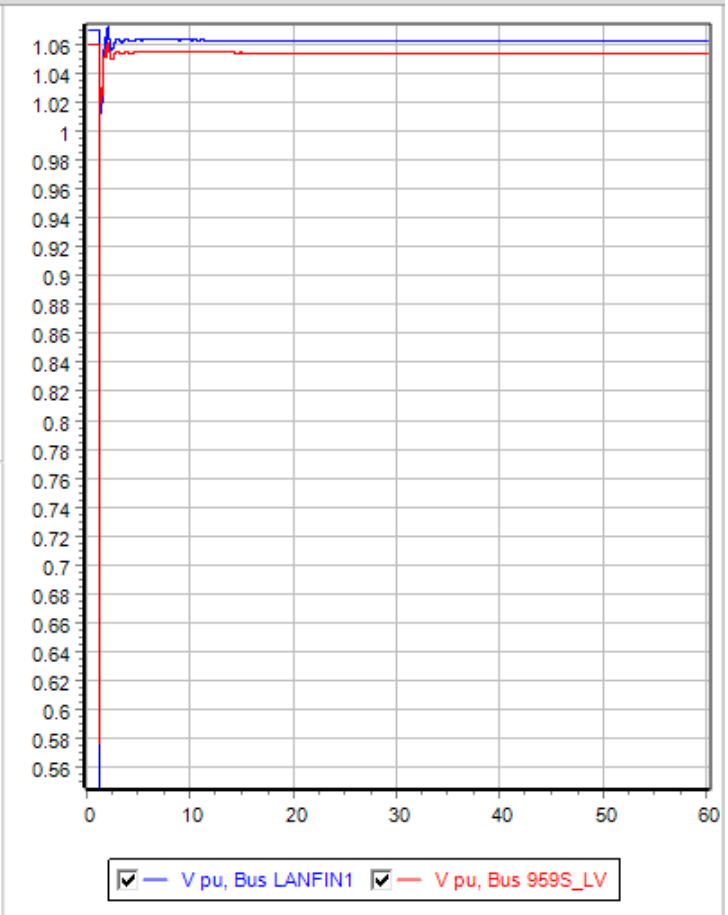
Study Case:
Scenario 6 (2022WP)

December 04, 2020 19:58:07

Lanfine 959S Voltages





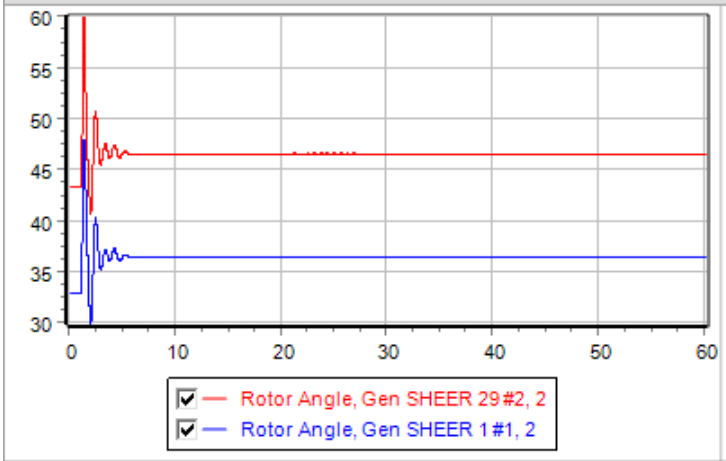


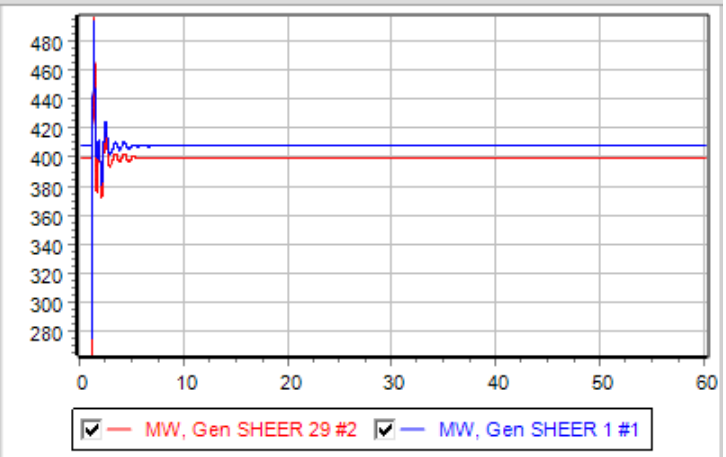
Contingency:
9L16/9L49: Cordel 755S to Tinchebray 972S

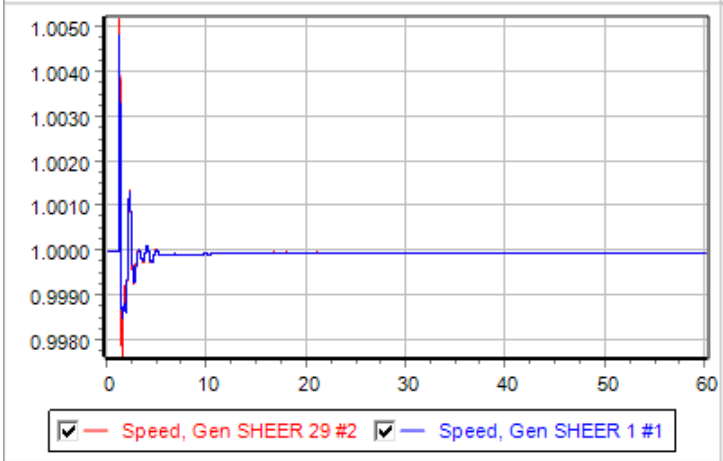
Study Case:
Scenario 6 (2022WP)

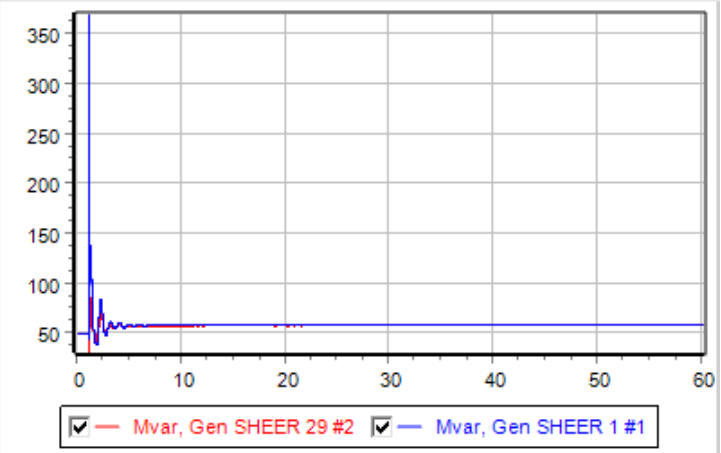
December 04, 2020 19:58:06

Sheerness







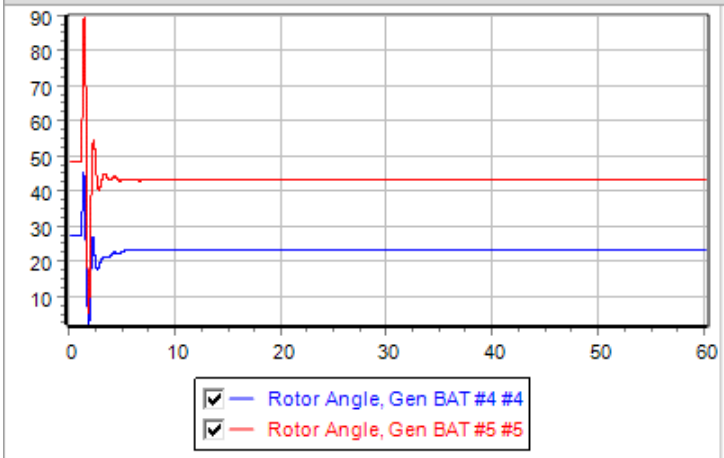


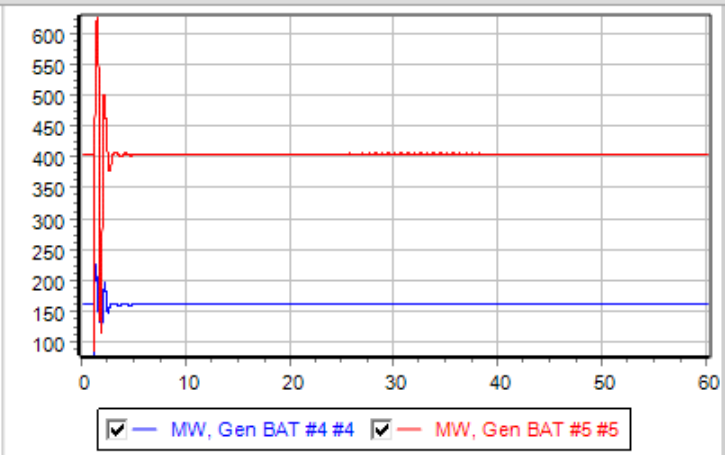
Contingency:
9L16/9L49: Cordel 755S to Tinchebray 972S

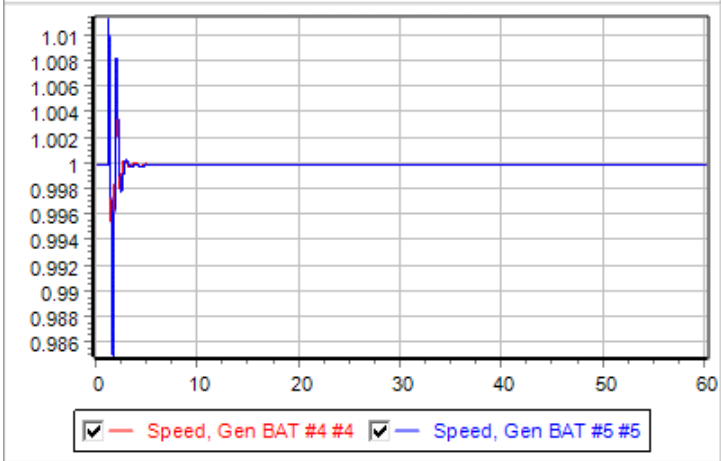
Study Case:
Scenario 6 (2022WP)

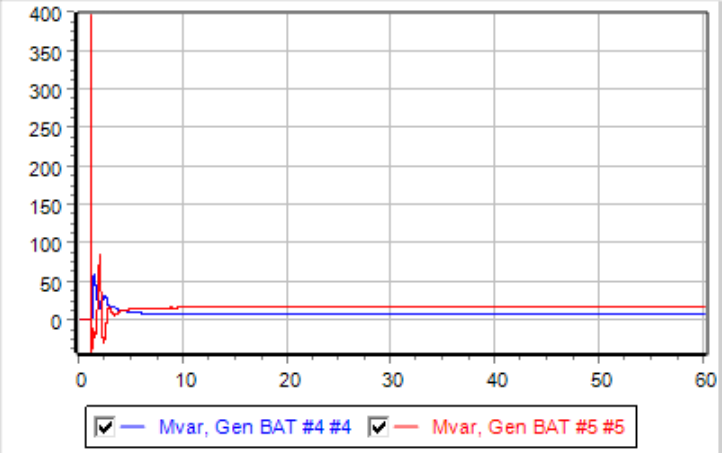
December 04, 2020 19:58:05

Battle River







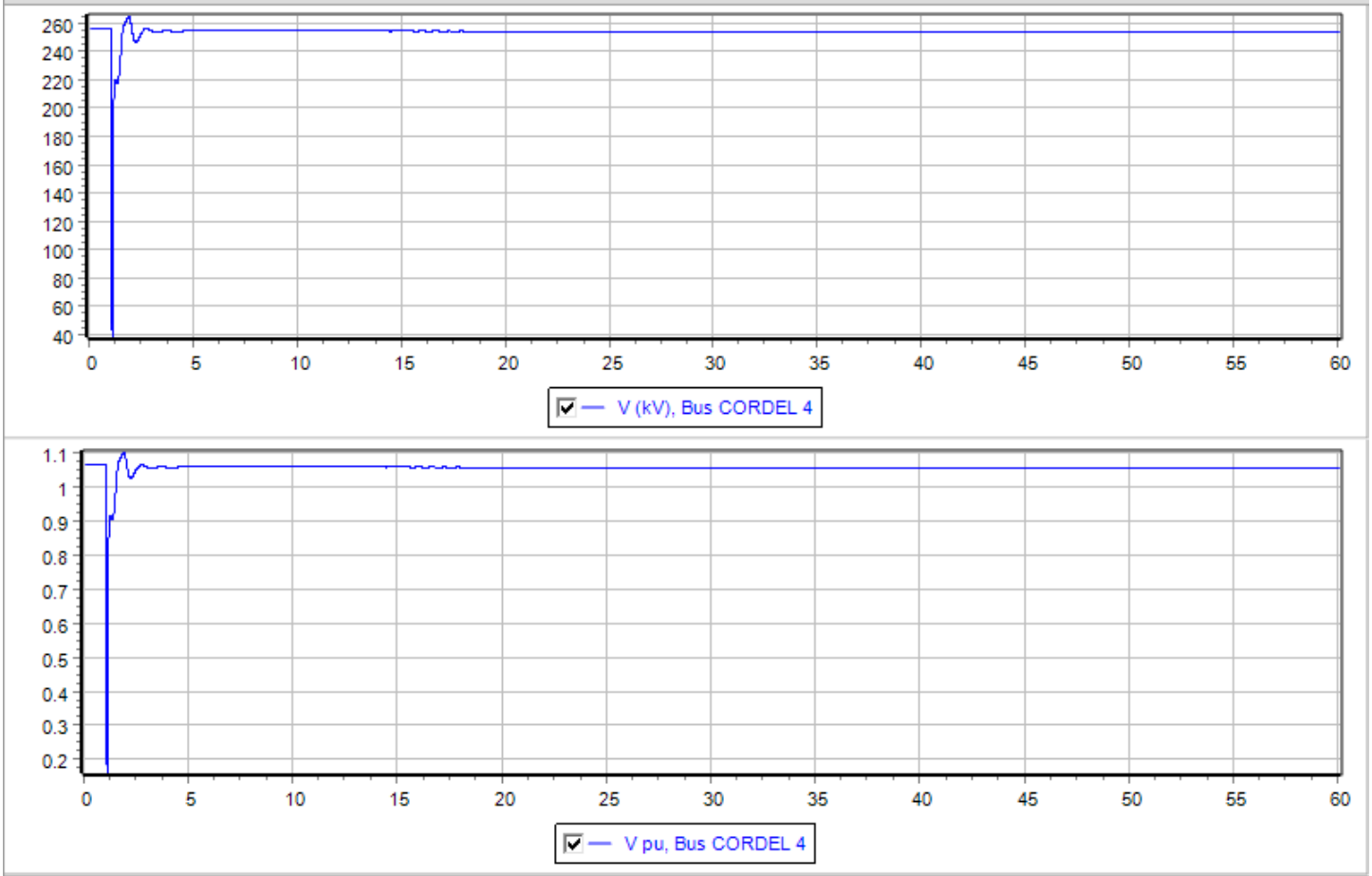


Contingency:
9L16/9L49: Tinchebray 972S to Cordel 755S

Study Case:
Scenario 6 (2022WP)

December 04, 2020 20:01:32

Cordel 755S Voltages

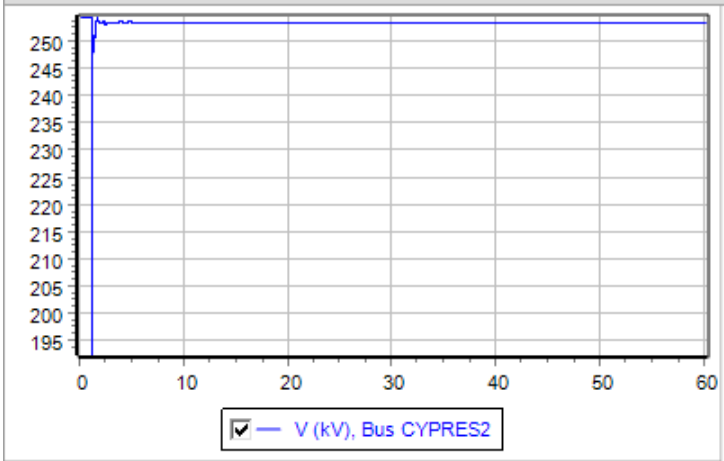


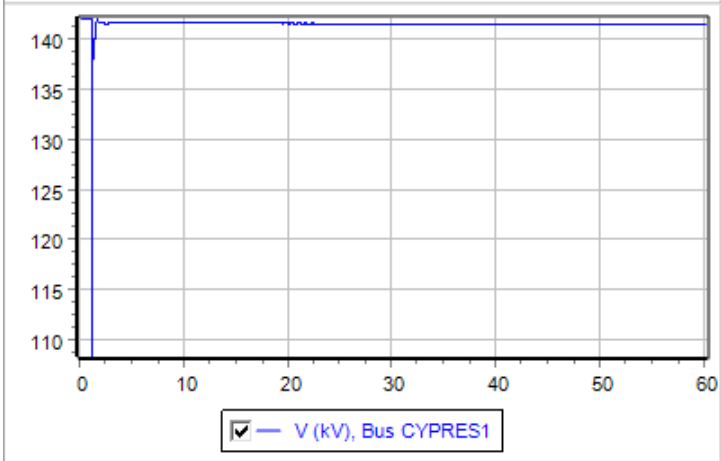
Contingency:
9L16/9L49: Tinchebray 972S to Cordel 755S

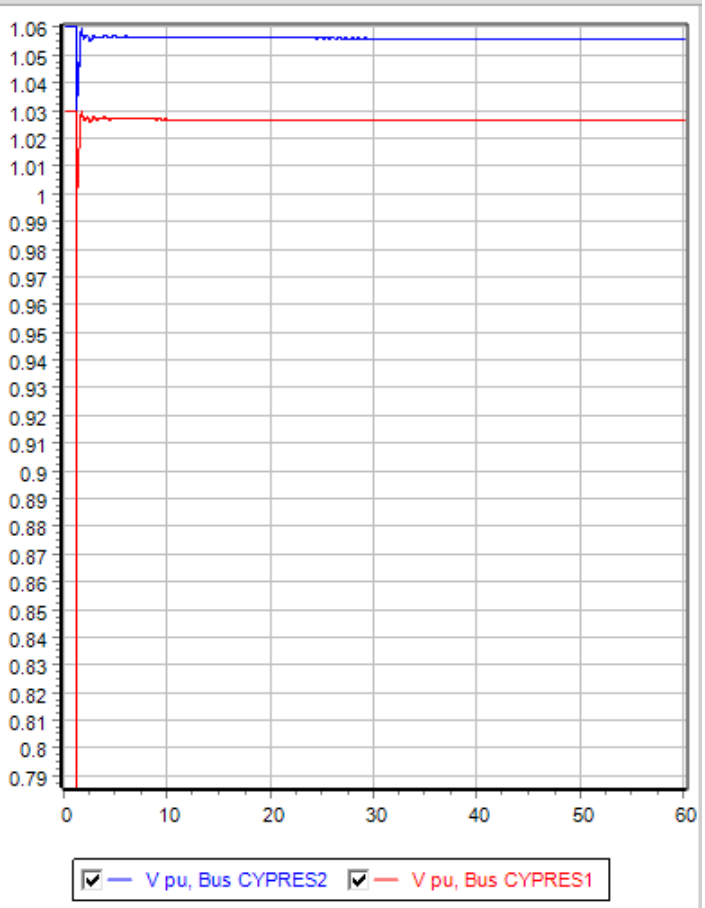
Study Case:
Scenario 6 (2022WP)

December 04, 2020 20:01:35

Cypress 562S Voltages





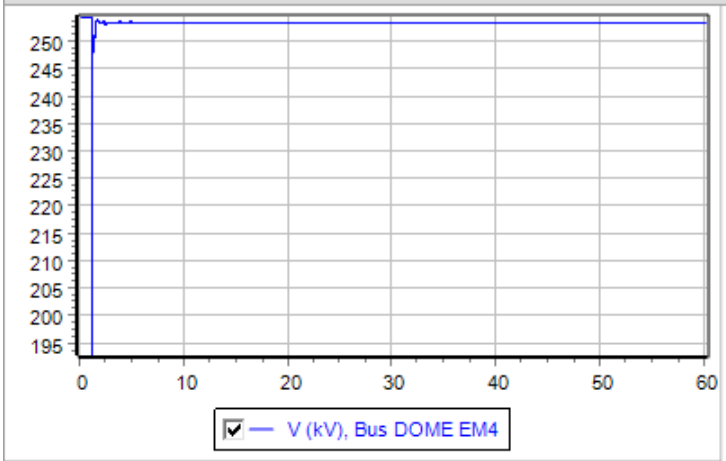


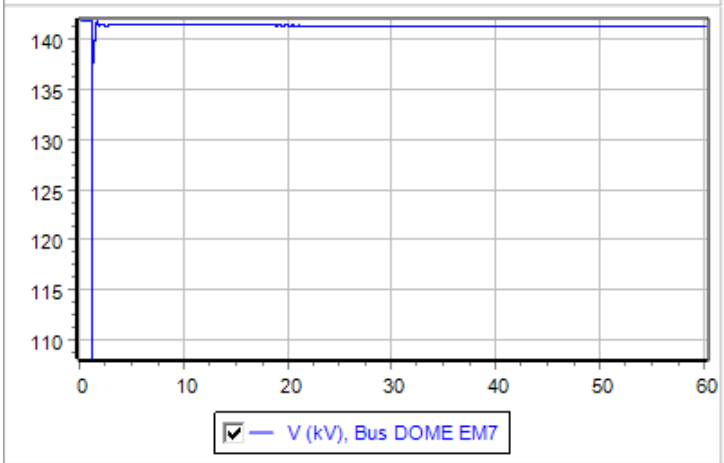
Contingency:
9L16/9L49: Tinchebray 972S to Cordel 755S

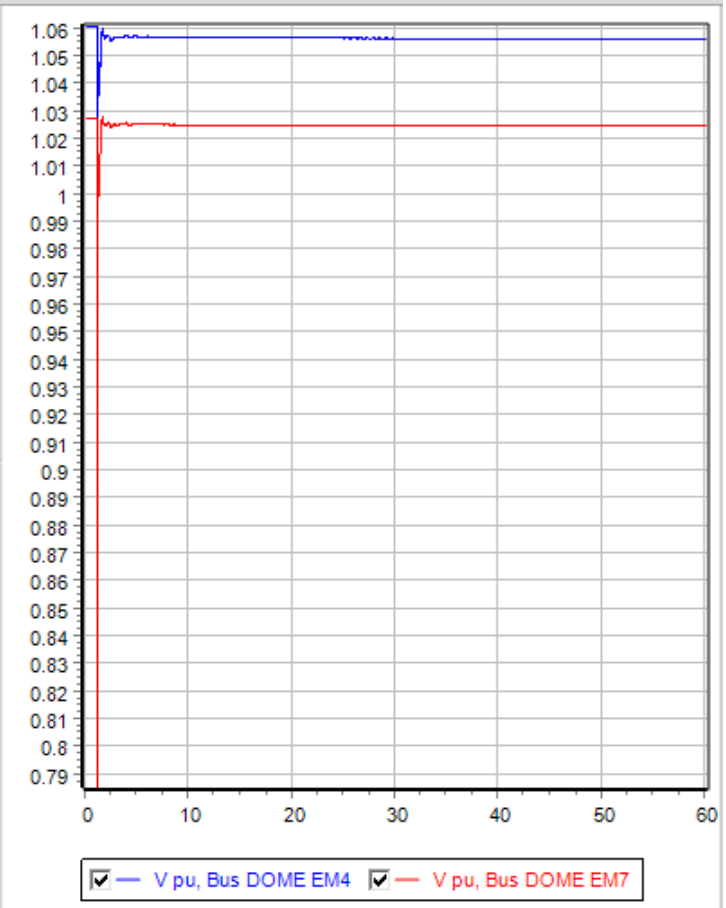
Study Case:
Scenario 6 (2022WP)

December 04, 2020 20:01:34

Dome 163S Voltages





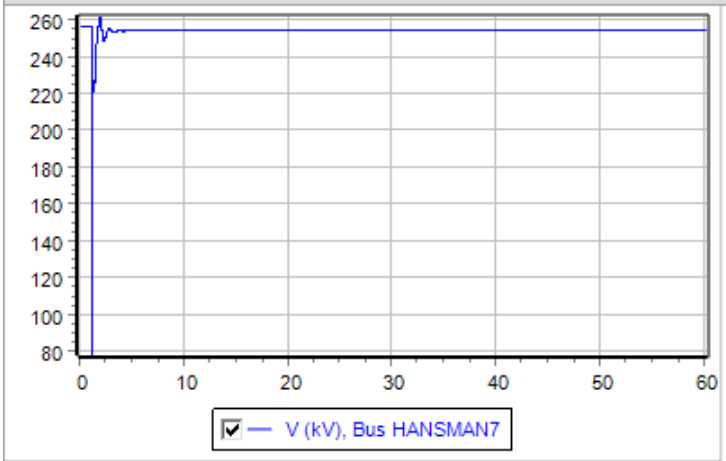


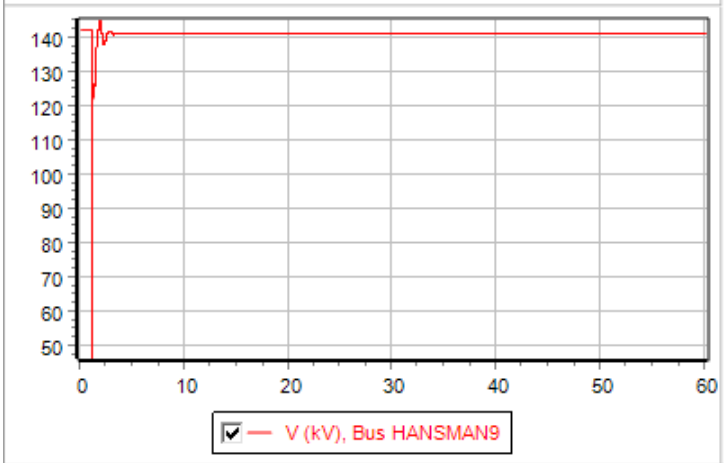
Contingency:
9L16/9L49: Tinchebray 972S to Cordel 755S

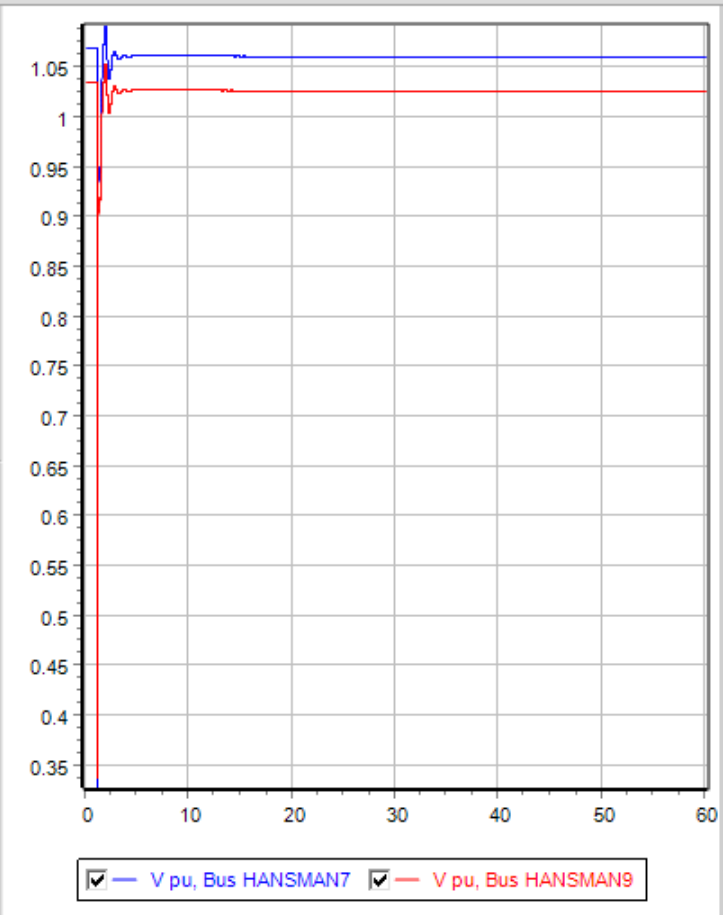
Study Case:
Scenario 6 (2022WP)

December 04, 2020 20:01:34

Hansman Lake 650S Voltages





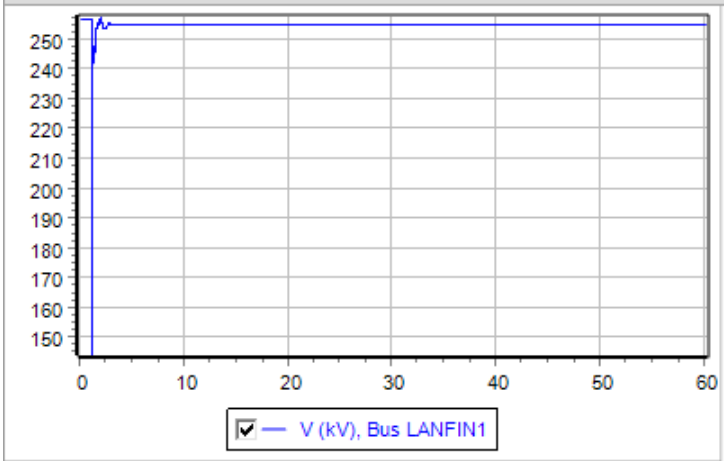


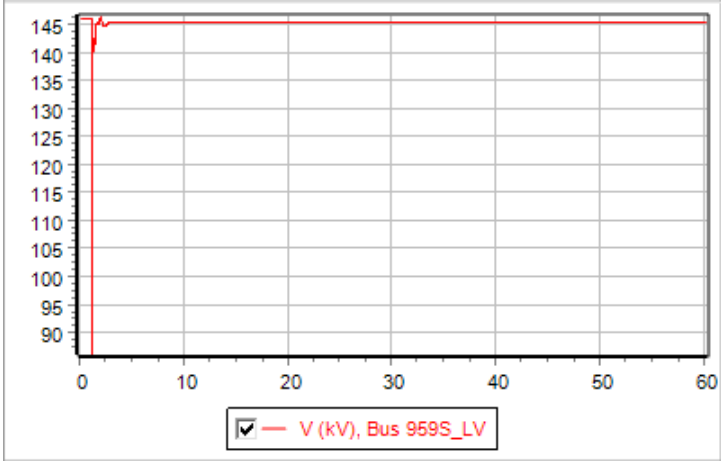
Contingency:
9L16/9L49: Tinchebray 972S to Cordel 755S

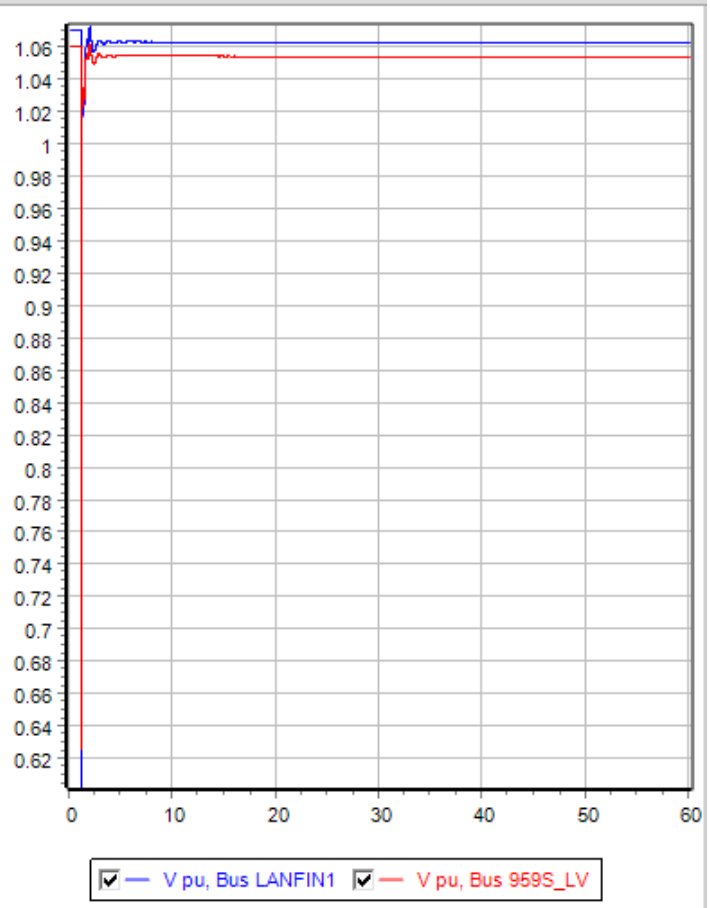
Study Case:
Scenario 6 (2022WP)

December 04, 2020 20:01:33

Lanfine 959S Voltages





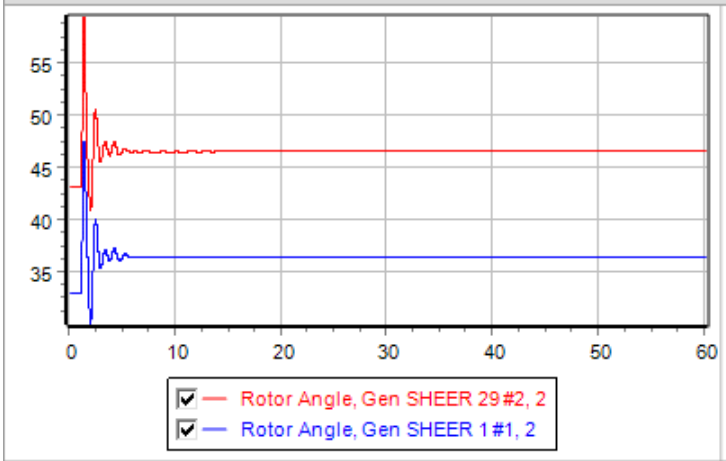


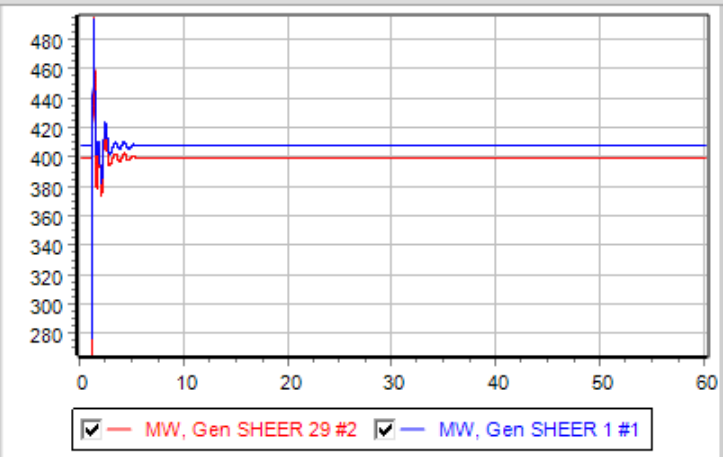
Contingency:
9L16/9L49: Tinchebray 972S to Cordel 755S

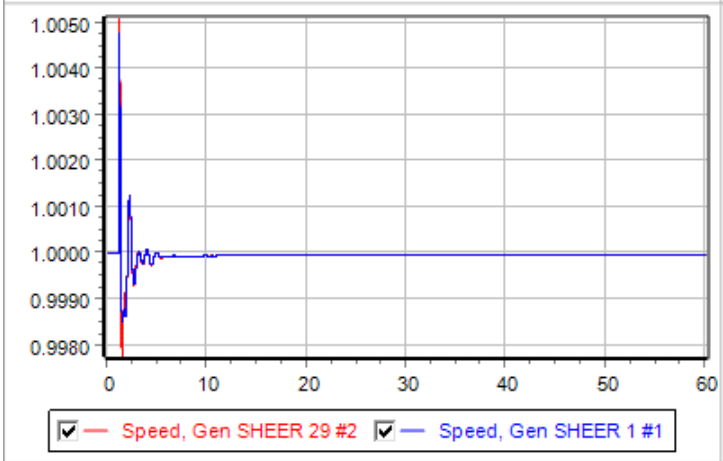
Study Case:
Scenario 6 (2022WP)

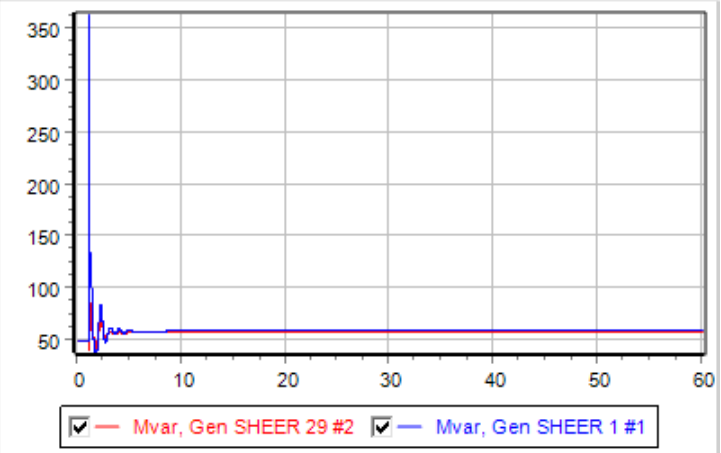
December 04, 2020 20:01:33

Sheerness







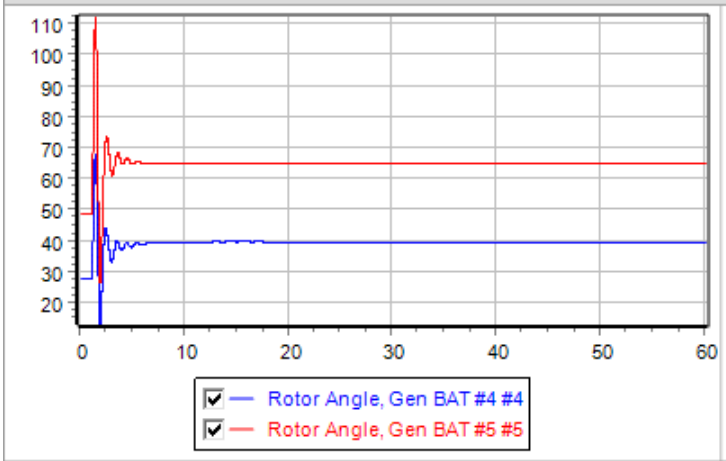


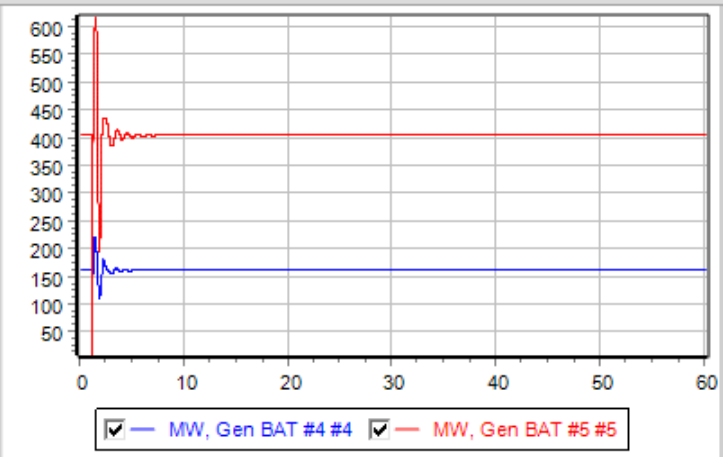
Contingency:
9L16/9L49: Tinchebray 972S to Cordel 755S

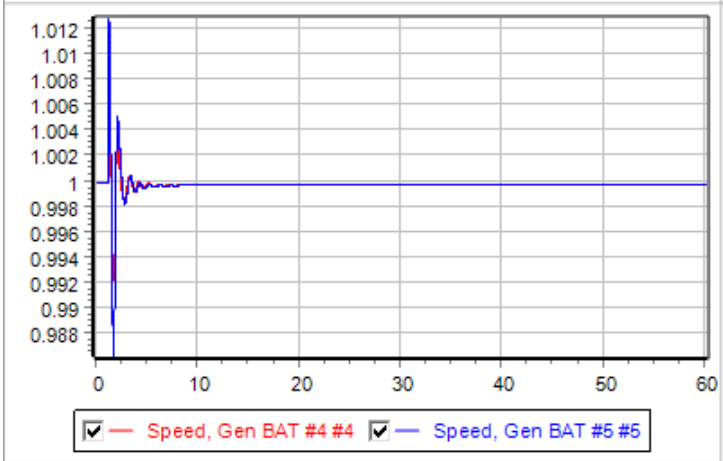
Study Case:
Scenario 6 (2022WP)

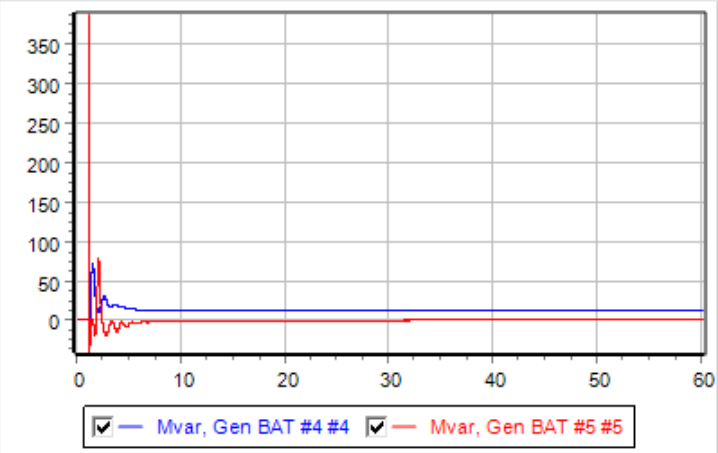
December 04, 2020 20:01:31

Battle River







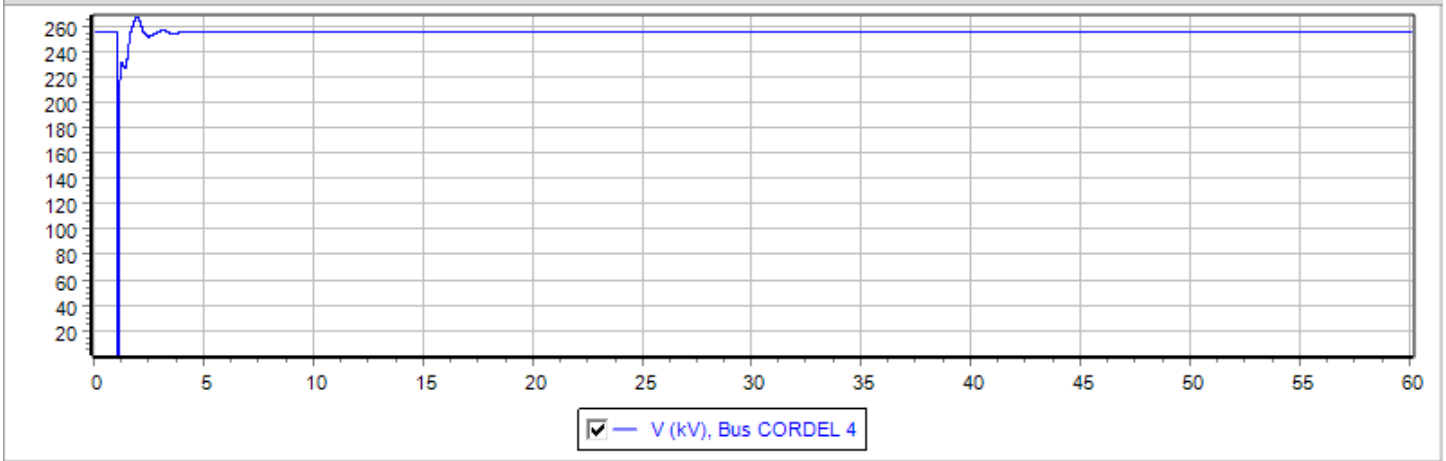


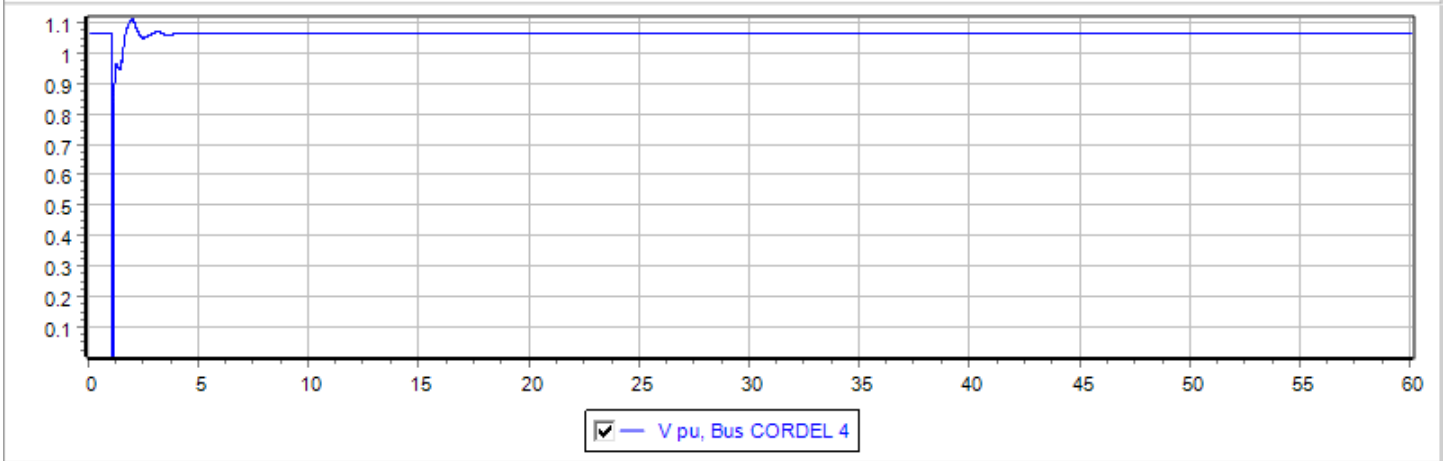
Contingency:
9L20: Cordel 755S to Nevis 766S

Study Case:
Scenario 6 (2022WP)

December 04, 2020 20:04:59

Cordel 755S Voltages



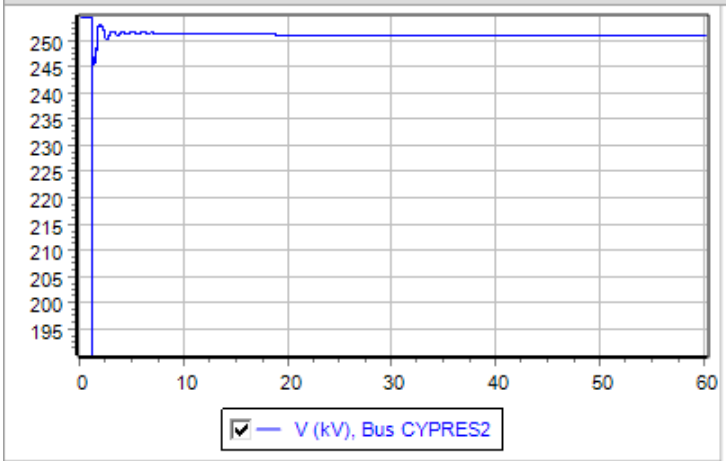


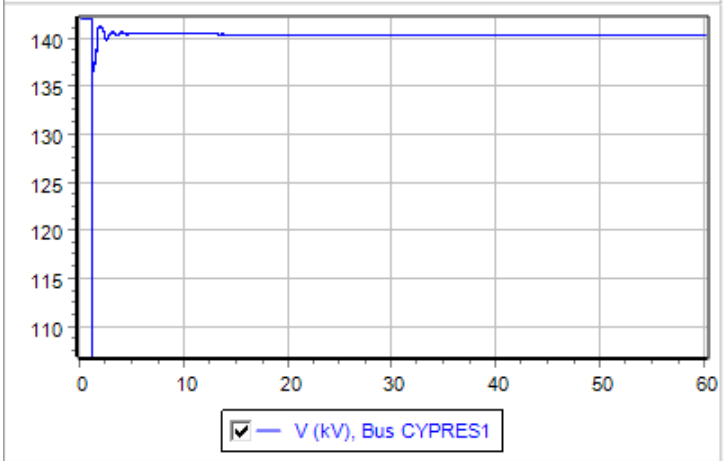
Contingency:
9L20: Cordel 755S to Nevis 766S

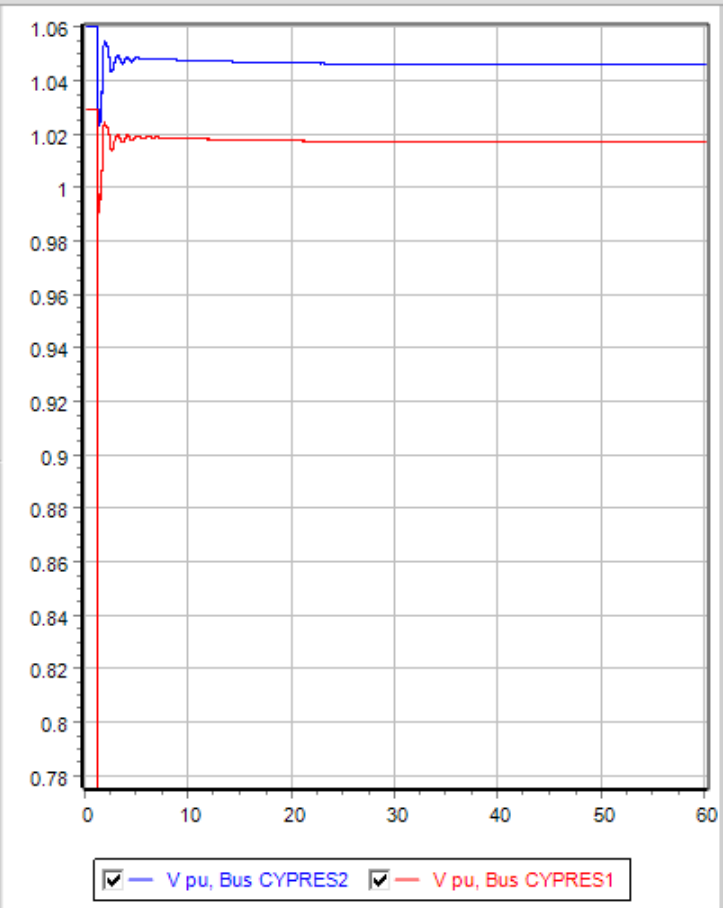
Study Case:
Scenario 6 (2022WP)

December 04, 2020 20:05:02

Cypress 562S Voltages





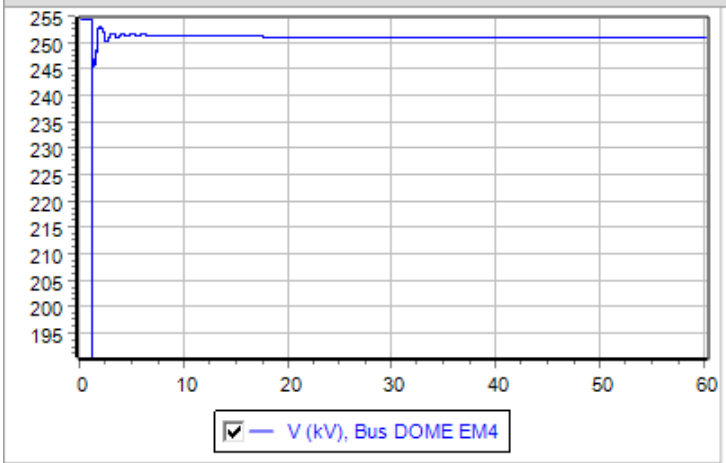


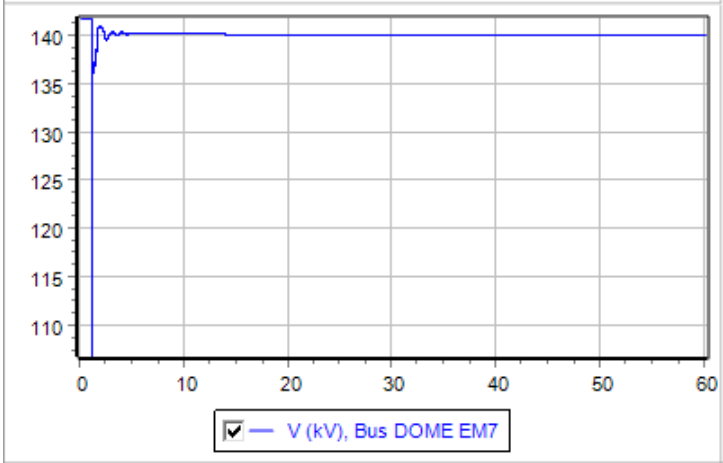
Contingency:
9L20: Cordel 755S to Nevis 766S

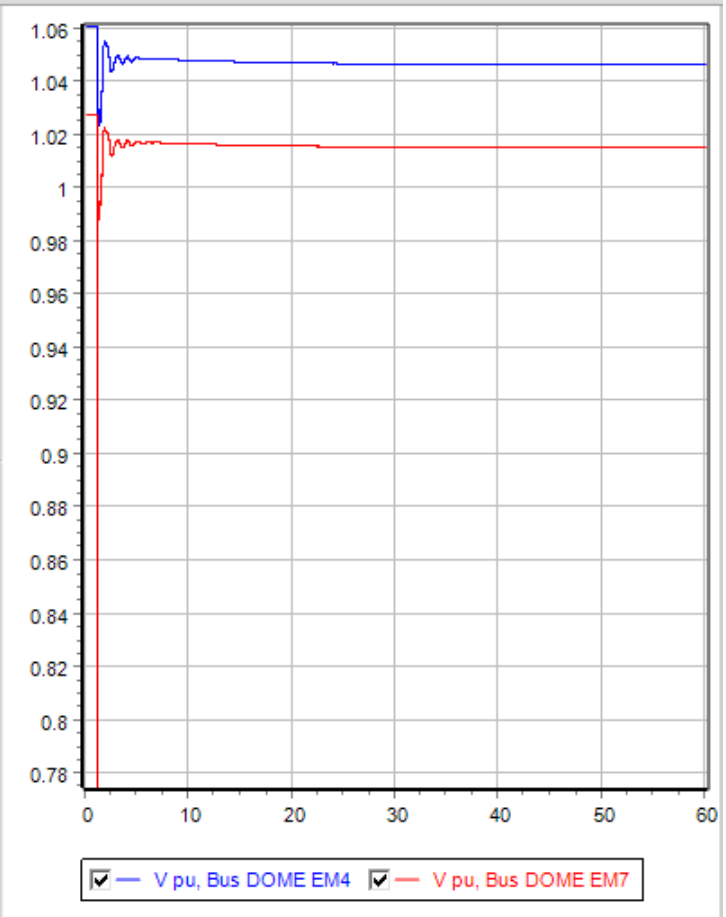
Study Case:
Scenario 6 (2022WP)

December 04, 2020 20:05:01

Dome 163S Voltages





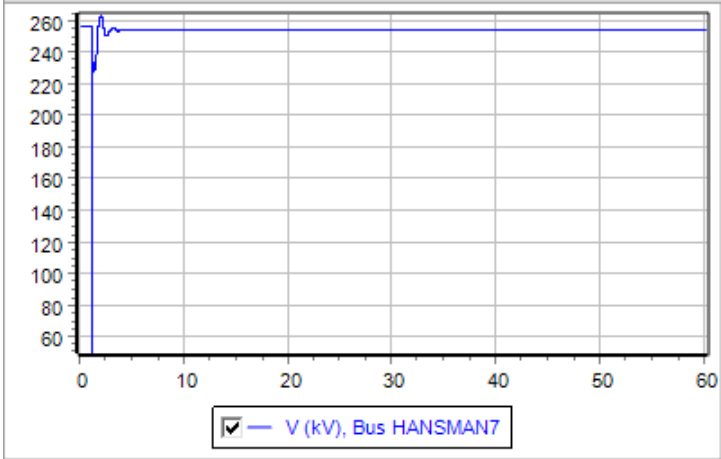


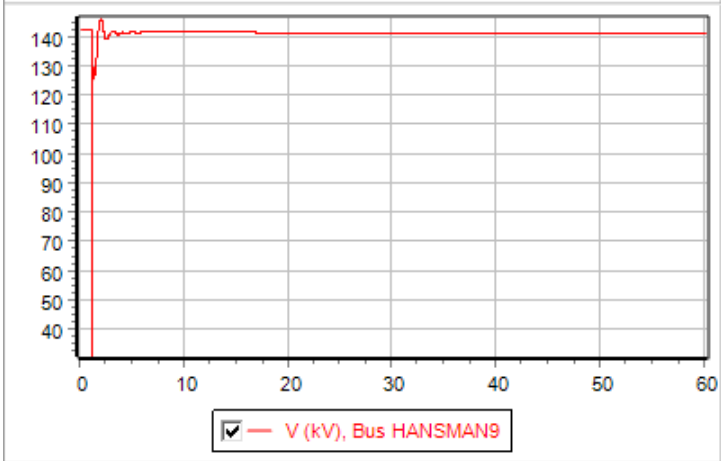
Contingency:
9L20: Cordel 755S to Nevis 766S

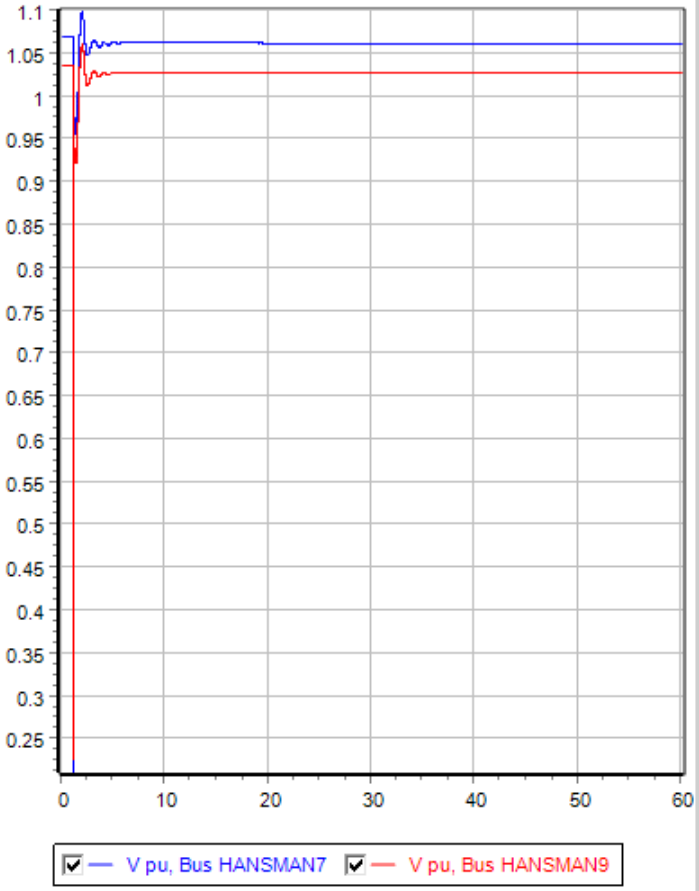
Study Case:
Scenario 6 (2022WP)

December 04, 2020 20:05:01

Hansman Lake 650S Voltages





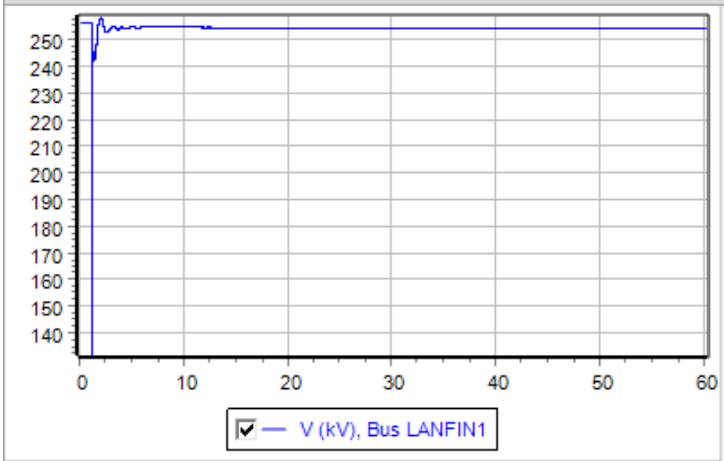


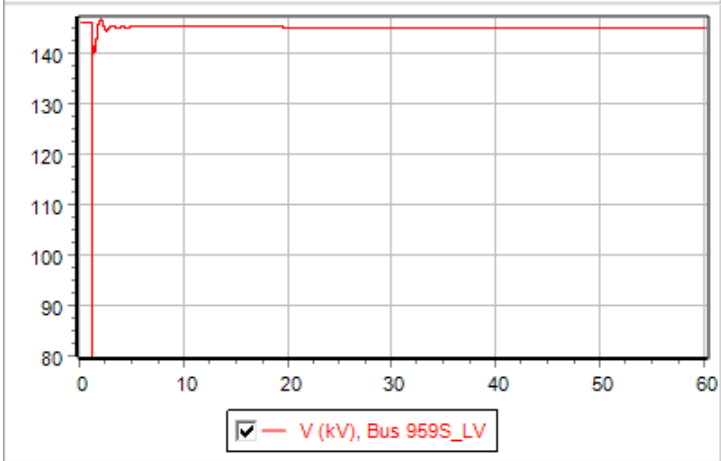
Contingency:
9L20: Cordel 755S to Nevis 766S

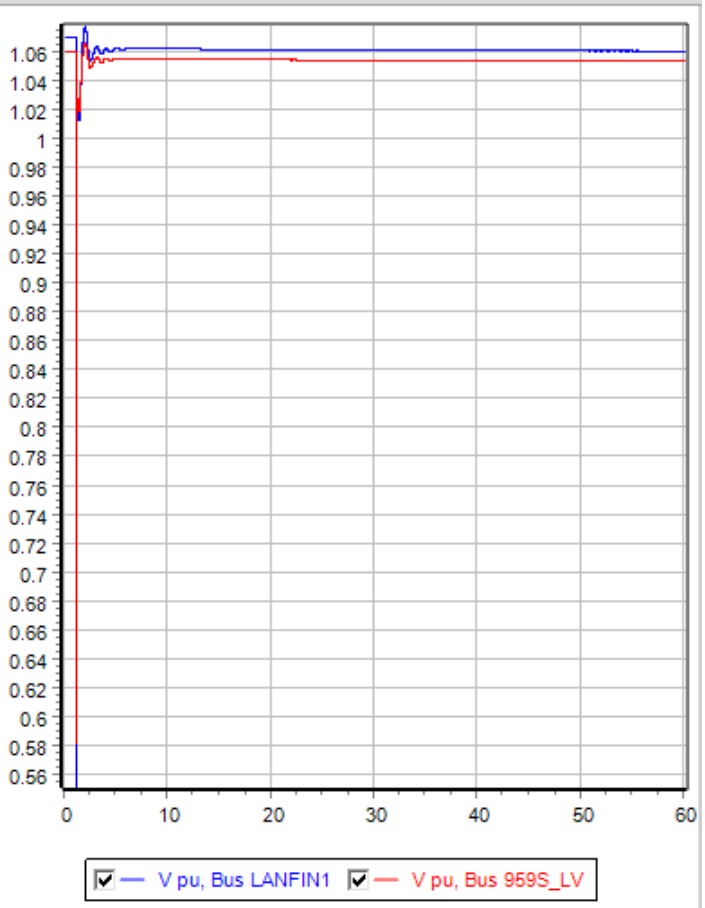
Study Case:
Scenario 6 (2022WP)

December 04, 2020 20:05:00

Lanfine 959S Voltages





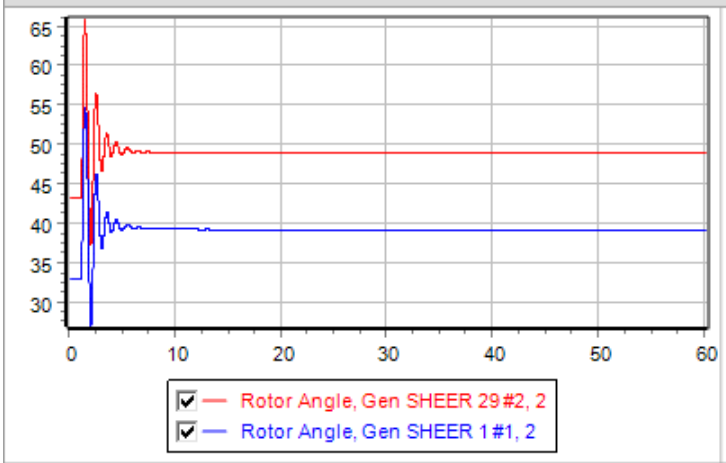


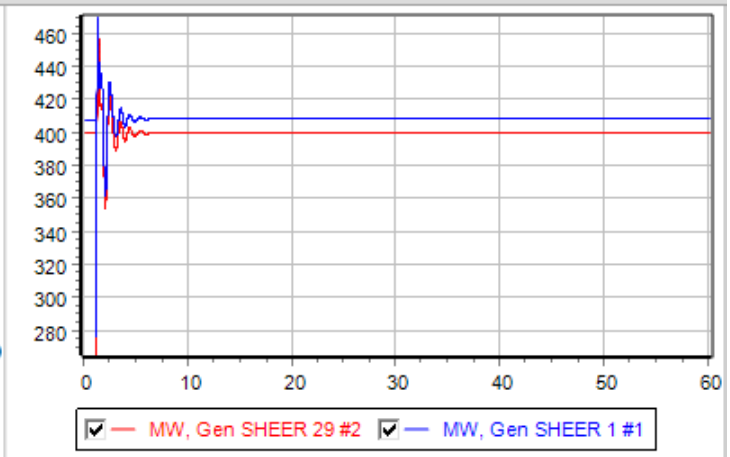
Contingency:
9L20: Cordel 755S to Nevis 766S

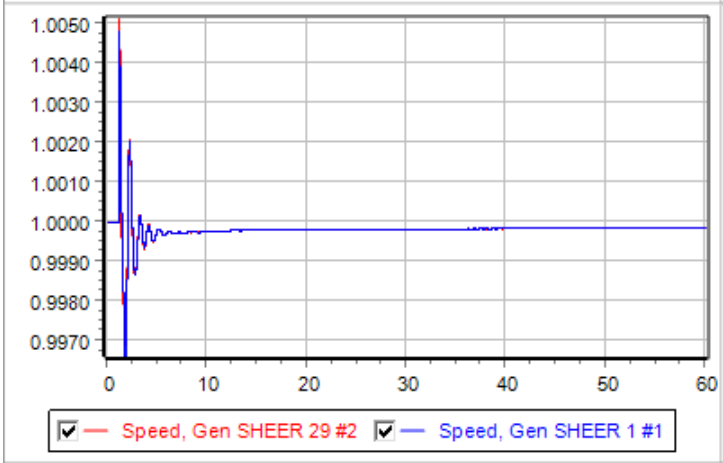
Study Case:
Scenario 6 (2022WP)

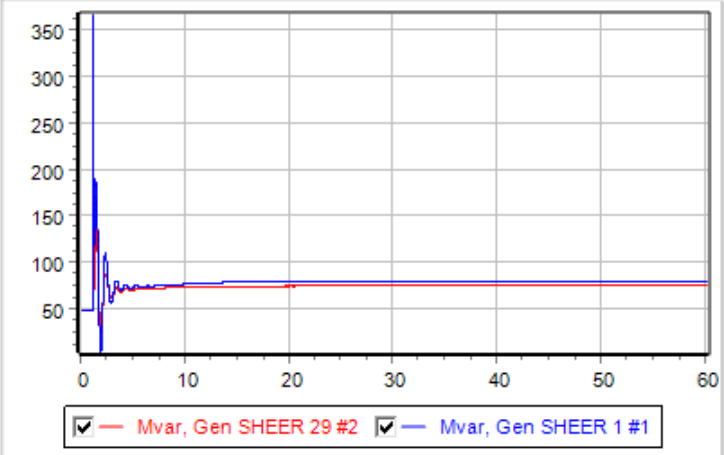
December 04, 2020 20:04:59

Sheerness







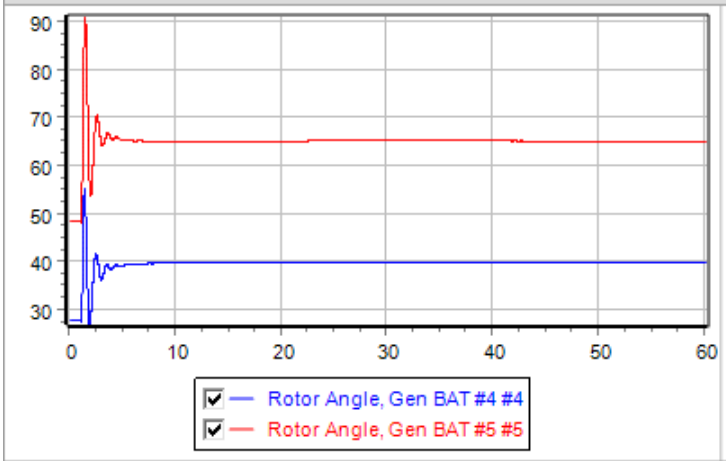


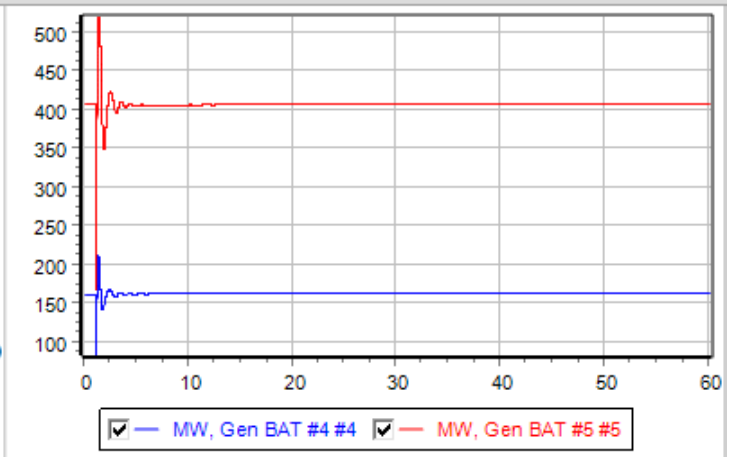
Contingency:
9L20: Cordel 755S to Nevis 766S

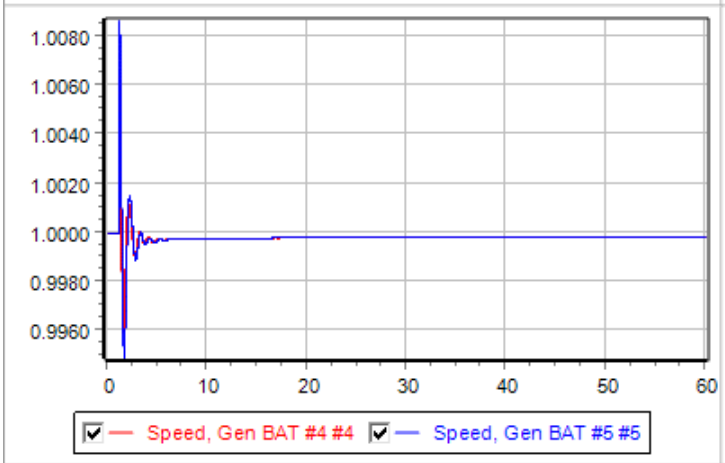
Study Case:
Scenario 6 (2022WP)

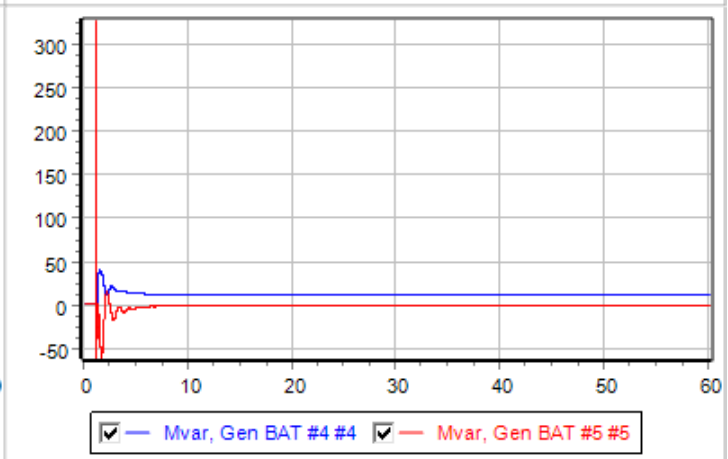
December 04, 2020 20:04:58

Battle River







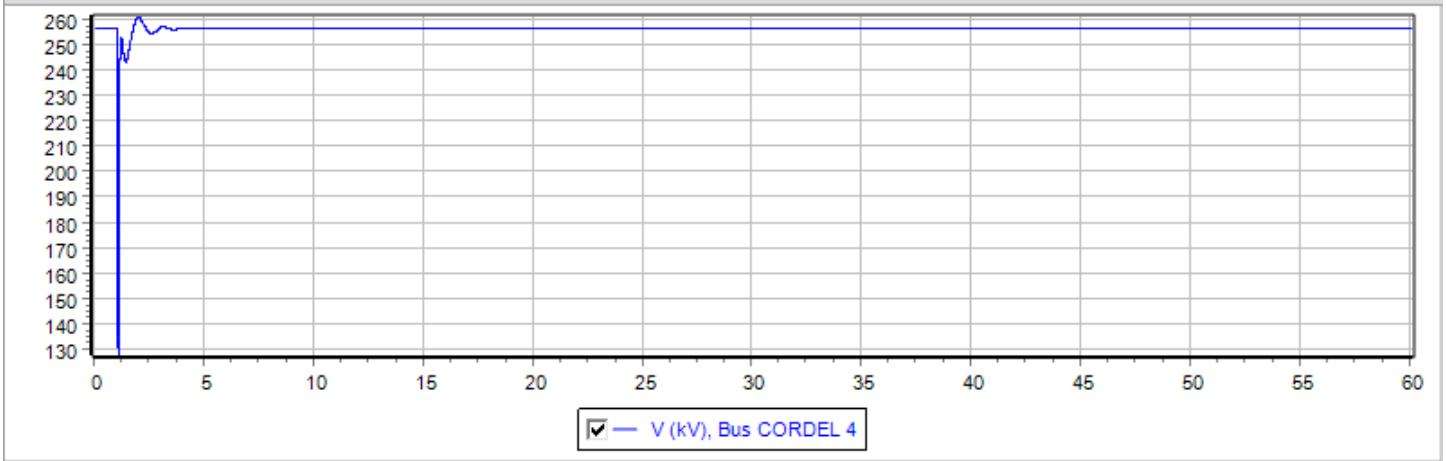


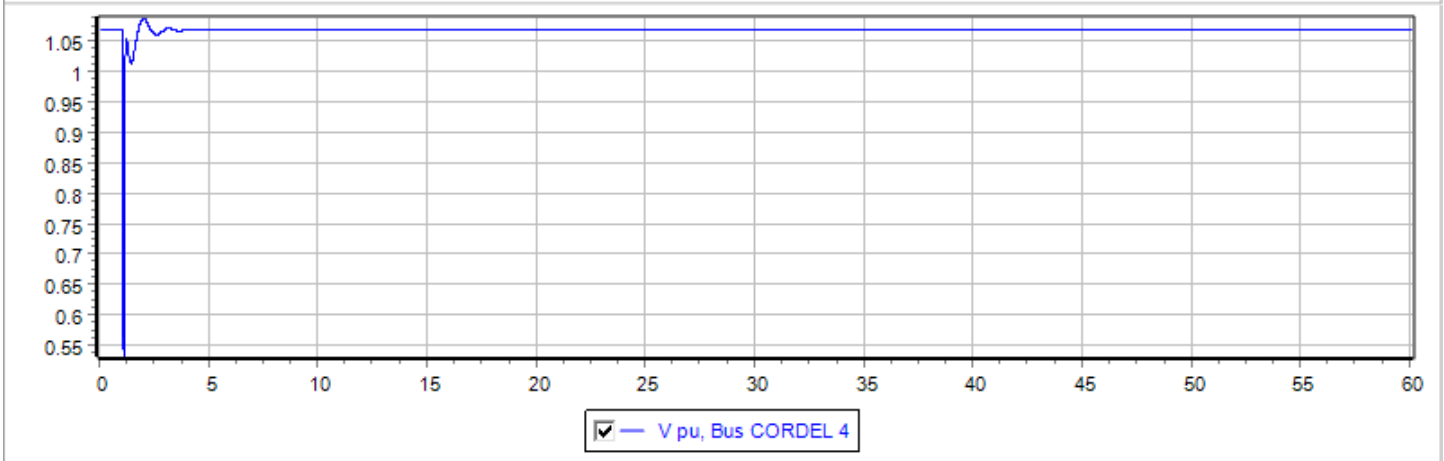
Contingency:
9L20: Nevis 766S to Cordel 755S

Study Case:
Scenario 6 (2022WP)

December 04, 2020 20:08:28

Cordel 755S Voltages



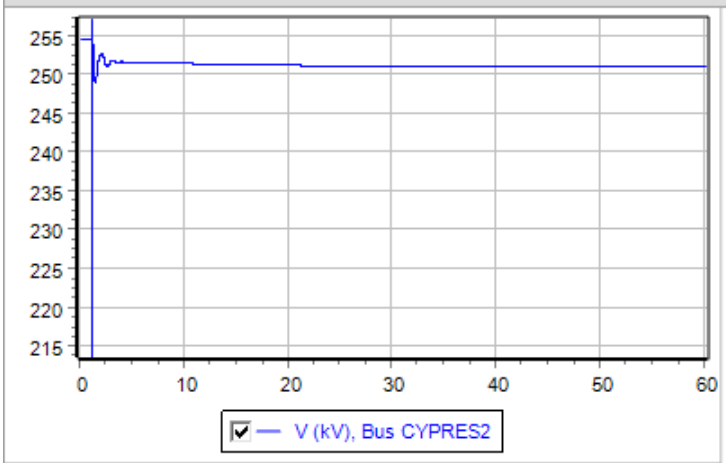


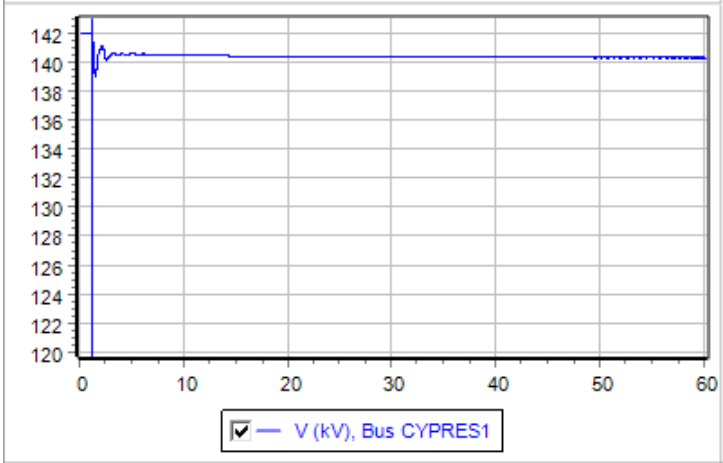
Contingency:
9L20: Nevis 766S to Cordel 755S

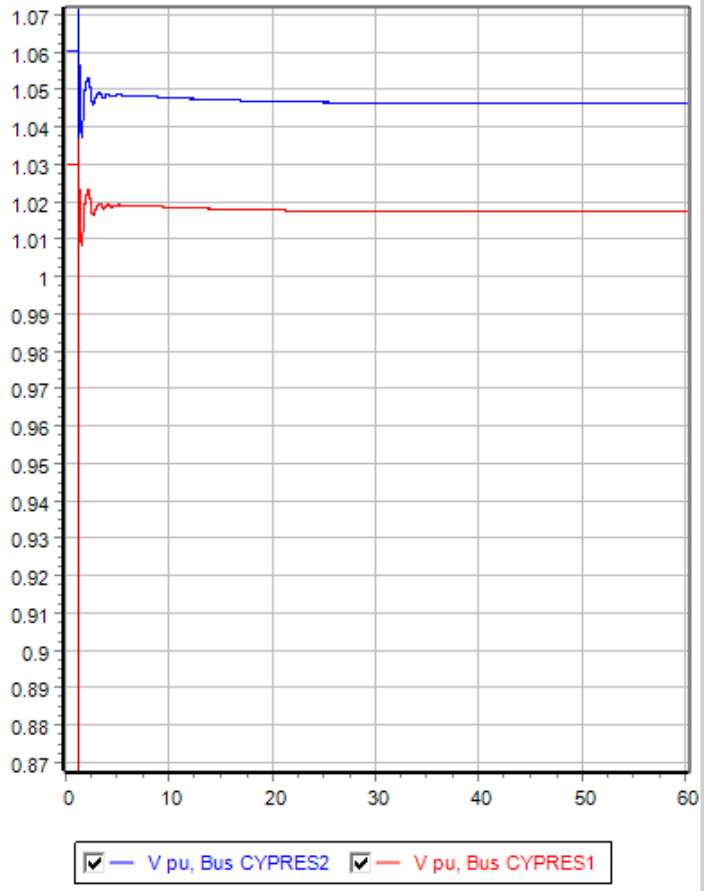
Study Case:
Scenario 6 (2022WP)

December 04, 2020 20:08:30

Cypress 562S Voltages





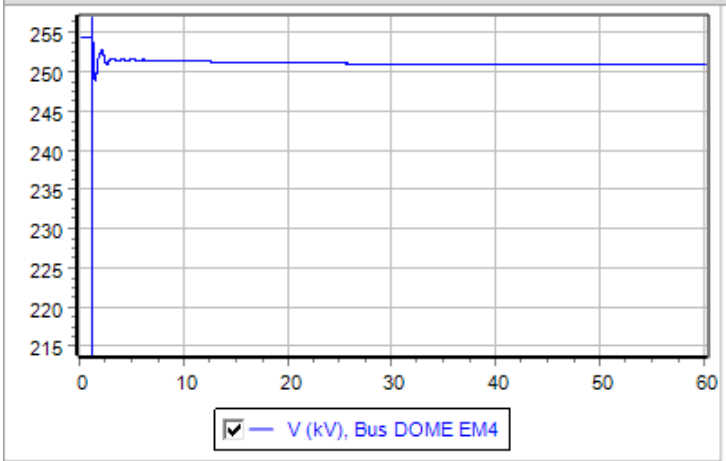


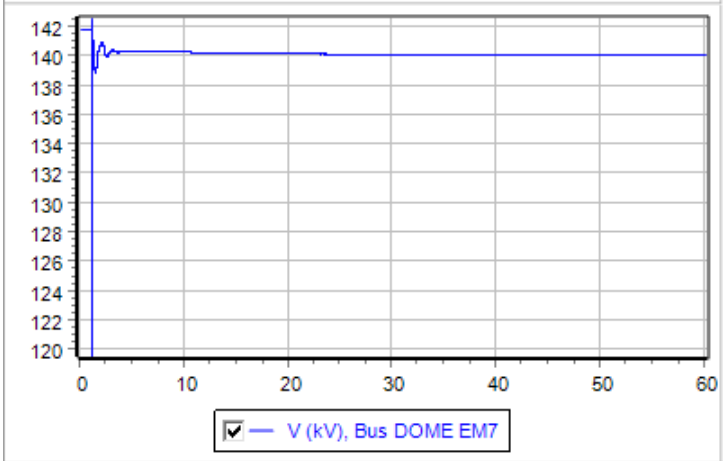
Contingency:
9L20: Nevis 766S to Cordel 755S

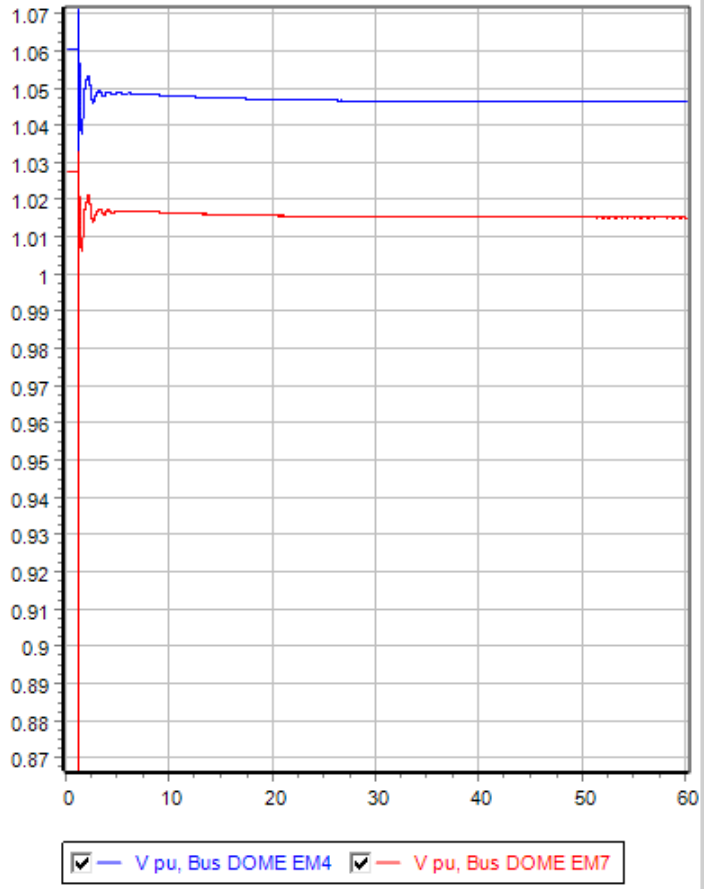
Study Case:
Scenario 6 (2022WP)

December 04, 2020 20:08:30

Dome 163S Voltages





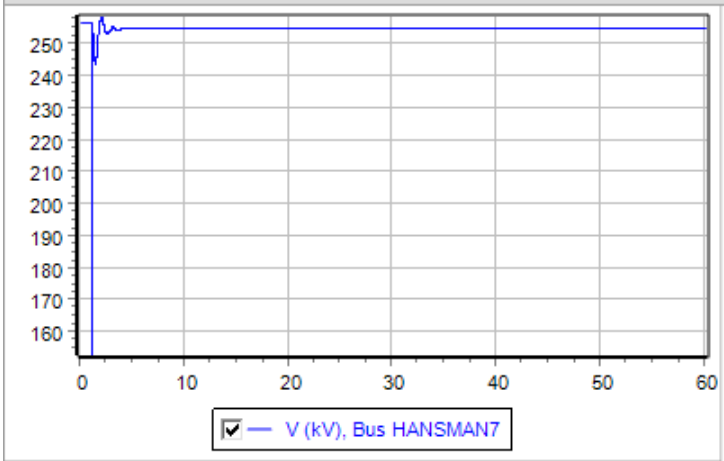


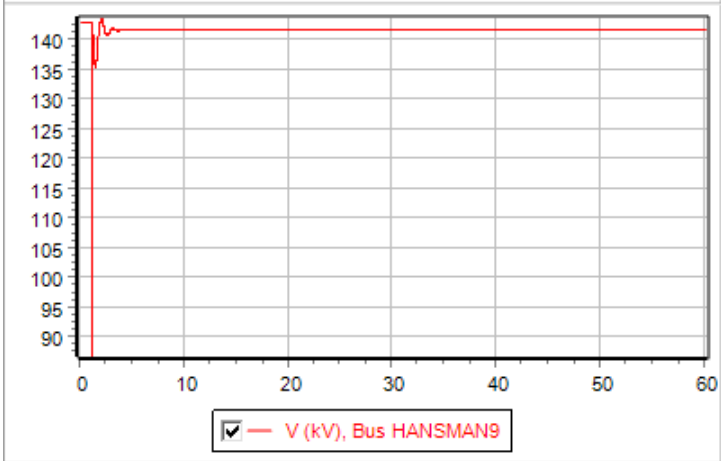
Contingency:
9L20: Nevis 766S to Cordel 755S

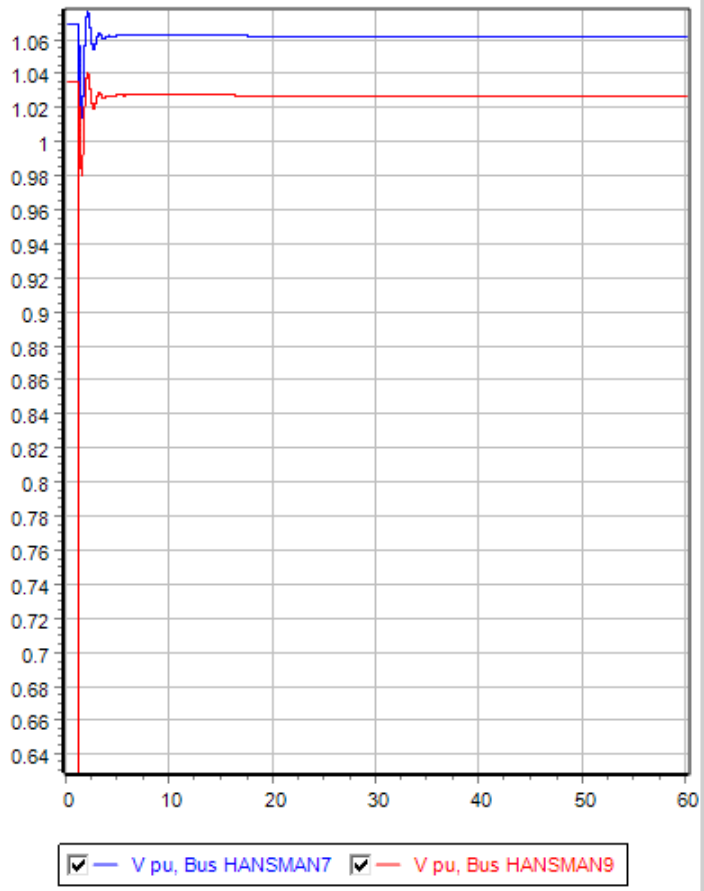
Study Case:
Scenario 6 (2022WP)

December 04, 2020 20:08:29

Hansman Lake 650S Voltages





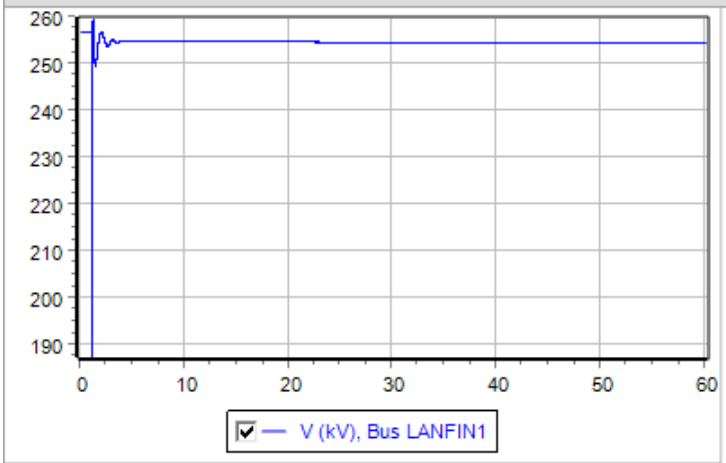


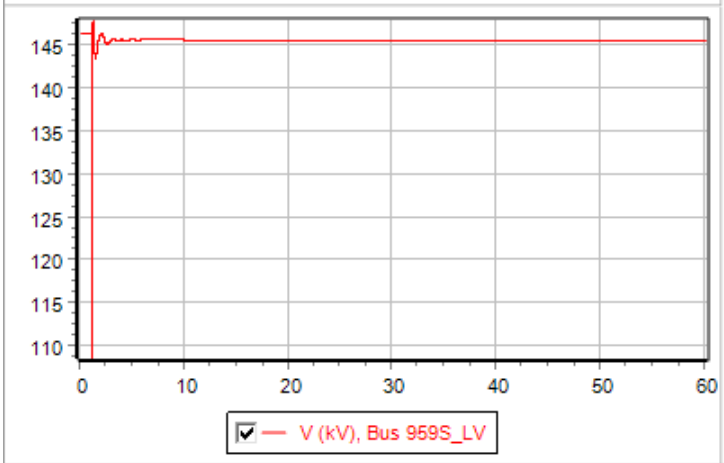
Contingency:
9L20: Nevis 766S to Cordel 755S

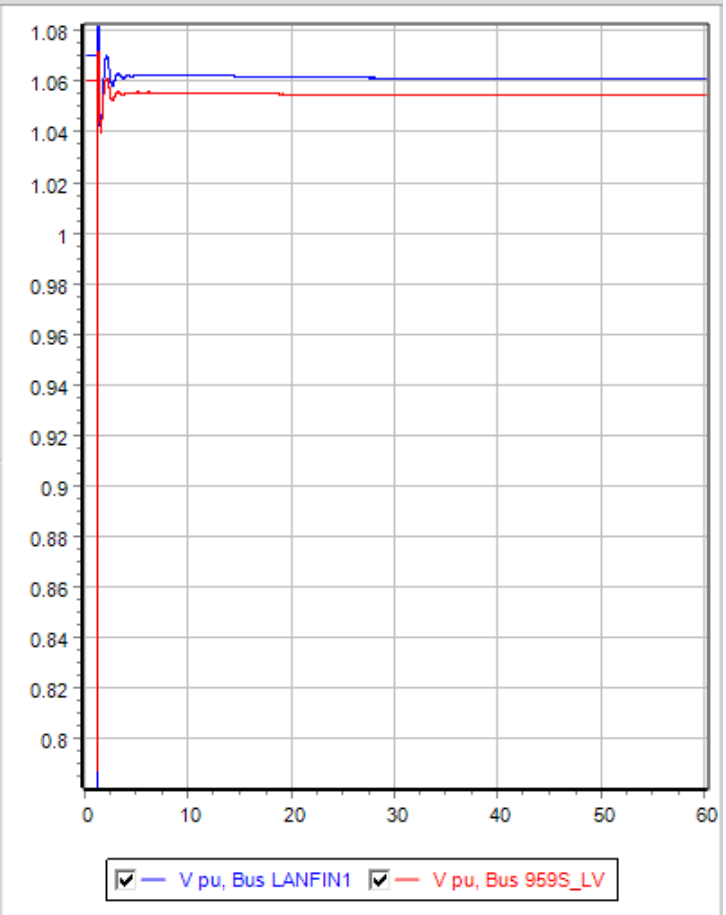
Study Case:
Scenario 6 (2022WP)

December 04, 2020 20:08:29

Lanfine 959S Voltages





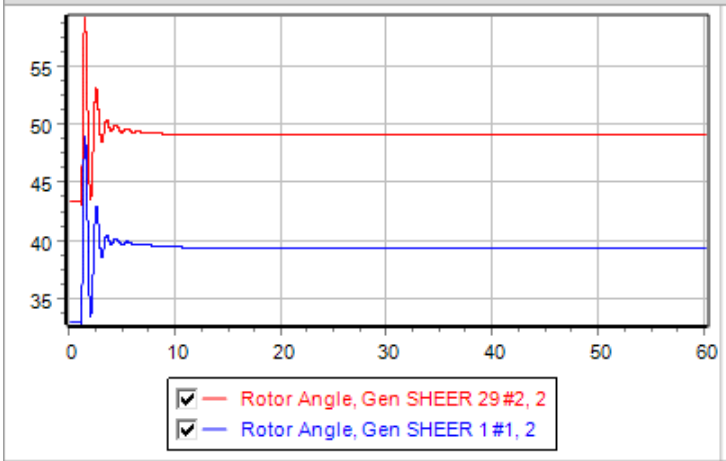


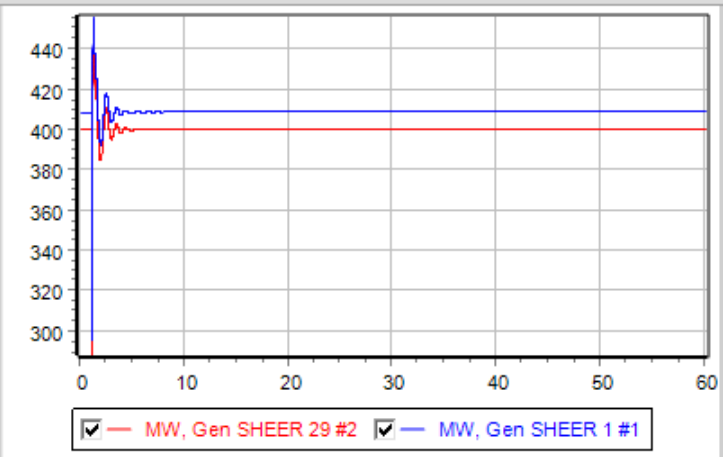
Contingency:
9L20: Nevis 766S to Cordel 755S

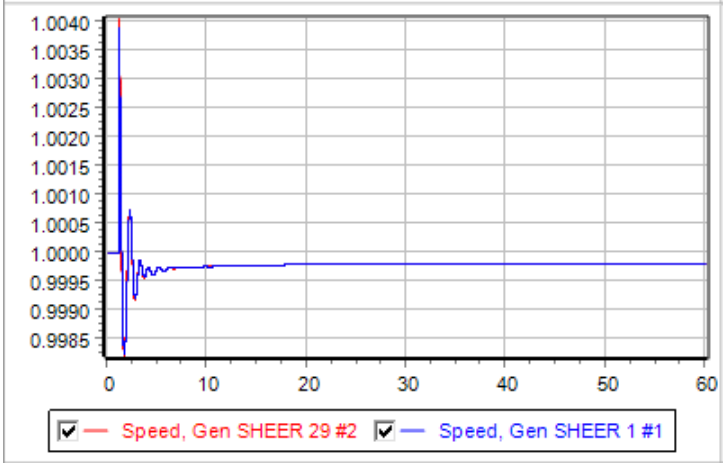
Study Case:
Scenario 6 (2022WP)

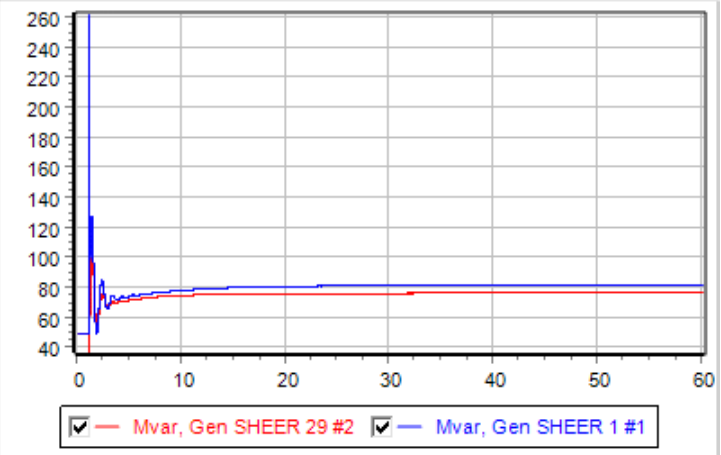
December 04, 2020 20:08:28

Sheerness







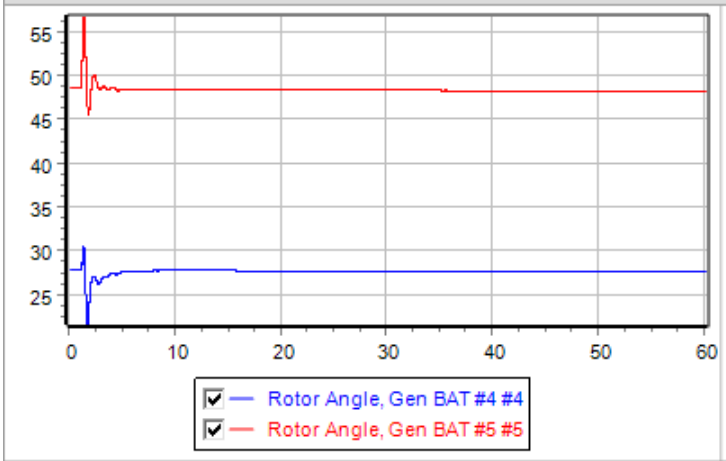


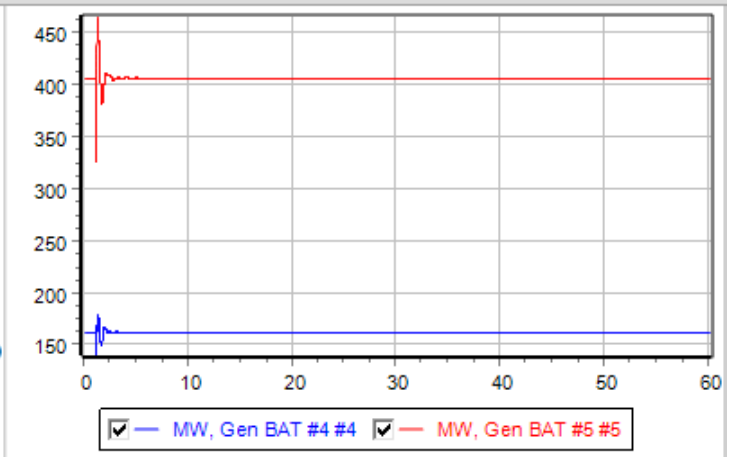
Contingency:
9L20: Nevis 766S to Cordel 755S

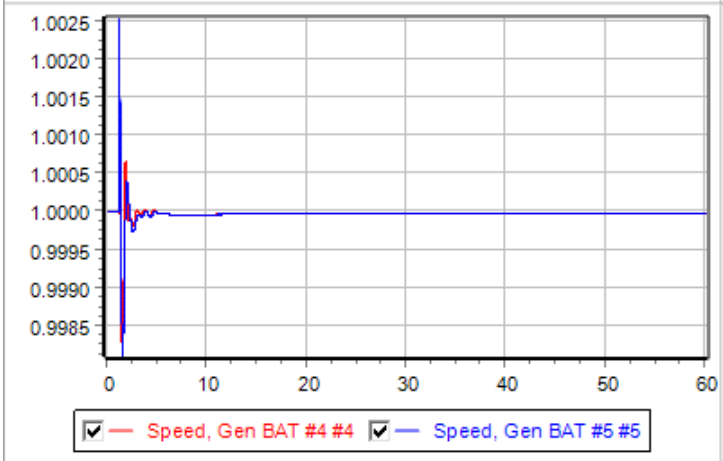
Study Case:
Scenario 6 (2022WP)

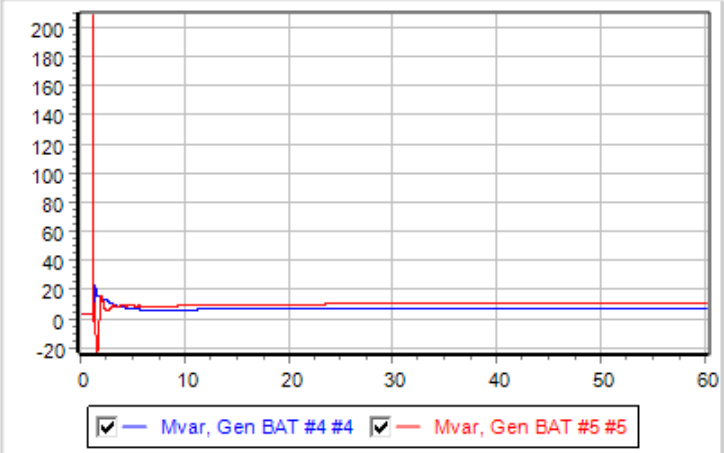
December 04, 2020 20:08:27

Battle River







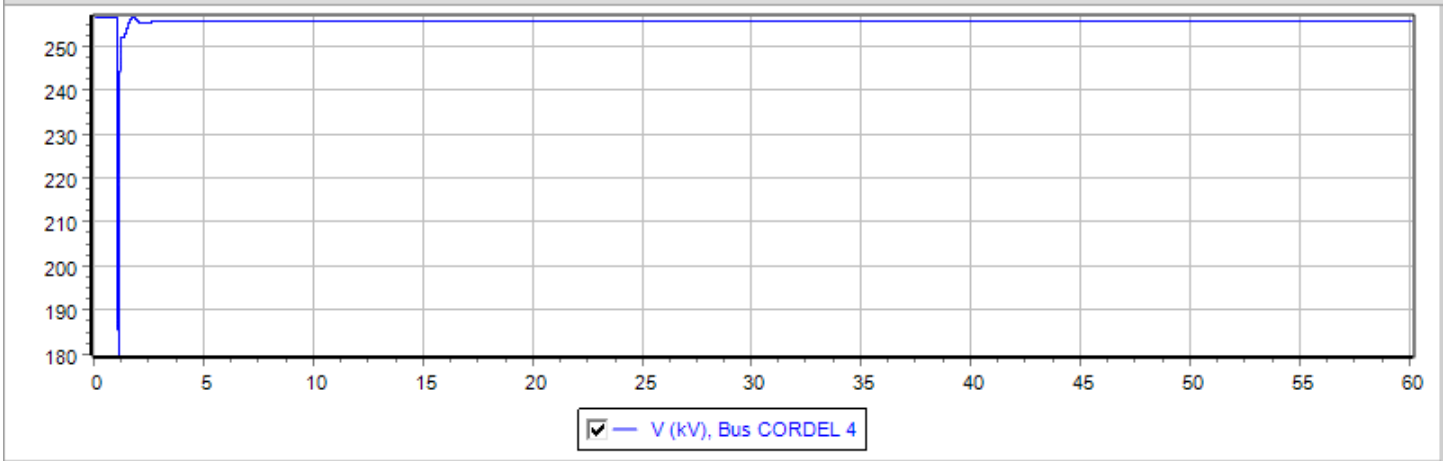


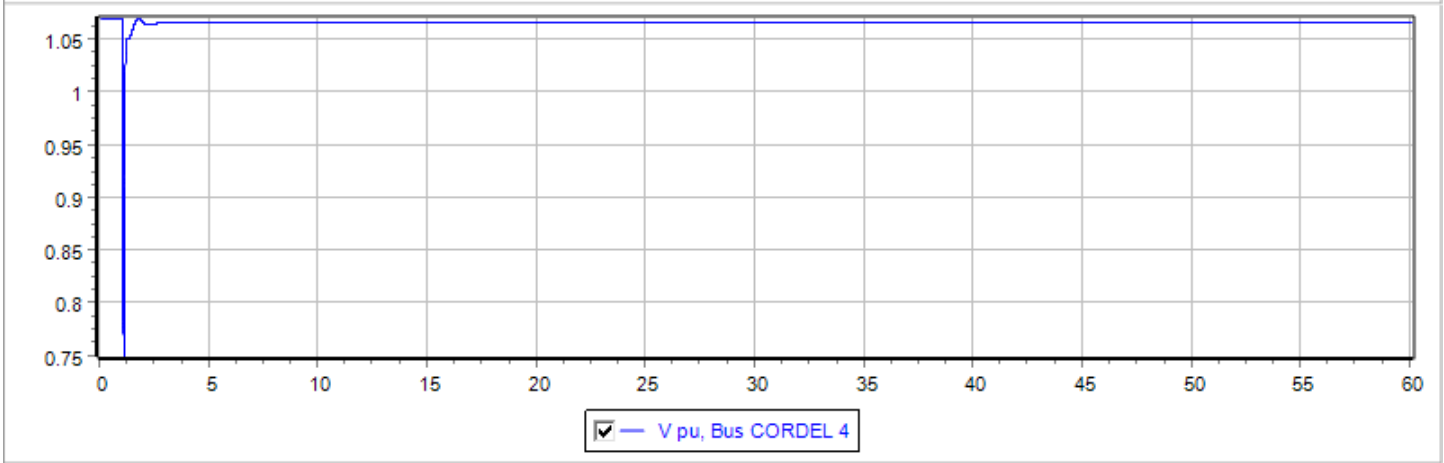
Contingency:
9L24: Lanfine 959S to Oakland 946S

Study Case:
Scenario 6 (2022WP)

December 04, 2020 20:12:22

Cordel 755S Voltages



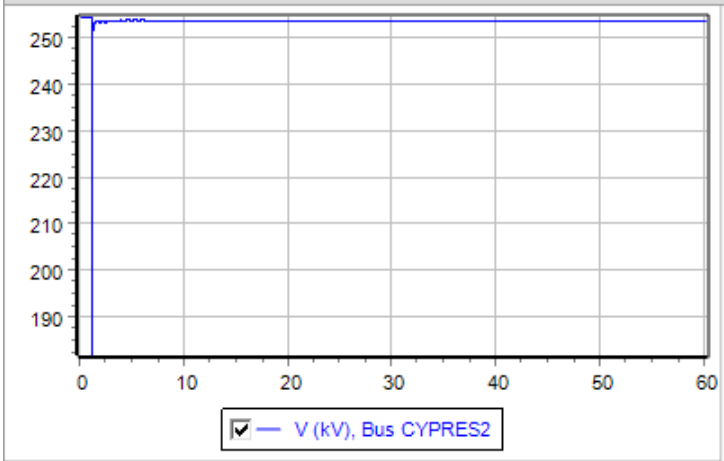


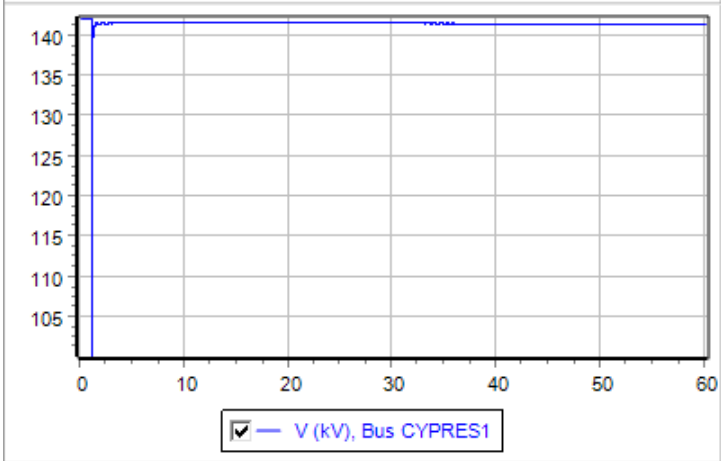
Contingency:
9L24: Lanfine 959S to Oakland 946S

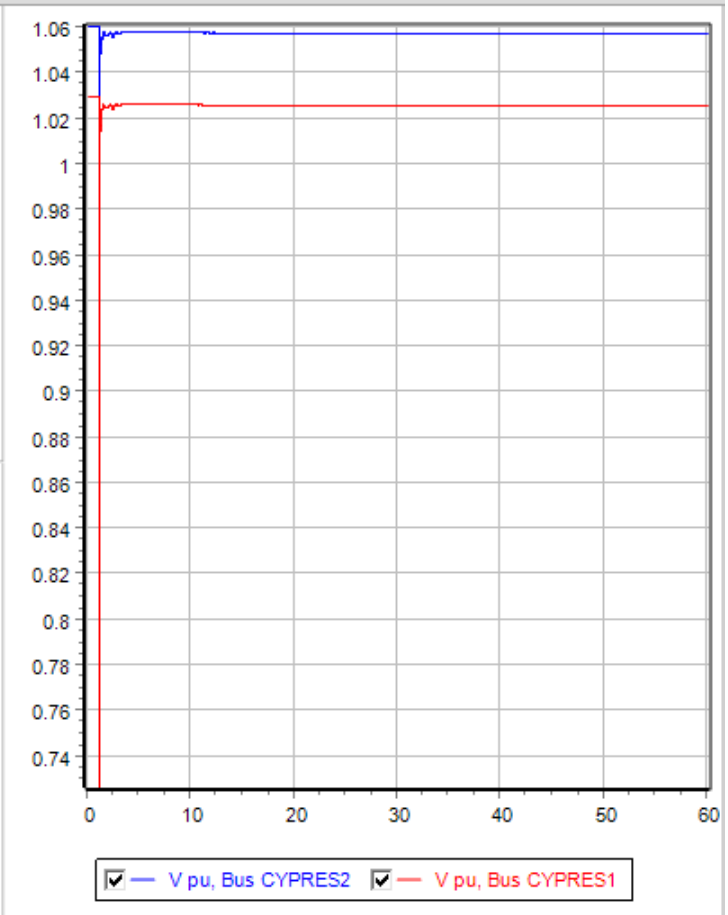
Study Case:
Scenario 6 (2022WP)

December 04, 2020 20:12:24

Cypress 562S Voltages





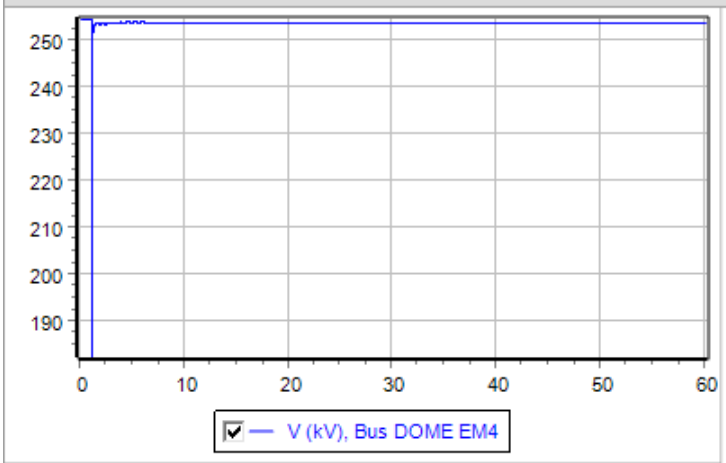


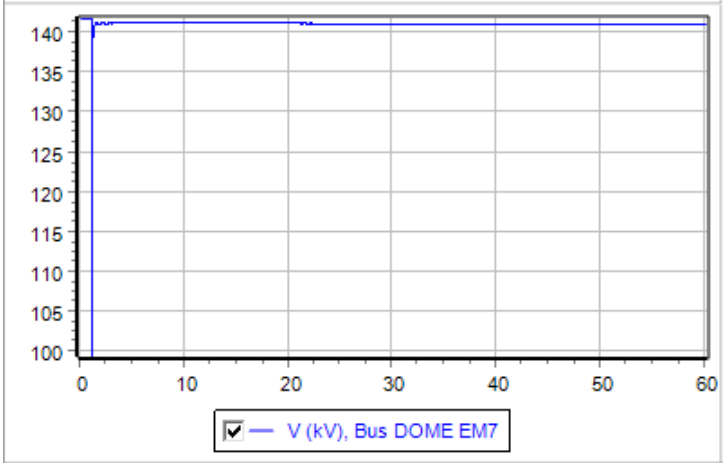
Contingency:
9L24: Lanfine 959S to Oakland 946S

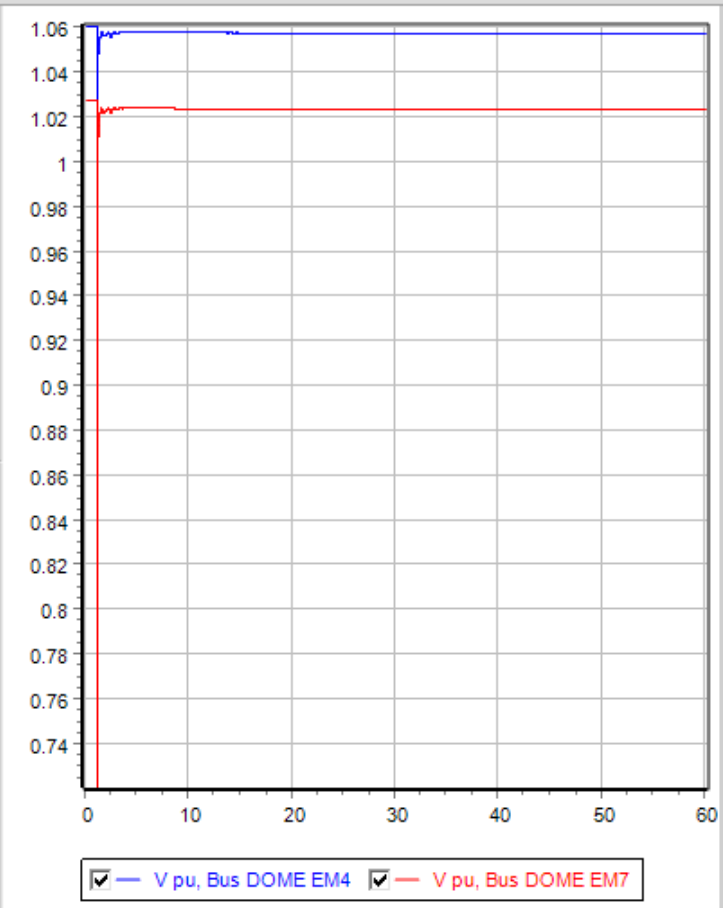
Study Case:
Scenario 6 (2022WP)

December 04, 2020 20:12:24

Dome 163S Voltages





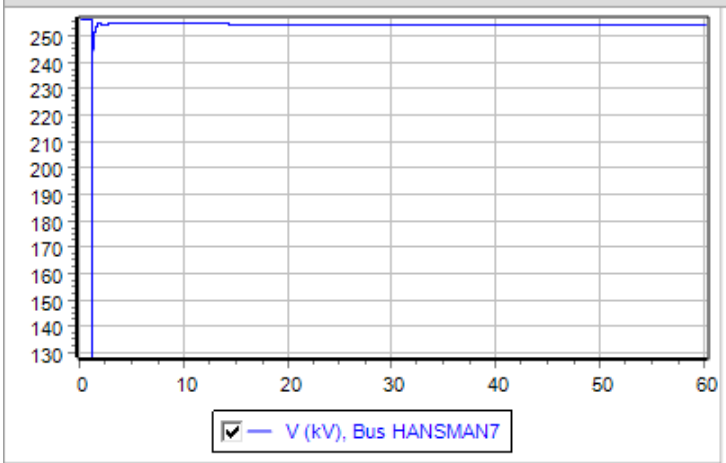


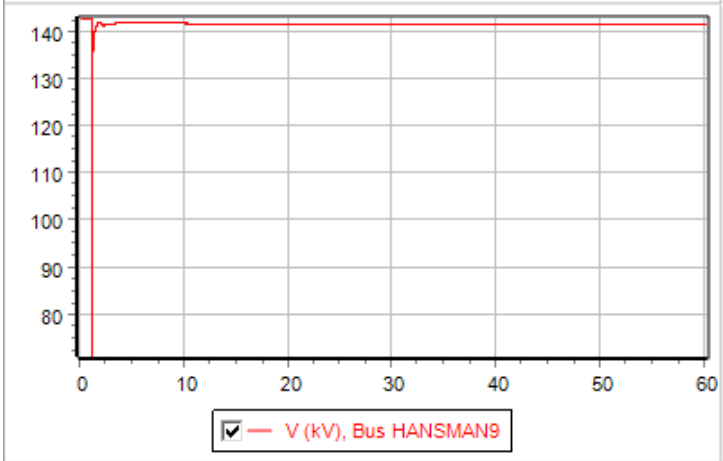
Contingency:
9L24: Lanfine 959S to Oakland 946S

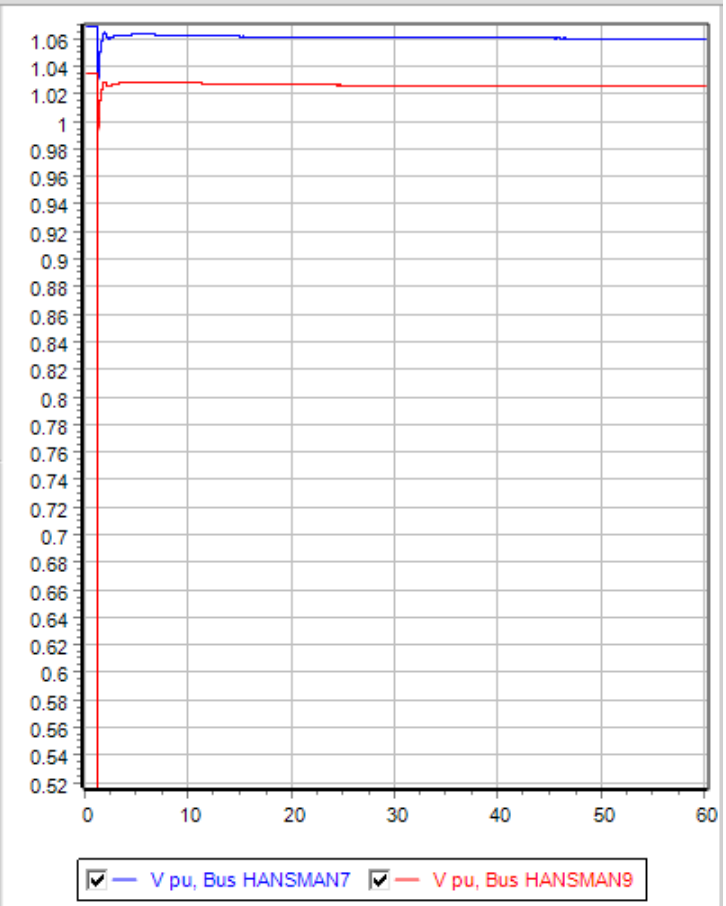
Study Case:
Scenario 6 (2022WP)

December 04, 2020 20:12:23

Hansman Lake 650S Voltages





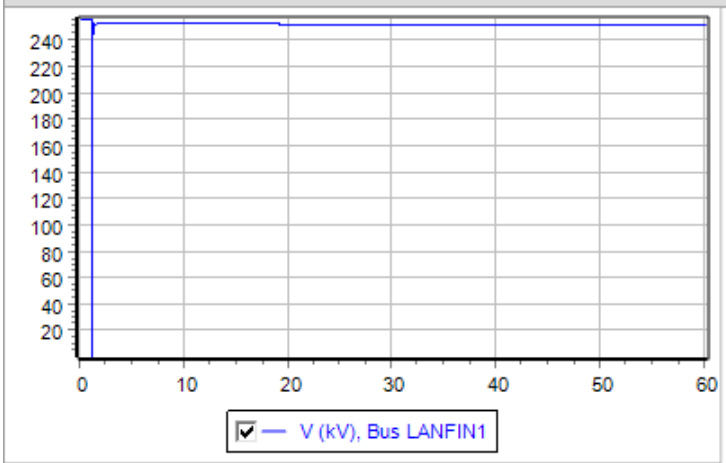


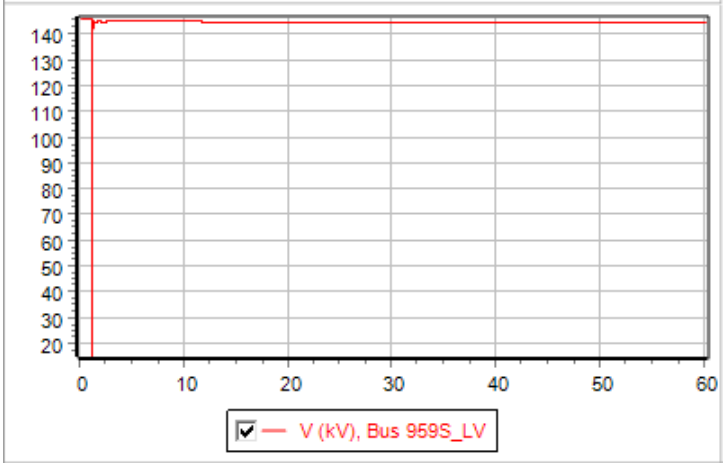
Contingency:
9L24: Lanfine 959S to Oakland 946S

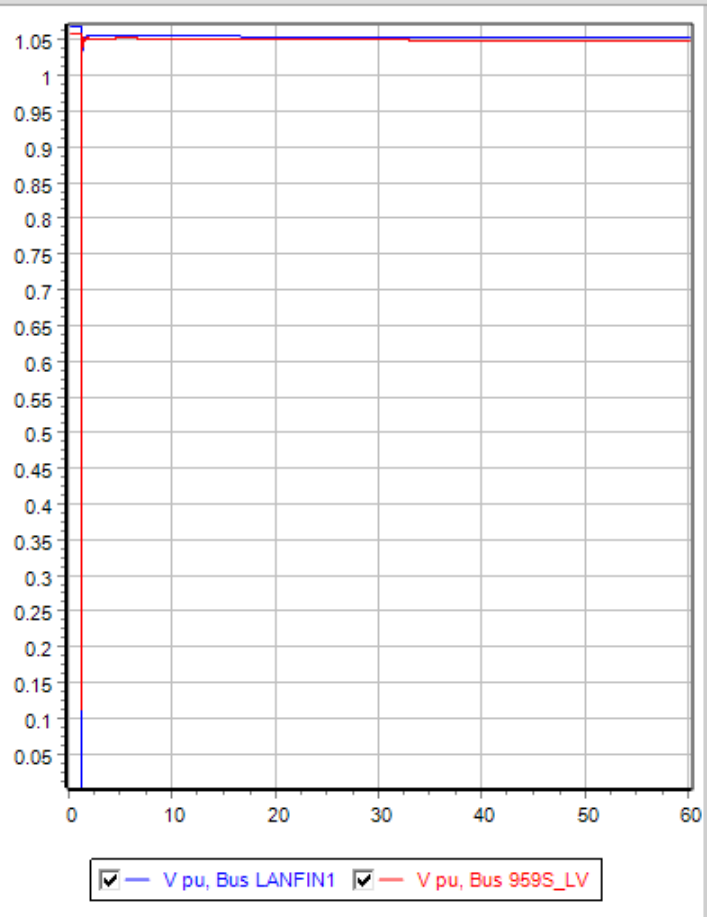
Study Case:
Scenario 6 (2022WP)

December 04, 2020 20:12:23

Lanfine 959S Voltages





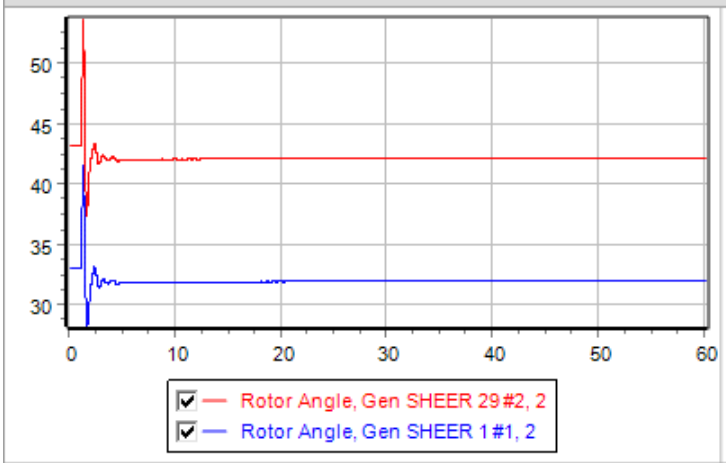


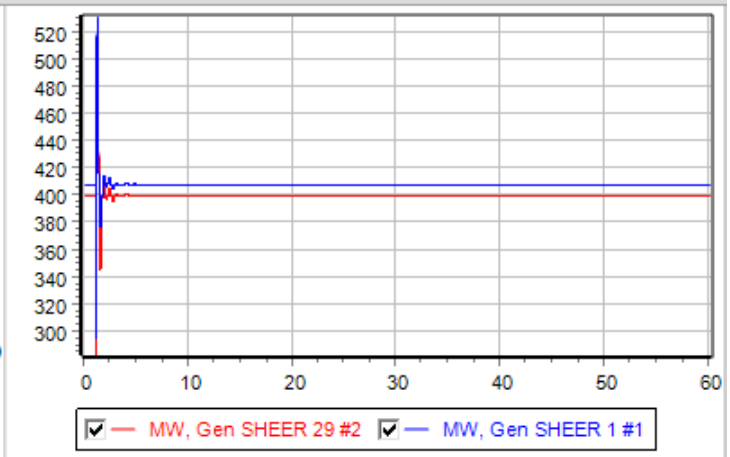
Contingency:
9L24: Lanfine 959S to Oakland 946S

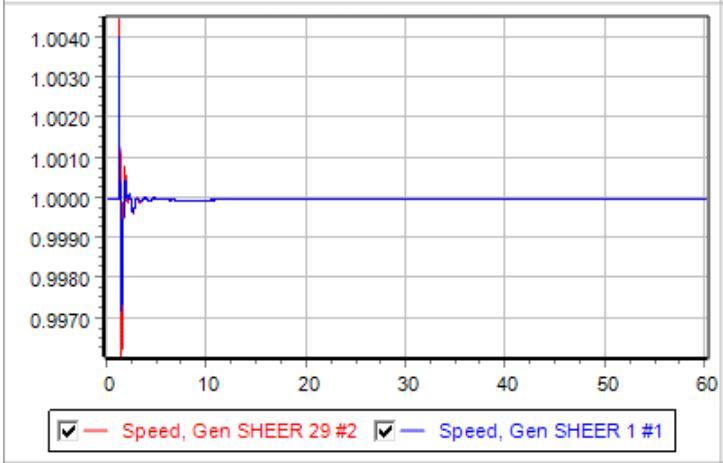
Study Case:
Scenario 6 (2022WP)

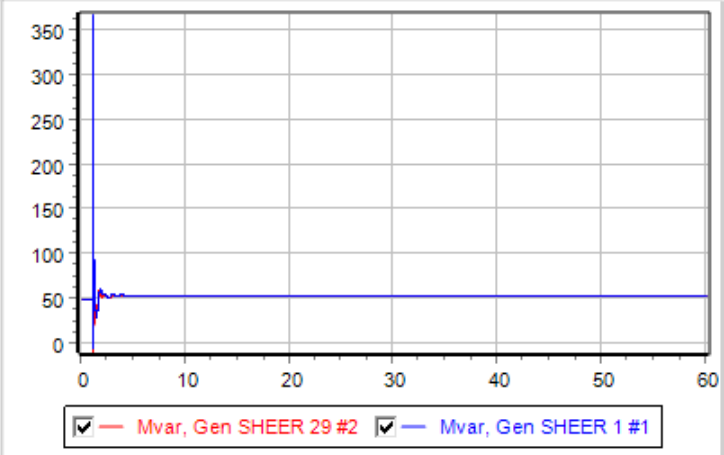
December 04, 2020 20:12:22

Sheerness







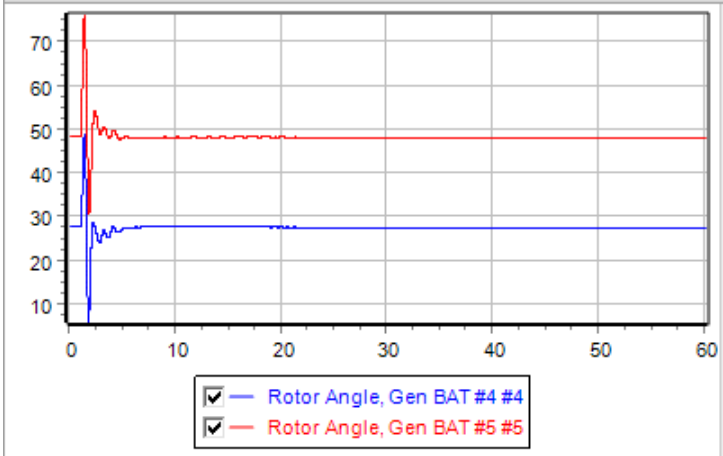


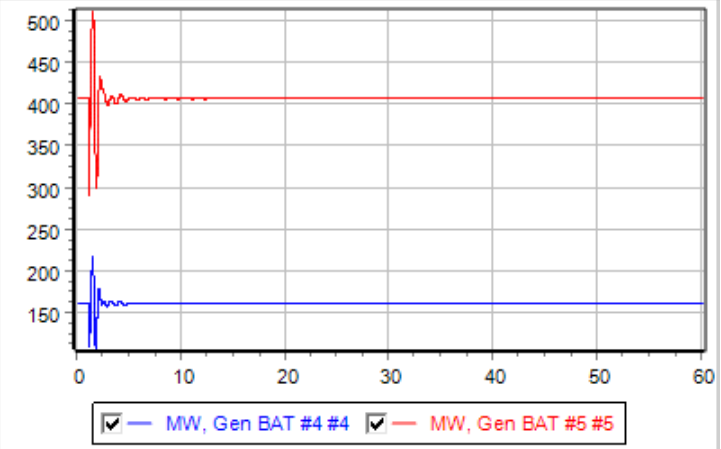
Contingency:
9L24: Lanfine 959S to Oakland 946S

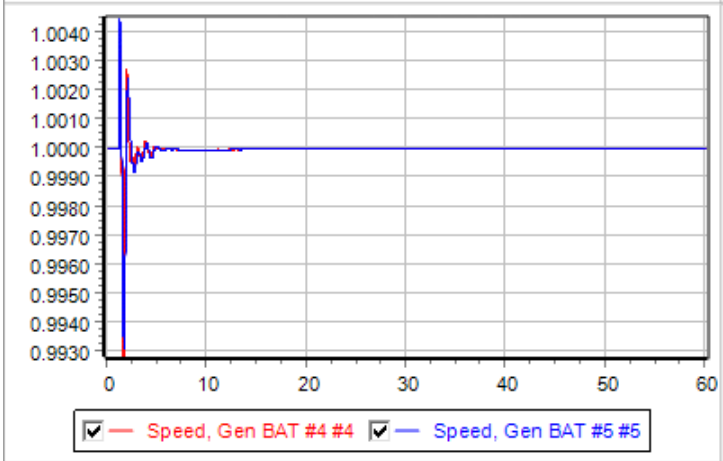
Study Case:
Scenario 6 (2022WP)

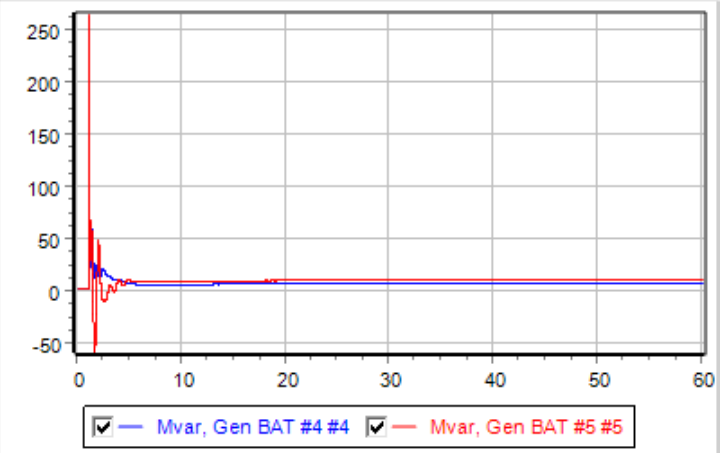
December 04, 2020 20:12:21

Battle River







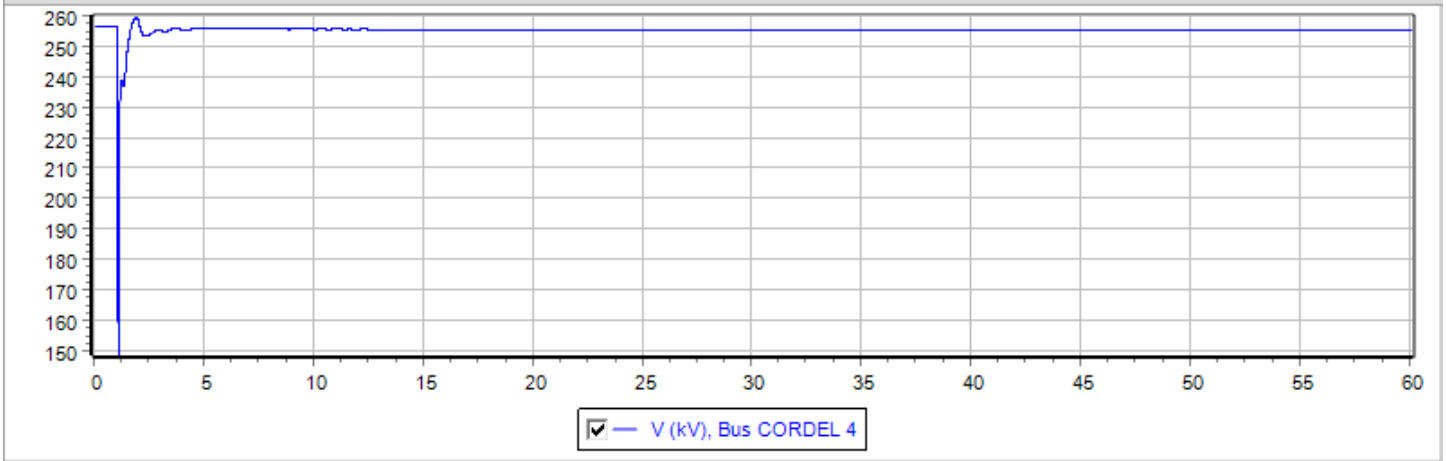


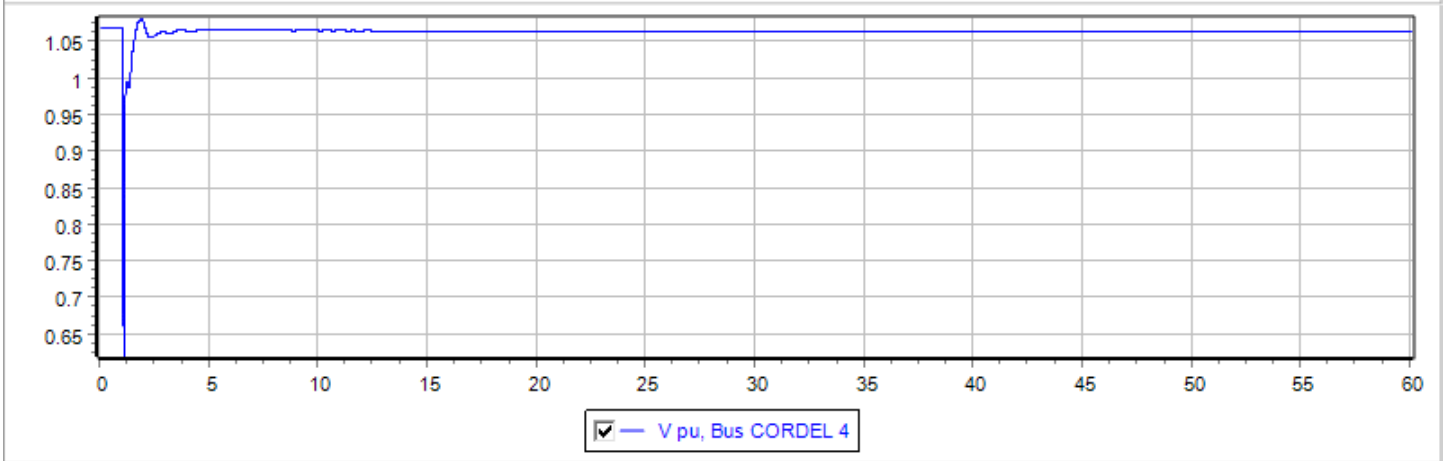
Contingency:
9L24: Oakland 946S to Lanfine 959S

Study Case:
Scenario 6 (2022WP)

December 04, 2020 20:16:21

Cordel 755S Voltages



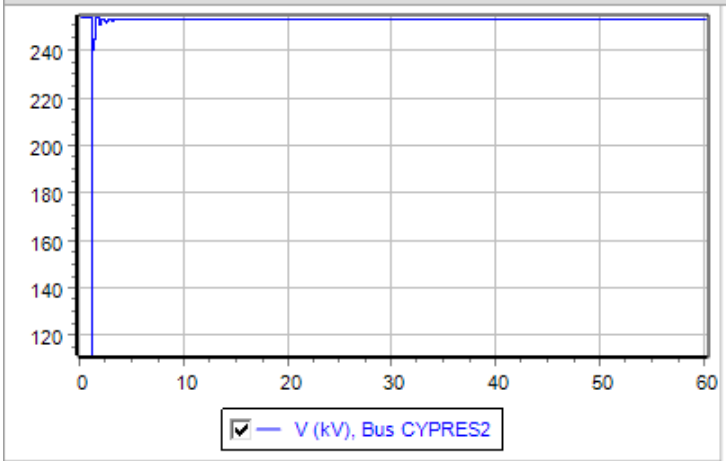


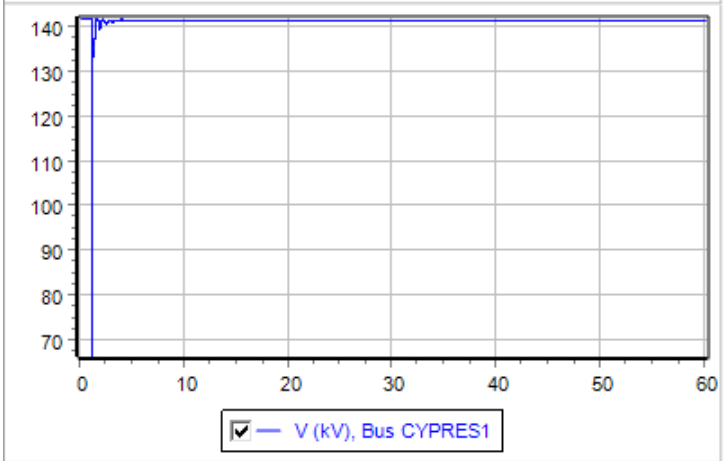
Contingency:
9L24: Oakland 946S to Lanfine 959S

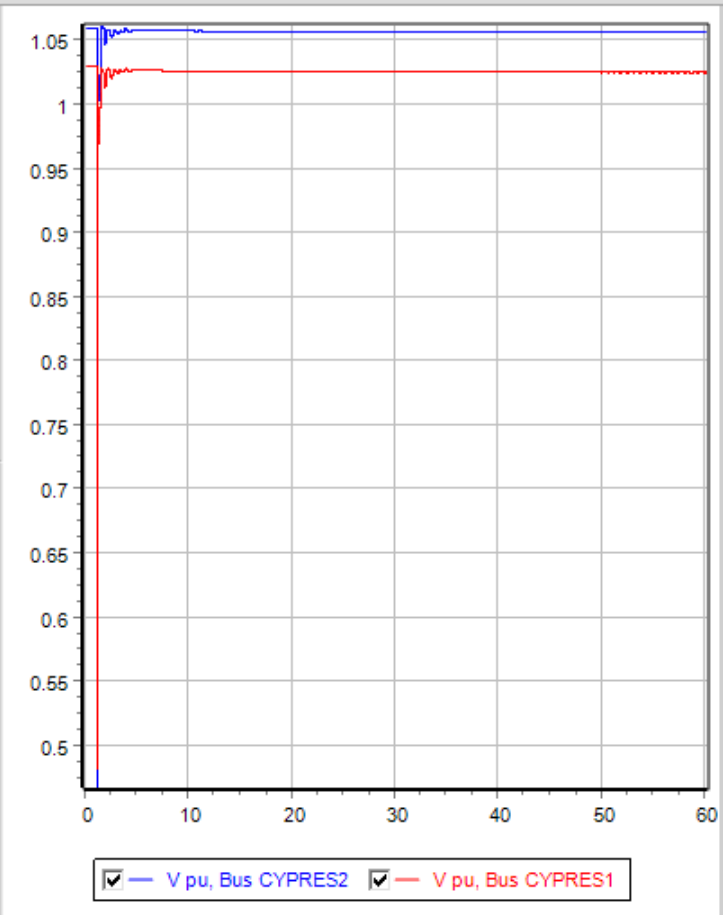
Study Case:
Scenario 6 (2022WP)

December 04, 2020 20:16:23

Cypress 562S Voltages





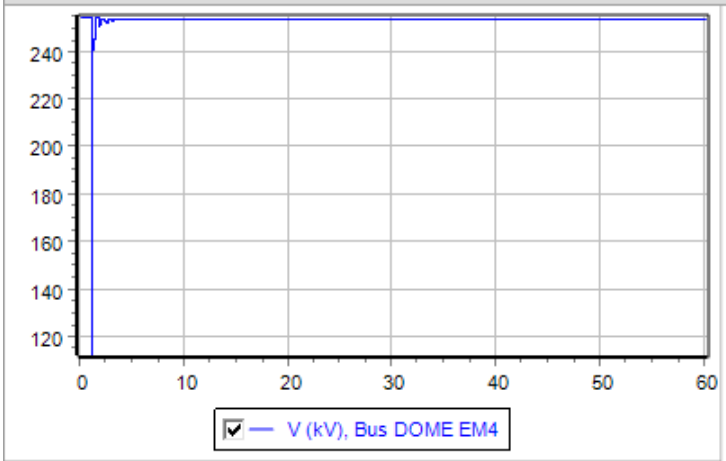


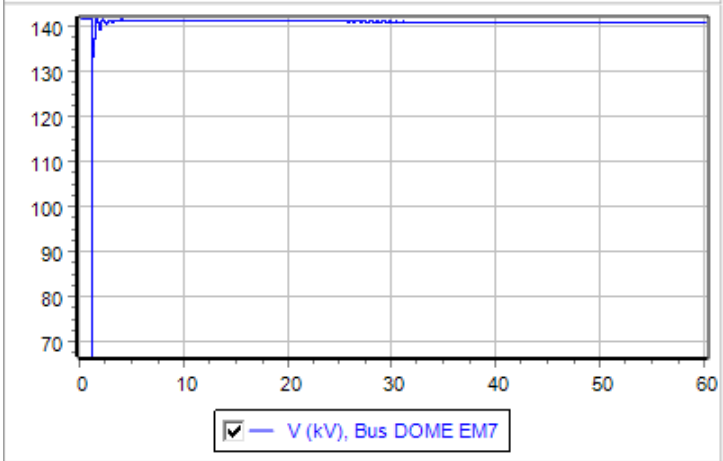
Contingency:
9L24: Oakland 946S to Lanfine 959S

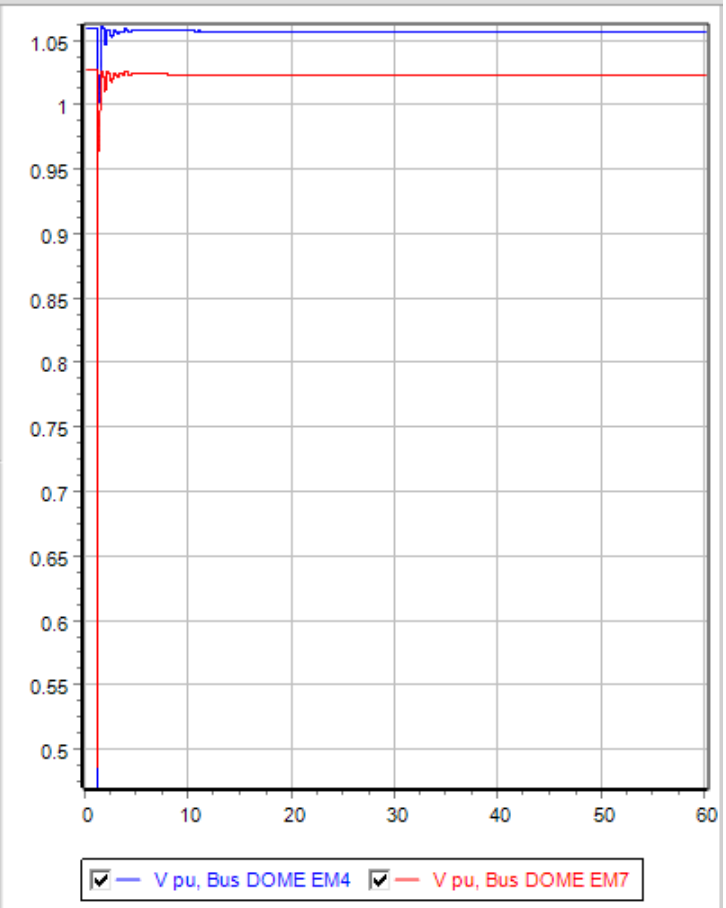
Study Case:
Scenario 6 (2022WP)

December 04, 2020 20:16:23

Dome 163S Voltages





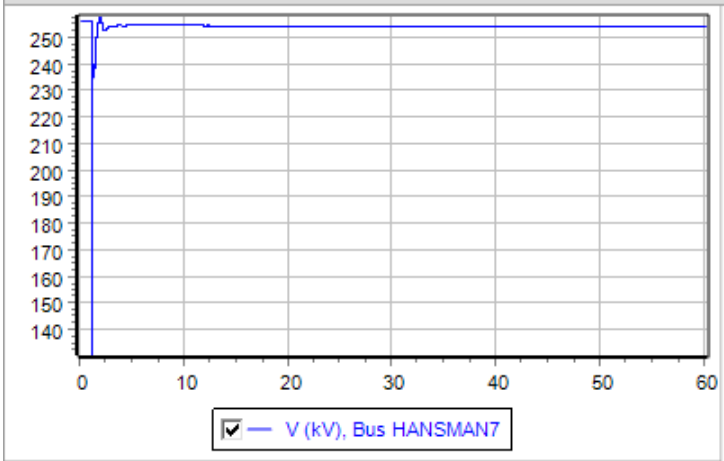


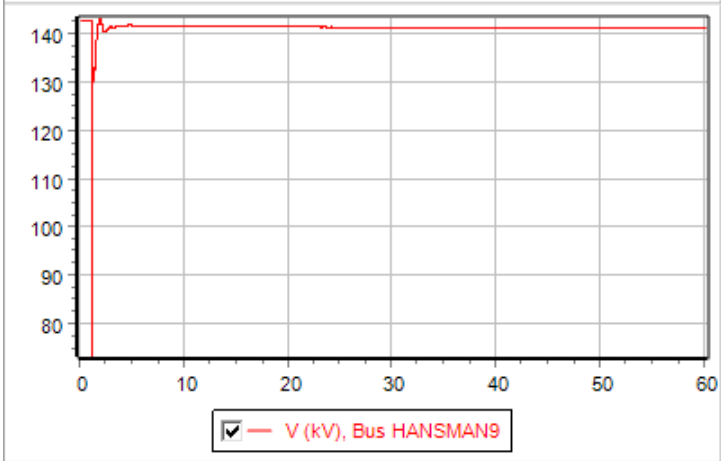
Contingency:
9L24: Oakland 946S to Lanfine 959S

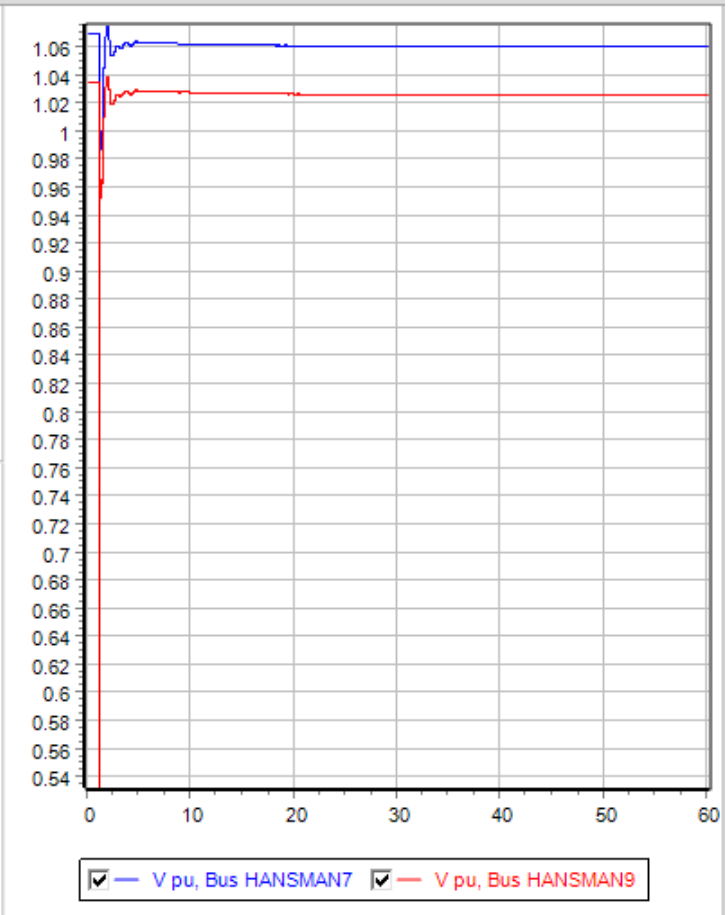
Study Case:
Scenario 6 (2022WP)

December 04, 2020 20:16:22

Hansman Lake 650S Voltages





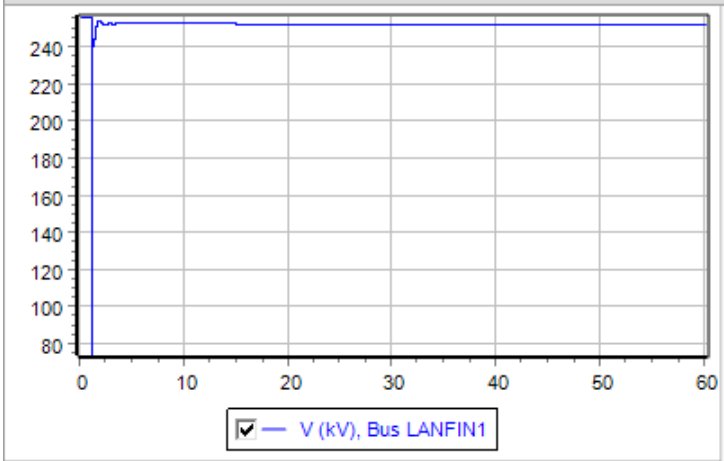


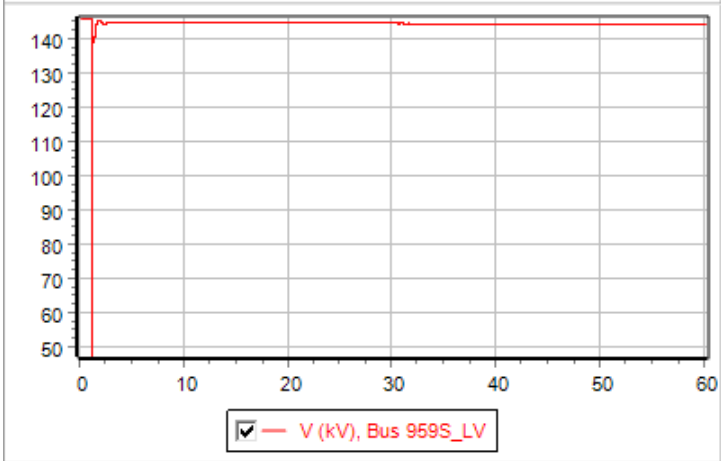
Contingency:
9L24: Oakland 946S to Lanfine 959S

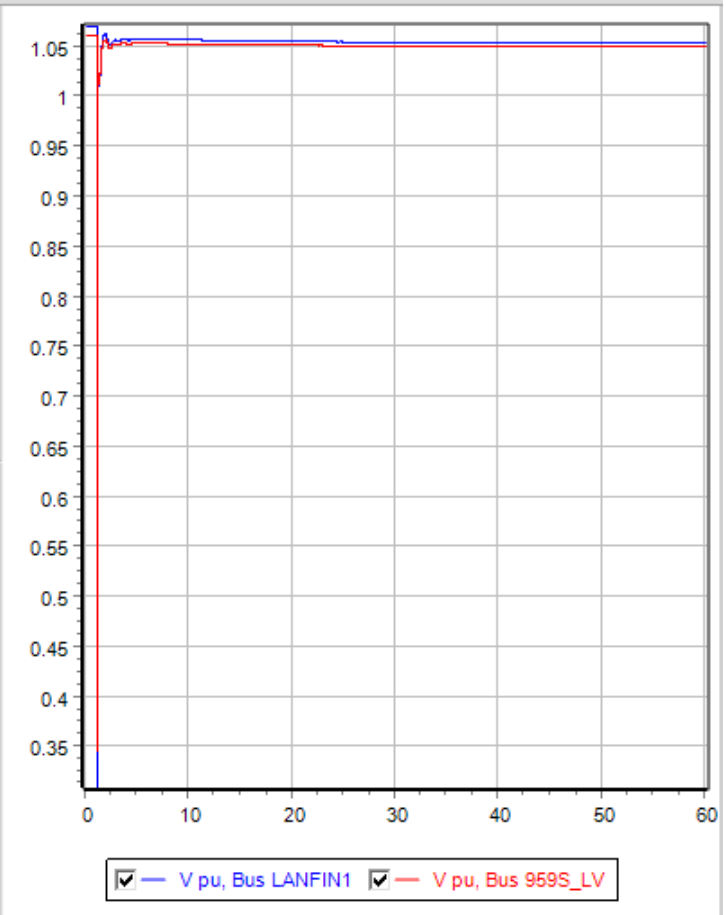
Study Case:
Scenario 6 (2022WP)

December 04, 2020 20:16:22

Lanfine 959S Voltages





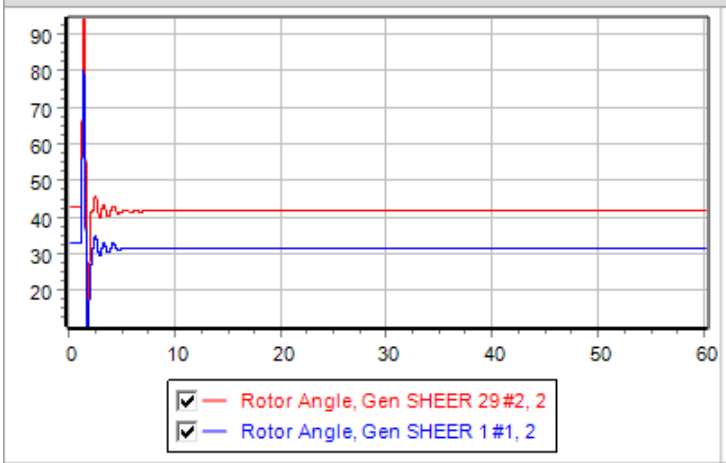


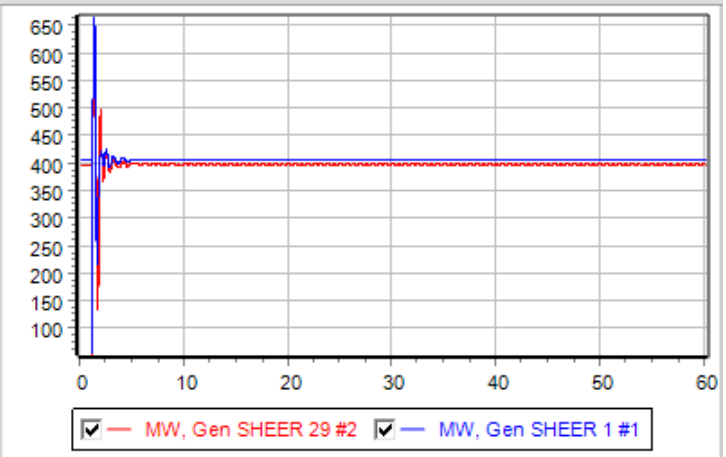
Contingency:
9L24: Oakland 946S to Lanfine 959S

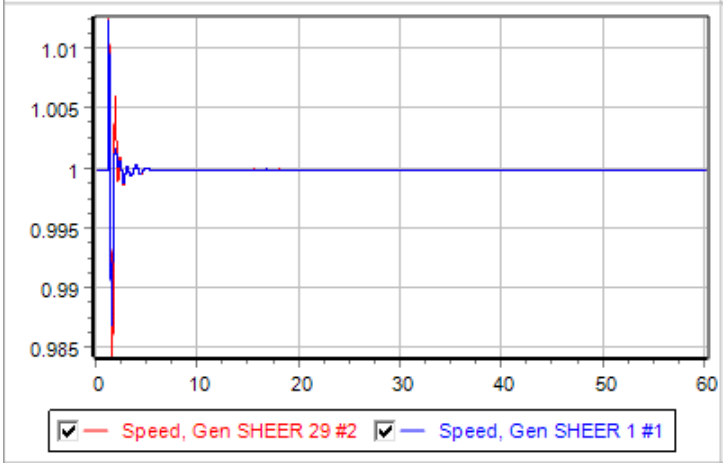
Study Case:
Scenario 6 (2022WP)

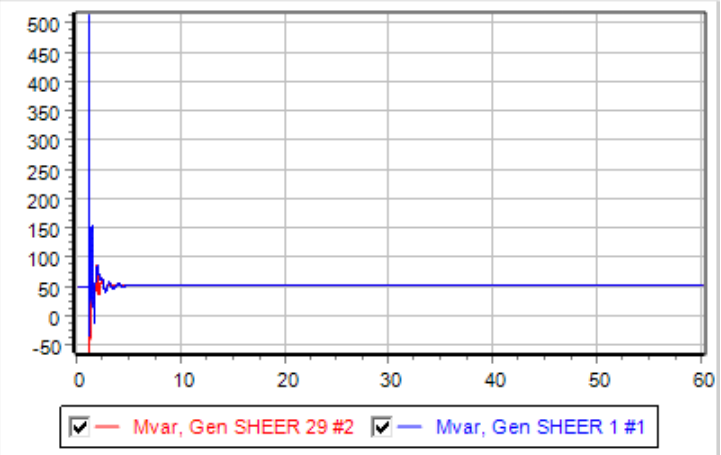
December 04, 2020 20:16:21

Sheerness







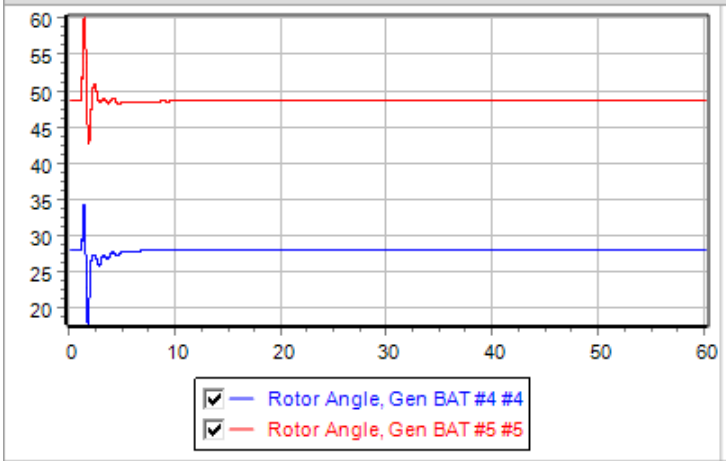


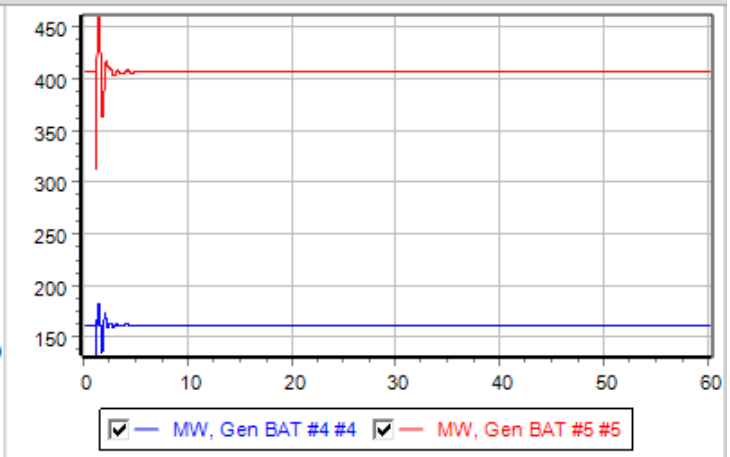
Contingency:
9L24: Oakland 946S to Lanfine 959S

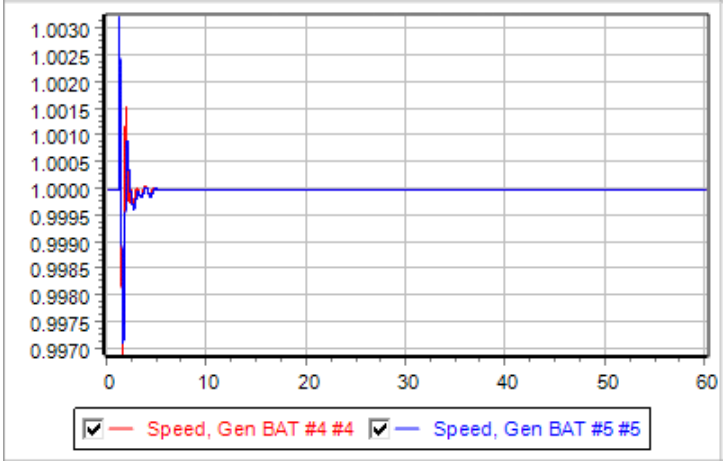
Study Case:
Scenario 6 (2022WP)

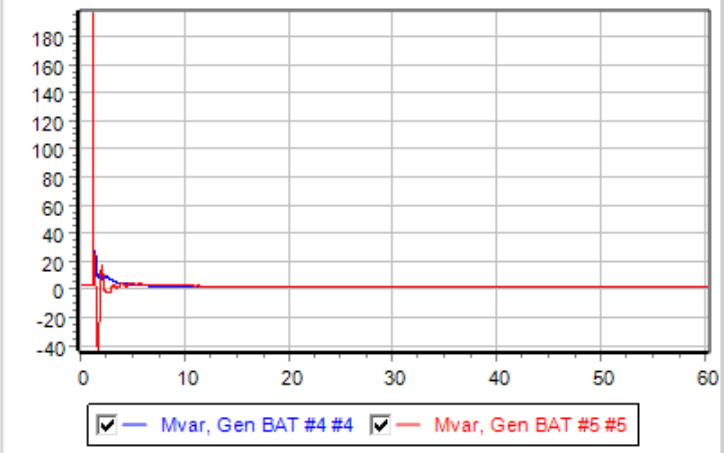
December 04, 2020 20:16:20

Battle River







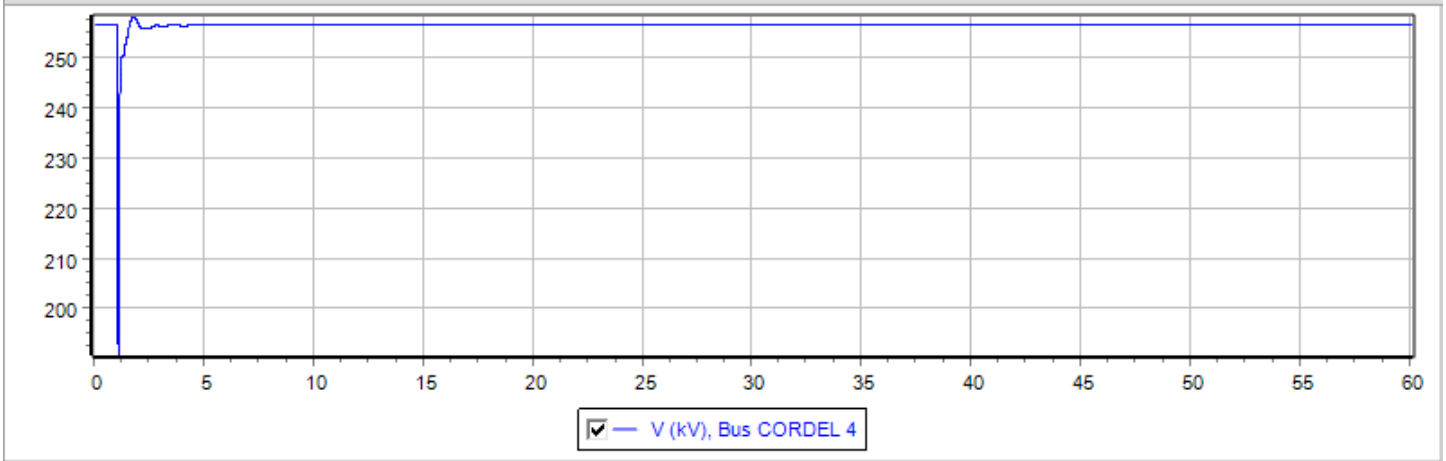


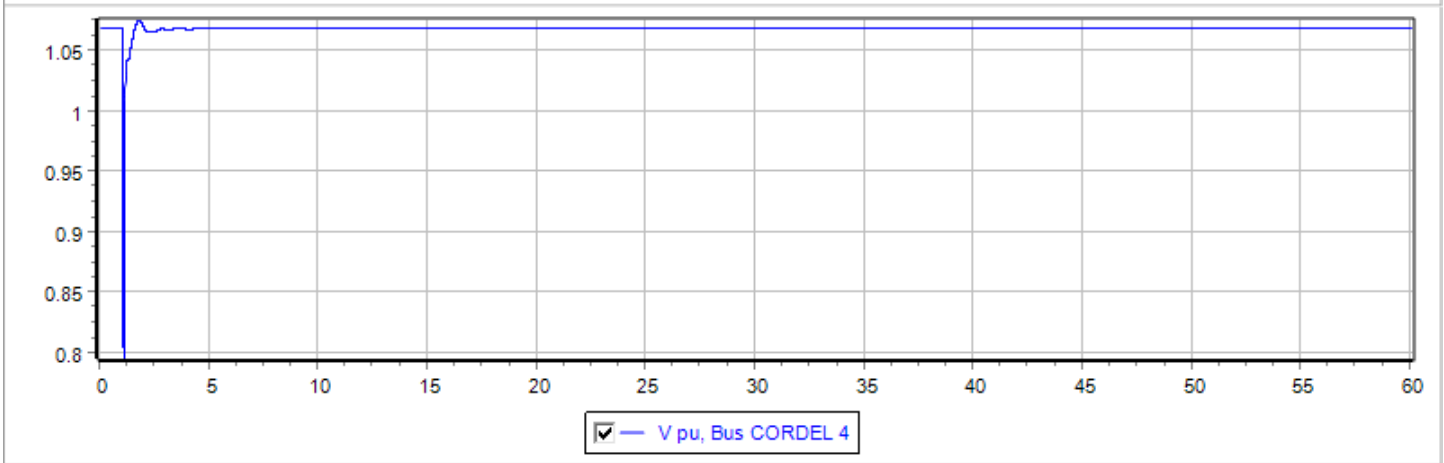
Contingency:
9L29: Coyote Lake 963S to Oakland 946S

Study Case:
Scenario 6 (2022WP)

December 04, 2020 20:20:01

Cordel 755S Voltages



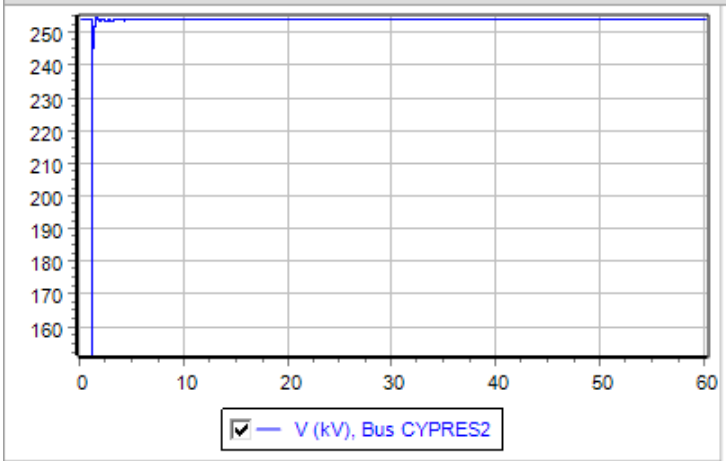


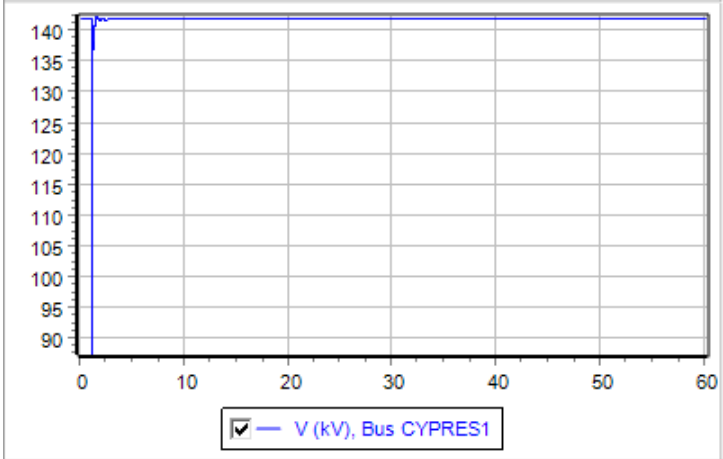
Contingency:
9L29: Coyote Lake 963S to Oakland 946S

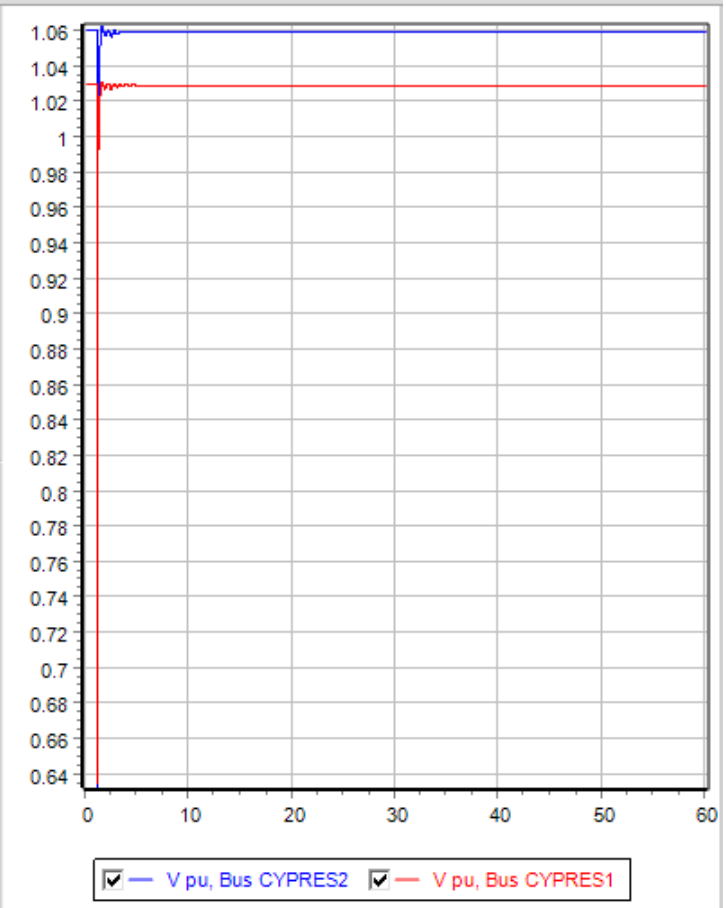
Study Case:
Scenario 6 (2022WP)

December 04, 2020 20:20:04

Cypress 562S Voltages





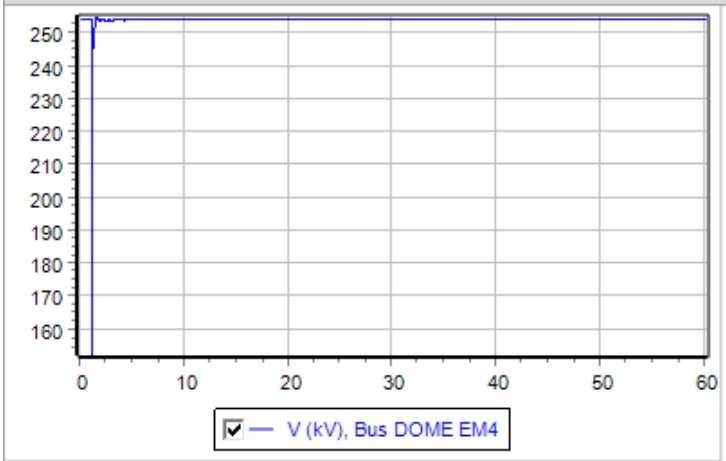


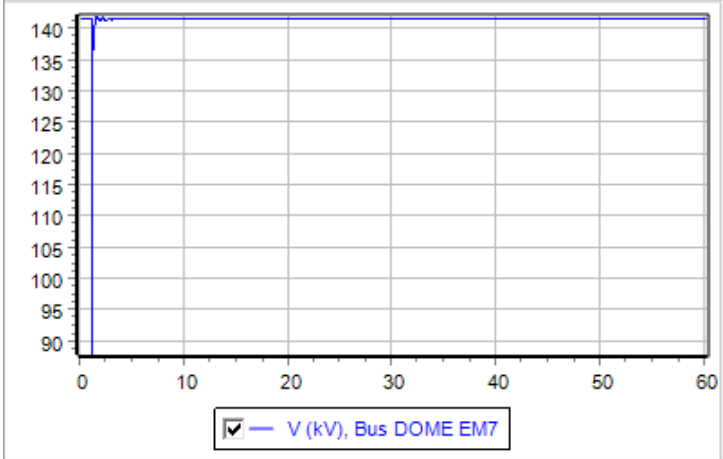
Contingency:
9L29: Coyote Lake 963S to Oakland 946S

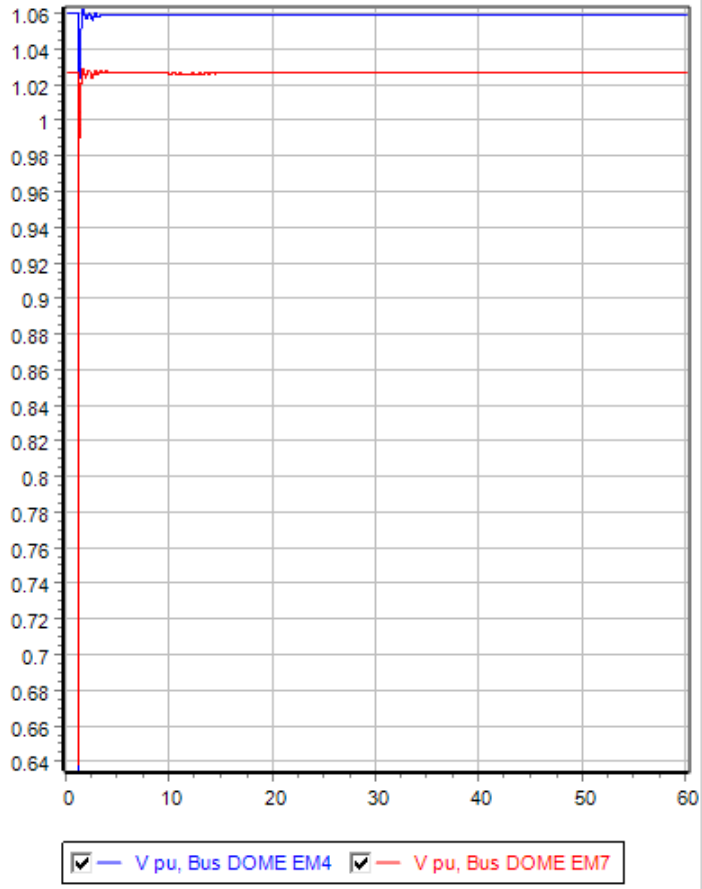
Study Case:
Scenario 6 (2022WP)

December 04, 2020 20:20:03

Dome 163S Voltages





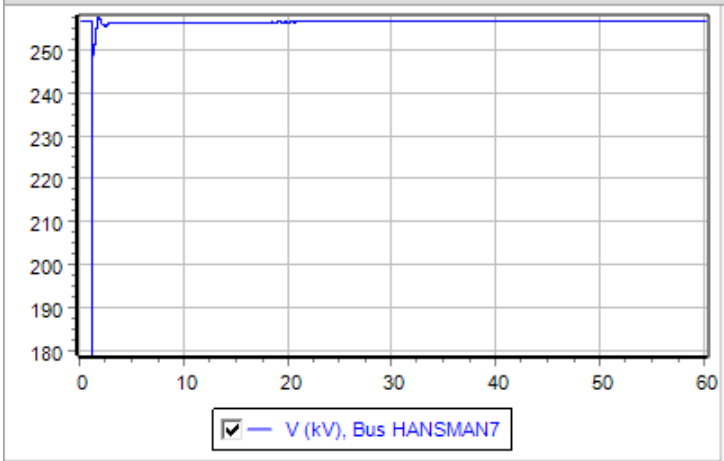


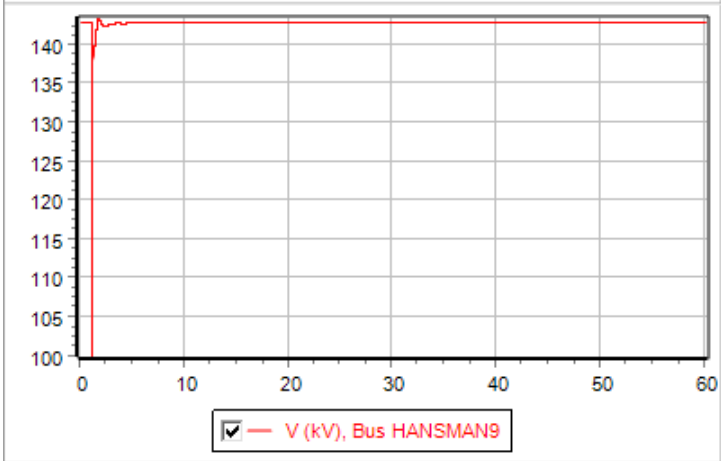
Contingency:
9L29: Coyote Lake 963S to Oakland 946S

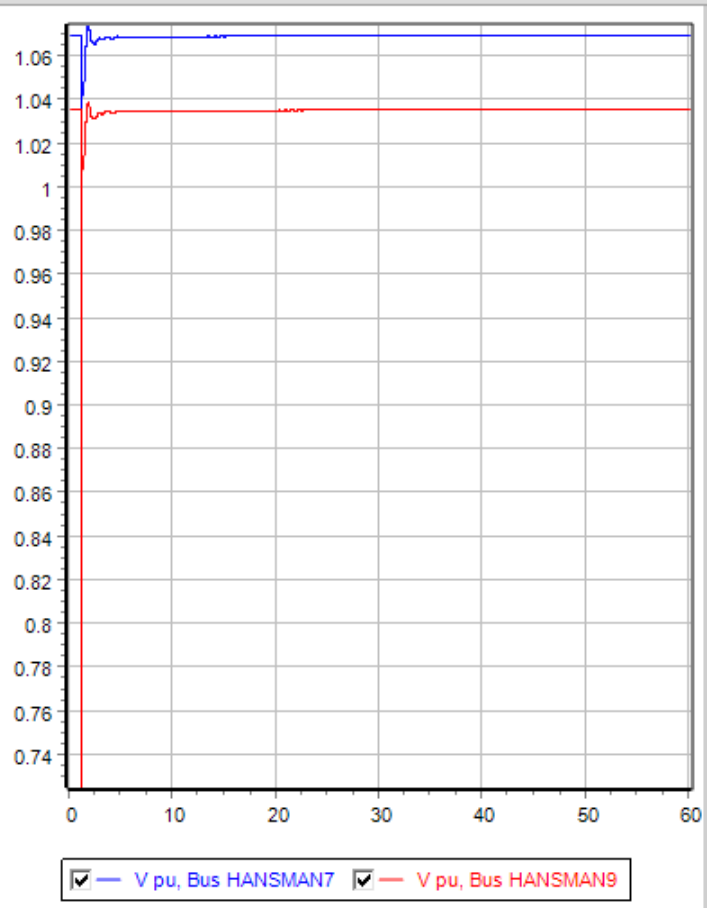
Study Case:
Scenario 6 (2022WP)

December 04, 2020 20:20:03

Hansman Lake 650S Voltages





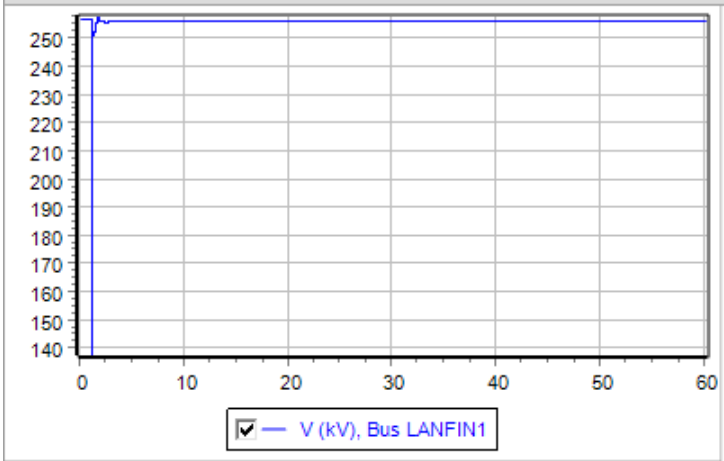


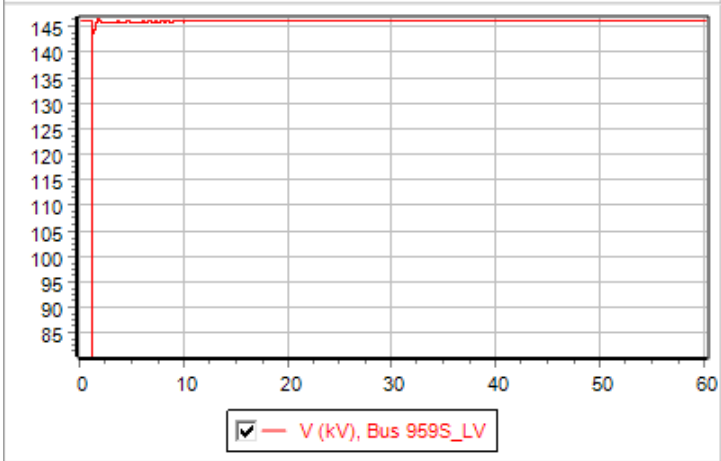
Contingency:
9L29: Coyote Lake 963S to Oakland 946S

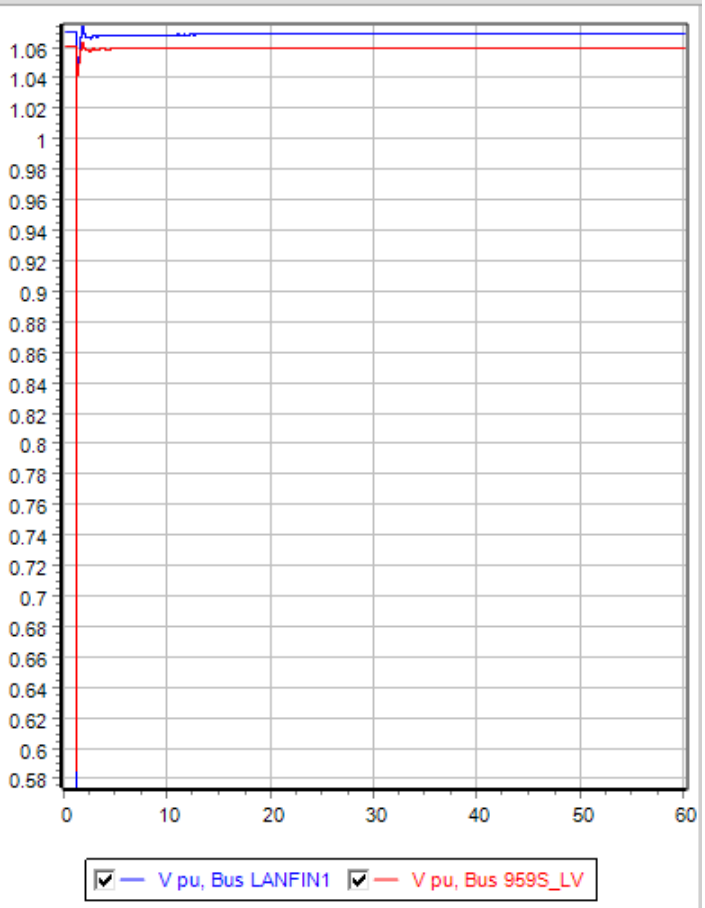
Study Case:
Scenario 6 (2022WP)

December 04, 2020 20:20:02

Lanfine 959S Voltages





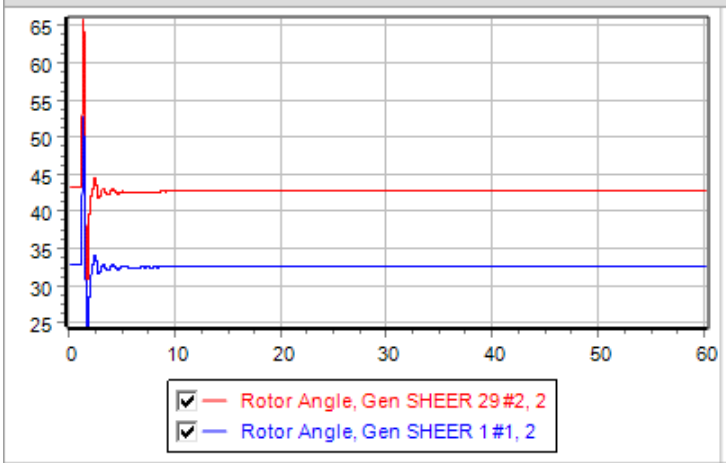


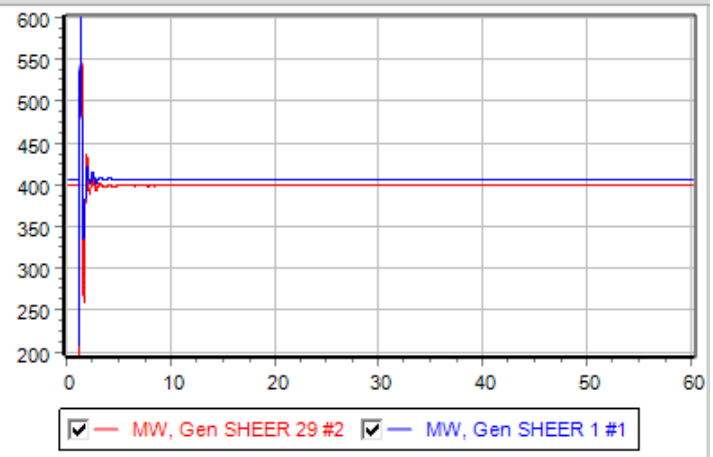
Contingency:
9L29: Coyote Lake 963S to Oakland 946S

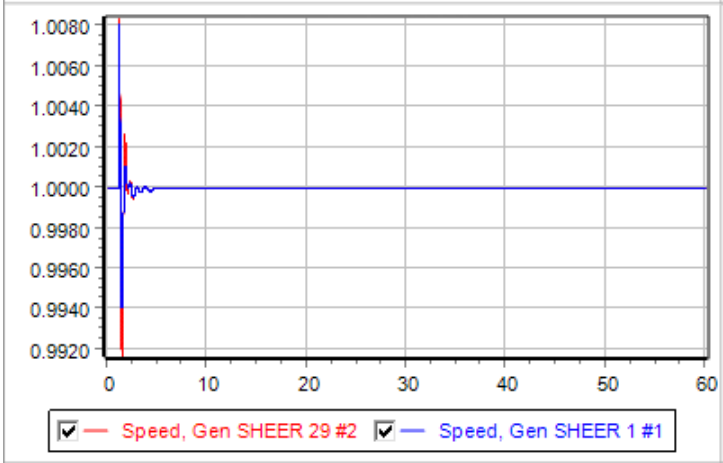
Study Case:
Scenario 6 (2022WP)

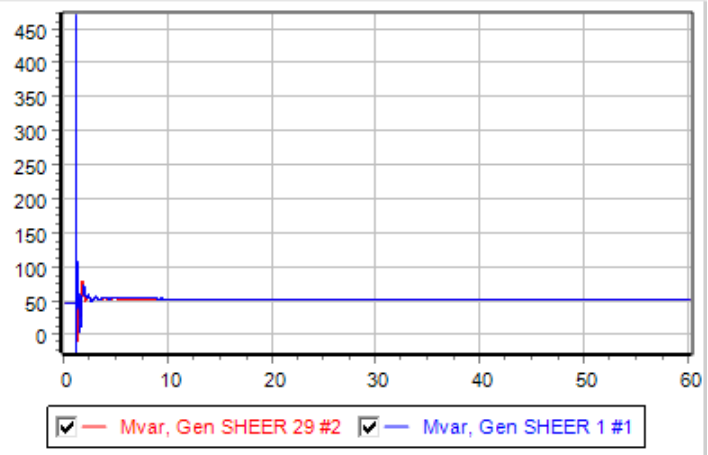
December 04, 2020 20:20:02

Sheerness







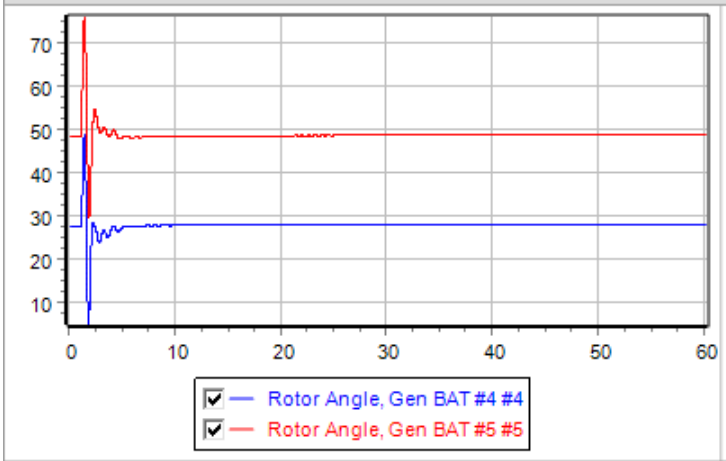


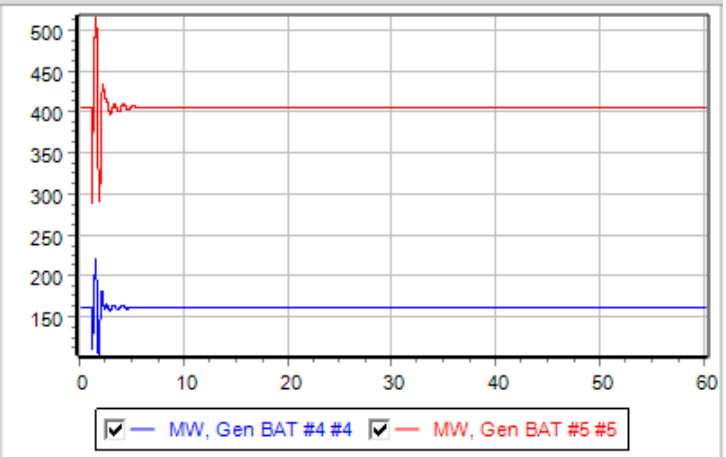
Contingency:
9L29: Coyote Lake 963S to Oakland 946S

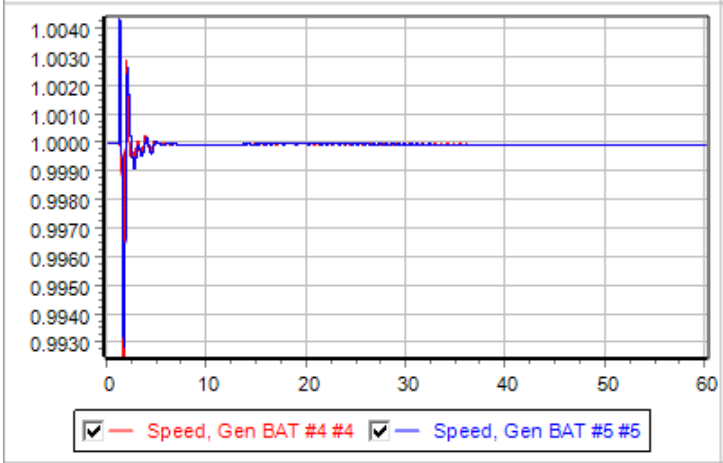
Study Case:
Scenario 6 (2022WP)

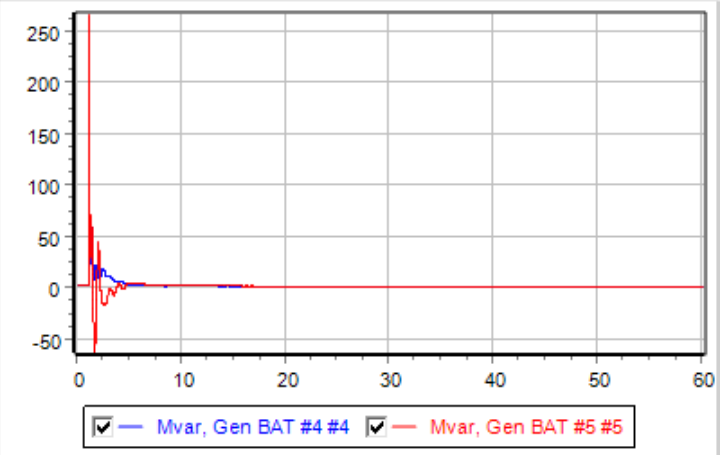
December 04, 2020 20:20:01

Battle River







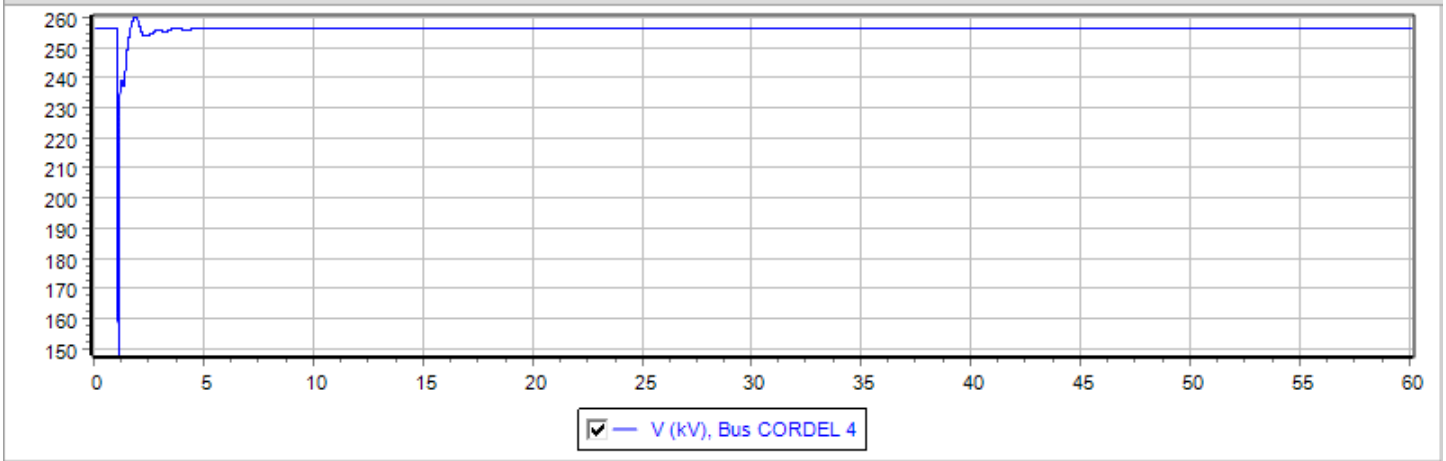


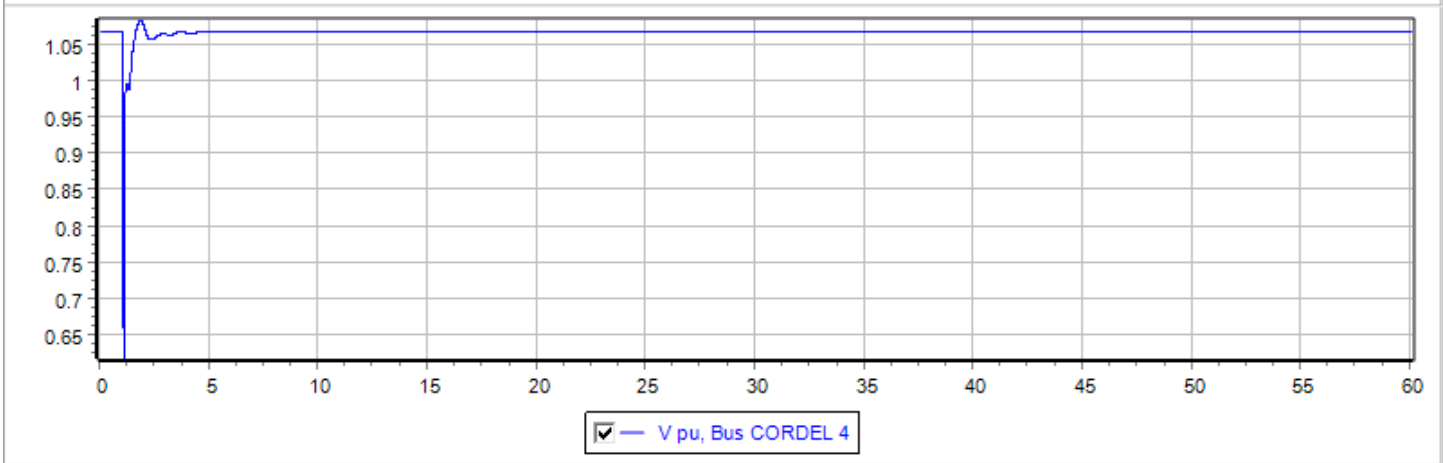
Contingency:
9L29: Oakland 946S to Coyote Lake 963S

Study Case:
Scenario 6 (2022WP)

December 04, 2020 20:23:58

Cordel 755S Voltages



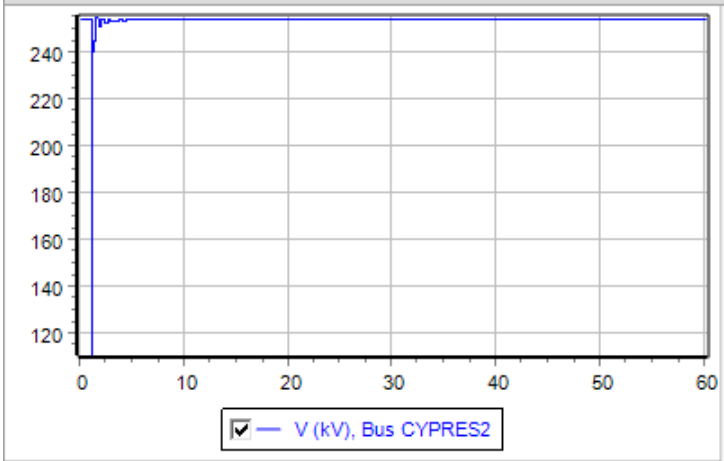


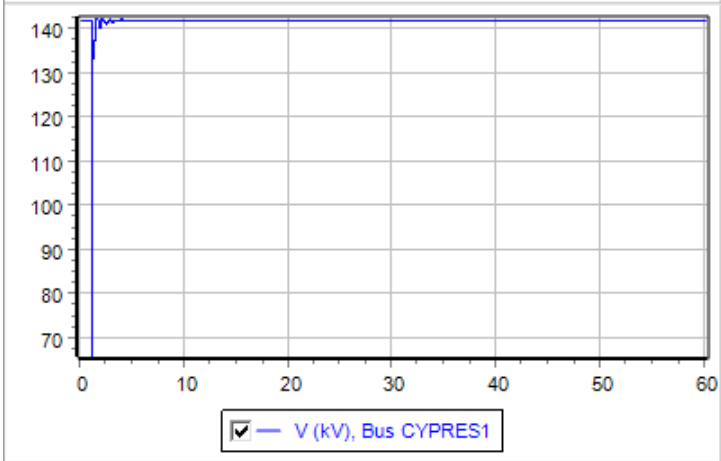
Contingency:
9L29: Oakland 946S to Coyote Lake 963S

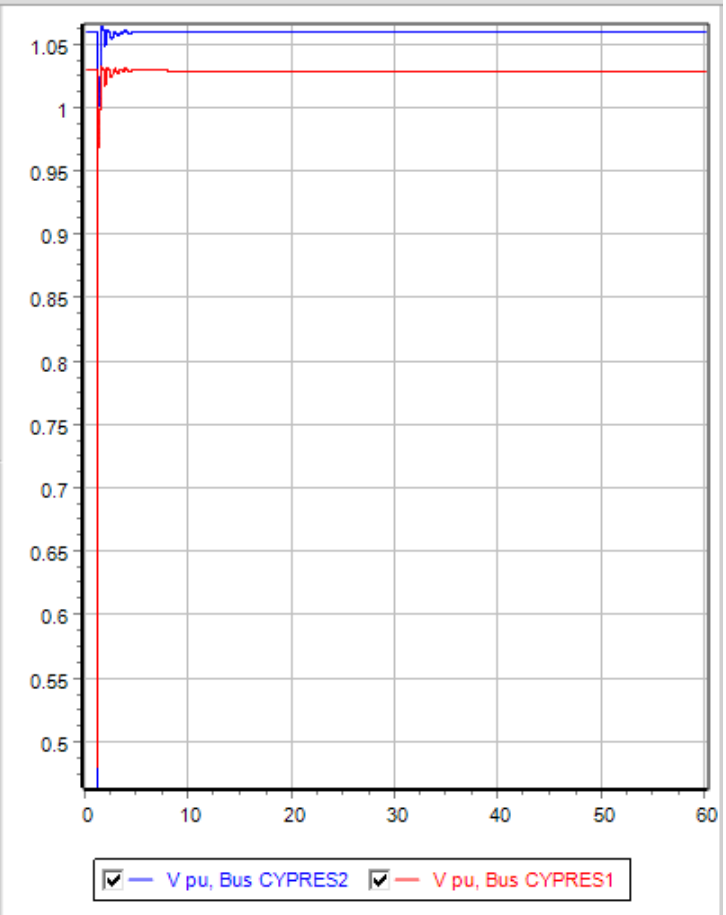
Study Case:
Scenario 6 (2022WP)

December 04, 2020 20:24:00

Cypress 562S Voltages





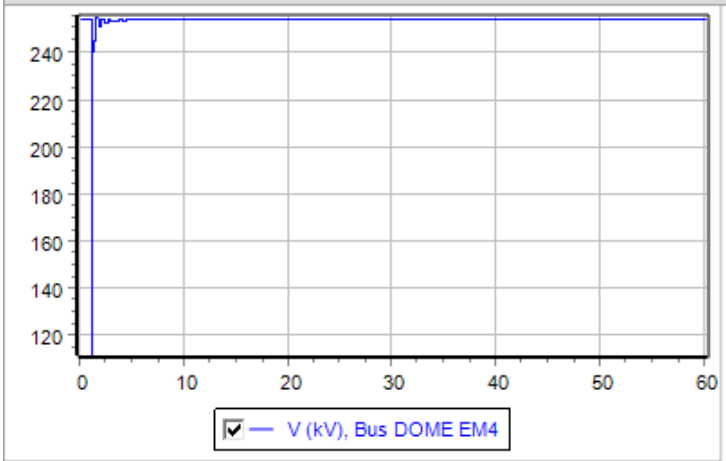


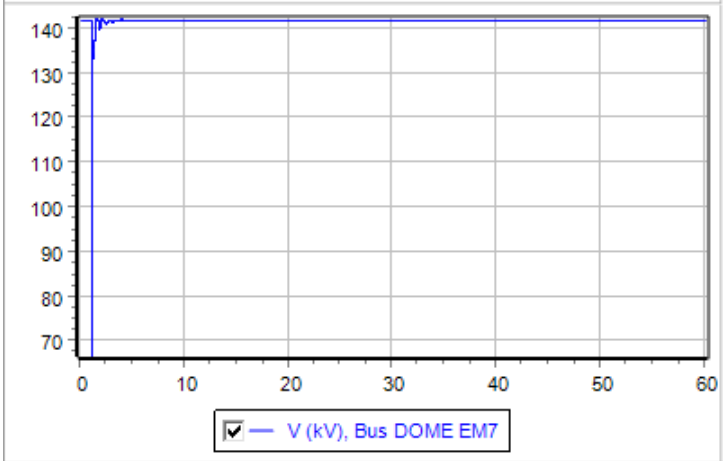
Contingency:
9L29: Oakland 946S to Coyote Lake 963S

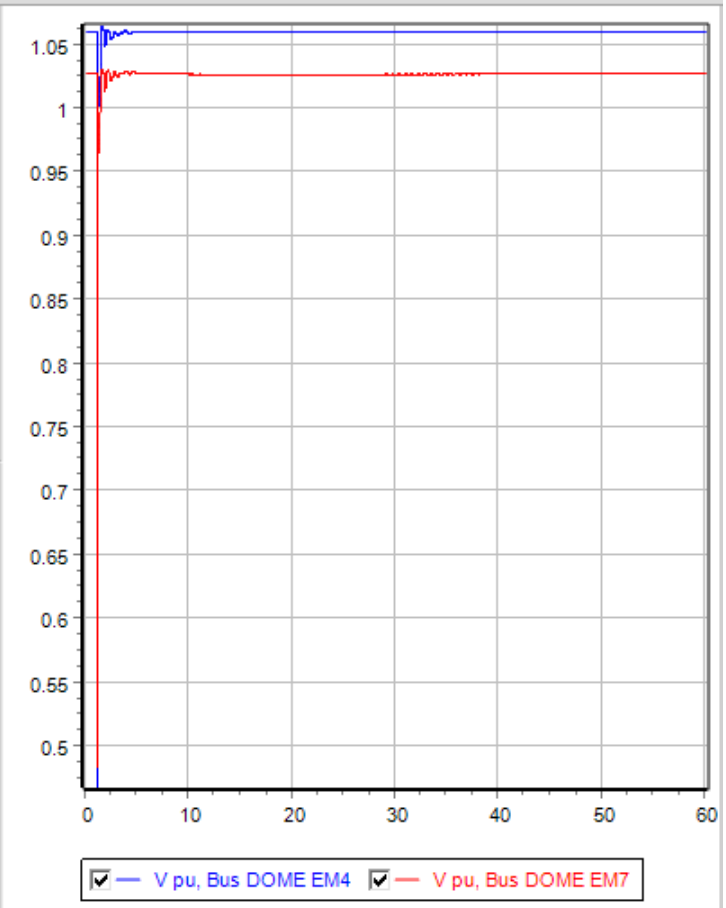
Study Case:
Scenario 6 (2022WP)

December 04, 2020 20:24:00

Dome 163S Voltages





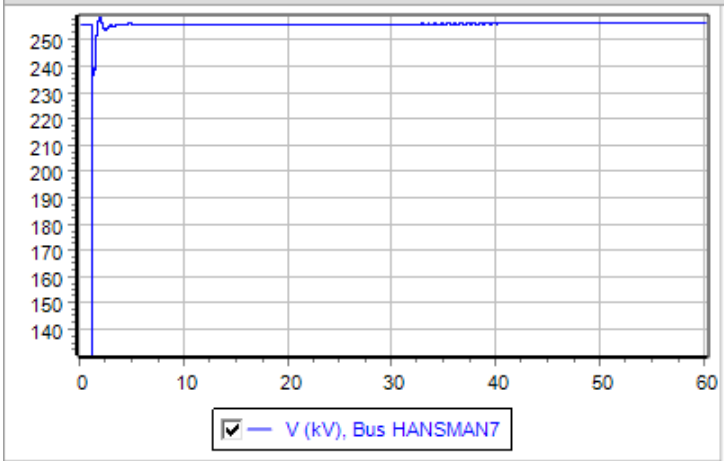


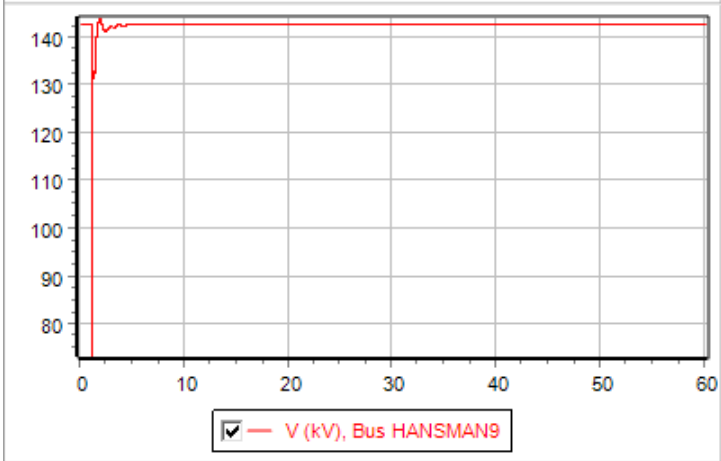
Contingency:
9L29: Oakland 946S to Coyote Lake 963S

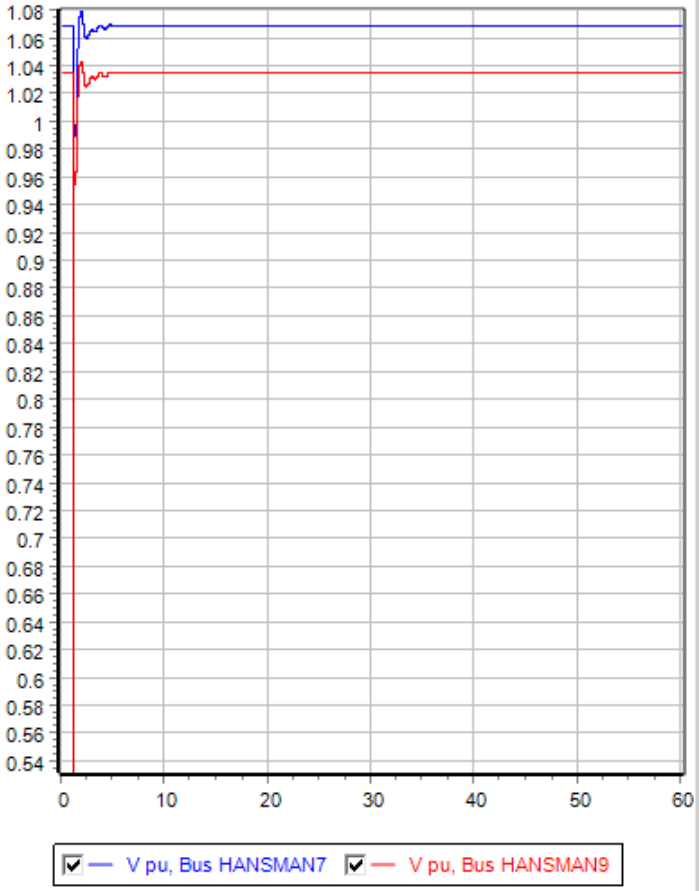
Study Case:
Scenario 6 (2022WP)

December 04, 2020 20:23:59

Hansman Lake 650S Voltages





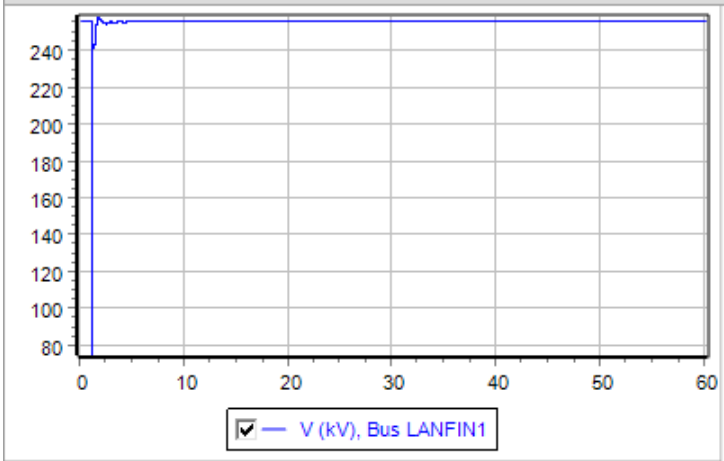


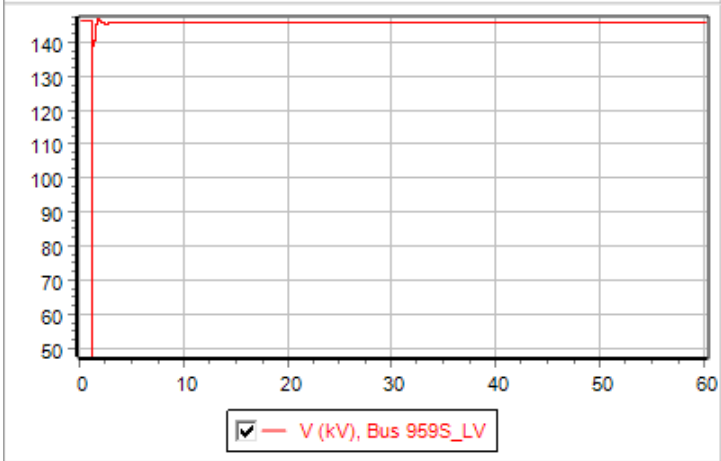
Contingency:
9L29: Oakland 946S to Coyote Lake 963S

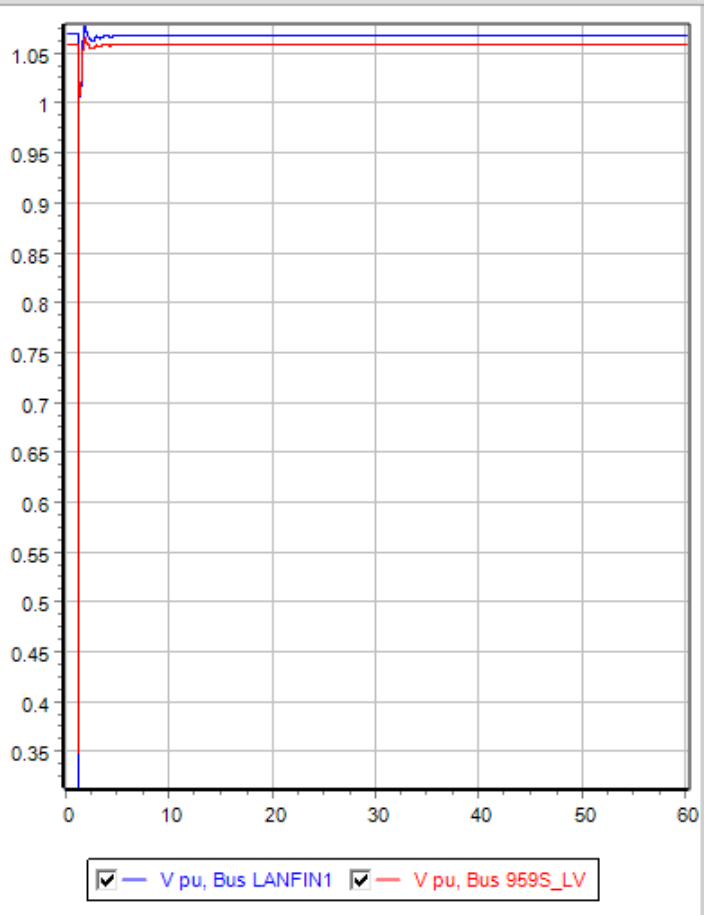
Study Case:
Scenario 6 (2022WP)

December 04, 2020 20:23:59

Lanfine 959S Voltages





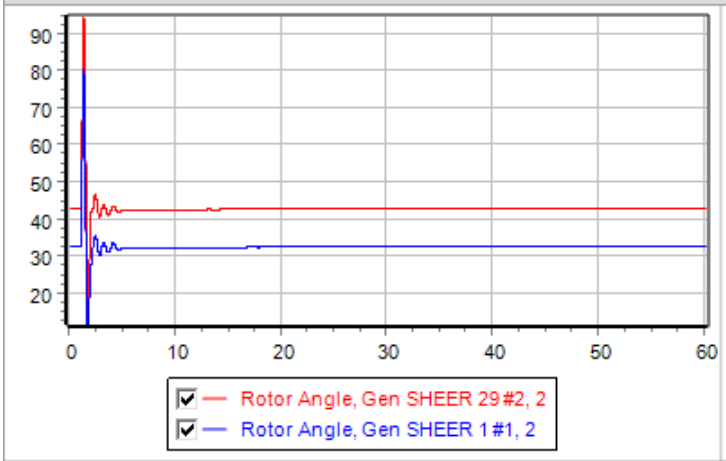


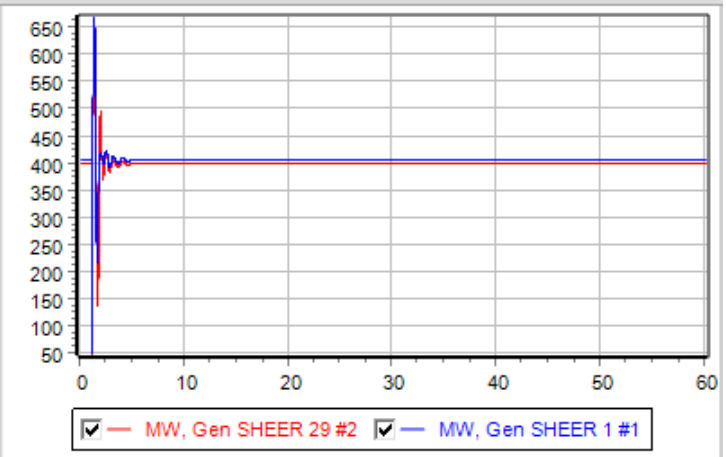
Contingency:
9L29: Oakland 946S to Coyote Lake 963S

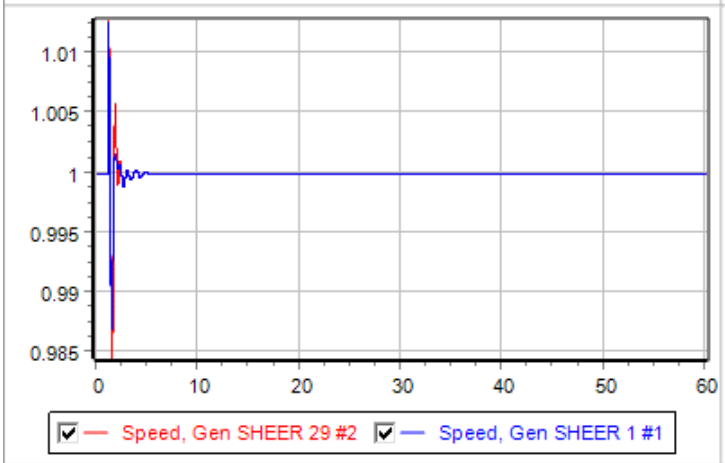
Study Case:
Scenario 6 (2022WP)

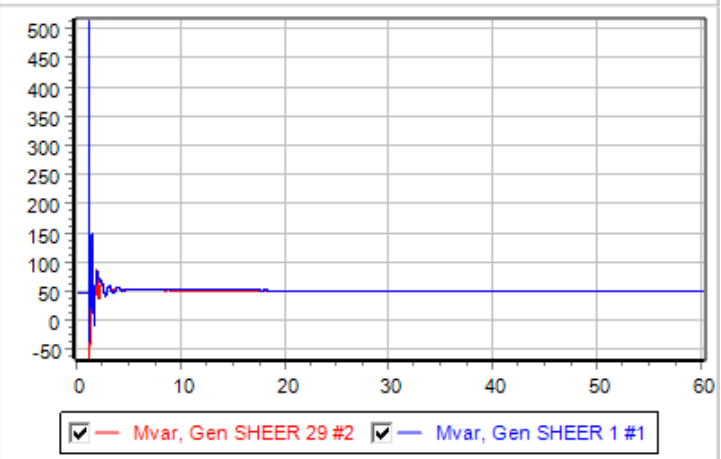
December 04, 2020 20:23:58

Sheerness







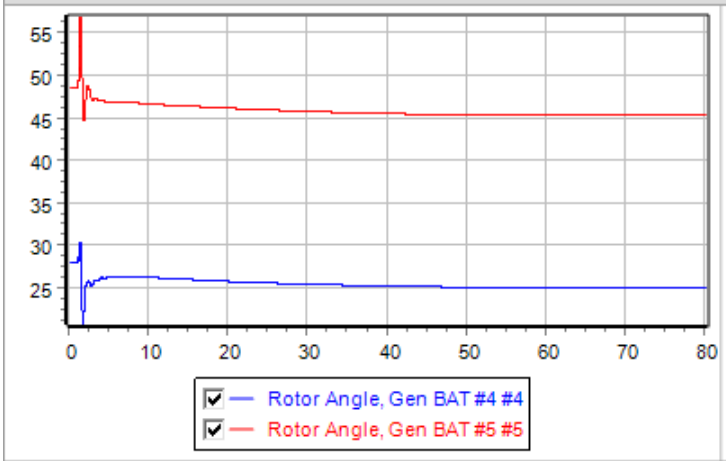


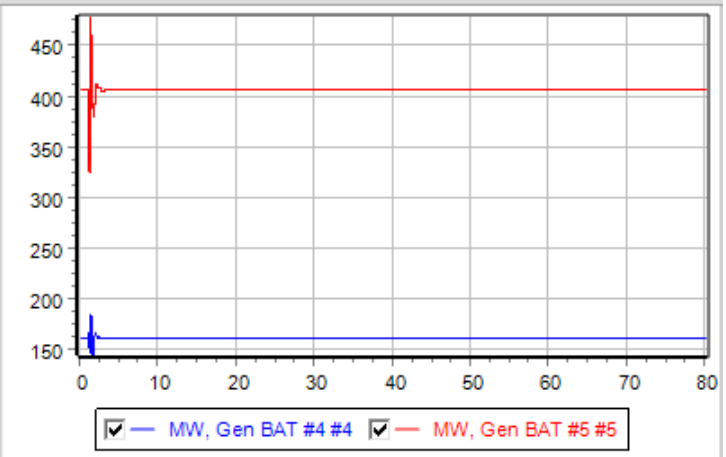
Contingency:
9L29: Oakland 946S to Coyote Lake 963S

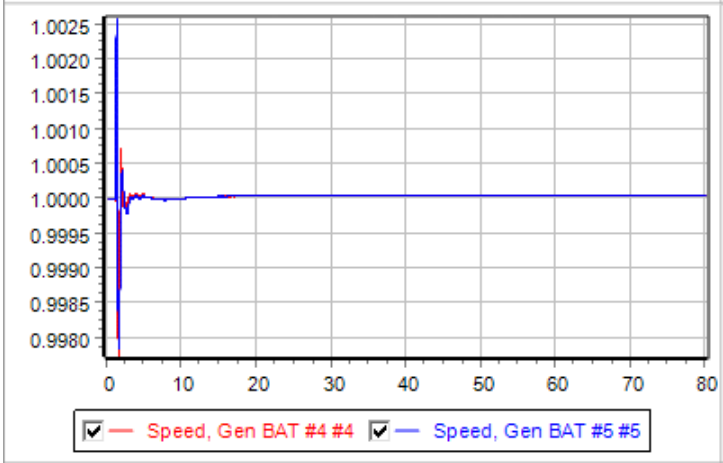
Study Case:
Scenario 6 (2022WP)

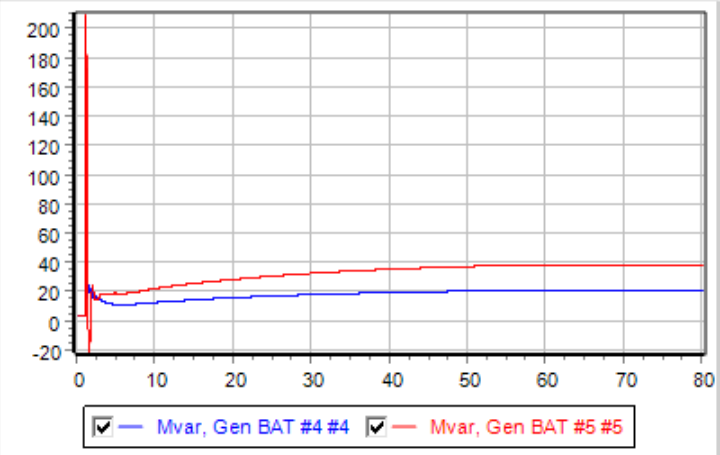
December 04, 2020 20:23:57

Battle River







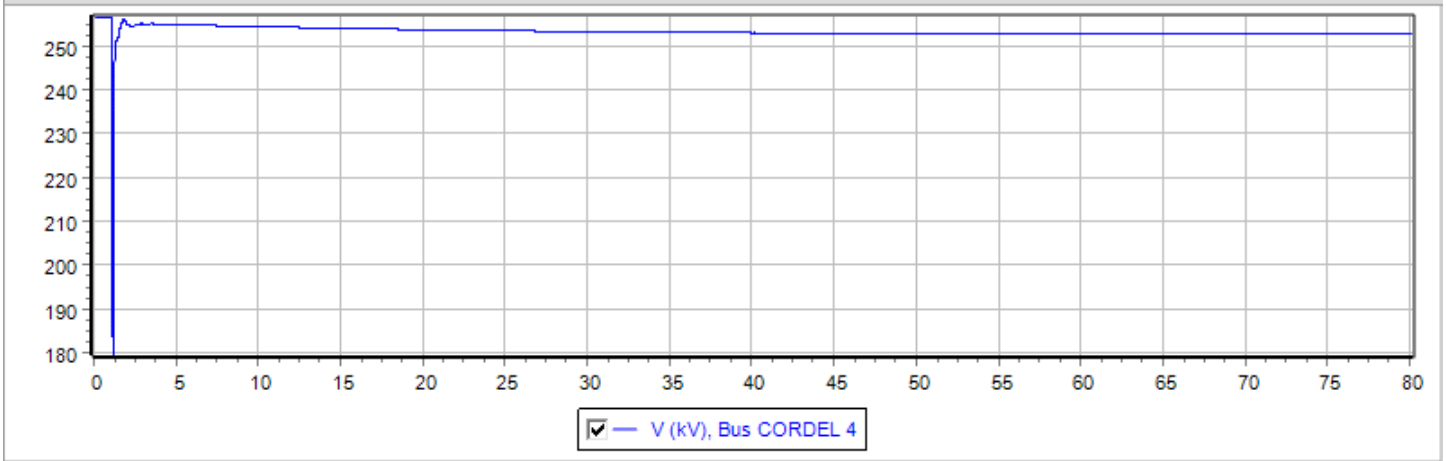


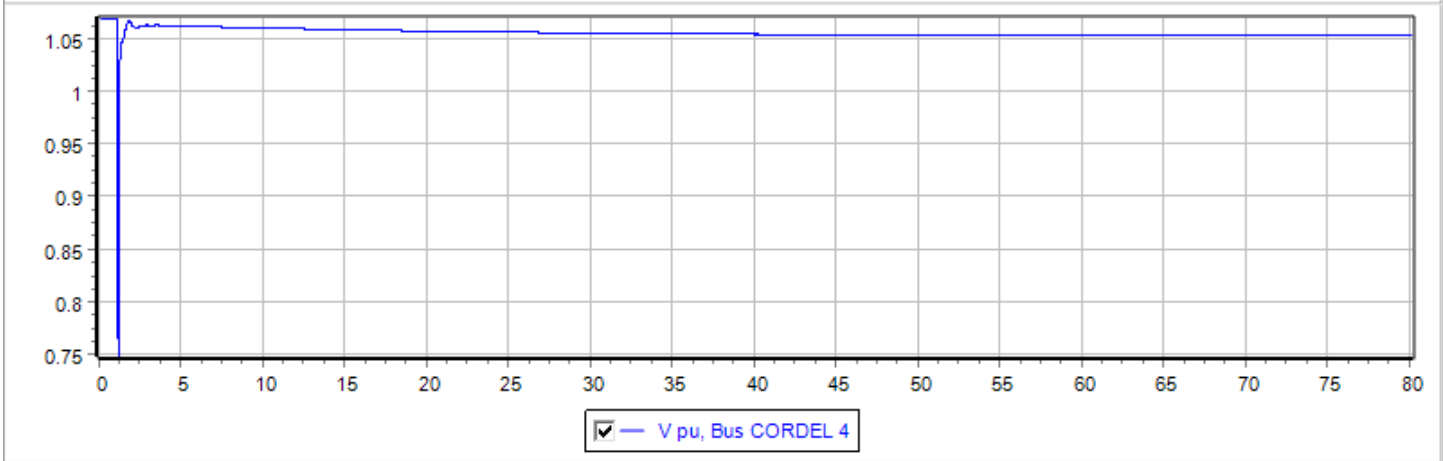
Contingency:
9L46: Lanfine 959S to N.Bridgen

Study Case:
Scenario 6 (2022WP)

December 04, 2020 20:29:14

Cordel 755S Voltages



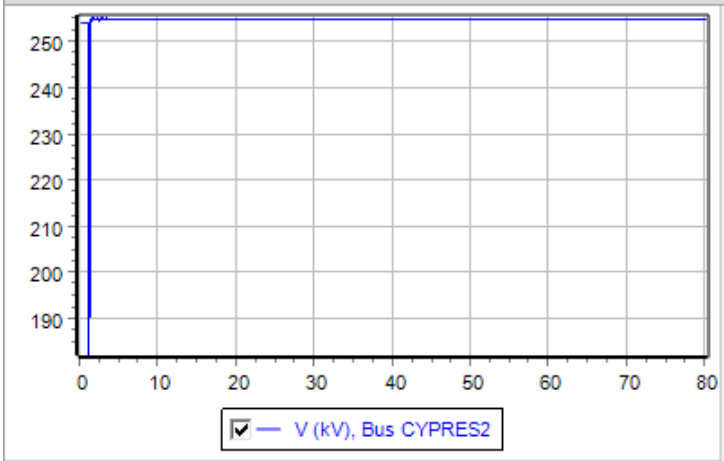


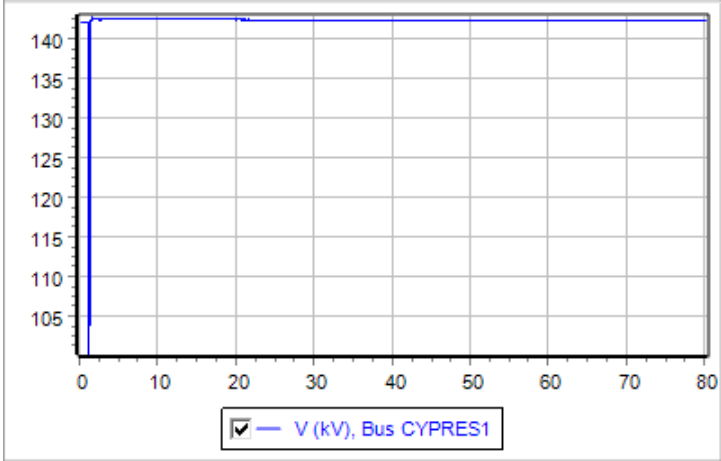
Contingency:
9L46: Lanfine 959S to N.Bridgen

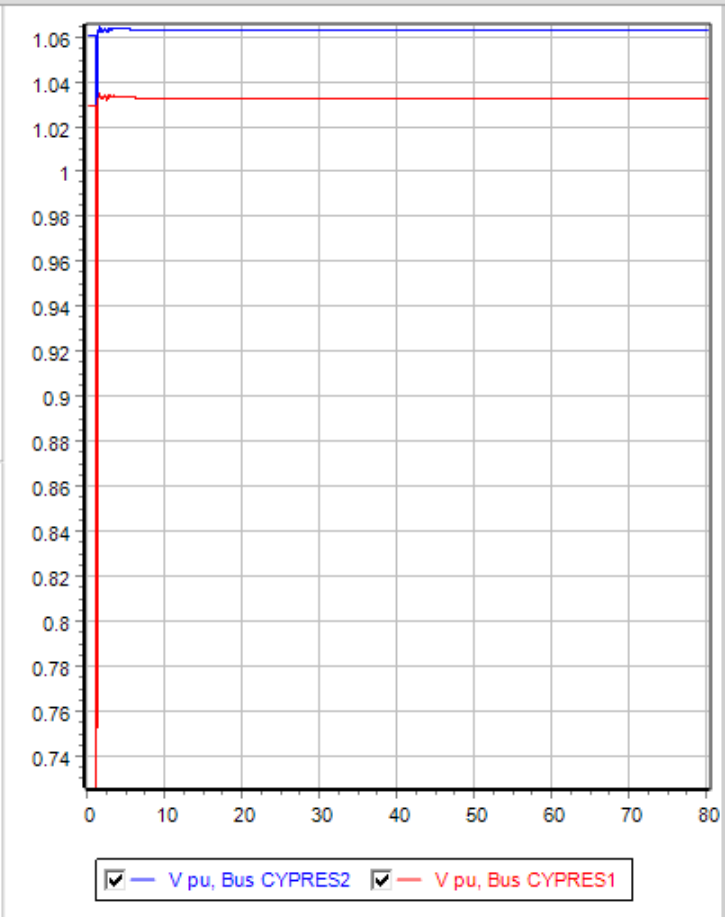
Study Case:
Scenario 6 (2022WP)

December 04, 2020 20:29:17

Cypress 562S Voltages





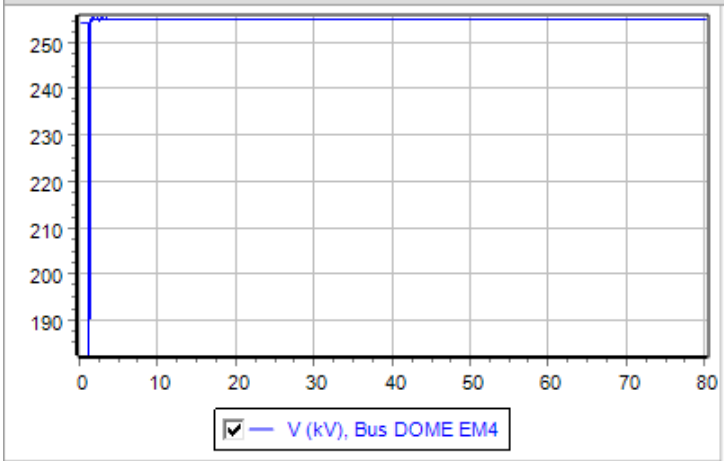


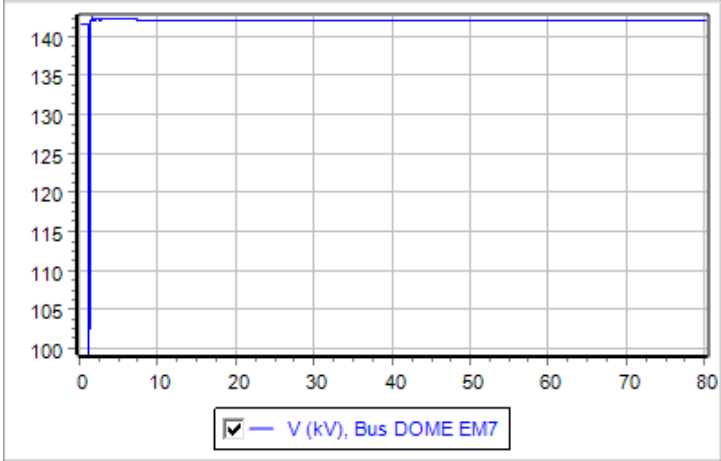
Contingency:
9L46: Lanfine 959S to N.Bridgen

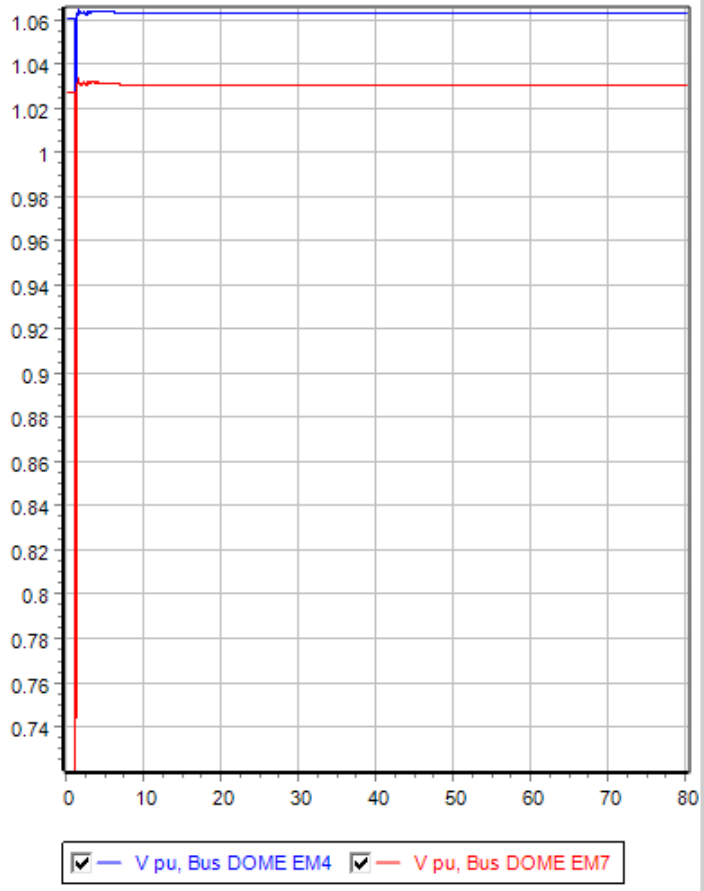
Study Case:
Scenario 6 (2022WP)

December 04, 2020 20:29:17

Dome 163S Voltages





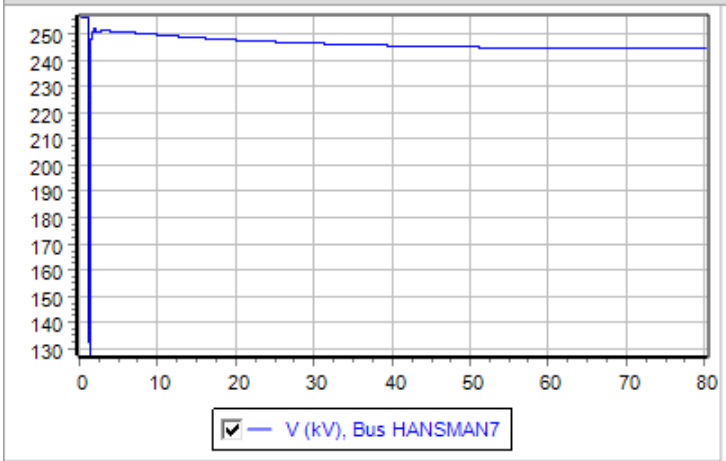


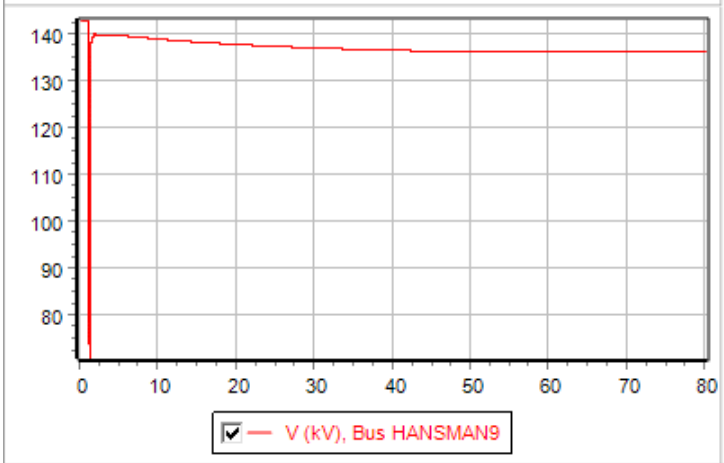
Contingency:
9L46: Lanfine 959S to N.Bridgen

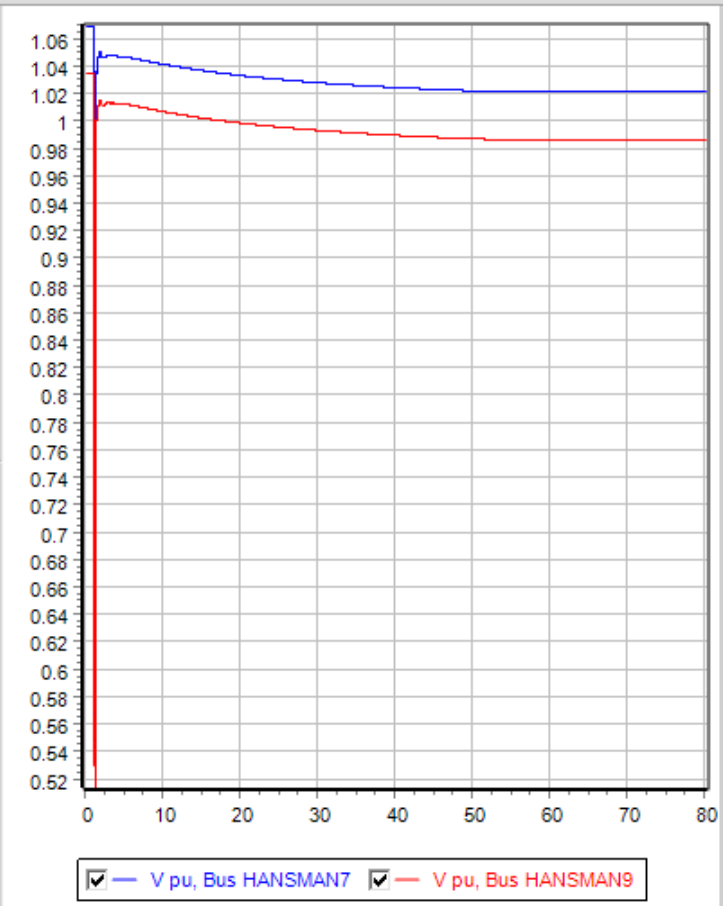
Study Case:
Scenario 6 (2022WP)

December 04, 2020 20:29:16

Hansman Lake 650S Voltages





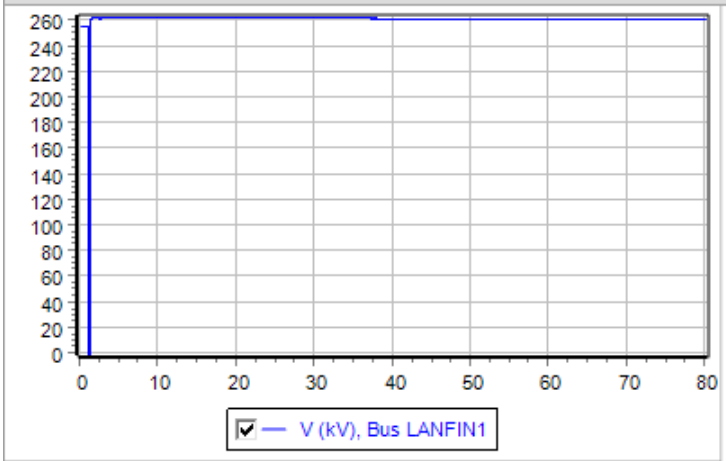


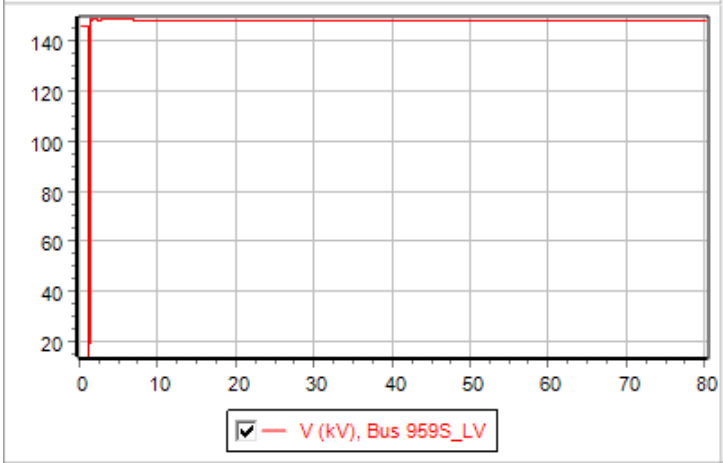
Contingency:
9L46: Lanfine 959S to N.Bridgen

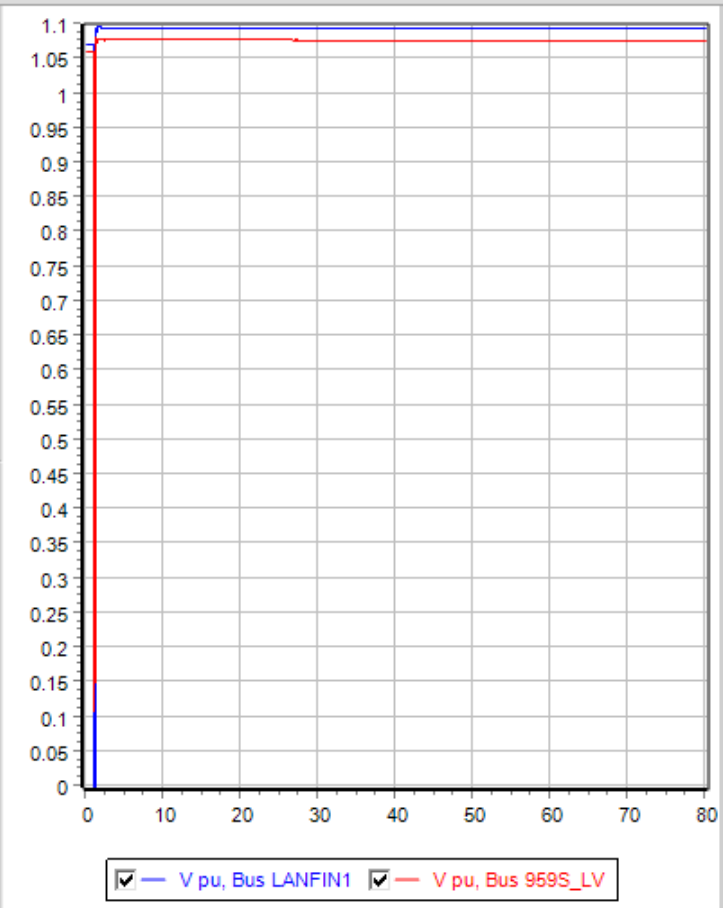
Study Case:
Scenario 6 (2022WP)

December 04, 2020 20:29:16

Lanfine 959S Voltages





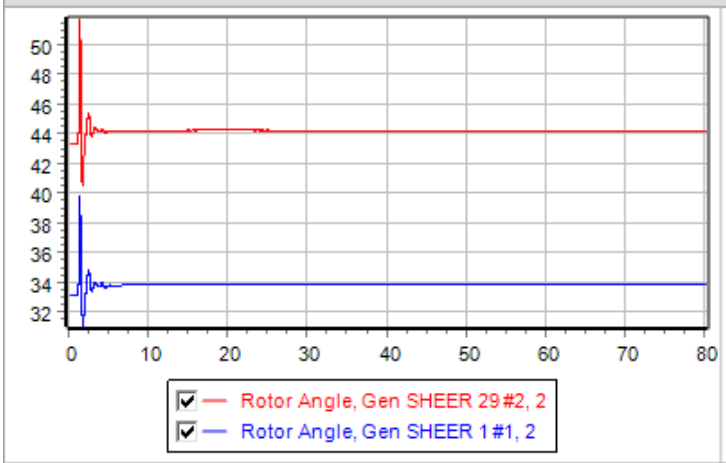


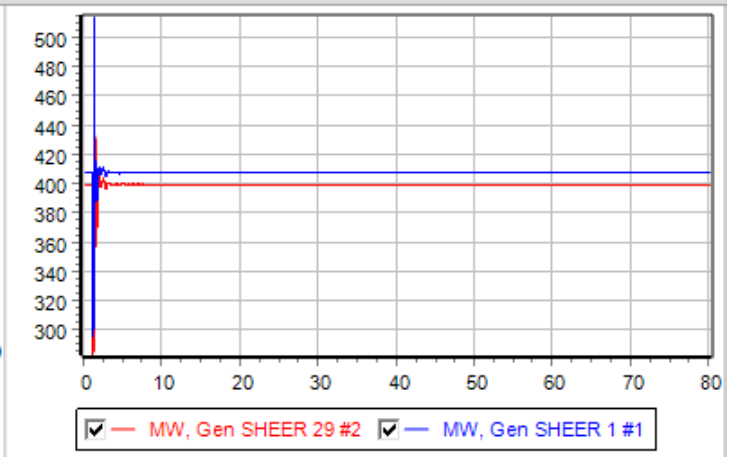
Contingency:
9L46: Lanfine 959S to N.Bridgen

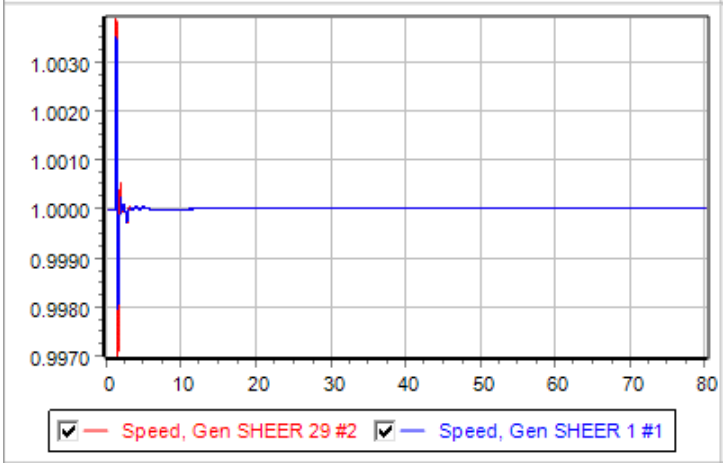
Study Case:
Scenario 6 (2022WP)

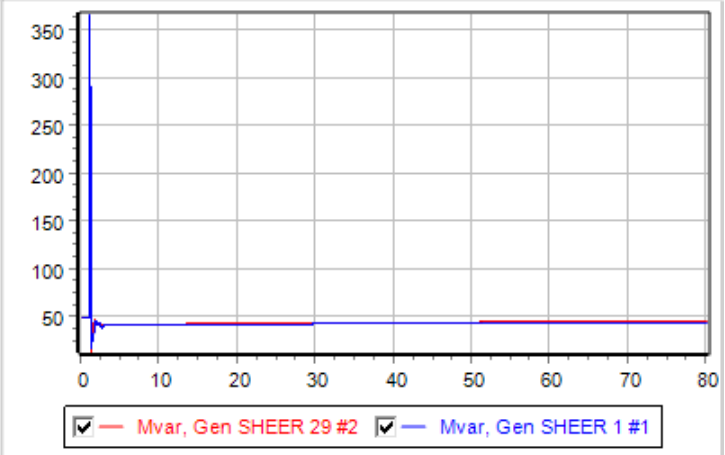
December 04, 2020 20:29:15

Sheerness







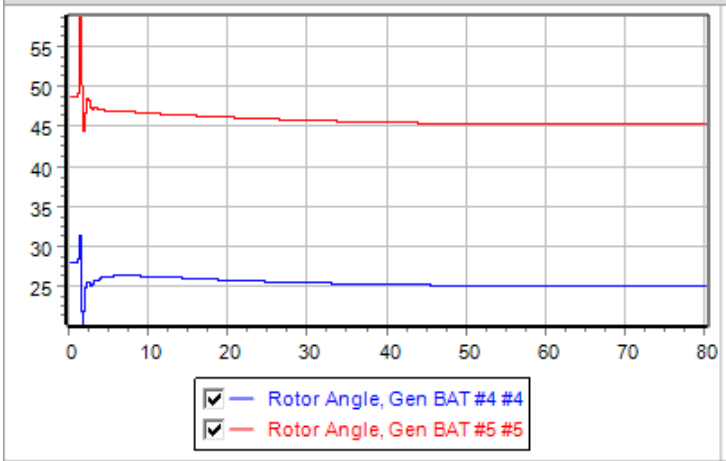


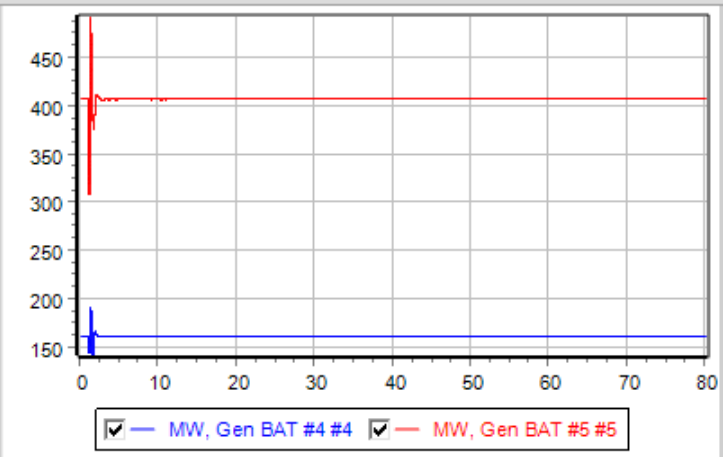
Contingency:
9L46: Lanfine 959S to N.Bridgen

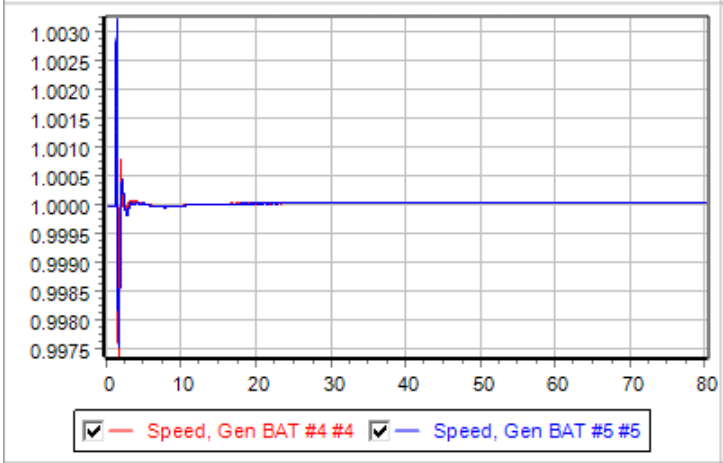
Study Case:
Scenario 6 (2022WP)

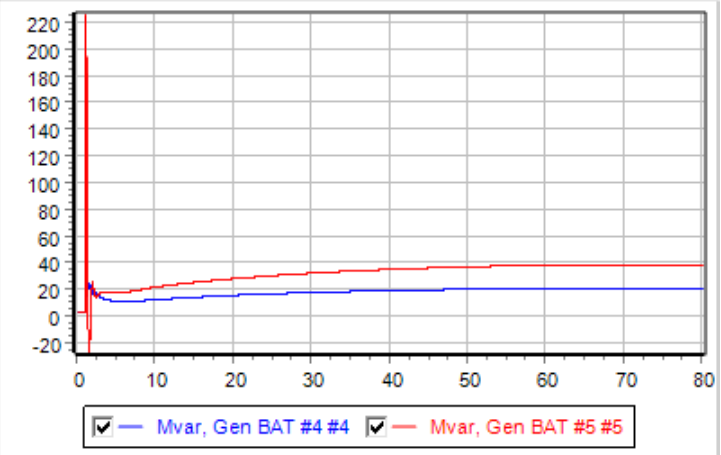
December 04, 2020 20:29:14

Battle River







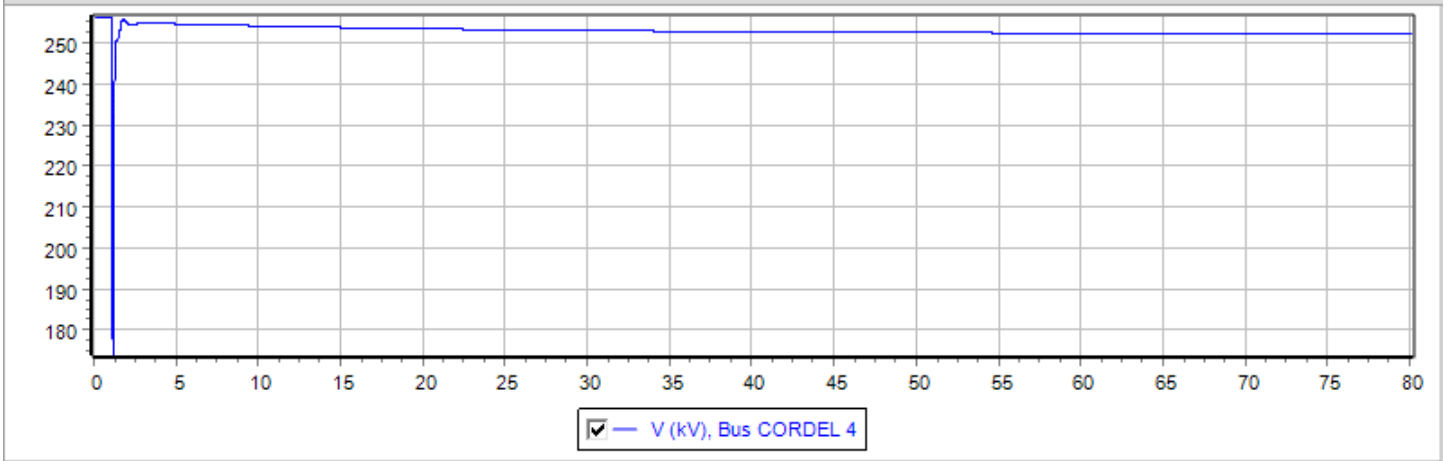


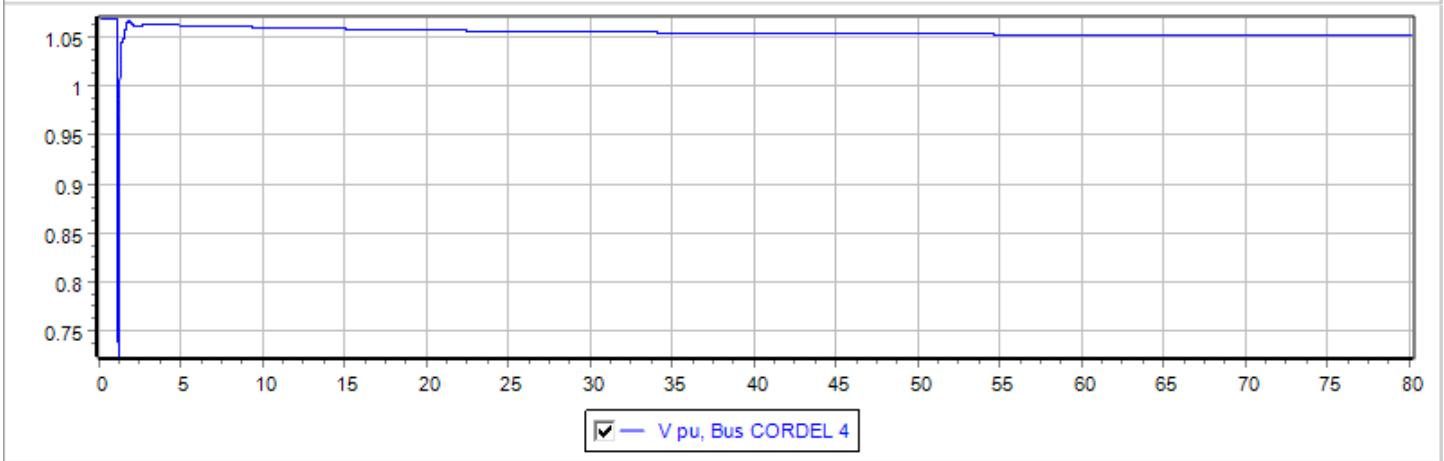
Contingency:
9L46: N.Bridgen to Lanfine 959S

Study Case:
Scenario 6 (2022WP)

December 04, 2020 20:34:08

Cordel 755S Voltages



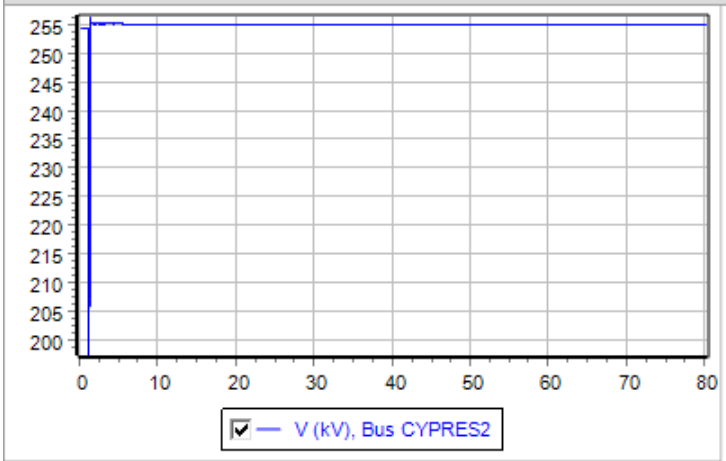


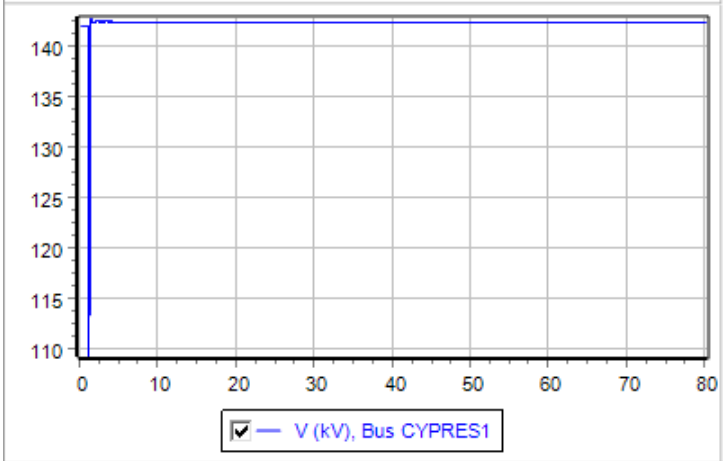
Contingency:
9L46: N.Bridgen to Lanfine 959S

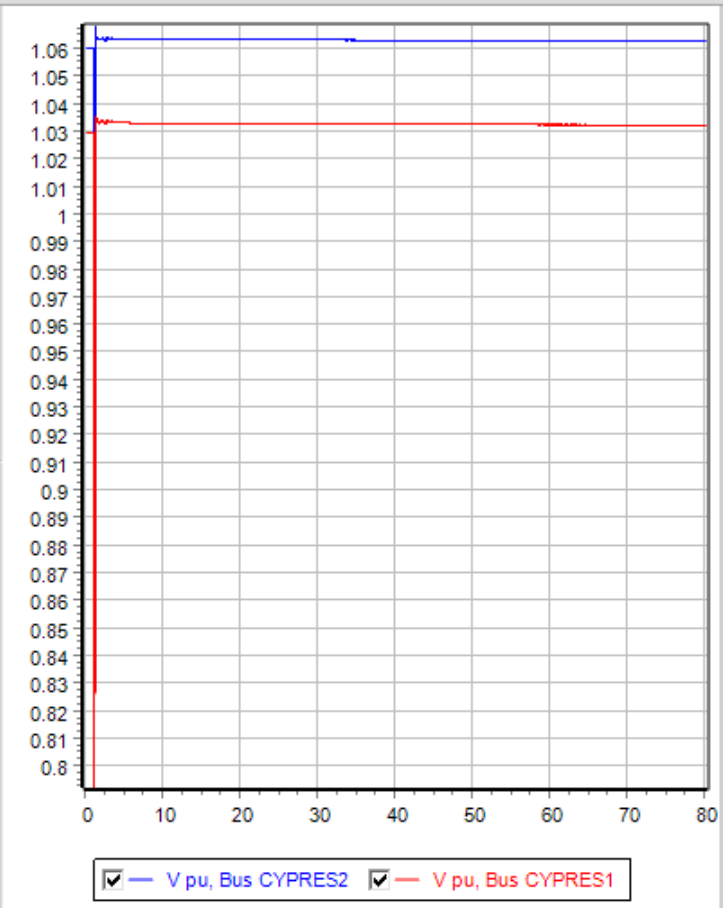
Study Case:
Scenario 6 (2022WP)

December 04, 2020 20:34:11

Cypress 562S Voltages





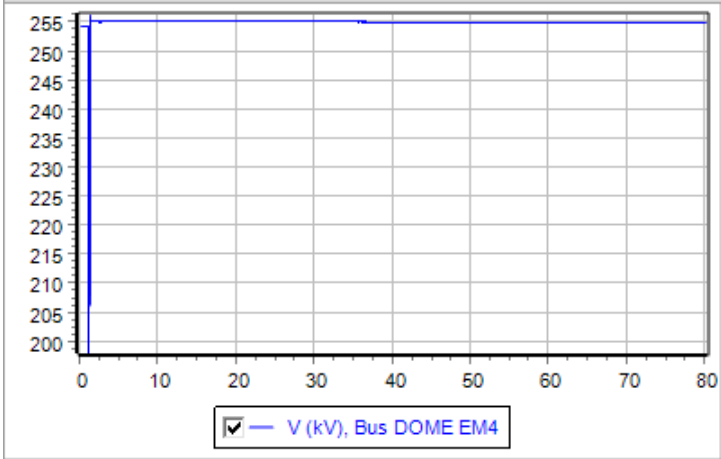


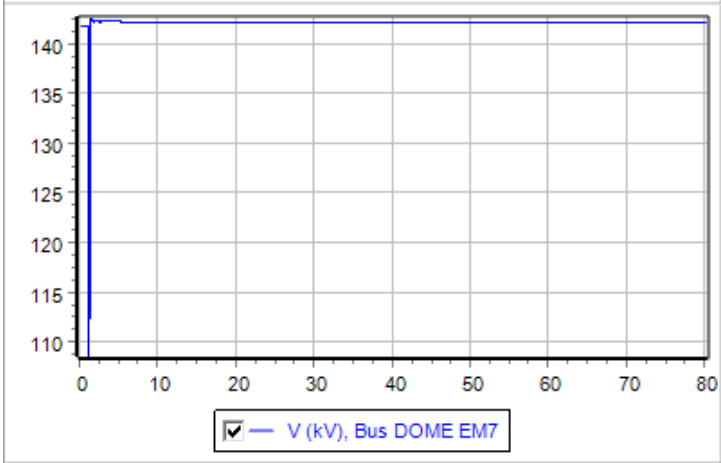
Contingency:
9L46: N.Bridgen to Lanfine 959S

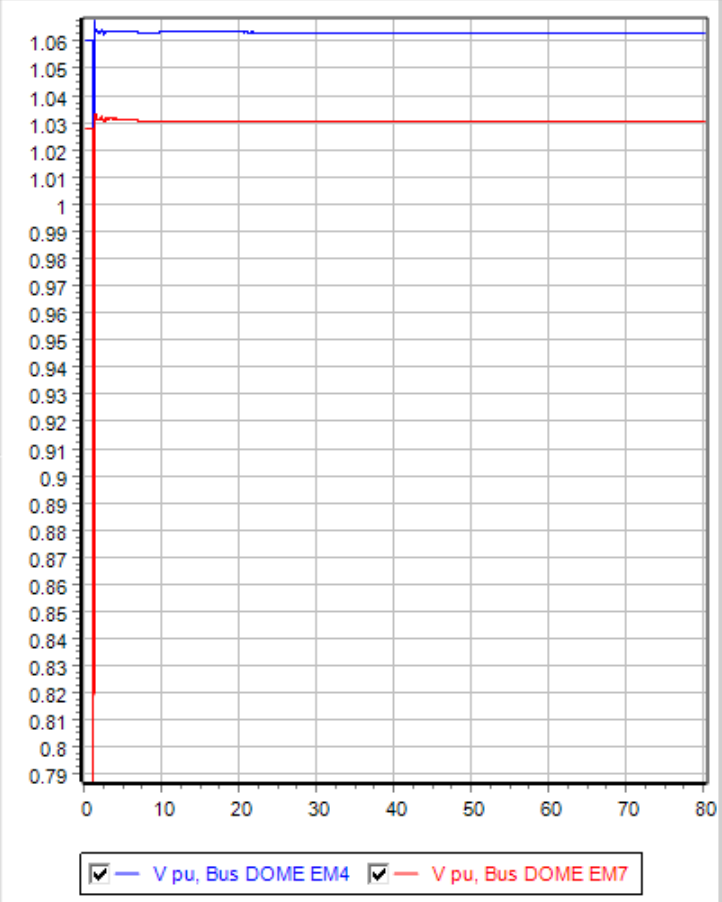
Study Case:
Scenario 6 (2022WP)

December 04, 2020 20:34:10

Dome 163S Voltages





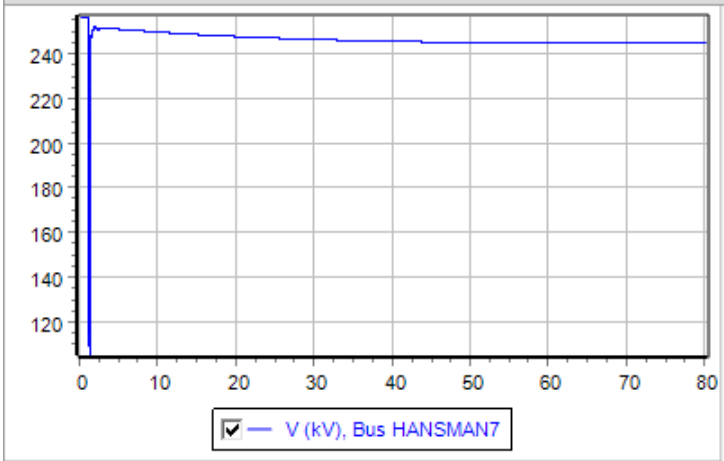


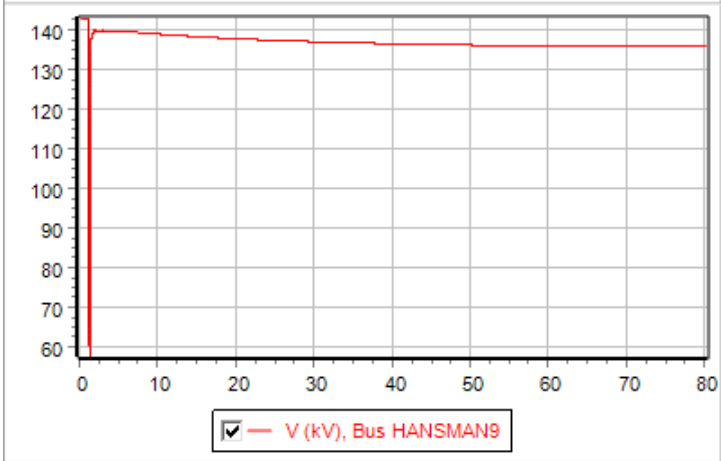
Contingency:
9L46: N.Bridgen to Lanfine 959S

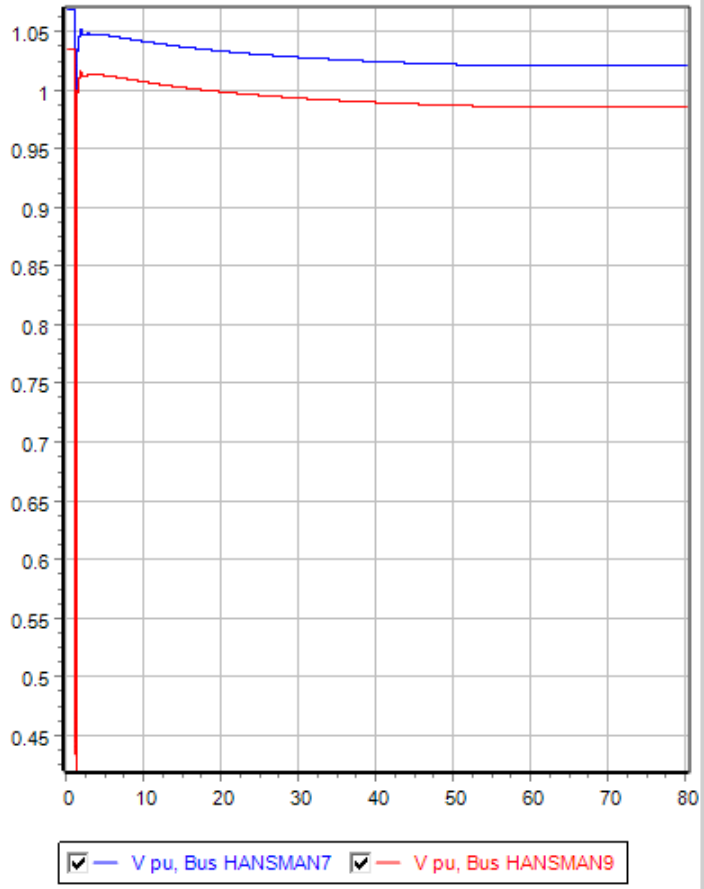
Study Case:
Scenario 6 (2022WP)

December 04, 2020 20:34:09

Hansman Lake 650S Voltages





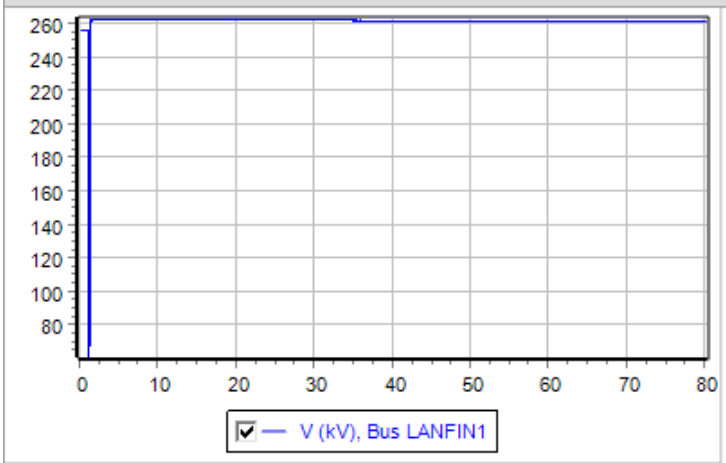


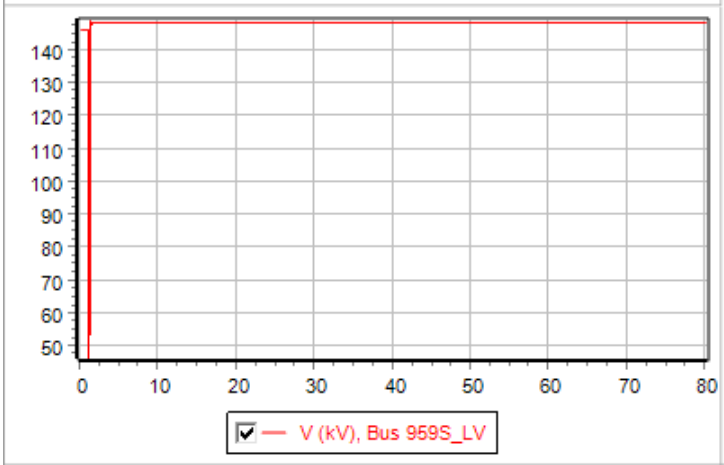
Contingency:
9L46: N.Bridgen to Lanfine 959S

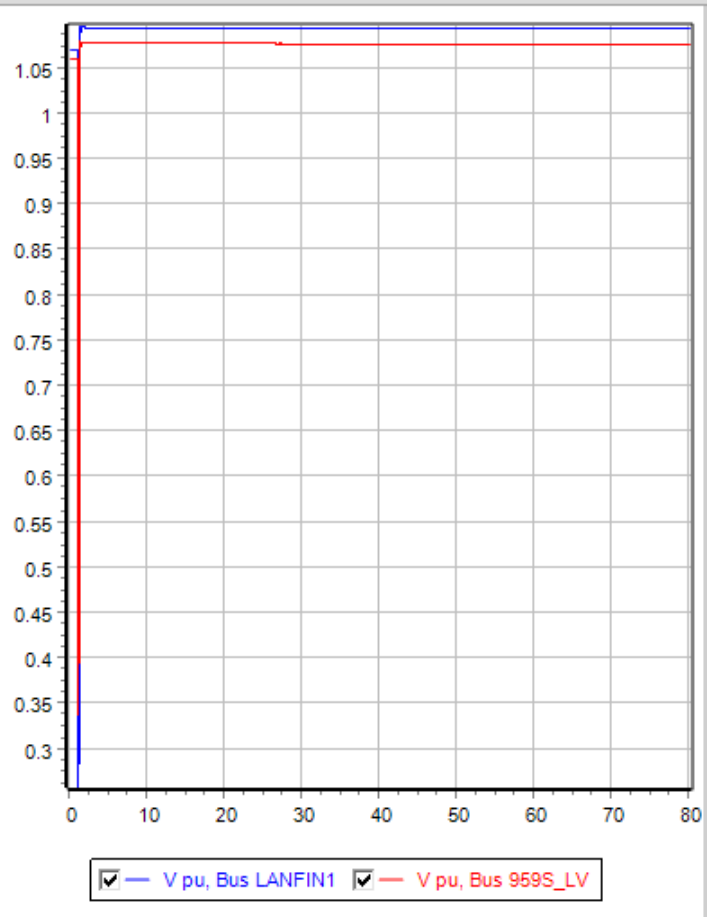
Study Case:
Scenario 6 (2022WP)

December 04, 2020 20:34:09

Lanfine 959S Voltages





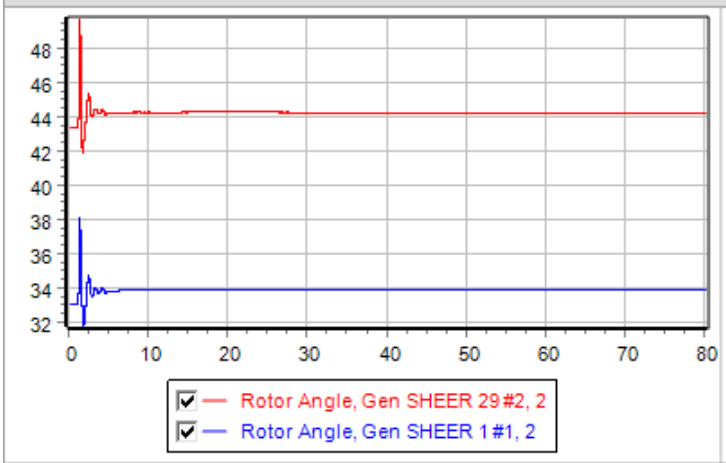


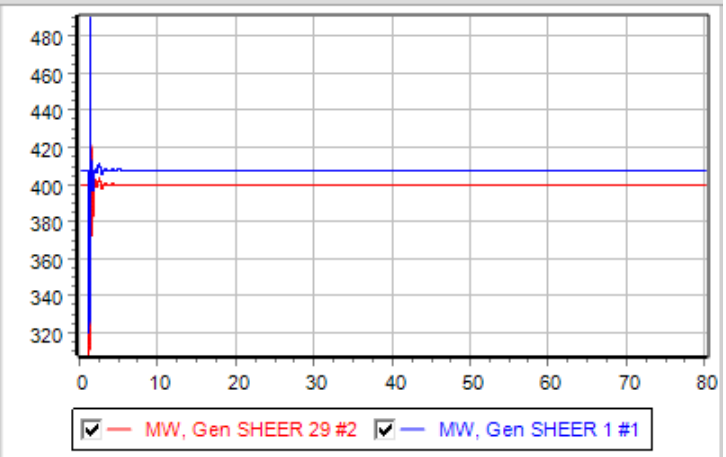
Contingency:
9L46: N.Bridgen to Lanfine 959S

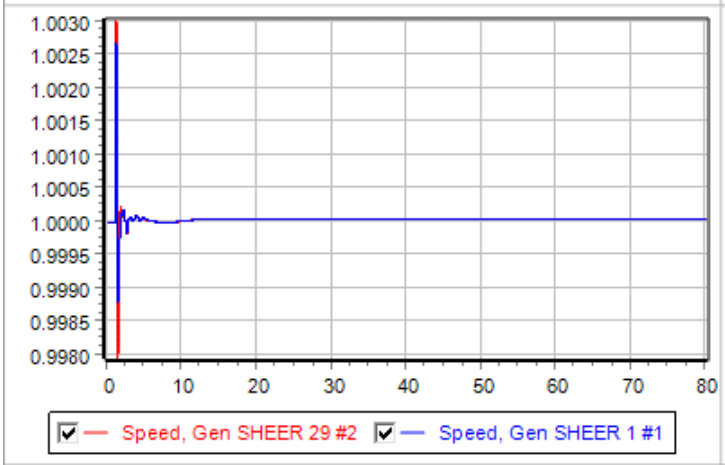
Study Case:
Scenario 6 (2022WP)

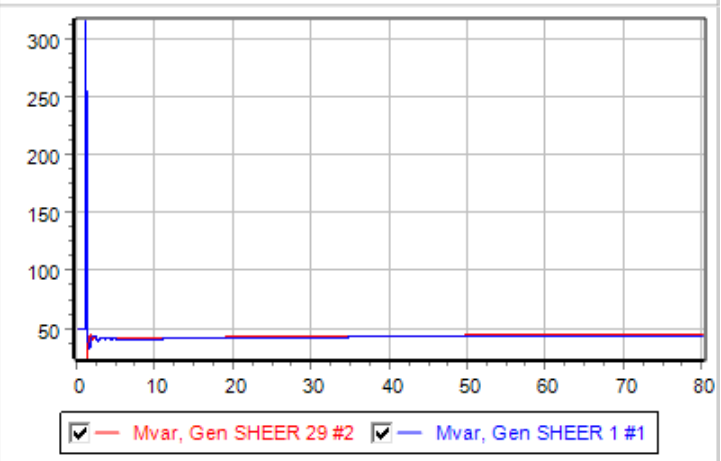
December 04, 2020 20:34:08

Sheerness







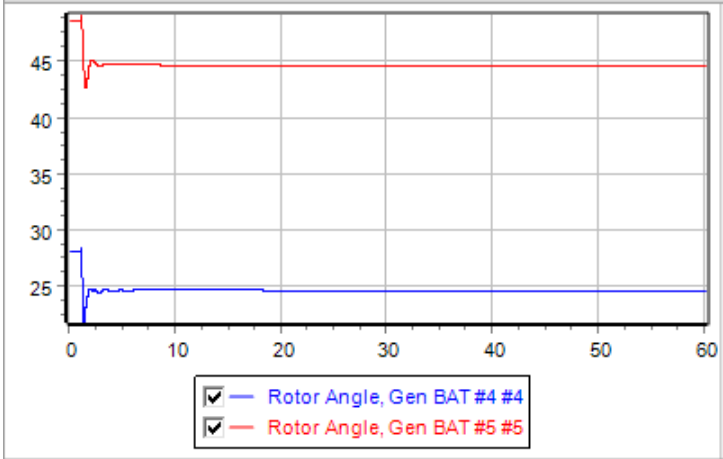


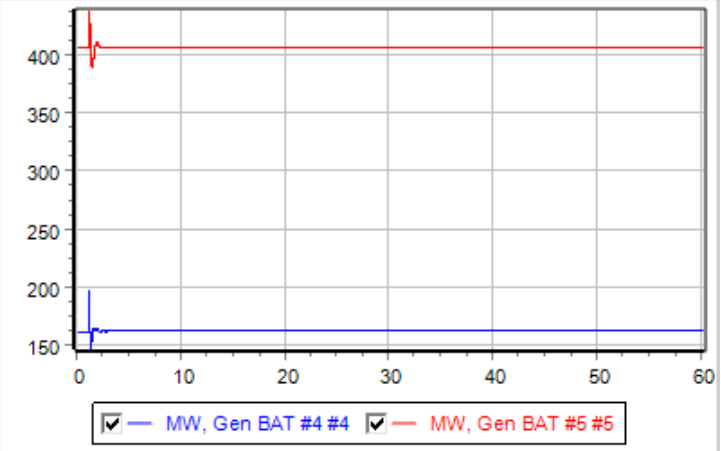
Contingency:
9L46: N.Bridgen to Lanfine 959S

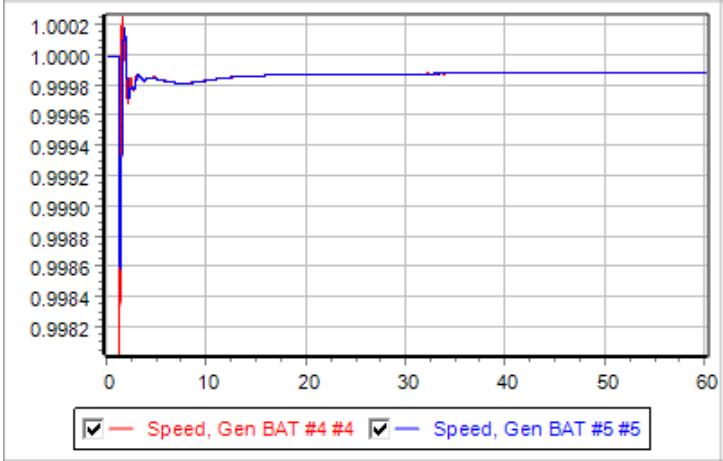
Study Case:
Scenario 6 (2022WP)

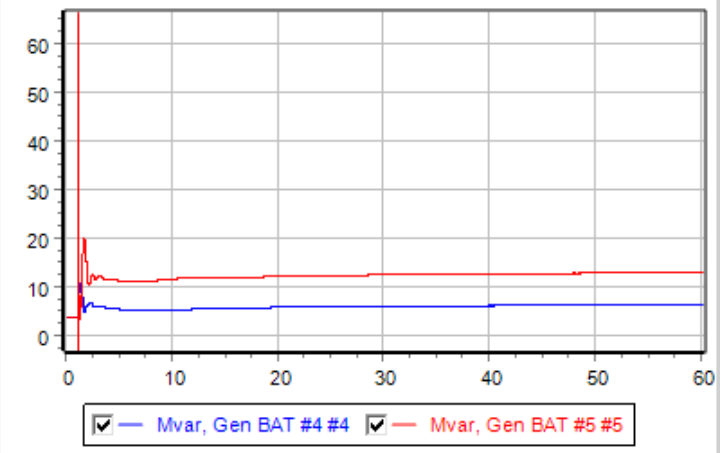
December 04, 2020 20:34:07

Battle River







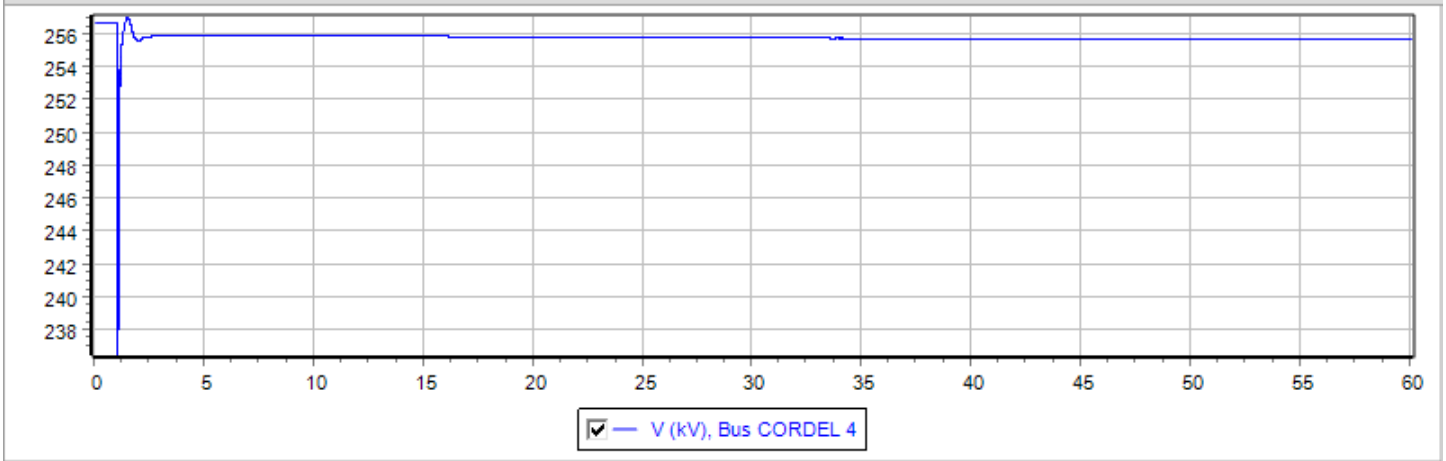


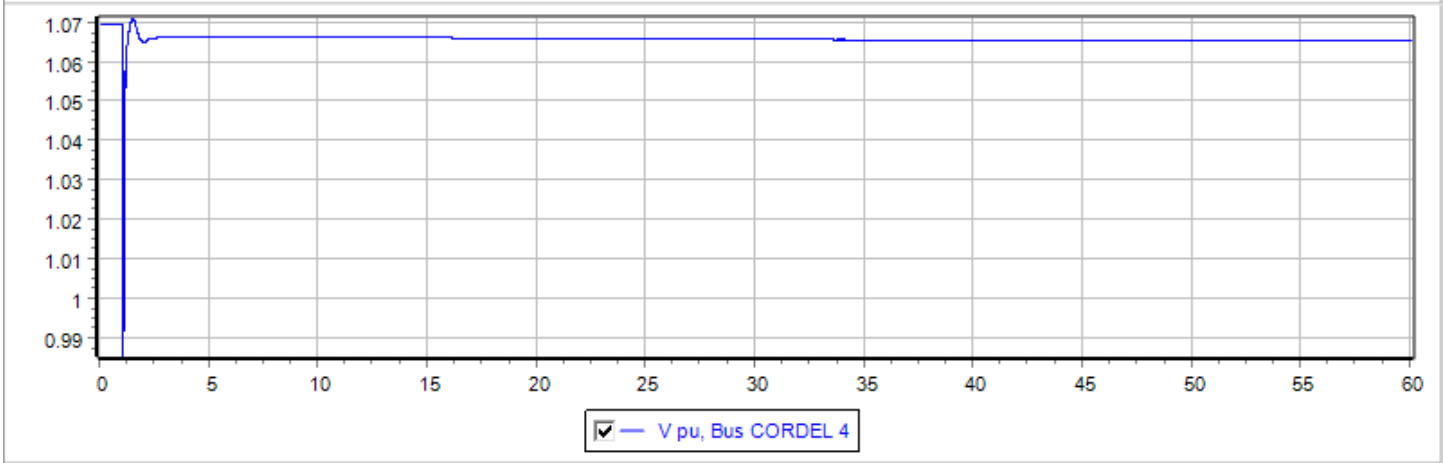
Contingency:
9L51: N.Bridgen to Pemukan 932S

Study Case:
Scenario 6 (2022WP)

December 04, 2020 20:37:41

Cordel 755S Voltages



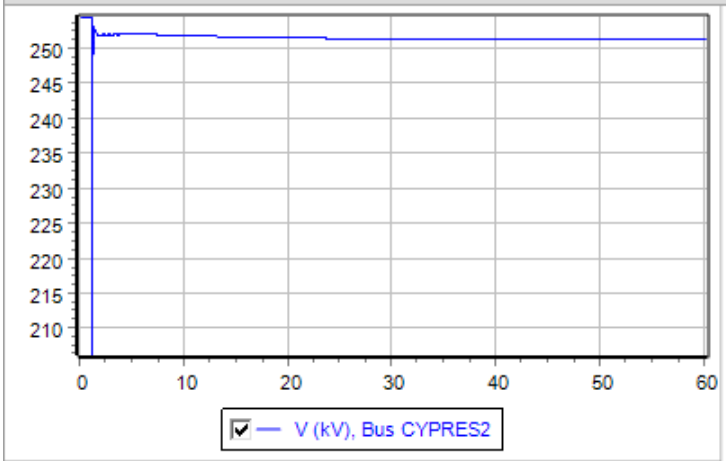


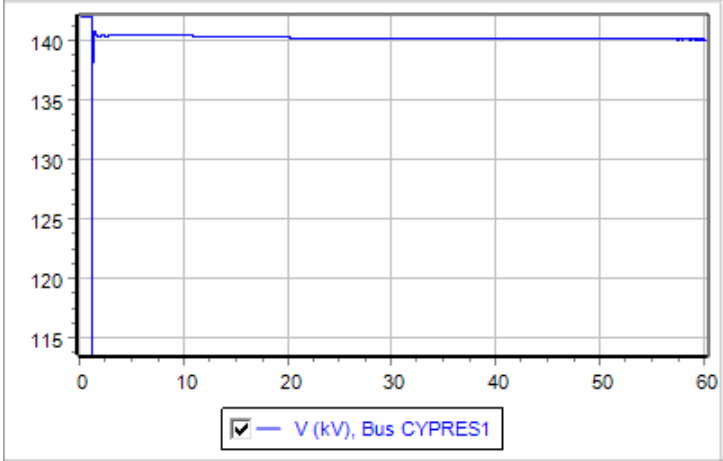
Contingency:
9L51: N.Bridgen to Pemukan 932S

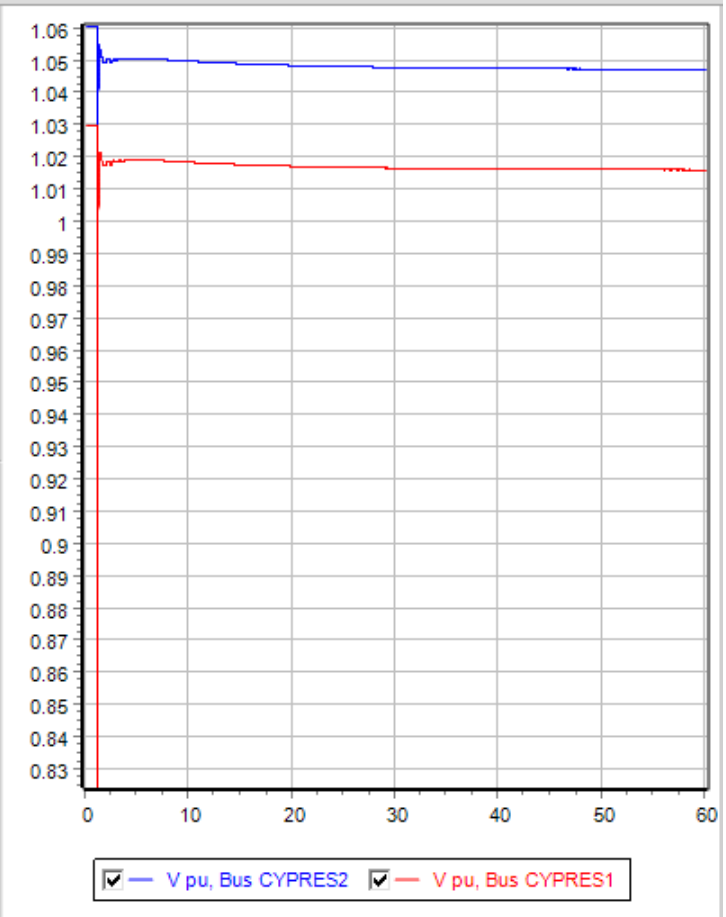
Study Case:
Scenario 6 (2022WP)

December 04, 2020 20:37:45

Cypress 562S Voltages





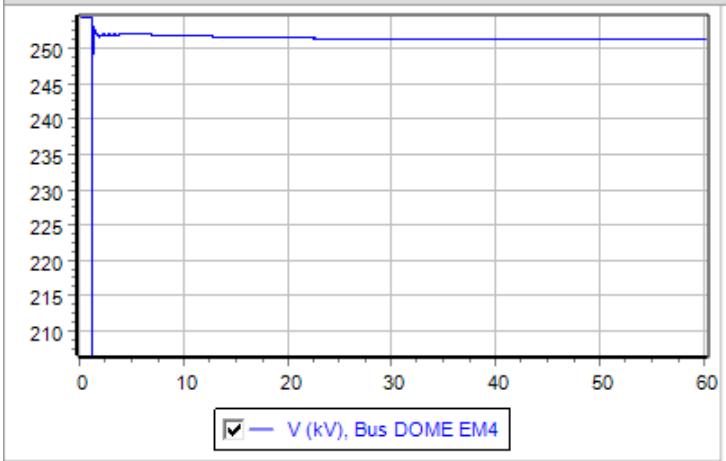


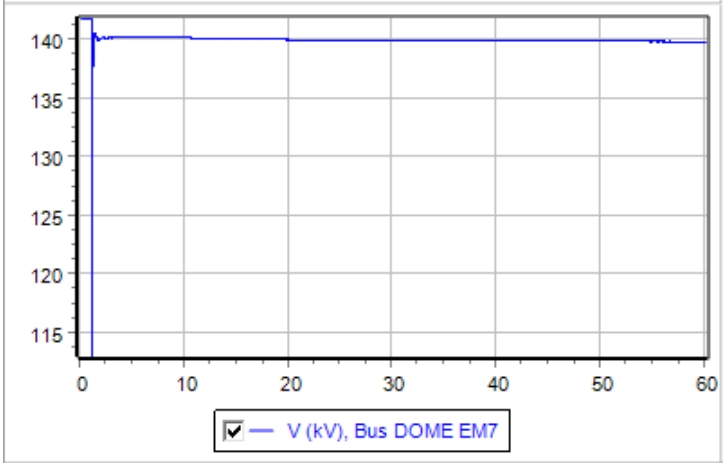
Contingency:
9L51: N.Bridgen to Pemukan 932S

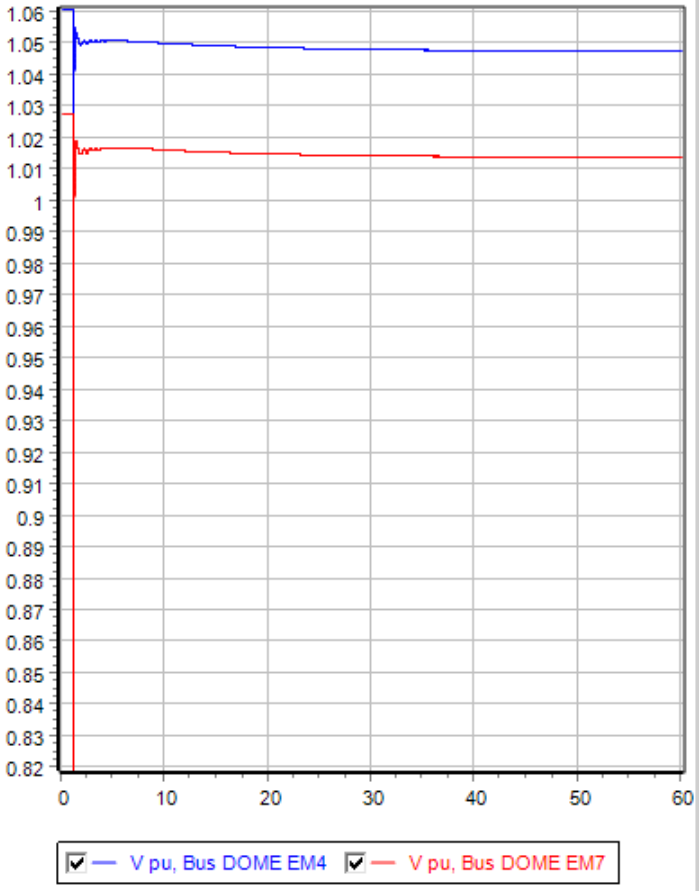
Study Case:
Scenario 6 (2022WP)

December 04, 2020 20:37:44

Dome 163S Voltages





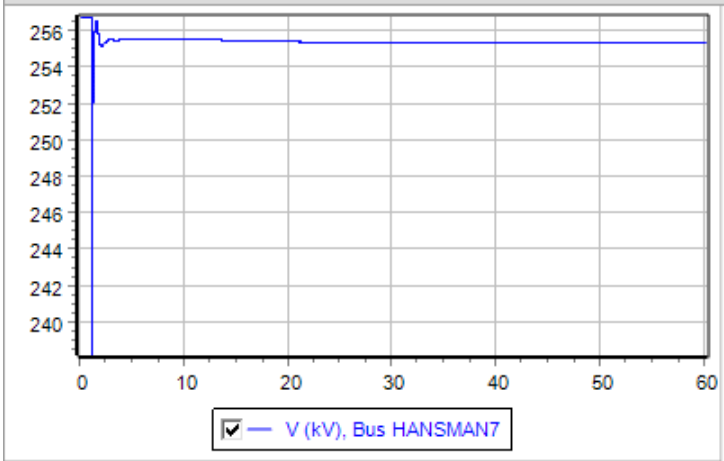


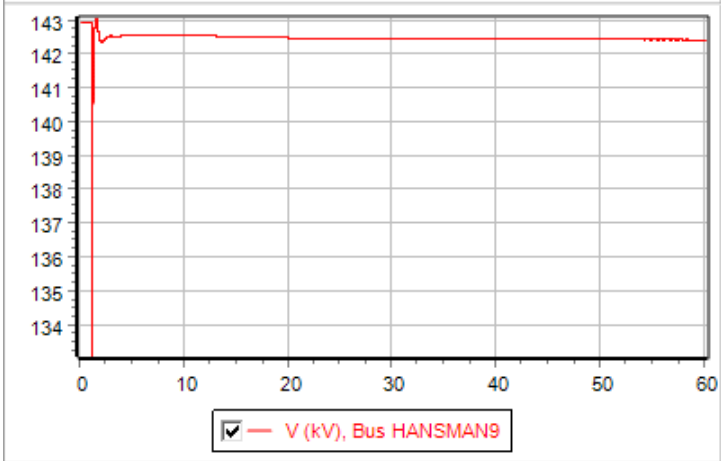
Contingency:
9L51: N.Bridgen to Pemukan 932S

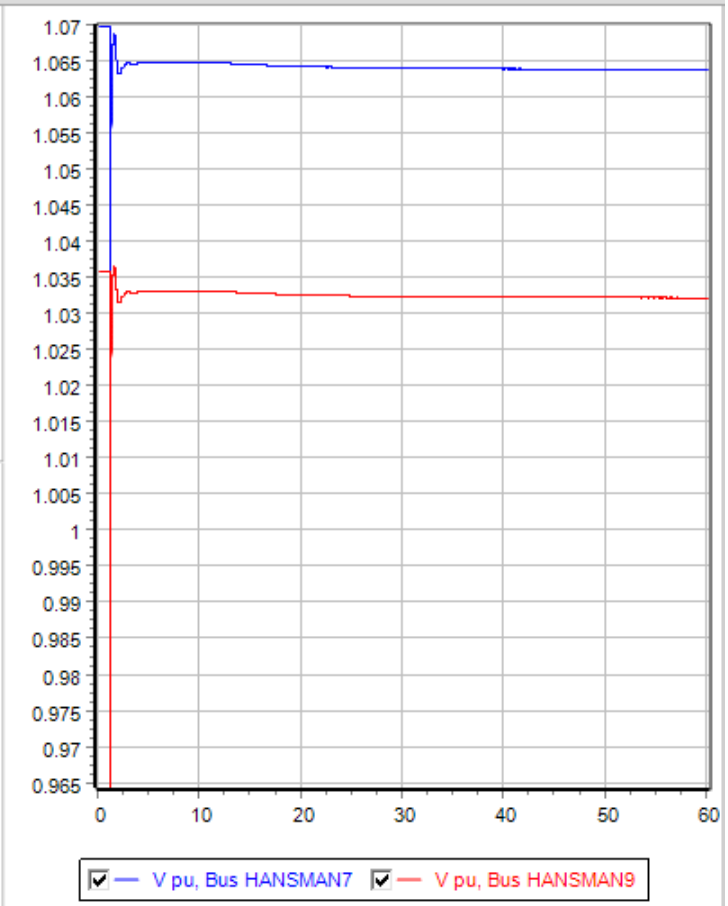
Study Case:
Scenario 6 (2022WP)

December 04, 2020 20:37:43

Hansman Lake 650S Voltages





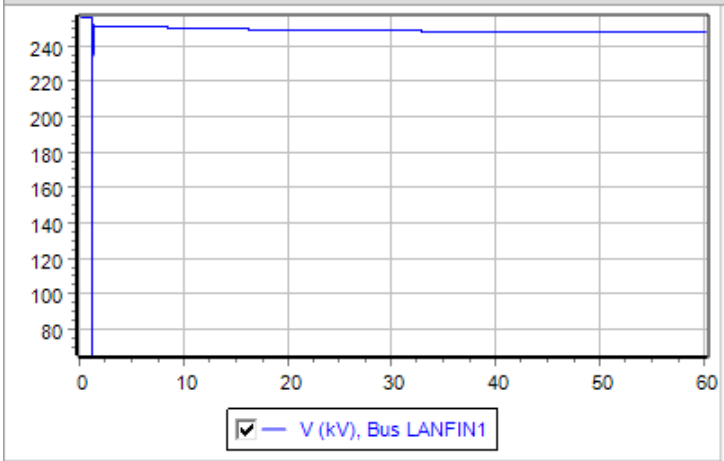


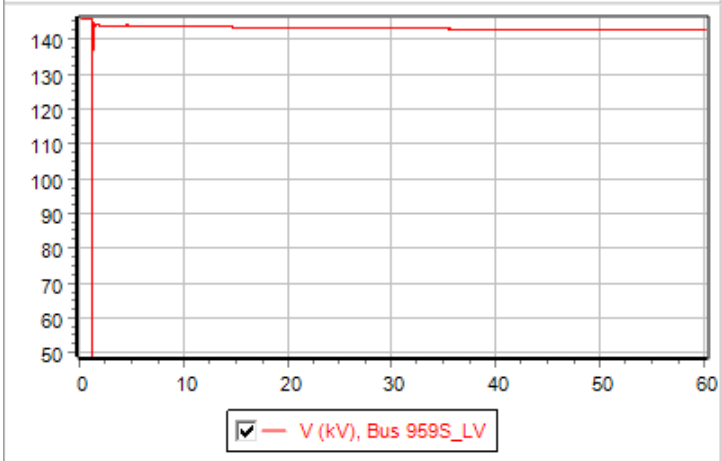
Contingency:
9L51: N.Bridgen to Pemukan 932S

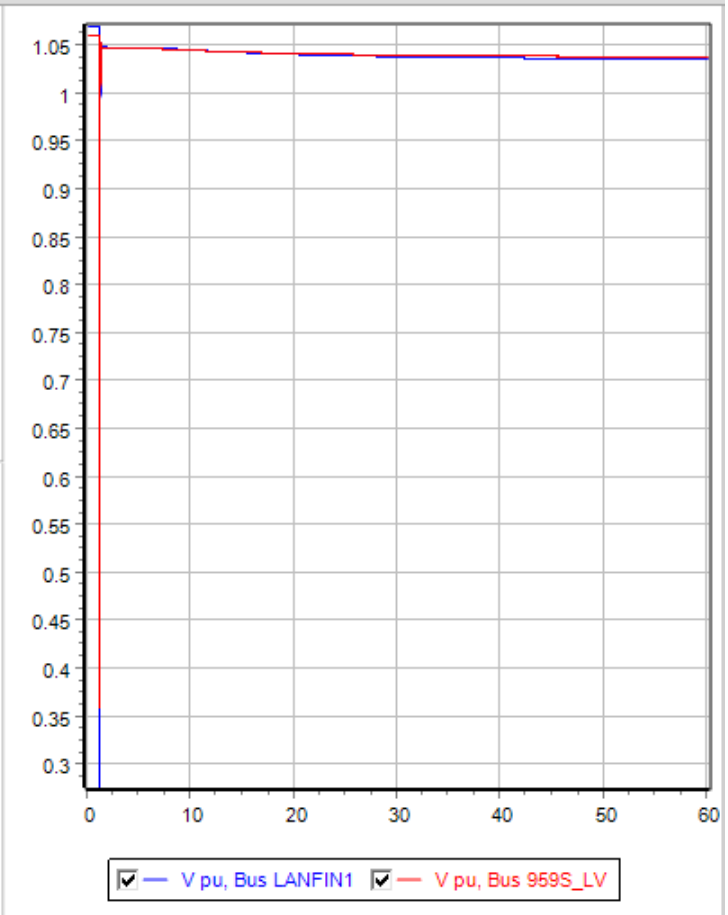
Study Case:
Scenario 6 (2022WP)

December 04, 2020 20:37:43

Lanfine 959S Voltages





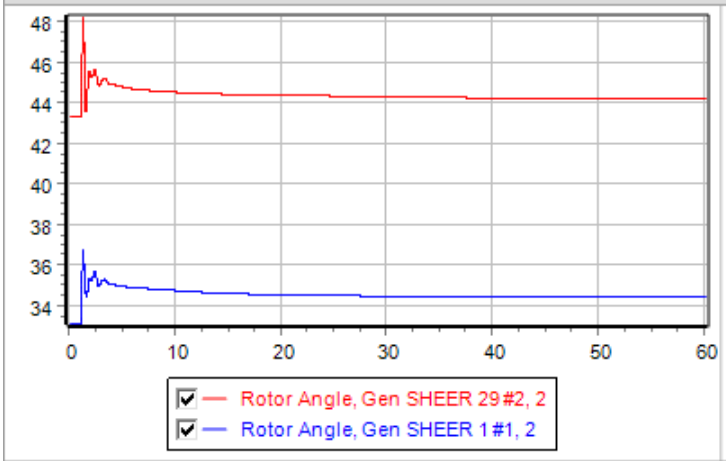


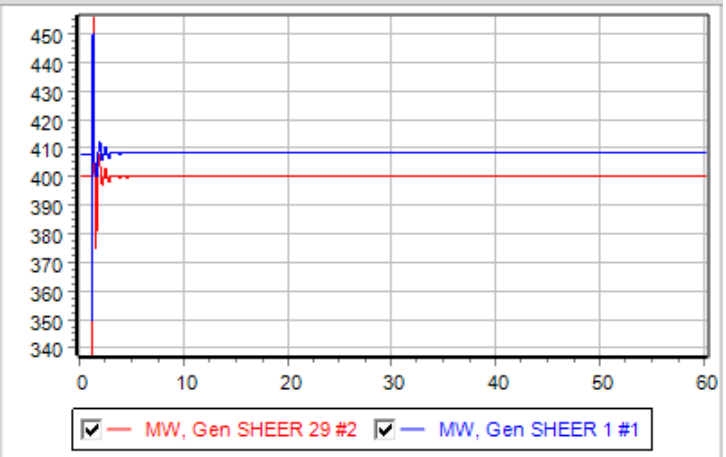
Contingency:
9L51: N.Bridgen to Pemukan 932S

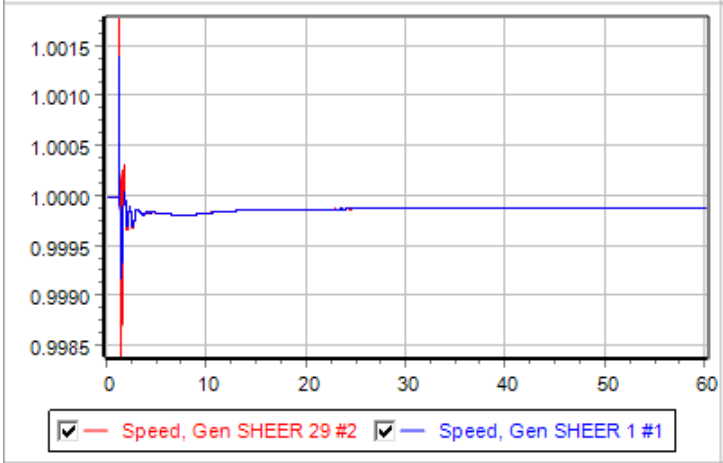
Study Case:
Scenario 6 (2022WP)

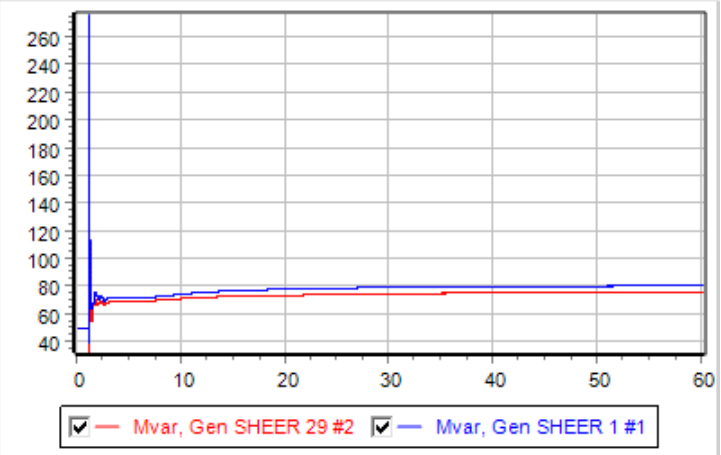
December 04, 2020 20:37:42

Sheerness







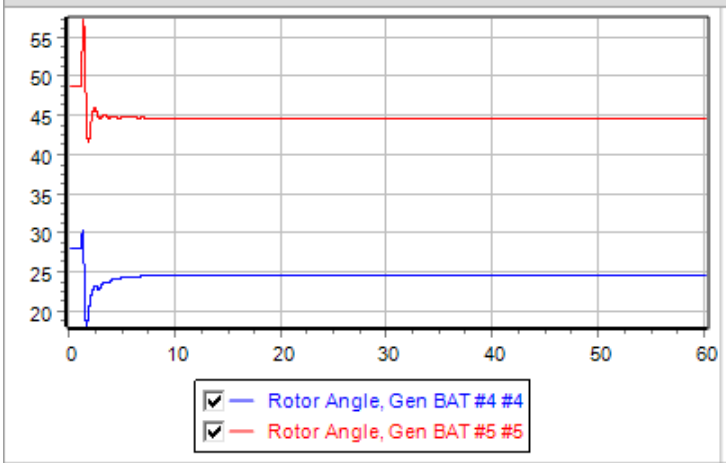


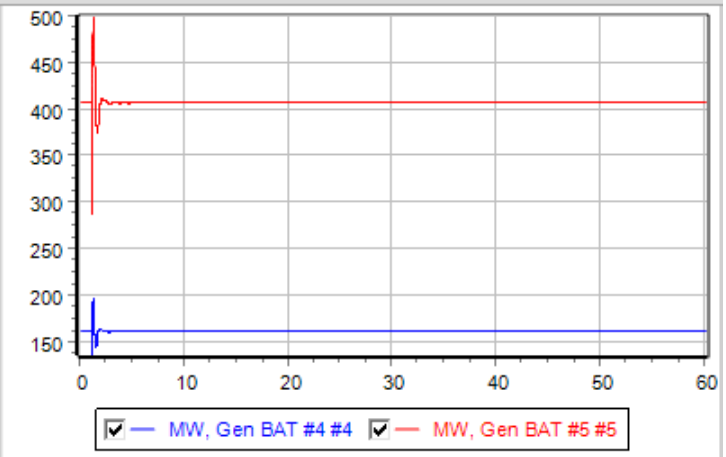
Contingency:
9L51: N.Bridgen to Pemukan 932S

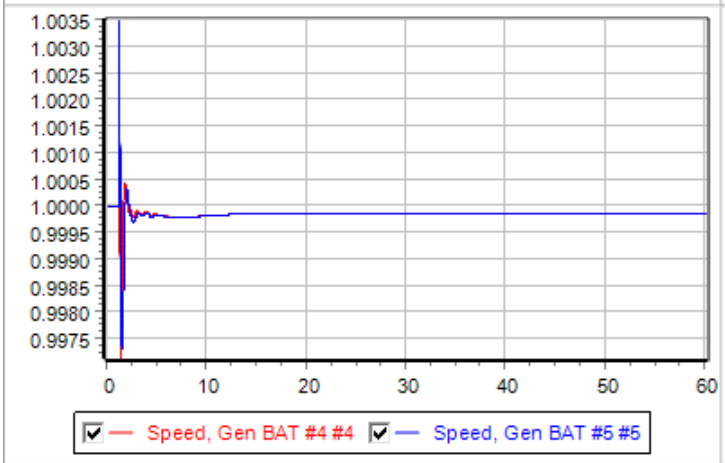
Study Case:
Scenario 6 (2022WP)

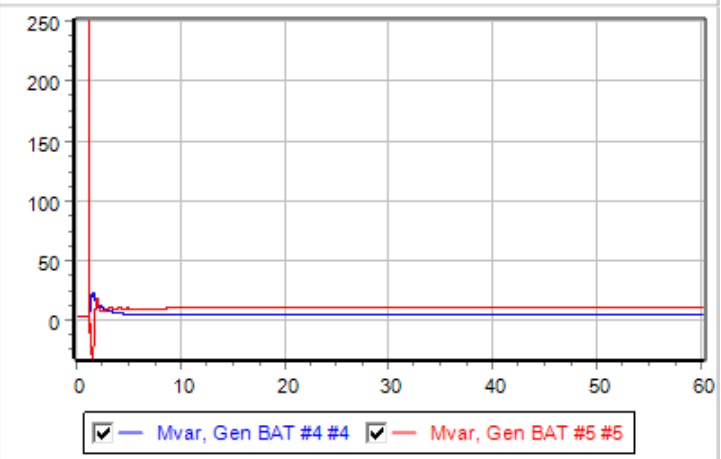
December 04, 2020 20:37:41

Battle River







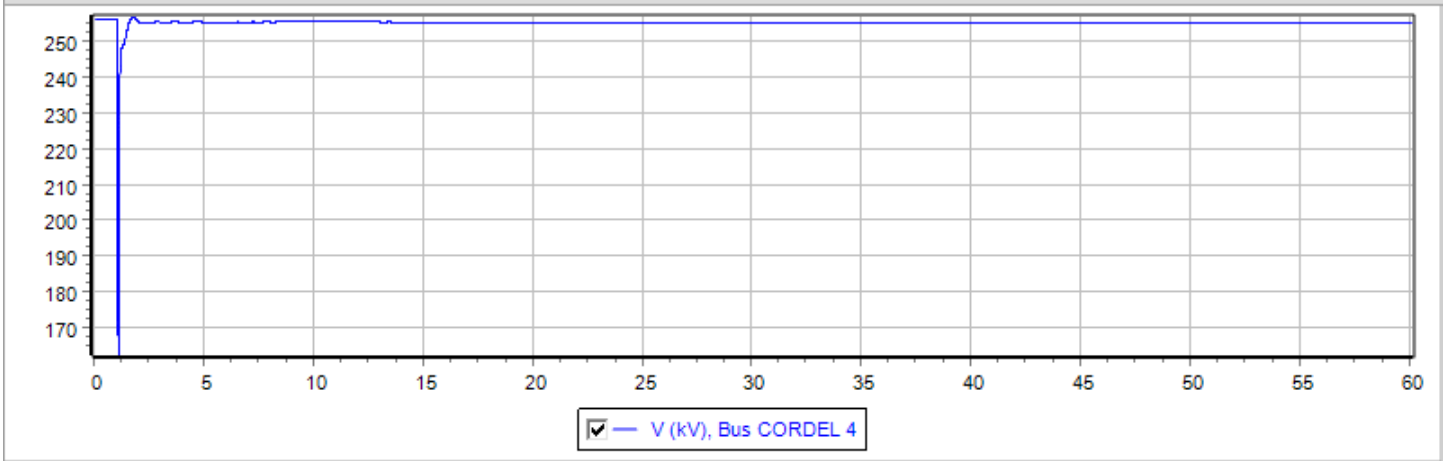


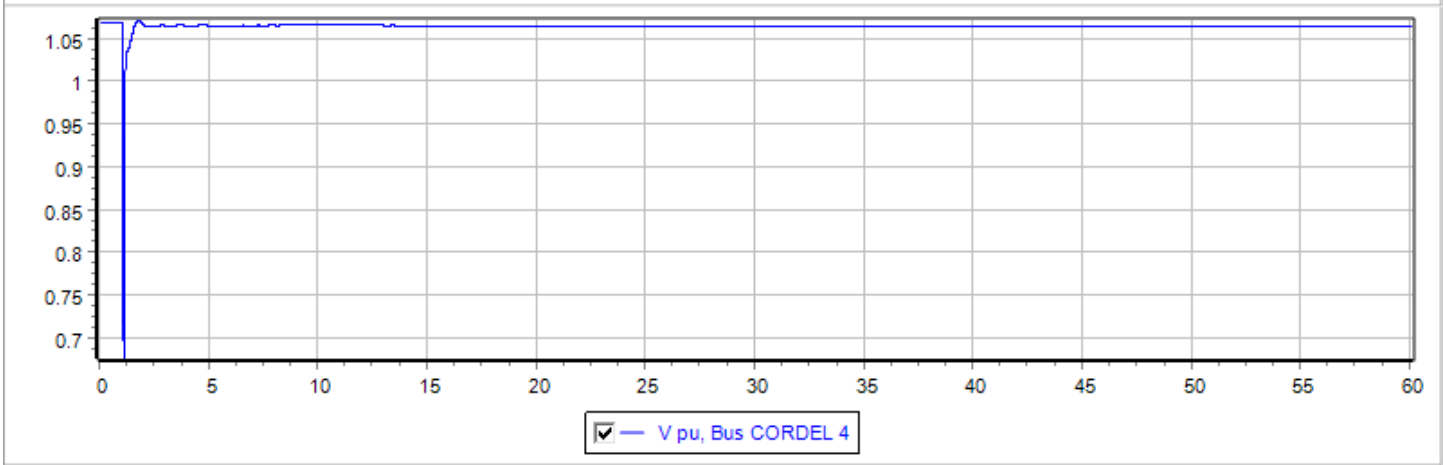
Contingency:
9L51: Pemukan 932S to N.Bridgen

Study Case:
Scenario 6 (2022WP)

December 04, 2020 20:41:34

Cordel 755S Voltages



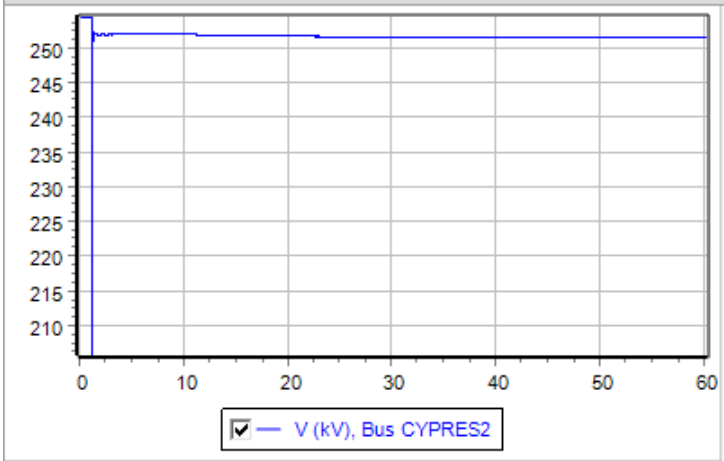


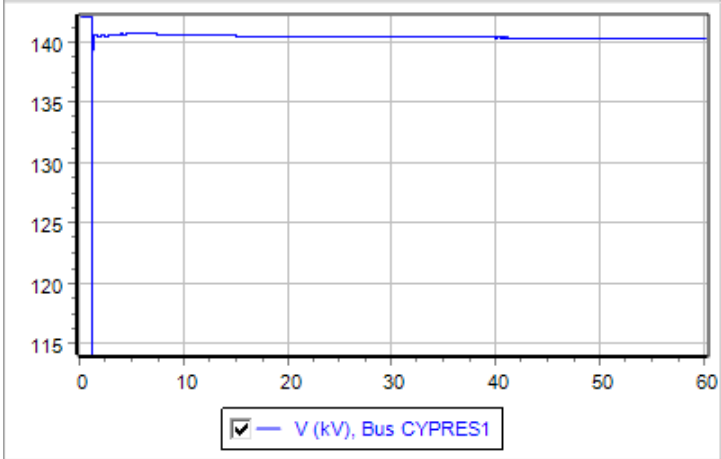
Contingency:
9L51: Pemukan 932S to N.Bridgen

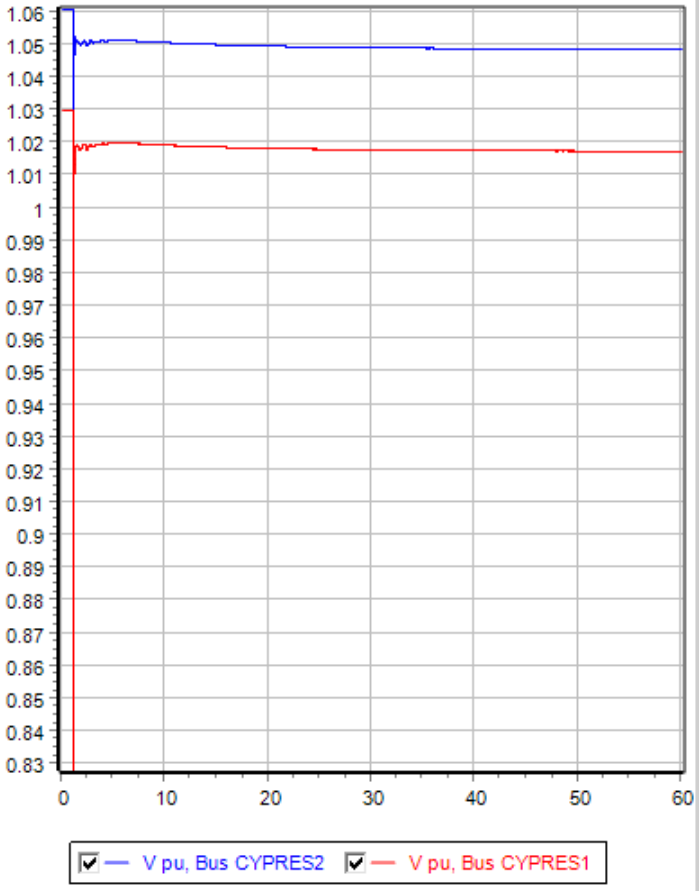
Study Case:
Scenario 6 (2022WP)

December 04, 2020 20:41:37

Cypress 562S Voltages





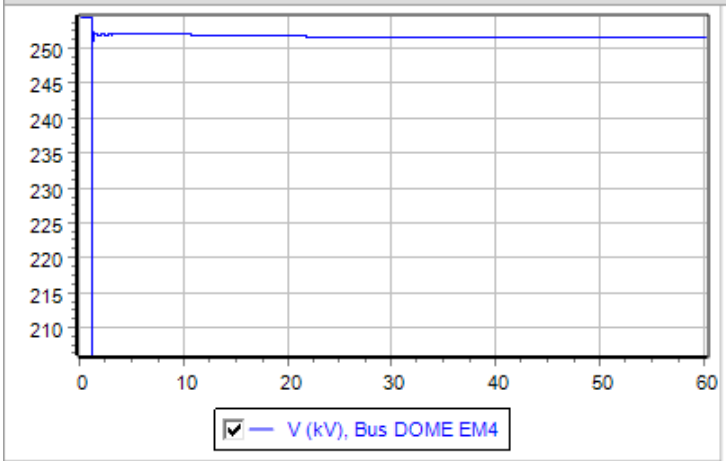


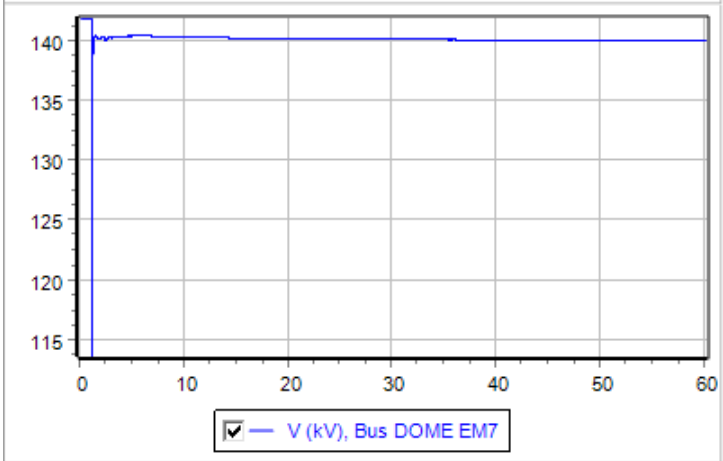
Contingency:
9L51: Pemukan 932S to N.Bridgen

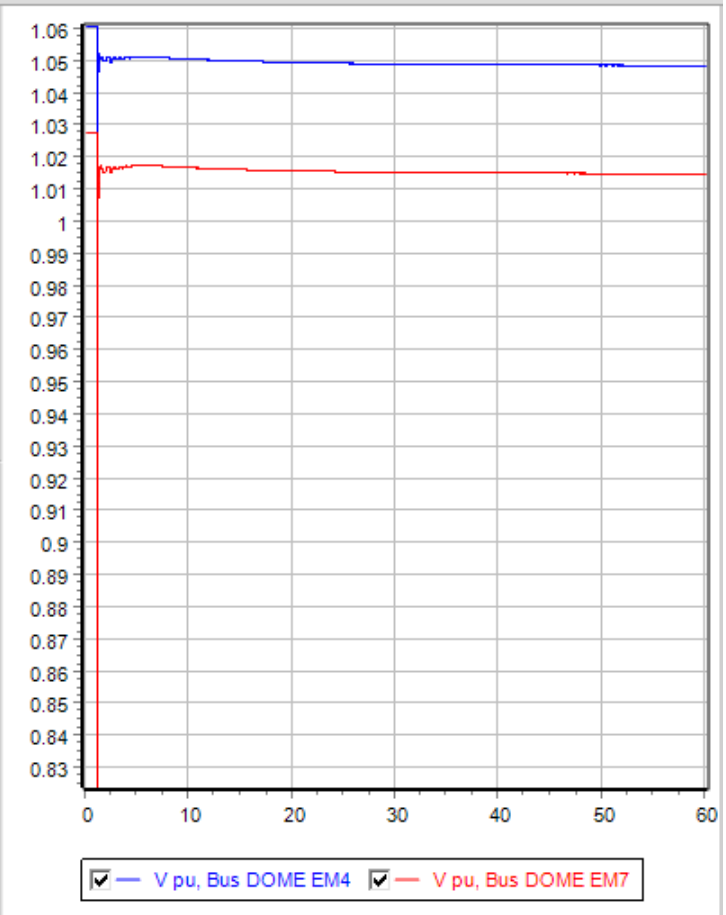
Study Case:
Scenario 6 (2022WP)

December 04, 2020 20:41:37

Dome 163S Voltages





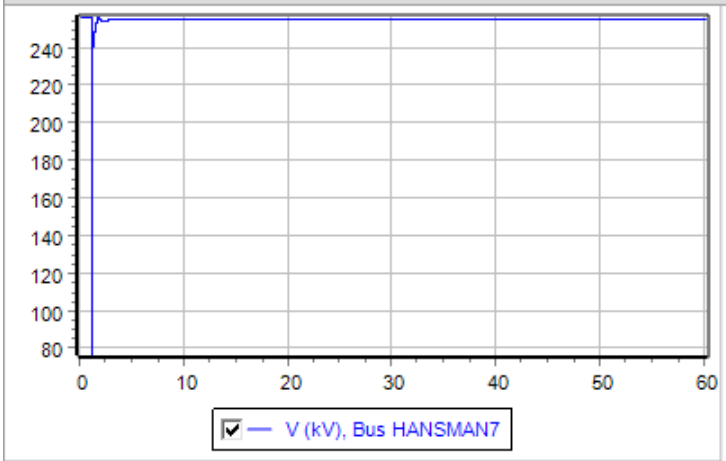


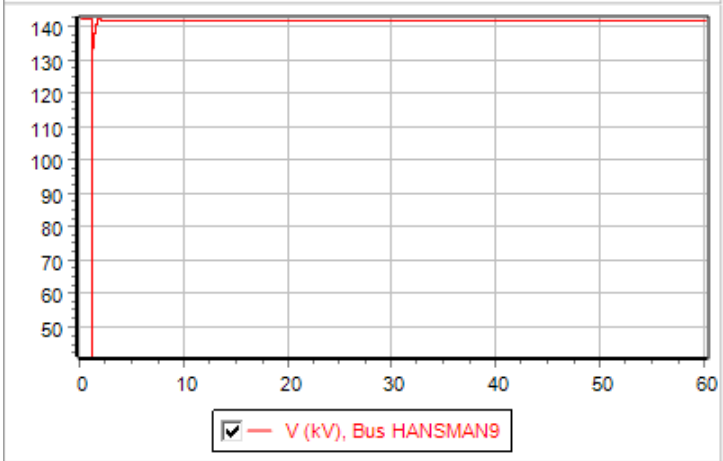
Contingency:
9L51: Pemukan 932S to N.Bridgen

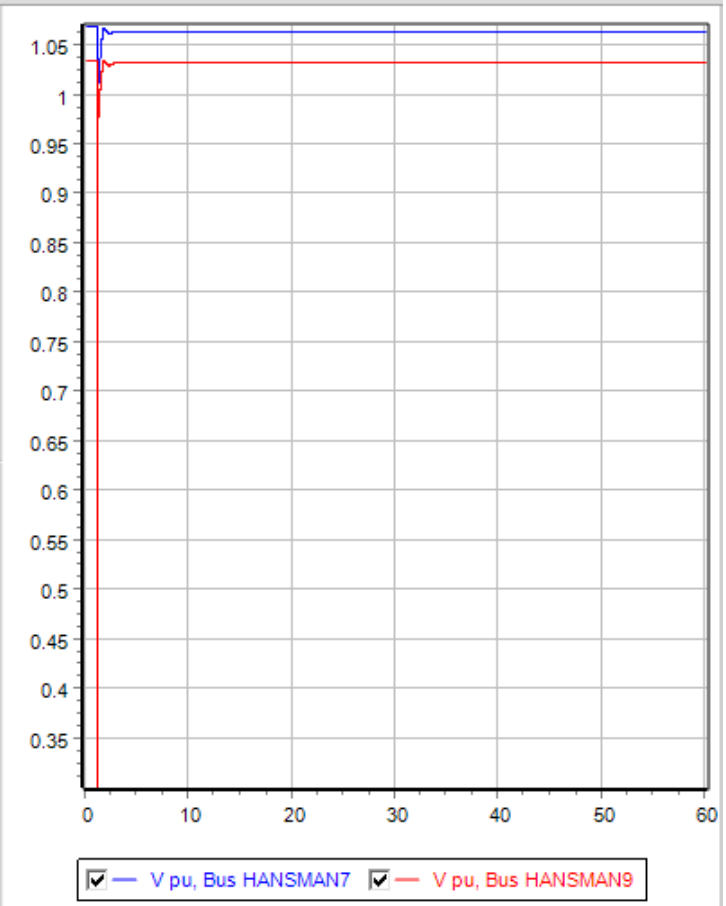
Study Case:
Scenario 6 (2022WP)

December 04, 2020 20:41:36

Hansman Lake 650S Voltages





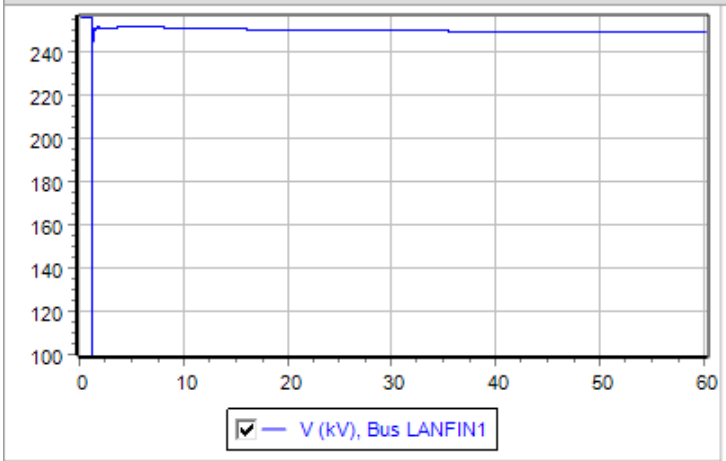


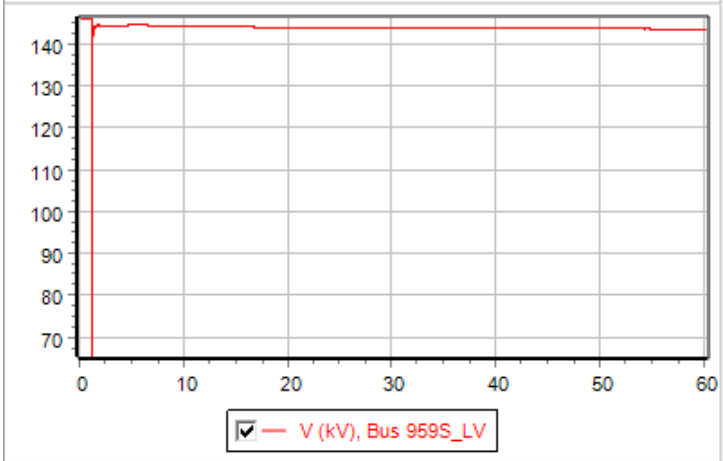
Contingency:
9L51: Pemukan 932S to N.Bridgen

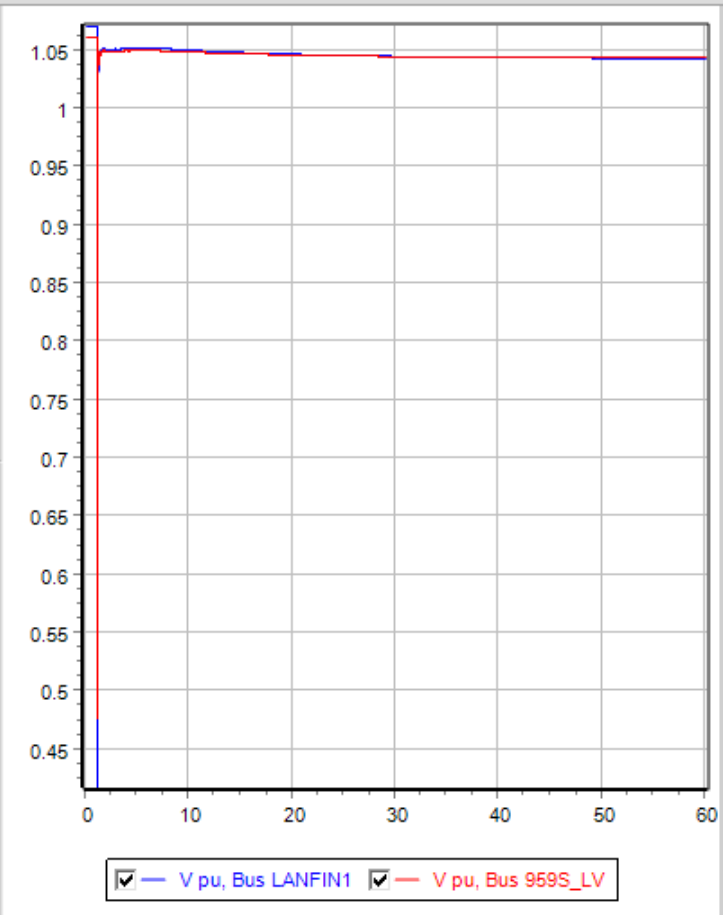
Study Case:
Scenario 6 (2022WP)

December 04, 2020 20:41:36

Lanfine 959S Voltages





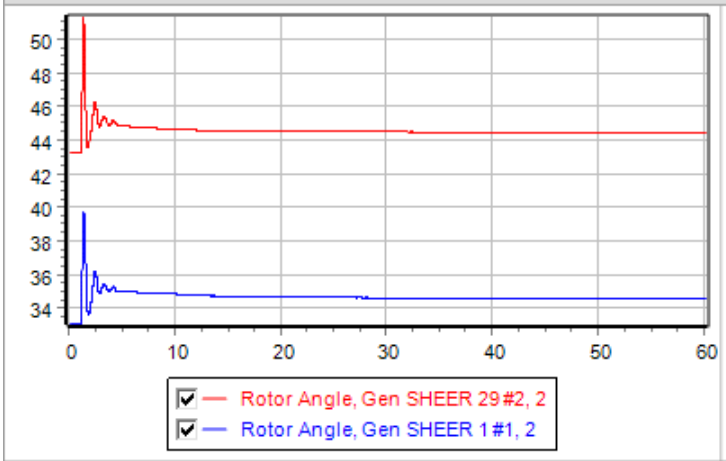


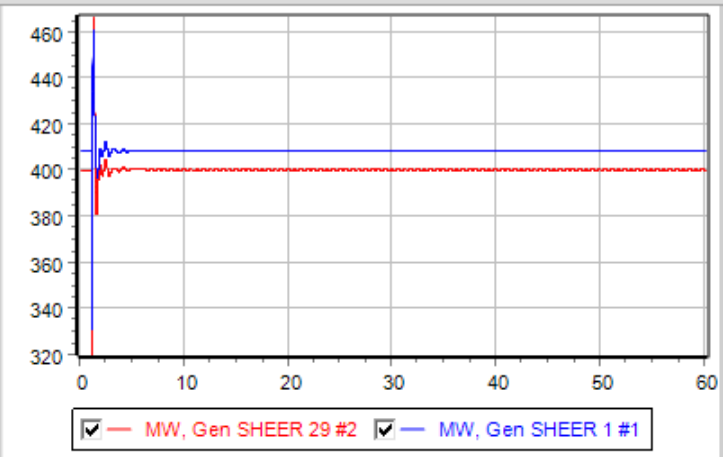
Contingency:
9L51: Pemukan 932S to N.Bridgen

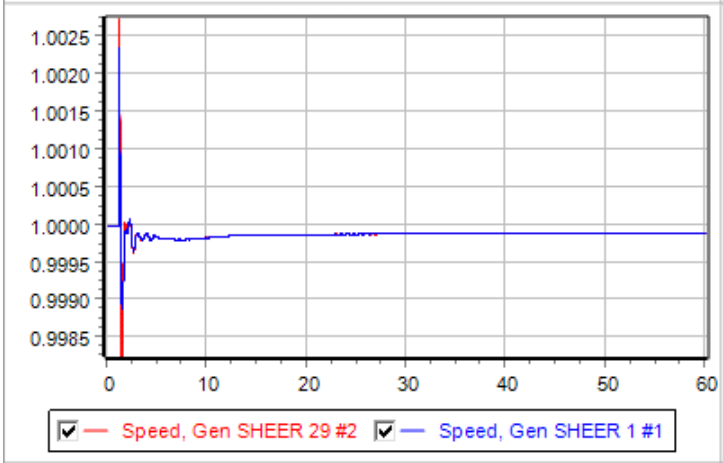
Study Case:
Scenario 6 (2022WP)

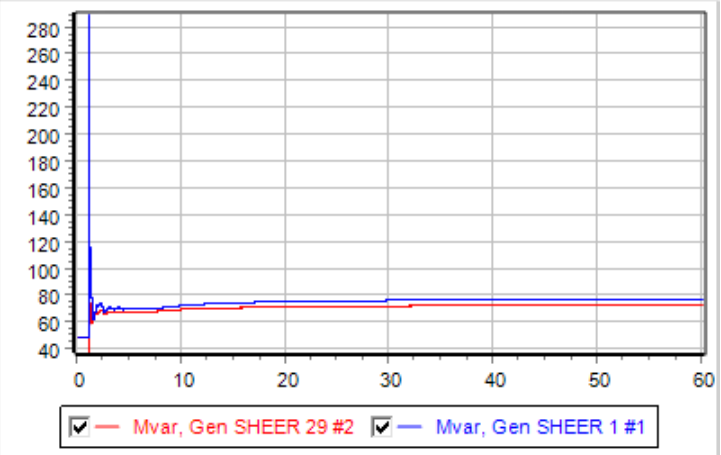
December 04, 2020 20:41:35

Sheerness







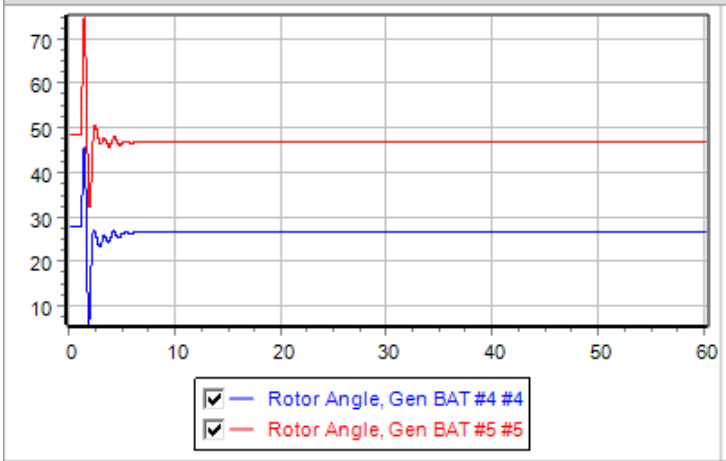


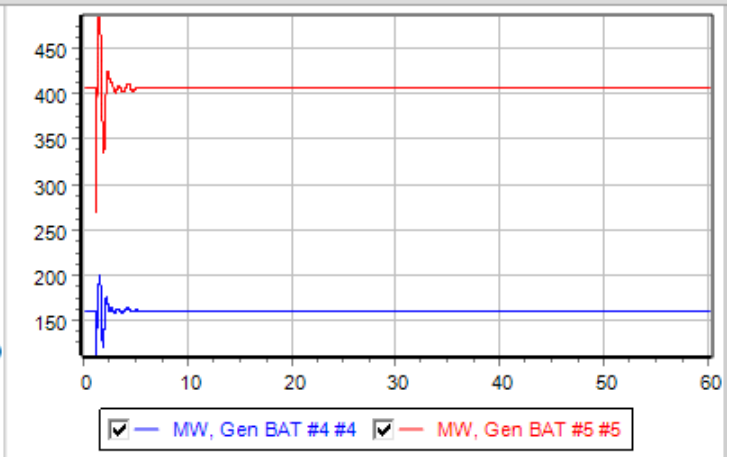
Contingency:
9L51: Pemukan 932S to N.Bridgen

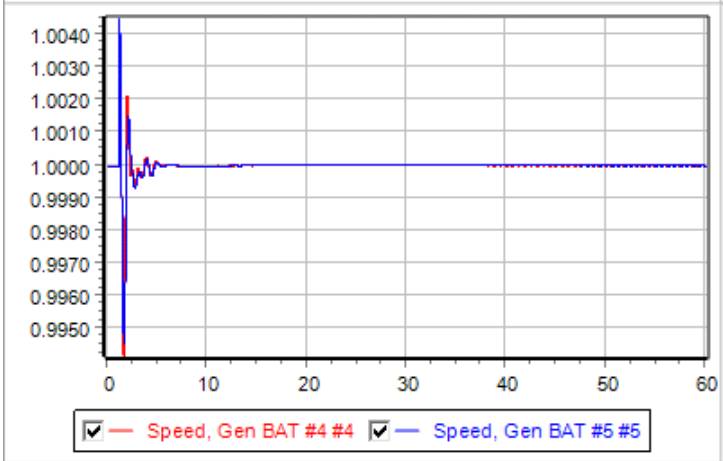
Study Case:
Scenario 6 (2022WP)

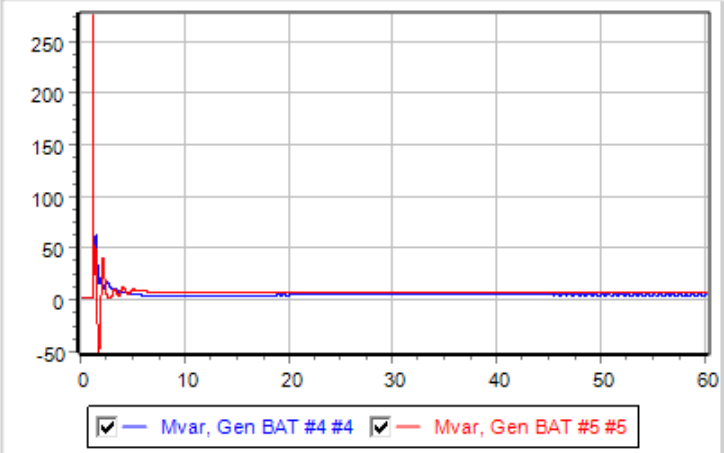
December 04, 2020 20:41:34

Battle River







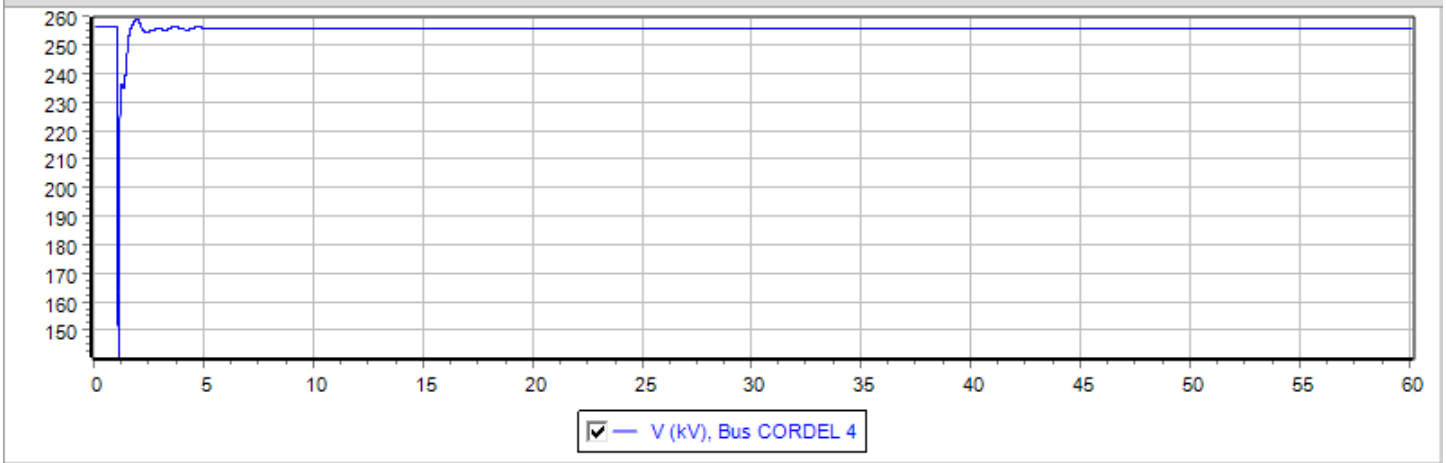


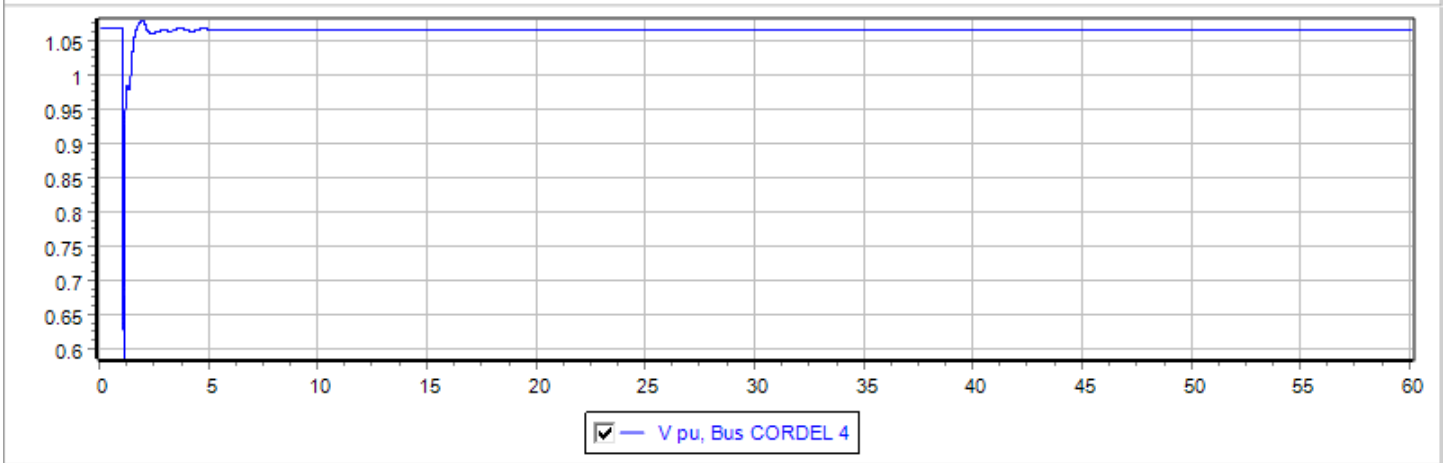
Contingency:
9L59: Anderson 801S to Tinchebray 972S

Study Case:
Scenario 6 (2022WP)

December 04, 2020 20:47:22

Cordel 755S Voltages



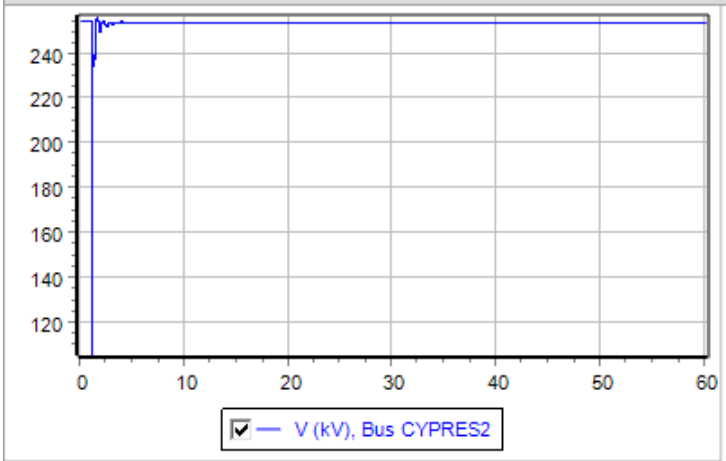


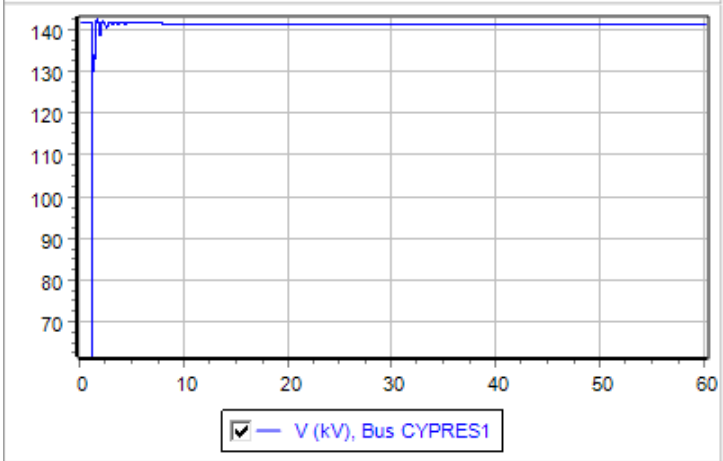
Contingency:
9L59: Anderson 801S to Tinchebray 972S

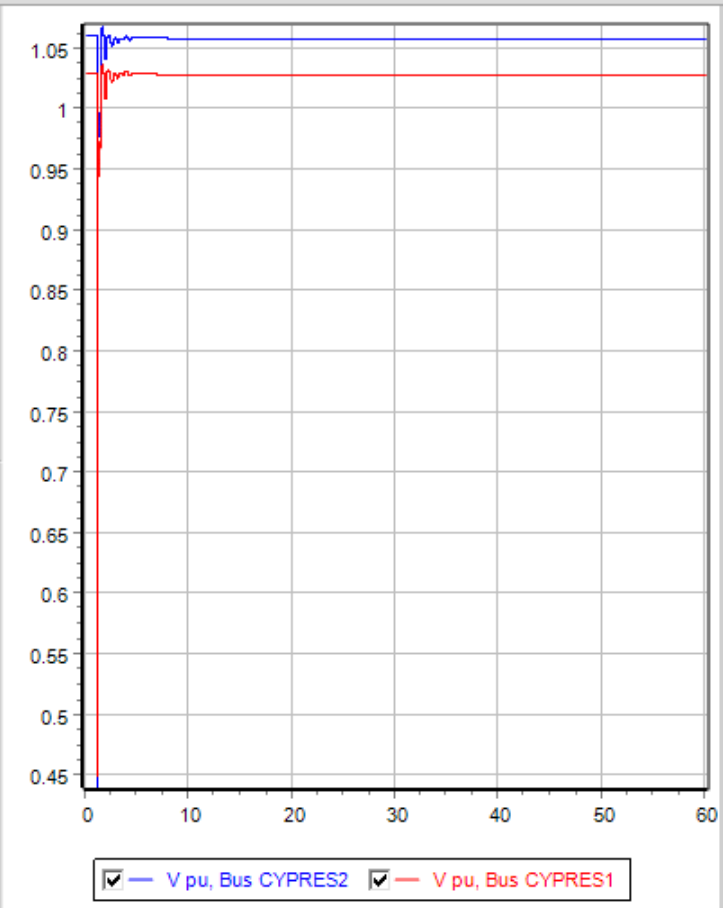
Study Case:
Scenario 6 (2022WP)

December 04, 2020 20:47:25

Cypress 562S Voltages





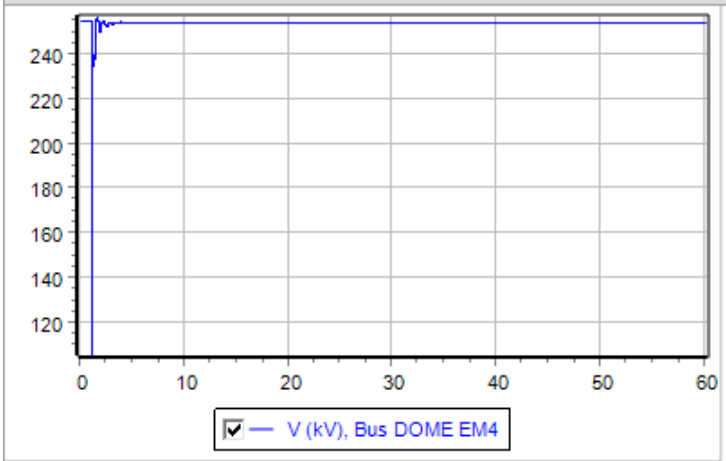


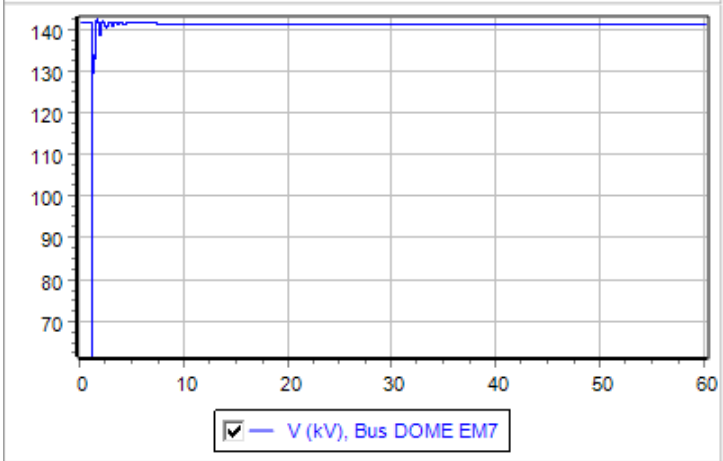
Contingency:
9L59: Anderson 801S to Tinchebray 972S

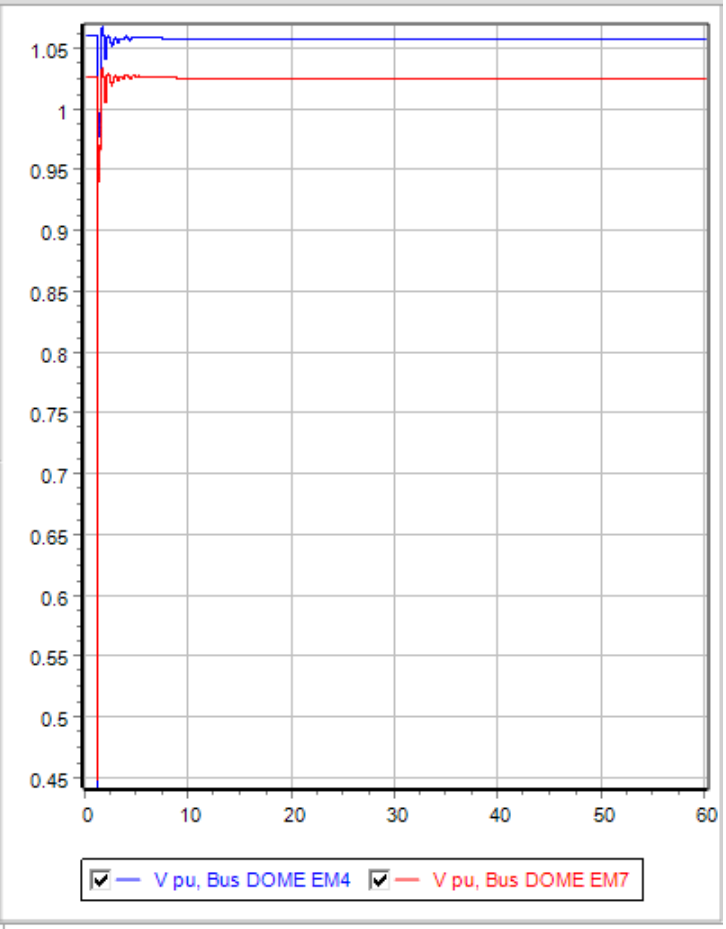
Study Case:
Scenario 6 (2022WP)

December 04, 2020 20:47:24

Dome 163S Voltages





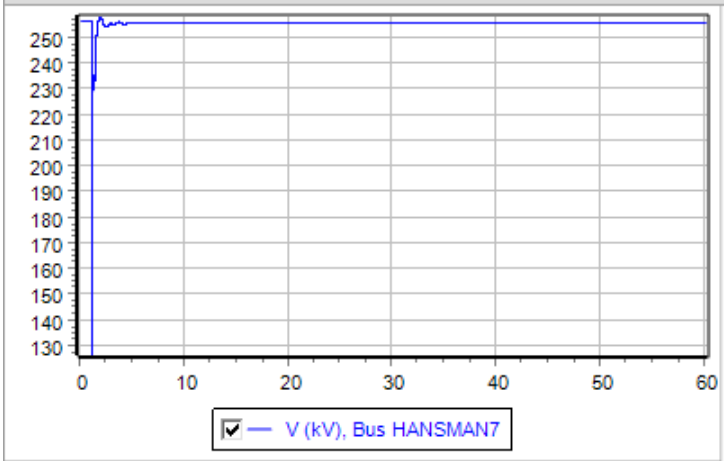


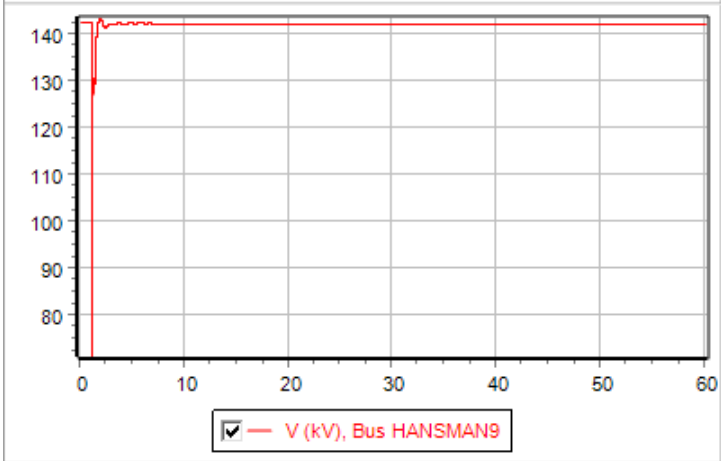
Contingency:
9L59: Anderson 801S to Tinchebray 972S

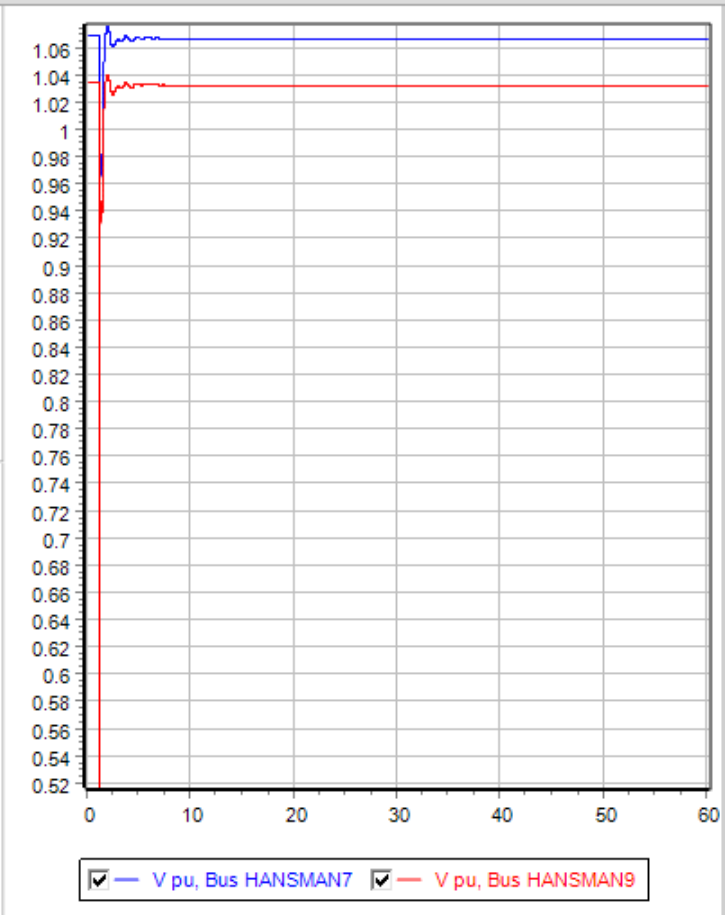
Study Case:
Scenario 6 (2022WP)

December 04, 2020 20:47:24

Hansman Lake 650S Voltages





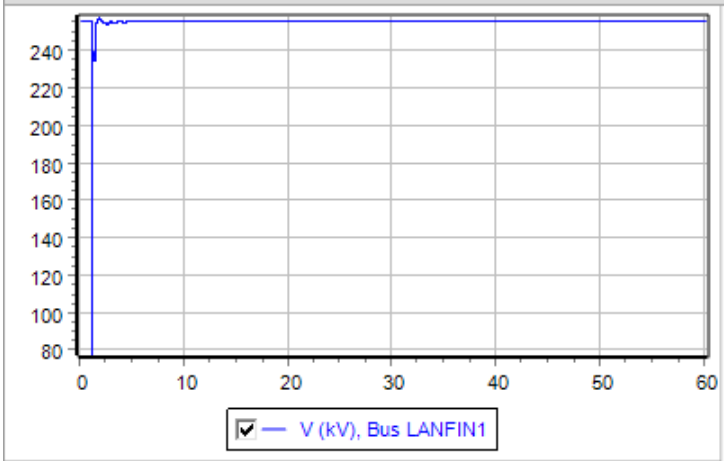


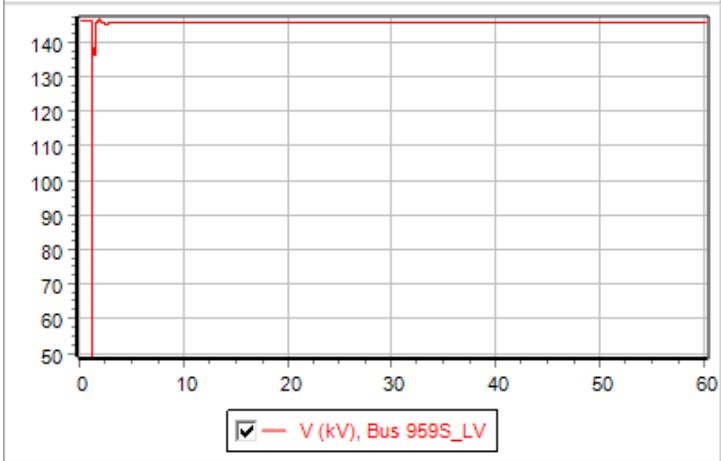
Contingency:
9L59: Anderson 801S to Tinchebray 972S

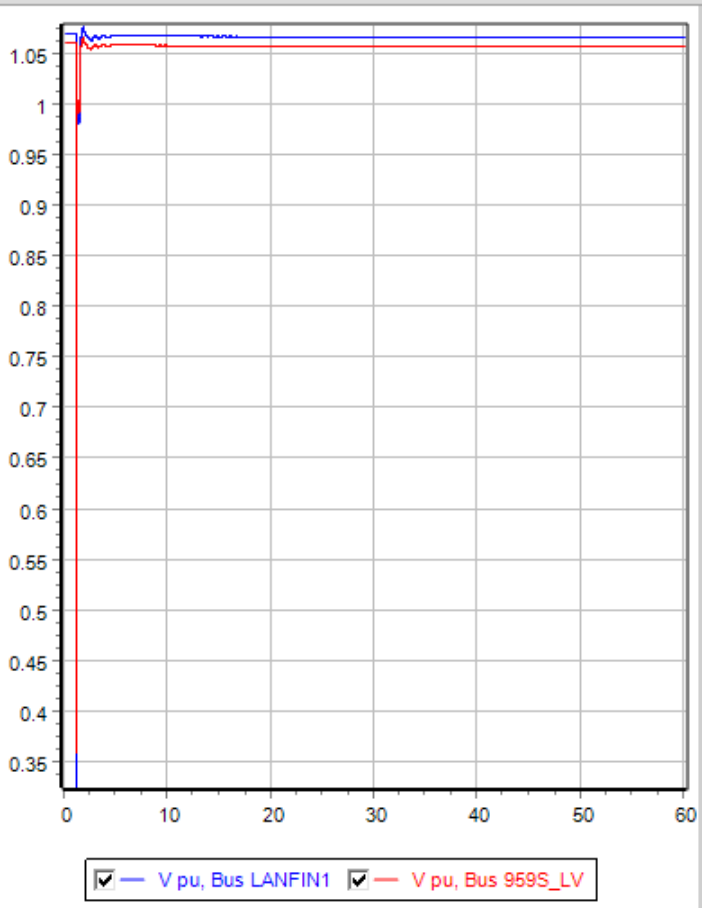
Study Case:
Scenario 6 (2022WP)

December 04, 2020 20:47:23

Lanfine 959S Voltages





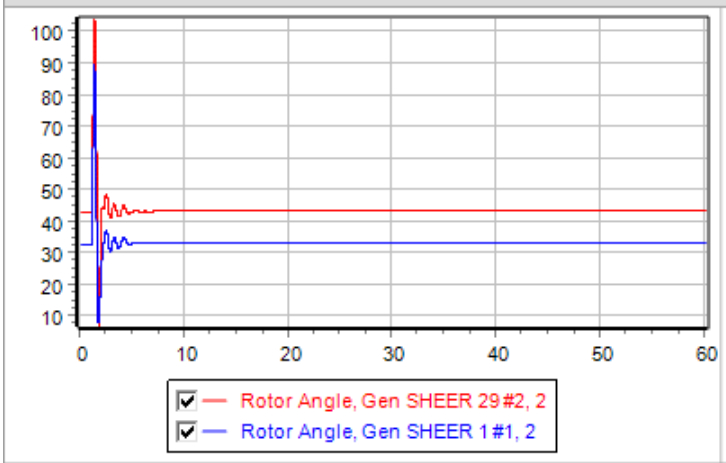


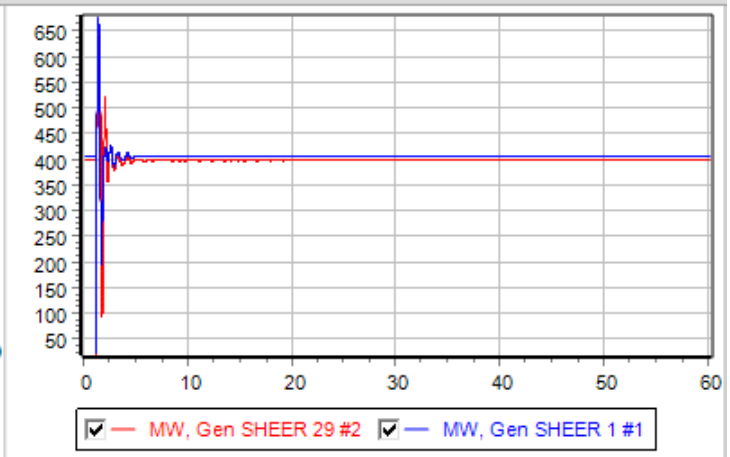
Contingency:
9L59: Anderson 801S to Tinchebray 972S

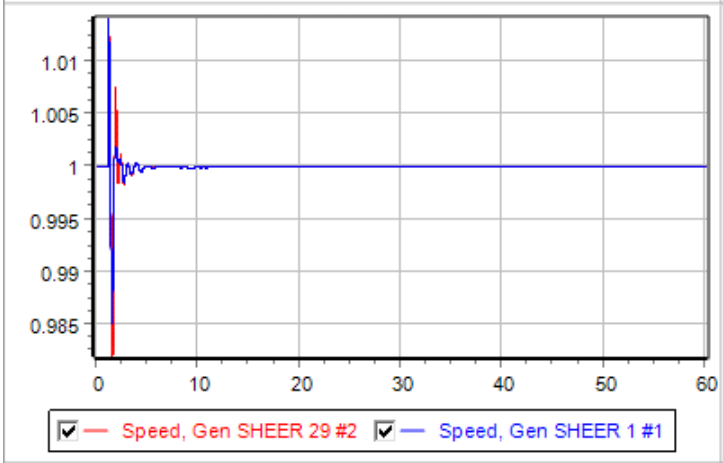
Study Case:
Scenario 6 (2022WP)

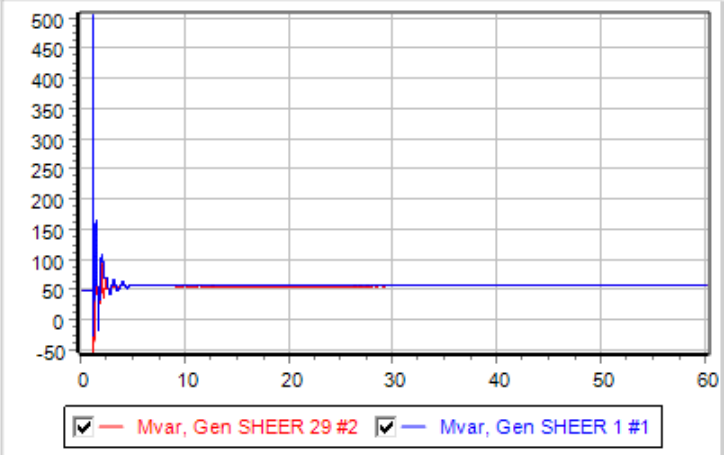
December 04, 2020 20:47:22

Sheerness







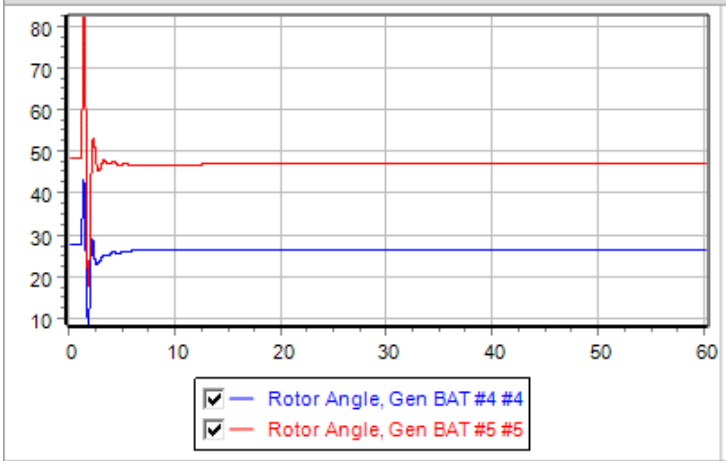


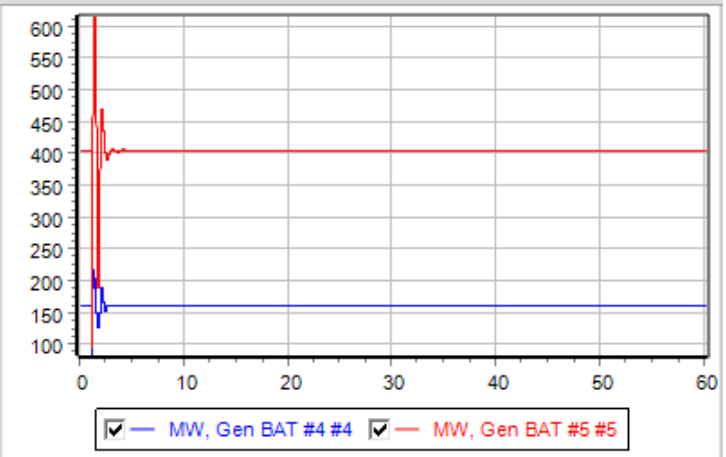
Contingency:
9L59: Anderson 801S to Tinchebray 972S

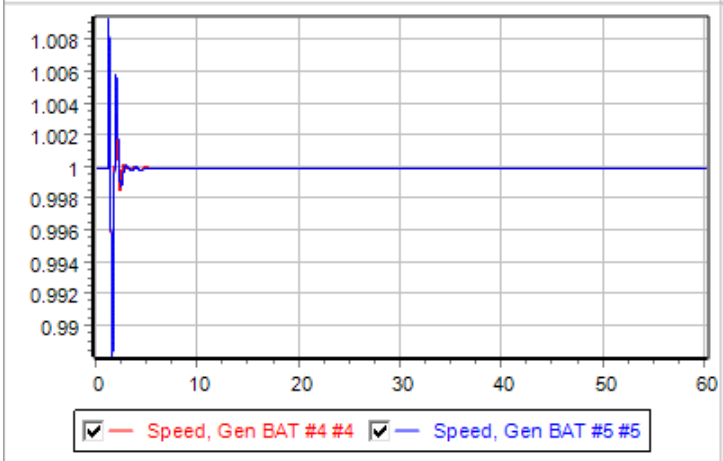
Study Case:
Scenario 6 (2022WP)

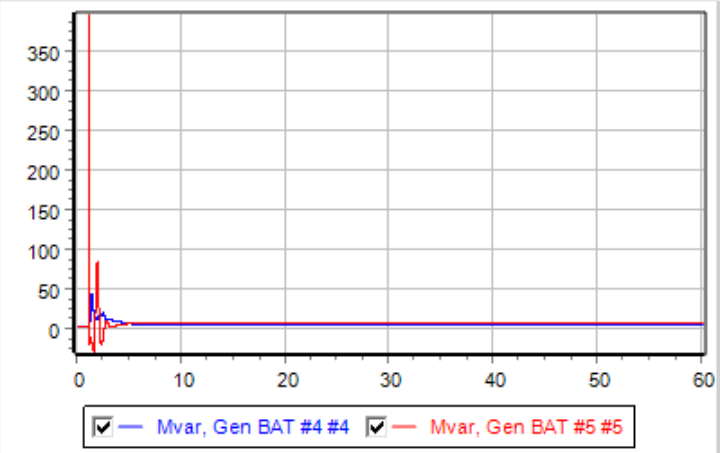
December 04, 2020 20:47:21

Battle River







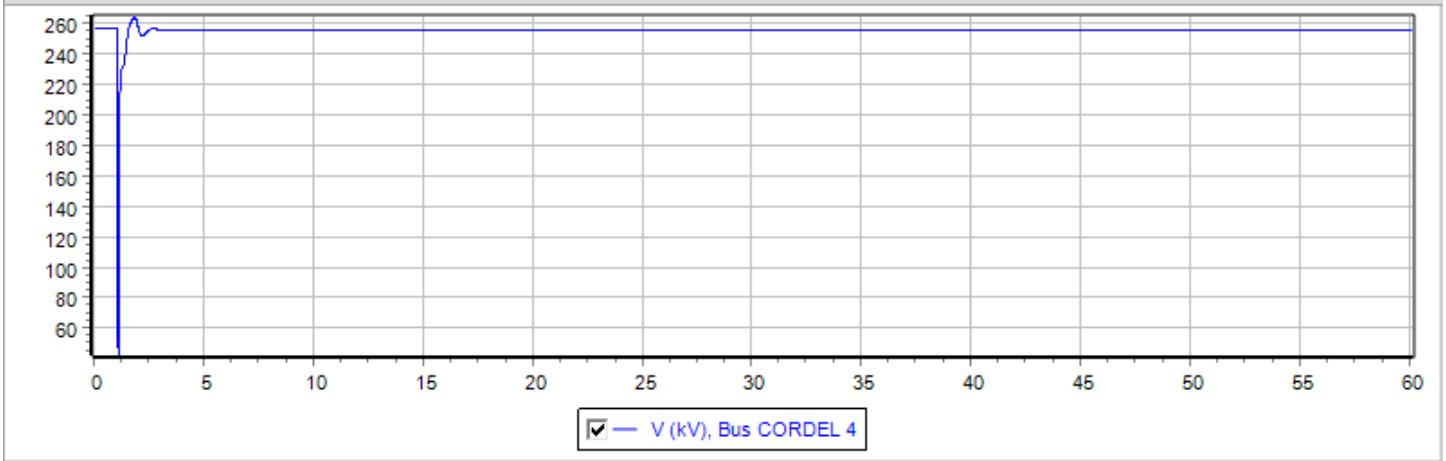


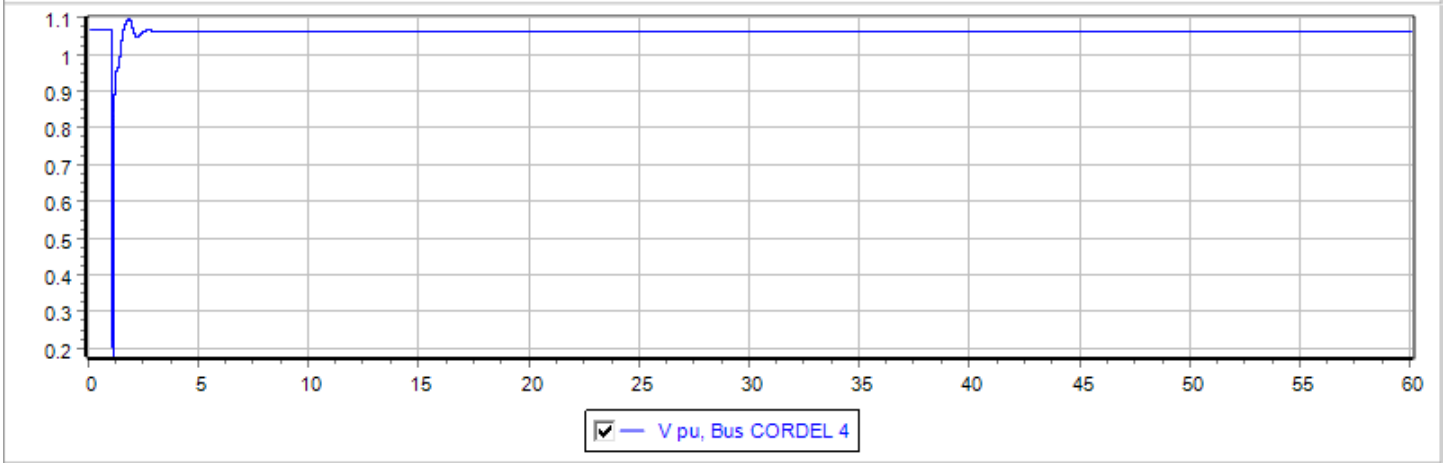
Contingency:
9L59: Tinchebray 972S to Anderson 801S

Study Case:
Scenario 6 (2022WP)

December 04, 2020 20:53:08

Cordel 755S Voltages



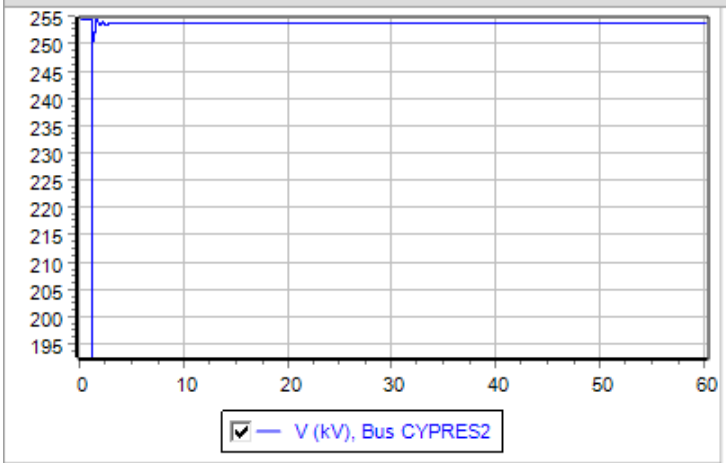


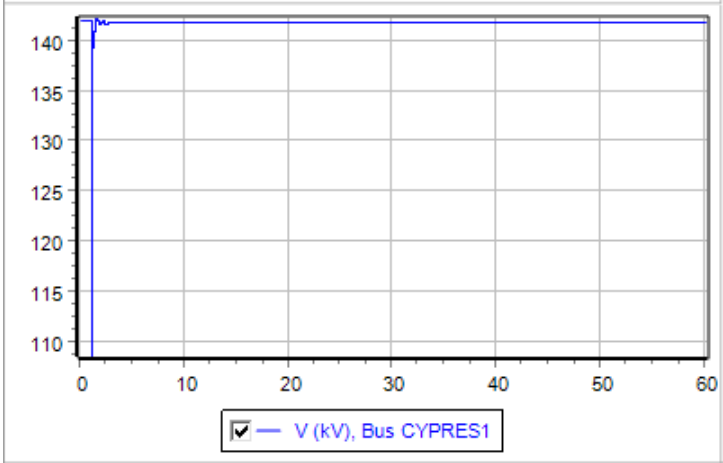
Contingency:
9L59: Tinchebray 972S to Anderson 801S

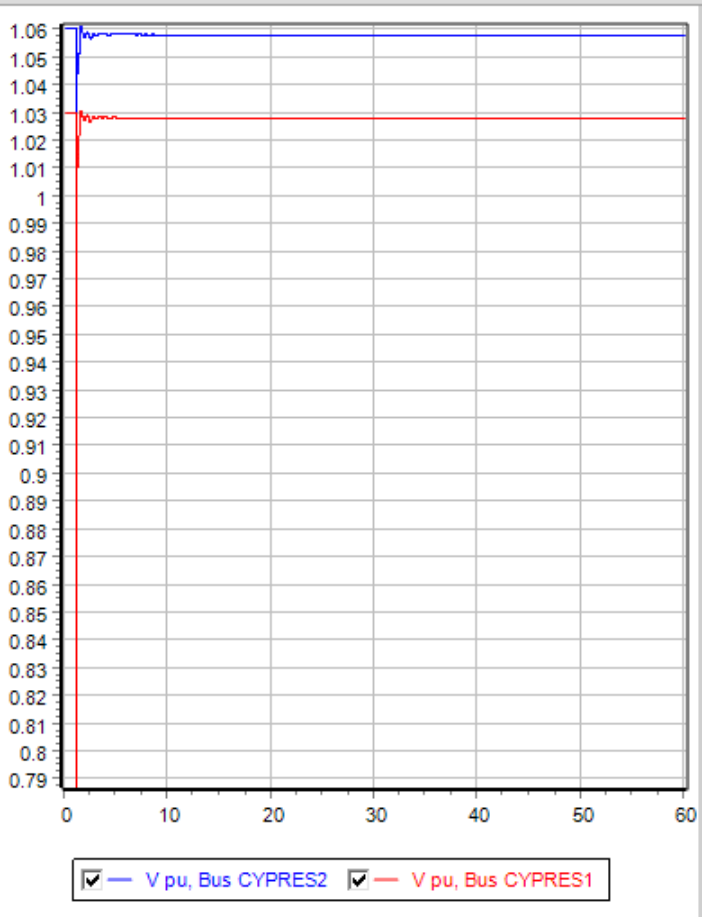
Study Case:
Scenario 6 (2022WP)

December 04, 2020 20:53:11

Cypress 562S Voltages





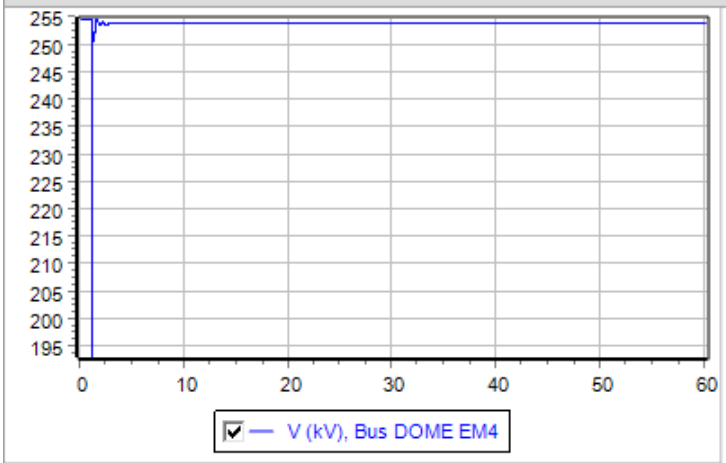


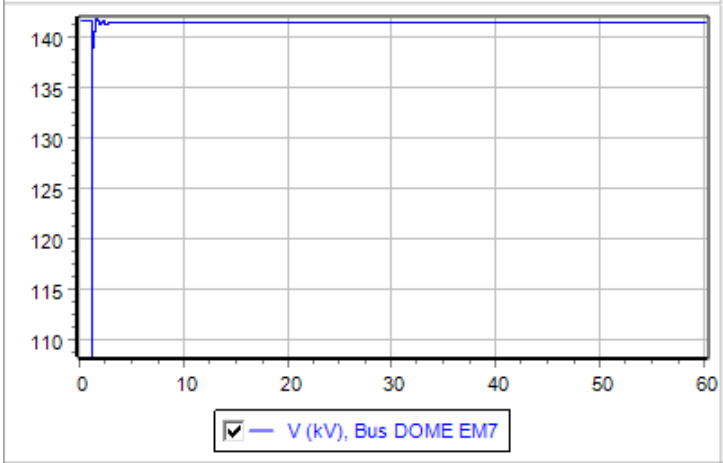
Contingency:
9L59: Tinchebray 972S to Anderson 801S

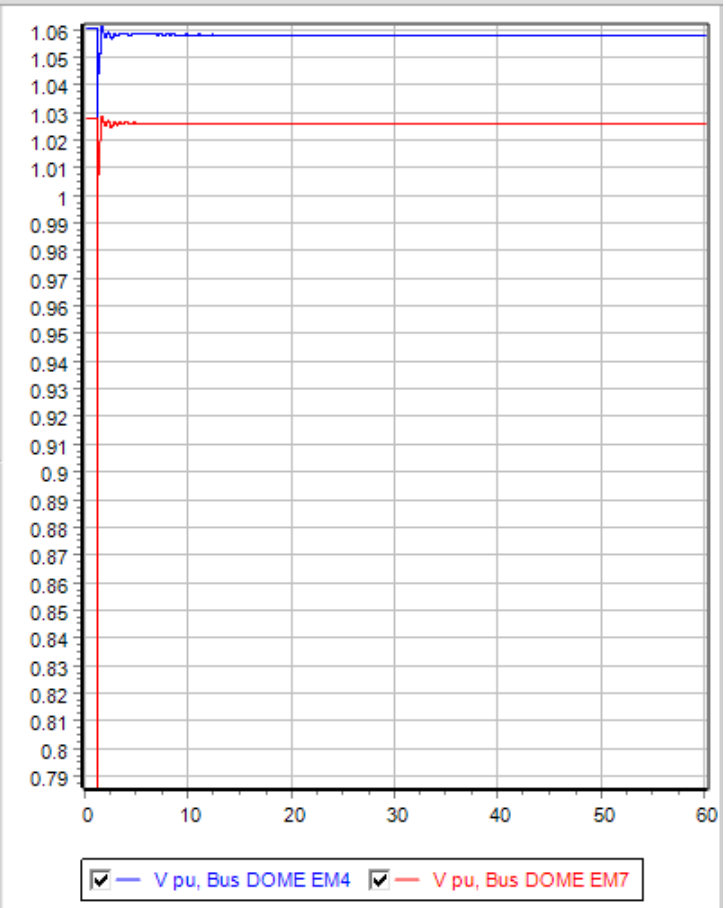
Study Case:
Scenario 6 (2022WP)

December 04, 2020 20:53:10

Dome 163S Voltages





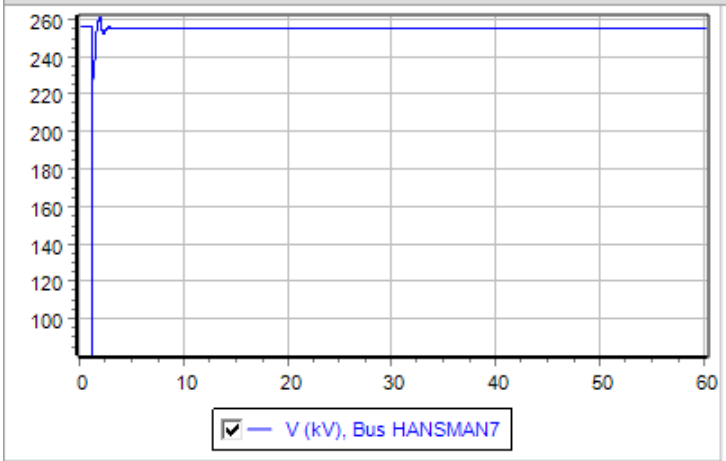


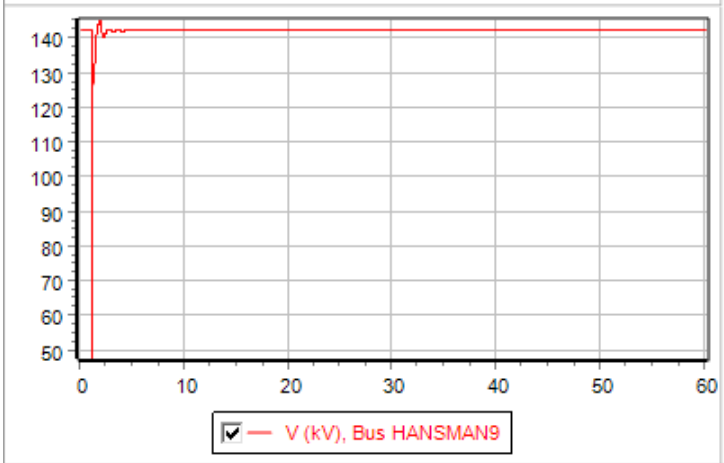
Contingency:
9L59: Tinchebray 972S to Anderson 801S

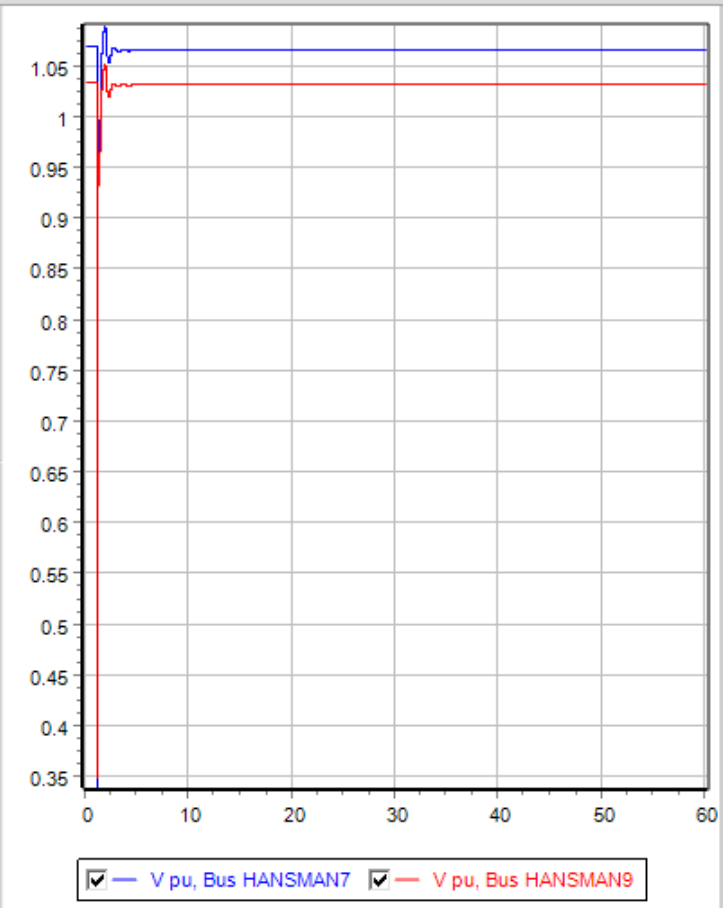
Study Case:
Scenario 6 (2022WP)

December 04, 2020 20:53:10

Hansman Lake 650S Voltages





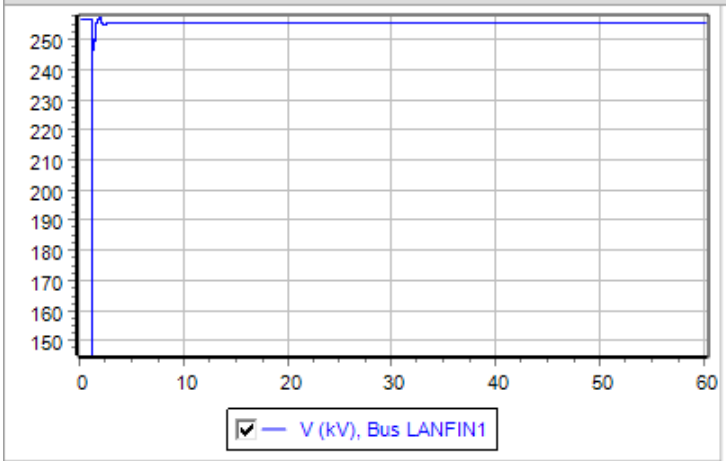


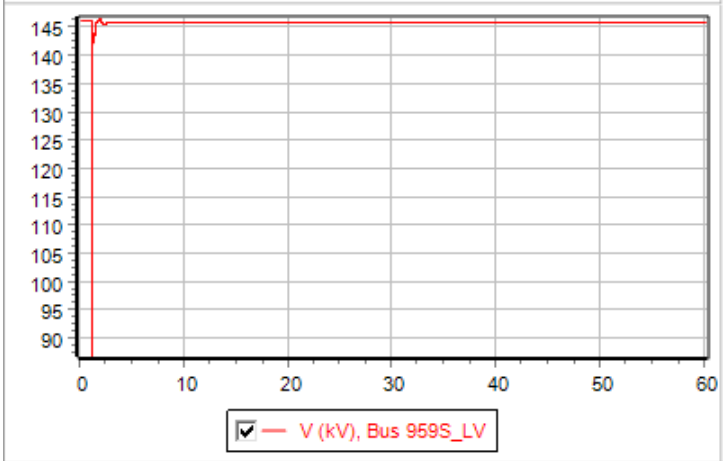
Contingency:
9L59: Tinchebray 972S to Anderson 801S

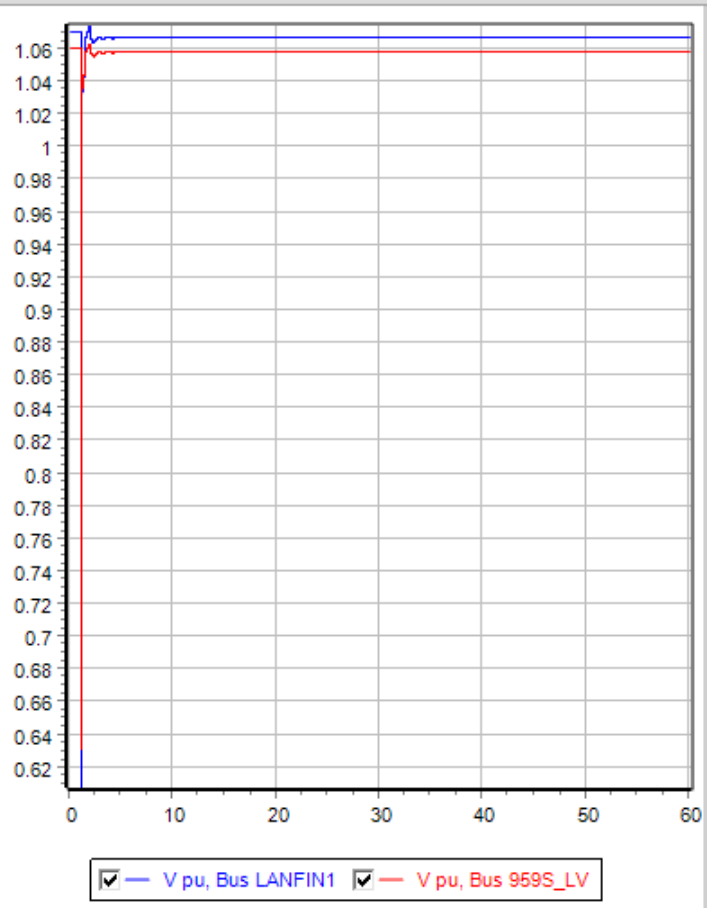
Study Case:
Scenario 6 (2022WP)

December 04, 2020 20:53:09

Lanfine 959S Voltages





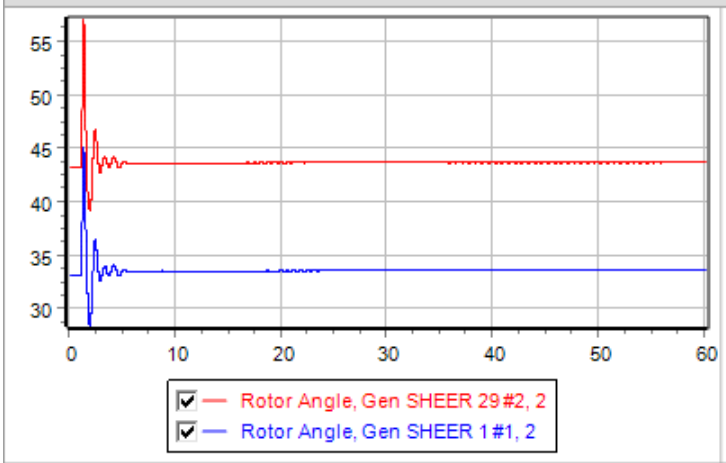


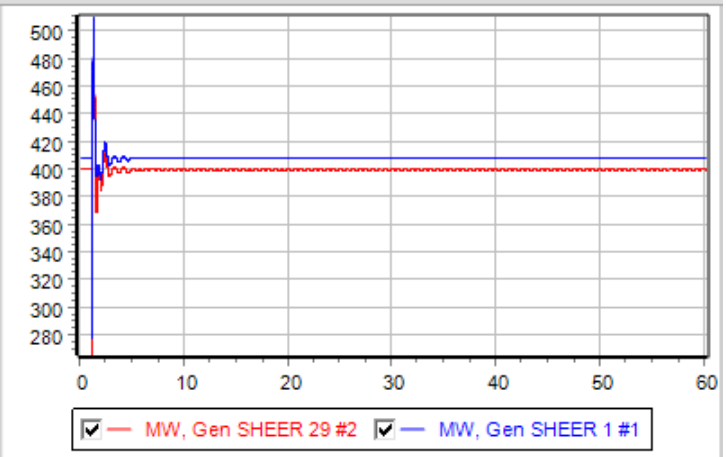
Contingency:
9L59: Tinchebray 972S to Anderson 801S

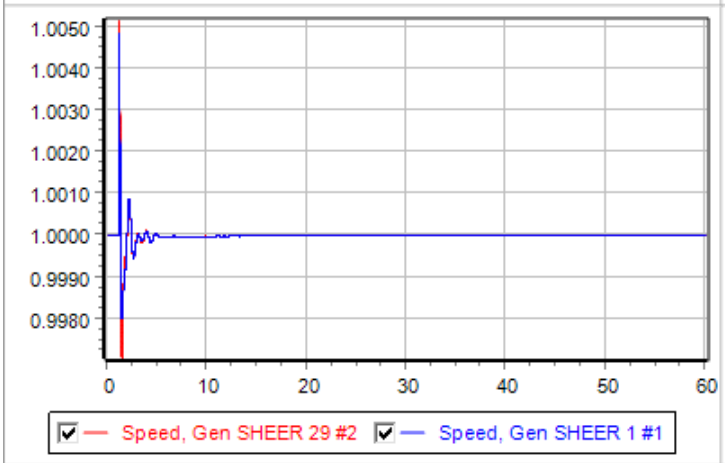
Study Case:
Scenario 6 (2022WP)

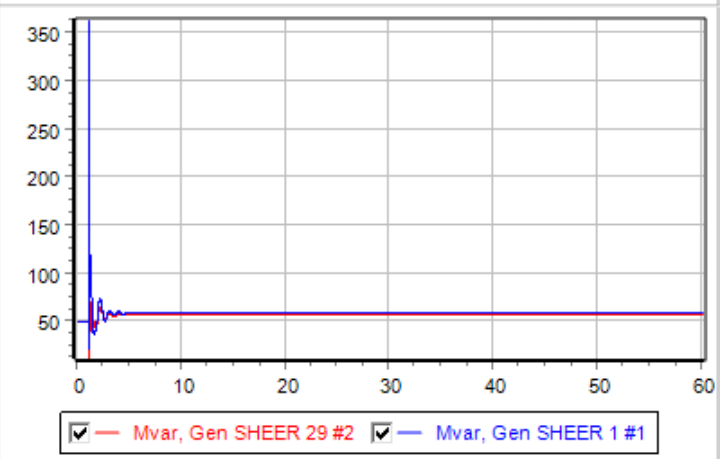
December 04, 2020 20:53:08

Sheerness







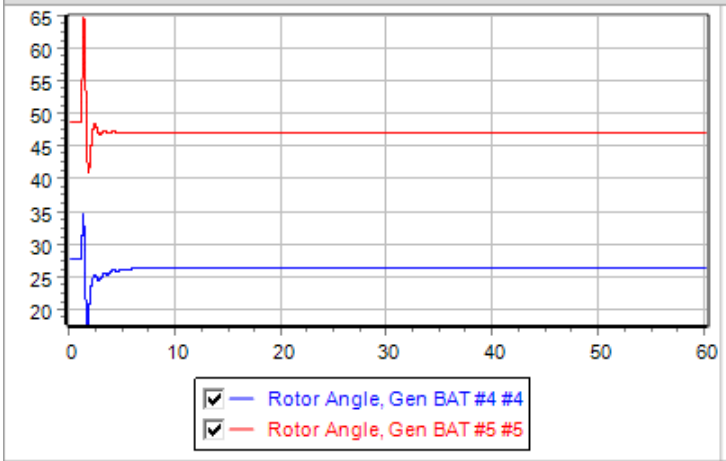


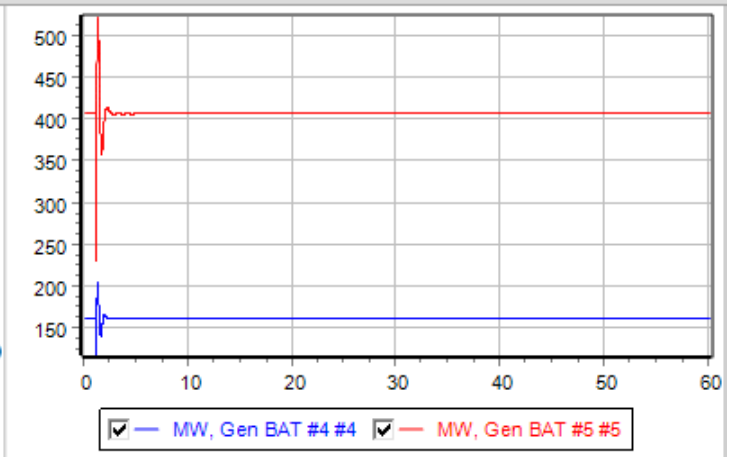
Contingency:
9L59: Tinchebray 972S to Anderson 801S

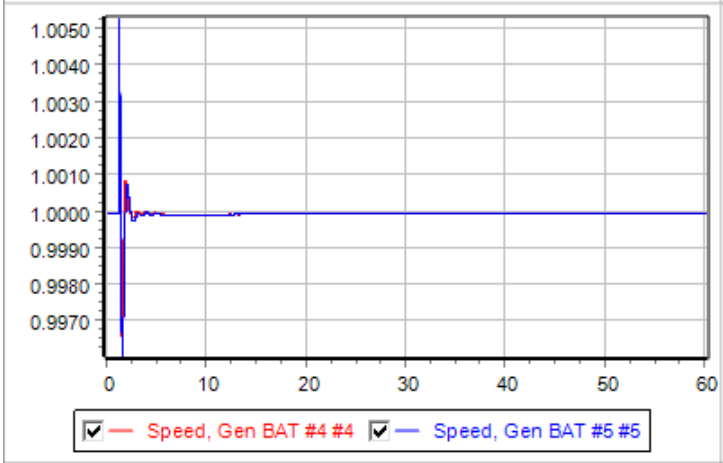
Study Case:
Scenario 6 (2022WP)

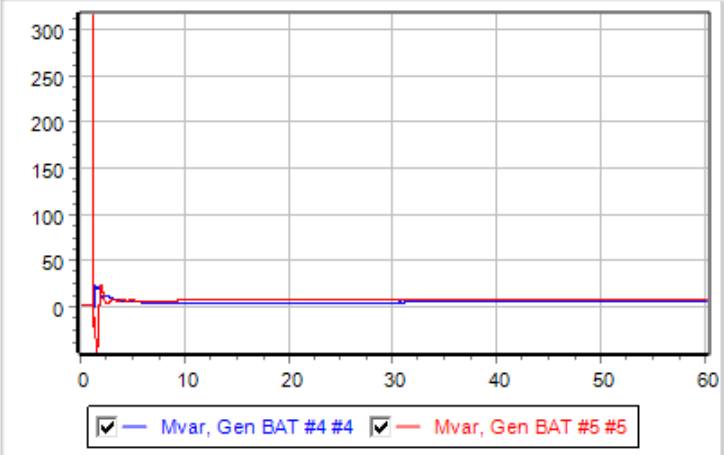
December 04, 2020 20:53:07

Battle River







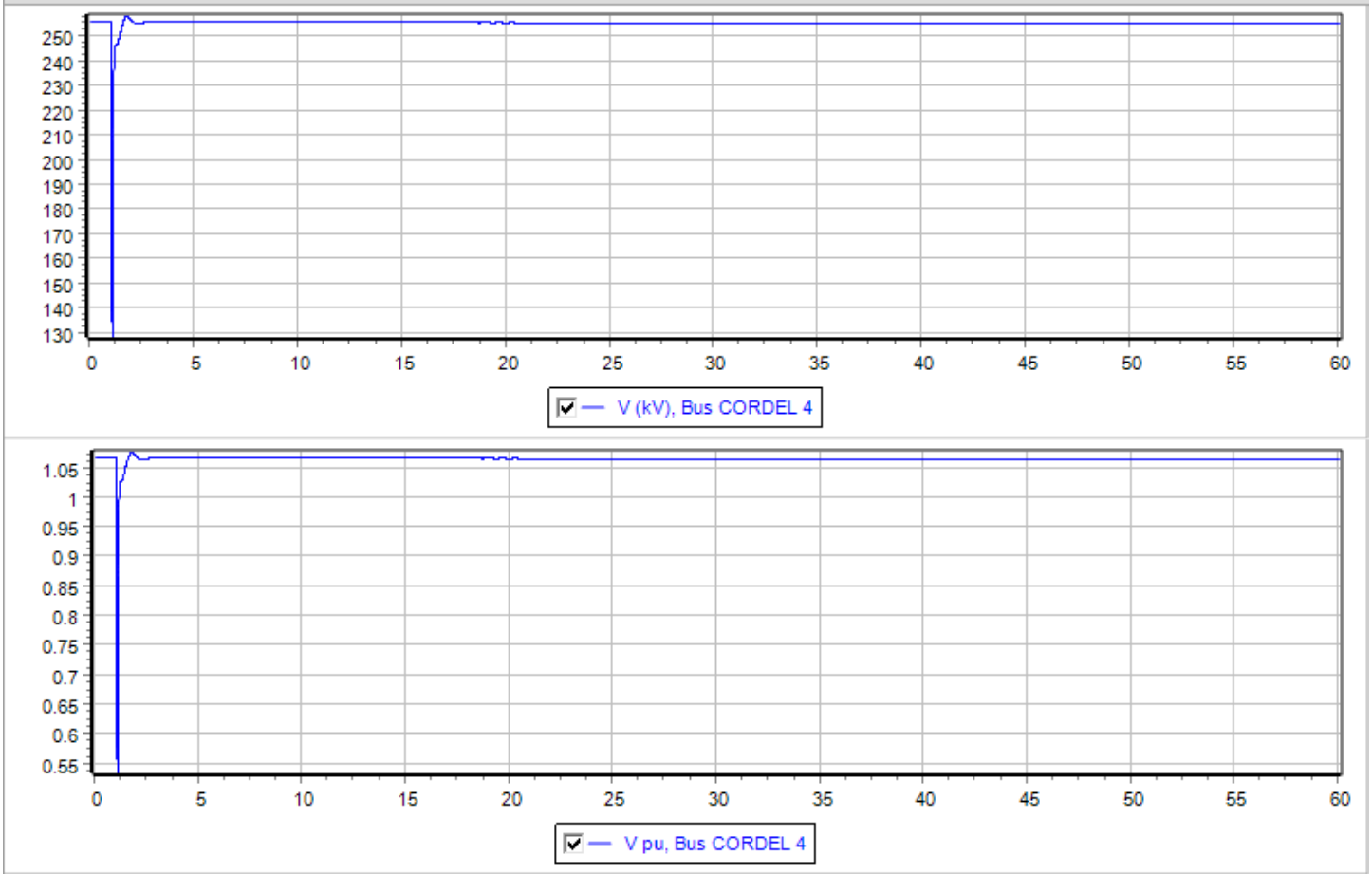


Contingency:
9L966: Hansman Lake 650S to Pemukan 932S

Study Case:
Scenario 6 (2022WP)

December 04, 2020 20:59:00

Cordel 755S Voltages

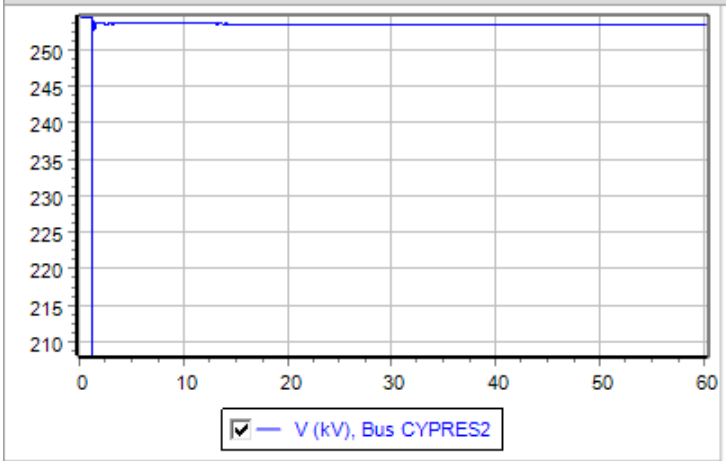


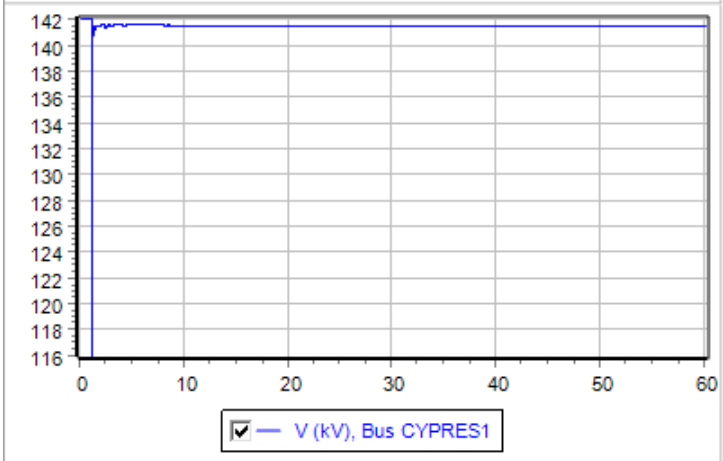
Contingency:
9L966: Hansman Lake 650S to Pemukan 932S

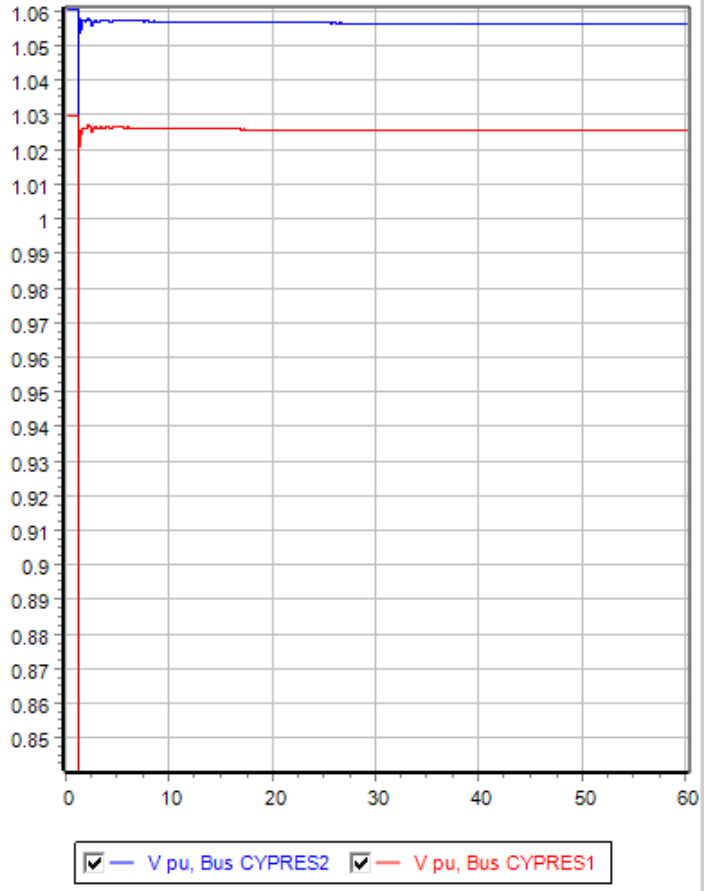
Study Case:
Scenario 6 (2022WP)

December 04, 2020 20:59:04

Cypress 562S Voltages





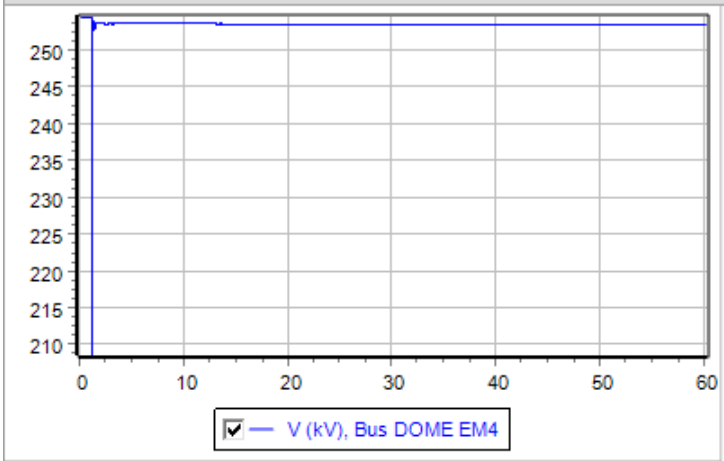


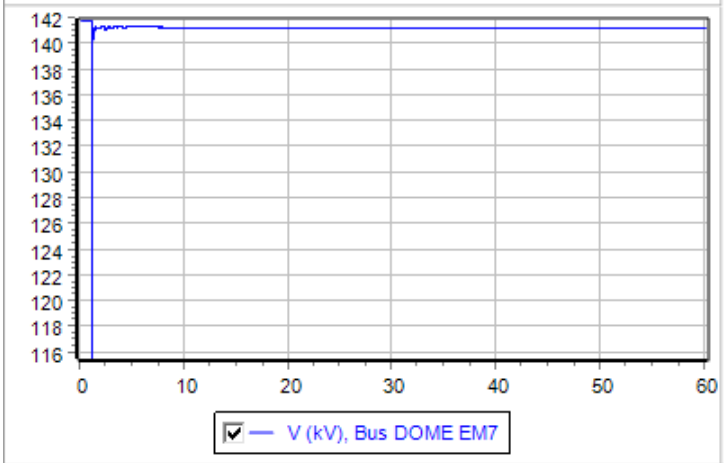
Contingency:
9L966: Hansman Lake 650S to Pemukan 932S

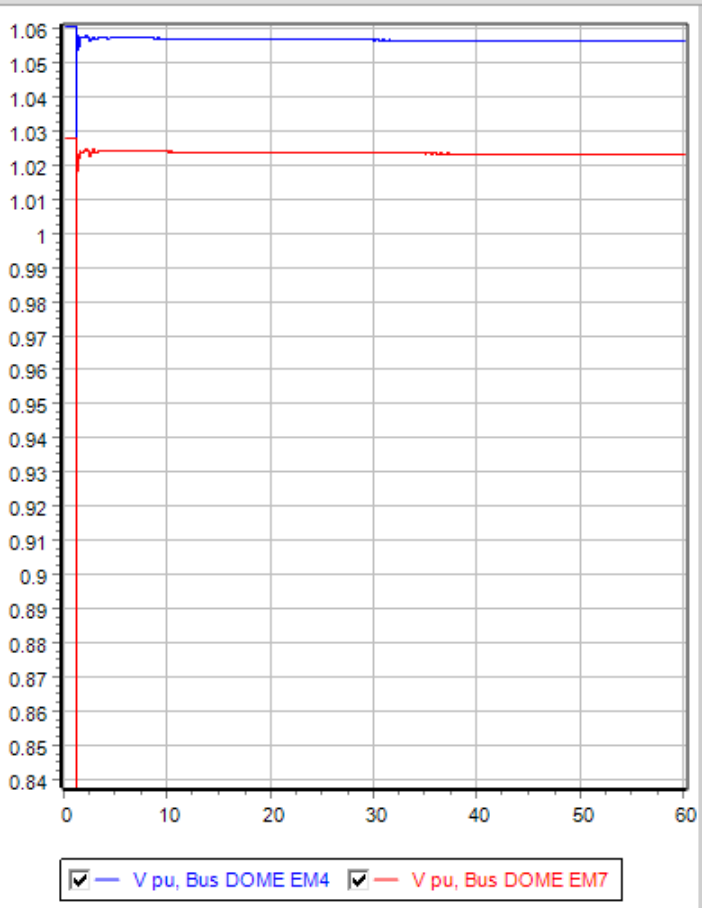
Study Case:
Scenario 6 (2022WP)

December 04, 2020 20:59:03

Dome 163S Voltages





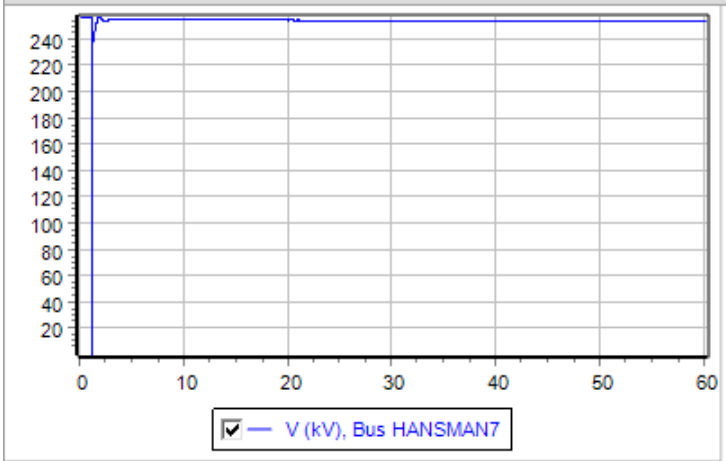


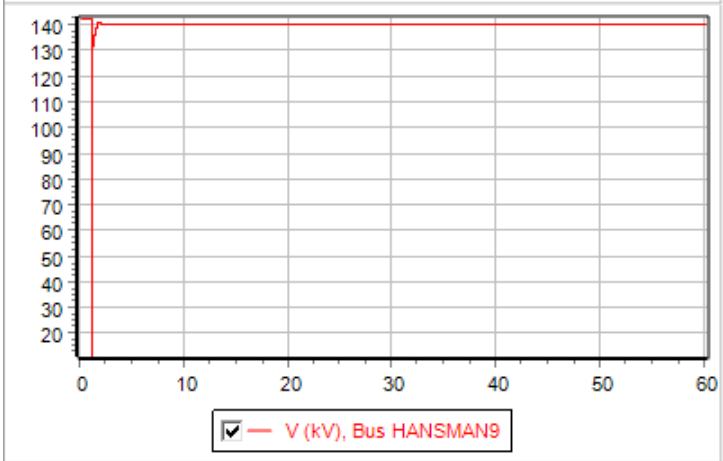
Contingency:
9L966: Hansman Lake 650S to Pemukan 932S

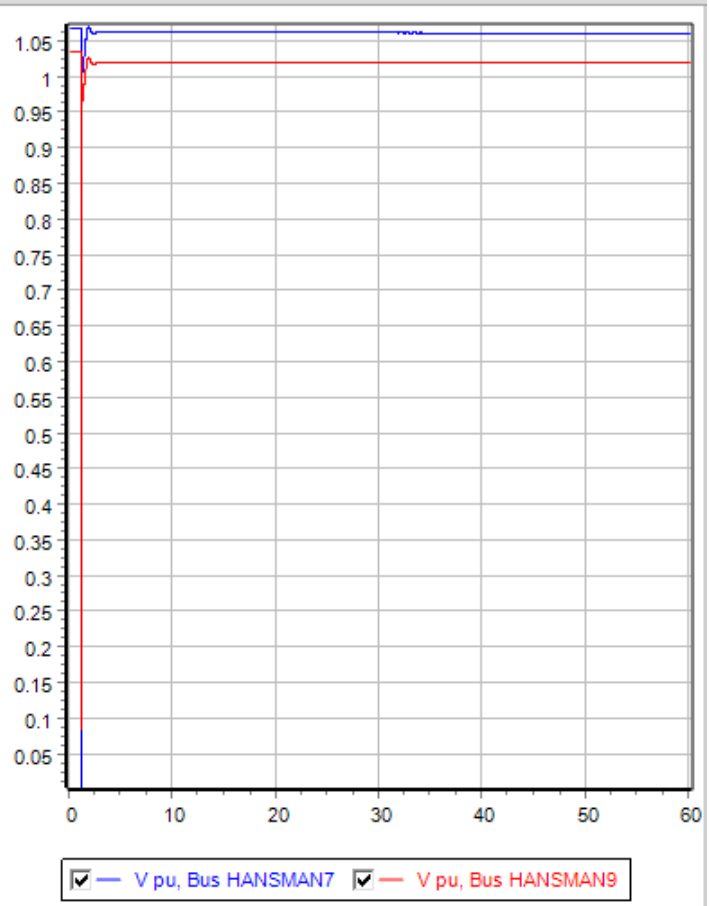
Study Case:
Scenario 6 (2022WP)

December 04, 2020 20:59:02

Hansman Lake 650S Voltages





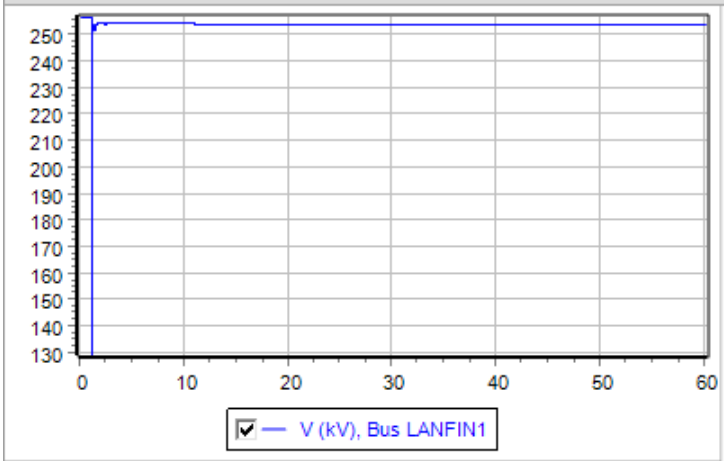


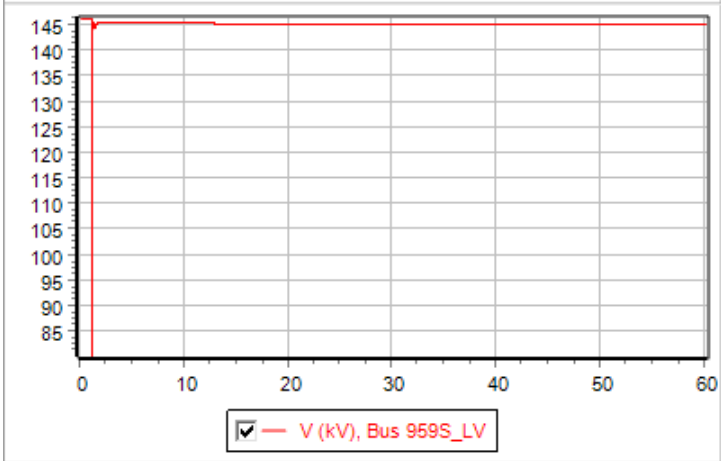
Contingency:
9L966: Hansman Lake 650S to Pemukan 932S

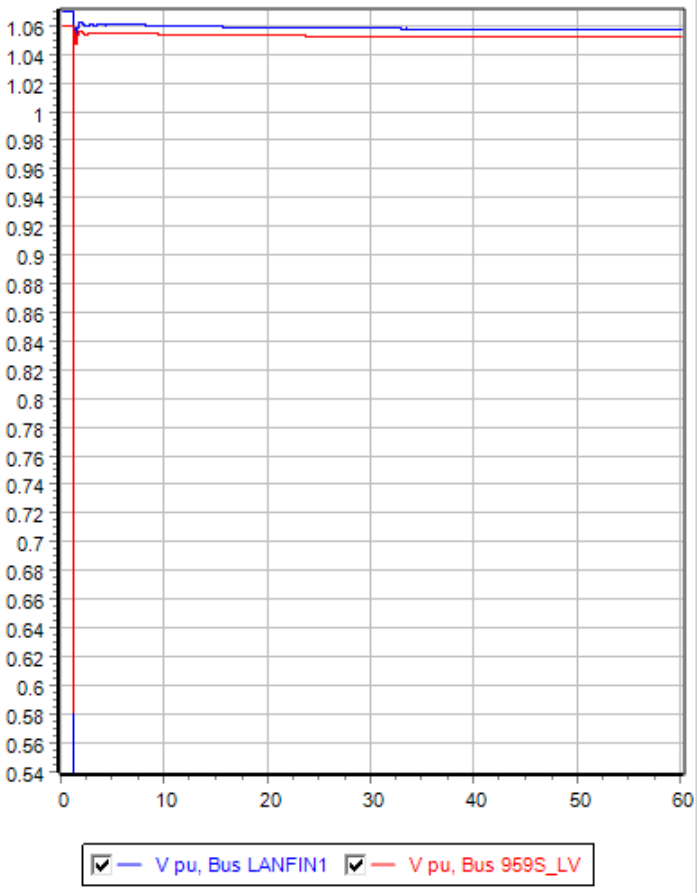
Study Case:
Scenario 6 (2022WP)

December 04, 2020 20:59:02

Lanfine 959S Voltages





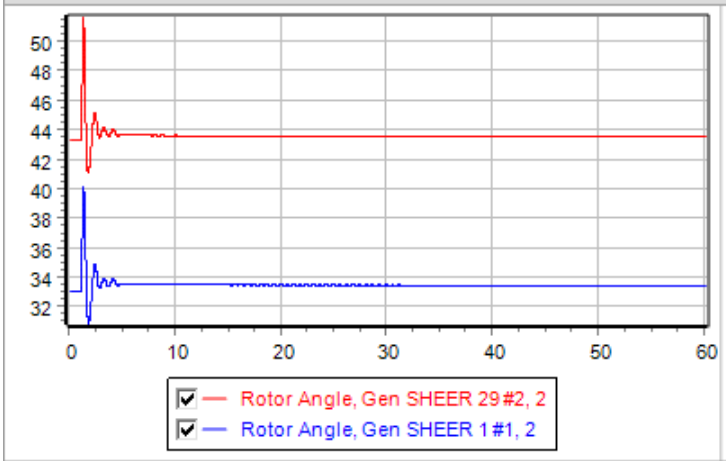


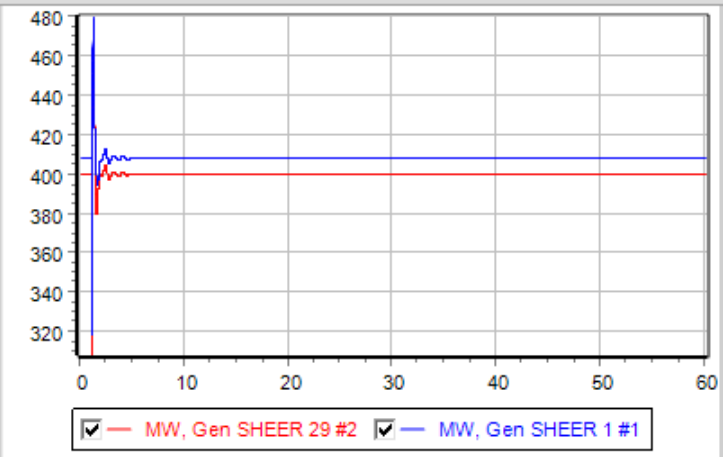
Contingency:
9L966: Hansman Lake 650S to Pemukan 932S

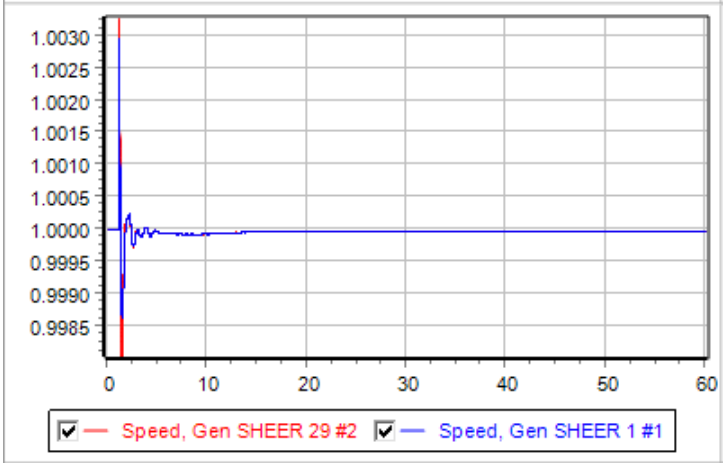
Study Case:
Scenario 6 (2022WP)

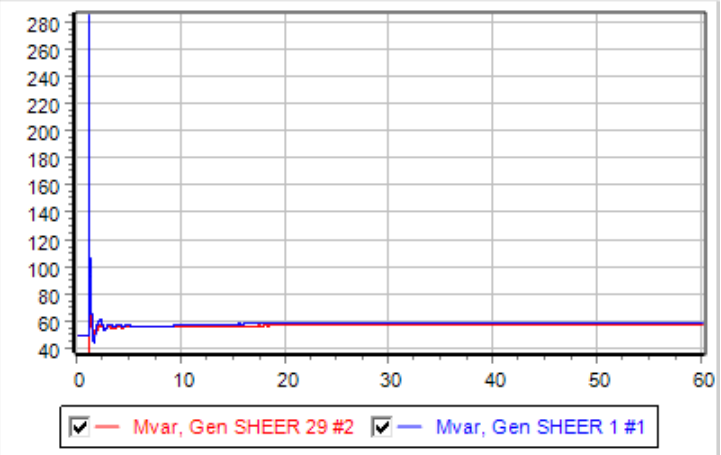
December 04, 2020 20:59:01

Sheerness







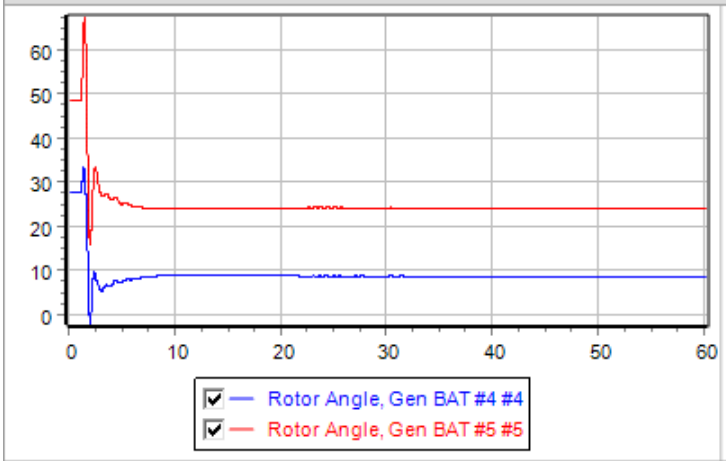


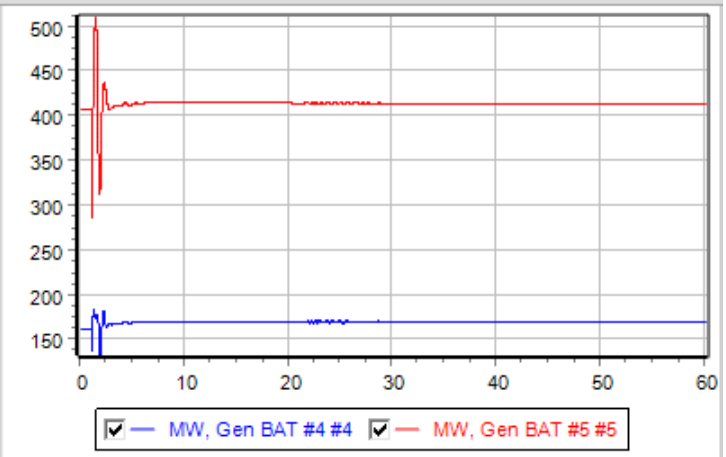
Contingency:
9L966: Hansman Lake 650S to Pemukan 932S

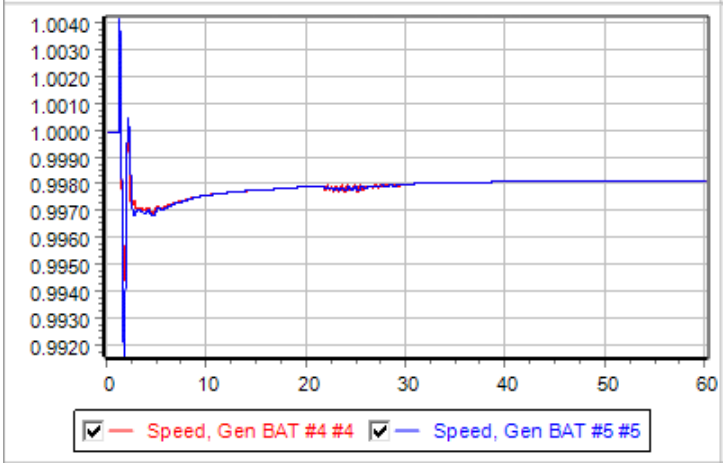
Study Case:
Scenario 6 (2022WP)

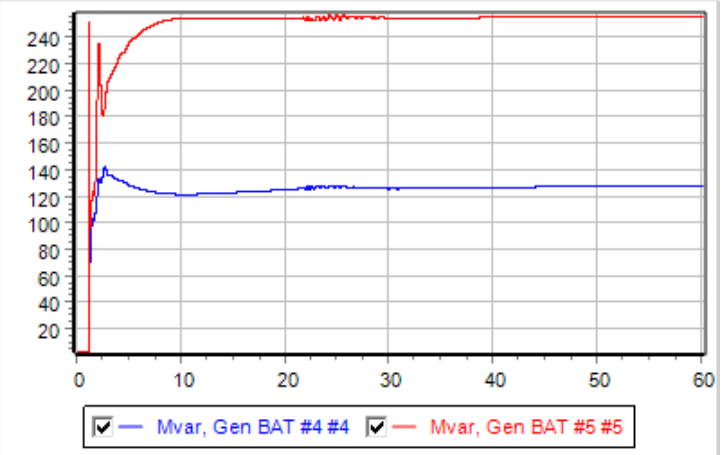
December 04, 2020 20:58:59

Battle River







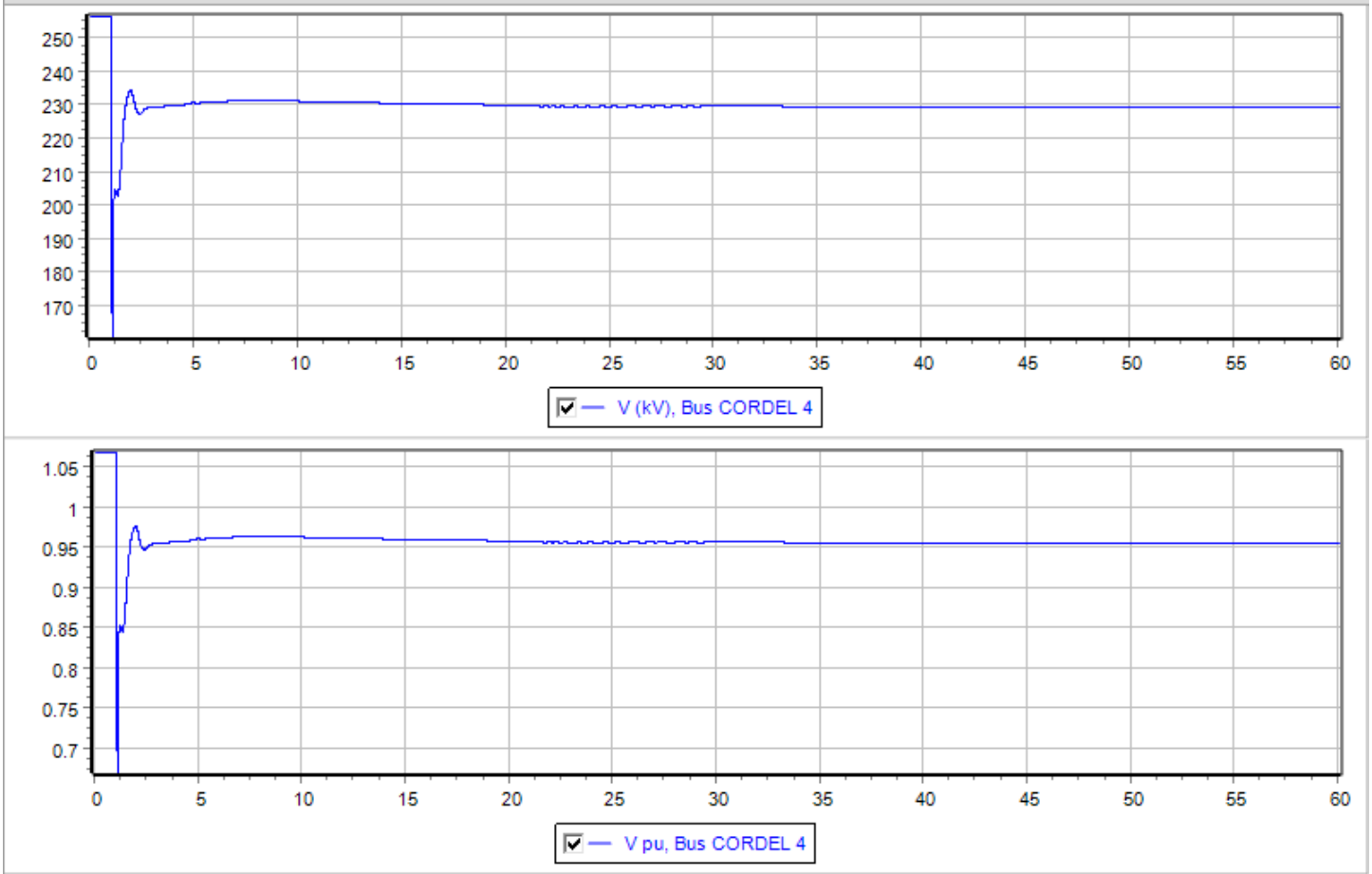


Contingency:
9L966: Pemukan 932S to Hansman Lake 650S

Study Case:
Scenario 6 (2022WP)

December 04, 2020 21:04:46

Cordel 755S Voltages

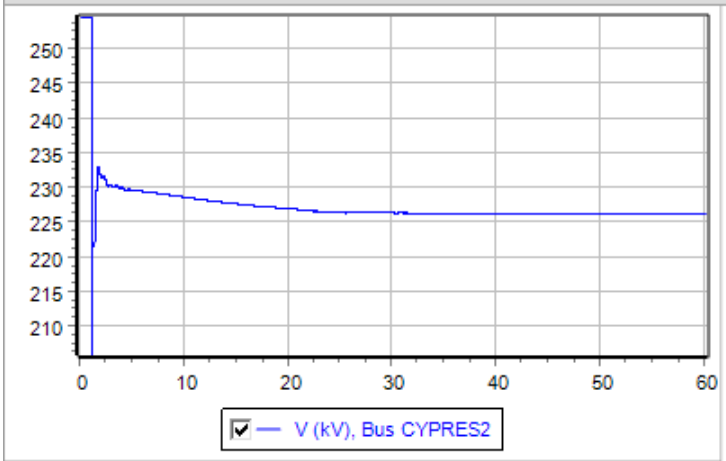


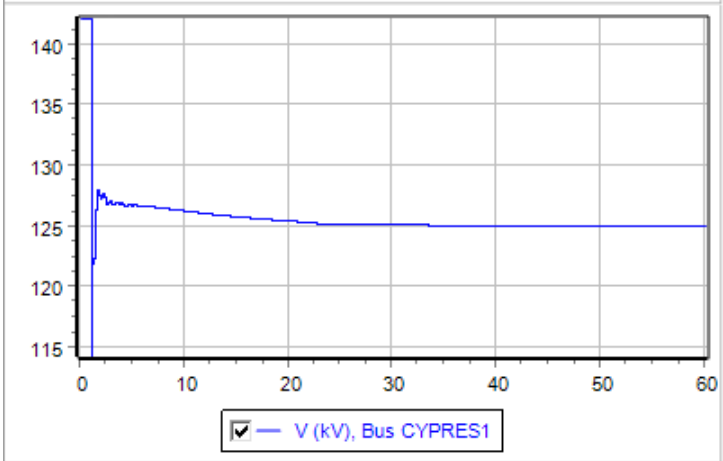
Contingency:
9L966: Pemukan 932S to Hansman Lake 650S

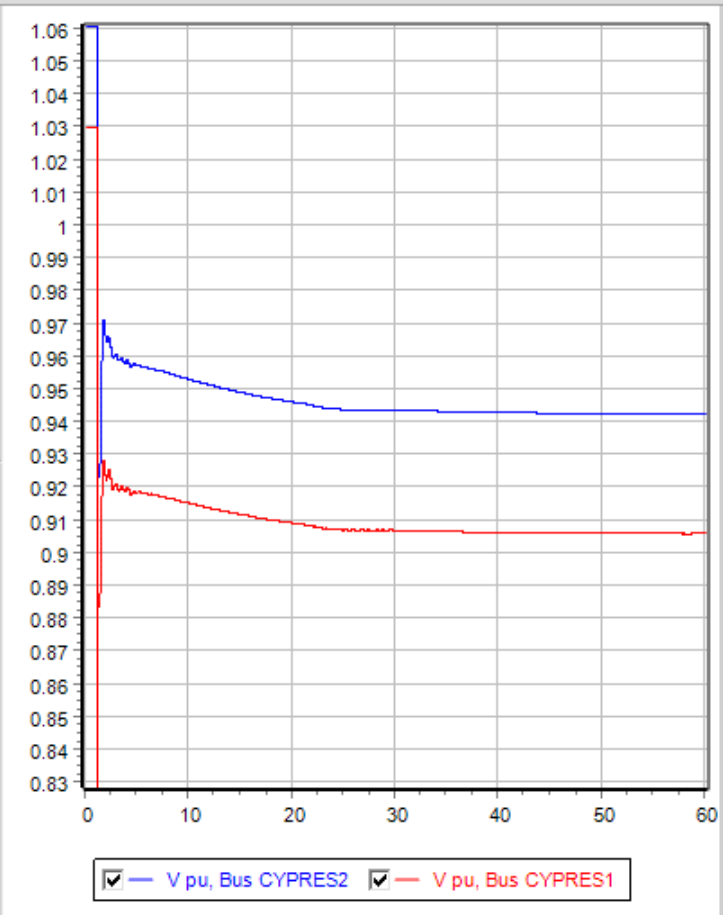
Study Case:
Scenario 6 (2022WP)

December 04, 2020 21:04:49

Cypress 562S Voltages





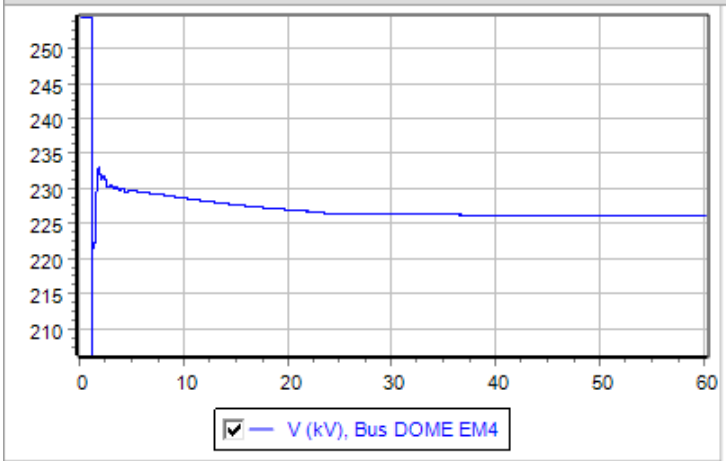


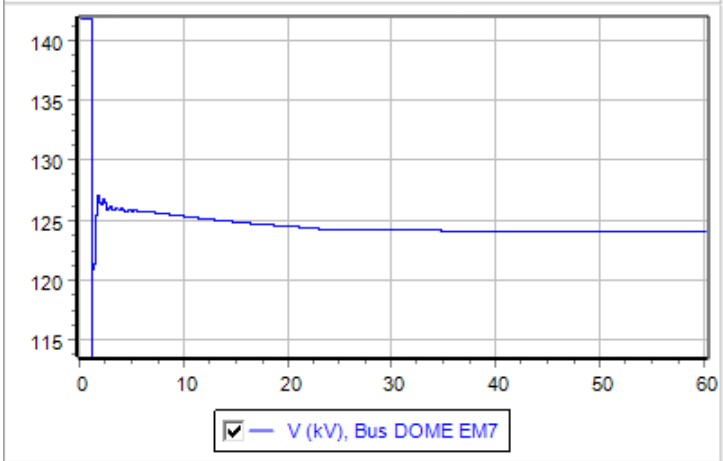
Contingency:
9L966: Pemukan 932S to Hansman Lake 650S

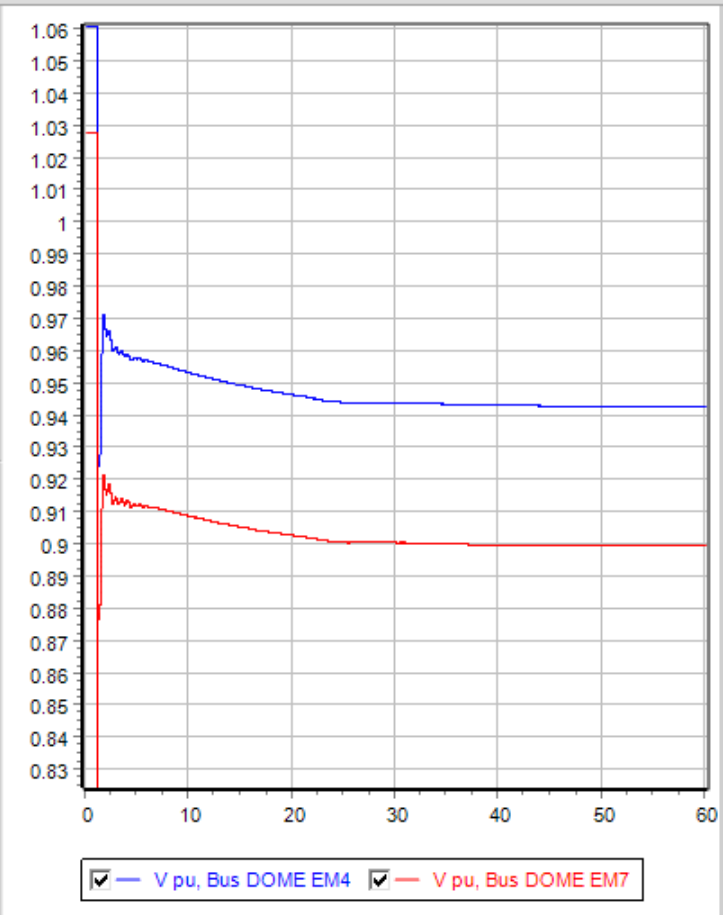
Study Case:
Scenario 6 (2022WP)

December 04, 2020 21:04:48

Dome 163S Voltages





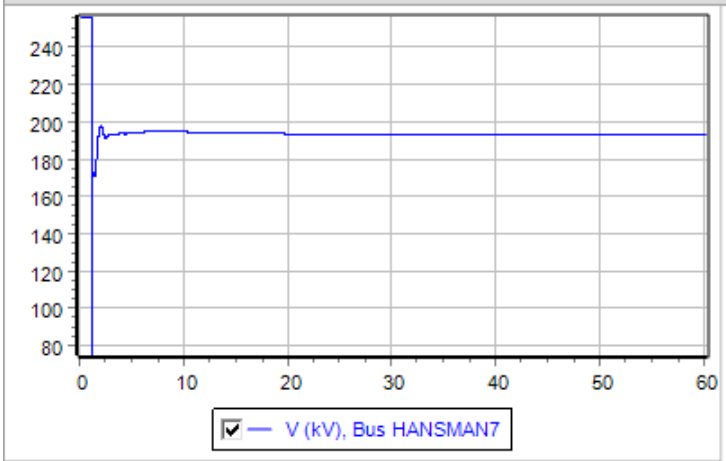


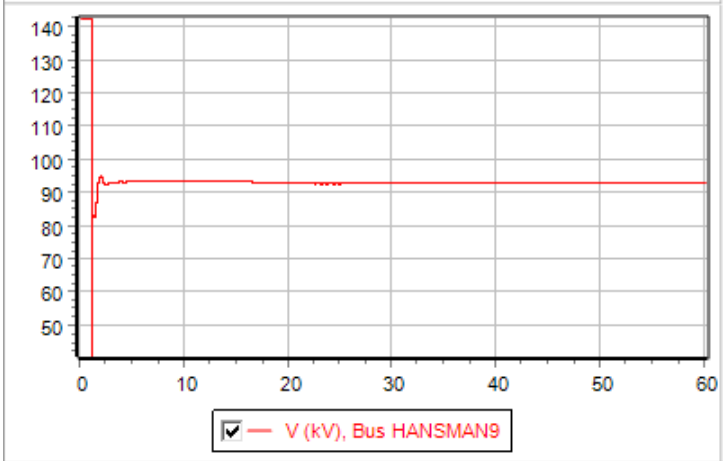
Contingency:
9L966: Pemukan 932S to Hansman Lake 650S

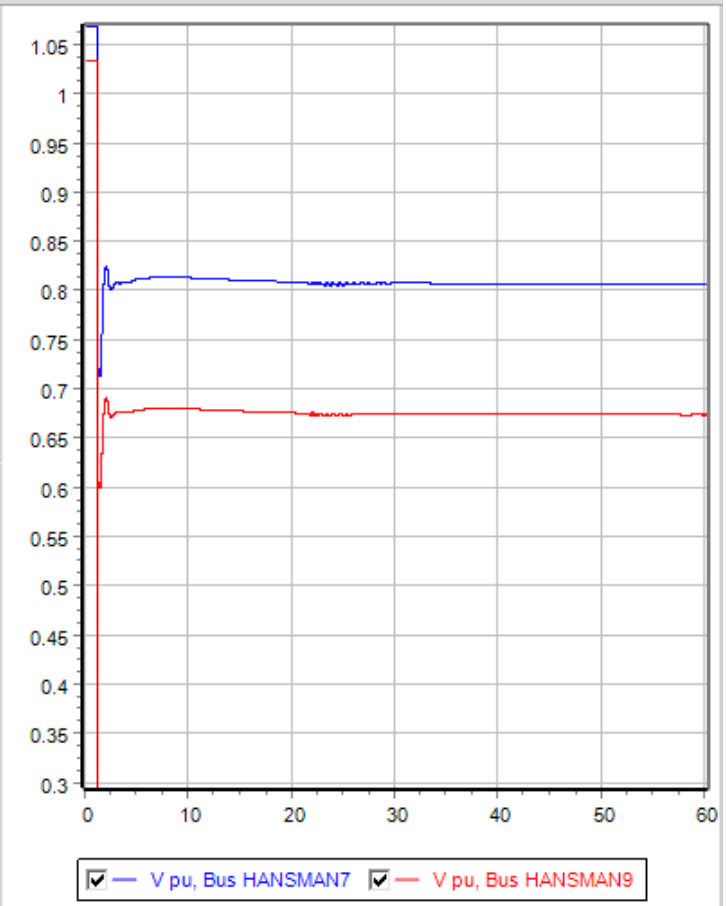
Study Case:
Scenario 6 (2022WP)

December 04, 2020 21:04:47

Hansman Lake 650S Voltages





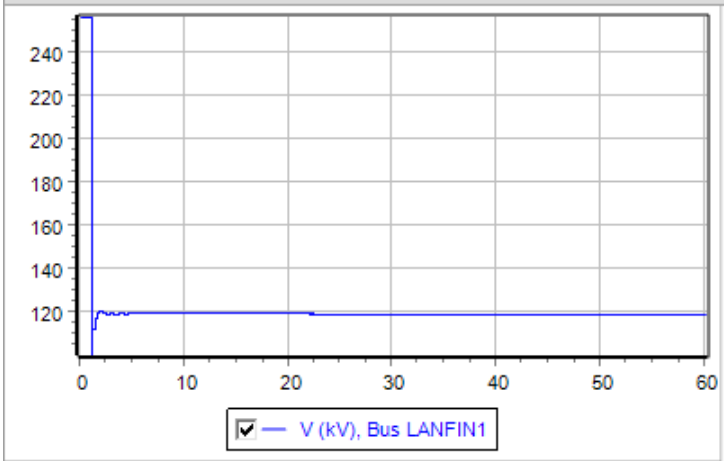


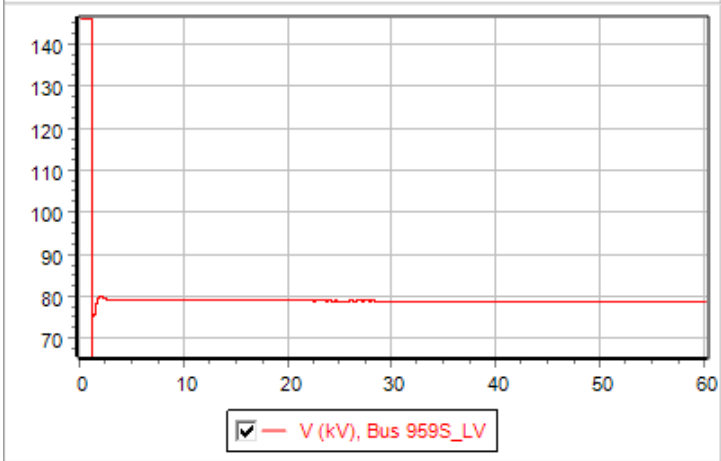
Contingency:
9L966: Pemukan 932S to Hansman Lake 650S

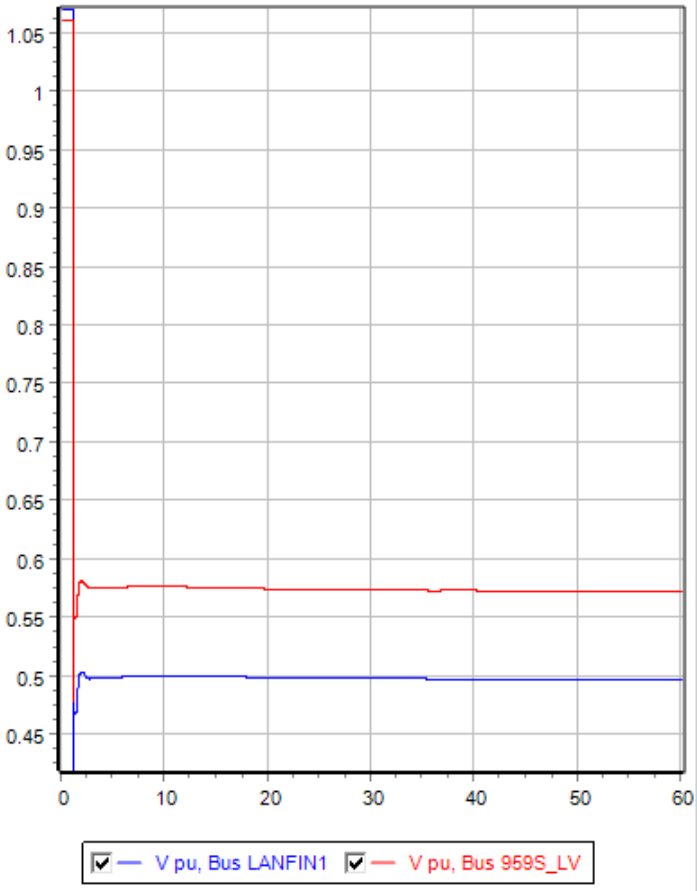
Study Case:
Scenario 6 (2022WP)

December 04, 2020 21:04:47

Lanfine 959S Voltages





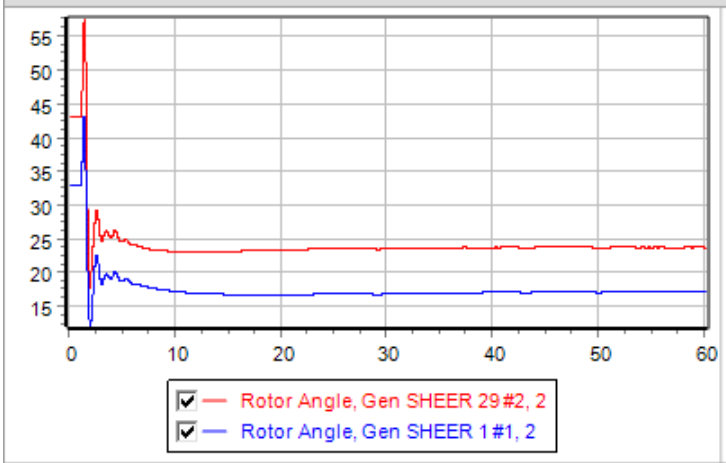


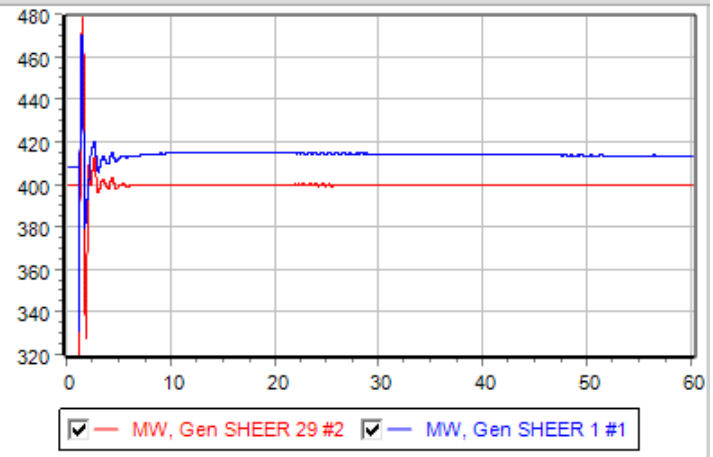
Contingency:
9L966: Pemukan 932S to Hansman Lake 650S

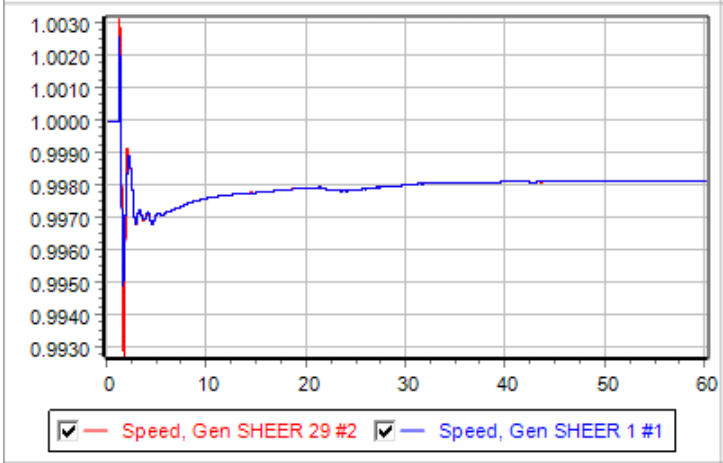
Study Case:
Scenario 6 (2022WP)

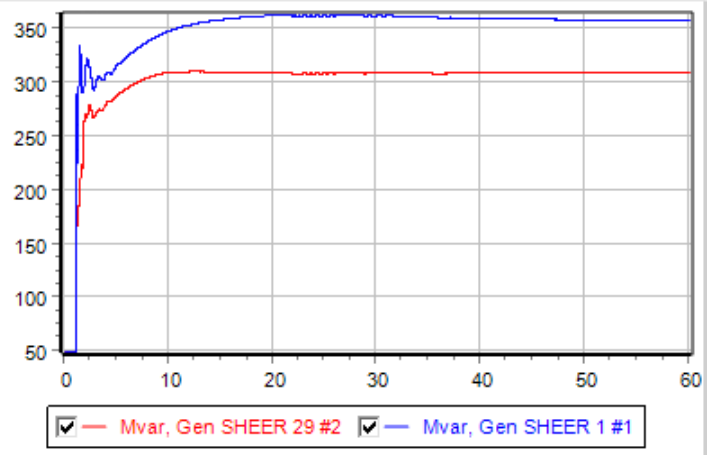
December 04, 2020 21:04:46

Sheerness







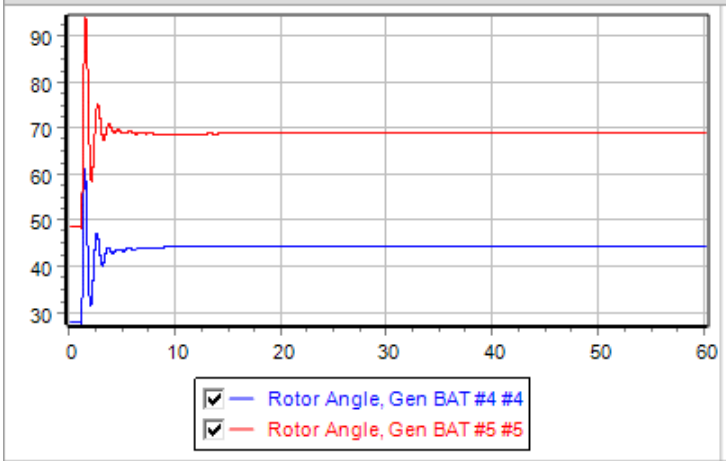


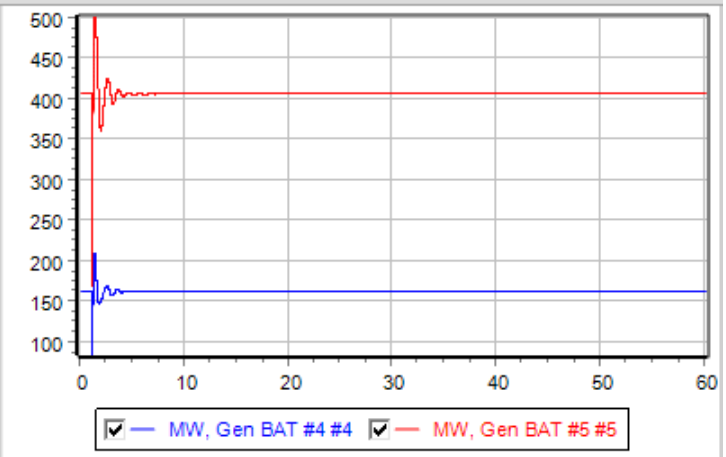
Contingency:
9L966: Pemukan 932S to Hansman Lake 650S

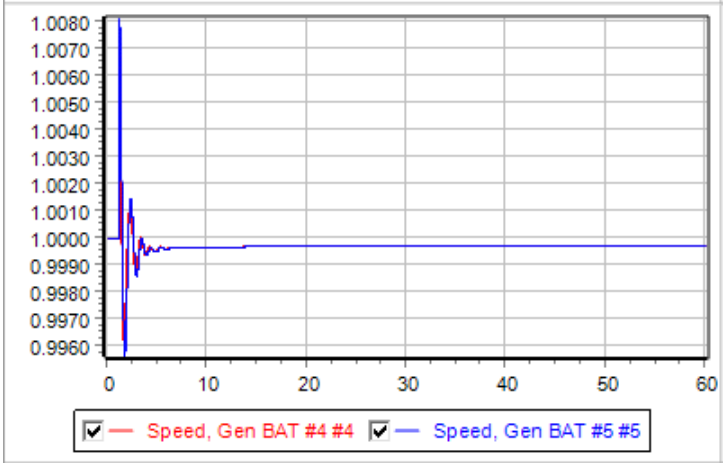
Study Case:
Scenario 6 (2022WP)

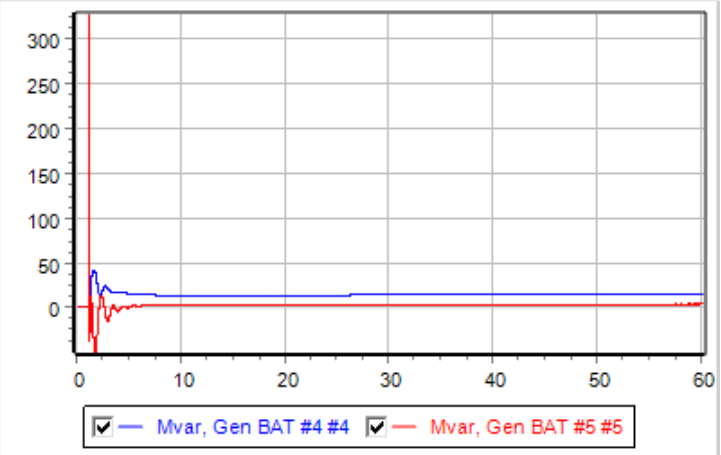
December 04, 2020 21:04:45

Battle River







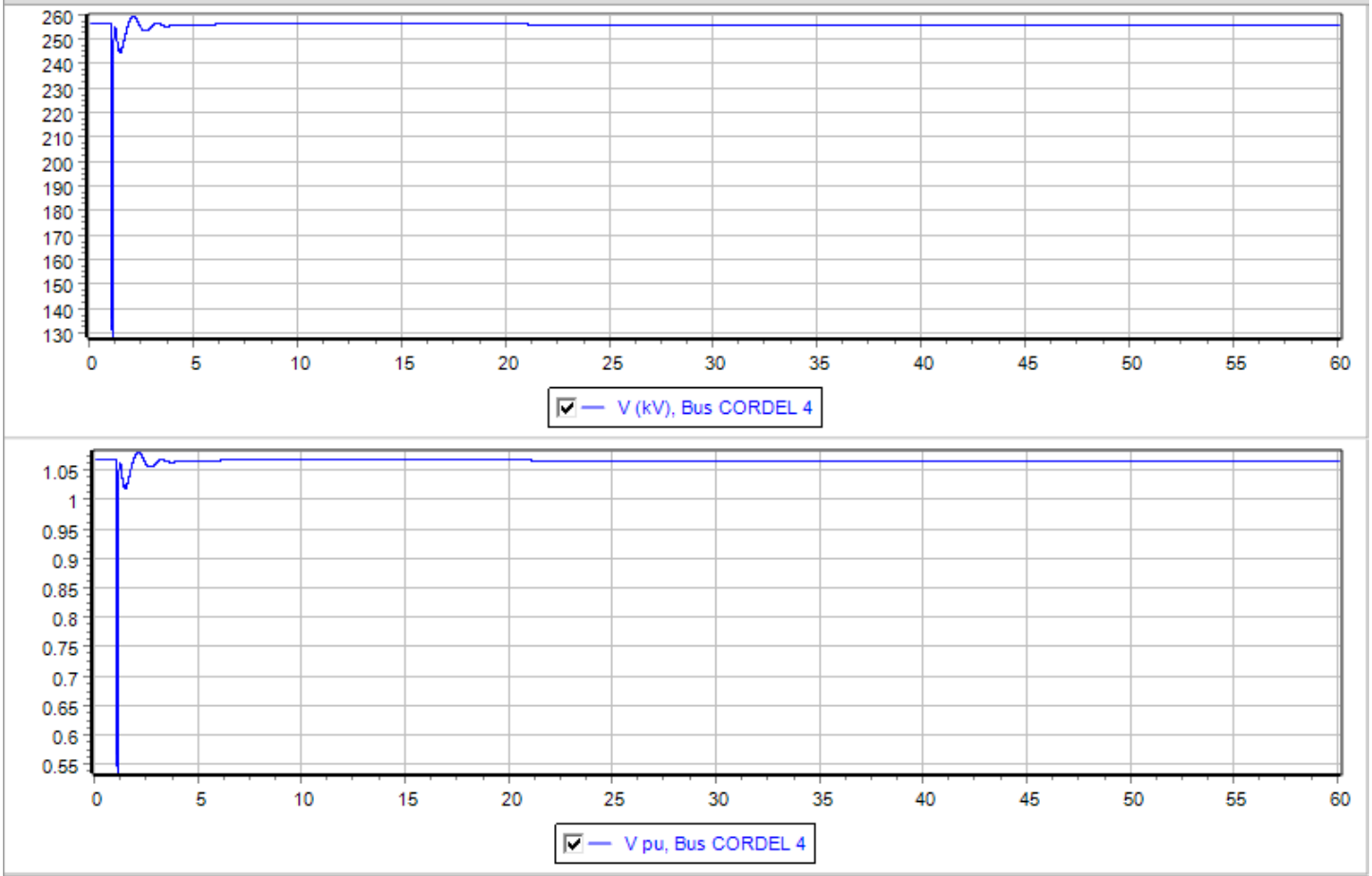


Contingency:
912L/9L912: Nevis 766S to Red Deer 63S

Study Case:
Scenario 6 (2022WP)

December 04, 2020 19:50:58

Cordel 755S Voltages

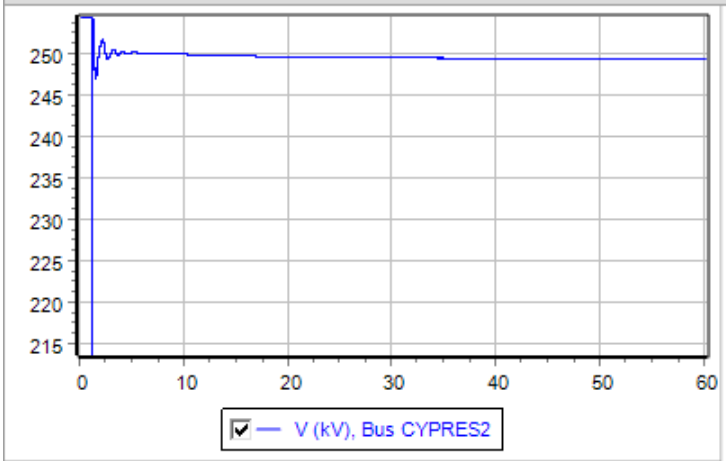


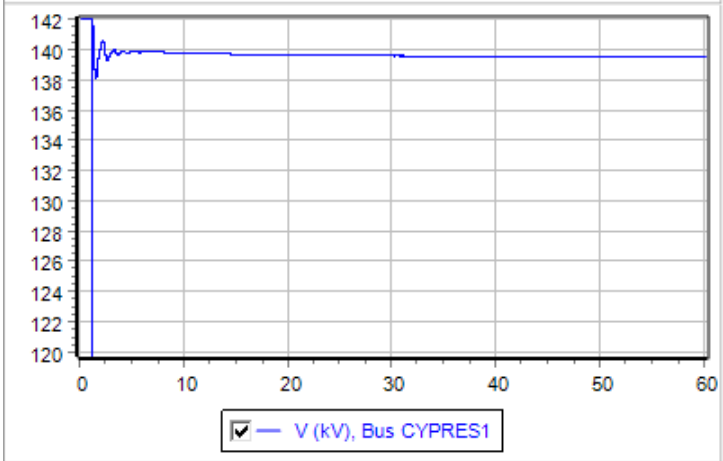
Contingency:
912L/9L912: Nevis 766S to Red Deer 63S

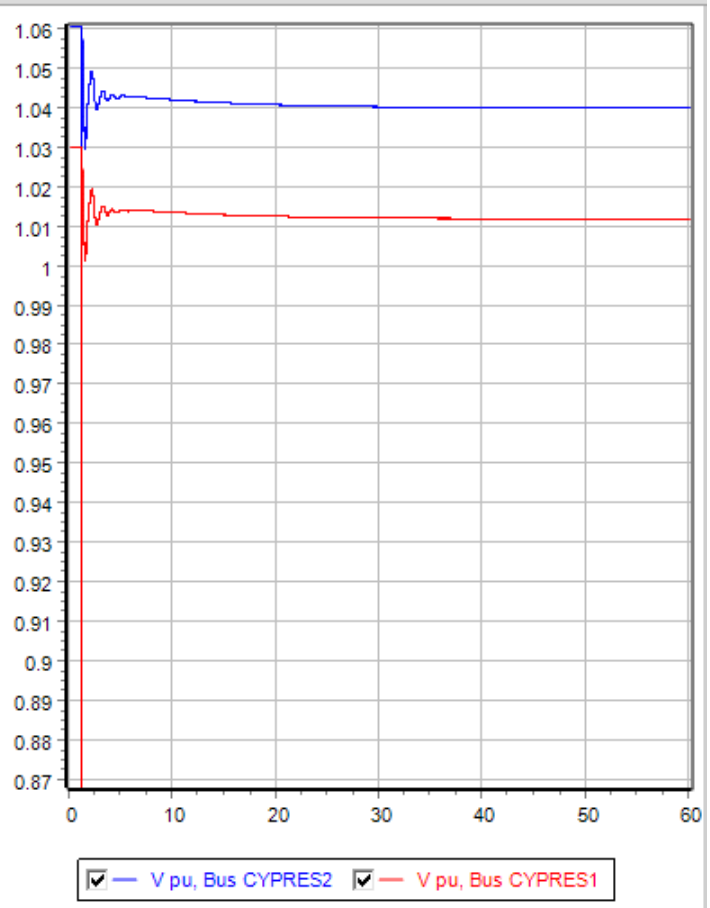
Study Case:
Scenario 6 (2022WP)

December 04, 2020 19:51:01

Cypress 562S Voltages





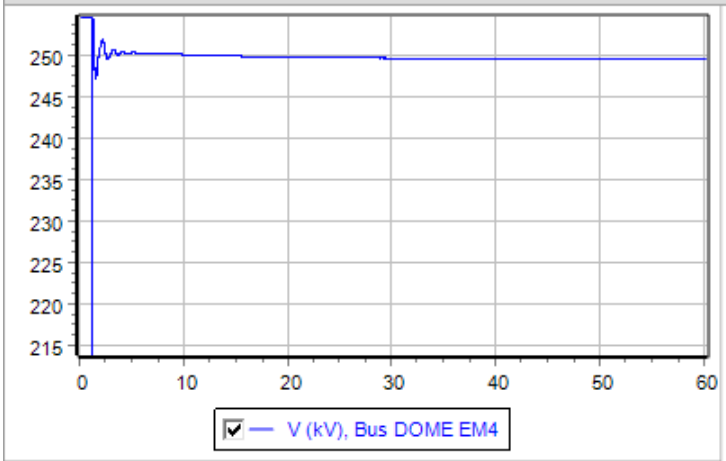


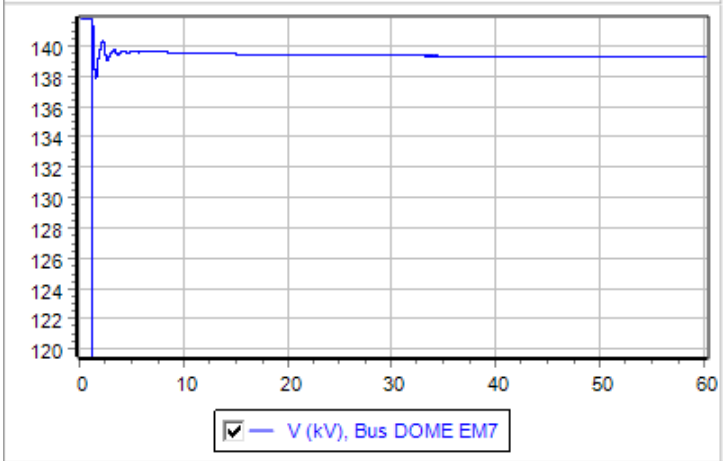
Contingency:
912L/9L912: Nevis 766S to Red Deer 63S

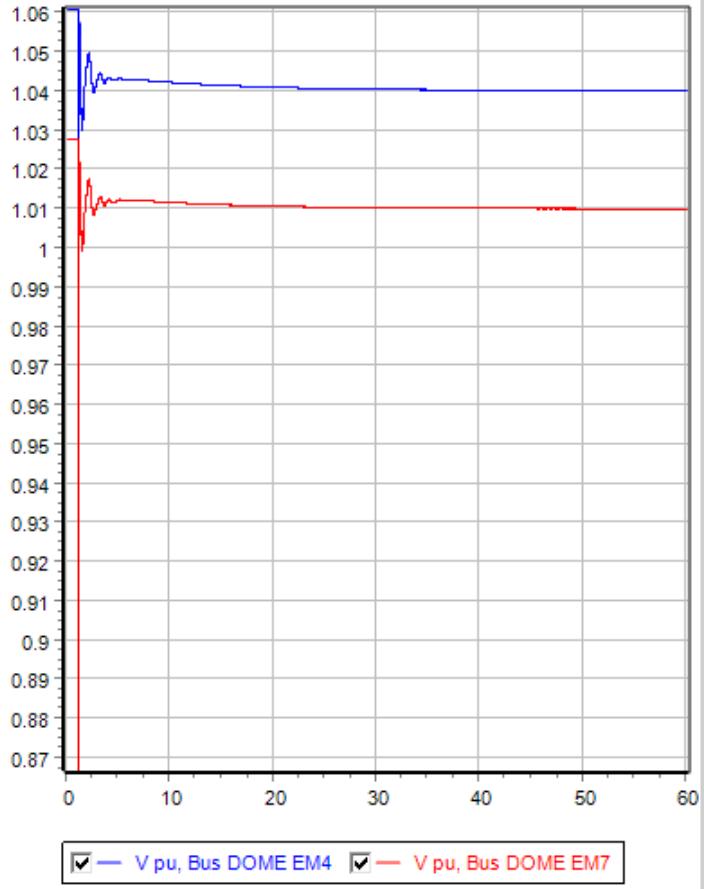
Study Case:
Scenario 6 (2022WP)

December 04, 2020 19:51:00

Dome 163S Voltages





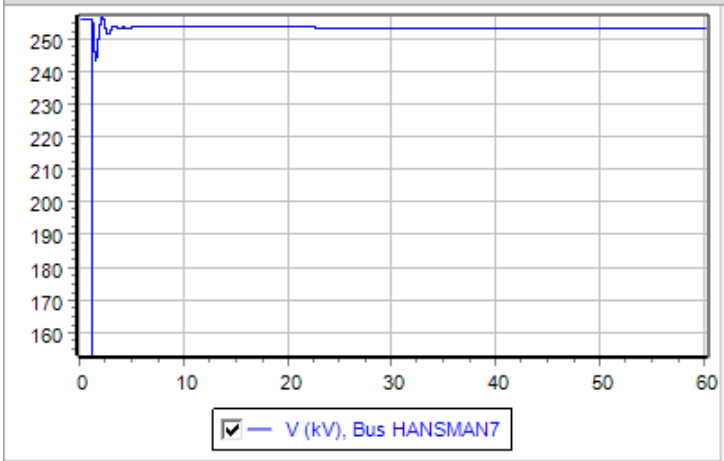


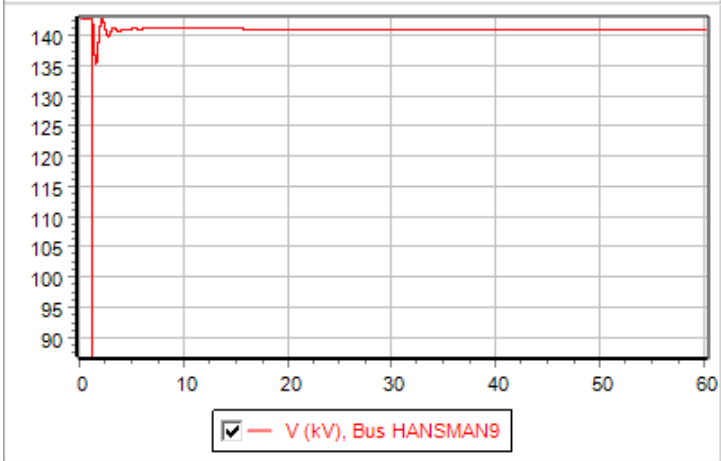
Contingency:
912L/9L912: Nevis 766S to Red Deer 63S

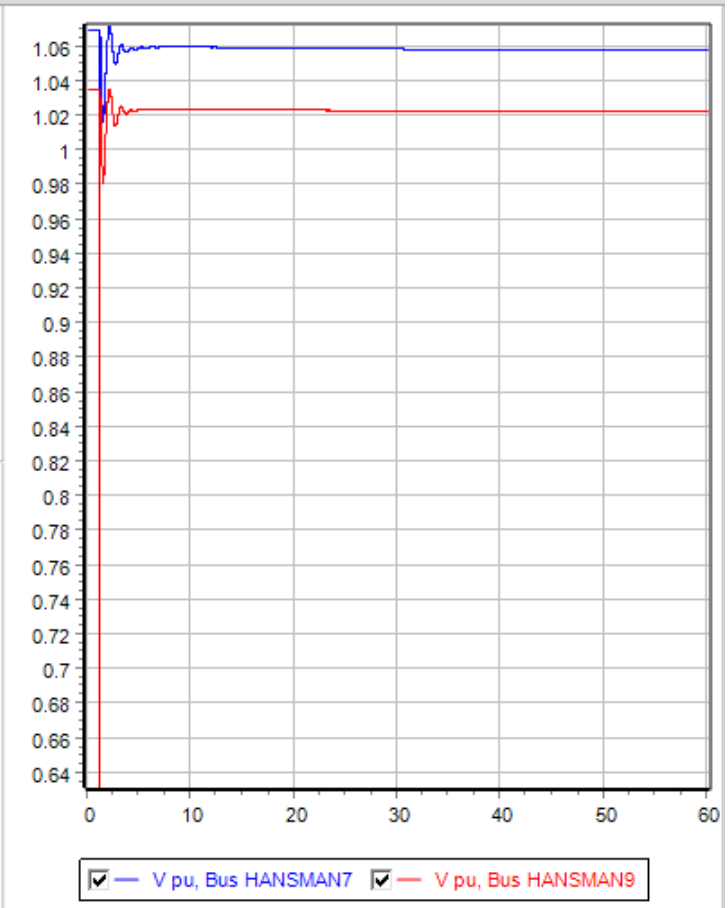
Study Case:
Scenario 6 (2022WP)

December 04, 2020 19:51:00

Hansman Lake 650S Voltages





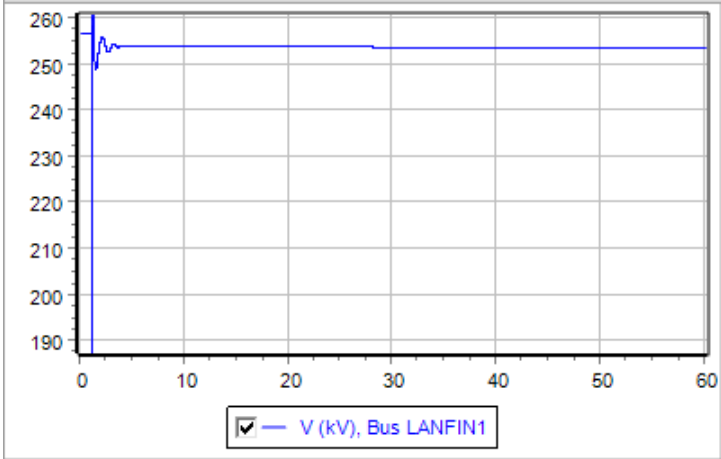


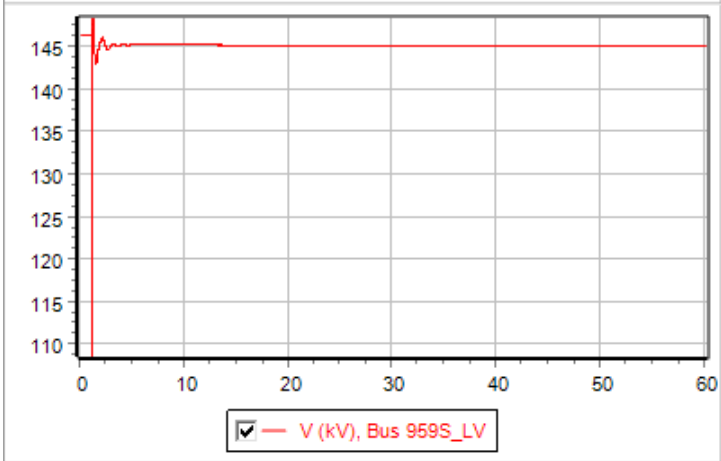
Contingency:
912L/9L912: Nevis 766S to Red Deer 63S

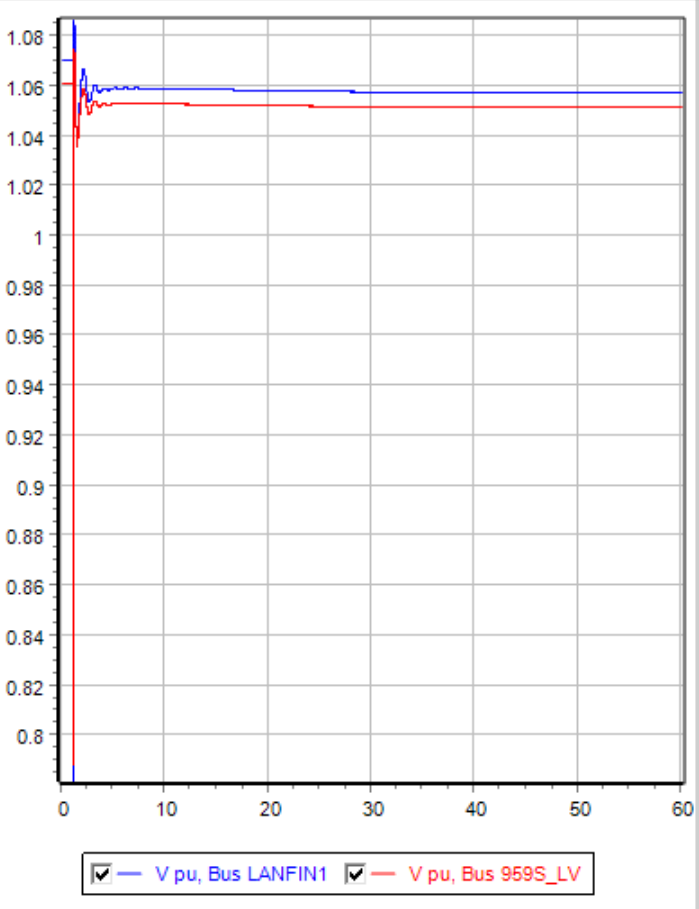
Study Case:
Scenario 6 (2022WP)

December 04, 2020 19:50:59

Lanfine 959S Voltages





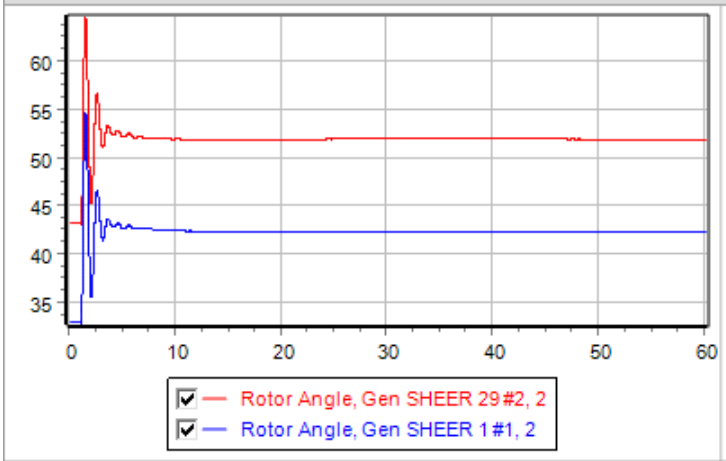


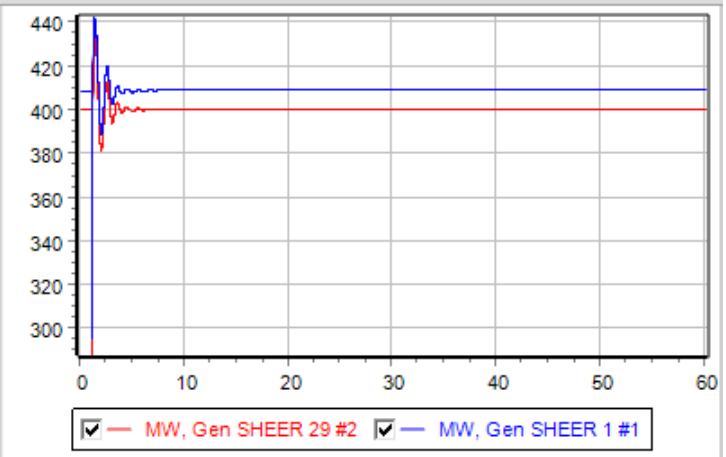
Contingency:
912L/9L912: Nevis 766S to Red Deer 63S

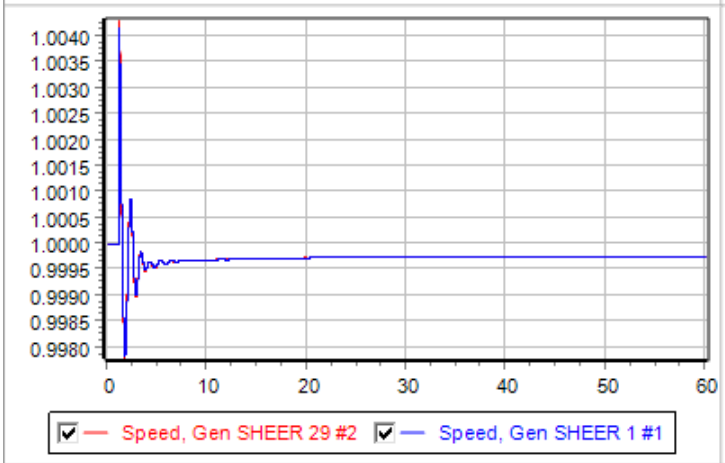
Study Case:
Scenario 6 (2022WP)

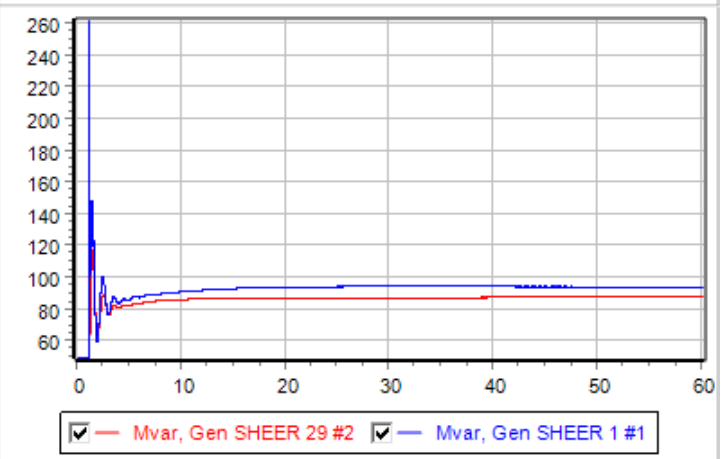
December 04, 2020 19:50:59

Sheerness







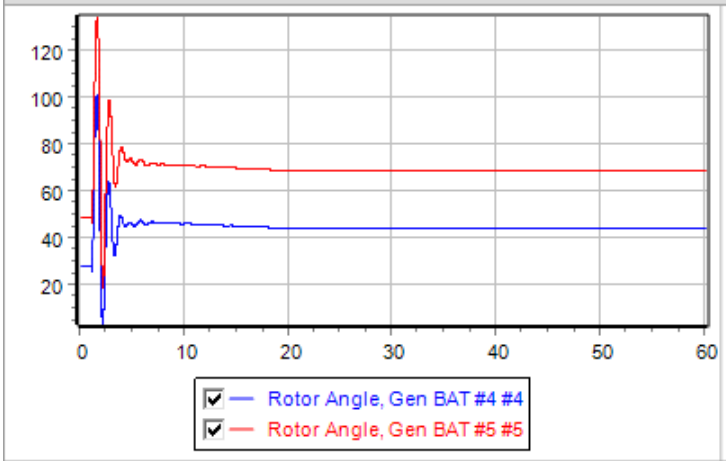


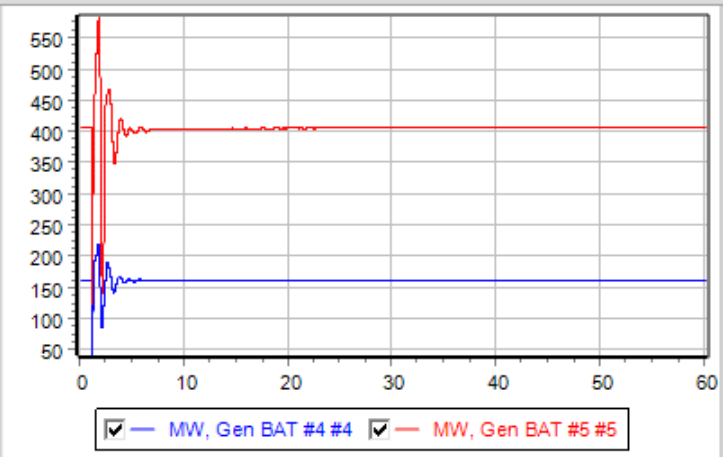
Contingency:
912L/9L912: Nevis 766S to Red Deer 63S

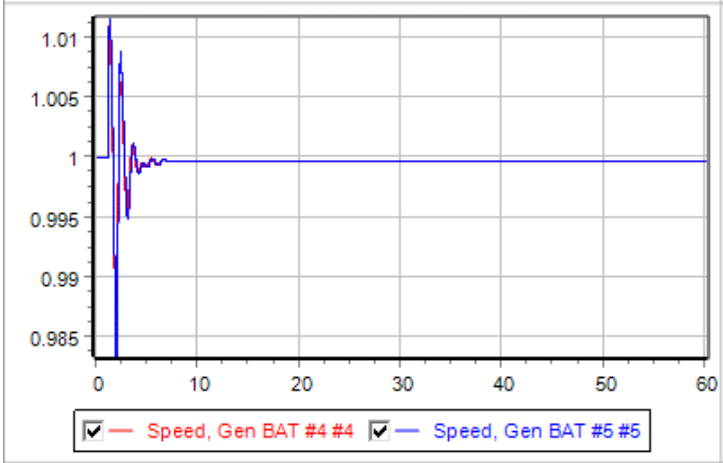
Study Case:
Scenario 6 (2022WP)

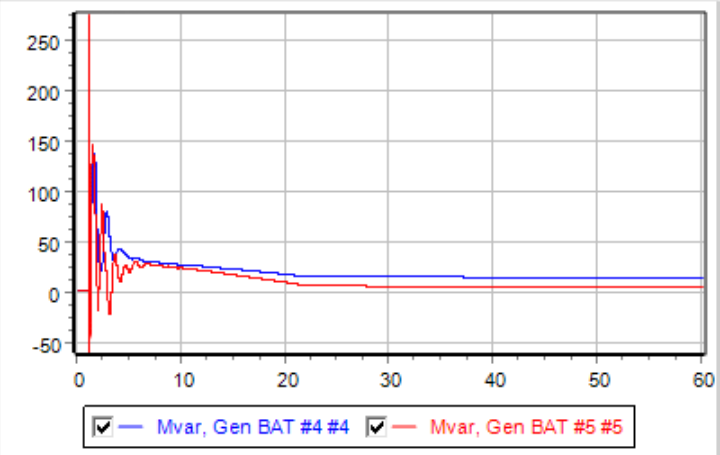
December 04, 2020 19:50:58

Battle River







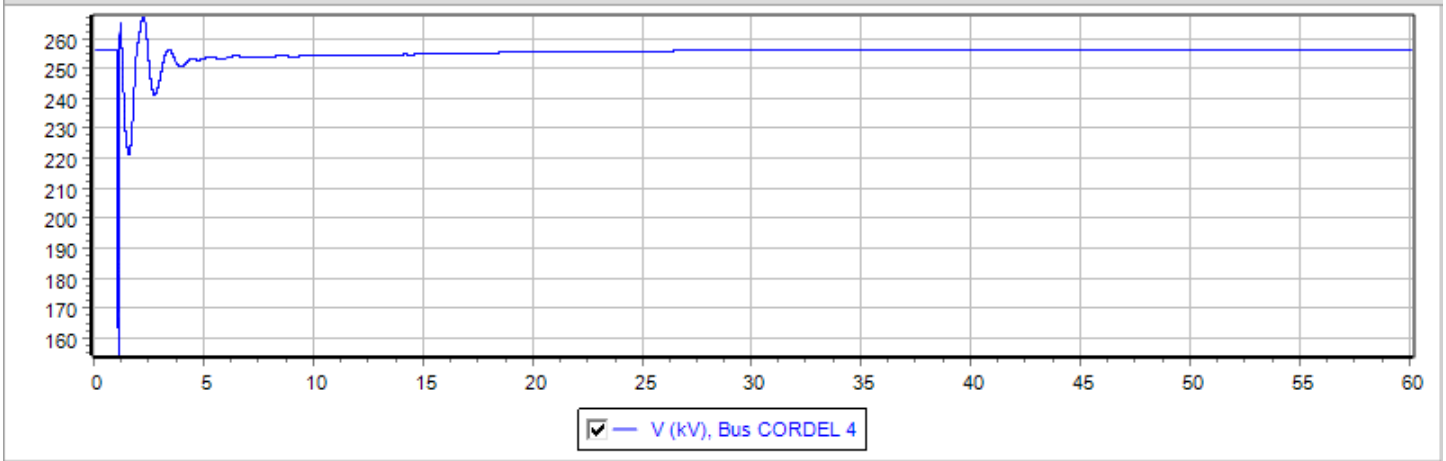


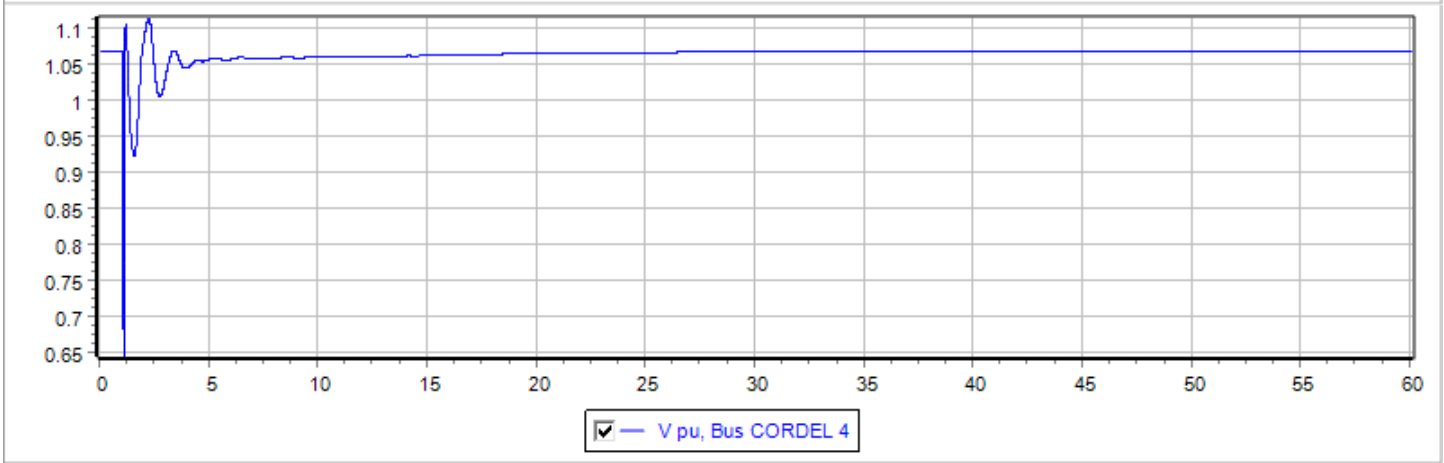
Contingency:
912L/9L912: Red Deer 63S to Nevis 766S

Study Case:
Scenario 6 (2022WP)

December 04, 2020 19:54:40

Cordel 755S Voltages



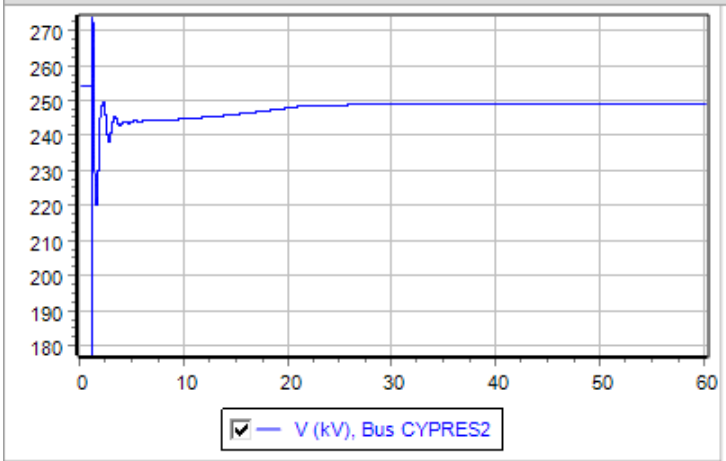


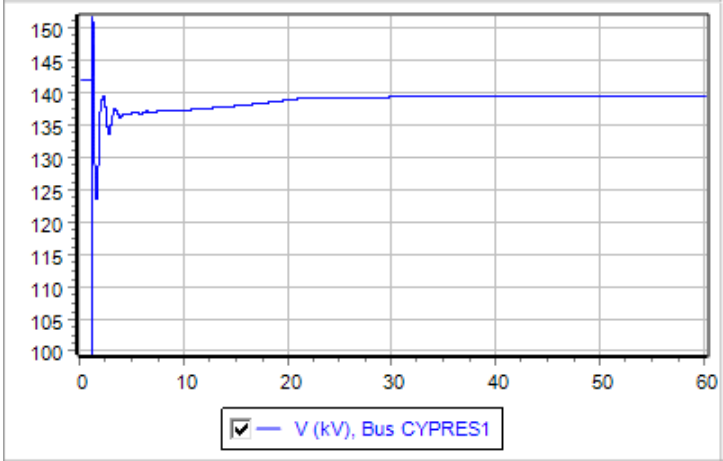
Contingency:
912L/9L912: Red Deer 63S to Nevis 766S

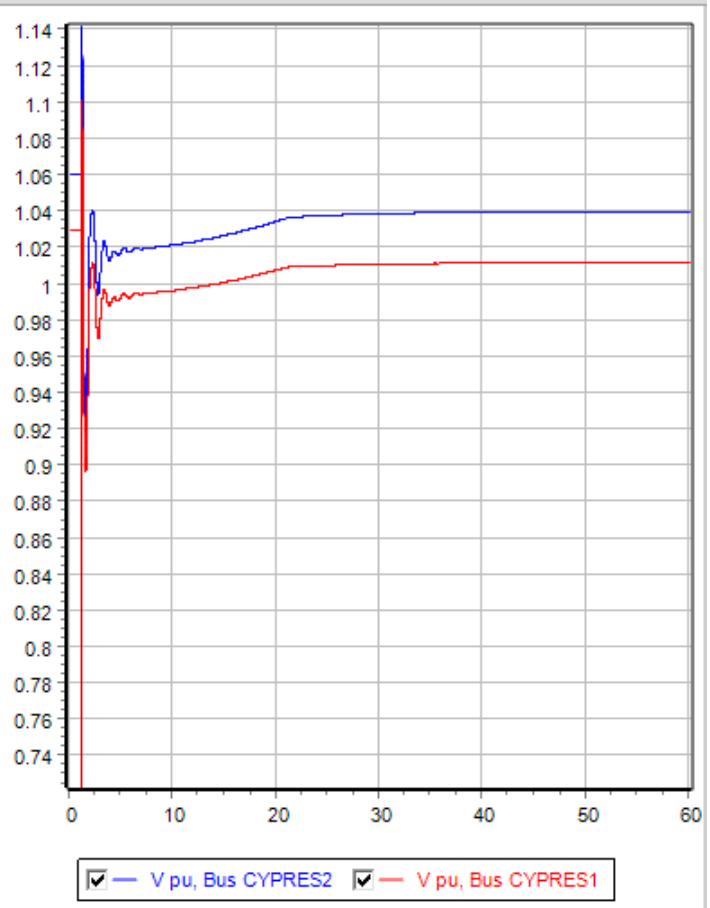
Study Case:
Scenario 6 (2022WP)

December 04, 2020 19:54:43

Cypress 562S Voltages





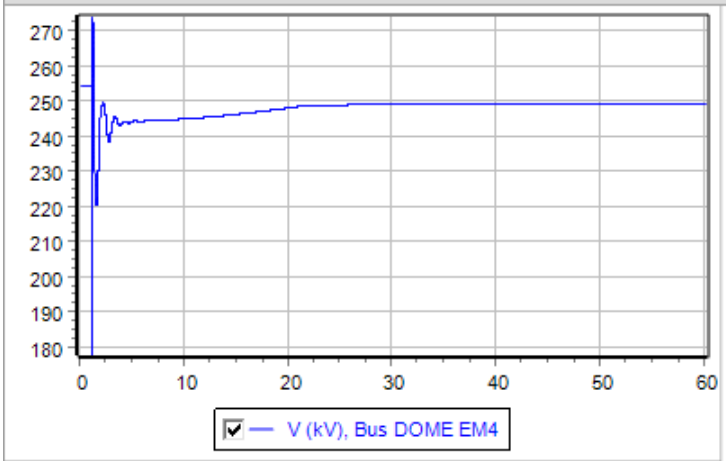


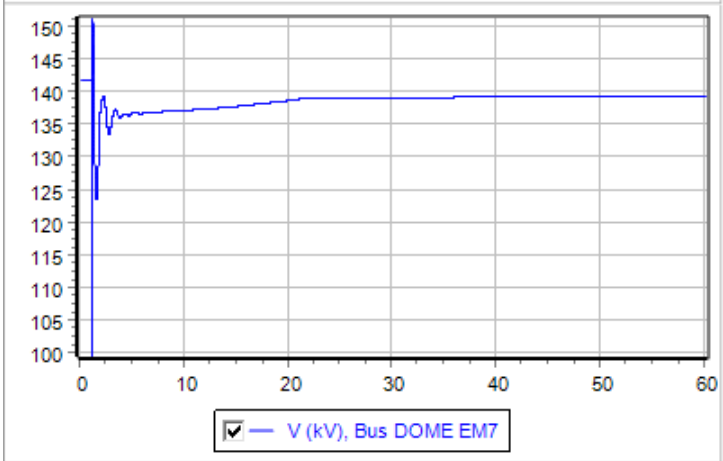
Contingency:
912L/9L912: Red Deer 63S to Nevis 766S

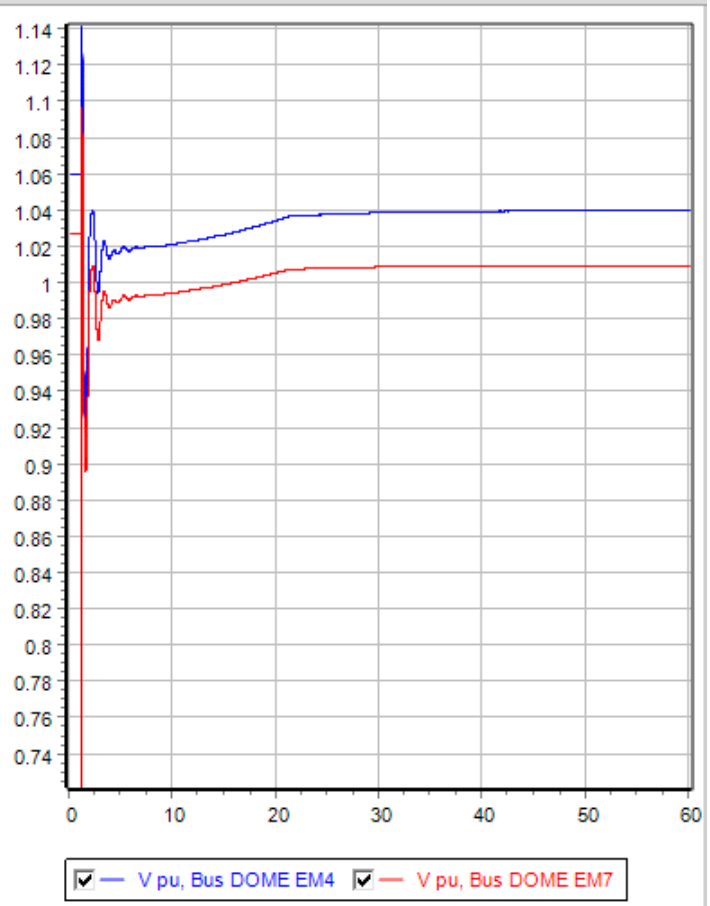
Study Case:
Scenario 6 (2022WP)

December 04, 2020 19:54:43

Dome 163S Voltages





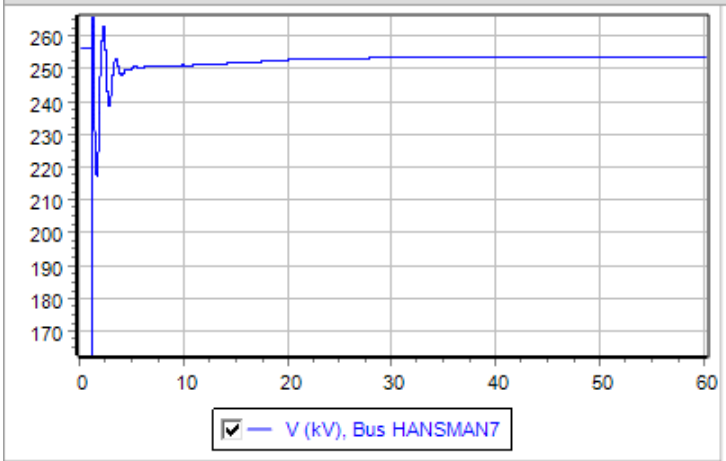


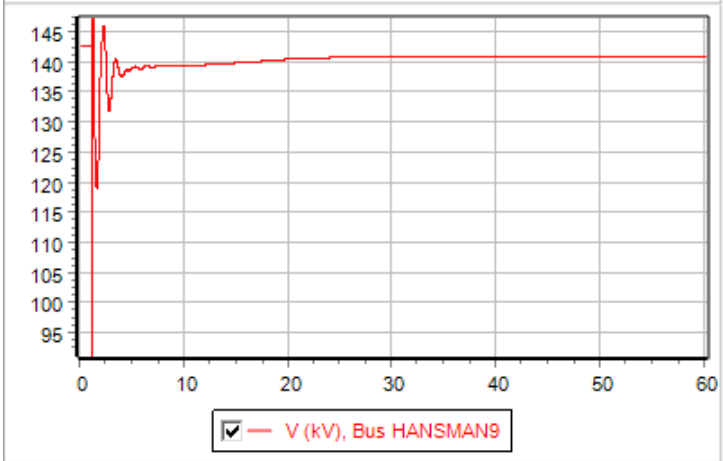
Contingency:
912L/9L912: Red Deer 63S to Nevis 766S

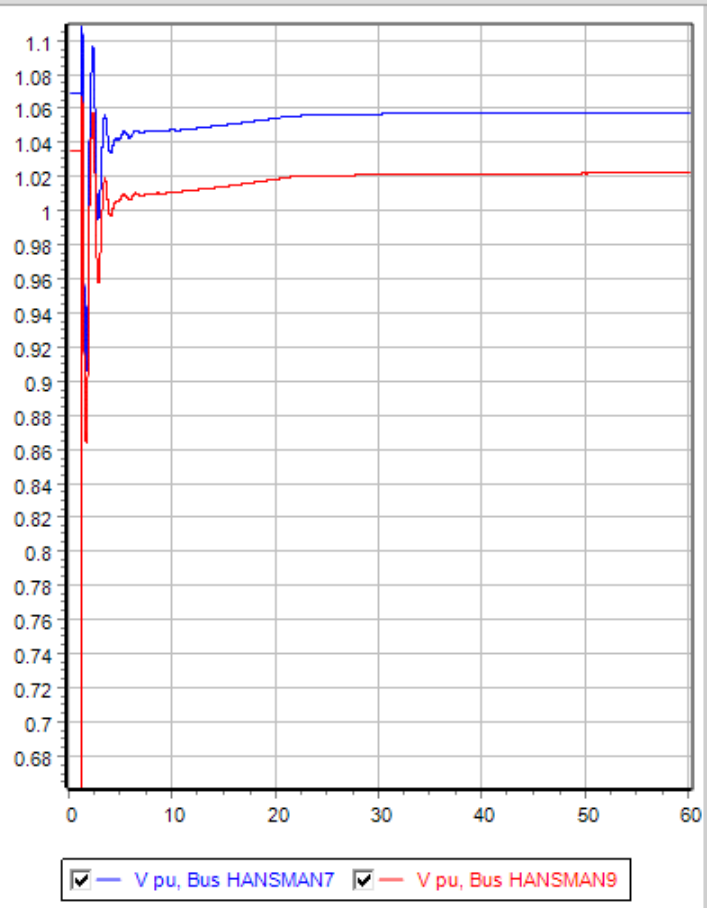
Study Case:
Scenario 6 (2022WP)

December 04, 2020 19:54:42

Hansman Lake 650S Voltages





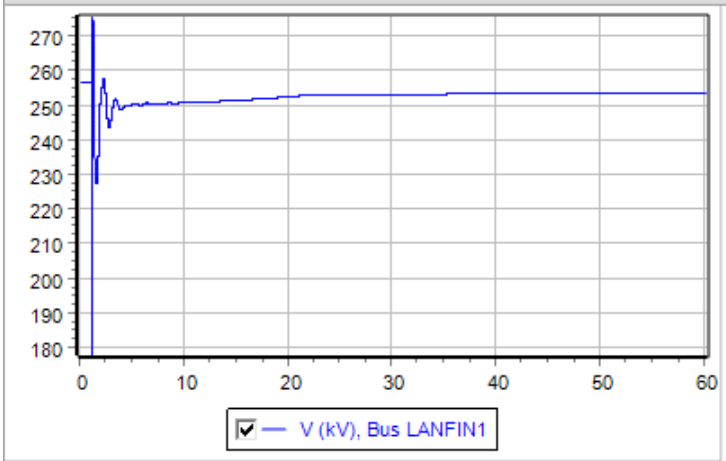


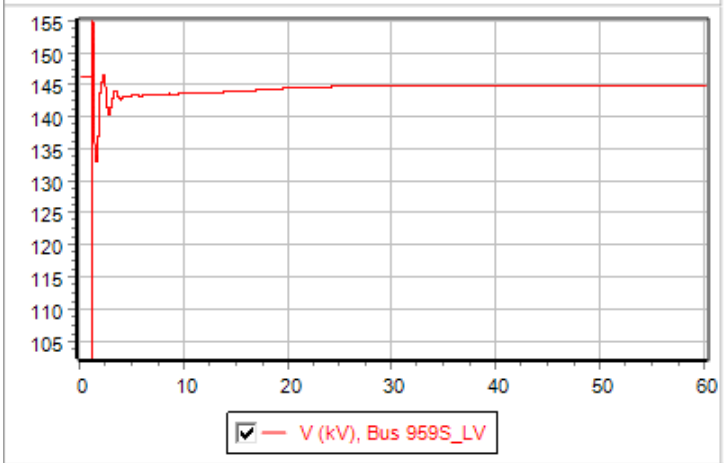
Contingency:
912L/9L912: Red Deer 63S to Nevis 766S

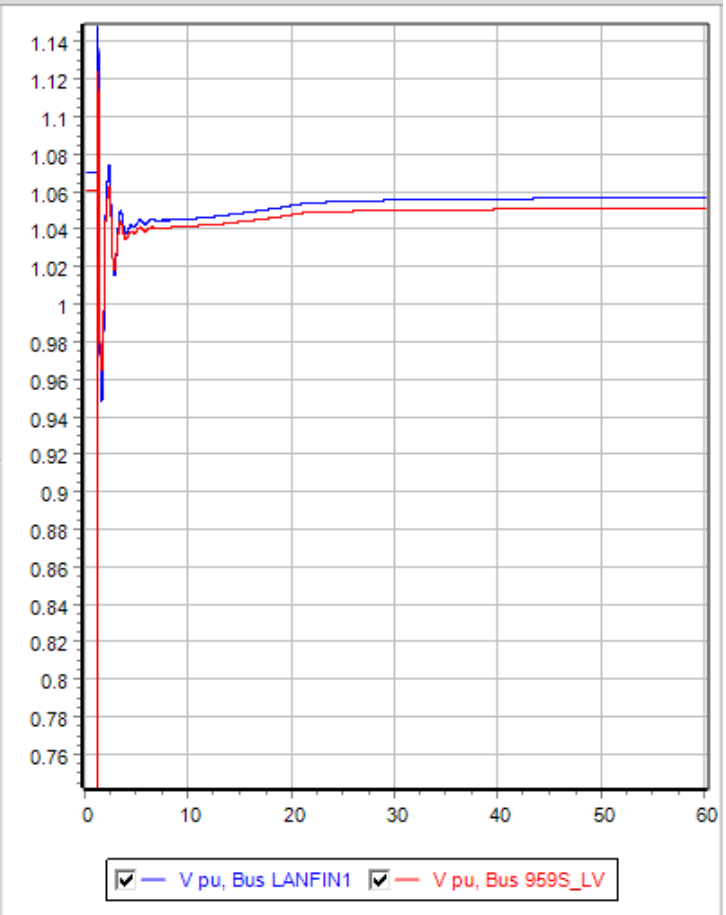
Study Case:
Scenario 6 (2022WP)

December 04, 2020 19:54:41

Lanfine 959S Voltages





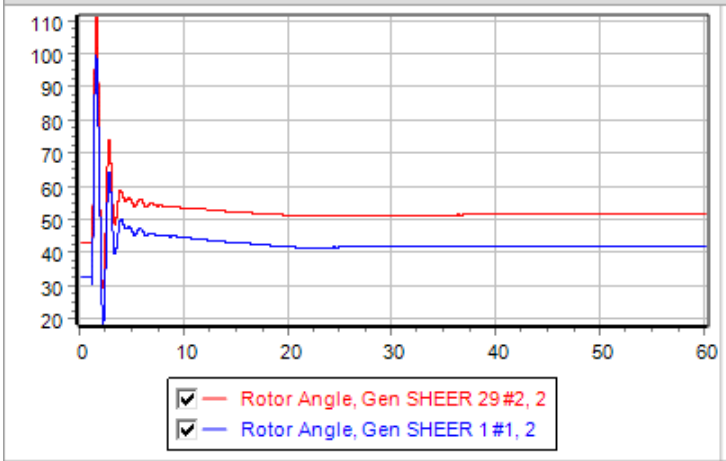


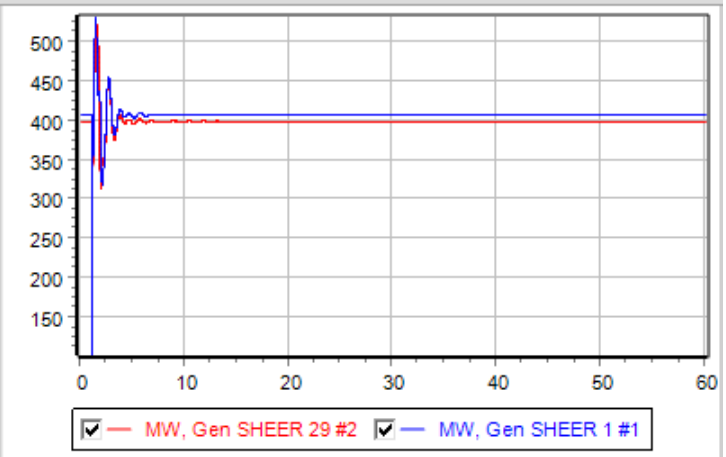
Contingency:
912L/9L912: Red Deer 63S to Nevis 766S

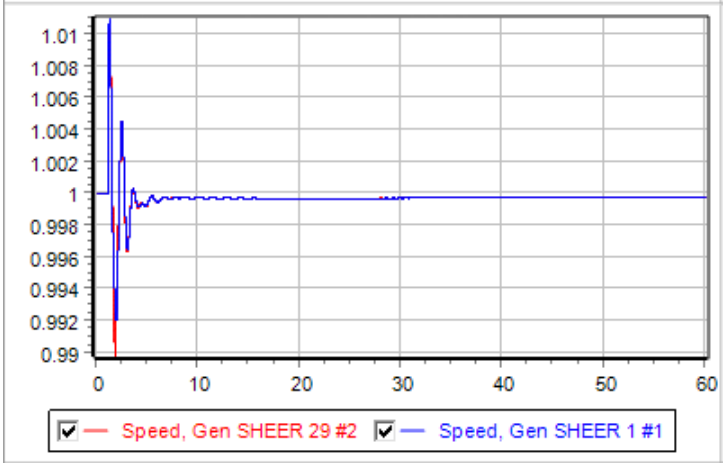
Study Case:
Scenario 6 (2022WP)

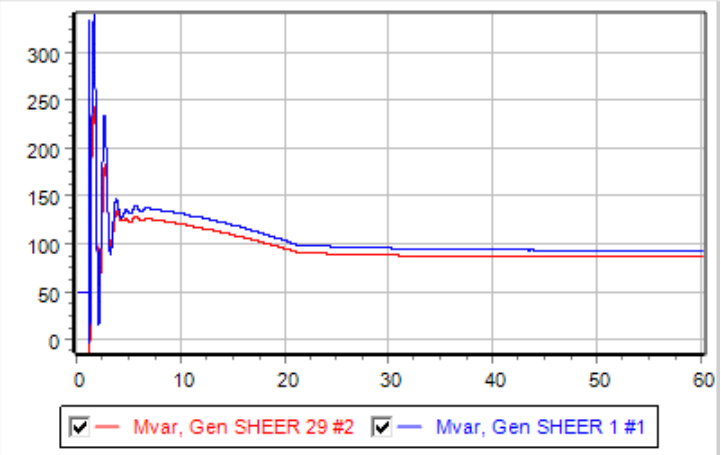
December 04, 2020 19:54:41

Sheerness









Contingency:
912L/9L912: Red Deer 63S to Nevis 766S

Study Case:
Scenario 6 (2022WP)

December 04, 2020 19:54:40

Engineering Connection Assessment: Stage 3 Study Results

P1898 Pattern Lanfine North Wind

V7

Attachment 5

Model Data and Assumptions

Steady State and Dynamic Model Data

Engineering Connection Assessment: Stage 3 Study Results

P1898 Pattern Lanfine North Wind

V7

Table of Contents

STEADY STATE MODEL 2
RAW IDEV File *3*
SEQ IDEV File *4*
DYNAMIC MODEL AND ASSUMPTIONS 5
DYR IDEV File *5*
CONTINGENCY ELEMENT DEFINITIONS 6

A5.1

Steady State Model

RAW IDEV File

```
VERSION 33
@!
@! This file provides positive sequence data for Project No.1898 by Pattern Renewable Holdings Canada 2 ULC
("Pattern").
@! The Project represents an addition of a 145 MW Pattern Lanfine North WAGF to the system with a connection to
144 kV at Lanfine 959S.
@! The Project is configured with 43 VESTAS V136-3.45MW turbines for the total installed capacity of 148.35MW.
The Project MARP is 145MW.
@! ********************************************************************************
@! In the case of discrepancies between this IDEV file and the corresponding PDUP document, the document is to
be considered
@! authoritative.
@! ********************************************************************************
@!
@! Created on November 2, 2020 by D.Brankovich, P.Eng., PowerEN Corporation, 403-512-9859,
db@powerencorp.com.
@!
RDCH
1
19438,'959S_LV     ', 138.0000,1,  42,  99,   1,1.00000,   0.0000, 1.10000, 0.90000, 1.10000, 0.90000
  996,'BBIRD_HV      ', 138.0000,1,  42,  99,   1,1.00000,   0.0000, 1.10000, 0.90000, 1.10000, 0.90000
 2996,'BBIRD_LV     ',  34.5000,1,  42,  99,   1,1.00000,   0.0000, 1.10000, 0.90000, 1.10000, 0.90000
67996,'BLP_C1      ',  34.5000,1,  42,  99,   1,1.00000,   0.0000, 1.10000, 0.90000, 1.10000, 0.90000
60996,'BLP_G1      ',   0.6500,2,  42,  99,   1,1.03999996,  42.107894, 1.05000, 0.95000, 2.00000, 0.95000
0 / END OF BUS DATA, BEGIN LOAD DATA
0 / END OF LOAD DATA, BEGIN FIXED SHUNT DATA
0 / END OF FIXED SHUNT DATA, BEGIN GENERATOR DATA
60996,'1 ',   145.000,    4.607,    72.600,   -49.300,1.04000,    0,   166.700,   0.00000,   0.55500,   0.00000,
0.00000,1.00000,1,  100.0,   145.000,    0.000,   1,1.0000,   0,1.0000,   0,1.0000,   0,1.0000,1, 1.0000
0 / END OF GENERATOR DATA, BEGIN BRANCH DATA
19438,  996,'1 ',3.53000E-3,1.57200E-2,4.13300E-2, 187.00, 233.00, 233.00,  0.00000,  0.00000,  0.00000,
0.00000,1,1,  22.0,   1,1.0000,   0,1.0000,   0,1.0000,   0,1.0000
2996, 67996,'1 ',1.90000E-5,1.09000E-3,0.00000E0, 167.00, 167.00, 167.00,  0.00000,  0.00000,  0.00000,
0.00000,1,1,   0.0,   1,1.0000,   0,1.0000,   0,1.0000,   0,1.0000
0 / END OF BRANCH DATA, BEGIN TRANSFORMER DATA
   996,  2996,    0,'1 ',1,1,1,0.00000E-1,0.00000E-1,2,'            ',1,   1,1.0000,   0,1.0000,   0,1.0000,   0,1.0000,'
'
1.30000E-3,7.80000E-2, 100.00
1.030000,240.000,   0.000, 170.00, 170.00, 170.00,-1,   996,1.050000,0.950000,1.050000,0.950000, 21, 0, 0.00000,
0.00000,  0.000
1.000000, 34.500
 67996, 60996,    0,'1 ',1,1,1,0.00000E-1,0.00000E-1,2,'            ',1,   1,1.0000,   0,1.0000,   0,1.0000,   0,1.0000,'
'
5.00000E-3,5.20000E-2, 100.00
1.000000, 34.500,   0.000, 172.00, 172.00, 172.00,-1, 67996,1.050000,0.950000,1.050000,0.950000,  5, 0, 0.00000,
0.00000,  0.000
1.000000,  0.650
0 / END OF TRANSFORMER DATA, BEGIN AREA DATA
0 / END OF AREA DATA, BEGIN TWO-TERMINAL DC DATA
0 / END OF TWO-TERMINAL DC DATA, BEGIN VOLTAGE SOURCE CONVERTER DATA
```

0 / END OF VOLTAGE SOURCE CONVERTER DATA, BEGIN IMPEDANCE CORRECTION DATA
0 / END OF IMPEDANCE CORRECTION DATA, BEGIN MULTI-TERMINAL DC DATA
0 / END OF MULTI-TERMINAL DC DATA, BEGIN MULTI-SECTION LINE DATA
0 / END OF MULTI-SECTION LINE DATA, BEGIN ZONE DATA
0 / END OF ZONE DATA, BEGIN INTER-AREA TRANSFER DATA
0 / END OF INTER-AREA TRANSFER DATA, BEGIN OWNER DATA
0 / END OF OWNER DATA, BEGIN FACTS CONTROL DEVICE DATA
0 / END OF FACTS CONTROL DEVICE DATA, BEGIN SWITCHED SHUNT DATA
0 /END OF SWITCHED SHUNT DATA, BEGIN GNE DEVICE DATA
0 /END OF GNE DEVICE DATA
Q

SEQ IDEV File

Version 33
@!
@! This file provides positive sequence data for Project No.1898 by Pattern Renewable Holdings Canada 2 ULC (“Pattern”).
@! The Project represents an addition of a 145 MW Pattern Lanfine North WAGF to the system with a connection to 144 kV at Lanfine 959S.
@! The Project is configured with 43 VESTAS V136-3.45MW turbines for the total installed capacity of 148.35MW. The Project MARP is 145MW.
@! **
@! In the case of discrepancies between this IDEV file and the corresponding PDUP document, the document is to be considered
@! authoritative.
@! **
@!
@! Created on November 2, 2020 by D.Brankovich, P.Eng., PowerEN Corporation, 403-512-9859, db@powerencorp.com.
@!
RESQ
1
1, 33 / PSSÆE-33.1
60996,'1 ', 0.000000000, 0.954999983, 0.954999983, 0.954999983, 0.000000000, 0.954999983, 0.000000000, 0.954999983,1, 0.000000000, 0.000000000
0 / END OF MACHINE IMPEDANCE DATA, BEGIN LOAD DATA
0 / END OF LOAD DATA, BEGIN ZERO SEQ. NON-TRANSFORMER BRANCH DATA
19438, 996,'1 ', 0.00883, 0.03930, 0.04133, 0.00000, 0.00000, 0.00000, 0.00000
2996, 67996,'1 ', 0.00005, 0.00273, 0.00000, 0.00000, 0.00000, 0.00000, 0.00000
0 / END OF ZERO SEQ. NON-TRANSFORMER BRANCH DATA, BEGIN ZERO SEQ. MUTUAL DATA
0 / END OF ZERO SEQ. MUTUAL DATA, BEGIN ZERO SEQ. TRANSFORMER DATA
996, 2996, 0,'1 ', 1, 1, 14, 0.00000, 0.00000, 0.00174, 0.08694, 0.00000, 0.00000, 0.00000, 0.00000, 0.00000, 0.00000
67996, 60996, 0,'1 ', 1, 1, 13, 0.00000, 0.00000, 0.00400, 0.04700, 0.00000, 0.00000, 0.00000, 0.00000, 0.00000, 0.00000
0 / END OF ZERO SEQ. TRANSFORMER DATA, BEGIN ZERO SEQ. SWITCHED SHUNT DATA
0 / END OF ZERO SEQ. SWITCHED SHUNT DATA, BEGIN ZERO SEQ. FIXED SHUNT DATA
0 / END OF ZERO SEQ. FIXED SHUNT DATA, BEGIN ZERO SEQ. MACHINE DATA
0 / END ZERO SEQ. MACHINE DATA
Q

Dynamic Model and Assumptions

DYR IDEV File

```
 60996 'REGCA1' 1   1  0.02  2  0.9  0.05  1.22  1.05  0.8  -0.4  -1.3  0.02  1.2  999  -999  0.8  /
 60996 'REECA1' 1   0  0  0  1  0  0  0.3  1.5  0  -0.05  0.05  0  1.1  -1.1  0  0  0.05  0  0.05  0.4  -0.4  1.08  0.92  0
0.1  1  120  0  0.02  99  -99  1  0  1.11  0.04  0.05  1.07  0.2  0.9  0.35  0.85  0.7  0.5  0.05  0.19  0.2  0.6  0.35  0.52
0.7  0.99  /
 60996 'WTDTA1' 1   5.3  1  0.22  1.85  0.05  /
 60996 'REPCA1' 1   0  0  0  0  0  1  1  1.25  1.6  2  0  0.05  0  0  0  0.12  1  -1  0  0  1  -1  1.6  1.0667  0.125  -0.0006
0.0006
```

Contingency Element Definitions

Contingency Element Definitions for Power Flow Analysis

Contingency	Actions
1002L (Ware Junction 132S-Amoco Empress 163S)	OPEN Line JENNER 4_240.0 (260) TO DOME EM4_240.0 (262) CKT 02
1011L (Amoco Empress 163S-Cypress 562S)	OPEN Line DOME EM4_240.0 (262) TO CYPRES2_240.0 (677) CKT 11
1034L (Bowmanton 244S-Cassils 324S)	OPEN Line BOWMAN1_240.0 (669) TO CASS01_240.0 (918) CKT 34
1035L (Bowmanton 244S-Newell 2075S)	OPEN Line BOWMAN1_240.0 (669) TO NEWELL2_240.0 (1012) CKT 35
1047L (Nilrem 574S-Hansman Lk 650S)	OPEN Line HANSMAN7_240.0 (649) TO NILREM3_240.0 (1427) CKT 47
1051L (West Brooks 28S-Cassils 324S)	OPEN Line W BROOK4_240.0 (430) TO CASS01_240.0 (918) CKT 51
1052L (West Brooks 28S-Cassils 324S)	OPEN Line W BROOK4_240.0 (430) TO CASS01_240.0 (918) CKT 52
1053L (Ware Junction 132S-Cassils 324S)	OPEN Line WARE JCT_240.0 (225) TO CASS01_240.0 (918) CKT 53
1075L (West Brooks 28S-Ware Junction 132S)	OPEN Line WARE JCT_240.0 (225) TO W BROOK4_240.0 (430) CKT 75
1087L (Cassils 324S-Newell 2075S)	OPEN Line CASS01_240.0 (918) TO NEWELL2_240.0 (1012) CKT 87
1088L (Cassils 324S-Newell 2075S)	OPEN Line CASS01_240.0 (918) TO NEWELL2_240.0 (1012) CKT 88
114ST1 (Ghost Pine 114S 34.5kV/138kV transformer)	OPEN Transformer GHOSTPI1_138.0 (603) TO GHOSTPI4_ 34.5 (2610) CKT T1
137ST1 (Sedgewick 137S 138kV/25kV Transformer)	OPEN Transformer SEDGEWI9_ 25.0 (4078) TO SEDGEWI7_138.0 (78) CKT T1
137ST1 (Sedgewick 137S 138kV/25kV Transformer)	OPEN Line HARDIST7_138.0 (73) TO SEDGEWI7_138.0 (78) CKT 02
137ST1 (Sedgewick 137S 138kV/25kV Transformer)	OPEN Line SEDGEWI7_138.0 (78) TO BAT. RV7_138.0 (1491) CKT 02
163ST5 (Amoco Empress 163S 240kV/138kV transformer)	OPEN Line SANDHIL7_138.0 (111) TO DOME EM7_138.0 (267) CKT 71
163ST5 (Amoco Empress 163S 240kV/138kV transformer)	OPEN Line DOME EM7_138.0 (267) TO EMPLIQTP_138.0 (911) CKT 60
163ST5 (Amoco Empress 163S 240kV/138kV transformer)	OPEN Line SANDYPT7_138.0 (53) TO DOME EM7_138.0 (267) CKT 69
163ST5 (Amoco Empress 163S 240kV/138kV transformer)	OPEN Line EMPRESA7_138.0 (266) TO DOME EM7_138.0 (267) CKT 60
163ST5 (Amoco Empress 163S 240kV/138kV transformer)	OPEN Line DOME EM7_138.0 (267) TO CYPRES1_138.0 (674) CKT 69
163ST5 (Amoco Empress 163S 240kV/138kV transformer)	OPEN Transformer DOME EM4_240.0 (262) TO DOME EM7_138.0 (267) CKT T5
17ST1 (Benalto 17S 138kV/25kV transformer)	OPEN Line BENALTO7_138.0 (99) TO SYLV_138_138.0 (780) CKT 37
17ST1 (Benalto 17S 138kV/25kV transformer)	OPEN Line BENALTO7_138.0 (99) TO ROCKY M7_138.0 (100) CKT 17
17ST1 (Benalto 17S 138kV/25kV transformer)	OPEN Line BENALTO7_138.0 (99) TO 758L JCT_138.0 (956) CKT 57
17ST1 (Benalto 17S 138kV/25kV transformer)	OPEN Transformer BENALTO4_240.0 (155) TO BENALTO7_138.0 (99) CKT T3
17ST1 (Benalto 17S 138kV/25kV transformer)	OPEN Transformer BENALTO9_ 25.0 (4099) TO BENALTO7_138.0 (99) CKT T1
198ST1 (Blackfalds 198S 138kV/25 kV transformer)	OPEN Transformer BLACKFA7_138.0 (113) TO BLACKFA9_ 25.0 (4113) CKT T1
198ST1 (Blackfalds 198S 138kV/25 kV transformer)	OPEN Line BLACKFA7_138.0 (113) TO W LACOMB_138.0 (116) CKT 80
198ST2 (Blackfalds 198S 138kV/25 kV transformer)	OPEN Line BLACKFA7_138.0 (113) TO N RED D7_138.0 (119) CKT 44
198ST2 (Blackfalds 198S 138kV/25 kV transformer)	OPEN Transformer BLACKFA7_138.0 (113) TO BLACKFA8_ 25.0 (3113) CKT T2
212ST1 (Lacombe 212S 138kV/25kV transformer)	OPEN Transformer LACOMBE9_ 25.0 (4114) TO LACOMBE7_138.0 (114) CKT T1
212ST1 (Lacombe 212S 138kV/25kV transformer)	OPEN Line LACOMBE7_138.0 (114) TO W LACOMB_138.0 (116) CKT 80
212ST1 (Lacombe 212S 138kV/25kV transformer)	OPEN Line LACOMBE7_138.0 (114) TO ELLIS 7_138.0 (388) CKT 23
213ST1 (Hughenden 213S 138kV/25kV transformer)	OPEN Transformer HUGHEND7_138.0 (75) TO HUGHEND8_ 25.0 (3075) CKT T1

Contingency Element Definitions for Power Flow Analysis

213ST2 (Hughenden 213S 138kV/25kV transformer)	OPEN Transformer HUGHEND9_ 25.0 (4075) TO HUGHEND7_138.0 (75) CKT T2
217ST7 (N.Red Deer 217S 138kV/25kV transformer)	OPEN Line N RED D7_138.0 (119) TO GAETZ 7_138.0 (148) CKT 78
217ST7 (N.Red Deer 217S 138kV/25kV transformer)	OPEN Transformer N RED D8_ 25.0 (3119) TO N RED D7_138.0 (119) CKT T7
217ST7 (N.Red Deer 217S 138kV/25kV transformer)	OPEN Transformer RD14S-B2_ 25.0 (40002) TO N RED D7_138.0 (119) CKT T2
217ST7 (N.Red Deer 217S 138kV/25kV transformer)	OPEN Line N RED D7_138.0 (119) TO TL138_138.0 (465) CKT 68
217ST7 (N.Red Deer 217S 138kV/25kV transformer)	OPEN Transformer RD14S-B1_ 25.0 (40001) TO N RED D7_138.0 (119) CKT T1
217ST7 (N.Red Deer 217S 138kV/25kV transformer)	OPEN Line BLACKFA7_138.0 (113) TO N RED D7_138.0 (119) CKT 44
217ST7 (N.Red Deer 217S 138kV/25kV transformer)	OPEN Line S RED DE_138.0 (115) TO N RED D7_138.0 (119) CKT 25
221ST1 (Sunken Lk. 221S 138kV/4.16 kV transformer)	OPEN Transformer SUNKEN7_138.0 (112) TO SUNKEN9_ 4.2 (4112) CKT T1
221ST2 (Sunken Lk. 221S 138kV/4.16 kV transformer)	OPEN Transformer SUNKEN7_138.0 (112) TO SUNKEN8_ 4.2 (3112) CKT T2
252ST2 (Jarrow 252S 138kV/25kV transformer)	OPEN Transformer JARROW 9_ 25.0 (3072) TO JARROW 7_138.0 (72) CKT T2
252ST2 (Jarrow 252S 138kV/25kV transformer)	OPEN Line JARROW 7_138.0 (72) TO WAINWRI7_138.0 (297) CKT 08
252ST2 (Jarrow 252S 138kV/25kV transformer)	OPEN Line JARROW 7_138.0 (72) TO JAROW TP_138.0 (1490) CKT 91
267ST1 (Kilarney Lk. 267S 138kV/25kV transformer)	OPEN Transformer KILLARN7_138.0 (219) TO KILLARN9_ 25.0 (4219) CKT T1
277ST1 (Hayter 277S 138kV/25kV transformer)	OPEN Transformer HAYTER 7_138.0 (220) TO HAYTER 9_ 25.0 (4220) CKT T1
277ST1 (Hayter 277S 138kV/25kV transformer)	OPEN Line KILLARN7_138.0 (219) TO HAYTER 7_138.0 (220) CKT 48
296ST1/296ST2 (Rosyth 296S 138kV/4.16kV transformer)	OPEN Transformer IPL HAR7_138.0 (373) TO IPL HAA9_ 4.2 (3373) CKT T2
296ST1/296ST2 (Rosyth 296S 138kV/4.16kV transformer)	OPEN Transformer IPL HAR7_138.0 (373) TO IPL HAR9_ 4.2 (4373) CKT T1
296ST1/296ST2 (Rosyth 296S 138kV/4.16kV transformer)	OPEN Line IPL HAR7_138.0 (373) TO CLIPP_TP_138.0 (715) CKT 69
296ST1/296ST2 (Rosyth 296S 138kV/4.16kV transformer)	OPEN Line CLIPPER7_138.0 (484) TO CLIPP_TP_138.0 (715) CKT 69
296ST1/296ST2 (Rosyth 296S 138kV/4.16kV transformer)	OPEN Line HARDIST7_138.0 (73) TO BATSD_TP_138.0 (860) CKT 69
296ST1/296ST2 (Rosyth 296S 138kV/4.16kV transformer)	OPEN Transformer IPL HAR7_138.0 (373) TO IPL HAA8_ 4.2 (2373) CKT T3
297ST1/297ST2 (Rimbey 297S 138kV/25kV transformer)	OPEN Transformer RIMBEY 9_ 25.0 (4098) TO RIMBEY 7_138.0 (98) CKT T1
297ST1/297ST2 (Rimbey 297S 138kV/25kV transformer)	OPEN Transformer RIMBEY 7_138.0 (98) TO RIMBEY10_ 25.0 (3098) CKT T2
330L1_330L3	OPEN Line NOVA C27_138.0 (355) TO NOVA TP1_138.0 (1749) CKT L1
330L1_330L3	OPEN Line JOFFRE 7_138.0 (383) TO NOVA TP1_138.0 (1749) CKT L1
330L1_330L3	OPEN Line NOVA_R3A_138.0 (749) TO NOVA TP1_138.0 (1749) CKT L3
330L2_330L4	OPEN Line NOVA_R3B_138.0 (760) TO NOVA TP2_138.0 (1760) CKT L4
330L2_330L4	OPEN Line JOFFRE 7_138.0 (383) TO NOVA TP2_138.0 (1760) CKT L2
330L2_330L4	OPEN Line NOVA C17_138.0 (354) TO NOVA TP2_138.0 (1760) CKT L2
363ST1 (Sedalia 363S 34.5kV/240kV transformer)	OPEN Transformer SEDALIA2_ 34.5 (67831) TO SEDALIA1_240.0 (831) CKT T1
363ST2 (Sedalia 363S 34.5kV/240kV transformer)	OPEN Transformer SEDALIA3_ 34.5 (67832) TO SEDALIA1_240.0 (831) CKT T2
377ST1 (Hardisty 377S 138nkV/25kV transformer)	OPEN Transformer HARDIST7_138.0 (73) TO HARDIST9_ 25.0 (4073) CKT T1
377ST1 (Hardisty 377S 138nkV/25kV transformer)	OPEN Line HARDIST7_138.0 (73) TO BATSD_TP_138.0 (860) CKT 69
377ST1 (Hardisty 377S 138nkV/25kV transformer)	OPEN Line HARDIST7_138.0 (73) TO TUCUMAN7_138.0 (483) CKT 81

Contingency Element Definitions for Power Flow Analysis

377ST1 (Hardisty 377S 138nkV/25kV transformer)	OPEN Line HARDIST7_138.0 (73) TO EXPRESTP_138.0 (809) CKT 03
377ST1 (Hardisty 377S 138nkV/25kV transformer)	OPEN Line HARDIST7_138.0 (73) TO SEDGEWI7_138.0 (78) CKT 02
394ST1 (Empress 394S transformers)	OPEN Transformer EMPRESS9_25.0 (4266) TO EMPRESA7_138.0 (266) CKT T1
394ST1 (Empress 394S transformers)	OPEN Transformer EMPRESS8_25.0 (4366) TO EMPRESA7_138.0 (266) CKT T2
394ST1 (Empress 394S transformers)	OPEN Transformer EMPRESA7_138.0 (266) TO PANCAN 9_13.8 (3266) CKT T4
394ST1 (Empress 394S transformers)	OPEN Transformer EMPRESA7_138.0 (266) TO PANCAN 9_13.8 (2266) CKT T3
394ST1 (Empress 394S transformers)	OPEN Line EMPRESA7_138.0 (266) TO CYPRES1_138.0 (674) CKT 68
394ST1 (Empress 394S transformers)	OPEN Line EMPRESA7_138.0 (266) TO DOME EM7_138.0 (267) CKT 60
395ST1 (N.Holden 395S 138kV/25kV transformer)	OPEN Transformer N HOLDE9_25.0 (4068) TO N HOLDE7_138.0 (68) CKT T1
395ST1 (N.Holden 395S 138kV/25kV transformer)	OPEN Line N HOLDE7_138.0 (68) TO IPPL ST7_138.0 (76) CKT 01
395ST1 (N.Holden 395S 138kV/25kV transformer)	OPEN Line BARDO 7_138.0 (65) TO N HOLDE7_138.0 (68) CKT 74
395ST1 (N.Holden 395S 138kV/25kV transformer)	OPEN Line N HOLDE7_138.0 (68) TO VEGREVL7_138.0 (1367) CKT 77
472AL (Sunken Lk. 221S-Metiskow 648S)	OPEN Line HUGHEND7_138.0 (75) TO 472ALTAP_138.0 (861) CKT 72
472AL (Sunken Lk. 221S-Metiskow 648S)	OPEN Line METIS647_138.0 (74) TO 472ALTAP_138.0 (861) CKT 72
472AL (Sunken Lk. 221S-Metiskow 648S)	OPEN Line SUNKEN7_138.0 (112) TO 472ALTAP_138.0 (861) CKT 72
478ST1 or 478ST2 (Tucuman 478S 138kV/25kV transformer)	OPEN Line TUCUMAN7_138.0 (483) TO NILREM5_138.0 (19427) CKT 80
478ST1 or 478ST2 (Tucuman 478S 138kV/25kV transformer)	OPEN Line HARDIST7_138.0 (73) TO TUCUMAN7_138.0 (483) CKT 81
478ST1 or 478ST2 (Tucuman 478S 138kV/25kV transformer)	OPEN Transformer TUCUMAN7_138.0 (483) TO TUCUMAN9_25.0 (4483) CKT T1
478ST1 or 478ST2 (Tucuman 478S 138kV/25kV transformer)	OPEN Line TUCUMAN7_138.0 (483) TO NILREM5_138.0 (19427) CKT 79
478ST1 or 478ST2 (Tucuman 478S 138kV/25kV transformer)	OPEN Line WAINWRI7_138.0 (297) TO TUCUMAN7_138.0 (483) CKT 04
478ST1 or 478ST2 (Tucuman 478S 138kV/25kV transformer)	OPEN Transformer TUCUMAN7_138.0 (483) TO TUCUMAN8_25.0 (3483) CKT T2
508ST1 (Lakesend 508S 138kV/41.16kV transformer)	OPEN Transformer LAKESEN7_138.0 (716) TO LAKESEN8_4.2 (2716) CKT T1
51ST3/51ST4 (Wainwright 51S 138kV/25kV transformer)	OPEN Transformer WAINWRI7_138.0 (297) TO WAINWRI1_25.0 (3297) CKT T4
51ST3/51ST4 (Wainwright 51S 138kV/25kV transformer)	OPEN Transformer WAINWRI7_138.0 (297) TO WAINWRI9_25.0 (2297) CKT T3
526ST1/526ST2 (Buffalo Crk. 526S 138kV/25kV transformer)	OPEN Transformer BUFFALO9_25.0 (4079) TO BUFFALO7_138.0 (79) CKT T1
526ST1/526ST2 (Buffalo Crk. 526S 138kV/25kV transformer)	OPEN Transformer BUFFALO7_138.0 (79) TO BUFFALO8_25.0 (3079) CKT T2
526ST1/526ST2 (Buffalo Crk. 526S 138kV/25kV transformer)	OPEN Line BUFFALO7_138.0 (79) TO JAROW TP_138.0 (1490) CKT 50
526ST1/526ST2 (Buffalo Crk. 526S 138kV/25kV transformer)	OPEN Line BUFFALO7_138.0 (79) TO BAUERTAP_138.0 (766) CKT 29
534ST1 (Eckville 534S 138kV/25 kV transformer)	OPEN Line ECKVILL7_138.0 (97) TO 758L JCT_138.0 (956) CKT 58
534ST1 (Eckville 534S 138kV/25 kV transformer)	OPEN Transformer ECKVILL9_25.0 (4097) TO ECKVILL7_138.0 (97) CKT T1
536ST1 (Brookfield 536S 138kV/4.16kV transformer)	OPEN Line JOFFRE 7_138.0 (383) TO BROOKFLD_138.0 (398) CKT 89
536ST1 (Brookfield 536S 138kV/4.16kV transformer)	OPEN Transformer BROOKFLD_138.0 (398) TO BROOKFLD_4.2 (4398) CKT T1
545ST1 (Provost 545S 138kV/25kV transformer)	OPEN Transformer PROVOST7_138.0 (86) TO PROVOST9_25.0 (4086) CKT T1
545ST1 (Provost 545S 138kV/25kV transformer)	OPEN Line PROVOST7_138.0 (86) TO 715AL TP_138.0 (874) CKT 15
545ST1 (Provost 545S 138kV/25kV transformer)	OPEN Line METIS647_138.0 (74) TO 715AL TP_138.0 (874) CKT 15

Contingency Element Definitions for Power Flow Analysis

574ST2 (Nilrem 574S 240kV/138kV transformer)	OPEN Transformer NILREM5_138.0 (19427) TO NILREM7_25.0 (19428) CKT T3
574ST2 (Nilrem 574S 240kV/138kV transformer)	OPEN Transformer NILREM3_240.0 (1427) TO NILREM5_138.0 (19427) CKT T2
580ST1 (Nilrem 574S 240kV/138kV transformer)	OPEN Transformer SYLV_138_138.0 (780) TO SYLV_25A_25.0 (2780) CKT T1
580ST1 (Sylvan Lk. 580S 138kV/25kV transformer)	OPEN Line BENALTO7_138.0 (99) TO SYLV_138_138.0 (780) CKT 37
580ST1 (Sylvan Lk. 580S 138kV/25kV transformer)	OPEN Line RED DE B_138.0 (118) TO SYLV_138_138.0 (780) CKT 48
580ST2 (Sylvan Lk. 580S 138kV/25kV transformer)	OPEN Transformer SYLV_138_138.0 (780) TO SYLV_25B_25.0 (4780) CKT T2
580ST2 (Sylvan Lk. 580S 138kV/25kV transformer)	OPEN Line RED DE B_138.0 (118) TO SYLV_138_138.0 (780) CKT 48
580ST2 (Sylvan Lk. 580S 138kV/25kV transformer)	OPEN Line BENALTO7_138.0 (99) TO SYLV_138_138.0 (780) CKT 37
601L (Warlow 230S-Jenner 275S)	OPEN Line JENNER7_138.0 (292) TO WARLOW7_138.0 (344) CKT 01
609ST1 (Wheatland 609S 34.5kV/138 kV transformer)	OPEN Transformer WINTHV_138.0 (759) TO WINTLV1_34.5 (60787) CKT T1
609ST2 (Wheatland 609S 34.5kV/138 kV transformer)	OPEN Transformer WINTHV_138.0 (759) TO WINTLV2_34.5 (60843) CKT T2
615S901T (Halkirk 615S 34.5kV/140kV transformer)	OPEN Transformer HALKIRK1_240.0 (1435) TO HALKIRK2_34.5 (19435) CKT T1
648ST1 (Metiskow 648S 138kV/25kV transformer)	OPEN Transformer METIS649_25.0 (4074) TO METIS647_138.0 (74) CKT T1
648ST1 (Metiskow 648S 138kV/25kV transformer)	OPEN Transformer METIS644_240.0 (87) TO METIS647_138.0 (74) CKT T3
648ST1 (Metiskow 648S 138kV/25kV transformer)	OPEN Line METIS647_138.0 (74) TO HANSMAN9_138.0 (648) CKT 85
648ST1 (Metiskow 648S 138kV/25kV transformer)	OPEN Line METIS647_138.0 (74) TO KILRY TP_138.0 (814) CKT 49
648ST1 (Metiskow 648S 138kV/25kV transformer)	OPEN Line METIS647_138.0 (74) TO 472ALTAP_138.0 (861) CKT 72
648ST3 (Metiskow 648S 240kV/138kV transformer)	OPEN Transformer METIS644_240.0 (87) TO METIS647_138.0 (74) CKT T3
648ST3 (Metiskow 648S 240kV/138kV transformer)	OPEN Line METIS644_240.0 (87) TO HANSMAN7_240.0 (649) CKT 54
650ST1 (Hansman Lk. 650S 240kV/138kV transformer)	OPEN Transformer HANSMAN7_240.0 (649) TO HANSMAN9_138.0 (648) CKT T1
650ST3 (Hansman Lk. 650S 240kV/138kV transformer)	OPEN Transformer HANSMAN7_240.0 (649) TO HANSMSV_18.0 (2648) CKT T3
658L (Cypress 562S-Chappice Lk. 649S)	OPEN Transformer CHAPPIC9_25.0 (4320) TO CHAPPIC7_138.0 (320) CKT T1
658L (Cypress 562S-Chappice Lk. 649S)	OPEN Line CHAPPIC7_138.0 (320) TO CYPRES1_138.0 (674) CKT 58
658L (Cypress 562S-Chappice Lk. 649S)	OPEN Line CHAPPIC7_138.0 (320) TO BOWMAN3_138.0 (645) CKT 74
666L (W.Brooks 28S-Tilley 498S)	OPEN Line TILLEY 7_138.0 (275) TO W BROOK7_138.0 (276) CKT 66
668L (Empress 394S-Cypress 562S)	OPEN Line EMPRESA7_138.0 (266) TO CYPRES1_138.0 (674) CKT 68
669L (Amoco Empress 163S-Cypress 562S)	OPEN Line DOME EM7_138.0 (267) TO CYPRES1_138.0 (674) CKT 69
696L \ 7L696 (Lakesend 508S-Ribstone Crk. 892S))	OPEN Line LAKESEN7_138.0 (716) TO RIBSTON1_138.0 (1477) CKT 96
6L02 (Stettler 769S-Marion Lk. 873S)	OPEN Line MARION 8_69.0 (1437) TO STETTLE8_69.0 (1439) CKT 02
6L02 (Stettler 769S-Marion Lk. 873S)	OPEN Line MARION 8_69.0 (1437) TO MANNIX 8_69.0 (1488) CKT 02
6L02 (Stettler 769S-Marion Lk. 873S)	OPEN Line MANNIX 8_69.0 (1488) TO BAT. RV8_69.0 (1492) CKT 02
6L03 \ 6L17 (Battle River 757S-Sullivan Lk. 775S)	OPEN Line SULLV LK_69.0 (1406) TO 6L17TAP_69.0 (1407) CKT 03
6L03 \ 6L17 (Battle River 757S-Sullivan Lk. 775S)	OPEN Line CASTOR 8_69.0 (1404) TO 6L17TAP_69.0 (1407) CKT 17
6L03 \ 6L17 (Battle River 757S-Sullivan Lk. 775S)	OPEN Line 6L17TAP_69.0 (1407) TO BAT. RV8_69.0 (1492) CKT 03
6L05 (Battle River 757S-Heisler 764S)	OPEN Line HEISLER8_69.0 (1400) TO BIGKNIF8_69.0 (1401) CKT 05

Contingency Element Definitions for Power Flow Analysis

6L05 (Battle River 757S-Heisler 764S)	OPEN Line BIGKNIF8_ 69.0 (1401) TO BAT. RV8_ 69.0 (1492) CKT 05
6L08 (Bigfoot 756S-Battle River 757S)	OPEN Line BAT. RV8_ 69.0 (1492) TO BIGFOOT8_ 69.0 (1498) CKT 08
6L09 \ 6LA09 \ 6L21 (Hanna 763S-Oyen 767S)	OPEN Line YOUNGST8_ 69.0 (1476) TO RICHDAL8_ 69.0 (1478) CKT 09
6L09 \ 6LA09 \ 6L21 (Hanna 763S-Oyen 767S)	OPEN Line YOUNGST8_ 69.0 (1476) TO AEC TAP_ 69.0 (1479) CKT 09
6L09 \ 6LA09 \ 6L21 (Hanna 763S-Oyen 767S)	OPEN Line OYEN 8_ 69.0 (1475) TO AEC TAP_ 69.0 (1479) CKT 09
6L09 \ 6LA09 \ 6L21 (Hanna 763S-Oyen 767S)	OPEN Line AEC TAP_ 69.0 (1479) TO AEC EXP_ 69.0 (1480) CKT 21
6L12 \ 6L25 (Corronation 773S-Sullivan Lk. 775S)	OPEN Line SULLV LK_ 69.0 (1406) TO CORO JCT_ 69.0 (1466) CKT 12
6L12 \ 6L25 (Corronation 773S-Sullivan Lk. 775S)	OPEN Line CORONAT8_ 69.0 (1465) TO CORO JCT_ 69.0 (1466) CKT 25
6L15 (Hanna 763S-Sullivan Lk. 775S)	OPEN Line SULLV LK_ 69.0 (1406) TO HANNA 8_ 69.0 (1408) CKT 15
6L44	OPEN Line STETTLE8_ 69.0 (1439) TO BIG VAL8_ 69.0 (1442) CKT 44
6L56 (Hanna 763S-Michichi Crk. 802S)	OPEN Line HANNA 8_ 69.0 (1408) TO MICH. C8_ 69.0 (1449) CKT 56
702L (Battle River 757S-Hardisty 377S)	OPEN Line SEDGEWI7_138.0 (78) TO BAT. RV7_138.0 (1491) CKT 02
702L (Battle River 757S-Hardisty 377S)	OPEN Line HARDIST7_138.0 (73) TO SEDGEWI7_138.0 (78) CKT 02
703ALtap (Sunken Lk. 221S-Metiskow 648S)	OPEN Line SUNKEN7_138.0 (112) TO 472ALTAP_138.0 (861) CKT 72
703ALtap (Sunken Lk. 221S-Metiskow 648S)	OPEN Line METIS647_138.0 (74) TO 472ALTAP_138.0 (861) CKT 72
703ALtap (Sunken Lk. 221S-Metiskow 648S)	OPEN Line HUGHEND7_138.0 (75) TO 472ALTAP_138.0 (861) CKT 72
703L \ 703AL \ 703BL (Hughenden 213S-Hardisty 377S)	OPEN Line HUGHEND7_138.0 (75) TO EXPRESTP_138.0 (809) CKT 03
703L \ 703AL \ 703BL (Hughenden 213S-Hardisty 377S)	OPEN Line HRT EXP7_138.0 (37) TO EXPRESTP_138.0 (809) CKT 03
703L \ 703AL \ 703BL (Hughenden 213S-Hardisty 377S)	OPEN Line HARDIST7_138.0 (73) TO EXPRESTP_138.0 (809) CKT 03
704L (Wainwright 51S-Tucuman 478S)	OPEN Line WAINWRI7_138.0 (297) TO TUCUMAN7_138.0 (483) CKT 04
709S701T/709S702T wP1410 (Vegreville 709S transformers)	OPEN Transformer VEGREVL9_ 25.0 (19367) TO VEGREVL7_138.0 (1367) CKT 1T
709S701T/709S702T wP1410 (Vegreville 709S transformers)	OPEN Transformer VEGREVL7_138.0 (1367) TO VEGREVL8_ 69.0 (1368) CKT 2T
709S701T/709S702T wP1410 (Vegreville 709S transformers)	OPEN Line VINCENT8_138.0 (1363) TO VEGREVL7_138.0 (1367) CKT 34
709S701T/709S702T wP1410 (Vegreville 709S transformers)	OPEN Line N HOLDE7_138.0 (68) TO VEGREVL7_138.0 (1367) CKT 77
709S701T/709S702T wP1410 (Vegreville 709S transformers)	OPEN Line WATT_TAP_138.0 (1366) TO VEGREVL7_138.0 (1367) CKT 92
715L (Provost 545S-Hansman Lk. 650S)	OPEN Line HANSMAN9_138.0 (648) TO 715AL TP_138.0 (874) CKT 15
715L (Provost 545S-Hansman Lk. 650S)	OPEN Line PROVOST7_138.0 (86) TO 715AL TP_138.0 (874) CKT 15
748L (Kilarney Lk. 267S-Hayter 277S)	OPEN Line KILLARN7_138.0 (219) TO HAYTER 7_138.0 (220) CKT 48
749L \ 749AL (Metiskow 648S-Edgerton 899S)	OPEN Line METIS647_138.0 (74) TO KILRY TP_138.0 (814) CKT 49
749L \ 749AL (Metiskow 648S-Edgerton 899S)	OPEN Line KILLARN7_138.0 (219) TO KILRY TP_138.0 (814) CKT 49
749L \ 749AL (Metiskow 648S-Edgerton 899S)	OPEN Line EDGERTO7_138.0 (362) TO KILRY TP_138.0 (814) CKT 49
749L \ 749AL (Metiskow 648S-Edgerton 899S)	OPEN Gen BULLCRK1_ 0.7 (550003) #G1
749L \ 749AL (Metiskow 648S-Edgerton 899S)	OPEN Gen BULLCRK2_ 0.7 (550004) #G2
751S701T or 751S702T (Hill 751S 138kV/25kV transformer)	OPEN Transformer HILL 7_138.0 (1393) TO HILL_ 25.0 (99393) CKT T1
751S701T or 751S702T (Hill 751S 138kV/25kV transformer)	OPEN Transformer HILL 7_138.0 (1393) TO HILL 9_ 25.0 (18393) CKT 2T

Contingency Element Definitions for Power Flow Analysis

751S701T or 751S702T (Hill 751S 138kV/25kV transformer)	OPEN Line HILL 7_138.0 (1393) TO LLOYD 7_138.0 (1455) CKT 42
751S701T or 751S702T (Hill 751S 138kV/25kV transformer)	OPEN Line KITSCOT7_138.0 (1387) TO HILL 7_138.0 (1393) CKT 14
756S601T (Bigfoot 756S transformers)	OPEN Transformer BIGFOOT8_ 69.0 (1498) TO BIGFOOA9_ 6.9 (18498) CKT T1
756S602T (Bigfoot 756S transformers)	OPEN Transformer BIGFOOT8_ 69.0 (1498) TO BIGFOOT9_ 25.0 (19498) CKT T2
756S602T (Bigfoot 756S transformers)	OPEN Line BAT. RV8_ 69.0 (1492) TO BIGFOOT8_ 69.0 (1498) CKT 08
757L (Benalto 17S-Rimbey 297S)	OPEN Line RIMBEY 7_138.0 (98) TO 758L JCT_138.0 (956) CKT 57
757L (Benalto 17S-Rimbey 297S)	OPEN Line ECKVILL7_138.0 (97) TO 758L JCT_138.0 (956) CKT 58
757L (Benalto 17S-Rimbey 297S)	OPEN Line BENALTO7_138.0 (99) TO 758L JCT_138.0 (956) CKT 57
757S701T (Battle River 757S transformer)	OPEN Transformer BAT. RV7_138.0 (1491) TO BAT. RV8_ 69.0 (1492) CKT T1
757S702T (Battle River 757S transformer)	OPEN Transformer BAT. RV7_138.0 (1491) TO STNB AUX_ 4.2 (18491) CKT 2T
757S703T (Battle River 757S transformer)	OPEN Transformer BAT. RV7_138.0 (1491) TO BAT #3_ 16.0 (1495) CKT 3T
757S704T (Battle River 757S transformer)	OPEN Transformer BAT. RV7_138.0 (1491) TO BAT #4_ 16.0 (1496) CKT 4T
757S905T (Battle River 757S transformer)	OPEN Transformer BAT RV79_240.0 (1469) TO BAT #5_ 21.0 (1497) CKT 5T
757S912T (Battle River 757S transformer)	OPEN Transformer BAT RV80_240.0 (1489) TO BAT. RV7_138.0 (1491) CKT 2T
759S601T (Castor 759S 69kV/25kV transformer)	OPEN Transformer CASTOR 9_ 25.0 (19404) TO CASTOR 8_ 69.0 (1404) CKT 1T
763L (West Brooks 28S-Vauxhall 158S)	OPEN Line W BROOK7_138.0 (276) TO ENCH TAP_138.0 (928) CKT 63
763L (West Brooks 28S-Vauxhall 158S)	OPEN Line VAUXHAL7_138.0 (274) TO ENCH TAP_138.0 (928) CKT 63
763L (West Brooks 28S-Vauxhall 158S)	OPEN Line ENCHANT7_138.0 (286) TO ENCH TAP_138.0 (928) CKT 63
763S601T (Hanna 763S 69kV/25kV transformer)	OPEN Transformer HANNA 9_ 25.0 (19408) TO HANNA 8_ 69.0 (1408) CKT T2
764S701T (Heisler 764S 69kV/25kV transformer)	OPEN Transformer HEISLER9_ 25.0 (19400) TO HEISLER8_ 69.0 (1400) CKT 2T
765S601T (Manix Mine 765S 69kV/25kV transformer)	OPEN Transformer MANNIX7_ 25.0 (18488) TO MANNIX 8_ 69.0 (1488) CKT 1T
766S701T (Nevis 766S 138kV/25kV transformer)	OPEN Transformer NEVIS 7_138.0 (1423) TO NEVIS 9_ 25.0 (19423) CKT 1T
766S701T (Nevis 766S 138kV/25kV transformer)	OPEN Transformer NEVIS 4_240.0 (1422) TO NEVIS 7_138.0 (1423) CKT 1T
766S901T (Nevis 766S 240kV/138kV transformer)	OPEN Transformer NEVIS 4_240.0 (1422) TO NEVIS 7_138.0 (1423) CKT 1T
766S901T (Nevis 766S 240kV/138kV transformer)	OPEN Line RED DEE4_240.0 (152) TO NEVIS 4_240.0 (1422) CKT 12
766S901T (Nevis 766S 240kV/138kV transformer)	OPEN Line NEVIS 4_240.0 (1422) TO CORDEL 4_240.0 (1499) CKT 20
768S701T (Rowley 768S 138kV/25kV transformer)	OPEN Transformer 768S_HV_138.0 (1436) TO 768S_LV_ 25.0 (19436) CKT T1
769L \ 769AL (Rosyth 796S-Hardisty 377S)	OPEN Line HARDIST7_138.0 (73) TO BATSD_TP_138.0 (860) CKT 69
769L \ 769AL (Rosyth 796S-Hardisty 377S)	OPEN Line CLIPP_TP_138.0 (715) TO BATSD_TP_138.0 (860) CKT 69
769L \ 769AL (Rosyth 796S-Hardisty 377S)	OPEN Line BAT SND1_138.0 (609) TO BATSD_TP_138.0 (860) CKT 69
769L \ 769AL (Rosyth 796S-Hardisty 377S)	OPEN Line CLIPPER7_138.0 (484) TO CLIPP_TP_138.0 (715) CKT 69
769L \ 769AL (Rosyth 796S-Hardisty 377S)	OPEN Line IPL HAR7_138.0 (373) TO CLIPP_TP_138.0 (715) CKT 69
769S701T (Stettler 769S 138kV/25kV transformer)	OPEN Transformer 769_HVR_138.0 (1428) TO STETTLE9_ 25.0 (19439) CKT T1
770S701T (3 Hills 770S 138kV/25kV transformers)	OPEN Transformer 3 HILLS7_138.0 (1433) TO 3HILLS/1_ 25.0 (19433) CKT 1T
770S703T (3 Hills 770S 138kV/25kV transformers)	OPEN Transformer 3HILLS/3_ 25.0 (18433) TO 3 HILLS7_138.0 (1433) CKT 3T

Contingency Element Definitions for Power Flow Analysis

771S701T (Veteran 771S 138kV/25kV transformer)	OPEN Transformer VETERAN9_25.0 (19468) TO VETERAN7_138.0 (1470) CKT 1T
772S601T (Yongstown 772S 69kV/25kV transformer)	OPEN Transformer YOUNGST9_25.0 (19476) TO YOUNGST8_69.0 (1476) CKT 1T
773S601T (Corronation 773S 69kV/25kV transformer)	OPEN Transformer CORONAT9_25.0 (19465) TO CORONAT8_69.0 (1465) CKT 1T
774S702T (Monitor 774S 138 kV/25kV transformer)	OPEN Transformer MONITOR7_138.0 (1471) TO MONITOA9_25.0 (18471) CKT 1T
776S601T (Richdale 776S 69kV/25kV transformer)	OPEN Transformer RICHDAL9_25.0 (19478) TO RICHDAL8_69.0 (1478) CKT 1T
784L (Ellis 332S-Joffre 535S)	OPEN Line ELLIS 7_138.0 (388) TO COMINTAP_138.0 (975) CKT 84
784L (Ellis 332S-Joffre 535S)	OPEN Line COMINCO7_138.0 (387) TO COMINTAP_138.0 (975) CKT 84
784L (Ellis 332S-Joffre 535S)	OPEN Line JOFFRE 7_138.0 (383) TO COMINTAP_138.0 (975) CKT 84
795L (Brooks 121S-Hays 421S)	OPEN Line BROOKS 7_138.0 (256) TO HAYS 7_138.0 (401) CKT 95
7L110 (Monitor 774S-Loyalist 903S)	OPEN Line LOYALIS7_138.0 (1458) TO MONITOR7_138.0 (1471) CKT 10
7L116 (Excell 910S-Lanfine 959S)	OPEN Line EXCEL7_138.0 (1459) TO 959S_LV_138.0 (19438) CKT 16
7L127 (Monitor 774S-Pemukan 932S)	OPEN Line MONITOR7_138.0 (1471) TO PEMUKN3_138.0 (19419) CKT 27
7L128 (Michichi Crk. 802S-CoyoteLk. 963S)	OPEN Line COYTLK1_138.0 (1421) TO MICH. C7_138.0 (1448) CKT 28
7L129 \ 7LA129 (Buffalo Crk. 526S-Vermilion 710S)	OPEN Line BAUERTAP_138.0 (766) TO BAUER1_138.0 (1113) CKT 29
7L129 \ 7LA129 (Buffalo Crk. 526S-Vermilion 710S)	OPEN Line BAUERTAP_138.0 (766) TO VERMILO7_138.0 (1383) CKT 29
7L129 \ 7LA129 (Buffalo Crk. 526S-Vermilion 710S)	OPEN Line BUFFALO7_138.0 (79) TO BAUERTAP_138.0 (766) CKT 29
7L132 (Oyen 767S-Lanfine 959S)	OPEN Line OYEN 7_138.0 (1474) TO 959S_LV_138.0 (19438) CKT 32
7L137 (Rowley 768S-3 Hills 770S)	OPEN Line 3 HILLS7_138.0 (1433) TO 768S_HV_138.0 (1436) CKT 37
7L143 (Nevis 766S-Stettler 769S)	OPEN Line NEVIS 7_138.0 (1423) TO 769_HVR_138.0 (1428) CKT 43
7L153 (Wheatland 609S-Wintering Hills 804S)	OPEN Line WINTHV_138.0 (759) TO WINT HI7_138.0 (1460) CKT 1
7L159 \ 7LA159 (3 Hills 770S-Heatburg 948S)	OPEN Line GHOSTPI3_138.0 (602) TO 948S_HV_138.0 (1429) CKT 59
7L159 \ 7LA159 (3 Hills 770S-Heatburg 948S)	OPEN Line GHOSTPI3_138.0 (602) TO 3 HILLS7_138.0 (1433) CKT 59
7L159 \ 7LA159 (Ghost Pine 114S-3 Hills 770S-Heatburg 948S)	OPEN Line GHOSTPI3_138.0 (602) TO GHOSTPI1_138.0 (603) CKT 59
7L16 (Nevis 766S-Heatburg 948S)	OPEN Line NEVIS 7_138.0 (1423) TO 948S_HV_138.0 (1429) CKT 16
7L171 (Michichi Crk. 802S-Wintering hills 804S)	OPEN Line MICH. C7_138.0 (1448) TO WINT HI7_138.0 (1460) CKT 71
7L224 (Hansman Lk. 650S-Monitor 774S)	OPEN Line HANSMAN9_138.0 (648) TO MONITOR7_138.0 (1471) CKT 24
7L25 (Rowley 768S-Michichi Crk. 802S)	OPEN Line 768S_HV_138.0 (1436) TO MICH. C7_138.0 (1448) CKT 25
7L42 (Lloydminster 716S-Hill 751S)	OPEN Transformer LLOYD 7_138.0 (1455) TO LLOYD 9_25.0 (14055) CKT 1T
7L42 (Lloydminster 716S-Hill 751S)	OPEN Line HILL 7_138.0 (1393) TO LLOYD 7_138.0 (1455) CKT 42
7L50 (Buffalo Crk. 526S-Battle River 757S)	OPEN Line JAROW TP_138.0 (1490) TO BAT. RV7_138.0 (1491) CKT 50
7L50 (Buffalo Crk. 526S-Battle River 757S)	OPEN Line BUFFALO7_138.0 (79) TO JAROW TP_138.0 (1490) CKT 50
7L50 (Buffalo Crk. 526S-Battle River 757S)	OPEN Line JARROW 7_138.0 (72) TO JAROW TP_138.0 (1490) CKT 91
7L701 \ 7LA701 \ 701L (Strome 223S-Battle River 757S)	OPEN Line IPPL ST7_138.0 (76) TO HEIS_TP8_138.0 (1007) CKT 01
7L701 \ 7LA701 \ 701L (Strome 223S-Battle River 757S)	OPEN Line HEIS_TP8_138.0 (1007) TO HEISLER7_138.0 (1464) CKT 01
7L701 \ 7LA701 \ 701L (Strome 223S-Battle River 757S)	OPEN Line HEIS_TP8_138.0 (1007) TO BAT. RV7_138.0 (1491) CKT 01

Contingency Element Definitions for Power Flow Analysis

7L749 \ 749L \ 7LB749 Lloydminster 716S-Edgerton 899S)	OPEN Line PV-TAP7_138.0 (862) TO LLOYD 7_138.0 (1455) CKT 49
7L749 \ 749L \ 7LB749 Lloydminster 716S-Edgerton 899S)	OPEN Line PV-TAP7_138.0 (862) TO BRIKER1_138.0 (1314) CKT 49
7L749 \ 749L \ 7LB749 Lloydminster 716S-Edgerton 899S)	OPEN Line EDGERTO7_138.0 (362) TO PV-TAP7_138.0 (862) CKT 49
7L760 \ 760L (Empress 394S-Oyen 767S)	OPEN Line CVD_TAP_138.0 (1452) TO KSP_TAP_138.0 (1453) CKT 60
7L760 \ 760L (Empress 394S-Oyen 767S)	OPEN Line KSP_TAP_138.0 (1453) TO BINDLOS7_138.0 (1454) CKT 60
7L760 \ 760L (Empress 394S-Oyen 767S)	OPEN Line KSP_TAP_138.0 (1453) TO OYEN 7_138.0 (1474) CKT 60
7L760 \ 760L (Empress 394S-Oyen 767S)	OPEN Line EMP LIQ7_138.0 (263) TO EMPLIQTP_138.0 (911) CKT 60
7L760 \ 760L (Empress 394S-Oyen 767S)	OPEN Line EMPRESA7_138.0 (266) TO DOME EM7_138.0 (267) CKT 60
7L760 \ 760L (Empress 394S-Oyen 767S)	OPEN Line DOME EM7_138.0 (267) TO EMPLIQTP_138.0 (911) CKT 60
7L760 \ 760L (Empress 394S-Oyen 767S)	OPEN Line EMPLIQTP_138.0 (911) TO KSP_TAP_138.0 (1453) CKT 60
7L79 (Ribstone Crk. 892S-Pemukan 932S)	OPEN Line VETERAN7_138.0 (1470) TO RIBSTON1_138.0 (1477) CKT 79
7L79 (Ribstone Crk. 892S-Pemukan 932S)	OPEN Line VETERAN7_138.0 (1470) TO PEMUKN3_138.0 (19419) CKT 79
7L85 (Anderson 801S-Wintering Hills 804S)	OPEN Line WINT HI7_138.0 (1460) TO BULLPON7_138.0 (1463) CKT 85
7L85 (Anderson 801S-Wintering Hills 804S)	OPEN Line BULLPON7_138.0 (1463) TO ANDERSON_138.0 (1485) CKT 85
7L92 \ 7LA92 (Vegreville 709S -Vilna 777S)	OPEN Line WATT_TAP_138.0 (1366) TO VEGREVL7_138.0 (1367) CKT 92
7L92 \ 7LA92 (Vegreville 709S -Vilna 777S)	OPEN Line WATTLAKE_138.0 (1361) TO WATT_TAP_138.0 (1366) CKT 92
7L92 \ 7LA92 (Vegreville 709S -Vilna 777S)	OPEN Line VILNA 7_138.0 (1357) TO WATT_TAP_138.0 (1366) CKT 92
7L92 \ 7LA92 (Vegreville 709S -Vilna 777S)	OPEN Line WHITBY 7_138.0 (1350) TO VILNA 7_138.0 (1357) CKT 92
7LA65 Vegreville 709S-Drury 2007S)	OPEN Line 7LA65_T_TAP_138.0 (1324) TO VINCENT8_138.0 (1363) CKT 65
7LA65 Vegreville 709S-Drury 2007S)	OPEN Line STEELE_138_138.0 (1125) TO 7LA65_T_TAP_138.0 (1324) CKT 65
7LA65 Vegreville 709S-Drury 2007S)	OPEN Line 7LA65_T_TAP_138.0 (1324) TO VERMILO7_138.0 (1383) CKT 65
801S701T (Anderson 801S 240kV/138kV transformer)	OPEN Transformer ANDERSON_138.0 (1485) TO ANDERSO9_ 25.0 (19485) CKT 1
801S901T (Anderson 801S 240kV/138kV transformer)	OPEN Transformer ANDERSO4_240.0 (1484) TO ANDERSON_138.0 (1485) CKT 1
802S702T (Michichi Crk. 802S 138kV/25kV transformers)	OPEN Transformer MICH. C7_138.0 (1448) TO MICH.C19_ 25.0 (19448) CKT T2
802S703T (Michichi Crk. 802S 138kV/25kV transformers)	OPEN Transformer MICH. C7_138.0 (1448) TO MICH. C9_ 25.0 (18448) CKT T3
803S701T (Bullpond 803S 138kV/25kV transformer)	OPEN Transformer BULLPON9_ 25.0 (19463) TO BULLPON7_138.0 (1463) CKT 1
804S701T (Wintering Hills 804S 138kV/25kV transformer)	OPEN Transformer WINT HI9_ 25.0 (19460) TO WINT HI7_138.0 (1460) CKT 1T
80AL/80L/461L (Blakfalds 198S-Ponoka 331S)	OPEN Line LACOMBE7_138.0 (114) TO W LACOMB_138.0 (116) CKT 80
80AL/80L/461L (Blakfalds 198S-Ponoka 331S)	OPEN Line BLACKFA7_138.0 (113) TO W LACOMB_138.0 (116) CKT 80
814L (W.Brooks 28S-Brooks 121S)	OPEN Line BROOKS 7_138.0 (256) TO W BROOK7_138.0 (276) CKT 14
827L (W.Brooks 28S-Brooks 121S)	OPEN Line BROOKS 7_138.0 (256) TO W BROOK7_138.0 (276) CKT 27
830L (Cypress 562S-McNeal 840S)	OPEN Line CYPRES1_138.0 (674) TO MCNEILL_138.0 (1473) CKT 30
843S601T (Bigknife Creek 69kV/4.16kV transformer)	OPEN Transformer BIGKNIF8_ 69.0 (1401) TO BIGKNIF9_ 4.2 (19401) CKT 1T
853L (W.Brooks 28S-Queenstown 504S)	OPEN Line W BROOK7_138.0 (276) TO BASNTAP_138.0 (877) CKT 53
853L (W.Brooks 28S-Queenstown 504S)	OPEN Line QUENSTWN_138.0 (333) TO BASNTAP_138.0 (877) CKT 53

Contingency Element Definitions for Power Flow Analysis

853L (W.Brooks 28S-Queenstown 504S)	OPEN Line BASSAN7_138.0 (399) TO BASNTAP_138.0 (877) CKT 53
863S902T (Painterath 863S 138kV/25kV transformer)	OPEN Transformer PAINTRT4_240.0 (1403) TO PAINTRT2_ 25.0 (18403) CKT T2
863S902T (Painterath 863S 138kV/25kV transformer)	OPEN Line PAINTRT4_240.0 (1403) TO CORDEL 4_240.0 (1499) CKT 27
863S902T (Painterath 863S 138kV/25kV transformer)	OPEN Line HANSMAN7_240.0 (649) TO PAINTRT4_240.0 (1403) CKT 48
869L (Amoco Empress 163S-Sandy Pt. 204S)	OPEN Line SANDYPT7_138.0 (53) TO DOME EM7_138.0 (267) CKT 69
871L (Amoco Empress 163S-sand Hills 341S)	OPEN Line SANDHIL7_138.0 (111) TO DOME EM7_138.0 (267) CKT 71
873S602T (Marion Lk. 873S 138kV/25kV transformer)	OPEN Transformer MARION 9_ 25.0 (19437) TO MARION 8_ 69.0 (1437) CKT T2
87ST1 (Gaetz 87S 1240kV/138kV transformer)	OPEN Line GAETZ 4_240.0 (147) TO RED DEE4_240.0 (152) CKT 14
87ST1 (Gaetz 87S 1240kV/138kV transformer)	OPEN Transformer GAETZ 7_138.0 (148) TO GAETZ 4_240.0 (147) CKT T1
87ST2 (Gaetz 87S 1240kV/138kV transformer)	OPEN Transformer GAETZ 7_138.0 (148) TO GAETZ 4_240.0 (147) CKT T2
87ST2 (Gaetz 87S 1240kV/138kV transformer)	OPEN Line BIGSTON4_240.0 (81) TO GAETZ 4_240.0 (147) CKT 14
885L (Metiskow 648S-Hansman Lk. 650S)	OPEN Line METIS647_138.0 (74) TO HANSMAN9_138.0 (648) CKT 85
892S701T (Ribstone Crk. 892S 138kV/4.16kV transformer)	OPEN Transformer RIBSTON1_138.0 (1477) TO RIBSTON7_ 4.2 (18477) CKT 1T
892S701T (Ribstone Crk. 892S 138kV/4.16kV transformer)	OPEN Line VETERAN7_138.0 (1470) TO RIBSTON1_138.0 (1477) CKT 79
892S701T (Ribstone Crk. 892S 138kV/4.16kV transformer)	OPEN Line LAKESEN7_138.0 (716) TO RIBSTON1_138.0 (1477) CKT 96
899ST3a (Edgerton 899S 138kV/25kV transformer)	OPEN Transformer EDGERTO7_138.0 (362) TO EDGERTO9_ 25.0 (4361) CKT 3T
899ST3a (Edgerton 899S 138kV/25kV transformer)	OPEN Line EDGERTO7_138.0 (362) TO PV-TAP7_138.0 (862) CKT 49
899ST3a (Edgerton 899S 138kV/25kV transformer)	OPEN Line EDGERTO7_138.0 (362) TO KILRY TP_138.0 (814) CKT 49
903ST1 (Loyalist 903S 138kV/4.16kV transformer)	OPEN Transformer LOYALIS7_138.0 (1458) TO LOYALIS8_ 4.2 (17458) CKT T1
910ST1 (Excel 910S 138kV/4.16kV tranformer)	OPEN Transformer EXCEL7_138.0 (1459) TO EXCEL8_ 4.2 (17459) CKT T1
912L \ 9L912 (Red Deer 63S-Nevis 766S)	OPEN Line RED DEE4_240.0 (152) TO NEVIS 4_240.0 (1422) CKT 12
923L (Milo 356S-Newell 2075S)	OPEN Line MILO 1_240.0 (943) TO NEWELL2_240.0 (1012) CKT 23
931L (W.Brooks 28S-Ware Junct. 132S)	OPEN Line WARE JCT_240.0 (225) TO W BROOK4_240.0 (430) CKT 31
933L (Ware Junct. 132S-Anderson 801S)	OPEN Line WARE JCT_240.0 (225) TO ANDERSO4_240.0 (1484) CKT 33
935L (Cassils 324S-Milo 356S)	OPEN Line CASS01_240.0 (918) TO MILO 1_240.0 (943) CKT 35
944L (Ware Junct. 132S-Jenner 275S)	OPEN Line WARE JCT_240.0 (225) TO JENNER 4_240.0 (260) CKT 44
945L (Jenner275S-Cypress 562S)	OPEN Line JENNER 4_240.0 (260) TO CYPRES2_240.0 (677) CKT 45
948L \ 9L948 (Hansman LK. 650S-Painterath 863S)	OPEN Line HANSMAN7_240.0 (649) TO PAINTRT4_240.0 (1403) CKT 48
948S701T (Heatburg 948S 138kV/25kV transformer)	OPEN Transformer 948S_HV_138.0 (1429) TO 948S_LV_ 25.0 (19429) CKT 1T
953L \ 9L953 (Nilrem 574S-Cordel 755S)	OPEN Line NILREM3_240.0 (1427) TO CORDEL 4_240.0 (1499) CKT 53
954L (Metiskow 648S 1240kV/138kV transformer)	OPEN Line METIS644_240.0 (87) TO HANSMAN7_240.0 (649) CKT 54
954L (Nilrem 574S-Cordel 755S)	OPEN Transformer METIS644_240.0 (87) TO METIS647_138.0 (74) CKT T3
954L/648ST3 (Metiskow 648S 1240kV/138kV transformer)	OPEN Line METIS644_240.0 (87) TO HANSMAN7_240.0 (649) CKT 54
954L/648ST3 (Metiskow 648S 1240kV/138kV transformer)	OPEN Transformer METIS644_240.0 (87) TO METIS647_138.0 (74) CKT T3
966L \ 9L966 (Hansman Lk. 650S-Pemukan 932S)	OPEN Line HANSMAN7_240.0 (649) TO PEMUKN1_240.0 (1419) CKT 66

Contingency Element Definitions for Power Flow Analysis

9L100 (Anderson 801S-Sheerness 807S)	OPEN Line ANDERSO4_240.0 (1484) TO SHEER 24_240.0 (1486) CKT 00
9L16 (Cordel 755S-Tinchebray 972S)	OPEN Line TNCHBRY1_240.0 (1431) TO CORDEL 4_240.0 (1499) CKT 16
9L20 (Cordel 755S-Nevis 766S)	OPEN Line NEVIS 4_240.0 (1422) TO CORDEL 4_240.0 (1499) CKT 20
9L24 (Oakland 946S-Lanfine 959S)	OPEN Line LANFIN1_240.0 (1438) TO OAKLND1_240.0 (1440) CKT 24
9L27 (Cordel 755S-Paintearth 863S)	OPEN Line PAINTRT4_240.0 (1403) TO CORDEL 4_240.0 (1499) CKT 27
9L29 (Coyote Lake 963S-Oakland 946S)	OPEN Line OAKLND1_240.0 (1440) TO 963S_HV_240.0 (1447) CKT 29
9L46 (Pemukan 932S-Lanfine 959S)	OPEN Line N_BRIGDEN_240.0 (1413) TO LANFIN1_240.0 (1438) CKT 46
9L51 (Sedalia 363S-Pemukan 932S)	OPEN Line N_BRIGDEN_240.0 (1413) TO PEMUKN1_240.0 (1419) CKT 51
9L59 (Anderson 801S-Tinchebray 972S)	OPEN Line TNCHBRY1_240.0 (1431) TO ANDERSO4_240.0 (1484) CKT 59
9L70 (Anderson 801S-Oakland 946S)	OPEN Line OAKLND1_240.0 (1440) TO ANDERSO4_240.0 (1484) CKT 70
9L79 (Cordel 755S-Battle River 757S)	OPEN Line BAT RV79_240.0 (1469) TO CORDEL 4_240.0 (1499) CKT 79
9L80 (Cordel 755S-Battle River 757S)	OPEN Line BAT RV80_240.0 (1489) TO CORDEL 4_240.0 (1499) CKT 80
9L933 \ 933L (Ware Junction 132S-Anderson 801S)	OPEN Line WARE JCT_240.0 (225) TO ANDERSO4_240.0 (1484) CKT 33
9L934 \ 934L (Ware Junction 132S-Anderson 801S)	OPEN Line WARE JCT_240.0 (225) TO ANDERSO4_240.0 (1484) CKT 34
9L950 \ 950L (Ware Junction 132S-Anderson 801S)	OPEN Line WARE JCT_240.0 (225) TO ANDERSO4_240.0 (1484) CKT 50
9L97 (Anderson 801S-Oakland 946S)	OPEN Line OAKLND1_240.0 (1440) TO ANDERSO4_240.0 (1484) CKT 97
EATL	OPEN Line NEWELL2_240.0 (1012) TO NEWELL1_240.0 (1618) CKT 75
EATL	OPEN Line HTHFIELD_500.0 (1614) TO HTHFIELD_500.0 (1615) CKT 29
Ellis 332ST1 (Ellis332S 138kV/13.8kV transformer)	OPEN Transformer ELLIS 7_138.0 (388) TO ELLIS2 9_13.8 (4388) CKT T1
Ellis 332ST1 (Ellis332S 138kV/13.8kV transformer)	OPEN Line UC PRENT_138.0 (384) TO ELLIS 7_138.0 (388) CKT 74
Ellis 332ST2 (Ellis332S 138kV/13.8kV transformer)	OPEN Transformer ELLIS 7_138.0 (388) TO ELLIS2 9_13.8 (4388) CKT T2
Ellis 332ST2 (Ellis332S 138kV/13.8kV transformer)	OPEN Line ELLIS 7_138.0 (388) TO COMINTAP_138.0 (975) CKT 84
Joffre_1 (Joffre 535S Load Group 1)	OPEN Transformer JOFFRE 7_138.0 (383) TO AGE JOC9_13.8 (4383) CKT T1
Joffre_1 (Joffre 535S Load Group 1)	OPEN Transformer JOFFRE 7_138.0 (383) TO AGE JOF9_13.8 (3886) CKT T5
Joffre_1 (Joffre 535S Load Group 1)	OPEN Transformer JOFFRE 7_138.0 (383) TO AGE JOE9_25.0 (2383) CKT 3T
Joffre_2 (Joffre 535S Load Group 2)	OPEN Transformer JOFFRE 7_138.0 (383) TO AGE JOD9_13.8 (4886) CKT T4
Joffre_2 (Joffre 535S Load Group 2)	OPEN Transformer JOFFRE 7_138.0 (383) TO AGE JOB9_13.8 (3383) CKT T2
Joffre_2 (Joffre 535S Load Group 2)	OPEN Transformer JOFFRE 7_138.0 (383) TO AGEJOE10_25.0 (2886) CKT T6
Prenttis T1 (UC Prenttis 276S 138kV/13.8kV transformer)	OPEN Transformer UC PRENT_138.0 (384) TO UNION C9_13.8 (4384) CKT T1
Prenttis T1 (UC Prenttis 276S 138kV/13.8kV transformer)	OPEN Line UC PRENT_138.0 (384) TO ELLIS 7_138.0 (388) CKT 74
Prenttis T2 (UC Prenttis 276S 138kV/13.8kV transformer)	OPEN Transformer UC PRENT_138.0 (384) TO UNION C9_13.8 (4384) CKT T2
Prenttis T2 (UC Prenttis 276S 138kV/13.8kV transformer)	OPEN Line GAETZ 7_138.0 (148) TO UC PRENT_138.0 (384) CKT 59
Prenttis T3 (UC Prenttis 276S 138kV/13.8kV transformer)	OPEN Transformer UC PRENT_138.0 (384) TO UNION A9_13.8 (2384) CKT T3
Prenttis T3 (UC Prenttis 276S 138kV/13.8kV transformer)	OPEN Line JOFFRE 7_138.0 (383) TO UC PRENT_138.0 (384) CKT 75
RD 15ST1 (Red Deer 15S 138kV/25kV transformer)	OPEN Line S RED DE_138.0 (115) TO RED DE A_138.0 (117) CKT 26

Contingency Element Definitions for Power Flow Analysis

RD 15ST1 (S.Red Deer 194S 138kV/25kV transformer)	OPEN Transformer RD15S-B1_ 25.0 (40003) TO S RED DE_138.0 (115) CKT T1
RD 15ST1 (S.Red Deer 194S 138kV/25kV transformer)	OPEN Line S RED DE_138.0 (115) TO N RED D7_138.0 (119) CKT 25
RD 15ST2 (Red Deer 15S 138kV/25kV transformer)	OPEN Transformer RD15S-B2_ 25.0 (40004) TO S RED DE_138.0 (115) CKT T2
RD 15ST2 (Red Deer 15S 138kV/25kV transformer)	OPEN Line S RED DE_138.0 (115) TO N RED D7_138.0 (119) CKT 25
RD 15ST2 (Red Deer 15S 138kV/25kV transformer)	OPEN Line S RED DE_138.0 (115) TO RED DE A_138.0 (117) CKT 26

Contingency Element Definitions for Transient Stability Analysis

Contingency Name	Time (Seconds)	Object	Action	Element
912L/9L912: Nevis 766S to Red Deer 63S	1	Branch '1422''152''12'	FAULT 0 3PB SOLID	Line NEVIS 4 FROM RED DEE4 CKT 12
912L/9L912: Nevis 766S to Red Deer 63S	1.08333	Branch '1422''152''12'	OPEN NEAR	Line NEVIS 4 FROM RED DEE4 CKT 12
912L/9L912: Nevis 766S to Red Deer 63S	1.1	Branch '1422''152''12'	CLEARFAULT	Line NEVIS 4 FROM RED DEE4 CKT 12
912L/9L912: Nevis 766S to Red Deer 63S	1.1	Branch '1422''152''12'	OPEN FAR	Line NEVIS 4 FROM RED DEE4 CKT 12
912L/9L912: Red Deer 63S to Nevis 766S	1	Branch '152''1422''12'	FAULT 1 3PB SOLID	Line RED DEE4 TO NEVIS 4 CKT 12
912L/9L912: Red Deer 63S to Nevis 766S	1.083333	Branch '152''1422''12'	OPEN NEAR	Line RED DEE4 TO NEVIS 4 CKT 12
912L/9L912: Red Deer 63S to Nevis 766S	1.1	Branch '152''1422''12'	CLEARFAULT	Line RED DEE4 TO NEVIS 4 CKT 12
912L/9L912: Red Deer 63S to Nevis 766S	1.1	Branch '152''1422''12'	OPEN FAR	Line RED DEE4 TO NEVIS 4 CKT 12
9L16/9L49: Cordel 755S to Tinchebray 972S	1	Branch '1499''1431''16'	FAULT 2 3PB SOLID	Line CORDEL 4 FROM TNCHBRY1 CKT 16
9L16/9L49: Cordel 755S to Tinchebray 972S	1.083333	Branch '1499''1431''16'	OPEN NEAR	Line CORDEL 4 FROM TNCHBRY1 CKT 16
9L16/9L49: Cordel 755S to Tinchebray 972S	1.1	Branch '1499''1431''16'	OPEN FAR	Line CORDEL 4 FROM TNCHBRY1 CKT 16
9L16/9L49: Tinchebray 972S to Cordel 755S	1	Branch '1431''1499''16'	FAULT 2 3PB SOLID	Line TNCHBRY1 TO CORDEL 4 CKT 16
9L16/9L49: Tinchebray 972S to Cordel 755S	1.083333	Branch '1431''1499''16'	OPEN NEAR	Line TNCHBRY1 TO CORDEL 4 CKT 16
9L16/9L49: Tinchebray 972S to Cordel 755S	1.1	Branch '1431''1499''16'	OPEN FAR	Line TNCHBRY1 TO CORDEL 4 CKT 16
9L20: Cordel 755S to Nevis 766S	1	Branch '1499''1422''20'	FAULT 1 3PB SOLID	Line CORDEL 4 FROM NEVIS 4 CKT 20
9L20: Cordel 755S to Nevis 766S	1.08333	Branch '1499''1422''20'	OPEN NEAR	Line CORDEL 4 FROM NEVIS 4 CKT 20
9L20: Cordel 755S to Nevis 766S	1.1	Branch '1499''1422''20'	OPEN FAR	Line CORDEL 4 FROM NEVIS 4 CKT 20
9L20: Nevis 766S to Cordel 755S	1	Branch '1422''1499''20'	FAULT 1 3PB SOLID	Line NEVIS 4 TO CORDEL 4 CKT 20
9L20: Nevis 766S to Cordel 755S	1.08333	Branch '1422''1499''20'	OPEN NEAR	Line NEVIS 4 TO CORDEL 4 CKT 20
9L20: Nevis 766S to Cordel 755S	1.1	Branch '1422''1499''20'	OPEN FAR	Line NEVIS 4 TO CORDEL 4 CKT 20
9L24: Lanfine 959S to Oakland 946S	1	Branch '1438''1440''24'	FAULT 1 3PB SOLID	Line LANFIN1 TO OAKLND1 CKT 24
9L24: Lanfine 959S to Oakland 946S	1.083333	Branch '1438''1440''24'	OPEN NEAR	Line LANFIN1 TO OAKLND1 CKT 24
9L24: Lanfine 959S to Oakland 946S	1.1	Branch '1438''1440''24'	OPEN FAR	Line LANFIN1 TO OAKLND1 CKT 24
9L24: Oakland 946S to Lanfine 959S	1	Branch '1440''1438''24'	FAULT 1 3PB SOLID	Line OAKLND1 FROM LANFIN1 CKT 24
9L24: Oakland 946S to Lanfine 959S	1.083333	Branch '1440''1438''24'	OPEN NEAR	Line OAKLND1 FROM LANFIN1 CKT 24
9L24: Oakland 946S to Lanfine 959S	1.1	Branch '1440''1438''24'	OPEN FAR	Line OAKLND1 FROM LANFIN1 CKT 24
9L29: Coyote Lake 963S to Oakland 946S	1	Branch '1447''1440''29'	FAULT 1 3PB SOLID	Line 963S_HV FROM OAKLND1 CKT 29
9L29: Coyote Lake 963S to Oakland 946S	1.083333	Branch '1447''1440''29'	OPEN NEAR	Line 963S_HV FROM OAKLND1 CKT 29
9L29: Coyote Lake 963S to Oakland 946S	1.1	Branch '1447''1440''29'	OPEN FAR	Line 963S_HV FROM OAKLND1 CKT 29
9L29: Oakland 946S to Coyote Lake 963S	1	Branch '1440''1447''29'	FAULT 1 3PB SOLID	Line OAKLND1 TO 963S_HV CKT 29
9L29: Oakland 946S to Coyote Lake 963S	1.083333	Branch '1440''1447''29'	OPEN NEAR	Line OAKLND1 TO 963S_HV CKT 29
9L29: Oakland 946S to Coyote Lake 963S	1.1	Branch '1440''1447''29'	OPEN FAR	Line OAKLND1 TO 963S_HV CKT 29
9L46: Lanfine 959S to N.Bridgen	1	Branch '1438''1413''46'	FAULT 0 3PB SOLID	Line LANFIN1 FROM N_BRIGDEN CKT 46
9L46: Lanfine 959S to N.Bridgen	1.08333	Branch '1438''1413''46'	OPEN NEAR	Line LANFIN1 FROM N_BRIGDEN CKT 46
9L46: Lanfine 959S to N.Bridgen	1.1	Branch '1438''1413''46'	CLEARFAULT	Line LANFIN1 FROM N_BRIGDEN CKT 46
9L46: Lanfine 959S to N.Bridgen	1.1	Branch '1438''1413''46'	OPEN FAR	Line LANFIN1 FROM N_BRIGDEN CKT 46
9L46: N.Bridgen to Lanfine 959S	1	Branch '1413''1438''46'	OPEN NEAR	Line N_BRIGDEN TO LANFIN1 CKT 46
9L46: N.Bridgen to Lanfine 959S	1	Branch '1413''1438''46'	FAULT 0 3PB SOLID	Line N_BRIGDEN TO LANFIN1 CKT 46
9L46: N.Bridgen to Lanfine 959S	1.08333	Branch '1413''1438''46'	OPEN NEAR	Line N_BRIGDEN TO LANFIN1 CKT 46
9L46: N.Bridgen to Lanfine 959S	1.1	Branch '1413''1438''46'	CLEARFAULT	Line N_BRIGDEN TO LANFIN1 CKT 46
9L51: N.Bridgen to Pemukan 932S	1	Branch '1413''1419''51'	OPEN FAR	Line N_BRIGDEN TO PEMUKN1 CKT 51
9L51: N.Bridgen to Pemukan 932S	1	Branch '1413''1419''51'	FAULT 0 3PB SOLID	Line N_BRIGDEN TO PEMUKN1 CKT 51
9L51: N.Bridgen to Pemukan 932S	1.0833	Branch '1413''1419''51'	OPEN NEAR	Line N_BRIGDEN TO PEMUKN1 CKT 51
9L51: N.Bridgen to Pemukan 932S	1.1	Branch '1413''1419''51'	CLEARFAULT	Line N_BRIGDEN TO PEMUKN1 CKT 51
9L51: Pemukan 932S to N.Bridgen	1	Branch '1419''1413''51'	FAULT 0 3PB SOLID	Line PEMUKN1 FROM N_BRIGDEN CKT 51
9L51: Pemukan 932S to N.Bridgen	1.08333	Branch '1419''1413''51'	OPEN NEAR	Line PEMUKN1 FROM N_BRIGDEN CKT 51
9L51: Pemukan 932S to N.Bridgen	1.1	Branch '1419''1413''51'	OPEN NEAR	Line PEMUKN1 FROM N_BRIGDEN CKT 51
9L51: Pemukan 932S to N.Bridgen	1.1	Branch '1419''1413''51'	CLEARFAULT	Line PEMUKN1 FROM N_BRIGDEN CKT 51
9L59: Anderson 801S to Tinchebray 972S	1	Branch '1484''1431''59'	FAULT 1 3PB SOLID	Line ANDERSO4 FROM TNCHBRY1 CKT 59
9L59: Anderson 801S to Tinchebray 972S	1.083333	Branch '1484''1431''59'	OPEN NEAR	Line ANDERSO4 FROM TNCHBRY1 CKT 59
9L59: Anderson 801S to Tinchebray 972S	1.1	Branch '1484''1431''59'	OPEN FAR	Line ANDERSO4 FROM TNCHBRY1 CKT 59
9L59: Tinchebray 972S to Anderson 801S	1	Branch '1431''1484''59'	FAULT 1 3PB SOLID	Line TNCHBRY1 TO ANDERSO4 CKT 59
9L59: Tinchebray 972S to Anderson 801S	1.083333	Branch '1431''1484''59'	OPEN NEAR	Line TNCHBRY1 TO ANDERSO4 CKT 59
9L59: Tinchebray 972S to Anderson 801S	1.1	Branch '1431''1484''59'	OPEN FAR	Line TNCHBRY1 TO ANDERSO4 CKT 59
9L966: Hansman Lake 650S to Pemukan 932S	1	Branch '649''1419''66'	FAULT 1 3PB SOLID	Line HANSMAN7 TO PEMUKN1 CKT 66
9L966: Hansman Lake 650S to Pemukan 932S	1.083333	Branch '649''1419''66'	OPEN NEAR	Line HANSMAN7 TO PEMUKN1 CKT 66
9L966: Hansman Lake 650S to Pemukan 932S	1.1	Branch '649''1419''66'	OPEN FAR	Line HANSMAN7 TO PEMUKN1 CKT 66
9L966: Pemukan 932S to Hansman Lake 650S	1	Branch '1419''649''66'	FAULT 1 3PB SOLID	Line PEMUKN1 FROM HANSMAN7 CKT 66
9L966: Pemukan 932S to Hansman Lake 650S	1.08333	Branch '1419''649''66'	OPEN NEAR	Line PEMUKN1 FROM HANSMAN7 CKT 66
9L966: Pemukan 932S to Hansman Lake 650S	1.1	Branch '1419''649''66'	OPEN FAR	Line PEMUKN1 FROM HANSMAN7 CKT 66

Attachment A6

Post-Mitigation Power Flow Diagrams for Category B Contingencies

Table of Contents

Scenario 4 (2022SP) 3
Figure RAS-S4-1: Contingency: 648ST1 (Metiskow 648S transformer) with Mod. RAS 138 and 491L opened ..4
Figure RAS-S4-2: Contingency: 749L \749AL with Modified RAS 138 5
Figure RAS-S4-3: Contingency: 766S901T with Modified RAS 134/138 6
Figure RAS-S4-4: Contingency 7L749 \749L \7LB749 with Modified RAS 138 7
Figure RAS-S4-5: Contingency 899ST3a with Modified RAS 138 8
Figure RAS-S4-6: Contingency: 912L \9L912 with Modified RAS 134/138 9
Figure RAS-S4-7: Contingency: 966L \ 9L966 (Hansman Lk. 650S-Pemukan 932S) with new RAS 7L224 10
Figure RAS-S4-8: Contingency 9L20 (Cordel 755S-Nevis 766S) with Mod. RAS 138/ Mod. RAS 139 11
Figure RAS-S4-9: Contingency EATL with Mod.RAS 138/ Mod.RAS 139 12

Scenario 5 (2022SL) 13
Figure RAS-S5-1: Contingency 9L20 with Modified RAS 139 14

Scenario 6 (2022WP) 15
Figure RAS-S6-1: 648ST1 (Metiskow 648S 138 kV/25 kV transformer) with Mod.RAS 138 and 491L opened..16
Figure RAS-S6-2: Contingency 749L \ 749AL (Metiskow 648S-Edgerton 899S) with Mod RAS 138..... 17
Figure RAS-S6-3: Contingency 766S901T (Nevis 766S 240kV/138kV transformer) with Mod. RAS 134/ Mod. RAS 138 18
Figure RAS-S6-4: Contingency 7L749 \ 749L \ 7LB749 Lloydminster 716S-Edgerton 899S) with Mod. RAS 138 19
Figure RAS-S6-5: Contingency 899ST3a (Edgerton 899S 138kV/25kV transformer) with Mod. RAS 138..... 20
Figure RAS-S6-6: Contingency 912L \ 9L912 (Red Deer 63S-Nevis 766S) with Mod. RAS 134/ Mod. RAS 138..21
Figure RAS-S6-7: Contingency 9L20 (Cordel 755S-Nevis 766S) with Mod.RAS 134/ Mod.RAS 138/ Mod.RAS 139 22
Figure RAS-S6-8: Contingency EATL with Mod. RAS 134/ Mod. RAS 138 23

Sensitivity Scenario 4a (2022SP) 24
Figure RAS-S4a-1: 749L\749AL (Metiskow 648S-Edgerton 899S) with Mod.RAS 138 and 491L opene 25
Figure RAS-S4a-2: 766S901T (Nevis 766S 240kV/138kV transformer) with Mod.RAS 134 and lines 491L and 174L opened 26
Figure RAS-S4a-3: 7L701\7LA701\701L (Strome 223S -Battle River 757S) with Mod.RAS 138 27
Figure RAS-S4a-4: 7L749\749L\7LB749 Lloydminster 716S-Edgerton 899S) with Mod.RAS 138 and 491L opened..... 28
Figure RAS-S4a-5: 899ST3a (Edgerton 899S 138kV/25kV transformer) with Mod.RAS 138 and 491L opened. 29
Figure RAS-S4a-6: 912L\9L912 (Red Deer 63S-Nevis 766S) with Mod.RAS 134/ Mod.RAS 138 and lines 491L and 174L opened 30
Figure RAS-S4a-7: 966L\9L966 (Hansman Lk. 650S - Pemukan 932S) with New 7L224 RAS 31
Figure RAS-S4a-8: 9L20 (Cordel 755S -Nevis 766S) with Mod.RAS 134/ Mod.RAS 138/ Mod.RAS 139..... 32
Figure RAS-S4a-9: EATL with Mod.RAS 134/ Mod.RAS 138 and lines 491L and 174L opened 33

Sensitivity Scenario 4b (2022SP) 34
Figure RAS-S4b-1: 766S901T (Nevis 766S 240kV/138kV transformer) with Mod.RAS 134 35
Figure RAS-S4b-2: 912L\9L912 (Red Deer 63S-Nevis 766S) with Mod.RAS 134 36

Figure RAS-S4b-3: 966L\9L966 (Hansman Lk. 650S-Pemukan 932S) with New 7L224 RAS 37
Figure RAS-S4b-4: 9L20 (Cordel 755S-Nevis 766S) with Mod.RAS 134/ Mod.RAS 139 38
Figure RAS-S4b-5: EATL with Mod.RAS 134 39
Sensitivity Scenario 4c (2022SP) 40
Figure RAS-S4c-1: 966L \ 9L966 (Hansman Lk. 650S-Pemukan 932S) with New 7L224 RAS 41

A6.2

Scenario 4 (2022SP)

Figure RAS-S4-1: Contingency: 648ST1 (Metiskow 648S transformer) with Mod. RAS 138 and 491L opened

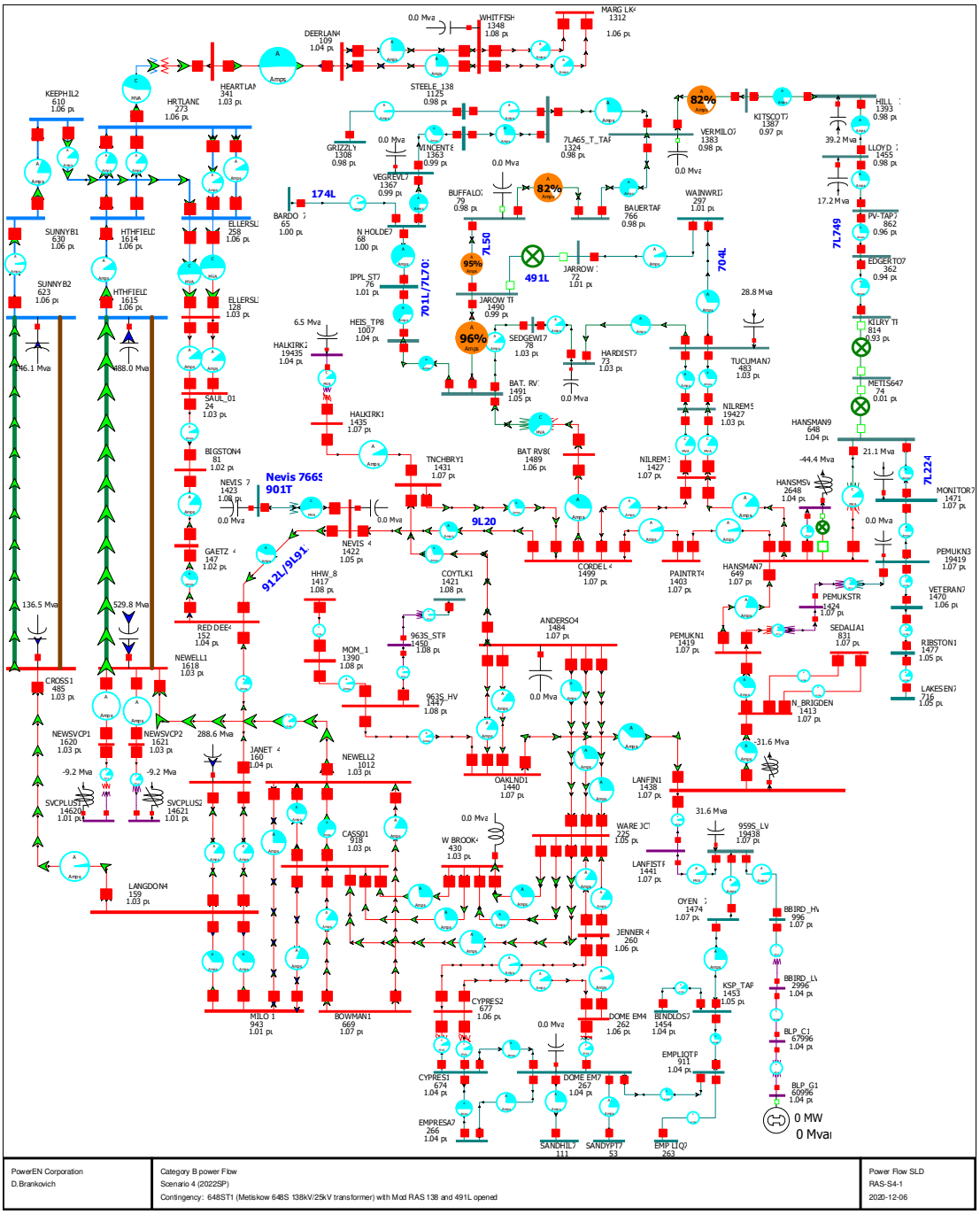


Figure RAS-S4-2: Contingency: 749L \749AL with Modified RAS 138

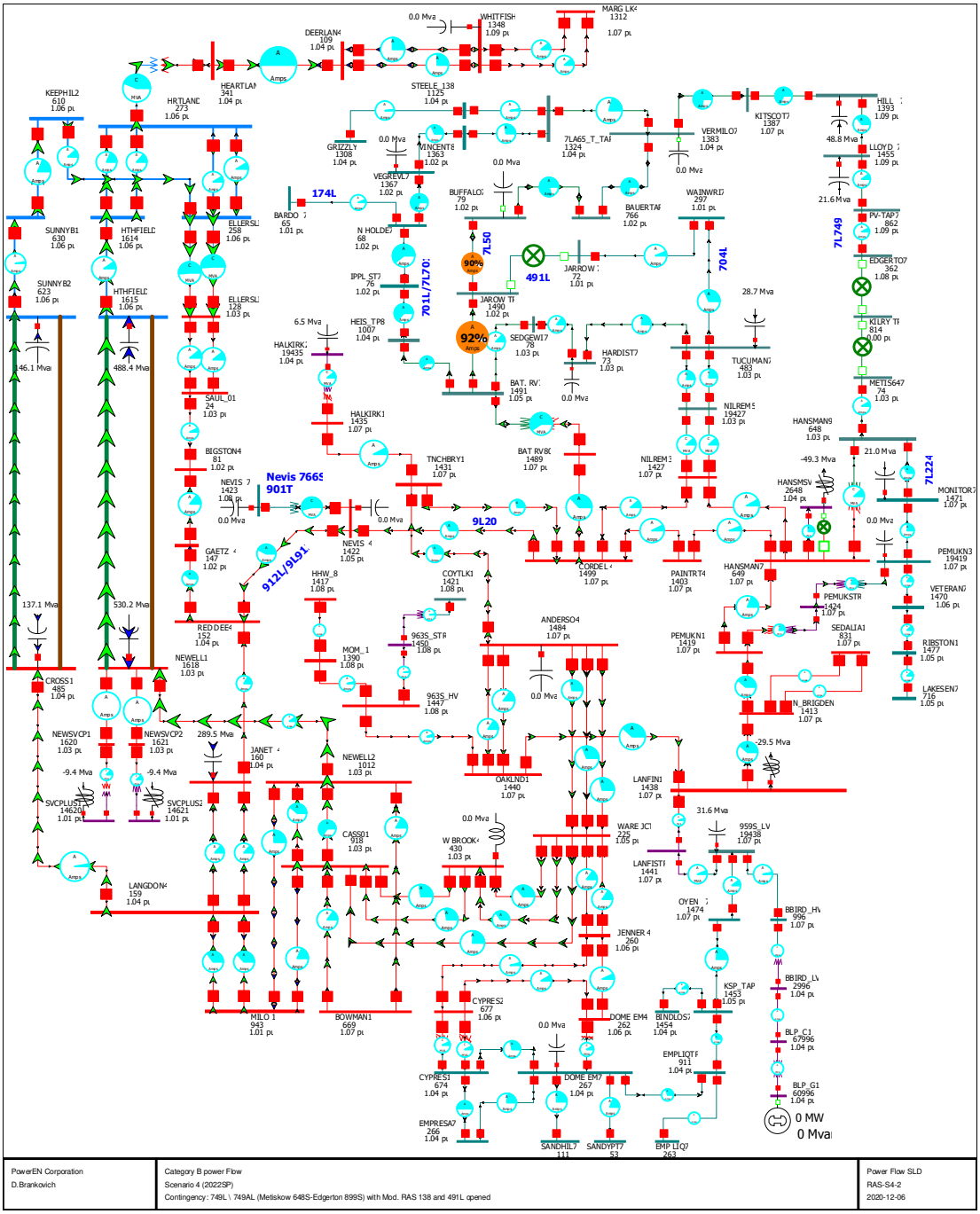


Figure RAS-S4-3: Contingency: 766S901T with Modified RAS 134/138

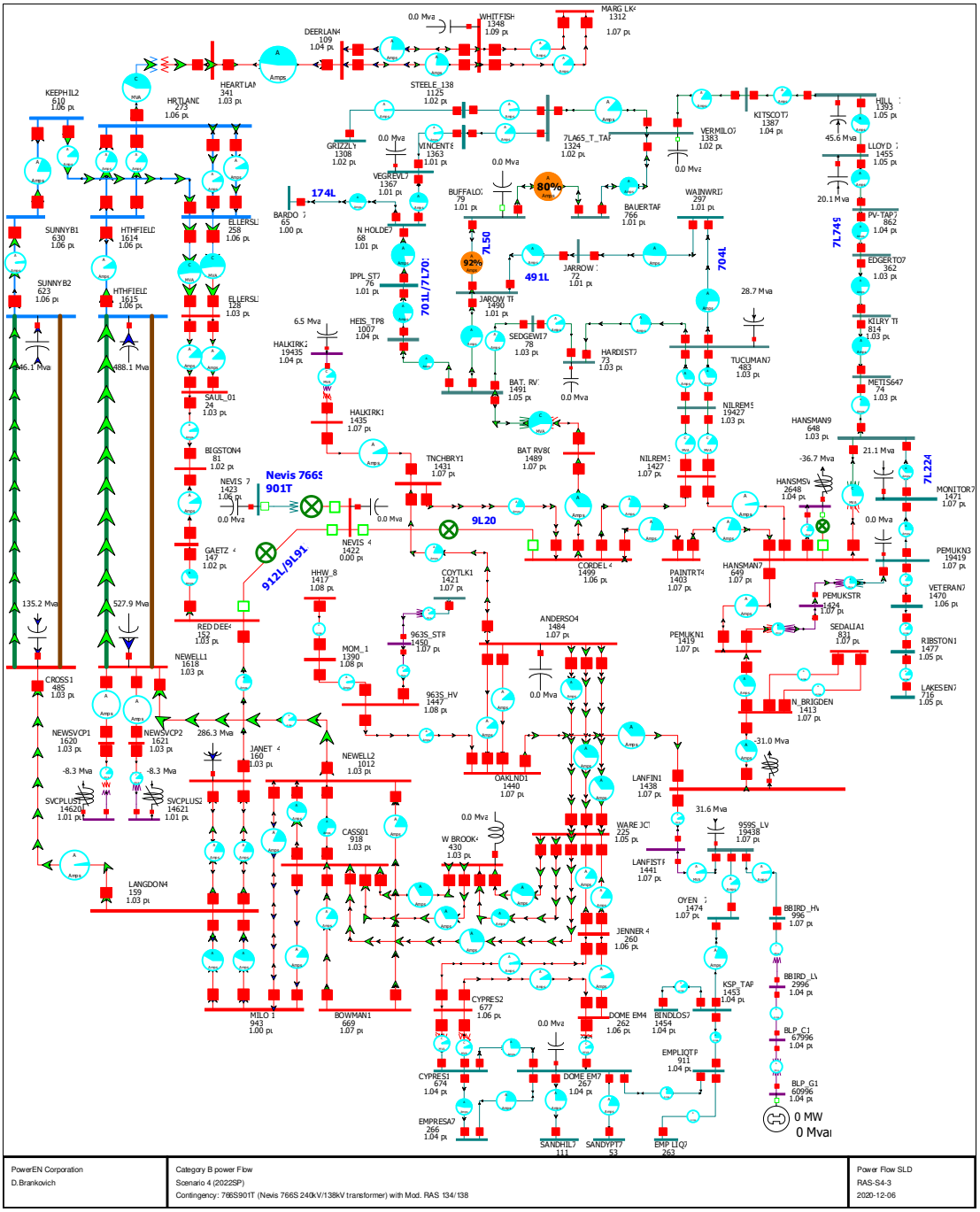


Figure RAS-S4-4: Contingency 7L749 \749L \7LB749 with Modified RAS 138

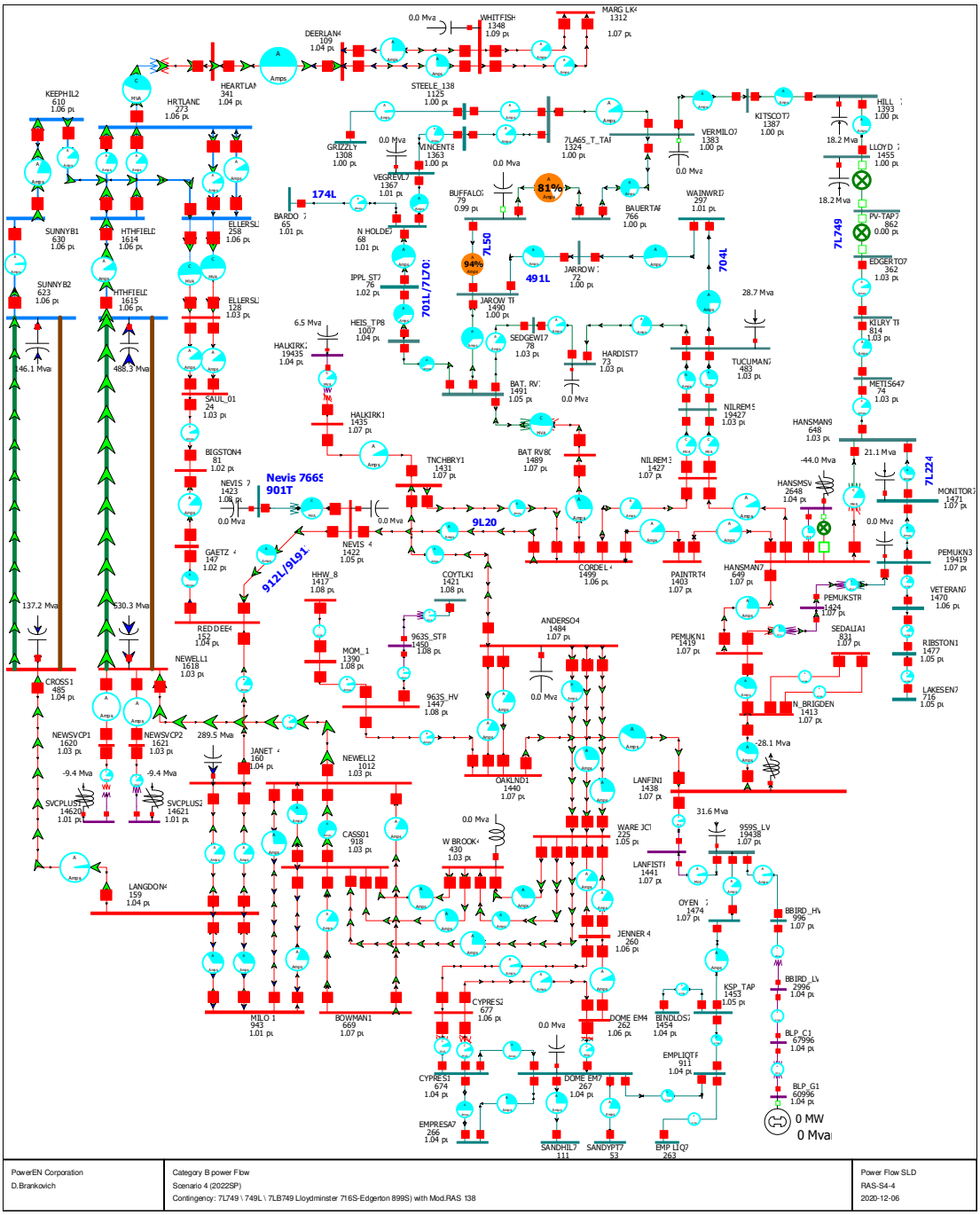


Figure RAS-S4-5: Contingency 899ST3a with Modified RAS 138

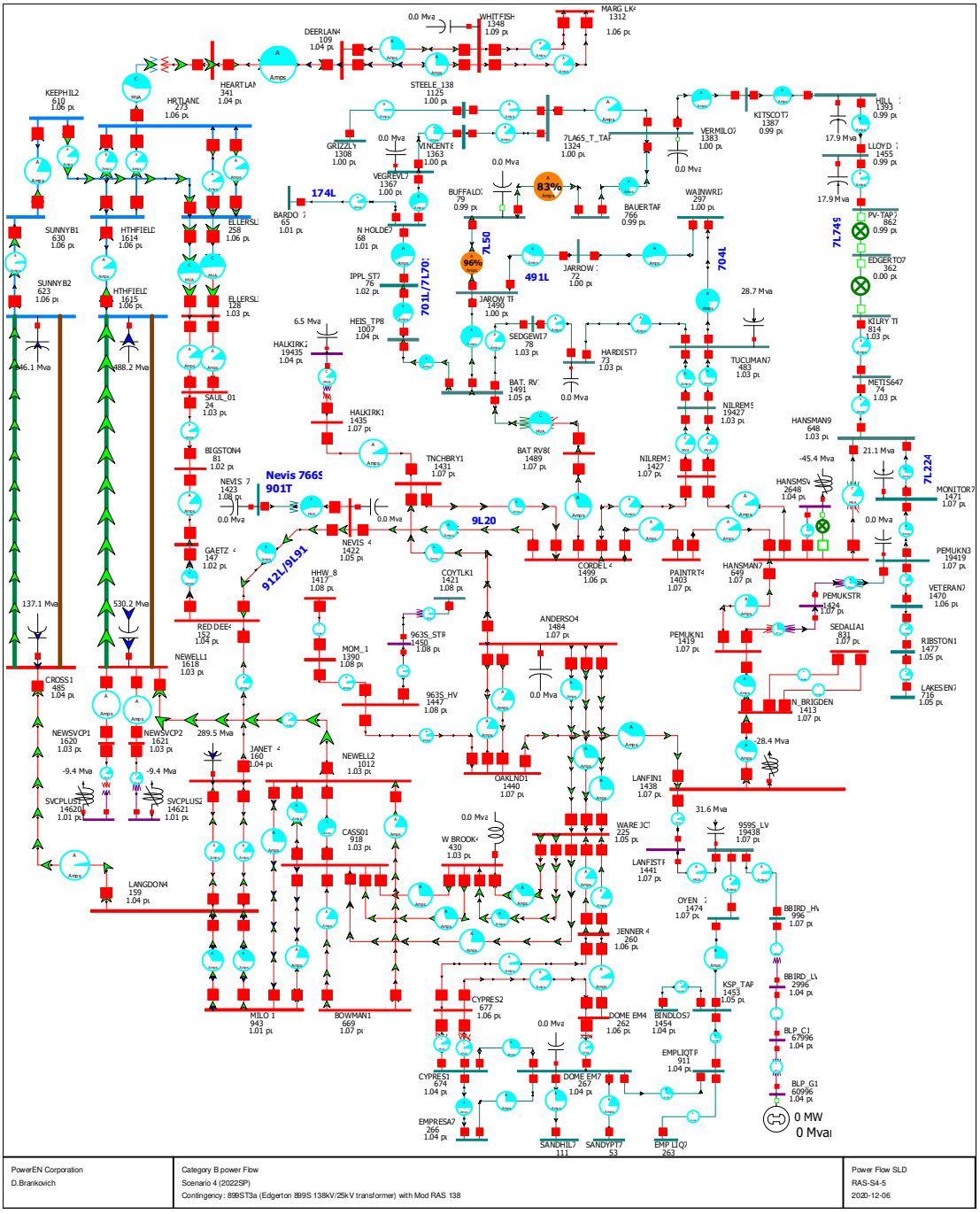


Figure RAS-S4-6: Contingency: 912L \9L912 with Modified RAS 134/138

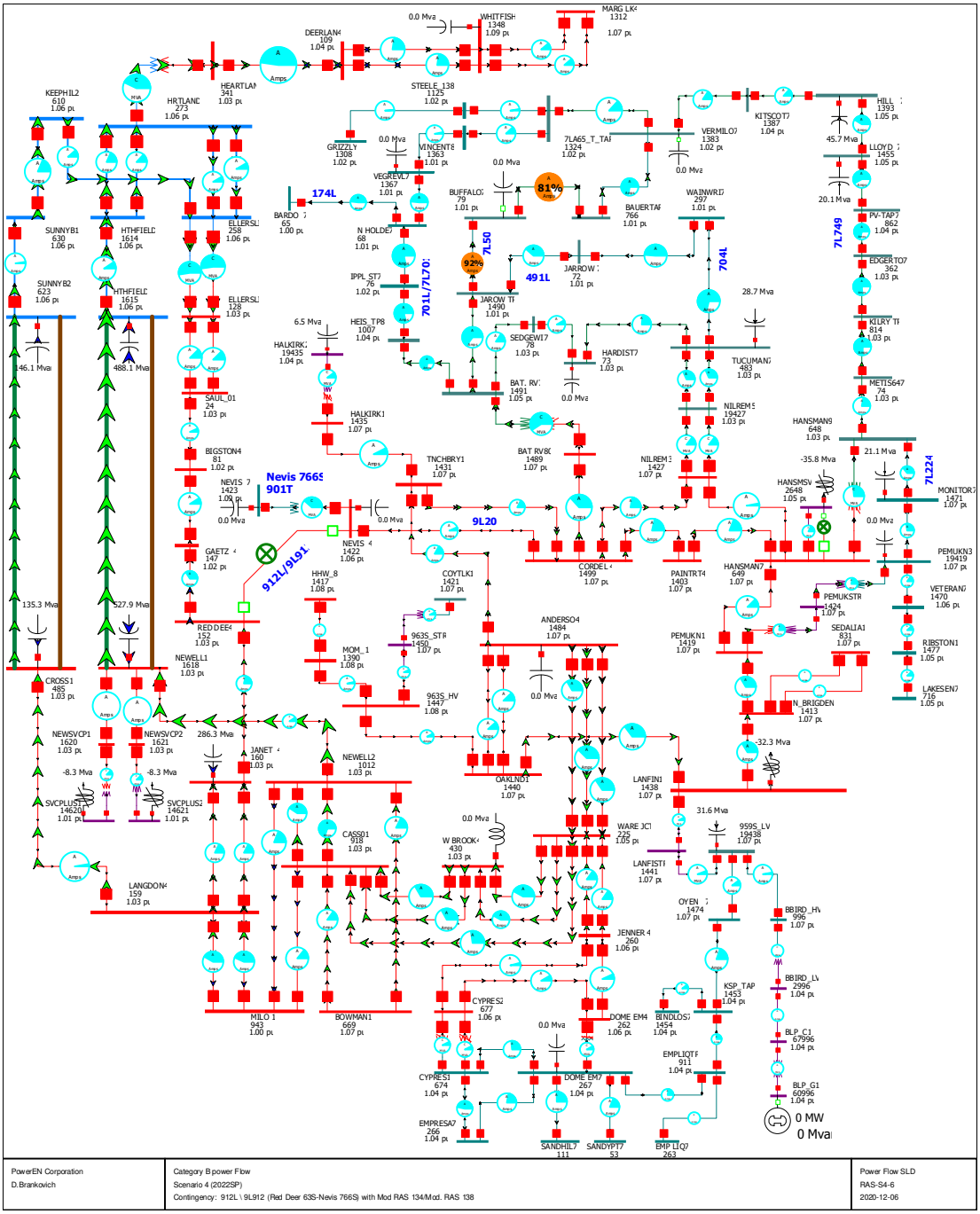


Figure RAS-S4-7: Contingency: 966L \ 9L966 (Hansman Lk. 650S-Pemukan 932S) with new RAS 7L224

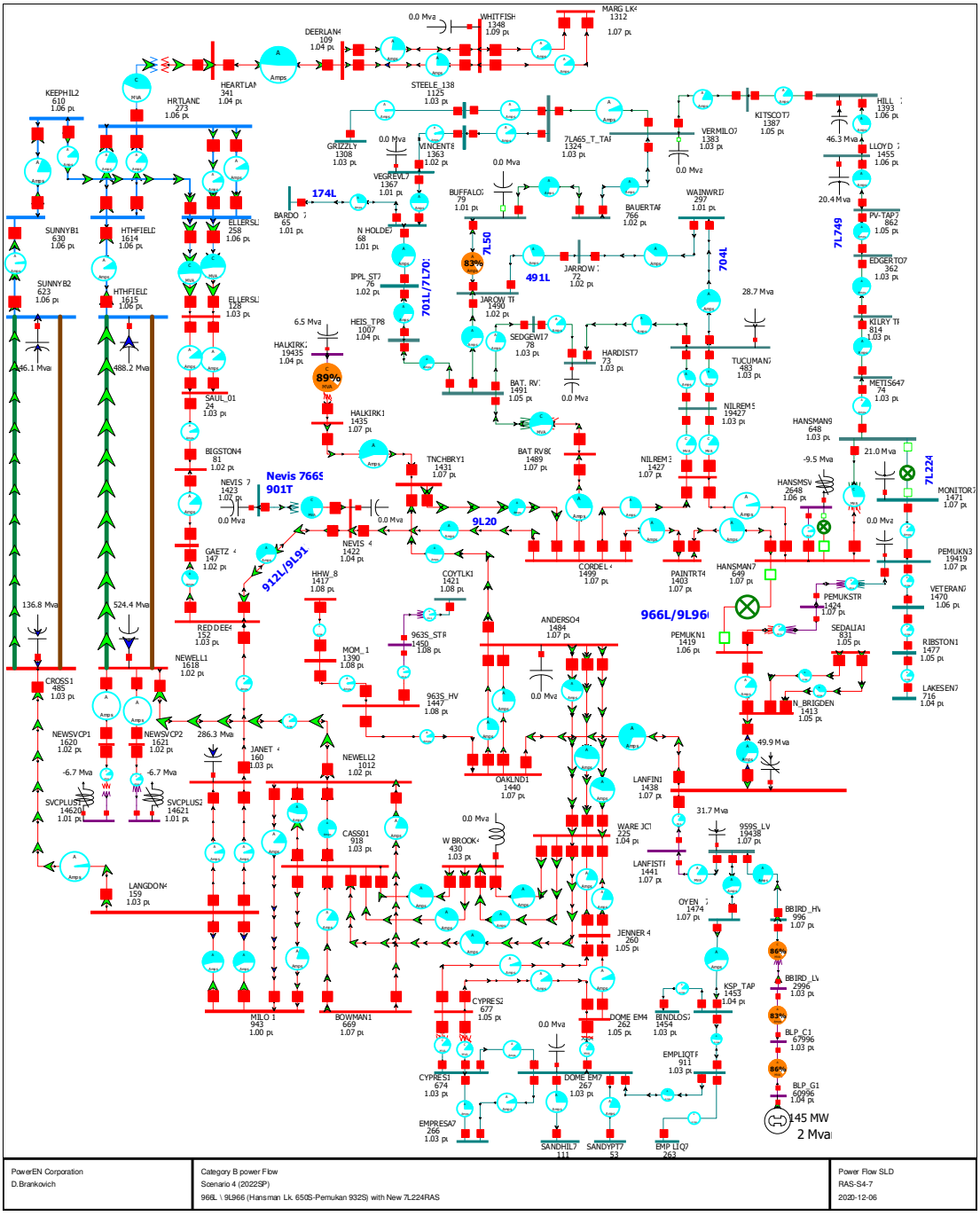


Figure RAS-S4-8: Contingency 9L20 (Cordel 755S-Nevis 766S) with Mod. RAS 138/ Mod. RAS 139

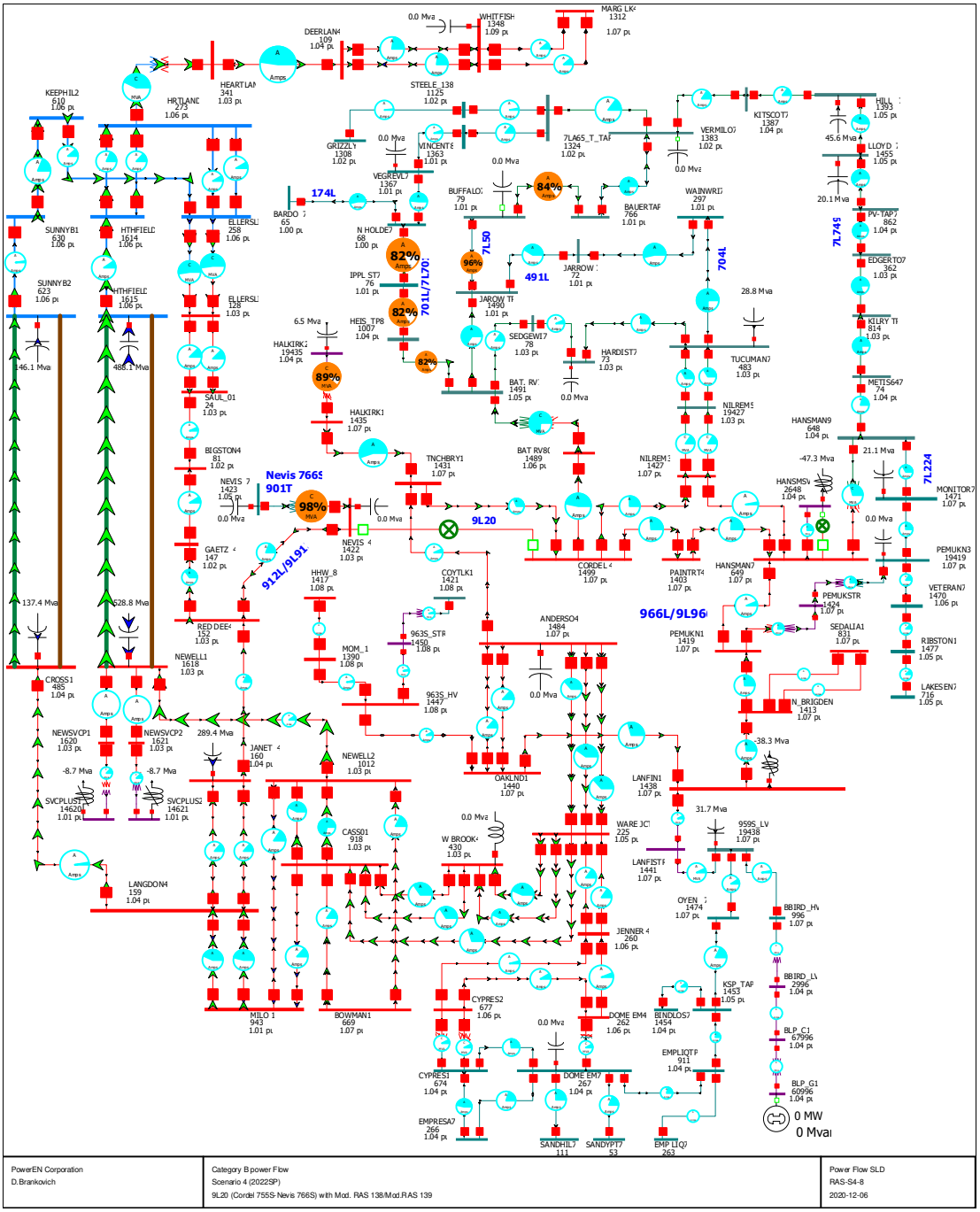
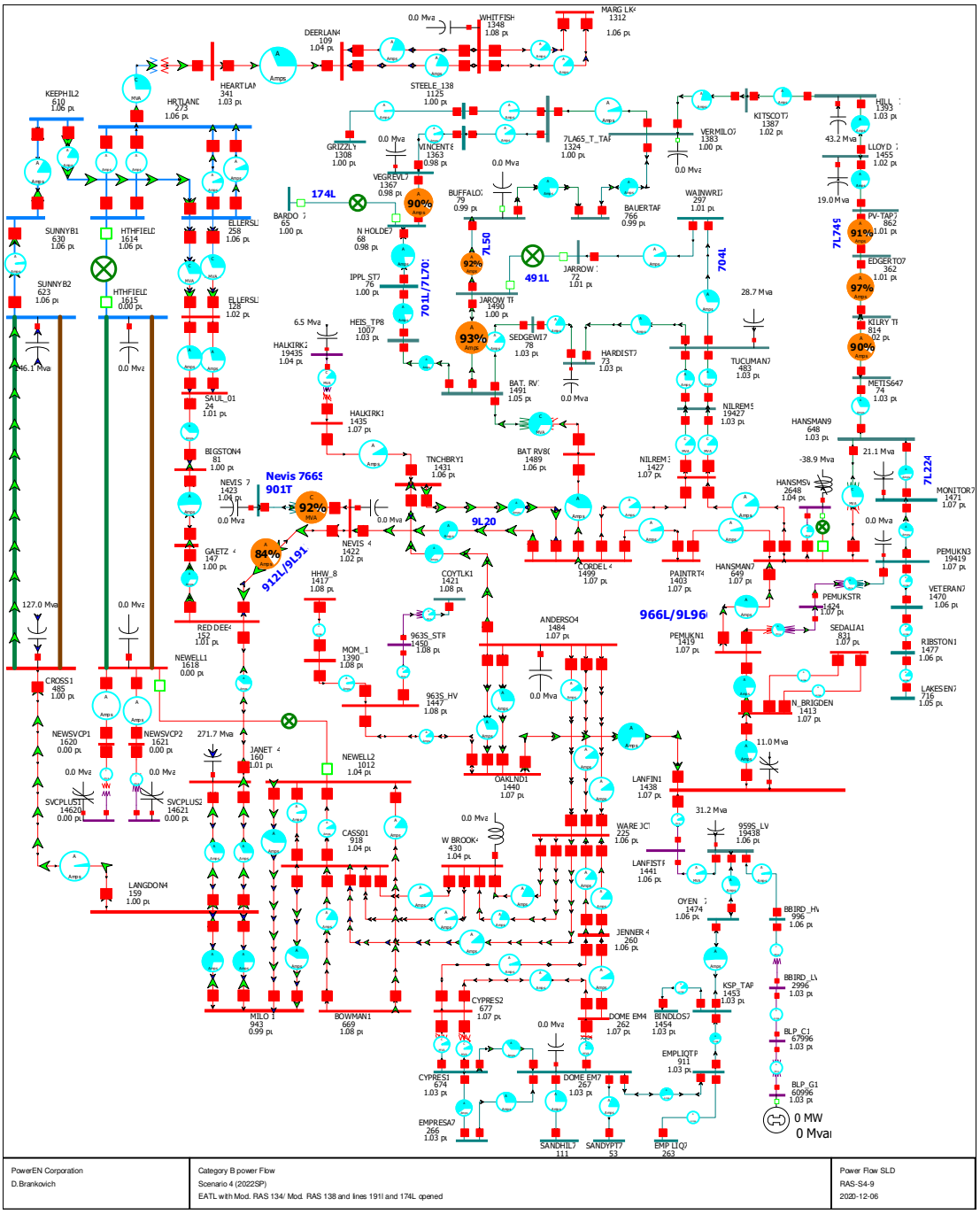


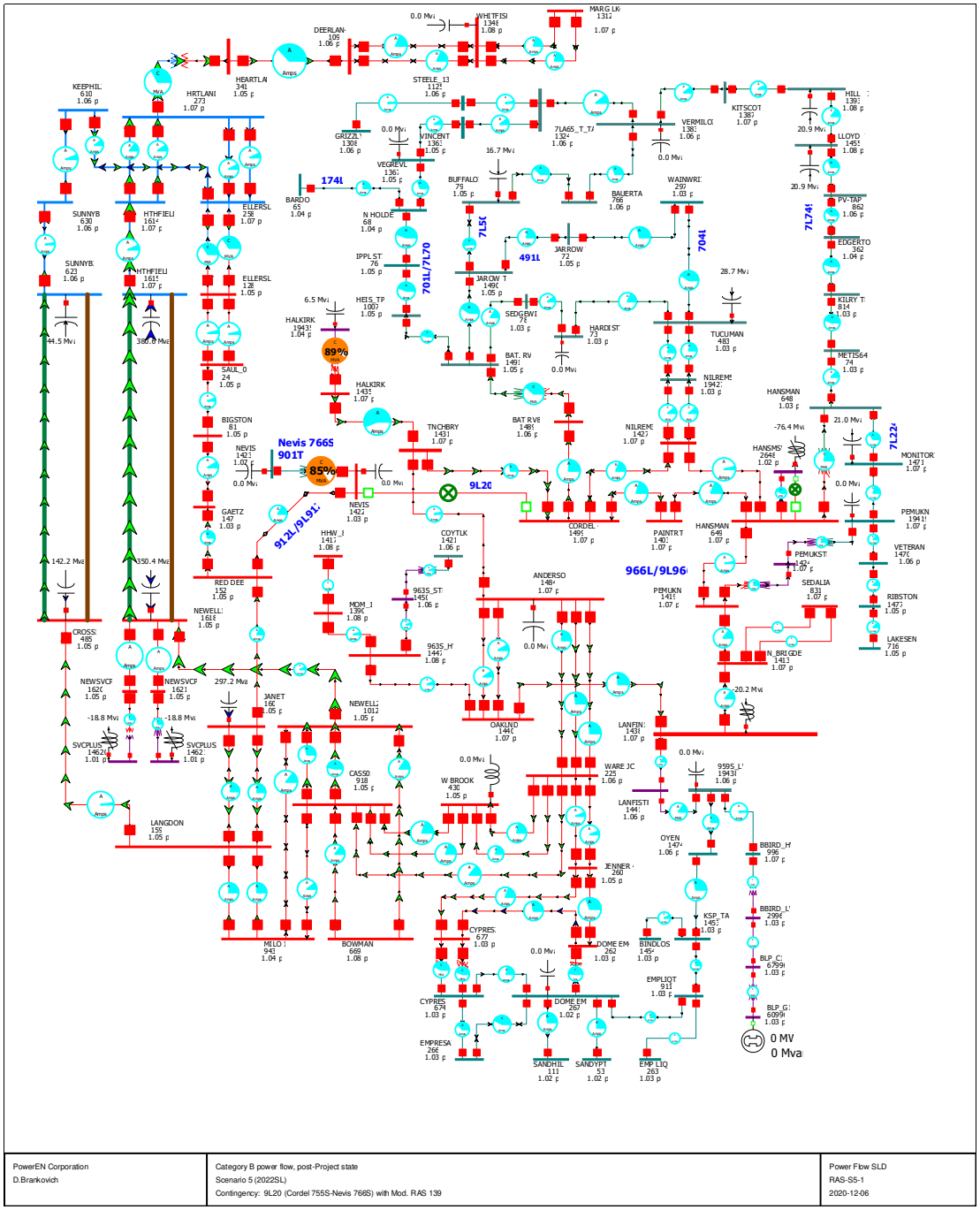
Figure RAS-S4-9: Contingency EATL with Mod.RAS 138/ Mod.RAS 139



A6.1

Scenario 5 (2022SL)

Figure RAS-S5-1: Contingency 9L20 with Modified RAS 139



PowerEN Corporation D.Brankovich	Category B power flow, post-Project state Scenario 5 (2022SL) Contingency: 9L20 (Cordel 755S-Nevis 766S) with Mod. RAS 139	Power Flow SLD RAS-S5-1 2020-12-06

A6.3

Scenario 6 (2022WP)

Figure RAS-S6-1: 648ST1 (Metiskow 648S 138 kV/25 kV transformer) with Mod.RAS 138 and 491L opened

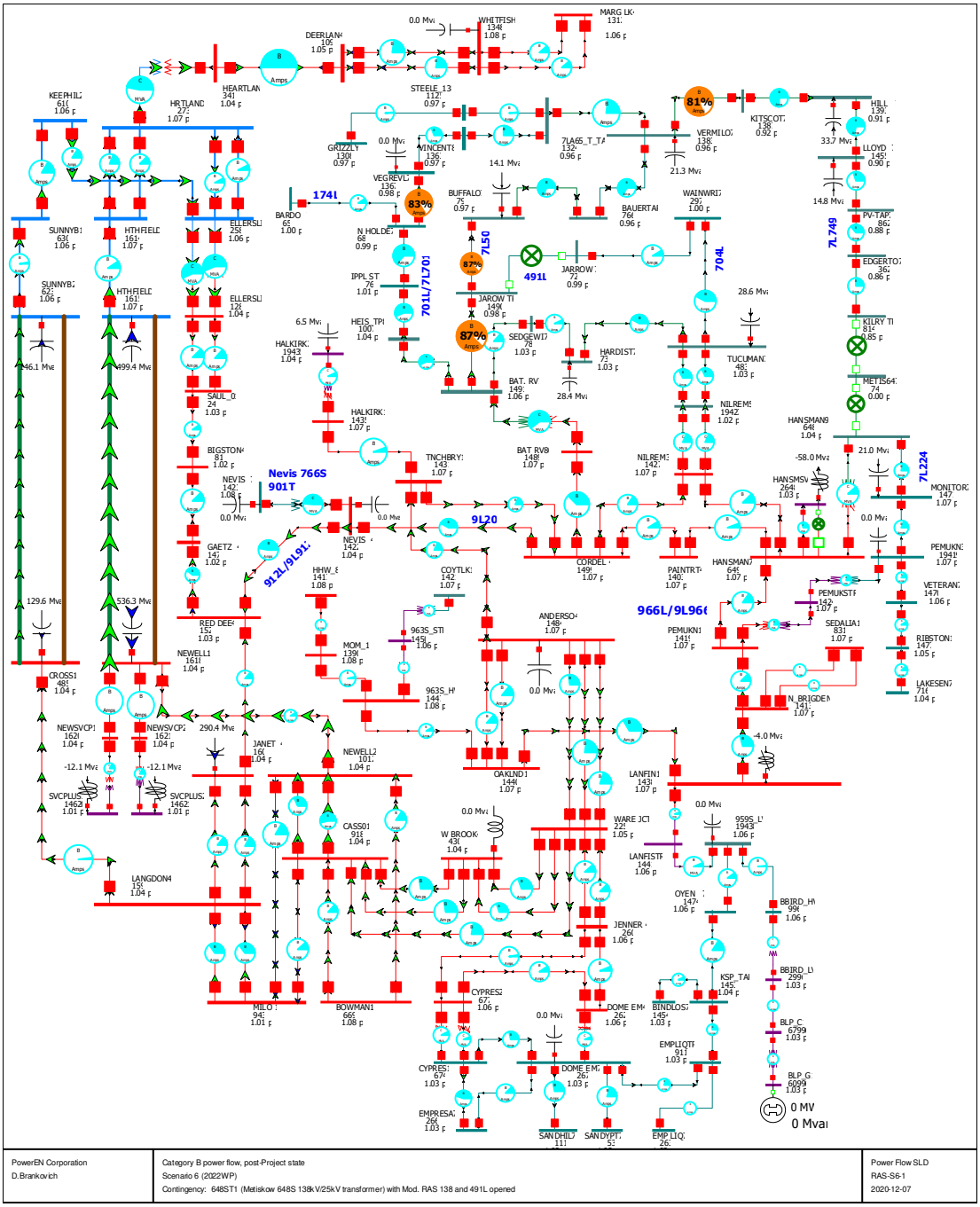


Figure RAS-S6-2: Contingency 749L \ 749AL (Metiskow 648S-Edgerton 899S) with Mod RAS 138

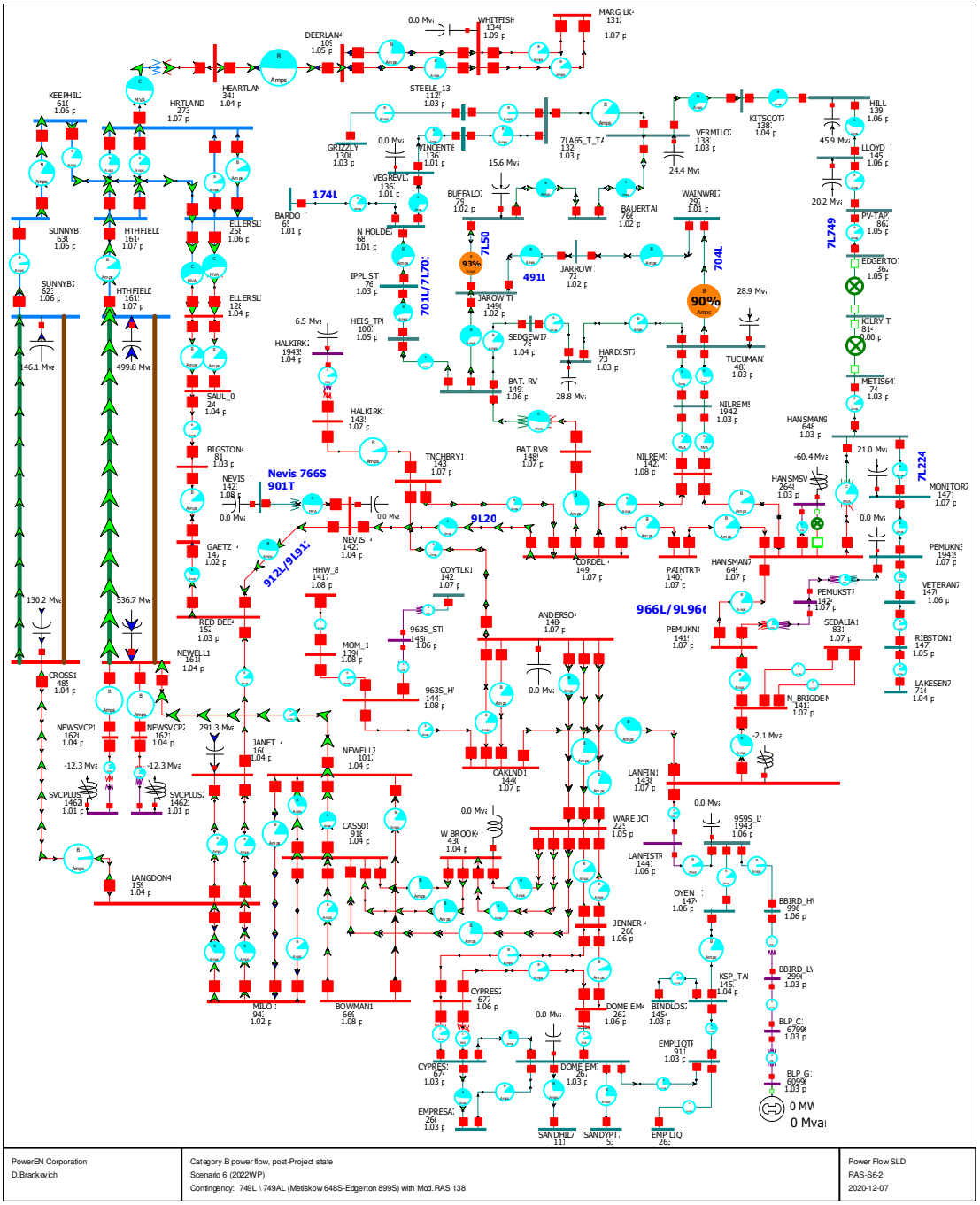


Figure RAS-S6-3: Contingency 766S901T (Nevis 766S 240kV/138kV transformer) with Mod. RAS 134/ Mod. RAS 138

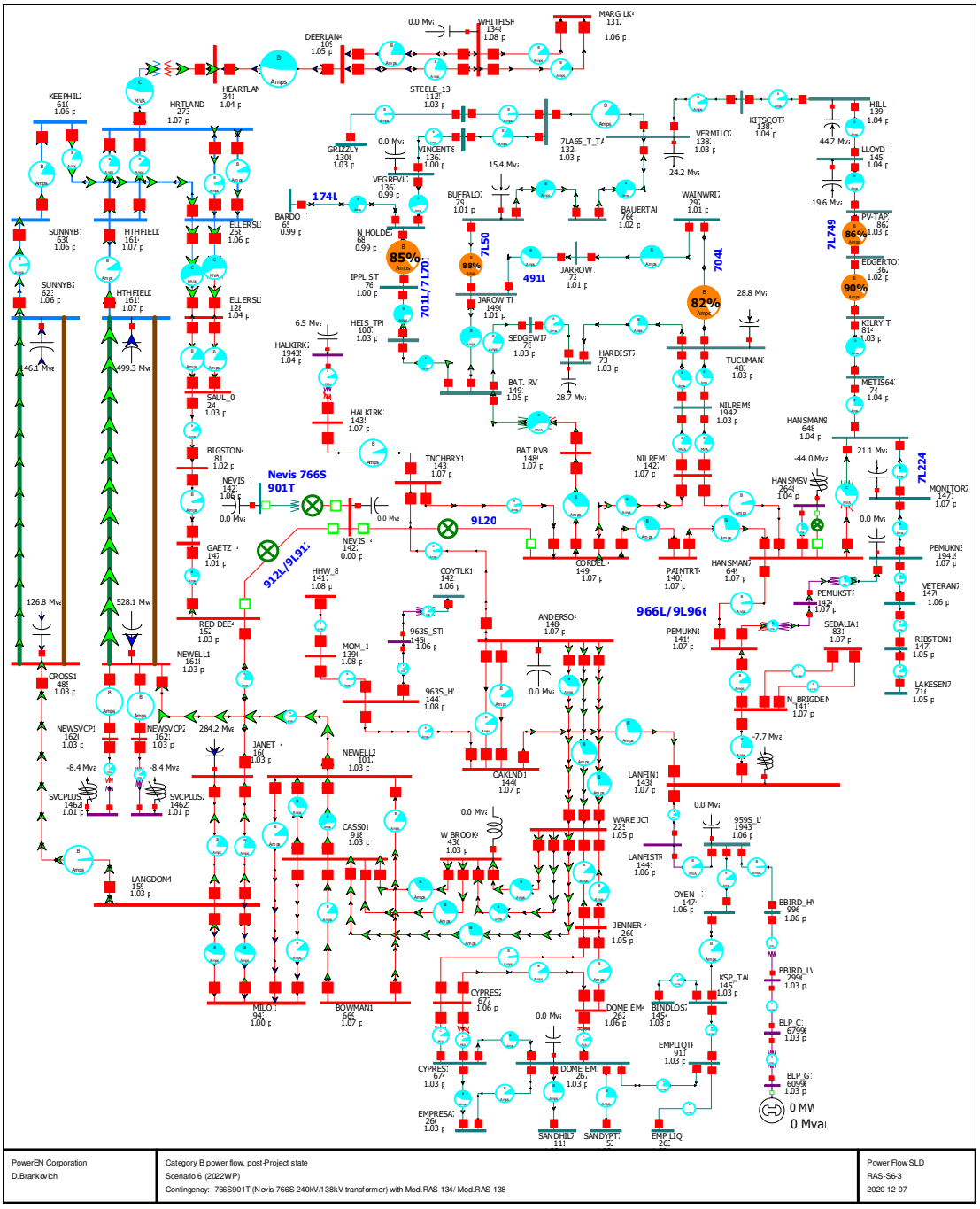


Figure RAS-S6-4: Contingency 7L749 \ 749L \ 7LB749 Lloydminster 716S-Edgerton 899S) with Mod. RAS 138

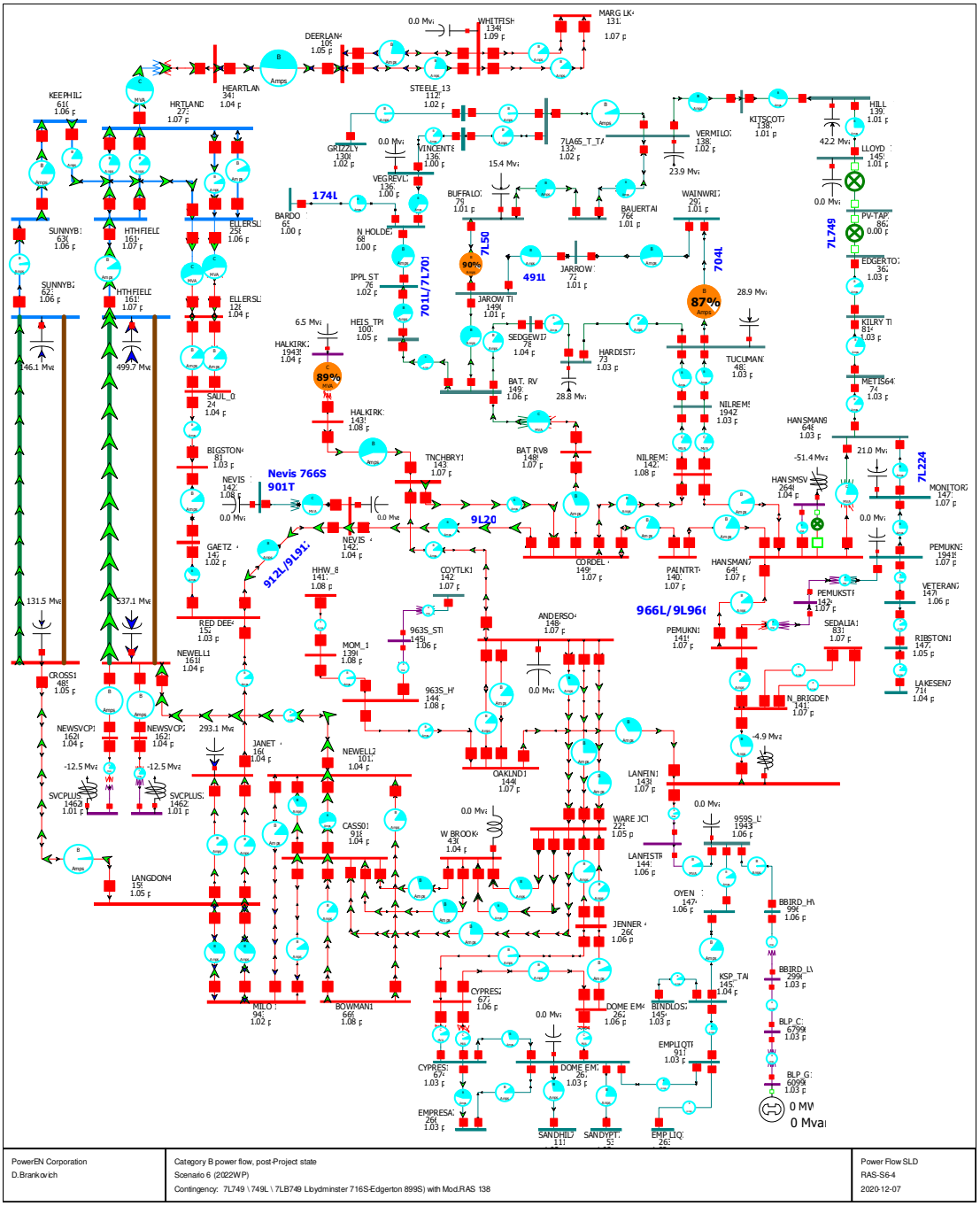


Figure RAS-S6-5: Contingency 899ST3a (Edgerton 899S 138kV/25kV transformer) with Mod. RAS 138

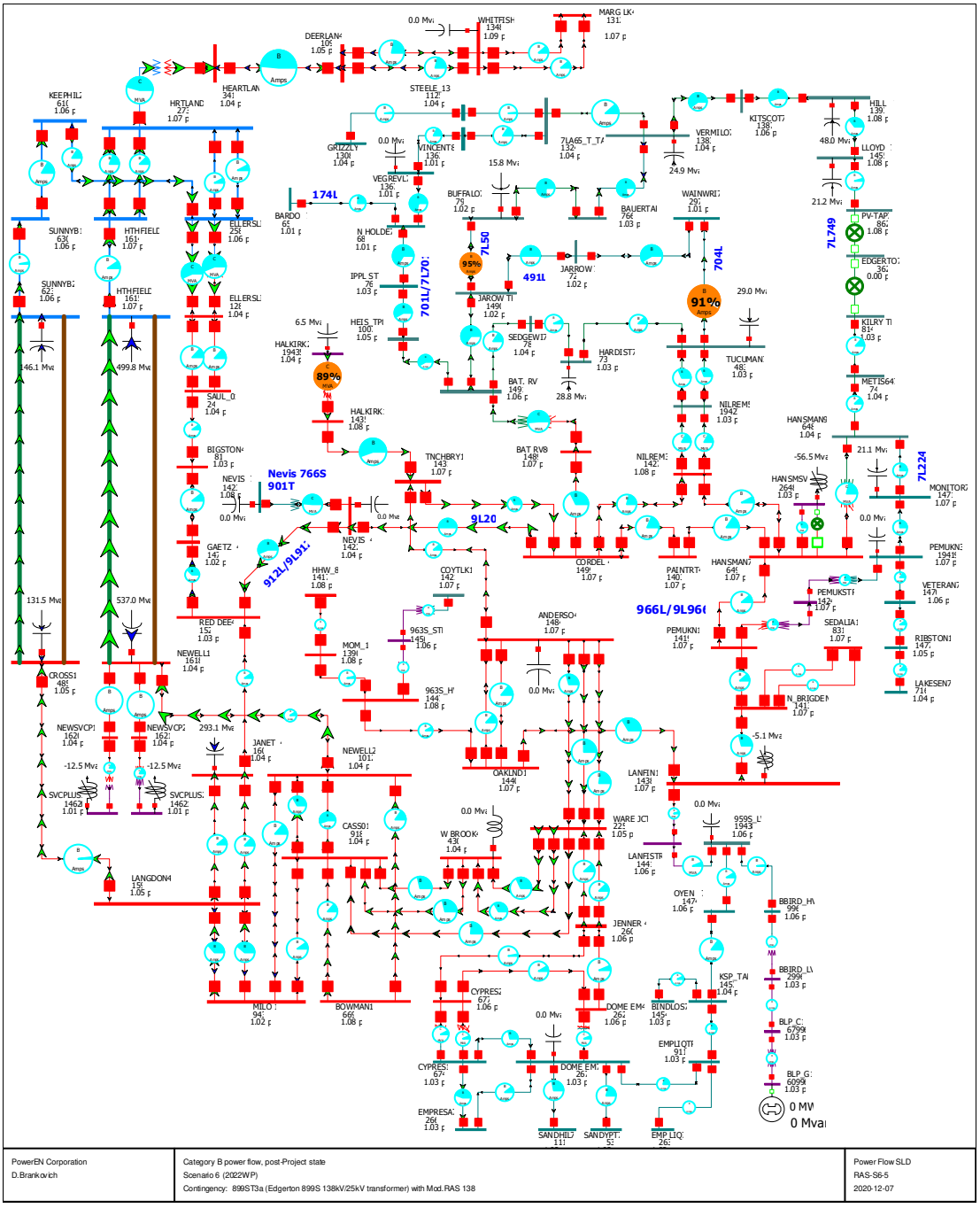


Figure RAS-S6-6: Contingency 912L \ 9L912 (Red Deer 63S-Nevis 766S) with Mod. RAS 134/ Mod. RAS 138

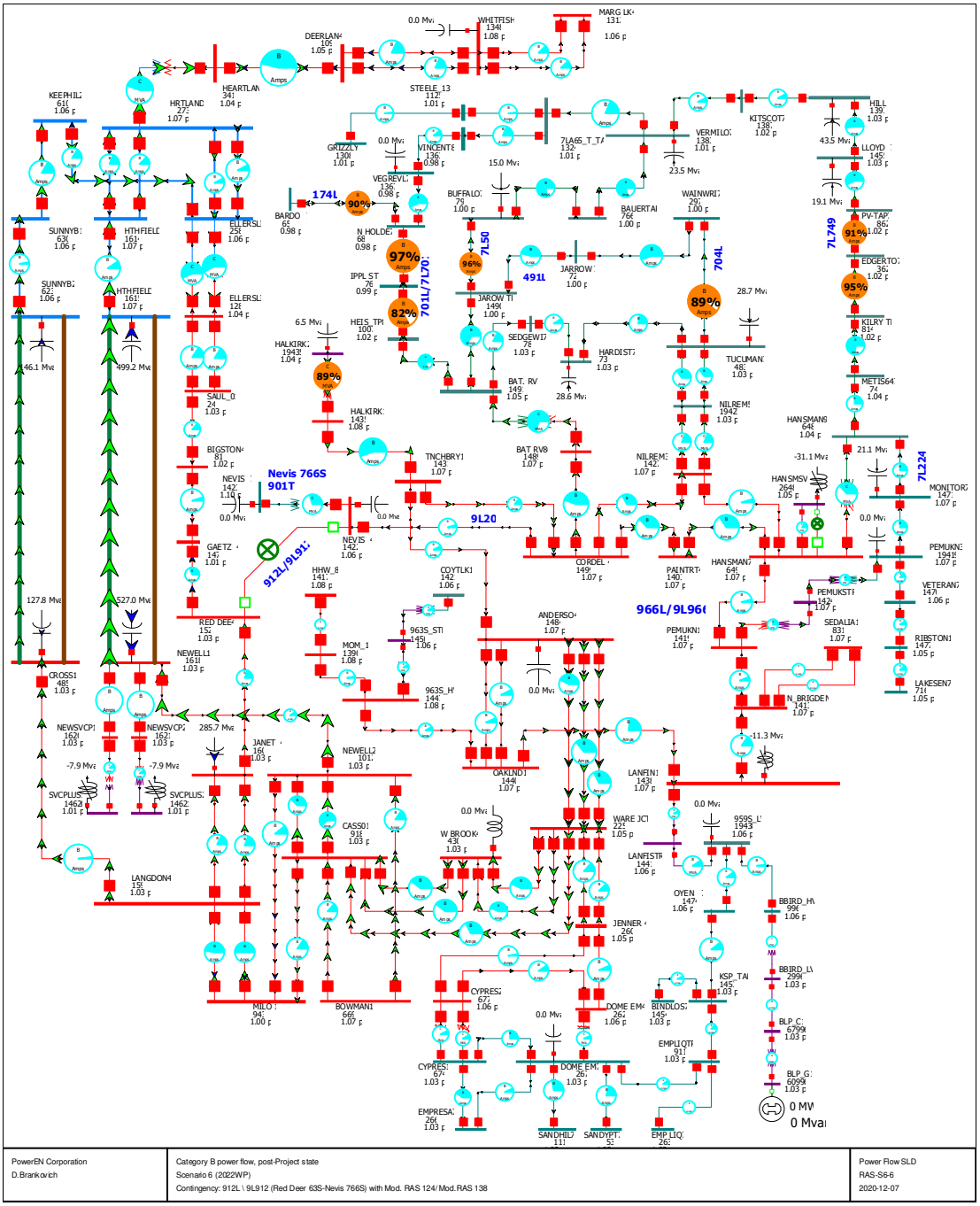


Figure RAS-S6-7: Contingency 9L20 (Cordel 755S-Nevis 766S) with Mod.RAS 134/ Mod.RAS 138/ Mod.RAS 139

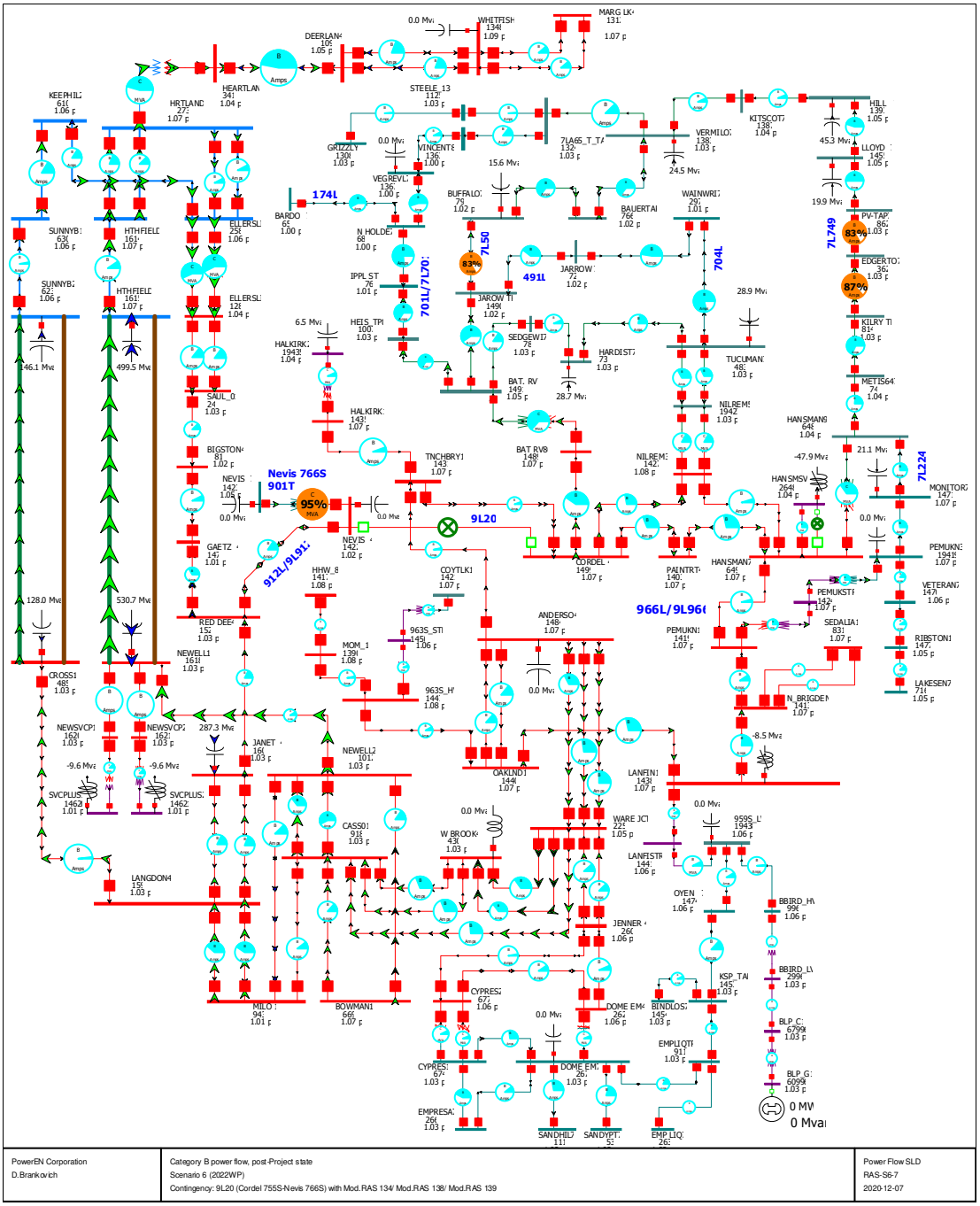
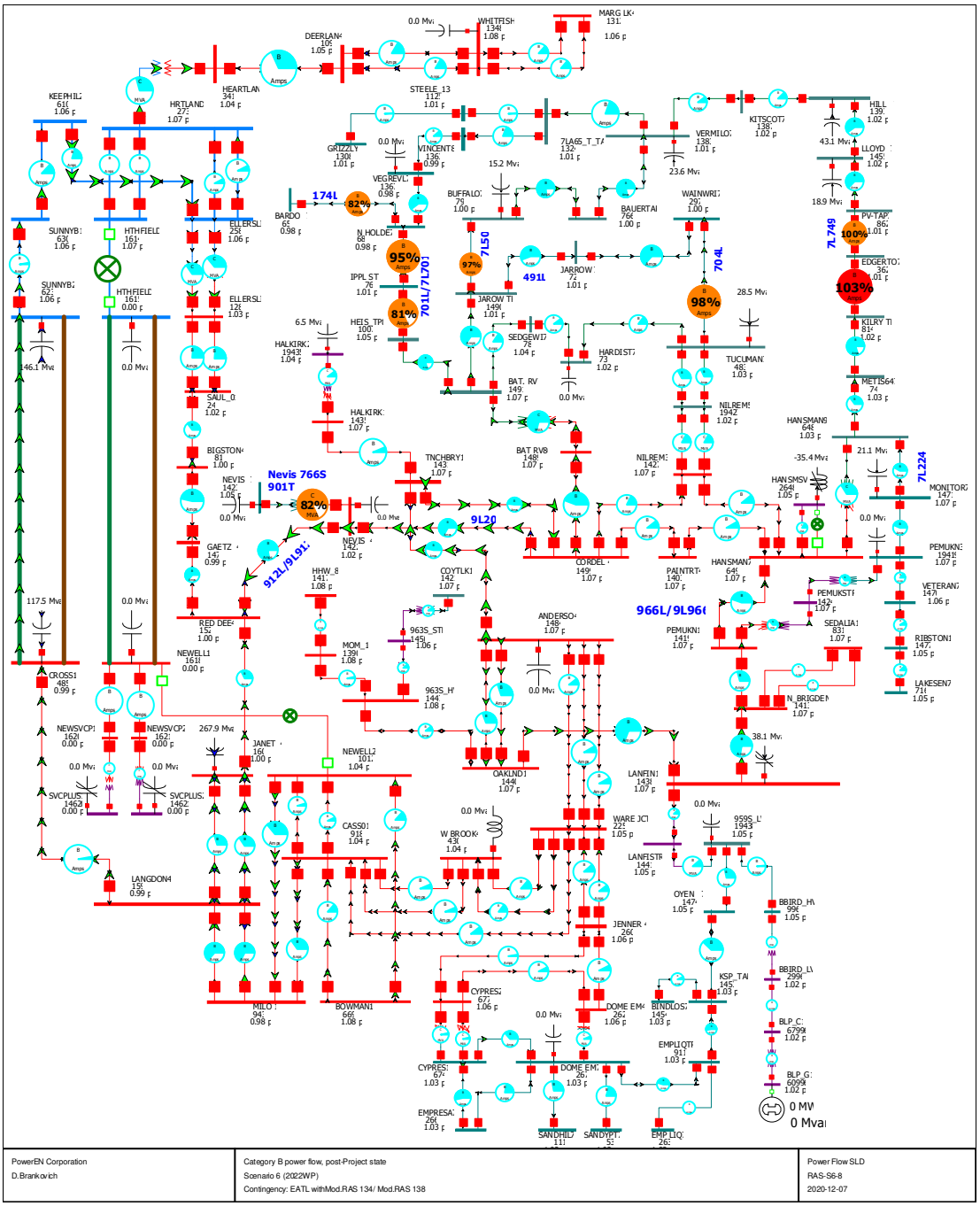


Figure RAS-S6-8: Contingency EATL with Mod. RAS 134/ Mod. RAS 138



A6.4

Sensitivity Scenario 4a (2022SP)

Figure RAS-S4a-1: 749L\749AL (Metiskow 648S-Edgerton 899S) with Mod.RAS 138 and 491L opened

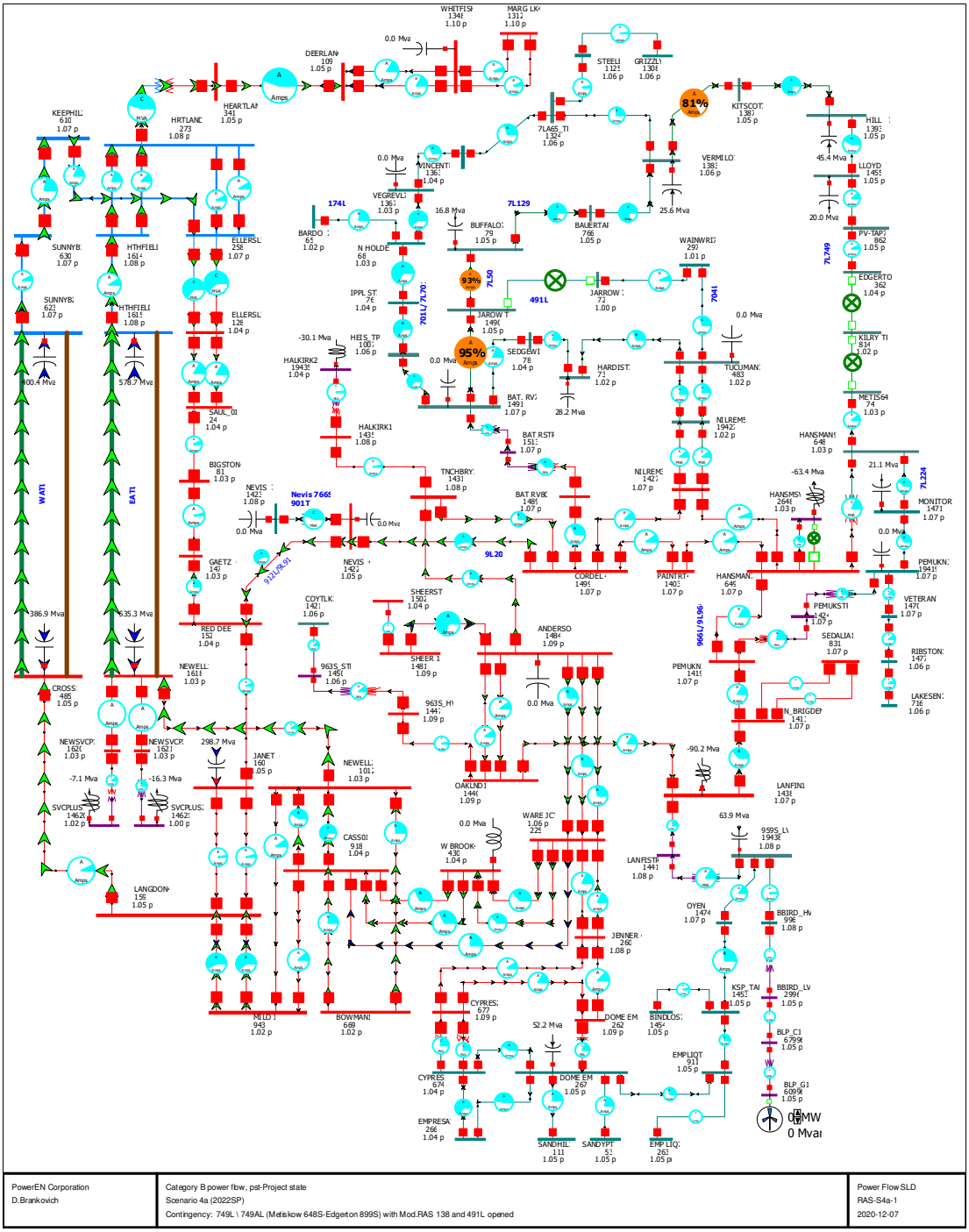
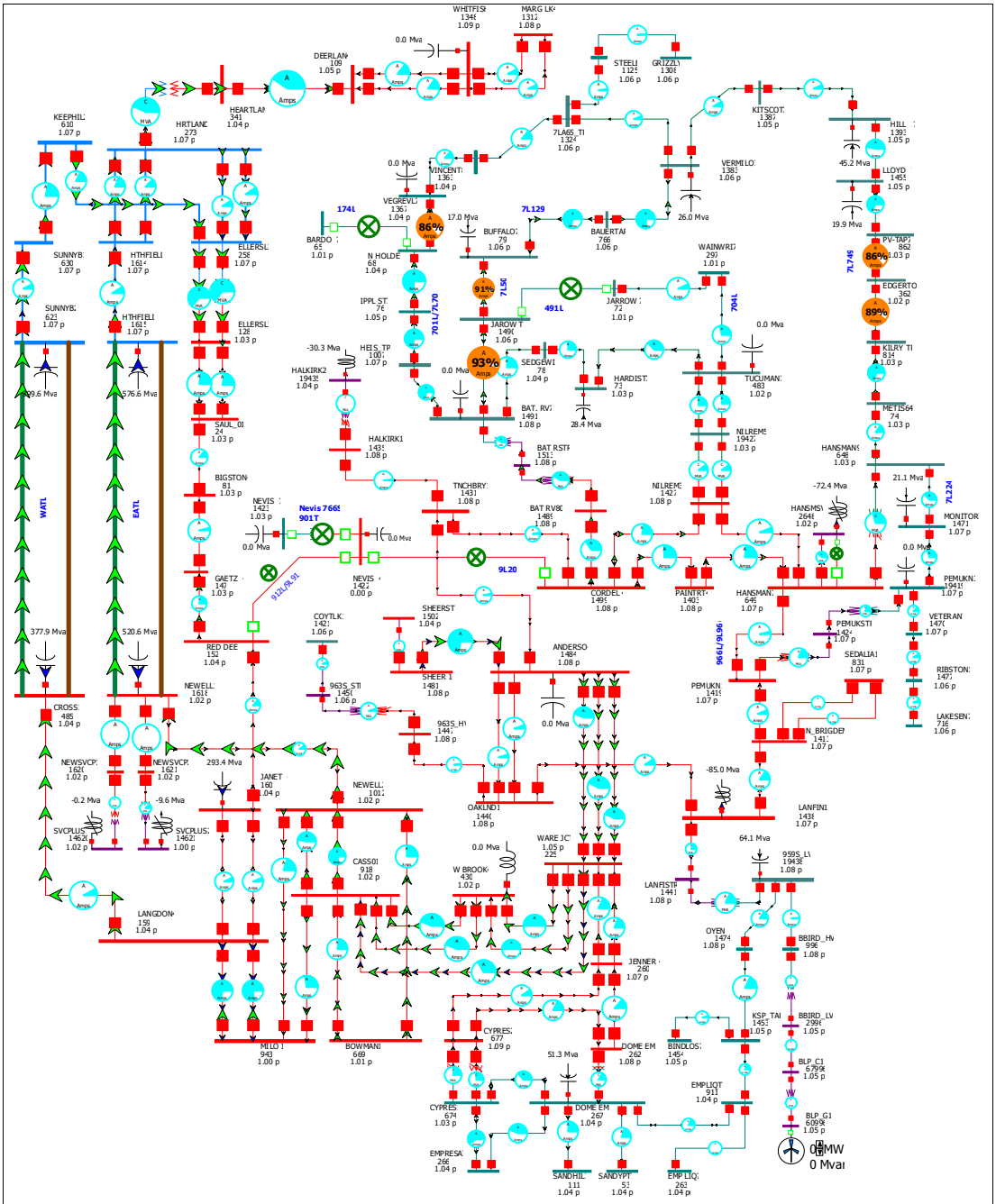


Figure RAS-S4a-2: 766S901T (Nevis 766S 240kV/138kV transformer) with Mod.RAS 134 and lines 491L and 174L opened



PowerEN Corporation D.Brankovich	Category B power flow, pst-Project state Scenario 4a (2022SP) Contingency: 766S901T (Nevis 766S 240kV/138kV transformer) with Mod.RAS 134 and lines 491Land 174L opened	Power Flow SLD RAS-S4a-2 2020-12-07

Figure RAS-S4a-3: 7L701\7LA701\701L (Strome 223S -Battle River 757S) with Mod.RAS 138

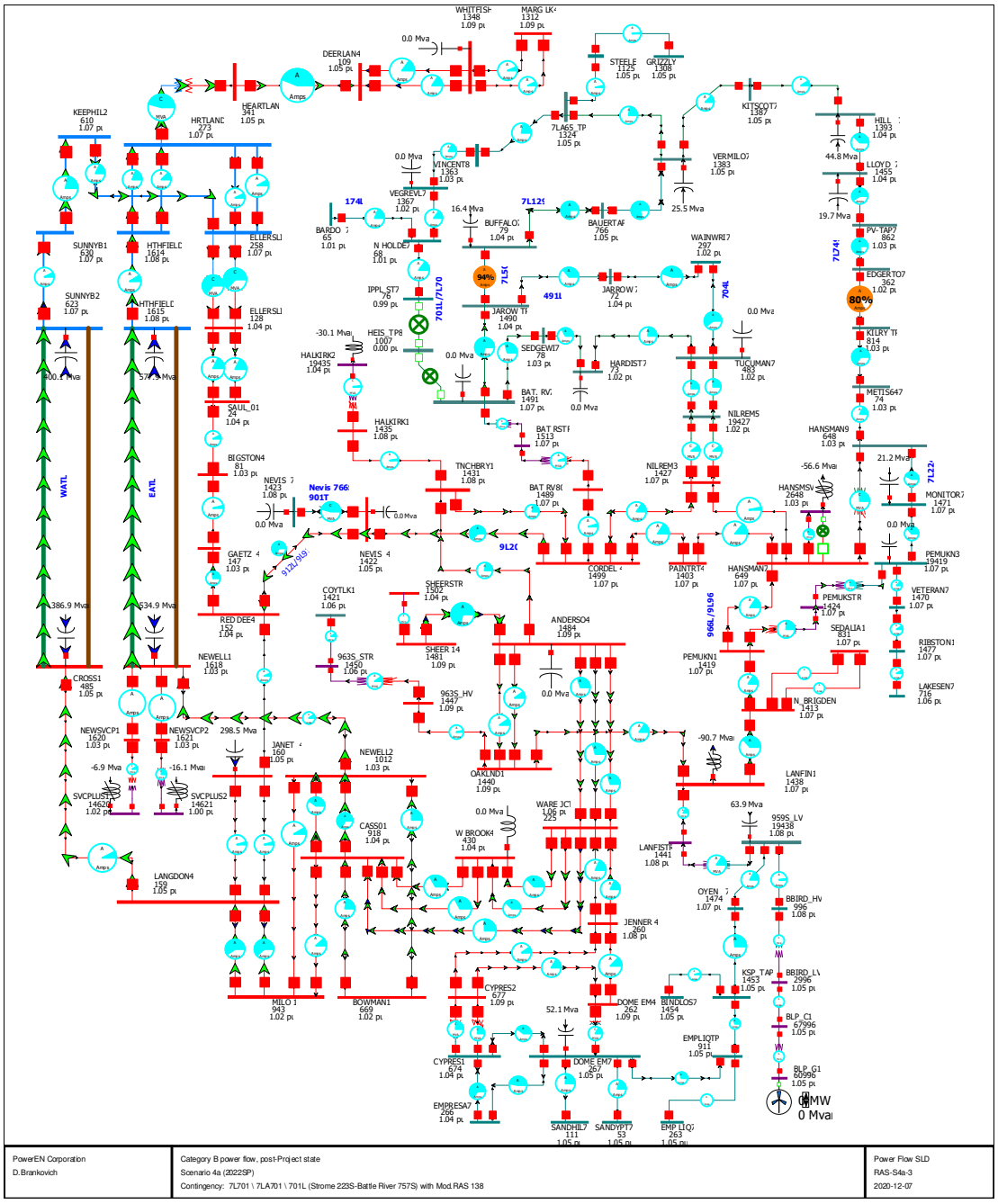


Figure RAS-S4a-4: 7L749\749L\7LB749 Lloydminster 716S-Edgerton 899S) with Mod.RAS 138 and 491L opened

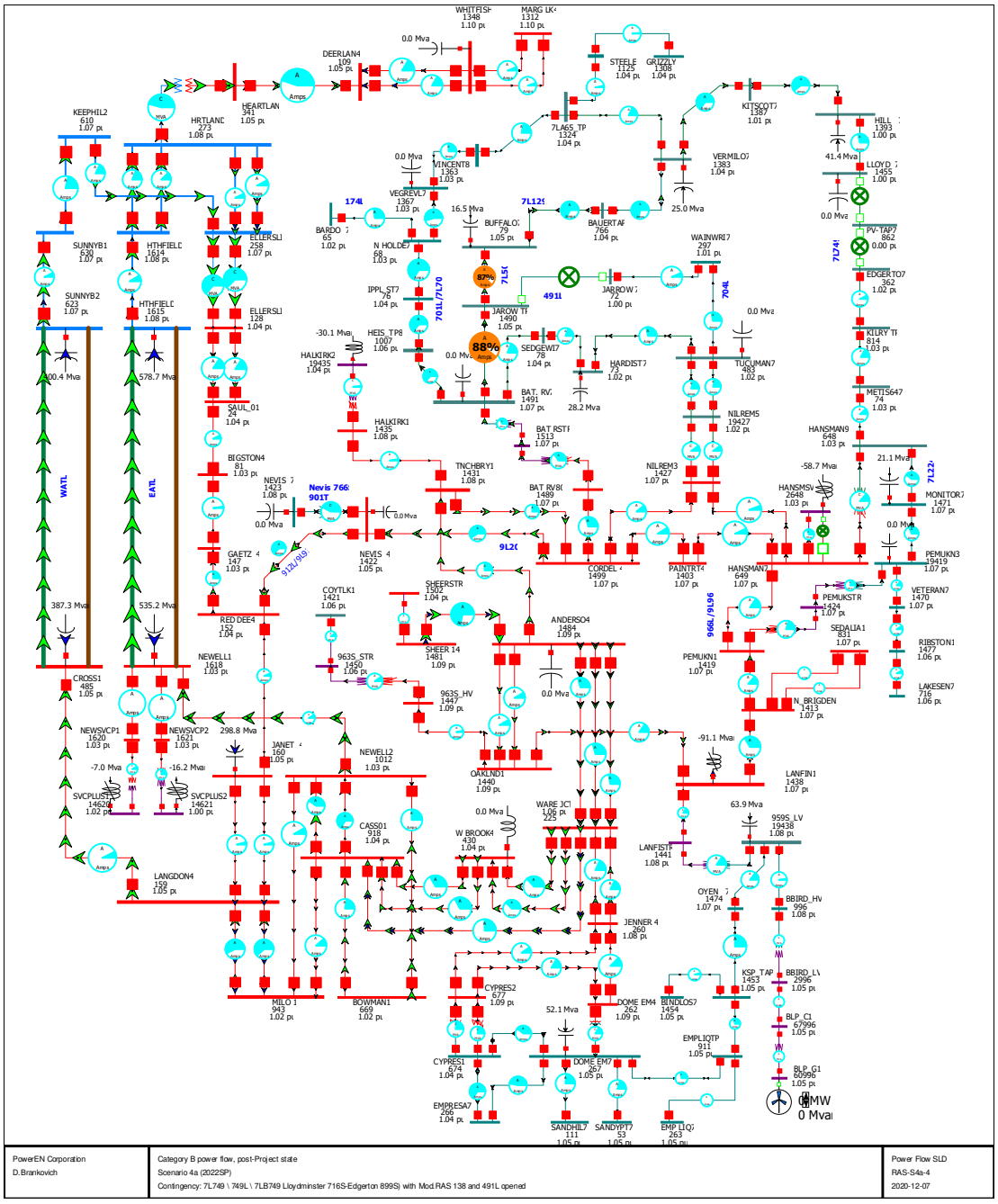


Figure RAS-S4a-5: 899ST3a (Edgerton 899S 138kV/25kV transformer) with Mod.RAS 138 and 491L opened

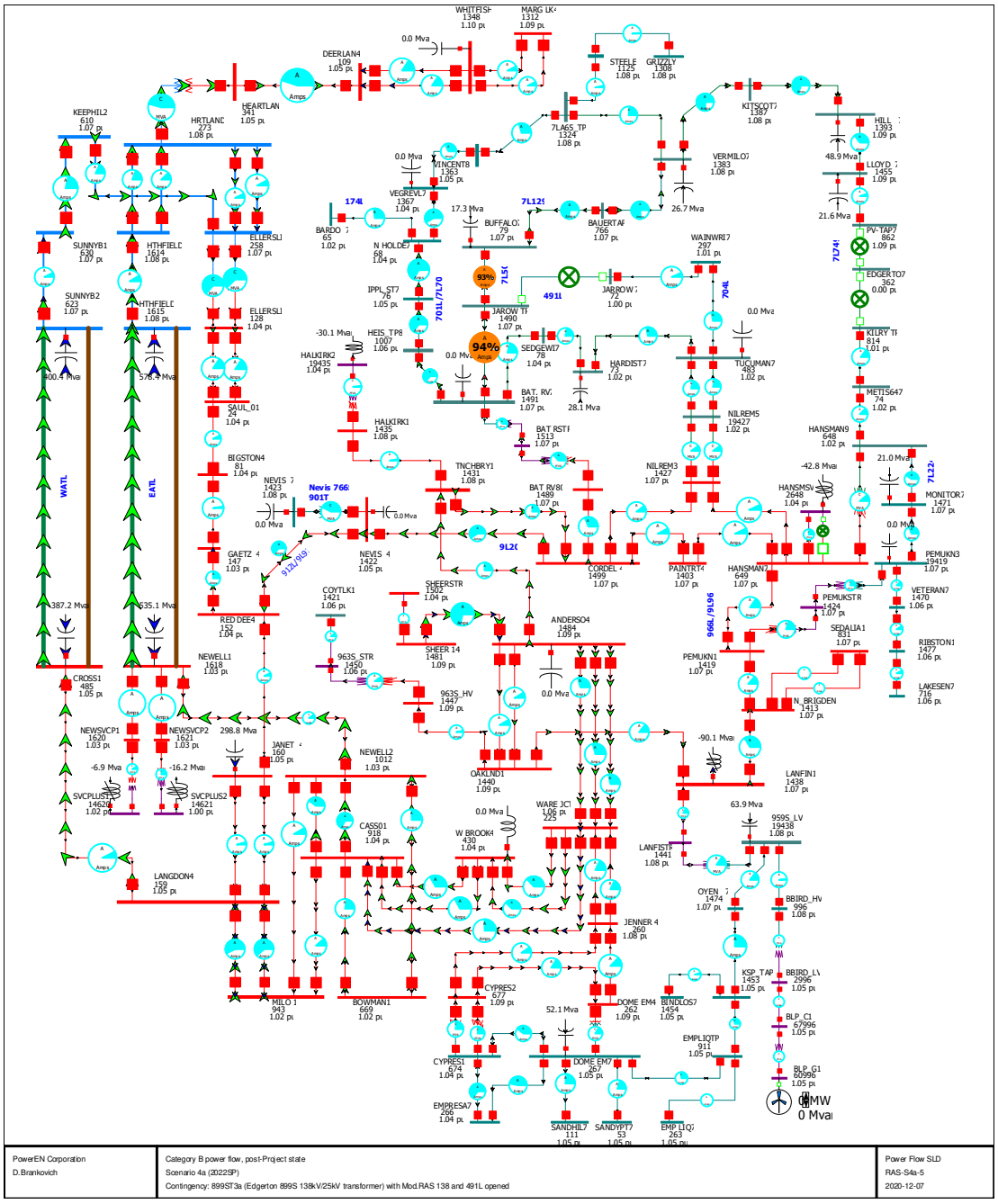


Figure RAS-S4a-6: 912L\9L912 (Red Deer 63S-Nevis 766S) with Mod.RAS 134/ Mod.RAS 138 and lines 491L and 174L opened

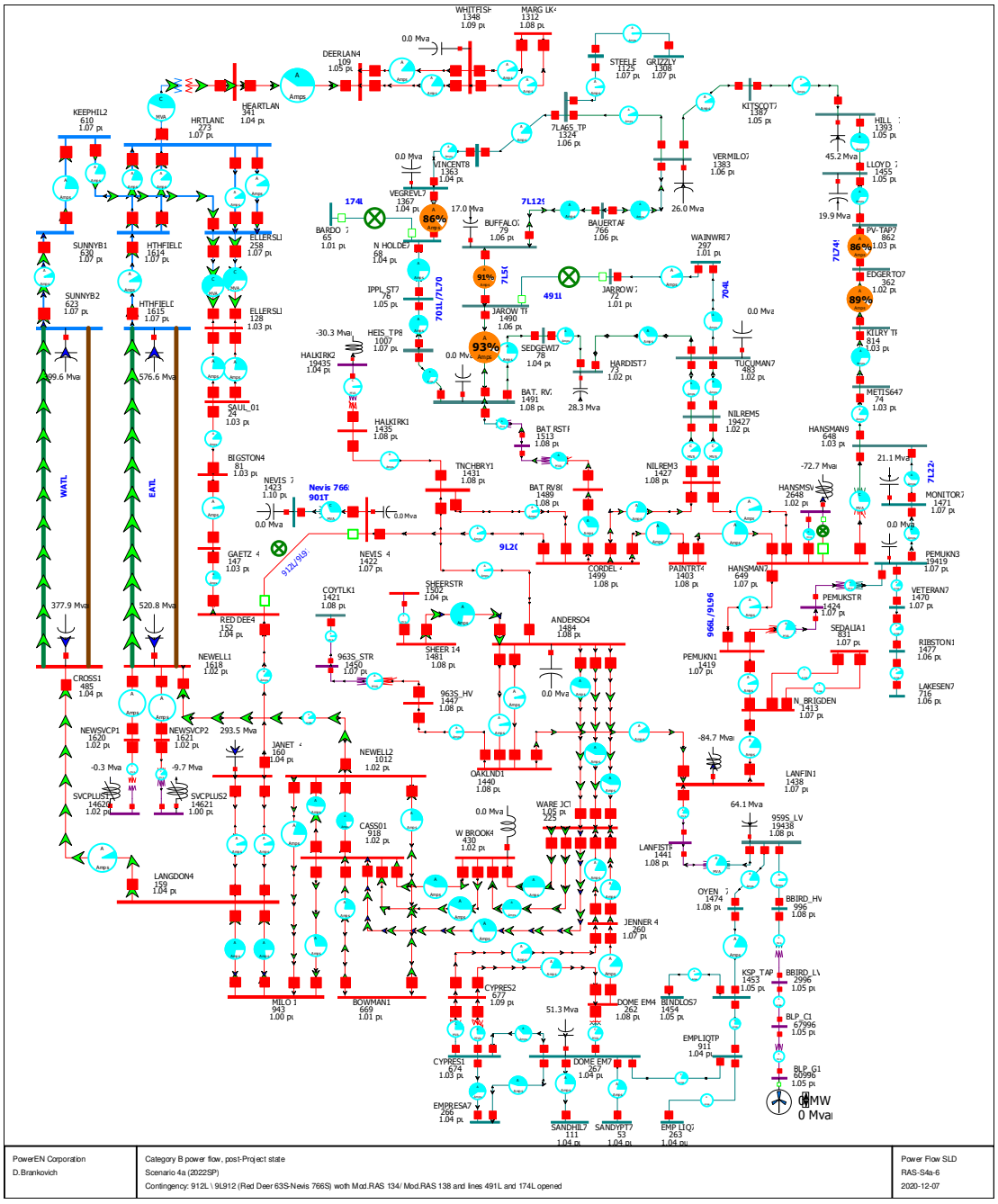


Figure RAS-S4a-7: 966L\9L966 (Hansman Lk. 650S - Pemukan 932S) with New 7L224 RAS

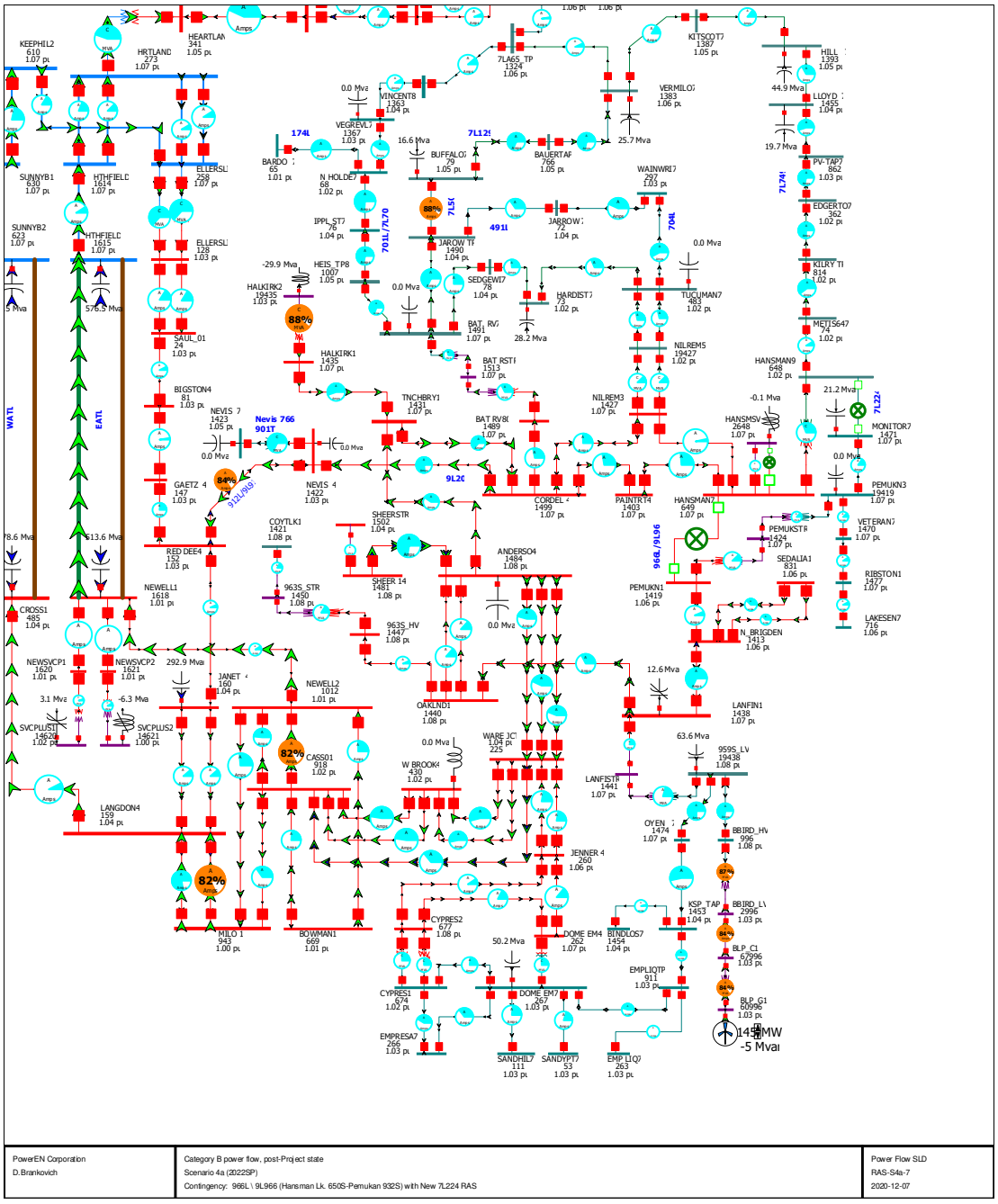


Figure RAS-S4a-8: 9L20 (Cordel 755S -Nevis 766S) with Mod.RAS 134/ Mod.RAS 138/ Mod.RAS 139

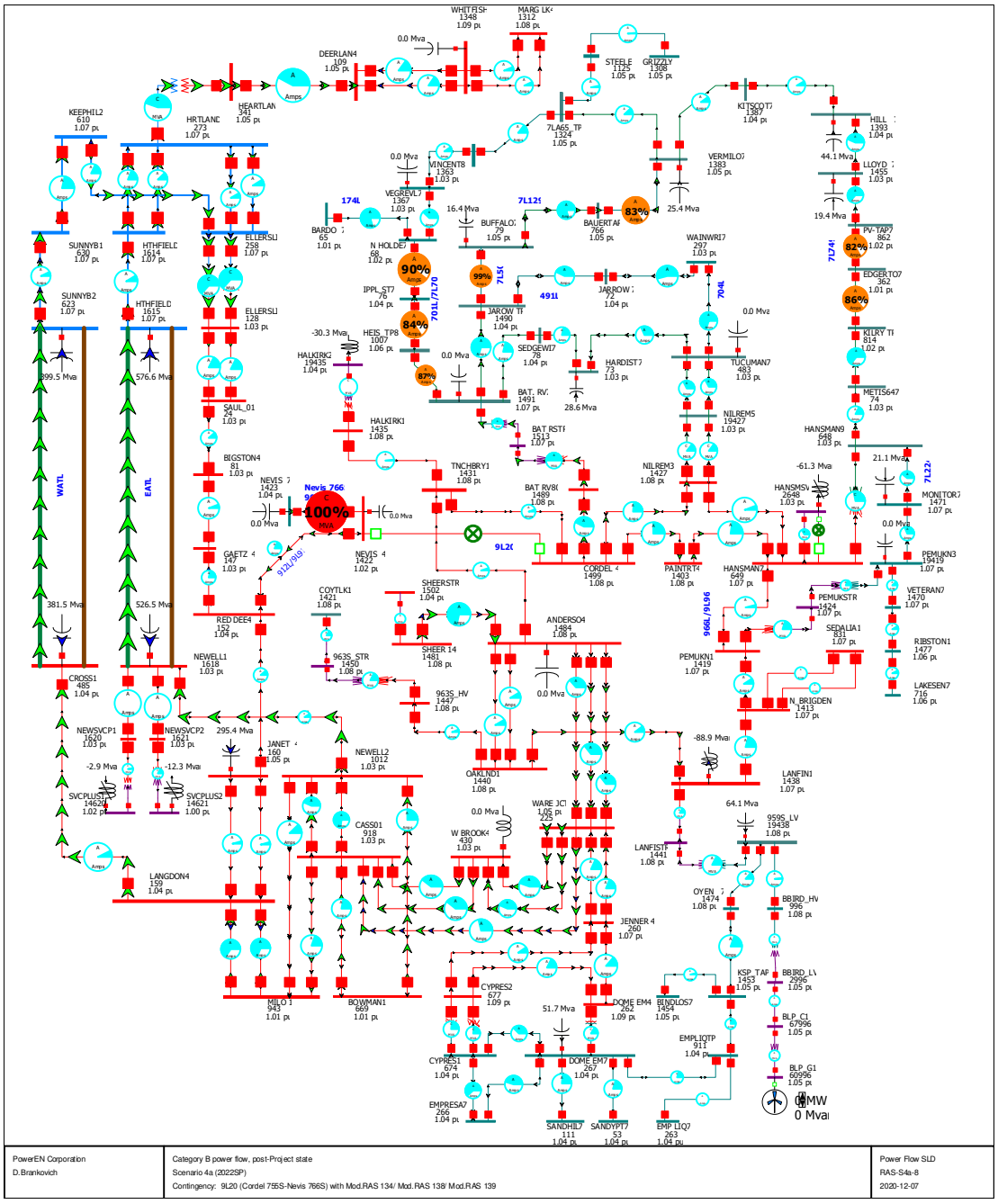
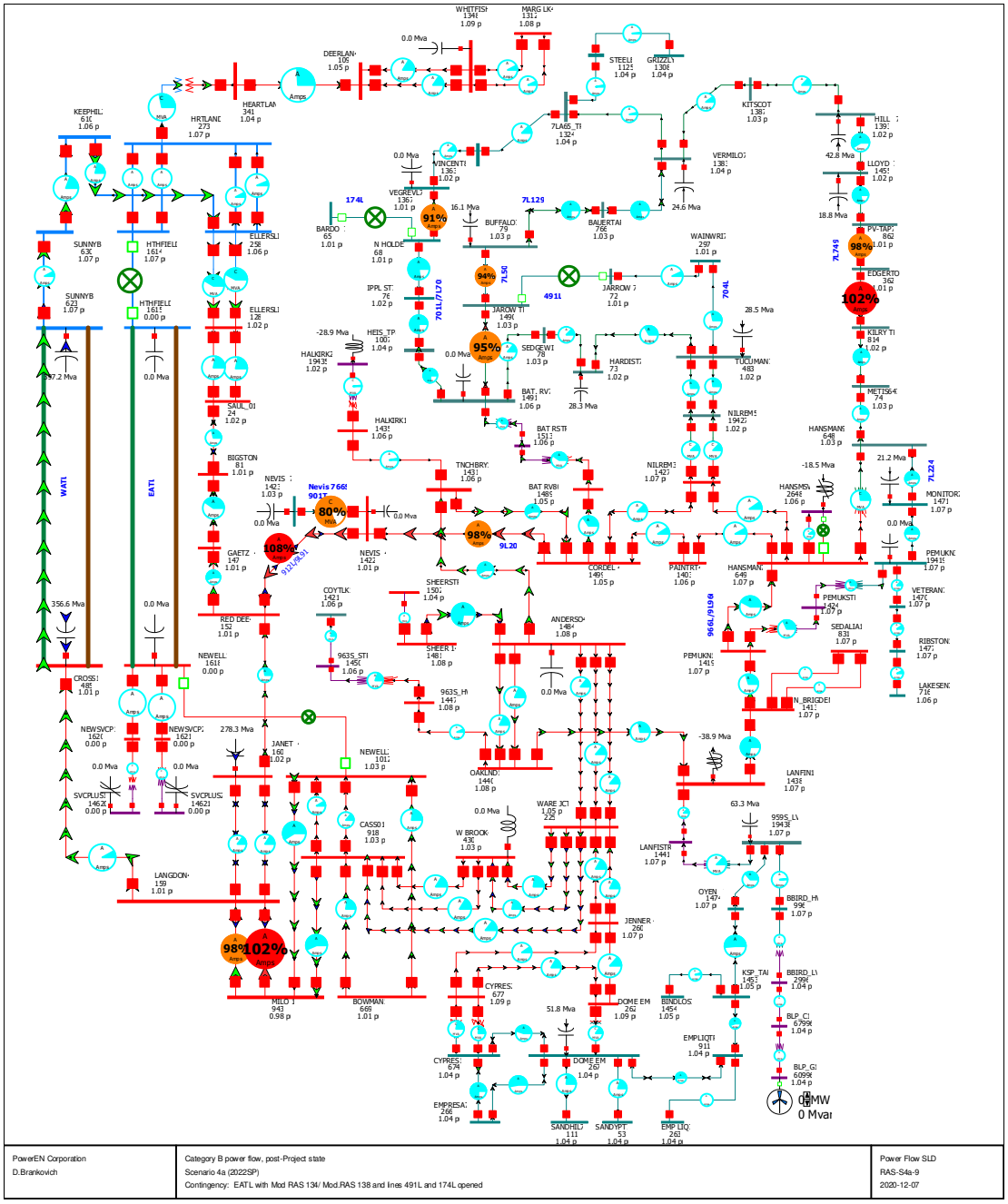


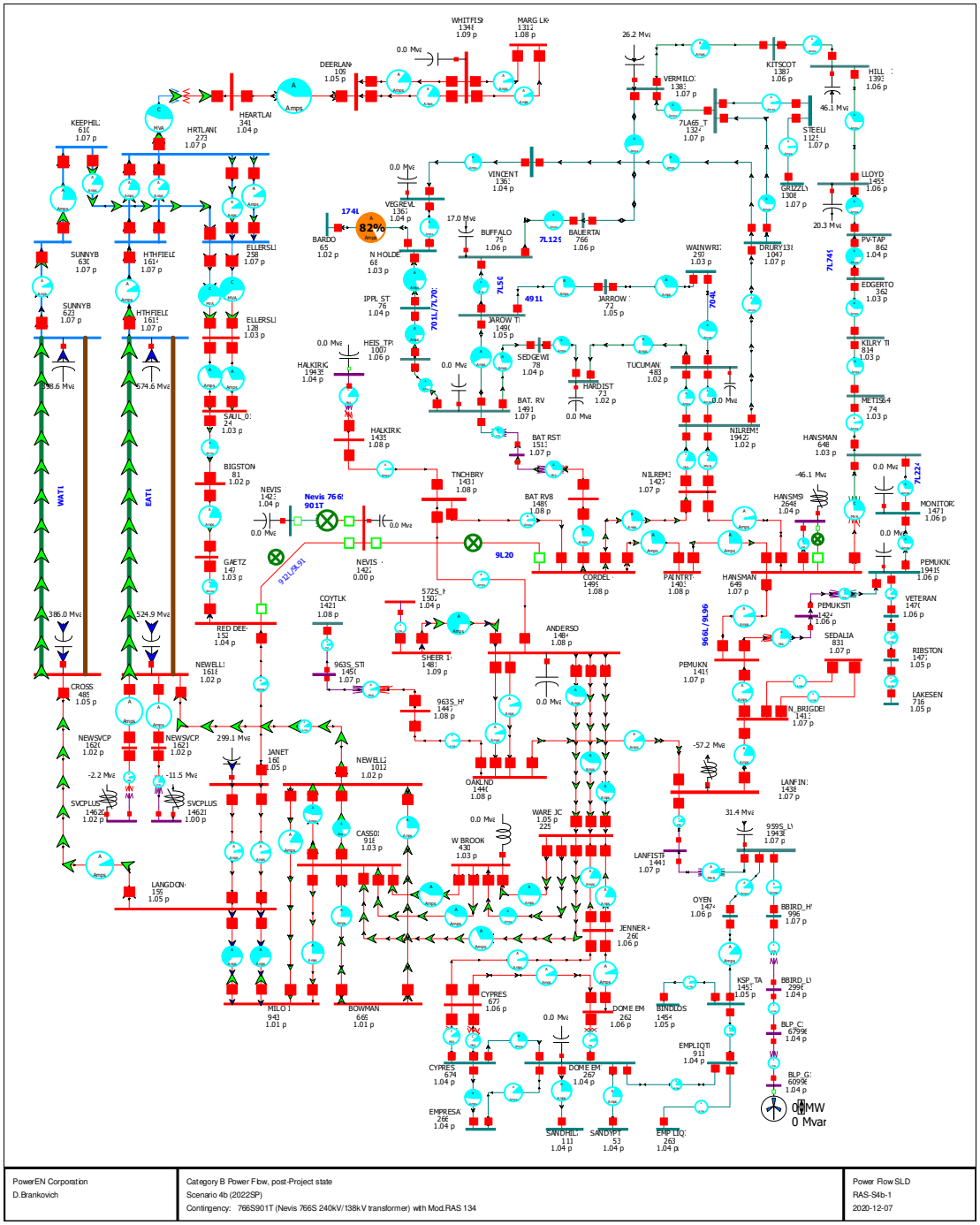
Figure RAS-S4a-9: EATL with Mod.RAS 134/ Mod.RAS 138 and lines 491L and 174L opened



A6.5

Sensitivity Scenario 4b (2022SP)

Figure RAS-S4b-1: 766S901T (Nevis 766S 240kV/138kV transformer) with Mod.RAS 134



PowerEN Corporation D.Brankovich	Category B Power Flow, post-Project state Scenario 4b (2022SP) Contingency: 766S901T (Nevis 766S 240kV/138kV transformer) with Mod.RAS 134	Power Flow SLD RAS-S4b-1 2020-12-07

Figure RAS-S4b-2: 912L\9L912 (Red Deer 63S-Nevis 766S) with Mod.RAS 134

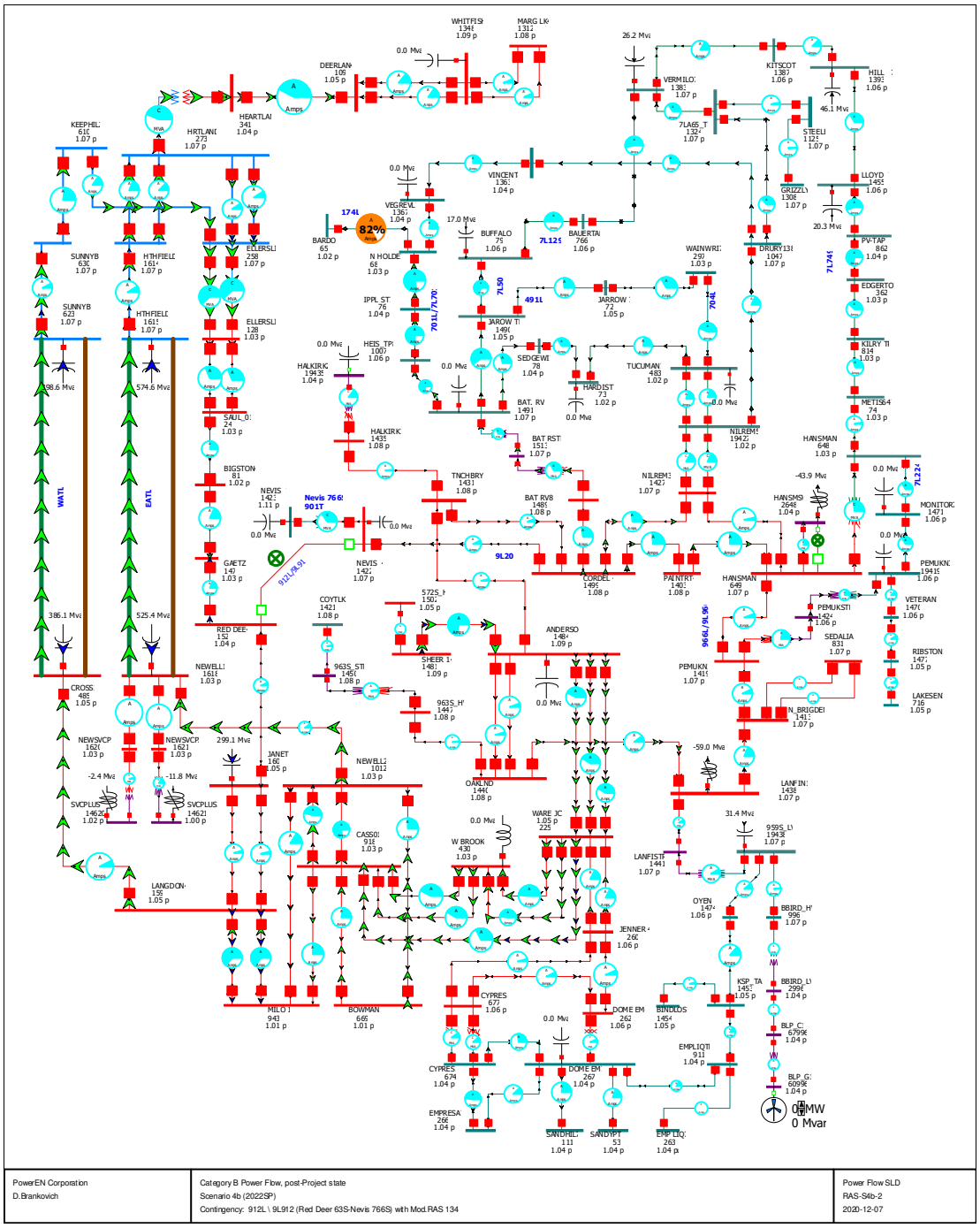


Figure RAS-S4b-3: 966L\9L966 (Hansman Lk. 650S-Pemukan 932S) with New 7L224 RAS

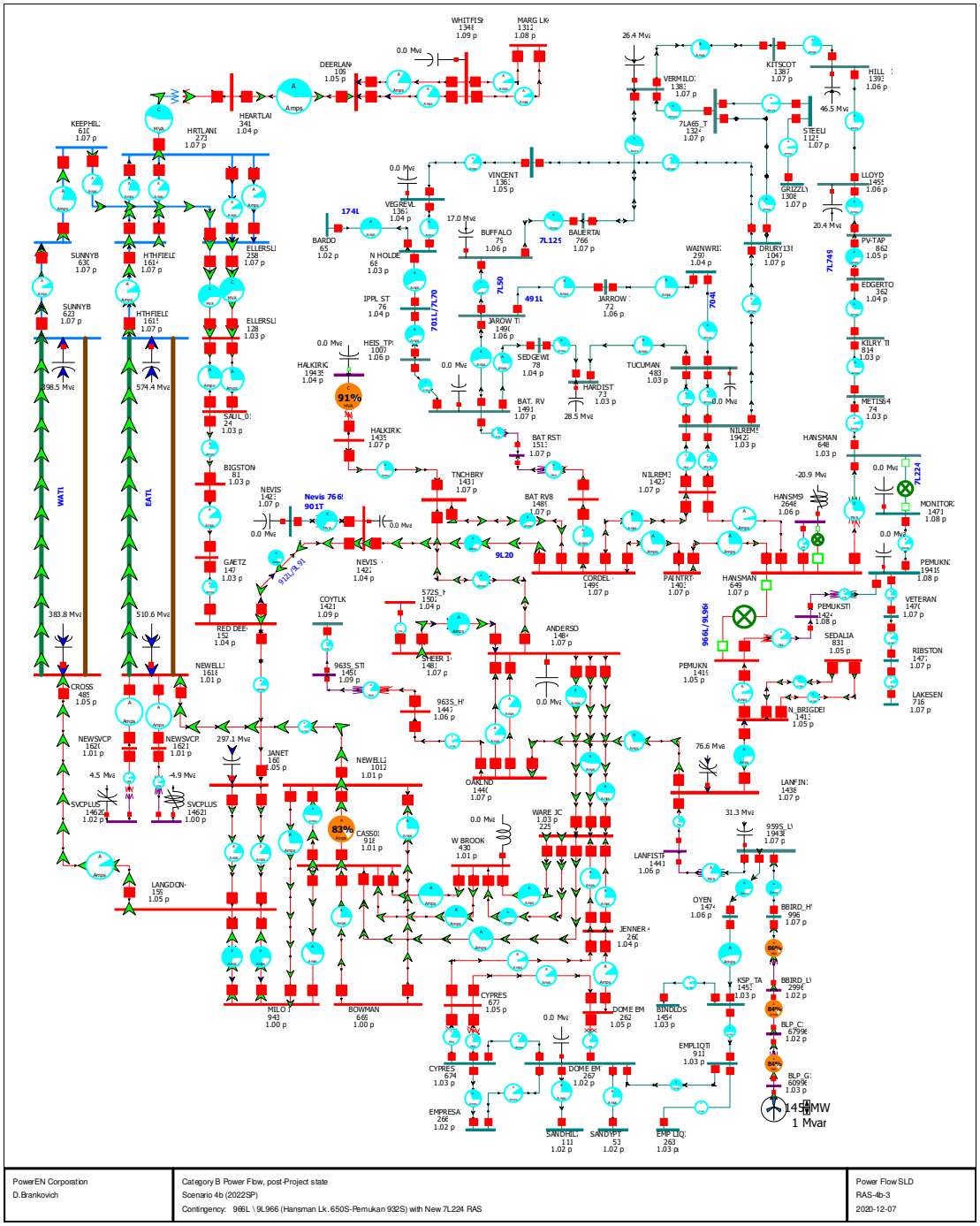


Figure RAS-S4b-4: 9L20 (Cordel 755S-Nevis 766S) with Mod.RAS 134/ Mod.RAS 139

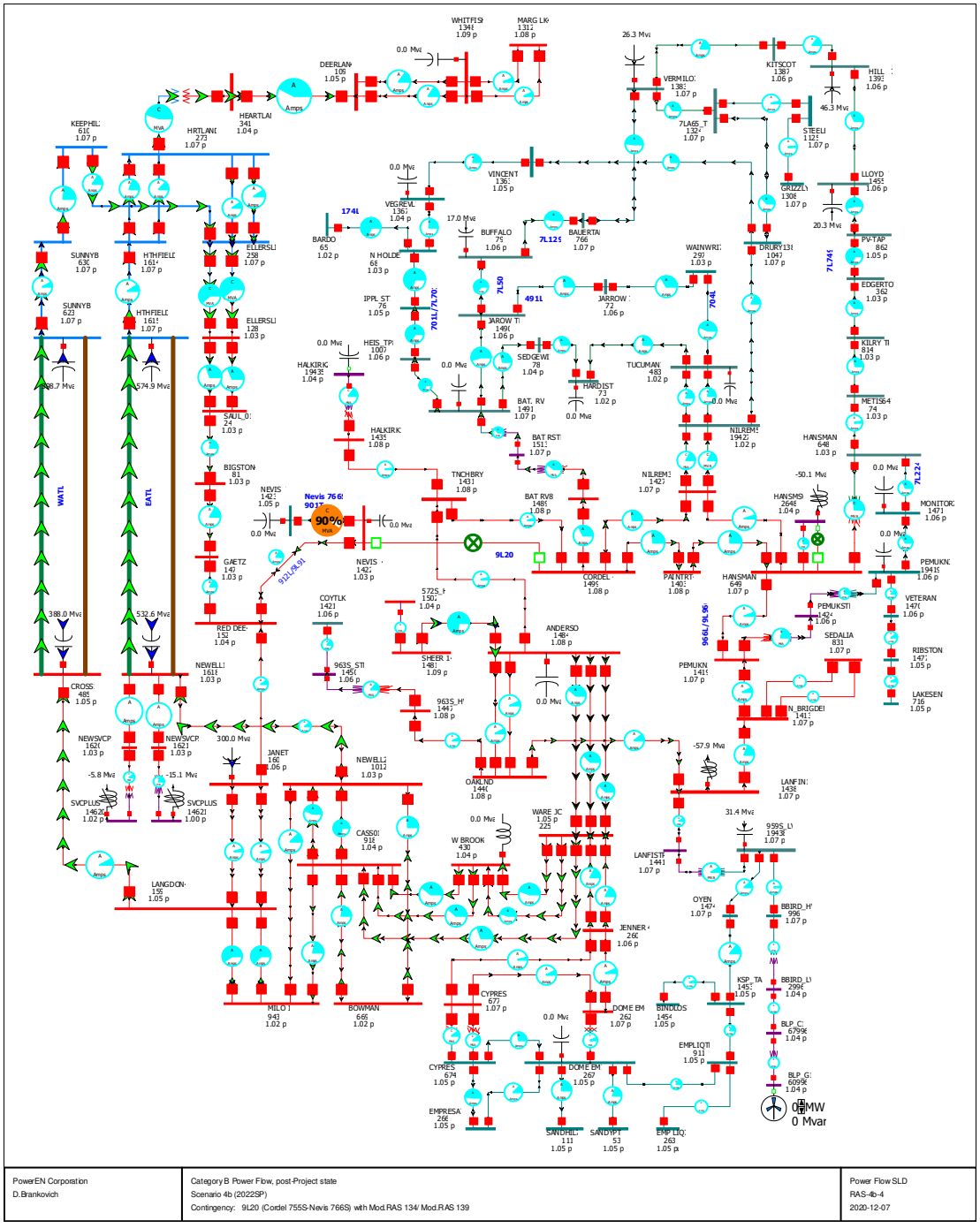
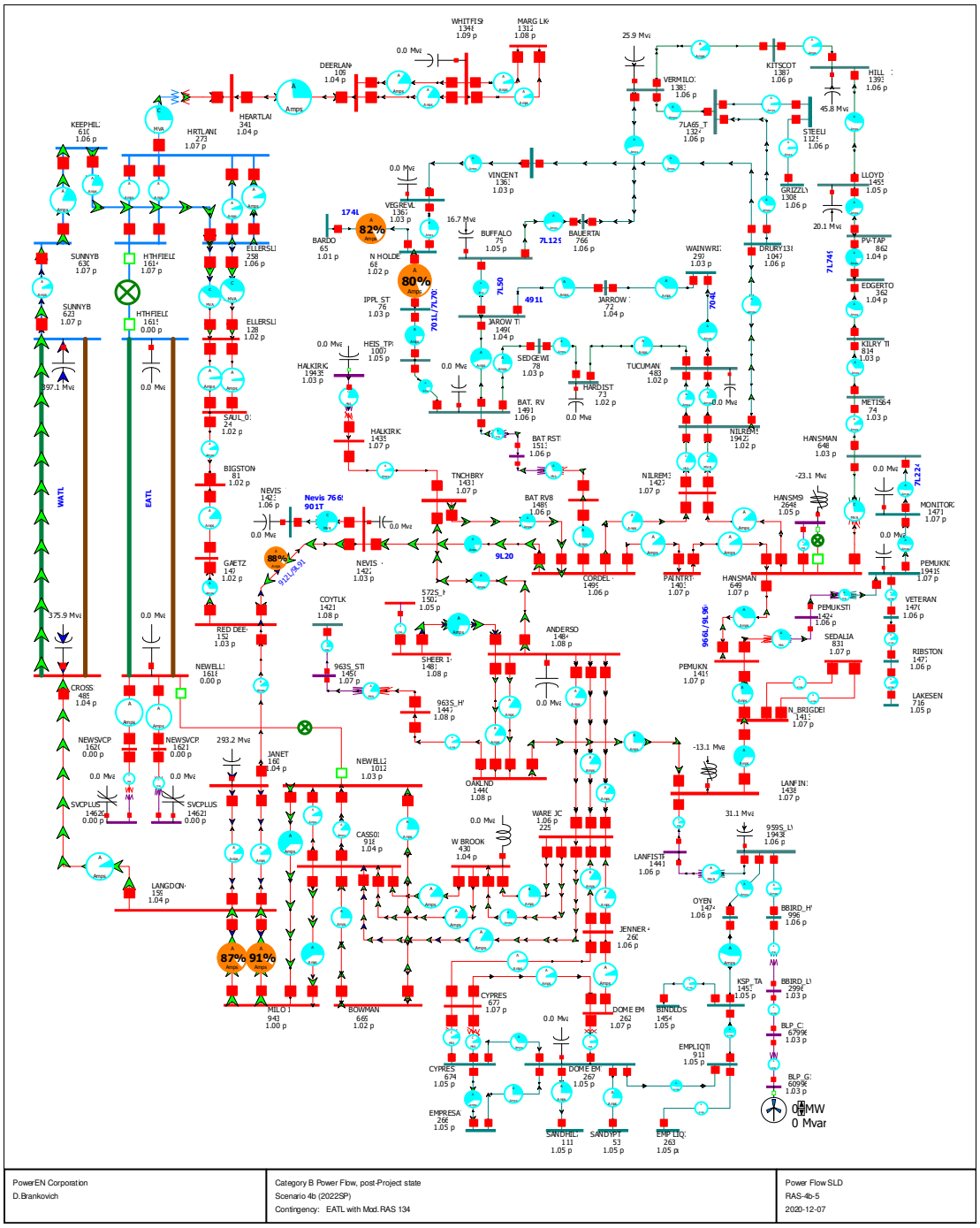


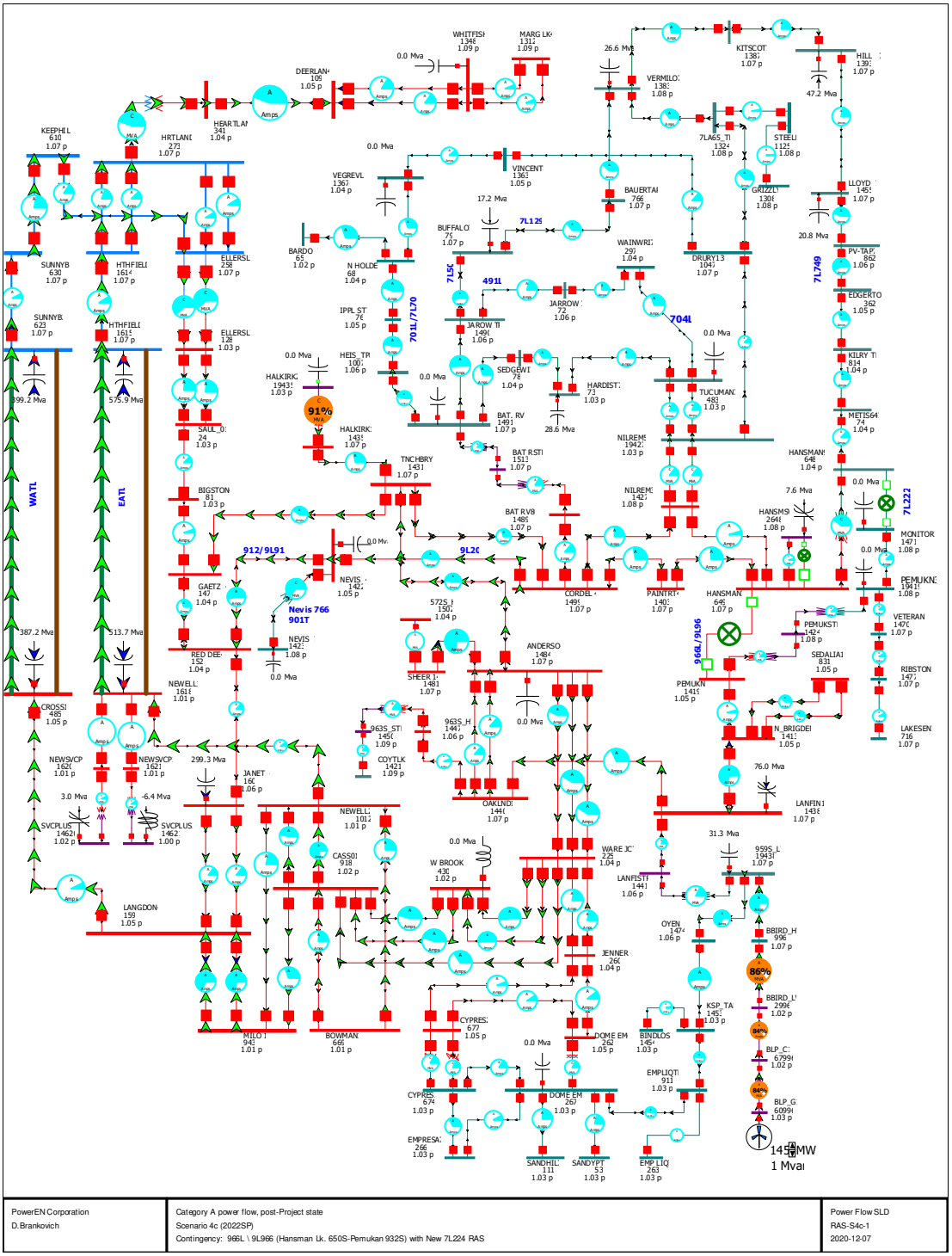
Figure RAS-S4b-5: EATL with Mod.RAS 134



A6.6

Sensitivity Scenario 4c (2022SP)

Figure RAS-S4c-1: 966L \ 9L966 (Hansman Lk. 650S-Pemukan 932S) with New 7L224 RAS



Attachment A7

Constraint Effectiveness Factors

Scenario 4 (2022SP)

CEF- Scenario 4

	Generator Name	Buffalo Atlee WAGF (P1853)	Battle River #3 (BR3)	Battle River #4 (BR4)	Battle River #5 (BR5)	Pattern Lanfine WAGF (P1898)	Bull Creek WAGF (BUL1, BUL2)	Ghost Pine WAGF (NEP1)	Halkirk WAGF (HAL1)	Jenner WAGF (P1533)	Sharp Hills WAGF (P1567)	Sheerness (SH1, SH2)	Wintering Hills (SCR4)
	Area	EMPRESS	ALLIANCE	ALLIANCE	ALLIANCE	HANNA	PROVOST	HANNA	HANNA	EMPRESS	HANNA	SHEERNES	SHEERNES
Contingency	Element Name	CEF %											
648ST1	7L16 (Nevis 766S-Heatburg 948S)	2.6	2.4	2.4	3.3	3.2	-70.4	2.5	3.3	2.6	3.6	2.7	2.7
749L \ 749AL	7L16 (Nevis 766S-Heatburg 948S)	5.5	10.4	10.4	8.2	7.0	9.5	5.8	8.0	5.5	7.9	6.0	6.1
749L \ 749AL	7L151 (Oyen 767S-Lanfine 959S)	5.6	10.5	10.5	8.4	7.2	9.6	6.0	8.2	5.6	8.0	6.2	6.2
766S901T	7L701 (Battle River 757S-7LA701)	7.6	22.2	22.2	16.0	10.2	12.7	6.3	15.4	7.6	11.8	8.9	8.1
766S901T	7L701 (Battle River 757S-7LA701)	6.2	13.8	13.8	11.5	8.0	5.9	8.7	11.1	6.2	8.9	7.1	7.6
766S901T	7L701 (Battle River 757S-7LA701)	8.5	22.3	22.3	16.5	11.4	13.2	14.0	15.9	8.5	12.6	10.0	11.2
766S901T	7L701 (Battle River 757S-7LA701)	8.4	22.1	22.1	16.3	11.2	13.0	13.8	15.7	8.4	12.4	9.8	11.1
766S901T	7L129 (Buffalo Crk. 526S-Bauer tap point)	6.3	14.0	14.0	11.6	8.1	6.1	8.9	11.2	6.3	9.0	7.2	7.8
766S901T	7L129 (Buffalo Crk. 526S-Bauer tap point)	7.1	18.9	18.9	15.0	10.3	15.0	11.7	14.4	7.1	11.9	8.5	9.6
7L50	7L129 (Buffalo Crk. 526S-Bauer tap point)	4.0	4.2	4.2	5.2	5.6	15.8	3.8	5.1	4.0	6.7	4.4	4.3
7L50	7L129 (Buffalo Crk. 526S-Bauer tap point)	4.1	4.2	4.2	5.2	5.7	15.9	3.9	5.1	4.1	6.8	4.4	4.3
7L50	7L129 (Buffalo Crk. 526S-Bauer tap point)	4.5	4.6	4.6	5.6	6.1	-83.7	4.3	5.5	4.5	7.2	4.8	4.7
7L701 \ 7LA701 \ 701L	7L129 (Buffalo Crk. 526S-Bauer tap point)	5.5	13.7	13.7	9.0	6.8	3.9	6.3	8.8	5.5	7.3	6.1	6.3
7L749 \ 749L \ 7LB749	7L129 (Buffalo Crk. 526S-Bauer tap point)	5.4	10.4	10.4	8.2	7.0	9.4	5.8	8.0	5.4	7.9	6.0	6.0
7L749 \ 749L \ 7LB749	7L749 (Edgerton 899S-Briker tap point)	5.6	10.5	10.5	8.4	7.1	9.6	6.0	8.2	5.6	8.0	6.1	6.2
899ST3a	7L749 (Edgerton 899S-Briker tap point)	5.5	10.4	10.4	8.2	7.0	9.5	5.8	8.0	5.5	7.9	6.0	6.1
899ST3a	7L159 (Heatburg 948S-7LA159)	5.6	10.5	10.5	8.4	7.2	9.6	6.0	8.2	5.6	8.0	6.2	6.2
912L \ 9L912	7L159 (Heatburg 948S-7LA159)	7.6	21.9	21.9	15.4	10.1	12.3	11.6	14.8	7.6	11.5	8.9	9.4
912L \ 9L912	703L (Hardisty 377S-703BL)	6.2	13.8	13.8	11.4	8.0	5.8	9.8	11.0	6.2	8.8	7.1	7.9
912L \ 9L912	7L701(Strome 233S-7LA701)	8.5	22.3	22.3	16.5	11.4	13.1	14.5	15.9	8.5	12.6	10.0	11.3
912L \ 9L912	7L701(Strome 233S-7LA701)	8.4	22.1	22.1	16.3	11.2	12.9	14.3	15.7	8.4	12.4	9.8	11.2
912L \ 9L912	7L701(Strome 233S-7LA701)	6.3	13.9	13.9	11.5	8.1	6.0	9.9	11.1	6.3	9.0	7.2	8.0
912L \ 9L912	701L/7L701 (Strome 223S-N.Holden 395S)	7.1	18.9	18.9	14.9	10.3	15.0	12.7	14.3	7.1	11.9	8.6	9.8
959S901T	701L/7L701 (Strome 223S-N.Holden 395S)	-0.1	-0.1	-0.1	-0.1	99.9	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1
966L \ 9L966	701L/7L701 (Strome 223S-N.Holden 395S)	7.8	-6.7	-6.7	-6.2	20.2	-20.2	1.3	-4.9	7.8	29.7	7.9	6.5
9L16	701L/7L701 (Strome 223S-N.Holden 395S)	20.4	-18.1	-18.1	-19.5	37.1	-30.0	2.7	22.6	20.4	49.5	22.6	17.6
9L20	7L50 (Buffalo Crk 526S-Jarrow tap point)	5.2	3.8	3.8	4.8	6.0	4.6	60.1	5.0	5.2	5.6	6.5	18.7
9L20	7L50 (Buffalo Crk 526S-Jarrow tap point)	7.2	21.6	21.6	15.5	9.7	12.3	3.5	14.9	7.2	11.3	8.4	7.1
9L20	7L50 (Buffalo Crk 526S-Jarrow tap point)	5.6	12.9	12.9	10.7	7.2	5.2	4.0	10.3	5.6	8.1	6.3	5.9
9L20	7L50 (Buffalo Crk 526S-Jarrow tap point)	5.3	3.8	3.8	4.8	6.0	4.7	60.1	5.0	5.3	5.7	6.5	18.7
9L20	7L50 (Buffalo Crk 526S-Jarrow tap point)	7.3	20.5	20.5	14.9	9.8	11.6	5.3	14.3	7.3	11.1	8.5	8.1
9L20	7L50 (Buffalo Crk 526S-Jarrow tap point)	5.7	13.1	13.1	10.8	7.4	5.3	4.2	10.4	5.7	8.2	6.5	6.1
9L20	7L50 (Buffalo Crk 526S-Jarrow tap point)	6.7	10.6	10.6	9.6	8.7	8.8	55.0	9.5	6.7	8.9	8.4	19.4
9L966	7L50 (Buffalo Crk 526S-Jarrow tap point)	7.8	-6.7	-6.7	-6.2	20.2	-20.2	1.3	-4.9	7.8	29.7	7.9	6.5
EATL	749L (Edgerton 899S-Kilarney tap point)	3.3	-0.4	-0.4	-0.3	3.1	0.6	60.9	0.1	3.3	2.2	4.2	17.1
EATL	749L (Edgerton 899S-Kilarney tap point)	4.8	16.2	16.2	8.9	6.0	7.1	4.5	8.6	4.8	6.9	5.4	5.0
EATL	749L (Metiskow 648S-749AL)	4.1	9.7	9.7	6.7	5.0	2.0	4.6	6.5	4.1	5.4	4.5	4.7
EATL	7L224 (Hansman Lake 650S-Monitor 774S)	2.7	1.4	1.4	3.1	4.0	15.1	2.4	3.1	2.7	5.0	2.9	2.8
EATL	7L224 (Hansman Lake 650S-Monitor 774S)	3.4	-0.3	-0.3	-0.3	3.1	0.6	60.9	0.1	3.4	2.2	4.2	17.1
EATL	174L (Bardo 197S-N.Holden 395S)	5.3	15.9	15.9	9.1	6.7	7.2	6.4	8.9	5.3	7.3	6.0	6.4
EATL	174L (Bardo 197S-N.Holden 395S)	5.1	15.7	15.7	9.0	6.5	7.0	6.3	8.7	5.1	7.1	5.8	6.2
EATL	174L (Bardo 197S-N.Holden 395S)	4.3	9.8	9.8	6.8	5.2	2.2	4.8	6.6	4.3	5.6	4.7	4.8
EATL	9L46 (New Bridgeden 2088S-Pemukan 932S)	2.8	1.4	1.4	3.1	4.1	15.1	2.4	3.1	2.8	5.0	3.0	2.9
EATL	9L46 (New Bridgeden 2088S-Pemukan 932S)	3.9	12.4	12.4	7.5	5.6	8.9	4.6	7.2	3.9	6.5	4.5	4.8
EATL	912L (Red Deer 63S-Nevis 766S)	12.8	-10.7	-10.7	-10.3	33.1	-25.3	2.2	-8.2	12.8	48.6	13.0	10.7

CEF- Scenario 4

EATL	Nevis 766S 901T	19.8	39.4	39.4	44.9	28.5	36.6	49.2	43.1	19.8	32.6	24.5	30.7
EATL	Nevis 766S 901T	3.4	3.2	3.2	0.5	3.6	1.6	56.5	0.8	3.4	2.8	4.3	16.5

Scenario 5 (2022SL)

CEF - Scenario 5

	Generator Name	Buffalo Atlee WAGF (P1853)	Battle River #3 (BR3)	Battle River #4 (BR4)	Battle River #5 (BR5)	Pattern Lanfine WAGF (P1898)	Bull Creek WAGF (BUL1, BUL2)	Ghost Pine WAGF (NEP1)	Halkirk WAGF (HAL1)	Jenner WAGF (P1533)	Sharp Hills WAGF (P1567)	Sheerness (SH1, SH2)	Wintering Hills (SCR4)
	Area	EMPRESS	ALLIANCE	ALLIANCE	ALLIANCE	HANNA	PROVOST	HANNA	HANNA	EMPRESS	HANNA	SHEERNES	SHEERNES
Contingency	Element Name	CEF %											
1035L	7L151 (Oyen 767S-Lanfine 959S)	-0.0776	-0.0136	-0.0136	-0.0142	-0.0595	-0.0199	-0.012	-0.0145	-0.0776	-0.0318	-0.0175	-0.0173
9L20	658L (Cypress 562S-Chapicce Lk 649S)	0.0659	0.1049	0.1049	0.0941	0.0855	0.0862	0.5483	0.093	0.0659	0.0876	0.0828	0.1923
9L51	Nevis 766S 901T	-0.0383	0.007	0.007	0.0117	0.2969	0.0103	0.0098	0.0135	-0.0383	0.1879	0.0313	0.0177
EATL	Nevis 766S 901T	0.0333	0.0318	0.0318	0.0039	0.0354	0.0156	0.564	0.0074	0.0333	0.0276	0.0424	0.1641

Scenario 6 (2022WP)

CEF - Scenario 6

100	Generator Name	Buffalo Atlee WAGF (P1853)	Battle River #3 (BR3)	Battle River #4 (BR4)	Battle River #5 (BR5)	Pattern Lanfine WAGF (P1898)	Bull Creek WAGF (BUL1, BUL2)	Ghost Pine WAGF (NEP1)	Halkirk WAGF (HAL1)	Jenner WAGF (P1533)	Sharp Hills WAGF (P1567)	Sheerness (SH1, SH2)	Wintering Hills (SCR4)
Area		EMPRESS	ALLIANCE	ALLIANCE	ALLIANCE	HANNA	PROVOST	HANNA	HANNA	EMPRESS	HANNA	SHEERNES	SHEERNES
Contingency	Element Name												
648ST1	7L701 (Battle River 757S-7LA701)	0.9	0.8	0.8	1.7	1.6	-72.0	0.9	1.7	0.9	2.0	1.1	1.1
749L \ 749AL	7L701 (Battle River 757S-7LA701)	2.7	7.6	7.6	5.4	4.2	6.7	3.0	5.2	2.7	5.1	3.2	3.3
766S901T	7L701 (Battle River 757S-7LA701)	5.4	20.0	20.0	13.8	8.0	10.5	4.1	13.2	5.4	9.6	6.7	5.9
766S901T	7L129 (Buffalo Crk. 526S-Bauer tap point)	4.0	11.7	11.7	9.3	5.8	3.7	6.5	8.9	4.0	6.7	4.9	5.4
766S901T	7L129 (Buffalo Crk. 526S-Bauer tap point)	2.2	1.8	1.8	3.8	4.0	15.4	2.4	3.7	2.2	5.1	2.7	2.6
766S901T	7L749 (Edgerton 899S-Briker tap point)	6.1	19.9	19.9	14.1	8.9	10.7	11.6	13.5	6.1	10.2	7.5	8.8
766S901T	7L749 (Edgerton 899S-Briker tap point)	6.1	19.9	19.9	14.1	8.9	10.7	11.6	13.5	6.1	10.2	7.5	8.8
766S901T	7L749 (Edgerton 899S-Briker tap point)	4.0	11.7	11.7	9.3	5.8	3.7	6.5	8.9	4.0	6.7	4.9	5.4
766S901T	7L749 (Edgerton 899S-Briker tap point)	2.2	1.8	1.8	3.8	4.0	15.4	2.4	3.7	2.2	5.1	2.7	2.6
766S901T	7L749 (Edgerton 899S-Briker tap point)	6.2	18.1	18.1	14.1	9.4	14.2	10.9	13.5	6.2	11.0	7.7	8.7
7L50	703L (Hardisty 377S-703BL)	2.0	2.2	2.2	3.2	3.6	13.8	1.8	3.1	2.0	4.7	2.4	2.3
7L50	7L701(Strome 233S-7LA701)	2.0	2.2	2.2	3.2	3.6	13.8	1.8	3.1	2.0	4.7	2.4	2.3
7L701 \ 7LA701 \ 701L	7L701(Strome 233S-7LA701)	2.7	10.8	10.8	6.2	3.9	1.1	3.5	5.9	2.7	4.5	3.3	3.5
7L749 \ 749L \ 7LB749	7L701(Strome 233S-7LA701)	2.7	7.6	7.6	5.4	4.2	6.7	3.0	5.2	2.7	5.1	3.2	3.3
899ST3a	7L701(Strome 233S-7LA701)	2.7	7.6	7.6	5.4	4.2	6.7	3.0	5.2	2.7	5.1	3.2	3.3
912L \ 9L912	701L/7L701 (Strome 223S-N.Holden 395S)	5.5	19.7	19.7	13.2	7.9	10.1	9.4	12.6	5.5	9.4	6.7	7.2
912L \ 9L912	701L/7L701 (Strome 223S-N.Holden 395S)	4.0	11.6	11.6	9.2	5.8	3.7	7.6	8.8	4.0	6.6	4.9	5.7
912L \ 9L912	701L/7L701 (Strome 223S-N.Holden 395S)	2.2	1.7	1.7	3.7	4.0	15.3	3.2	3.6	2.2	5.1	2.7	2.8
912L \ 9L912	701L/7L701 (Strome 223S-N.Holden 395S)	6.1	19.9	19.9	14.0	8.9	10.7	12.0	13.5	6.1	10.2	7.5	8.9
912L \ 9L912	7L50 (Buffalo Crk 526S-Jarrow tap point)	6.1	19.9	19.9	14.0	8.9	10.7	12.0	13.5	6.1	10.2	7.5	8.9
912L \ 9L912	7L50 (Buffalo Crk 526S-Jarrow tap point)	4.0	11.6	11.6	9.2	5.8	3.7	7.6	8.8	4.0	6.6	4.9	5.7
912L \ 9L912	7L50 (Buffalo Crk 526S-Jarrow tap point)	2.2	1.7	1.7	3.7	4.0	15.3	3.2	3.6	2.2	5.1	2.7	2.8
912L \ 9L912	7L50 (Buffalo Crk 526S-Jarrow tap point)	6.2	18.0	18.0	14.0	9.4	14.1	11.9	13.4	6.2	11.0	7.7	9.0
9L16	7L50 (Buffalo Crk 526S-Jarrow tap point)	14.8	-23.6	-23.6	-25.1	31.6	-35.5	-2.9	17.1	14.8	43.9	17.1	12.1
9L20	7L50 (Buffalo Crk 526S-Jarrow tap point)	5.1	19.5	19.5	13.4	7.6	10.1	1.3	12.7	5.1	9.1	6.3	4.9
9L20	7L50 (Buffalo Crk 526S-Jarrow tap point)	2.0	1.5	1.5	3.5	3.7	15.1	0.7	3.4	2.0	4.8	2.4	2.0
9L20	7L50 (Buffalo Crk 526S-Jarrow tap point)	5.1	18.3	18.3	12.7	7.6	9.4	3.1	12.1	5.1	8.9	6.3	5.9
9L20	749L (Edgerton 899S-Kilarney tap point)	5.1	18.3	18.3	12.7	7.6	9.4	3.1	12.1	5.1	8.9	6.3	5.9
9L20	749L (Edgerton 899S-Kilarney tap point)	3.4	10.8	10.8	8.5	5.1	3.0	1.8	8.1	3.4	5.9	4.2	3.8
9L20	749L (Edgerton 899S-Kilarney tap point)	2.0	1.5	1.5	3.5	3.7	15.1	0.7	3.4	2.0	4.8	2.4	2.0
9L20	749L (Edgerton 899S-Kilarney tap point)	5.3	16.5	16.5	12.7	8.2	12.9	2.8	12.2	5.3	9.8	6.5	5.9
9L20	749L (Edgerton 899S-Kilarney tap point)	6.5	10.4	10.4	9.3	8.5	8.5	54.7	9.2	6.5	8.7	8.2	19.1
EATL	174L (Bardo 197S-N.Holden 395S)	1.4	0.0	0.0	1.8	2.7	13.8	1.0	1.8	1.4	3.7	1.6	1.5
EATL	174L (Bardo 197S-N.Holden 395S)	3.0	13.5	13.5	6.8	4.4	4.8	4.1	6.5	3.0	5.0	3.6	4.0
EATL	174L (Bardo 197S-N.Holden 395S)	3.0	13.5	13.5	6.8	4.4	4.8	4.1	6.5	3.0	5.0	3.6	4.0
EATL	174L (Bardo 197S-N.Holden 395S)	2.0	7.6	7.6	4.6	2.9	-0.1	2.5	4.4	2.0	3.3	2.4	2.5
EATL	9L46 (New Bridgeden 2088S-Pemukan 932S)	1.4	0.0	0.0	1.8	2.7	13.8	1.0	1.8	1.4	3.7	1.6	1.5
EATL	9L46 (New Bridgeden 2088S-Pemukan 932S)	3.1	11.6	11.6	6.7	4.8	8.2	3.8	6.4	3.1	5.7	3.7	4.0
EATL	912L (Red Deer 63S-Nevis 766S)	9.2	-14.2	-14.2	-13.9	29.5	-28.9	-1.4	-11.8	9.2	45.1	9.4	7.1
EATL	Nevis 766S 901T	19.3	38.9	38.9	44.5	28.0	36.1	48.8	42.6	19.3	32.1	24.0	30.2

Sensitivity Scenario 4a (222SP)

CEF - Sensitivity Scenario 4a

	Name of Bus	Buffalo Atlee 1 WAGF (P1853)	Buffalo Atlee 2 WAGF (P2199)	Buffalo Atlee 3 WAGF (P1892)	Battle River 4 (BAT #4)	Battle River 5 (BAT #5)	Bellshill Gas Plant	Pattern Lanfine N. (P1898)	Bull Creek WAGF (BUL1, BUL2)	Ghost Pine WAGF (NEP1)	HALKIRK WAGF (HAL1)	Joss Jenner WAGF (P1533)	Joss Jenner WAGF (P1698)	Sharp Hills WAGF (P1567)	Sheerness 1 (SH1, SH2)	Winetring Hills (SCR4)
	Number of Bus	552260	557261	553260	1496	70001	2088	60996	550003	2621	67435	60798	61798	60831	1482	60789
	ID	G4	G1	G5	4	G5	G1	1	G1	G1	G1	G1	G3	G1	1	G1
	Area Name of Gen	EMPRESS	EMPRESS	EMPRESS	ALLIANCE	ALLIANCE	WAINWRIG	HANNA	PROVOST	HANNA	HANNA	EMPRESS	EMPRESS	HANNA	SHEERNES	SHEERNES
Contingency	Element								CEF %							
1053L (Ware Junction 132S-Cassils 324S)	912L (Red Deer 63S-Nevis 766S)	20.38	20.38	20.38	40.18	45.19	39.98	29.04	37.58	49.59	43.38	20.38	20.38	33.1	25.18	31.32
1075L (West Brooks 28S-Ware Junction 132S)	912L (Red Deer 63S-Nevis 766S)	20.46	20.46	20.46	40.22	45.23	40.03	29.11	37.64	49.64	43.43	20.46	20.46	33.17	25.27	31.4
1087L (Cassils 324S-Newell 2075S)	912L (Red Deer 63S-Nevis 766S)	19.7	19.7	19.7	39.84	44.82	39.61	28.49	37.18	49.2	42.98	19.7	19.7	32.59	24.5	30.72
163ST5 (Amoco Empress 163S 240kV/138kV transformer)	912L (Red Deer 63S-Nevis 766S)	18.68	18.68	18.68	40.15	45.11	40.03	31.13	37.77	49.34	43.25	18.68	18.68	33.67	24.43	30.78
213ST1 (Hughenden 213S 138kV/25kV transformer)	912L (Red Deer 63S-Nevis 766S)	19.61	19.61	19.61	39.79	44.77	39.57	28.41	37.12	49.15	42.93	19.61	19.61	32.52	24.41	30.64
252ST2 (Jarrow 252S 138kV/25kV transformer)	912L (Red Deer 63S-Nevis 766S)	19.87	19.87	19.87	39.66	45.11	40.35	28.81	37.67	49.37	43.26	19.87	19.87	33.01	24.7	30.91
267ST1 (Kilarney Lk. 267S 138kV/25kV transformer)	912L (Red Deer 63S-Nevis 766S)	19.61	19.61	19.61	39.79	44.77	39.57	28.41	37.12	49.15	42.93	19.61	19.61	32.52	24.41	30.64
296ST1/296ST2 (Rosyth 296S 138kV/4.16kV transformer)	912L (Red Deer 63S-Nevis 766S)	19.61	19.61	19.61	39.79	44.77	39.57	28.41	37.12	49.15	42.93	19.61	19.61	32.52	24.41	30.64
377ST1 (Hardisty 377S 138nkV/25kV transformer)	912L (Red Deer 63S-Nevis 766S)	19.58	19.58	19.58	39.88	44.8	39.88	28.33	36.72	49.15	42.96	19.58	19.58	32.39	24.38	30.62
394ST1 (Empress 394S transformers)	912L (Red Deer 63S-Nevis 766S)	19.6	19.6	19.6	39.8	44.77	39.57	28.44	37.13	49.15	42.93	19.6	19.6	32.53	24.41	30.64
395ST1 (N.Holden 395S 138kV/25kV transformer)	7L50 (Buffalo Crk 526S-Jarrow tap point)	5.19	5.19	5.19	12.17	8.32	11.32	6.15	4.35	5.95	8.08	5.19	5.19	6.55	5.7	5.9
395ST1 (N.Holden 395S 138kV/25kV transformer)	912L (Red Deer 63S-Nevis 766S)	22.07	22.07	22.07	47.16	49.27	45.28	31.71	41.36	52.14	47.28	22.07	22.07	36.2	27.24	33.64
395ST1 (N.Holden 395S 138kV/25kV transformer)	9L20 (Cordel 755S-Nevis 768S)	18.6	18.6	18.6	43.51	48.46	42.77	27.92	39.45	-4.5	46.14	18.6	18.6	33.16	22.8	16.95
472AL (Sunken Lk. 221S-Metiskow 648S)	912L (Red Deer 63S-Nevis 766S)	19.57	19.57	19.57	39.87	44.79	39.87	28.32	36.71	49.15	42.95	19.57	19.57	32.38	24.37	30.61
478ST1 or 478ST2 (Tucuman 478S 138kV/25kV transformer)	912L (Red Deer 63S-Nevis 766S)	19.93	19.93	19.93	39.48	45.22	38.92	28.86	37.43	49.43	43.37	19.93	19.93	33.05	24.76	30.97
51ST3/51ST4 (Wainwright 51S 138kV/25kV transformer)	912L (Red Deer 63S-Nevis 766S)	19.61	19.61	19.61	39.79	44.77	39.57	28.41	37.12	49.15	42.93	19.61	19.61	32.52	24.41	30.64
526ST1/526ST2 (Buffalo Crk. 526S 138kV/25kV transformer)	701L/7L701 (Strome 223S-N.Holden 395S)	6.18	6.18	6.18	17.44	10.72	13.5	7.79	8.31	7.42	10.38	6.18	6.18	8.48	6.96	7.35
526ST1/526ST2 (Buffalo Crk. 526S 138kV/25kV transformer)	749L (Edgerton 899S-Kilarney tap point)	4.14	4.14	4.14	4.56	5.3	6.24	5.76	13.04	3.96	5.23	4.14	4.14	6.83	4.51	4.41
526ST1/526ST2 (Buffalo Crk. 526S 138kV/25kV transformer)	7L749 (Edgerton 899S-Briker tap point)	4.08	4.08	4.08	4.49	5.24	6.17	5.7	12.98	3.89	5.17	4.08	4.08	6.77	4.44	4.35
526ST1/526ST2 (Buffalo Crk. 526S 138kV/25kV transformer)	912L (Red Deer 63S-Nevis 766S)	20.77	20.77	20.77	42.45	46.66	42.26	29.83	38.16	50.47	44.77	20.77	20.77	34.05	25.7	31.96
545ST1 (Provost 545S 138kV/25kV transformer)	912L (Red Deer 63S-Nevis 766S)	19.62	19.62	19.62	39.8	44.78	39.58	28.43	36.51	49.16	42.94	19.62	19.62	32.54	24.42	30.65
648ST1 (Metiskow 648S 138kV/25kV transformer)	715L (648S Tap Point-Provost 545S)	2.84	2.84	2.84	1.55	2.89	2.33	4.09	-75.81	2.45	2.9	2.84	2.84	4.98	3.02	2.89
648ST1 (Metiskow 648S 138kV/25kV transformer)	715L (Hansman Lk 650S- 648S Tap Point)	2.84	2.84	2.84	1.55	2.89	2.33	4.09	-75.81	2.45	2.9	2.84	2.84	4.98	3.02	2.89
648ST1 (Metiskow 648S 138kV/25kV transformer)	7L50 (Buffalo Crk 526S-Jarrow tap point)	4.49	4.49	4.49	10.02	7.33	10.87	5.34	-2.49	5.08	7.12	4.49	4.49	5.73	4.95	5.08
703ALtap (Sunken Lk. 221S-Metiskow 648S)	912L (Red Deer 63S-Nevis 766S)	19.57	19.57	19.57	39.88	44.8	39.88	28.32	36.71	49.15	42.95	19.57	19.57	32.39	24.37	30.61
704L (Wainwright 51S-Tucuman 478S)	912L (Red Deer 63S-Nevis 766S)	19.89	19.89	19.89	39.68	45.13	40.37	28.83	37.69	49.39	43.28	19.89	19.89	33.03	24.72	30.93
709S701T/709S702T wP1410 (Vegreville 709S transformers)	912L (Red Deer 63S-Nevis 766S)	20.27	20.27	20.27	41	45.78	40.88	29.32	38.63	49.86	43.92	20.27	20.27	33.56	25.15	31.39
749L \ 749AL (Metiskow 648S-Edgerton 899S)	704L (51S WAINWRIGHT to 478S Tucuman)	3.35	3.35	3.35	-0.63	4.09	8.21	4.9	8.24	2.86	4.05	3.35	3.35	6	3.65	3.42
749L \ 749AL (Metiskow 648S-Edgerton 899S)	7L129 (Buffalo Crk. 526S-Bauer tap point)	5.56	5.56	5.56	10.3	8.35	11.25	7.11	9.55	5.93	8.15	5.56	5.56	8	6.12	6.17
749L \ 749AL (Metiskow 648S-Edgerton 899S)	7L50 (Buffalo Crk 526S-Jarrow tap point)	5.67	5.67	5.67	10.41	8.46	11.36	7.22	9.66	6.04	8.26	5.67	5.67	8.1	6.22	6.28
751S701T or 751S702T (Hill 751S 138kV/25kV transformer)	912L (Red Deer 63S-Nevis 766S)	20.02	20.02	20.02	39.97	45.25	40.06	29.08	39.24	49.5	43.41	20.02	20.02	33.36	24.87	31.07
766S901T (Nevis 766S 240kV/138kV transformer)	174L (Bardo 197S-N.Holden 395S)	7.09	7.09	7.09	18.63	15.08	16.66	10.33	14.79	11.69	14.5	7.09	7.09	11.94	8.58	9.59
766S901T (Nevis 766S 240kV/138kV transformer)	701L/7L701 (Strome 223S-N.Holden 395S)	8.39	8.39	8.39	21.72	16.52	17.73	11.25	13.57	13.76	15.92	8.39	8.39	12.53	9.86	11.1
766S901T (Nevis 766S 240kV/138kV transformer)	704L (51S WAINWRIGHT to 478S Tucuman)	3.48	3.48	3.48	0.84	5.45	9.26	5.11	6.93	3.13	5.31	3.48	3.48	6.19	3.94	3.72
766S901T (Nevis 766S 240kV/138kV transformer)	749L (Edgerton 899S-Kilarney tap point)	3.72	3.72	3.72	3.43	5.28	5.07	5.47	13.59	3.97	5.18	3.72	3.72	6.61	4.16	4.14
766S901T (Nevis 766S 240kV/138kV transformer)	7L129 (Buffalo Crk. 526S-Bauer tap point)	6.19	6.19	6.19	13.71	11.58	13.85	8.02	7.66	8.72	11.18	6.19	6.19	8.9	7.13	7.64
766S901T (Nevis 766S 240kV/138kV transformer)	7L50 (Buffalo Crk 526S-Jarrow tap point)	6.3	6.3	6.3	13.82	11.69	13.96	8.13	7.77	8.82	11.28	6.3	6.3	9.01	7.23	7.75
766S901T (Nevis 766S 240kV/138kV transformer)	7L701 (Battle River 757S-7LA701)	7.63	7.63	7.63	21.73	16.2	17.57	10.24	13.25	6.21	15.54	7.63	7.63	11.83	8.93	8.13
766S901T (Nevis 766S 240kV/138kV transformer)	7L701(Strome 233S-7LA701)	8.52	8.52	8.52	21.86	16.65	17.86	11.38	13.7	13.9	16.05	8.52	8.52	12.67	9.99	11.24
766S901T (Nevis 766S 240kV/138kV transformer)	7L749 (Edgerton 899S-Briker tap point)	3.66	3.66	3.66	3.37	5.21	5.01	5.4	13.52	3.9	5.11	3.66	3.66	6.54	4.1	4.08
769L \ 769AL (Rosyth 796S-Hardisty 377S)	912L (Red Deer 63S-Nevis 766S)	19.61	19.61	19.61	39.79	44.77	39.57	28.41	37.12	49.15	42.93	19.61	19.61	32.52	24.41	30.64
769S701T (Stettler 769S 138kV/25kV transformer)	912L (Red Deer 63S-Nevis 766S)	19.61	19.61	19.61	39.79	44.77	39.57	28.41	37.12	49.15	42.93	19.61	19.61	32.52	24.41	30.64
770S703T (3 Hills 770S 138kV/25kV transformers)	912L (Red Deer 63S-Nevis 766S)	19.61	19.61	19.61	39.79	44.77	39.57	28.41	37.12	49.15	42.93	19.61	19.61	32.52	24.41	30.64
7L129 \ 7LA129 (Buffalo Crk. 526S-Vermilion 710S)	701L/7L701 (Strome 223S-N.Holden 395S)	6.18	6.18	6.18	17.44	10.72	13.5	7.79	8.31	7.42	10.38	6.18	6.18	8.48	6.96	7.35
7L129 \ 7LA129 (Buffalo Crk. 526S-Vermilion 710S)	749L (Edgerton 899S-Kilarney tap point)	4.14	4.14	4.14	4.56	5.3	6.24	5.76	13.04	3.96	5.23	4.14	4.14	6.83	4.51	4.41
7L129 \ 7LA129 (Buffalo Crk. 526S-Vermilion 710S)	7L749 (Edgerton 899S-Briker tap point)	4.08	4.08	4.08	4.49	5.24	6.17	5.7	12.98	3.89	5.17	4.08	4.08	6.77	4.44	4.35
7L129 \ 7LA129 (Buffalo Crk. 526S-Vermilion 710S)	912L (Red Deer 63S-Nevis 766S)	20.77	20.77	20.77	42.45	46.66	42.26	29.83	38.16	50.47	44.77	20.77	20.77	34.05	25.7	31.96
7L132 (Oyen 767S-Lanfine 959S)	912L (Red Deer 63S-Nevis 766S)	18.92	18.92	18.92	40.04	45.05	39.93	30.93	37.7	49.18	43.2	18.92	18.92	33.57	24.47	30.6
7L42 (Lloydminster 716S-Hill 751S)	7L50 (Buffalo Crk 526S-Jarrow tap point)	5.5	5.5	5.5	10.24	8.29	11.19	7.05	9.5	5.87	8.09	5.5	5.5	7.94	6.06	6.11
7L42 (Lloydminster 716S-Hill 751S)	912L (Red Deer 63S-Nevis 766S)	20.08	20.08	20.08	40.04	45.31	40.12	29.14	39.3	49.56	43.47	20.08	20.08	33.43	24.93	31.14
7L50 (Buffalo Crk. 526S-Battle River 757S)	701L/7L701 (Strome 223S-N.Holden 395S)	6.17	6.17	6.17	17.86	10.75	13.33	7.72	8.1	7.45	10.4	6.17	6.17	8.36	6.95	7.35
7L50 (Buffalo Crk. 526S-Battle River 757S)	749L (Edgerton 899S-Kilarney tap point)	4.19	4.19	4.19	4.43	5.34	6.35	5.83	13.17	3.99	5.27	4.19	4.19	6.92	4.56	4.46
7L50 (Buffalo Crk. 526S-Battle River 757S)	7L701(Strome 233S-7LA701)	6.3	6.3	6.3	17.99	10.88	13.46	7.86	8.24	7.58	10.54	6.3	6.3	8.5	7.08	7.49
7L50 (Buffalo Crk. 526S-Battle River 757S)	7L749 (Edgerton 899S-Briker tap point)	4.12	4.12	4.12	4.36	5.27	6.29	5.77	13.11	3.92	5.2	4.12	4.12	6.86	4.49	4.39
7L50 (Buffalo Crk. 526S-Battle River 757S)	912L (Red Deer 63S-Nevis 766S)	20.8	20.8	20.8	42.49	46.69	42.29	29.85	38.18	50.5	44.8	20.8	20.8	34.08	25.72	31.99
7L701 \ 7LA701 \ 701L (Strome 223S-Battle River 757S)	7L50 (Buffalo Crk 526S-Jarrow tap point)	5.51	5.51	5.51	13.22	9.05	12.42	6.72	5.59	6.29	8.79	5.51	5.51	7.29	6.11	6.3
7L701 \ 7LA701 \ 701L (Strome 223S-Battle River 757S)	912L (Red Deer 63S-Nevis 766S)	21.88	21.88	21.88	46.32	48.71	44.4	31.29	40.35	51.93	46.75	21.88	21.88	35.64	26.98	33.37
7L701 \ 7LA701 \ 701L (Strome 223S-Battle River 757S)	9L20 (Cordel 755S-Nevis 768S)	18.42	18.42	18.42	42.95	48.02	42.1	27.52	38.59	-4.86	45.72	18.42	18.42	32.67	22.55	16.61
7L749 \ 749L \ 7LB749 Lloydminster 716S-Edgerton 899S)	704L (51S WAINWRIGHT to 478S Tucuman)	3.33	3.33	3.33	-0.64	4.07	8.19	4.88	8.24	2.84	4.03	3.33	3.33	5.98	3.63	3.4
7L749 \ 749L \ 7LB749 Lloydminster 716S-Edgerton 899S)	7L129 (Buffalo Crk. 526S-Bauer tap point)	5.53	5.53	5.53	10.27	8.32	11.22	7.08	9.53	5.9	8.12	5.53	5.53	7.96	6.08	6.14
7L749 \ 749L \ 7LB749 Lloydminster 716S-Edgerton 899S)	7L50 (Buffalo Crk 526S-Jarrow tap point)	5.64	5.64	5.64	10.38	8.43	11.32	7.19	9.63	6	8.23	5.64	5.64	8.07	6.19	6.25
7L749 \ 749L \ 7LB749 Lloydminster 716S-Edgerton 899S)	912L (Red Deer 63S-Nevis 766S)	20.13	20.13	20.13	40.09	45.37	40.17	29.2	39.35	49.61	43.53	20.13	20.13	33.48	24.98	31.19
7L760 \ 760L (Empress 394S-Oyen 767S)	912L (Red Deer 63S-Nevis 766S)	18.67	18.67	18.67	40.15	45.11	40.02	31.13	37.77	49.33	43.25	18.67	18.67	33.67	24.42	30.78
7L79 (Ribstone Crk. 892S-Pemukan 932S)	912L (Red Deer 63S-Nevis 766S)	19.61	19.61	19.61	39.79	44.77	39.57	28.41	37.12	49.15	42.93	19.61	19.61	32.52	24.41	30.64
7L92 \ 7LA92 (Vegreville 709S -Vilna 777S)	912L (Red Deer 63S-Nevis 766S)	20.16	20.16	20.16	40.9	45.58	40.56	29.1	38.04	49.76	43.73	20.16	20.16	33.27	25.01	31.26
802S702T (Michichi Crk. 802S 138kV/25kV transformers)	912L (Red Deer 63S-Nevis 766S)	19.61	19.61	19.61	39.79	44.77	39.57	28.41	37.12	49.15	42.93	19.61	19.61	32.52	24.41	30.64
802S703T (Michichi Crk. 802S 138kV/25kV transformers)	912L (Red Deer 63S-Nevis 766S)	19.61	19.61	19.61	39.79	44.77	39.57	28.41	37.12	49.15	42.93	19.61	19.61	32.52	24.41	30.64

CEF - Sensitivity Scenario 4a

871L (Amoco Empress 163S-sand Hills 341S)	912L (Red Deer 63S-Nevis 766S)	19.61	19.61	19.61	39.79	44.77	39.57	28.41	37.12	49.15	42.93	19.61	19.61	32.52	24.41	30.64
899ST3a (Edgerton 899S 138kV/25kV transformer)	704L (51S WAINWRIGHT to 478S Tucuman)	3.35	3.35	3.35	-0.63	4.09	8.21	4.9	8.25	2.86	4.05	3.35	3.35	6	3.65	3.42
899ST3a (Edgerton 899S 138kV/25kV transformer)	7L129 (Buffalo Crk. 526S-Bauer tap point)	5.56	5.56	5.56	10.3	8.35	11.25	7.11	9.56	5.93	8.15	5.56	5.56	8	6.12	6.17
899ST3a (Edgerton 899S 138kV/25kV transformer)	7L50 (Buffalo Crk 526S-Jarrow tap point)	5.67	5.67	5.67	10.41	8.46	11.36	7.22	9.67	6.04	8.26	5.67	5.67	8.1	6.22	6.28
899ST3a (Edgerton 899S 138kV/25kV transformer)	912L (Red Deer 63S-Nevis 766S)	20.15	20.15	20.15	40.1	45.38	40.19	29.21	39.37	49.63	43.54	20.15	20.15	33.49	24.99	31.2
912L \ 9L912 (Red Deer 63S-Nevis 766S)	174L (Bardo 197S-N.Holden 395S)	7.1	7.1	7.1	18.57	14.95	16.58	10.31	14.7	12.77	14.37	7.1	7.1	11.89	8.59	9.85
912L \ 9L912 (Red Deer 63S-Nevis 766S)	701L/7L701 (Strome 223S-N.Holden 395S)	8.4	8.4	8.4	21.69	16.44	17.68	11.24	13.52	14.37	15.85	8.4	8.4	12.51	9.86	11.25
912L \ 9L912 (Red Deer 63S-Nevis 766S)	704L (51S WAINWRIGHT to 478S Tucuman)	3.49	3.49	3.49	0.76	5.29	9.15	5.09	6.82	4.45	5.17	3.49	3.49	6.13	3.95	4.04
912L \ 9L912 (Red Deer 63S-Nevis 766S)	749L (Edgerton 899S-Kilarney tap point)	3.73	3.73	3.73	3.39	5.19	5.02	5.46	13.53	4.67	5.1	3.73	3.73	6.58	4.17	4.31
912L \ 9L912 (Red Deer 63S-Nevis 766S)	7L129 (Buffalo Crk. 526S-Bauer tap point)	6.2	6.2	6.2	13.64	11.44	13.76	8.01	7.58	9.82	11.05	6.2	6.2	8.85	7.14	7.91
912L \ 9L912 (Red Deer 63S-Nevis 766S)	7L50 (Buffalo Crk 526S-Jarrow tap point)	6.31	6.31	6.31	13.75	11.55	13.87	8.11	7.68	9.93	11.16	6.31	6.31	8.96	7.25	8.02
912L \ 9L912 (Red Deer 63S-Nevis 766S)	7L701 (Battle River 757S-7LA701)	7.67	7.67	7.67	21.4	15.52	17.14	10.17	12.82	11.68	14.93	7.67	7.67	11.6	9	9.46
912L \ 9L912 (Red Deer 63S-Nevis 766S)	7L701(Strome 233S-7LA701)	8.53	8.53	8.53	21.82	16.58	17.81	11.38	13.65	14.5	15.99	8.53	8.53	12.64	10	11.38
912L \ 9L912 (Red Deer 63S-Nevis 766S)	7L749 (Edgerton 899S-Briker tap point)	3.66	3.66	3.66	3.33	5.12	4.95	5.39	13.47	4.6	5.03	3.66	3.66	6.52	4.11	4.24
923L (Milo 356S-Newell 2075S)	912L (Red Deer 63S-Nevis 766S)	22.63	22.63	22.63	41.08	46.17	40.97	30.81	38.71	50.61	44.45	22.63	22.63	34.61	27.13	33.03
931L (W.Brooks 28S-Ware Junct. 132S)	912L (Red Deer 63S-Nevis 766S)	20.46	20.46	20.46	40.22	45.23	40.03	29.11	37.64	49.64	43.43	20.46	20.46	33.17	25.27	31.4
933L (Ware Junct. 132S-Anderson 801S)	912L (Red Deer 63S-Nevis 766S)	18.9	18.9	18.9	40.44	45.48	40.26	29.16	37.87	49.92	43.7	18.9	18.9	33.41	25.8	31.85
935L (Cassils 324S-Milo 356S)	912L (Red Deer 63S-Nevis 766S)	22.59	22.59	22.59	41.07	46.16	40.96	30.78	38.7	50.6	44.44	22.59	22.59	34.59	27.11	33.01
953L \ 9L953 (Nilrem 574S-Cordel 755S)	912L (Red Deer 63S-Nevis 766S)	19.5	19.5	19.5	39.79	45.6	37.5	27.69	35.13	49.38	43.68	19.5	19.5	31.31	24.32	30.61
966L \ 9L966 (Hansman Lk. 650S-Pemukan 932S)	7L224 (Hansman Lake 650S-Monitor 774S)	7.72	7.72	7.72	-6.69	-6.22	-10.42	20.14	-20.86	1.27	-4.95	7.72	7.72	29.66	7.88	6.44
9L16 (Cordel 755S-Tinchebray 972S)	9L46 (New Bridgeden 2088S-Pemukan 932S)	20.16	20.16	20.16	-18.37	-19.68	-23.02	36.93	-30.89	2.5	22.51	20.16	20.16	49.31	22.51	17.48
9L20 (Cordel 755S-Nevis 766S)	174L (Bardo 197S-N.Holden 395S)	6.12	6.12	6.12	17.11	13.7	15.25	9.07	13.5	3.63	13.12	6.12	6.12	10.65	7.36	6.75
9L20 (Cordel 755S-Nevis 766S)	701L/7L701 (Strome 223S-N.Holden 395S)	7.38	7.38	7.38	20.12	15.07	16.25	9.93	12.22	5.32	14.48	7.38	7.38	11.18	8.58	8.13
9L20 (Cordel 755S-Nevis 766S)	704L (51S WAINWRIGHT to 478S Tucuman)	3.33	3.33	3.33	0.6	5.23	9.04	4.91	6.73	1.87	5.1	3.33	3.33	5.99	3.75	3.28
9L20 (Cordel 755S-Nevis 766S)	749L (Edgerton 899S-Kilarney tap point)	3.52	3.52	3.52	3.11	4.98	4.77	5.2	13.31	2.24	4.88	3.52	3.52	6.34	3.9	3.53
9L20 (Cordel 755S-Nevis 766S)	7L129 (Buffalo Crk. 526S-Bauer tap point)	5.63	5.63	5.63	12.82	10.77	13.03	7.29	6.92	4.04	10.38	5.63	5.63	8.15	6.42	6
9L20 (Cordel 755S-Nevis 766S)	7L159 (Heatburg 948S-7LA159)	5.06	5.06	5.06	3.73	4.63	4.18	5.81	4.59	59.93	4.78	5.06	5.06	5.47	6.37	18.61
9L20 (Cordel 755S-Nevis 766S)	7L16 (Nevis 766S-Heatburg 948S)	5.02	5.02	5.02	3.69	4.58	4.14	5.77	4.55	59.88	4.74	5.02	5.02	5.43	6.33	18.57
9L20 (Cordel 755S-Nevis 766S)	7L50 (Buffalo Crk 526S-Jarrow tap point)	5.74	5.74	5.74	12.93	10.88	13.14	7.4	7.02	4.15	10.49	5.74	5.74	8.26	6.53	6.11
9L20 (Cordel 755S-Nevis 766S)	7L701 (Battle River 757S-7LA701)	7.3	7.3	7.3	21.21	15.73	17.09	9.81	12.81	3.47	15.08	7.3	7.3	11.39	8.52	7.17
9L20 (Cordel 755S-Nevis 766S)	7L701(Strome 233S-7LA701)	7.51	7.51	7.51	20.25	15.2	16.38	10.07	12.35	5.45	14.62	7.51	7.51	11.31	8.71	8.27
9L20 (Cordel 755S-Nevis 766S)	7L749 (Edgerton 899S-Briker tap point)	3.45	3.45	3.45	3.04	4.91	4.7	5.13	13.25	2.18	4.82	3.45	3.45	6.27	3.84	3.47
9L20 (Cordel 755S-Nevis 766S)	Nevis 766S 901T	6.56	6.56	6.56	10.4	9.43	9.61	8.55	8.77	54.83	9.33	6.56	6.56	8.77	8.29	19.28
9L24 (Oakland 946S-Lanfine 959S)	912L (Red Deer 63S-Nevis 766S)	18.69	18.69	18.69	41	45.88	41.4	34.72	40.13	48.8	43.76	18.69	18.69	38.55	22.45	29.16
9L59 (Anderson 801S-Tinchebray 972S)	9L46 (New Bridgeden 2088S-Pemukan 932S)	20.16	20.16	20.16	-18.37	-19.68	-23.02	36.93	-30.89	2.5	-19.68	20.16	20.16	49.31	22.51	17.48
9L80 (Cordel 755S-Battle River 757S)	912L (Red Deer 63S-Nevis 766S)	20.72	20.72	20.72	28.62	47.6	35.06	29.42	37.57	49.9	45.62	20.72	20.72	33.56	25.68	31.54
9L933 \ 933L (Ware Junction 132S-Anderson 801S)	912L (Red Deer 63S-Nevis 766S)	18.9	18.9	18.9	40.44	45.48	40.26	29.16	37.87	49.92	43.7	18.9	18.9	33.41	25.8	31.85
9L934 \ 934L (Ware Junction 132S-Anderson 801S)	912L (Red Deer 63S-Nevis 766S)	18.9	18.9	18.9	40.44	45.48	40.26	29.16	37.87	49.92	43.7	18.9	18.9	33.41	25.8	31.85
9L950 \ 950L (Ware Junction 132S-Anderson 801S)	912L (Red Deer 63S-Nevis 766S)	18.91	18.91	18.91	40.44	45.47	40.25	29.16	37.86	49.91	43.7	18.91	18.91	33.4	25.8	31.85
EATL	174L (Bardo 197S-N.Holden 395S)	3.85	3.85	3.85	11.97	7.53	10.02	5.6	8.55	4.62	7.26	3.85	3.85	6.5	4.54	4.77
EATL	701L/7L701 (Strome 223S-N.Holden 395S)	5.17	5.17	5.17	15.14	9.08	11.17	6.57	7.41	6.28	8.79	5.17	5.17	7.15	5.85	6.21
EATL	704L (51S WAINWRIGHT to 478S Tucuman)	2.59	2.59	2.59	-1.06	3.24	7.34	3.79	5.12	2.19	3.2	2.59	2.59	4.64	2.83	2.64
EATL	749L (Edgerton 899S-Kilarney tap point)	2.87	2.87	2.87	1.66	3.24	3.29	4.22	11.91	2.52	3.22	2.87	2.87	5.16	3.11	2.97
EATL	7L129 (Buffalo Crk. 526S-Bauer tap point)	4.15	4.15	4.15	9.49	6.76	9.63	5.04	3.7	4.69	6.57	4.15	4.15	5.46	4.59	4.71
EATL	7L159 (Heatburg 948S-7LA159)	3.18	3.18	3.18	-0.51	-0.48	-0.15	2.94	0.5	60.75	-0.07	3.18	3.18	2.04	4.04	16.97
EATL	7L50 (Buffalo Crk 526S-Jarrow tap point)	4.26	4.26	4.26	9.59	6.87	9.74	5.14	3.81	4.79	6.67	4.26	4.26	5.56	4.7	4.82
EATL	7L701 (Battle River 757S-7LA701)	4.82	4.82	4.82	15.63	9.02	11.4	6.04	7.43	4.55	8.7	4.82	4.82	6.88	5.46	5.01
EATL	7L701(Strome 233S-7LA701)	5.3	5.3	5.3	15.27	9.21	11.3	6.7	7.55	6.41	8.92	5.3	5.3	7.29	5.98	6.34
EATL	7L749 (Edgerton 899S-Briker tap point)	2.81	2.81	2.81	1.59	3.17	3.23	4.15	11.85	2.46	3.16	2.81	2.81	5.1	3.04	2.91
EATL	912L (Red Deer 63S-Nevis 766S)	19.61	19.61	19.61	39.79	44.77	39.57	28.41	37.12	49.15	42.93	19.61	19.61	32.52	24.41	30.64
EATL	9L20 (Cordel 755S-Nevis 768S)	16.41	16.41	16.41	36.97	44.46	37.69	24.99	35.67	-7.14	42.28	16.41	16.41	29.88	20.28	14.29
EATL	9L46 (New Bridgeden 2088S-Pemukan 932S)	12.65	12.65	12.65	-10.73	-10.39	-16.15	32.97	-26.14	2.06	-8.29	12.65	12.65	48.55	12.89	10.54

Sensitivity Scenario 4b (2022SP)

CEF - Sensitivity Scenario 4b

		Name of Bus	Buffalo Atlee 1 WAGF (P1853)	Buffalo Atlee 2 WAGF (P2199)	Buffalo Atlee 3 WAGF (P1892)	Battle River 4 (BAT #4)	Battle River 5 (BAT #5)	Bellshill Gas Plant	Pattern Lanfine N. (P1898)	Bull Creek WAGF (BUL1, BUL2)	Ghost Pine WAGF (NEP1)	HALKIRK WAGF (HAL1)	Joss Jenner WAGF (P1533)	Joss Jenner WAGF (P1698)	Paintearth WAGF (P1704)	Sharp Hills WAGF (P1567)	Sheerness 1 (SH1, SH2)	Winetring Hills (SCR4)
		Number of Bus	552260	557261	553260	1496	70001	2088	60996	550003	2621	67435	60798	61798	61418	60831	1482	60789
		ID	G4	G1	G5	4	G5	G1	1	G1	G1	G1	G1	G3	G1	G1	1	G1
		Area Name of Gen	EMPRESS	EMPRESS	EMPRESS	ALLIANCE	ALLIANCE	WAINWRIG	HANNA	PROVOST	HANNA	HANNA	EMPRESS	EMPRESS	HANNA	HANNA	SHEERNES	SHEERNES
Contingency		Element Name								CEF %								
7665901T (Nevis 766S 240kV/138kV transformer)	N HOLDE7 (68) -> BARDO 7 (65) CKT 74	174L (Bardo 197S-N.Holden 395S)	6.21	6.21	6.21	18.32	14.8	16.62	9.73	14.42	11.05	14.17	6.21	6.21	14.17	11.49	7.81	8.87
7665901T (Nevis 766S 240kV/138kV transformer)	IPPL ST7 (76) -> N HOLDE7 (68) CKT 01	701L/7L701 (Strome 223S-N.Holden 395S)	6.56	6.56	6.56	20.11	14.47	15.41	9.28	11.75	11.98	13.89	6.56	6.56	13.89	10.46	7.98	9.26
7665901T (Nevis 766S 240kV/138kV transformer)	BAT. RV7 (1491) -> HEIS_TP8 (1007) CKT 01	7L701 (Battle River 757S-7LA701)	5.98	5.98	5.98	20.26	14.33	15.44	8.45	11.6	4.6	13.69	5.98	5.98	13.69	9.95	7.24	6.46
7665901T (Nevis 766S 240kV/138kV transformer)	HEIS_TP8 (1007) -> IPPL ST7 (76) CKT 01	7L701(Strome 233S-7LA701)	6.7	6.7	6.7	20.25	14.61	15.54	9.41	11.89	12.12	14.02	6.7	6.7	14.02	10.6	8.12	9.39
912L \ 9L912 (Red Deer 63S-Nevis 766S)	N HOLDE7 (68) -> BARDO 7 (65) CKT 74	174L (Bardo 197S-N.Holden 395S)	6.22	6.22	6.22	18.25	14.65	16.52	9.72	14.33	12.29	14.04	6.22	6.22	14.04	11.45	7.83	9.17
912L \ 9L912 (Red Deer 63S-Nevis 766S)	IPPL ST7 (76) -> N HOLDE7 (68) CKT 01	701L/7L701 (Strome 223S-N.Holden 395S)	6.57	6.57	6.57	20.09	14.42	15.37	9.27	11.72	12.44	13.84	6.57	6.57	13.84	10.44	7.99	9.37
912L \ 9L912 (Red Deer 63S-Nevis 766S)	BAT. RV7 (1491) -> HEIS_TP8 (1007) CKT 01	7L701 (Battle River 757S-7LA701)	6.02	6.02	6.02	19.95	13.68	15.05	8.39	11.18	9.93	13.1	6.02	6.02	13.1	9.74	7.31	7.76
912L \ 9L912 (Red Deer 63S-Nevis 766S)	HEIS_TP8 (1007) -> IPPL ST7 (76) CKT 01	7L701(Strome 233S-7LA701)	6.7	6.7	6.7	20.22	14.55	15.51	9.41	11.85	12.57	13.97	6.7	6.7	13.97	10.58	8.12	9.5
966L \ 9L966 (Hansman Lk. 650S-Pemukan 932S)	MONITOR7 (1471) -> HANSMAN9 (648) CKT 24	7L224 (Hansman Lake 650S-Monitor 774S)	7.17	7.17	7.17	-6.82	-6.31	-10.35	19.74	-21.19	1.03	-5.07	7.17	7.17	-5.07	29.33	7.41	6.04
9L16 (Cordel 755S-Tinchebray 972S)	N_BRIGDEN (1413) -> PEMUKN1 (1419) CKT 51	9L46 (New Bridgeden 2088S-Pemukan 932S)	18.42	18.42	18.42	-18.56	-19.76	-22.81	35.82	-31.38	1.78	20.91	18.42	18.42	20.91	48.59	20.91	16.13
9L20 (Cordel 755S-Nevis 766S)	N HOLDE7 (68) -> BARDO 7 (65) CKT 74	174L (Bardo 197S-N.Holden 395S)	5.38	5.38	5.38	16.91	13.56	15.35	8.62	13.26	3.29	12.94	5.38	5.38	12.94	10.35	6.74	6.21
9L20 (Cordel 755S-Nevis 766S)	IPPL ST7 (76) -> N HOLDE7 (68) CKT 01	701L/7L701 (Strome 223S-N.Holden 395S)	5.75	5.75	5.75	18.74	13.25	14.17	8.19	10.62	4.4	12.68	5.75	5.75	12.68	9.34	6.93	6.66
9L20 (Cordel 755S-Nevis 766S)	GHOSTPI3 (602) -> 948S_HV (1429) CKT 59	7L159 (Heatburg 948S-7LA159)	4.48	4.48	4.48	3.33	4.12	3.66	5.25	4.13	59.61	4.27	4.48	4.48	4.27	4.92	5.81	18.11
9L20 (Cordel 755S-Nevis 766S)	948S_HV (1429) -> NEVIS 7 (1423) CKT 16	7L16 (Nevis 766S-Heatburg 948S)	4.43	4.43	4.43	3.29	4.07	3.61	5.21	4.09	59.57	4.23	4.43	4.43	4.23	4.88	5.76	18.06
9L20 (Cordel 755S-Nevis 766S)	BAT. RV7 (1491) -> HEIS_TP8 (1007) CKT 01	7L701 (Battle River 757S-7LA701)	5.77	5.77	5.77	19.9	14.01	15.12	8.17	11.3	2.6	13.38	5.77	5.77	13.38	9.66	6.96	5.78
9L20 (Cordel 755S-Nevis 766S)	HEIS_TP8 (1007) -> IPPL ST7 (76) CKT 01	7L701(Strome 233S-7LA701)	5.89	5.89	5.89	18.87	13.39	14.3	8.32	10.75	4.53	12.82	5.89	5.89	12.82	9.48	7.07	6.8
9L20 (Cordel 755S-Nevis 766S)	NEVIS 7 (1423) -> NEVIS 4 (1422) CKT 1T	Nevis 766S 901T	5.8	5.8	5.8	9.85	8.73	8.87	7.81	8.14	54.41	8.63	5.8	5.8	8.63	8.03	7.54	18.62
EATL	N HOLDE7 (68) -> BARDO 7 (65) CKT 74	174L (Bardo 197S-N.Holden 395S)	3.34	3.34	3.34	11.91	7.57	10.37	5.38	8.49	4.46	7.26	3.34	3.34	7.26	6.44	4.15	4.44
EATL	IPPL ST7 (76) -> N HOLDE7 (68) CKT 01	701L/7L701 (Strome 223S-N.Holden 395S)	3.99	3.99	3.99	14.41	8.07	9.85	5.39	6.48	5.42	7.76	3.99	3.99	7.76	5.95	4.69	5.13
EATL	HEIS_TP8 (1007) -> IPPL ST7 (76) CKT 01	7L701(Strome 233S-7LA701)	4.12	4.12	4.12	14.54	8.2	9.98	5.52	6.61	5.55	7.9	4.12	4.12	7.9	6.09	4.83	5.27
EATL	NEVIS 4 (1422) -> RED DEE4 (152) CKT 12	912L (Red Deer 63S-Nevis 766S)	17.5	17.5	17.5	38.57	43.11	37.5	26.4	35.58	47.68	41.24	17.5	17.5	41.24	30.51	22.39	28.76
EATL	CORDEL 4 (1499) -> NEVIS 4 (1422) CKT 20	9L20 (Cordel 755S-Nevis 768S)	14.63	14.63	14.63	35.9	42.98	35.79	23.24	34.31	-8.42	40.78	14.63	14.63	40.78	28.11	18.55	12.68
EATL	N_BRIGDEN (1413) -> PEMUKN1 (1419) CKT 51	9L46 (New Bridgeden 2088S-Pemukan 932S)	11.83	11.83	11.83	-10.95	-10.54	-16.01	32.48	-26.53	1.7	-8.49	11.83	11.83	-8.49	48.24	12.21	9.95

Sensitivity Scenario 4c (2022SP)

CEF - Sensitivity Scenario 4c

	Name of Bus	Buffalo Atlee 1 WAGF (P1853)	Buffalo Atlee 2 WAGF (P2199)	Buffalo Atlee 3 WAGF (P1892)	BADLANDS 6	BADLANDS 7	Battle River 4 (BAT #4)	Battle River 5 (BAT #5)	Bellshill Gas Plant	Pattern Lanfine N. (P1898)	Bull Creek WAGF (BUL1, BUL2)	Ghost Pine WAGF (NEP1)	HALKIRK WAGF (HAL1)	Joss Jenner WAGF (P1533)	Joss Jenner WAGF (P1698)	Painteart h WAGF (P1704)	Sharp Hills WAGF (P1567)	Sheerness 1 (SH1, SH2)	Winetring Hills (SCR4)
	Number of Bus	552260	557261	553260	61632	60632	1496	70001	2088	60996	550003	2621	67435	60798	61798	61418	60831	1482	60789
	ID	G4	G1	G5	G1	G2	4	G5	G1	1	G1	G1	G1	G1	G3	G1	G1	1	G1
	Area Name of Gen	EMPRESS	EMPRESS	EMPRESS	SHEERNES	SHEERNES	ALLIANCE	ALLIANCE	WAINWRIG	HANNA	PROVOST	HANNA	HANNA	EMPRESS	EMPRESS	HANNA	HANNA	SHEERNES	SHEERNES
Contingency	Element Name									CEF %									
766S901T (Nevis 766S 240kV/138kV transformer)	7L701 (Battle River 757S-7LA701)	3.7	3.7	3.7	3.5	3.5	15.4	8.8	10.7	5.0	7.0	1.2	7.8	3.7	3.7	7.8	6.0	4.3	3.4
766S901T (Nevis 766S 240kV/138kV transformer)	7L701(Strome 233S-7LA701)	4.3	4.3	4.3	6.1	6.1	15.2	8.9	10.6	5.9	7.2	8.6	7.9	4.3	4.3	7.9	6.5	5.1	6.2
766S901T (Nevis 766S 240kV/138kV transformer)	701L/7L701 (Strome 223S-N.Holden 395S)	4.2	4.2	4.2	5.9	5.9	15.1	8.7	10.5	5.8	7.0	8.4	7.8	4.2	4.2	7.8	6.4	5.0	6.1
766S901T (Nevis 766S 240kV/138kV transformer)	174L (Bardo 197S-N.Holden 395S)	3.5	3.5	3.5	5.1	5.1	12.6	8.3	11.0	5.7	9.0	7.0	7.2	3.5	3.5	7.2	6.9	4.4	5.2
912L \ 9L912 (Red Deer 63S-Nevis 766S)	7L701 (Battle River 757S-7LA701)	3.8	3.8	3.8	4.5	4.5	15.3	8.4	10.5	5.1	6.8	5.7	7.5	3.8	3.8	7.5	6.0	4.5	4.5
912L \ 9L912 (Red Deer 63S-Nevis 766S)	7L701(Strome 233S-7LA701)	4.3	4.3	4.3	6.0	6.0	15.2	8.9	10.6	5.9	7.2	8.0	8.0	4.3	4.3	8.0	6.5	5.1	6.0
912L \ 9L912 (Red Deer 63S-Nevis 766S)	701L/7L701 (Strome 223S-N.Holden 395S)	4.2	4.2	4.2	5.8	5.8	15.1	8.8	10.5	5.8	7.0	7.9	7.8	4.2	4.2	7.8	6.4	4.9	5.9
912L \ 9L912 (Red Deer 63S-Nevis 766S)	174L (Bardo 197S-N.Holden 395S)	3.5	3.5	3.5	5.2	5.2	12.6	8.2	11.0	5.7	9.0	7.1	7.2	3.5	3.5	7.2	6.9	4.4	5.3
966L \ 9L966 (Hansman Lk. 650S-Pemukan 932S)	7L224 (Hansman Lake 650S-Monitor 774S)	7.7	7.7	7.7	6.8	6.8	-5.7	-5.1	-9.3	20.4	-20.2	1.6	-3.6	7.7	7.7	-3.6	30.1	8.1	6.7
9L16 (Cordel 755S-Tinchebray 972S)	9L46 (New Bridgeden 2088S-Pemukan 932S)	15.1	15.1	15.1	12.9	12.9	-19.3	-20.5	-23.8	32.8	-32.8	0.1	8.7	15.1	15.1	8.7	46.1	16.6	12.5
9L20 (Cordel 755S-Nevis 766S)	7L701 (Battle River 757S-7LA701)	3.7	3.7	3.7	3.6	3.6	15.5	8.8	10.7	5.1	7.1	1.7	7.8	3.7	3.7	7.8	6.1	4.4	3.5
9L20 (Cordel 755S-Nevis 766S)	7L159 (Heatburg 948S-7LA159)	3.6	3.6	3.6	15.9	15.9	1.3	1.8	1.7	3.9	2.2	59.2	1.8	3.6	3.6	1.8	3.3	4.6	17.1
9L20 (Cordel 755S-Nevis 766S)	701L/7L701 (Strome 223S-N.Holden 395S)	3.8	3.8	3.8	4.5	4.5	14.6	8.3	10.0	5.3	6.6	3.6	7.4	3.8	3.8	7.4	6.0	4.5	4.5
9L20 (Cordel 755S-Nevis 766S)	174L (Bardo 197S-N.Holden 395S)	3.1	3.1	3.1	3.8	3.8	12.1	7.9	10.6	5.3	8.6	2.4	6.9	3.1	3.1	6.9	6.4	3.9	3.8
9L20 (Cordel 755S-Nevis 766S)	Nevis 766S 901T	4.0	4.0	4.0	15.6	15.6	6.0	4.2	5.1	5.2	4.5	53.7	3.8	4.0	4.0	3.8	4.9	5.3	16.7
EATL	9L20 (Cordel 755S-Nevis 768S)	9.2	9.2	9.2	6.5	6.5	25.4	30.8	25.4	15.5	24.2	-14.5	26.5	9.2	9.2	26.5	19.3	11.7	5.9
EATL	701L/7L701 (Strome 223S-N.Holden 395S)	3.2	3.2	3.2	4.1	4.1	12.9	6.3	8.3	4.3	5.0	4.5	5.7	3.2	3.2	5.7	4.7	3.7	4.2
EATL	174L (Bardo 197S-N.Holden 395S)	2.4	2.4	2.4	3.3	3.3	10.2	5.5	8.6	4.1	6.8	3.5	4.9	2.4	2.4	4.9	5.0	3.0	3.3
EATL	9L46 (New Bridgeden 2088S-Pemukan 932S)	12.8	12.8	12.8	11.3	11.3	-9.2	-8.5	-14.2	33.8	-24.8	2.7	-6.0	12.8	12.8	-6.0	49.8	13.4	11.1
EATL	912L (Red Deer 63S-Nevis 766S)	11.9	11.9	11.9	21.1	21.1	27.6	30.4	26.6	18.4	25.1	41.4	26.4	11.9	11.9	26.4	21.3	15.3	21.7