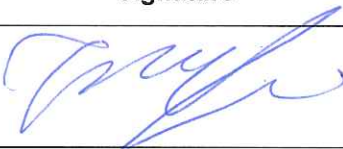



## **APPENDIX A CONNECTION ASSESSMENT**

# Engineering Connection Assessment

## Riverview Wind Power Plant Connection

Date: 2018-05-28

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Version: V1



May 30, 2018

**APEGA**  
 Permit-to-Practice 12517  
 P-8200

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# 1. Introduction

This report details the engineering studies conducted to assess the impact of the Project (as defined below) on the performance of the Alberta interconnected electric system (AIES).

## 1.1. Project

### 1.1.1. Project Overview

Riverview Limited Partnership (RLP), by its general partner Enel Alberta Wind Inc., (Market Participant) submitted a request for system access service to the Alberta Electric System Operator (AESO) to connect its proposed Riverview Wind Power Plant (the Facility) to the AIES. The Facility consists of a 115 MW wind aggregated generation facility (WAGF) in the AESO planning area of Fort Macleod (Area 53). The Facility includes the Market Participant's proposed expansion of the existing Castle Rock Ridge 205S substation. This expansion will serve as the Market Participant's collector substation.

The Market Participant's request for system access service includes a request for a Rate STS, *Supply Transmission Service*, contract capacity of 115 MW and a Rate DTS, *Demand Transmission Service*, contract capacity of 1 MW at the Castle Rock Ridge 205S substation, and a request for transmission development (collectively, the Riverview Project).

The scheduled ISD for the Riverview Project is June 30, 2019.

### 1.1.2. Load Component

The Project includes a load component:

- Requested Rate DTS contract capacity: 1 MW
- Load Type: Substation service and auxiliary load.

### 1.1.3. Generation Component

The Project includes the following generation component:

- Requested Rate STS contract capacity: 115 MW
- Facility Maximum Authorized Real Power (MARP): 115 MW
- Facility Maximum Capability (MC): 115 MW
- Generator type: Wind
- Type, number and size generators: 50 Siemens SWT 101 turbines (2.3 MW each)
- It is assumed that the aggregated generating facility has the minimum continuous reactive power capability of either supplying reactive power at 0.9 power factor (PF) lagging or absorbing reactive power at 0.95 PF leading, per the technical requirements

of Section 502.1 of the ISO rules, Wind Aggregated Generating Facilities Technical Requirements

## **1.2. Study Scope**

### **1.2.1. Study Objectives**

The objectives of the studies are as follows:

- Update the findings of earlier connection engineering studies completed for the Project.
- Assess the impact of the Project on the performance of the AIES.
- Identify any violations of the relevant AESO criteria, standards or requirements, both before and after connection of the Project.
- Recommend mitigation measures, if required, to reliably connect the Project to the AIES.

### **1.2.2. Study Area**

#### **1.2.2.1. Study Area Description**

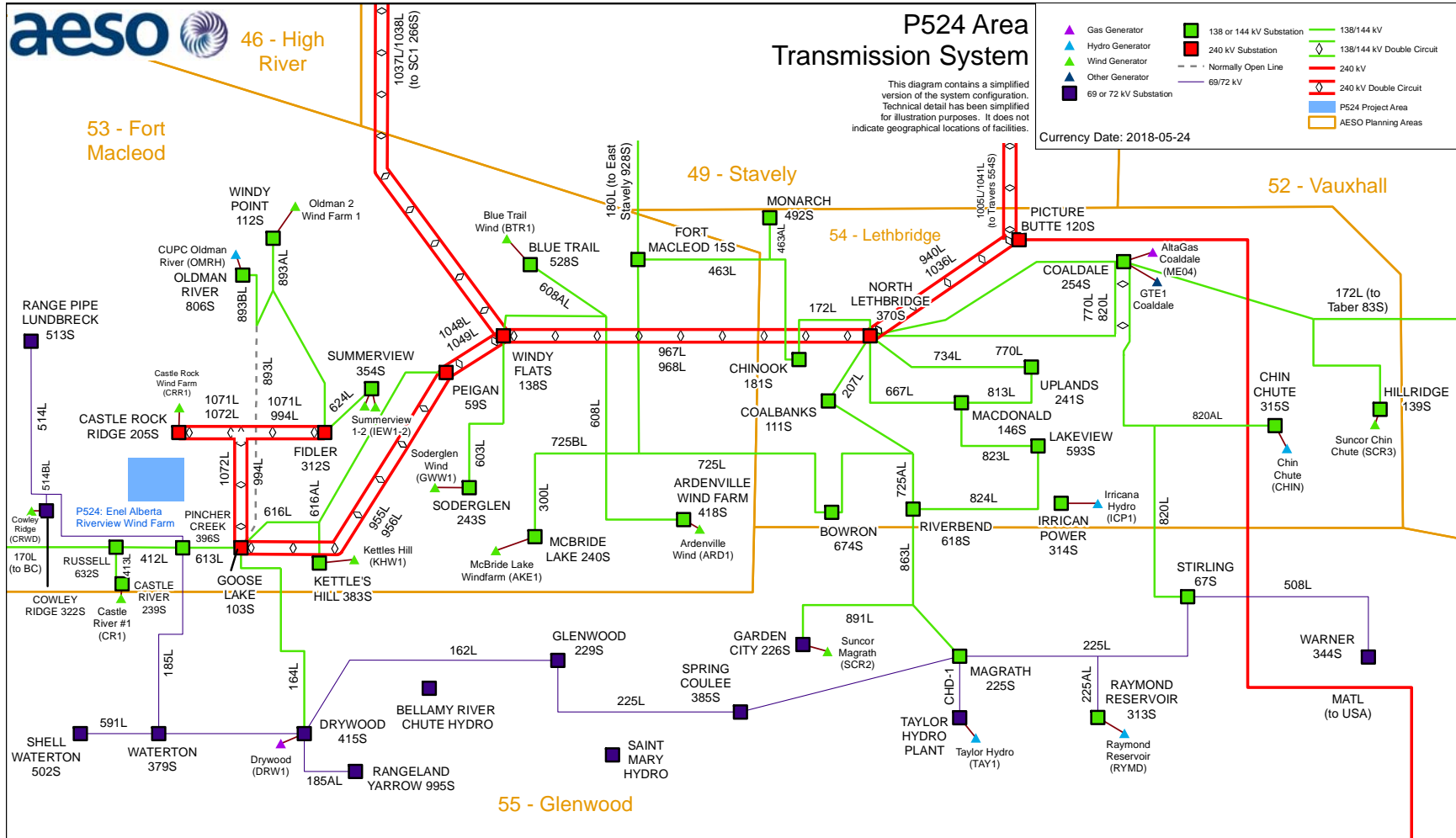
Geographically, the Project is located in the Fort Macleod area (Area 53), which is part of the AESO South Planning Region. The Fort Macleod area is adjacent to the planning areas of High River (Area 46), Stavely (Area 49), Lethbridge (Area 54) and Glenwood (Area 55).

From a transmission system perspective, the Fort Macleod area consists mainly of 69 kV, 138 kV and 240 kV transmission systems.

The Study Area for the Project consists of the AESO planning areas of Fort MacLeod (Area 53), Lethbridge (Area 54) and Glenwood (Area 55). The Study Area also includes the tie lines connecting these planning areas to neighboring planning areas. All transmission facilities within the Study Area were studied and monitored to assess the impact of the Project on the AIES, including any violations of the Reliability Criteria (as defined in Section 2.1.1).

Figure 1-1 shows the transmission system in the Study Area.

Figure 1-1: Study Area Transmission System



### 1.2.2.2. Existing Constraints

Existing constraints in the Study Area are managed in accordance with Section 302.1 of the ISO rules, *Real Time Transmission Constraint Management* (TCM Rule). Remedial action schemes (RASs) are being used to mitigate certain existing constraints in the Study Area, as follows:

1. RAS 36: Garden City 226s WAGF Trip Scheme.
2. RAS 37: Peigan 59s-616L Overload Mitigation Scheme
3. RAS 40: Coleman 799S- 786L Overload Mitigation Scheme
4. RAS 42: Spring Coulee 385s - 225LW Overload Mitigation Scheme
5. RAS 43: Stirling 67s - 508L Load Trip Scheme
6. RAS 126: Magrath 225s Generation Trip Scheme
7. RAS 129: Goose Lake 103s 613L Overload Mitigation Scheme
8. RAS 136: Direct Transfer Trip to MATL on Loss of 1201L
9. RAS 137: MATL Local Detection Scheme
10. RAS 612: 103S overvoltage - I-354S IPP trip

### 1.2.2.3. AESO Long-Term Transmission Plans (LTP)

The *AESO 2017 Long-term Transmission Plan (2017 LTP)*<sup>1</sup> includes the following system transmission developments in the Study Area, in the near term (by 2022):

- Add a new 500/240kV substation at Chapel Rock and two 240 kV lines from Chapel Rock to the Pincher Creek area

The above system developments will not be included in the system topology for the pre-Project and post-Project studies because these transmission developments are not expected to be in service before the Project ISD.

### 1.2.3. Engineering Studies Performed

The following pre-Project studies were performed:

- Power flow
- Short-circuit

The following post-Project studies were performed:

- Power flow
- Transient stability
- Short-circuit

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<sup>1</sup> The 2017 LTP document is available on the AESO website.



## 2. Criteria, System Data, and Study Assumptions

### 2.1. Criteria, Standards, and Requirements

#### 2.1.1. Transmission Planning Standards and Reliability Criteria

The Transmission Planning (TPL) Standards, which are included in the Alberta Reliability Standards, and the AESO's *Transmission Planning Criteria – Basis and Assumptions*<sup>2</sup> (collectively, the Reliability Criteria) were 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:

- Seasonal continuous thermal rating of the line's loading limits.
- Highest specified loading limits for transformers.
- For Category A conditions: Voltage range under normal operating condition should follow the AESO Information Document #2010-007RS, *General Operating Practices – Voltage Control* (ID #2010-007RS). ID #2010-007RS relates to Section 304.4 of the ISO rules, *Maintaining Network Voltage*. For the busses not listed in ID #2010-007RS, Table 2-1 in the *Transmission Planning Criteria – Basis and Assumptions* applies.

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<sup>2</sup> Filed under separate cover

- For Category B conditions: The extreme voltage range values per Table 2-1 in the *Transmission Planning Criteria – Basis and Assumptions*.(Attachment A)
- Desired post-contingency voltage change limits for three defined post event timeframes as provided in Table 2-1 below.

**Table 2-1: 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 low voltage bus.	±10%	±7%	±5%

### 2.1.2. ISO Rules and Information Documents (IDs)

ID # 2010-007RS was applied to establish pre-contingency voltage profiles in the Study Area. The TCM Rule was followed in setting up the study scenarios and in assessing the impact of the Project. In addition, due regard was given to the AESO’s *Connection Study Requirements* and the AESO’s *Generation and Load Interconnection Standard*.

### 2.1.3. Wind Aggregated Generating Facility Requirements

The Facility should meet the technical requirements of Section 502.1 of the ISO rules, *Wind Aggregated Generating Facilities Technical Requirements*.

## 2.2. Study Scenarios

Table 2-2 provides a list of the study scenarios. The 2019 study year was selected to correspond to the scheduled ISD of the Project. The Project load is not significant compared to the load in the Study Area, hence it was not considered in this study.

The Study Area has low load variation between winter and summer seasons and the transmission facilities in the Study Area have summer ratings that are significantly lower than the winter ratings. As a result, summer loading scenarios, both summer light (SL) and summer peak (SP), were selected since they provide the most stressed operating conditions.

**Table 2-2: Connection Study Scenarios**

Scenario Type	Year/ Season Load	System Generation Dispatch Conditions		Project Generation (MW)
		Wind	Import	
Pre-Project	2019 SP	High	High	0
	2019 SL	High	Zero	0
Post-Project	2019 SP	High	High	115
	2019 SL	High	Zero	115
	2027 WP	n/a		115

## 2.3. Load and Generation Assumptions

### 2.3.1. Load Assumptions

The relevant AESO Planning Region load forecasts used for the studies are shown in Table 2-3. The forecasts are based on the *AESO 2017 Long-term Outlook (2017 LTO)*.

**Table 2-3: Forecast Area Load (2017 LTO at South Planning Region Peak)**

AESO Planning Region Name	Year/Season	Forecast Peak Load (MW)
South	2019 SP	1,395
	2019 SL	838

### 2.3.2. Generation Assumptions

The generation forecast to be used for the studies is based on the 2017 LTO. The generation assumptions for the studies assume high wind dispatch conditions.

The dispatch levels used for the existing non-wind generators in the Study Area are provided in Table 2-4.

**Table 2-4: Existing Non-Wind and Non-Solar Generation Dispatch Levels**

Generating facility Name	Bus Number	AESO Planning Area	P <sub>max</sub> (MW)	Unit Net Generation (MW)*	
				2019 SL	2019 SP
Taylor Hydro Facility	4670	55	14	11.5	10.7
Raymond Reservoir Hydroelectric Facility	414	55	21	12.7	13.3
Irrican Hydro Facility	450	55	7	4.2	3.8
Drywood Power Plant	4226	55	6	0	0
Lethbridge Coaldale	4690	54	6.4	4.6	0
Chin Chute Hydroelectric Facility	407	54	15	6	9.1
Old Man River Dam	2230	53	32	24.2	30.8

Generating facility Name	Bus Number	AESO Planning Area	Pmax (MW)	Unit Net Generation (MW)*	
				2019 SL	2019 SP
<b>Total</b>				63.2	67.7

\*Note: Unit net generation refers to gross generating unit output less unit service load.

Per the 2017 LTO, the total forecast renewable electricity generation in 2019 is 1,891 MW. This includes existing, under-construction, and planned renewable electricity generation facilities.

Using the 2017 LTO's 2019 renewable generation forecast of 1,891 MW, the generation assumptions will dispatch the renewable electricity generation facilities to yield the credible worst-case power flow conditions for the Study Area. The pre-Project dispatch levels for the existing renewable electricity generation facilities are shown in Table 2-5.

**Table 2-5: Existing Renewable Generation Dispatch Levels**

Generating Facility Name	AESO Planning Area No.	MC (MW)	Unit Net Generation (MW)*	
			2019 SL	2019 SP
Ardenville Wind	53	68	68	68
Blue Trail Wind	53	66	66	66
Castle River #1	53	39	39	39
Castle Rock Wind Farm	53	77	77	77
Cowley Ridge	53	20	20	20
Enmax Taber	52	81	81	81
Kettles Hill	53	63	63	63
McBride Lake Windfarm	53	73	73	73
Soderglen Wind	53	71	71	71
Summerview 1	53	66	66	66
Summerview 2	53	66	66	66
Suncor Chin Chute	54	30	30	30
Suncor Magrath	53	30	30	30
Suncor Wintering Hills	43	88	88	88
Old Man River	46	46	46	46
Blackspring Ridge	49	300	300	300
Ghost Pine	42	82	37.3	37.3
Halkirk	42	150	150	150
Fortis Bull Creek Phases 1 and 2	37	29.5	29.5	29.5
Brooks Solar	47	15	9.6	9.6
<b>Total</b>			<b>1410.4</b>	<b>1410.4</b>

\*Note: Unit net generation refers to gross generating unit output less unit service load.

The remaining forecasted renewable generation growth (480.6 MW) is allocated to future renewable projects in the Study Area as identified in Table 2-6 to create stressed study conditions.

**Table 2-6: Pre-Project Scenario Dispatch Levels for Planned Renewable Generation**

AESO Project Name	AESO Project Number	Planned ISD	AESO Planning Area	Pmax (MW)	Unit Net Generation (MW)	
					2019 SL	2019 SP
EDPR Sharp Hills Wind Farm New Facility Generator Capacity	1567	August 1, 2019	42	300	248.4	248.4
Capital Power Whitla Wind Power Facility	1800	Sep. 1, 2019	4	300	201.6	201.6
Phase 2 of Castle Rock Ridge Wind Power Plant	462	November 1, 2019	53	32.2	30.6	30.6
<b>Total</b>					480.6	480.6

For the post-project scenarios, the renewable dispatches were adjusted as follows for both SL and SP scenarios:

- Dispatch Ghostpine to 0 MW
- Dispatch Fortis Bull Creek Phases 1 and 2 to 0 MW
- Reduce the Halkirk dispatch to 101.8 MW.
- Dispatch the Facility to 115 MW.

This will result in a total post-Project renewable dispatch consistent with the 2017 LTO's 2019 renewable generation forecast of 1,891 MW.

### 2.3.3. Intertie Flow Assumptions

Intertie assumptions are included for the British Columbia-Alberta (BC-AB), Saskatchewan-Alberta (SK-AB), and Montana-Alberta Tie Line (MATL) interties. Details on the assumptions can be found in Table 2-7.

**Table 2-7: Intertie Assumptions**

Year/Season/Dispatch Condition	Intertie Assumptions (MW)		
	Import (+)/Export (-) to BC-AB	Import (+)/Export (-) to SK-AB	Import (+) /Export (-) to MATL
2019 SP High Import	800	150	300
2019 SL Zero Import	0	0	0

### 2.3.4. HVDC Power Order

The Western Alberta Transmission HVDC Line (WATL) and the Eastern Alberta Transmission HVDC Line (EATL) assumptions were expected to have minimal impact for this connection studies, and they were dispatched to minimize total system loss in all study scenarios.

**Table 2-8: HVDC Power Order by Scenario**

Scenario Name	WATL (MW)*	EATL (MW)*
2019 SL Pre- Project	Blocked	350 S → N
2019 SP Pre-Project	425 S → N	700 S → N
2019 SL Post- Project	Blocked	350 S → N
2019 SP Post- Project	425 S → N	700 S → N

Note: \*S → N: HVDC flow direction is South to North

## 2.4. System Projects

No system transmission project will be considered in the system topology for the study scenarios because planned system transmission developments are not expected to be in service before the scheduled Project ISD.

## 2.5. Connection Projects

No connection projects, other than the renewable projects listed in Table 2-6, were included in the studies.

## 2.6. Facility Ratings and Shunt Elements

The legal owner of transmission facilities (TFO) provided the thermal ratings for the transmission lines in the vicinity of the Study Area. The seasonal continuous ratings and the short-term emergency ratings for the main transmission lines in the Study Area are shown in Table 2-9.

**Table 2-9: Thermal Rating Assumptions for Key Transmission Lines in the Study Area**

Line ID	Line Description	Voltage Class (kV)	Summer	
			Seasonal Continuous Rating (MVA)	Short-term Emergency Rating (MVA)
164L	Goose Lake 103S - Drywood 415S	138	111	122
616L	Goose Lake 103S - Peigan 59S	138	119	131
412L	Pincher Creek 396S - Russell 632S	138	121	133
170L	Russell 632S -Coleman 799S	138	121	133
786L	Natal B1S - Coleman 799S	138	99	109
613L	Goose Lake 103S - Pincher Creek 396S	138	119	131
1071L	Fidler 312S -Castle Rock Ridge 205S	240	952	1047
1072L	Goose Lake 103S - Castle Rock Ridge 205S	240	967	1160
994L	Goose Lake 103S - Fidler 312S	240	831	1047

Line ID	Line Description	Voltage Class (kV)	Summer	
			Seasonal Continuous Rating (MVA)	Short-term Emergency Rating (MVA)
967L	Windy Flats 138S - N Lethbridge 370S	240	499	599
968L	Windy Flats 138S - N Lethbridge 370S	240	499	733
185L	Pincher Creek 396S - Shell Canada Waterton 379S	69	41	45
185L	Shell Canada Waterton 379S -Drywood 415S	69	57	63
162L	Drywood 415S -Glenwood 229S	69	40	44
225L	Glenwood 229S -Spring Coulee 385S	69	22	24
225L	Spring Coulee 385S - Magrath 225S	69	24	28
225L	Magrath 225S- Raymond 313S tap-point	69	25	28
225L	Stirling 67S - Raymond 313S tap-point	69	25	28
1037L/ 1038L	Windy Flats 138S - Foothills 237S	240	973	1071
955L /956L	Goose Lake 103S - Peigan 59S	240	611	751
1048L/ 1049L	Peigan 59S - Windy Flats 138S	240	611	733

The TFO also provided the ratings for the existing transformers in the Study Area. The ratings of the key transformers in the Study Area are shown in Table 2-10.

**Table 2-10: Key Transformer Ratings in the Study Area**

Substation Name and Number	Transformer	MVA Rating
Fidler 312S	240/138 kV T1	400
Goose Lake 103S	240/138 kV T1	400
Peigan 59S	240/138 kV T1	179
Windy Flats 138S	240/138 kV T2	400

The details of key shunt elements in the Study Area, as provided by the TFO, are shown in Table 2-11

**Table 2-11: 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 (MVA <sub>r</sub> )	Number of Switched Shunt Blocks	Total at nominal voltage (MVA <sub>r</sub> )
Pincher Creek 396S	138	1x24.46	24.46	-	-
Windy Flats 138S	240	-	-	2x75	150

## 2.7. Dynamic Data and Assumptions

Dynamic data for the Facility (as provided by the Market Participant) is summarized in Attachment B.

## 2.8. Protection Fault Clearing Times

The transient stability studies were performed for the contingencies shown in Table 2-12. The studies were performed using the actual fault clearing times for the selected contingencies, as provided by the TFO. The fault clearing times for future planned transmission lines were based on the typical fault clearing time assumptions in the *Transmission Planning Criteria – Basis and Assumptions*.

**Table 2-12: Contingencies Studied for Transient Stability Assessment and the Respective Protection Fault Clearing Times**

Contingency (System Element Lost)				Faulted Location	Clearing Time (No. of Cycles)	
Line ID	Nominal Bus Voltage (kV)	Terminal Location			Terminal 1	Terminal 2
		Terminal 1	Terminal 2			
994L	240	Fidler 312S	Goose Lake 103S	Fidler 312S	4	5
				Goose Lake 103S	5	4
1071L	240	Fidler 312S	Castle Rock Ridge 205S	Fidler 312S	4	5
				Castle Rock Ridge 205S	5	4
1072L	240	Castle Rock Ridge 205S	Goose Lake 103S	Castle Rock Ridge 205S	4	5
				Goose Lake 103S	5	4
955L	240	Peigan 59S	Goose Lake 103S	Peigan 59S	5	5
				Goose Lake 103S	6	4
1048L	240	Peigan 59S	Windy Flat 138S	Peigan 59S	4	5
				Windy Flat 138S	5	4
1037L	240	Windy Flat 138S	Foothills 237S	Windy Flat 138S	5.5	4.5
				Foothills 237S	5.5	4.5
967L	240	Windy Flat 138S	North Lethbridge 370S	Windy Flat 138S	5	6
				North Lethbridge 370S	6	5

## 2.9. Voltage Profile Assumptions

The AESO ID# 2010-007RS was used to establish normal system (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 all the busses not included in the



ID# 2010-007RS. These voltages were utilized to set the voltage profile for the study base cases prior to power flow analysis.

### 3. Study Methodology

All of the studies were performed using PSS/E software Version 33.

#### 3.1. Connection Studies Carried Out

The studies that were carried out are identified in Table 3-1.

**Table 3-1: Summary of Studies Performed**

Scenario Type	Scenario Name	Power Flow	Transient Stability	Short-circuit
Pre-Project	2019 SP High Import Pre-Project	X		X
	2019 SL Zero Import Pre-Project	X		
Post-Project	2019 SP High Import Post-Project	X	X	X
	2019 SL Zero Import Post-Project	X	X	
	2027 WP Post-Project			X

#### 3.2. Power Flow Analysis

Power flow analysis was conducted for all study scenarios to identify any thermal and voltage criteria violations as per the Reliability Criteria, and to identify any POD voltage deviations from the desired limits in Table 2-1. The purpose of the power flow analysis is to quantify any violations in the Study Area both for the pre-Project and post-Project study scenarios. For the Category B power flow studies, transformer taps and switched shunt reactive compensating devices such as shunt capacitors and reactors were locked and continuous shunt devices were enabled.

POD low voltage bus deviations were assessed for both the pre-Project and post-Project networks by first locking all tap-point changers and area shunt reactive compensating devices to identify any post-transient voltage deviations above 10%. Second, tap-point changers were 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 taps and shunt reactive compensating devices were allowed to adjust, and voltage deviations above 5%, if any, were reported.

##### 3.2.1. Contingencies Studied

Power flow analysis was performed for all Category B contingencies in the Study Area. All transmission facilities in the Study Area were monitored for Reliability Criteria violations.

### 3.3. Transient Stability Analysis

Transient stability analysis was performed for the 2019 post-Project scenarios, as shown in Table 3-1.

Keephills generating unit 3 in Wabamun (Area 40) was used as the reference for the studies.

The results reported include response plots for bus voltage, machine relative angle and active and reactive power outputs for key generation units within the Study Area. The results also provide the key branch active and reactive power flow surrounding the Facility.

Near and far end three-phase-to-ground faults were applied to transmission lines to assess the stability of the system. The applied faults were cleared by opening the respective near-end and far-end line breakers using the fault clearing times as depicted in Table 2-12.

A system dynamic response was considered acceptable if the following conditions were met after a disturbance:

- All the generators exhibited stable and damped response and remained connected to the AIES,
- All oscillations in the system were damped successfully as per Western Electricity Coordinating Council (WECC) and AESO Transmission Planning Criteria – Basis and Assumptions.

#### 3.3.1. Contingencies Studied

Transient stability studies were performed for selected Category B contingencies, as shown in Table 2-12.

### 3.4. Short-Circuit Studies

Short-circuit studies were performed for the SP pre-Project and post-Project study scenarios, as well as for the long-term assessment using the 2027 WP Post-project scenario, as shown in Table 3-1.

A maximum fault level was 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 was used for reporting the results.

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

- Peigan 59S
- Castle Rock Ridge 205S
- Goose Lake 103S
- Fidler 312S

## 4. Pre-Project Study Results

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

### 4.1. Power Flow

Power flow diagrams illustrating the pre-Project power flow studies results are included in Attachment C.

#### 4.1.1. 2019 SP High Import Pre-Project Scenario

##### Category A Condition

No Reliability Criteria violations (as defined in Section 2.1.1) were observed under the Category A condition.

##### Category B Conditions

A thermal criteria violation was observed under one Category B condition, as shown in Table 4-1.

**Table 4-1: Thermal Criteria Violations for the 2019 SP High Import Pre-Project Scenario Under Category B**

Contingency (System Element Lost)	Details of Violation (Violation observed On)	Seasonal Continuous Rating (MVA)	Short-term Emergency Rating (MVA)	Pre-Project Results	
				Power flow (MVA)	% Loading
Riverbend 618S Transformer T1	225L (Stirling 67S - Raymond 313S tap-point)	25	28	31.77	127.11

No voltage criteria violations were observed under Category B conditions. No voltage deviations beyond the desired limits listed in Table 2-1 (hereafter referred to as, point of delivery (POD) bus voltage deviations) were observed under Category B conditions.

#### 4.1.2. 2019 SL Zero Import Pre-Project Scenario

##### Category A Condition

No Reliability Criteria violations were observed under the Category A condition.

##### Category B Conditions

A thermal criteria violation was observed under certain Category B conditions, as shown in Table 4-2.

**Table 4-2: Thermal Criteria Violations for the 2019 SL Zero Import Pre-Project Scenario Under Category B**

Contingency (System Element Lost)	Details of Violation (Violation observed On)	Seasonal Continuous Rating (MVA)	Short-term Emergency Rating (MVA)	Pre-Project Results	
				Power flow (MVA)	% Loading
Riverbend 618S Transformer T1	225L (Stirling 67S - Raymond 313S tap-point)	25	28	32.82	131.28

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

## 5. Connection Alternative

The AESO, in consultation with the TFO and the Market Participant, identified only one connection alternative to respond to the Market Participant's request for system access service. The developments associated with the connection alternative are described below.

### **Modify the existing Castle Rock Ridge 205S substation**

This involves modifying the existing Castle Rock Ridge 205S substation, including adding one 240 kV circuit breaker and associated equipment. The Facility would connect to the existing Castle Rock Ridge 205S substation.

## 6. Post-Project Study Results

### 6.1. Power Flow

The post-Project scenarios power flow diagrams are provided in Attachment D.

#### 6.1.1. 2019 SP High Import Post-Project Scenario

##### Category A Condition

No Reliability Criteria violations were observed under the Category A condition.

##### Category B Conditions

A thermal criteria violation was observed under certain Category B conditions, as shown in Table 6-1.

**Table 6-1: Thermal Criteria Violations for the 2019 SP High Import Post-Project Scenario Under Category B**

Contingency (System Element Lost)	Details of Violation (Violation observed On)	Seasonal Continuous Rating (MVA)	Short-term Emergency Rating (MVA)	Pre- Project		Post-Project		% Loading Difference (Post-Pre)
				Power flow (MVA)	% Loading	Power flow (MVA)	% Loading	
Riverbend 618S Transformer T1	225L (Stirling 67S - Raymond 313S tap-point)	25	28	31.77	127.11	33.05	132.2	5.0

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

#### 6.1.2. 2019 SL Zero Import Post Riverview Project Scenario

##### Category A Condition

No Reliability Criteria violations were observed under the Category A condition.

##### Category B Conditions

A Thermal criteria violation was observed under certain Category B conditions, as shown Table 6-2.

**Table 6-2: Thermal Criteria Violations for the 2019 SL Zero Import Post-Project Scenario Under Category B**

Contingency (System Element Lost)	Details of Violation (Violation observed On)	Seasonal Continuous Rating (MVA)	Short-term Emergency Rating (MVA)	Pre-Project		Post-Project		% Loading Difference (Post-Pre)
				Power flow (MVA)	% Loading	Power flow (MVA)	% Loading	
Riverbend 618S Transformer T1	225L (Stirling 67S - Raymond 313S tap-point)	25	28	32.82	131.28	34	136	4.7

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

## 6.2. Transient Stability

Transient stability plots are provided in Attachment E.

### 6.2.1. Post-Project Scenarios

The system showed acceptable dynamic response to all Category B conditions studied for both 2019 SP high import and 2019 SL zero import scenarios. No transient stability concerns were identified.



## 7. Short-Circuit Studies Results

Short circuit studies were performed for all 2019 SP pre-the Project and post-Project scenarios and for the 2027 WP post-Project scenario to determine the expected system short circuit levels<sup>3</sup> in the vicinity of the Project. Single phase and three phase fault currents were calculated at substations in electric proximity to the Project.

### 7.1. Pre-Project Scenario

Short-circuit studies were performed to determine fault levels under the 2019 SP High Import Pre-Project scenario. 2019 High Import Pre-Project scenario short-circuit levels are provided in Table 7-1.

**Table 7-1: Short-Circuit Current Levels – 2019 SP High Import Pre-Project Scenario**

Substation Name and Number	Base Voltage (kV)	Pre-Fault Voltage	Pre-Fault Voltage (pu)	3-Φ Fault (kA)	Positive Sequence Thevenin Source Impedance (R1+jX1)	Positive Sequence Thevenin Source Impedance (R1+jX1) (pu)	1-Φ Fault (kA)	Zero Sequence Thevenin Source Impedance (R0+jX0)	Zero Sequence Thevenin Source Impedance (R0+jX0) (pu)
Peigan 59S	138	142.08	1.03	7.5	1.70+11.45j	0.009+0.060j	6.6	2.14+16.06j	0.011+0.084j
Castle Rock Ridge 205S	240	242.32	1.01	7.4	2.95+19.80j	0.005+0.034j	6.1	5.86+32.97j	0.010+0.057j
Goose Lake 103S	240	241.92	1.01	7.3	2.89+19.82j	0.005+0.034j	6.4	4.37+29.18j	0.008+0.051j
	138	141.5	1.03	7.8	0.89+10.95j	0.005+0.057j	7.8	1.38+11.07j	0.007+0.058j
Fidler 312S	138	142.08	1.03	7.5	1.70+11.45j	0.009+0.060j	6.6	2.14+16.06j	0.011+0.084j
	240	242.32	1.01	7.4	2.95+19.80j	0.005+0.034j	6.1	5.86+32.97j	0.010+0.057j

### 7.2. Post Project Scenarios

The 2019 SP High Import Post-Project short-circuit levels are provided in Table 7-2.

<sup>3</sup> Short-circuit current studies were based on modeling information provided to the AESO by third parties. The authenticity of the modeling information has not been validated. Fault levels could change as a result of system developments, new customer connections, or additional generation in the area. It is recommended that these changes be monitored and fault levels reviewed to ensure that the fault levels are within equipment operating limits. The information provided in this study should not be used as the sole source of information for electrical equipment specifications or for the design of safety-grounding systems.

**Table 7-2: Short-Circuit Current Levels – 2019 SP High Import Post-Project Scenario**

Substation Name and Number	Base Voltage (kV)	Pre-Fault Voltage	Pre-Fault Voltage (pu)	3-Φ Fault (kA)	Positive Sequence Thevenin Source Impedance (R1+jX1)	Positive Sequence Thevenin Source Impedance (R1+jX1) (pu)	1-Φ Fault (kA)	Zero Sequence Thevenin Source Impedance (R0+jX0)	Zero Sequence Thevenin Source Impedance (R0+jX0) (pu)
Peigan 59S	138	141.33	1.02	7.5	1.67+11.33j	0.009+0.060j	6.7	2.28+15.62j	0.012+0.082j
Castle Rock Ridge 205S	240	241.2	1.01	7.6	2.79+19.14j	0.005+0.033j	6.8	7.01+25.99j	0.012+0.045j
Goose Lake 103S	240	240.85	1	7.5	2.75+19.26j	0.005+0.033j	6.8	5.29+25.44j	0.009+0.044j
	138	141.01	1.02	7.9	0.86+10.80j	0.005+0.057j	8	1.54+10.24j	0.008+0.054j
Fidler 312S	138	141.33	1.02	7.5	1.67+11.33j	0.009+0.060j	6.7	2.28+15.62j	0.012+0.082j
	240	241.2	1.01	7.6	2.79+19.14j	0.005+0.033j	6.8	7.01+25.99j	0.012+0.045j

The 2027 WP Post-Project short-circuit levels are provided in Table 7-3.

**Table 7-3: Short-Circuit Current Levels – 2027 WP Post -Project Scenario**

Substation Name and Number	Base Voltage (kV)	Pre-Fault Voltage	Pre-Fault Voltage (pu)	3-Φ Fault (kA)	Positive Sequence Thevenin Source Impedance (R1+jX1)	Positive Sequence Thevenin Source Impedance (R1+jX1) (pu)	1-Φ Fault (kA)	Zero Sequence Thevenin Source Impedance (R0+jX0)	Zero Sequence Thevenin Source Impedance (R0+jX0) (pu)
Peigan 59S	138	138.72	1.01	7.6	1.39+10.44j	0.007+0.055j	7	1.60+13.22j	0.008+0.069j
Castle Rock Ridge 205S	240	246.71	1.03	8.3	2.16+16.98j	0.004+0.029j	8.4	3.36+16.98j	0.006+0.029j
Goos Lake 103S	240	247.03	1.03	8.2	2.17+17.38j	0.004+0.030j	7.7	3.83+20.59j	0.007+0.036j
	138	138.76	1.01	8.2	0.64+9.81j	0.003+0.052j	8.5	1.05+8.64j	0.006+0.045j
Fidler 312S	138	138.72	1.01	7.6	1.39+10.44j	0.007+0.055j	7	1.60+13.22j	0.008+0.069j
	240	246.71	1.03	8.3	2.16+16.98j	0.004+0.029j	8.4	3.36+16.98j	0.006+0.029j

### 7.3. Short-Circuit Results Summary

Post-Project short-circuit fault levels are not significantly higher than pre-Project levels. The long term (2027 scenario) short circuit levels were found to be within the designed capabilities of the nearby facilities. The short-circuit results show that the short-circuit levels will not significantly increase after connection of the Project.

## 8. Results Analysis and Mitigation Measures

The Reliability Criteria violations observed during the connection assessment studies and the associated mitigation measures are summarized in Table 8-1. Under certain Category B conditions, a thermal criteria violation was observed in the pre-Project and post-Project scenarios.

**Table 8-1: Thermal Criteria Violations and Mitigation Measures for Pre-Project and Post-Project Scenarios under Category B Conditions**

Reliability Criteria Violations		Scenarios	Pre-Project		Post-Project		Project Impact
Details of Violation (Violation observed On)	Contingency (System Element Lost)		Thermal Violation Type	Mitigation Measure	Thermal Violation Type	Mitigation Measure	
225L (Stirling 67S - Raymond 313S tap-point)	Riverbend 618S Transformer T1	2019 High Import SP 2019 Zero Import SL	Above emergency	Existing RAS 36	Above emergency	Existing RAS 36	Marginally increased thermal criteria violation

Notes:

The thermal violation is considered to be marginally increased after connection of the Project because the facility's effectiveness factor for the observed thermal criteria violation is less than 0.5% and the existing RAS 36 can still effectively mitigate the thermal criteria violation, as shown in Table 6-2 below.

Thermal loading above the seasonal continuous rating of the 69 kV transmission line 225L is currently being mitigated through existing RASs 36. This mitigation measure can continue to be used to effectively mitigate thermal overloads on 225L after connection of the Project, as shown in Table 8-2.

**Table 8-2: Post-RAS 225L Power Flow Study Results under Category B Conditions**

Scenario	Contingency	Limiting Branch	Seasonal Continuous Rating (MVA)	Short-term Emergency Rating (MVA)	Pre-Project with RAS		Post-Project with RAS	
					Power flow (MVA)	% Loading	Power flow (MVA)	% Loading
2019 High Import SP	Riverbend 618S Transformer T1	225L (Stirling 67S - Raymond 313S tap-point)	25	28	16.2	64	17.6	70
2019 Zero Import SL	Riverbend 618S Transformer T1	225L (Stirling 67S - Raymond 313S tap-point)	25	28	17.4	69.6	18.6	74

## 9. Project Dependencies

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

## 10. Conclusions and Recommendations

Based on the study results, the Project is technically viable. The connection assessment identified a system performance issue that occurred both pre-Project and post-Project. This issue can continue to be mitigated through the use of existing RAS 36. With implementation of this mitigation measure, the connection of the project does not adversely affect the performance of the AIES.

It is recommended to proceed with the Project and connect the Facility by modifying the existing Castle Rock Ridge substation, as the preferred option to respond to the Market Participant's request for system access service. It is also recommended to continue to use existing RAS 36 to mitigate the identified system performance issues.

## Attachment A

### Transmission Planning Criteria – Basis and Assumptions

# Transmission Planning Criteria- Basis and Assumptions

## 1. Introduction

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

## 2. Transmission Reliability Standards and Criteria<sup>1</sup>

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.

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<sup>1</sup> A complete description of these standards are given in: AESO. *Alberta Reliability Standards*. Available from <http://www.aeso.ca/rulesprocedures/17004.html>



### 2.1 Thermal Loading Criteria

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

### 2.2 Voltage Range and Voltage Stability Criteria

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

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

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

**Table 2-2: Voltage Stability Criteria**

Performance Level	Disturbance (1)(2)(3)(4) Initiated by: Fault or No fault DC Disturbance	MW Margin (P-V method) (5)(6)(7)	MVAr Margin (V-Q method) (6)(7)
A	Any element such as: One Generator One Circuit One Transformer One Reactive Power Source One DC Monopole	$\geq 5\%$	Worst Case Scenario(8)
B	Bus Section	$\geq 5\%$	50% of Margin Requirement

Performance Level	Disturbance (1)(2)(3)(4) Initiated by: Fault or No fault DC Disturbance	MW Margin (P-V method) (5)(6)(7)	MVAr Margin (V-Q method) (6)(7)
			in Level A
C	Any combination of two elements such as: A Line and a Generator A Line and a Reactive Power Source Two Generators Two Circuits Two Transformers Two Reactive Power Sources DC Bipole	$\geq 2.5\%$	50% of Margin Requirement in Level A
D	Any combination of three or more elements. i.e.: Three or More Circuits on ROW Entire Substation Entire Plant Including Switchyard	$> 0$	$> 0$

### 2.3 Transient Stability Analysis Assumptions

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

**Table 2-3: Fault Clearing Times**

Nominal	Near End	Far End
kV	Cycles	Cycles
500	4	5
240	5	6
144/138	6	8

with telecommunications		
144/138	6	30
without telecommunications		

**Table 2-4: Stuck Breaker Clearing Times for Lines**

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

**Table 2-5: Stuck Breaker Clearing Times for Transformers**

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

## **Attachment B**

# **Dynamic Data and Assumptions for Equipment Proposed for Connection**

**Table B-1: Generic Renewable Energy Generator/Converter Model(WT4G1)**

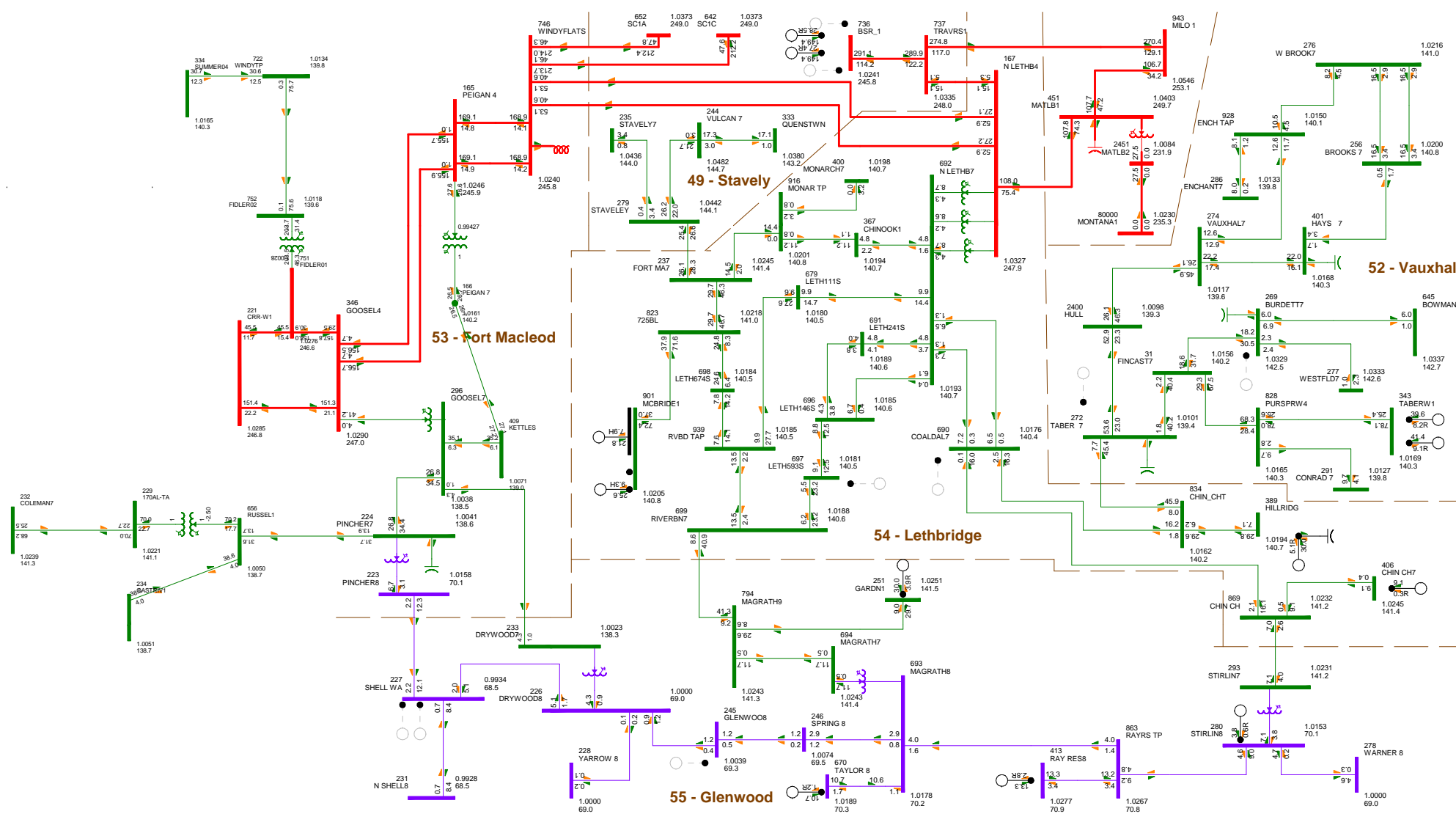
TIQCmd	TIPCcmd	VLPL1	VLPL2	GLVPL	VHVRCR	CURHVRCR
0.02	0.02	0.4	0.9	1	1.2	2
Rip_LVPL	T_LVPL					
5	0.02					

**Table B-2: Generic Renewable Energy Electrical Control Model (WT4E1)**

Tfv	KPV	KIV	Kpp	KIP	Kf	Tf	QMX	QMN	IPmax	TRV	dPMX
0.15	18	5	0.05	0.1	0	0.08	0.45	-0.45	1.1	0.02	0.5
dPMN	T_Power	KQI	VMINCL	VMAXCL	KVI	Tv	Tp	ImaxTD	lphi	lqhi	
-0.5	0.05	0.1	0.9	1.1	100	0.05	0.05	1.7	1.11	1.11	
PFLAG	VARFLG	PQFLAG									
1	1	0									

## Attachment C

### Pre-Project Power flow Diagrams

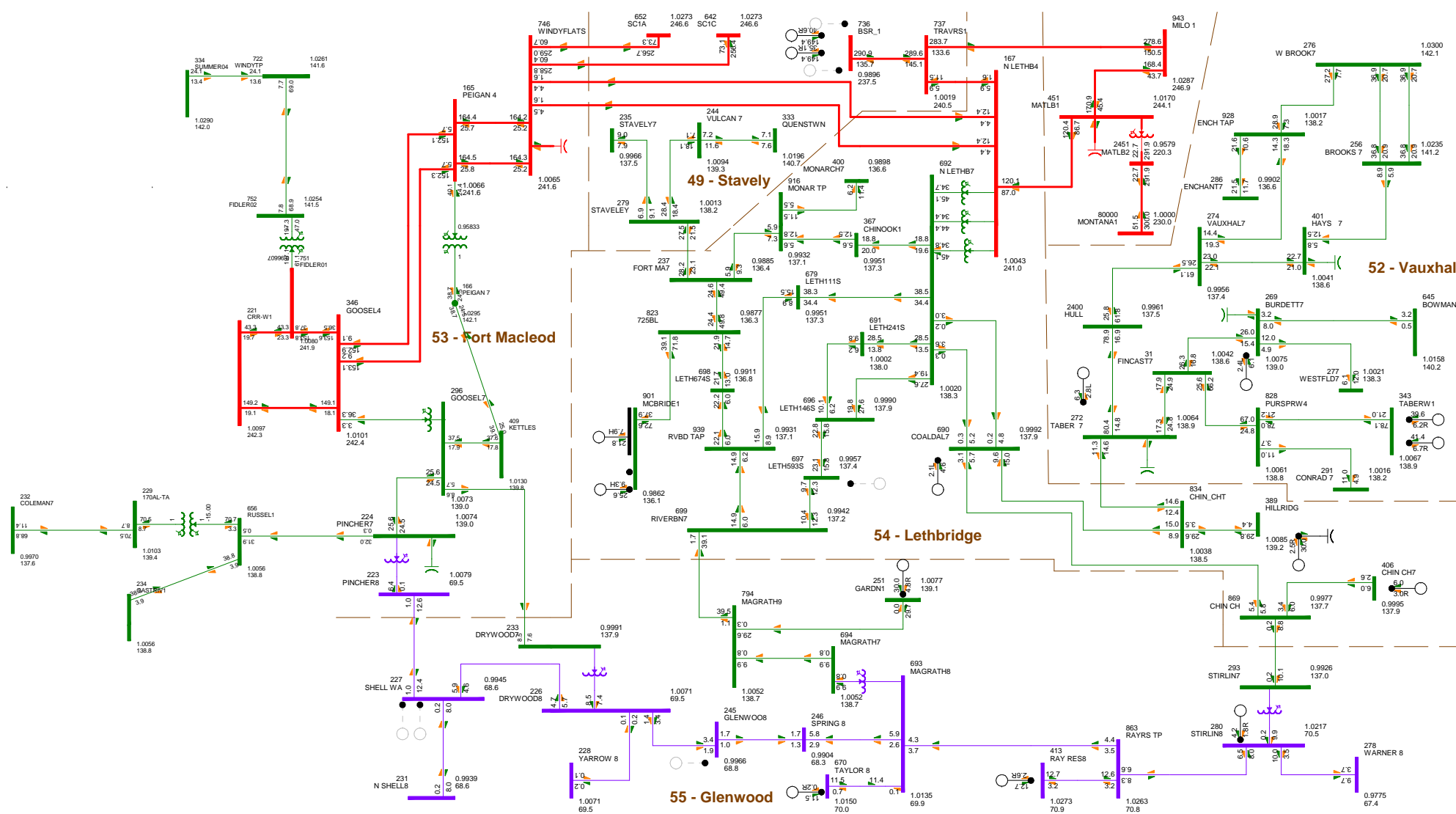


**P524**

BC Import:-6.6 MW      Sask Import:-0.1 MW      MATL Import:0.0 MW

**P524\_2019SL\_SC1\_PRE  
CAT A  
FIG C-1  
WED, DEC 27 2017 11:29**

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



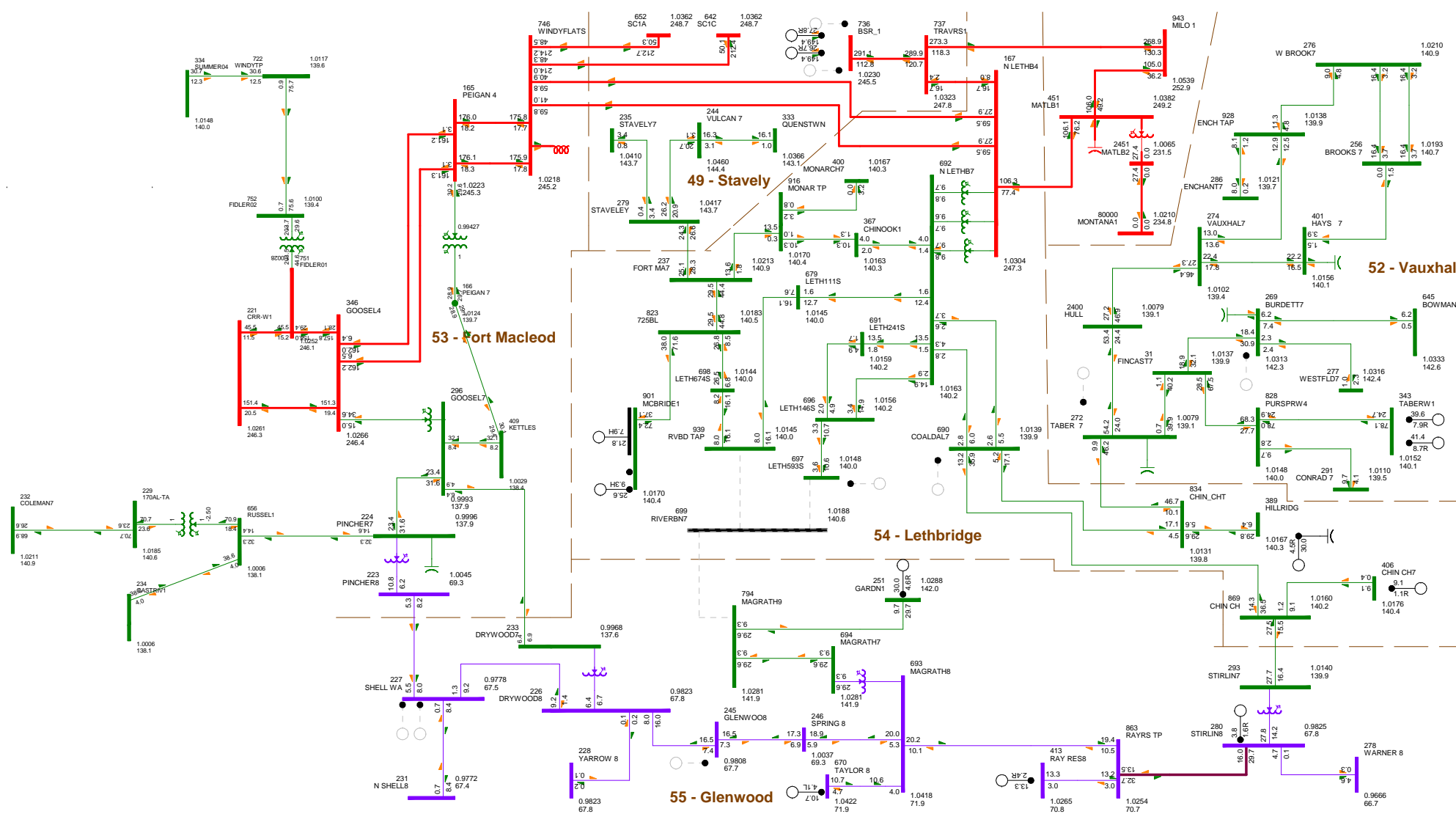
**P524**

BC Import: 796.8 MW    Sask Import: 150.0 MW    MATL Import: 300.0 MW

**P524\_2019SP\_SC3\_PRE  
CAT A  
FIG C-2  
WED, DEC 27 2017 11:29**

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





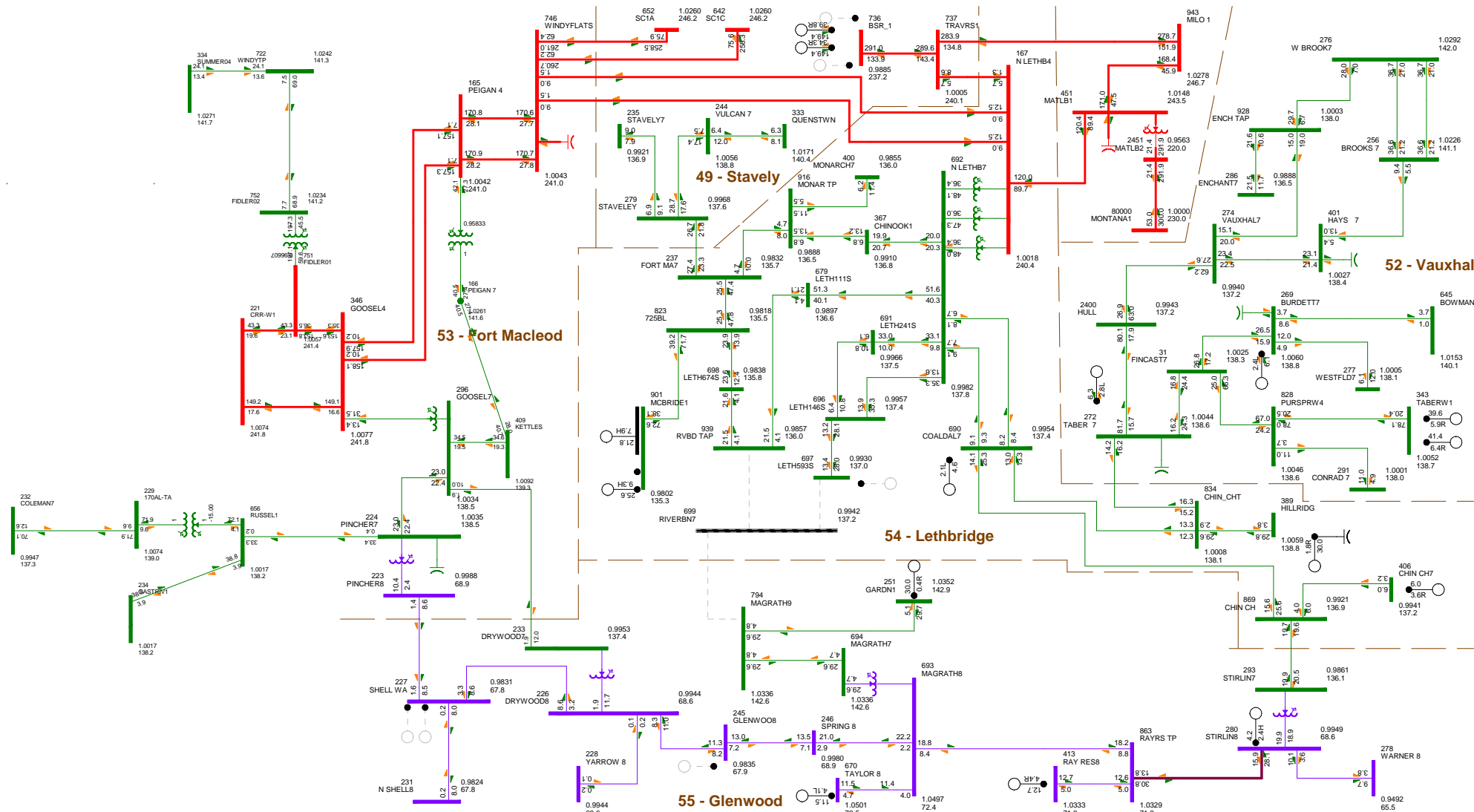
**P524**

BC Import:-4.2 MW      Sask Import:-0.1 MW      MATL Import:0.0 MW

**P524\_2019SL\_SC1\_PRE**  
**618S TRANSFORMER**  
**FIG C-3**  
**FRI, JAN 05 2018 22:31**

Bus - Voltage (kV/pu)  
 Branch - MW/Mvar  
 Equipment - MW/Mvar  
 100.0%Rate A

kV: <=25.000 <=69.000 <=138.000 <=240.000 <=500.000 >500.000



**P524**

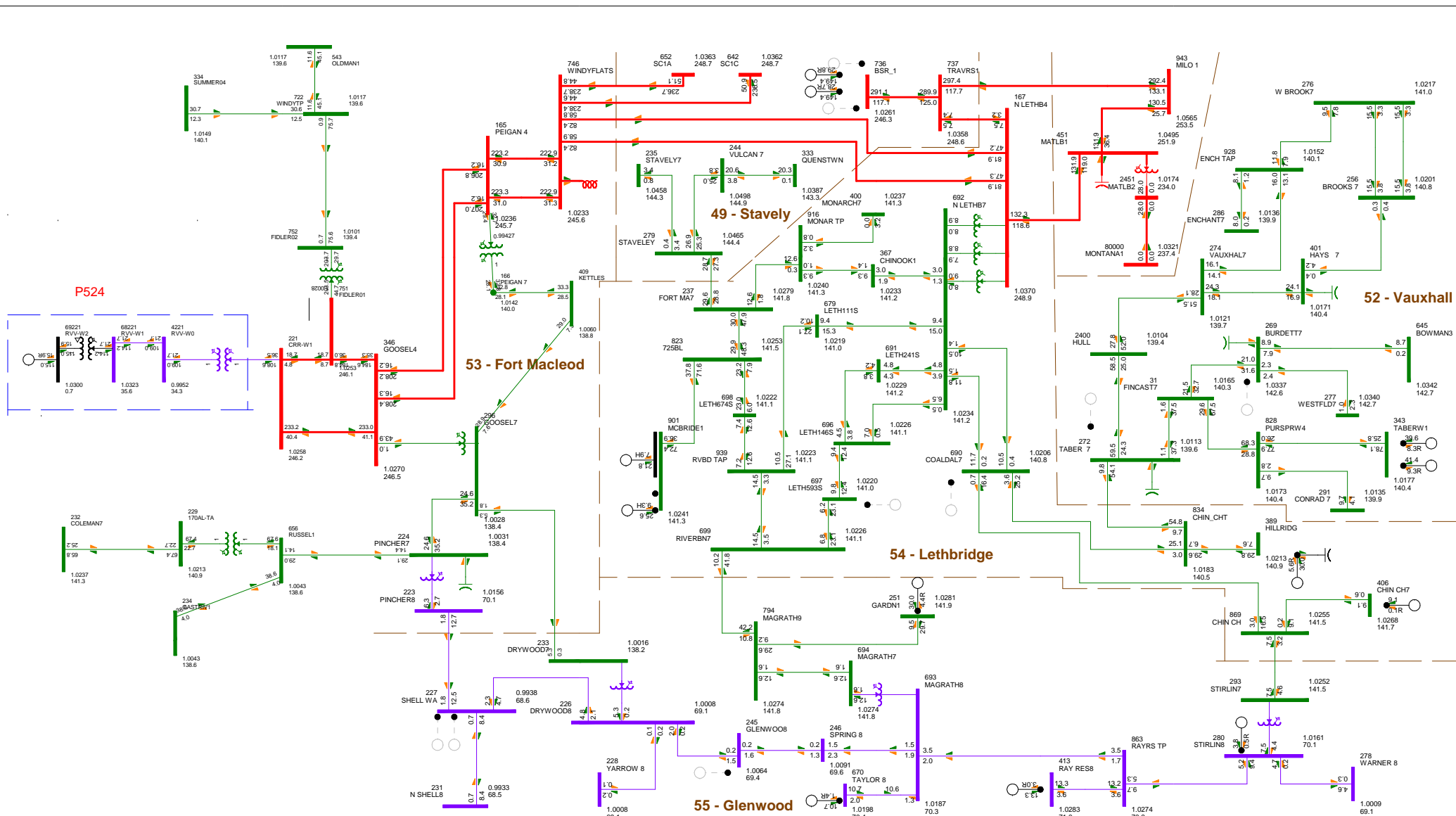
BC Import:791.3 MW      Sask Import:150.0 MW      MATL Import:300.0 MW

**P524\_2019SP\_SC3\_PRE**  
**618S TRANSFORMER**  
**FIG C-4**  
**FRI, JAN 05 2018 22:32**

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

## Attachment D

### Post-Project Power flow Diagrams



BC Import:0.5 MW

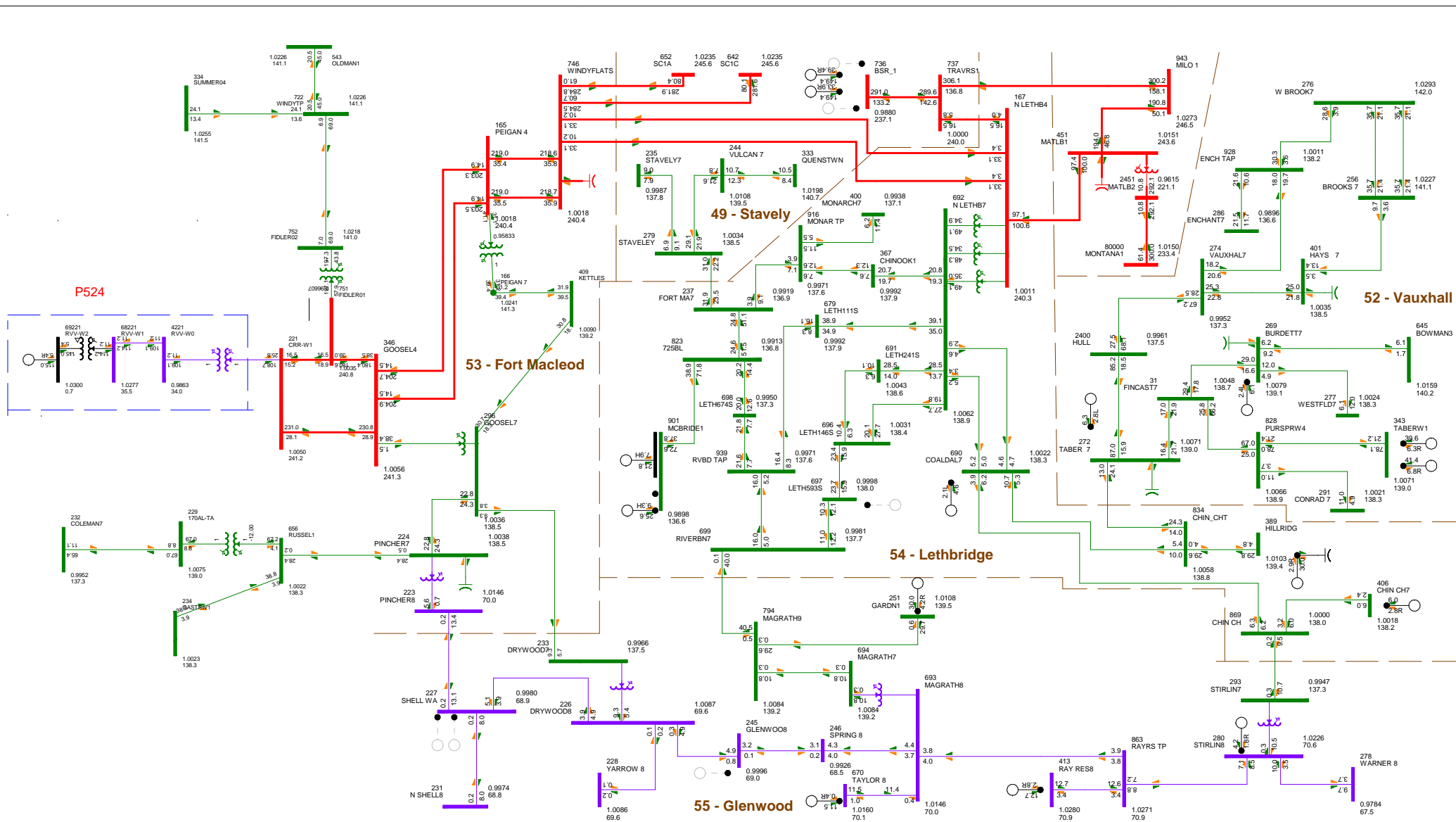
Sask Import:-0.1 MW

MATL Import:0.0 MW

**P524\_2019SL\_SC2\_POST**  
**CAT A**  
**FIG D-1**  
**WED, DEC 27 2017 11:29**

Bus - Voltage (kV/pu)  
 Branch - MW/Mvar  
 Equipment - MW/Mvar  
 100.0%Rate A

kV: <=25.000 <=69.000 <=138.000 <=240.000 <=500.000 >500.000

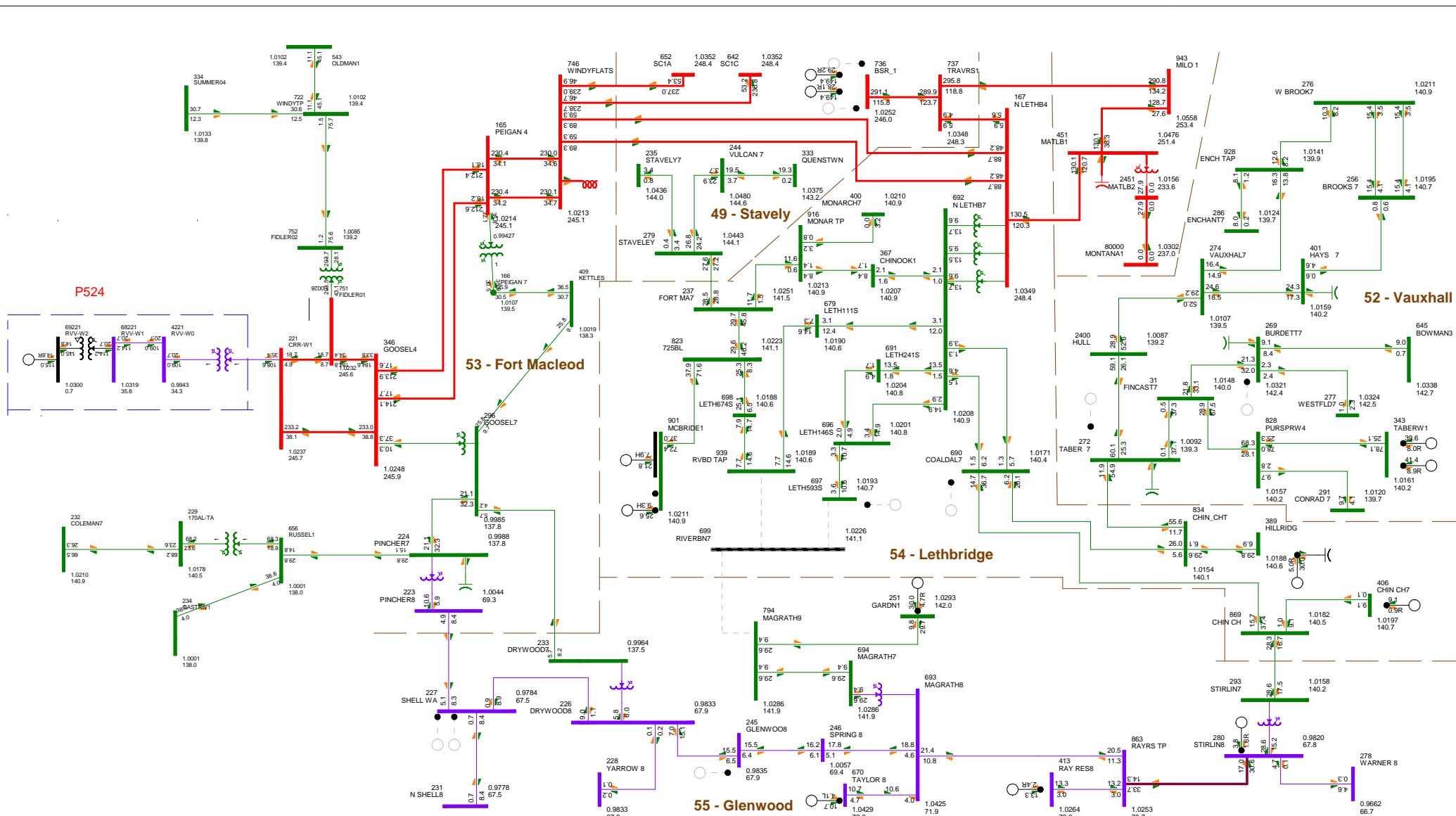


BC Import:800.4 MW    Sask Import:150.0 MW    MATL Import:0.0 MW

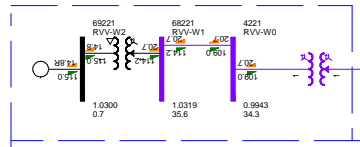
**P524\_2019SP\_SC4\_POST**  
**CAT A**  
**FIG D-2**  
**WED, DEC 27 2017 11:29**

Bus - Voltage (kV/pu)  
 Branch - MW/Mvar  
 Equipment - MW/Mvar  
 100.0%Rate A

kV: <=25.000 <=69.000 <=138.000 <=240.000 <=500.000 >500.000



P524



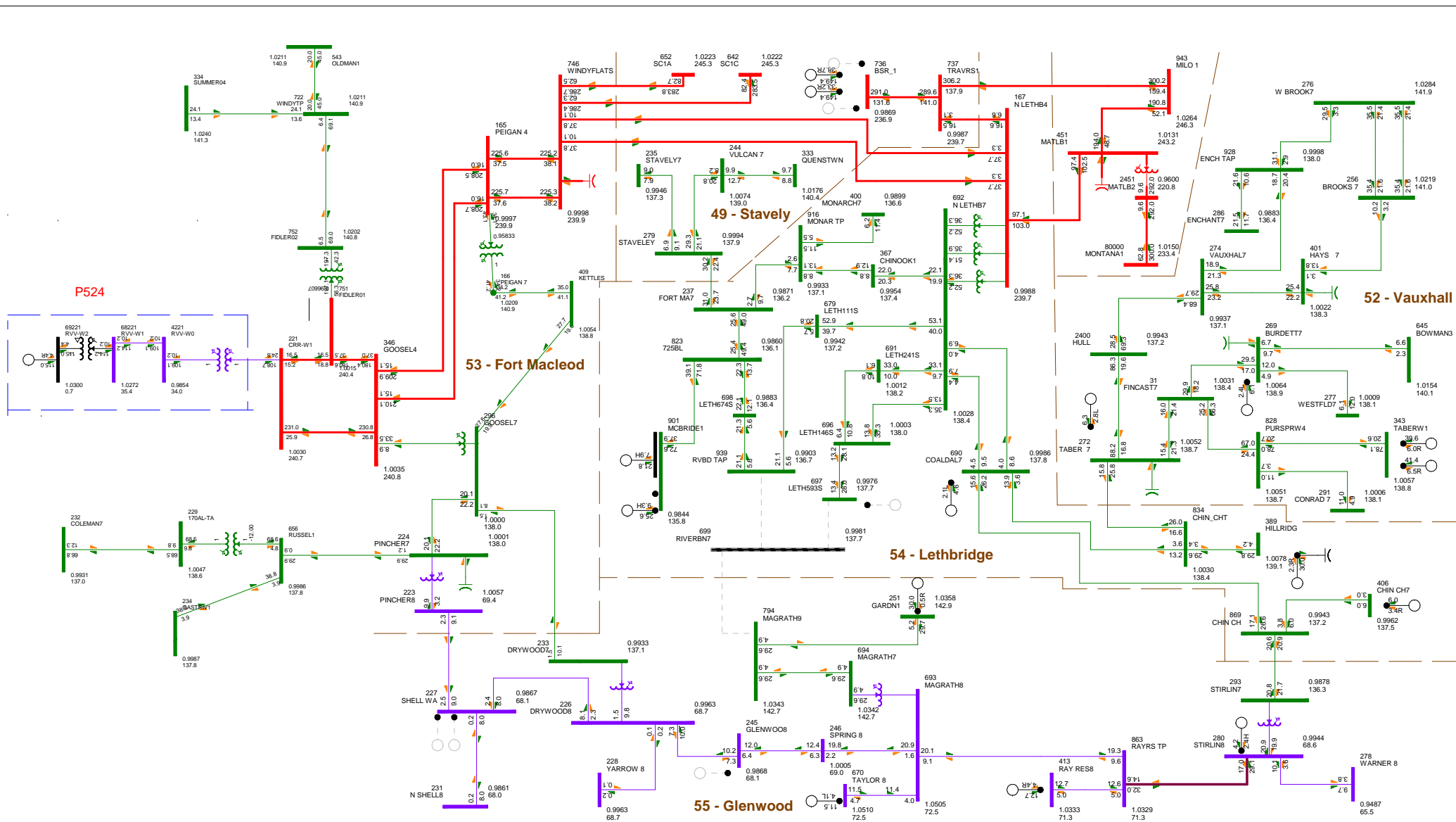
BC Import:2.9 MW

Sask Import:-0.1 MW

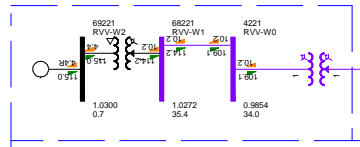
MATL Import:0.0 MW

P524\_2019SL\_SC2\_POST  
618S TRANSFORMER  
FIG D-3  
FRI, JAN 05 2018 22:31

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



P524



BC Import:794.9 MW

Sask Import:150.0 MW

MATL Import:0.0 MW

P524 2019SL SC4 POST  
618S TRANSFORMER  
FIG D-4  
FRI, JAN 05 2018 22:32

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

## Attachment E

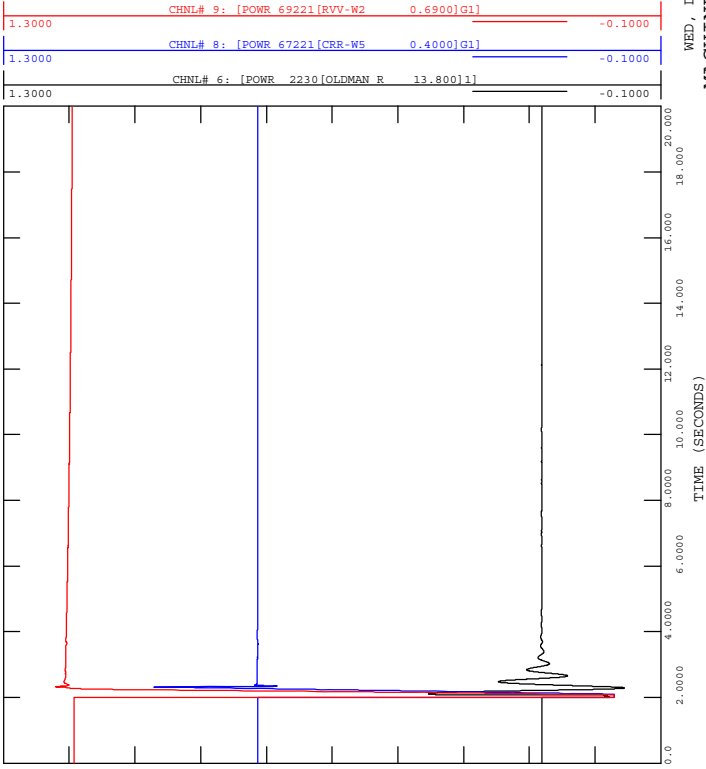
### Post-Project Transient Stability Diagrams





FIGURE E-1B  
P524\_2019SL\_SC2\_POST  
3 PHASE FAULT ON 955L AT 59S

FILE: E-1\_955L ( Peigan 59S).out

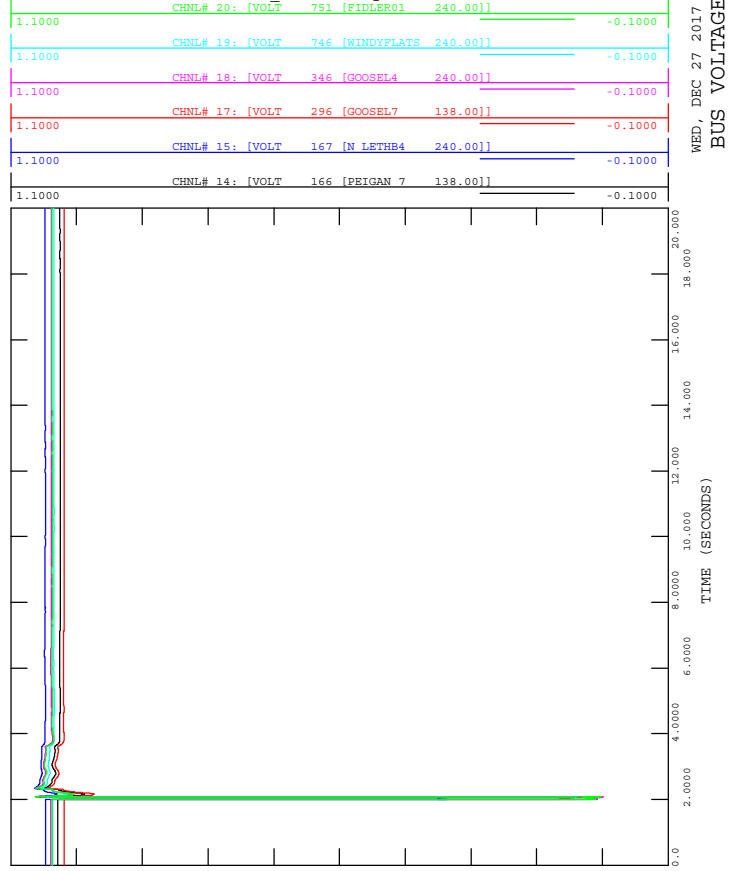


WED, DEC 27 2017 10:51  
MACHINE PELEC (PU)



FIGURE E-1D  
P524\_2019SL\_SC2\_POST  
3 PHASE FAULT ON 955L AT 59S

FILE: E-1\_955L ( Peigan 59S).out

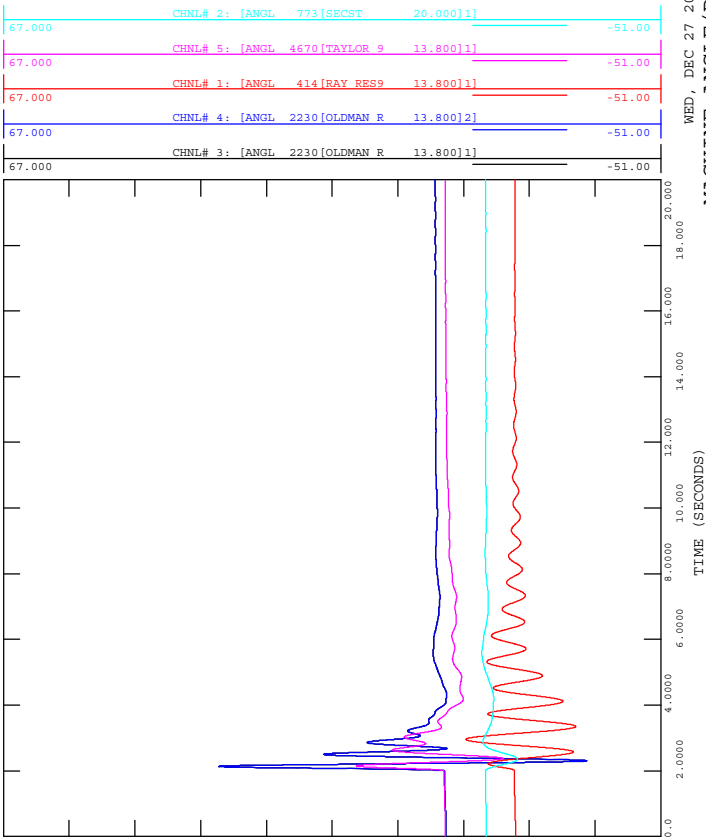


WED, DEC 27 2017 10:51  
BUS VOLTAGE (PU)



FIGURE E-1A  
P524\_2019SL\_SC2\_POST  
3 PHASE FAULT ON 955L AT 59S

FILE: E-1\_955L ( Peigan 59S).out

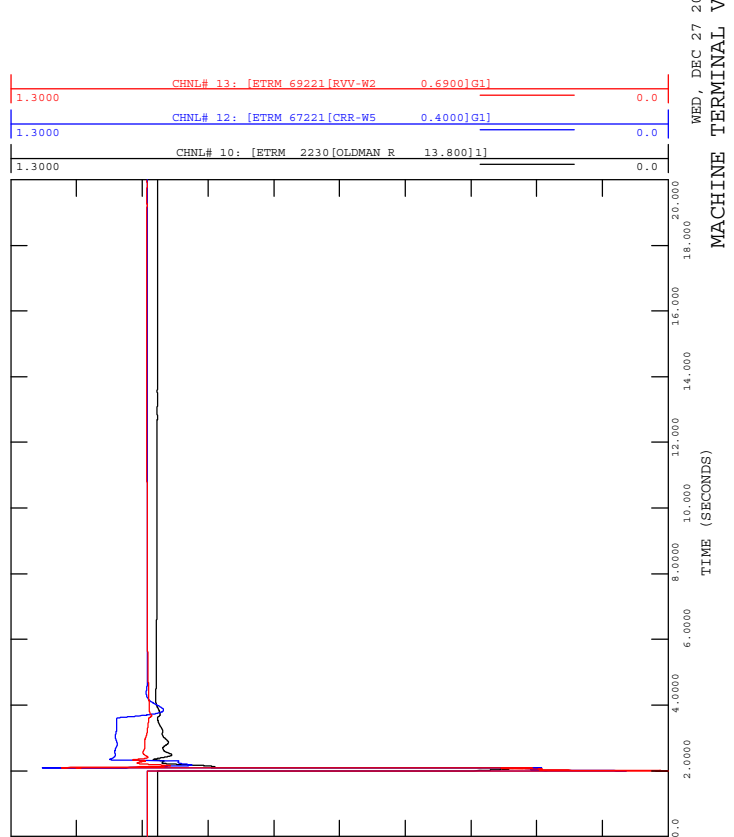


WED, DEC 27 2017 10:51  
MACHINE ANGLE (DEGREE)



FIGURE E-1C  
P524\_2019SL\_SC2\_POST  
3 PHASE FAULT ON 955L AT 59S

FILE: E-1\_955L ( Peigan 59S).out



WED, DEC 27 2017 10:51  
MACHINE TERMINAL VOLTAGE



FIGURE E-1F  
P524\_2019SL\_SC2\_POST  
3 PHASE FAULT ON 955L AT 59S

FILE: E-1\_955L ( Peigan 59S).out

WED, DEC 27 2017 10:52  
BRANCH Q FLOW (PU)

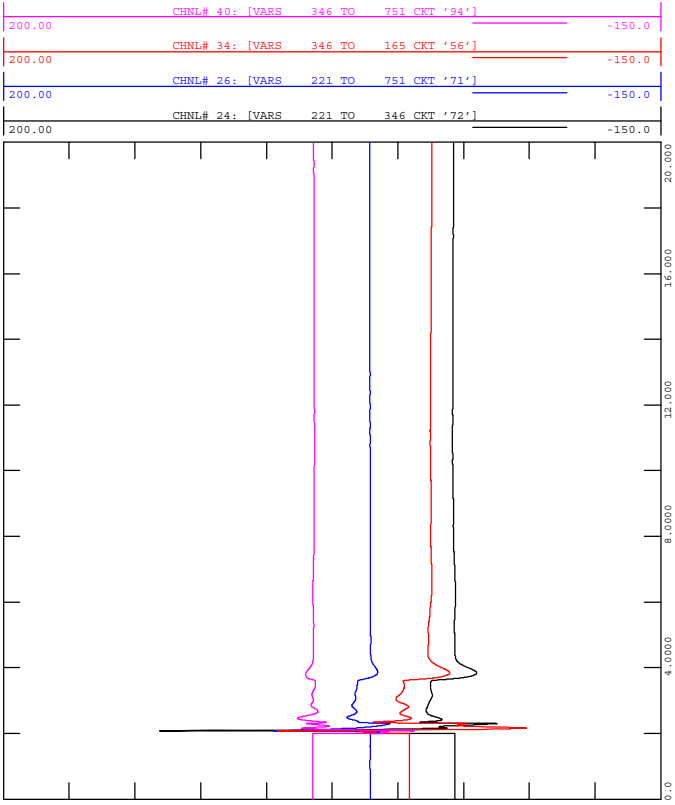


FIGURE E-1E  
P524\_2019SL\_SC2\_POST  
3 PHASE FAULT ON 955L AT 59S

FILE: E-1\_955L ( Peigan 59S).out

WED, DEC 27 2017 10:52  
BRANCH P FLOW (PU)

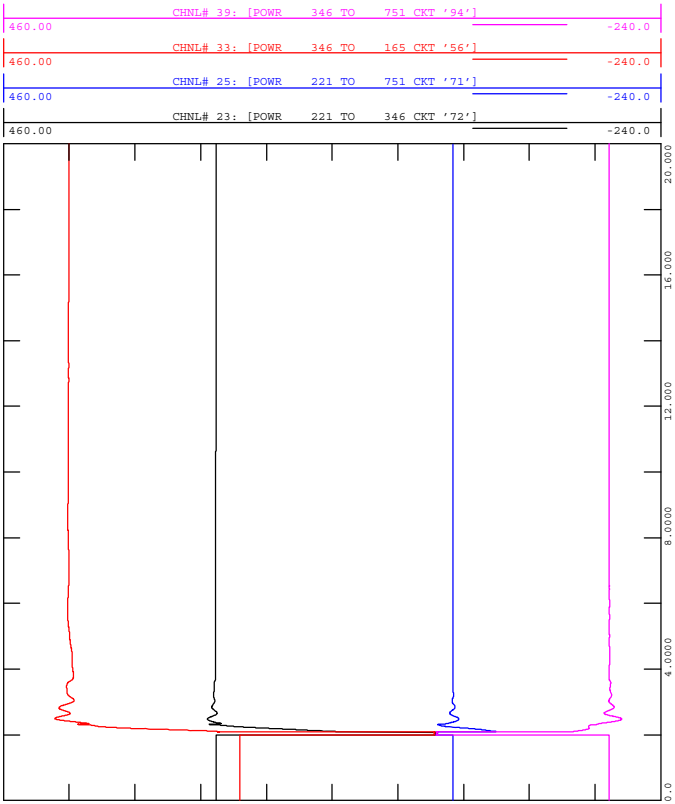




FIGURE E-2B  
P524\_2019SL\_SC2\_POST  
3 PHASE FAULT ON 955L AT 103S

FILE: E-2\_955L (Goose Lake 103S) .out

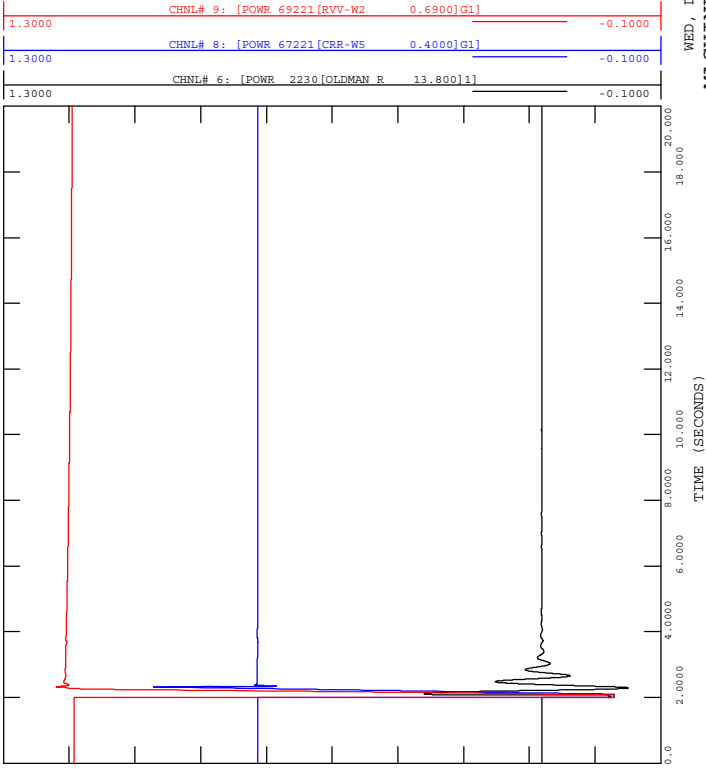


FIGURE E-2D  
P524\_2019SL\_SC2\_POST  
3 PHASE FAULT ON 955L AT 103S

FILE: E-2\_955L (Goose Lake 103S) .out

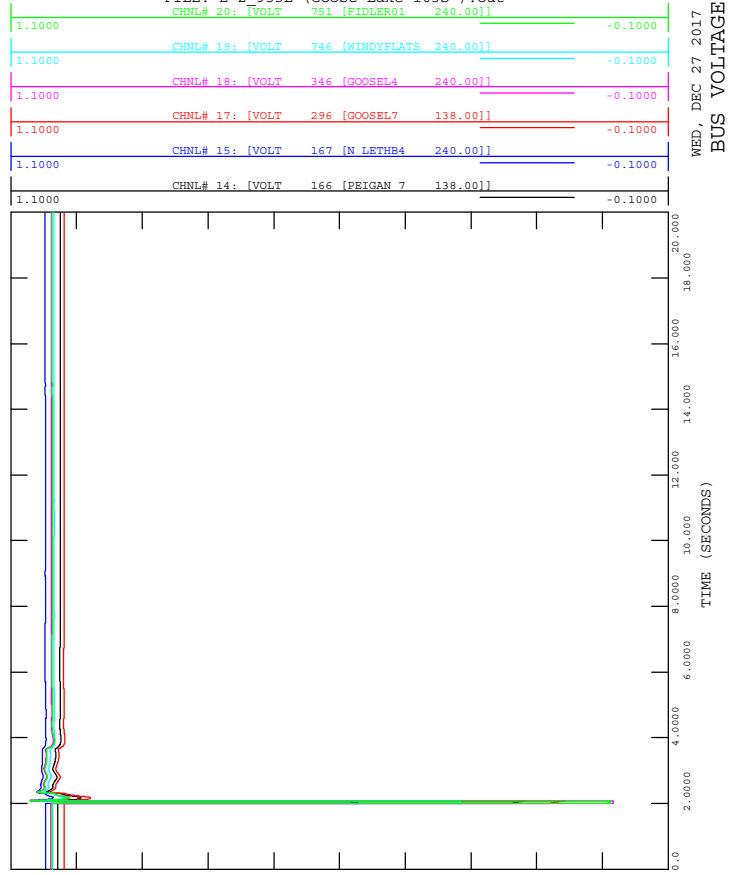


FIGURE E-2A  
P524\_2019SL\_SC2\_POST  
3 PHASE FAULT ON 955L AT 103S

FILE: E-2\_955L (Goose Lake 103S) .out

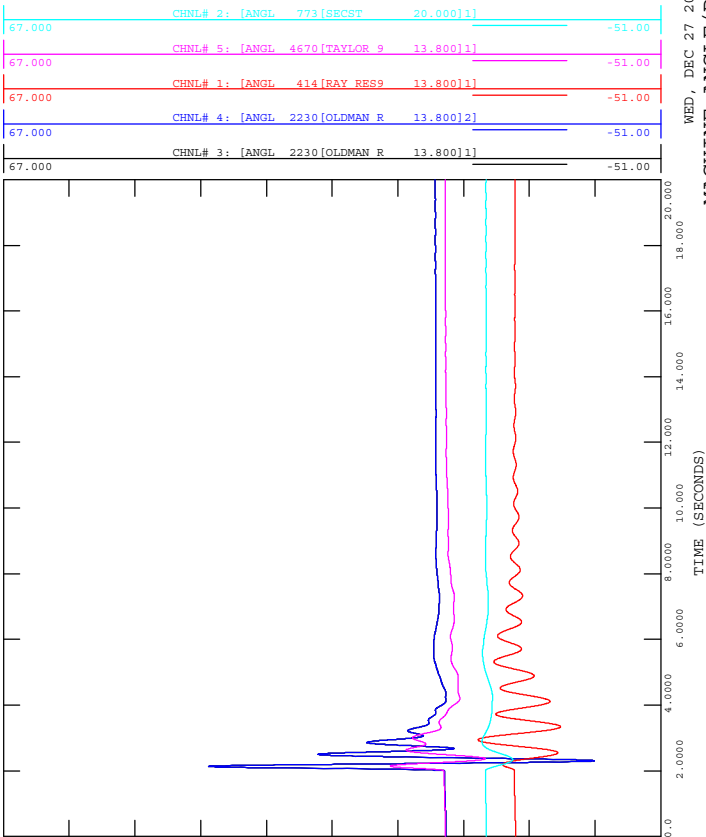


FIGURE E-2C  
P524\_2019SL\_SC2\_POST  
3 PHASE FAULT ON 955L AT 103S

FILE: E-2\_955L (Goose Lake 103S) .out

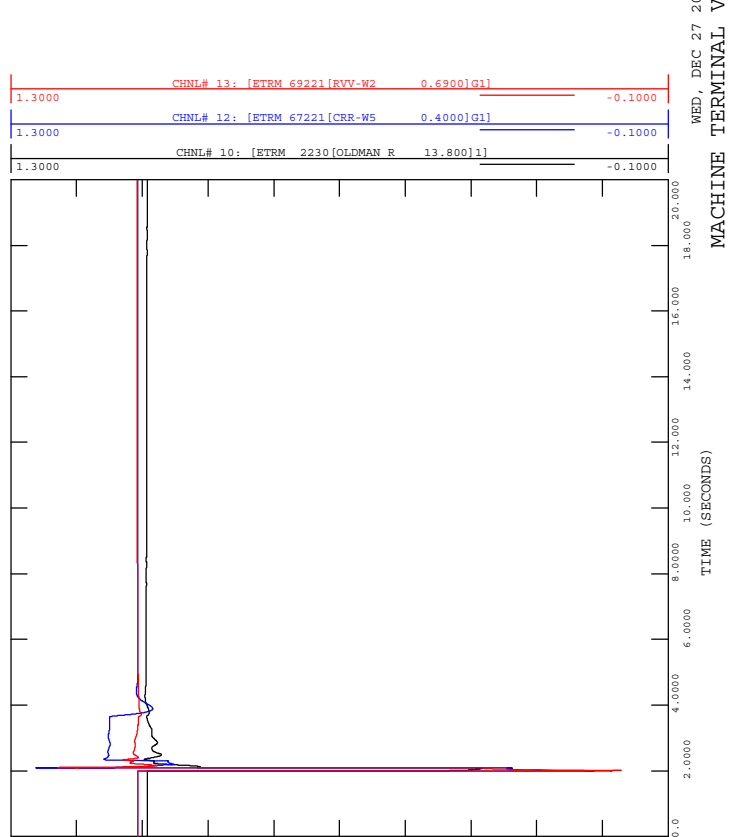




FIGURE E-2F  
 P524\_2019SL\_SC2\_POST  
 3 PHASE FAULT ON 955L AT 103S

FILE: E-2\_955L (Goose Lake 103S) .out

WED, DEC 27 2017 10:52  
 BRANCH Q FLOW (PU)

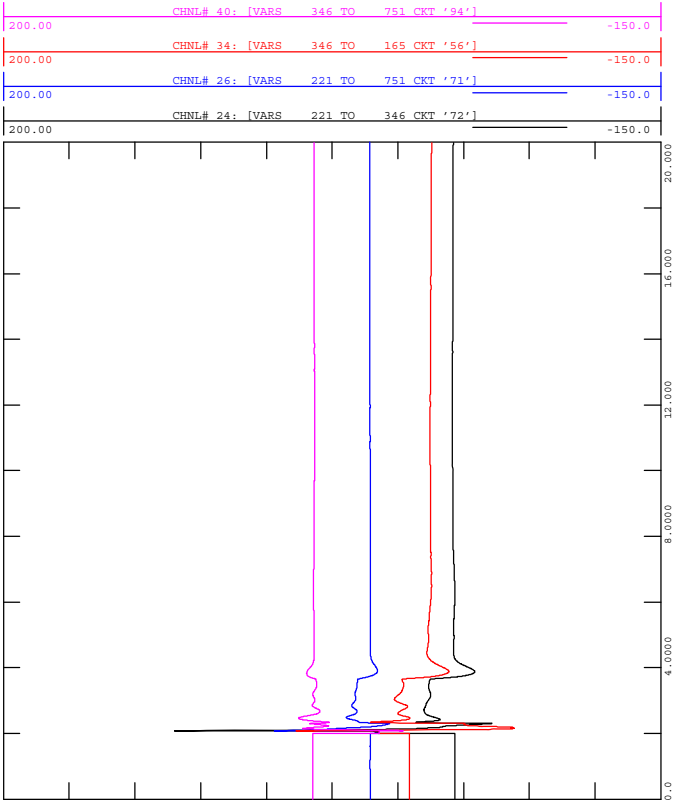


FIGURE E-2E  
 P524\_2019SL\_SC2\_POST  
 3 PHASE FAULT ON 955L AT 103S

FILE: E-2\_955L (Goose Lake 103S) .out

WED, DEC 27 2017 10:52  
 BRANCH P FLOW (PU)

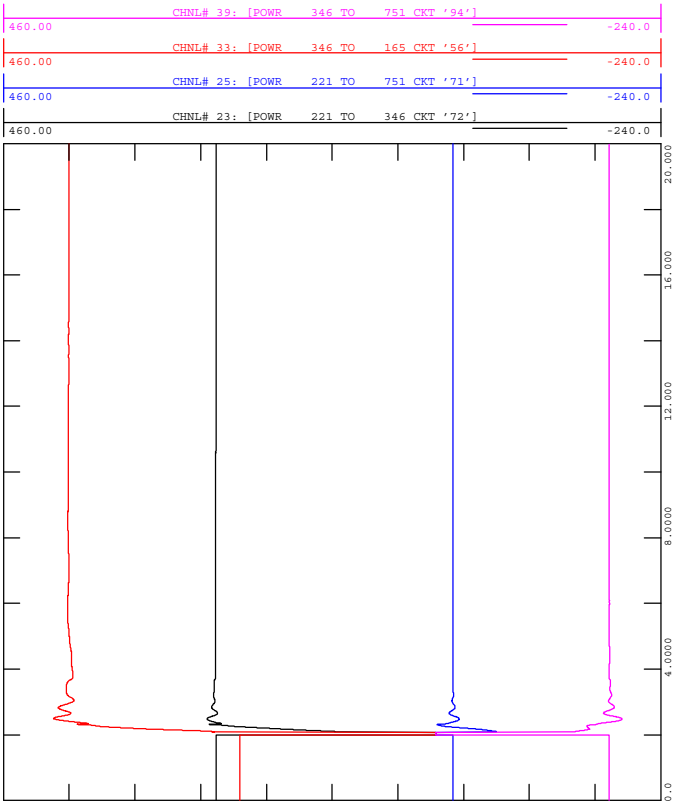
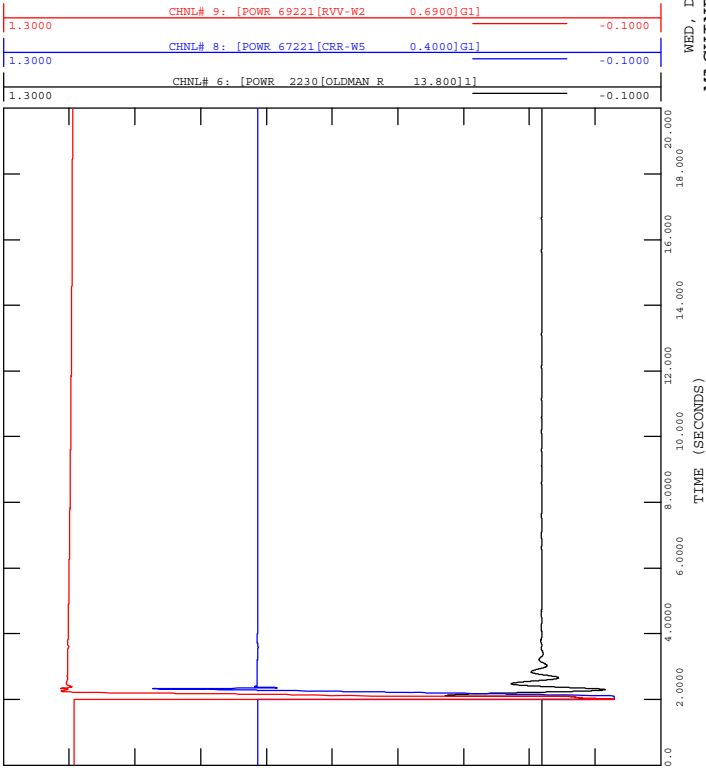




FIGURE E-3B  
P524\_2019SL\_SC2\_POST  
3 PHASE FAULT ON 967L AT 370S

FILE: E-3\_967L ( North Lethbridge 370S).out

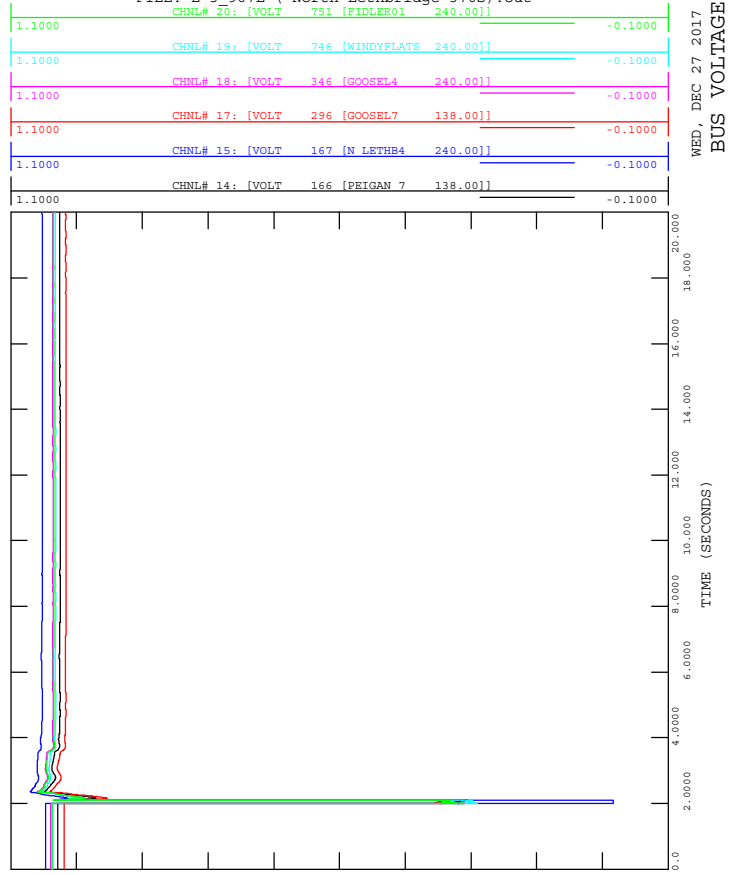


WED, DEC 27 2017 10:52  
MACHINE PELEC (PU)



FIGURE E-3D  
P524\_2019SL\_SC2\_POST  
3 PHASE FAULT ON 967L AT 370S

FILE: E-3\_967L ( North Lethbridge 370S).out

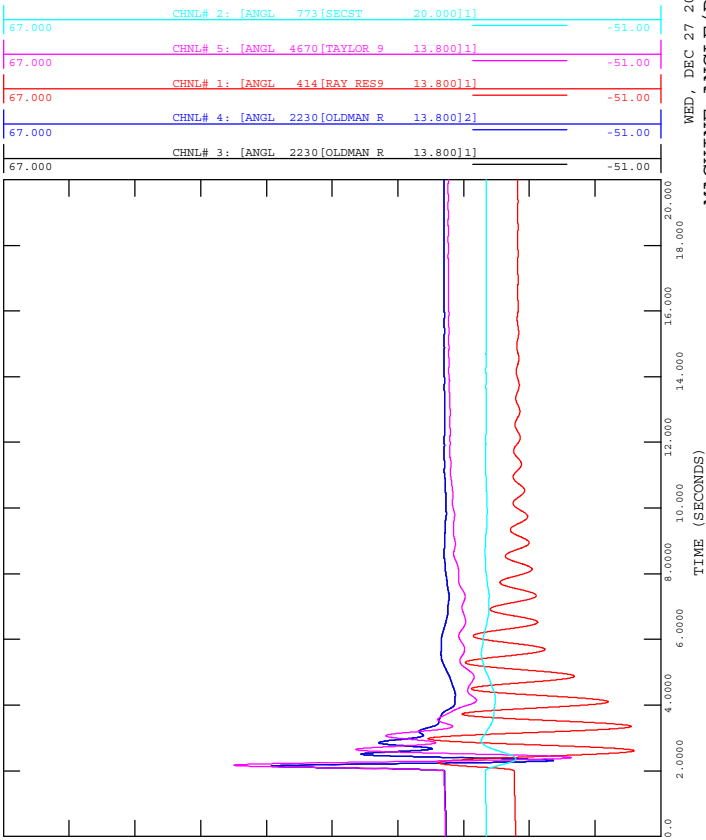


WED, DEC 27 2017 10:52  
BUS VOLTAGE (PU)



FIGURE E-3A  
P524\_2019SL\_SC2\_POST  
3 PHASE FAULT ON 967L AT 370S

FILE: E-3\_967L ( North Lethbridge 370S).out

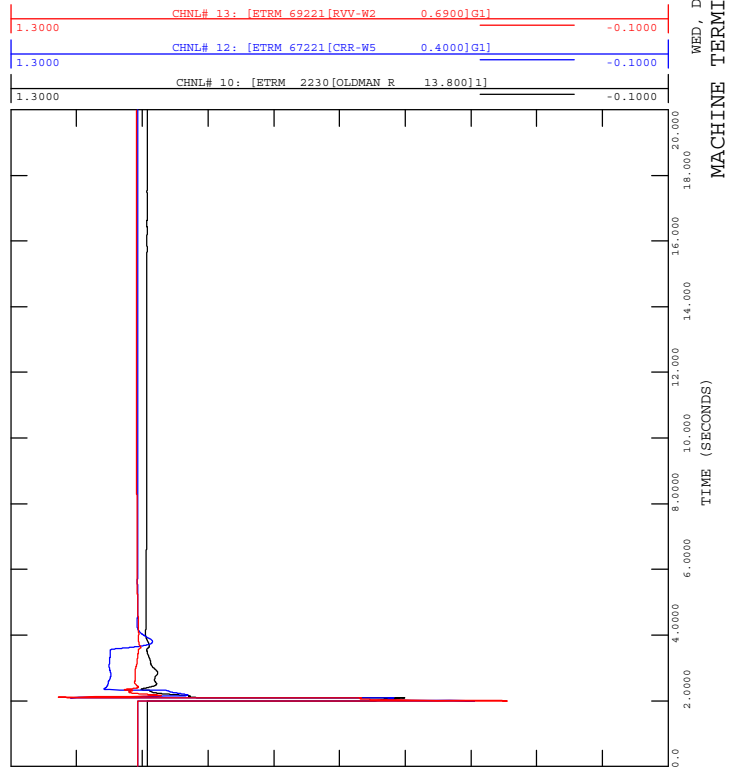


WED, DEC 27 2017 10:52  
MACHINE ANGLE (DEGREE)



FIGURE E-3C  
P524\_2019SL\_SC2\_POST  
3 PHASE FAULT ON 967L AT 370S

FILE: E-3\_967L ( North Lethbridge 370S).out



WED, DEC 27 2017 10:52  
MACHINE TERMINAL VOLTAGE



FIGURE E-3F  
 P524\_2019SL\_SC2\_POST  
 3 PHASE FAULT ON 967L AT 370S

FILE: E-3\_967L ( North Lethbridge 370S).out

WED, DEC 27 2017 10:52  
 BRANCH Q FLOW (PU)

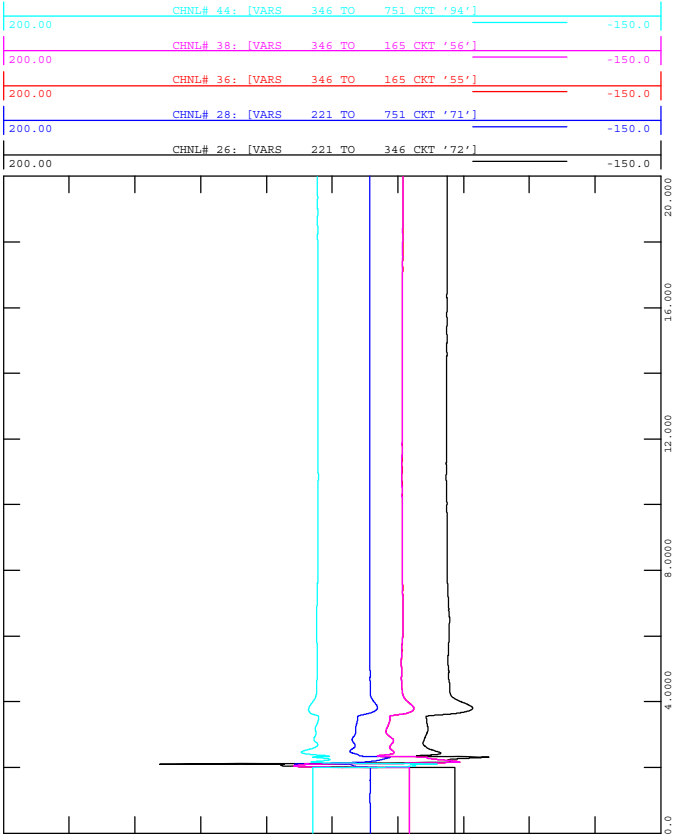


FIGURE E-3E  
 P524\_2019SL\_SC2\_POST  
 3 PHASE FAULT ON 967L AT 370S

FILE: E-3\_967L ( North Lethbridge 370S).out

WED, DEC 27 2017 10:52  
 BRANCH P FLOW (PU)

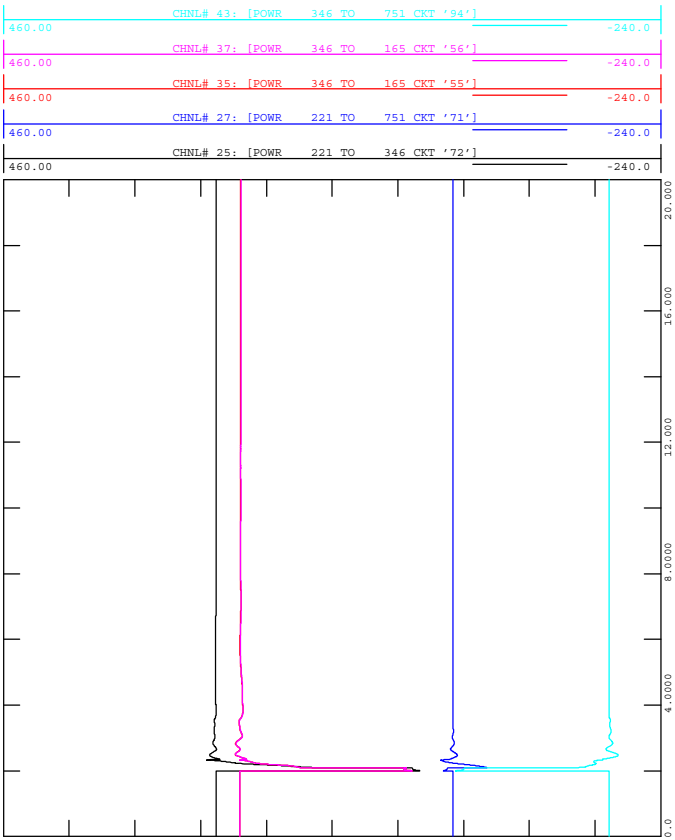
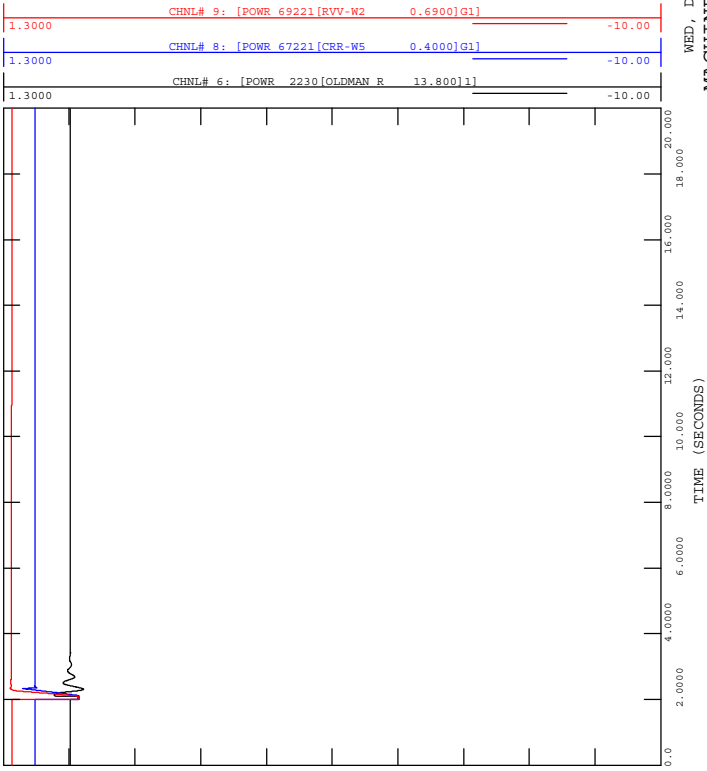




FIGURE E-4B  
P524\_2019SL\_SC2\_POST  
3 PHASE FAULT ON 967L AT 138S

FILE: E-4\_967L ( Windy Flat 138S).out

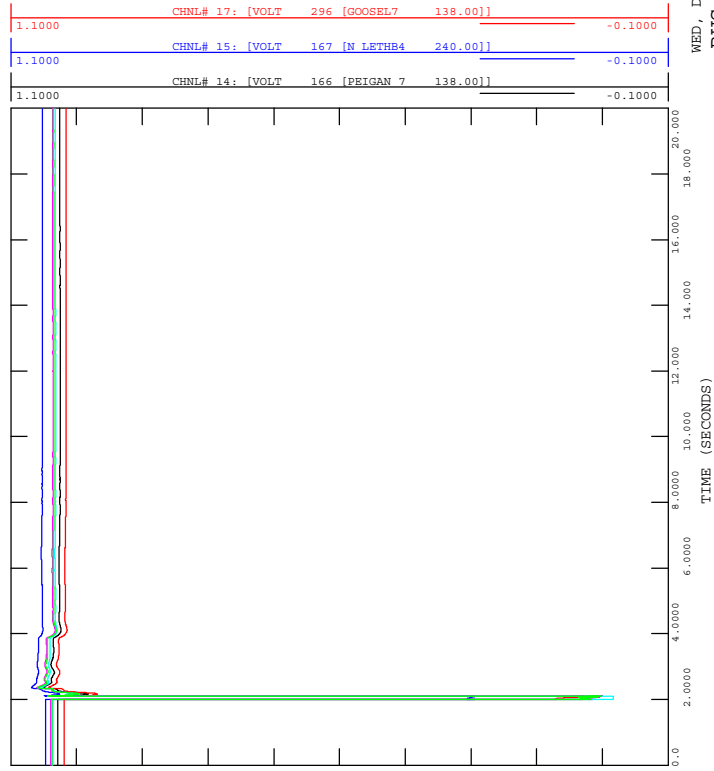


WED, DEC 27 2017 10:52  
MACHINE PELEC (PU)



FIGURE E-4D  
P524\_2019SL\_SC2\_POST  
3 PHASE FAULT ON 967L AT 138S

FILE: E-4\_967L ( Windy Flat 138S).out

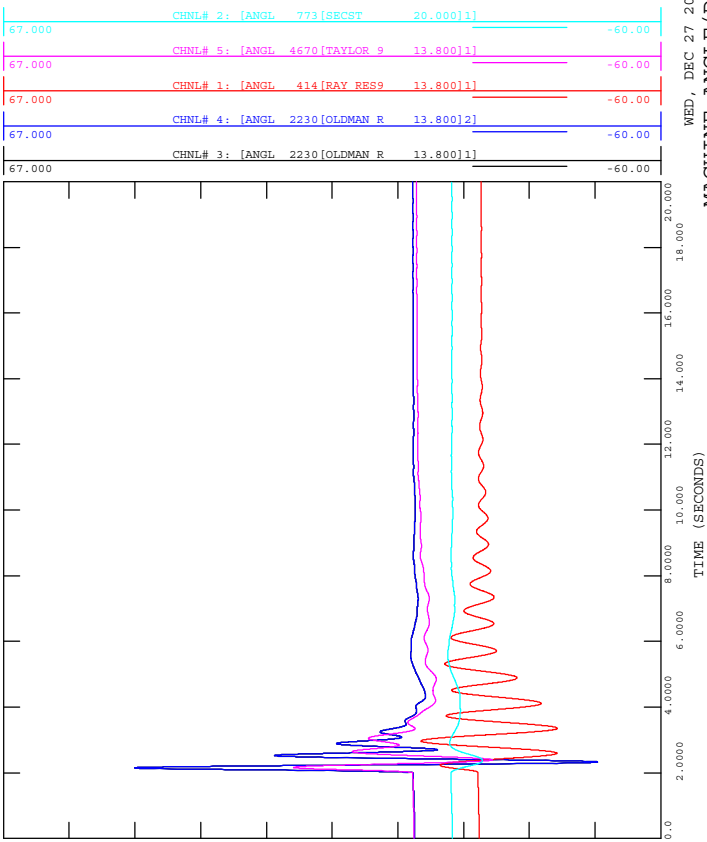


WED, DEC 27 2017 10:52  
BUS VOLTAGE (PU)



FIGURE E-4A  
P524\_2019SL\_SC2\_POST  
3 PHASE FAULT ON 967L AT 138S

FILE: E-4\_967L ( Windy Flat 138S).out

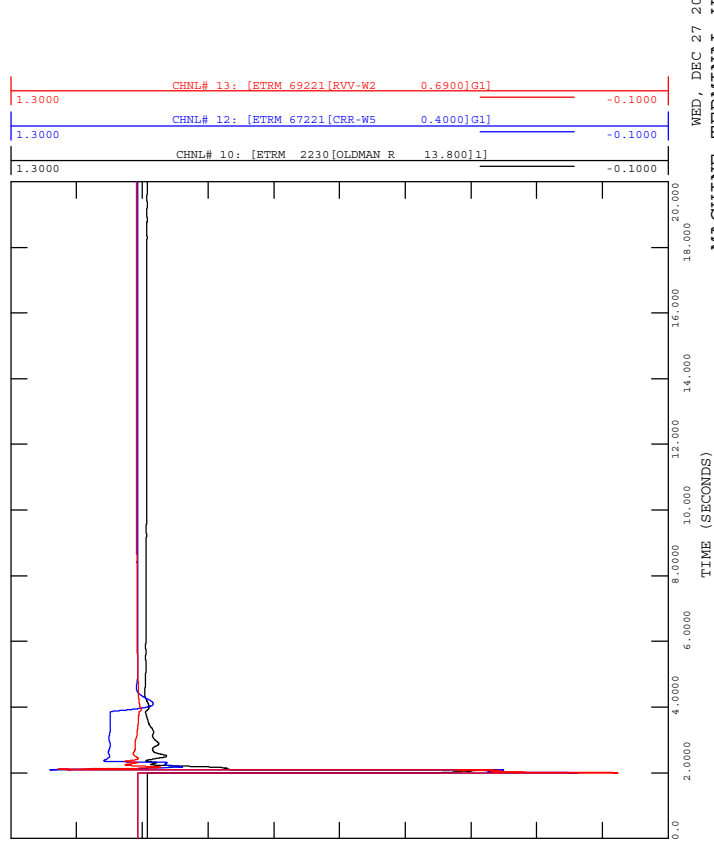


WED, DEC 27 2017 10:52  
MACHINE ANGLE (DEGREE)



FIGURE E-4C  
P524\_2019SL\_SC2\_POST  
3 PHASE FAULT ON 967L AT 138S

FILE: E-4\_967L ( Windy Flat 138S).out



WED, DEC 27 2017 10:52  
MACHINE TERMINAL VOLTAGE



FIGURE E-4F  
 P524\_2019SL\_SC2\_POST  
 3 PHASE FAULT ON 967L AT 138S

FILE: E-4\_967L ( Windy Flat 138S).out

WED, DEC 27 2017 10:52  
 BRANCH Q FLOW (PU)

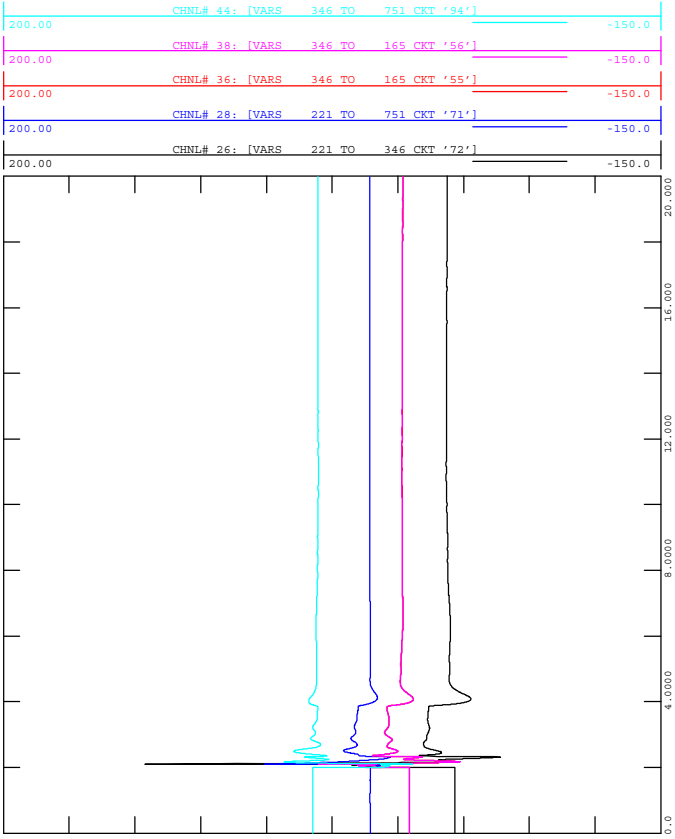


FIGURE E-4E  
 P524\_2019SL\_SC2\_POST  
 3 PHASE FAULT ON 967L AT 138S

FILE: E-4\_967L ( Windy Flat 138S).out

WED, DEC 27 2017 10:52  
 BRANCH P FLOW (PU)

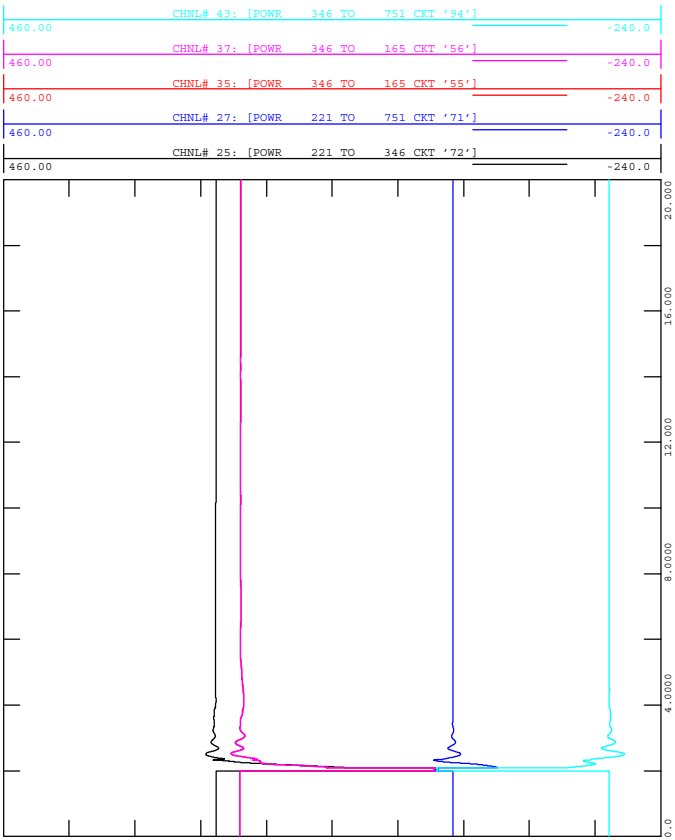
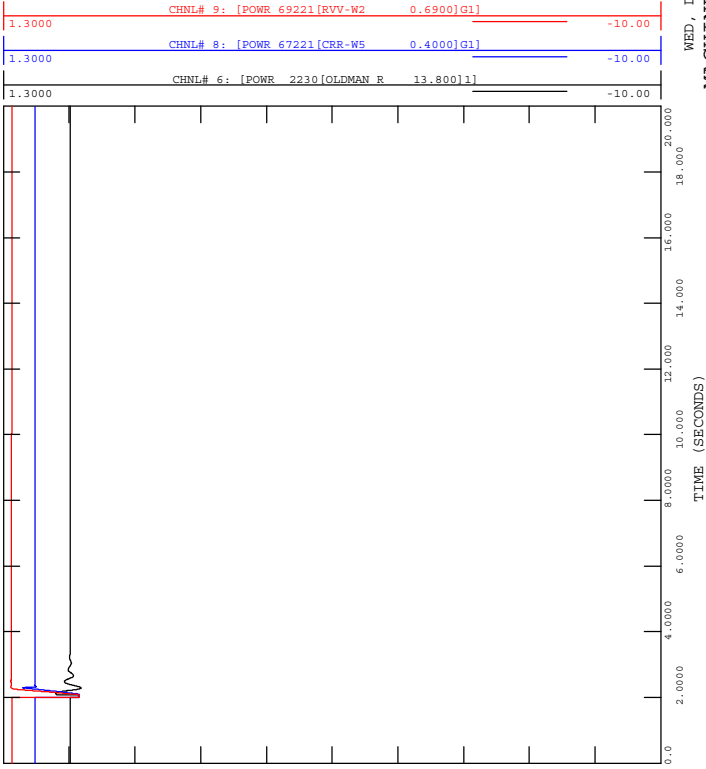






FIGURE E-5B  
P524\_2019SL\_SC2\_POST  
3 PHASE FAULT ON 994L AT 103S

FILE: E-5\_994L ( GoosLake 103S).out

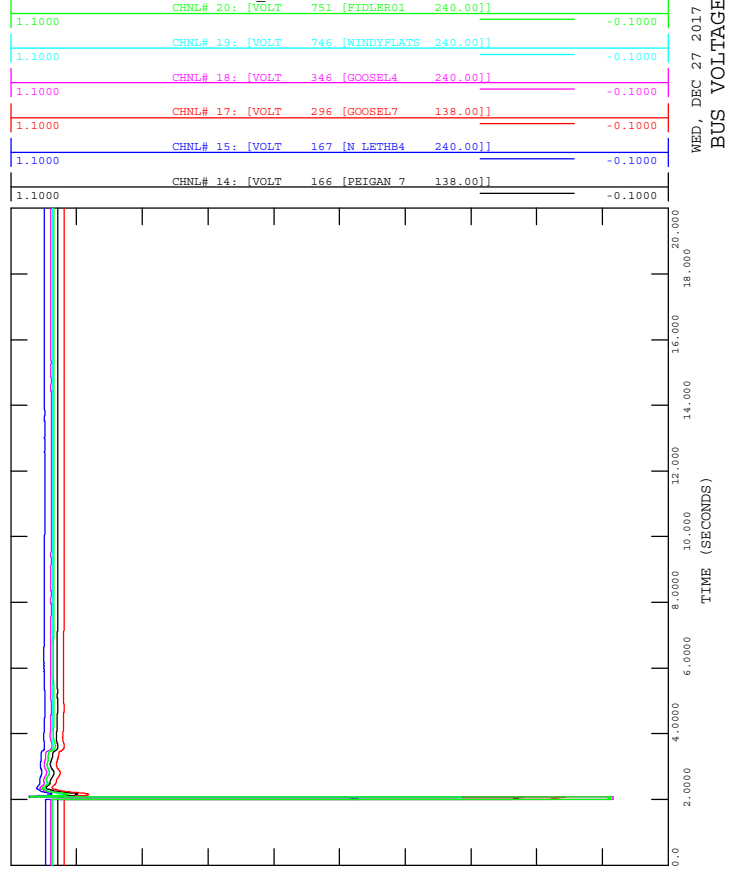


WED, DEC 27 2017 10:52  
MACHINE PELEC (PU)



FIGURE E-5D  
P524\_2019SL\_SC2\_POST  
3 PHASE FAULT ON 994L AT 103S

FILE: E-5\_994L ( GoosLake 103S).out

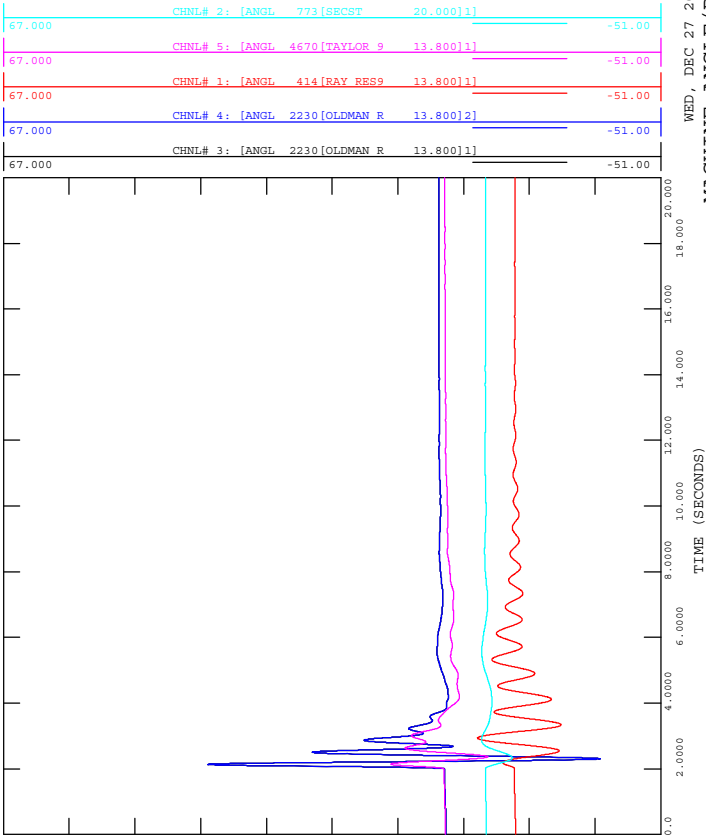


WED, DEC 27 2017 10:52  
BUS VOLTAGE (PU)



FIGURE E-5A  
P524\_2019SL\_SC2\_POST  
3 PHASE FAULT ON 994L AT 103S

FILE: E-5\_994L ( GoosLake 103S).out

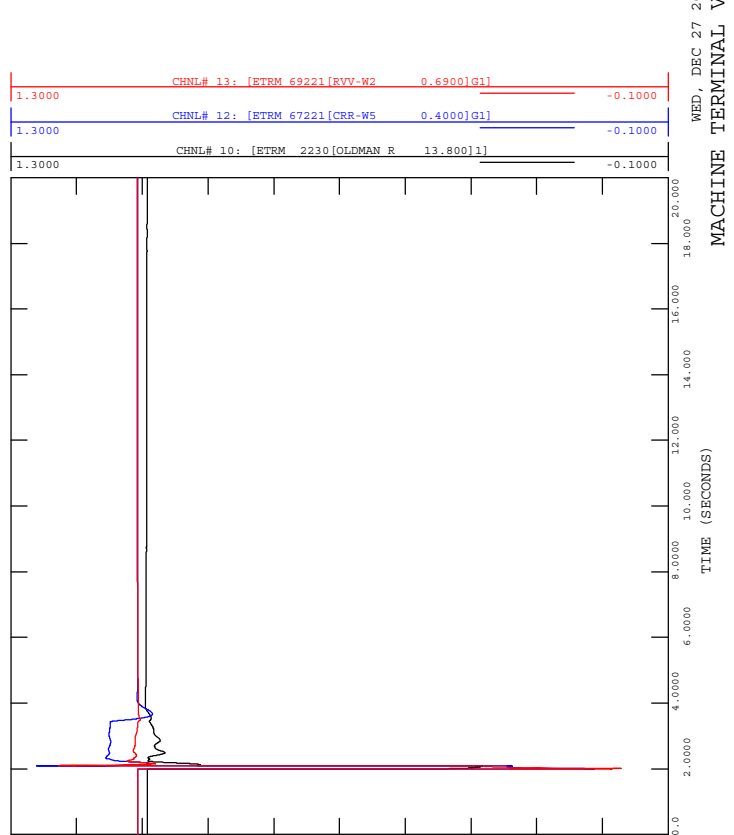


WED, DEC 27 2017 10:52  
MACHINE ANGLE (DEGREE)



FIGURE E-5C  
P524\_2019SL\_SC2\_POST  
3 PHASE FAULT ON 994L AT 103S

FILE: E-5\_994L ( GoosLake 103S).out



WED, DEC 27 2017 10:52  
MACHINE TERMINAL VOLTAGE



FIGURE E-5F  
 P524\_2019SL\_SC2\_POST  
 3 PHASE FAULT ON 994L AT 103S

FILE: E-5\_994L ( GoosLake 103S).out

WED, DEC 27 2017 10:52  
 BRANCH Q FLOW (PU)

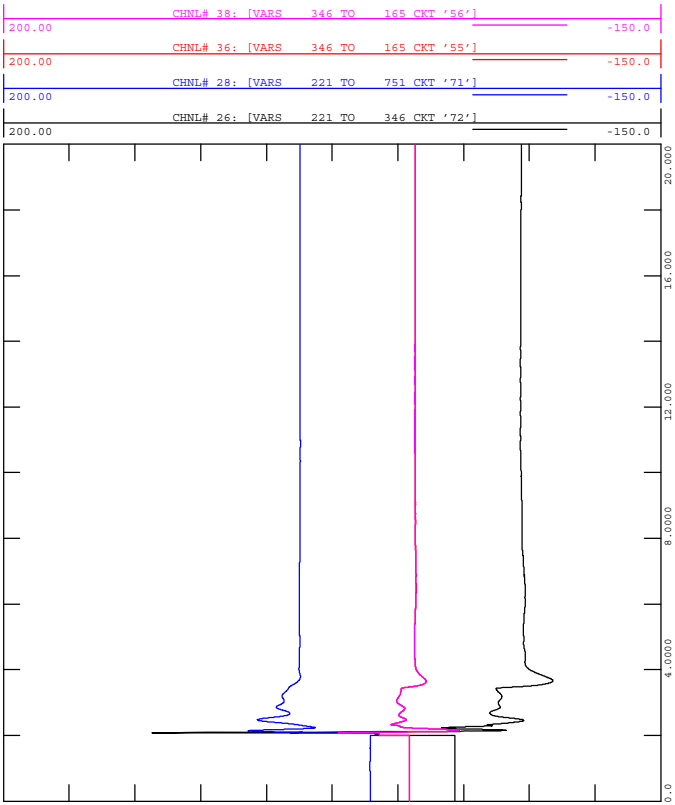


FIGURE E-5E  
 P524\_2019SL\_SC2\_POST  
 3 PHASE FAULT ON 994L AT 103S

FILE: E-5\_994L ( GoosLake 103S).out

WED, DEC 27 2017 10:52  
 BRANCH P FLOW (PU)

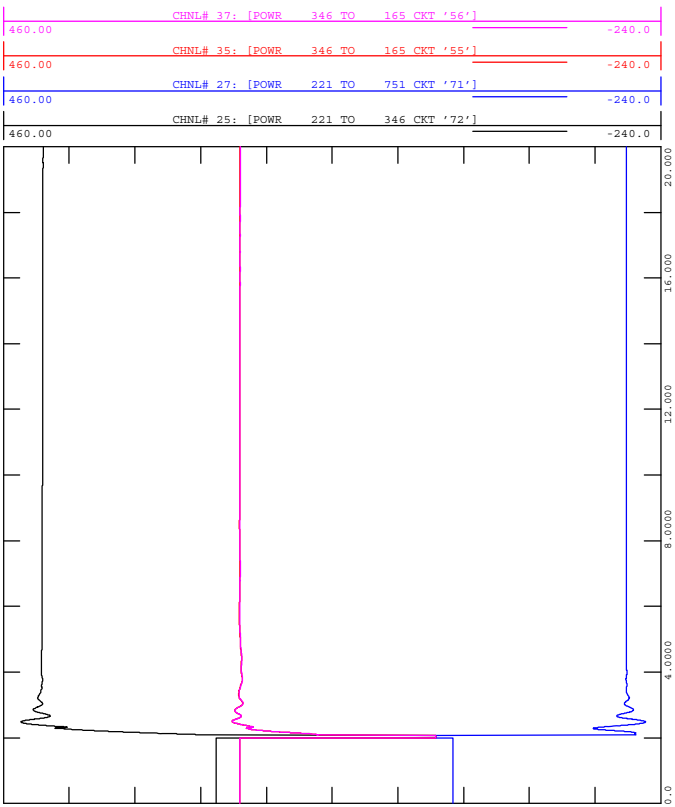
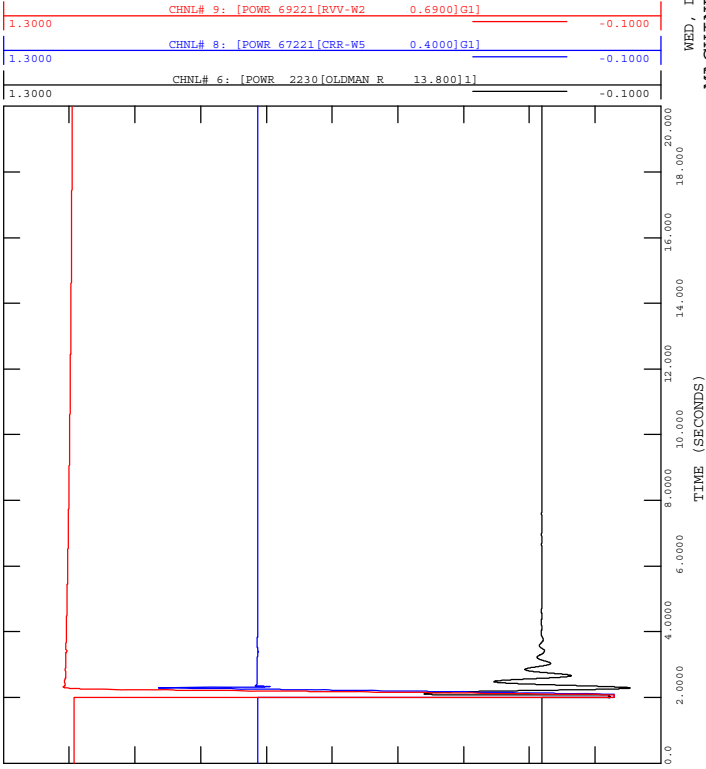




FIGURE E-6B  
P524\_2019SL\_SC2\_POST  
3 PHASE FAULT ON 994L AT 312S

FILE: E-6\_994L (Fidler 312S ).out

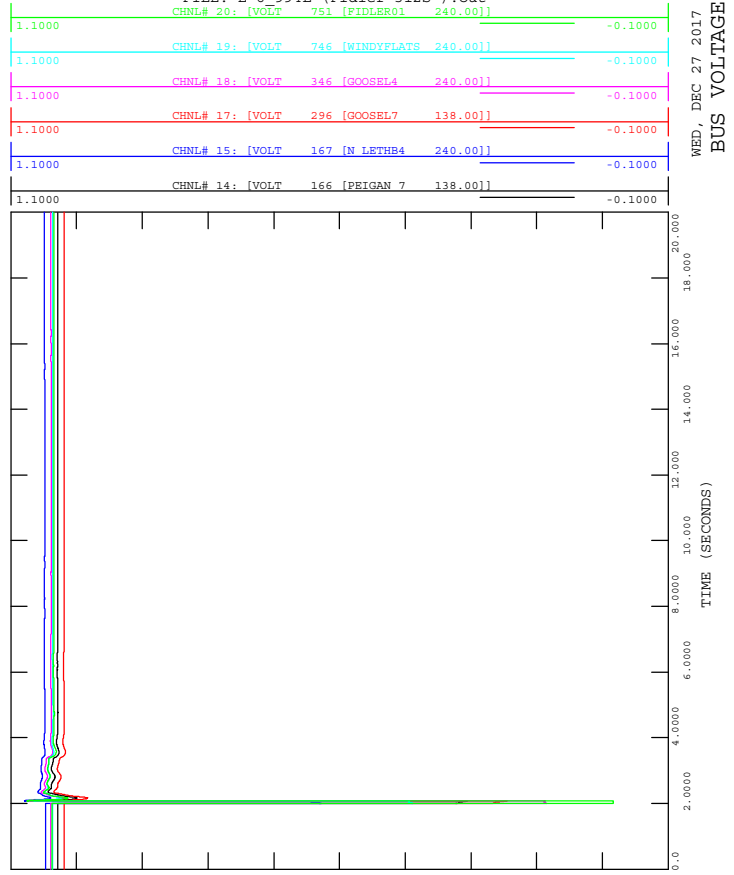


WED, DEC 27 2017 10:52  
MACHINE PELEC (PU)



FIGURE E-6D  
P524\_2019SL\_SC2\_POST  
3 PHASE FAULT ON 994L AT 312S

FILE: E-6\_994L (Fidler 312S ).out

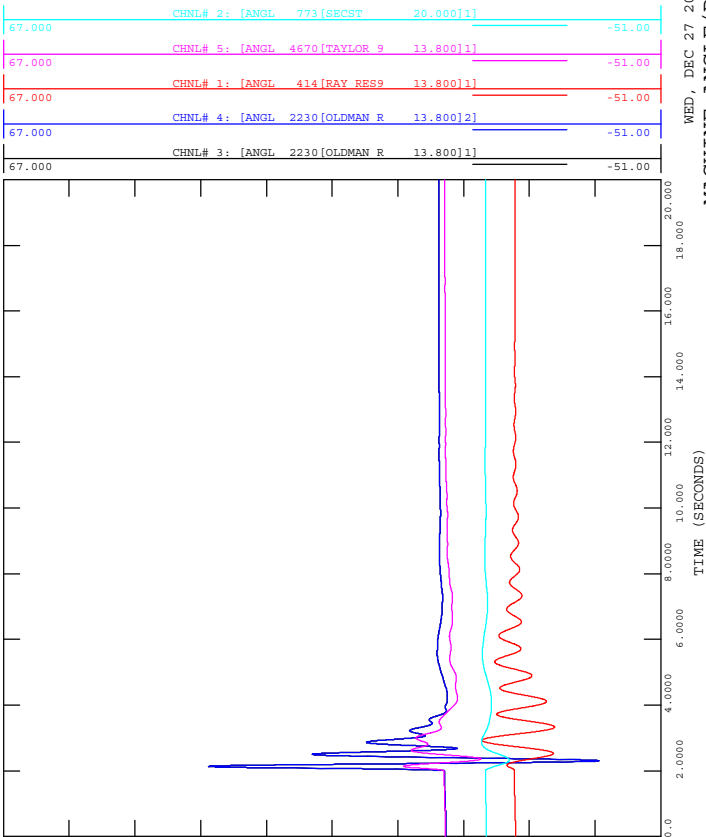


WED, DEC 27 2017 10:52  
BUS VOLTAGE (PU)



FIGURE E-6A  
P524\_2019SL\_SC2\_POST  
3 PHASE FAULT ON 994L AT 312S

FILE: E-6\_994L (Fidler 312S ).out

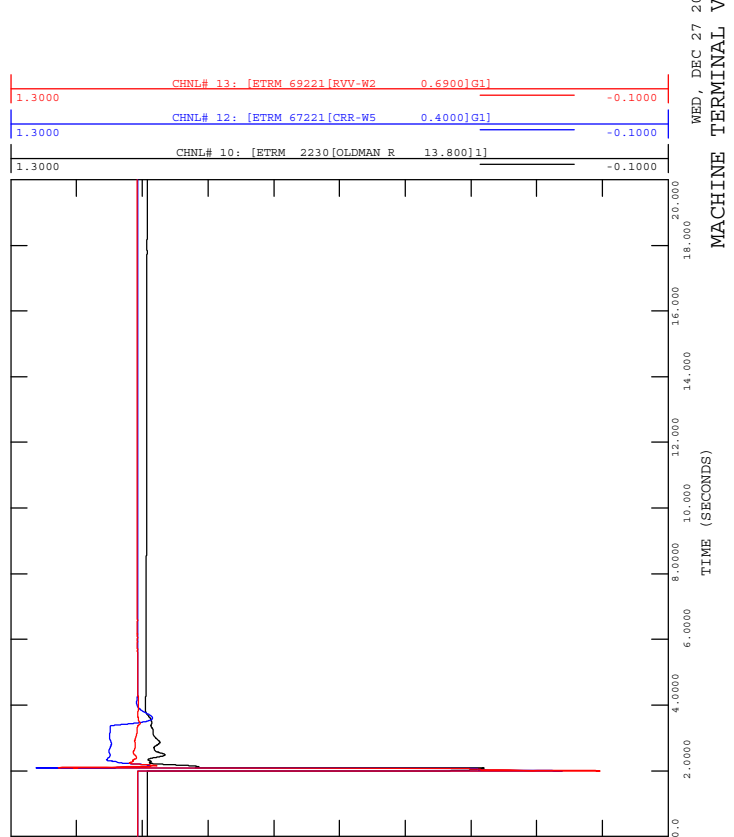


WED, DEC 27 2017 10:52  
MACHINE ANGLE (DEGREE)



FIGURE E-6C  
P524\_2019SL\_SC2\_POST  
3 PHASE FAULT ON 994L AT 312S

FILE: E-6\_994L (Fidler 312S ).out



WED, DEC 27 2017 10:52  
MACHINE TERMINAL VOLTAGE



FIGURE E-6F  
 P524\_2019SL\_SC2\_POST  
 3 PHASE FAULT ON 994L AT 312S

FILE: E-6\_994L (Fidler 312S ).out

WED, DEC 27 2017 10:52  
 BRANCH Q FLOW (PU)

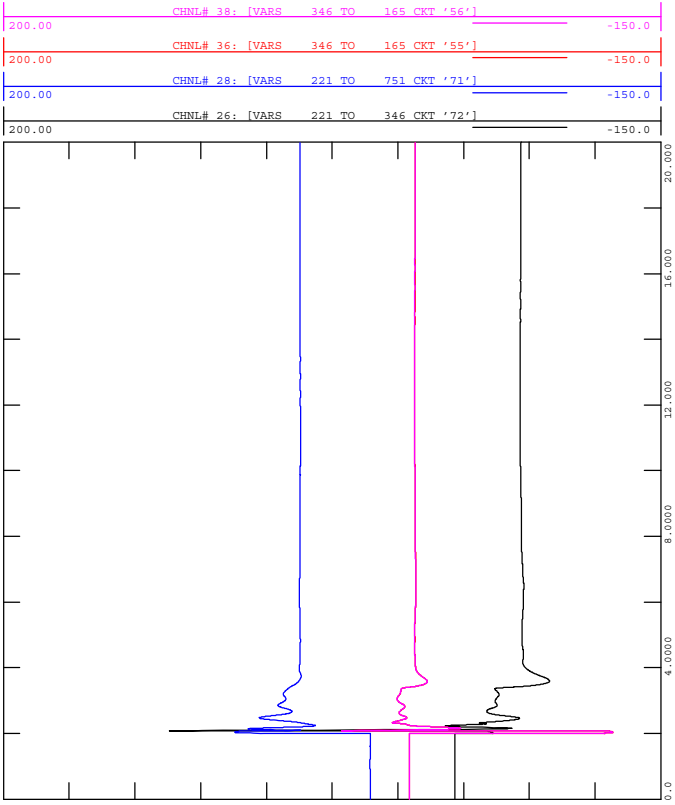


FIGURE E-6E  
 P524\_2019SL\_SC2\_POST  
 3 PHASE FAULT ON 994L AT 312S

FILE: E-6\_994L (Fidler 312S ).out

WED, DEC 27 2017 10:52  
 BRANCH P FLOW (PU)

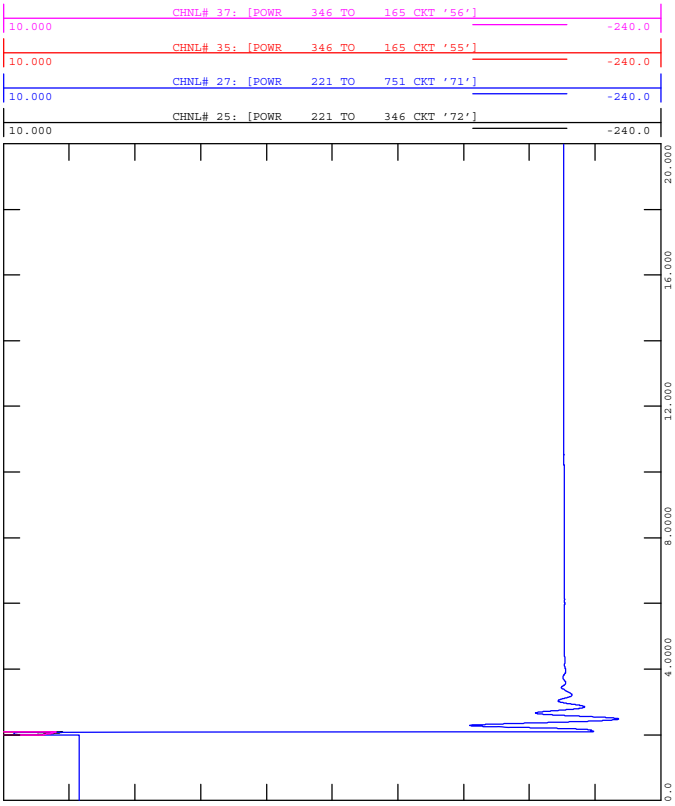
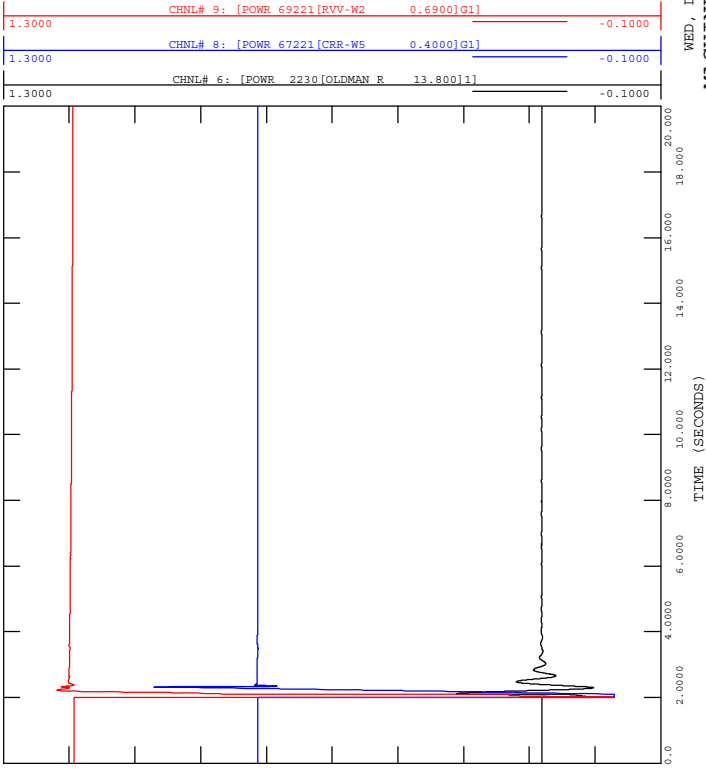




FIGURE E-7B  
P524\_2019SL\_SC2\_POST  
3 PHASE FAULT ON 1037L AT 237S

FILE: E-7\_1037L ( Foothills 237S).out

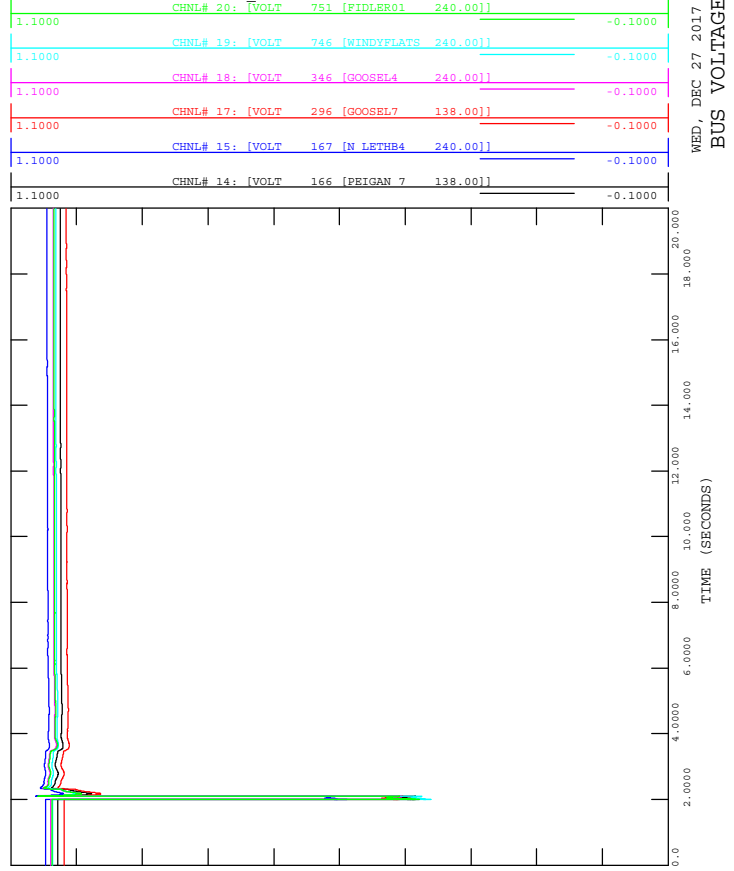


WED, DEC 27 2017 10:52  
MACHINE PELEC (PU)



FIGURE E-7D  
P524\_2019SL\_SC2\_POST  
3 PHASE FAULT ON 1037L AT 237S

FILE: E-7\_1037L ( Foothills 237S).out

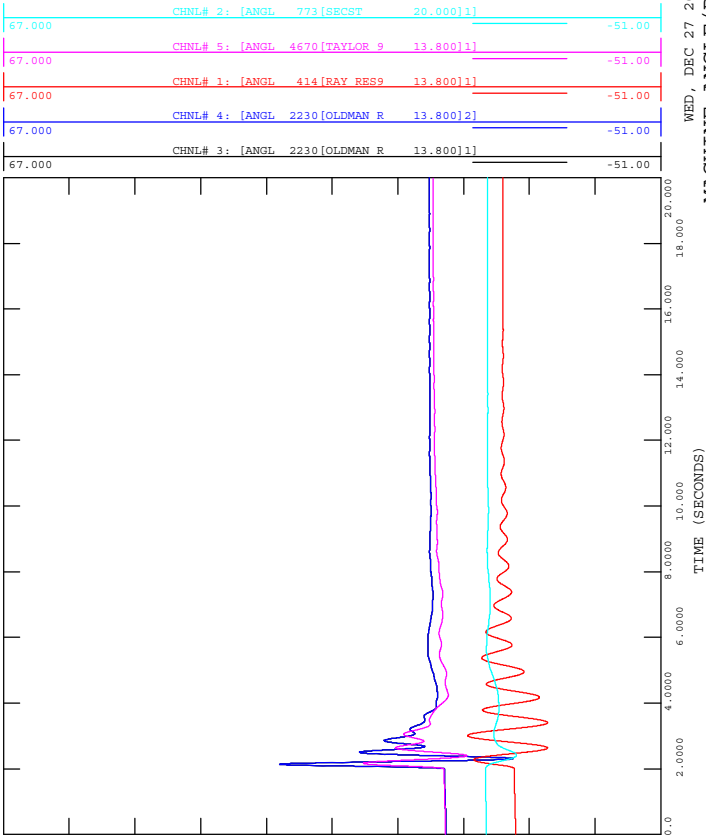


WED, DEC 27 2017 10:52  
BUS VOLTAGE (PU)



FIGURE E-7A  
P524\_2019SL\_SC2\_POST  
3 PHASE FAULT ON 1037L AT 237S

FILE: E-7\_1037L ( Foothills 237S).out

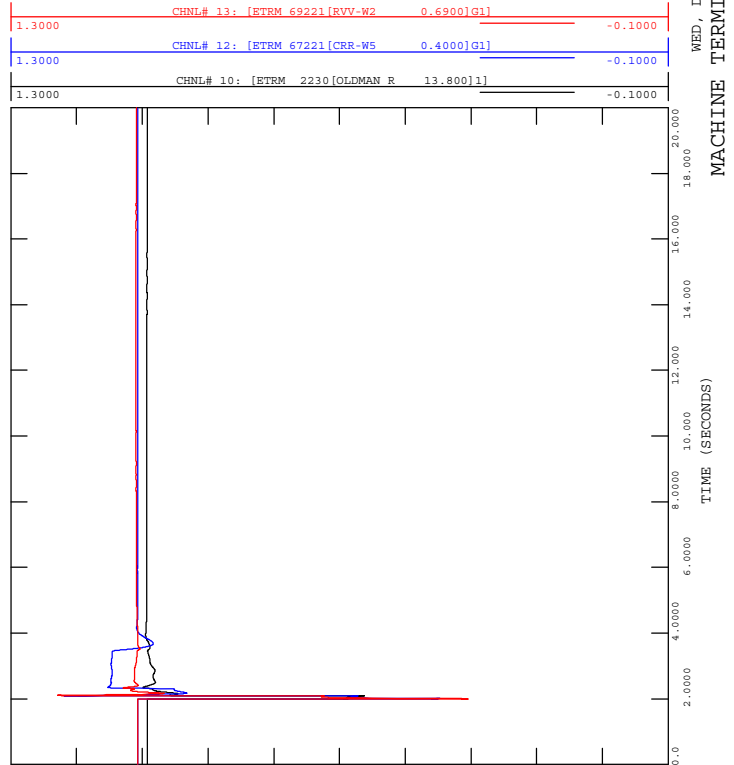


WED, DEC 27 2017 10:52  
MACHINE ANGLE (DEGREE)



FIGURE E-7C  
P524\_2019SL\_SC2\_POST  
3 PHASE FAULT ON 1037L AT 237S

FILE: E-7\_1037L ( Foothills 237S).out



WED, DEC 27 2017 10:52  
MACHINE TERMINAL VOLTAGE



FIGURE E-7F  
 P524\_2019SL\_SC2\_POST  
 3 PHASE FAULT ON 1037L AT 237S

FILE: E-7\_1037L ( Foothills 237S).out

WED, DEC 27 2017 10:52  
 BRANCH Q FLOW (PU)

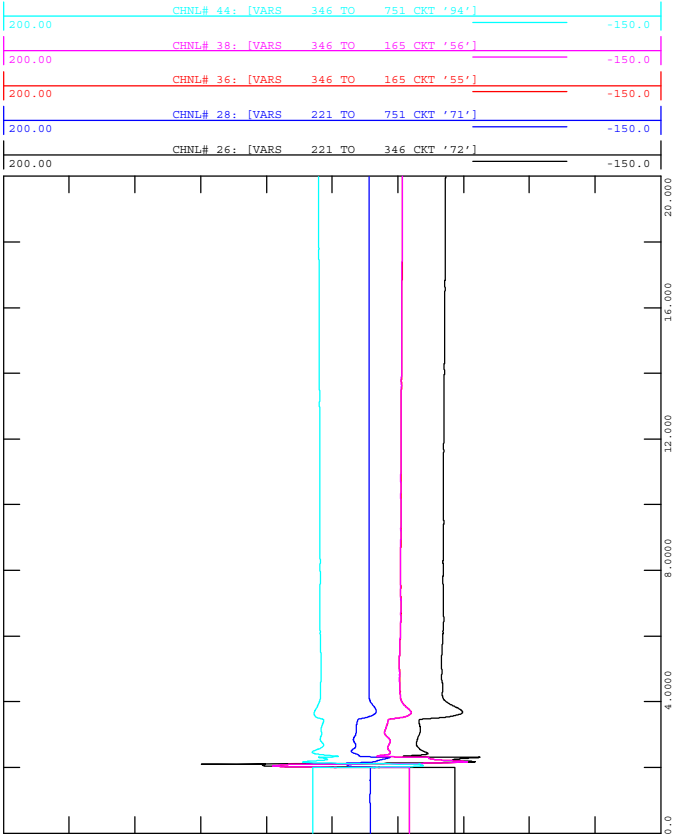


FIGURE E-7E  
 P524\_2019SL\_SC2\_POST  
 3 PHASE FAULT ON 1037L AT 237S

FILE: E-7\_1037L ( Foothills 237S).out

WED, DEC 27 2017 10:52  
 BRANCH P FLOW (PU)

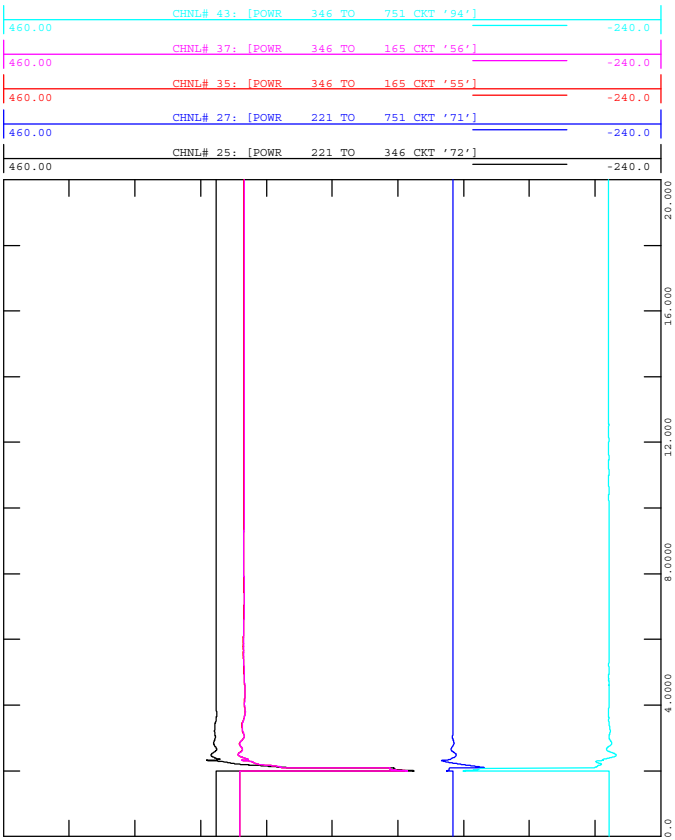
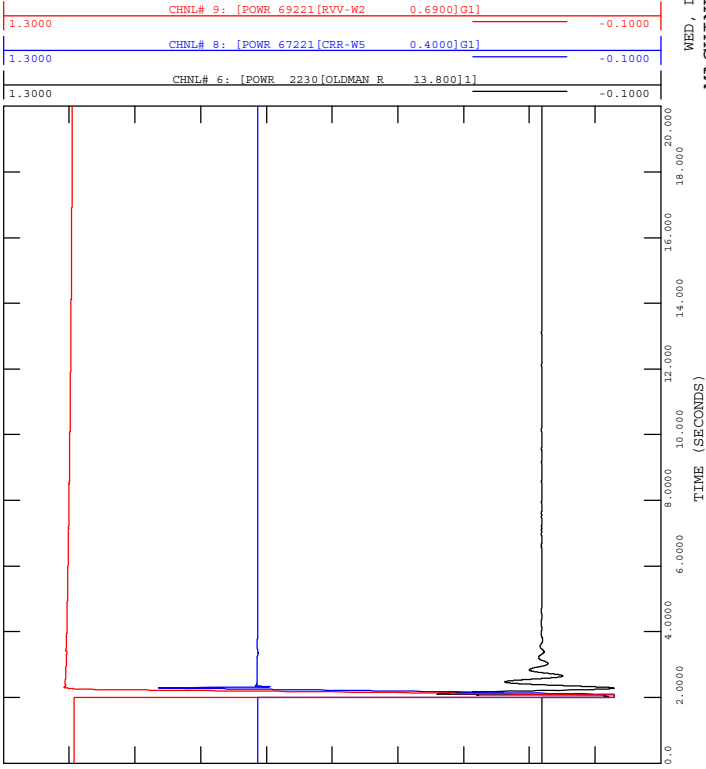




FIGURE E-8B  
P524\_2019SL\_SC2\_POST  
3 PHASE FAULT ON 1037L AT 138S

FILE: E-8\_1037L (Windy Flat 138S ).out

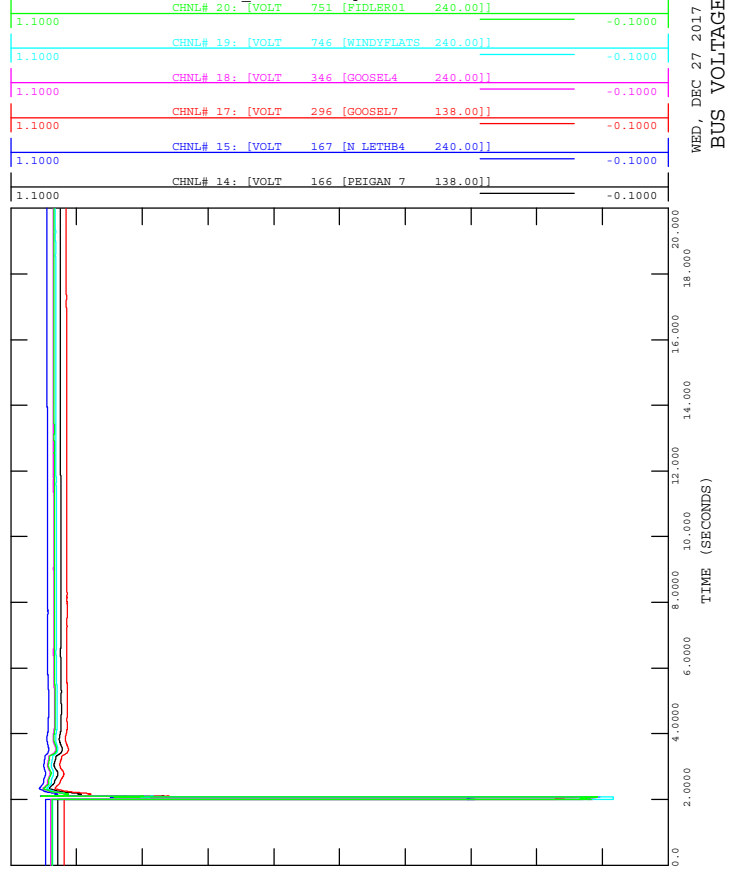


WED, DEC 27 2017 10:52  
MACHINE PELEC (PU)



FIGURE E-8D  
P524\_2019SL\_SC2\_POST  
3 PHASE FAULT ON 1037L AT 138S

FILE: E-8\_1037L (Windy Flat 138S ).out

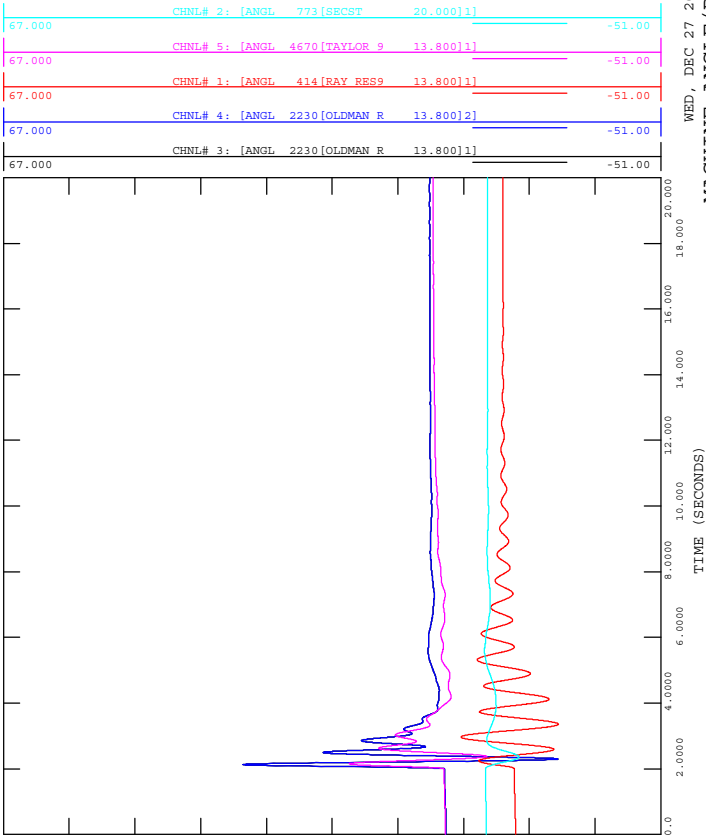


WED, DEC 27 2017 10:52  
BUS VOLTAGE (PU)



FIGURE E-8A  
P524\_2019SL\_SC2\_POST  
3 PHASE FAULT ON 1037L AT 138S

FILE: E-8\_1037L (Windy Flat 138S ).out

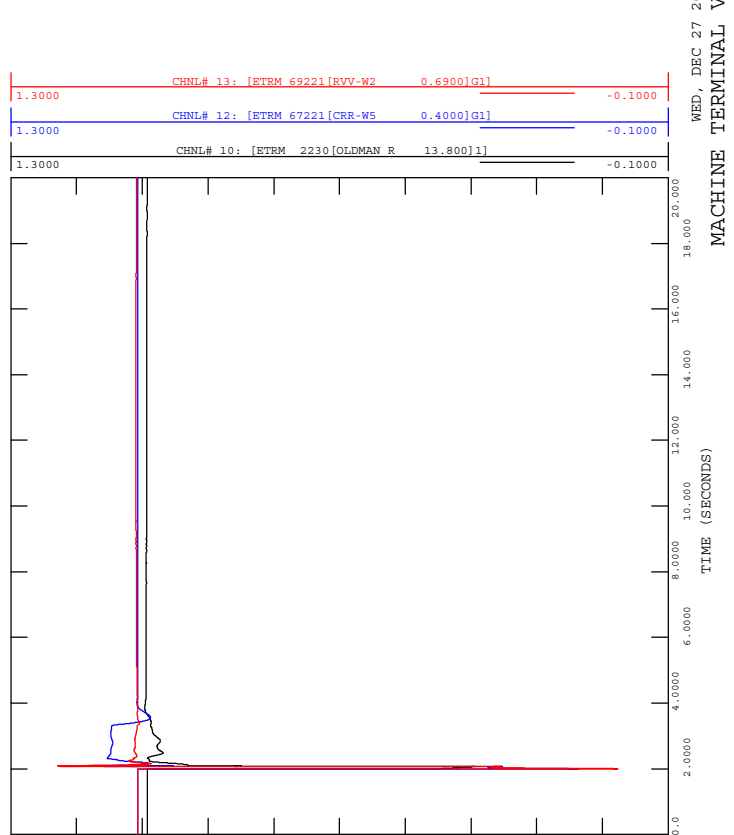


WED, DEC 27 2017 10:52  
MACHINE ANGLE (DEGREE)



FIGURE E-8C  
P524\_2019SL\_SC2\_POST  
3 PHASE FAULT ON 1037L AT 138S

FILE: E-8\_1037L (Windy Flat 138S ).out

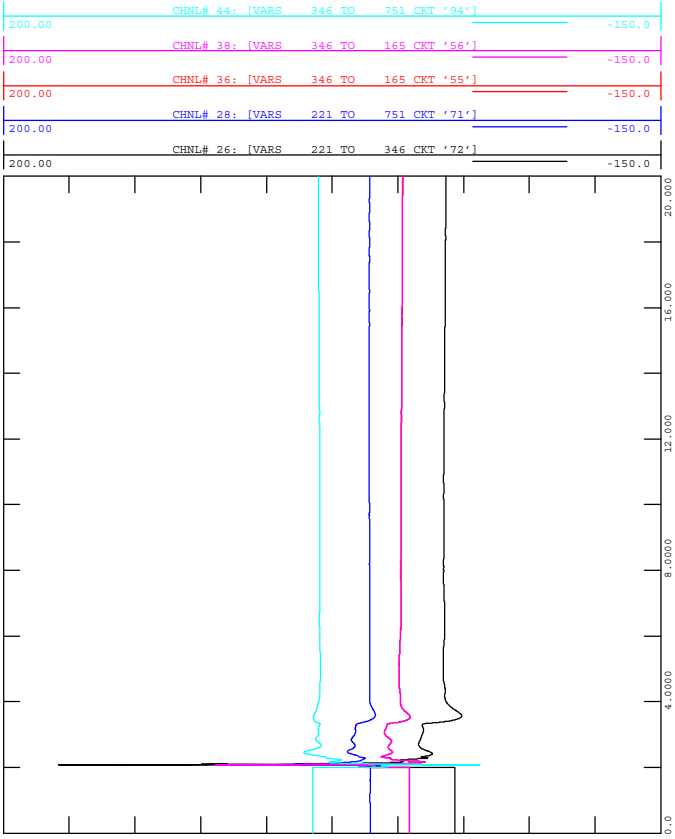


WED, DEC 27 2017 10:52  
MACHINE TERMINAL VOLTAGE



FIGURE E-8F  
P524\_2019SL\_SC2\_POST  
3 PHASE FAULT ON 1037L AT 138S

FILE: E-8\_1037L (Windy Flat 138S ).out

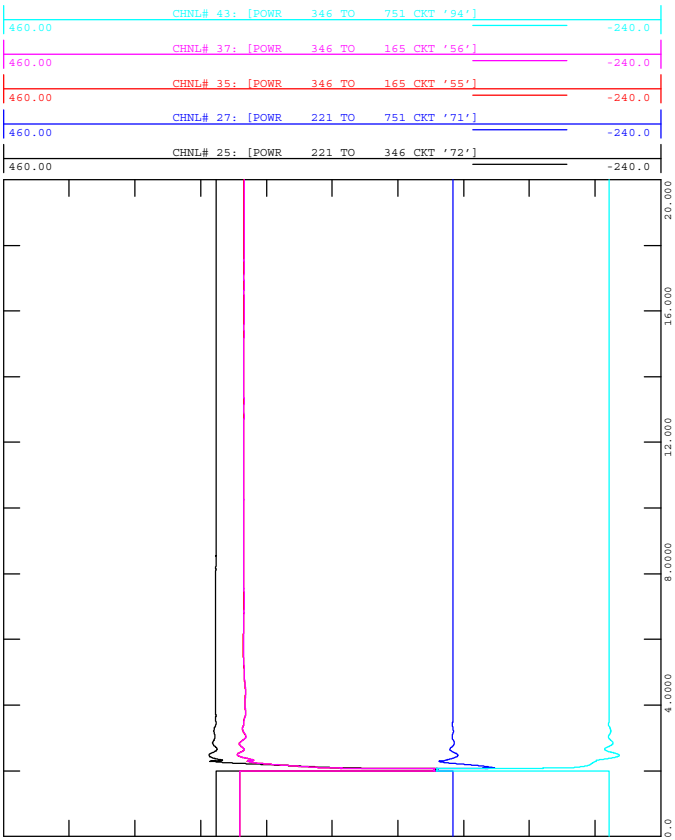


WED, DEC 27 2017 10:52  
BRANCH Q FLOW (PU)



FIGURE E-8E  
P524\_2019SL\_SC2\_POST  
3 PHASE FAULT ON 1037L AT 138S

FILE: E-8\_1037L (Windy Flat 138S ).out



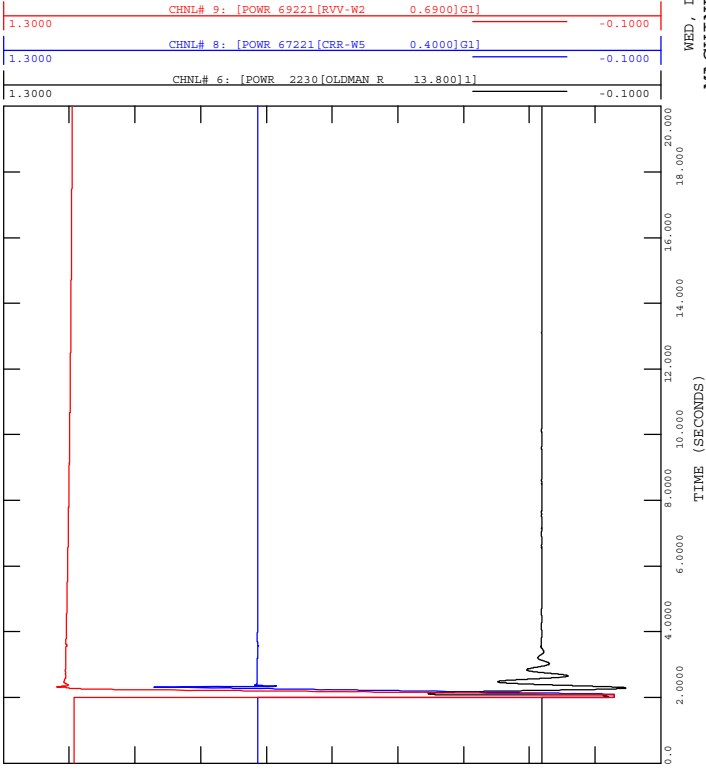
WED, DEC 27 2017 10:52  
BRANCH P FLOW (PU)





FIGURE E-9B  
P524\_2019SL\_SC2\_POST  
3 PHASE FAULT ON 1048L AT 138S

FILE: E-9\_1048L ( Windy Flat 138S).out

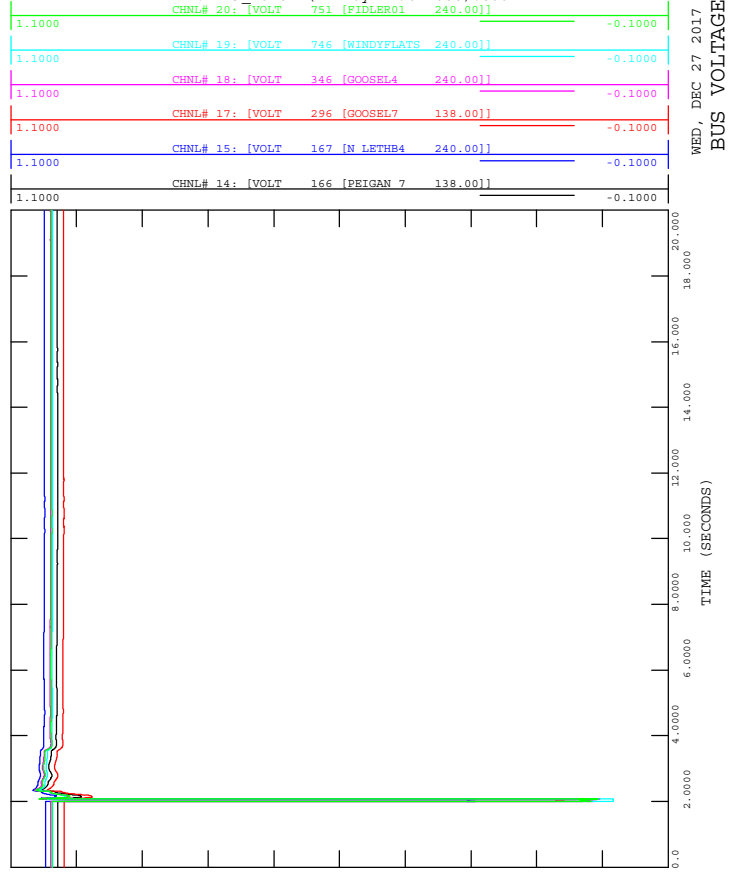


WED, DEC 27 2017 10:52  
MACHINE PELEC (PU)



FIGURE E-9D  
P524\_2019SL\_SC2\_POST  
3 PHASE FAULT ON 1048L AT 138S

FILE: E-9\_1048L ( Windy Flat 138S).out

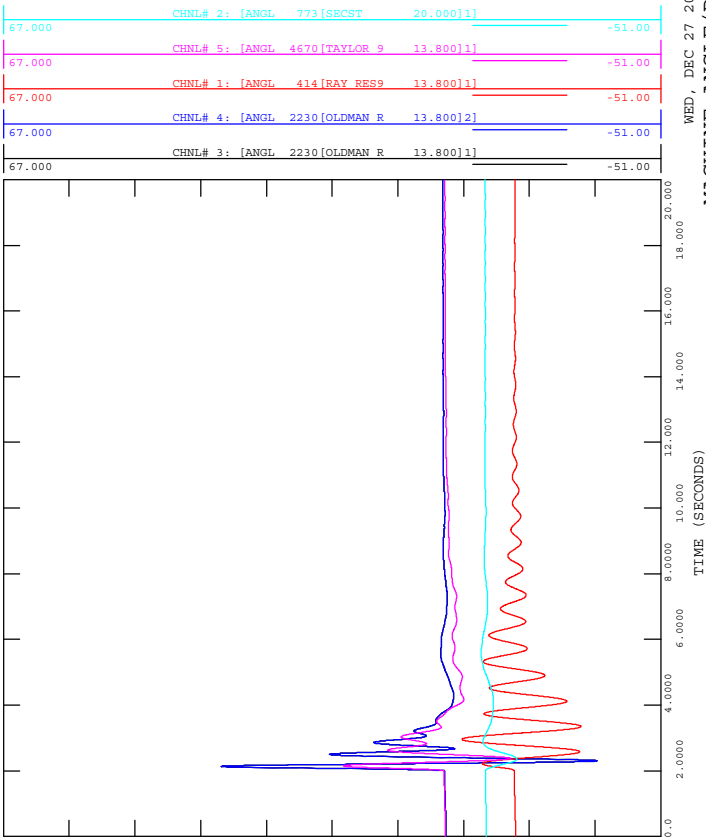


WED, DEC 27 2017 10:52  
BUS VOLTAGE (PU)



FIGURE E-9A  
P524\_2019SL\_SC2\_POST  
3 PHASE FAULT ON 1048L AT 138S

FILE: E-9\_1048L ( Windy Flat 138S).out

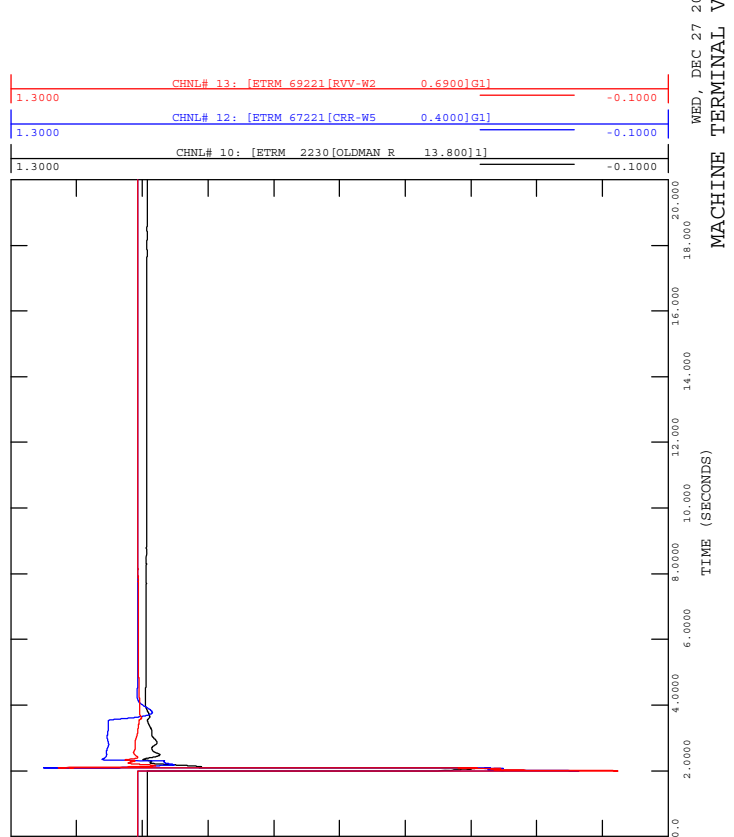


WED, DEC 27 2017 10:52  
MACHINE ANGLE (DEGREE)



FIGURE E-9C  
P524\_2019SL\_SC2\_POST  
3 PHASE FAULT ON 1048L AT 138S

FILE: E-9\_1048L ( Windy Flat 138S).out

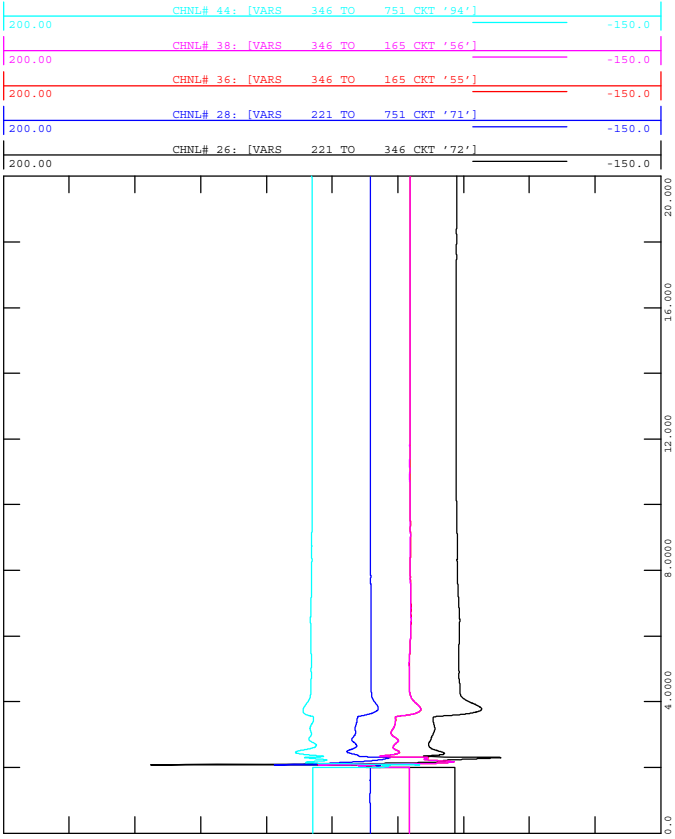


WED, DEC 27 2017 10:52  
MACHINE TERMINAL VOLTAGE



FIGURE E-9F  
 P524\_2019SL\_SC2\_POST  
 3 PHASE FAULT ON 1048L AT 138S

FILE: E-9\_1048L ( Windy Flat 138S).out

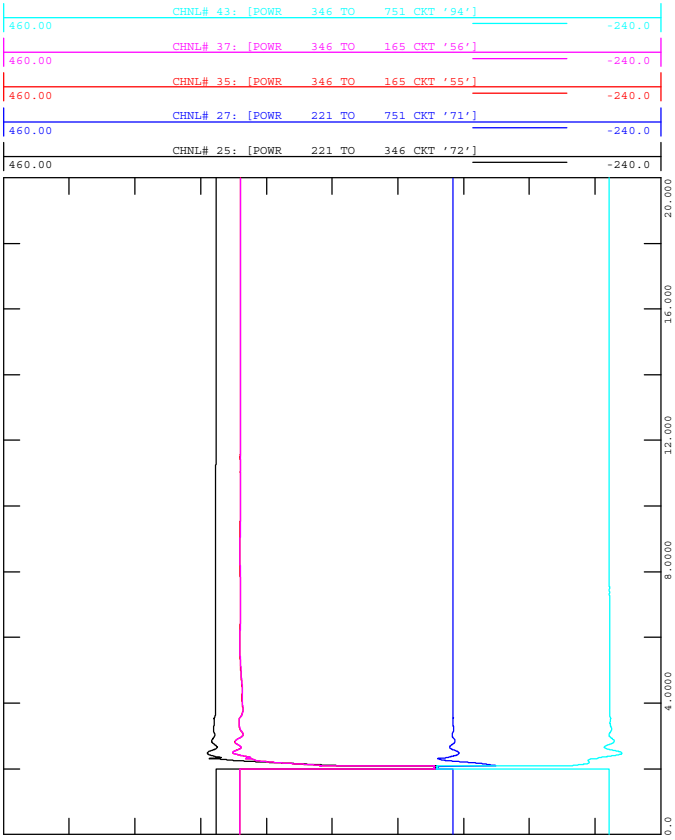


WED, DEC 27 2017 10:52  
 BRANCH Q FLOW (PU)



FIGURE E-9E  
 P524\_2019SL\_SC2\_POST  
 3 PHASE FAULT ON 1048L AT 138S

FILE: E-9\_1048L ( Windy Flat 138S).out

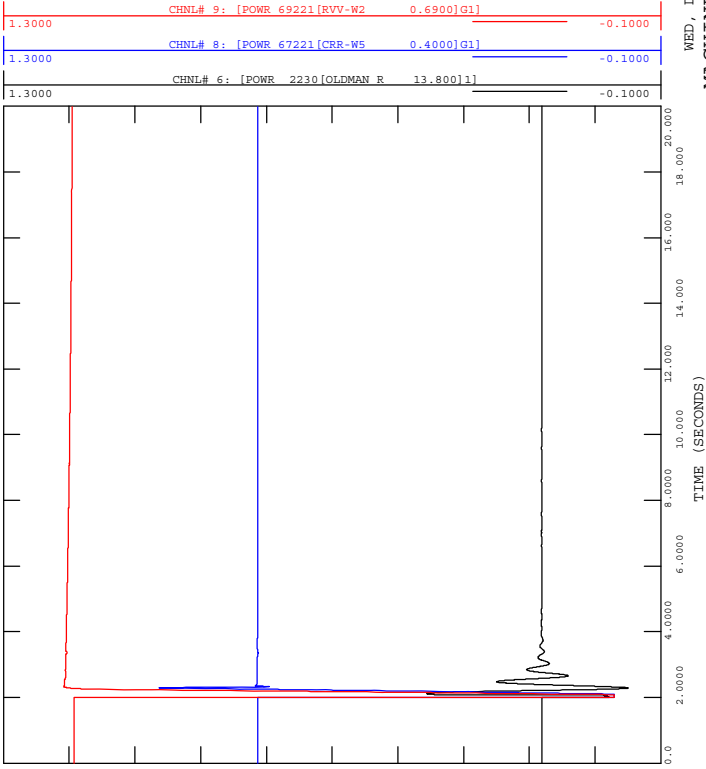


WED, DEC 27 2017 10:52  
 BRANCH P FLOW (PU)



FIGURE E-10B  
P524\_2019SL\_SC2\_POST  
3 PHASE FAULT ON 1048L AT 59S

FILE: E-10\_1048L (Peigan 59S).out

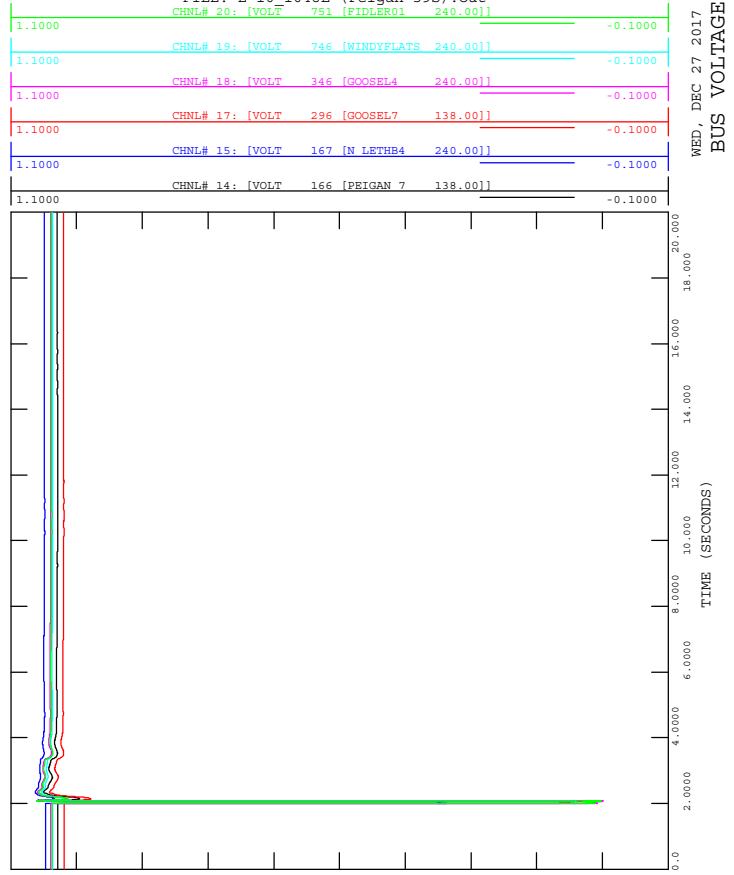


WED, DEC 27 2017 10:52  
MACHINE PELEC (PU)



FIGURE E-10D  
P524\_2019SL\_SC2\_POST  
3 PHASE FAULT ON 1048L AT 59S

FILE: E-10\_1048L (Peigan 59S).out

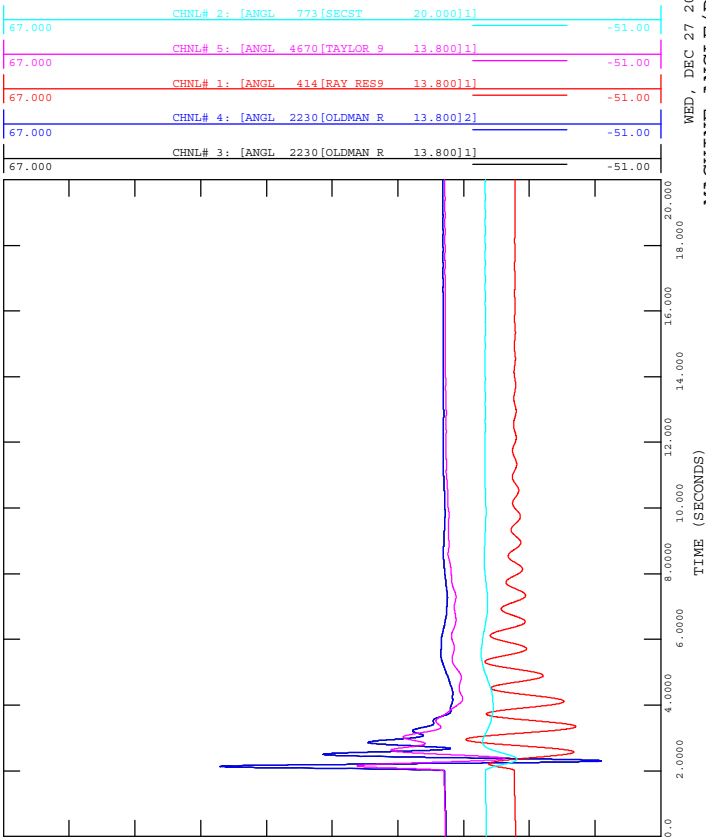


WED, DEC 27 2017 10:52  
BUS VOLTAGE (PU)



FIGURE E-10A  
P524\_2019SL\_SC2\_POST  
3 PHASE FAULT ON 1048L AT 59S

FILE: E-10\_1048L (Peigan 59S).out

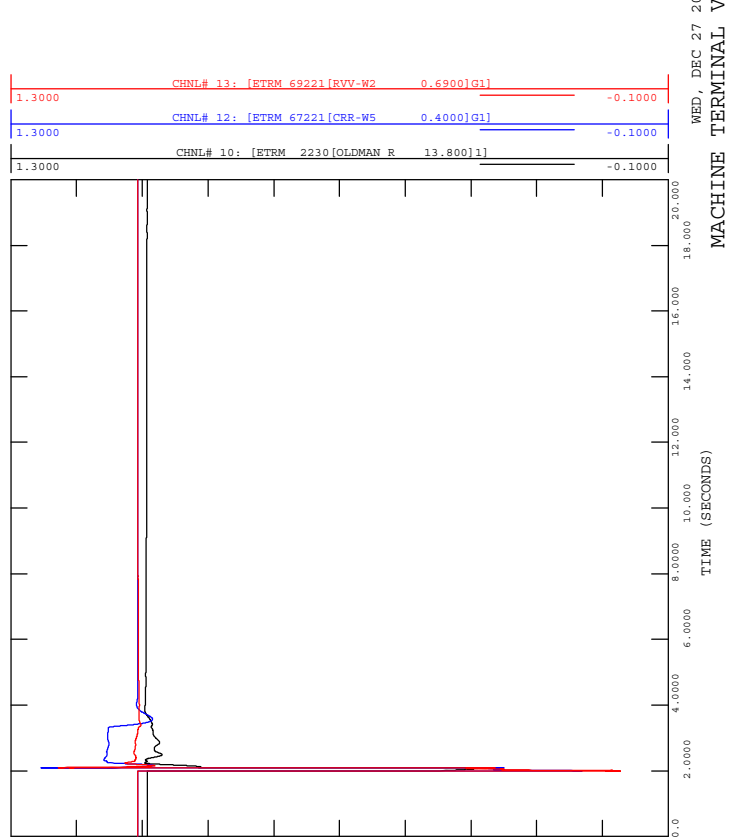


WED, DEC 27 2017 10:52  
MACHINE ANGLE (DEGREE)



FIGURE E-10C  
P524\_2019SL\_SC2\_POST  
3 PHASE FAULT ON 1048L AT 59S

FILE: E-10\_1048L (Peigan 59S).out

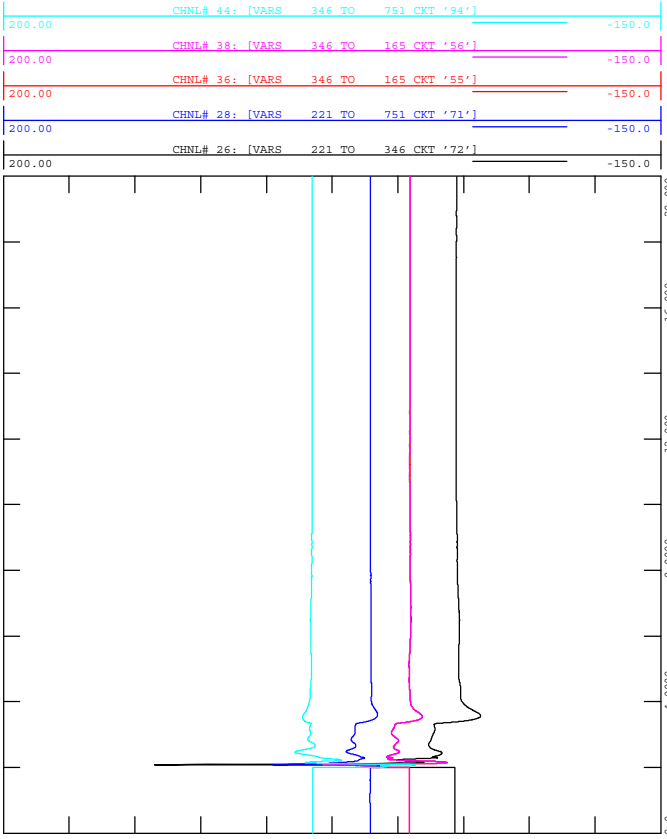


WED, DEC 27 2017 10:52  
MACHINE TERMINAL VOLTAGE



FIGURE E-10F  
 P524\_2019SL\_SC2\_POST  
 3 PHASE FAULT ON 1048L AT 59S

FILE: E-10\_1048L (Peigan 59S).out

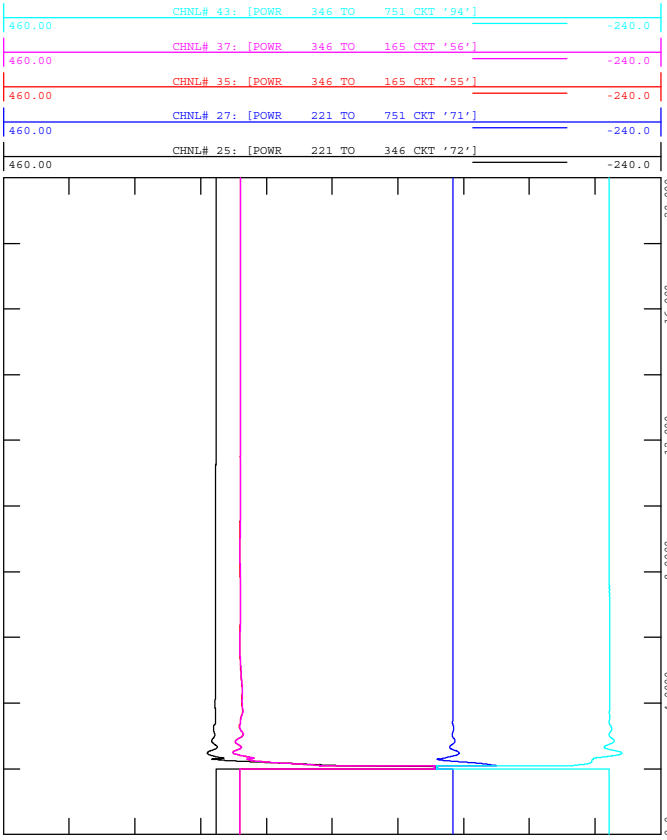


WED, DEC 27 2017 10:52  
 BRANCH Q FLOW (PU)



FIGURE E-10E  
 P524\_2019SL\_SC2\_POST  
 3 PHASE FAULT ON 1048L AT 59S

FILE: E-10\_1048L (Peigan 59S).out



WED, DEC 27 2017 10:52  
 BRANCH P FLOW (PU)



FIGURE E-11B  
P524\_2019SL\_SC2\_POST  
3 PHASE FAULT ON 1071L AT 205S

FILE: E-11\_1071L ( Castle Rock Ridge 205S).out

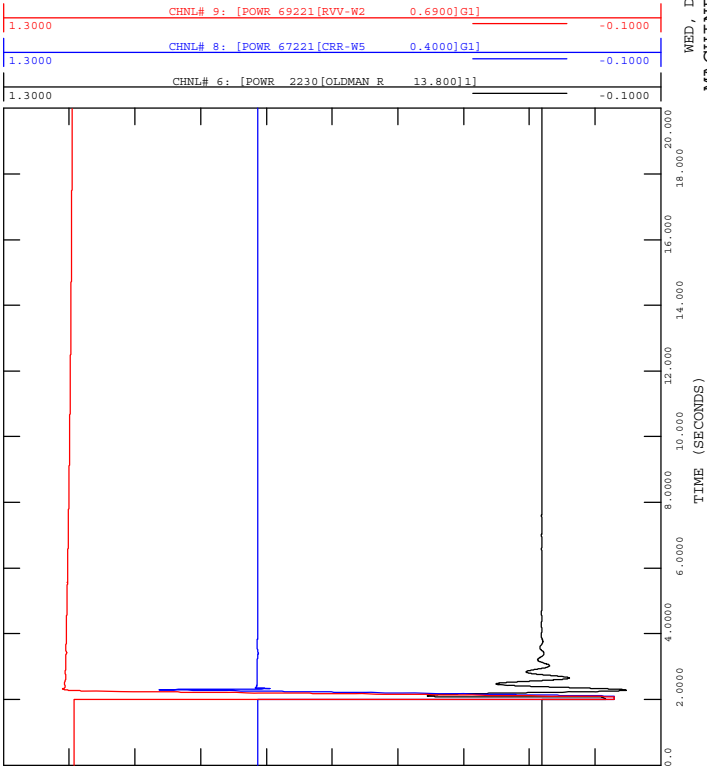


FIGURE E-11D  
P524\_2019SL\_SC2\_POST  
3 PHASE FAULT ON 1071L AT 205S

FILE: E-11\_1071L ( Castle Rock Ridge 205S).out

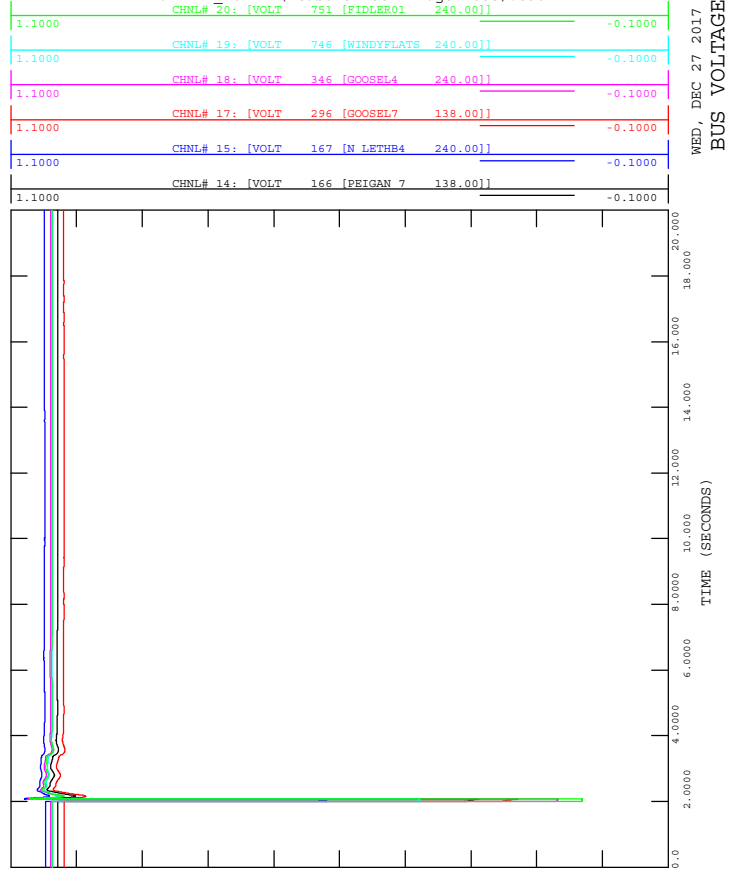


FIGURE E-11A  
P524\_2019SL\_SC2\_POST  
3 PHASE FAULT ON 1071L AT 205S

FILE: E-11\_1071L ( Castle Rock Ridge 205S).out

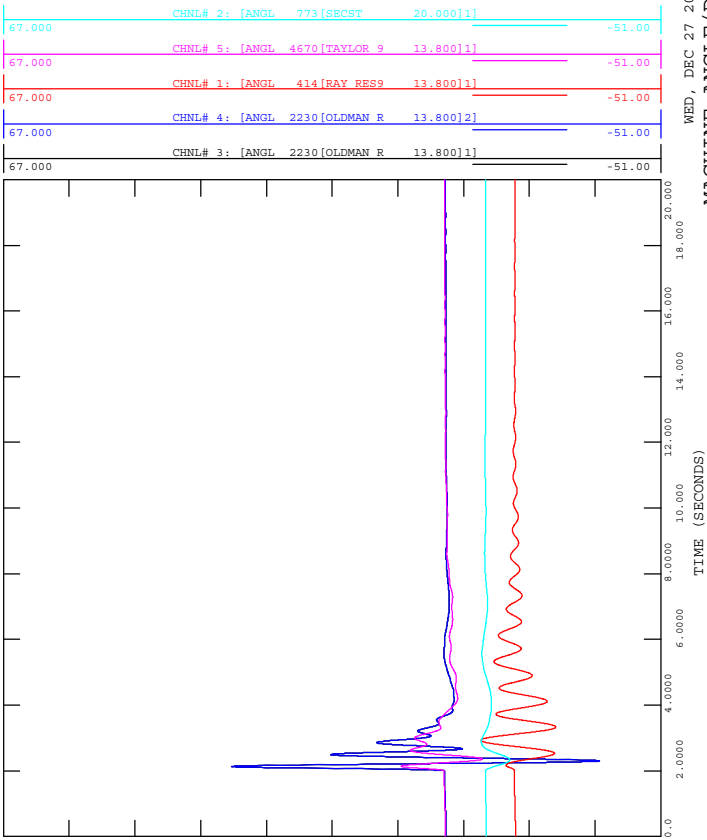


FIGURE E-11C  
P524\_2019SL\_SC2\_POST  
3 PHASE FAULT ON 1071L AT 205S

FILE: E-11\_1071L ( Castle Rock Ridge 205S).out

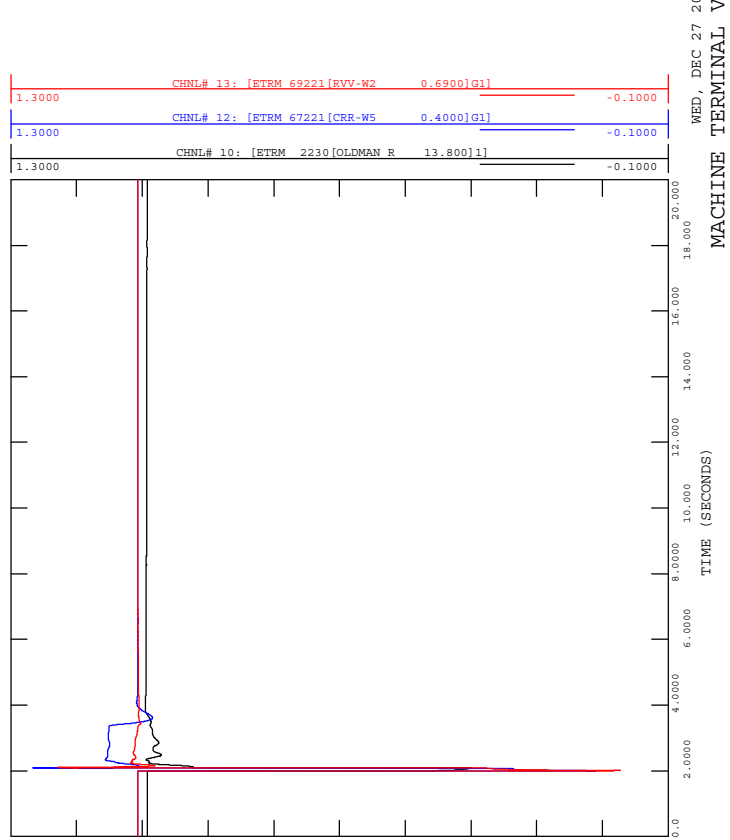




FIGURE E-11F  
 P524\_2019SL\_SC2\_POST  
 3 PHASE FAULT ON 1071L AT 205S

FILE: E-11\_1071L ( Castle Rock Ridge 205S).out

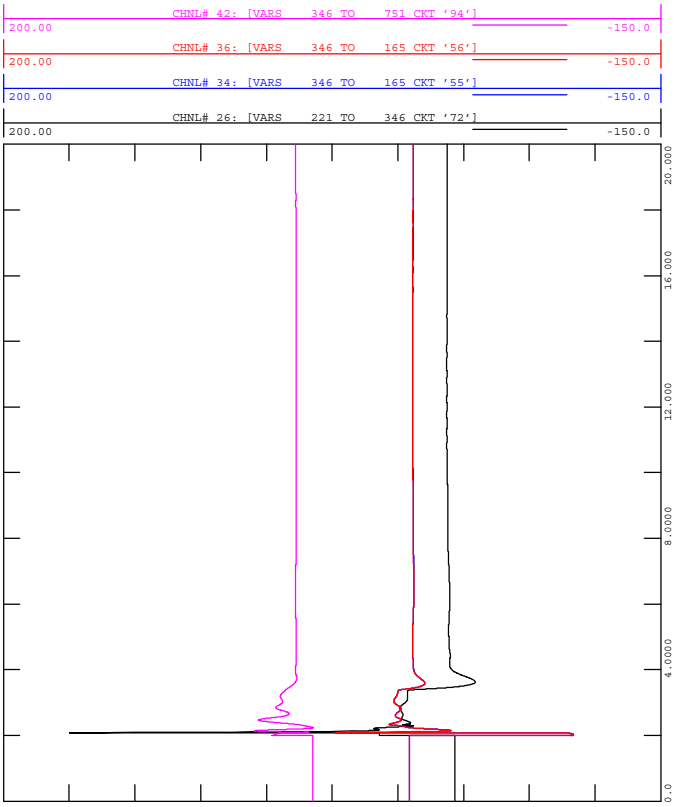


FIGURE E-11E  
 P524\_2019SL\_SC2\_POST  
 3 PHASE FAULT ON 1071L AT 205S

FILE: E-11\_1071L ( Castle Rock Ridge 205S).out

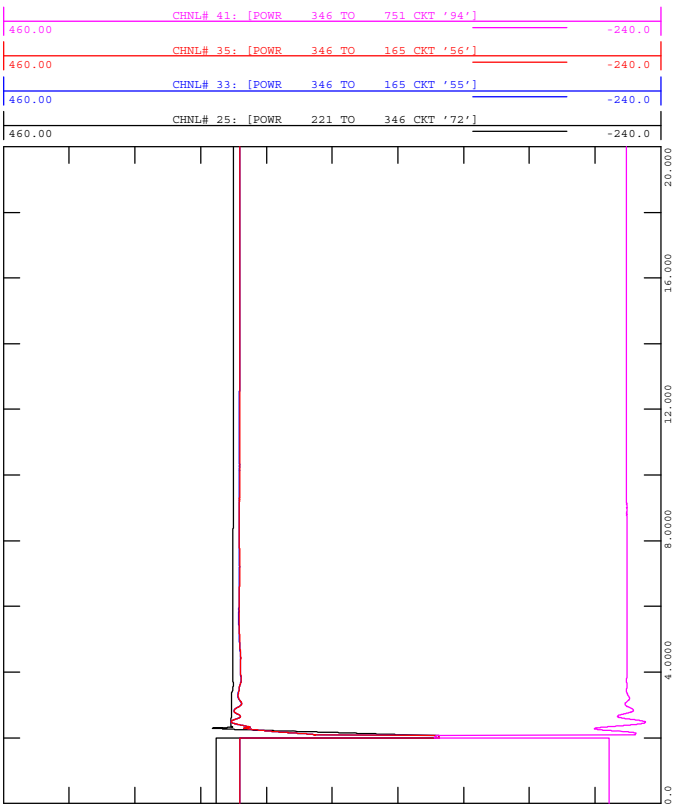
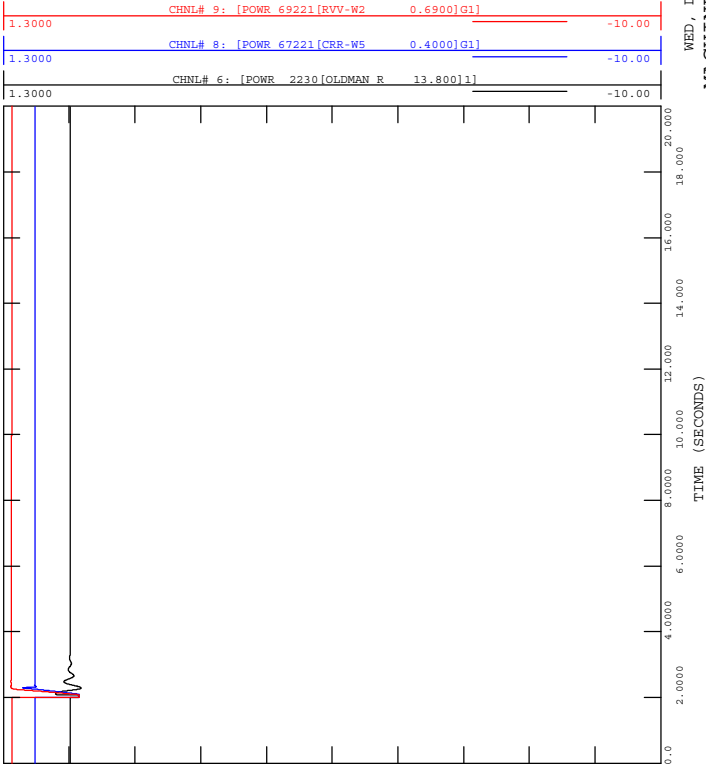




FIGURE E-12B  
P524\_2019SL\_SC2\_POST  
3 PHASE FAULT ON 1071L AT 312S

FILE: E-12\_1071L (Fidler 312S ).out

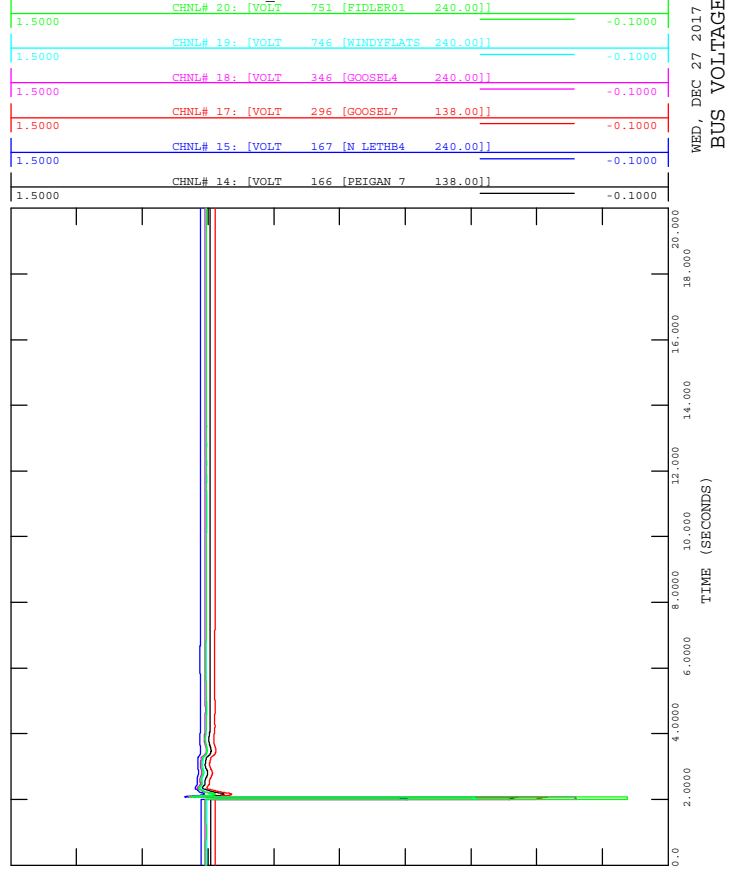


WED, DEC 27 2017 10:52  
MACHINE PELEC (PU)



FIGURE E-12D  
P524\_2019SL\_SC2\_POST  
3 PHASE FAULT ON 1071L AT 312S

FILE: E-12\_1071L (Fidler 312S ).out

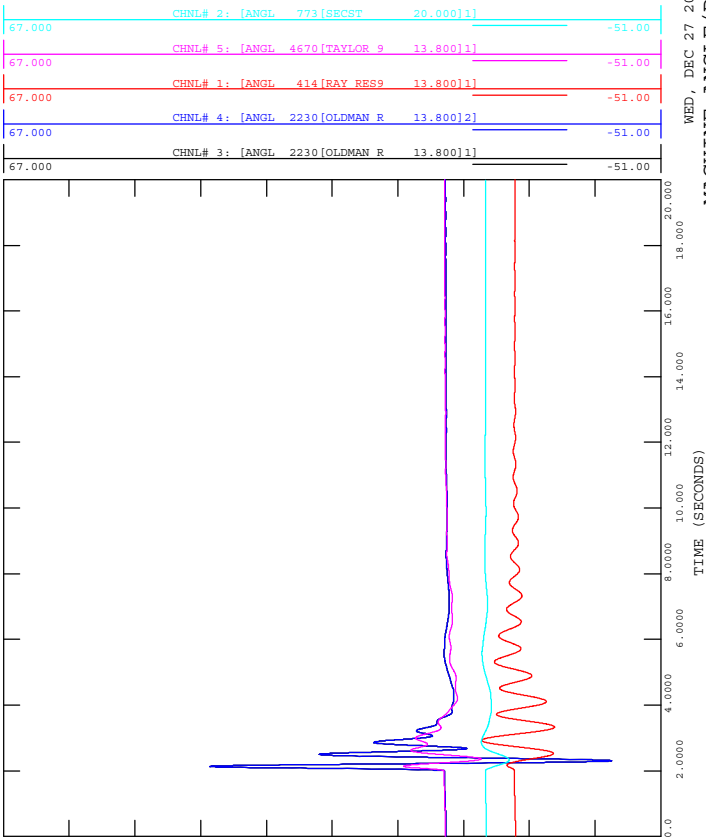


WED, DEC 27 2017 10:52  
BUS VOLTAGE (PU)



FIGURE E-12A  
P524\_2019SL\_SC2\_POST  
3 PHASE FAULT ON 1071L AT 312S

FILE: E-12\_1071L (Fidler 312S ).out

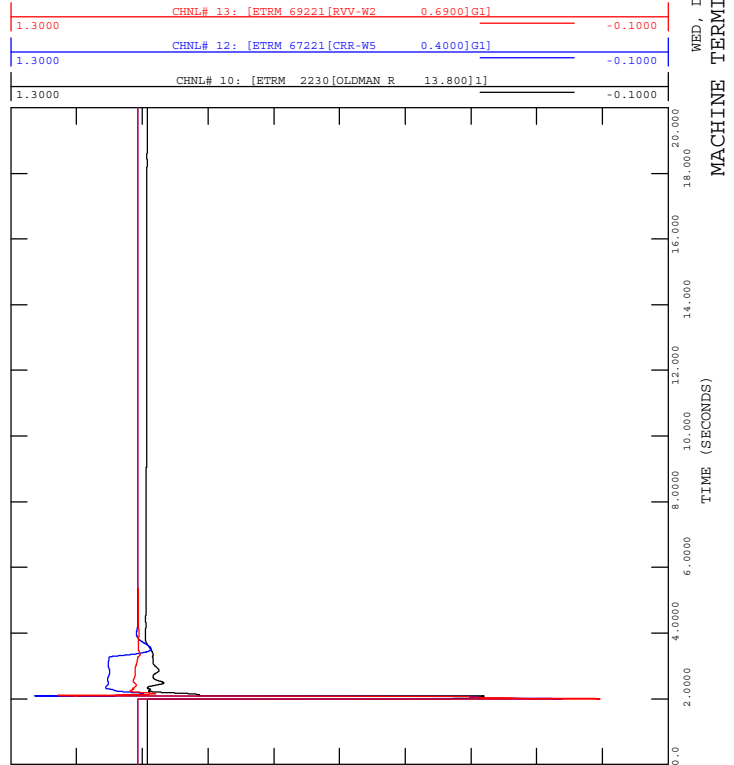


WED, DEC 27 2017 10:52  
MACHINE ANGLE (DEGREE)



FIGURE E-12C  
P524\_2019SL\_SC2\_POST  
3 PHASE FAULT ON 1071L AT 312S

FILE: E-12\_1071L (Fidler 312S ).out



WED, DEC 27 2017 10:52  
MACHINE TERMINAL VOLTAGE



FIGURE E-12F  
 P524\_2019SL\_SC2\_POST  
 3 PHASE FAULT ON 1071L AT 312S

FILE: E-12\_1071L (Fidler 312S ).out

WED, DEC 27 2017 10:52  
 BRANCH Q FLOW (PU)

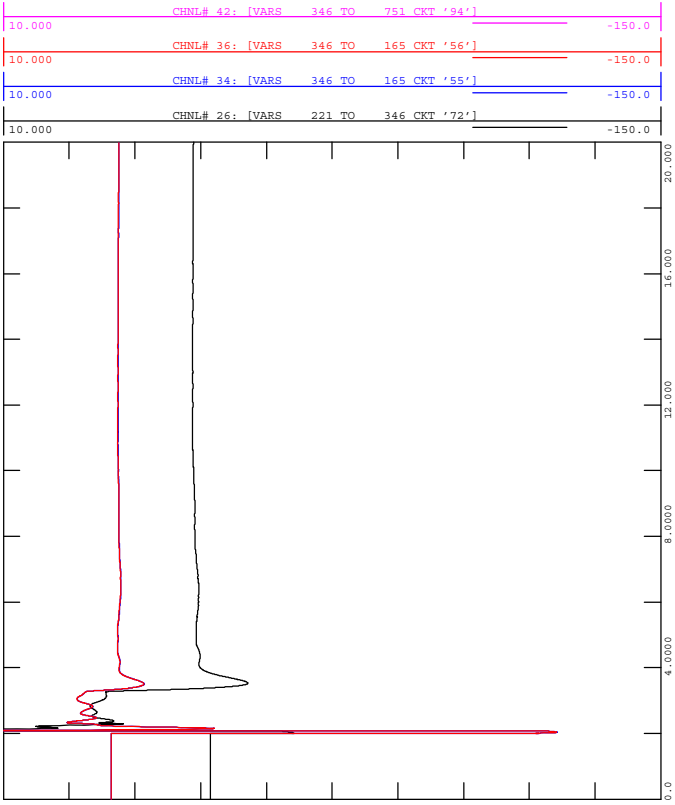


FIGURE E-12E  
 P524\_2019SL\_SC2\_POST  
 3 PHASE FAULT ON 1071L AT 312S

FILE: E-12\_1071L (Fidler 312S ).out

WED, DEC 27 2017 10:52  
 BRANCH P FLOW (PU)

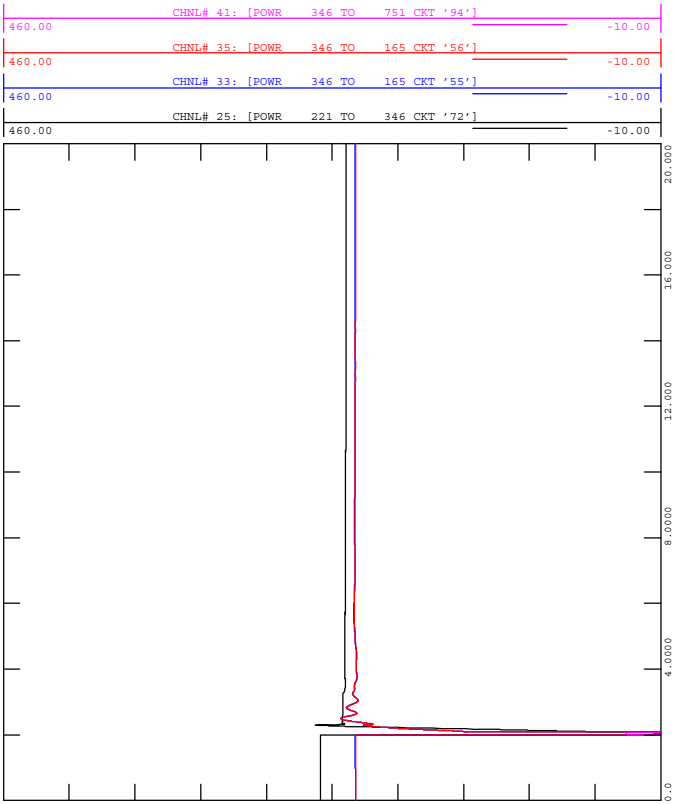
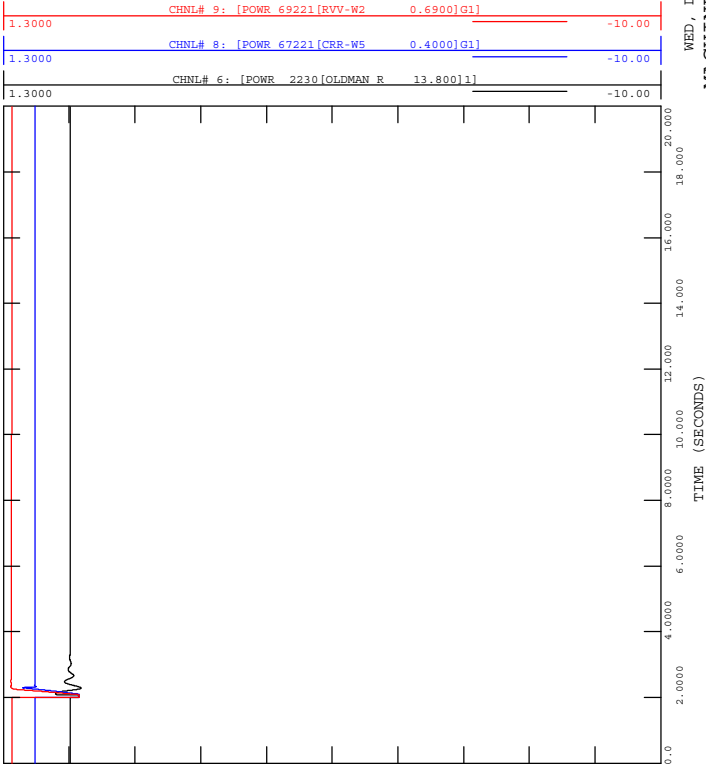






FIGURE E-13B  
P524\_2019SL\_SC2\_POST  
3 PHASE FAULT ON 1072L AT 103S

FILE: E-13\_1072L ( Goose lake 103S).out

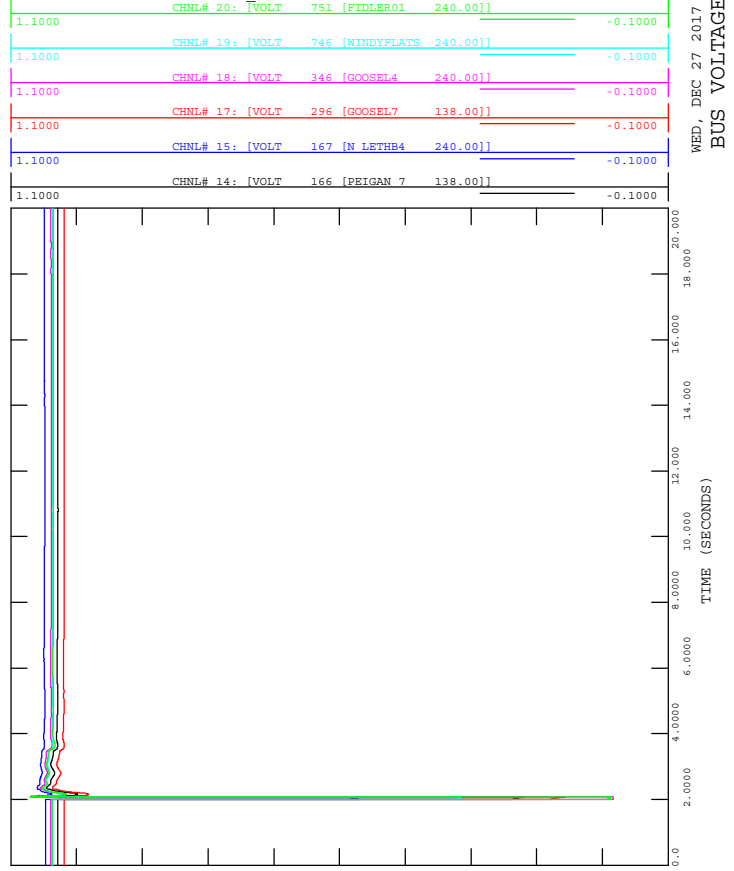


WED, DEC 27 2017 10:52  
MACHINE PELEC (PU)



FIGURE E-13D  
P524\_2019SL\_SC2\_POST  
3 PHASE FAULT ON 1072L AT 103S

FILE: E-13\_1072L ( Goose lake 103S).out

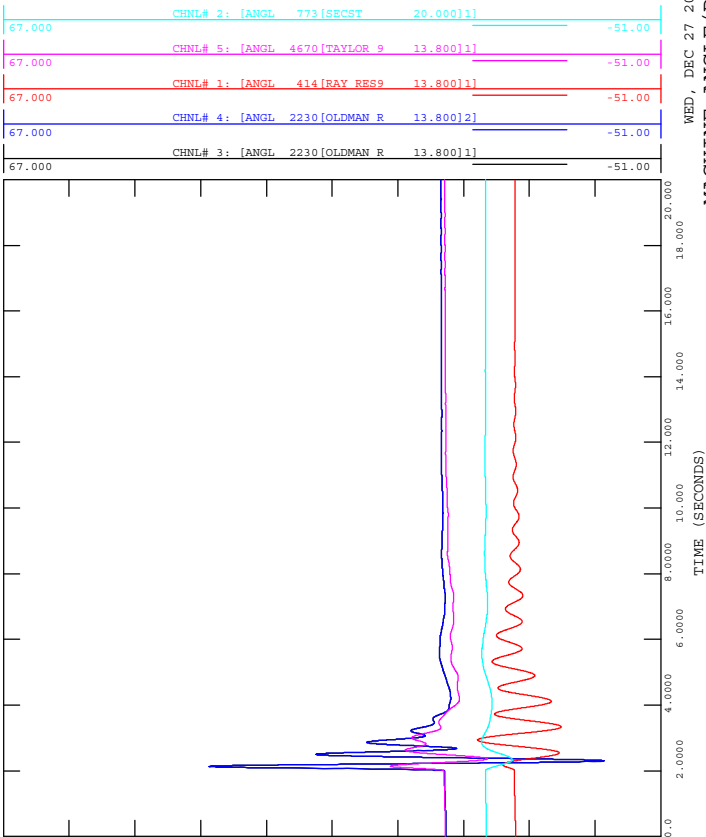


WED, DEC 27 2017 10:52  
BUS VOLTAGE (PU)



FIGURE E-13A  
P524\_2019SL\_SC2\_POST  
3 PHASE FAULT ON 1072L AT 103S

FILE: E-13\_1072L ( Goose lake 103S).out

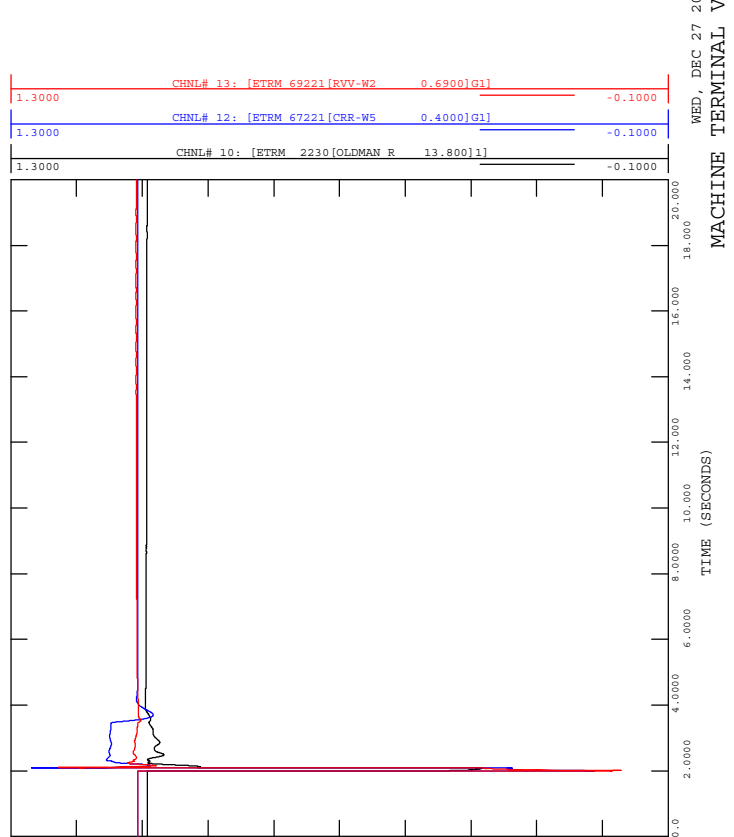


WED, DEC 27 2017 10:52  
MACHINE ANGLE (DEGREE)



FIGURE E-13C  
P524\_2019SL\_SC2\_POST  
3 PHASE FAULT ON 1072L AT 103S

FILE: E-13\_1072L ( Goose lake 103S).out

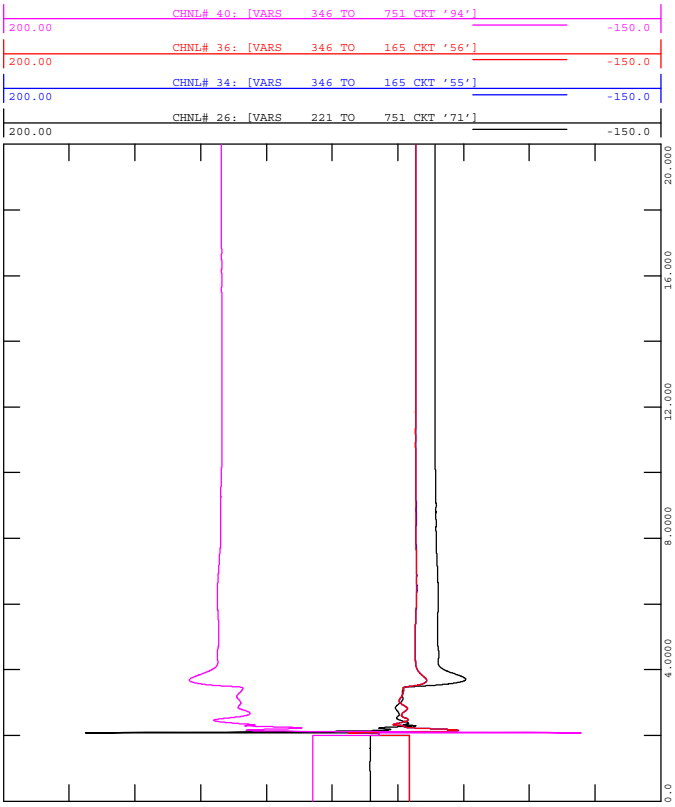


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MACHINE TERMINAL VOLTAGE



FIGURE E-13F  
 P524\_2019SL\_SC2\_POST  
 3 PHASE FAULT ON 1072L AT 103S

FILE: E-13\_1072L ( Goose lake 103S).out

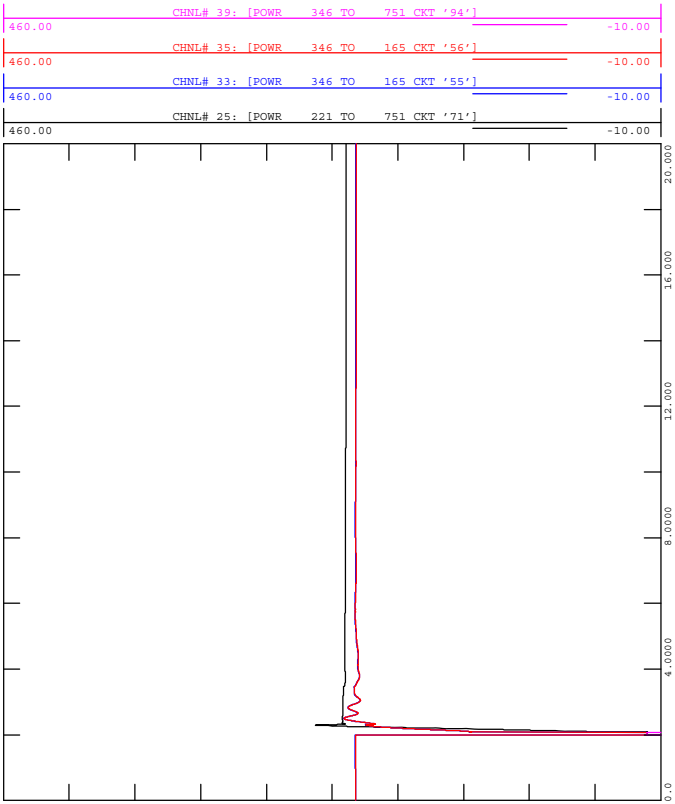


WED, DEC 27 2017 10:52  
 BRANCH Q FLOW (PU)



FIGURE E-13E  
 P524\_2019SL\_SC2\_POST  
 3 PHASE FAULT ON 1072L AT 103S

FILE: E-13\_1072L ( Goose lake 103S).out

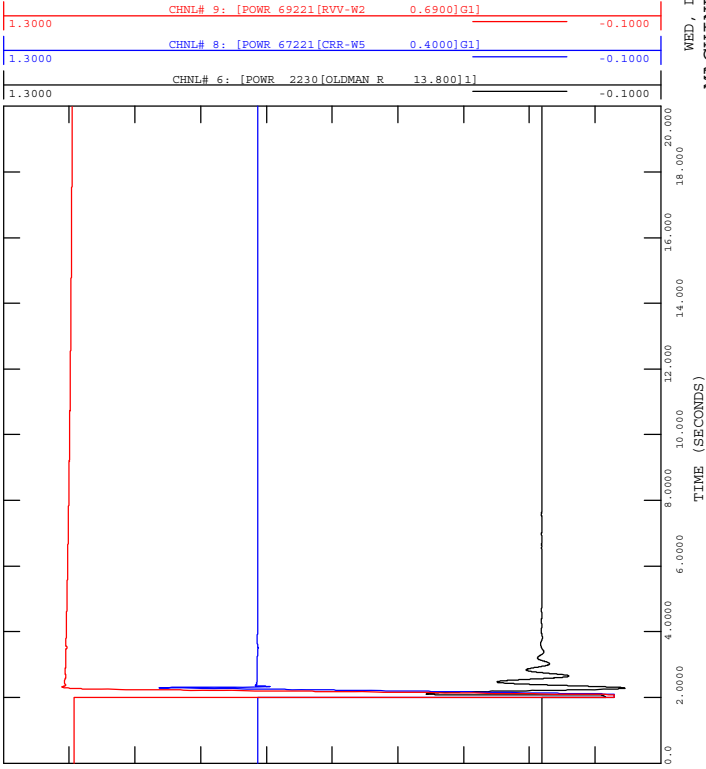


WED, DEC 27 2017 10:52  
 BRANCH P FLOW (PU)



FIGURE E-14B  
P524\_2019SL\_SC2\_POST  
3 PHASE FAULT ON 1072L AT 205S

FILE: E-14\_1072L (Castle Rock Ridge 205S ).out

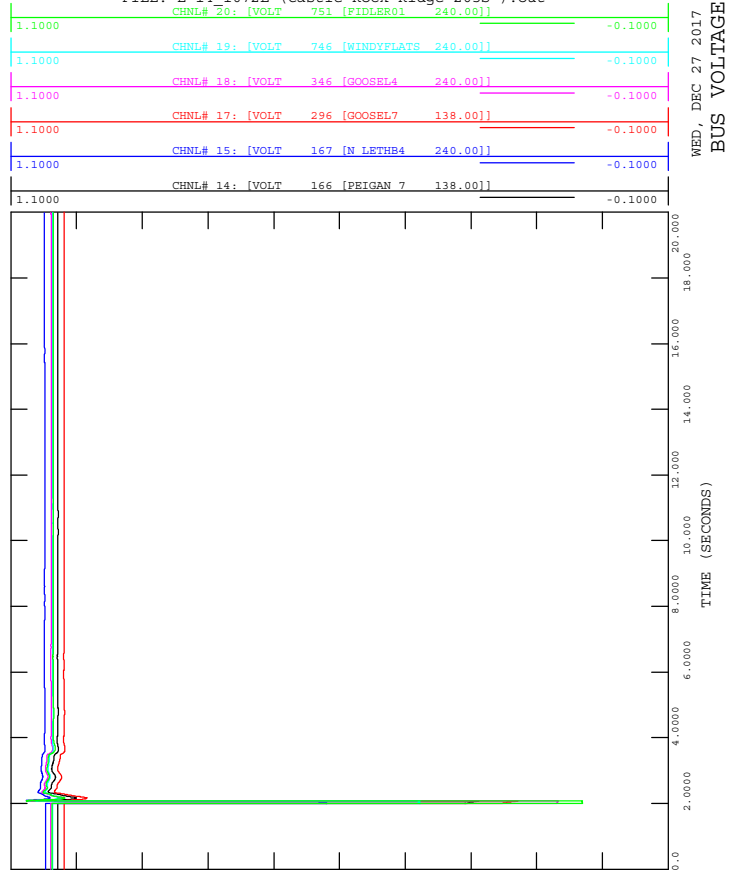


WED, DEC 27 2017 10:52  
MACHINE PELEC (PU)



FIGURE E-14D  
P524\_2019SL\_SC2\_POST  
3 PHASE FAULT ON 1072L AT 205S

FILE: E-14\_1072L (Castle Rock Ridge 205S ).out

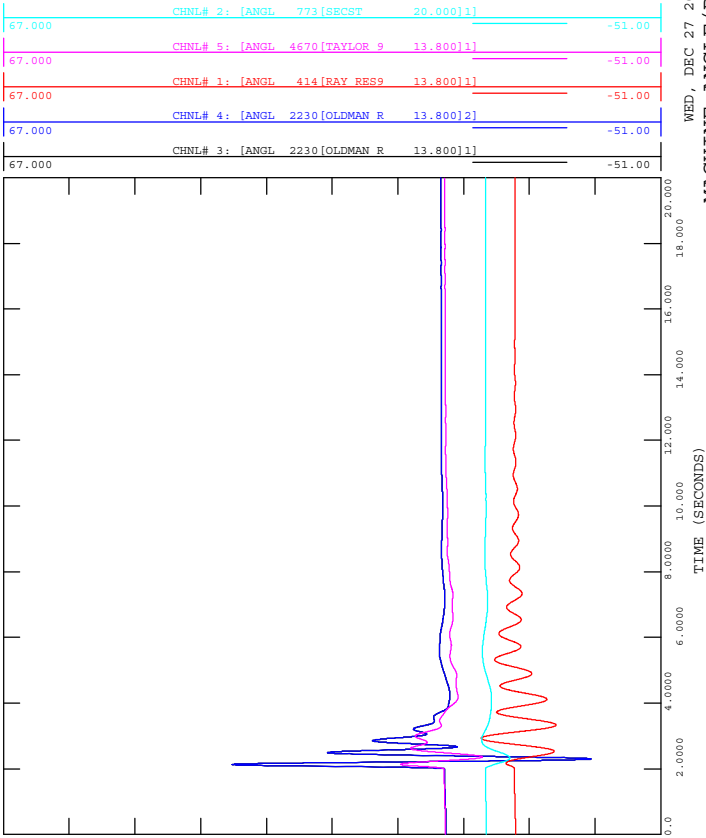


WED, DEC 27 2017 10:52  
BUS VOLTAGE (PU)



FIGURE E-14A  
P524\_2019SL\_SC2\_POST  
3 PHASE FAULT ON 1072L AT 205S

FILE: E-14\_1072L (Castle Rock Ridge 205S ).out

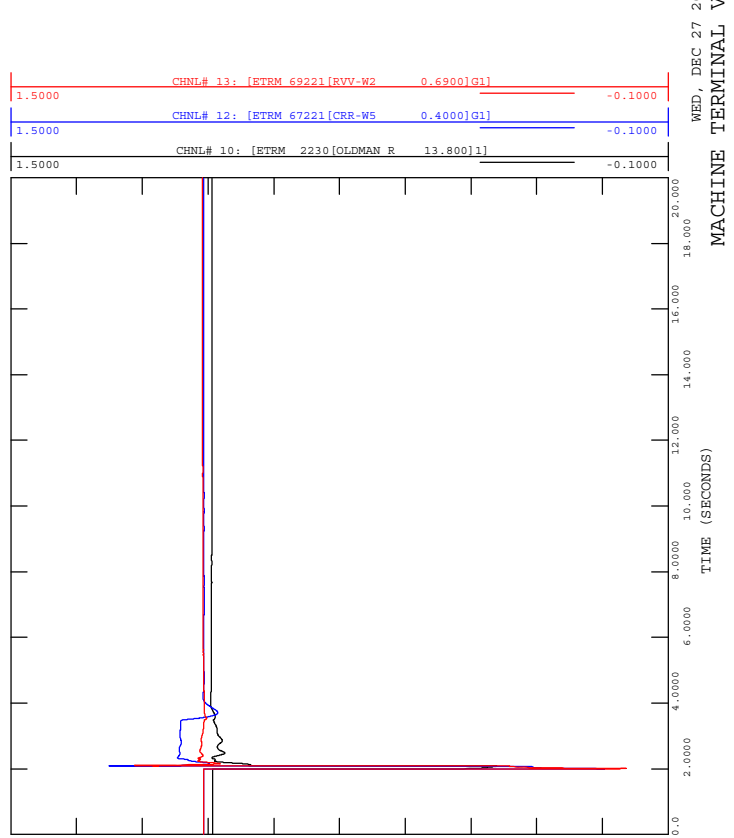


WED, DEC 27 2017 10:52  
MACHINE ANGLE (DEGREE)



FIGURE E-14C  
P524\_2019SL\_SC2\_POST  
3 PHASE FAULT ON 1072L AT 205S

FILE: E-14\_1072L (Castle Rock Ridge 205S ).out



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MACHINE TERMINAL VOLTAGE



FIGURE E-14F  
 P524\_2019SL\_SC2\_POST  
 3 PHASE FAULT ON 1072L AT 205S

FILE: E-14\_1072L (Castle Rock Ridge 205S ).out

WED, DEC 27 2017 10:52  
 BRANCH Q FLOW (PU)

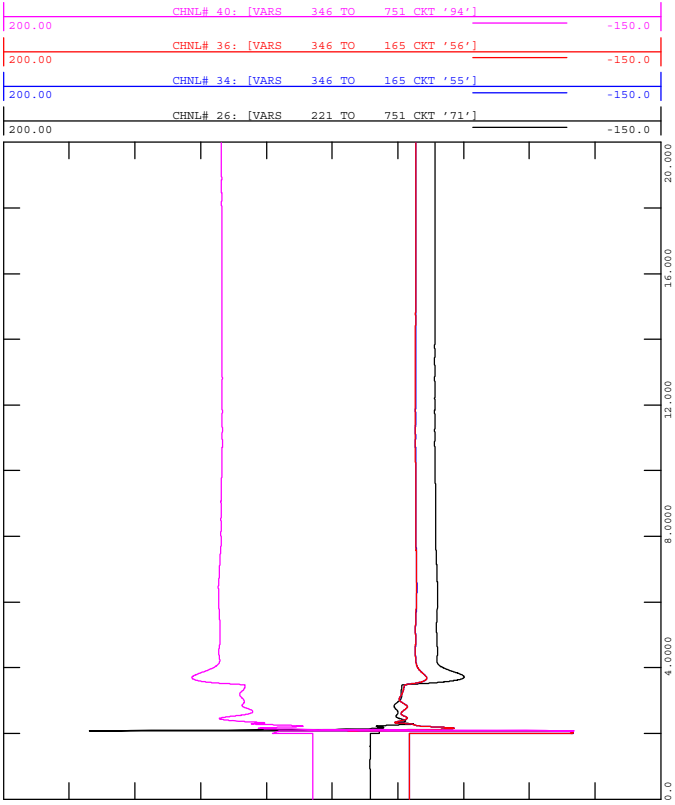


FIGURE E-14E  
 P524\_2019SL\_SC2\_POST  
 3 PHASE FAULT ON 1072L AT 205S

FILE: E-14\_1072L (Castle Rock Ridge 205S ).out

WED, DEC 27 2017 10:52  
 BRANCH P FLOW (PU)

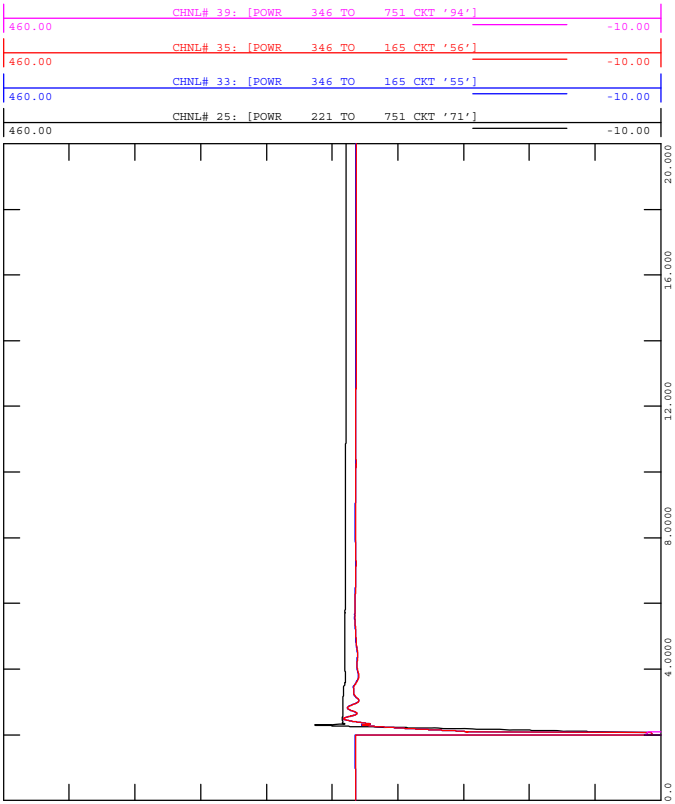
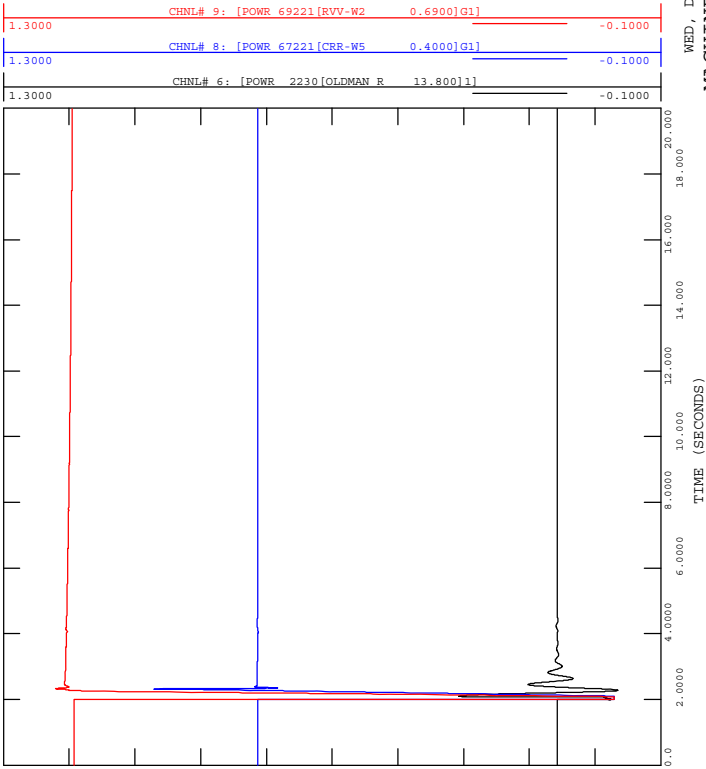




FIGURE E-15B  
P524\_2019SP\_SC4\_POST  
3 PHASE FAULT ON 955L AT 59S

FILE: E-15\_955L ( Peigan 59S).out

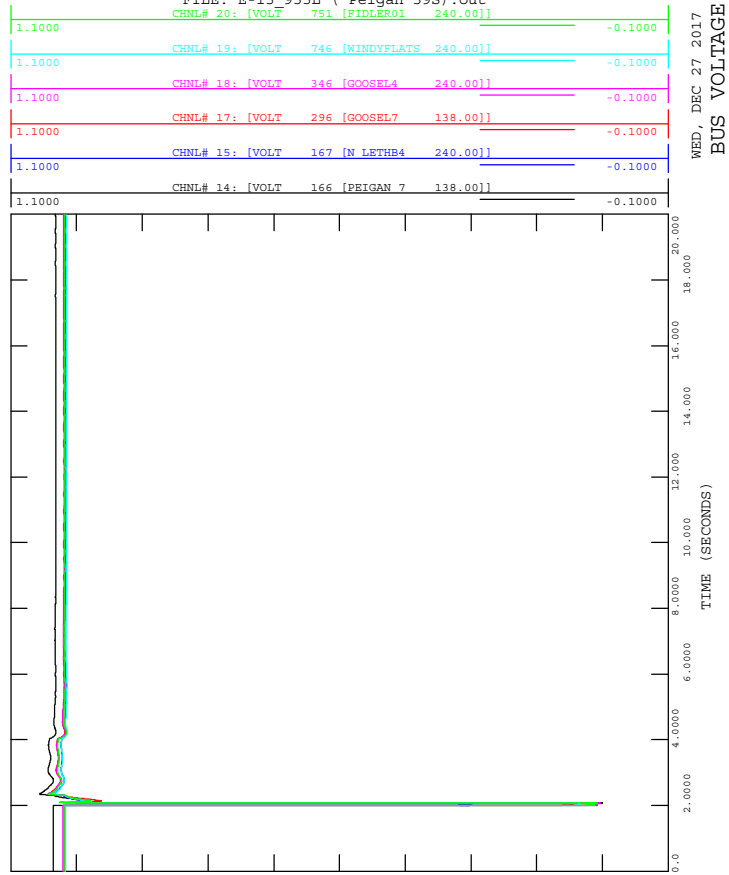


WED, DEC 27 2017 10:52  
MACHINE PELEC (PU)



FIGURE E-15D  
P524\_2019SP\_SC4\_POST  
3 PHASE FAULT ON 955L AT 59S

FILE: E-15\_955L ( Peigan 59S).out

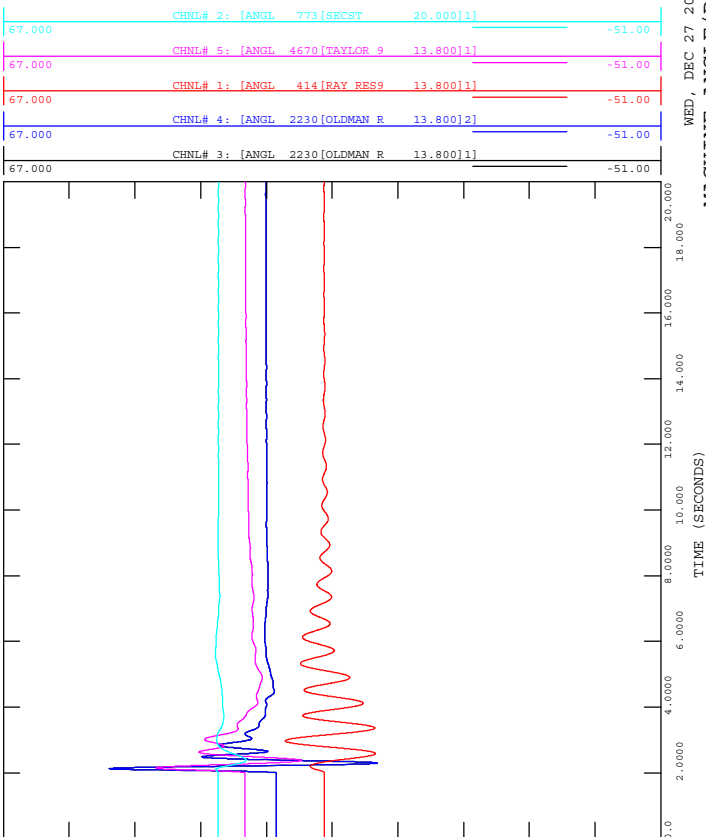


WED, DEC 27 2017 10:52  
BUS VOLTAGE (PU)



FIGURE E-15A  
P524\_2019SP\_SC4\_POST  
3 PHASE FAULT ON 955L AT 59S

FILE: E-15\_955L ( Peigan 59S).out

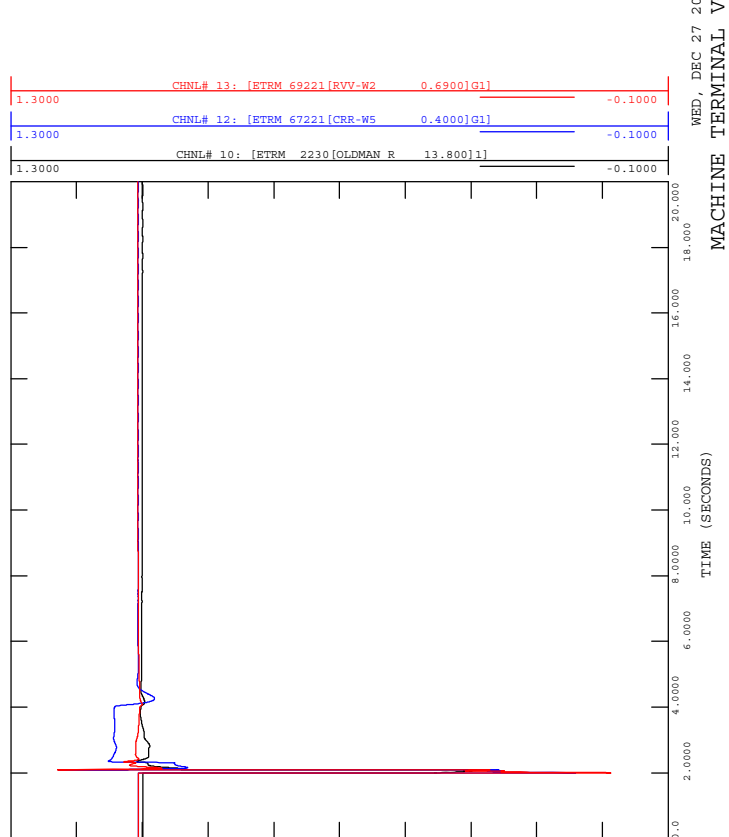


WED, DEC 27 2017 10:52  
MACHINE ANGLE (DEGREE)



FIGURE E-15C  
P524\_2019SP\_SC4\_POST  
3 PHASE FAULT ON 955L AT 59S

FILE: E-15\_955L ( Peigan 59S).out



WED, DEC 27 2017 10:52  
MACHINE TERMINAL VOLTAGE



FIGURE E-15F  
 P524\_2019SP\_SC4\_POST  
 3 PHASE FAULT ON 955L AT 59S

FILE: E-15\_955L ( Peigan 59S).out

WED, DEC 27 2017 10:52  
 BRANCH Q FLOW (PU)

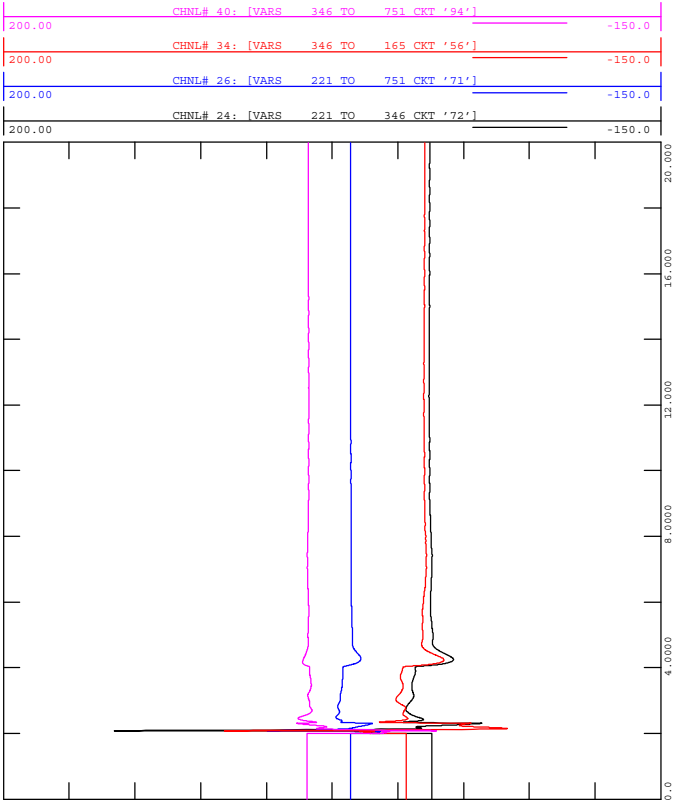


FIGURE E-15E  
 P524\_2019SP\_SC4\_POST  
 3 PHASE FAULT ON 955L AT 59S

FILE: E-15\_955L ( Peigan 59S).out

WED, DEC 27 2017 10:52  
 BRANCH P FLOW (PU)

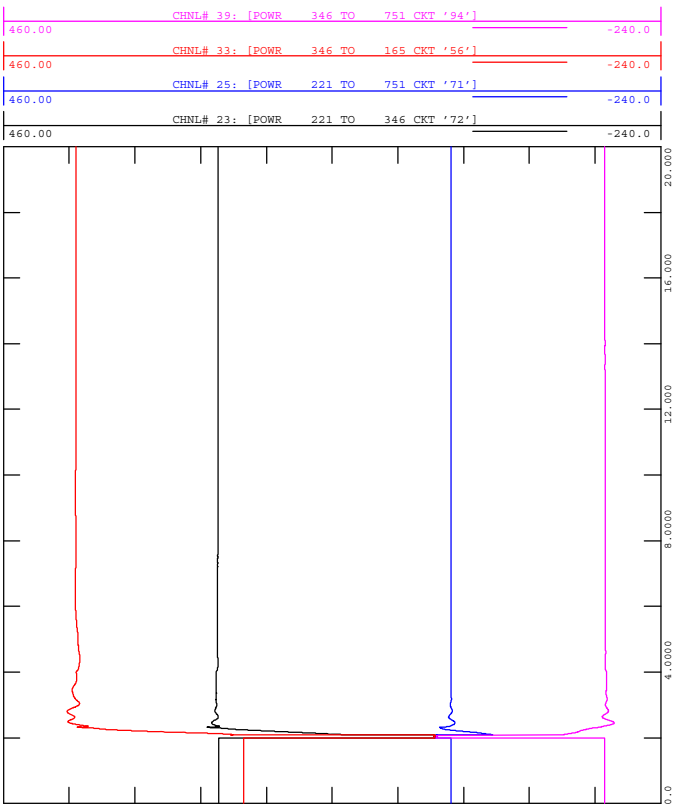
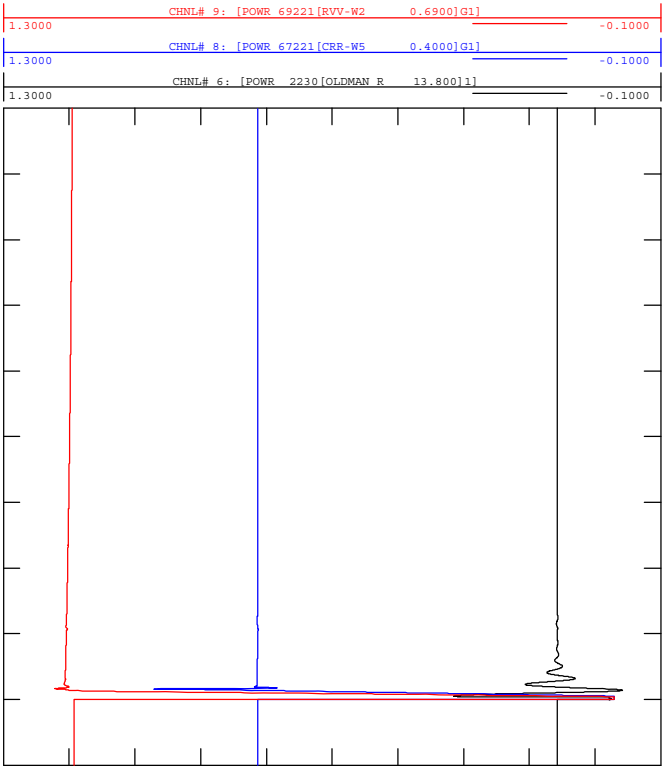




FIGURE E-16B  
P524\_2019SP\_SC4\_POST  
3 PHASE FAULT ON 955L AT 103S

FILE: E-16\_955L (Goose Lake 103S ).out

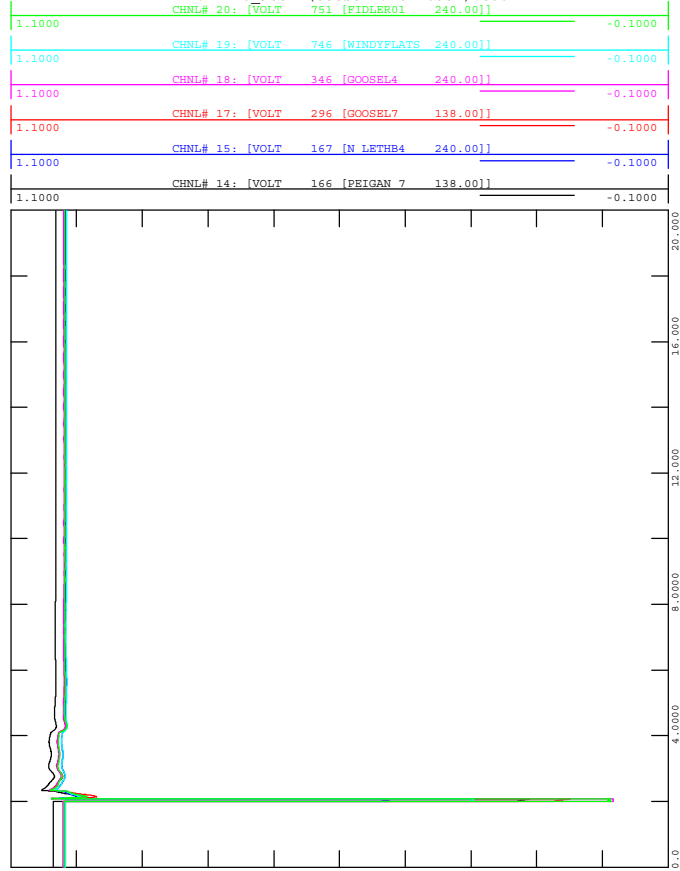


WED, DEC 27 2017 10:52  
MACHINE PELEC (PU)



FIGURE E-16D  
P524\_2019SP\_SC4\_POST  
3 PHASE FAULT ON 955L AT 103S

FILE: E-16\_955L (Goose Lake 103S ).out

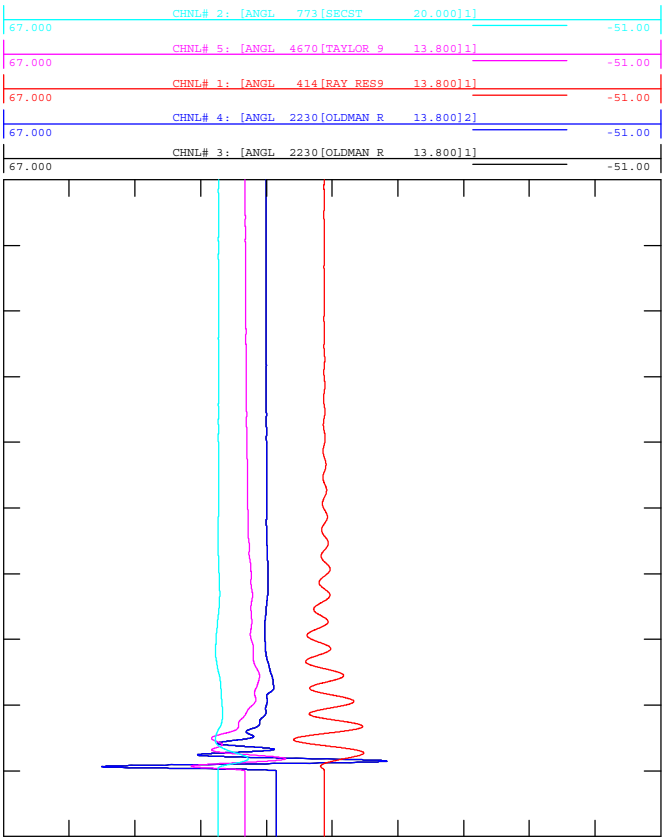


WED, DEC 27 2017 10:52  
BUS VOLTAGE (PU)



FIGURE E-16A  
P524\_2019SP\_SC4\_POST  
3 PHASE FAULT ON 955L AT 103S

FILE: E-16\_955L (Goose Lake 103S ).out

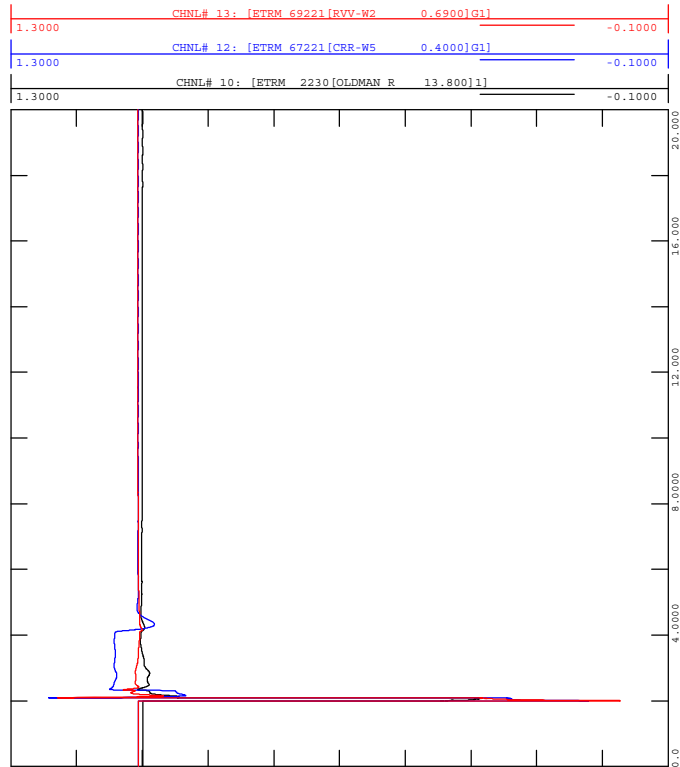


WED, DEC 27 2017 10:52  
MACHINE ANGLE (DEGREE)



FIGURE E-16C  
P524\_2019SP\_SC4\_POST  
3 PHASE FAULT ON 955L AT 103S

FILE: E-16\_955L (Goose Lake 103S ).out



WED, DEC 27 2017 10:52  
MACHINE TERMINAL VOLTAGE



FIGURE E-16F  
 P524\_2019SP\_SC4\_POST  
 3 PHASE FAULT ON 955L AT 103S

FILE: E-16\_955L (Goose Lake 103S ).out

WED, DEC 27 2017 10:52  
 BRANCH Q FLOW (PU)

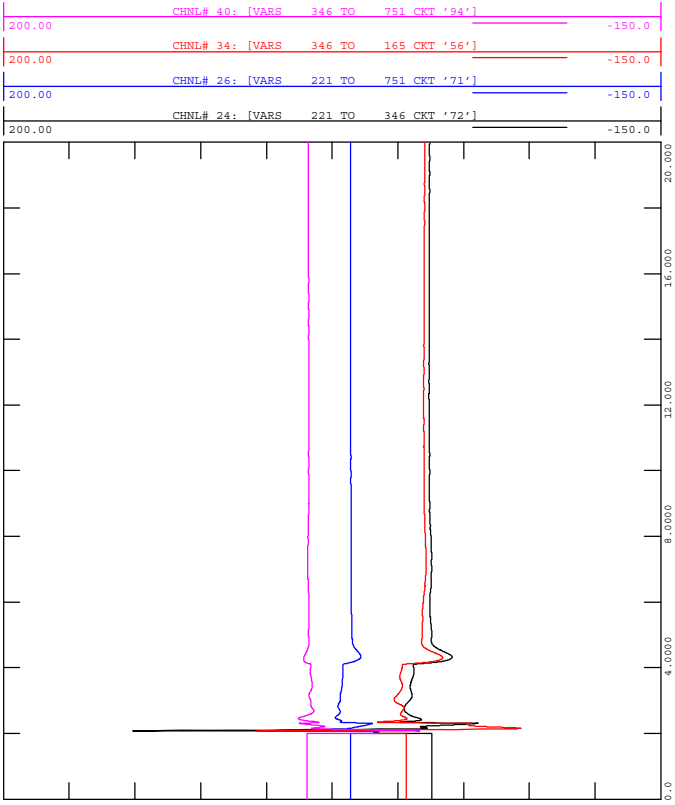


FIGURE E-16E  
 P524\_2019SP\_SC4\_POST  
 3 PHASE FAULT ON 955L AT 103S

FILE: E-16\_955L (Goose Lake 103S ).out

WED, DEC 27 2017 10:52  
 BRANCH P FLOW (PU)

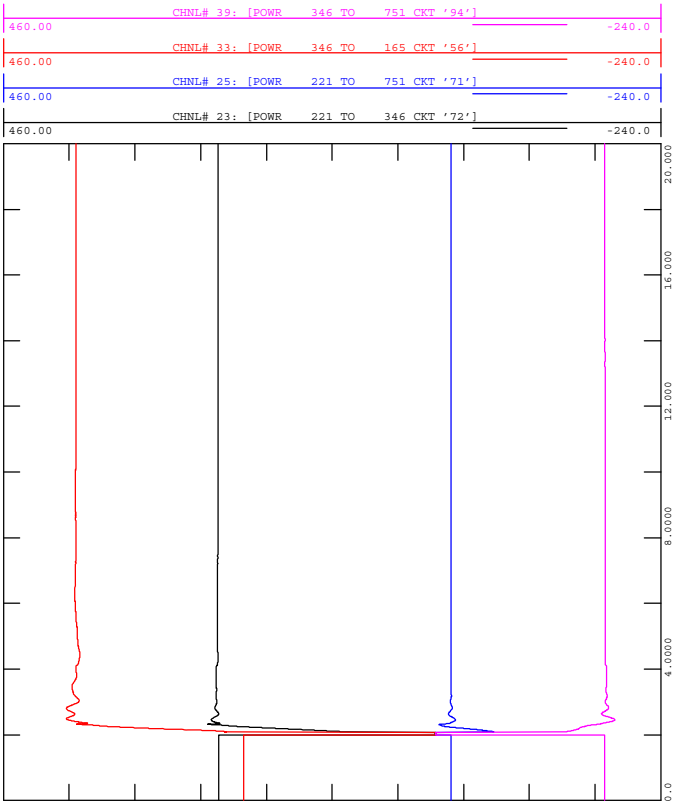
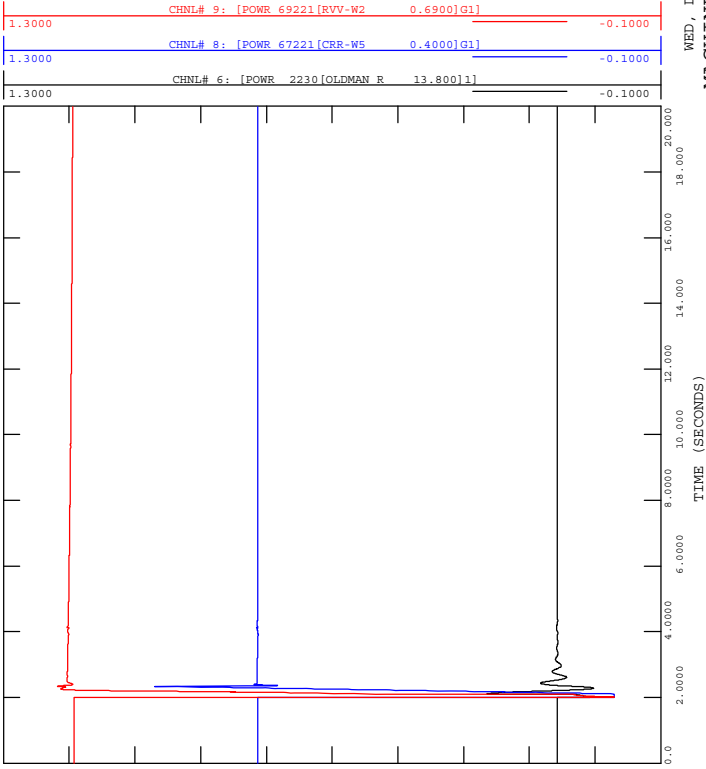






FIGURE E-17B  
P524\_2019SP\_SC4\_POST  
3 PHASE FAULT ON 967L AT 370S

FILE: E-17\_967L ( North Lethbridge 370S).out

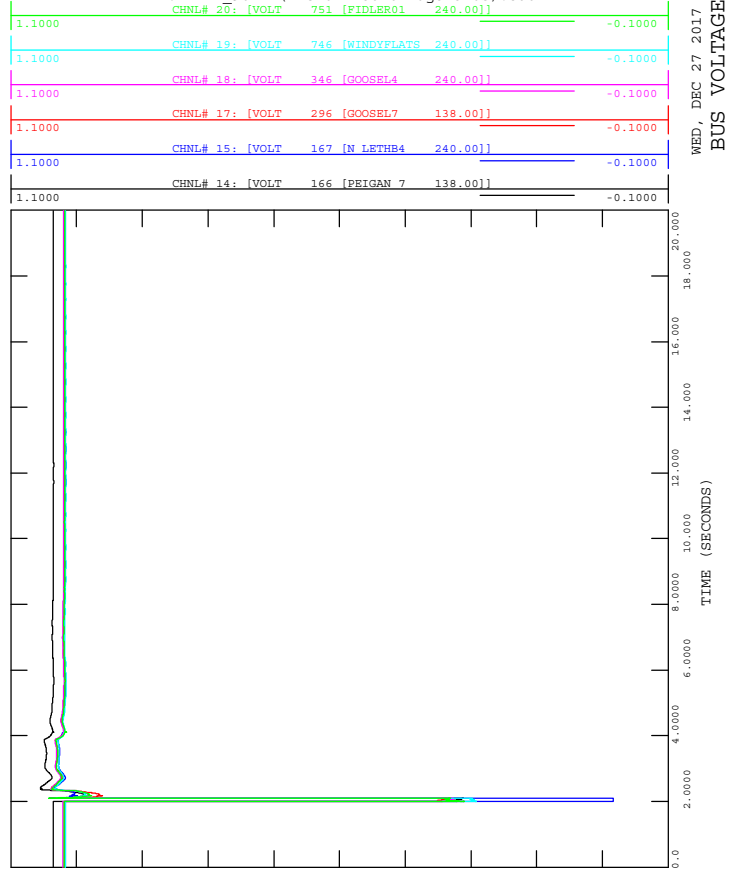


WED, DEC 27 2017 10:52  
MACHINE PELEC (PU)



FIGURE E-17D  
P524\_2019SP\_SC4\_POST  
3 PHASE FAULT ON 967L AT 370S

FILE: E-17\_967L ( North Lethbridge 370S).out

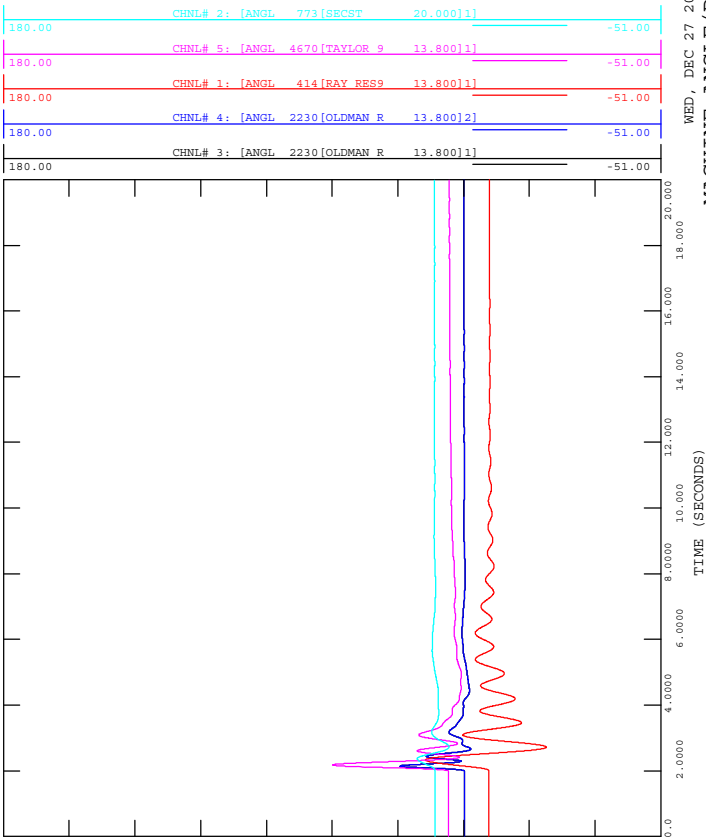


WED, DEC 27 2017 10:52  
BUS VOLTAGE (PU)



FIGURE E-17A  
P524\_2019SP\_SC4\_POST  
3 PHASE FAULT ON 967L AT 370S

FILE: E-17\_967L ( North Lethbridge 370S).out

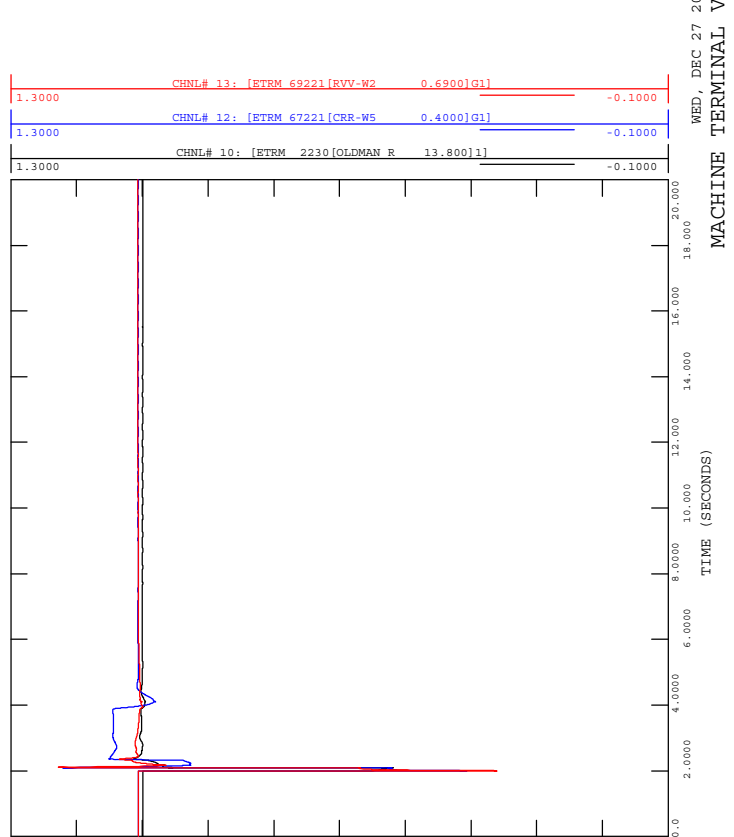


WED, DEC 27 2017 10:52  
MACHINE ANGLE (DEGREE)



FIGURE E-17C  
P524\_2019SP\_SC4\_POST  
3 PHASE FAULT ON 967L AT 370S

FILE: E-17\_967L ( North Lethbridge 370S).out

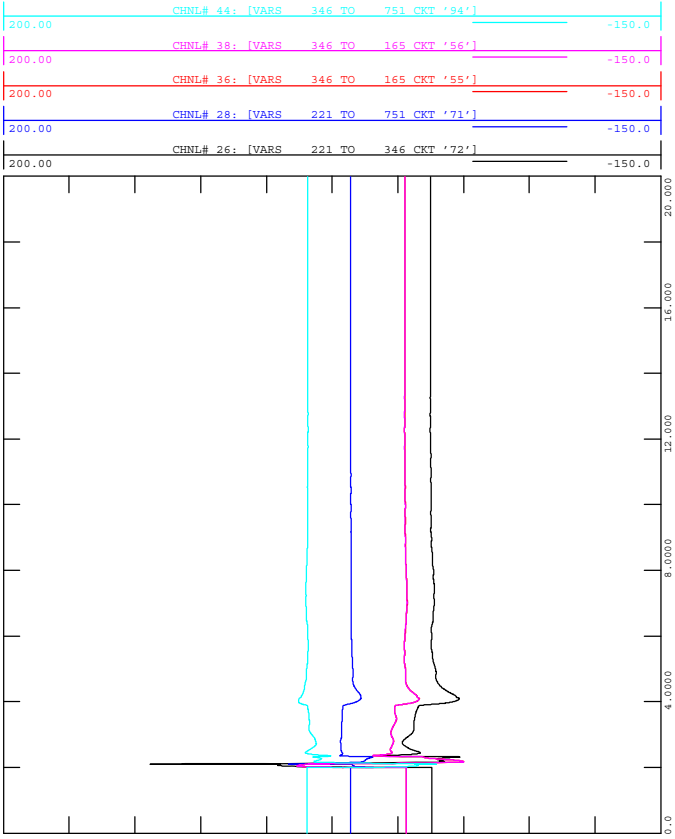


WED, DEC 27 2017 10:52  
MACHINE TERMINAL VOLTAGE



FIGURE E-17F  
 P524\_2019SP\_SC4\_POST  
 3 PHASE FAULT ON 967L AT 370S

FILE: E-17\_967L ( North Lethbridge 370S).out

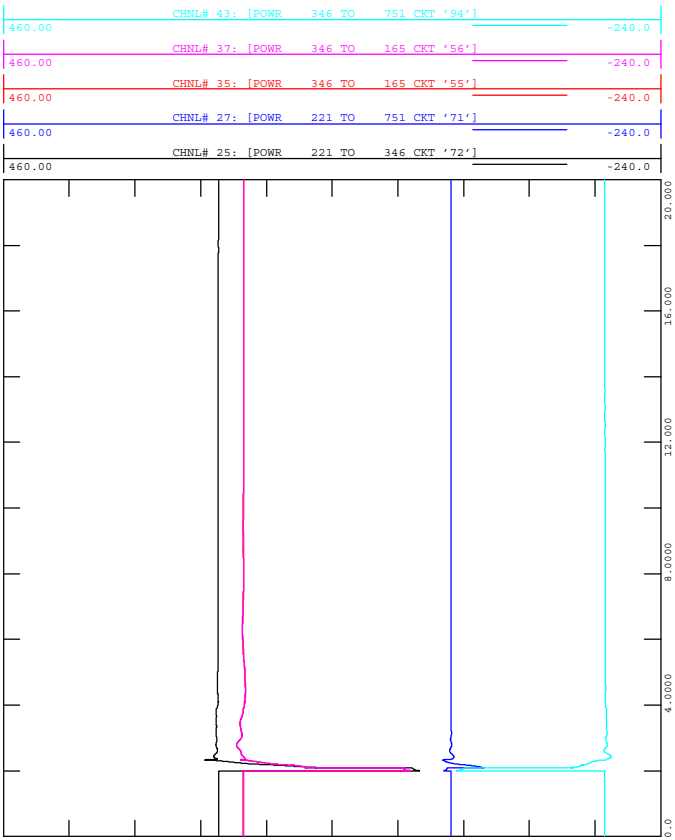


WED, DEC 27 2017 10:52  
 BRANCH Q FLOW (PU)



FIGURE E-17E  
 P524\_2019SP\_SC4\_POST  
 3 PHASE FAULT ON 967L AT 370S

FILE: E-17\_967L ( North Lethbridge 370S).out

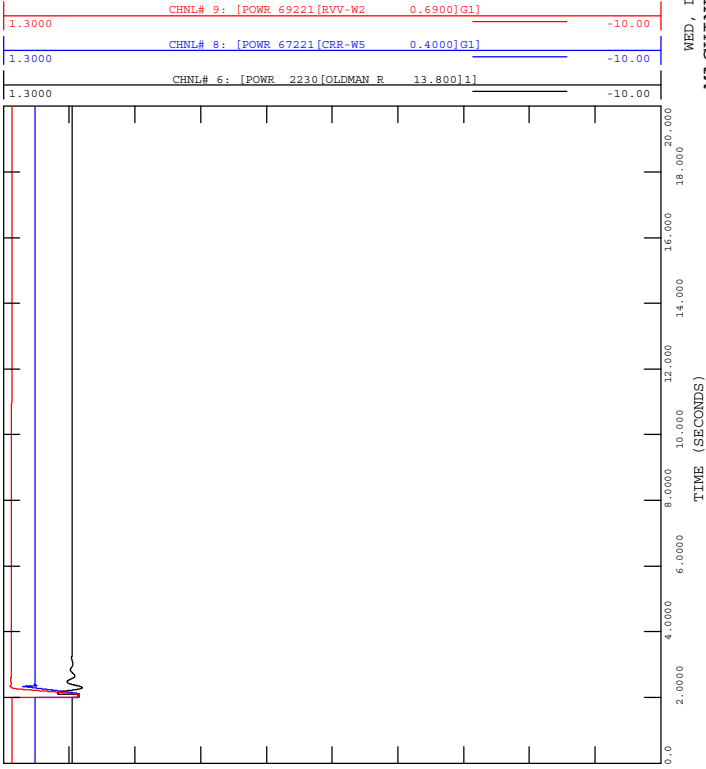


WED, DEC 27 2017 10:52  
 BRANCH P FLOW (PU)



FIGURE E-18B  
P524\_2019SP\_SC4\_POST  
3 PHASE FAULT ON 967L AT 138S

FILE: E-18\_967L ( Windy Flat 138S).out

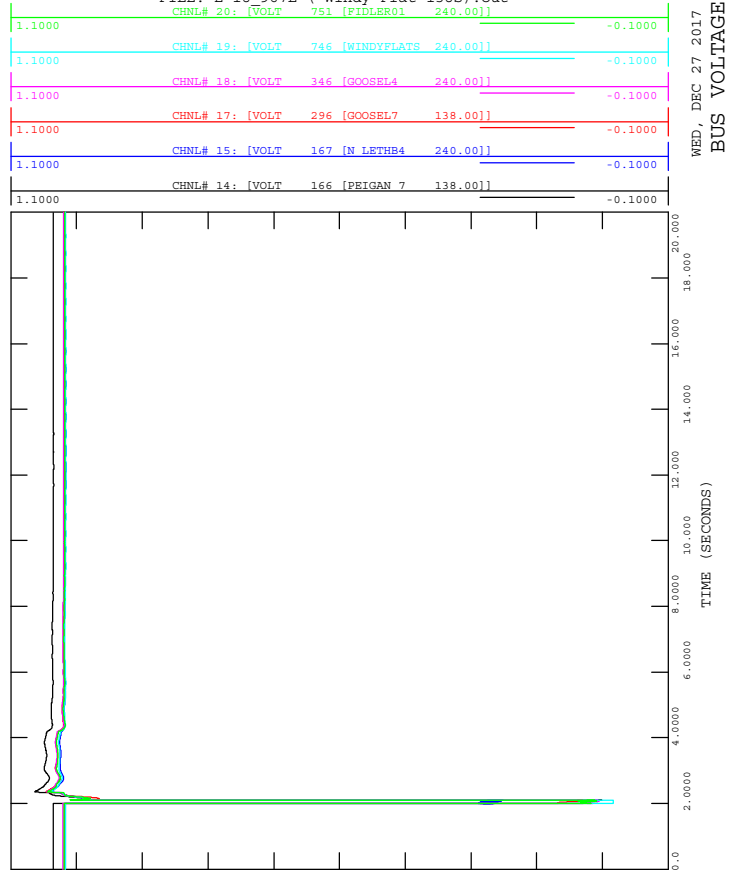


WED, DEC 27 2017 10:52  
MACHINE PELEC (PU)



FIGURE E-18D  
P524\_2019SP\_SC4\_POST  
3 PHASE FAULT ON 967L AT 138S

FILE: E-18\_967L ( Windy Flat 138S).out

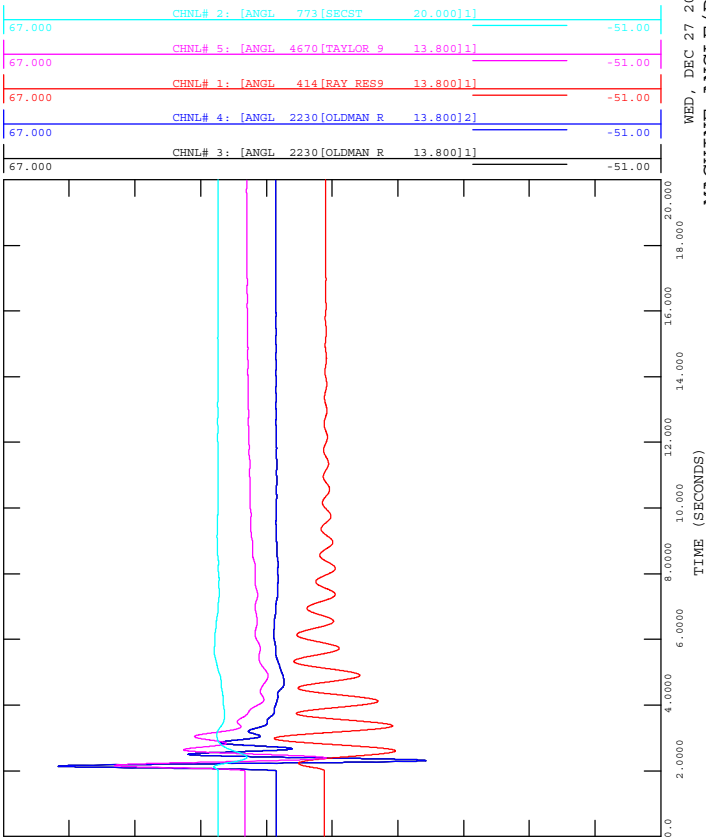


WED, DEC 27 2017 10:52  
BUS VOLTAGE (PU)



FIGURE E-18A  
P524\_2019SP\_SC4\_POST  
3 PHASE FAULT ON 967L AT 138S

FILE: E-18\_967L ( Windy Flat 138S).out

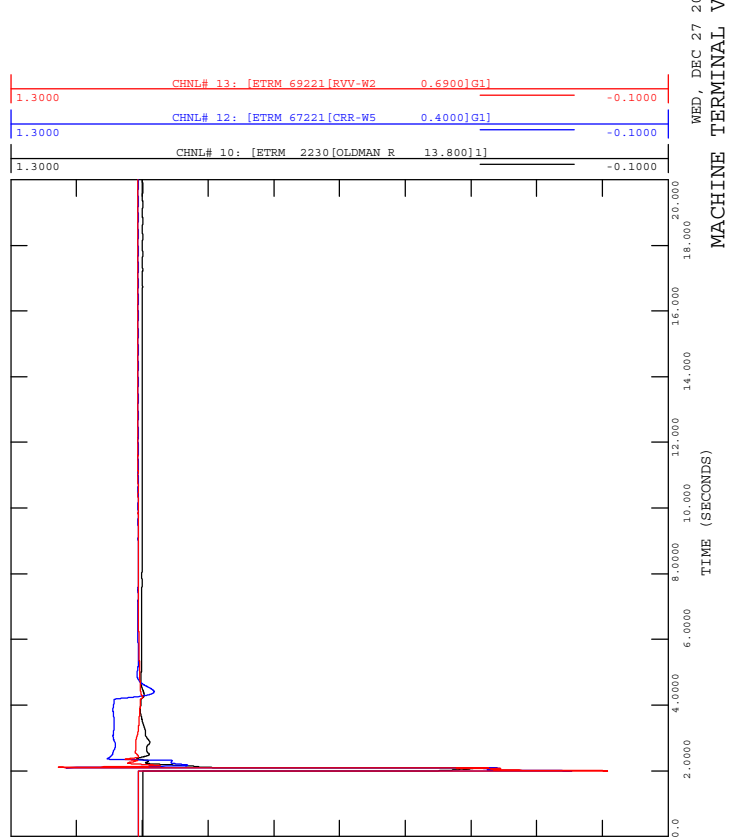


WED, DEC 27 2017 10:52  
MACHINE ANGLE (DEGREE)



FIGURE E-18C  
P524\_2019SP\_SC4\_POST  
3 PHASE FAULT ON 967L AT 138S

FILE: E-18\_967L ( Windy Flat 138S).out

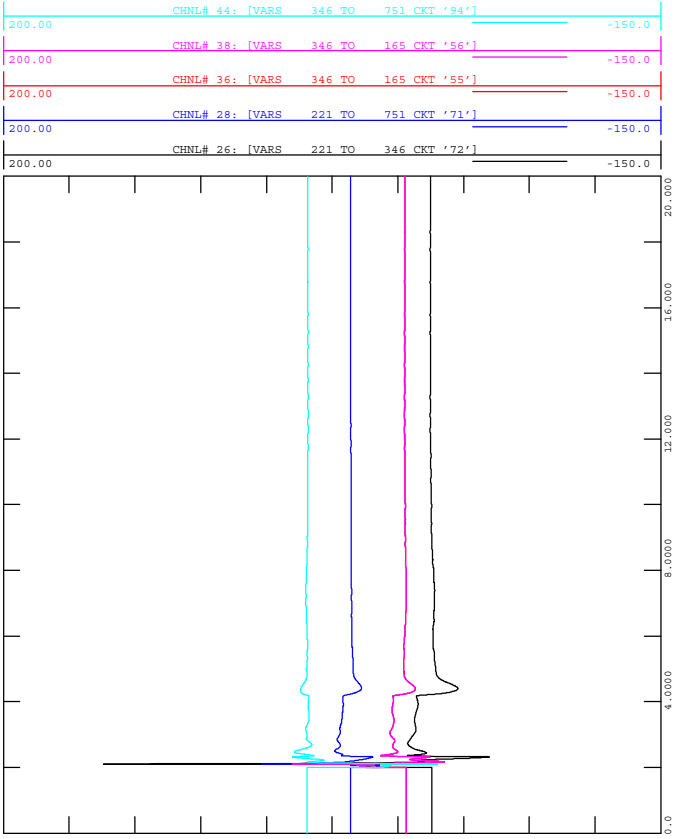


WED, DEC 27 2017 10:52  
MACHINE TERMINAL VOLTAGE



FIGURE E-18F  
 P524\_2019SP\_SC4\_POST  
 3 PHASE FAULT ON 967L AT 138S

FILE: E-18\_967L ( Windy Flat 138S).out

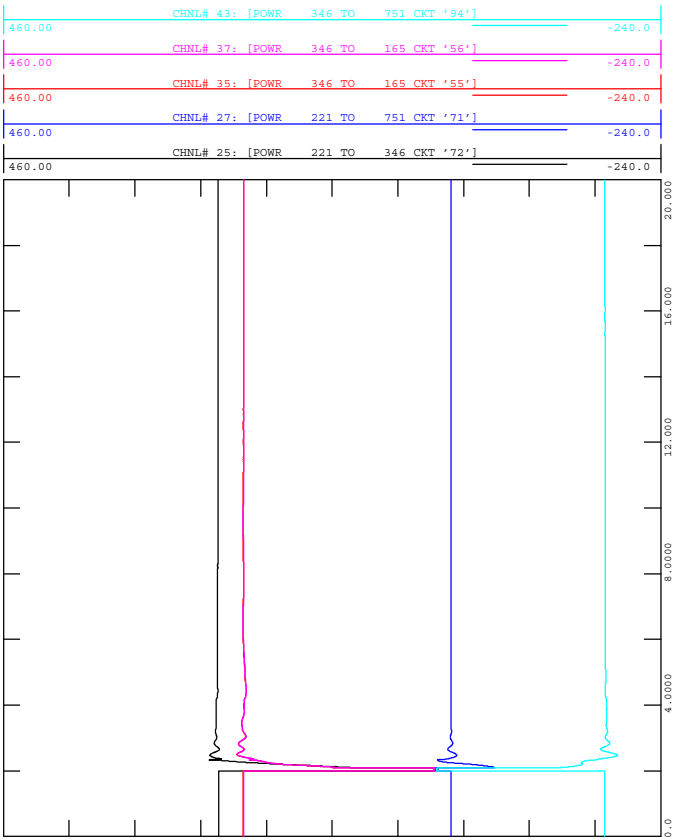


WED, DEC 27 2017 10:52  
 BRANCH Q FLOW (PU)



FIGURE E-18E  
 P524\_2019SP\_SC4\_POST  
 3 PHASE FAULT ON 967L AT 138S

FILE: E-18\_967L ( Windy Flat 138S).out

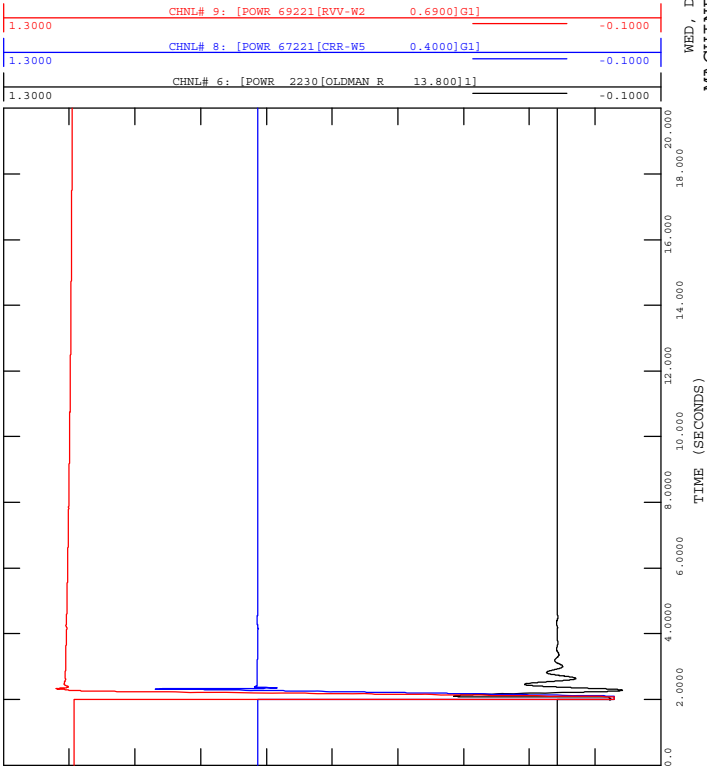


WED, DEC 27 2017 10:52  
 BRANCH P FLOW (PU)



FIGURE E-19B  
P524\_2019SP\_SC4\_POST  
3 PHASE FAULT ON 994L AT 103S

FILE: E-19\_994L ( GoosLake 103S).out

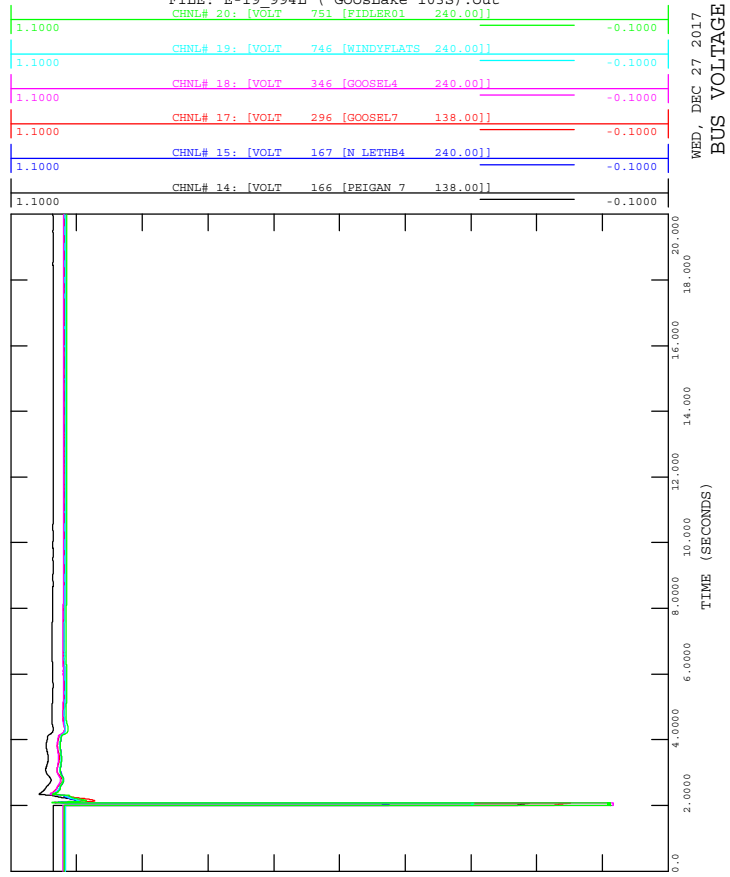


WED, DEC 27 2017 10:52  
MACHINE PELEC (PU)



FIGURE E-19D  
P524\_2019SP\_SC4\_POST  
3 PHASE FAULT ON 994L AT 103S

FILE: E-19\_994L ( GoosLake 103S).out

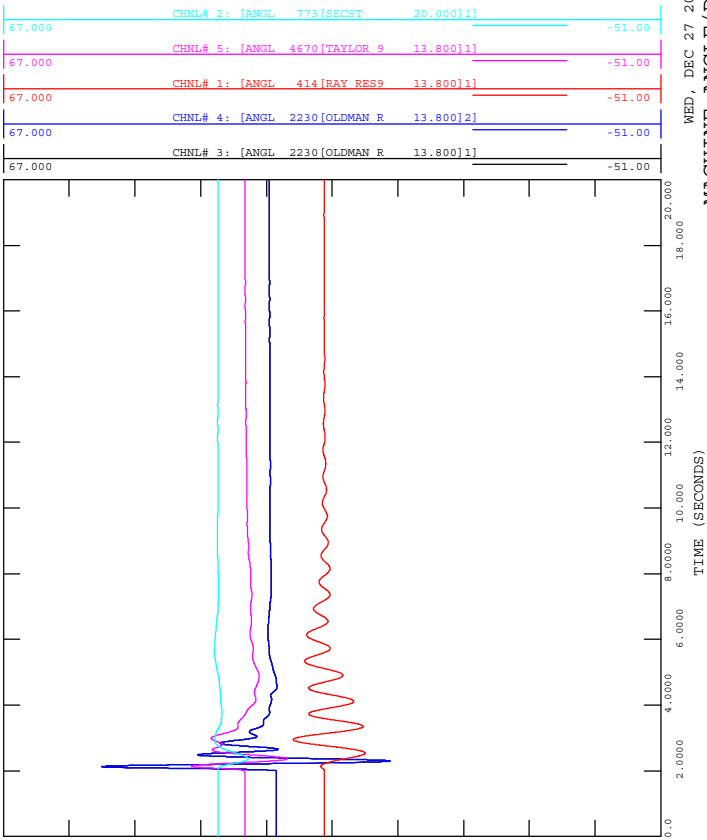


WED, DEC 27 2017 10:52  
BUS VOLTAGE (PU)



FIGURE E-19A  
P524\_2019SP\_SC4\_POST  
3 PHASE FAULT ON 994L AT 103S

FILE: E-19\_994L ( GoosLake 103S).out

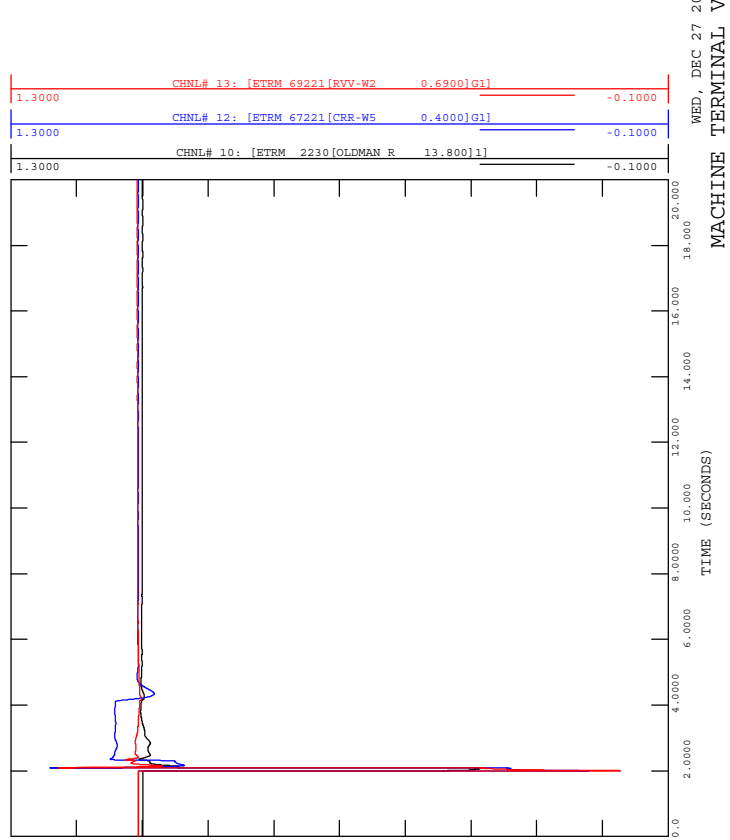


WED, DEC 27 2017 10:52  
MACHINE ANGLE (DEGREE)



FIGURE E-19C  
P524\_2019SP\_SC4\_POST  
3 PHASE FAULT ON 994L AT 103S

FILE: E-19\_994L ( GoosLake 103S).out



WED, DEC 27 2017 10:52  
MACHINE TERMINAL VOLTAGE



FIGURE E-19F  
 P524\_2019SP\_SC4\_POST  
 3 PHASE FAULT ON 994L AT 103S

FILE: E-19\_994L ( GoosLake 103S).out

WED, DEC 27 2017 10:52  
 BRANCH Q FLOW (PU)

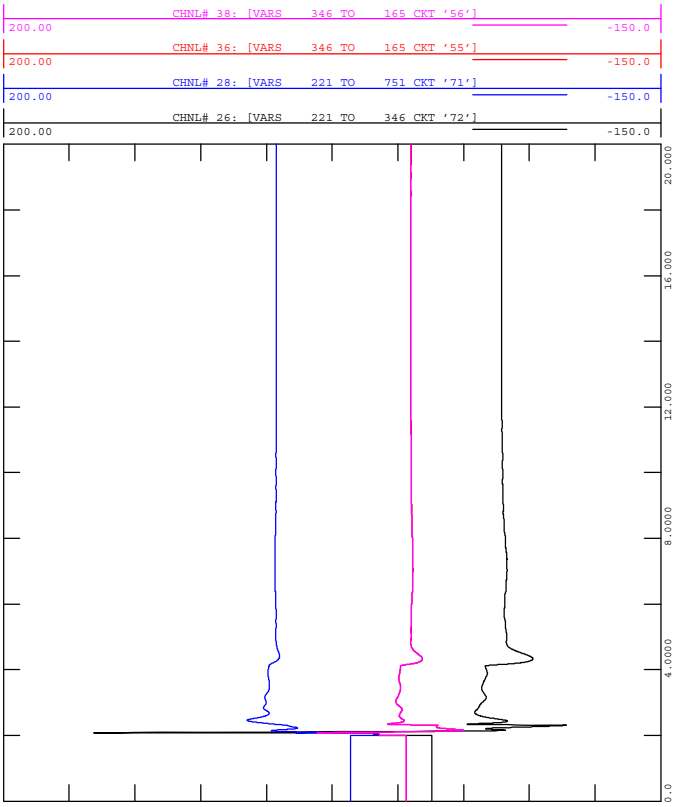


FIGURE E-19E  
 P524\_2019SP\_SC4\_POST  
 3 PHASE FAULT ON 994L AT 103S

FILE: E-19\_994L ( GoosLake 103S).out

WED, DEC 27 2017 10:52  
 BRANCH P FLOW (PU)

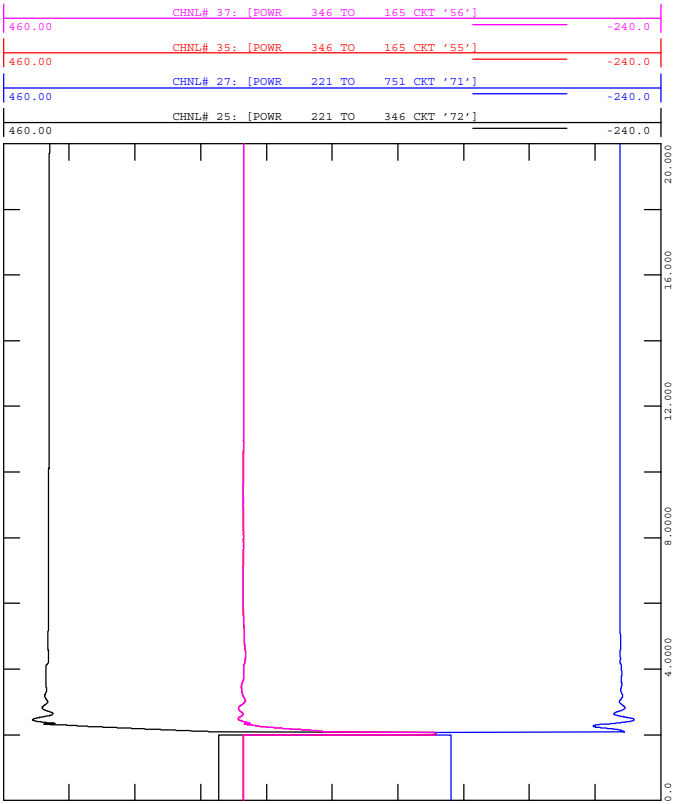
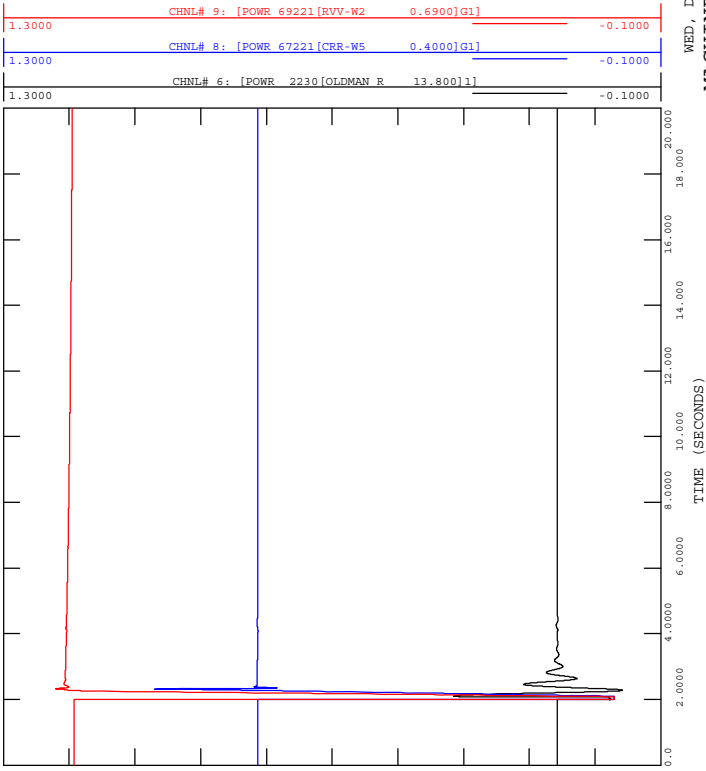




FIGURE E-20B  
P524\_2019SP\_SC4\_POST  
3 PHASE FAULT ON 994L AT 312S

FILE: E-20\_994L (Fidler 312S ).out

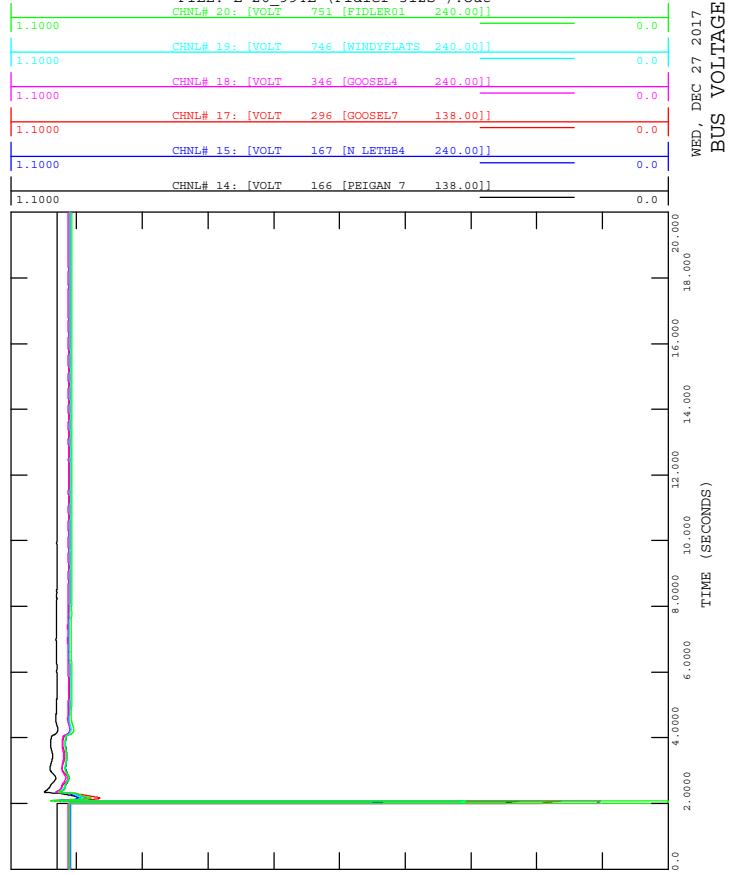


WED, DEC 27 2017 10:52  
MACHINE PELEC (PU)



FIGURE E-20D  
P524\_2019SP\_SC4\_POST  
3 PHASE FAULT ON 994L AT 312S

FILE: E-20\_994L (Fidler 312S ).out

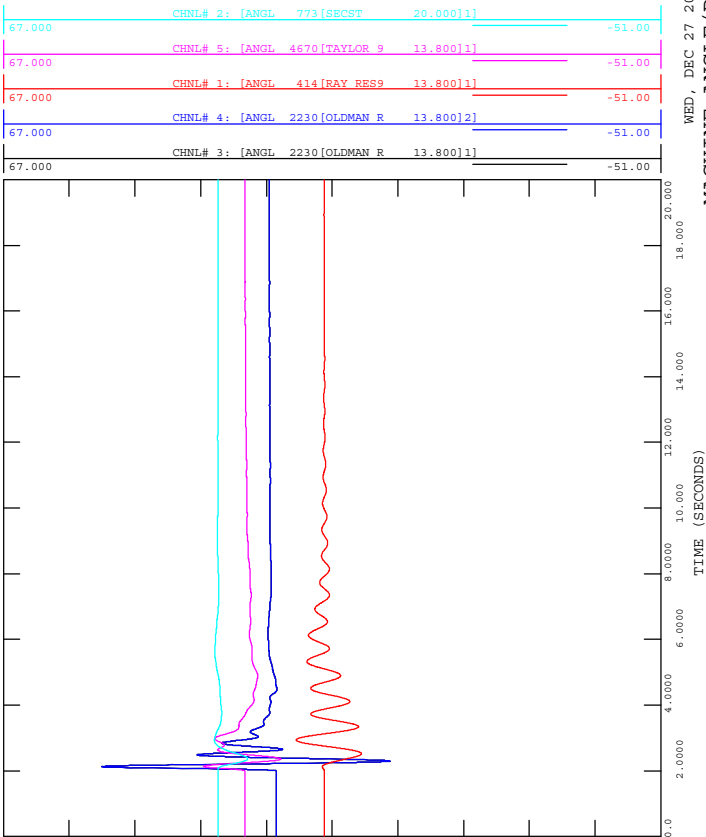


WED, DEC 27 2017 10:52  
BUS VOLTAGE (PU)



FIGURE E-20A  
P524\_2019SP\_SC4\_POST  
3 PHASE FAULT ON 994L AT 312S

FILE: E-20\_994L (Fidler 312S ).out

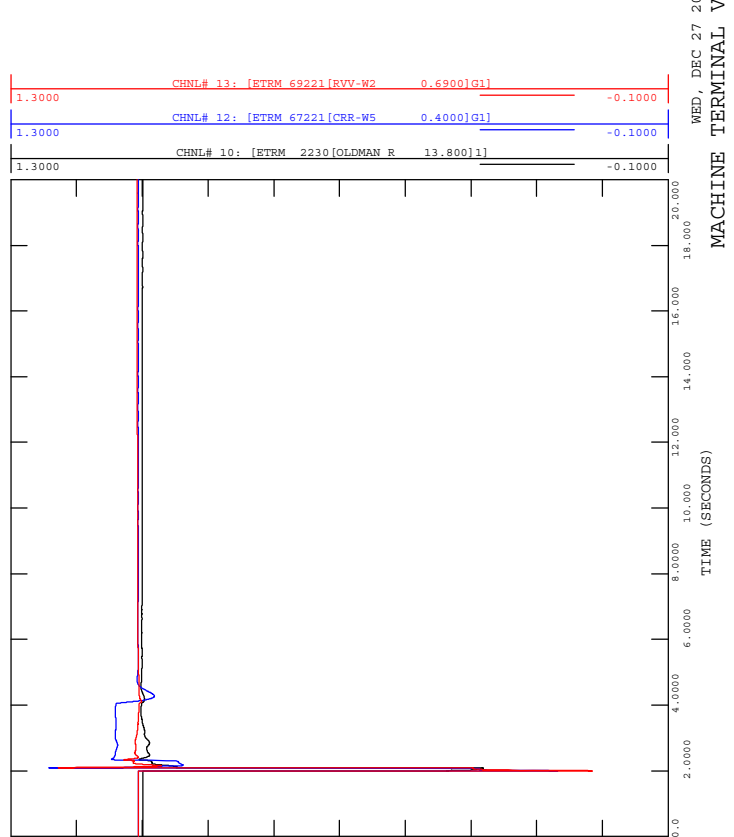


WED, DEC 27 2017 10:52  
MACHINE ANGLE (DEGREE)



FIGURE E-20C  
P524\_2019SP\_SC4\_POST  
3 PHASE FAULT ON 994L AT 312S

FILE: E-20\_994L (Fidler 312S ).out



WED, DEC 27 2017 10:52  
MACHINE TERMINAL VOLTAGE



FIGURE E-20F  
 P524\_2019SP\_SC4\_POST  
 3 PHASE FAULT ON 994L AT 312S

FILE: E-20\_994L (Fidler 312S ).out

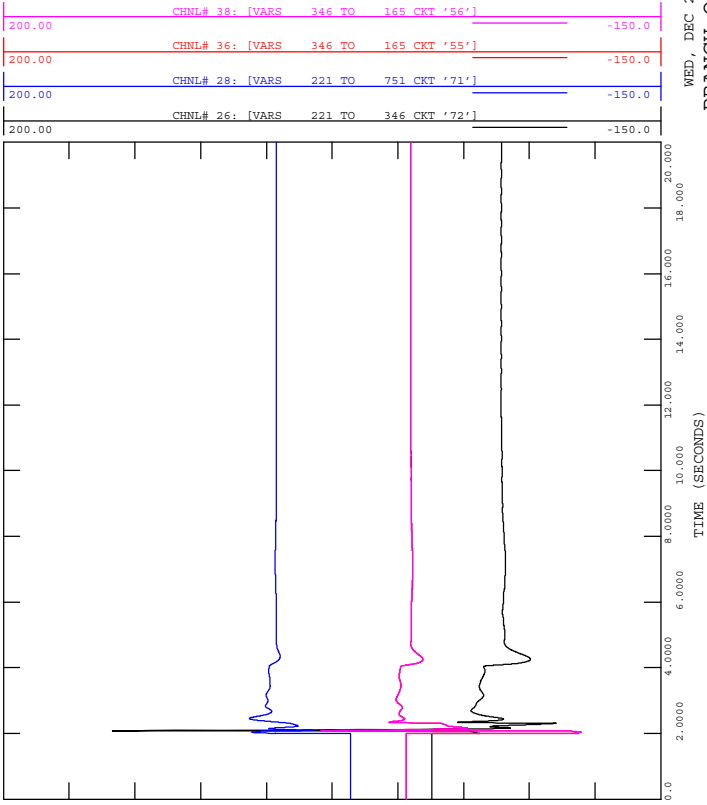


FIGURE E-20E  
 P524\_2019SP\_SC4\_POST  
 3 PHASE FAULT ON 994L AT 312S

FILE: E-20\_994L (Fidler 312S ).out

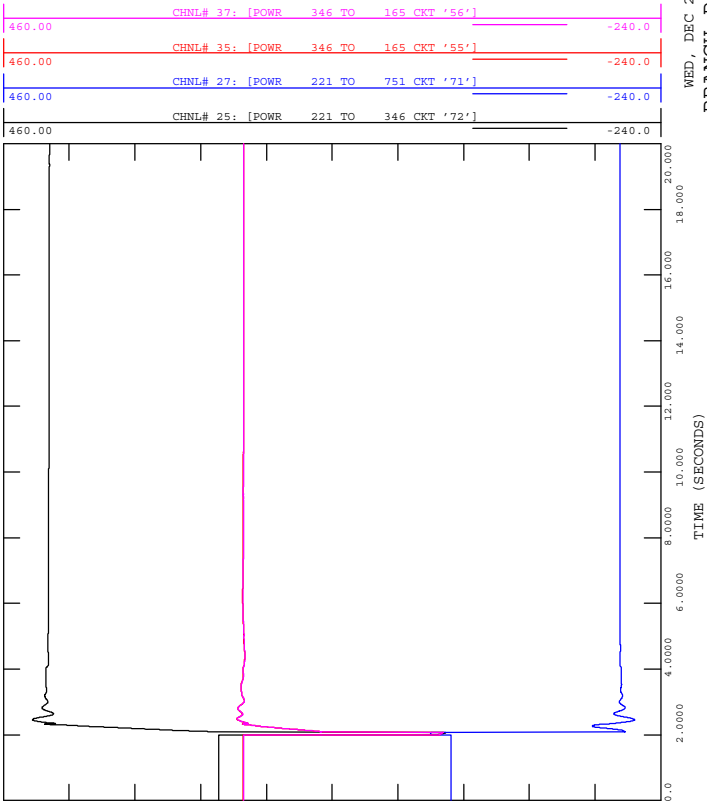
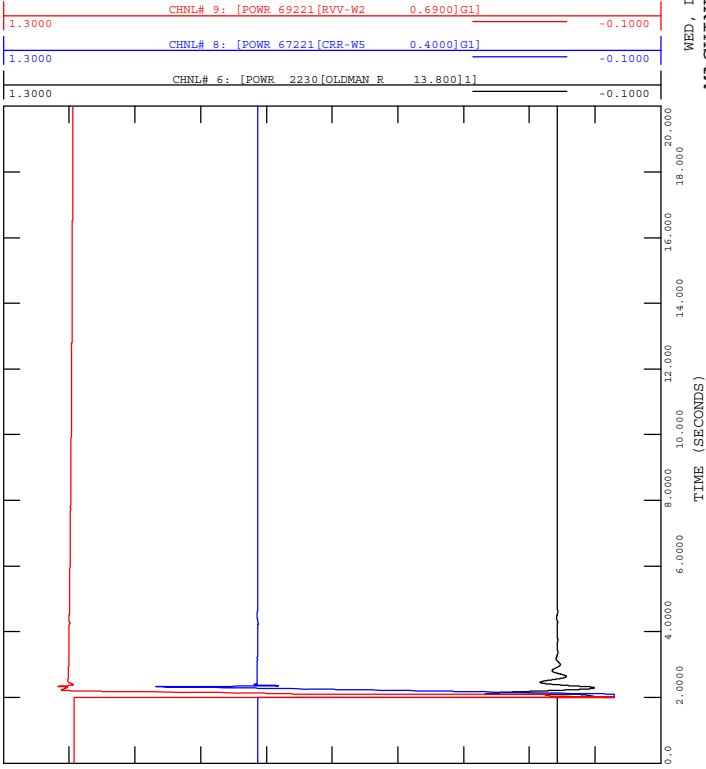






FIGURE E-21B  
P524\_2019SP\_SC4\_POST  
3 PHASE FAULT ON 1037L AT 237S

FILE: E-21\_1037L ( Foothills 237S).out

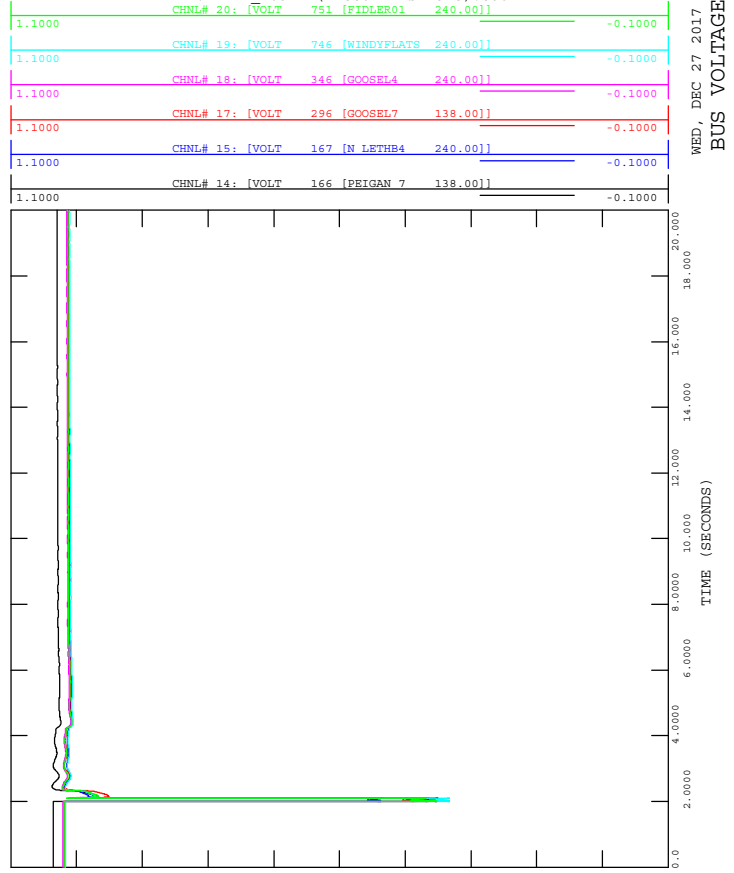


WED, DEC 27 2017 10:52  
MACHINE PELEC (PU)



FIGURE E-21D  
P524\_2019SP\_SC4\_POST  
3 PHASE FAULT ON 1037L AT 237S

FILE: E-21\_1037L ( Foothills 237S).out

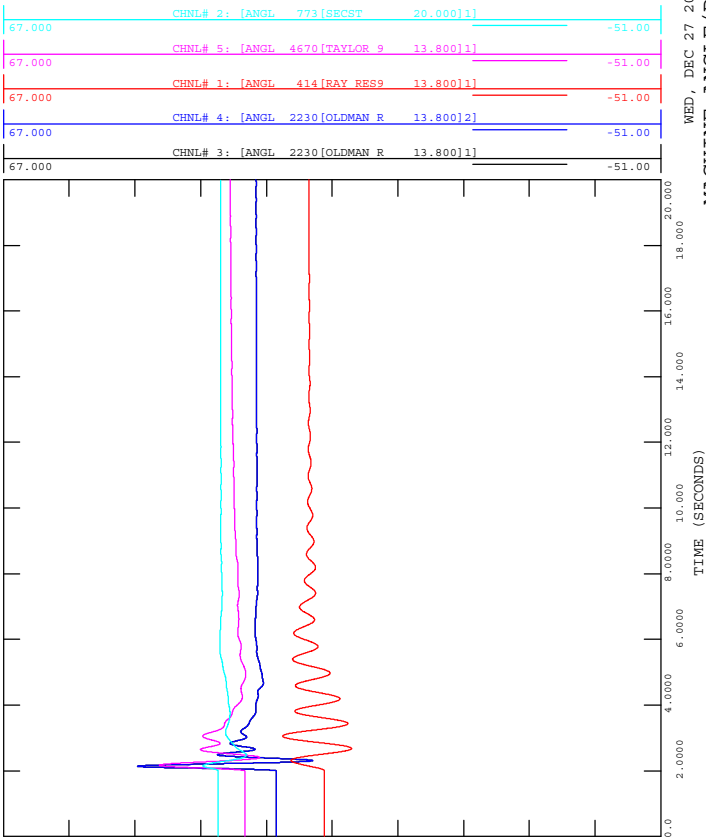


WED, DEC 27 2017 10:52  
BUS VOLTAGE (PU)



FIGURE E-21A  
P524\_2019SP\_SC4\_POST  
3 PHASE FAULT ON 1037L AT 237S

FILE: E-21\_1037L ( Foothills 237S).out

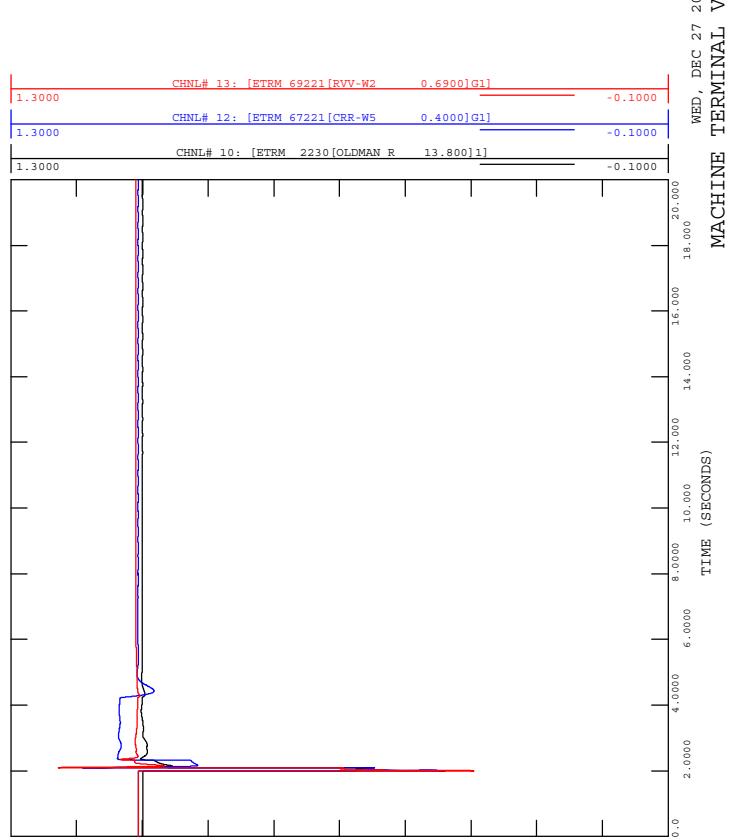


WED, DEC 27 2017 10:52  
MACHINE ANGLE (DEGREE)



FIGURE E-21C  
P524\_2019SP\_SC4\_POST  
3 PHASE FAULT ON 1037L AT 237S

FILE: E-21\_1037L ( Foothills 237S).out

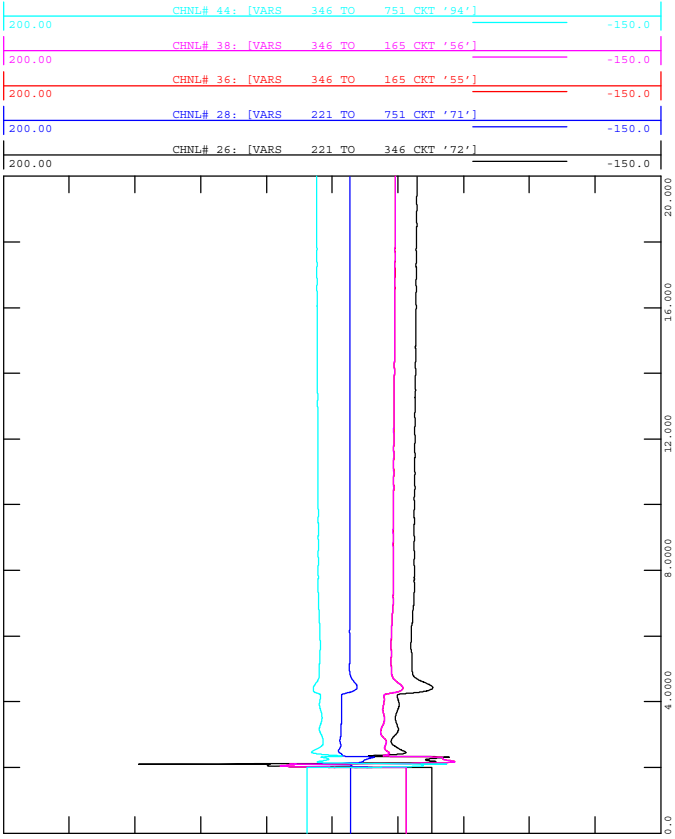


WED, DEC 27 2017 10:52  
MACHINE TERMINAL VOLTAGE



FIGURE E-21F  
 P524\_2019SP\_SC4\_POST  
 3 PHASE FAULT ON 1037L AT 237S

FILE: E-21\_1037L ( Foothills 237S).out

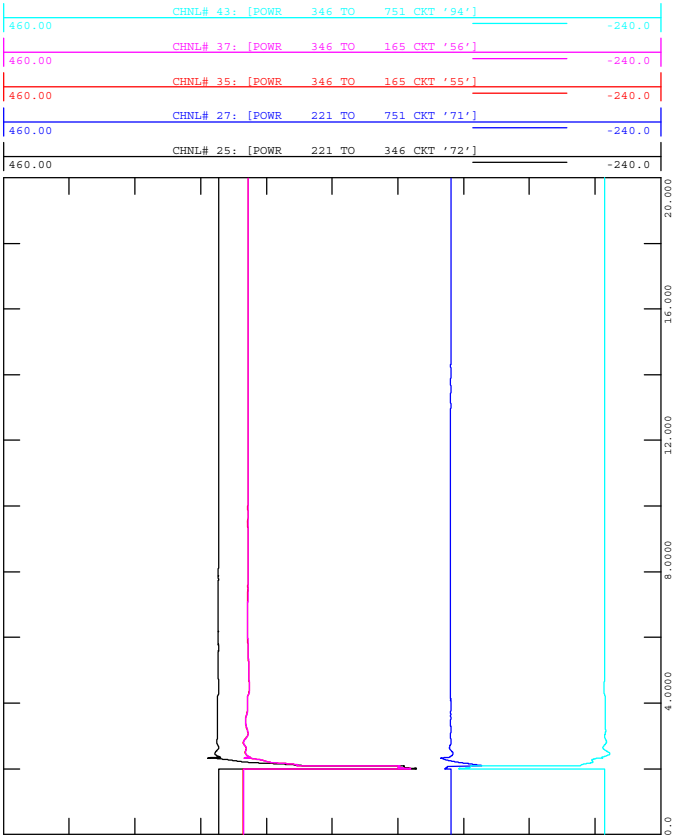


WED, DEC 27 2017 10:52  
 BRANCH Q FLOW (PU)



FIGURE E-21E  
 P524\_2019SP\_SC4\_POST  
 3 PHASE FAULT ON 1037L AT 237S

FILE: E-21\_1037L ( Foothills 237S).out

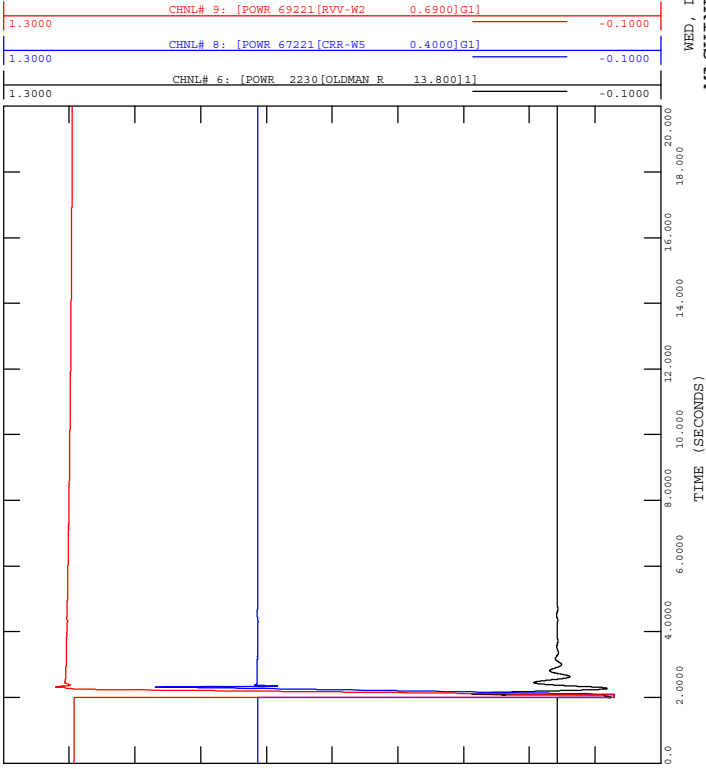


WED, DEC 27 2017 10:52  
 BRANCH P FLOW (PU)



FIGURE E-22B  
P524\_2019SP\_SC4\_POST  
3 PHASE FAULT ON 1037L AT 138S

FILE: E-22\_1037L (Windy Flat 138S ).out

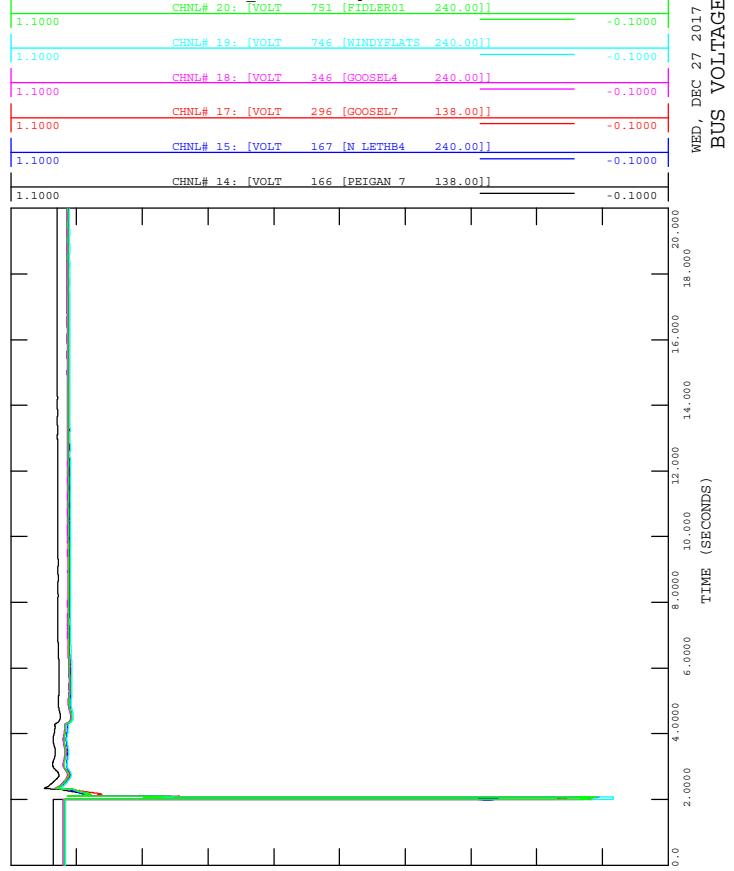


WED, DEC 27 2017 10:52  
MACHINE PELEC (PU)



FIGURE E-22D  
P524\_2019SP\_SC4\_POST  
3 PHASE FAULT ON 1037L AT 138S

FILE: E-22\_1037L (Windy Flat 138S ).out

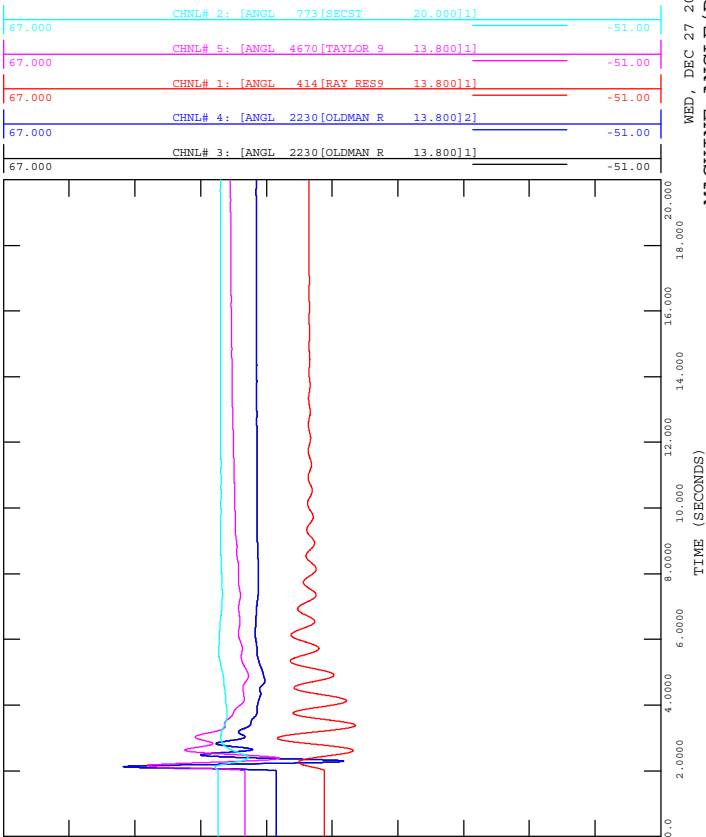


WED, DEC 27 2017 10:52  
BUS VOLTAGE (PU)



FIGURE E-22A  
P524\_2019SP\_SC4\_POST  
3 PHASE FAULT ON 1037L AT 138S

FILE: E-22\_1037L (Windy Flat 138S ).out

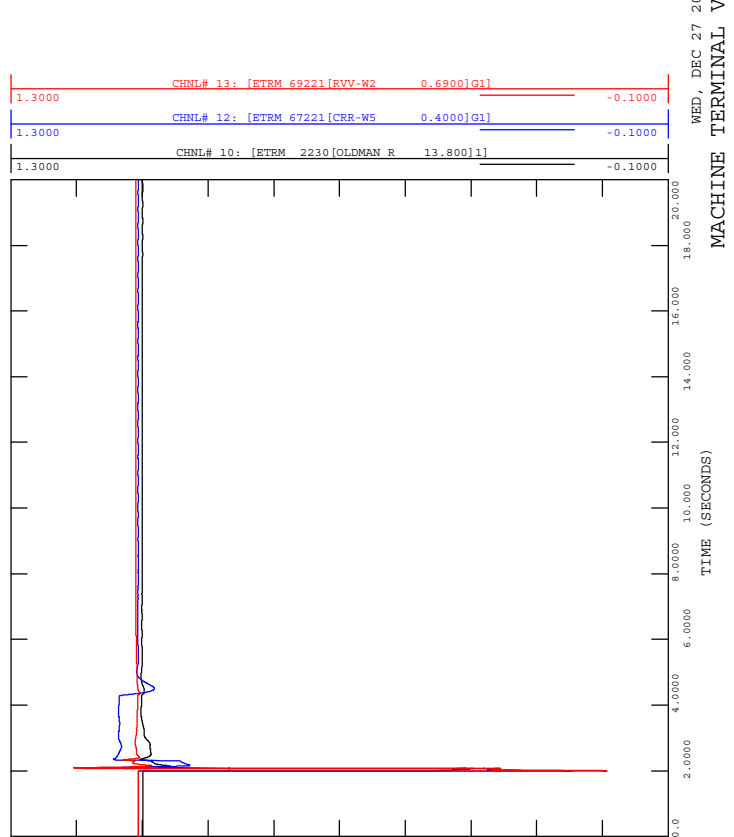


WED, DEC 27 2017 10:52  
MACHINE ANGLE (DEGREE)



FIGURE E-22C  
P524\_2019SP\_SC4\_POST  
3 PHASE FAULT ON 1037L AT 138S

FILE: E-22\_1037L (Windy Flat 138S ).out

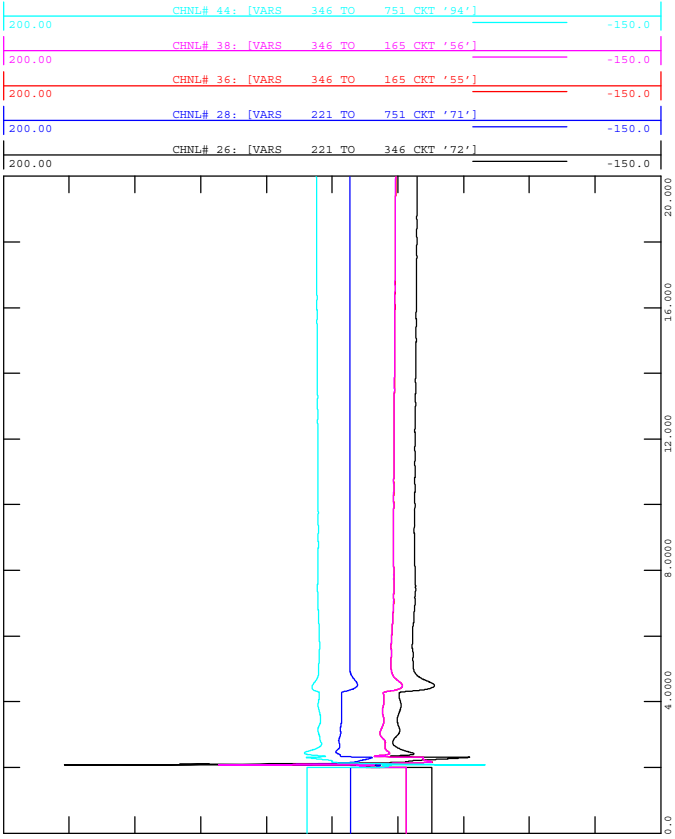


WED, DEC 27 2017 10:52  
MACHINE TERMINAL VOLTAGE



FIGURE E-22F  
 P524\_2019SP\_SC4\_POST  
 3 PHASE FAULT ON 1037L AT 138S

FILE: E-22\_1037L (Windy Flat 138S ).out

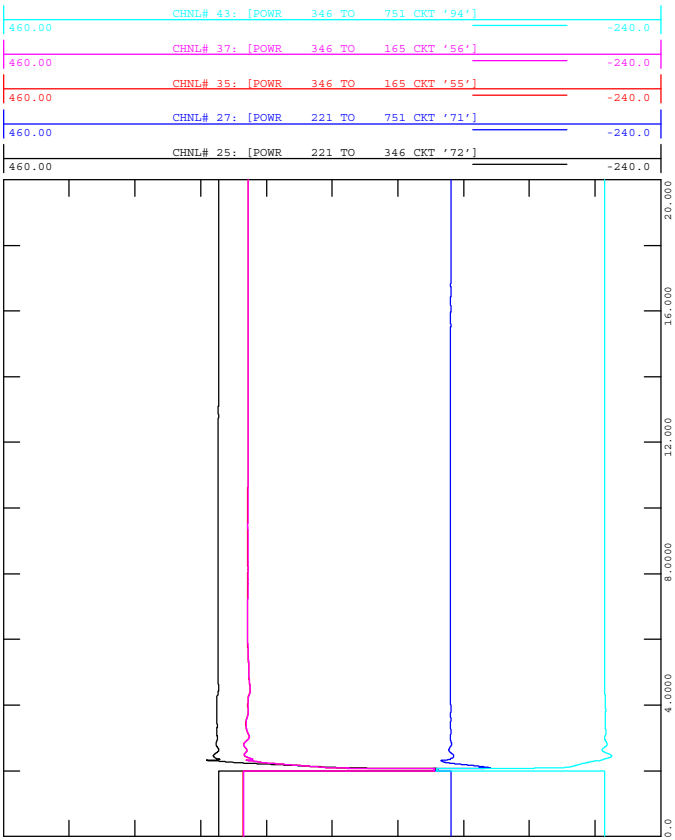


WED, DEC 27 2017 10:52  
 BRANCH Q FLOW (PU)



FIGURE E-22E  
 P524\_2019SP\_SC4\_POST  
 3 PHASE FAULT ON 1037L AT 138S

FILE: E-22\_1037L (Windy Flat 138S ).out

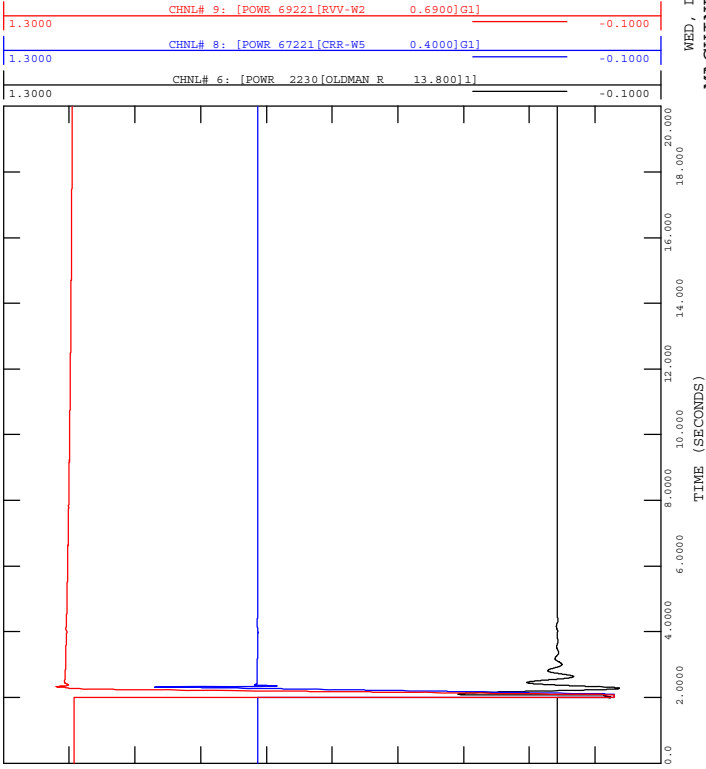


WED, DEC 27 2017 10:52  
 BRANCH P FLOW (PU)



FIGURE E-23B  
P524\_2019SP\_SC4\_POST  
3 PHASE FAULT ON 1048L AT 138S

FILE: E-23\_1048L ( Windy Flat 138S).out

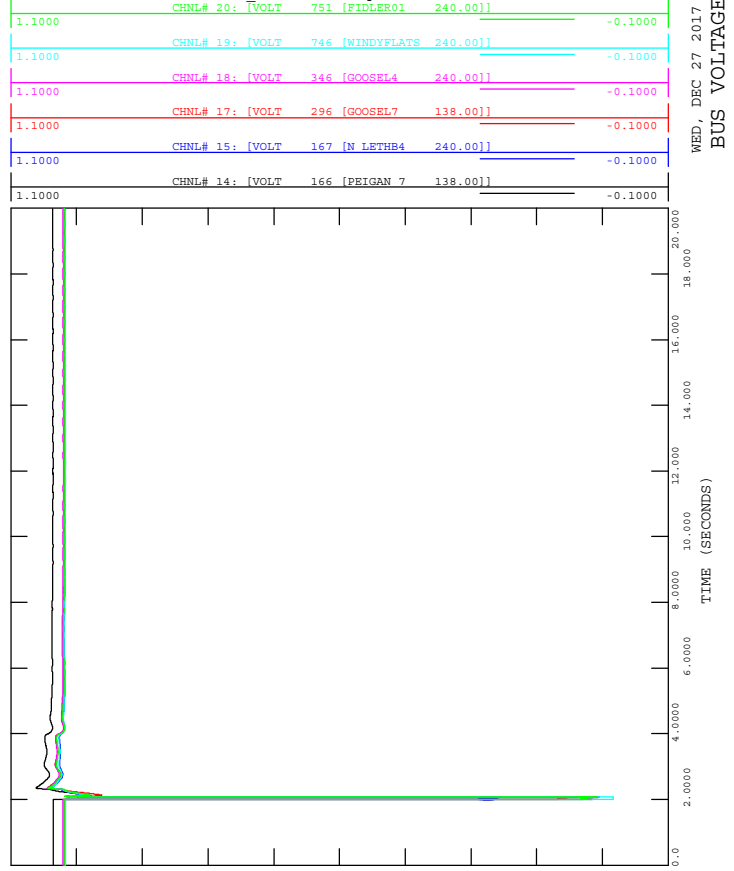


WED, DEC 27 2017 10:52  
MACHINE PELEC (PU)



FIGURE E-23D  
P524\_2019SP\_SC4\_POST  
3 PHASE FAULT ON 1048L AT 138S

FILE: E-23\_1048L ( Windy Flat 138S).out

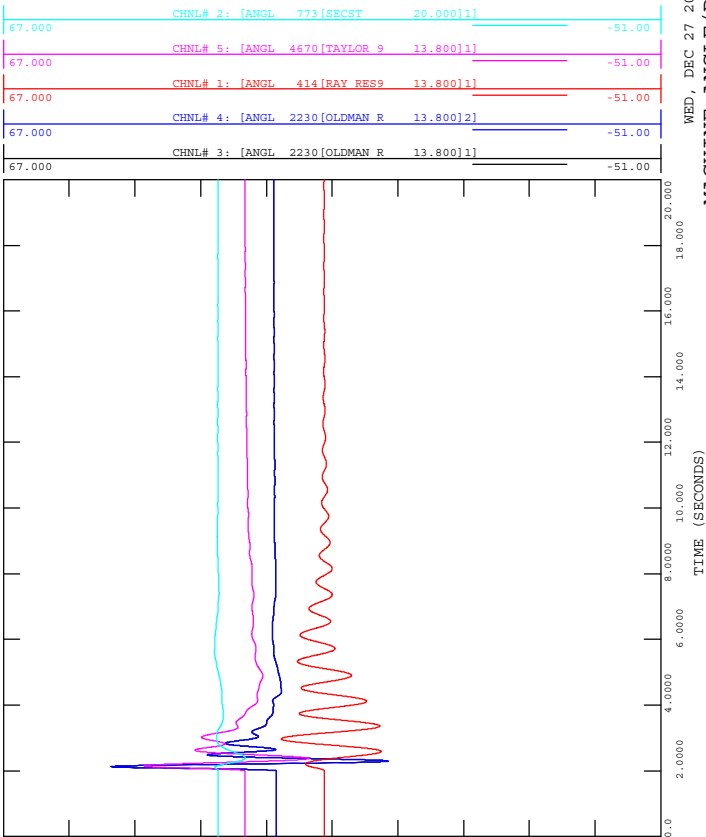


WED, DEC 27 2017 10:52  
BUS VOLTAGE (PU)



FIGURE E-23A  
P524\_2019SP\_SC4\_POST  
3 PHASE FAULT ON 1048L AT 138S

FILE: E-23\_1048L ( Windy Flat 138S).out

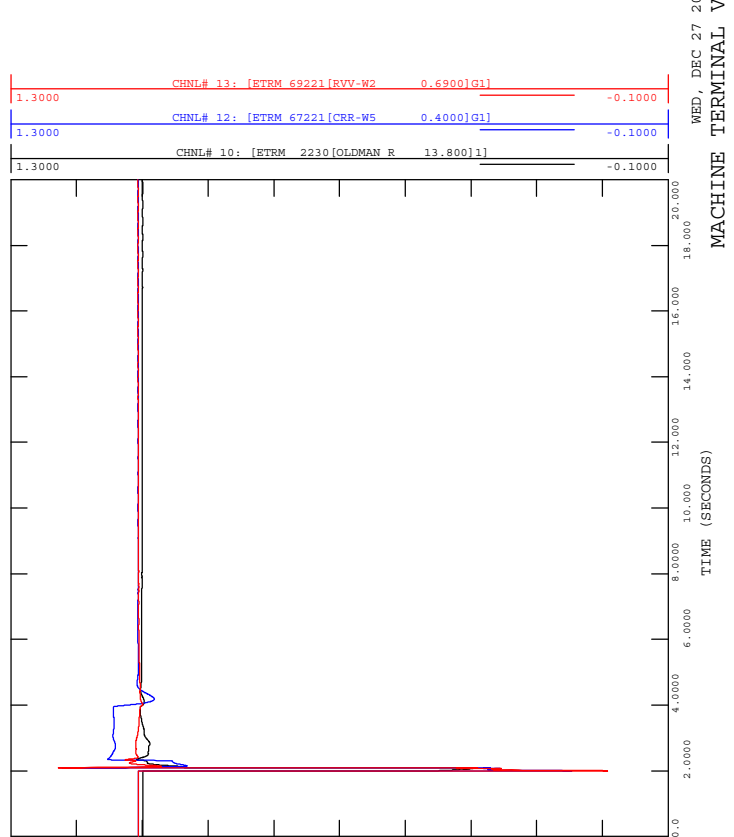


WED, DEC 27 2017 10:52  
MACHINE ANGLE (DEGREE)



FIGURE E-23C  
P524\_2019SP\_SC4\_POST  
3 PHASE FAULT ON 1048L AT 138S

FILE: E-23\_1048L ( Windy Flat 138S).out

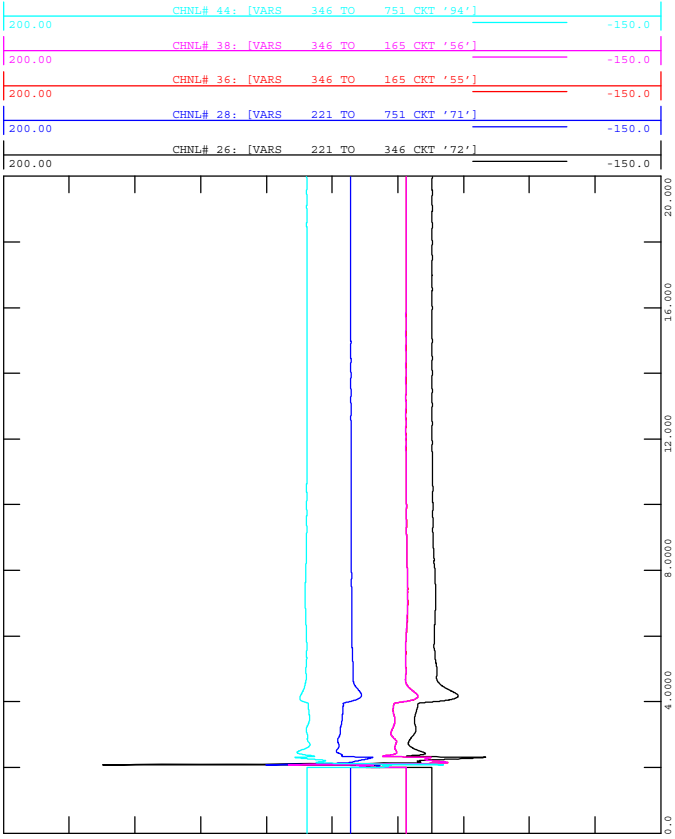


WED, DEC 27 2017 10:52  
MACHINE TERMINAL VOLTAGE



FIGURE E-23F  
 P524\_2019SP\_SC4\_POST  
 3 PHASE FAULT ON 1048L AT 138S

FILE: E-23\_1048L ( Windy Flat 138S).out

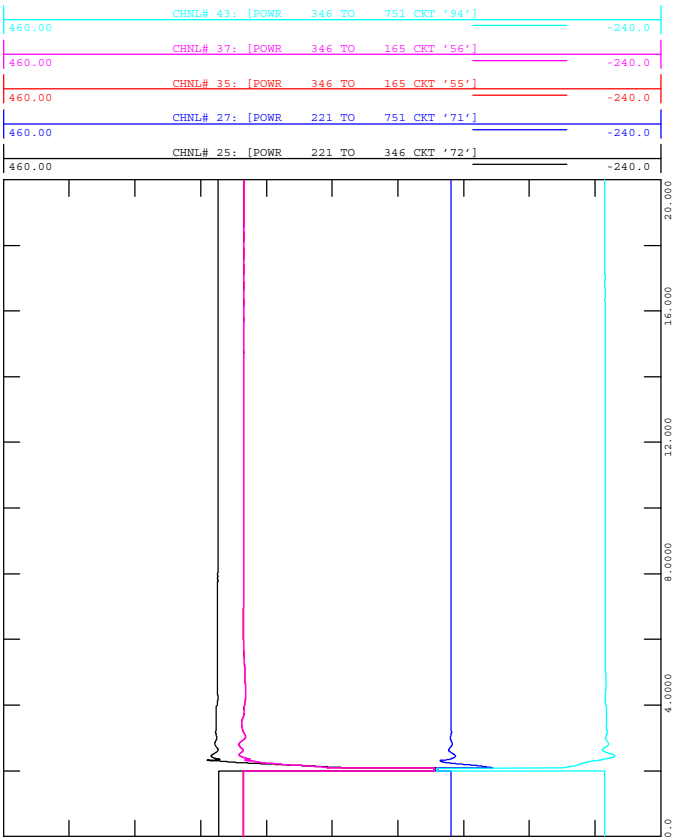


WED, DEC 27 2017 10:52  
 BRANCH Q FLOW (PU)



FIGURE E-23E  
 P524\_2019SP\_SC4\_POST  
 3 PHASE FAULT ON 1048L AT 138S

FILE: E-23\_1048L ( Windy Flat 138S).out

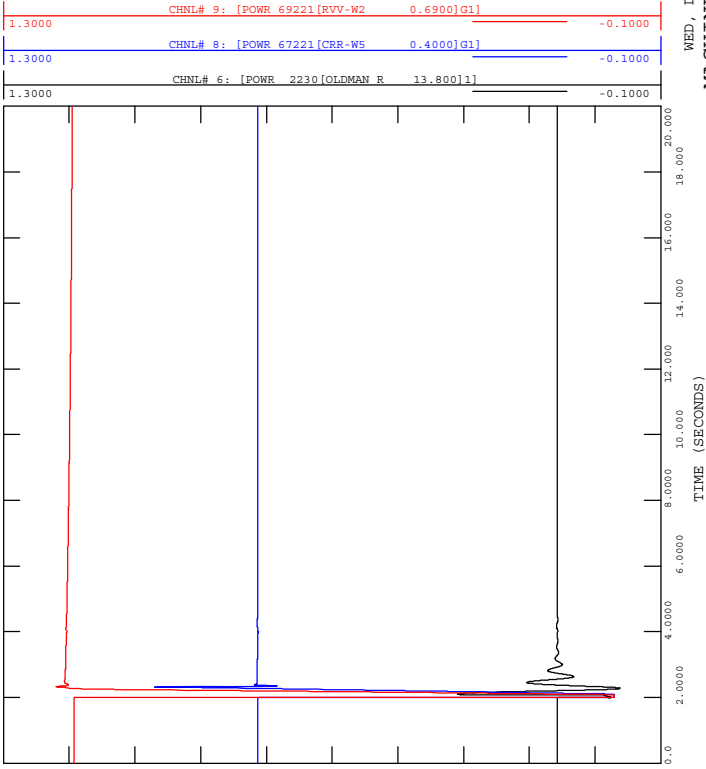


WED, DEC 27 2017 10:52  
 BRANCH P FLOW (PU)



FIGURE E-24B  
P524\_2019SP\_SC4\_POST  
3 PHASE FAULT ON 1048L AT 59S

FILE: E-24\_1048L (Peigan 59S).out

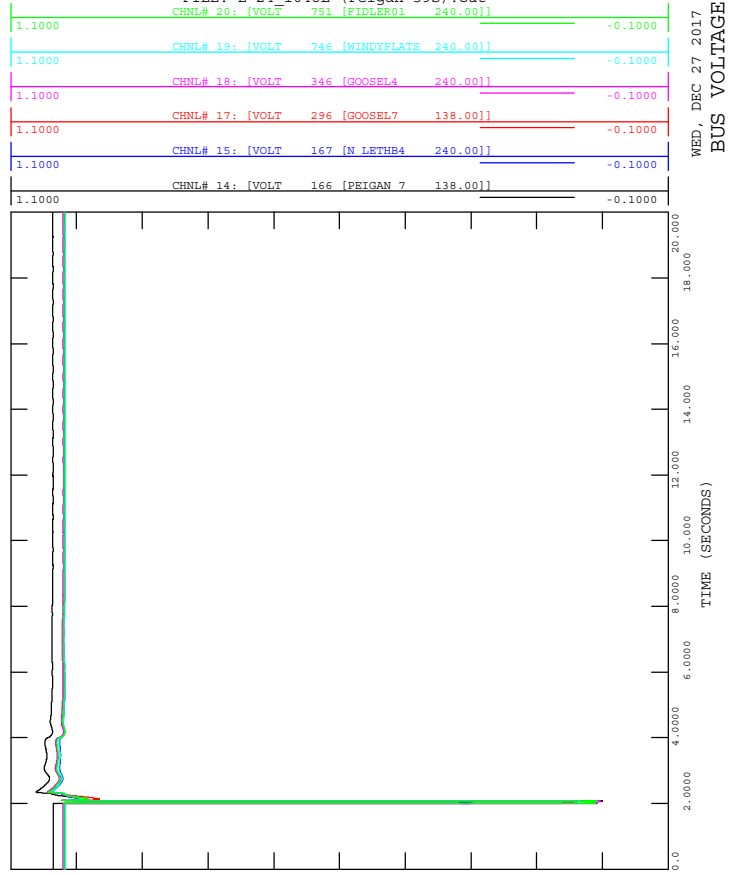


WED, DEC 27 2017 10:52  
MACHINE PELEC (PU)



FIGURE E-24D  
P524\_2019SP\_SC4\_POST  
3 PHASE FAULT ON 1048L AT 59S

FILE: E-24\_1048L (Peigan 59S).out

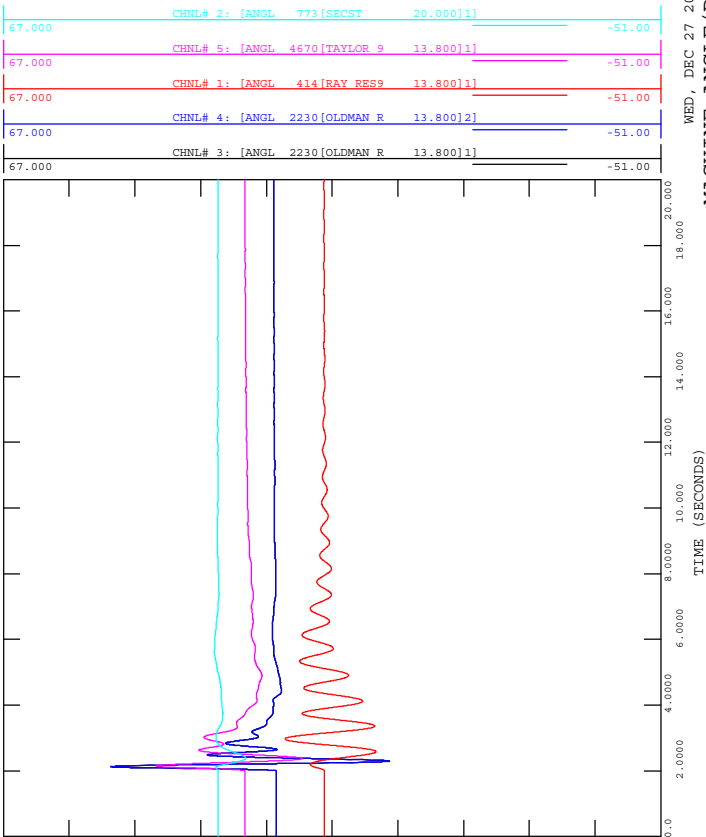


WED, DEC 27 2017 10:52  
BUS VOLTAGE (PU)



FIGURE E-24A  
P524\_2019SP\_SC4\_POST  
3 PHASE FAULT ON 1048L AT 59S

FILE: E-24\_1048L (Peigan 59S).out

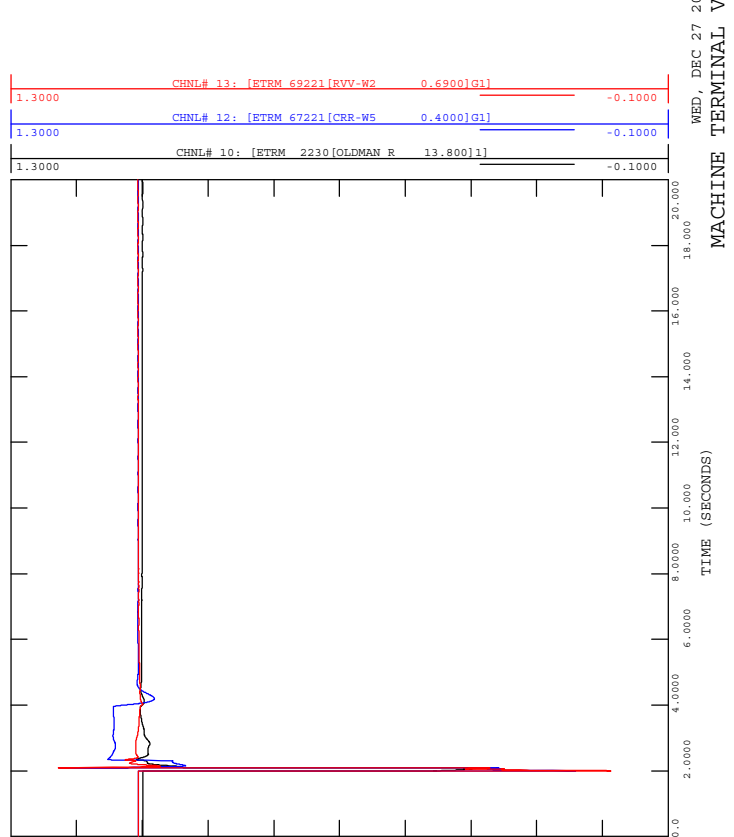


WED, DEC 27 2017 10:52  
MACHINE ANGLE (DEGREE)



FIGURE E-24C  
P524\_2019SP\_SC4\_POST  
3 PHASE FAULT ON 1048L AT 59S

FILE: E-24\_1048L (Peigan 59S).out



WED, DEC 27 2017 10:52  
MACHINE TERMINAL VOLTAGE



FIGURE E-24F  
 P524\_2019SP\_SC4\_POST  
 3 PHASE FAULT ON 1048L AT 59S

FILE: E-24\_1048L (Peigan 59S).out

WED, DEC 27 2017 10:52  
 BRANCH Q FLOW (PU)

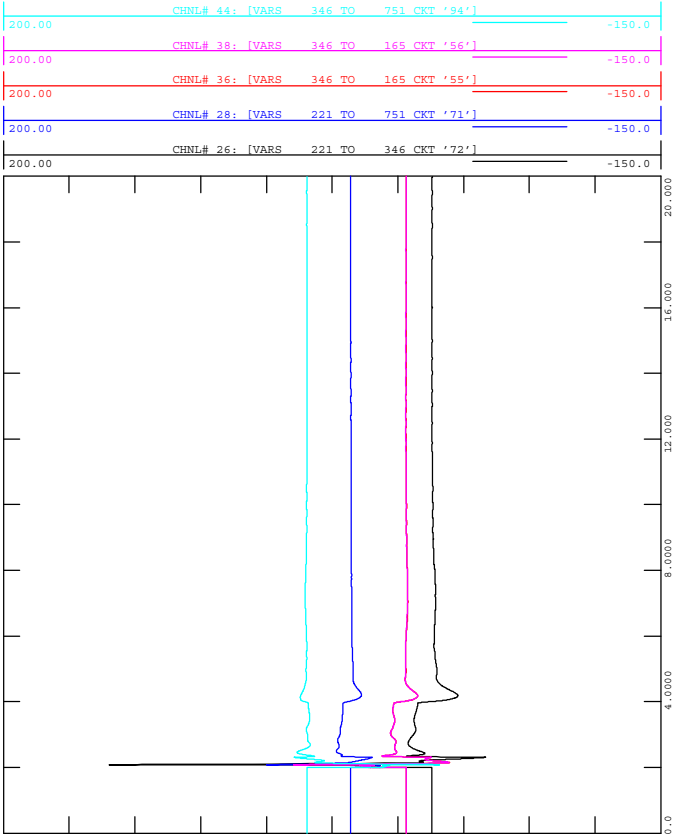


FIGURE E-24E  
 P524\_2019SP\_SC4\_POST  
 3 PHASE FAULT ON 1048L AT 59S

FILE: E-24\_1048L (Peigan 59S).out

WED, DEC 27 2017 10:52  
 BRANCH P FLOW (PU)

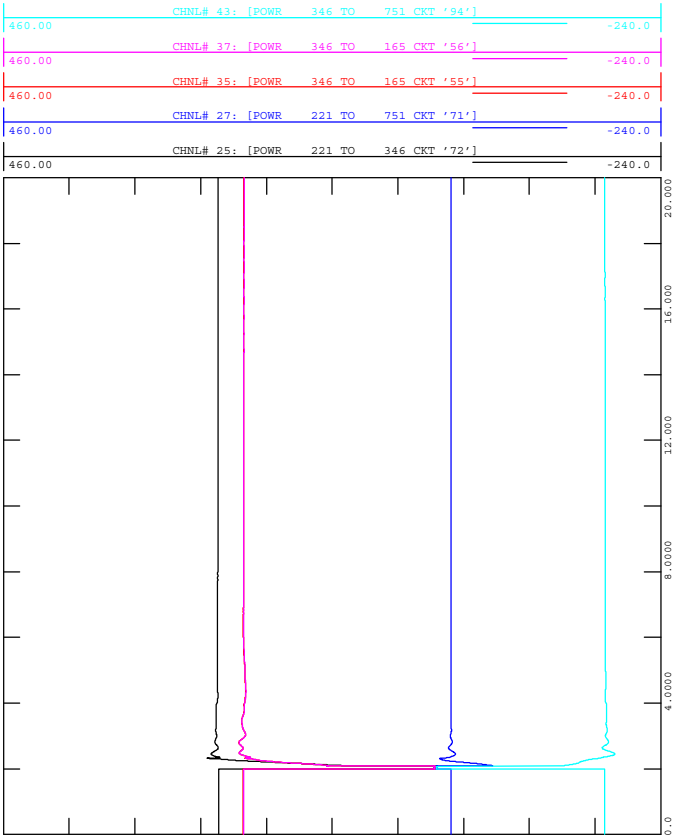






FIGURE E-25B  
P524\_2019SP\_SC4\_POST  
3 PHASE FAULT ON 1071L AT 205S

FILE: E-25\_1071L ( Castle Rock Ridge 205S).out

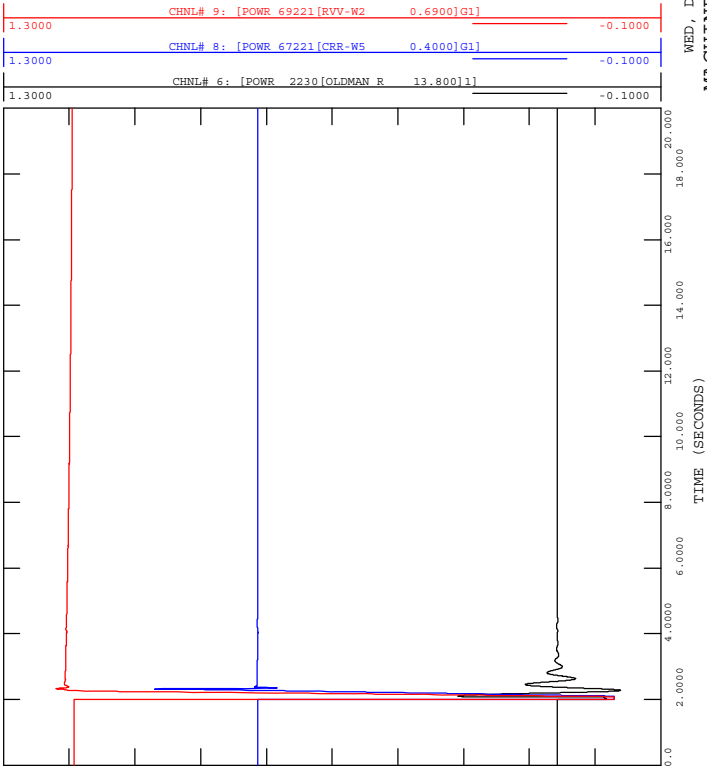


FIGURE E-25D  
P524\_2019SP\_SC4\_POST  
3 PHASE FAULT ON 1071L AT 205S

FILE: E-25\_1071L ( Castle Rock Ridge 205S).out

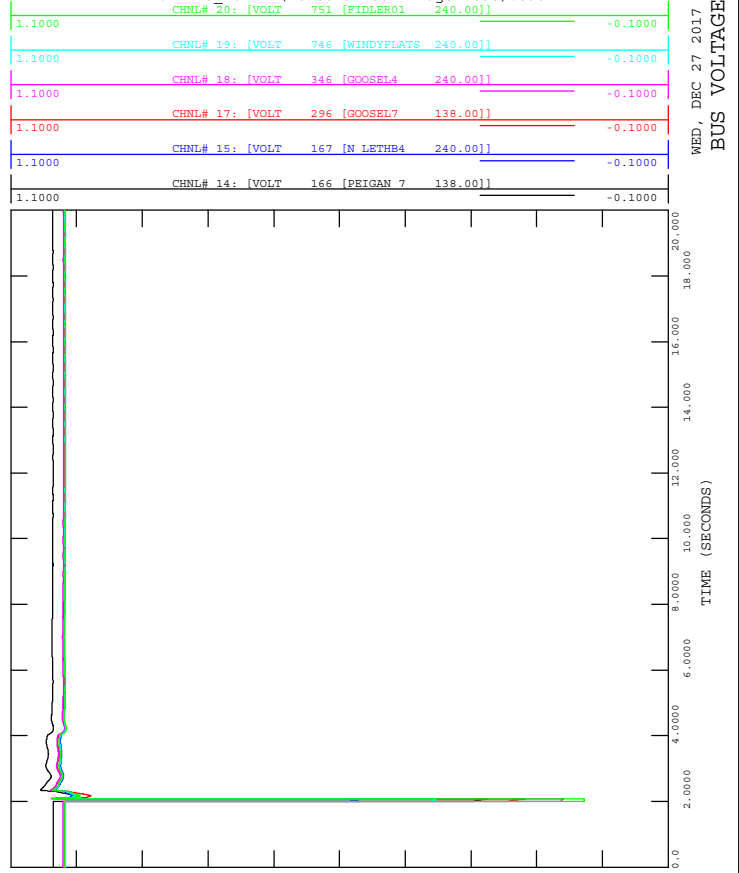


FIGURE E-25A  
P524\_2019SP\_SC4\_POST  
3 PHASE FAULT ON 1071L AT 205S

FILE: E-25\_1071L ( Castle Rock Ridge 205S).out

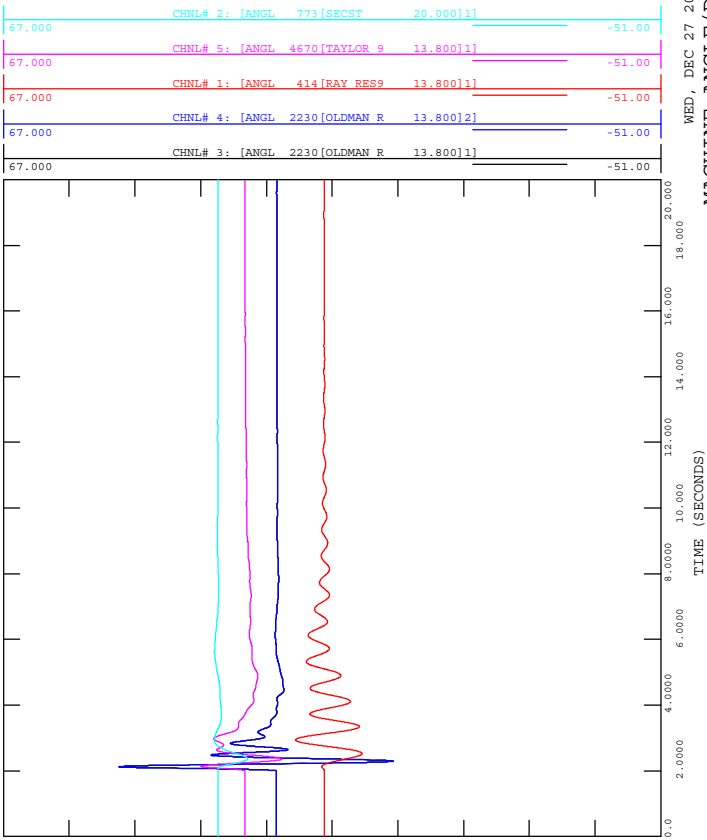


FIGURE E-25C  
P524\_2019SP\_SC4\_POST  
3 PHASE FAULT ON 1071L AT 205S

FILE: E-25\_1071L ( Castle Rock Ridge 205S).out

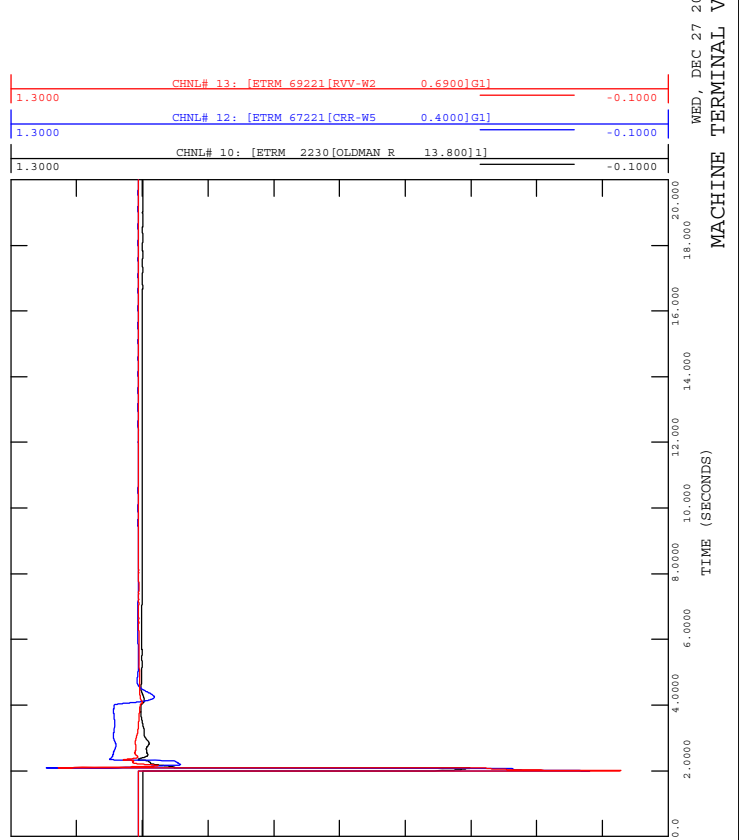




FIGURE E-25F  
 P524\_2019SP\_SC4\_POST  
 3 PHASE FAULT ON 1071L AT 205S

FILE: E-25\_1071L ( Castle Rock Ridge 205S).out

WED, DEC 27 2017 10:52  
 BRANCH Q FLOW (PU)

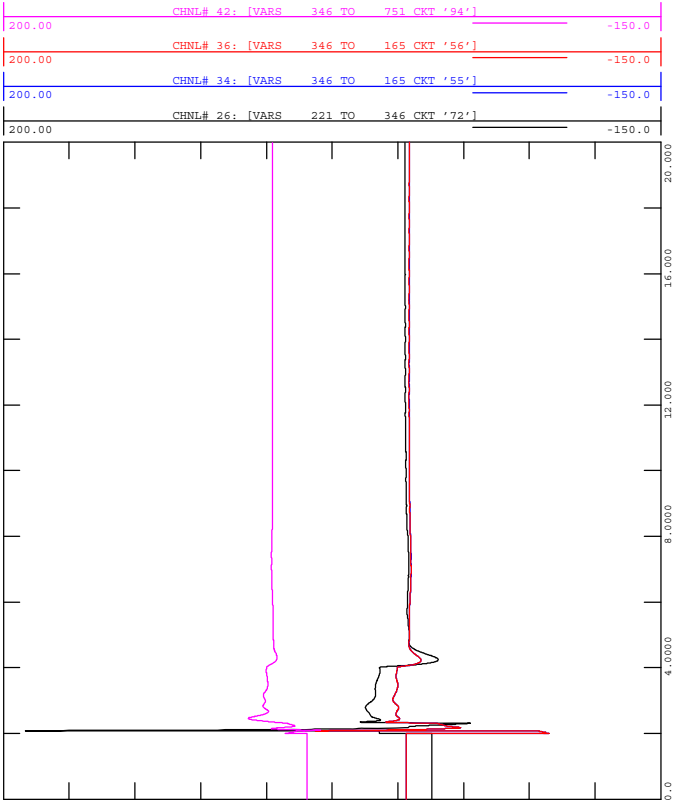


FIGURE E-25E  
 P524\_2019SP\_SC4\_POST  
 3 PHASE FAULT ON 1071L AT 205S

FILE: E-25\_1071L ( Castle Rock Ridge 205S).out

WED, DEC 27 2017 10:52  
 BRANCH P FLOW (PU)

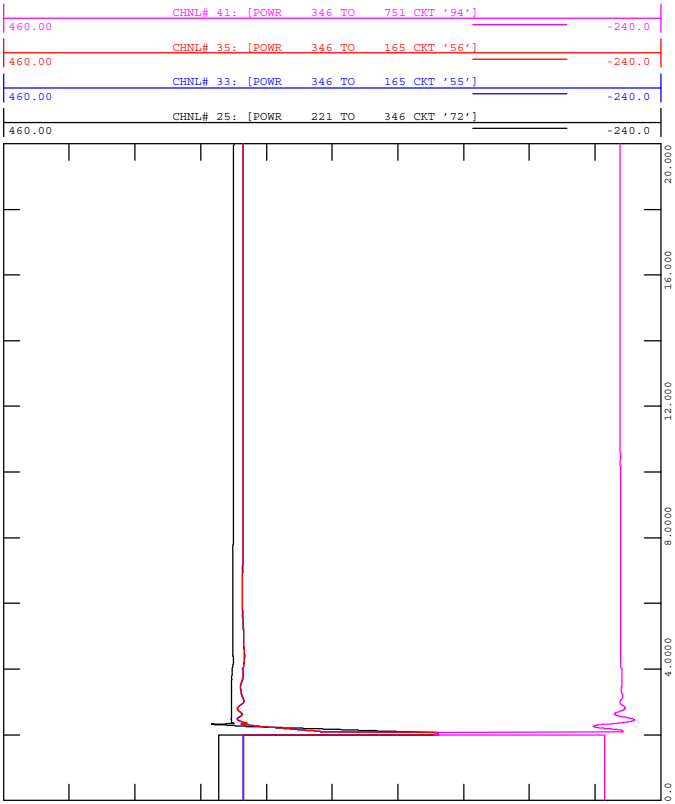
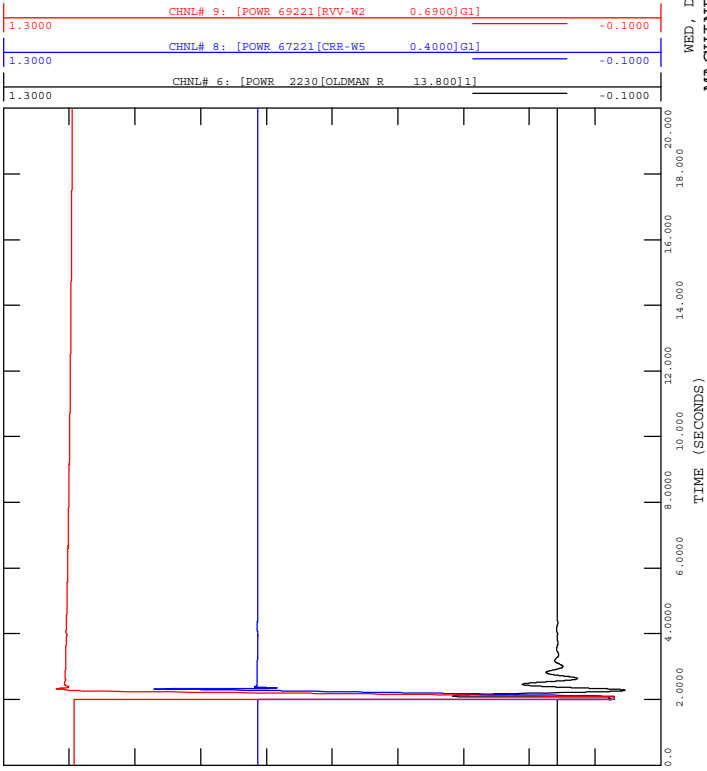




FIGURE E-26B  
P524\_2019SP\_SC4\_POST  
3 PHASE FAULT ON 1071L AT 312S

FILE: E-26\_1071L (Fidler 312S ).out

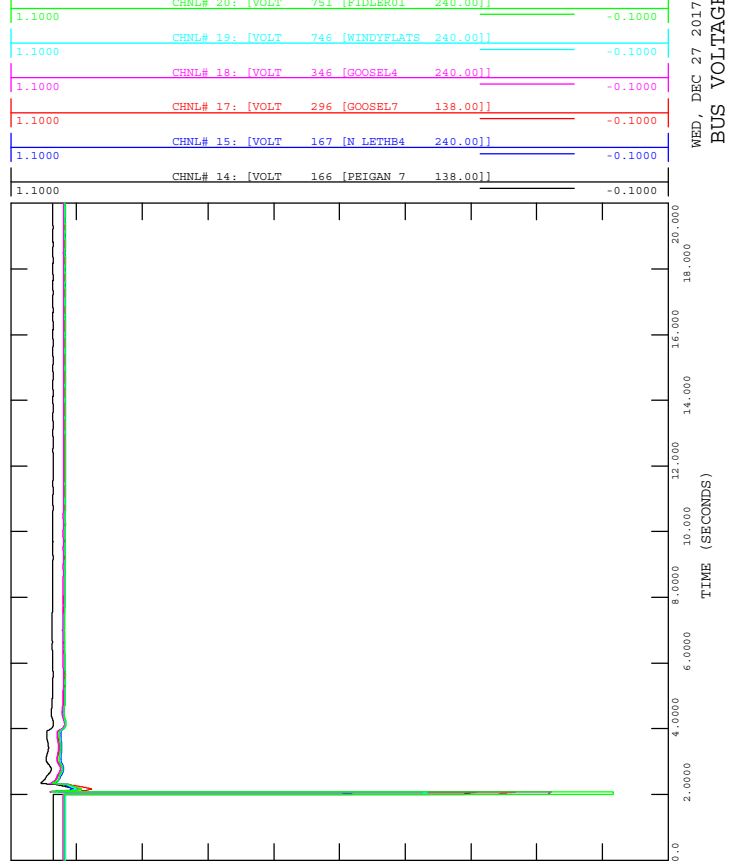


WED, DEC 27 2017 10:52  
MACHINE PELEC (PU)



FIGURE E-26D  
P524\_2019SP\_SC4\_POST  
3 PHASE FAULT ON 1071L AT 312S

FILE: E-26\_1071L (Fidler 312S ).out

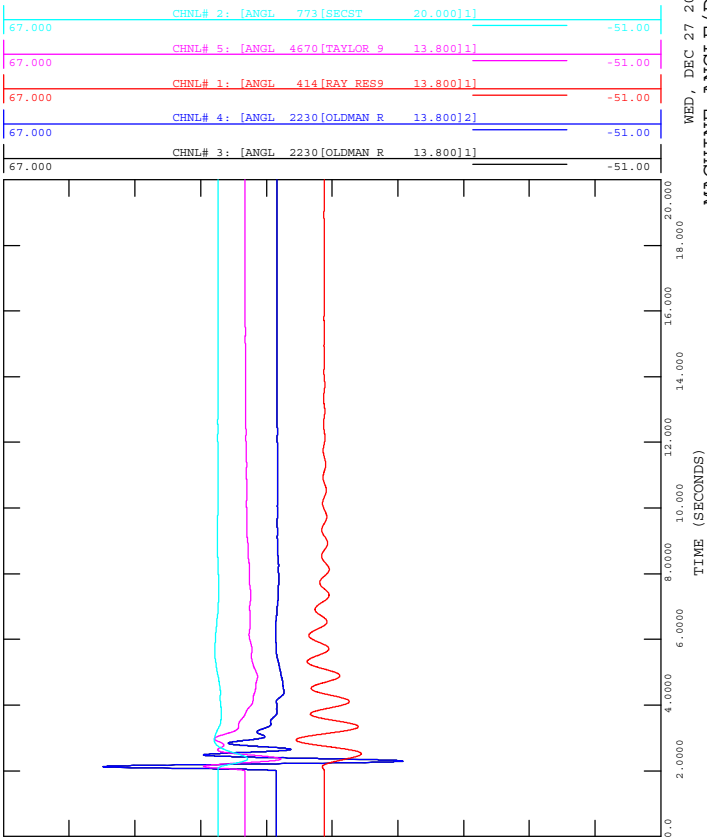


WED, DEC 27 2017 10:52  
BUS VOLTAGE (PU)



FIGURE E-26A  
P524\_2019SP\_SC4\_POST  
3 PHASE FAULT ON 1071L AT 312S

FILE: E-26\_1071L (Fidler 312S ).out

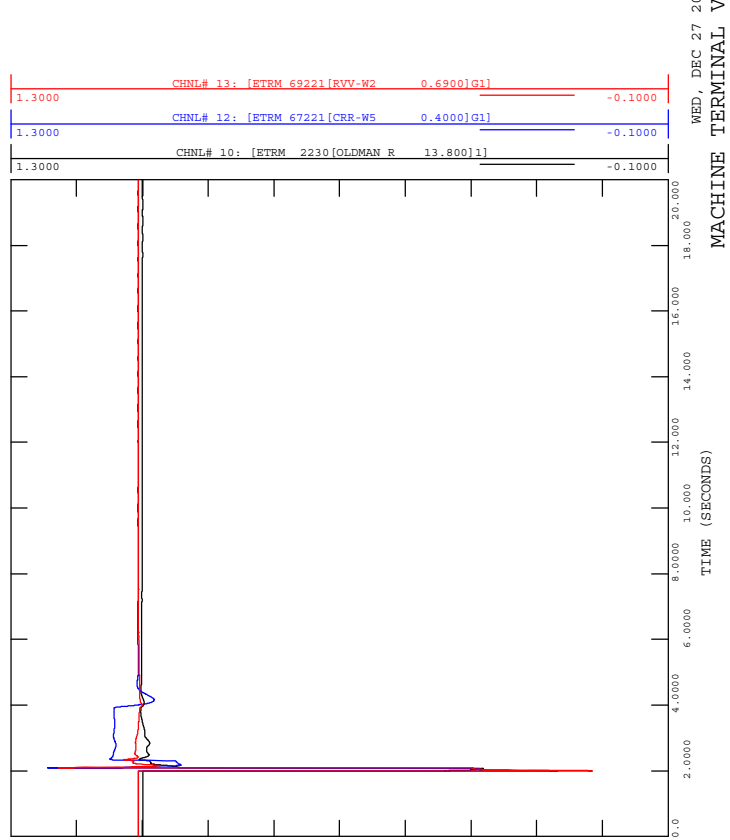


WED, DEC 27 2017 10:52  
MACHINE ANGLE (DEGREE)



FIGURE E-26C  
P524\_2019SP\_SC4\_POST  
3 PHASE FAULT ON 1071L AT 312S

FILE: E-26\_1071L (Fidler 312S ).out



WED, DEC 27 2017 10:52  
MACHINE TERMINAL VOLTAGE



FIGURE E-26F  
P524\_2019SP\_SC4\_POST  
3 PHASE FAULT ON 1071L AT 312S

FILE: E-26\_1071L (Fidler 312S ).out

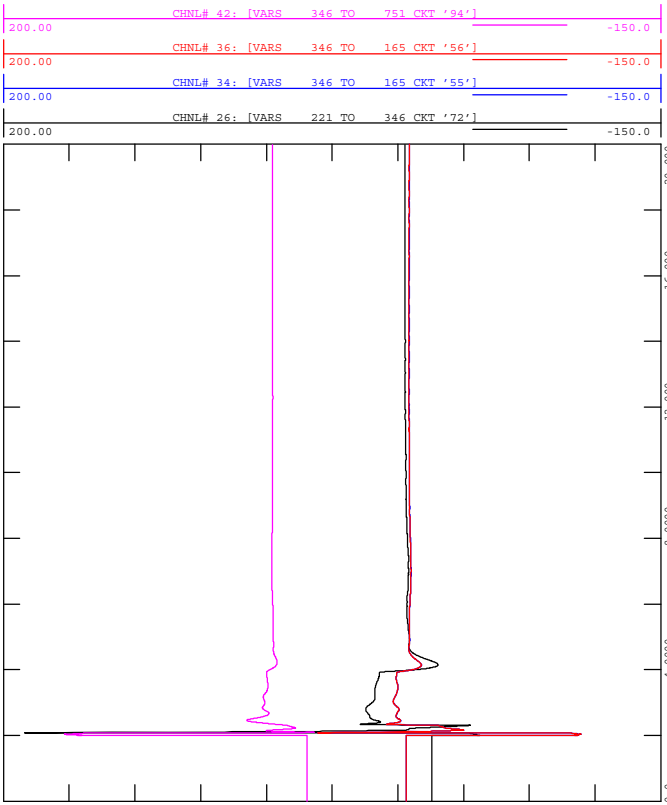


FIGURE E-26E  
P524\_2019SP\_SC4\_POST  
3 PHASE FAULT ON 1071L AT 312S

FILE: E-26\_1071L (Fidler 312S ).out

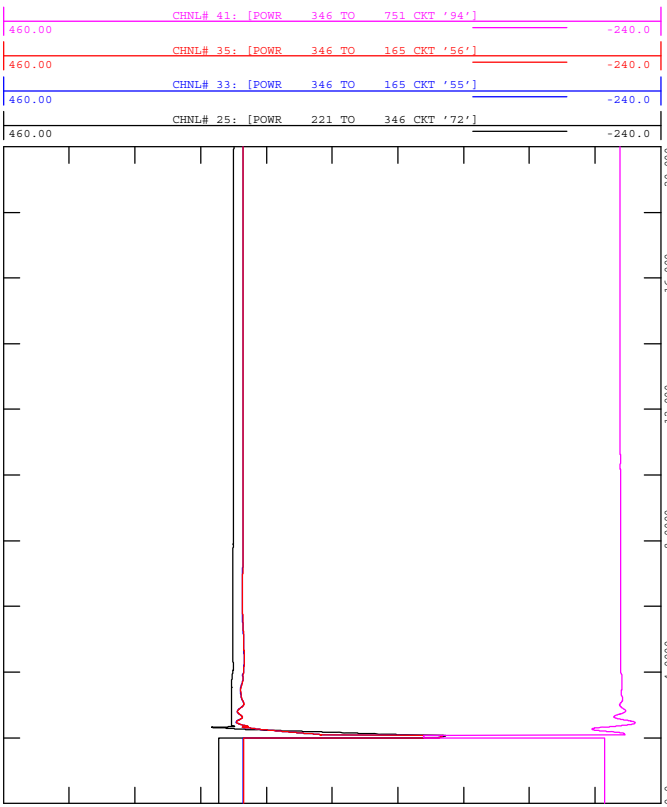
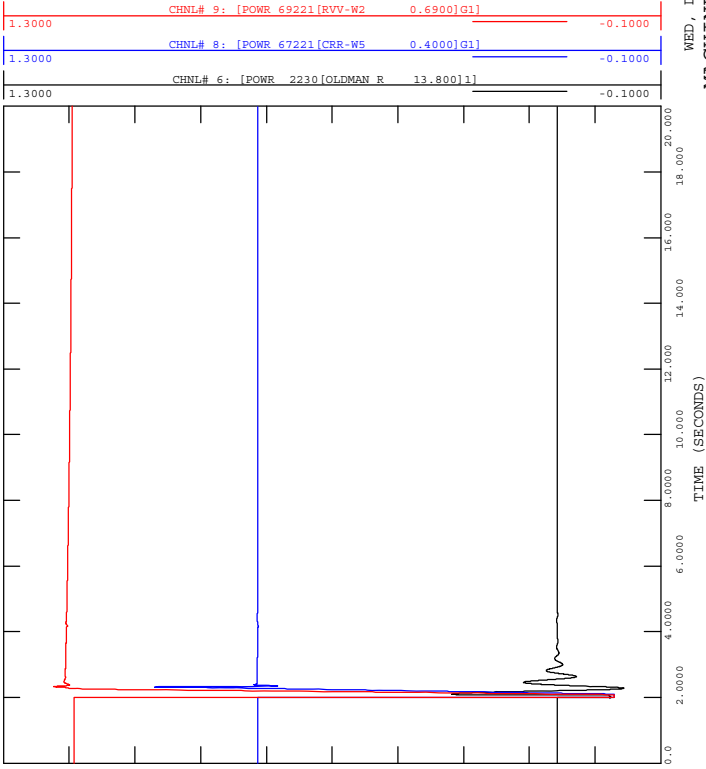




FIGURE E-27B  
P524\_2019SP\_SC4\_POST  
3 PHASE FAULT ON 1072L AT 103S

FILE: E-27\_1072L ( Goose lake 103S).out

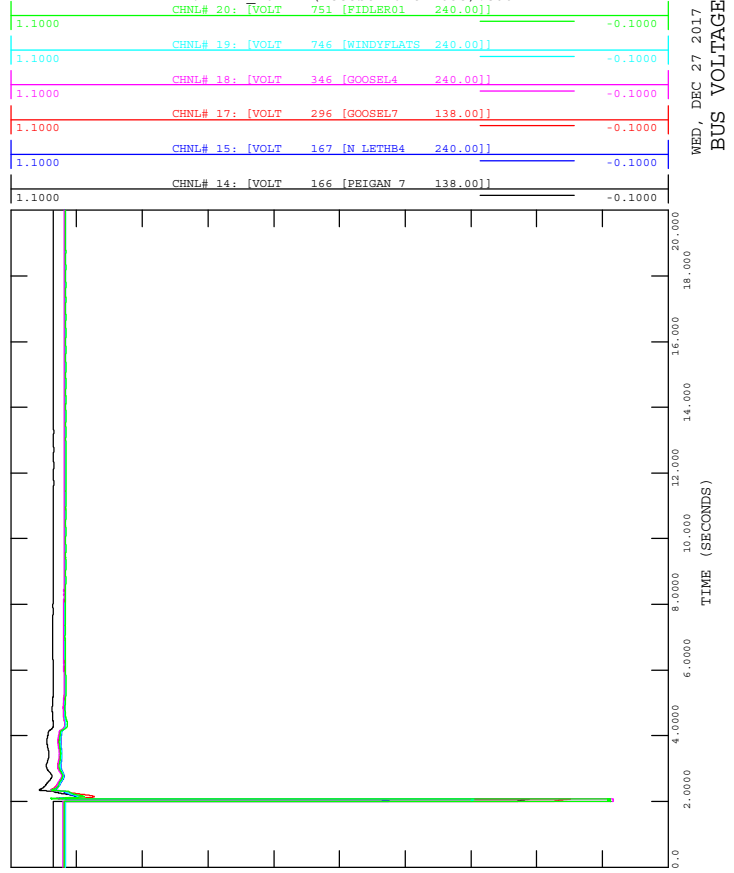


WED, DEC 27 2017 10:52  
MACHINE PELEC (PU)



FIGURE E-27D  
P524\_2019SP\_SC4\_POST  
3 PHASE FAULT ON 1072L AT 103S

FILE: E-27\_1072L ( Goose lake 103S).out

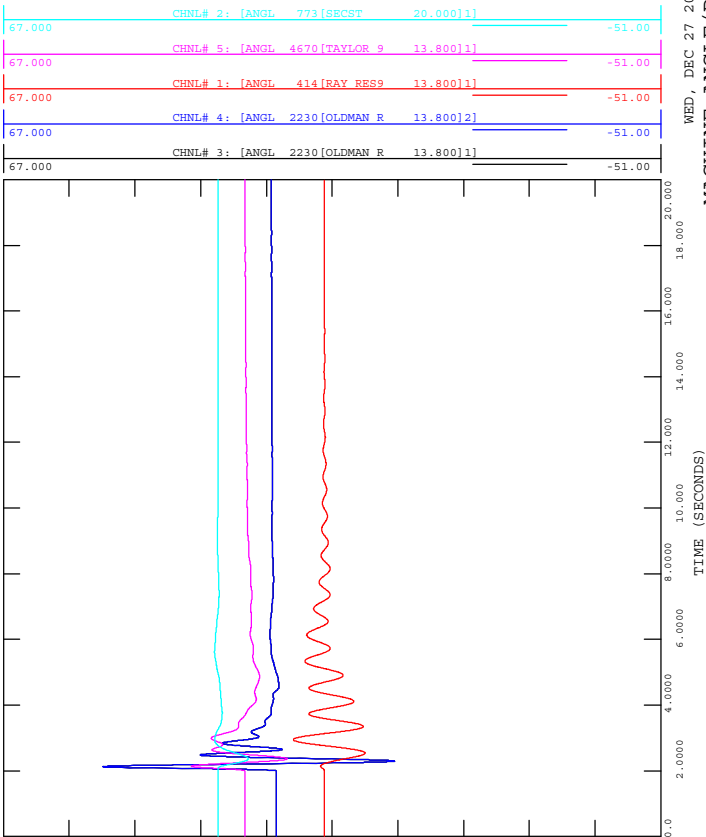


WED, DEC 27 2017 10:52  
BUS VOLTAGE (PU)



FIGURE E-27A  
P524\_2019SP\_SC4\_POST  
3 PHASE FAULT ON 1072L AT 103S

FILE: E-27\_1072L ( Goose lake 103S).out

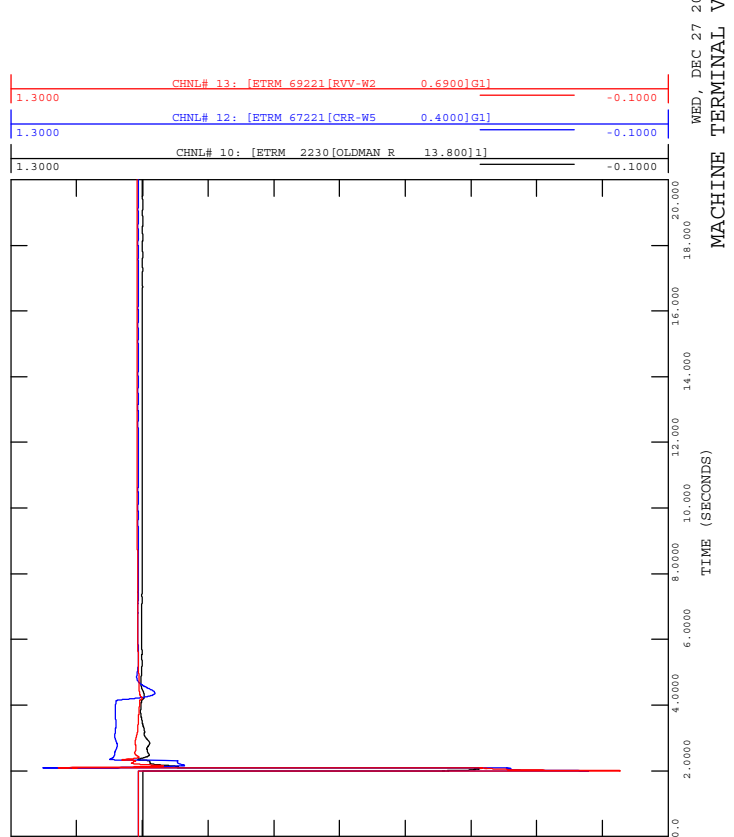


WED, DEC 27 2017 10:52  
MACHINE ANGLE (DEGREE)



FIGURE E-27C  
P524\_2019SP\_SC4\_POST  
3 PHASE FAULT ON 1072L AT 103S

FILE: E-27\_1072L ( Goose lake 103S).out



WED, DEC 27 2017 10:52  
MACHINE TERMINAL VOLTAGE



FIGURE E-27F  
 P524\_2019SP\_SC4\_POST  
 3 PHASE FAULT ON 1072L AT 103S

FILE: E-27\_1072L ( Goose lake 103S).out

WED, DEC 27 2017 10:52  
 BRANCH Q FLOW (PU)

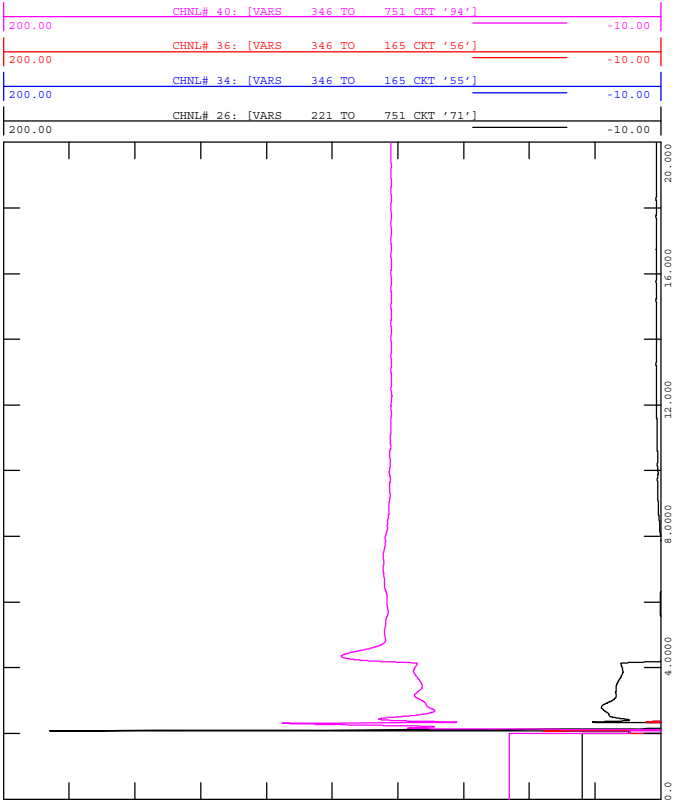


FIGURE E-27E  
 P524\_2019SP\_SC4\_POST  
 3 PHASE FAULT ON 1072L AT 103S

FILE: E-27\_1072L ( Goose lake 103S).out

WED, DEC 27 2017 10:52  
 BRANCH P FLOW (PU)

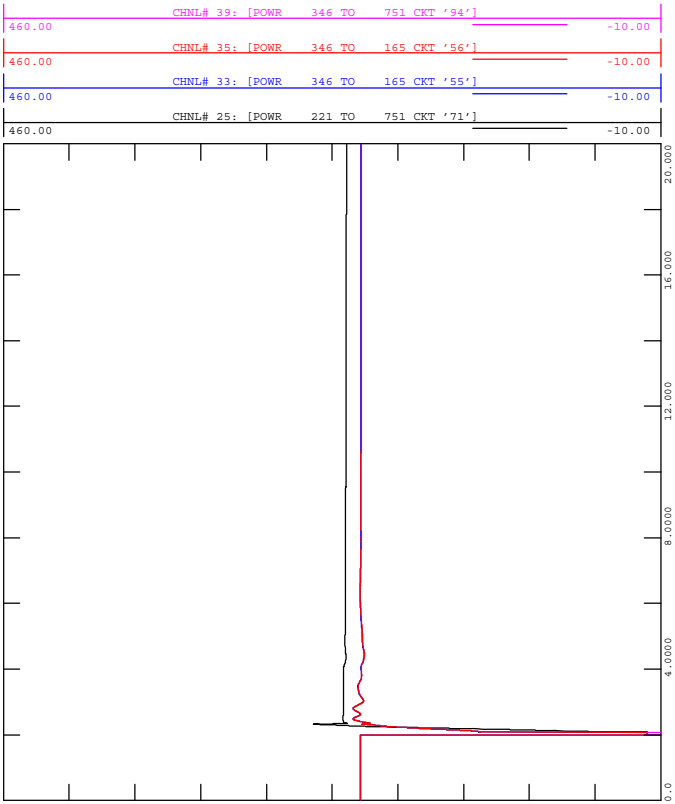
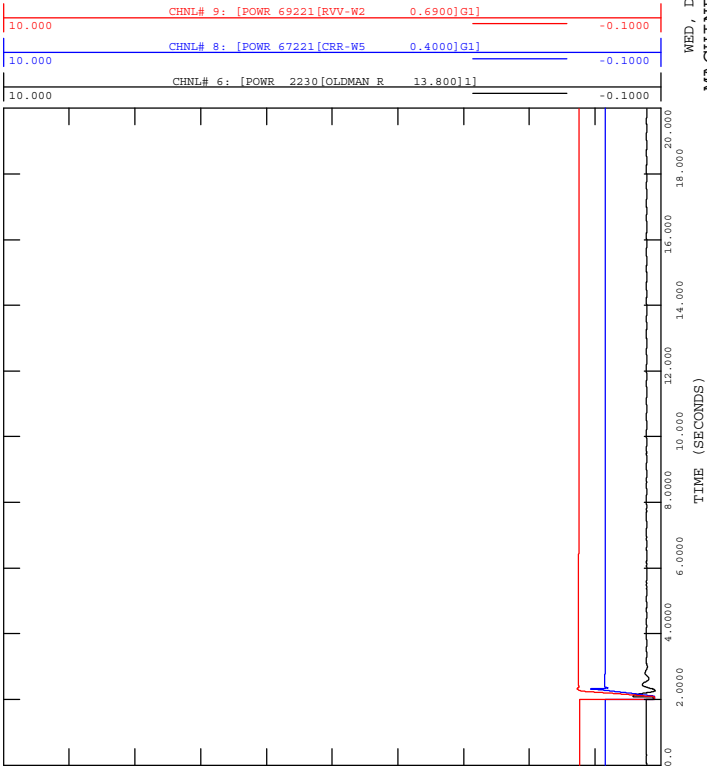




FIGURE E-28B  
P524\_2019SP\_SC4\_POST  
3 PHASE FAULT ON 1072L AT 205S

FILE: E-28\_1072L (Castle Rock Ridge 205S ).out

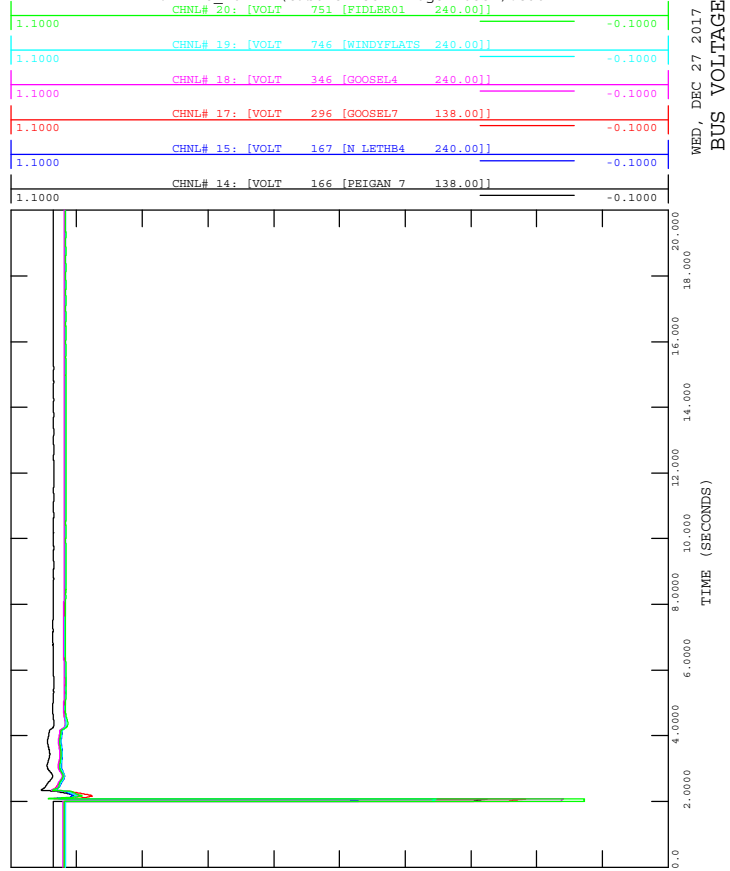


WED, DEC 27 2017 10:52  
MACHINE PELEC (PU)



FIGURE E-28D  
P524\_2019SP\_SC4\_POST  
3 PHASE FAULT ON 1072L AT 205S

FILE: E-28\_1072L (Castle Rock Ridge 205S ).out

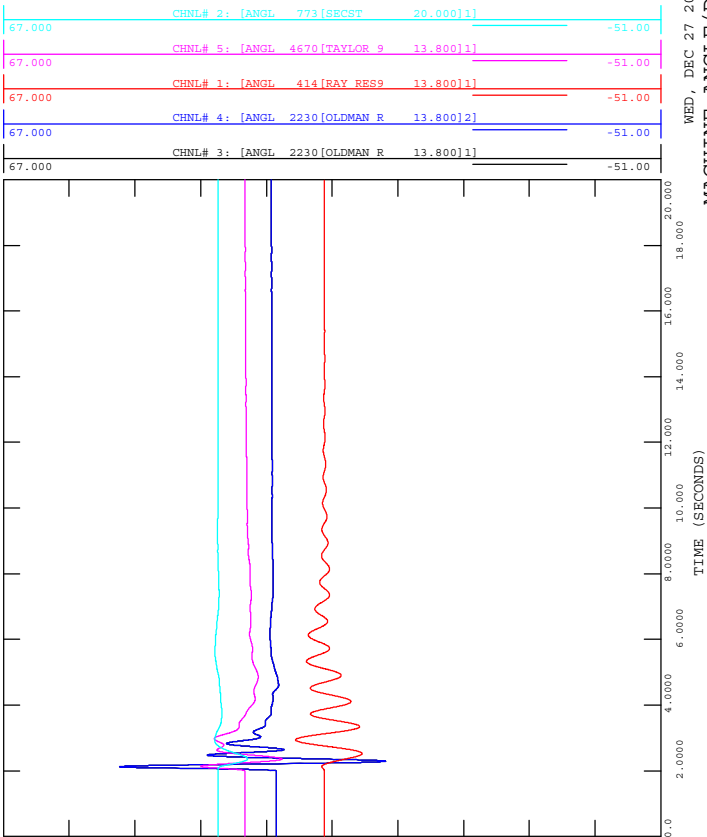


WED, DEC 27 2017 10:52  
BUS VOLTAGE (PU)



FIGURE E-28A  
P524\_2019SP\_SC4\_POST  
3 PHASE FAULT ON 1072L AT 205S

FILE: E-28\_1072L (Castle Rock Ridge 205S ).out

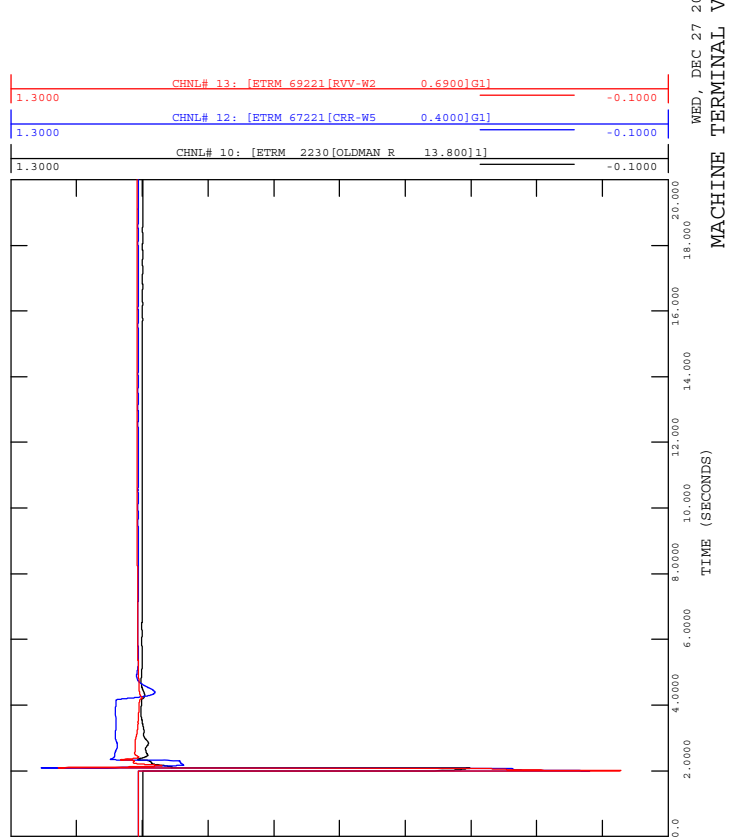


WED, DEC 27 2017 10:52  
MACHINE ANGLE (DEGREE)



FIGURE E-28C  
P524\_2019SP\_SC4\_POST  
3 PHASE FAULT ON 1072L AT 205S

FILE: E-28\_1072L (Castle Rock Ridge 205S ).out



WED, DEC 27 2017 10:52  
MACHINE TERMINAL VOLTAGE



FIGURE E-28F  
P524\_2019SP\_SC4\_POST  
3 PHASE FAULT ON 1072L AT 205S

FILE: E-28\_1072L (Castle Rock Ridge 205S ).out

WED, DEC 27 2017 10:52  
BRANCH Q FLOW (PU)

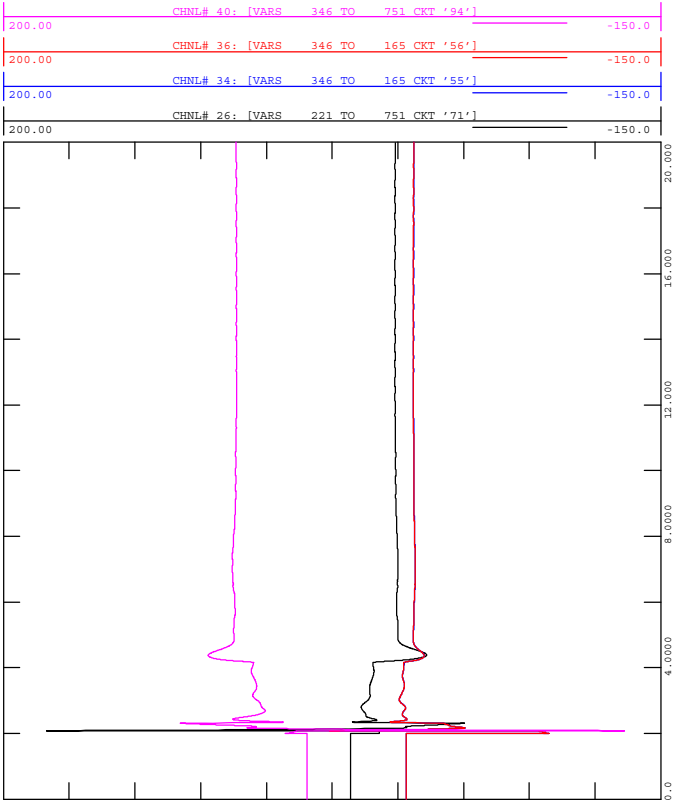
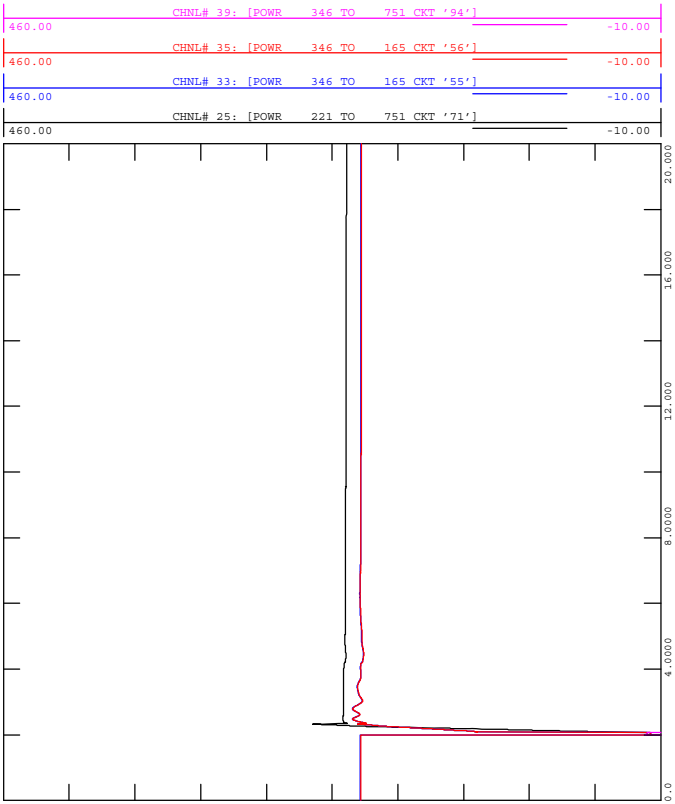


FIGURE E-28E  
P524\_2019SP\_SC4\_POST  
3 PHASE FAULT ON 1072L AT 205S

FILE: E-28\_1072L (Castle Rock Ridge 205S ).out

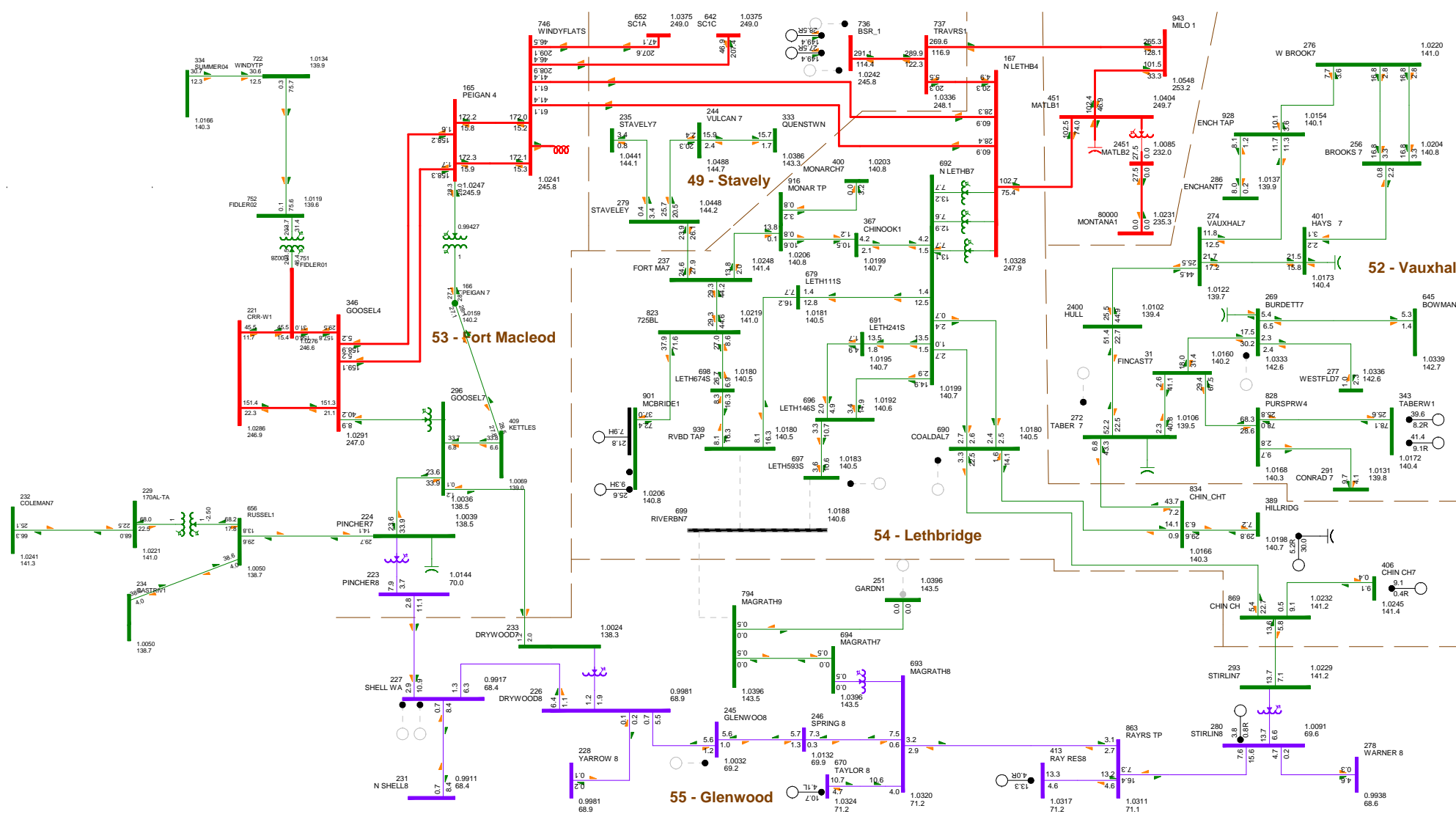
WED, DEC 27 2017 10:52  
BRANCH P FLOW (PU)





## Attachment F

### Post-Mitigation Power flow Diagrams

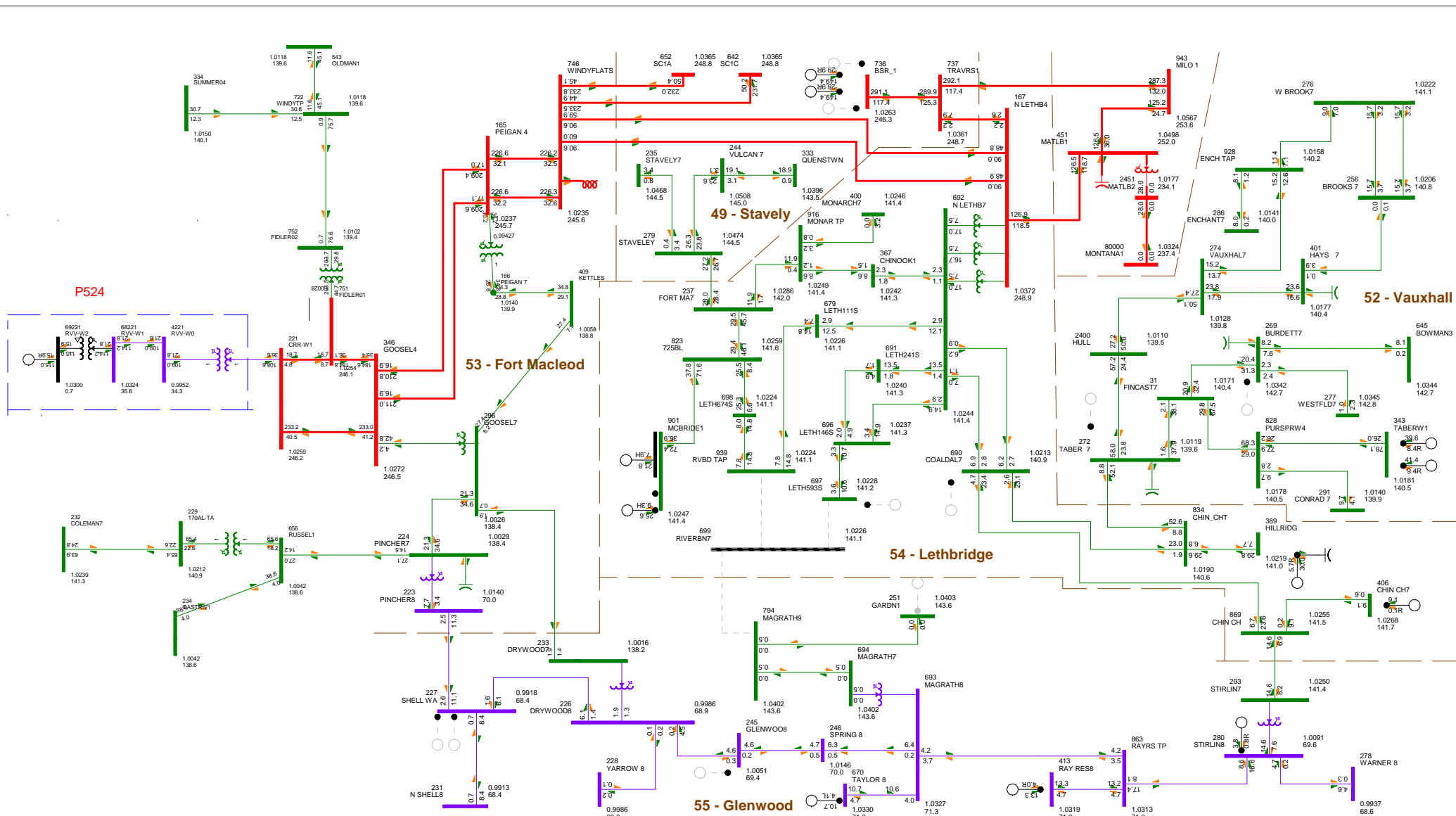


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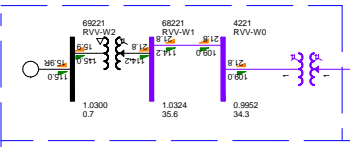
BC Import:18.0 MW    Sask Import:-0.1 MW    MATL Import:0.0 MW

**P524\_2019SL\_SC1\_PRE  
618S TRANSFORMER & POST RAS#36  
FIG F-1  
SAT, JAN 06 2018 0:55**

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



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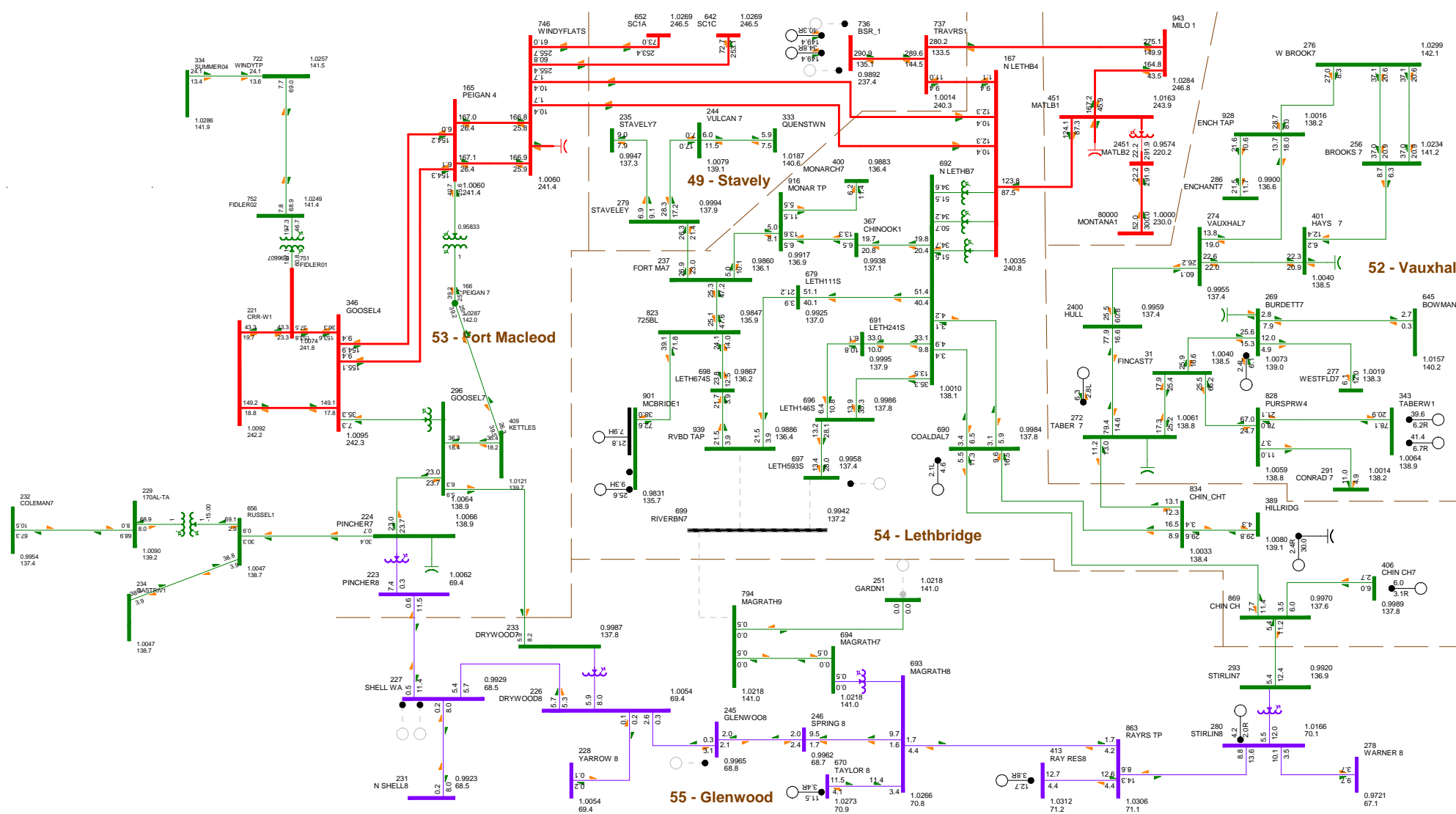
BC Import:25.0 MW

Sask Import:-0.1 MW

MATL Import:0.0 MW

**P524\_2019SL\_SC2\_POST**  
**618S TRANSFORMER & POST RAS#36**  
**FIG F-2**  
**SAT, JAN 06 2018 0:55**

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

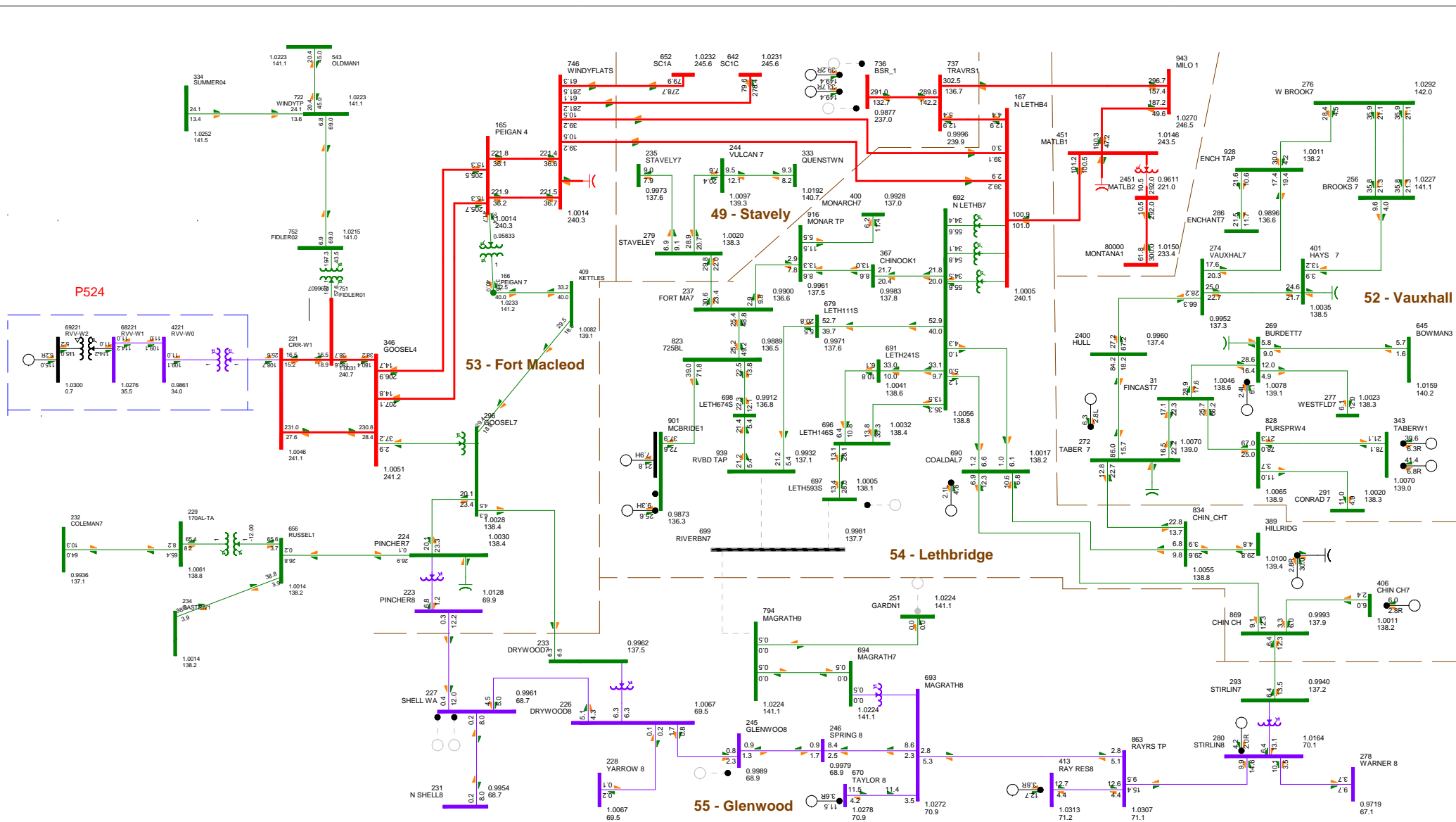


**P524**

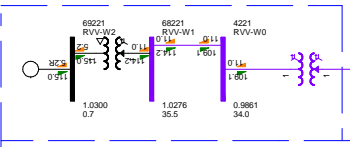
BC Import: 814.0 MW    Sask Import: 150.0 MW    MATL Import: 300.0 MW

**P524\_2019SP\_SC3\_PRE  
618S TRANSFORMER & POST RAS#36  
FIG F-3  
SAT, JAN 06 2018 0:55**

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



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BC Import:817.6 MW    Sask Import:150.0 MW    MATL Import:0.0 MW

**P524\_2019SL\_SC4\_POST**  
**618S TRANSFORMER & POST RAS#36**  
**FIG F-4**  
**SAT, JAN 06 2018 0:55**

Bus - Voltage (kV/pu)  
 Branch - MW/Mvar  
 Equipment - MW/Mvar  
 100.0%Rate A

kV: <=25.000 <=69.000 <=138.000 <=240.000 <=500.000 >500.000