Attachment 2 – South Termination of SATR 911L Replacement Project Assessment

South Termination of SATR 911L Replacement Project Assessment

AESO Project Number: RP-787-1

March 22, 2012

Date: March 22, 2012

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APEGGA Permit to Practice P-08200

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1. INTRODUCTION

This study report describes the analysis undertaken by the Alberta Electric System Operator (AESO) to assess the system impact of a new Windy Flats 138S substation to terminate the proposed 240 kV 1037L/1038L, approved as part of the Southern Alberta Transmission Reinforcement (SATR) as a replacement for the existing 911L.

1.1 Background

In the SATR needs identification document (SATR NID), the AESO recommended the construction of a 240 kV looped system in southern Alberta to meet the need for transmission system reinforcement in southern Alberta, driven predominantly by the forecast development of wind generation.[1] Part of this 240 kV looped system was construction of a new double-circuit 240 kV line terminating in the south at Peigan 59S substation and in the north at the future Foothills substation. The Peigan 59S substation was also proposed to be equipped with 2x200MVA transformers replacing the existing 179MVA transformer in order to reliably integrate the existing wind in the area at the Peigan Hub. This new double-circuit 240 kV line now designated as 1037L/1038L and the Peigan 59S upgrade, was approved in **Stage I**, paragraph 1 in *Approval No. U2011-115* (SATR NID Approval).

In the course of developing its facilities application in respect of 1037L/1038L, the transmission facility owner (TFO), AltaLink Management Ltd. (AltaLink) identified two alternatives for the southern termination point of the proposed transmission line. The original Peigan 59S termination and a new Windy Flats 138S substation termination, each as further described below.

1.2 Description of Alternate Configurations

The Peigan Configuration would terminate 1037L/1038L at the existing Peigan 59S substation and includes the installation of two shunt reactors[2] and two 200 MVA 240/138 kV transformers at Peigan 59S to replace the existing 179 MVA.

The Windy Flats Configuration would terminate 1037L/1038L at a new Windy Flats 138S substation east of the Piikani Reserve and includes the following transmission developments.

- new Windy Flats 138S substation including two shunt reactors and one 240/320/400 MVA 240/138 kV transformer
- in-out the existing 240 kV double circuit line 967L/1084L
- re-terminate the existing 603L and 608L at Windy Flats 138S (currently terminated at Peigan 59S)

[1] Application No. 1600862, SATR NID Executive Summary, page i.
[2] The shunt reactors are common to each of the alternatives and are further described in the AESO's Windy Flats Amendment to the SATR NID Approval.

The current area transmission system is shown in Figure 1-1. The Peigan Configuration is shown in Figure 1-2 and the Windy Flats Configuration is shown in Figure 1-3.

Figure 1-1: 2011 Area Transmission System

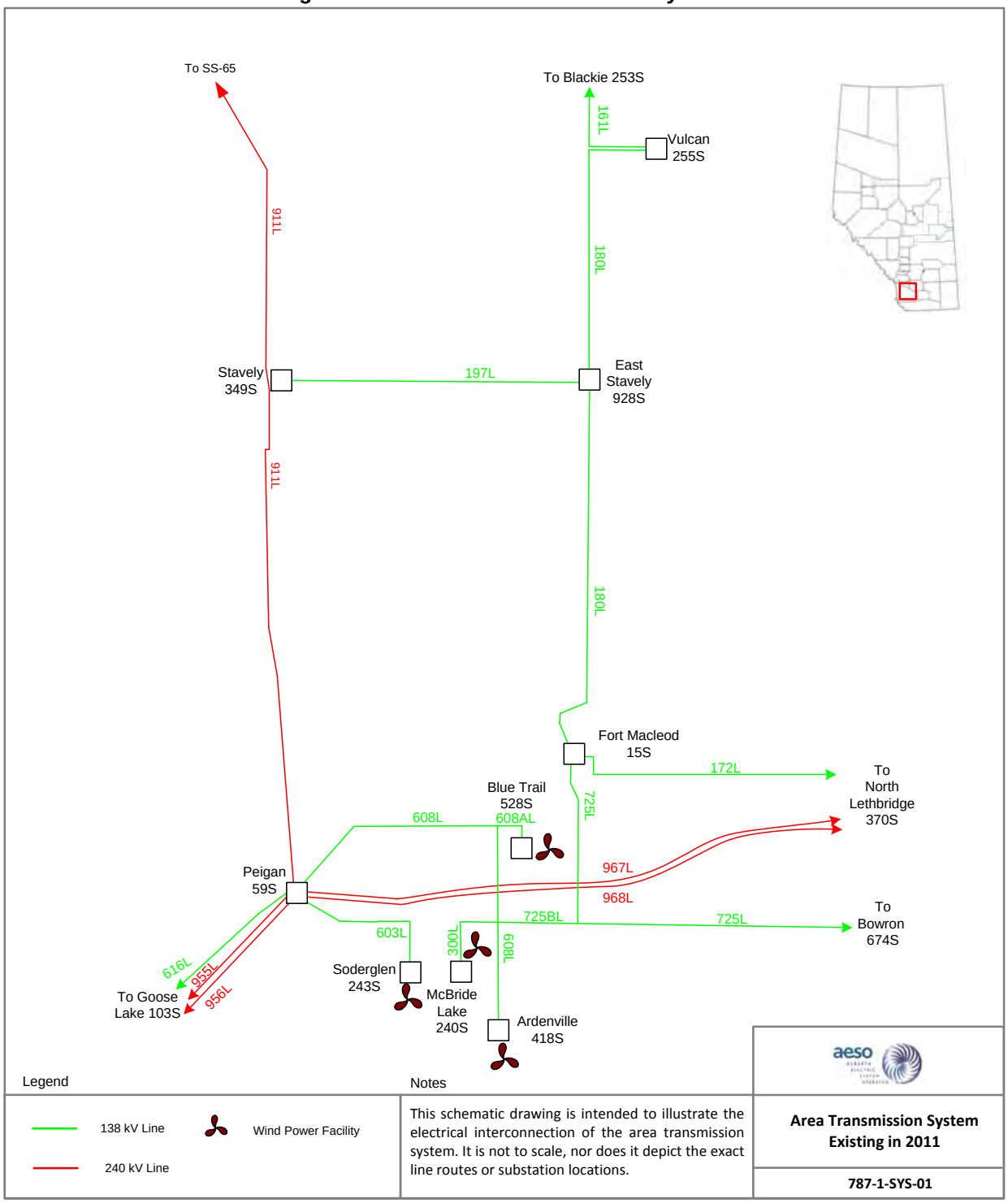


Figure 1-2: Area Transmission System –Peigan configuration

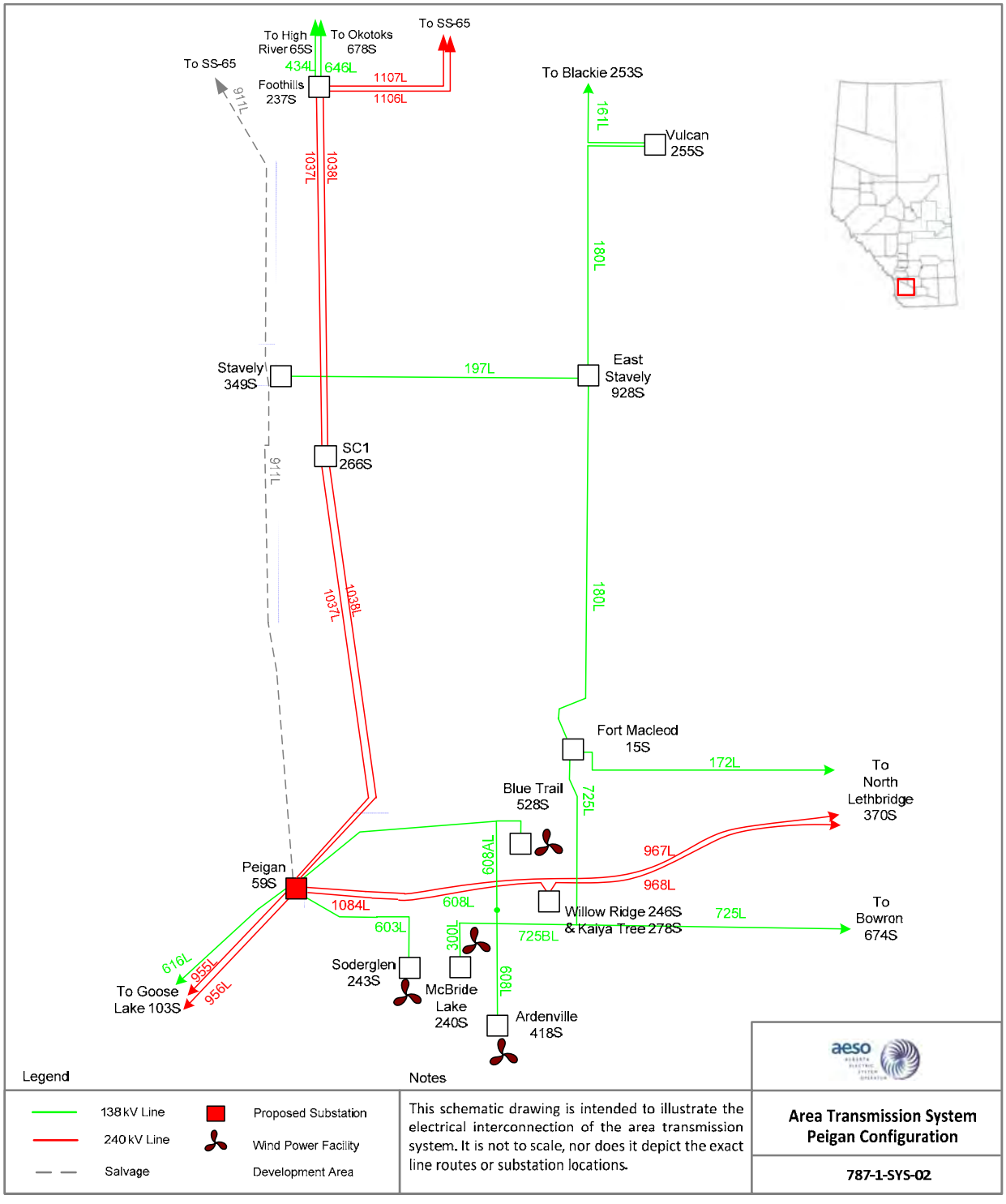
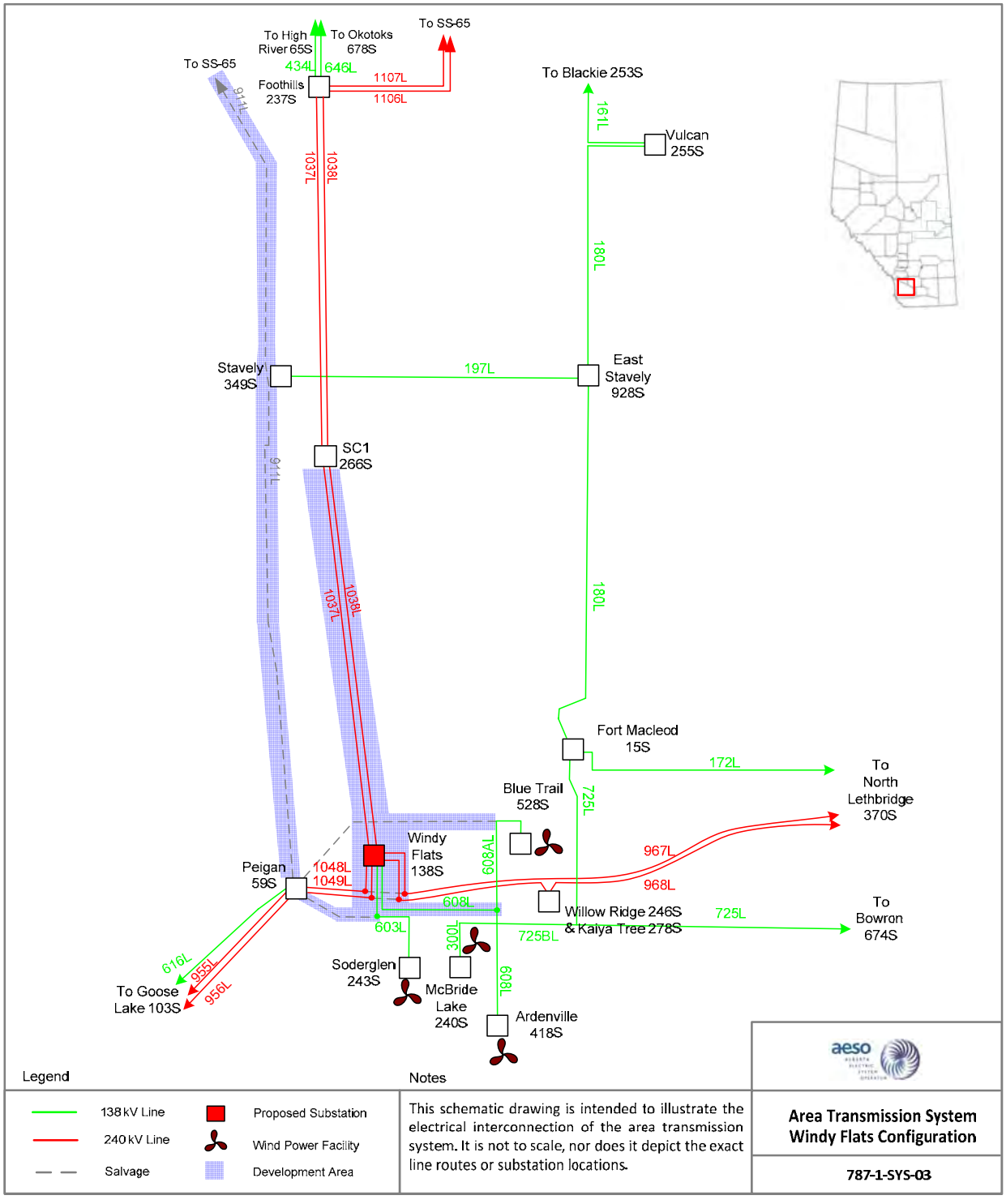


Figure 1-3: Area Transmission System –Windy Flats Configuration



1.3 Study Scope

The AESO performed steady state analysis to assess the system response for the Windy Flats Configuration. As a point of reference for comparative purposes, the AESO also completed steady state analysis for the Peigan Configuration.[3]

This report is presented in the following six sections:

1. Introduction
2. Criteria and Assumptions
3. Peigan Configuration Evaluation
4. Windy Flats Configuration Evaluation
5. Transformer Capacity Increase
6. Summary and Conclusions

The SATR Stage I and Stage II developments are planned to be completed by the end of 2015. In order to fully assess the system performance, 2016 summer peak and summer light load conditions were chosen for the assessment as further described in section 2.6.

2. CRITERIA AND ASSUMPTIONS

The analyses were conducted by using PTI PSS/E version 32.0.3. The following criteria and assumptions reflect the development of the base cases and the methodology used in the analyses.

2.1 Reliability Criteria

The AESO Transmission Reliability Criteria forms the basis for AIES studies. The transmission system will normally be designed to meet the Reliability Criteria under credible worst-case loading and generation conditions.

The AESO Reliability Criteria requires that system performance be evaluated under Category A (N-0 - system normal) conditions and Category B (N-1 - single element out-of-service) conditions. Category A represents a normal system with no contingencies and all facilities in service. Under Category A conditions, 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 ratings, and the system must be stable with no cascading outages.

Category B events result in the loss of any single specified system element under specified fault conditions with normal clearing. One of the specified system elements could be a generator, a transmission circuit, a transformer or single

[3] Peigan 59S, as the southern termination point for 1037L/1038L,originally formed part of the Evaluation of Alternatives described in section 5 of the SATR NID.

pole of a DC line. The acceptable impact on the system is the same as Category A.

The thermal limits used in this analysis were one hundred percent of the normal summer and winter ratings.

2.2 Applicable AESO OPPs

The desired minimum and maximum voltage limits specified by AESO OPP-702 were used to identify Category A (N-0) system voltage violations. OPP-702 voltage violations were alleviated prior to Category B (N-1) contingency analysis. Table 2-1 summarizes the OPP-702 desired voltage range for substations in the study area.

Table 2-1: OPP-702 Desired VoltageRange

Substation Name and Number	Nominal Voltage (kV)	Desired Min (kV)	Desired Max (kV)
Pincher Creek 396S	138	138	144
Peigan 59S	240	235	258
	138	138	144
North Lethbridge 370S	240	240	260
	138	138	144
West Brook T28S	240	245	260
	138	138	144

The extreme minimum and maximum voltage limits specified by the AESO Reliability Criteria were used to identify Category B system voltage violations. Table 2-2 shows the applicable acceptable steady state voltages for different transmission voltage classes. Table 2-3 shows the AESO's voltage deviation criteria for Point of Delivery (POD).

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

Nominal	Extreme Minimum	Normal Minimum	Normal Maximum	Extreme Maximum
240	220	240	264	264
138	124	135	145	150

Table 2-3: Voltage Deviation Criteria

	Time Period		
Parameter and Reference Point	Post Transient (Up to 30s)	Post Auto Control (30 sec to 5 min)	Post Manual Control (Steady State)
Voltage Deviation from Steady State at POD Low Voltage Bus	± 10%	± 7%	± 5%

2.3 Load Forecast

The study area loads modeled in the 2016 summer peak and summer light load scenarios are provided in Table 2-4 and are consistent with the AESO's 2009 corporate load forecast, *Future Demand and Energy Outlook (2009-2029)*.

Table 2-4: 2016 Load Forecast

Area	Summer Peak Load (MW)	Summer Light Load (MW)
53 Ft. MacLeod	44.5	9.6

2.4 Generation Assumptions

To test the credible worst-case generation conditions, the study assumes high wind conditions and dispatch of all existing wind generation directly connected to the Peigan 59S substation. Table 2-5 shows the local existing wind generation directly connected to Peigan 59S substation.

Table 2-5: Existing Wind Farm connected to Peigan 59S

Number	Plant Name	Net to Grid Output (MW)	Type
1	Soderglen	68	Wind
2	Kettles Hill	63	Wind
3	Blue Trail	66	Wind
4	Ardenville	66	Wind
Total		263	

2.5 Transmission System Assumptions

In the 2016 summer peak and summer light base cases, all of the SATR Stage I and Stage II developments described in the SATR NID Approval were assumed to be in place. SATR Stage III facilities were excluded from this analysis.

2.6 Study Scenarios

This analysis was based on assumptions regarding the future configuration of the AIES. Generally, the study assumptions reflect the best information available to the AESO at the time the studies were conducted. Study assumptions regarding the bulk transmission system are consistent with the study assumptions used in developing the Draft AESO *2011 Long-Term Transmission Plan*.

The 2016 summer peak and summer light load conditions were analyzed for each of the two alternatives. The following four study scenarios are:

- Scenario 1 is the 2016 summer peak load condition with the Peigan Configuration.
- Scenario 2 is 2016 summer light load condition with the Peigan Configuration.

- Scenario 3 is 2016 summer peak load condition with the Windy Flats Configuration.
- Scenario 4 is 2016 summer light load condition with the Windy Flats Configuration.[4]

MATL interchange was set to 0 MW. The Alberta to British Columbia (BC) interchange, the Alberta to Saskatchewan interchange and the City of Medicine Hat interchange assumptions are shown in Table 2-6 below.

Table 2-6: Study Scenarios

	Scenario 1	Scenario 2	Scenario 3	Scenario 4
AB to BC (MW)	0	700	0	700
AB to SK (MW)	0	150	0	150
CMH to AIES (MW)	-26	50	-26	50

Table Note: Positive numbers show that the flow direction is the same as the description in first column; negative numbers show the reversed direction.

Table 2-7 lists the critical Category B contingencies to assess technical performance. These critical contingencies were applied to each of the four scenarios.

Table 2-7: Critical Category B Contingencies

Contingency	From Substation	To Substation
1201L	Langdon 102S	BC Cranbrook
955L	Goose Lake 103S	Peigan 59S
956L	Goose Lake 103S	Peigan 59S
967L	Peigan 59S (Windy Flats 138S)	North Lethbridge 370S
968L	Willow Ridge 246S	North Lethbridge 370S
1037L	Peigan 59S (Windy Flats 138S)	Foothills 237S
1038L	Peigan 59S (Windy Flats 138S)	Foothills 237S
924L	Milo 356S	Langdon 102S
927L	Milo 356S	Langdon 102S

2.7 Monitored Areas

The study areas monitored for voltage and thermal violations during contingency analysis are shown in Table 2-8. These AESO planning areas are located in southern Alberta.

Table 2-8: Summary of Monitored Areas for Contingency Analysis

Area Number	Area Name	Voltage Range
4	Medicine Hat	138 kV and above
45	Strathmore/Blackie	138 kV and above
46	High River	138 kV and above

[4] Each scenario assumes high wind conditions as described in Sec 2.4.

Area Number	Area Name	Voltage Range
47	Brooks	138 kV and above
48	Empress	138 kV and above
49	Stavely	138 kV and above
52	Vauxhall	138 kV and above
53	Fort Macleod	69 kV and above
54	Lethbridge	138 kV and above
55	Glenwood	69 kV and above

3. PEIGAN CONFIGURATION EVALUATION

The performance of the Peigan Configuration system under Category A and Category B conditions was assessed by using 2016 summer peak and summer light cases. 608L overload was observed under Category A for both Scenario 1 and 2.[5] The results are summarized in Table 3-1. Only the 608L overloads persist under the Category B conditions; there is no additional violation observed under Category B conditions. The load flow diagrams are shown in attachment A and attachment B.

Table 3-1: Category A Overloads

Scenario	Figure Number	Contingency	Overloaded Element			
			Monitored Element	MVA Rating	MVA Flow	% Flow
1	A-1	Base Case	608L(608AL_TP 608AL – 59S)	96	138	144
2	B-1	Base Case	608L(608AL_TP 608AL – 59S)	96	145	151

4. WINDY FLATS CONFIGURATION EVALUATION

The performance of the Windy Flats Configuration system under Category A and Category B conditions was assessed using 2016 summer peak and summer light cases. There is no violation observed under either Category A or Category B conditions. The load flow diagrams are shown in attachment C and attachment D.

[5] 608L overload is managed by current AESO OPP-515.

5. TRANSFORMER SIZE AND REDUNDANCY CONSIDERATION

In the SATR NID, the AESO described the high wind interest in southern Alberta, including 724 MW of actual wind interest near the Peigan 59S collector substation.[6] As part of the SATR analysis, the AESO ascribed 262 MW of wind dispatch at Peigan 59S in 2017[7].

In the SATR recommended plan, the AESO proposed Peigan 59S as the south termination point for 1037L/1038L. Due to the high wind interest in the area, the SATR NID proposed to replace the existing 179 MVA transformer at Peigan 59S with 2x200 MVA 240/138kV transformers. In respect of the new Windy Flats substation, the AESO is proposing to leave the existing 179 MVA transformer at Peigan 59S in place and install one 400 MVA 240/138kV transformer at Windy Flats 138S substation to meet Transmission Reliability Criteria. Table 5-1 shows the local existing wind generation that will be directly connected to the Windy Flats 138S substation.

Table 5-1: Existing Wind Farm to be connected to Windy Flats 138S

Number	Plant Name	Net to Grid Output (MW)	Type
1	Soderglen	68	Wind
2	Blue Trail	66	Wind
3	Ardenville	66	Wind
Total		200	

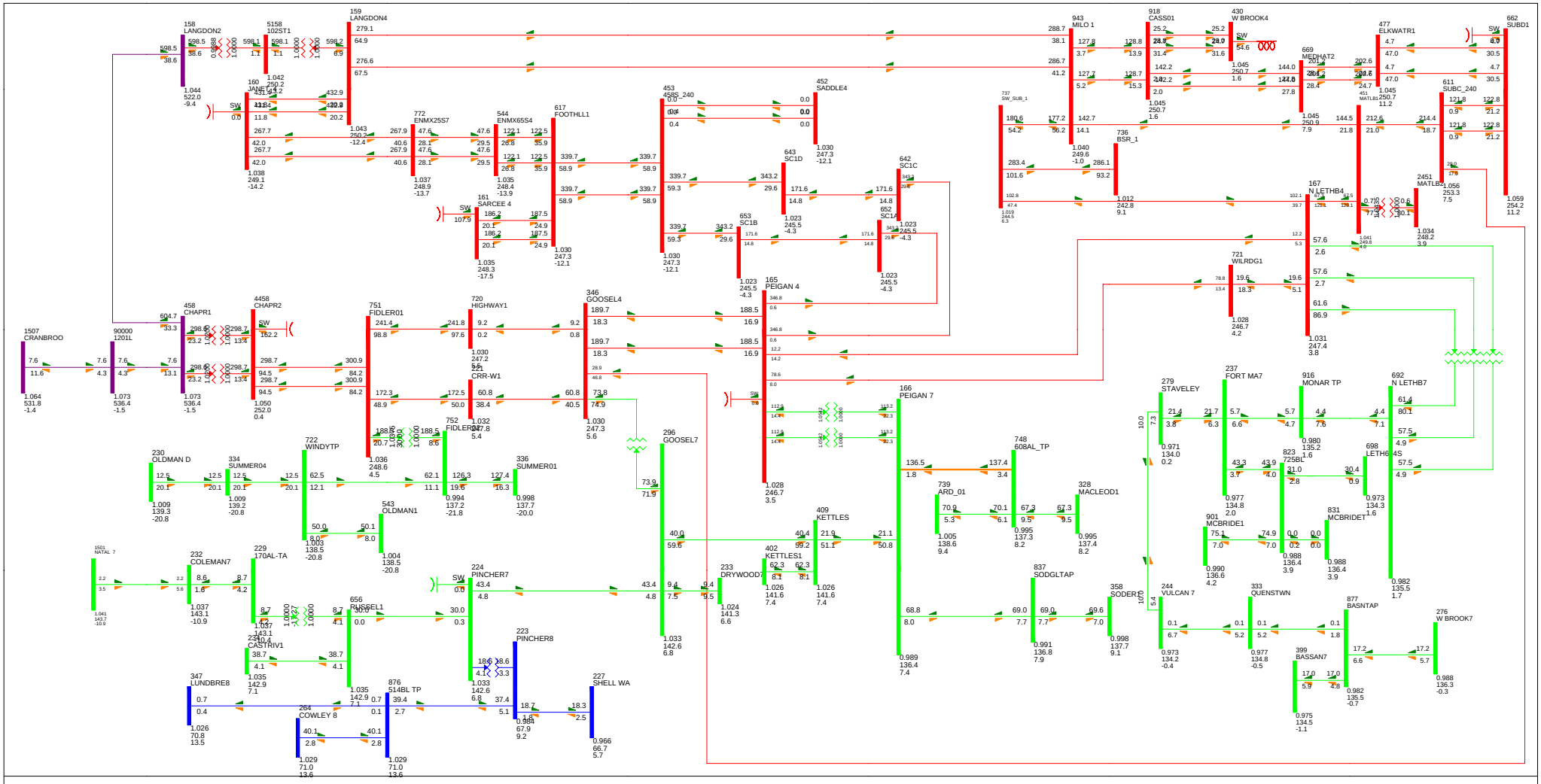
Provision at Windy Flats will be made so a second 240/138kV transformer can be added in the future when deemed necessary. The AESO will continue to monitor the wind connection projects in the vicinity of Windy Flats 138S substation and will file for the need to increase the capacity at Windy Flats 138S substation as the need arises.

6. SUMMARY AND CONCLUSIONS

The assessment demonstrated that the Peigan and Windy Flats configurations have similar functionality and proved that the proposed Windy Flats 138S configuration can meet system requirements and at the same time mitigate the 608L Category A constraint.

[6] SATR NID, Section 3.1.1 and Table 5.1-4.
[7] SATR NID, Table 5.1-4, page 31.

Appendix A:
Summer Peak load flow diagrams for Peigan Configuration



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2016 SOUTH SYSTEM

Figure A1 - System Normal Condition

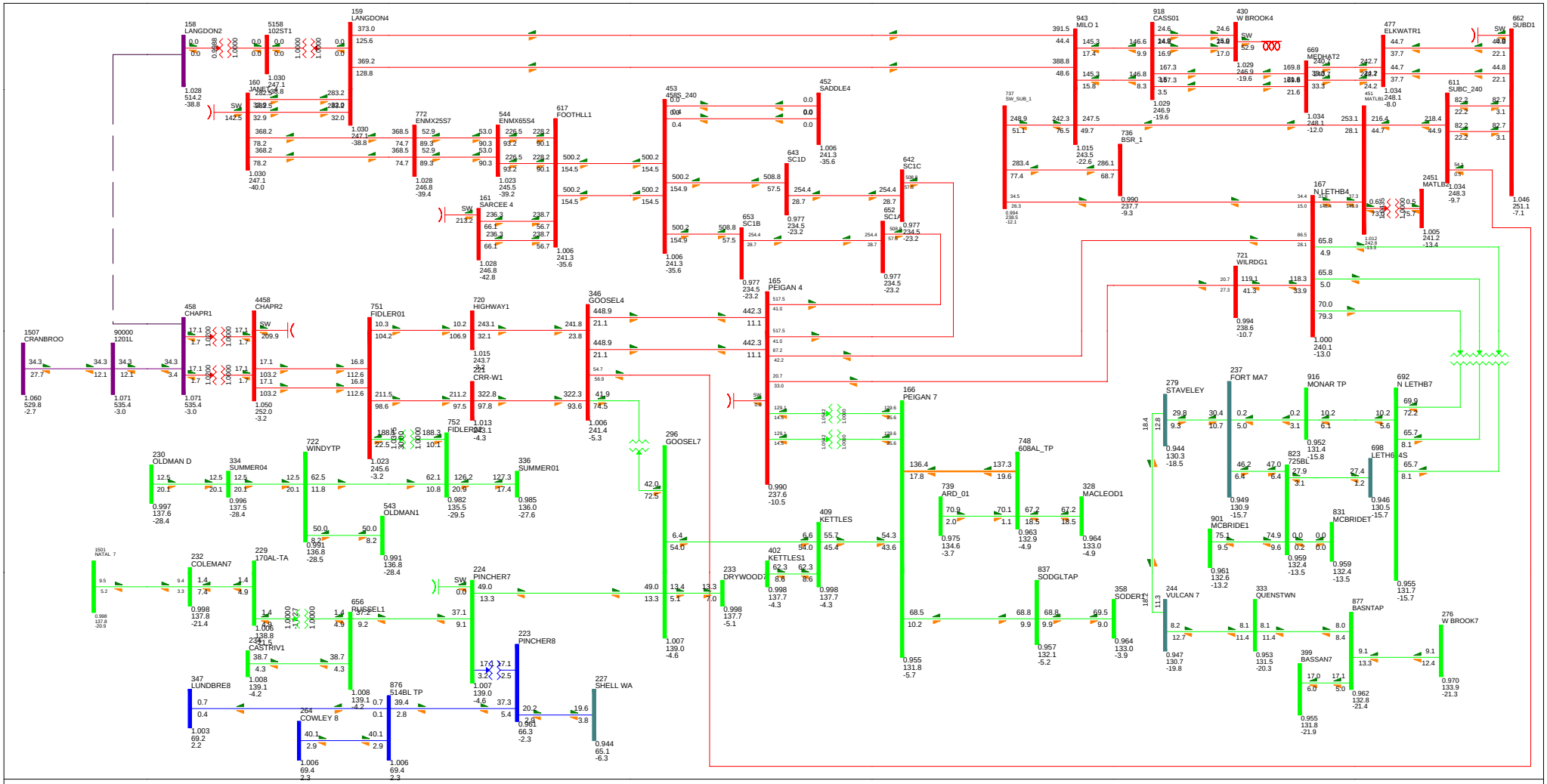
2016 SP Peigan Configuration

Thursday, December 1, 2011

KV: <=34.500 <=69.000 <=138.000 <=240.000
<=500.000 <=600.000 >600.000

BC Export: 0.0 MW

Bus - VOLTAGE (KV/PU) 100.0%RATEA
Branch - MW/MVAR
Equipment - MW/MVAR



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2016 SOUTH SYSTEM

Figure A2 - 1235L Contingency

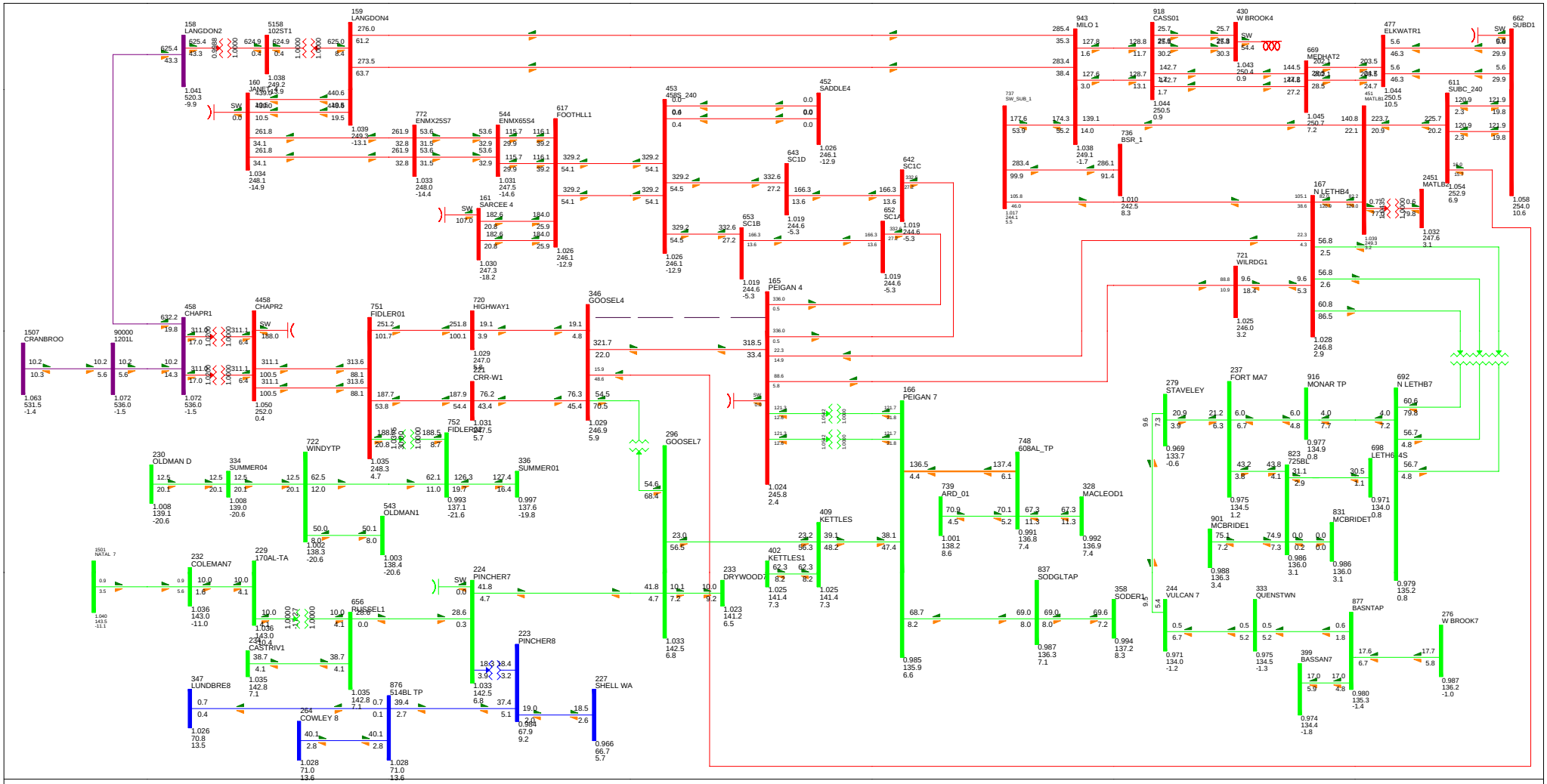
2016 SP Peigan Configuration

Thursday, December 1, 2011

KV: <=34.500 <=69.000 <=138.000 <=240.000
<=500.000 <=600.000 >600.000

BC Export: 0.0 MW

Bus - VOLTAGE (KV/PU) 100.0%RATEA
Branch - MW/MVAR
Equipment - MW/MVAR



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2016 SOUTH SYSTEM

Figure A3 - 955L Contingency

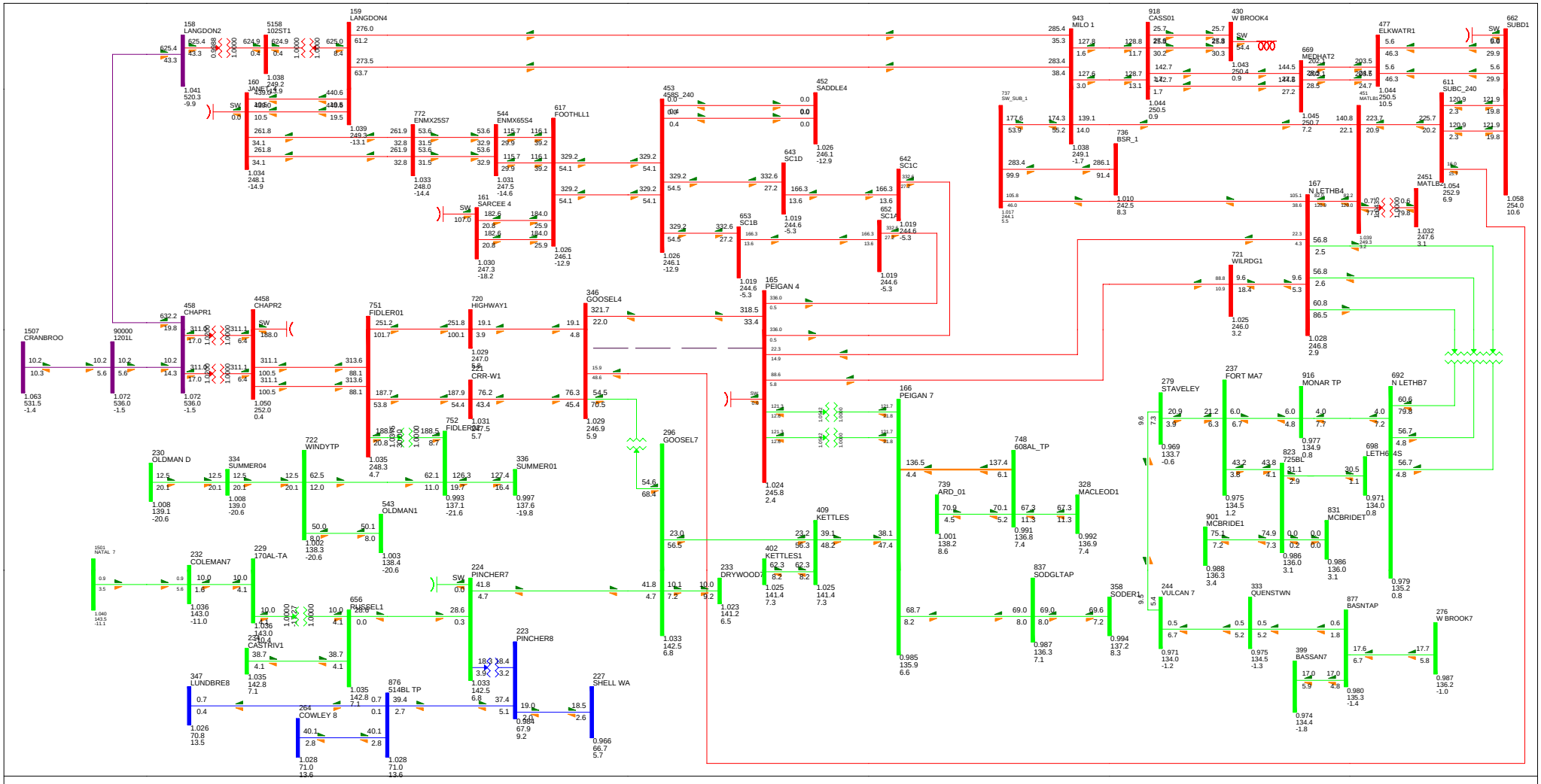
2016 SP Peigan Configuration

Thursday, December 1, 2011

KV: <=34.500 <=69.000 <=138.000 <=240.000
<=500.000 <=600.000 >600.000

BC Export: 0.0 MW

Bus - VOLTAGE (KV/PU) 100.0%RATEA
Branch - MW/MVAR
Equipment - MW/MVAR



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2016 SOUTH SYSTEM

Figure A4 - 956L Contingency

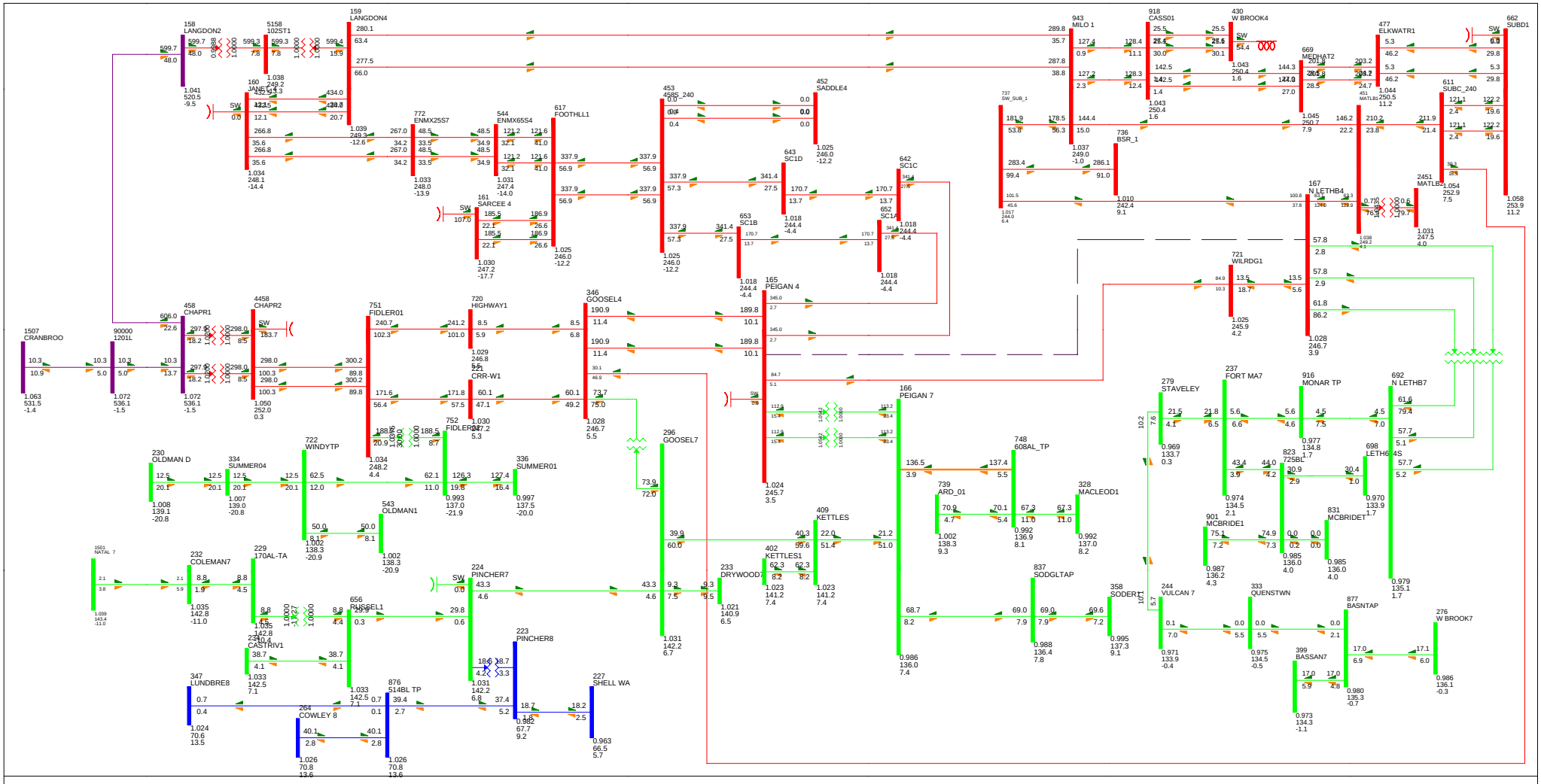
2016 SP Peigan Configuration

Thursday, December 1, 2011

KV: <=34.500 <=69.000 <=138.000 <=240.000
<=500.000 <=600.000 >600.000

BC Export: 0.0 MW

Bus - VOLTAGE (KV/PU) 100.0%RATEA
Branch - MW/MVAR
Equipment - MW/MVAR



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2016 SOUTH SYSTEM

Figure A5 - 967L Contingency

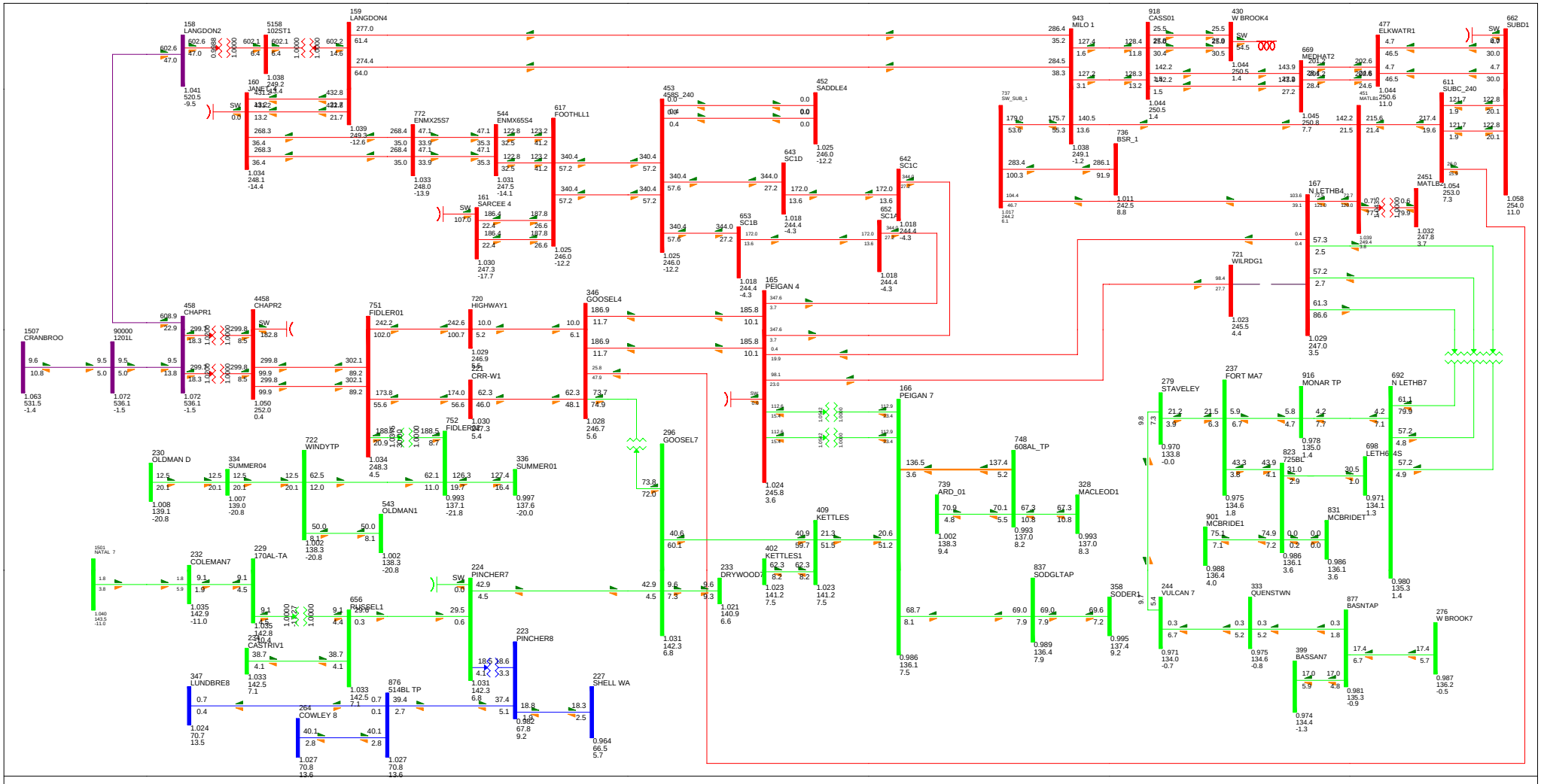
2016 SP Peigan Configuration

Thursday, December 1, 2011

KV: <=34.500 <=69.000 <=138.000 <=240.000
<=500.000 <=600.000 >600.000

BC Export: 0.0 MW

Bus - VOLTAGE (KV/PU) 100.0%RATEA
Branch - MW/MVAR
Equipment - MW/MVAR



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2016 SOUTH SYSTEM

Figure A6 - 968L Contingency

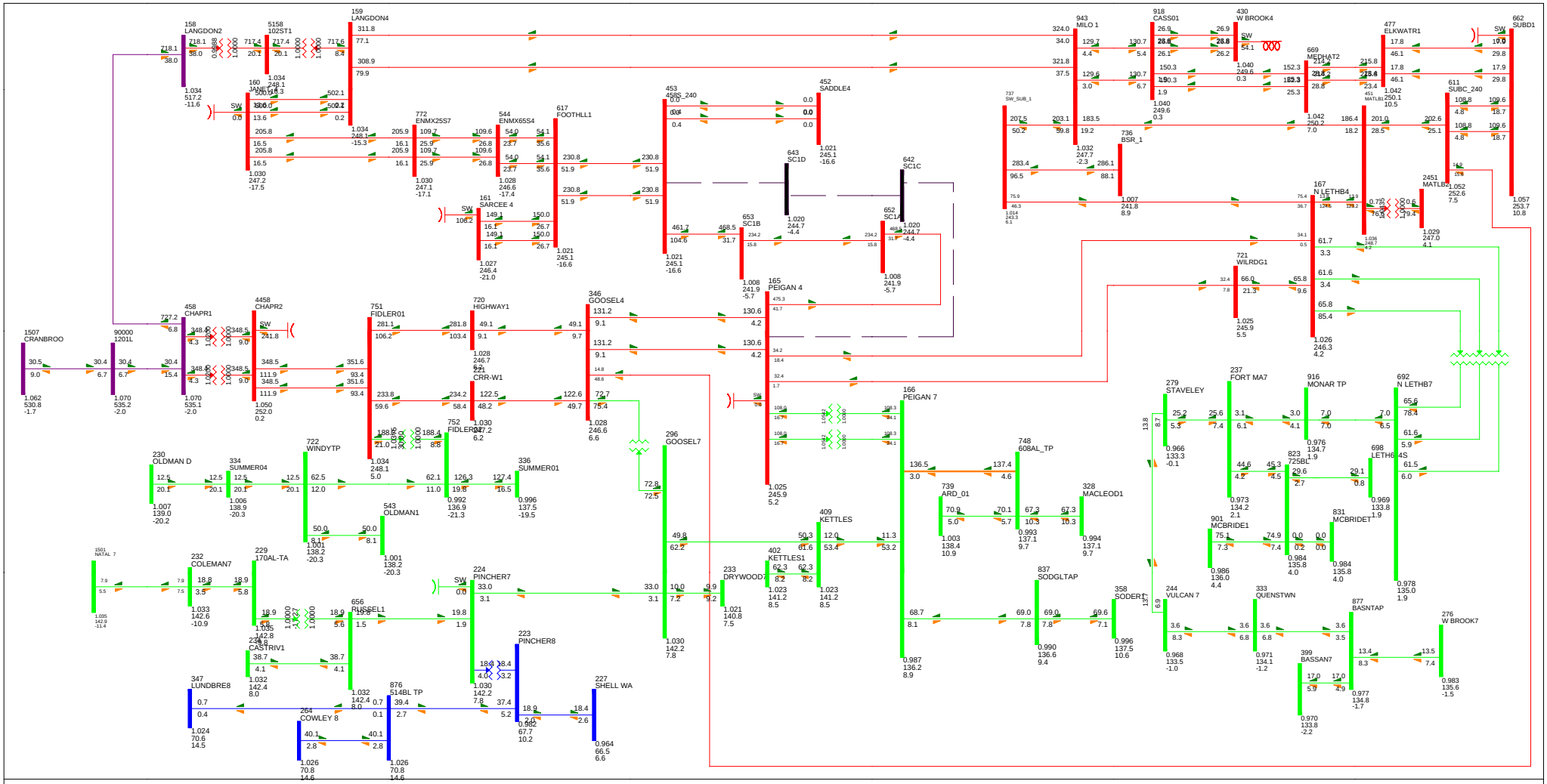
2016 SP Peigan Configuration

Thursday, December 1, 2011

KV: <=34.500 <=69.000 <=138.000 <=240.000
<=500.000 <=600.000 >600.000

BC Export: 0.0 MW

Bus - VOLTAGE (KV/PU) 100.0%RATEA
Branch - MW/MVAR
Equipment - MW/MVAR



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2016 SOUTH SYSTEM

Figure A7 - 1037L Contingency

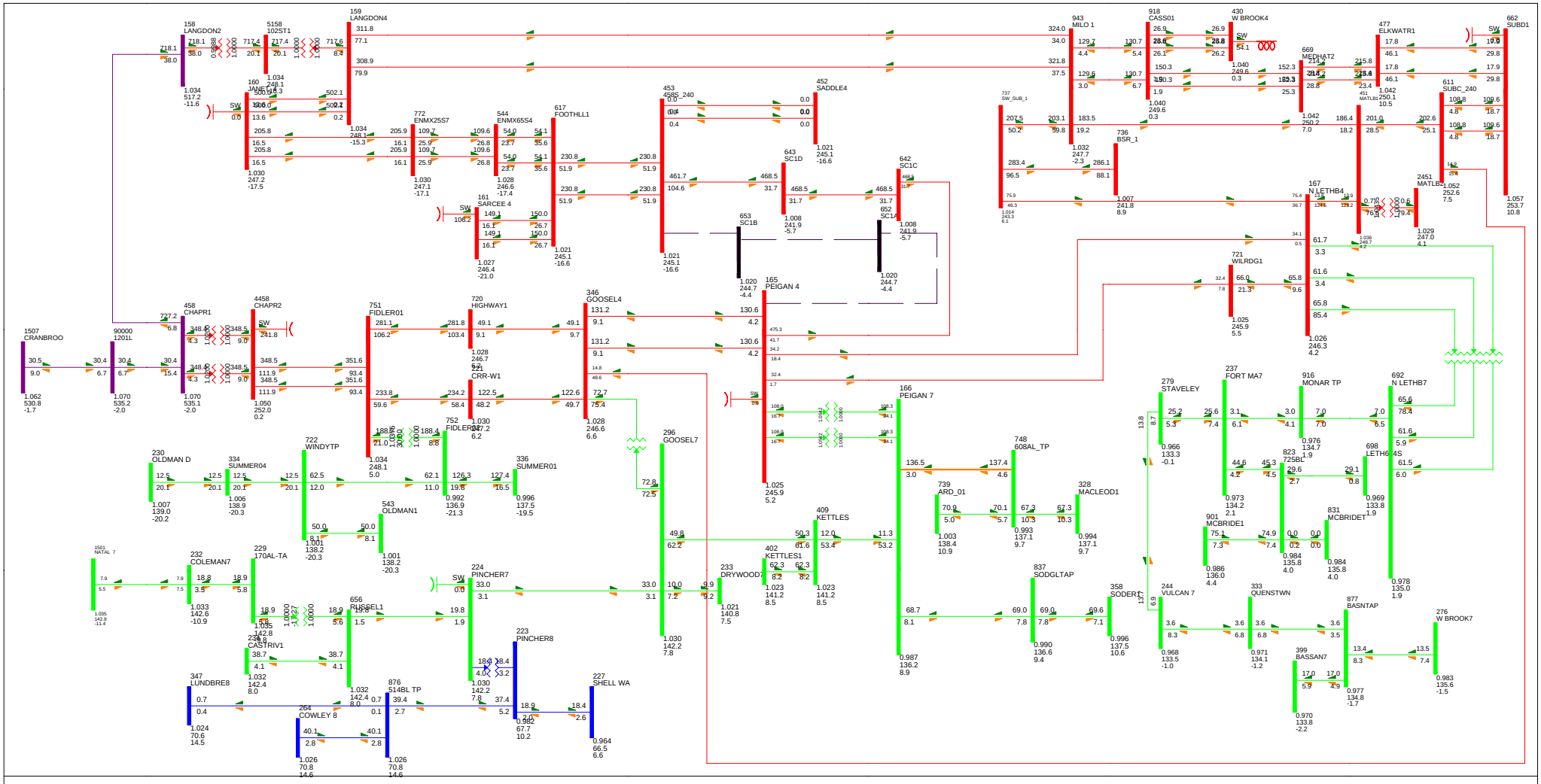
2016 SP Peigan Configuration

Thursday, December 1, 2011

KV: <=34.500 <=69.000 <=138.000 <=240.000
<=500.000 <=600.000 >600.000

BC Export: 0.0 MW

Bus - VOLTAGE (KV/PU) 100.0%RATEA
Branch - MW/MVAR
Equipment - MW/MVAR



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2016 SOUTH SYSTEM

Figure A8 - 1038L Contingency

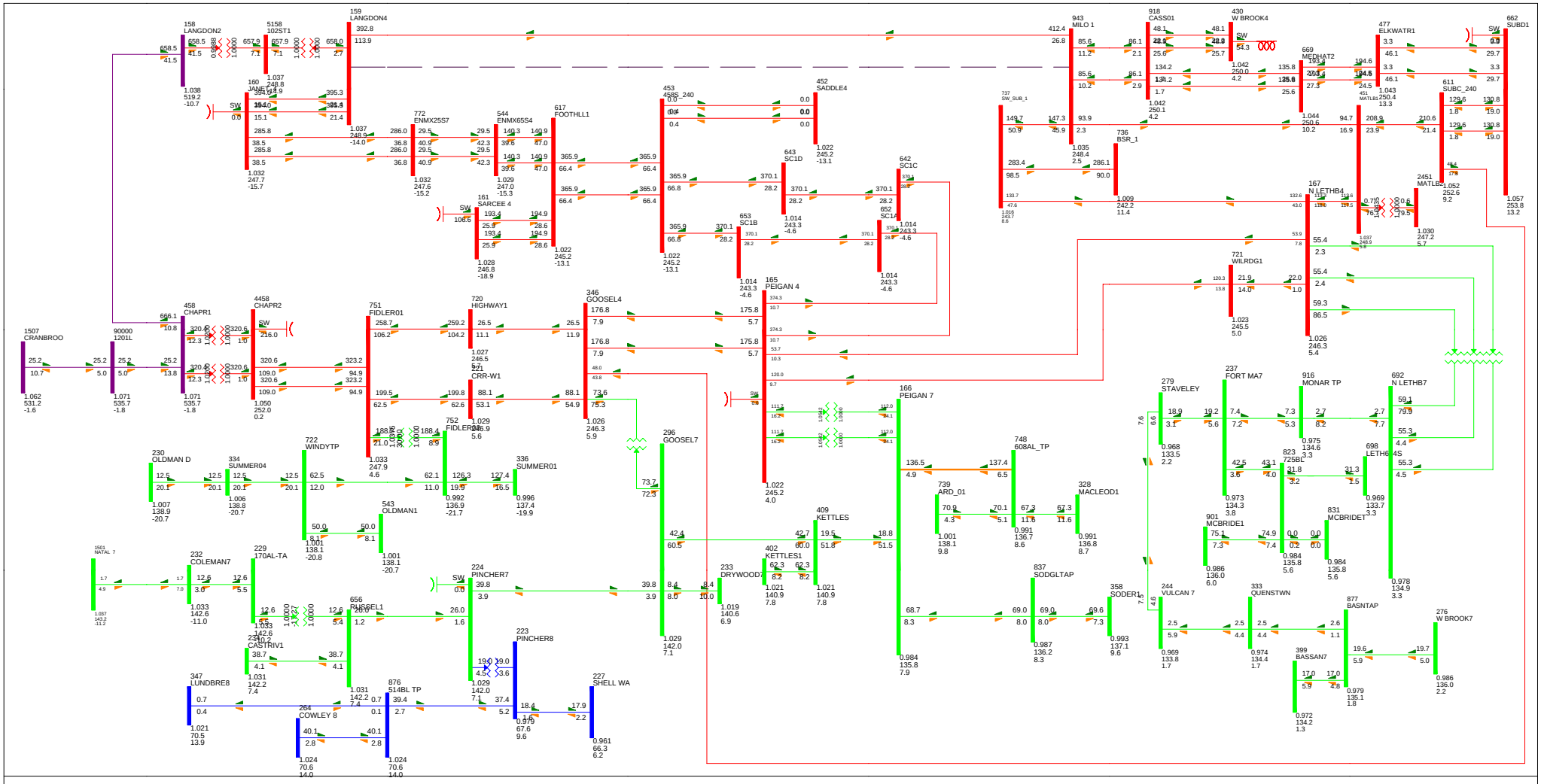
2016 SP Peigan Configuration

Thursday, December 1, 2011

KV: <=34.500 <=69.000 <=138.000 <=240.000
<=500.000 <=600.000 >600.000

BC Export: 0.0 MW

Bus - VOLTAGE (KV/PU) 100.0%RATEA
Branch - MW/MVAR
Equipment - MW/MVAR



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2016 SOUTH SYSTEM

Figure A9 - 924L Contingency

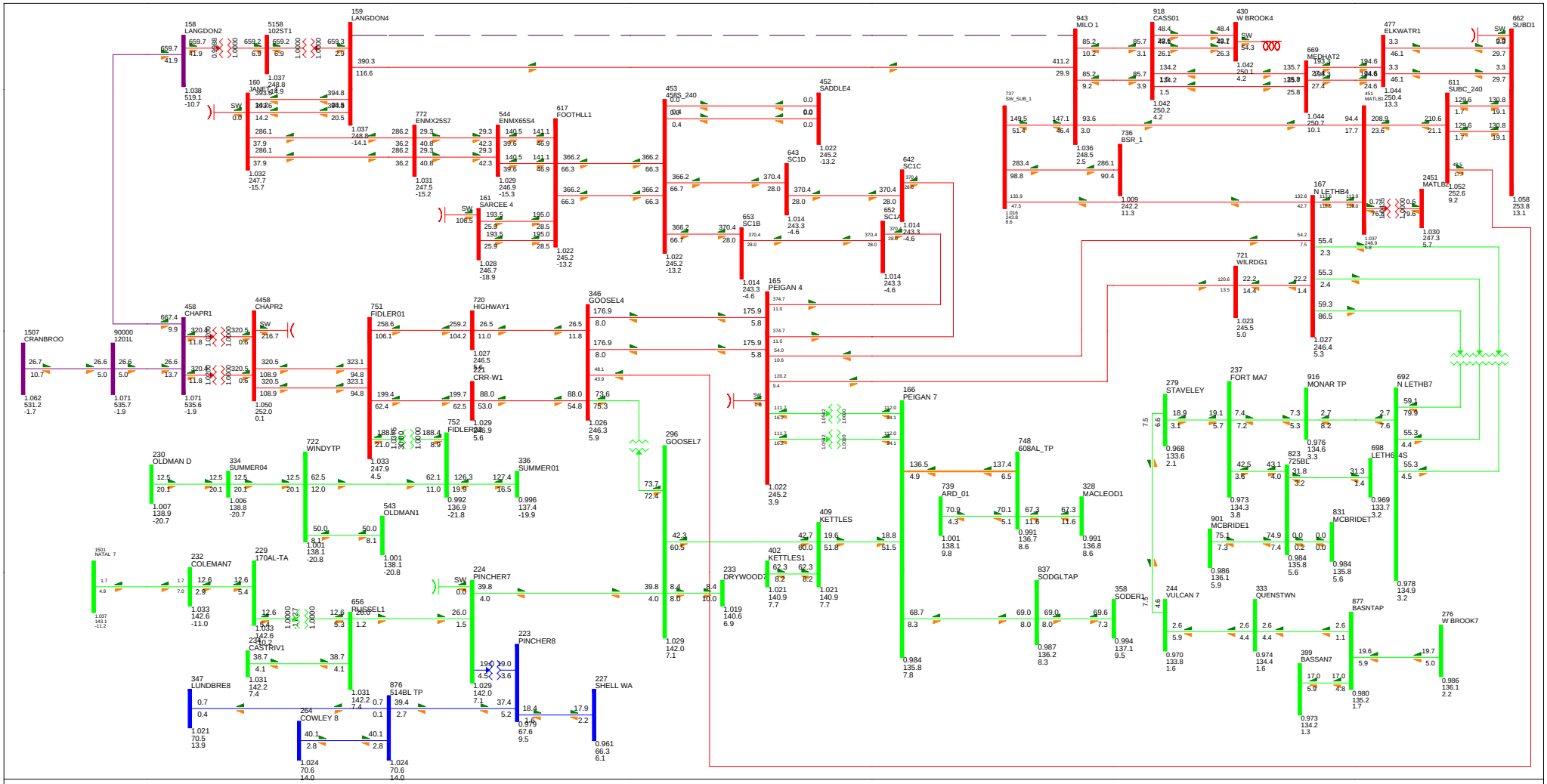
2016 SP Peigan Configuration

Thursday, December 1, 2011

KV: <=34.500 <=69.000 <=138.000 <=240.000
<=500.000 <=600.000 >600.000

BC Export: 0.0 MW

Bus - VOLTAGE (KV/PU) 100.0%RATEA
Branch - MW/MVAR
Equipment - MW/MVAR



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2016 SOUTH SYSTEM

Figure A10 - 927L Contingency

2016 SP Peigan Configuration

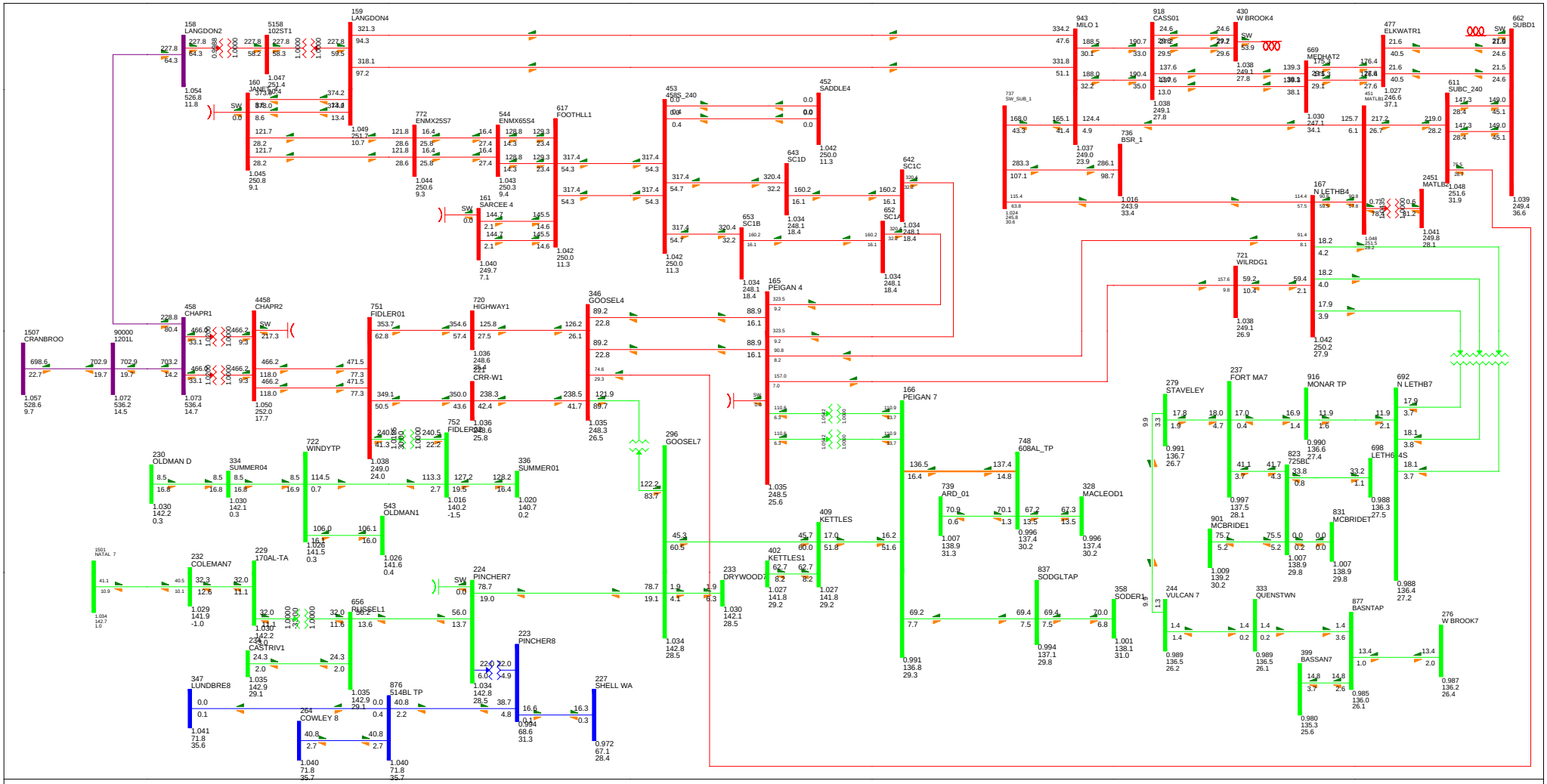
Thursday, December 1, 2011

KV: <=34.500 <=69.000 <=138.000 <=240.000
<=500.000 <=600.000 >600.000

BC Export: 0.0 MW

Bus - VOLTAGE (KV/PU) 100.0%RATEA
Branch - MW/MVAR
Equipment - MW/MVAR

Appendix B:
Summer Light load flow diagrams for Peigan Configuration



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2016 SOUTH SYSTEM

Figure B1 - System Normal Condition

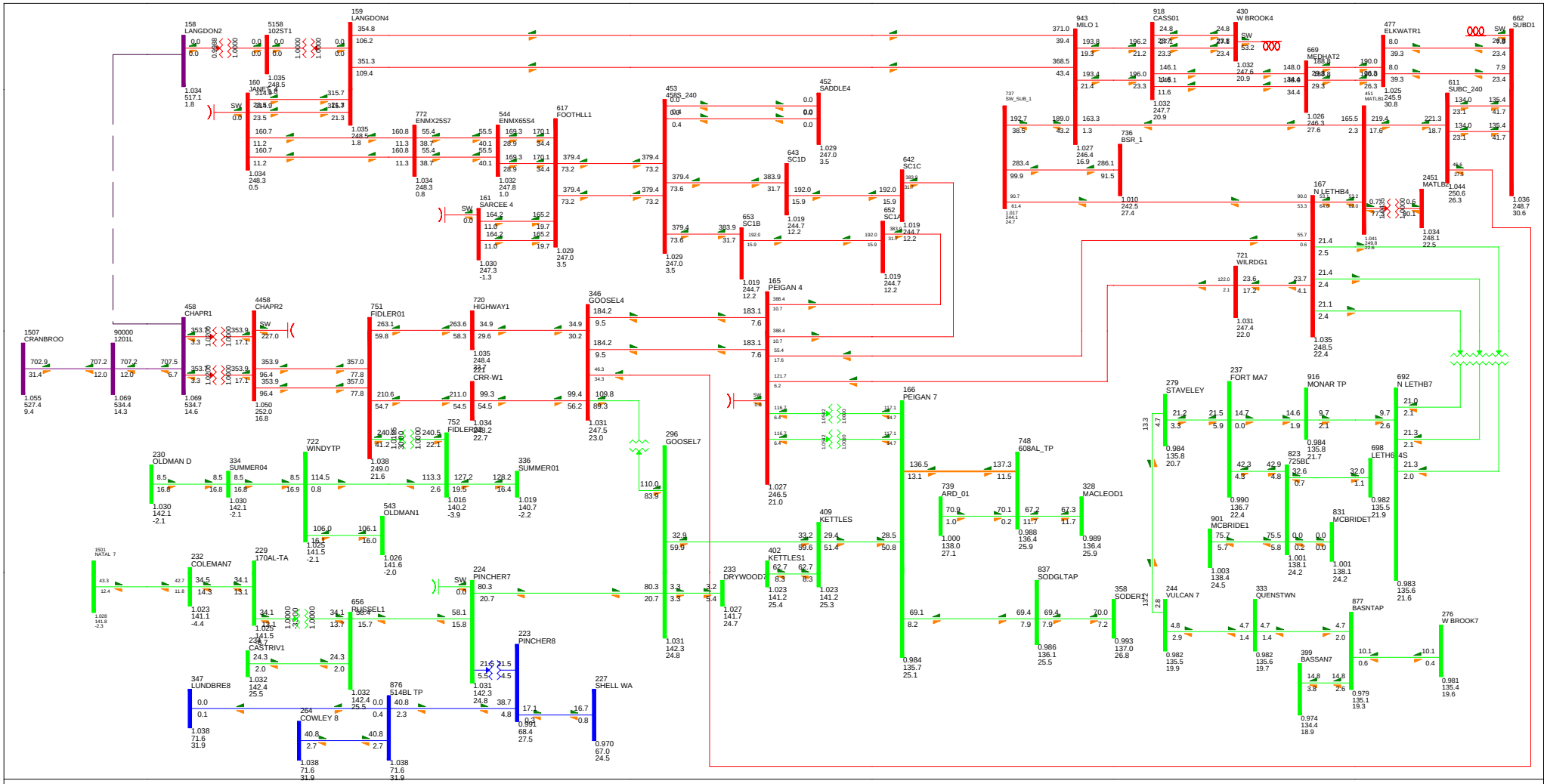
2016 SL Peigan Configuration

Thursday, December 1, 2011

KV: <=34.500 <=69.000 <=138.000 <=240.000
<=500.000 <=600.000 >600.000

BC Export: 700.0 MW

Bus - VOLTAGE (KV/PU) 100.0%RATEA
Branch - MW/MVAR
Equipment - MW/MVAR



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2016 SOUTH SYSTEM

Figure B2 - 1235L Contingency

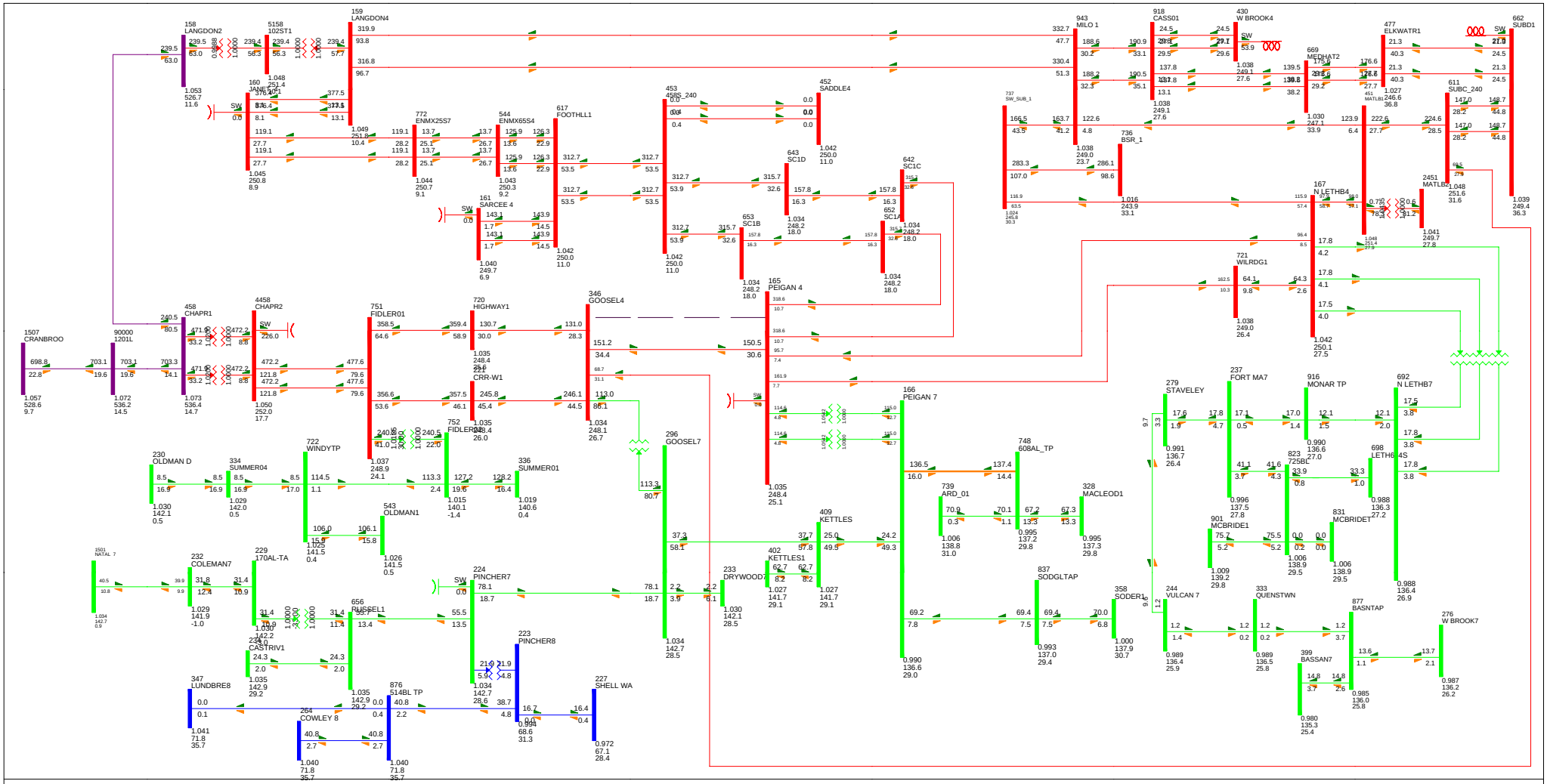
2016 SL Peigan Configuration

Thursday, December 1, 2011

KV: <=34.500 <=69.000 <=138.000 <=240.000
<=500.000 <=600.000 >600.000

BC Export: 700.0 MW

Bus - VOLTAGE (KV/PU) 100.0%RATEA
Branch - MW/MVAR
Equipment - MW/MVAR



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2016 SOUTH SYSTEM

Figure B3 - 955L Contingency

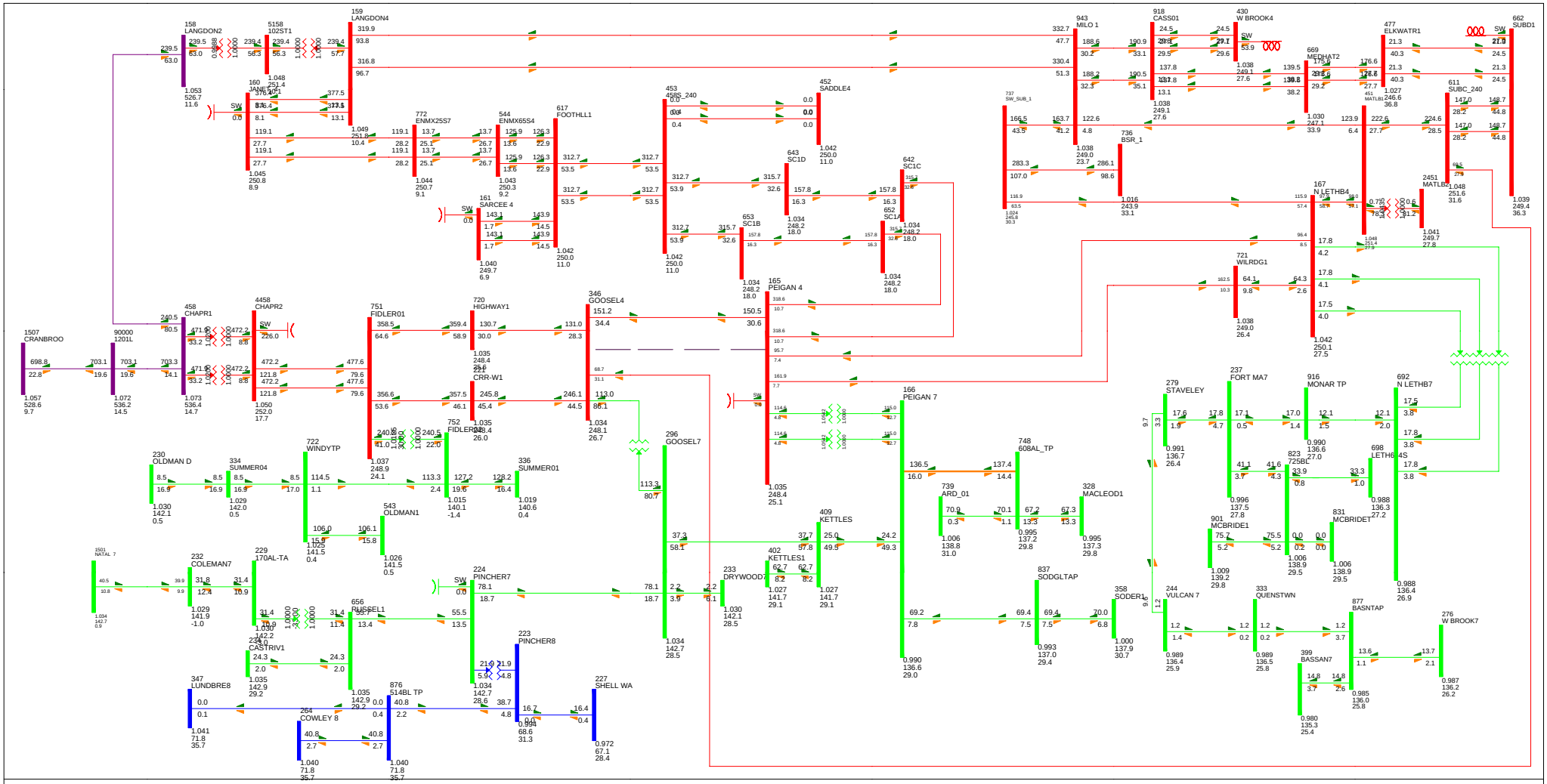
2016 SL Peigan Configuration

Thursday, December 1, 2011

KV: <=34.500 <=69.000 <=138.000 <=240.000
<=500.000 <=600.000 >600.000

BC Export: 700.0 MW

Bus - VOLTAGE (KV/PU) 100.0%RATEA
Branch - MW/MVAR
Equipment - MW/MVAR



TASMO MODEL; OUTPUT GENERATED 2010-11-19 13:28:45
SWINGBUS 1520 FOR FC-2009-6:2016-10-31:8:32--1-0-0-0

2016 SOUTH SYSTEM

Figure B4 - 956L Contingency

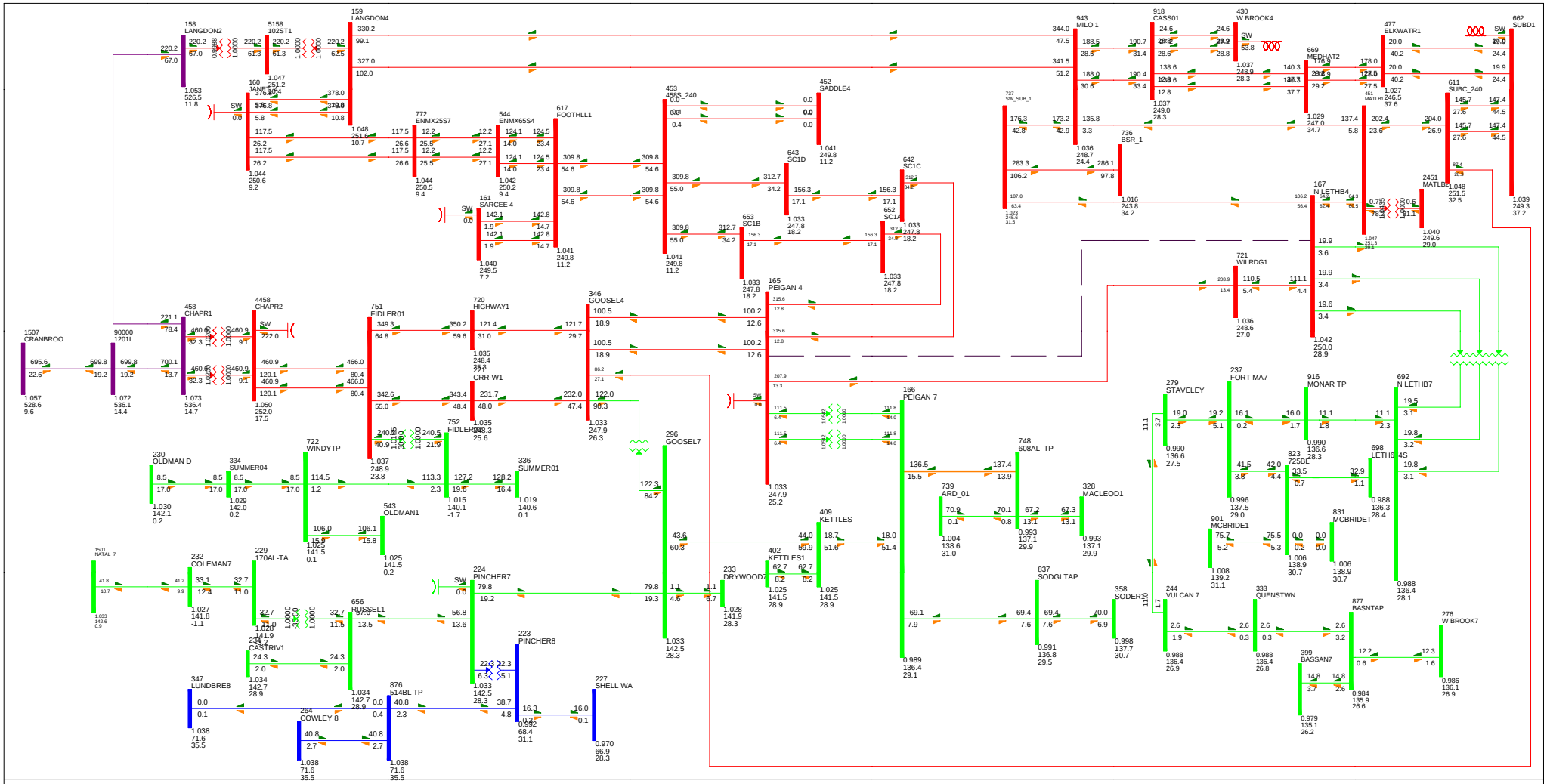
2016 SL Peigan Configuration

Thursday, December 1, 2011

KV: <=34.500 <=69.000 <=138.000 <=240.000
<=500.000 <=600.000 >600.000

BC Export: 700.0 MW

Bus - VOLTAGE (KV/PU) 100.0%RATEA
Branch - MW/MVAR
Equipment - MW/MVAR



TASMO MODEL; OUTPUT GENERATED 2010-11-19 13:28:45
SWINGBUS 1520 FOR FC-2009-6:2016-10-31:8:32--1-0-0-0

2016 SOUTH SYSTEM

Figure B5 - 967L Contingency

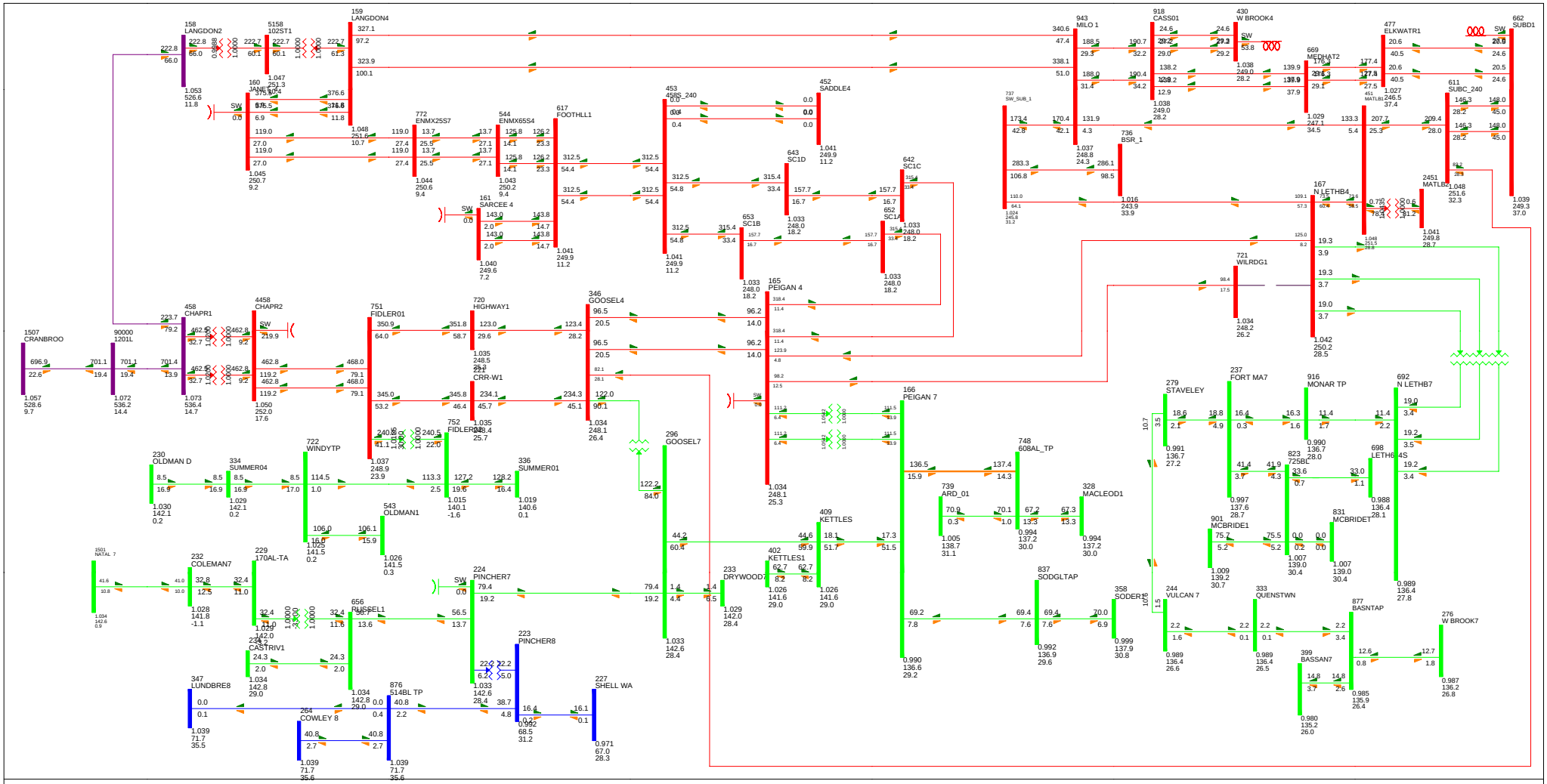
2016 SL Peigan Configuration

Thursday, December 1, 2011

KV: <=34.500 <=69.000 <=138.000 <=240.000
<=500.000 <=600.000 >600.000

BC Export: 700.0 MW

Bus - VOLTAGE (KV/PU) 100.0%RATEA
Branch - MW/MVAR
Equipment - MW/MVAR



TASMO MODEL; OUTPUT GENERATED 2010-11-19 13:28:45
SWINGBUS 1520 FOR FC-2009-6:2016-10-31:8:32--1-0-0-0

2016 SOUTH SYSTEM

Figure B6 - 968L Contingency

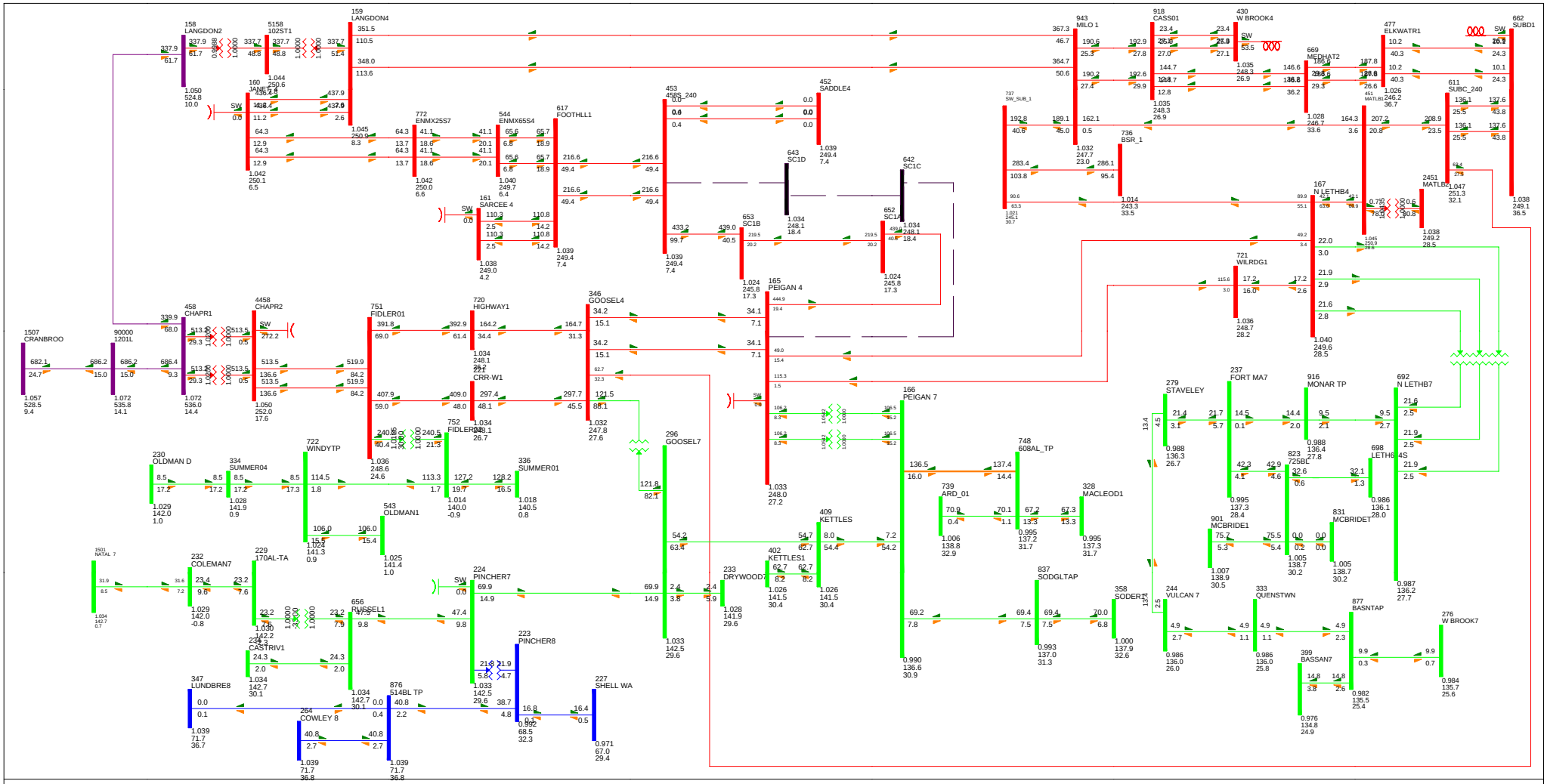
2016 SL Peigan Configuration

Thursday, December 1, 2011

KV: <=34.500 <=69.000 <=138.000 <=240.000
<=500.000 <=600.000 >600.000

BC Export: 700.0 MW

Bus - VOLTAGE (KV/PU) 100.0%RATEA
Branch - MW/MVAR
Equipment - MW/MVAR



TASMO MODEL; OUTPUT GENERATED 2010-11-19 13:28:45
SWINGBUS 1520 FOR FC-2009-6:2016-10-31:8:32--1-0-0-0

2016 SOUTH SYSTEM

Figure B7 - 1037L Contingency

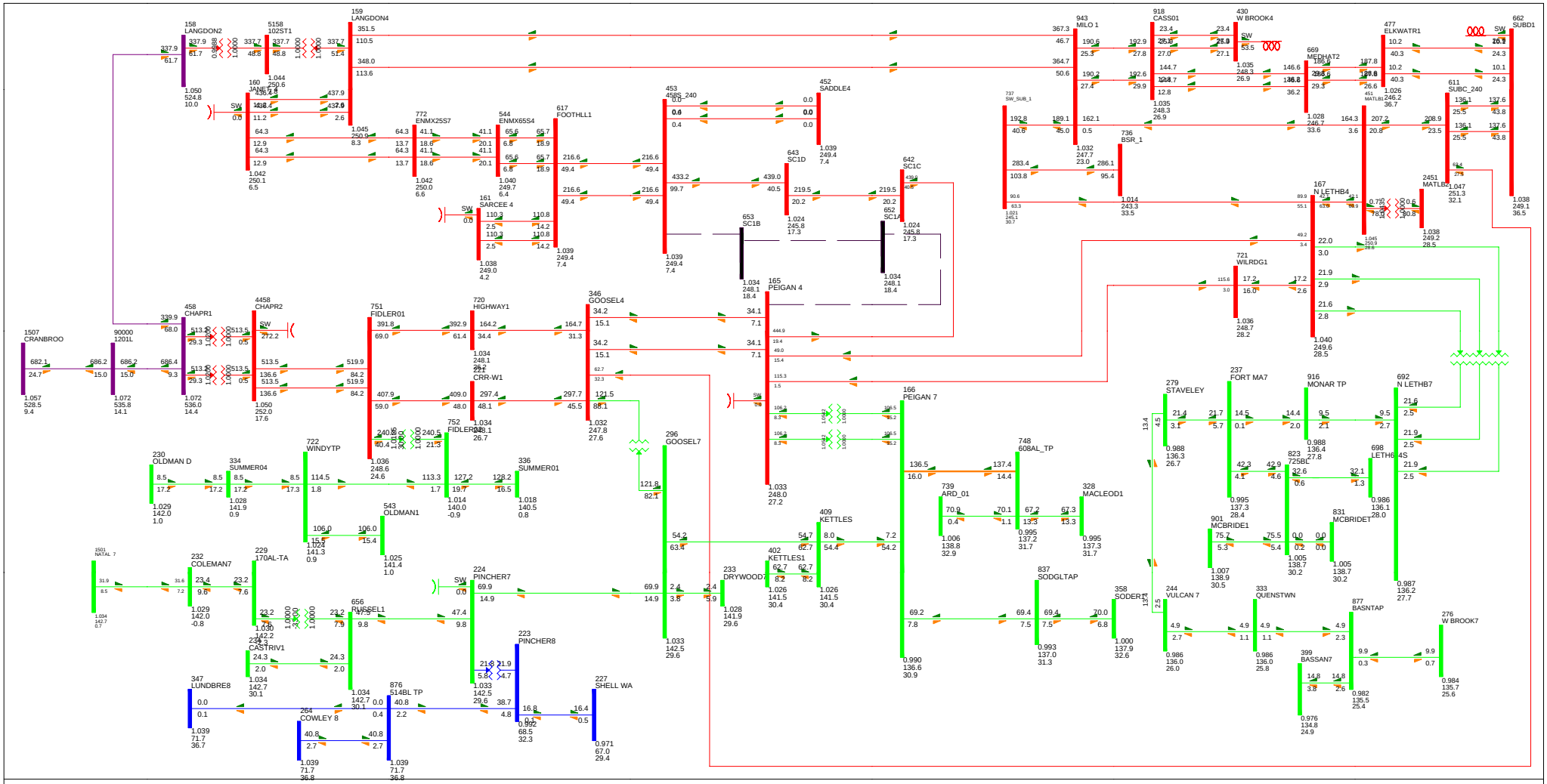
2016 SL Peigan Configuration

Thursday, December 1, 2011

KV: <=34.500 <=69.000 <=138.000 <=240.000
<=500.000 <=600.000 >600.000

BC Export: 700.0 MW

Bus - VOLTAGE (KV/PU) 100.0%RATEA
Branch - MW/MVAR
Equipment - MW/MVAR



TASMO MODEL; OUTPUT GENERATED 2010-11-19 13:28:45
SWINGBUS 1520 FOR FC-2009-6:2016-10-31:8:32--1-0-0-0

2016 SOUTH SYSTEM

Figure B8 - 1038L Contingency

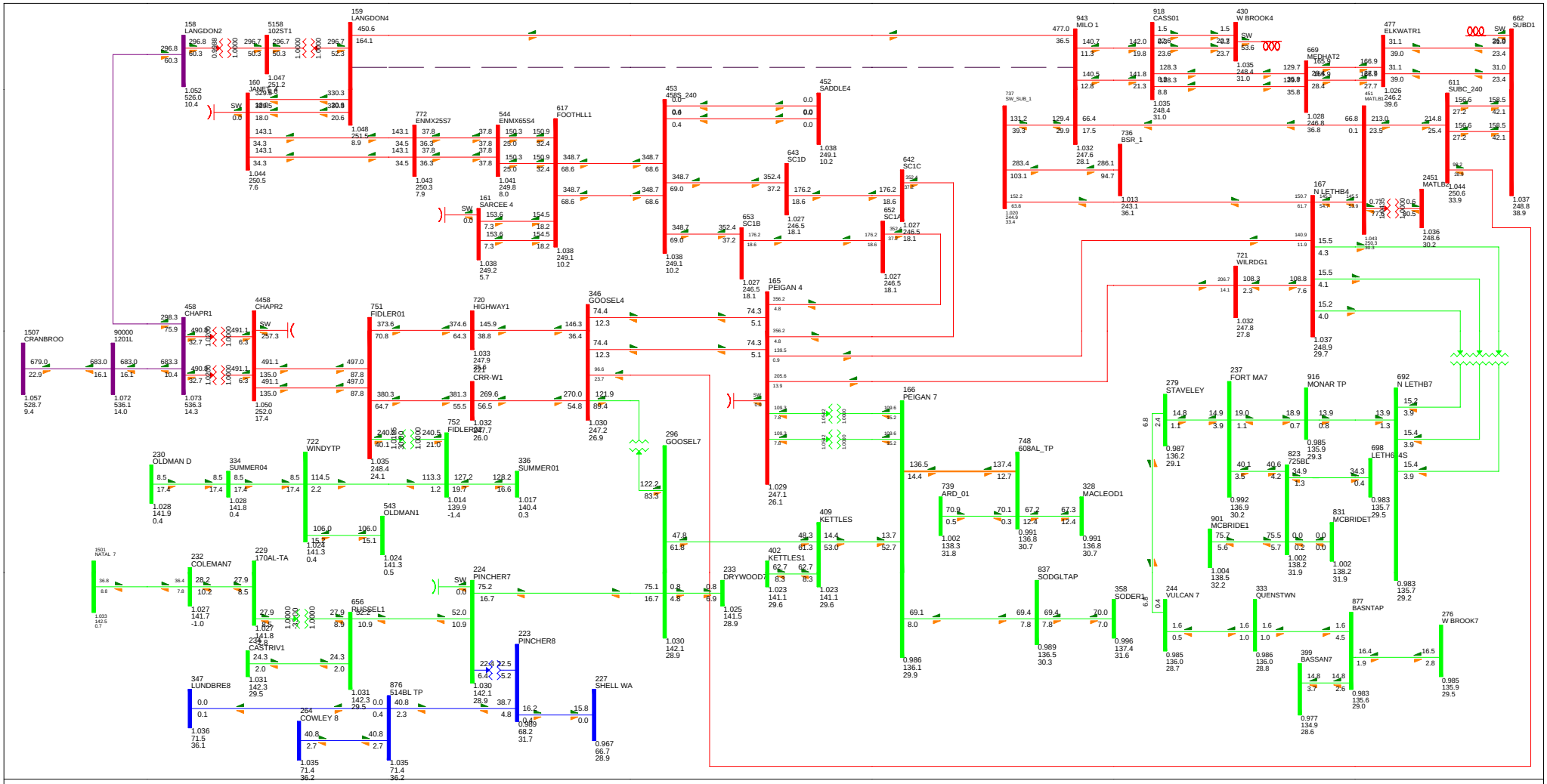
2016 SL Peigan Configuration

Thursday, December 1, 2011

KV: <=34.500 <=69.000 <=138.000 <=240.000
<=500.000 <=600.000 >600.000

BC Export: 700.0 MW

Bus - VOLTAGE (KV/PU) 100.0%RATEA
Branch - MW/MVAR
Equipment - MW/MVAR



TASMO MODEL; OUTPUT GENERATED 2010-11-19 13:28:45
SWINGBUS 1520 FOR FC-2009-6:2016-10-31:8:32--1-0-0-0

2016 SOUTH SYSTEM

Figure B9 - 924L Contingency

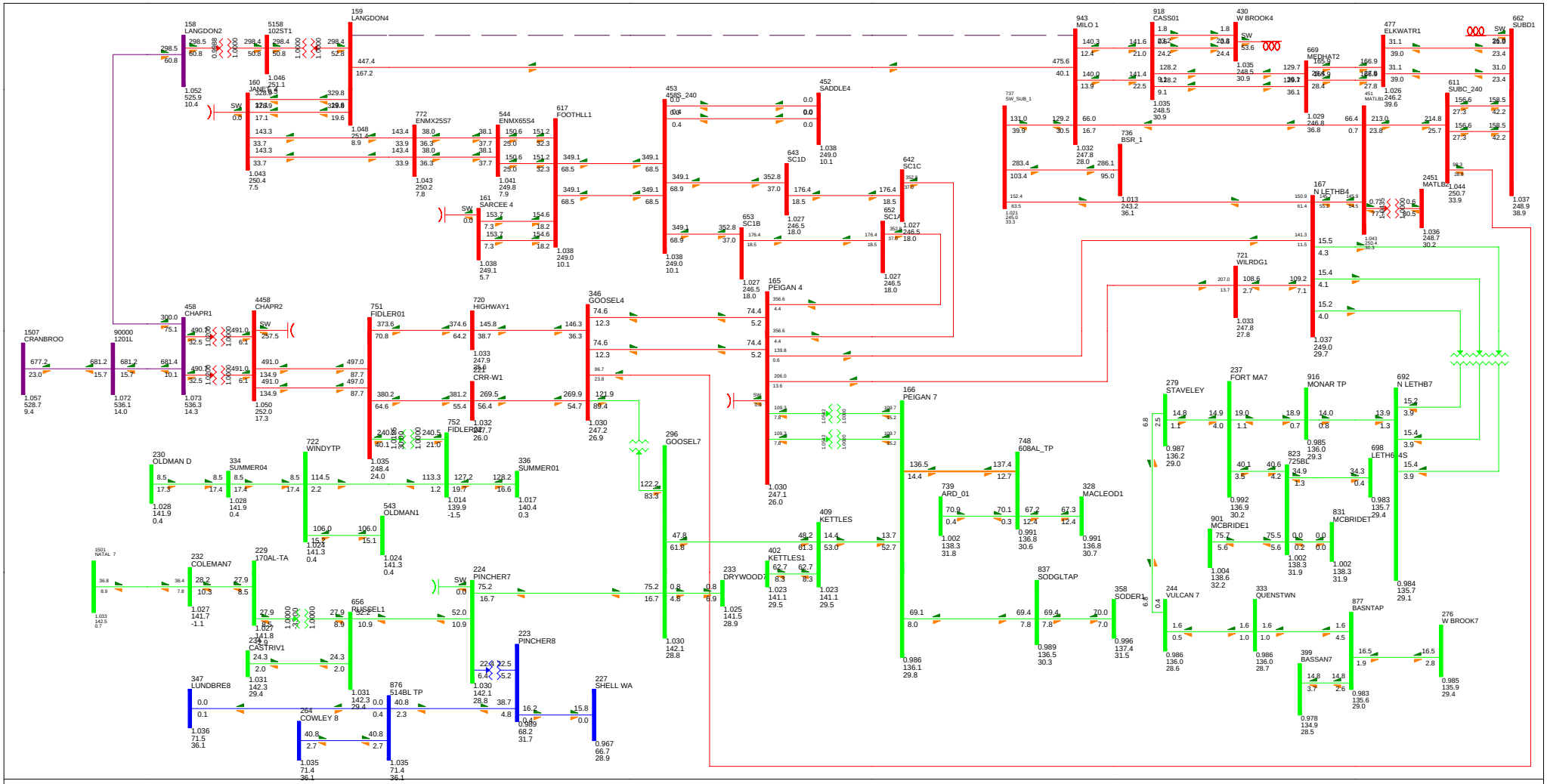
2016 SL Peigan Configuration

Thursday, December 1, 2011

KV: <=34.500 <=69.000 <=138.000 <=240.000
<=500.000 <=600.000 >600.000

BC Export: 700.0 MW

Bus - VOLTAGE (KV/PU) 100.0%RATEA
Branch - MW/MVAR
Equipment - MW/MVAR



TASMO MODEL; OUTPUT GENERATED 2010-11-19 13:28:45
SWINGBUS 1520 FOR FC-2009-6:2016-10-31:8:32--1-0-0-0

2016 SOUTH SYSTEM

Figure B10 - 927L Contingency

2016 SL Peigan Configuration

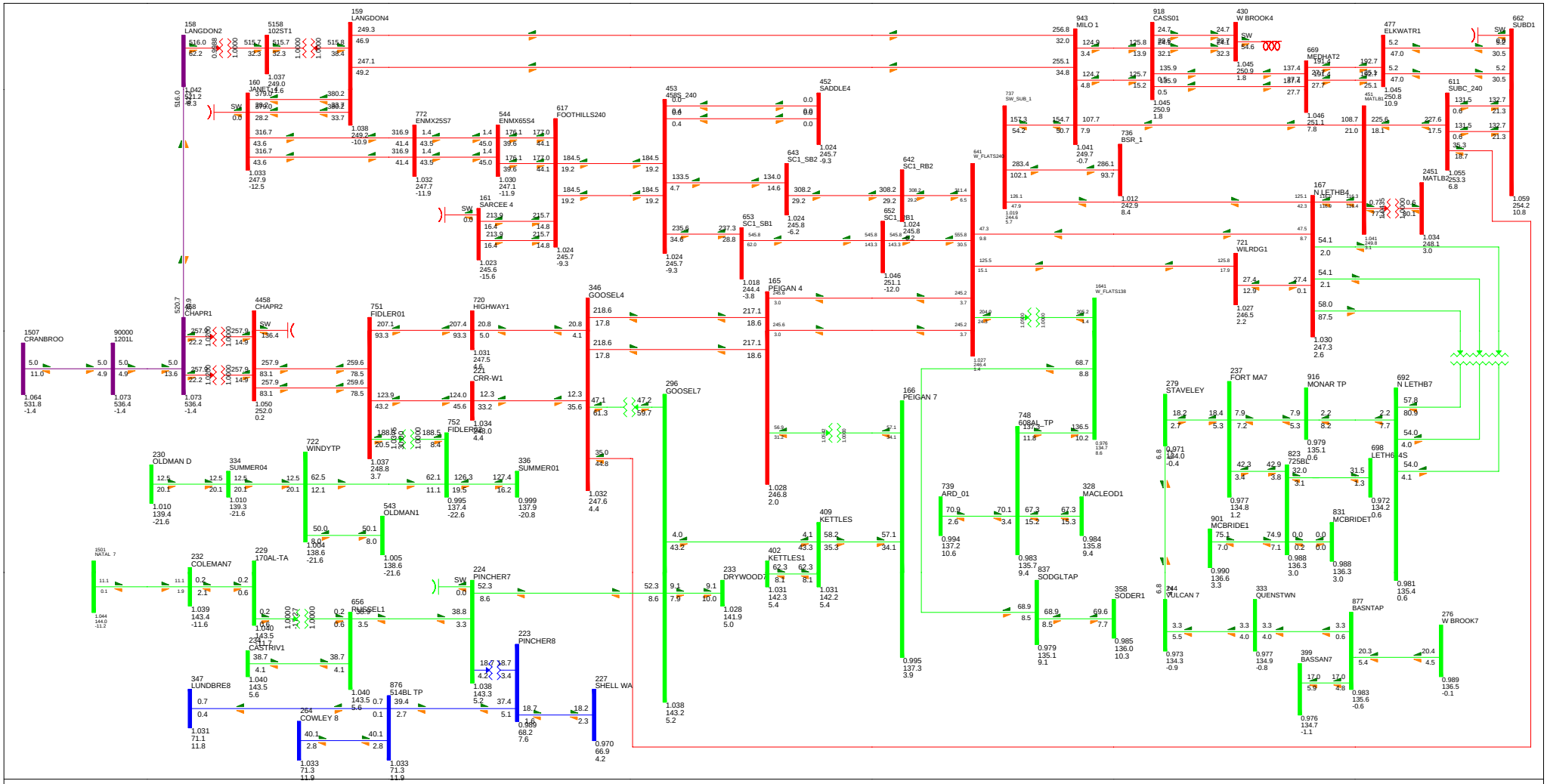
Thursday, December 1, 2011

KV: <=34.500 <=69.000 <=138.000 <=240.000
<=500.000 <=600.000 >600.000

BC Export: 700.0 MW

Bus - VOLTAGE (KV/PU) 100.0%RATEA
Branch - MW/MVAR
Equipment - MW/MVAR

Appendix C: Summer Peak load flow diagrams for Windy Flats Configuration



TASMO MODEL; OUTPUT GENERATED 2010-11-19 13:28:45
SWINGBUS 1520 FOR FC-2009-6:2016-10-31:8:32--1-0-0-0

2016 SOUTH SYSTEM

Figure C1 - System Normal Condition

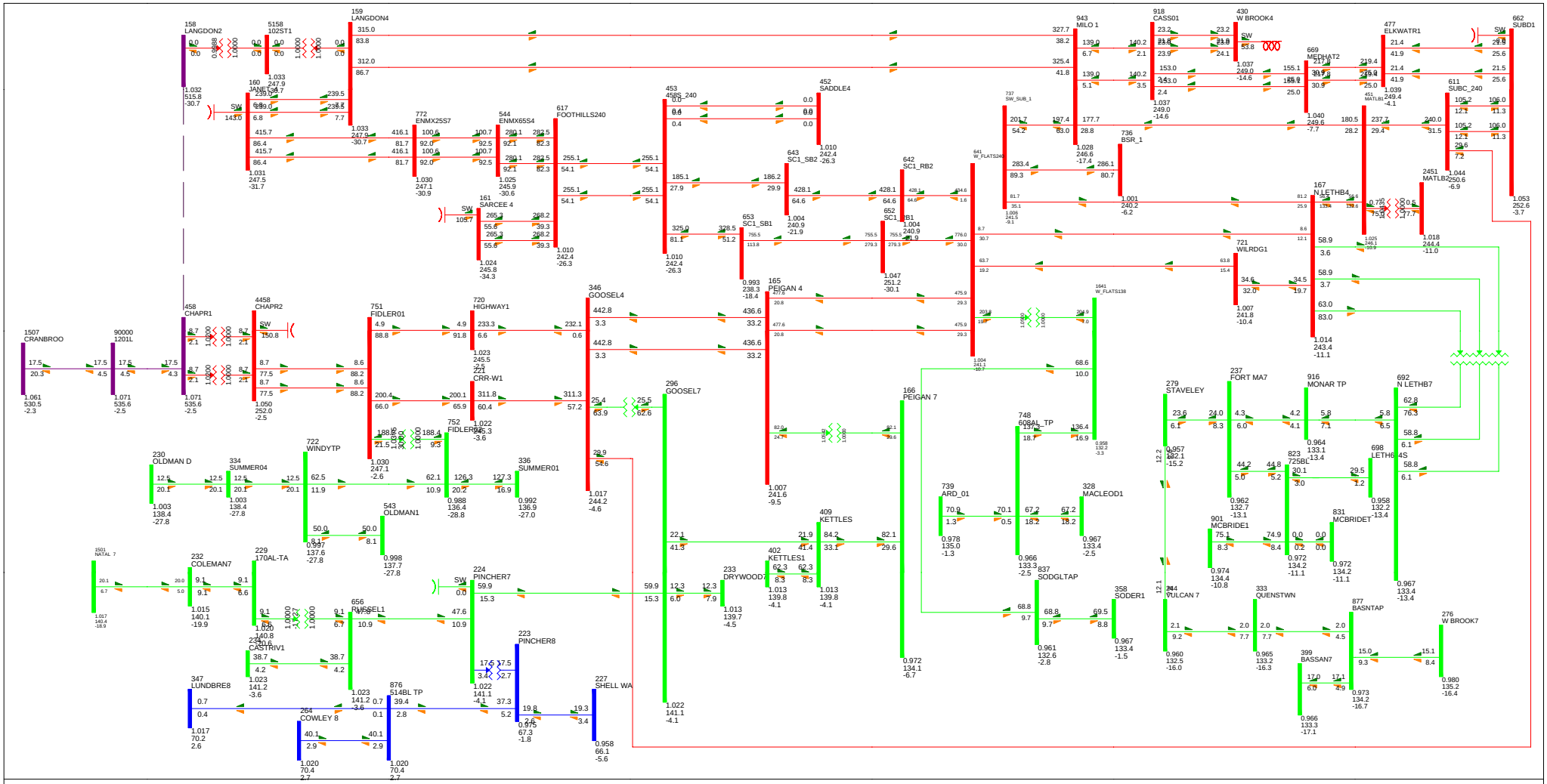
2016 SP Windy Flats Configuration

Thursday, March 22, 2012

KV: <=34.500 <=69.000 <=138.000 <=240.000
<=500.000 <=600.000 >600.000

BC Export: 0.0 MW

Bus - VOLTAGE (KV/PU) 100.0%RATEA
Branch - MW/MVAR
Equipment - MW/MVAR



TASMO MODEL; OUTPUT GENERATED 2010-11-19 13:28:45
SWINGBUS 1520 FOR FC-2009-6:2016-10-31:8:32--1-0-0-0

2016 SOUTH SYSTEM

Figure C2 - 1235L Contingency

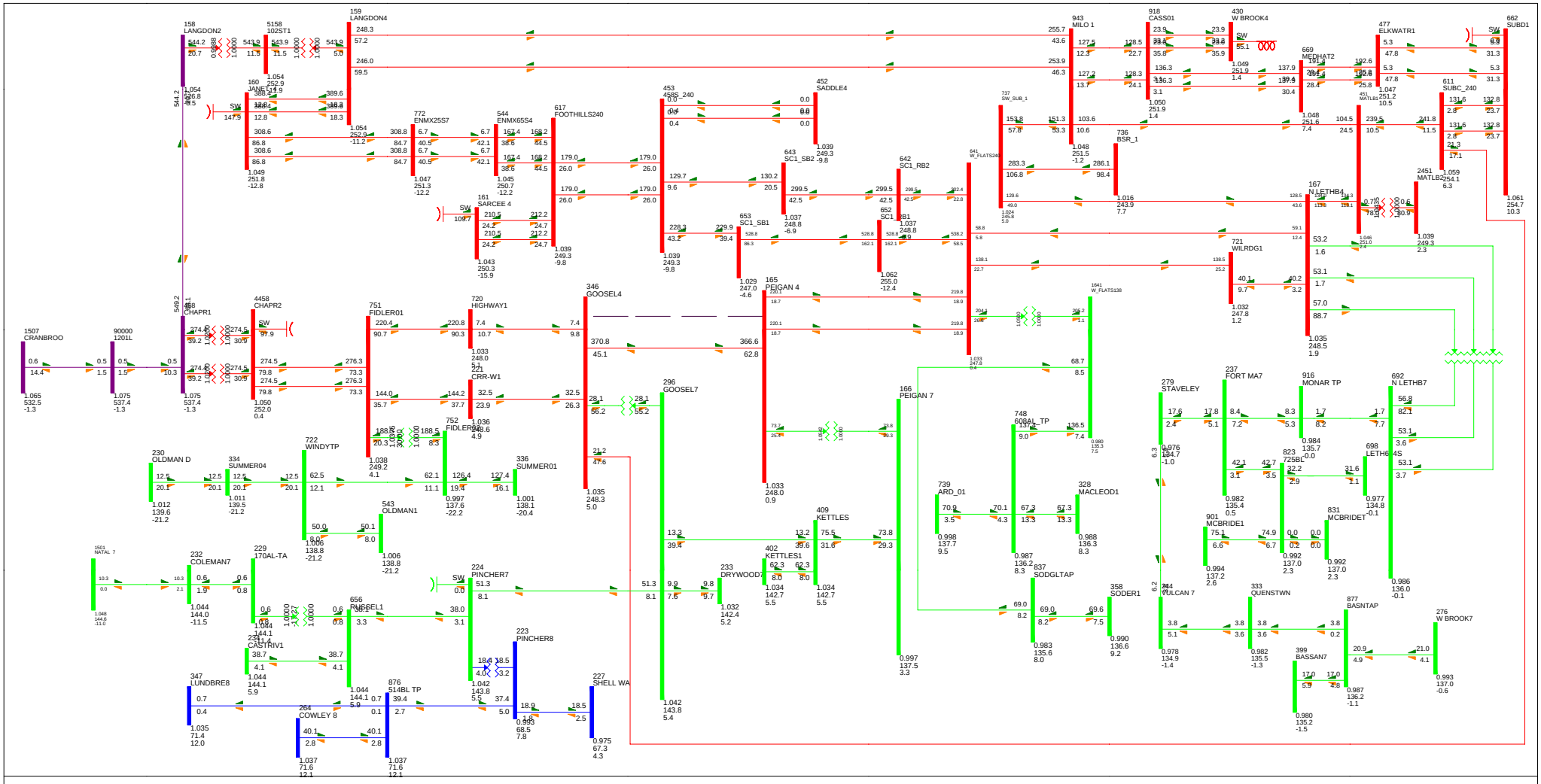
2016 SP Windy Flats Configuration

Thursday, March 22, 2012

KV: <=34.500 <=69.000 <=138.000 <=240.000
<=500.000 <=600.000 >600.000

BC Export: 0.0 MW

Bus - VOLTAGE (KV/PU) 100.0%RATEA
Branch - MW/MVAR
Equipment - MW/MVAR



TASMO MODEL; OUTPUT GENERATED 2010-11-19 13:28:45
SWINGBUS 1520 FOR FC-2009-6:2016-10-31:8:32--1-0-0-0

2016 SOUTH SYSTEM

Figure C3 - 955L Contingency

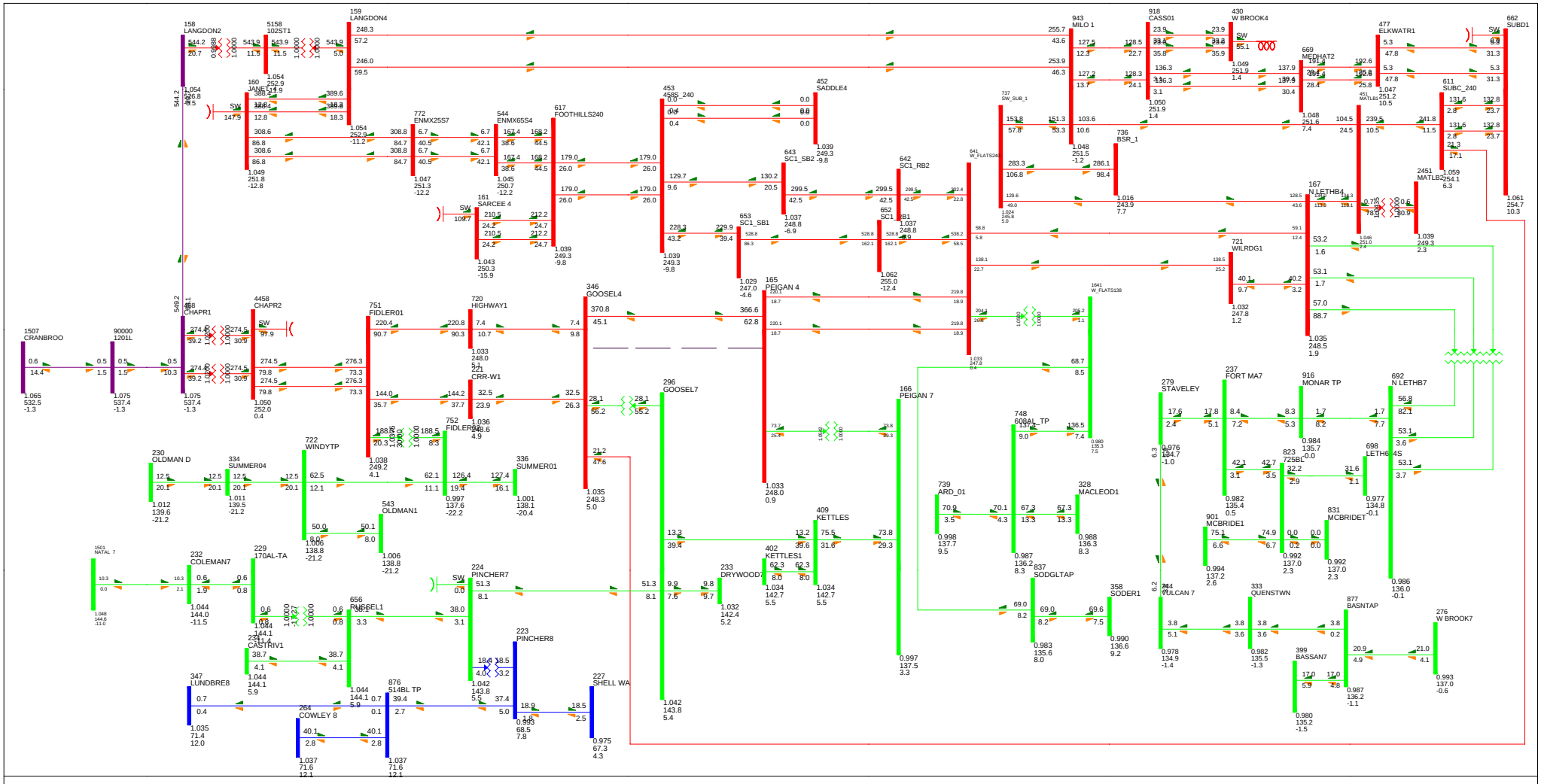
2016 SP Windy Flats Configuration

Thursday, March 22, 2012

KV: <=34.500 <=69.000 <=138.000 <=240.000
<=500.000 <=600.000 >600.000

BC Export: 0.0 MW

Bus - VOLTAGE (KV/PU) 100.0%RATEA
Branch - MW/MVAR
Equipment - MW/MVAR



TASMO MODEL; OUTPUT GENERATED 2010-11-19 13:28:45
SWINGBUS 1520 FOR FC-2009-6:2016-10-31:8:32--1-0-0-0

2016 SOUTH SYSTEM

Figure C4 - 956L Contingency

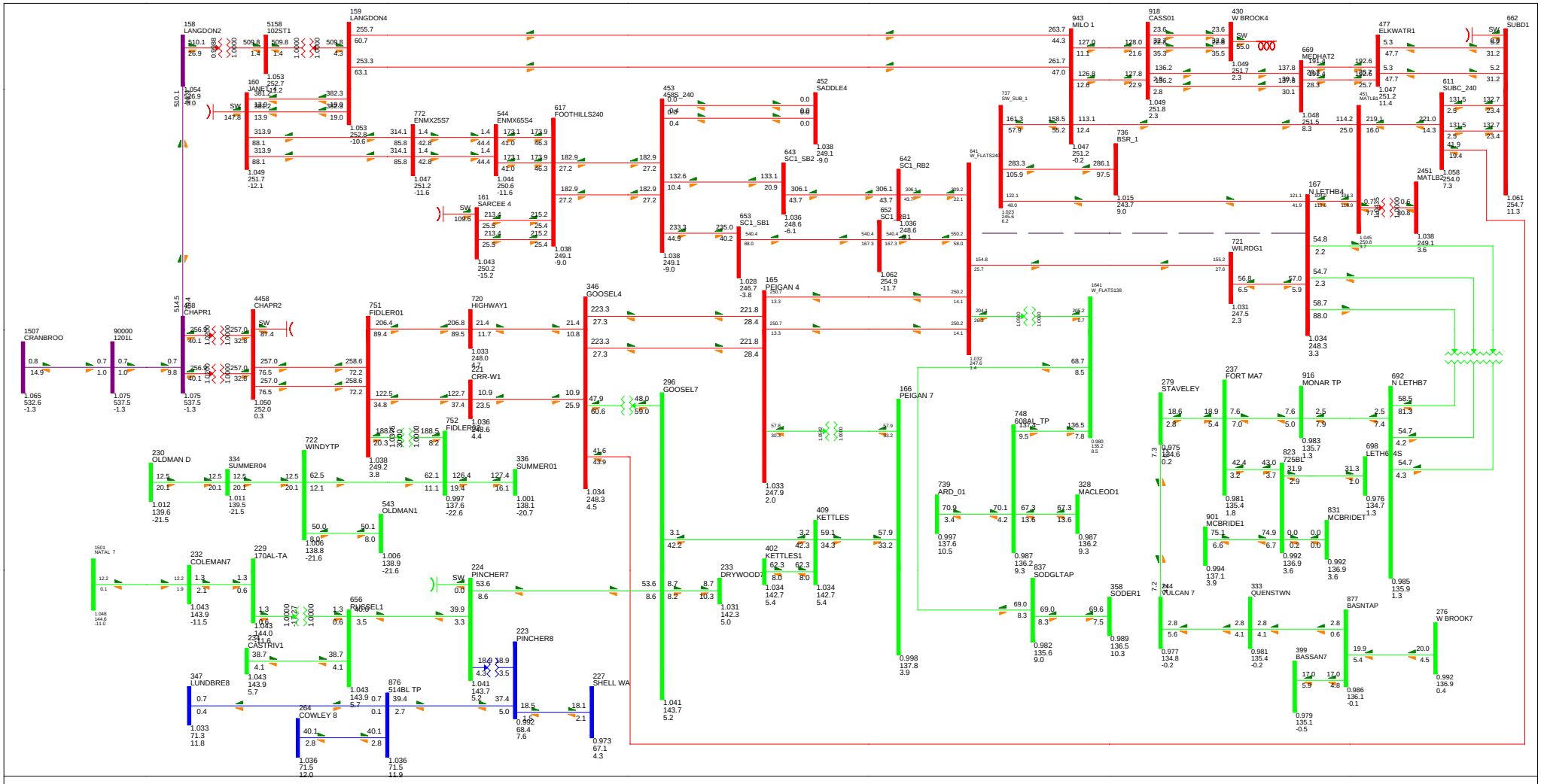
2016 SP Windy Flats Configuration

Thursday, March 22, 2012

KV: <=34.500 <=69.000 <=138.000 <=240.000
<=500.000 <=600.000 >600.000

BC Export: 0.0 MW

Bus - VOLTAGE (KV/PU) 100.0%RATEA
Branch - MW/MVAR
Equipment - MW/MVAR



TASMO MODEL; OUTPUT GENERATED 2010-11-19 13:28:45
SWINGBUS 1520 FOR FC-2009-6:2016-10-31:8:32--1-0-0-0

2016 SOUTH SYSTEM

Figure C5 - 967L Contingency

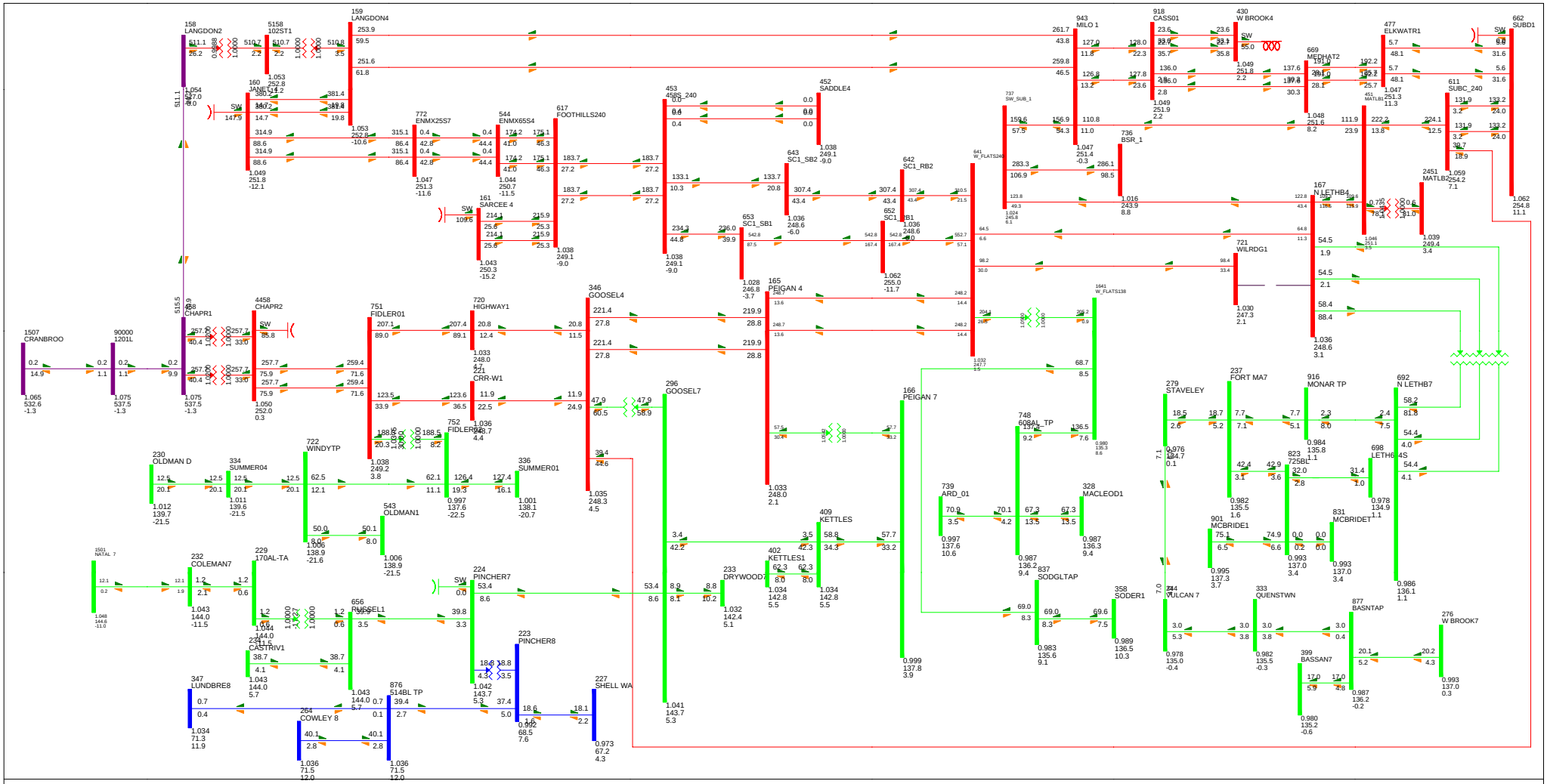
2016 SP Windy Flats Configuration

Thursday, March 22, 2012

KV: <=34.500 <=69.000 <=138.000 <=240.000
<=500.000 <=600.000 >600.000

BC Export: 0.0 MW

Bus - VOLTAGE (KV/PU) 100.0%RATEA
Branch - MW/MVAR
Equipment - MW/MVAR



TASMO MODEL; OUTPUT GENERATED 2010-11-19 13:28:45
SWINGBUS 1520 FOR FC-2009-6:2016-10-31:8:32--1-0-0-0

2016 SOUTH SYSTEM

Figure C6 - 968L Contingency

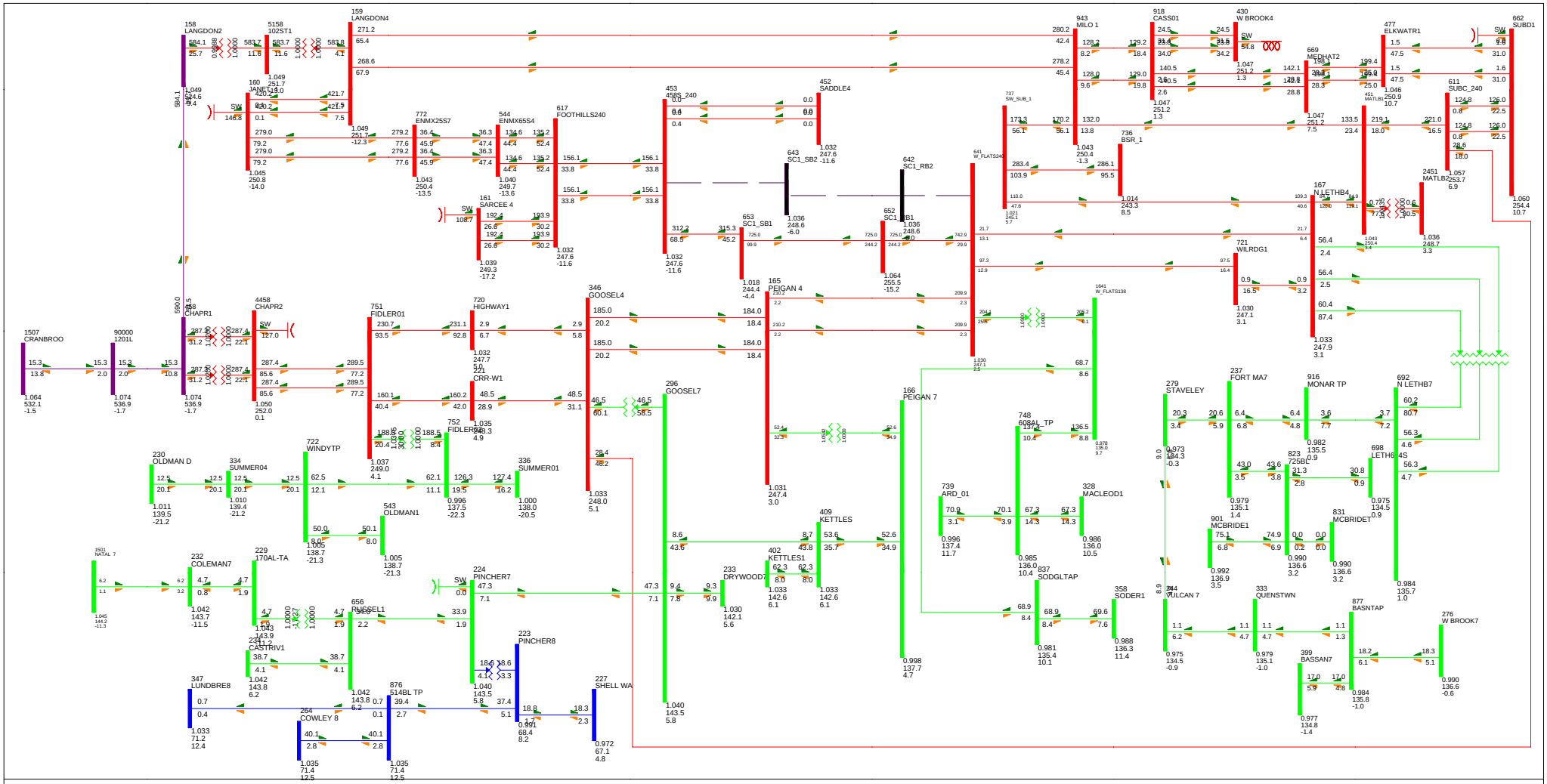
2016 SP Windy Flats Configuration

Thursday, March 22, 2012

KV: <=34.500 <=69.000 <=138.000 <=240.000
<=500.000 <=600.000 >600.000

BC Export: 0.0 MW

Bus - VOLTAGE (KV/PU) 100.0%RATEA
Branch - MW/MVAR
Equipment - MW/MVAR



TASMO MODEL; OUTPUT GENERATED 2010-11-19 13:28:45
SWINGBUS 1520 FOR FC-2009-6:2016-10-31:8:32--1-0-0-0

2016 SOUTH SYSTEM

Figure C7 - 1037L Contingency

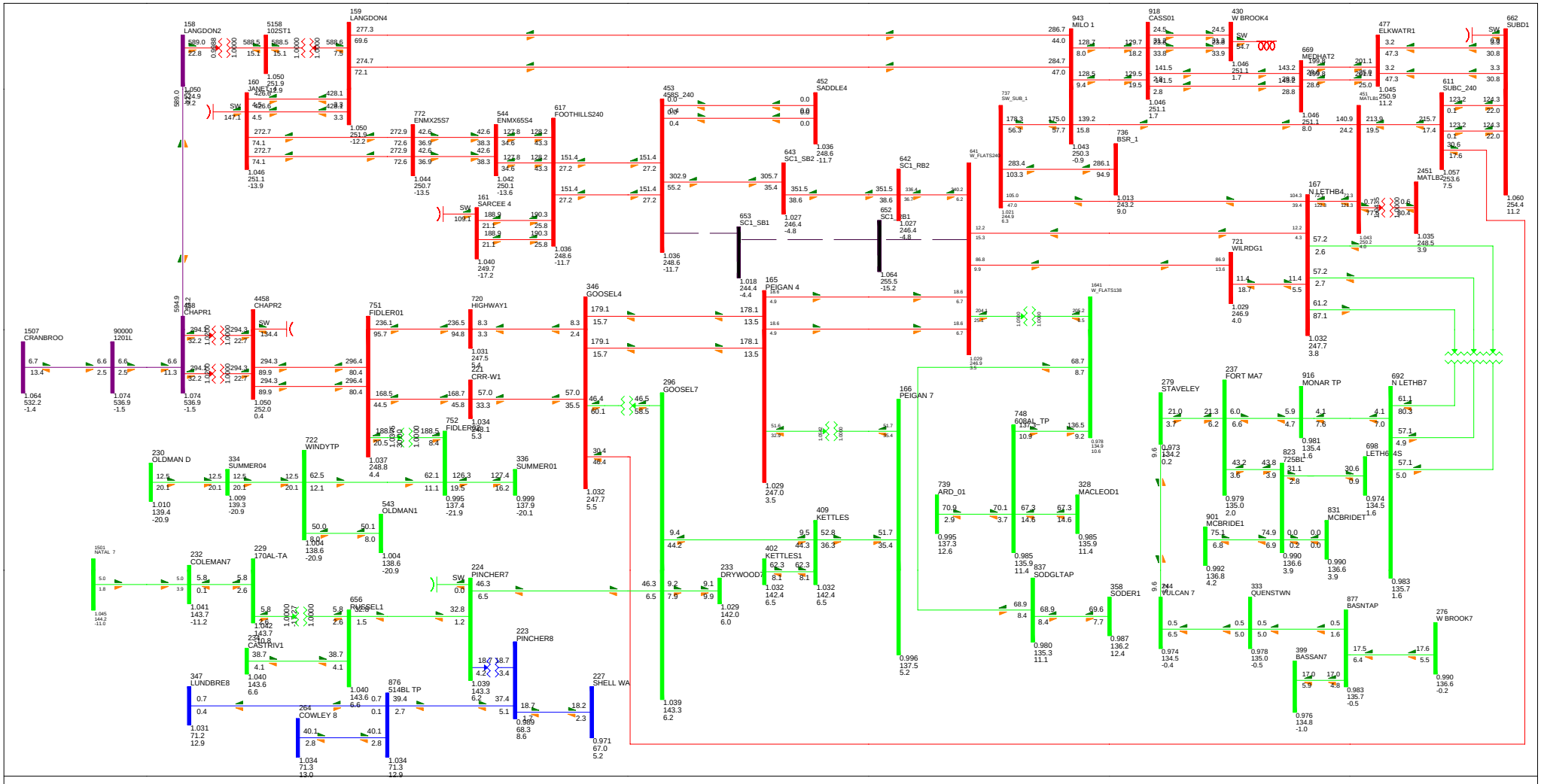
2016 SP Windy Flats Configuration

Thursday, March 22, 2012

KV: <=34.500 <=69.000 <=138.000 <=240.000
<=500.000 <=600.000 >600.000

BC Export: 0.0 MW

Bus - VOLTAGE (KV/PU) 100.0%RATEA
Branch - MW/MVAR
Equipment - MW/MVAR



TASMO MODEL; OUTPUT GENERATED 2010-11-19 13:28:45
SWINGBUS 1520 FOR FC-2009-6:2016-10-31:8:32--1-0-0-0

2016 SOUTH SYSTEM

Figure C8 - 1038L Contingency

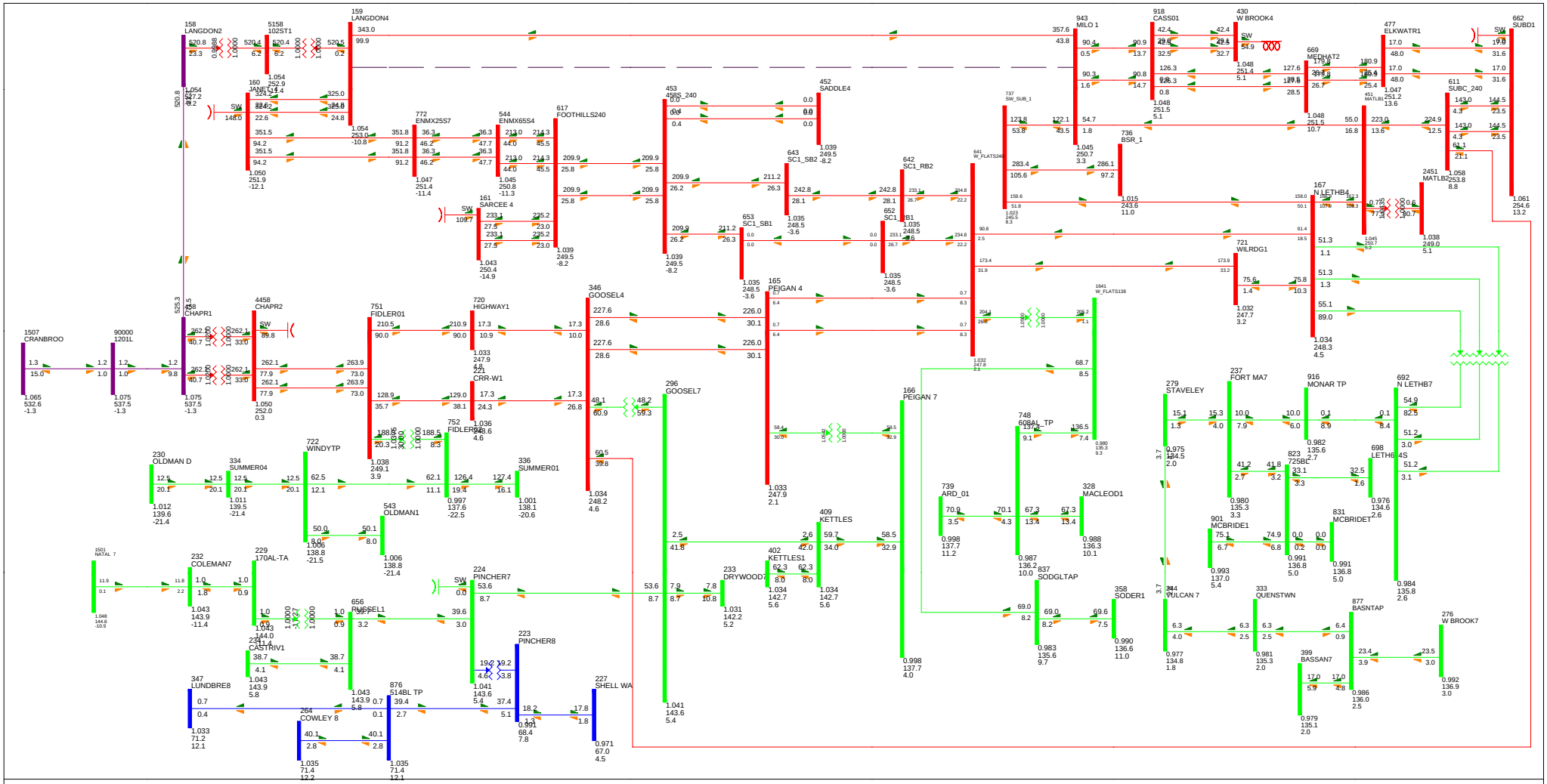
2016 SP Windy Flats Configuration

Thursday, March 22, 2012

KV: <=34.500 <=69.000 <=138.000 <=240.000
<=500.000 <=600.000 >600.000

BC Export: 0.0 MW

Bus - VOLTAGE (KV/PU) 100.0%RATEA
Branch - MW/MVAR
Equipment - MW/MVAR



TASMO MODEL; OUTPUT GENERATED 2010-11-19 13:28:45
SWINGBUS 1520 FOR FC-2009-6:2016-10-31:8:32--1-0-0-0

2016 SOUTH SYSTEM

Figure C9 - 924L Contingency

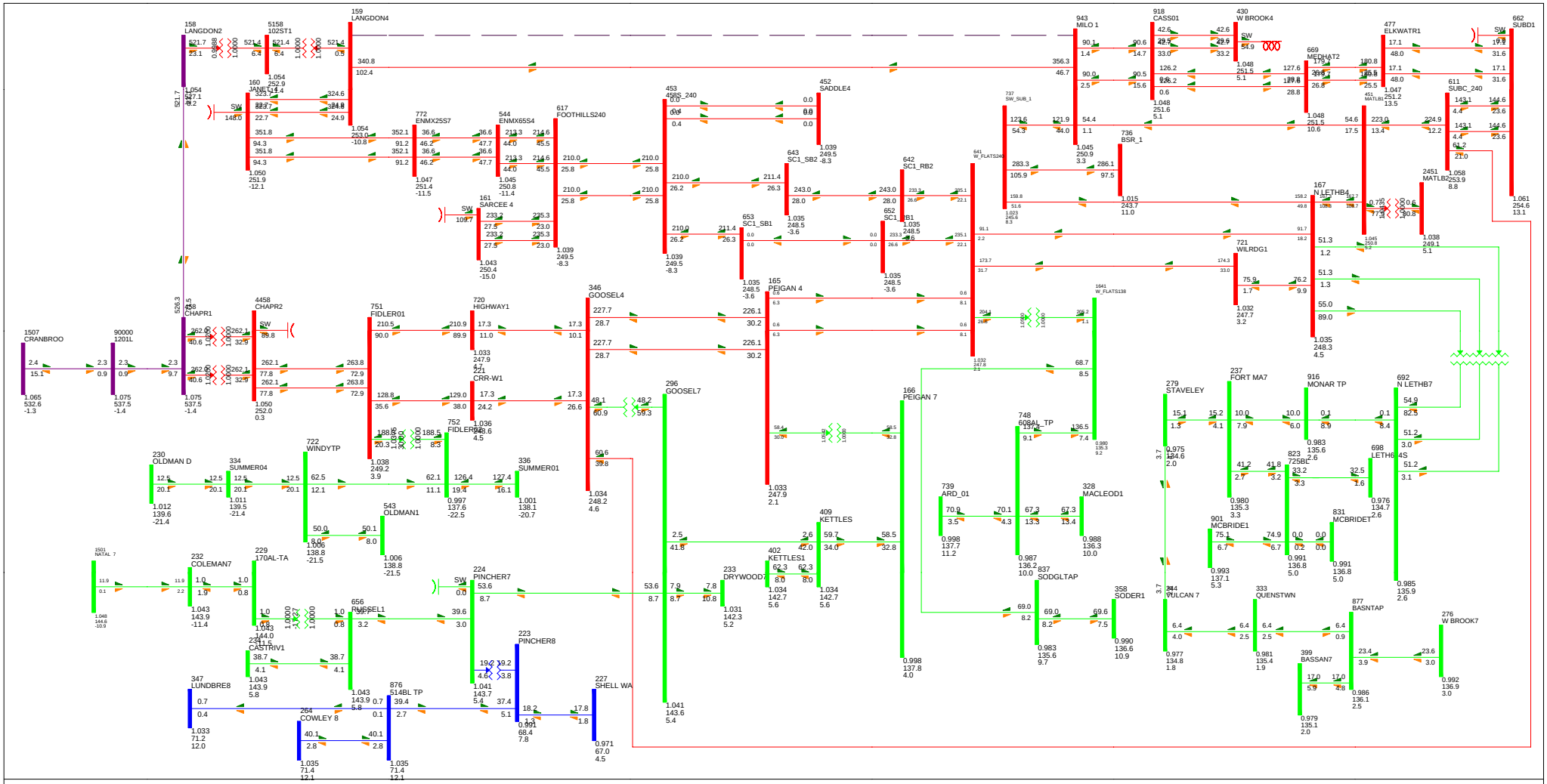
2016 SP Windy Flats Configuration

Thursday, March 22, 2012

KV: <=34.500 <=69.000 <=138.000 <=240.000
<=500.000 <=600.000 >600.000

BC Export: 0.0 MW

Bus - VOLTAGE (KV/PU) 100.0%RATEA
Branch - MW/MVAR
Equipment - MW/MVAR



TASMO MODEL; OUTPUT GENERATED 2010-11-19 13:28:45
SWINGBUS 1520 FOR FC-2009-6:2016-10-31:8:32--1-0-0-0

2016 SOUTH SYSTEM

Figure C10 - 927L Contingency

2016 SP Windy Flats Configuration

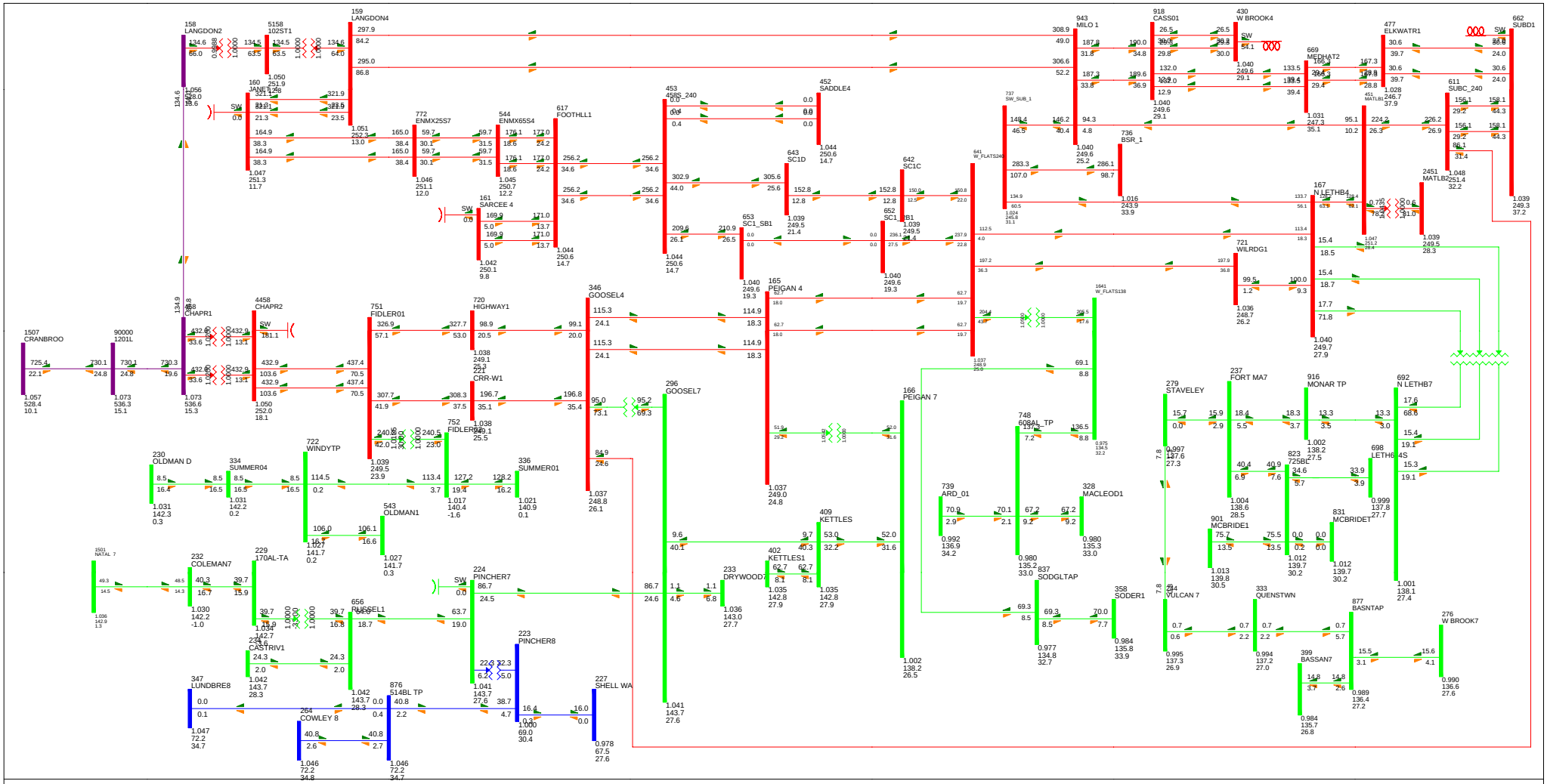
Thursday, March 22, 2012

KV: <=34.500 <=69.000 <=138.000 <=240.000
<=500.000 <=600.000 >600.000

BC Export: 0.0 MW

Bus - VOLTAGE (KV/PU) 100.0%RATEA
Branch - MW/MVAR
Equipment - MW/MVAR

Appendix D: Summer Light load flow diagrams for Windy Flats Configuration



TASMO MODEL; OUTPUT GENERATED 2010-11-19 13:28:45
SWINGBUS 1520 FOR FC-2009-6:2016-10-31:8:32--1-0-0-0

2016 SOUTH SYSTEM

Figure D1 - System Normal Condition

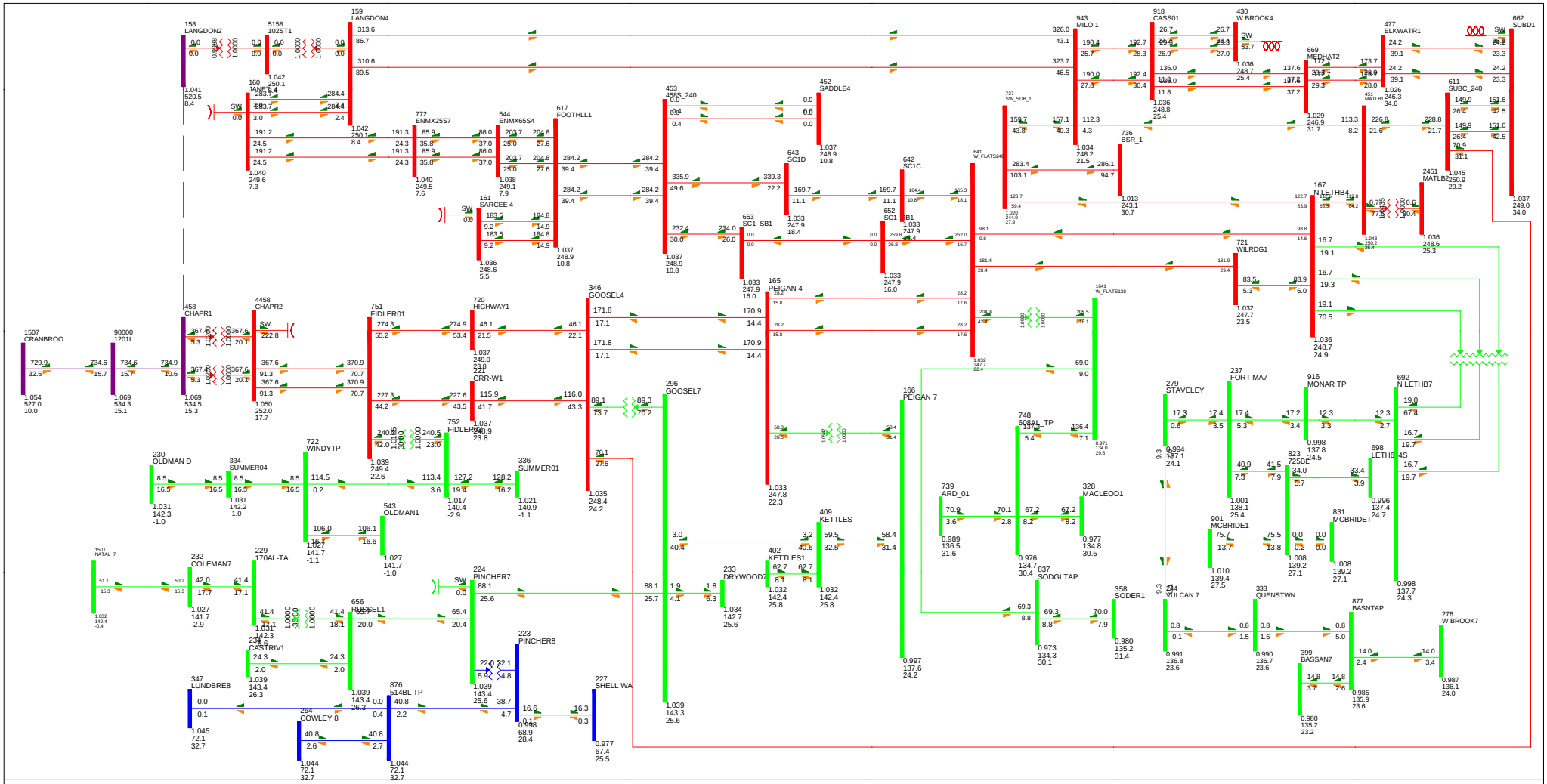
2016 SL Windy Flats Configuration

Thursday, March 22, 2012

KV: <=34.500 <=69.000 <=138.000 <=240.000
<=500.000 <=600.000 >600.000

BC Export: 700.0 MW

Bus - VOLTAGE (KV/PU) 100.0%RATEA
Branch - MW/MVAR
Equipment - MW/MVAR



TASMO MODEL; OUTPUT GENERATED 2010-11-19 13:28:45
SWINGBUS 1520 FOR FC-2009-6:2016-10-31:8:32--1-0-0-0

2016 SOUTH SYSTEM

Figure D2 - 1235L Contingency

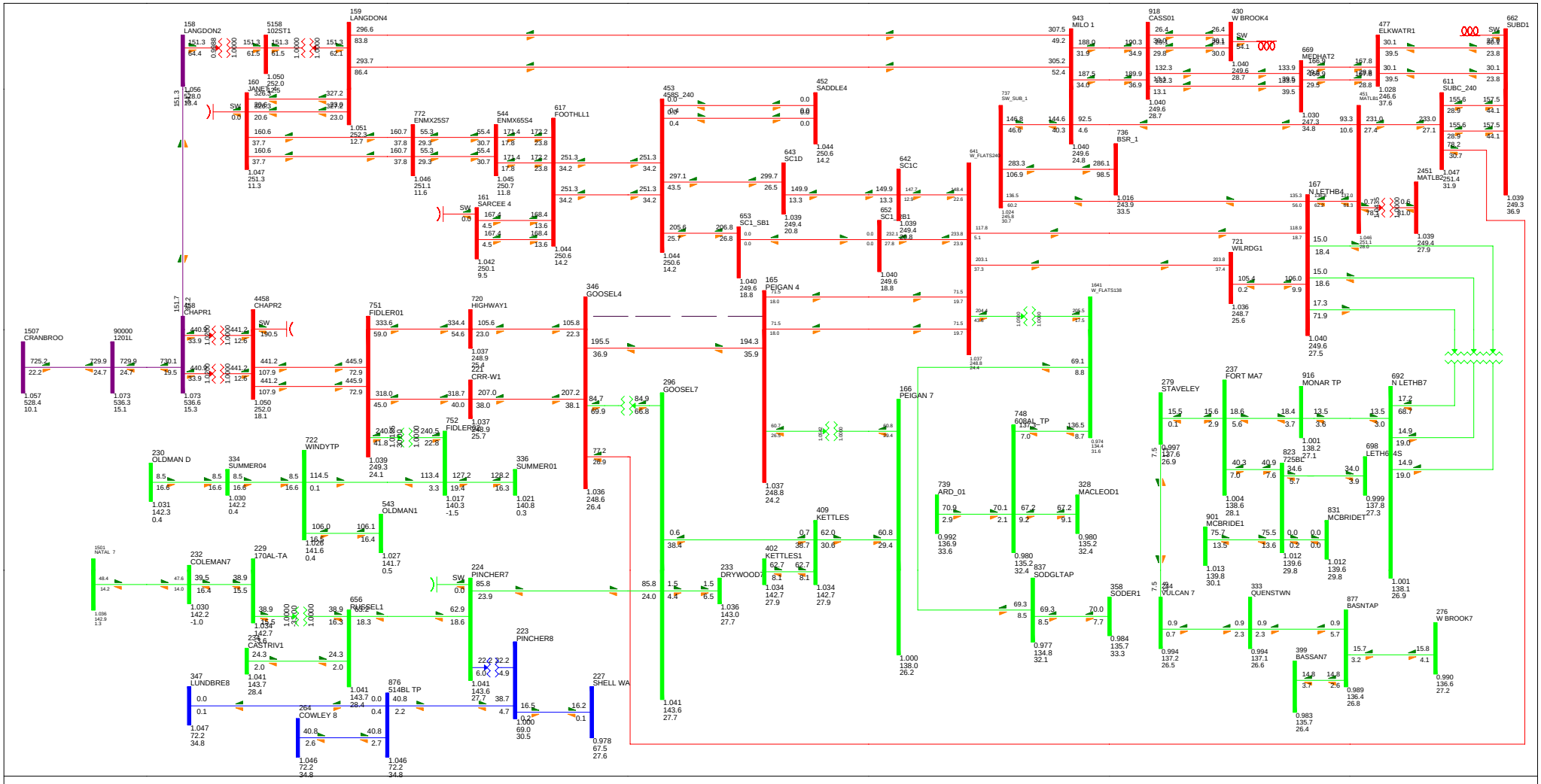
2016 SL Windy Flats Configuration

Thursday, March 22, 2012

KV: <=34.500 <=69.000 <=138.000 <=240.000
<=500.000 <=600.000 >600.000

BC Export: 700.0 MW

Bus - VOLTAGE (KV/PU) 100.0%RATEA
Branch - MW/MVAR
Equipment - MW/MVAR



TASMO MODEL; OUTPUT GENERATED 2010-11-19 13:28:45
SWINGBUS 1520 FOR FC-2009-6:2016-10-31:8:32--1-0-0-0

2016 SOUTH SYSTEM

Figure D3 - 955L Contingency

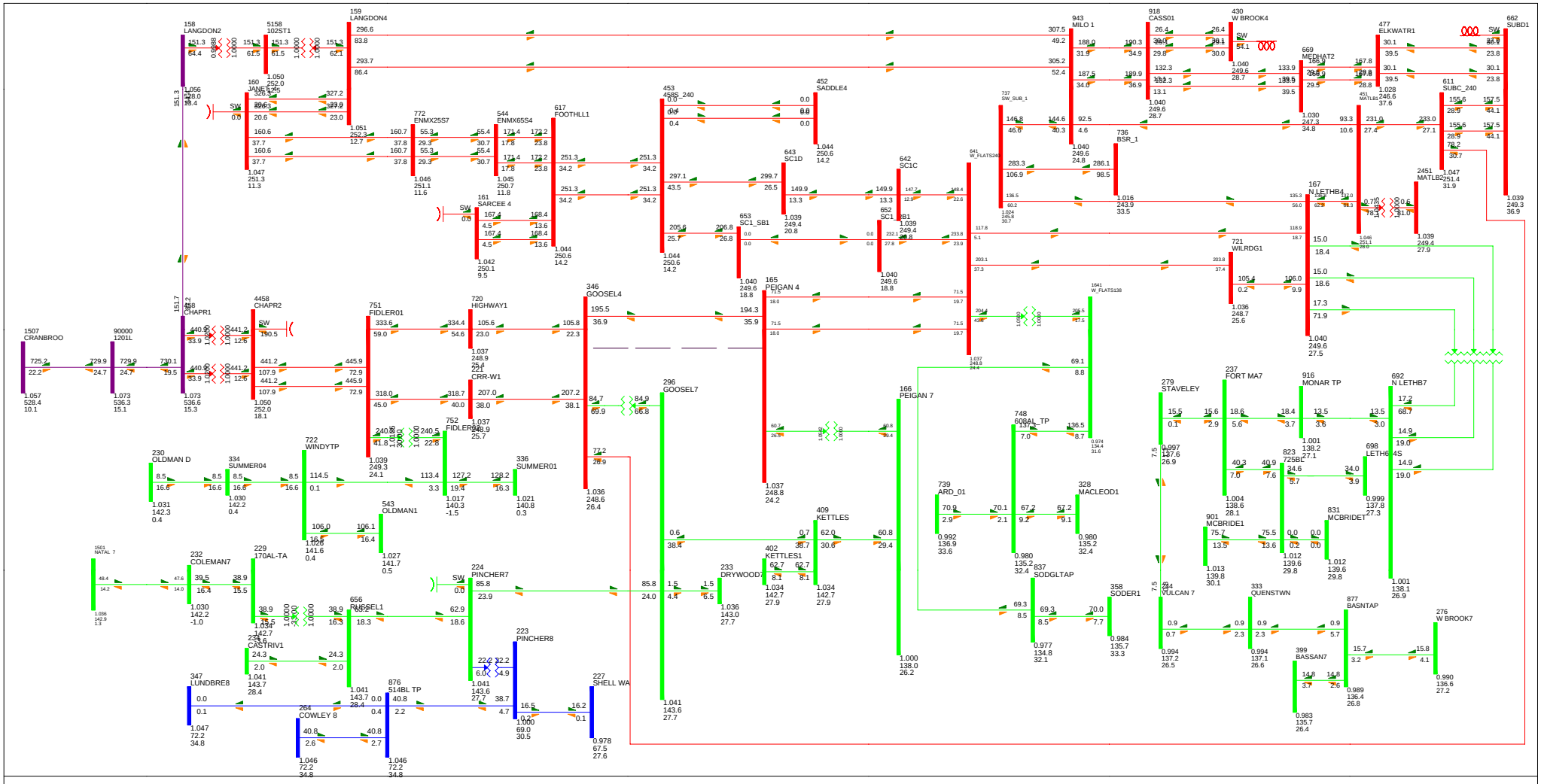
2016 SL Windy Flats Configuration

Thursday, March 22, 2012

KV: <=34.500 <=69.000 <=138.000 <=240.000
<=500.000 <=600.000 >600.000

BC Export: 700.0 MW

Bus - VOLTAGE (KV/PU) 100.0%RATEA
Branch - MW/MVAR
Equipment - MW/MVAR



TASMO MODEL; OUTPUT GENERATED 2010-11-19 13:28:45
SWINGBUS 1520 FOR FC-2009-6:2016-10-31:8:32--1-0-0-0

2016 SOUTH SYSTEM

Figure D4 - 956L Contingency

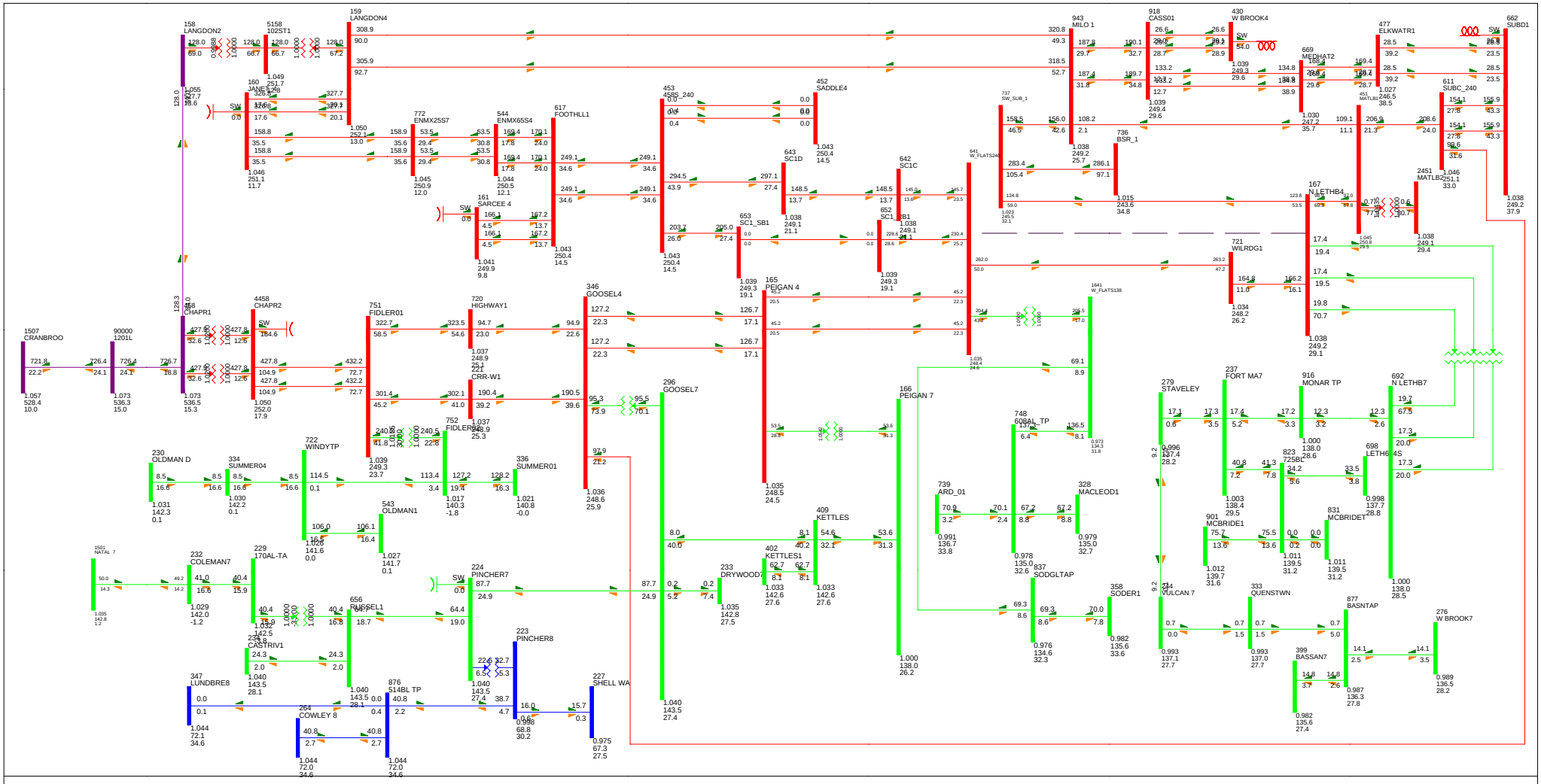
2016 SL Windy Flats Configuration

Thursday, March 22, 2012

KV: <=34.500 <=69.000 <=138.000 <=240.000
<=500.000 <=600.000 >600.000

BC Export: 700.0 MW

Bus - VOLTAGE (KV/PU) 100.0%RATEA
Branch - MW/MVAR
Equipment - MW/MVAR



TASMO MODEL; OUTPUT GENERATED 2010-11-19 13:28:45
SWINGBUS 1520 FOR FC-2009-6:2016-10-31:8:32--1-0-0-0

2016 SOUTH SYSTEM

Figure D5 - 967L Contingency

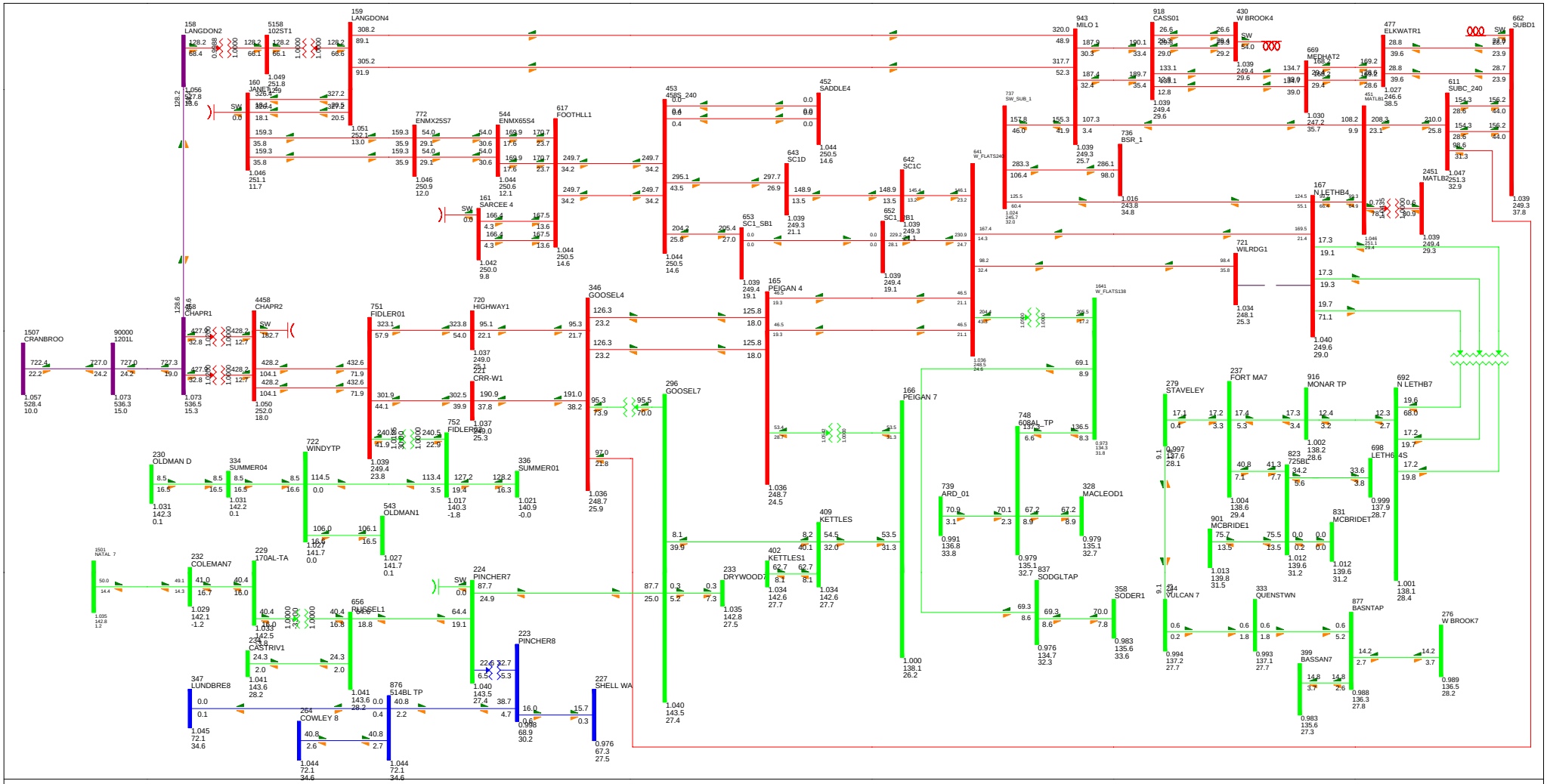
2016 SL Windy Flats Configuration

Thursday, March 22, 2012

KV: <=34.500 <=69.000 <=138.000 <=240.000
<=500.000 <=600.000 >600.000

BC Export: 700.0 MW

Bus - VOLTAGE (KV/PU) 100.0%RATEA
Branch - MW/MVAR
Equipment - MW/MVAR



TASMO MODEL; OUTPUT GENERATED 2010-11-19 13:28:45
SWINGBUS 1520 FOR FC-2009-6:2016-10-31:8:32--1-0-0-0

2016 SOUTH SYSTEM

Figure D6 - 968L Contingency

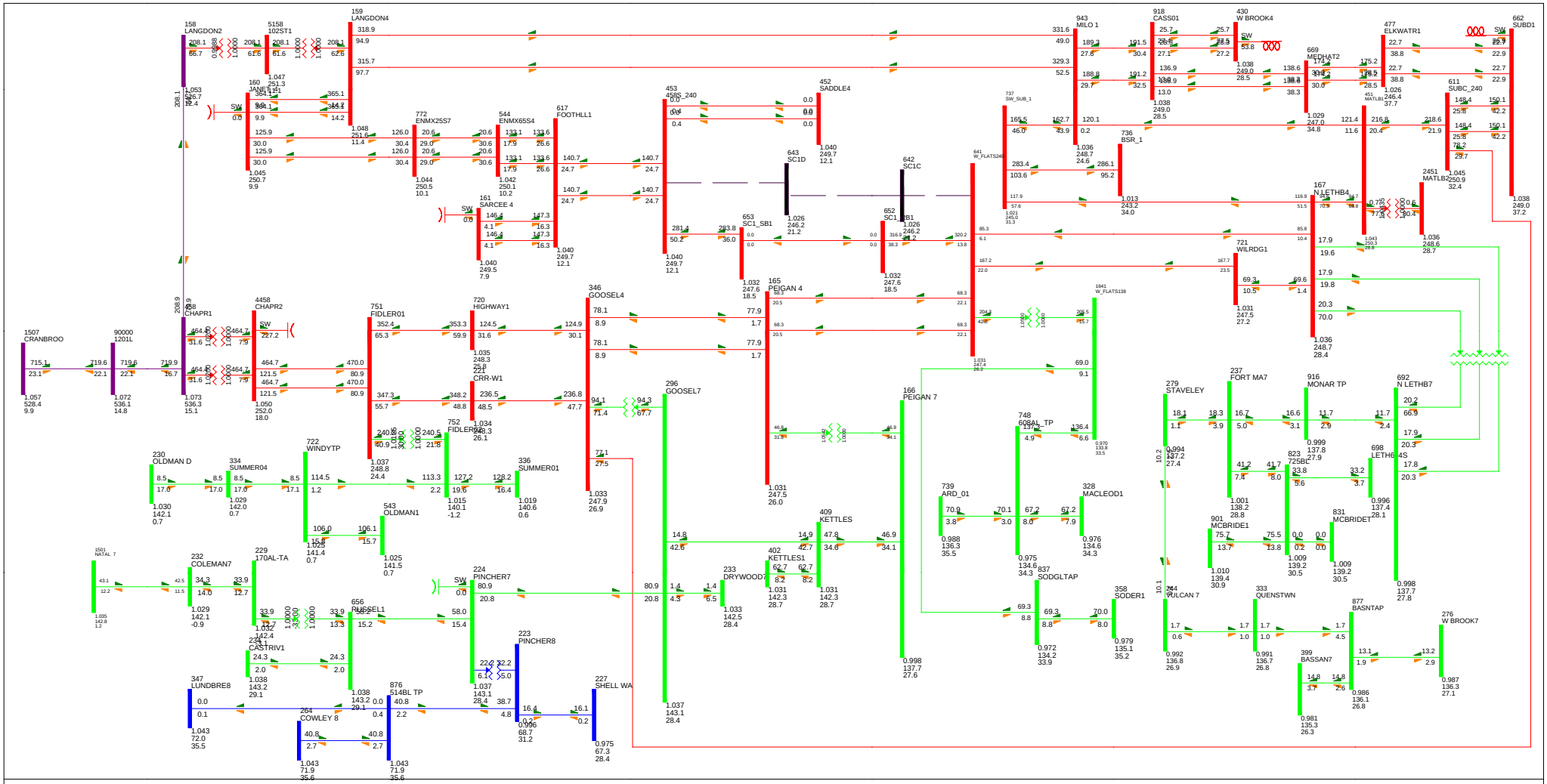
2016 SL Windy Flats Configuration

Thursday, March 22, 2012

KV: <=34.500 <=69.000 <=138.000 <=240.000
<=500.000 <=600.000 >600.000

BC Export: 700.0 MW

Bus - VOLTAGE (KV/PU) 100.0%RATEA
Branch - MW/MVAR
Equipment - MW/MVAR



TASMO MODEL; OUTPUT GENERATED 2010-11-19 13:28:45
SWINGBUS 1520 FOR FC-2009-6:2016-10-31:8:32--1-0-0-0

2016 SOUTH SYSTEM

Figure D7 - 1037L Contingency

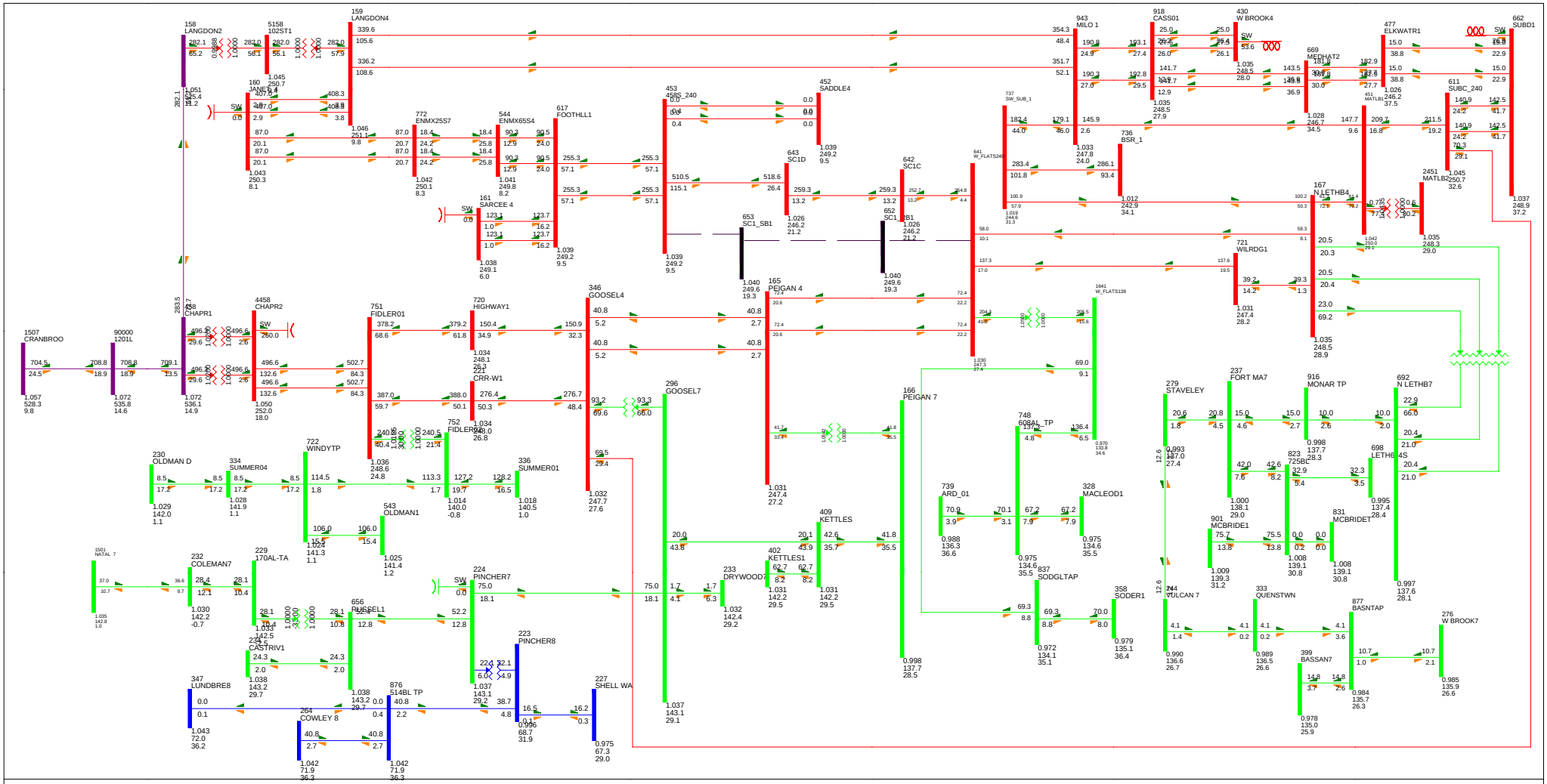
2016 SL Windy Flats Configuration

Thursday, March 22, 2012

KV: <=34.500 <=69.000 <=138.000 <=240.000
<=500.000 <=600.000 >600.000

BC Export: 700.0 MW

Bus - VOLTAGE (KV/PU) 100.0%RATEA
Branch - MW/MVAR
Equipment - MW/MVAR



TASMO MODEL; OUTPUT GENERATED 2010-11-19 13:28:45
SWINGBUS 1520 FOR FC-2009-6:2016-10-31:8:32--1-0-0-0

2016 SOUTH SYSTEM

Figure D8 - 1038L Contingency

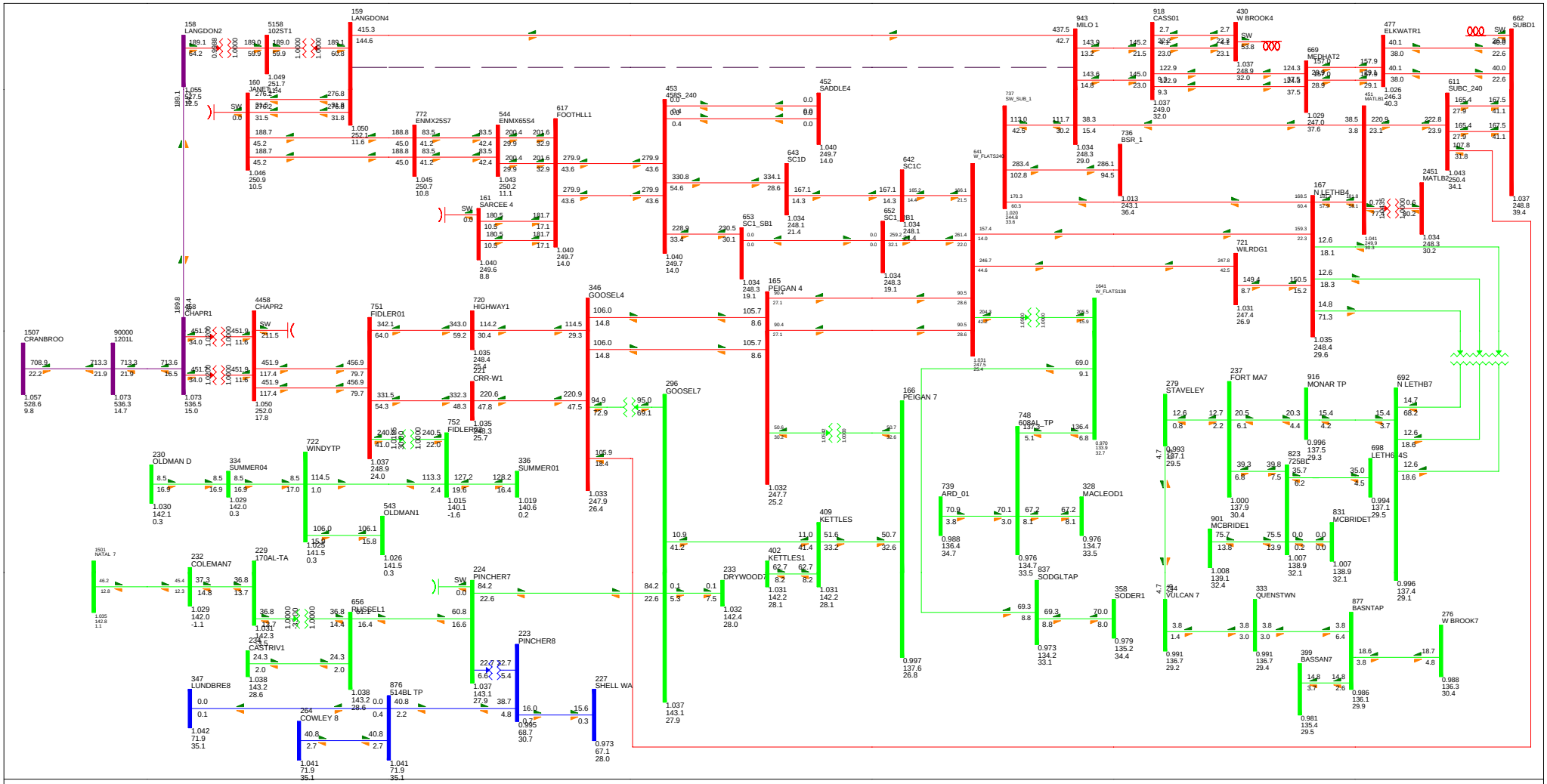
2016 SL Windy Flats Configuration

Thursday, March 22, 2012

KV: <=34.500 <=69.000 <=138.000 <=240.000
<=500.000 <=600.000 >600.000

BC Export: 700.0 MW

Bus - VOLTAGE (KV/PU) 100.0%RATEA
Branch - MW/MVAR
Equipment - MW/MVAR



TASMO MODEL; OUTPUT GENERATED 2010-11-19 13:28:45
SWINGBUS 1520 FOR FC-2009-6:2016-10-31:8:32--1-0-0-0

2016 SOUTH SYSTEM

Figure D9 - 924L Contingency

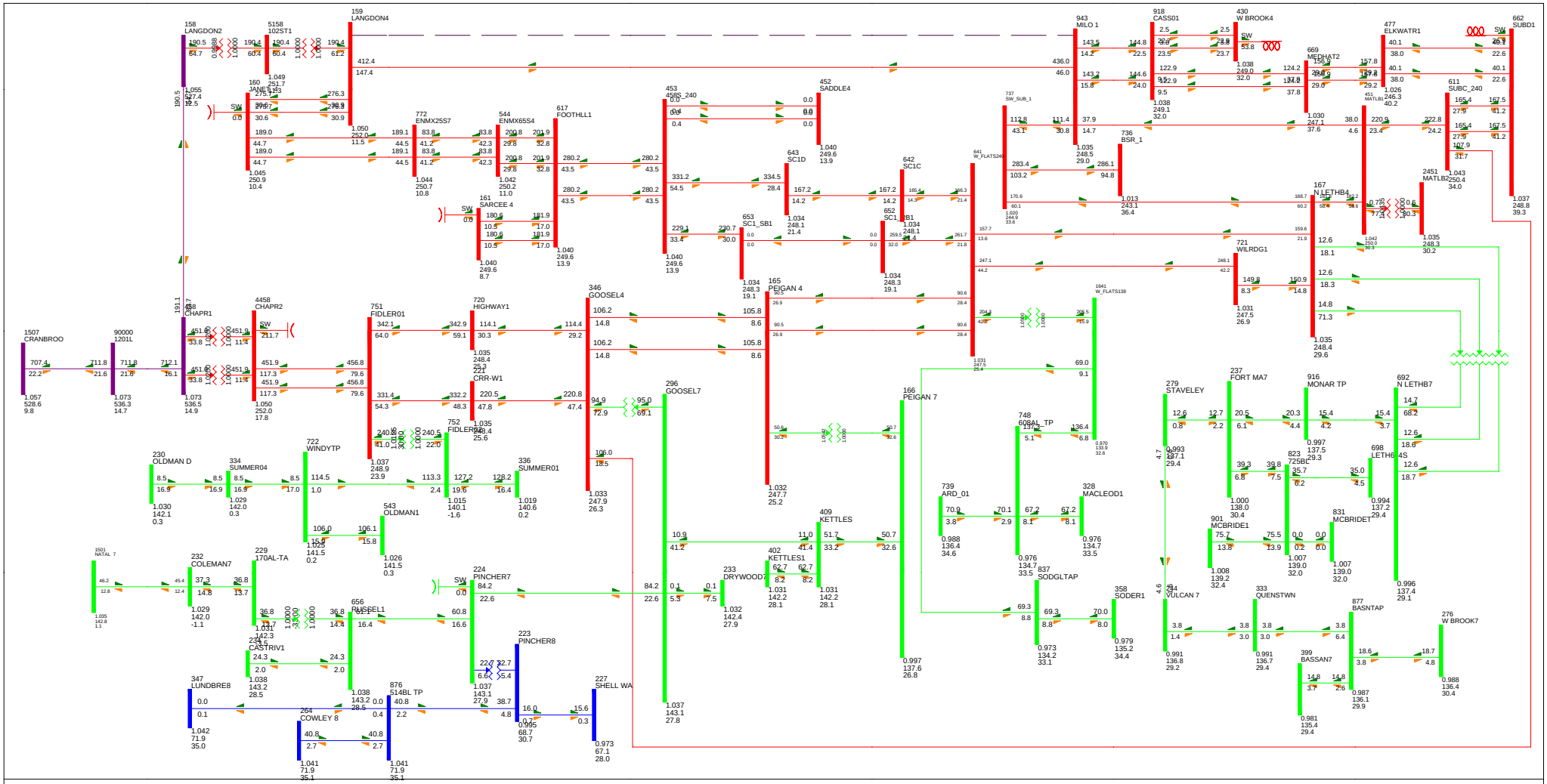
2016 SL Windy Flats Configuration

Thursday, March 22, 2012

KV: <=34.500 <=69.000 <=138.000 <=240.000
<=500.000 <=600.000 >600.000

BC Export: 700.0 MW

Bus - VOLTAGE (KV/PU) 100.0%RATEA
Branch - MW/MVAR
Equipment - MW/MVAR



TASMO MODEL; OUTPUT GENERATED 2010-11-19 13:28:45
SWINGBUS 1520 FOR FC-2009-6:2016-10-31:8:32--1-0-0-0

2016 SOUTH SYSTEM

Figure D10 - 927L Contingency

2016 SL Windy Flats Configuration

Thursday, March 22, 2012

KV: <=34.500 <=69.000 <=138.000 <=240.000
<=500.000 <=600.000 >600.000

BC Export: 700.0 MW

Bus - VOLTAGE (KV/PU) 100.0%RATEA
Branch - MW/MVAR
Equipment - MW/MVAR