APPENDIX A CONNECTION ASSESSMENT

BowArk Energy Queenstown Power Plant Connection

Project number: 1336

The attached engineering study report has been prepared by a third party as part of the AESOs connection process. The AESO has reviewed the report and the conclusions that it contains, and finds it acceptable for the purpose of assessing potential impacts of the proposed connection on the transmission system.

Information regarding the AESO's connection process can be found at: http://www.aeso.ca/connect/#overview

Date: January 28, 2015

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Connection Engineering Study Report for AUC Application

BowArk Energy

Queenstown Power Plant

File No. 1336

Revision: 9.9

Revision Date: January 28, 2015

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NOTICE TO USER

The base cases used for this study were three seasonal base cases from the Alberta Electric System Operator's ("AESO") web site, notably PBCS2012-2014_V32_R8, PBCS2012-2017_V32_R8 and PBCS2012-2022_V32_R8, published on March 1, 2012. These base cases were further augmented by additional data received from the AESO that was deemed relevant to this project by the AESO. PowerEN has relied on its expertise and its due diligence when preparing study cases for this project. However PowerEN makes no warranty regarding the accuracy of data obtained from the AESO, nor the assumptions used by the AESO to create the data from these sources.

Executive Summary

BowArk Energy Ltd. (BowArk) is proposing to design, construct and operate a new gas-fired generating facility, identified as the Queenstown Generation Plant, in the vicinity of Queenstown, Alberta. The plant is proposed to be connected to the existing Queenstown 504S substation in the Strathmore/Blackie planning area 45 through a short 138 kV line. BowArk initially requested a 2014 In-Service Date ("ISD"). However, the ISD was revised to September 30, 2015 to align the connection project with the 138 kV transmission developments in the local area in 2015 as part of the approved Southern Alberta Transmission Reinforcement (SATR) project[1].

This report contains results of system impact studies performed to assess the technical viability of the proposed connection.

Project Overview

The Queenstown Generation Plant will be configured with two General Electric LM6000 gas turbine generator packages with a turbine nameplate capacity of 40 MW and Maximum Authorized Real Power of 45 MW each, representing a total installed capacity equalling 90 MW. The LM6000 generator sets will be installed in a simple cycle configuration to permit fast (10 minute) start-up capability of the units.

The plant will be designed to permit base load and peaking operation, as well as to provide ancillary services in the form of regulating, spinning and supplemental reserve within both the active and standby markets.

Currently, there are no future expansion plans for the Queenstown Generation Plant.

Existing System

The existing Strathmore/Blackie Planning Area (Area 45) is comprised of a 138 kV transmission system. Additionally, a 240 kV double circuit 924L/927L passes through the Strathmore area, connecting Milo 356S and Langdon 102S substations located in neighbouring planning areas 47 (Brooks) and 6 (Calgary) respectively. Cavalier and Carseland generating units provide a strong source within the Strathmore area, supplying up to 215 MW of power. 138 kV capacitor banks are installed at Blackie 253S, Strathmore 151S and Hussar 431S substations.

The existing 138 kV system in the Blackie area will be modified as part of the SATR[2] and by Foothills Area Transmission Development (FATD) East[3] system projects. Together SATR and FATD projects will alleviate existing thermal and voltage constraints in the area. As a result of the SATR development, the existing Blackie area 138 kV transmission system will be split in two. Existing connections from Queenstown 504S to Gleichen 179S and Blackie 253S substations will be replaced by direct connections between:

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[1] The approved 138 kV transmission developments in the Blackie area were expected to be in-service by Q3 2015 when this report was being prepared. However, the in-service date of these developments is now shifted. Consequently, the ISD of the proposed connection has been revised to August 2016. All study findings and recommendations in this report will remain applicable.

[2] Approval No. U2014-138, Stage II, paragraph 8.

[3] Approval No. U2013-459, paragraph g.

- Queenstown 504S and Vulcan 255S;
- Blackie 253S and Gleichen 179S.

Study Scope

The purpose of this study was to:

- Assess the impact of the proposed alternative for connecting Queenstown Generation Plant on the Alberta Interconnected Electric System (AIES).
- Propose mitigation measures to manage any reliability concerns resulting from the proposed connection alternative.

The study was carried out for the 2015 and 2017[4] study years with post-SATR and post-FATD East system configuration. All base cases featured a high-wind generation dispatch scenario to simulate a credible worst case condition for the connection studies.

Three connection alternatives were identified for this project:

- Alternative 1 proposes a 138 kV direct connection to the existing Queenstown 504S substation.
- Alternative 2 proposes a 240 kV in-and-out connection into either 924L line or 927L line between Milo 356S and Langdon 102S substations, in a location close to the Queenstown Generation Plant.
- Alternative 3 proposes connection of the Queenstown Generation Plant via a “T” tap on the 138 kV 876L line between the Queenstown 504S and Gleichen 179S substations.

Alternative 2 was eliminated from the outset due to its associated developments that results in significant higher connection costs as compared to the other connection alternatives. Alternative 3 was eliminated from the outset as it could significantly increase the amount of remedial action schemes (RASs) required to facilitate the connection based on preliminary project assessment.

STUDIES PERFORMED

The following analyses were performed:

- Power Flow analysis
- Transient stability analysis
- Short-Circuit fault analysis

Study Conclusions

The system impact study was performed for the proposed Queenstown Generation Plant connection to the grid. Detailed studies were performed for Alternative 1 which considers connecting the generation facilities to the grid through a new 138 kV transmission line. The sum of all technical results presented in this report led to the following conclusions:

[4] 2015 study year was included considering the original Q3 2015 ISD of the proposed Queenstown generation connection. 2017 study year was included considering possible changes to the ISD of the SATR 138 kV developments in the Blackie area, which would impact the ISD of the proposed Queenstown Generation connection to the AIES.

1. Alternative 1 is the recommended 138 kV connection alternative. The recommended alternative utilizes the additional transmission capacity provided by the SATR project system modifications in the Blackie area.
2. Power flow study results demonstrated acceptable system performance with the proposed connection Alternative 1.
3. No transient stability issues were identified in any of the study cases with the proposed connection Alternative 1.
4. Short-circuit levels in the post-connection configuration remained within the 31.5 kA limit for 138 kV voltage levels. No upgrade to any existing substation equipment would be required as a result of the Queenstown Generation Plant connection under the proposed connection configuration.

Final Recommendations

The connection studies show that Alternative 1 is a technically viable connection alternative and it does not negatively impact the performance of the AIES. Based on the connection assessment analyses results and associated developments:

1. Alternative 1, a direct 138 kV connection between the proposed Queenstown Generation Plant and the existing Queenstown 504S substation, is recommended to reliably connect the proposed generation facilities to the grid following completion of the SATR Blackie area 138 kV Reconfiguration.
2. The Project's in-service date to be conditional upon the completion of the SATR 138 kV system modifications in the Strathmore/Blackie area.

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1. Introduction

This report contains the results of a system impact study performed to assess the technical feasibility of connecting a new gas-fired generating facility in the vicinity of Queenstown, Alberta.

BowArk Energy Ltd ("BowArk") has requested transmission system access for its proposed 90 MW Queenstown power plant facility located on SW-17-19-22-W4M, approximately 7.5 km southwest of the hamlet of Queenstown.

1.1. Project

1.1.1. Project Overview

BowArk is proposing to design, construct and operate a new gas-fired generating facility, identified as the Queenstown Generation Plant, in the vicinity of Queenstown, Alberta.

The Queenstown Generation Plant would be configured with two General Electric LM6000 gas turbine generator packages with a turbine nameplate capacity of 40 MW and Maximum Authorized Real Power of 45 MW each, representing a total installed capacity equalling 90 MW. The LM6000 generator sets will be installed in a simple cycle configuration to permit fast (10 minute) start-up capability of the units.

The plant will be designed to permit base load and peaking operation in addition to ancillary services of regulating, spinning and supplemental reserve within both the active and standby markets.

Currently, there are no future expansion plans for the Queenstown Power Plant.

BowArk Energy requested an In-Service-Date ("ISD") of June 1, 2014. However, this date has since been revised to September 30, 2015 in order to allow for Southern Alberta Transmission Reinforcement (SATR)[5] 138 kV system modifications in the Blackie area to be implemented. The ISD for the SATR approved Blackie area modifications is Q3 2015. [6]

The proposed developments for Queenstown Generation Plant connection are hereafter referred to as "the Project".

1.1.2. Load Component

Substation Service

- Load: 0.5 MW, power factor of 0.90;
- Load Type: station service load.

[5] Approval No. U2014-138, Stage II, paragraph 8.

[6] The approved 138 kV transmission developments in the Blackie area were expected to be in-service by Q3 2015 when this report was being prepared. However, the ISD of these developments is now shifted. Therefore, the requested ISD for connection has been further revised to August 2016 in accordance with the revised ISD for the 138 kV system modifications in the Blackie area. Study results and recommendations in this report will remain applicable.

1.1.3. Generation Component

- Maximum Authorized Real Power ("MARP"): 45 MW each;
- Maximum Capability ("MC"): 45 MW each;
- Generator Type: General Electric LM6000 gas turbine generator, turbine nameplate capacity of 40 MW;
- Number of generator units: 2;
- Reactive Power Capability of each generator unit: +/- 21.3 MVAr.

Table 1.1-1 shows the proposed plant's expected maximum seasonal output.

Table 1.1-1: Queenstown Generation Plant Maximum Expected Seasonal Output

Queenstown 2 by LM6000PF Maximum Net Plant Output				
Month	Maximum Generator Output* (New and Clean) 2 by LM6000PF (MW)	Station Service Consumption (MW)	Stepup TX Losses 99.5% Eff (MW)	Maximum Plant Net Output, High Side TX (MW)
Jan	90.4	0.78	0.43	89.2
Feb	90.4	0.78	0.44	89.2
Mar	90.4	0.78	0.42	89.2
Apr	90.2	0.78	0.41	89.0
May	88.0	0.78	0.39	86.8
Jun	87.2	0.78	0.38	86.0
Jul	84.6	0.78	0.36	83.5
Aug	86.0	0.78	0.37	84.9
Sep	87.8	0.78	0.39	86.6
Oct	90.4	0.78	0.41	89.2
Nov	90.4	0.78	0.43	89.2
Dec	90.4	0.78	0.44	89.2
* Based on 10 years of historical site climate data and GE APPS Program				

1.2. Study Scope

1.2.1. Study Objectives

The purpose of the study was to:

- Assess the impact of the proposed alternative for connecting Queenstown Generation Plant to the Alberta Interconnected Electric System (AIES).
- Propose mitigation measures to manage any reliability concerns resulting from the proposed connection alternative.

1.2.2. Study Area

The proposed Queenstown Generation Plant is located in the Strathmore/Blackie Planning Area (Area 45). For the purpose of this study, the study area ("**Study Area")** was defined to include all transmission system elements operating at voltages of 138 kV and higher, in Planning Areas 45, 47, and 49 as outlined in Table 1.2-1.

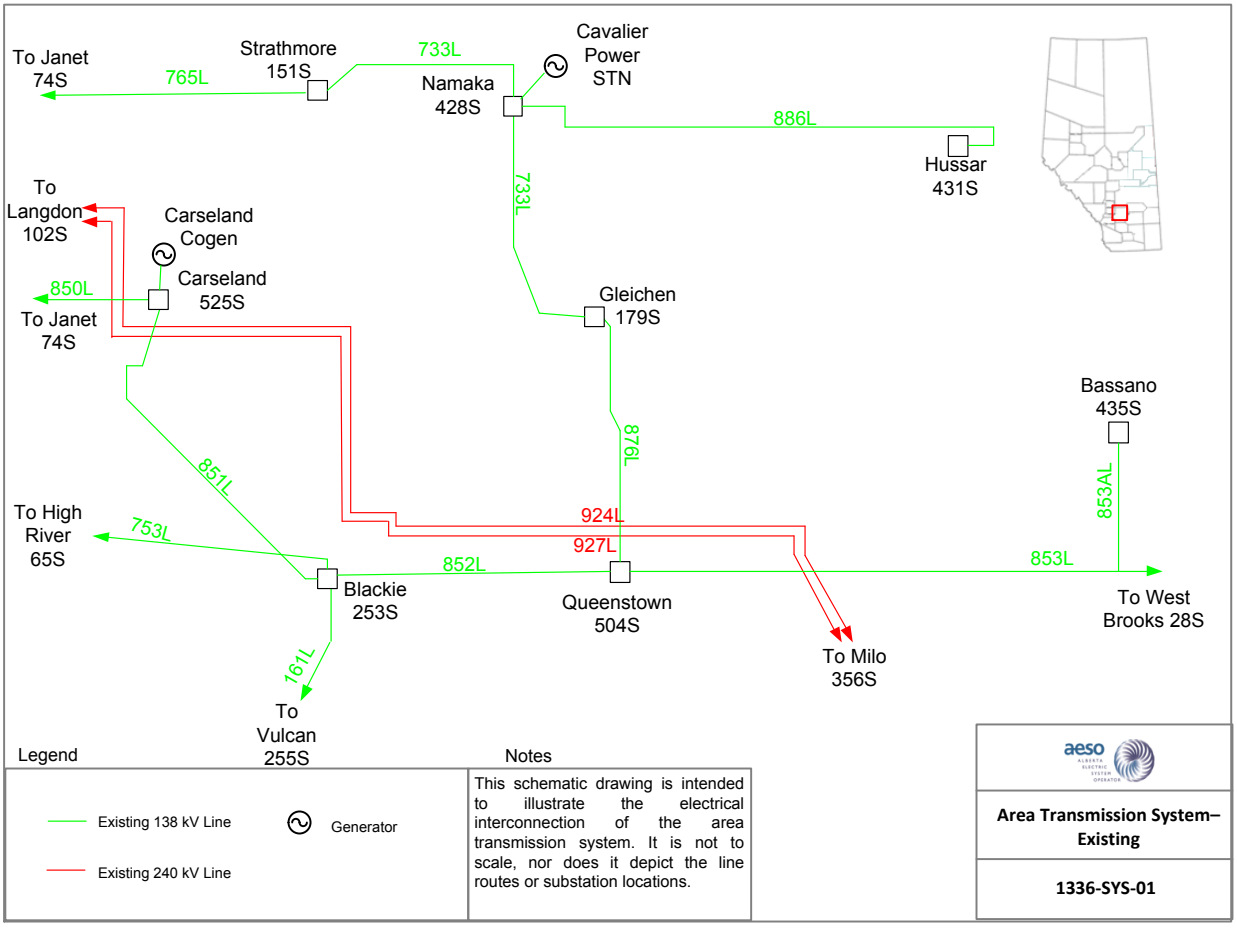
Table 1.2-1: Study Area

Area Number	Planning Area Name
45	Strathmore/Blackie
49	Stavely
47	Brooks

1.2.2.1. Existing System Description

The existing Strathmore/Blackie Planning Area (Area 45) is comprised predominantly of a 138 kV transmission system. A 240 kV double circuit 924L/927L passes through the area connecting Milo 356S and Langdon 102S substations, located in neighbouring planning areas 47 (Brooks) and 6 (Calgary) respectively. Cavalier and Carseland generating units provide a strong source within the Strathmore area, rated at 95 MW and 120 MW respectively. 138 kV capacitor banks are installed at Blackie 253S, Strathmore 151S and Hussar 431S substations. The existing transmission system configuration in the Strathmore/Blackie area is shown in Figure 1.2-1.

Figure 1.2-1: Existing Strathmore/Blackie Planning Area Transmission Configuration



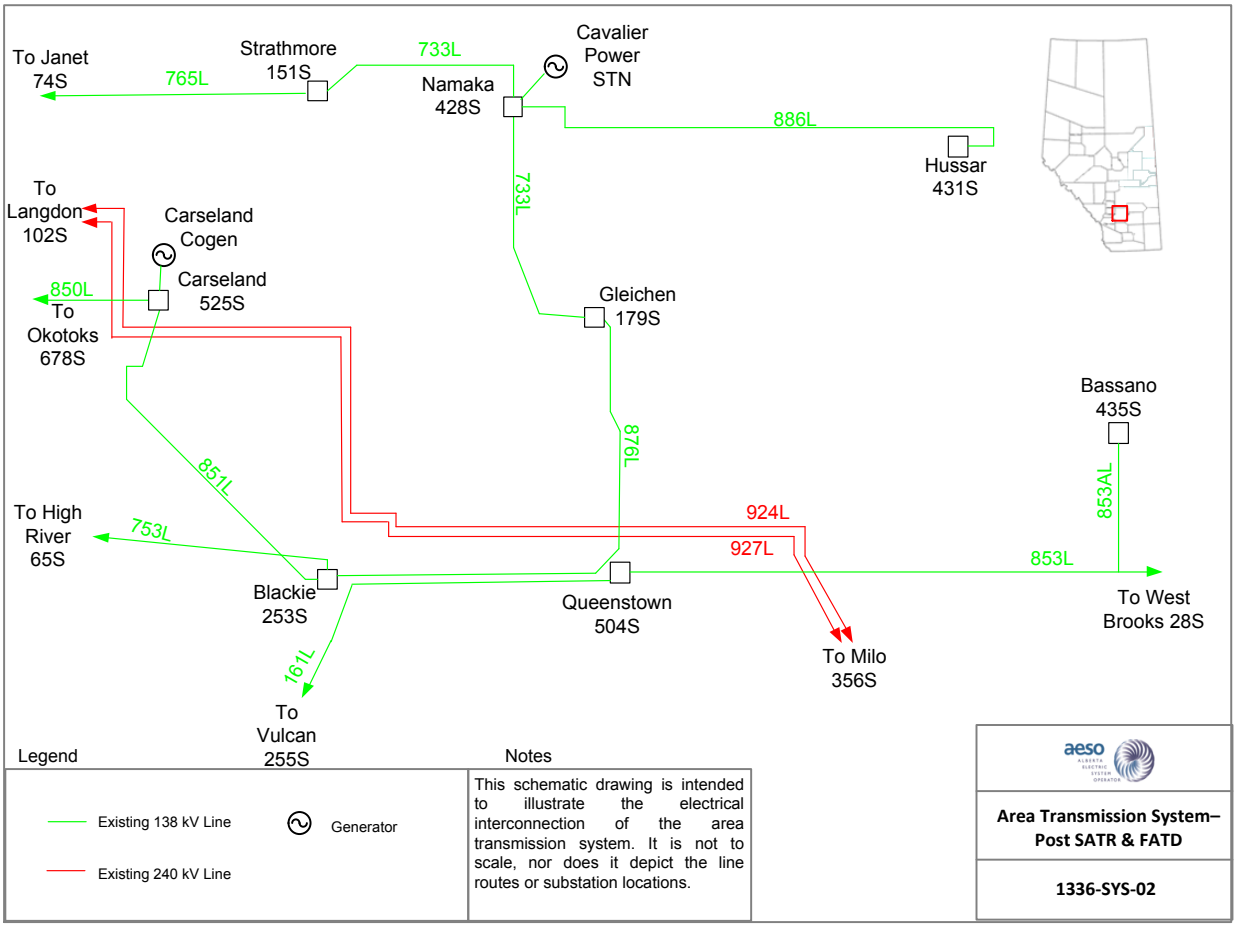
Under the SATR Blackie Area 138 kV Upgrade project (Project 787-11), the 138 kV system around the existing Blackie 253S and Queenstown 504S substations will be modified. As a result, a direct connection between the Blackie 253S and Gleichen 179S substations will be formed, bypassing the Queenstown 504S substation. A direct connection between the Queenstown 504S and Vulcan 255S substations will be also formed, bypassing the Blackie 253S substation. Consequently, the Queenstown 504S substation will be separated from the resulting 138 kV loop that will be directly connecting the Calgary and Strathmore/Blackie planning areas.

As part of the Foothills Area Transmission Development East (FATD East) project, the 138 kV 850L line, currently connecting Carseland 525S to the Janet 74S substation, will be re-configured to connect Carseland 525S and Okotoks 678S substations. The ISD for this portion of the FATD project is Q3 2015[7].

Refer to Figure 1.2-2 for the area transmission system after the completion of the above-mentioned SATR and FATD projects.

[7] The FATD East development in the Blackie/Strathmore area has no impact on the proposed Queenstown Power Plant connection.

Figure 1.2-2: Area Transmission Systems in 2015 Post SATR and FATD Blackie Area 138 kV System Modifications



1.2.3. Existing Constraints

The existing Strathmore/Blackie area 138 kV transmission system is prone to heavy loading under certain system conditions including high local area generation and high wind dispatch in the Southern Alberta. The 138 kV system is also susceptible to parallel flows from the neighbouring 240 kV transmission system under contingency conditions such as the loss of 911L between Janet 74S and Peigan 59S. Existing constraints will be addressed as part of the AESO's SATR and FATD system developments.

1.2.3.1. AESO Long-Term Plans

The AESO 2013 South Regional Plan[8] proposes the following system developments within the Strathmore/Blackie planning area in the near-term:

- 138 kV transmission line 733L Strathmore to Namaka to Gleichen protection upgrades by 2017.

1.3. Studies Performed

The following analyses were performed for the pre-connection analysis considering Category A operating conditions as well as Category B and selected Category C contingencies:

- Power flow analysis
- Transient stability analysis
- Short-Circuit fault studies

The following analyses were performed for the post-connection analysis considering Category A operating conditions as well as Category B and selected Category C contingencies:

- Power flow analysis
- Transient stability analysis
- Short-Circuit fault analysis

1.4. Report Overview

The Executive Summary provides a high-level summary of the report and its conclusions:

- Section 1 provides an Introduction.
- Section 2 describes the Standards, System Data, and Study Assumptions.
- Section 3 presents the Study Methodology.
- Section 4 discusses the Pre-Connection System Assessment.
- Section 5 discusses the connection alternatives.
- Section 6 provides a Technical Analysis of the Connection Alternatives.
- Section 7 provides a Short-Circuit Analysis.
- Section 8 discusses Project Interdependencies.
- Section 9 presents Study Conclusions and Recommendations.

[8] AESO 2013 South Region Plan, Table E-4 in the Executive Summary, and Section 10.4, which can be found on the AESO website at: http://www.aeso.ca/downloads/South_LRP_Report_Final.pdf

2. Criteria, System Data, and Study Assumptions

2.1. Criteria, Standards, and Requirements

2.1.1. Transmission Planning (TPL) Standards and AESO Transmission Reliability Criteria

Transmission Planning (TPL) standards are included in the Alberta Reliability Standards[9]. Within the TPL standards, the acceptable performance of the transmission system under various system conditions is defined in Appendix 1 of the TPL standards[10]. A summary of Category A through C system conditions is provided below:

> ***Category A*** *represents a normal system with no contingencies and all facilities in service. This is often referred to as the N-0 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 ratings and the system must be stable with no cascading outages.*
>
> ***Category B*** *events result in the loss of any specified single system element under specified fault conditions and normal clearing. The specified elements are a generator, a transmission circuit, a transformer or a single pole of a DC transmission line. This is often referred to as an N-1 event or with the most critical generator out of service, an N-G-1 event. 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.*
>
> ***Category C*** *events result in the loss of two or more specified system elements under specified fault conditions and include both normal and delayed fault-clearing events. When any two specified system elements are lost simultaneously, this is referred to as an N-2 event. All of the system limits for Category A and B events apply with the exception that planned, controlled loss of either firm load, firm transfers and/or certain generation is acceptable, provided there is no cascading events.*

The specific type of Category C outages that are relevant to this study will be outages of two circuits of a multiple circuit towerline. This specific subcategory of Category C outage events is designated as C5.

[9] Alberta Reliability Standards can be found on the AESO website at: http://www.aeso.ca/rulesprocedures/17006.html

[10] Appendix 1 to all four TPL standards, TPL-001-AB-0, TPL-002-AB-0, TPL-003-AB-0, and TPL004-AB-0, is the same and can be found on the AESO website at: http://www.aeso.ca/downloads/TPL-001-AB-0.pdf

The TPL standards specify the desired system performance under different contingency categories with respect to the "**Applicable Ratings**". For the purpose of applying these standards to this study, the "Applicable Ratings" shall mean[11]:

- Line summer loading limits (continuous thermal rating) for Summer Peak base cases and Light Load base cases.
- Highest specified loading limits for transformers.
- Normal Voltage Operating Range, as per AESO Information Document ID# 2010-007RS[12], for normal operating Category A conditions.
- Extreme Voltage Operating Range, as per Table 1-1 in the Transmission Planning Criteria – Basis and Assumptions, following Category B and C contingencies.
- Acceptable post-contingency voltage change limits for three defined post event timeframes as provided in Table 2.1-1 below.

Table 2.1-1: Acceptable Voltage Deviation

Parameter	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 Low Voltage Bus	±10%	±7%	±5%

2.1.2. AESO Operating Policies and Procedures (OPPs) and Authoritative Documents (ADs)

AESO Information document ID#2010-007RS, General Operating Practice – Voltage Control, and ID#2013-009R, South Area Transmission Constraint Management, were used as guidelines for the studies performed. Where defined, operating voltages for the key buses within the study area were set in accordance with the AESO Information Document ID# 2010-007RS under normal operating conditions in all study cases and prior to simulating any contingency events.

2.1.3. AESO Customer Connection Study Requirements

The AESO Connection Study Requirements[13] were applied for this study.

[11] Applicable ratings are in alignment with the AESO Transmission Planning Criteria – Basis and Assumptions, Version 1.

[12] ID# 2010-007RS can be found on the AESO website at: http://www.aeso.ca/rulesprocedures/18592.html.

[13] AESO Connection Study Requirements, R1, Sept 20, 2010, can be found at: http://www.aeso.ca/downloads/ConnectionStudyRequirements.pdf

2.1.4. AESO Generation and Load Interconnection Standard

Generation and Load Interconnection Standard[14] were respected during the studies for the proposed project.

2.2. Load and Generation Assumptions

2015 and 2017 Summer Peak (SP) and Summer Light (SL) scenarios were studied. Summer load conditions were chosen for the connection assessment as they represent more stressed system conditions in the Study Area compared with winter scenarios. The use of summer study scenarios leads to high area flows due to lighter local area loads and lower seasonal line ratings. Differences in seasonal generating capacity were taken into account.

The study cases were derived from the AESO's published 2012 Planning Base Case Suite and a series of specifically designed incremental modification files (IDEV files), also received from the AESO. The IDEV files contain instructions to modify the base cases' topology and to re-dispatch the load and generation in the base cases as required for this study.

The generation and load dispatch for all studied scenarios was provided by the AESO.

2.2.1. Load Assumptions

Load assumptions are based on the AESO 2012 Long-Term Outlook (2012 LTO) for the Central and South regions at Alberta Internal Load (AIL) peak with consideration to percentile metering point loading to ensure total AIL load levels remain consistent with the 2012 LTO. The incremental dispatch IDEVs contained loading assumptions as stated in the Table 2.2-1 below.

As part of its planning responsibilities, the AESO updates its corporate load forecasts routinely to ensure they reflect the latest economic projections, factors and timing. While the AESO has updated its regional forecasts since the connection studies were performed, the use of current AESO load forecasts (2014 Long-term Outlook) for the region would not materially alter the connection study results or affect its conclusions.

Table 2.2-1: 2012 LTO Load Forecast

Region Name and Season		Forecast Peak Load (MW)	
		2015	2017
Central	SP	1,573	1,630
	WP	1,756	1,823
	SL	1,164	1,223
South	SP	2,921	3,041
	WP	3,127	3,267
	SL	1,985	2,101
AIL	SP	11,042	11,923
	WP	12,130	13,005
	SL	8,128	8,864

[14] AESO Generation and Load Interconnection Standard, Rev. 1, Sept 19, 2006, can be found at: http://www.aeso.ca/downloads/Generation_and_Load_Standard_Rev1.pdf

2.2.2. Generation Assumptions

The key existing and proposed generators and their dispatch levels in the Study Area are listed in Table 2.2-2, Table 2.2-3, and Table 2.2-4 below.

High wind dispatch assumptions were used with all the existing wind generation facilities and all the wind generation facilities that are currently under construction dispatched up to their contracted Maximum Capacity ("MC") level. The remaining forecast wind growth was allocated to projects in the Southern Alberta region as identified in Table 2.2-4 to stress the local transmission network.

Incremental dispatch IDEVs were provided by the AESO to adjust the generation dispatch in the base cases to a closer starting point for the wind and intertie conditions listed in Table 2.2-2, Table 2.2-3, and Table 2.2-4 below.

The Queenstown power plant was dispatched to 87 MW in alignment with its maximum seasonal output at the time of Summer Peak and Summer Light load conditions. The reduction of generation capacity during the warm summer weather is offset by reduced line thermal ratings under the same condition creating a more stressed condition compared to winter scenarios.

Table 2.2-2 Local Area Non-Wind Generators in the Study Case(s)

Generator	Bus	Fuel Type	Total MC (MW)	2015 Dispatch (MW)	2017 Dispatch (MW)
Cavalier	3247, 4247	Gas	120	120	120
Carseland	3251, 4251	Co-gen	95	95	95
Queenstown	4758	Gas	87/90*	Pre: NA** Post: 87†	Pre: NA** Post: 87†
Shepard	773, 774, 775	Gas	850	850	850

* 90 MW only obtainable under cold weather conditions
** Pre-connection of Queenstown Generation Plan
† Post-connection of Queenstown Generation Plant Dispatch

Table 2.2-3: Wind Generators and Wind Projects

Plant Name	Planning Area	Bus Number	2015/2017 Dispatch (MW)
Existing Southern Alberta			
Castle River	53	2234, 3234	40
Cowley Ridge	53	255, 265, 4264	38
McBride Lake	53	2901, 3901, 4901	75
Summerview I	53	2338, 3338	69
Magrath	53	11002	30
Soderglen	53	12358, 13358	68

Chin Chute Wind	54	2389	30
Kettles Hill	53	2402, 3402	63
Taber Wind	52	15343, 16343	81
Blue Trail	53	66328, 67328	66
Summerview II	53	4339, 5337	66
Ardenville	53	4735, 4740	66
Castle Rock	53	67221	103*
Suncor Wintering Hills	43	60789, 60791, 60793, 60846, 60848, 60850	88
Greengate Blackspring Ridge I Wind Project	49	61736, 61737	300
Alberta Wind Energy Old Man River Wind Farm	53	61543	47
Subtotal South			**1230**
Existing central			
Ghost Pine	42	2621-2625	**82**
Halkirk	42	66435,67435	**150**
Subtotal Central			**232**
Total Alberta			**1462**

* Dispatch includes proposed stage two development.

ID# 2013-009R was respected when dispatching south wind generation.

Table 2.2-4: Wind Projects in Southern Alberta (Past Stage 2)

Southern Wind Projects Beyond Stage 2	Project Number	Anticipated ISD	Planning Area	Ref Bus Number	Total MC (MW)	2015 Dispatch (MW)	2017 Dispatch (MW)
Pteragen Peace Butte 116 MW Wind Farm	513	Q1 2015	4	2294, 4294	116	0	0
Naturener Wild Rose Wind Farm	479	Q4 2015	4	4631, 5633, 5631, 6631, 7631, 4632, 5632, 6632, 7632, 4633	200	0	0
Benign Energy Heritage Wind Farm	515	Q3 2017	53	66536	100	0	100

Benign Energy Heritage Wind Farm	515	Q3 2017	53	66536, 62536	250	0	95
Enel Alberta Riverview Wind Farm	524	Q4 2016	53	69221	115	0	0
Windy Point Wind Farm	580	Q4 2015	53	61546	61	0	0
Vindt Willowridge Wind Farm*	614	Jul 31, 2013	53	14724, 14722	100	93	100
GlenRidge Wind Farm Phase 1*	617	Sep 25, 2015	48	13724	100	0	0
Acciona New Dayton Wind Energy Project*	679	Dec 31, 2014	55	62631, 62632, 62633	99	92	99
Naturener Wild Rose Wind Farm Phase 2	693	Q1 2016	4	3462, 7463, 4462, 5462, 6462, 7462, 3463, 4463, 5463, 6463	200	0	0
Renewable Energy Services Ltd PC006 Wind Farm	750	Q1 2016	53	2781, 2773, 2775	47	0	0
Blood Tribe Wild Turnip Hill Wind Project*	766	Jun 1, 2015	54	62641, 64641	150	140	150
Old Elm & Pothole Creek Wind Farm	1080	Q1 2018	55	1752, 1755, 1753, 1756	300	0	0
Subtotal						**325**	**544**

* These projects were in the AESO connection queue (past Gate 2) at the time the studies were conducted. Since then these projects have been canceled. Dispatch of these generators results in a more stressed system condition than would be anticipated with the units dispatched off. Therefore, sensitivity studies are not required.

2.2.3 Intertie Flow Assumptions

It was assumed that intertie flow between AIES and adjacent systems were set to 0 MW for each intertie, in all study scenarios.

2.3. System Projects

Approved transmission development plans for the Study Area are shown in Table 2.3-1:

Table 2.3-1: System Projects Included in the Study

Project Name	Anticipated ISD
South Calgary 69 kV Transmission Upgrade[15]	2014
Foothills Area Transmission Development (FATD)[16]	2015
SATR Blackie Area 138 kV Reconfiguration[17]	2015
SATR 911L Line Replacement[17]	2015

2.4. Customer Connection Projects

Customer connection projects within/around the Study Area and past Gate 2 of the AESO's Customer Connection Process were included based on their anticipated ISD at the time of study. These projects are shown in Table 2.2-4 and Table 2.4-1.

Table 2.4-1: Customer Connection Projects Included in the Study

Project Name	AESO Project Number	Anticipated ISD
Big Rock 295S Substation	1232	Summer 2015
Black Diamond Transformer Replacement	1218	Summer 2015
Shepard Energy Centre	719	Winter 2014/2015

[15] South Calgary 69 kV Transmission Upgrade can be found on the AESO website at: http://www.aeso.ca/transmission/17665.html

[16] Foothills Area Transmission Development – East can be found on the AESO website at: http://www.aeso.ca/transmission/22896.html

[17] Southern Alberta Transmission Reinforcement can be found on the AESO website at: http://www.aeso.ca/transmission/16869.html

2.5. Facility Ratings and Shunt Elements

Table 2.5-1: Summary of Facility Ratings for Key Transmission Lines in the Study Area

Transmission Line	From Substation	To Substation	Summer (MVA)	Winter (MVA)
765L	Janet 74S	Strathmore 151S	85	90
733L	Strathmore 151S	Namaka 426S	120	143
733L	Namaka 428S	Gleichen 179S	120	148
886L	Namaka 428S	Hussar 431S	119	147
876L	Gleichen 179S	Blackie 253S	85	90
753L	Blackie 253S	High River 65S	121	143
851L	Blackie 253S	Carseland 525S	85	90
161L	Vulcan 255S	Queenstown 504S	117	120
853L	Queenstown 504S	West Brooks	121	148
924L	Langdon 102S	Milo 356S	481	581
927L	Langdon 102S	Milo 356S	576	711
935L	Milo 356S	Cassils 324S	489	499
923L	Milo 356S	Cassils 324S	489	499
1036L	Milo 356S	Travers 554S	481	581
1041L	Travers 544S	North Lethbridge 370S	481	581
1005L	Milo 356S	MATL 120S	481	581
940L	MATL 120S	North Lethbridge 370S	481	581

Table 2.5-2: Summary of Facility Ratings in/around the Study Area – Key Transformers

Station Name and Number	Transformer	MVA Rating
Janet 74S	T1 - 240/138 kV	400
	T2 - 240/138 kV	400
West Brooks 28S	T1 – 240/138 kV	400
	T2 – 240/138 kV	400

Table 2.5-3: Key Capacitor Banks in/around the Study Area

Substation Name and Number	Nominal Bus Voltage (kV)	Number of Blocks	Total at Nominal Voltage (MVAr)

Substation Name and Number	Nominal Bus Voltage (kV)	Number of Blocks	Total at Nominal Voltage (MVAr)
Janet 74S	240	2	268.8
	138	2	162
Blackie 253S	138	1	24.46
Strathmore 151S	138	1	24.35
Hussar 431S	138	1	9.17

2.6. Dynamic Data and Assumptions

2.6.1. Generators

The Dynamic model consisted of the following model components for the two Queenstown Power Plant generators:

- Machine Model: GENROU
- Exciter Model: EXAC2
- Governor Model: GGOV1
- Stabilizer Model: PSS2B

The model parameters are provided in Attachment A. For all other machines in the study cases, the dynamic model data published by the AESO was used.

2.6.2. Dynamic Load

Motors with ratings above 10 MW were modeled as machines in accordance with the AESO published base cases. Aside from these motors, the Alberta Interconnected Load (AIL) was modeled using the WECC default model of 20% induction motor load with the remaining load modeled as constant MVA load in transient stability analysis.

2.7. Protection Fault-Clearing Times

The transient analysis was performed using the estimated fault-clearing times of the transmission lines as indicated by the transmission facilities owner (TFO). The estimated fault clearing times are provided in the Attachment C.

2.8. Voltage Profile Assumptions

Voltage profile assumptions used in the study were consistent with the AESO General Operating Practice Voltage Control and Ratings.

3. Study Methodology

Power flow, transient stability, and short-circuit analyses were performed to assess the impact of the proposed Queenstown Generation Plant connection to the AIES. The applicable reliability standards and policies as provided in Section 2.1 were followed to evaluate system performance.

PowerWorld Simulator Version 16 was used to perform the studies. All system model data was provided and exchanged between BowArk and AESO in PSS/E version 32/33 electronic formats (RAW, SEQ, DYR).

3.1. Study Objectives

The purpose of the study was to:

- Assess the impact of the proposed alternative for connecting Queenstown Generation Plant to the AIES.
- Propose mitigation measures to manage any reliability concerns resulting from the proposed connection alternative.

3.2. Study Scenarios

The study scenarios used to evaluate the system impact of the proposed connection were developed to represent the post-SATR and FATD system configuration. The seasonal scenarios used for the connection studies include:

- 2015 SP with 0 MW import, high local generation and high wind (pre- and post-Project)
- 2015 SL with 0 MW import, high local generation and high wind (pre- and post-Project)
- 2017 SP with 0 MW import, high local generation and high wind (pre- and post-Project)
- 2017 SL with 0 MW import, high local generation and high wind (pre- and post-Project)

3.3. Studies Carried Out

- Power flow (Category A, B, and selected C5)
- Short-Circuit analysis
- Transient stability analysis (Category A and B)

3.4. Power Flow Analysis

Power flow studies were performed for pre- and post-connection of the Project to examine Category A (all elements in service) operating conditions as well as category B (single element out) and selected C5 (two circuits of a multi-circuit towerline) contingency conditions in accordance with the TPL Standards.

The Study Area was monitored with respect to Applicable Ratings as described in Sections 2 to record any violations, including the monitored quantities, such as thermal loading, or voltage magnitude post contingency events.

3.4.1. Study Cases

The four seasonal scenarios from Section 3.2 and two different system configurations representing the pre-connection state and 138 kV connection alternative (Alternative 1) were all combined to give a total of eight study cases prepared for this study.

The study cases were prepared in accordance with the load and generation dispatch assumptions in sections 2.2.1 and 2.2.2, respectively.

Table 3.4-1 shows a list of the study cases used in the connection assessment.

Table 3.4-1: Study Cases

Case Name	Study Case Description
P1336_2015SL_ALT0	2015 summer light scenario, pre-connection state
P1336_2015SL_ALT1	2015 summer light scenario, Alternative 1
P1336_2015SP_ALT0	2015 summer peak scenario, pre-connection state
P1336_2015SP_ALT1	2015 summer peak scenario, Alternative 1
P1336_2017SL_ALT0	2017 summer light scenario, pre-connection state
P1336_2017SL_ALT1	2017 summer light scenario, Alternative 1
P1336_2017SP_ALT0	2017 summer peak scenario, pre-connection state
P1336_2017SP_ALT1	2017 summer peak scenario, Alternative 1

3.4.2. Contingencies Studied

The contingency list included the following system elements:

1) All transmission system elements operating at 138 kV and above, in the Strathmore/Blackie area (Planning Area 45), as well as all branches connecting the Strathmore/Blackie area to the adjacent planning areas.
2) 138 kV lines forming the path: Queenstown – West Brooks – Vauxhall – Taber – Coaldale – North Lethbridge – Ft. McLeod – East Stavely – Vulcan.

3.5. Short-Circuit Analysis

For the short-circuit fault analysis, all the generators in the Study Area and the areas surrounding the Study Area were switched on to evaluate the maximum fault current under three-phase-to-ground faults and single-line-to-ground faults for 2015 and 2022. Short-circuit analyses were performed for the preferred connection alternative. Three phase bolted faults and

single-line-to-ground faults were applied to the point of connection bus at Queenstown 504S substation (bus 333) and to 138 kV buses at the neighbouring substations.

3.6. Transient Stability Analysis

A list of contingencies for transient stability analysis was selected to represent the critical contingencies for transient stability analysis. A three-phase–to-ground fault was applied to selected critical 138 kV and higher voltage class transmission lines in the Study Area to assess system stability with the proposed transmission developments in service. The fault was cleared by opening the near-end and far-end breakers of the line according to the fault clearing time given in Section 2.7.

A system dynamic response is considered acceptable if the following conditions are met after a disturbance:

- All the generators remain stable and connected to the AIES.
- The post-transient voltage does not differ from the pre-fault voltage by more than 10%.
- All oscillations in the system are damped successfully within approximately 20 seconds following a contingency.

4. Pre-Connection System Assessment

The pre-connection system is defined as the system configuration represented by the 2015 and 2017 study cases (Section 3.4.1) without the Project development. The power flow analysis was based on the TPL Standards, System Data and Study Assumptions as described in Section 2.

The analysis indicated that:

1) No thermal or voltage violations were detected in the pre-connection 2015 and 2017 study cases assuming Category A system conditions.
2) No thermal or voltage violations were detected in the pre-connection 2015 and 2017 study cases following single contingencies (Category B events).

Detailed results of the pre-connection power flow analysis are shown in Sections 4.1, 4.2, and 4.3. Attachment B shows detailed power flow diagrams.

4.1. Power Flow Analysis - Category A

No thermal or voltage violations were detected in the pre-connection state, assuming Category A system conditions, for either the 2015 or 2017 study years as summarized in Table 4.1-1.

Table 4.1-1: Pre-connection Loading Performance

Study Case	Violations	Diagram No.
2015SL	No Category A Violations	PF0-03
2015SP	No Category A Violations	PF0-04
2017SL	No Category A Violations	PF0-05

Study Case	Violations	Diagram No.
2017SP	No Category A Violations	PF0-06

4.2. Power Flow Analysis - Category B

No thermal or voltage violations were detected in the pre-connection state following single contingencies (Category B events) for either the 2015 or 2017 study years as summarized in Table 4.2-1, Table 4.2-2, Table 4.2-3, and Table 4.2-4.

Table 4.2-1: Power Flow Performance, 2015SL Pre-Connection

Diagram No.	Contingency	Thermal Loading				Voltage Performance
		Overloaded Element	Rating (MVA)	Flow (MVA)	% Overload	
	All Cat B Contingencies	None	-	-	-	Acceptable

Table 4.2-2: Power Flow Performance, 2015SP Pre-Connection

Diagram No.	Contingency	Thermal Loading				Voltage Performance
		Overloaded Element	Rating (MVA)	Flow (MVA)	% Overload	
	All Cat B Contingencies	None	-	-	-	Acceptable

Table 4.2-3: Power Flow Performance, 2017SL Pre-Connection

Diagram No.	Contingency	Thermal Loading				Voltage Performance
		Overloaded Element	Rating (MVA)	Flow (MVA)	% Overload	
	All Cat B Contingencies	None	-	-	-	Acceptable

Table 4.2-4: Power Flow Performance, 2017SP Pre-Connection

Diagram No.	Contingency	Thermal Loading				Voltage Performance
		Overloaded Element	Rating (MVA)	Flow (MVA)	% Overload	
	All Cat B Contingencies	None	-	-	-	Acceptable

4.3. Power Flow Analysis - Category C

Category C power flow analysis was limited to double circuit lines (Category C5) in the Study Area. The selection included the following lines:

Table 4.3-1: Double Circuit Lines Included in the Scope

Line Pairs
876L -- Blackie 253S (Bus 253) to Gleichen 179S (Bus 254)
161L -- Vulcan 255S (Bus 244) to Queenstown 504S (Bus 333)

4.3.1. Category C Thermal and Voltage Performance Results

The Power Flow analysis for the pre-connection state did not reveal any Category C voltage or thermal limit violations in any of the study cases.

Table 4.3-2: Power Flow Performance, 2015SL Pre-Connection

Diagram No.	Contingency	Thermal Loading				Voltage Performance
		Overloaded Element	Rating (MVA)	Flow (MVA)	% Overload	
	876L and 161L	None	-	-	-	Acceptable

Table 4.3-3: Power Flow Performance, 2015SP Pre-Connection

Diagram No.	Contingency	Thermal Loading				Voltage Performance
		Overloaded Element	Rating (MVA)	Flow (MVA)	% Overload	
	876L and 161L	None	-	-	-	Acceptable

Table 4.3-4: Power Flow Performance, 2017SL Pre-Connection

Diagram No.	Contingency	Thermal Loading				Voltage Performance
		Overloaded Element	Rating (MVA)	Flow (MVA)	% Overload	
	876L and 161L	None	-	-	-	Acceptable

Table 4.3-5: Power Flow Performance, 2017SP Pre-Connection

Diagram No.	Contingency	Thermal Loading				Voltage Performance
		Overloaded Element	Rating (MVA)	Flow (MVA)	% Overload	
	876L and 161L	None	-	-	-	Acceptable

4.4. Pre-Connection Transient Stability Analysis

4.4.1. Transient Stability Simulation Setup

4.4.1.1. Contingency Set

A list of contingencies was selected to represent the critical contingencies for transient stability analysis. Initial analysis indicated that contingencies involving the following three lines are the most critical contingency events for the Queenstown Generation Plant connection assessment:

- 161L from Queenstown 504S to Vulcan 255S
- 853L from Queenstown 504S to West Brooks 28S
- 180L from Vulcan 255S to Ft. Macleod 15S through E. Staveley 928S

Because of the difference in fault-clearing times between the line Near End and the Far End relative to the location of the fault, for each line, a 3-phase balanced fault was applied at each end of the line.

Each contingency scenario was characterized with the following event sequence:

1. Apply a 3-phase bolted fault at time t=1 second at the Near End of the line.
2. Open the Near End of the line after the specified Near End fault-clearing time.
3. Open the Far End of the line after the specified Far End fault-clearing time.

All simulation runs, with the exception of the no-fault run, were simulated over a period of 20 seconds with the time step of 0.25 cycles. The simulation time for the no-fault run was extended to 30 seconds.

4.4.1.2. Fault-Clearing times

The transient analysis was performed using the estimated fault-clearing times of the transmission lines as indicated by the transmission facilities owner (TFO) (Attachment C).

4.4.1.3. Monitored System Elements and Quantities

Table 4.4-1 shows the system elements and quantities selected for monitoring during transient stability simulation.

Table 4.4-1: Monitored System Elements and Quantities

System Elements	Quantities
Generator Buses	
• Sheerness (1487,1482) • Sheppard (773,774,775) • Carseland (4251, 3251) • Cavalier (4247, 3247)	• Rotor Angle • Rotor Speed • MW Output
System Buses	
• Queenstown (333) • Langdon (159) • Shepard (772) • Milo (943) • W. Brooks (430) • Vulcan (244)	• System Frequency
Branches	
• 924L Milo (943) to Langdon (159) • 765L Janet (207) to Strathmore (259) • 161L Queenstown (333) to Vulcan(244), • SVC at Langdon (5158 to 158)	• MW Flows • MVAr Flows

4.4.1.4. Transient Stability Results

The no-disturbance run resulted in a flat response throughout the timeframe being examined in the transient studies.

The system remained stable under all contingency scenarios selected for this study.

A complete set of transient stability graphs for the 2015 and 2017 study years, pre-connection Transient Stability Analysis, is provided in Attachments D and E, respectively.

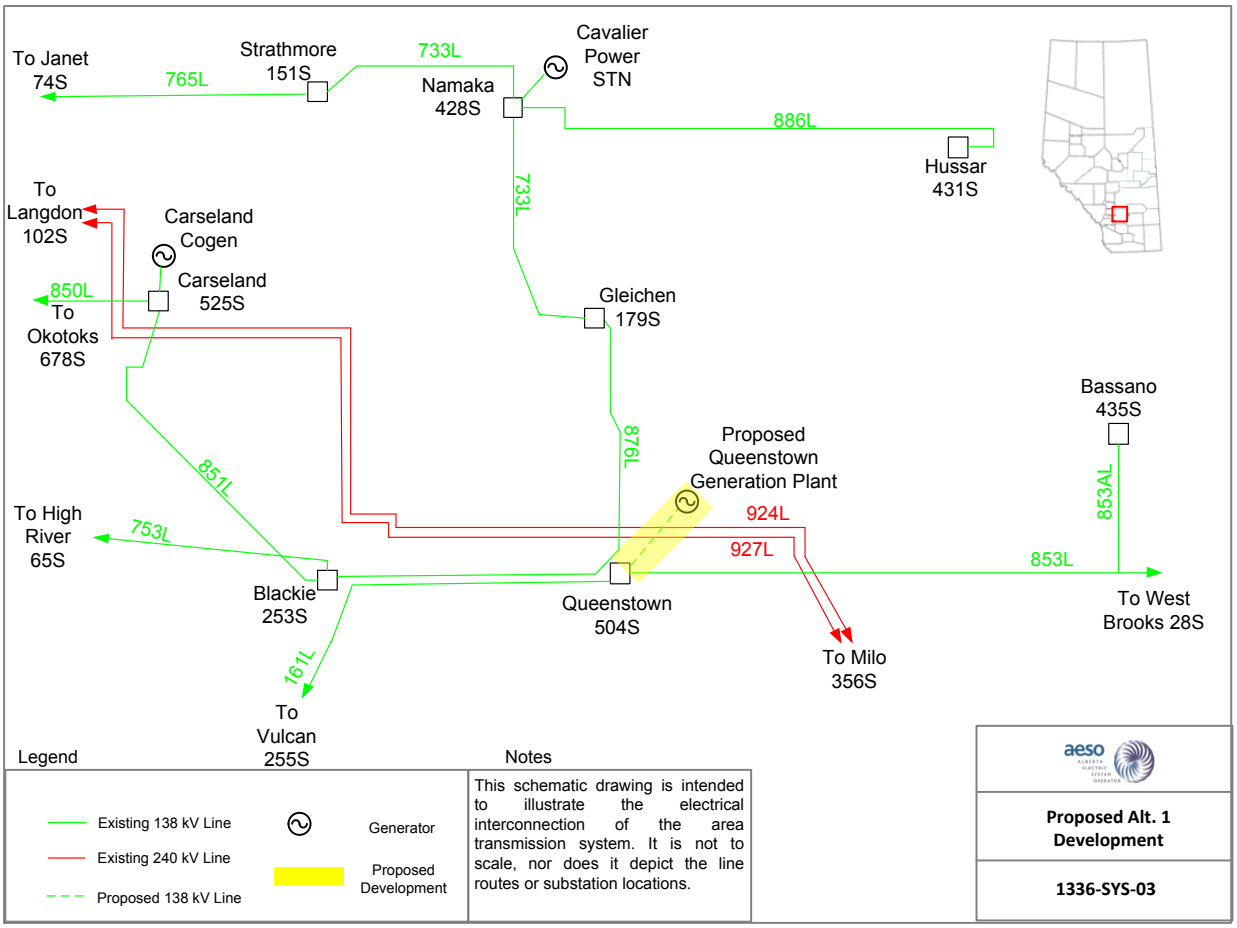
5. Connection Alternatives

5.1. Overview

5.1.1. Alternative 1 – Direct 138 kV Connection

Alternative 1 proposes a radial connection of the Queenstown Generation Plant to the existing Queenstown 504S substation using a single circuit 138 kV transmission line. This connection alternative is conditional to the completion of the SATR system development in the Blackie/Strathmore area. Figure 5.1-1 shows the local transmission system and the proposed Alternative 1 connection configuration. Development would include a short, approximately 100 meter, 138 kV transmission line. The customer will build a new 138 kV generation substation, designated McGregor Lake 200S.

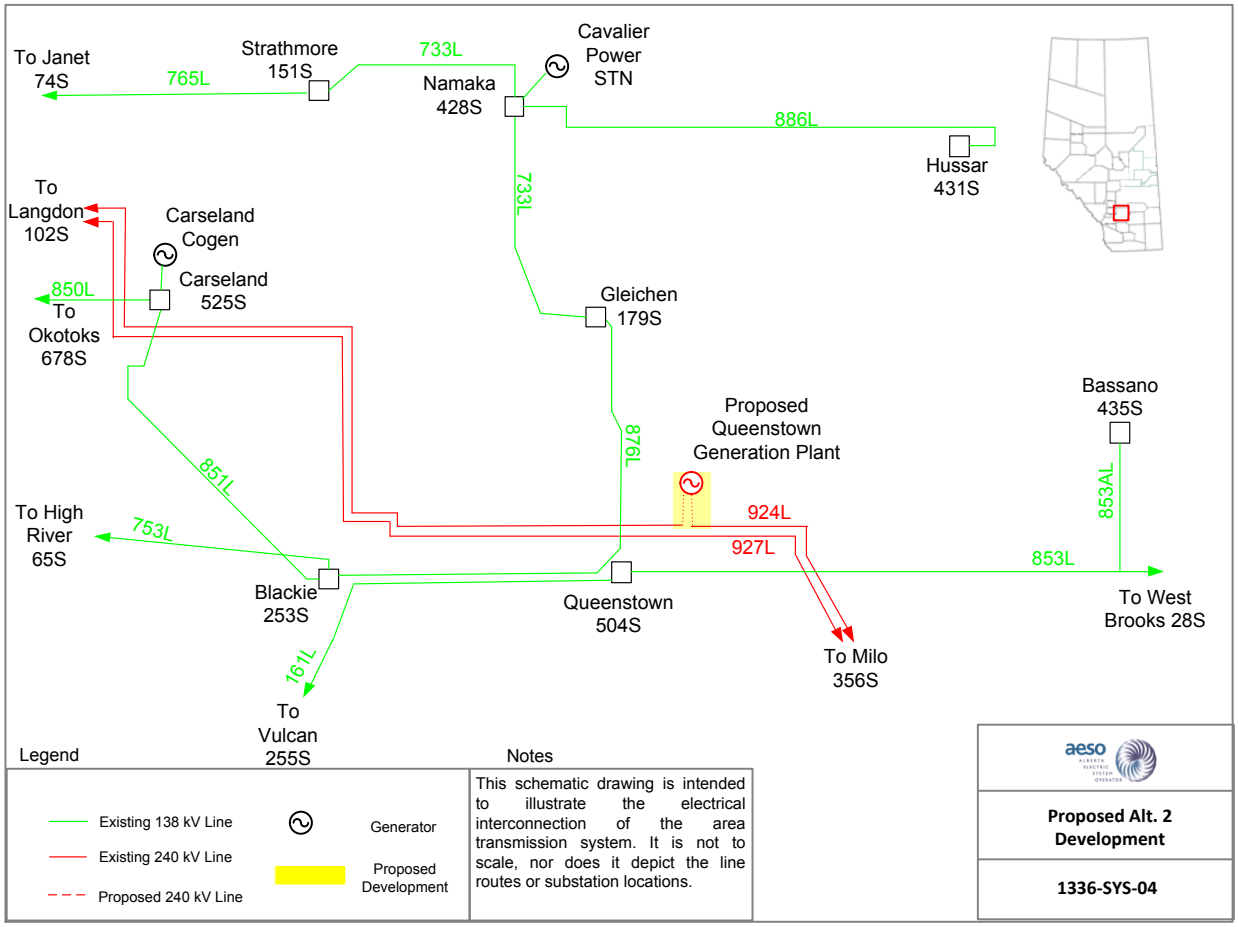
Figure 5.1-1: Alternative 1 – Direct 138kV Connection



5.1.2. Alternative 2 – 240 kV In-and-Out Connection Configuration

Alternative 2 proposes connecting the Queenstown Generation Plant to 240 kV line 924L or 927L, between Milo 356S and Langdon 102S substations, in an in-and-out configuration. The resulting configuration would allow a more direct connection of the generation plant to the Calgary load centre via the 240 kV system. The customer will build a new 240 kV generation substation, designated McGregor Lake 200S. Connection developments would require a double-circuit 240 kV transmission line, approximately 800 meters in length, to facilitate the in-and-out connection of the new McGregor Lake 200S substation to 924L or 927L. Figure 5.1-2 shows the connection configuration for Alternative 2.

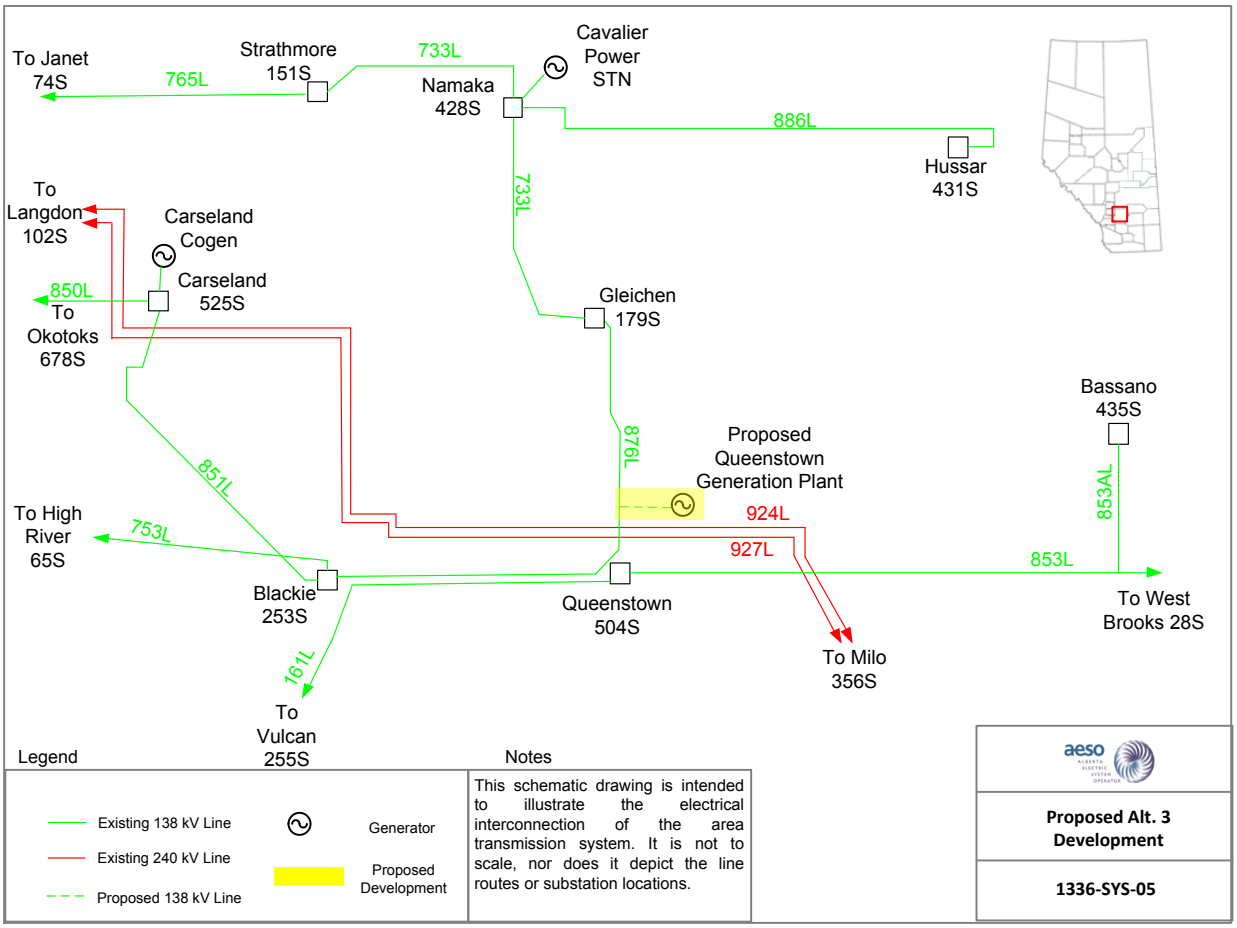
Figure 5.1-2: Alternative 2 – In-and-Out 240 kV Connection



5.1.3. Alternative 3 – 138 kV Tap Connection

Alternative 3 proposes the connection of the Queenstown Generation Plant via a 138 kV tap on the existing 876L line between Blackie 253S and Gleichen 179S substations as shown in Figure 5.1-3.

Figure 5.1-3: Alternative 3 – Tapped 138 kV



5.2. Connection Alternatives Evaluated

5.2.1. Connection Alternatives Selected for Further Studies

The connection alternative selected for further studies was Alternative 1. Single-line diagram for this alternative is provided in Attachment F. BowArk Energy preferred Alternative 1 as the associated developments and consequently cost of the 138 kV connection to the existing Queenstown 504S substation would be significantly lower as compared to Alternative 2.

5.2.2. Connection Alternatives Not Selected for Further Studies

Alternative 2 (240 kV in-and-out connection configuration) was eliminated due to its associated developments which results in significant higher connection costs as compared to the other connection alternatives. Alternative 3 (138 kV T-tap) was eliminated from any further consideration in this study due to its potential constraints. Preliminary review of a “T” tap to the 876L 138 kV circuit has revealed a significant number of remediation action requirements under N-0 and N-1 conditions, associated with both line and generator contingencies.

6. Technical Analysis of the Connection Alternative

This section contains the results of the post-connection power flow analysis for the proposed connection alternative.

For the purpose of power flow analysis, the Queenstown Generation Plant was assumed to have a maximum summer output of 87 MW. Typical climatic conditions in this period of a year are generally associated with the system summer peak and the summer light loading conditions. Transient stability analysis was conducted assuming a maximum Queenstown plant output of 90 MW.

6.1. Alternative 1

6.1.1. Power Flow Analysis

Alternative 1 power flow analysis was based on the TPL Standards, System Data and Study Assumptions as described in Section 2.

The analysis indicated that:

1) No thermal or voltage violations were detected post Alternative 1 connection for the 2015 and 2017 study years assuming Category A system conditions.
2) No thermal or voltage violations were detected post Alternative 1 connection for the 2015 and 2017 study years following Category B events.

Detailed results of Alternative 1 power flow analysis are shown in Sections 6.1.1.1, 6.1.1.2, and 6.1.1.3 below. Attachment G contains detailed power flow diagrams.

6.1.1.1. Power Flow Analysis - Alternative 1 Category A

No thermal or voltage violations were detected post connection of Alternative 1, assuming Category A system conditions, for either the 2015 or 2017 study years as summarized in Table 6.1-1, Table 6.1-2, Table 6.1-3, and Table 6.1-4.

Table 6.1-1: Power Flow Performance Cat. A - 2015SL Alternative 1

Diagram No.	Thermal Loading						Voltage Performance Post- Connection
	Rating (MVA)	Post- Connection		Pre- Connection		% Diff	
		Flow (MVA)	% Overload	Flow (MVA)	% Overload		
PF-03	No Category A violations found						Acceptable

Table 6.1-2: Power Flow Performance Cat. A - 2015SP Alternative 1

Diagram No.	Thermal Loading						Voltage Performance Post- Connection
	Rating (MVA)	Post- Connection		Pre- Connection		% Diff	
		Flow (MVA)	% Overload	Flow (MVA)	% Overload		
PF-04	No Category A violations found						Acceptable

Table 6.1-3: Power Flow Performance Cat. A - 2017SL Alternative 1

Diagram No.	Thermal Loading						Voltage Performance Post- Connection
	Rating (MVA)	Post- Connection		Pre- Connection		% Diff	
		Flow (MVA)	% Overload	Flow (MVA)	% Overload		
PF-05	No Category A violations found						Acceptable

Table 6.1-4: Power Flow Performance Cat. A - 2017SP Alternative 1

Diagram No.	Thermal Loading						Voltage Performance Post- Connection
	Rating (MVA)	Post- Connection		Pre- Connection		% Diff	
		Flow (MVA)	% Overload	Flow (MVA)	% Overload		
PF-06	No Category A violations found						Acceptable

6.1.1.2. Power Flow Analysis - Alternative 1 Category B

No thermal or voltage violations were detected post connection of Alternative 1 for either the 2015 or 2017 study years following Category B events as summarized in Table 6.1-5, Table 6.1-6, Table 6.1-7, and Table 6.1-8.

Table 6.1-5: Power Flow Performance Cat. B - 2015SL Alternative 1

Diagram No.	Contingency	Thermal Loading							Voltage Performance Post-Connection
		Overloaded Element	Rating (MVA)	Post- Connection		Pre- Connection		% Diff.	
				Flow (MVA)	% Overload	Flow (MVA)	% Overload		
	All Cat B.	No Category B violations found							Acceptable

Table 6.1-6: Power Flow Performance Cat. B - 2015SP Alternative 1

Diagram No.	Contingency	Thermal Loading							Voltage Performance Post-Connection
		Overloaded Element	Rating (MVA)	Post- Connection		Pre- Connection		% Diff.	
				Flow (MVA)	% Overload	Flow (MVA)	% Overload		
	All Cat B.	No Category B violations found							Acceptable

Table 6.1-7: Power Flow Performance Cat. B - 2017SL Alternative 1

Diagram No.	Contingency	Thermal Loading							Voltage Performance Post-Connection
		Overloaded Element	Rating (MVA)	Post- Connection		Pre- Connection		% Diff.	
				Flow (MVA)	% Overload	Flow (MVA)	% Overload		
	All Cat B.	No Category B violations found							Acceptable

Table 6.1-8: Power Flow Performance Cat. B - 2017SP Alternative 1

Diagram No.	Contingency	Thermal Loading							Voltage Performance Post-Connection
		Overloaded Element	Rating (MVA)	Post- Connection		Pre- Connection		% Diff.	
				Flow (MVA)	% Overload	Flow (MVA)	% Overload		
	All Cat B.	No Category B violations found							Acceptable

6.1.1.3. Power Flow Analysis - Alternative 1 Category C

The Power Flow analysis for the post-connection state did not reveal any Category C voltage or thermal limit violations in any of the study cases.

Table 6.1-9: Power Flow Performance Cat. C - 2015SL Alternative 1

Diagram No.	Contingency	Thermal Loading							Voltage Performance Post-Connection
		Overloaded Element	Rating (MVA)	Post- Connection		Pre- Connection		% Diff.	
				Flow (MVA)	% Overload	Flow (MVA)	% Overload		
	876L and 161L	No Category C violations found							Acceptable

Table 6.1-10: Power Flow Performance Cat. C - 2015SP Alternative 1

Diagram No.	Contingency	Thermal Loading							Voltage Performance Post-Connection
		Overloaded Element	Rating (MVA)	Post- Connection		Pre- Connection		% Diff.	
				Flow (MVA)	% Overload	Flow (MVA)	% Overload		
	876L and 161L	No Category C violations found							Acceptable

Table 6.1-11: Power Flow Performance Cat. C - 2017SL Alternative 1

Diagram No.	Contingency	Thermal Loading							Voltage Performance Post-Connection
		Overloaded Element	Rating (MVA)	Post- Connection		Pre- Connection		% Diff.	
				Flow (MVA)	% Overload	Flow (MVA)	% Overload		
	876L and 161L	No Category C violations found							Acceptable

Table 6.1-12: Power Flow Performance Cat. C - 2017SP Alternative 1

Diagram No.	Contingency	Thermal Loading							Voltage Performance Post-Connection
		Overloaded Element	Rating (MVA)	Post- Connection		Pre- Connection		% Diff.	
				Flow (MVA)	% Overload	Flow (MVA)	% Overload		
	876L and 161L	No Category C violations found							Acceptable

6.1.2. Transient Stability Analysis - Alternative 1

Transient stability analysis was carried out for connection Alternative 1, for 2015 and 2017 study years. The analysis assumed the Queenstown Generation Plant maximum output of 90 MW. The analysis was performed using the contingency set defined in Section 4.4.1.1. The system elements and quantities selected for monitoring during transient stability simulation are shown in Table 4.4-1. Rotor angle, speed and output power of Queenstown generators were also monitored. Fault clearing times are provided in Attachment C.

The Transient Stability analysis indicated that the system remained stable under all contingency scenarios selected for this study. A complete set of transient simulation plots is provided in Attachment I for 2015 summer light and summer peak conditions and in Attachment J for 2017 summer light and summer peak conditions.

6.2. Summary of Study Results

The proposed generating facility is configured with two General Electric LM6000 gas turbine generator packages with a turbine nameplate capacity of 40 MW and Maximum Authorized Real

Power of 45 MW each. For the purpose of power flow analysis, the plant was assumed to have a maximum output of 87 MW, which is also the maximum expected summer output of the plant. Transient stability analyses were performed with 90 MW output from the generation plant.

The study considered 138 kV connection configuration (Alternative 1) for detailed power flow analysis. The power flow study results in 2015 and 2017 showed compliance with all the applicable standards without any Category A, Category B and Category C thermal and voltage violations. Alternative 1 is the preferred alternative as it facilitates the connection of power plant through a short single circuit 138 kV transmission line (approximately 100 m long).

The results of Transient Stability analysis confirmed the system stability following connection of the proposed generation plant to the grid.

7. Short-Circuit Analysis[18]

7.1. Pre-Connection System State

Short-circuit analysis for the pre-connection system state was carried out by applying 3-phase balanced fault and a single-phase-to-ground fault individually to 138 kV buses at Queenstown 504S, Vulcan 255S, West Brooks 28S and Basano 435S.

The results of the short-circuit analysis for 2015 system configuration are summarized in Table 7.1-1.

Table 7.1-1: Summary of Pre-Connection Short-Circuit Levels, Year 2015

Substation Name and Number	Base Voltage (kV)	Pre-Fault Voltage (pu)	3-Φ Fault (kA)	Positive Sequence Thevenin Source Impedance (R1+jX1)	1-Φ Fault (kA)	Zero Sequence Thevenin Source Impedance (R0+jX0)
Queenstown 504S	138	1.02	2.86	0.05697+j0.13852 pu 10.85+26.38 Ohm	1.8	0.12409 + j0.40382 pu 23.63+j76.9Ohm
Vulcan 255S	138	1.01	1.8	0.06167 + j0.14664 pu 11.74+j27.93 Ohm	1.8	0.12893 + 0.43517 pu 24.55+j82.87 Ohm
West Brooks 28S	138	1.03	13.9	0.00499 + j0.03048 pu 0.95+j5.8 Ohm	15.6	0.00121 + 0.02048 pu 0.23+j3.9 Ohm
Basano 435S	138	1.02	3.3	0.04620 + j0.11859 pu 8.8+j22.58 Ohm	2.1	0.09538 + j0.33149 pu 18.16+j63.13 Ohm

[18] Short circuit current calculation is based on modeling information provided to the AESO by third parties and their authenticity has not been validated. The fault levels are expected to change in the future with system reinforcements, new load and/or generations in the area. Therefore it is recommended that the asset owners monitor these changes and review fault levels on a periodic basis and take steps to ensure these are within breaker operating limits. The information provided in this study is not intended to be used as the sole source of information for electrical equipment specification and the design of public or worker safety-grounding systems.

7.2. Post-Connection System State

Short-circuit analysis was carried out for Connection Alternative 1. The short-circuit levels are calculated for 2015 and 2022 study years. Table 7.2-1 and Table 7.2-2 show the calculated short-circuit current levels as well as the corresponding Thevenin source impedances for 2015 and 2022 respectively.

Table 7.2-1: Summary of Post-Connection Short-Circuit Levels, Alternative 1, Year 2015

Substation Name and Number	Base Voltage (kV)	Pre-Fault Voltage (pu)	3-Φ Fault (kA)	Positive Sequence Thevenin Source Impedance (R1+jX1)	1-Φ Fault (kA)	Zero Sequence Thevenin Source Impedance (R0+jX0)
McGregor Lake 200S	138	1.03	4.9	0.02003 + j0.08443 pu 3.82+j16.08 Ohm	4.8	0.00894 + j0.09439 pu 1.70+j17.98 Ohm
Queenstown 504S	138	1.02	5.3	0.02004 + j0.08438 pu 3.82+j16.07 Ohm	5	0.00926 + j0.09536 pu 1.76+j18.16 Ohm
Vulcan 255S	138	1.01	3.7	0.03661 + j0.10958 pu 6.97+j20.87 Ohm	2.7	0.05390 + j0.24244 pu 10.27+j46.17 Ohm
West Brooks 28S	138	1.03	14.5	0.00477 + j0.029 pu 0.908+j5.52 Ohm	14.7	0.00284 + 0.02769 pu 0.541+j5.27 Ohm
Bassano 435S	138	1.02	3.5	0.04259 + j0.11141 pu 8.11+j21.22 Ohm	2.2	0.08941 + j0.31447 pu 17.03+j59.89 Ohm

Table 7.2-2: Summary of Post-Connection Short-Circuit Levels, Alternative 1, Year 2022

Substation Name and Number	Base Voltage (kV)	Pre-Fault Voltage (pu)	3-Φ Fault (kA)	Positive Sequence Thevenin Source Impedance (R1+jX1)	1-Φ Fault (kA)	Zero Sequence Thevenin Source Impedance (R0+jX0)
McGregor Lake 200S	138	1.03	4.7	0.02208 + j0.08775 pu 4.2+j16.71 Ohm	4.7	0.00886 + j0.09441 pu 1.69+j17.98 Ohm
Queenstown 504S	138	1.03	4.8	0.02209 + j0.08206 pu 4.21+j15.63 Ohm	4.7	0.00918 + j0.09538 pu 1.75+j18.16 Ohm
Vulcan 255S	138	1.02	3.6	0.03830 + j0.1114 pu 6.96+j21.21 Ohm	2.7	0.05315 + j0.24281 pu 10.12+j46.24 Ohm
West Brooks 28S	138	1.03	15.3	0.00464 + j0.02767 0.88+j5.24 Ohm	15.4	0.00282 + j0.02751 0.54+j5.24 pu
Basano 435S	138	1.02	3.6	0.04322 + j0.11075 pu 8.23+j21.09 Ohm	2.27	0.08939 + j0.31435 17.02+j59.86 Ohm

7.3. Conclusions

7.3.1. Alternative 1, Post-SATR and Post-FATD System modifications In the Strathmore/Blackie area, Year 2015

The 2015 post-connection state under Alternative 1 has higher short-circuit levels compared with the pre-connection state for that year. The biggest increase in short-circuit levels occurred at 138 kV buses in close electrical proximity of the Queenstown Generation Plant, notably at: Queenstown 504S, Vulcan 255S and West Brooks 28S (Table 7.1-1 and Table 7.2-1). The post-connection short-circuit levels at these buses range between 3.8 kA to 14.5 kA for 3-phase faults and between 2.2 kA and 14.7 kA for the single-phase faults. While these increases are all directly attributed to the Project, the post-connection short-circuit levels at all the neighbouring substations remain well within the standard rating of 31.5 kA for 138 kV substation equipment.

7.3.2. Alternative 1, Post-SATR and Post-FATD System Configuration, Year 2022

Under Alternative 1, the post-connection short-circuit levels at Queenstown 504S were found to be comparable to the calculated 2015 levels. The Queenstown Generation Plant contributed to the increase in short circuit levels at Queenstown 504S by approximately 2 kA.

In conclusion, no upgrade to the existing substation equipment at any of the neighbouring substations referenced in this analysis would be required as a result of the Queenstown Generation Plant connection.

8. Project Interdependencies

The completion of the system modifications associated with the SATR Blackie 138 kV project is necessary for the reliable connection of Queenstown Generation Plant. Any revisions to the Blackie 138 kV project ISD will affect the ISD for the Queenstown Generation Plant connection to the grid.

9. Study Conclusions and Recommendations

9.1. Power Flow Analysis

The power flow analysis was carried out for the Queenstown Generation Plant connection to the grid. The generation plant includes two generator units with 90 MW maximum total outputs. The analysis investigated the technical merits of a 138 kV connection (Alternative 1).

The power flow study results for the proposed connection configuration in 2015 and 2017 showed compliance with all the applicable standards without any thermal and voltage violations assuming Category A system conditions and also following Category B and C events.

9.2. Transient Stability Analysis

Transient stability analysis was performed for Alternative 1 under 2015 and 2017 study scenarios. The system remained stable under all contingency scenarios selected for this study.

9.3. Short-Circuit Analysis

Short-circuit analysis included the pre-connection system state and the post-connection states under Connection Alternative 1. The analysis was carried out by applying a 3-phase balanced fault and a single-phase-to-ground fault to 138 kV buses at: McGregor Lake 200S, Queenstown 504S, Vulcan 255S, West Brooks 28S and Basano 435S.

Short-circuit levels in the post-connection state remained within the 31.5 kA limit for 138 kV.

9.4. Final Recommendations

The recommendations for the Queenstown Generation Plant connection are:

1. To connect the power plant using a single circuit 138 kV transmission line in accordance with Alternative 1.
2. The target connection ISD is September 30, 2015, conditional upon the completion of the SATR 138 kV system modifications in the Strathmore/Blackie area.[19]

[19] The connection ISD has been revised to August 2016 to align with the completion of the approved 138 kV transmission developments in the Blackie area. Study results and recommendations in this report will remain applicable.

Attachment A

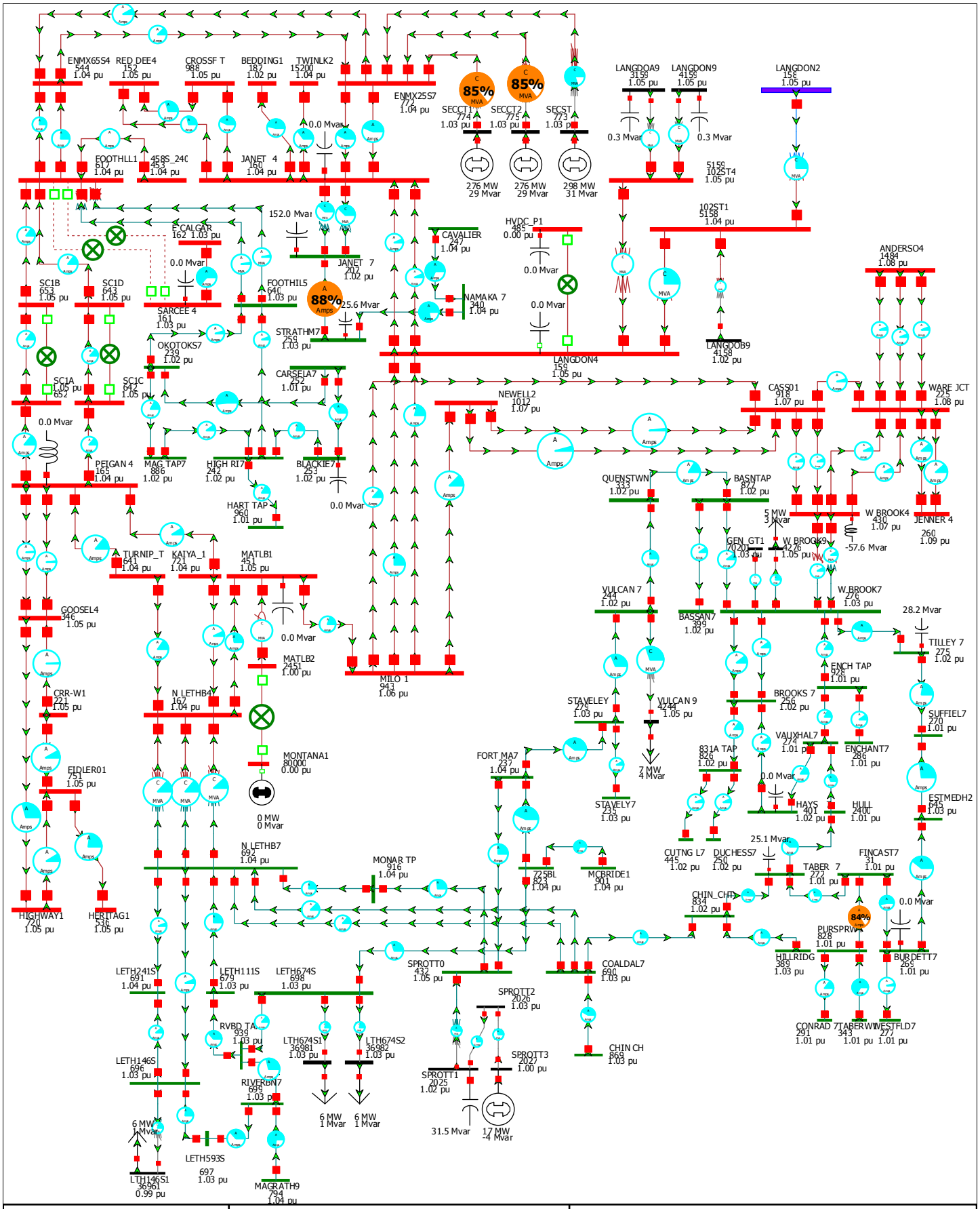
Generator Dynamic Model

Queenstown Generator Dynamic Model Specification

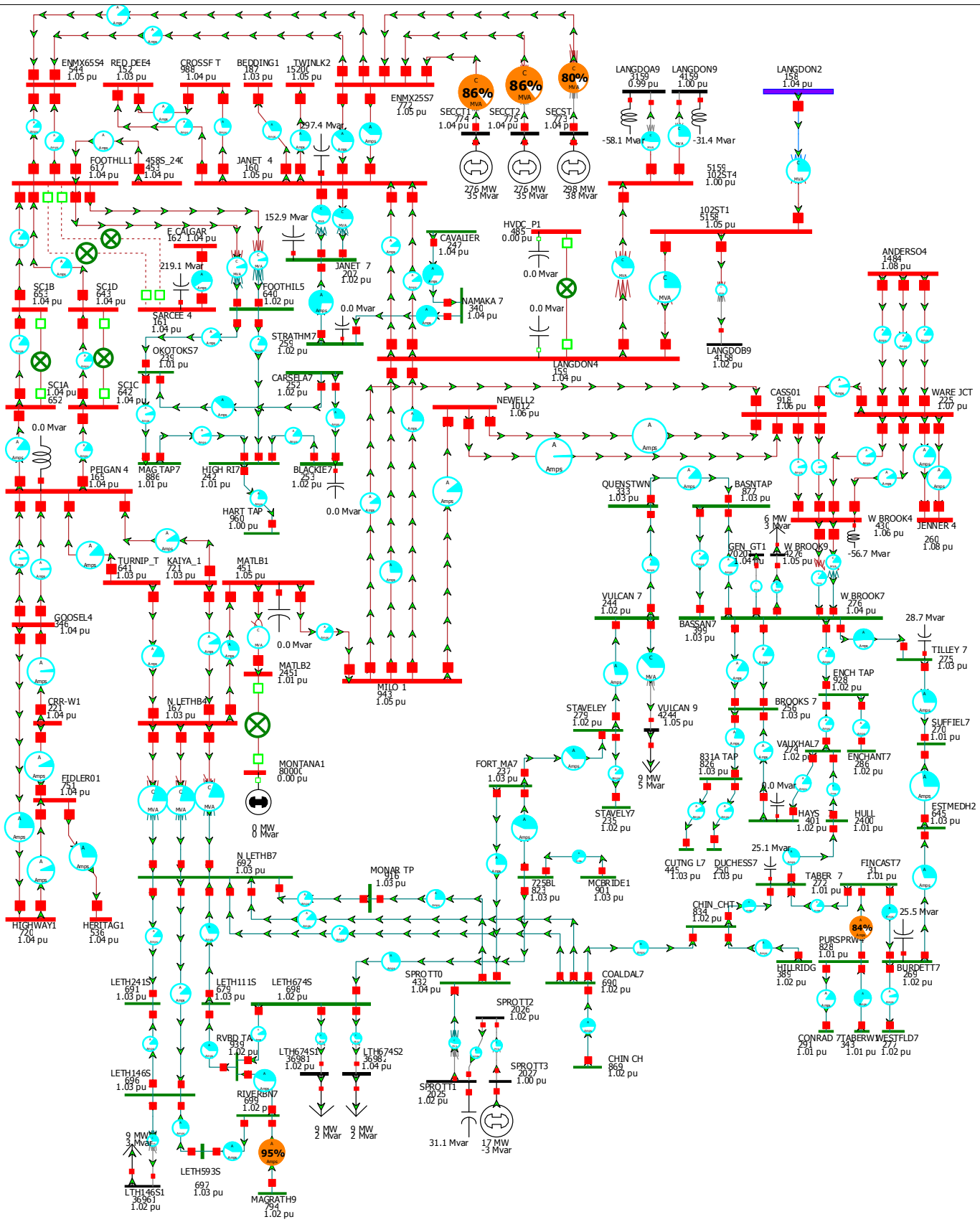
GENROU		EXAC2		GGOV1		PSS2B	
H	1.193	Tr	0	Trate	0	IB1	none
D	0	Tb	0	Rselect	1	IB2	none
Ra	0	Tc	0	Flag	0	Ics1	1
Xd	2.35	Ka	300	R	0.04	Ics2	3
Xq	2.15	Ta	0.0333	Tpelec	1	M	5
Xdp	0.2	VaMax	8	Maxerr	0.05	N	1
Xqp	0.24	VaMin	-8	Minerr	-0.05	Tw1	10
Xdpp	0.144	Kb	20	Kpgov	10	Tw2	10
Xl	0.088	Vrmax	105	Kigov	2	T6	0
Tdop	9.67	Vrmin	-85	Kdgov	0	Tw3	10
Tqop	2.95	Te	0.3	Tdgov	1	Tw4	0
Tdopp	0.05	Kl	10	Vmax	1	T7	10
Tqopp	0.05	Kh	1	Vmin	0.15	Ks2	1.47
S(1.0)	1.55	Kf	0.03	Tact	0.5	Ks3	1
S(1.2)	2.5	Tf	1.2	Kturb	1.5	T8	0.5
Rcomp	0	Kc	0.3	Wfnl	0.2	T9	0.1
Xcomp	0	Kd	0	Tb	0.5	Ks1	4
		Ke	1	Tc	0	T1	0.16
		VLr	8.4	Teng	0	T2	0.02
		E1	3.3	Tfload	3	T3	0.16
		SE(E1)	0.01	Kpload	1	T4	0.02
		E2	4.4	Kiload	1	T10	0.02
		SE(E2)	0.08	Ldref	1	T11	0.02
		Spdmlt	0	Dm	0	Vsi1max	0.02
				Ropen	1	Vsi1min	0.02
				Rclose	-1	Vsi2max	0.02
				Kimw	0.002	Vsi2min	0.02
				Aset	0.01	Vstmax	0.1
				Ka	10	Vstmin	-0.1
				Ta	1	A	1
				Db	0	Ta	0
				Tsa	4	Tb	0
				Tsb	5	Ks4	1
				Rup	99		
				Rdown	-99		

Attachment B

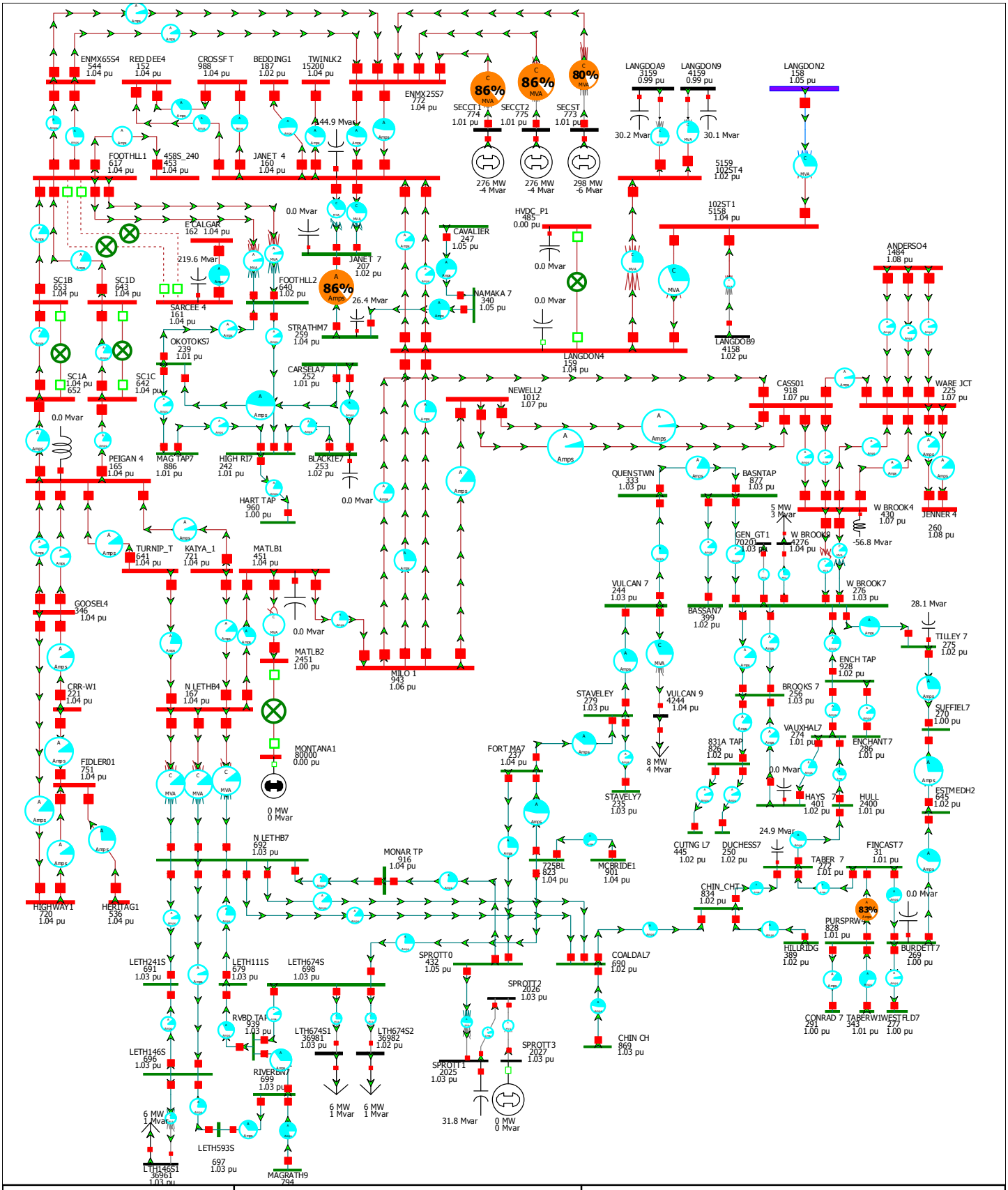
Pre-Connection Power Flow Analysis Results



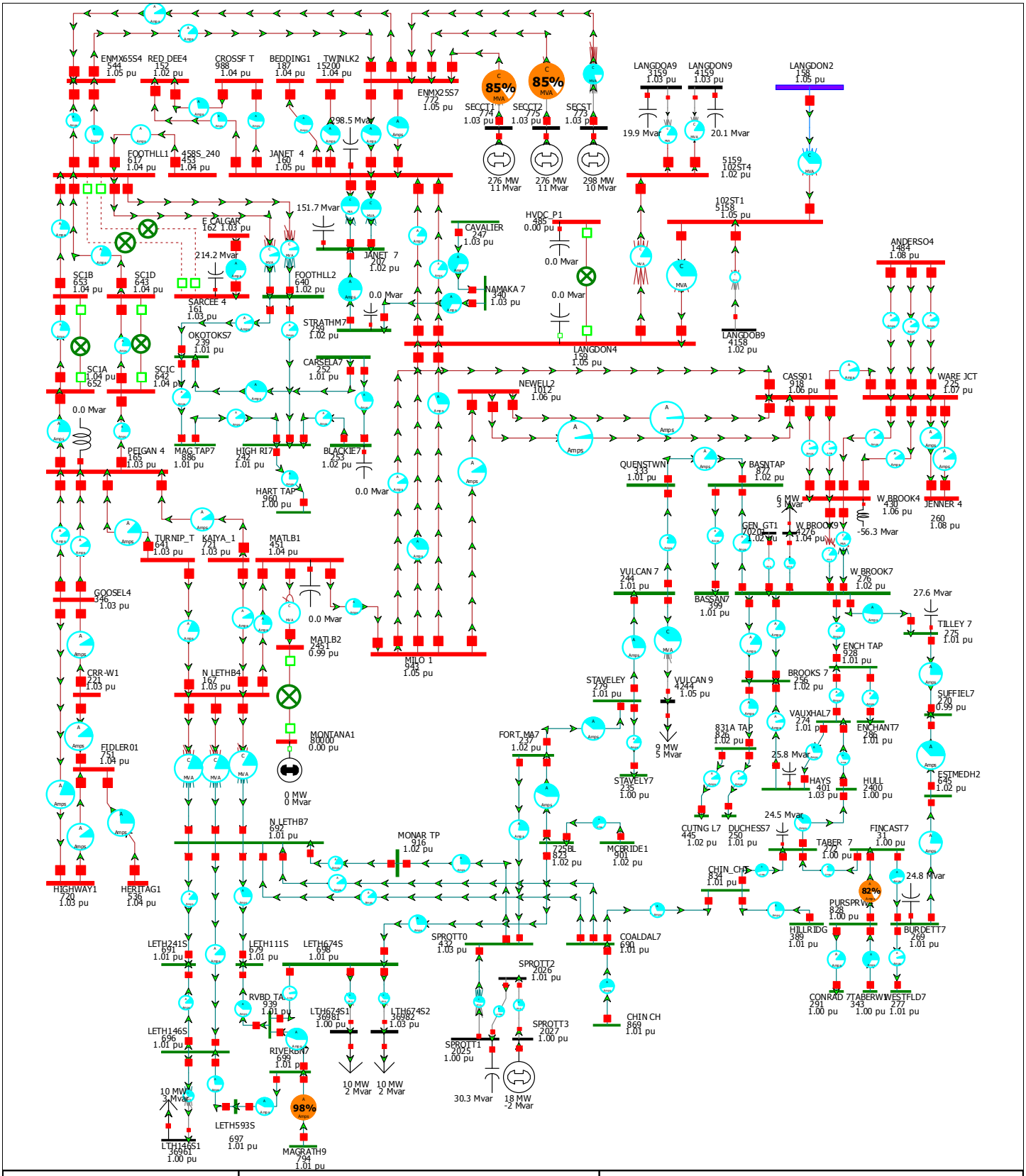
PowerEN Corporation D.Brankovich	Pre-Connection System State 2015SL Study Case, Category A	Steady State Power Flow - Alternative 0 PF0-03 4/3/2013



PowerEN Corporation D.Brankovich	Pre-Connection System State 2015SP Study Case, Category A	Steady State Power Flow - Alternative 0 PF0-04 4/3/2013



PowerEN Corporation D.Brankovich	Pre-Connection System State 2017SL Study case, Category A	Steady Sate Power Flow - ALternative 0 PF0-05 4/8/2013



PowerEN Corporation D. Brankovich	Pre-Connection System State 2017SP Study Case, Category A	Steady State Power Flow - Alternative 0 PF0-06 4/8/2013

Attachment C

Transient Stability Simulation Setup:

List of Contingencies

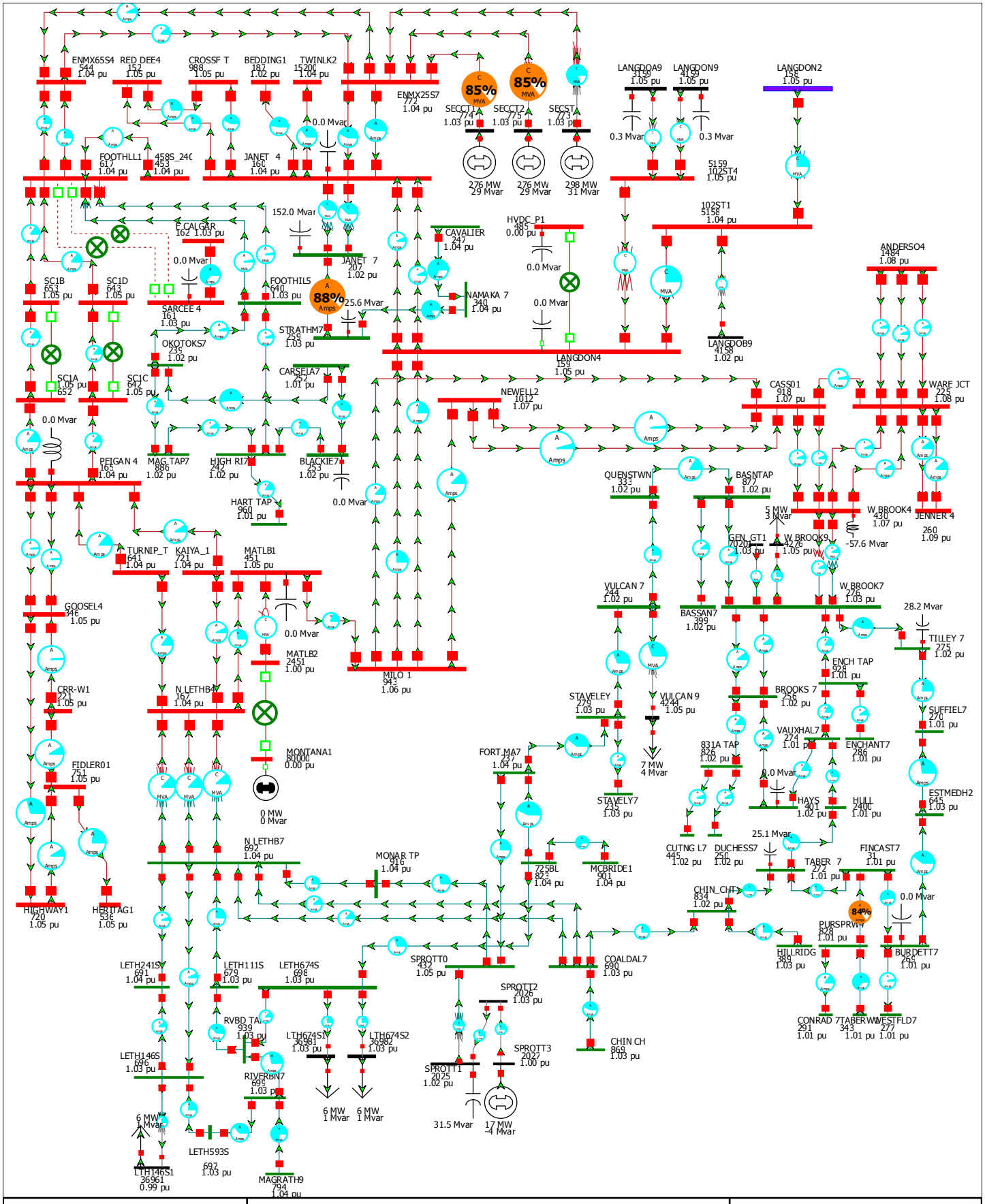
Transient Stability Contingency Set

Contingency Name	Time (Seconds)	Object	Description
161L QUEENSTOWN 504S - VULCAN 255S	1	Branch '333' '244' '61'	FAULT 5 3PB SOLID
161L QUEENSTOWN 504S - VULCAN 255S	1.1	Branch '333' '244' '61'	OPEN NEAR
161L QUEENSTOWN 504S - VULCAN 255S	1.475	Branch '333' '244' '61'	OPEN FAR
161L VULCAN 255S - QUEENSTOWN 504S	1	Branch '244' '333' '61'	FAULT 5 3PB SOLID
161L VULCAN 255S - QUEENSTOWN 504S	1.1	Branch '244' '333' '61'	OPEN NEAR
161L VULCAN 255S - QUEENSTOWN 504S	1.475	Branch '244' '333' '61'	OPEN FAR
180L Ft.McLeod 15S to Vulcan 255S	1	Branch '237' '279' '80'	FAULT 5 3PB SOLID
180L Ft.McLeod 15S to Vulcan 255S	1.092	Branch '237' '279' '80'	OPEN NEAR
180L Ft.McLeod 15S to Vulcan 255S	1.442	Branch '237' '279' '80'	OPEN FAR
180L Ft.McLeod 15S to Vulcan 255S	1.442	Branch '279' '244' '80'	OPEN BOTH
180L Vulcan 255S to Ft.McLeod 15S	1	Branch '244' '279' '80'	FAULT 5 3PB SOLID
180L Vulcan 255S to Ft.McLeod 15S	1.092	Branch '244' '279' '80'	OPEN NEAR
180L Vulcan 255S to Ft.McLeod 15S	1.433	Branch '279' '237' '80'	OPEN BOTH
180L Vulcan 255S to Ft.McLeod 15S	1.433	Branch '244' '279' '80'	OPEN FAR
853L QUEENSTOWN 504S - WEST BROOKS 28S	1	Branch '333' '877' '53'	FAULT 5 3PB SOLID
853L QUEENSTOWN 504S - WEST BROOKS 28S	1.0917	Branch '333' '877' '53'	OPEN NEAR
853L QUEENSTOWN 504S - WEST BROOKS 28S	1.1667	Branch '877' '276' '53'	OPEN FAR
853L QUEENSTOWN 504S - WEST BROOKS 28S	1.167	Branch '877' '276' '53'	OPEN FAR
853L QUEENSTOWN 504S - WEST BROOKS 28S	1.167	Bus '877'	OPEN
853L WEST BROOKS 28S - QUEENSTOWN 504S	1	Branch '276' '877' '53'	FAULT 5 3PB SOLID
853L WEST BROOKS 28S - QUEENSTOWN 504S	1.0917	Branch '276' '877' '53'	OPEN NEAR
853L WEST BROOKS 28S - QUEENSTOWN 504S	1.1667	Branch '877' '333' '53'	OPEN FAR
853L WEST BROOKS 28S - QUEENSTOWN 504S	1.167	Branch '877' '333' '53'	OPEN FAR
853L WEST BROOKS 28S - QUEENSTOWN 504S	1.167	Bus '877'	OPEN
Queenstown Plant _McGregor200s 138 kV Bus	1	Bus '758'	FAULT 3PB SOLID
Queenstown Plant _McGregor200s 138 kV Bus	1.1333	Bus '758'	OPEN
Queenstown Plant _McGregor200s 138 kV Bus	1.1333	Gen '4758' 'G1'	OPEN
Queenstown Plant _McGregor200s 138 kV Bus	1.1333	Gen '4758' 'G2'	OPEN
Queenstown Plant _McGregor200s 138 kV Bus	1.1333	Gen '4758' 'G3'	OPEN

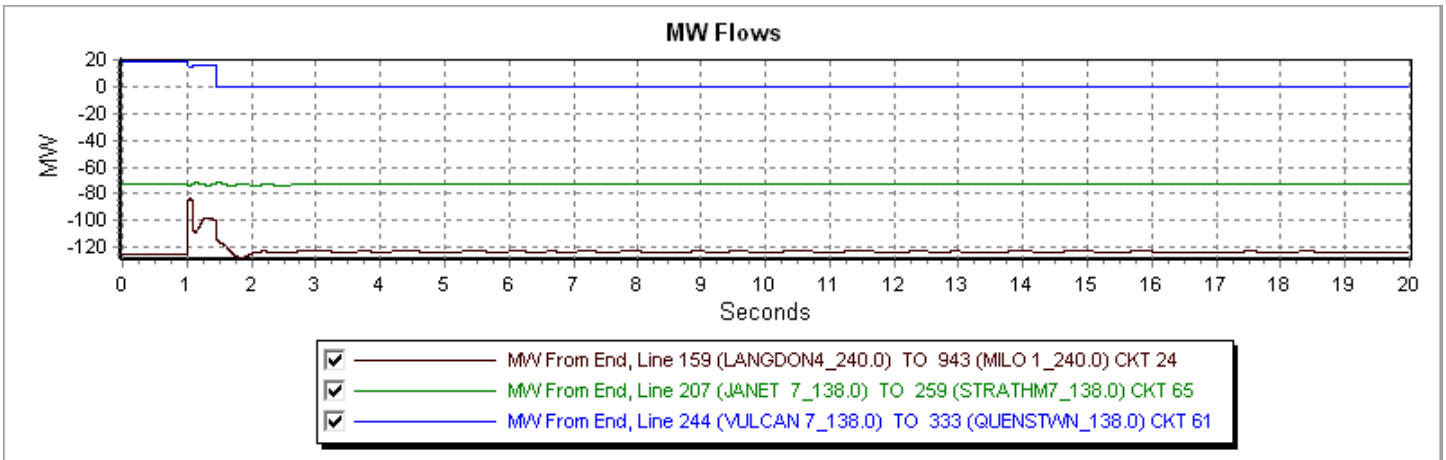
Attachment D

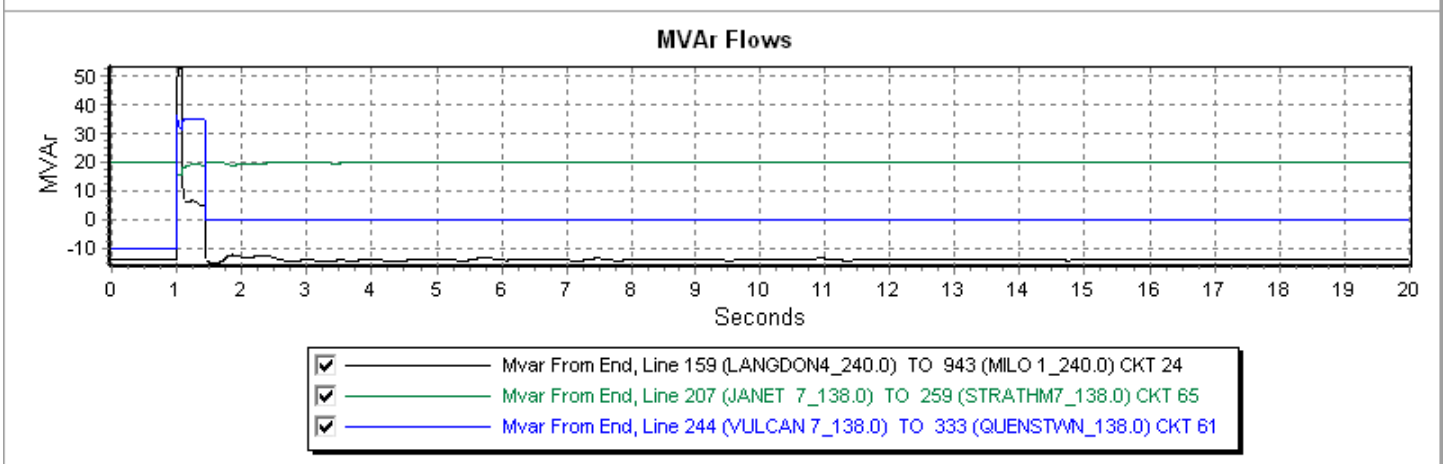
Pre-Connection Transient Stability Analysis Results

2015SL Study Case

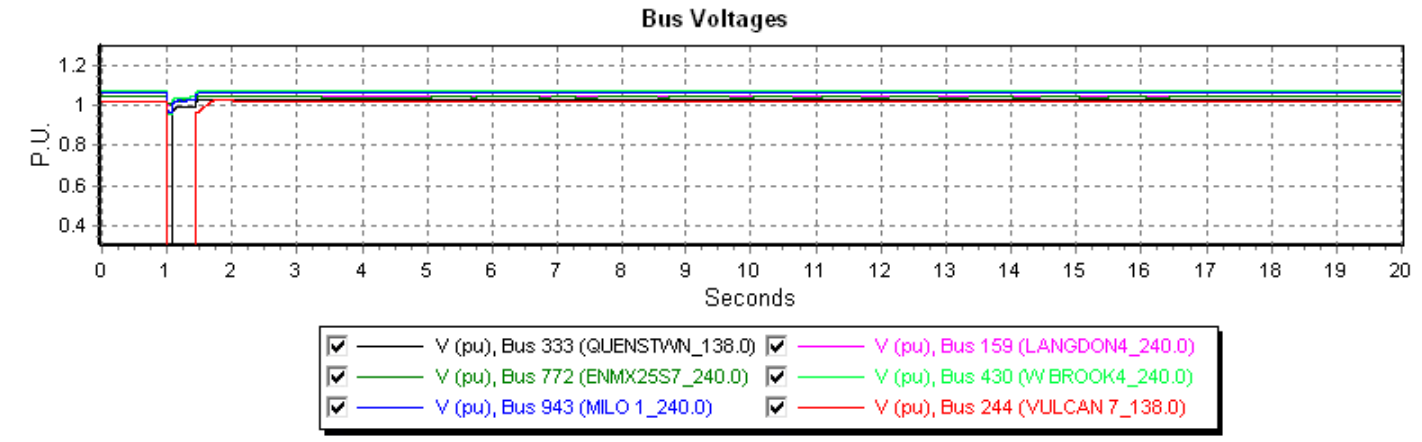


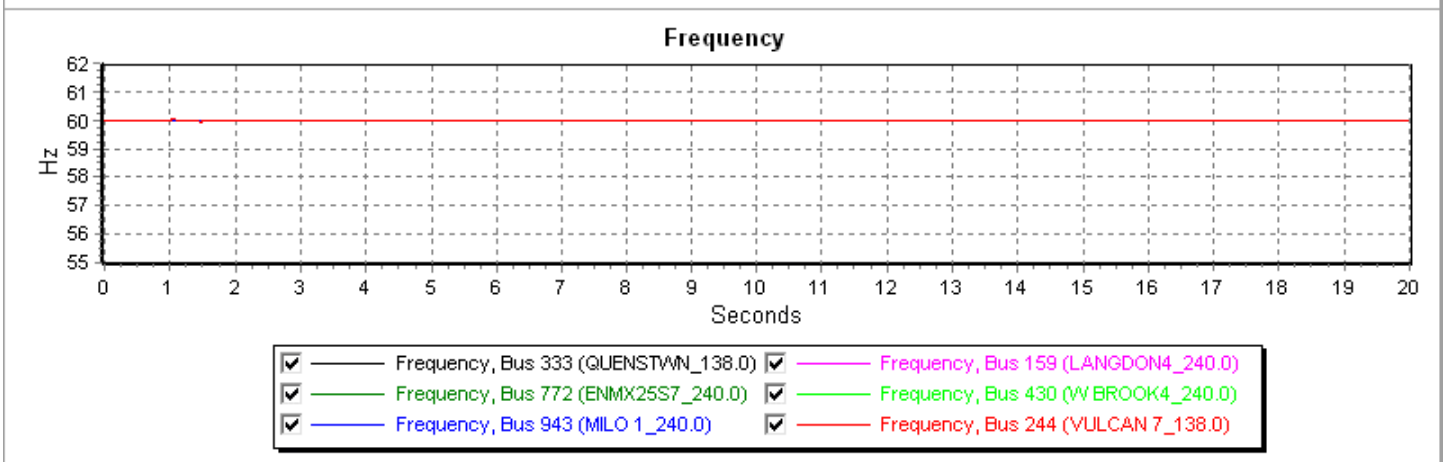
PowewrEN Corporation D. Brankovich	Pre-connection system state Initial conditions for transient stability simulation Study case: 2015SL	System Initial Conditions TS0-01 3/29/2014



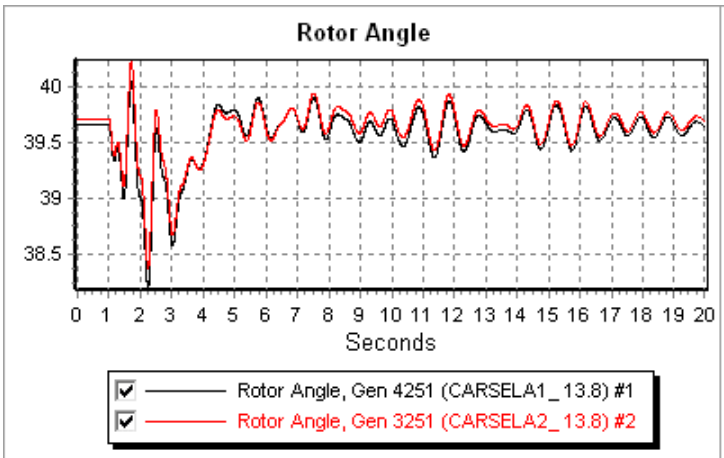


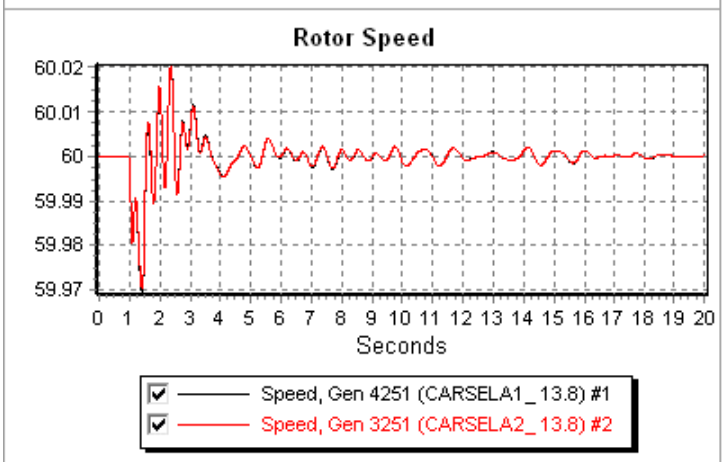
Contingency: 161L QUEENSTOWN 504S - VULCAN 255S	Branch Flows Queenstown Generating Plant Output: 90MW
	May 11, 2014 01:49:41

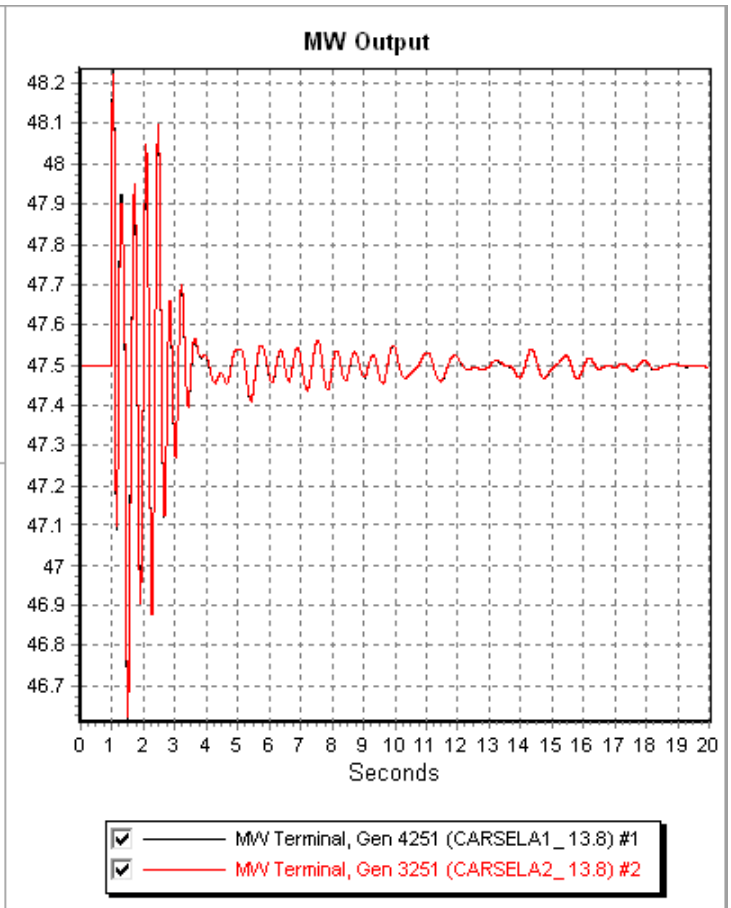




Contingency: 161L QUEENSTOWN 504S - VULCAN 255S	Bus Voltages and Frequency Queenstown Generating Plant Output: 90MW May 11, 2014 01:49:42



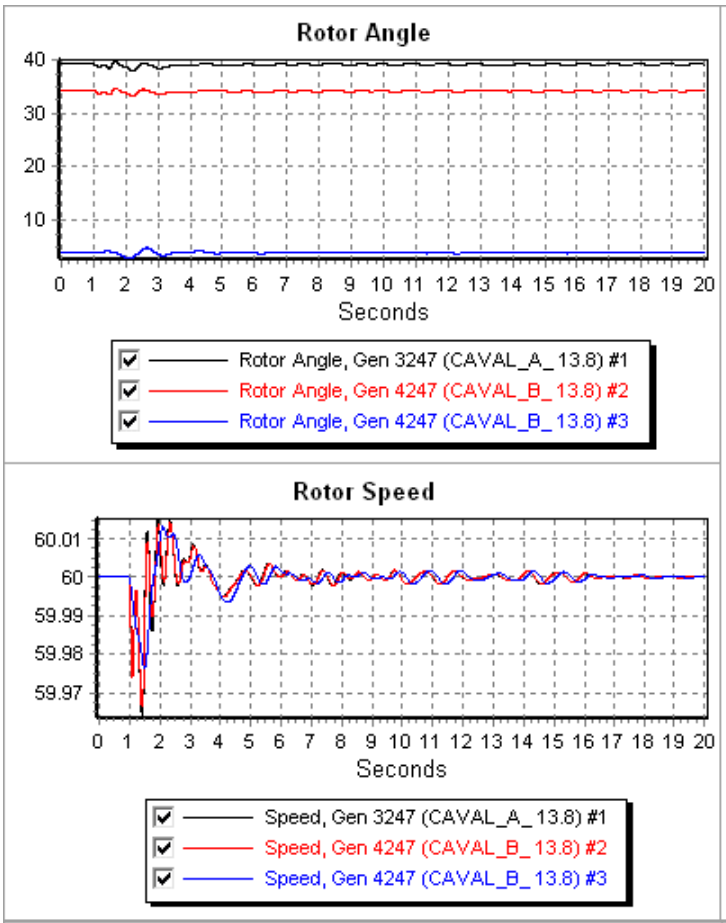


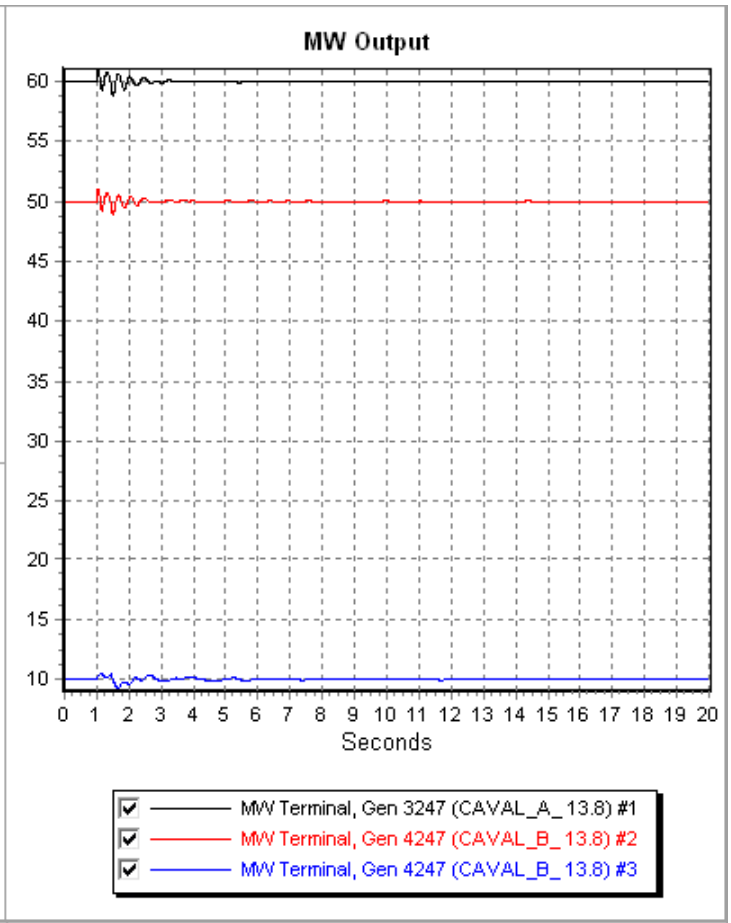


Contingency: 161L QUEENSTOWN 504S - VULCAN 255S

Carseland
Queenstown Generating Plant Output: 90MW

May 11, 2014 01:49:39

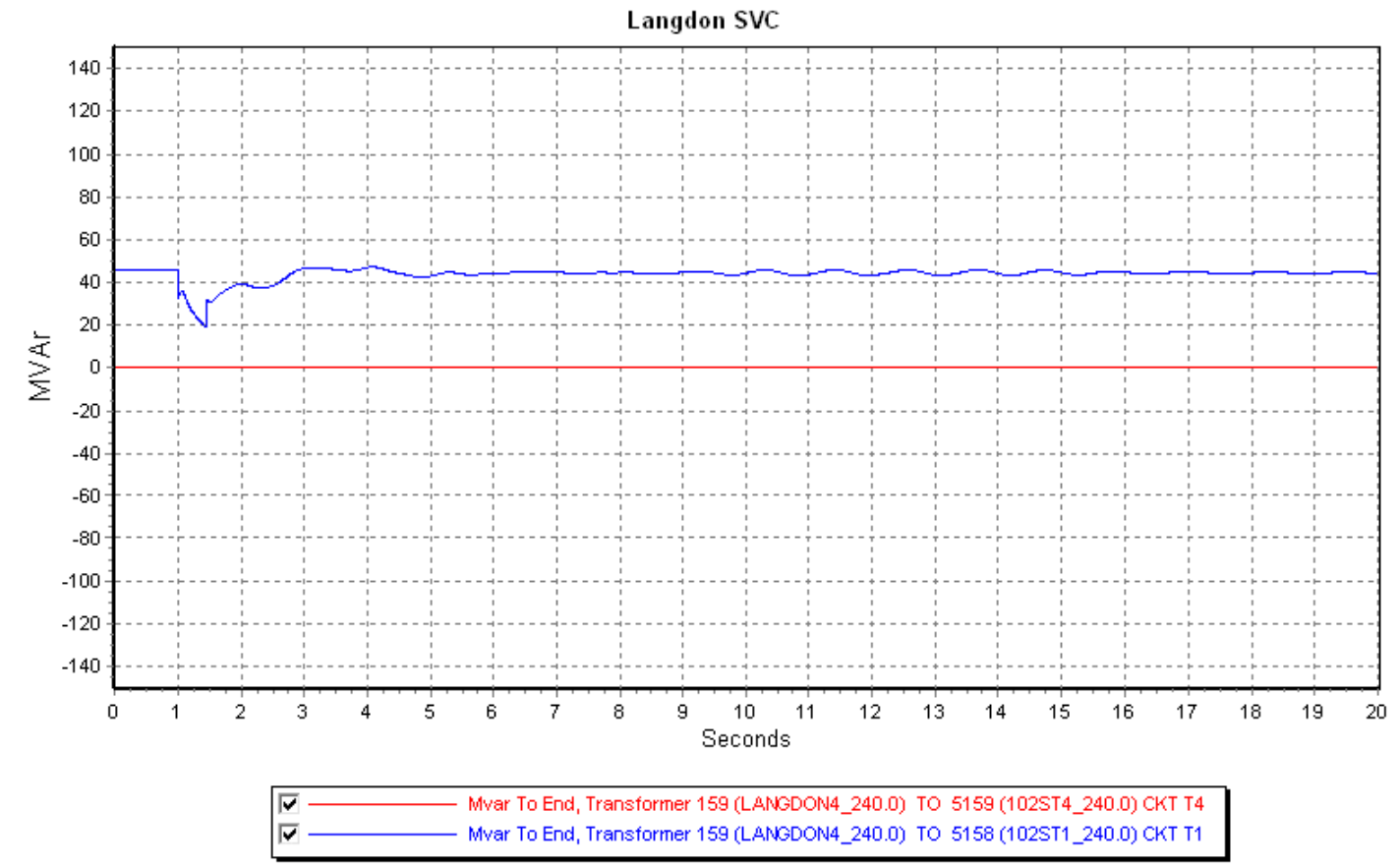




Contingency: 161L QUEENSTOWN 504S - VULCAN 255S

Cavalier
Queenstown Generating Plant Output: 90MW

May 11, 2014 01:49:41



Contingency: 161L QUEENSTOWN 504S - VULCAN 255S	Langdon SVC Queenstown Generating Plant Output: 90MW
	May 11, 2014 01:49:42

Rotor Angle

Seconds

Rotor Speed

Seconds

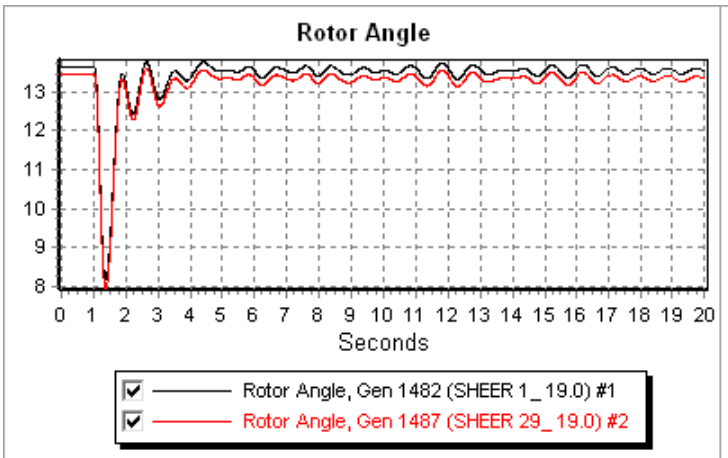
MW Output

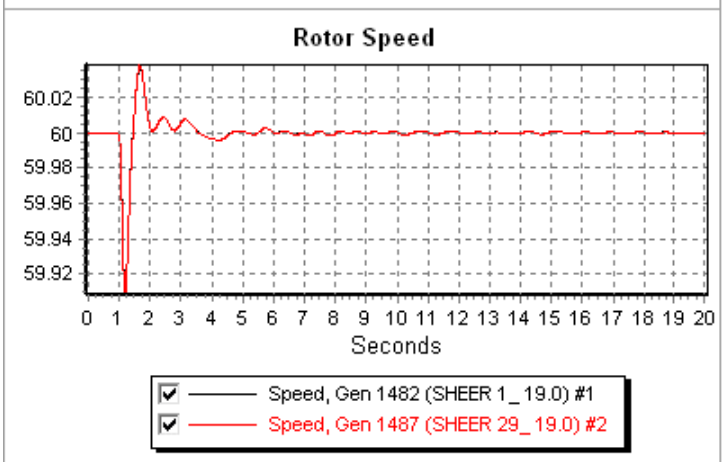
Seconds

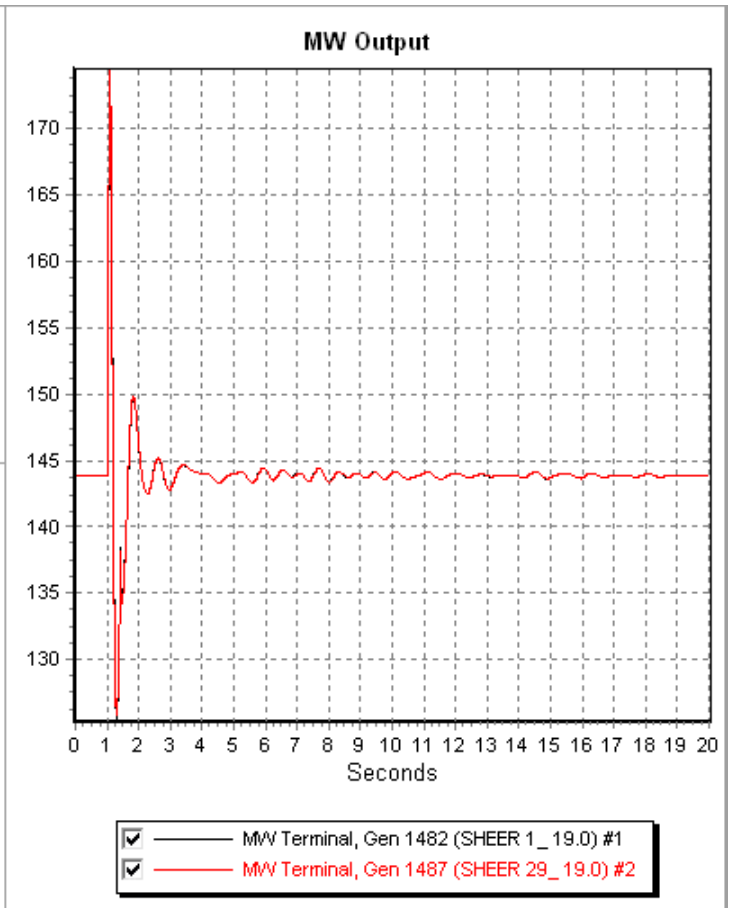
Contingency: 161L QUEENSTOWN 504S - VULCAN 255S

P1336
Queenstown Generating Plant
Output: 90MW

May 11, 2014 01:49:40



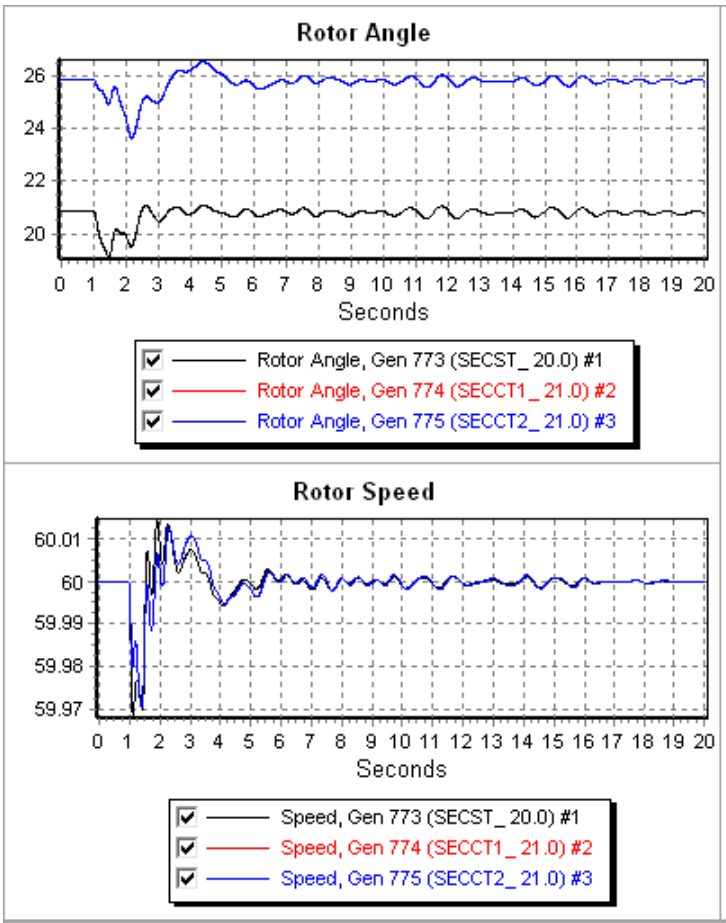


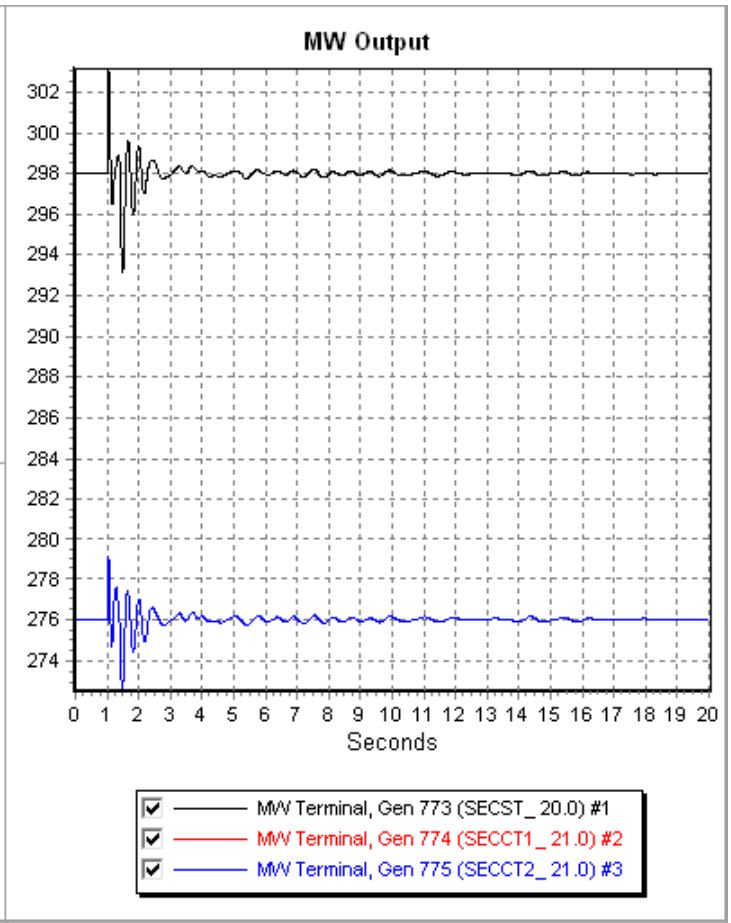


Contingency: 161L QUEENSTOWN 504S - VULCAN 255S

Sheerness
Queenstown Generating Plant Output: 90MW

May 11, 2014 01:49:38

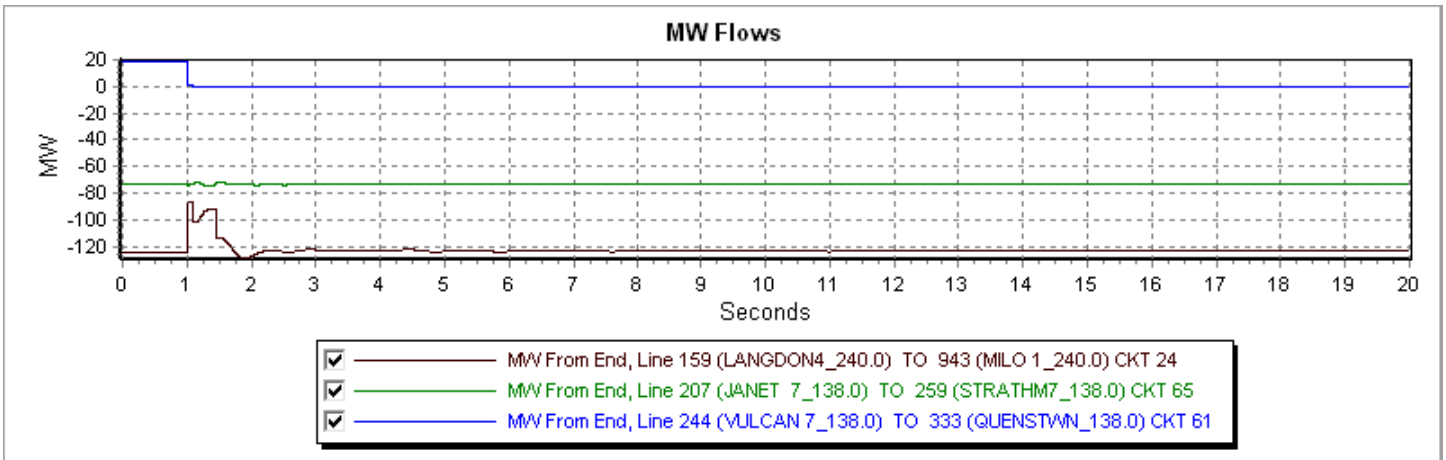


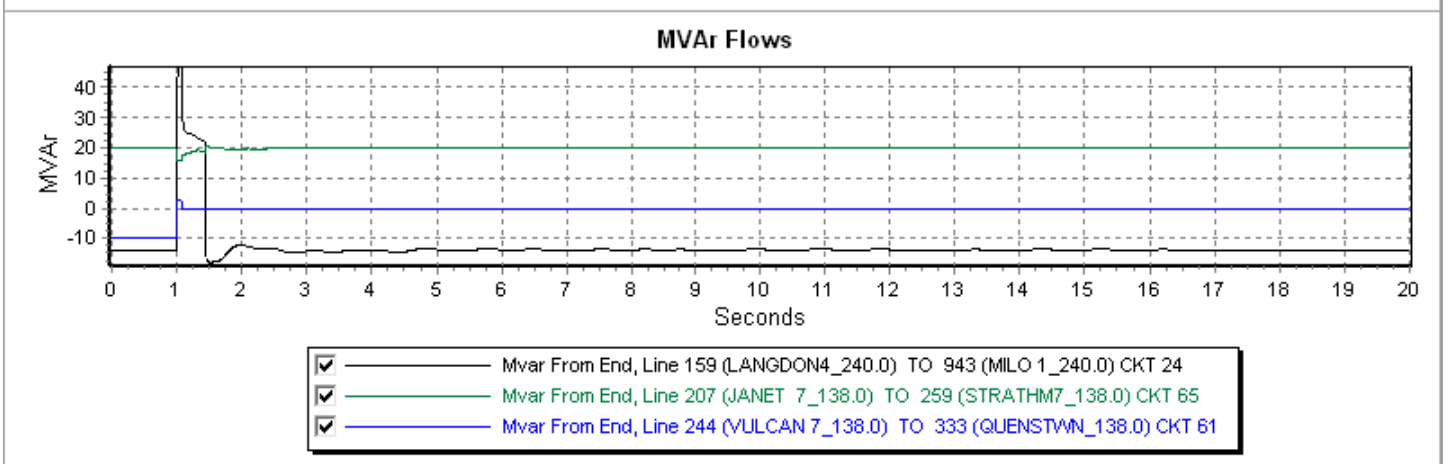


Contingency: 161L QUEENSTOWN 504S - VULCAN 255S

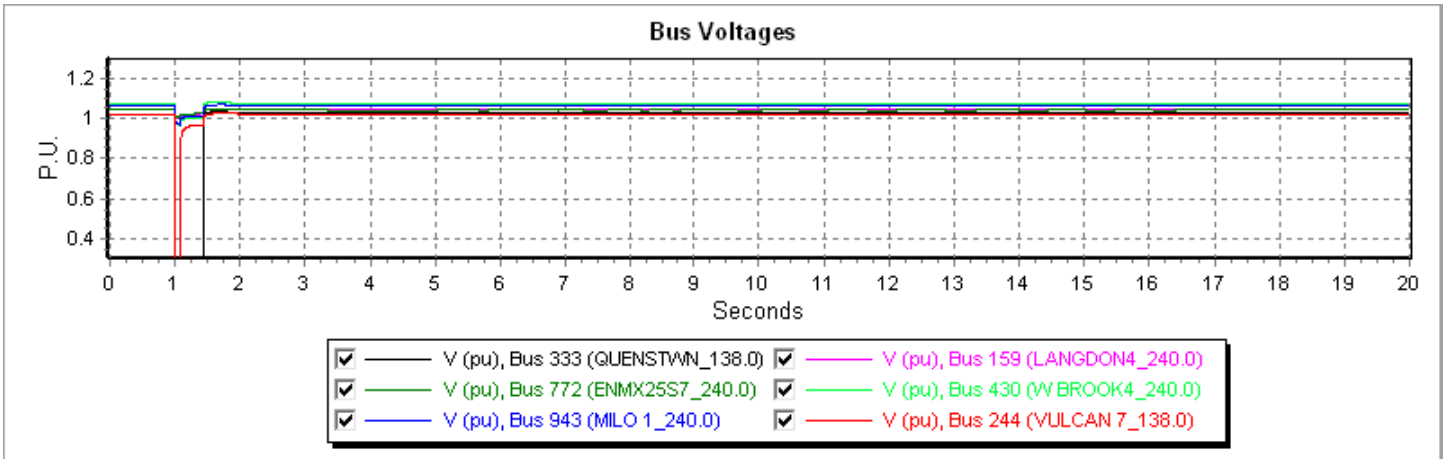
Sheppard
Queenstown Generating Plant Output: 90MW

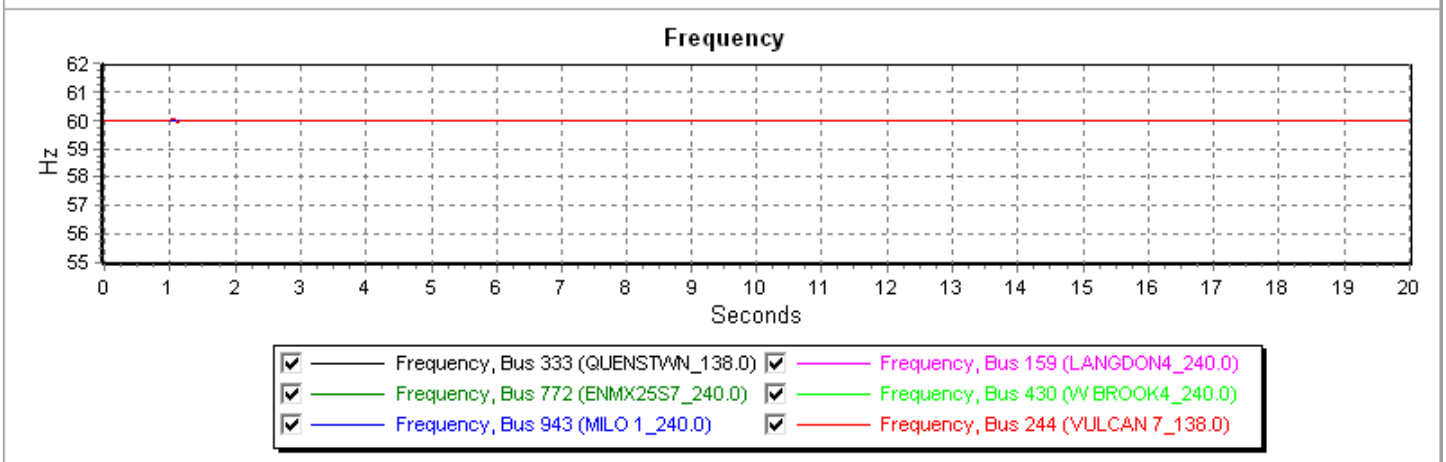
May 11, 2014 01:49:39



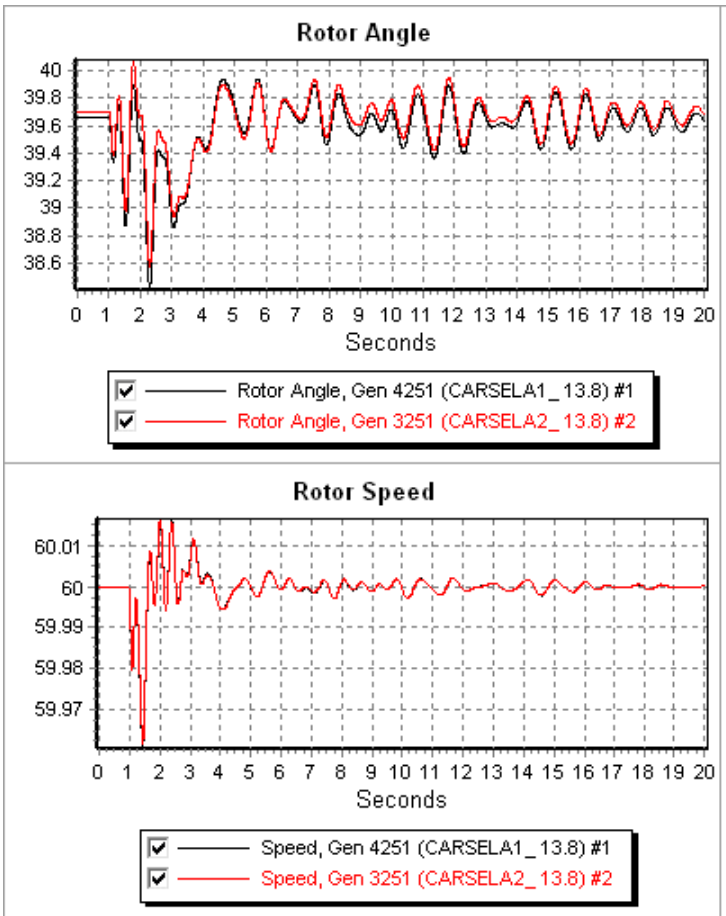


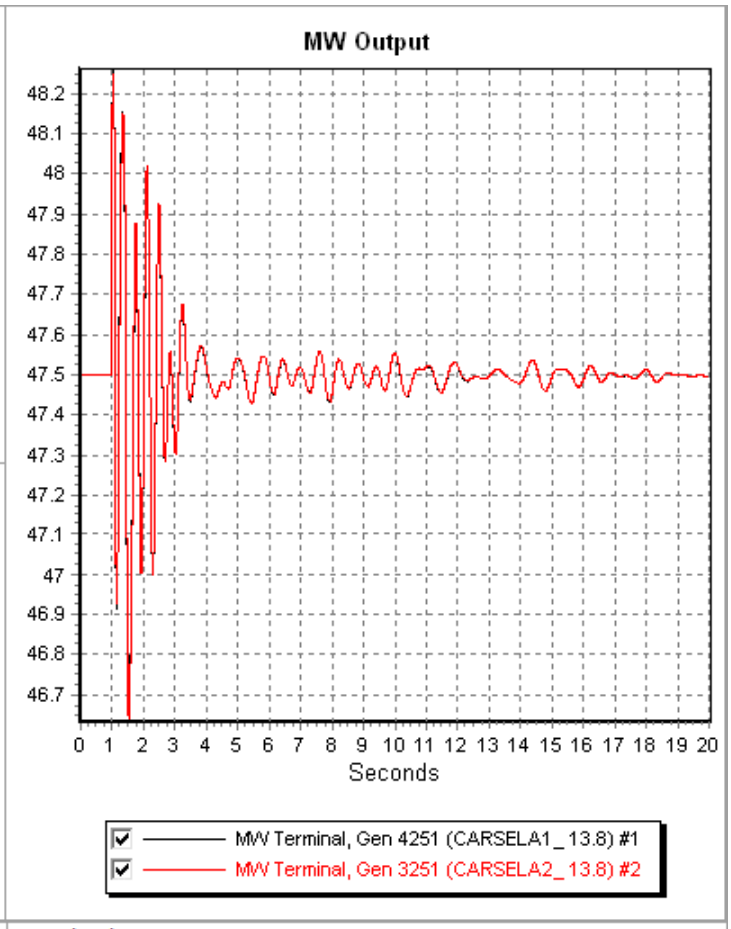
Contingency: 161L VULCAN 255S - QUEENSTOWN 504S	Branch Flows Queenstown Generating Plant Output: 90MW
	May 11, 2014 01:50:23





Contingency: 161L VULCAN 255S - QUEENSTOWN 504S	Bus Voltages and Frequency Queenstown Generating Plant Output: 90MW
	May 11, 2014 01:50:24

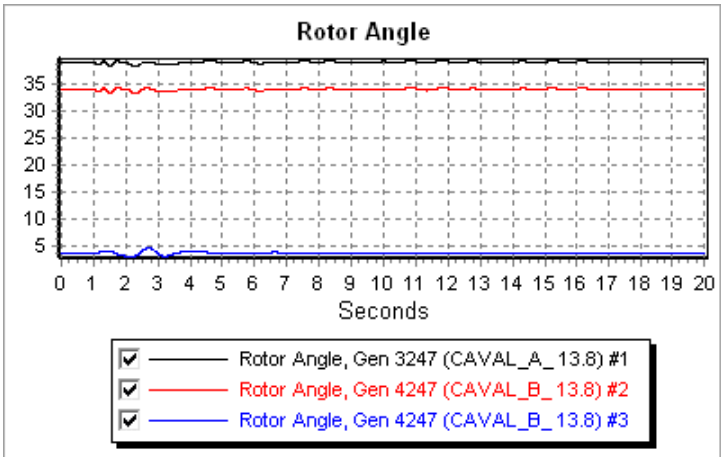


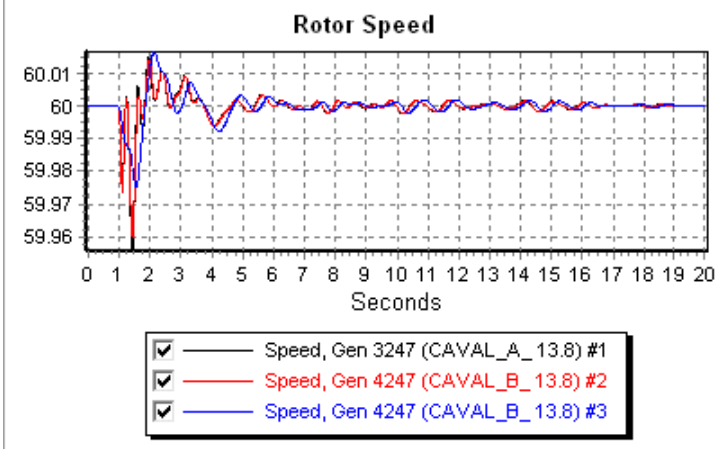


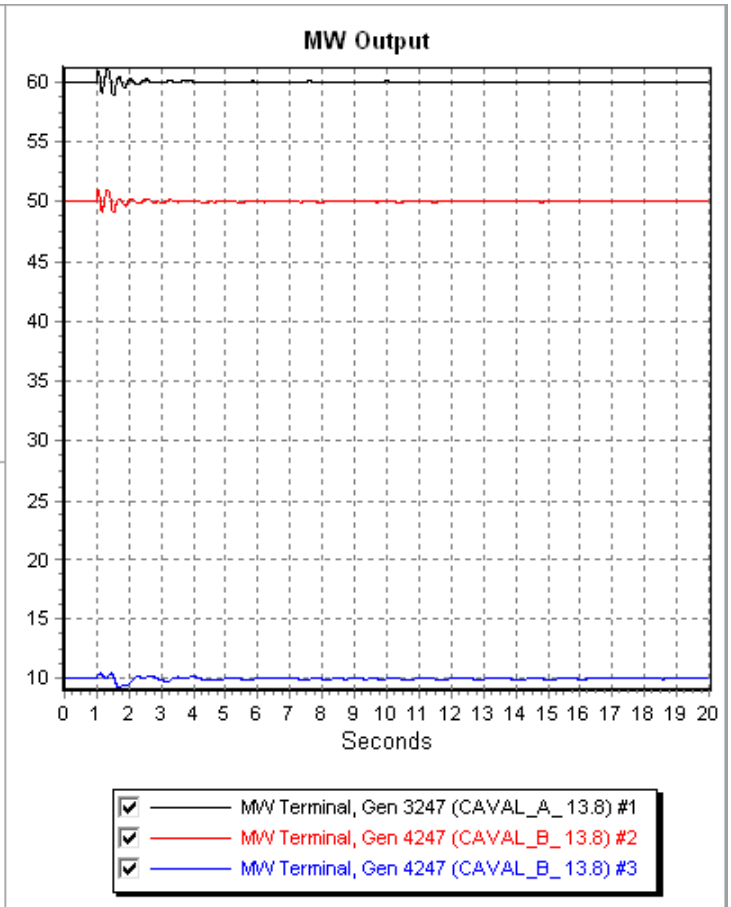
Contingency: 161L VULCAN 255S - QUEENSTOWN 504S

Carseland
Queenstown Generating Plant Output: 90MW

May 11, 2014 01:50:21



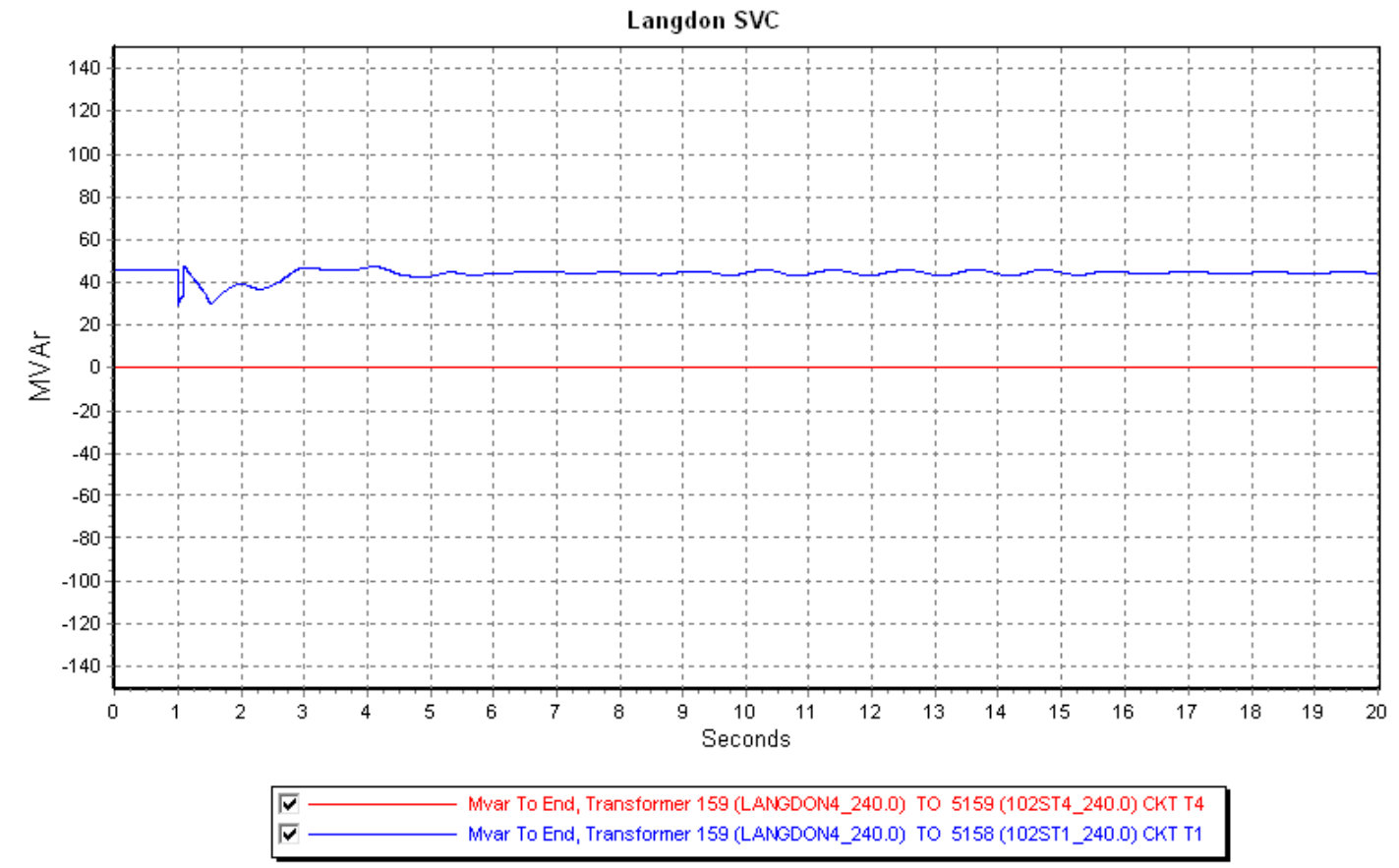




Contingency: 161L VULCAN 255S - QUEENSTOWN 504S

Cavalier
Queenstown Generating Plant Output: 90MW

May 11, 2014 01:50:23



Contingency: 161L VULCAN 255S - QUEENSTOWN 504S	Langdon SVC Queenstown Generating Plant Output: 90MW
	May 11, 2014 01:50:25

Rotor Angle

Seconds

Rotor Speed

Seconds

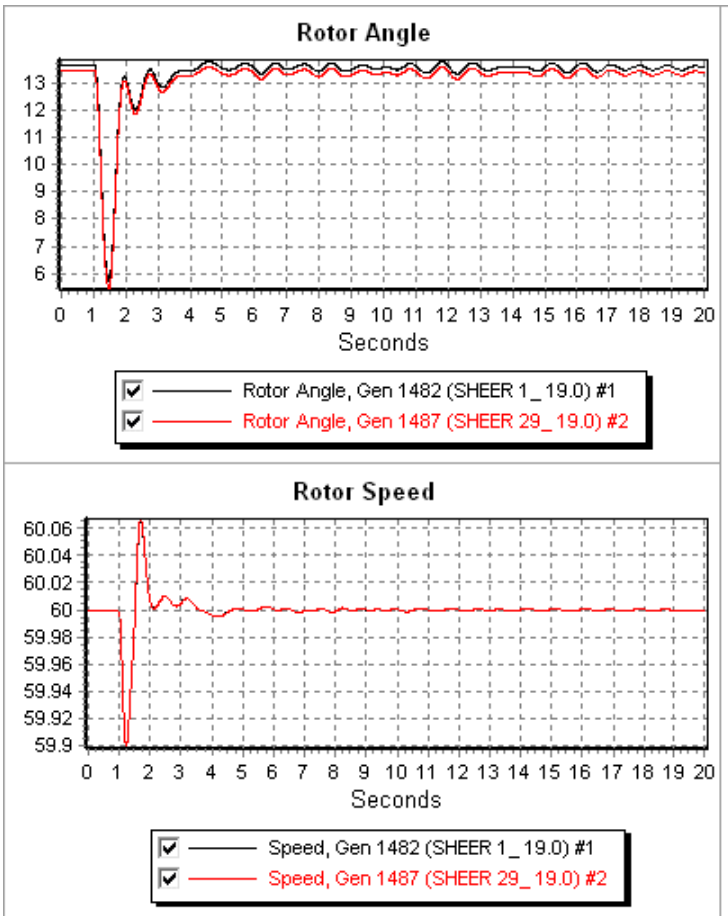
MW Output

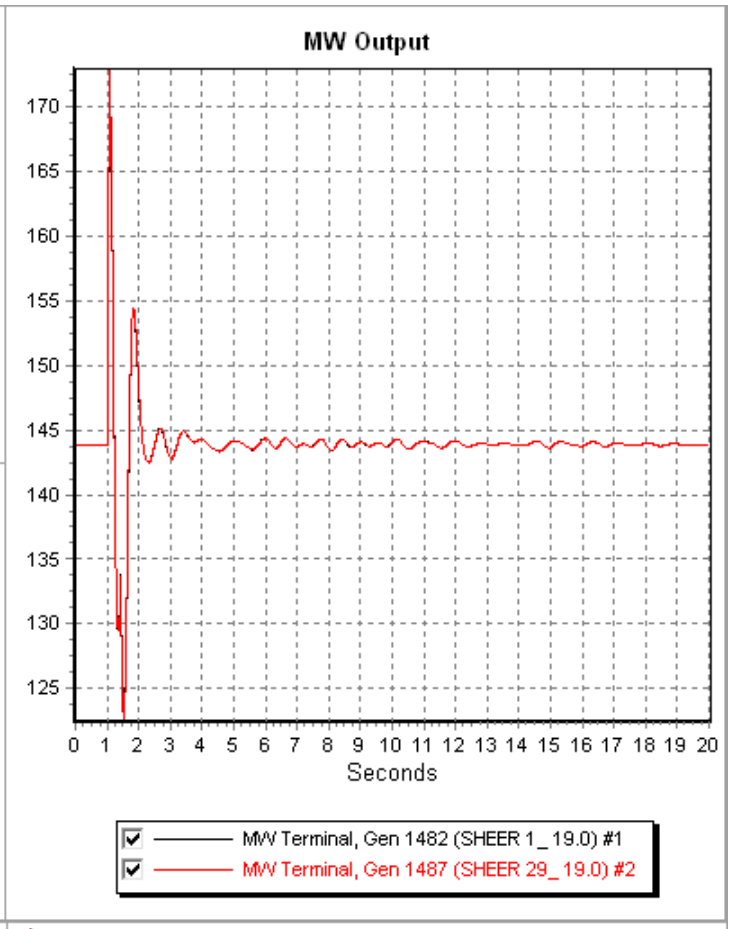
Seconds

Contingency: 161L VULCAN 255S - QUEENSTOWN 504S

P1336
Queenstown Generating Plant
Output: 90MW

May 11, 2014 01:50:22

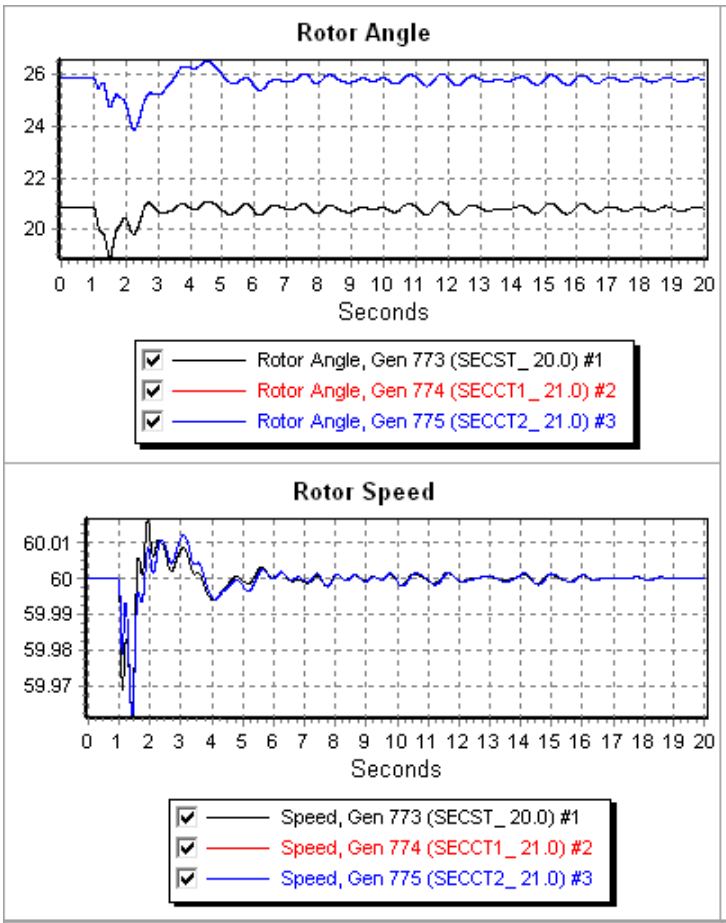


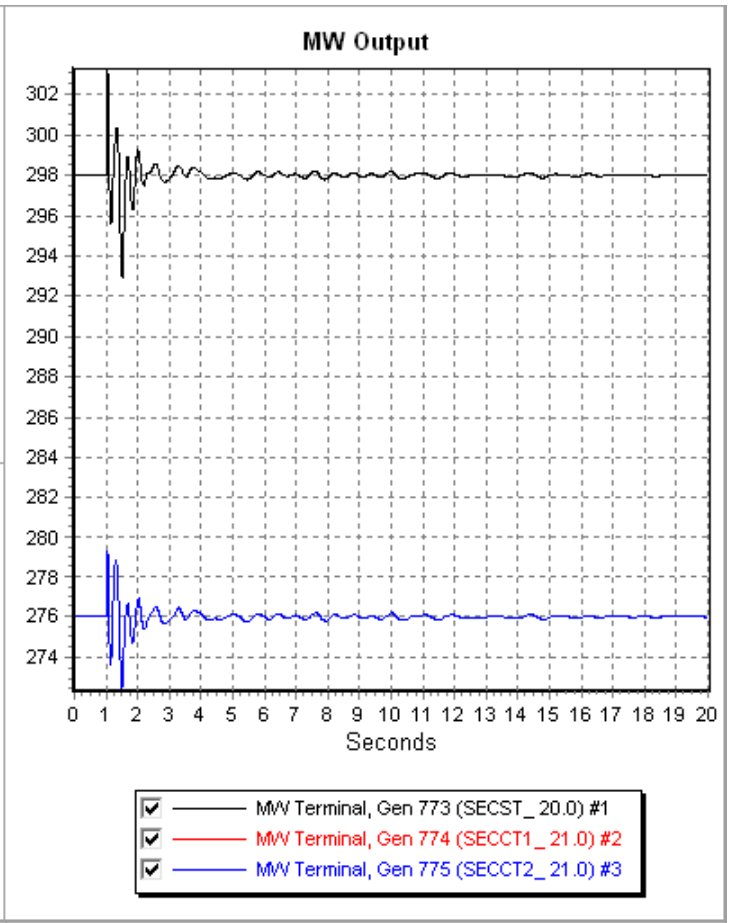


Contingency: 161L VULCAN 255S - QUEENSTOWN 504S

Sheerness
Queenstown Generating Plant Output: 90MW

May 11, 2014 01:50:21

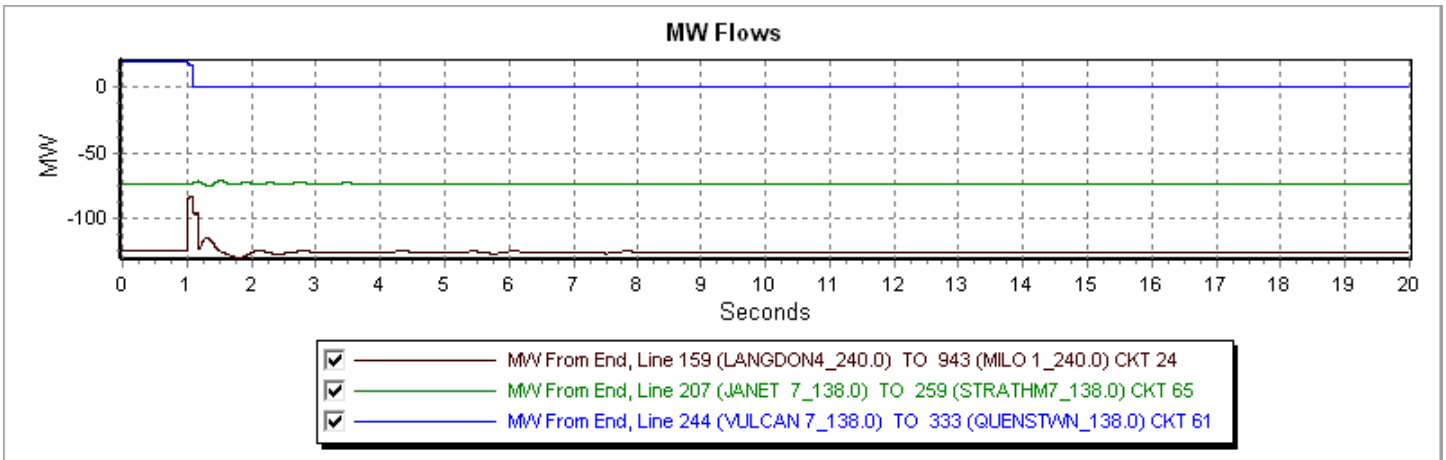


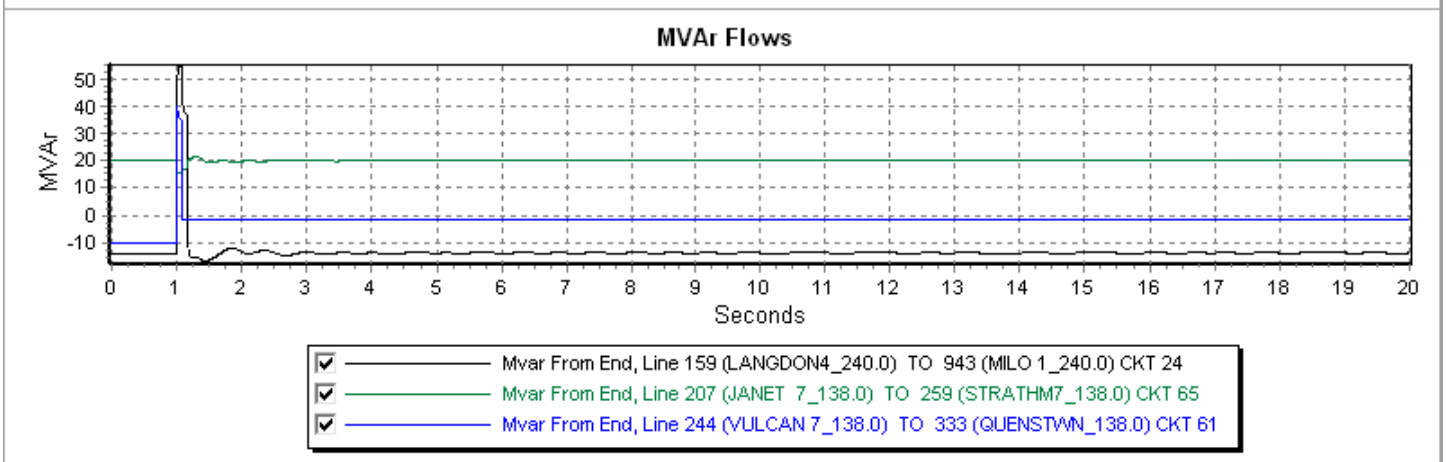


Contingency: 161L VULCAN 255S - QUEENSTOWN 504S

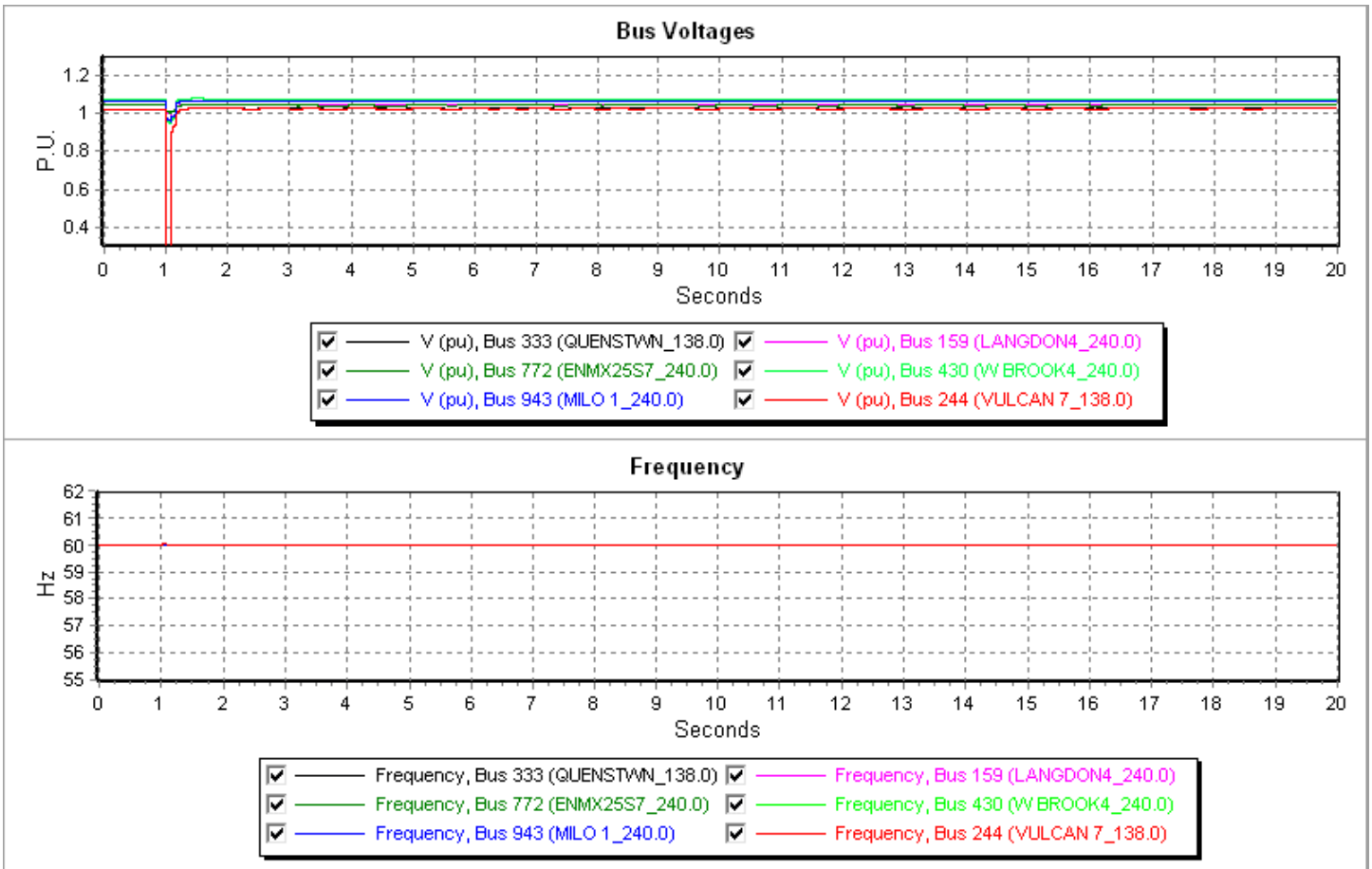
Sheppard
Queenstown Generating Plant Output: 90MW

May 11, 2014 01:50:22





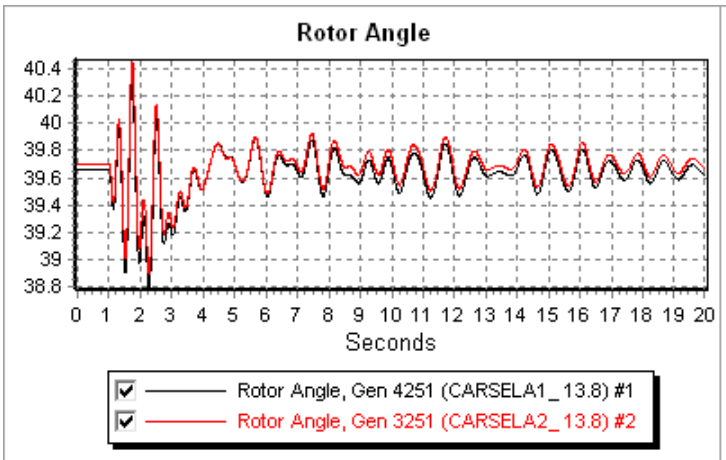
Contingency: 853L QUEENSTOWN 504S - WEST BROOKS 28S	Branch Flows Queenstown Generating Plant Output: 90MW
	May 11, 2014 01:54:02

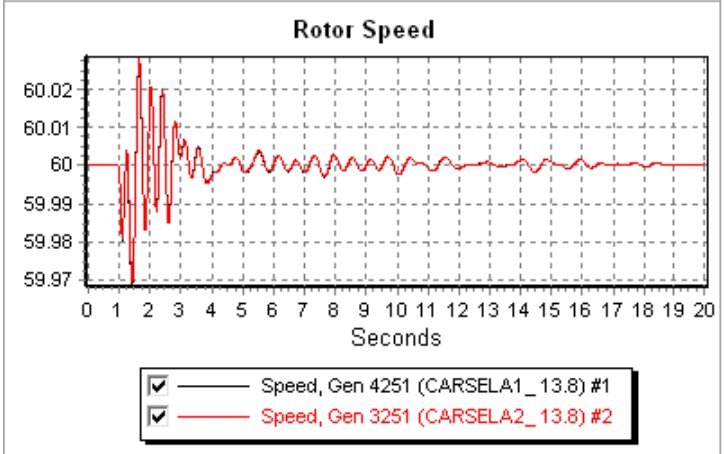


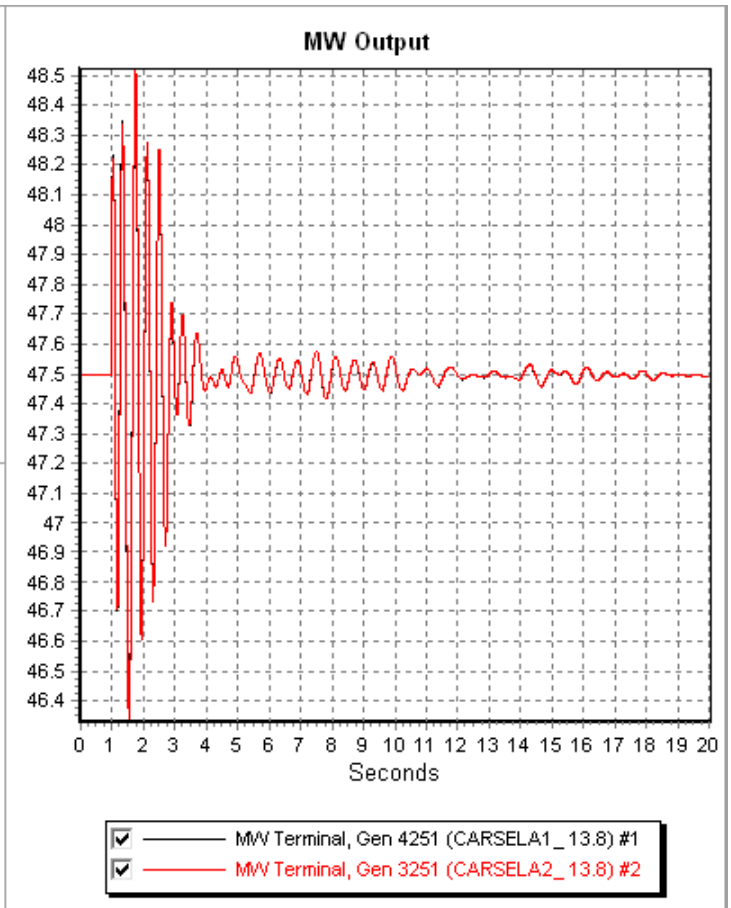
Contingency: 853L QUEENSTOWN 504S - WEST BROOKS 28S

Bus Voltages and Frequency
Queenstown Generating Plant Output: 90MW

May 11, 2014 01:54:03



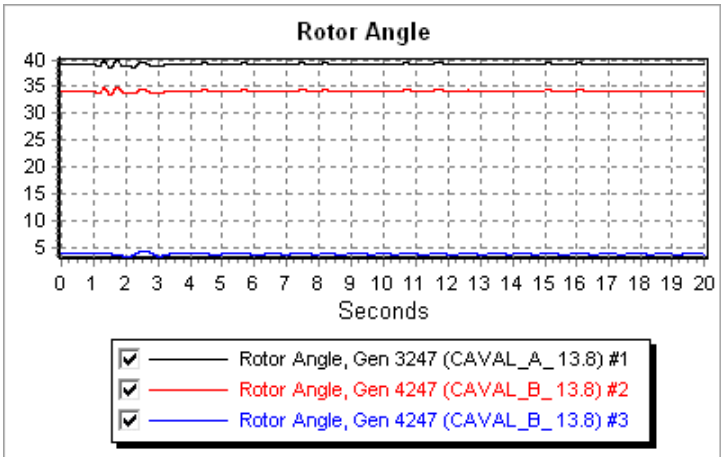


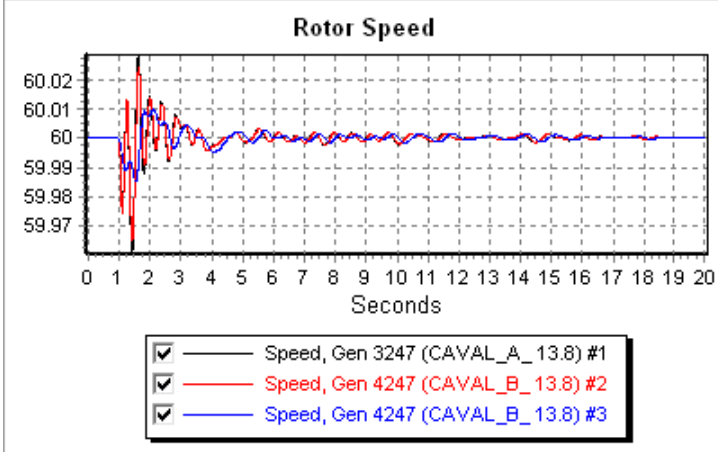


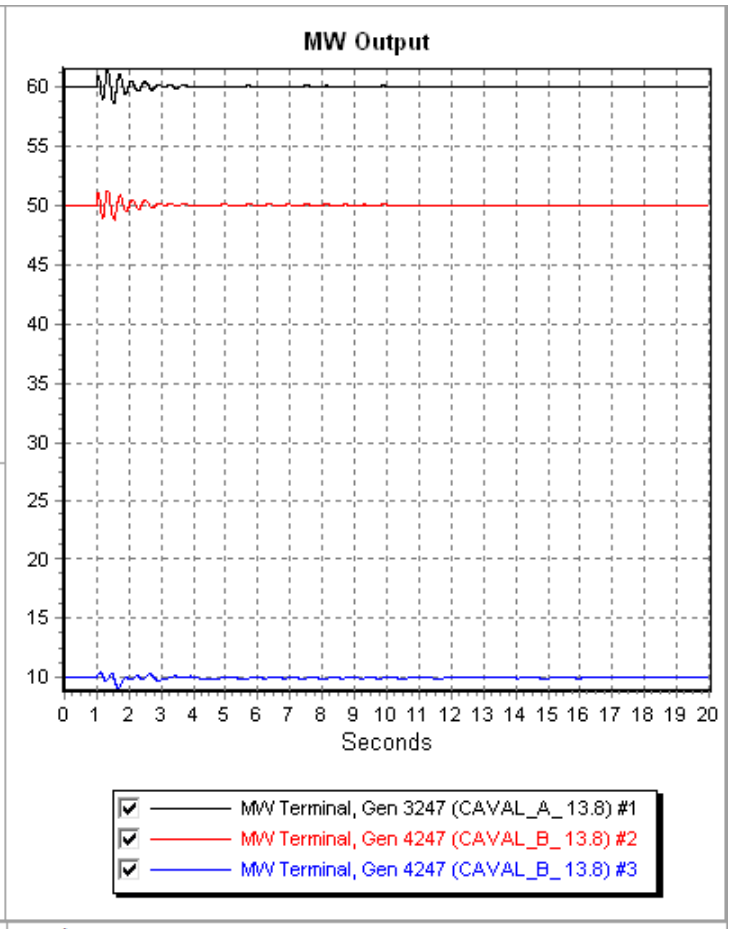
Contingency: 853L QUEENSTOWN 504S - WEST BROOKS 28S

Carseland
Queenstown Generating Plant Output: 90MW

May 11, 2014 01:54:00



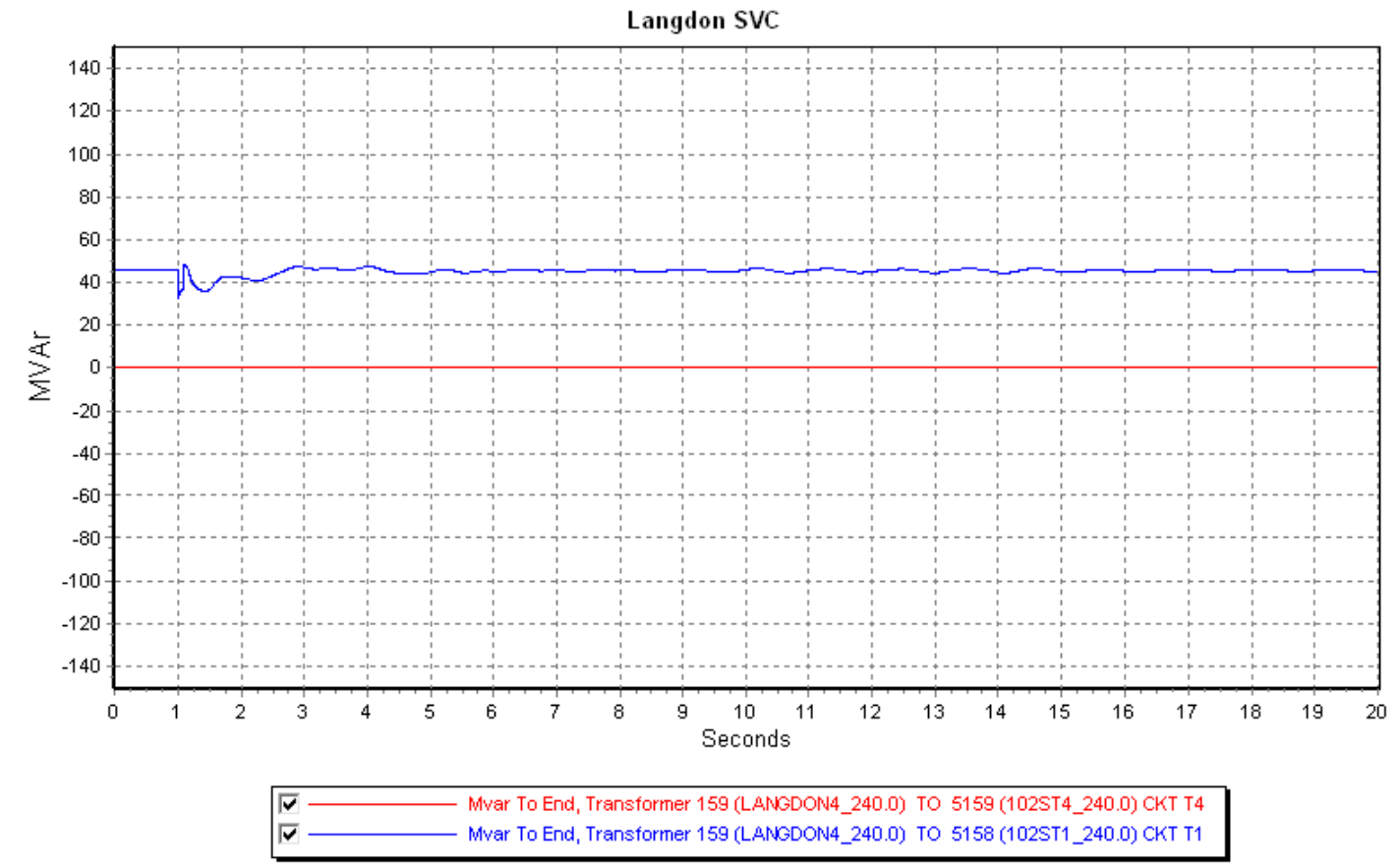




Contingency: 853L QUEENSTOWN 504S - WEST BROOKS 28S

Cavalier
Queenstown Generating Plant Output: 90MW

May 11, 2014 01:54:02



Contingency: 853L QUEENSTOWN 504S - WEST BROOKS 28S	Langdon SVC Queenstown Generating Plant Output: 90MW
	May 11, 2014 01:54:03

Rotor Angle

Seconds

Rotor Speed

Seconds

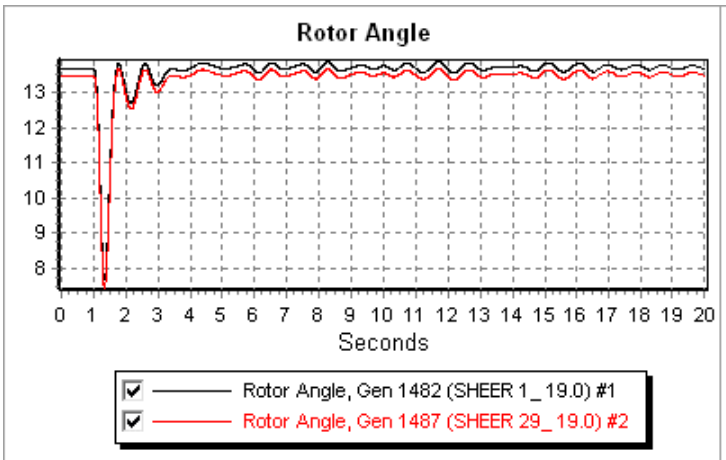
MW Output

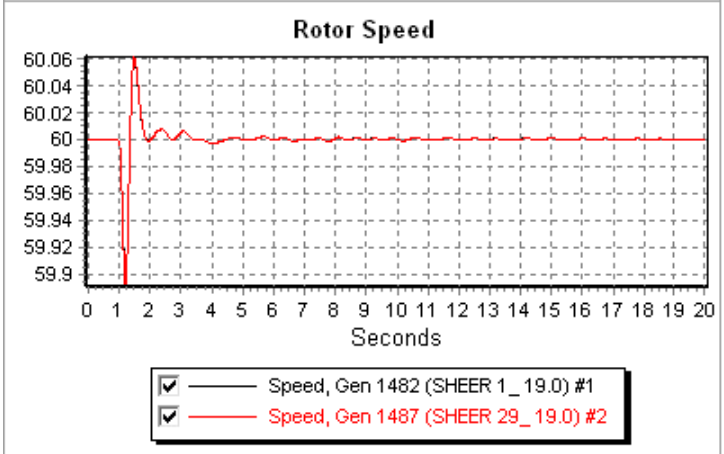
Seconds

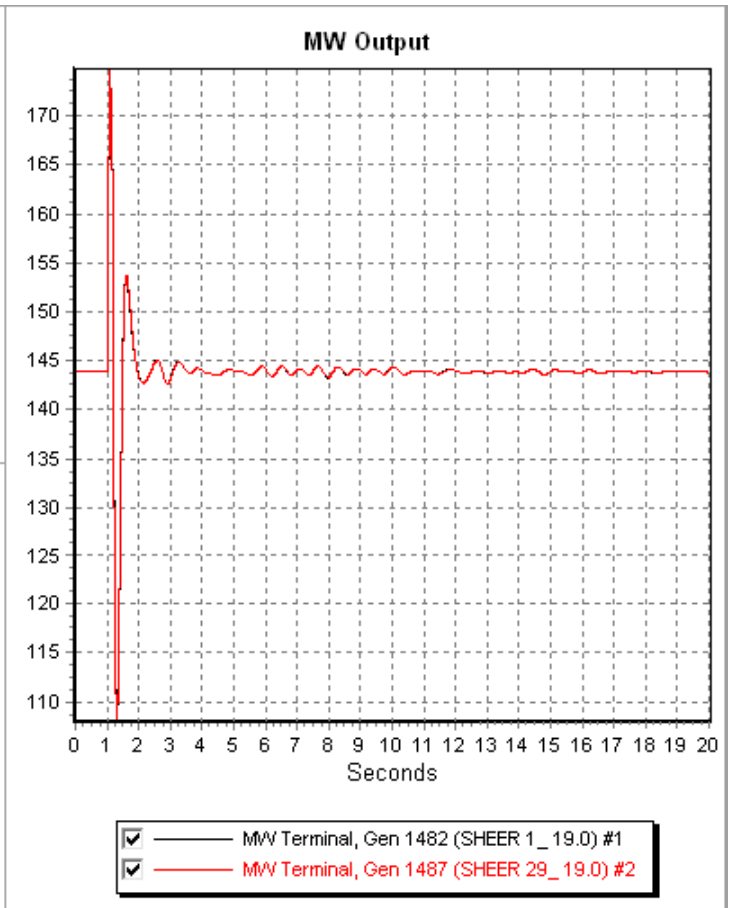
Contingency: 853L QUEENSTOWN 504S - WEST BROOKS 28S

P1336
Queenstown Generating Plant
Output: 90MW

May 11, 2014 01:54:01



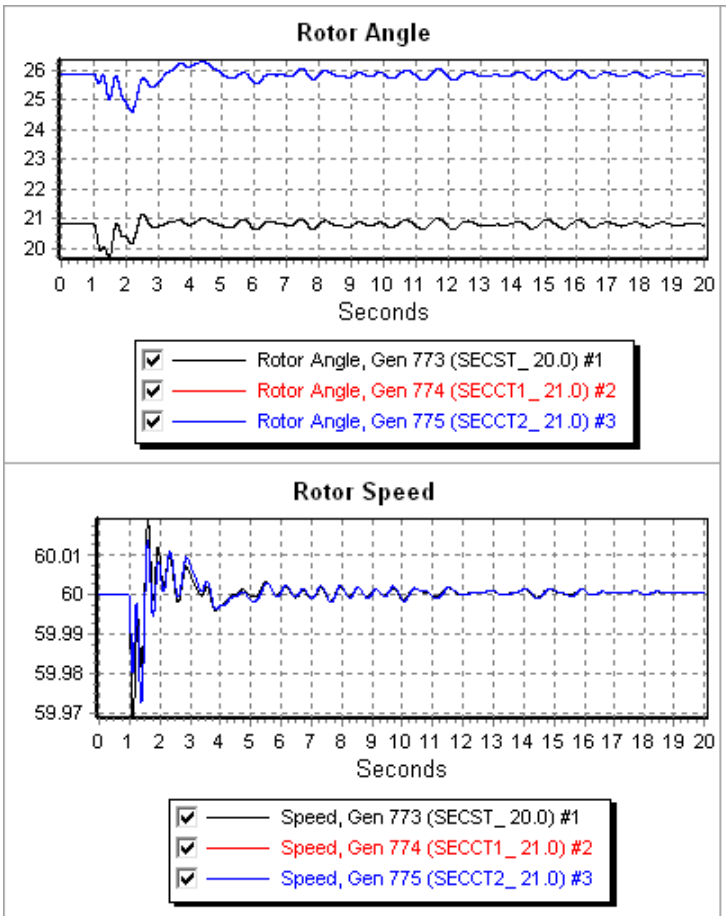


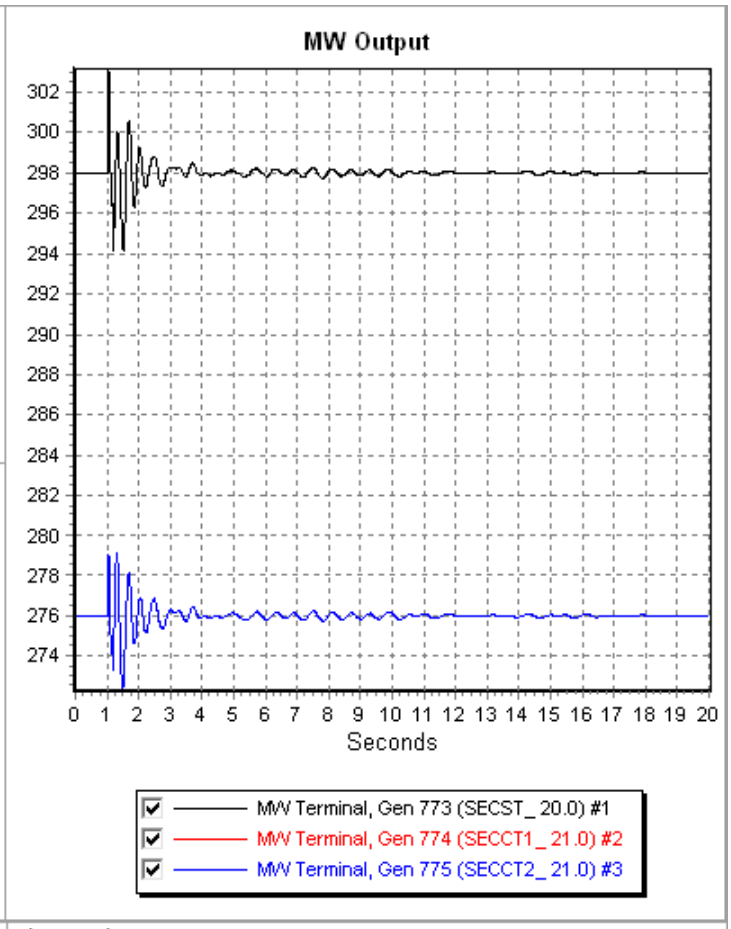


Contingency: 853L QUEENSTOWN 504S - WEST BROOKS 28S

Sheerness
Queenstown Generating Plant Output: 90MW

May 11, 2014 01:54:00

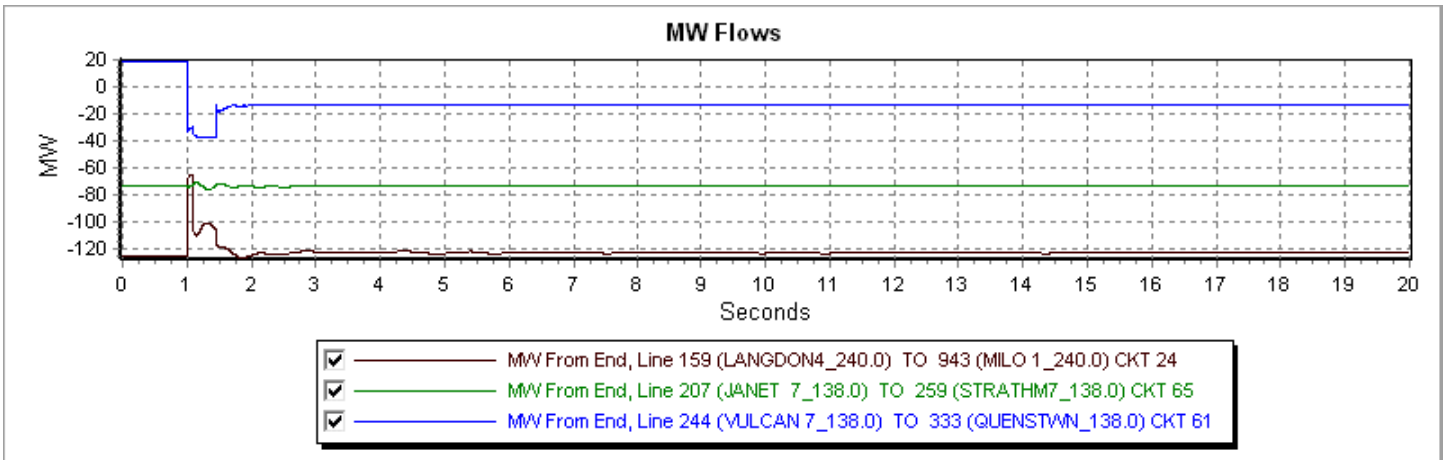


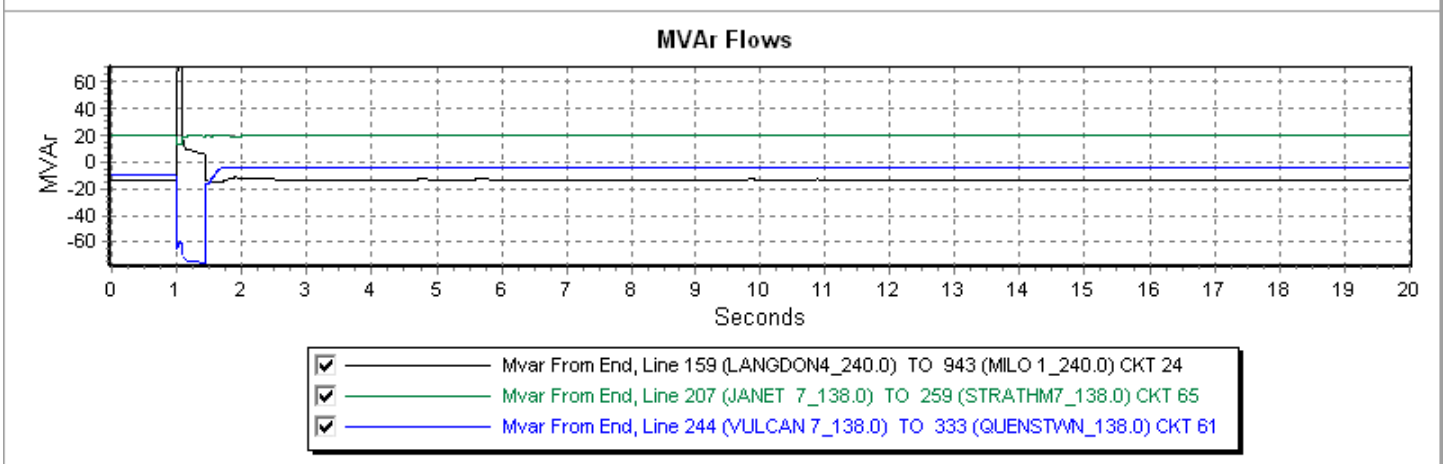


Contingency: 853L QUEENSTOWN 504S - WEST BROOKS 28S

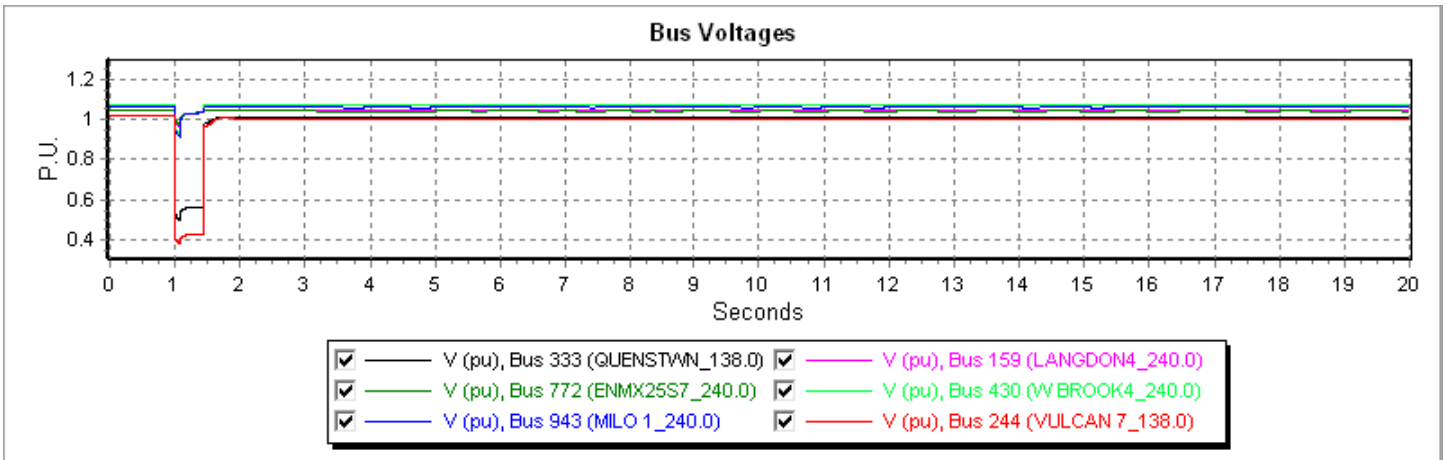
Sheppard
Queenstown Generating Plant Output: 90MW

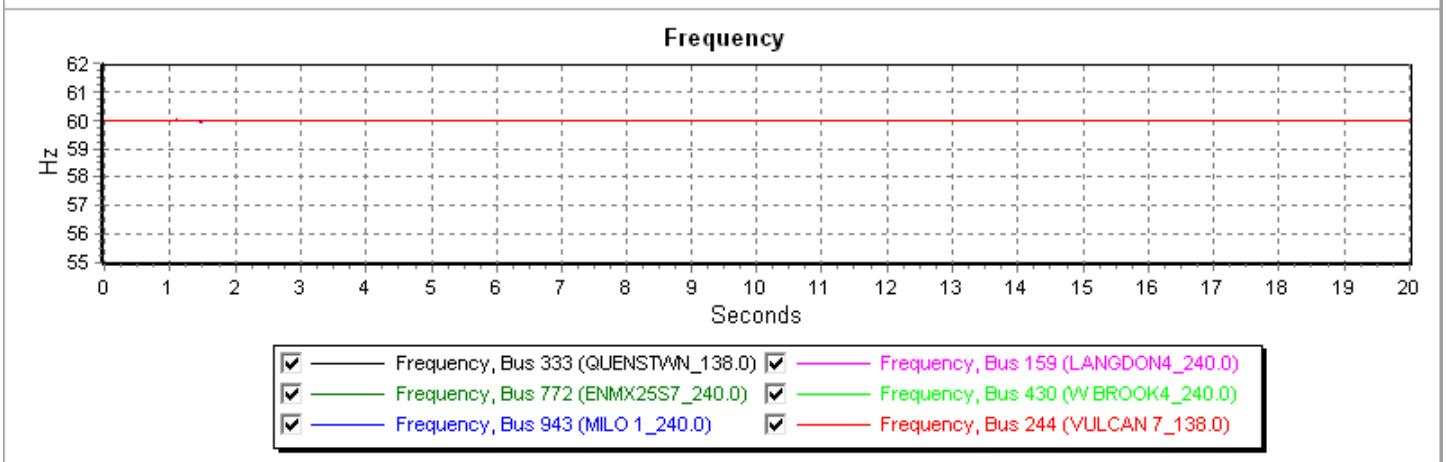
May 11, 2014 01:54:01



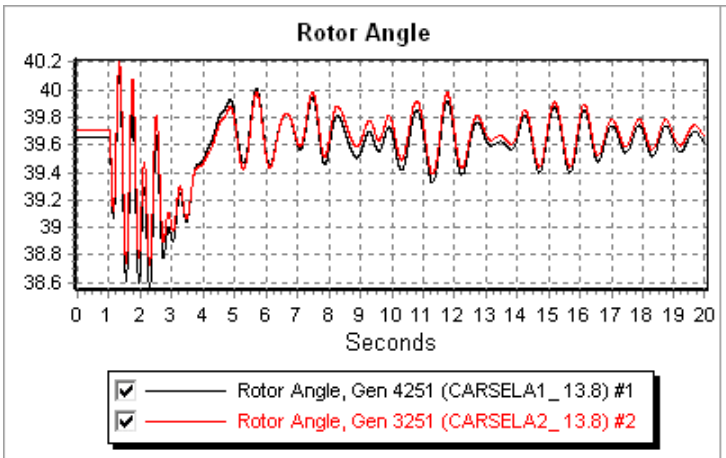


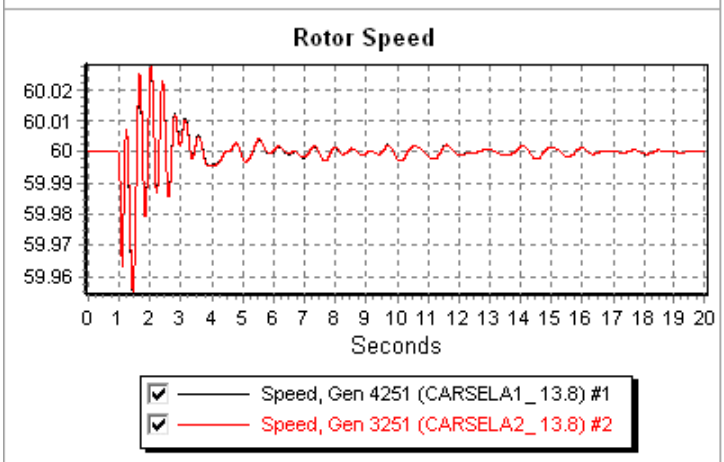
Contingency: 180L Ft.McLeod 15S to Staveley 928S	Branch Flows Queenstown Generating Plant Output: 90MW
	May 11, 2014 01:51:06

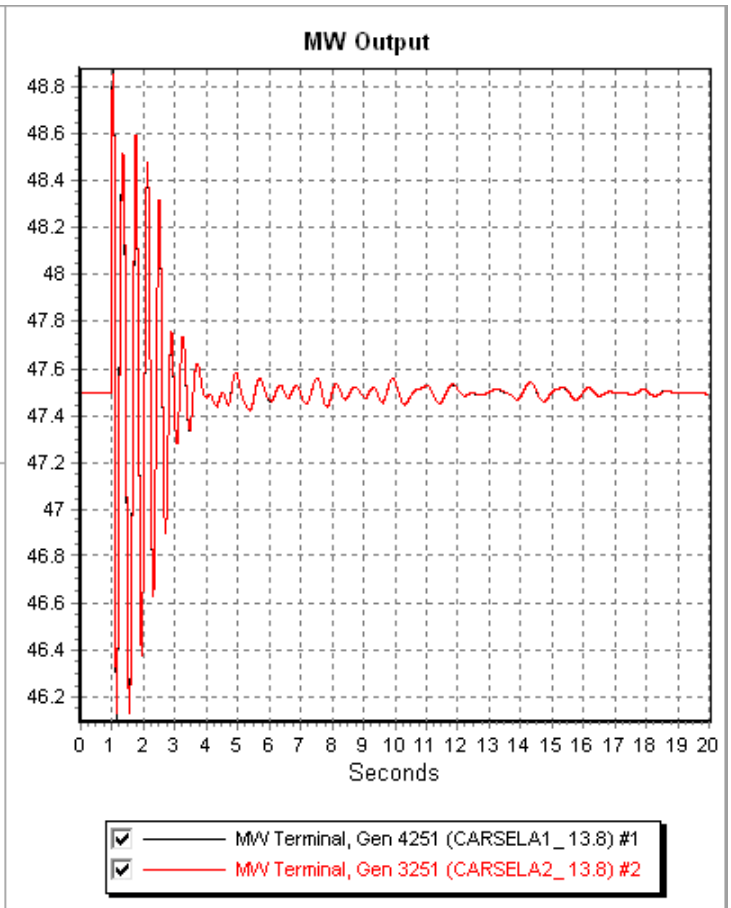




Contingency: 180L Ft.McLeod 15S to Staveley 928S	Bus Voltages and Frequency Queenstown Generating Plant Output: 90MW
	May 11, 2014 01:51:07



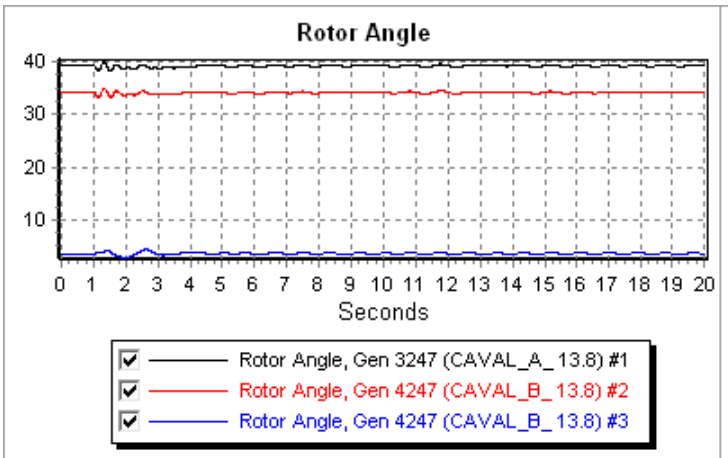


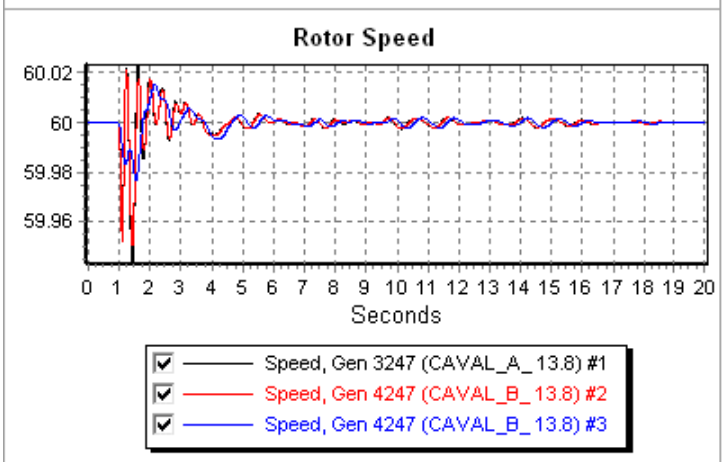


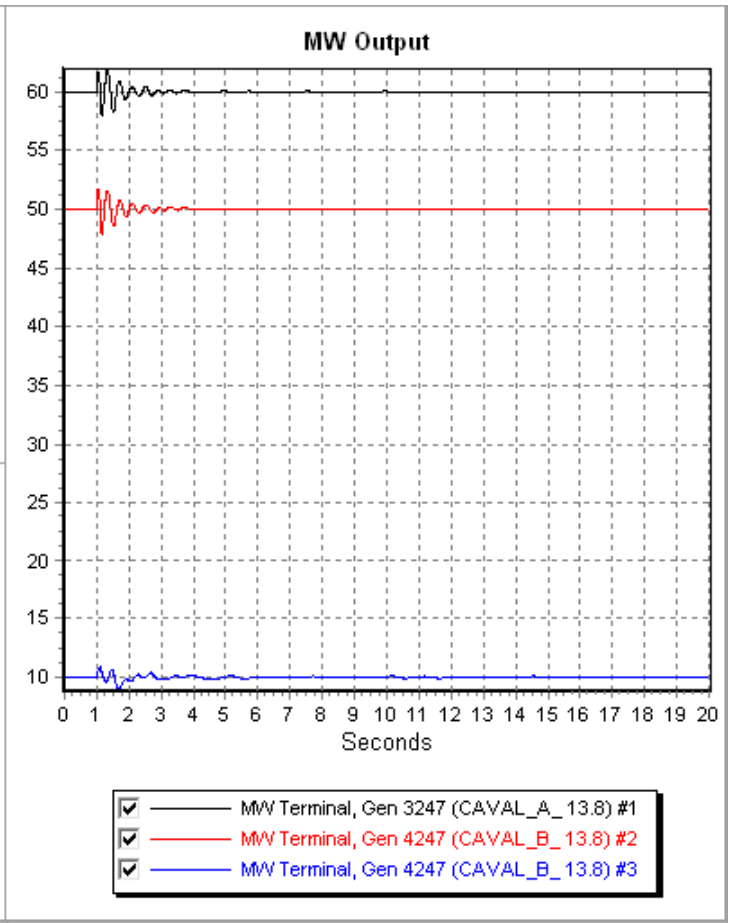
Contingency: 180L Ft.McLeod 15S to Staveley 928S

Carseland
Queenstown Generating Plant Output: 90MW

May 11, 2014 01:51:04



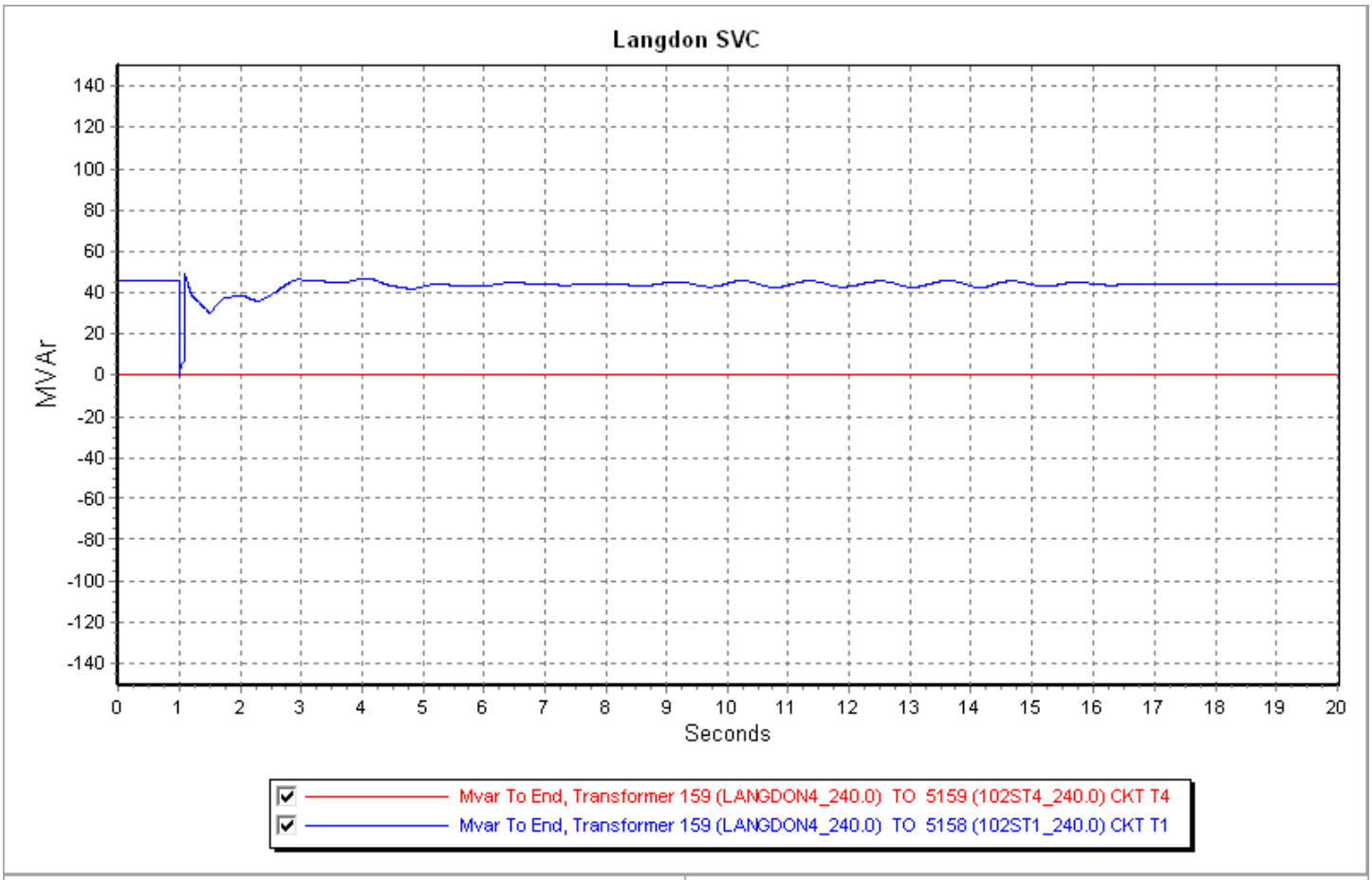




Contingency: 180L Ft.McLeod 15S to Staveley 928S

Cavalier
Queenstown Generating Plant Output: 90MW

May 11, 2014 01:51:06



Contingency: 180L Ft.McLeod 15S to Staveley 928S	Langdon SVC Queenstown Generating Plant Output: 90MW
	May 11, 2014 01:51:07

Rotor Angle

Seconds

Rotor Speed

Seconds

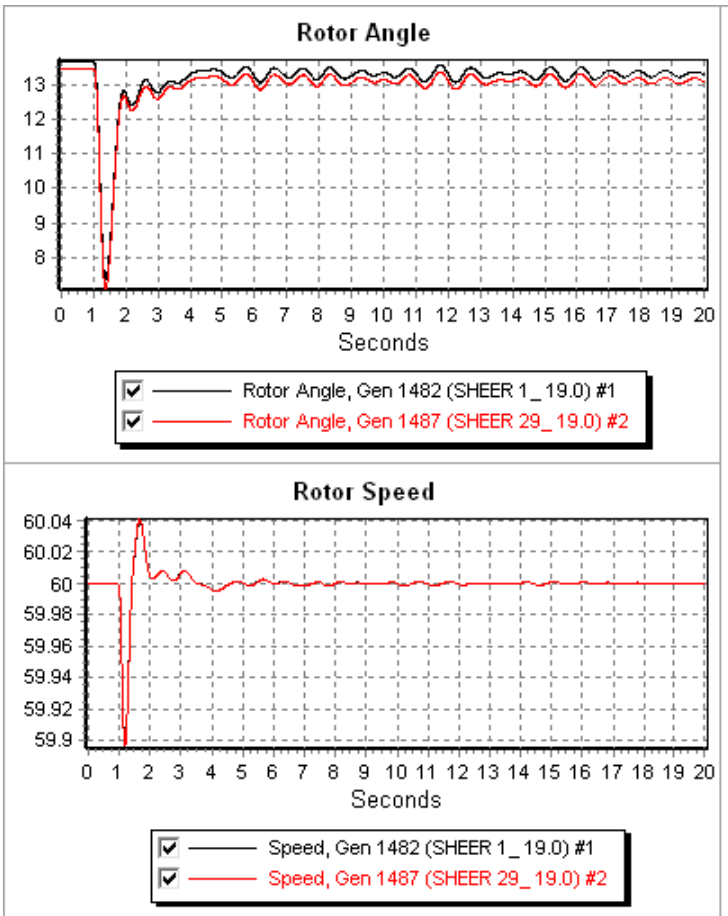
MW Output

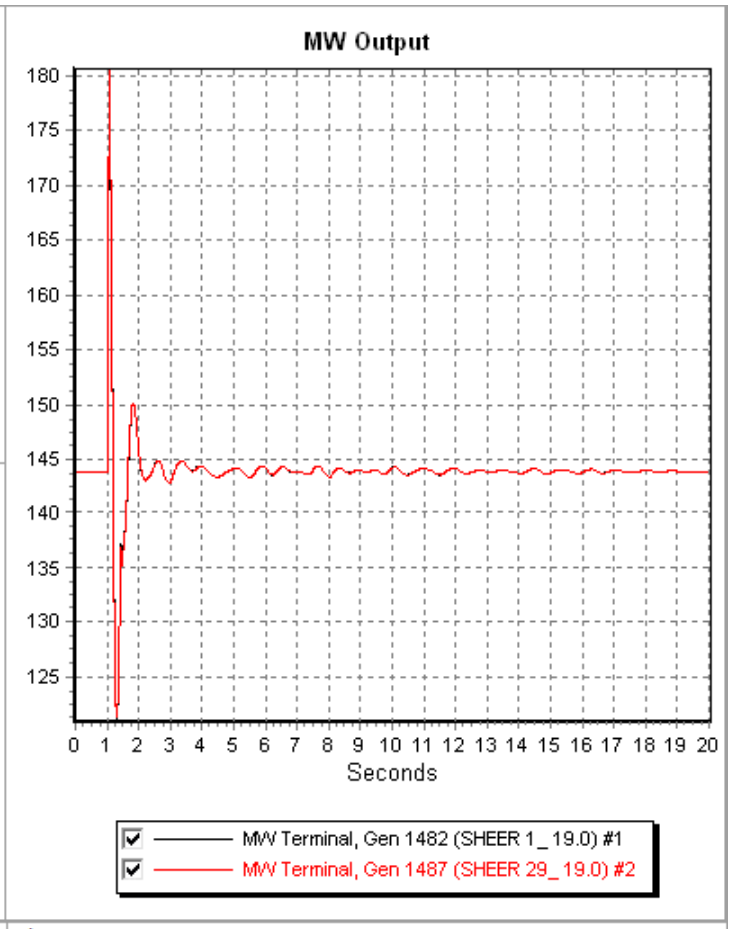
Seconds

Contingency: 180L Ft.McLeod 15S to Staveley 928S

P1336
Queenstown Generating Plant
Output: 90MW

May 11, 2014 01:51:05

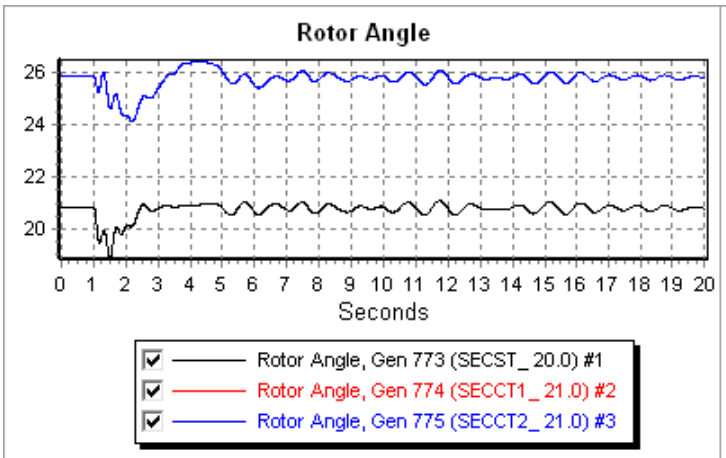


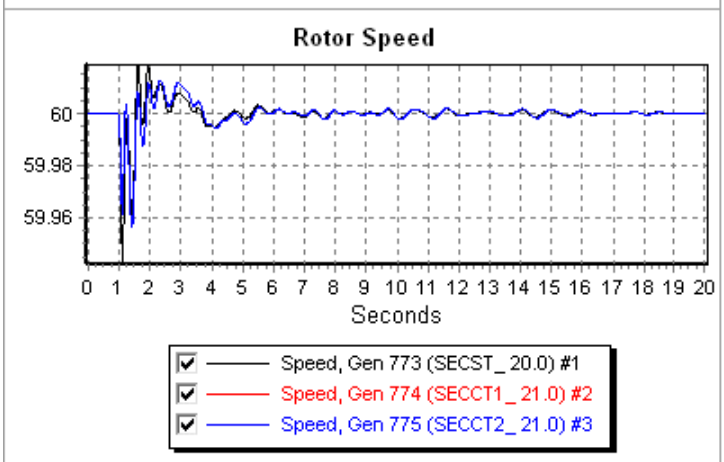


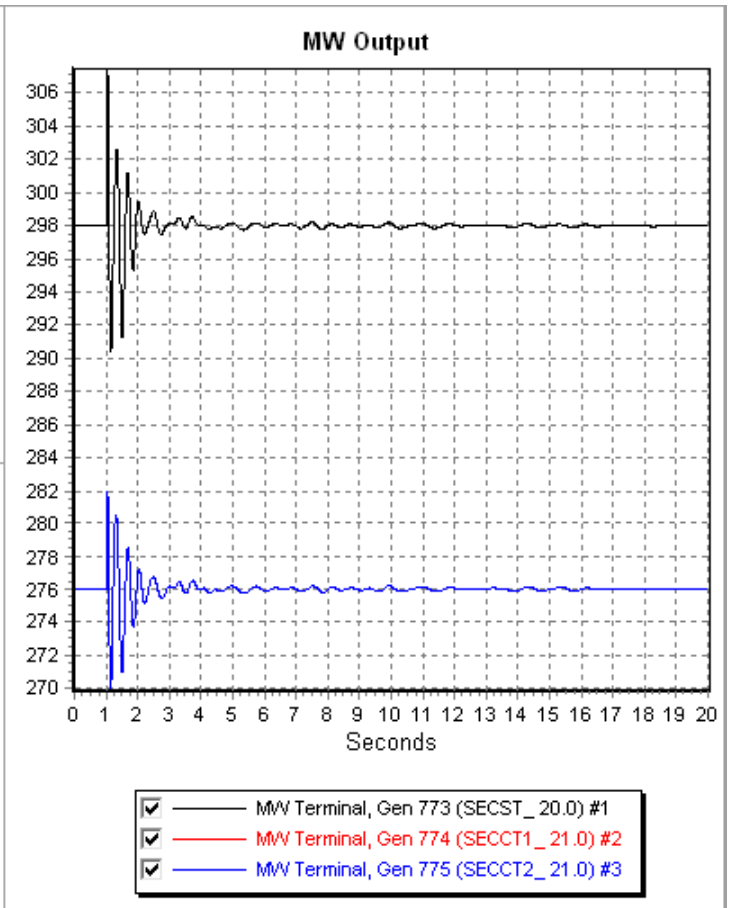
Contingency: 180L Ft.McLeod 15S to Staveley 928S

Sheerness
Queenstown Generating Plant Output: 90MW

May 11, 2014 01:51:03





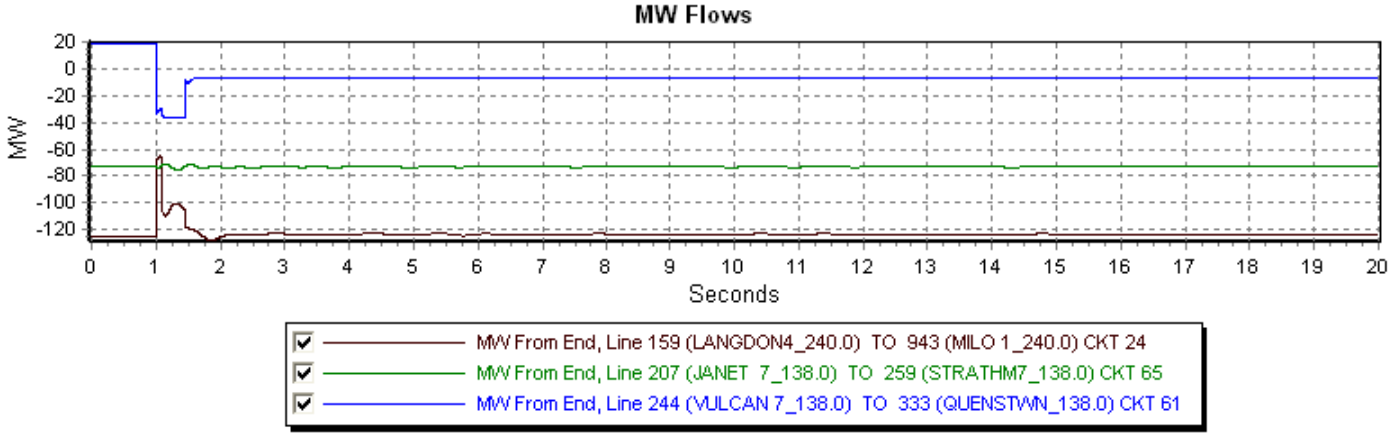


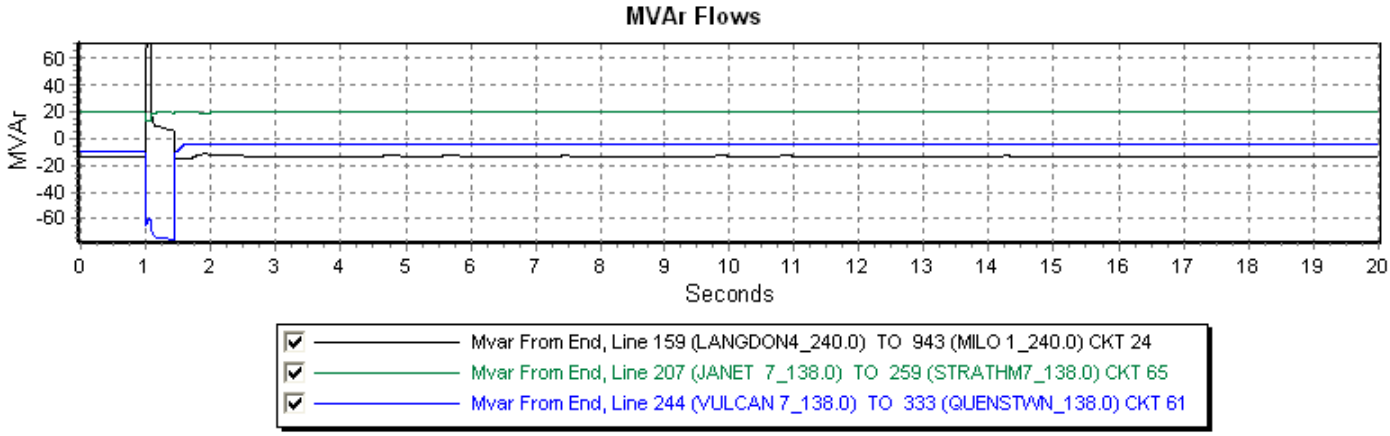
Contingency: 180L Ft.McLeod 15S to Staveley 928S

Sheppard
Queenstown Generating Plant Output: 90MW

May 11, 2014 01:51:04

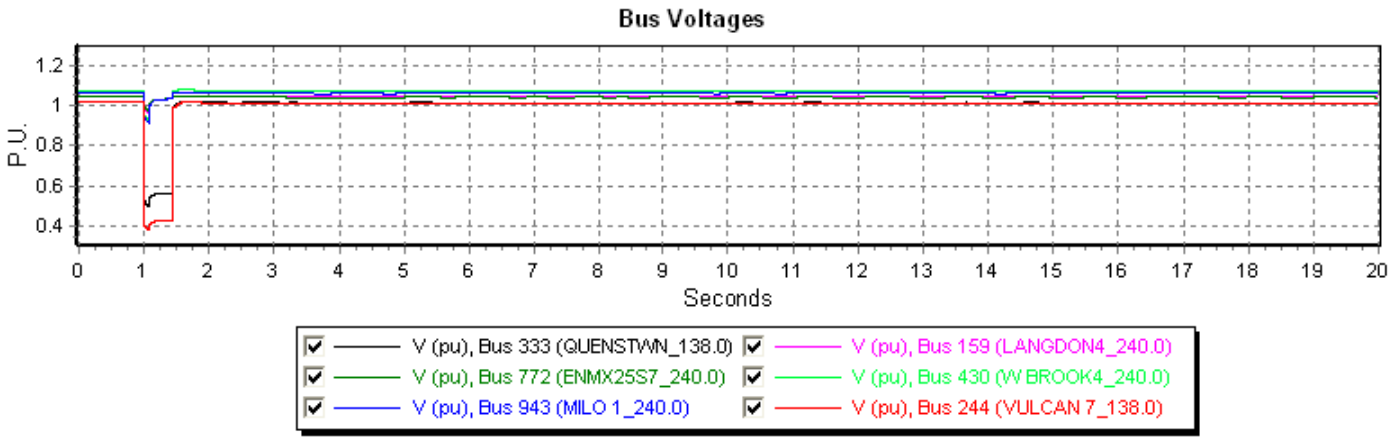
Branch Flows

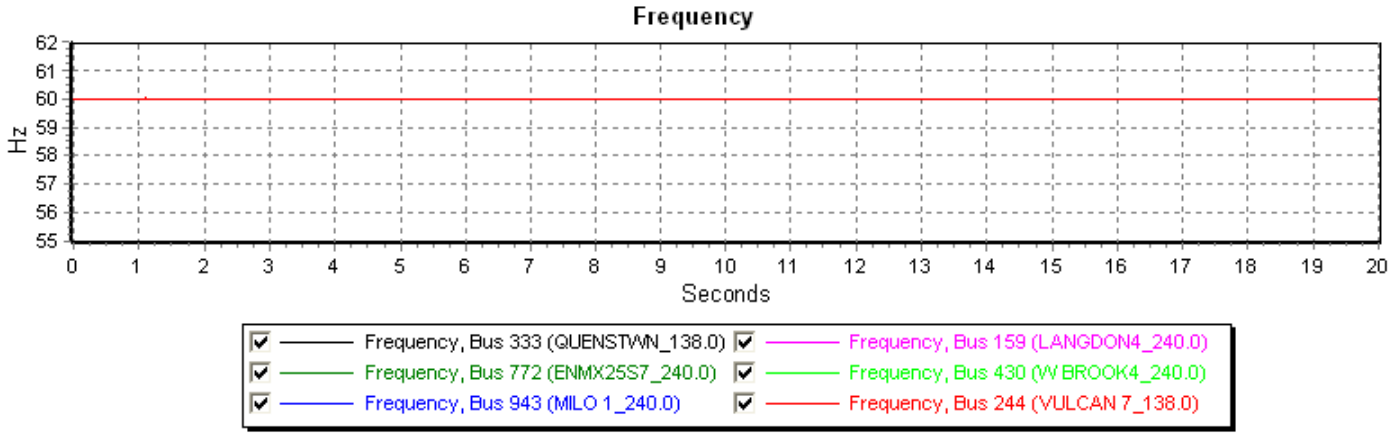




	Contingency: 180L Ft.McLeod 15S to Vulcan 255S	Branch Flows Queenstown Generating Plant Output: 90MW
		September 26, 2014 15:17:00

Bus Voltages and Frequency



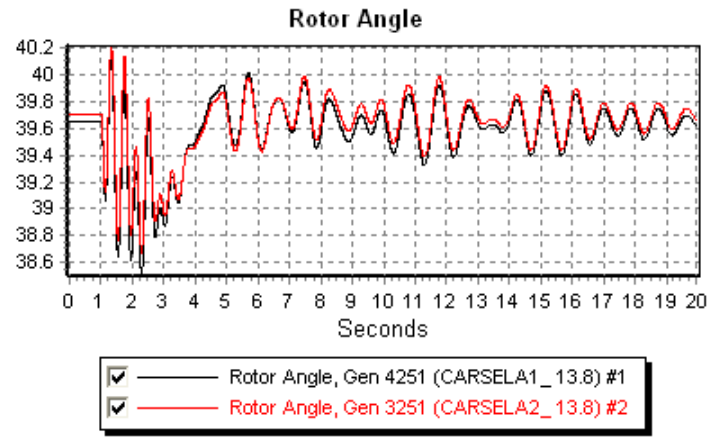


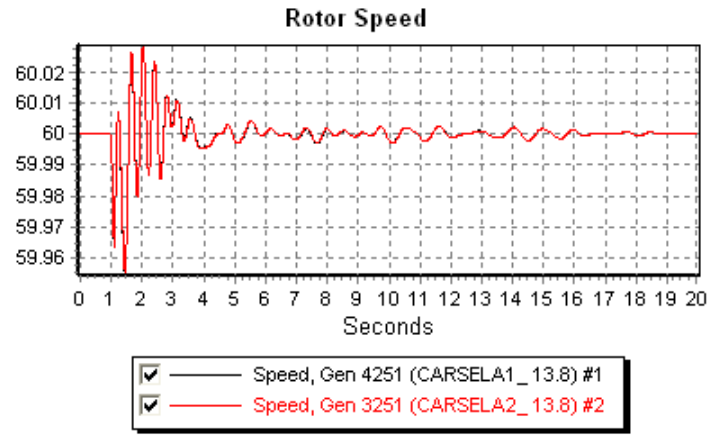
Contingency: 180L Ft.McLeod 15S to Vulcan 255S

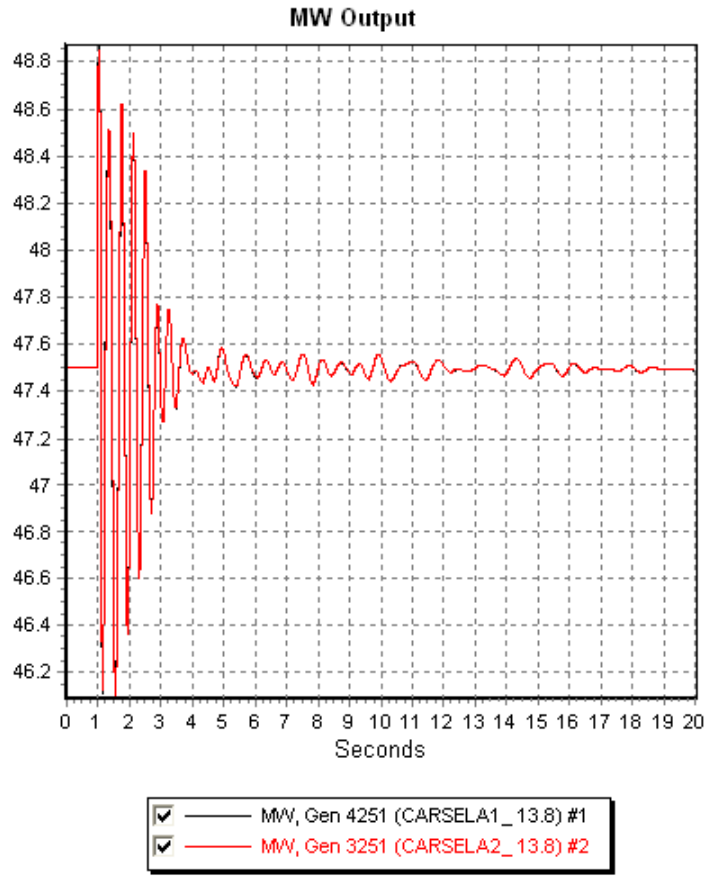
Bus Voltages and Frequency
Queenstown Generating Plant Output: 90MW

September 26, 2014 15:17:01

Carseland





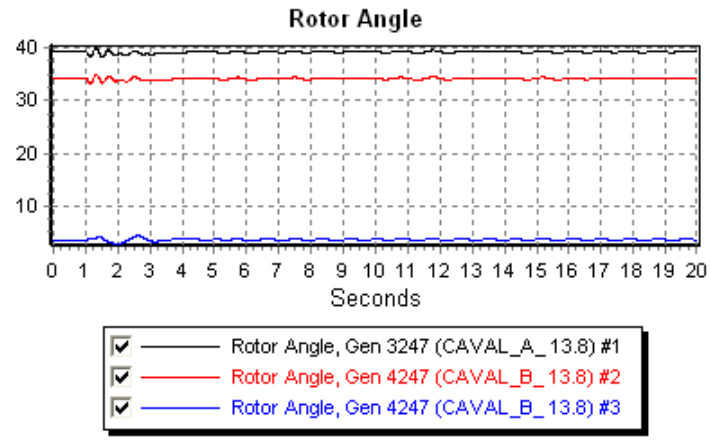


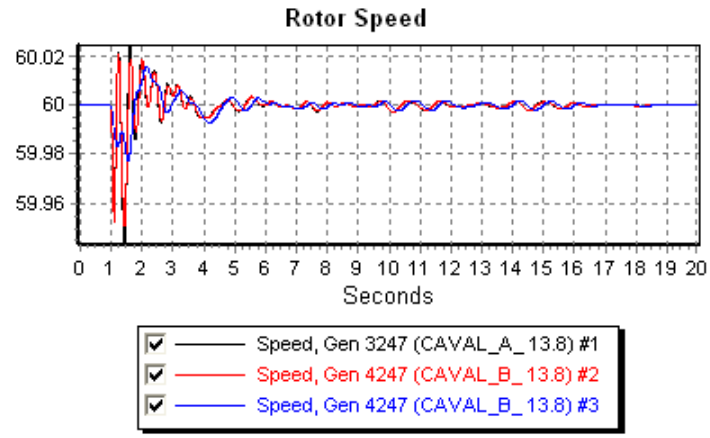
Contingency: 180L Ft.McLeod 15S to Vulcan 255S

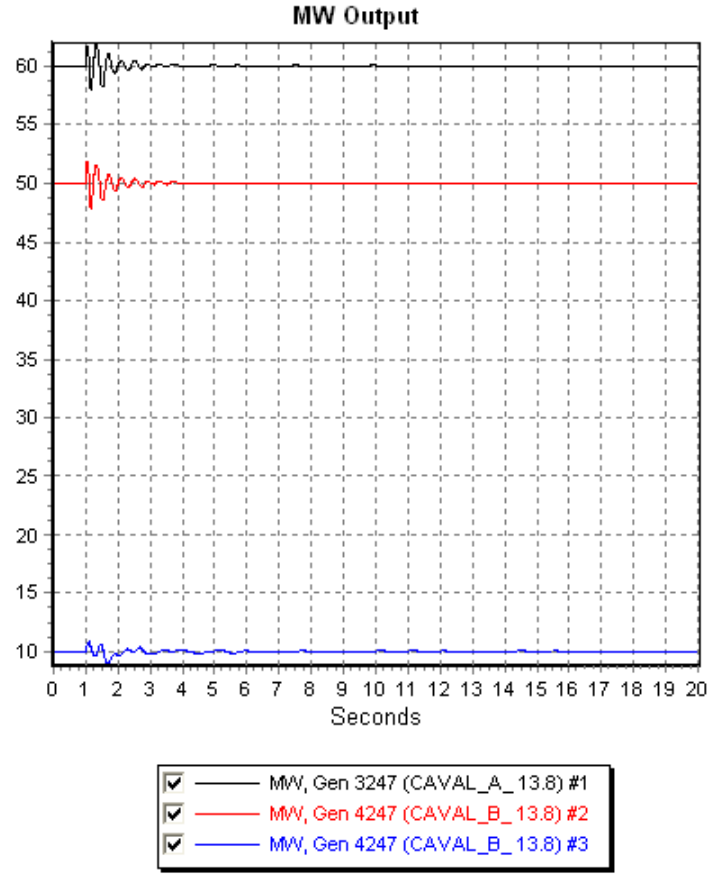
Carseland
Queenstown Generating Plant Output: 90MW

September 26, 2014 15:16:58

Cavalier





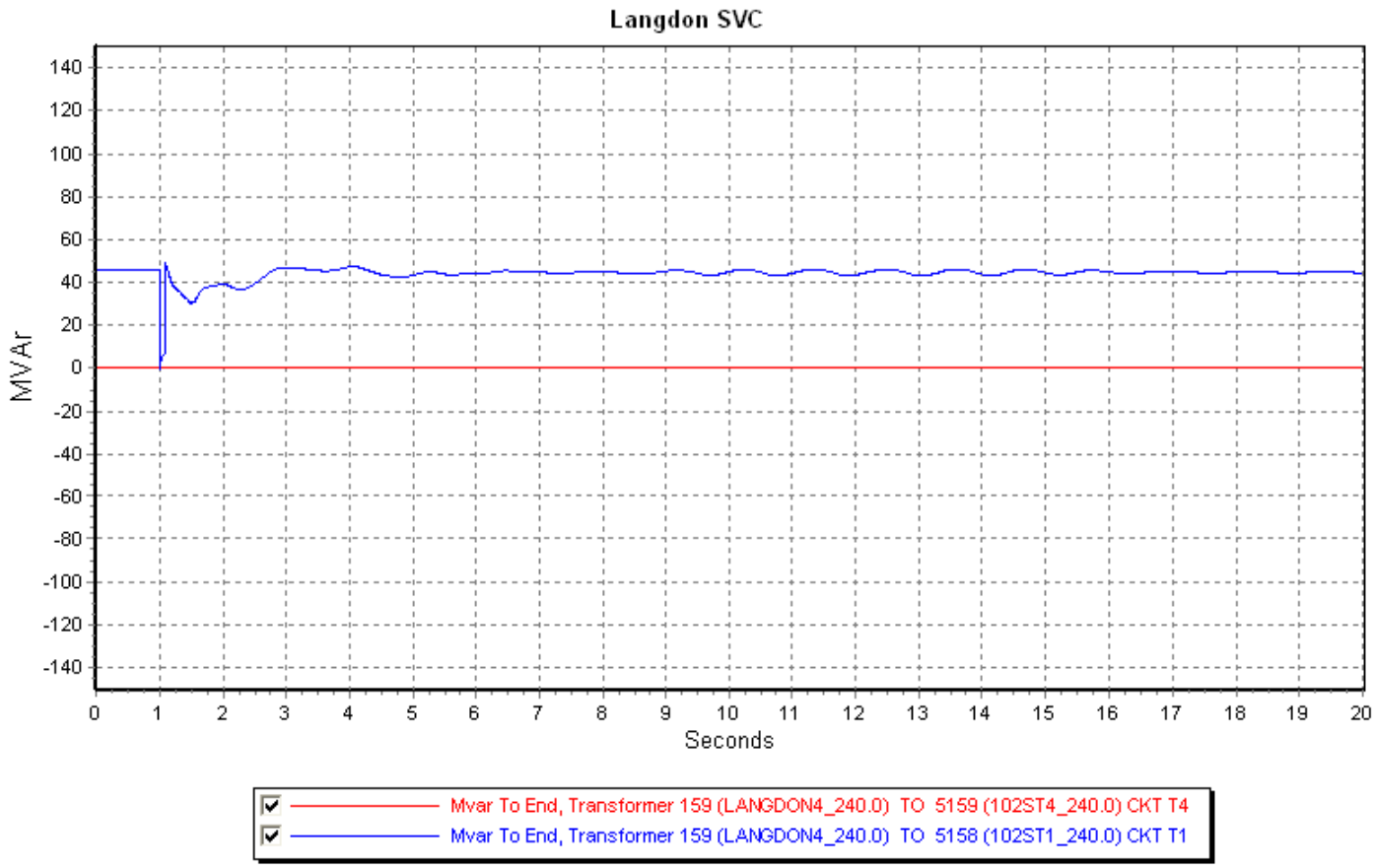


Contingency: 180L Ft.McLeod 15S to Vulcan 255S

Cavalier
Queenstown Generating Plant Output: 90MW

September 26, 2014 15:17:00

Langdon SVC



Contingency: 180L Ft.McLeod 15S to Vulcan 255S

Langdon SVC
Queenstown Generating Plant Output: 90MW

September 26, 2014 15:17:02

Queenstown Gen

Rotor Angle

Seconds

MW Output

Seconds

Rotor Speed

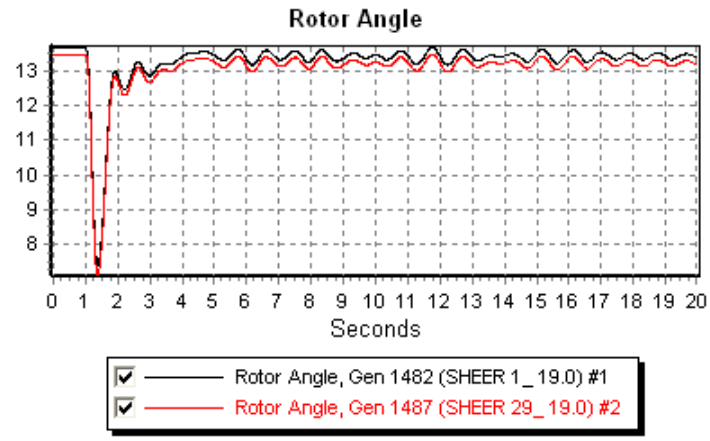
Seconds

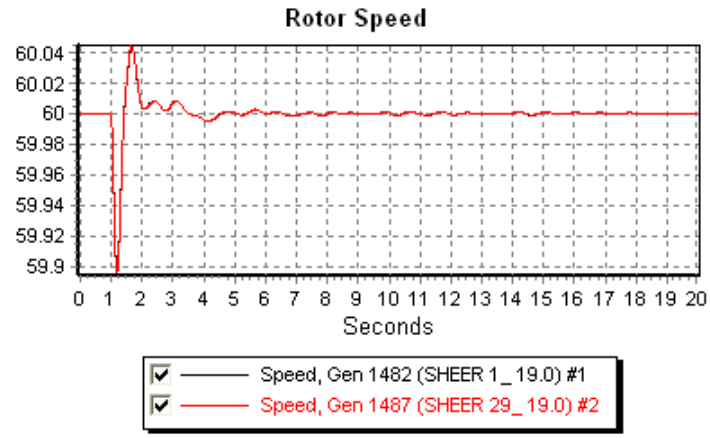
Contingency: 180L Ft.McLeod 15S to Vulcan 255S

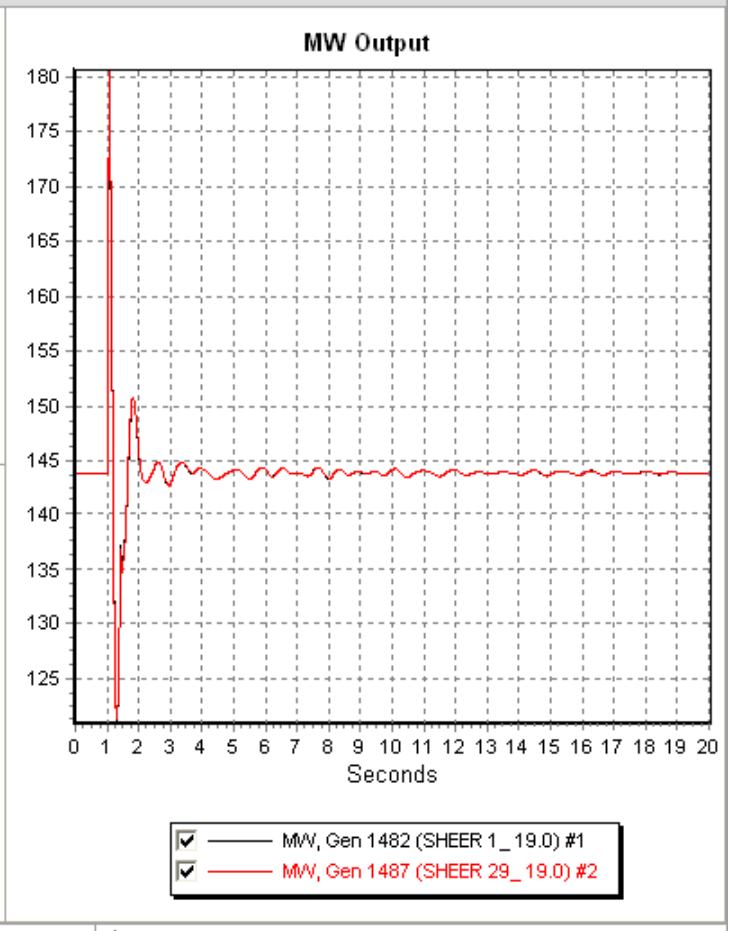
P1336
Queenstown Generating Plant
Output: 90MW

September 26, 2014 15:16:59

Sheerness





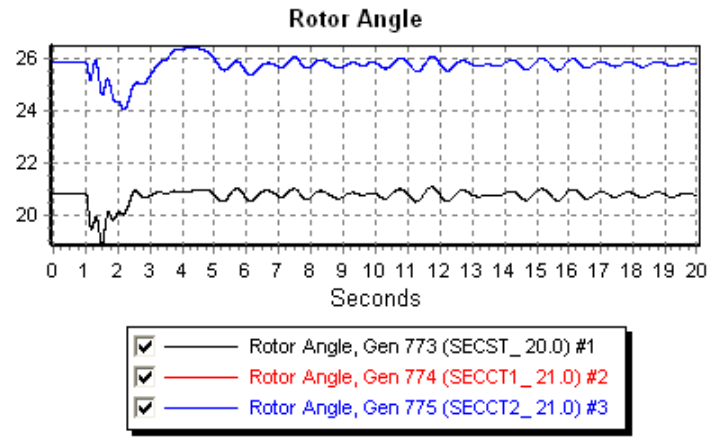


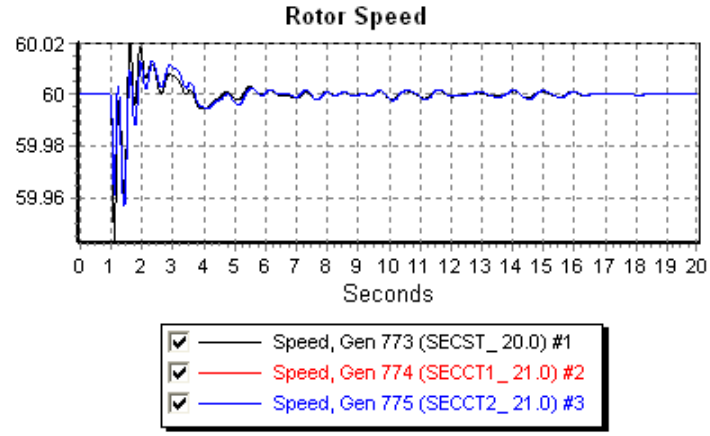
Contingency: 180L Ft.McLeod 15S to Vulcan 255S

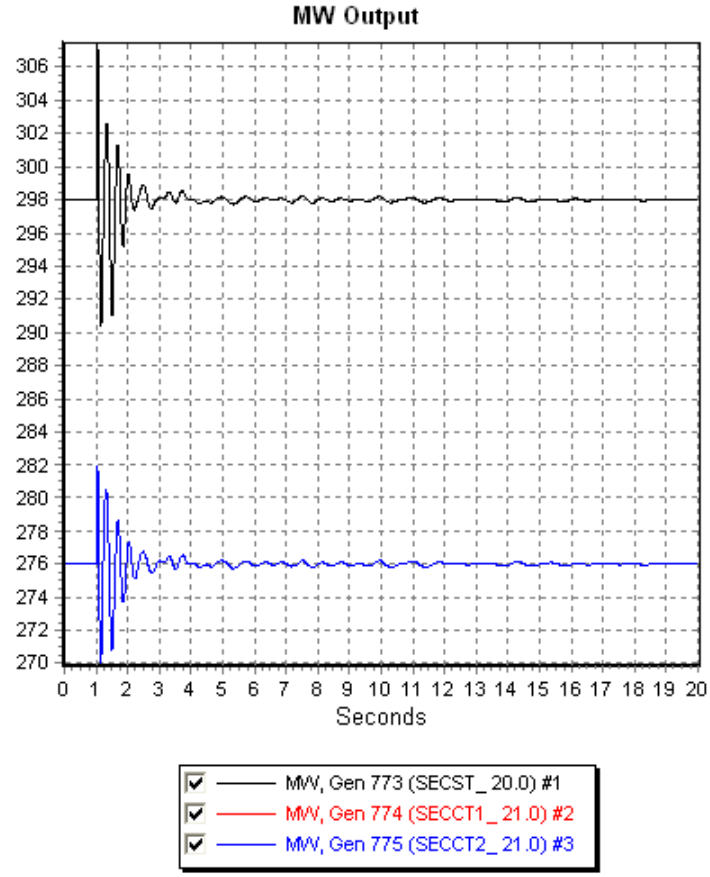
Sheerness
Queenstown Generating Plant Output: 90MW

September 26, 2014 15:16:57

Sheppard





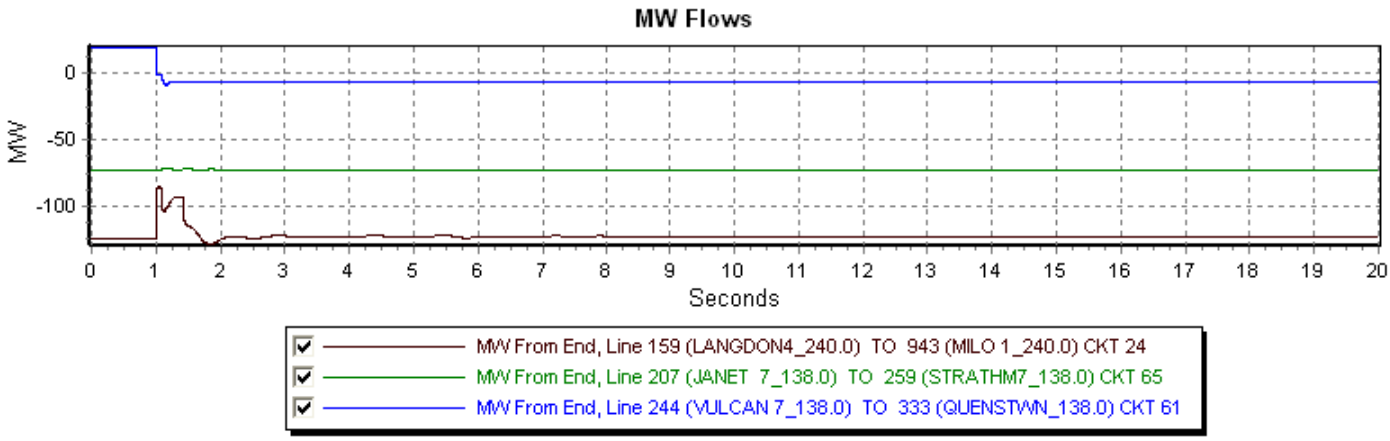


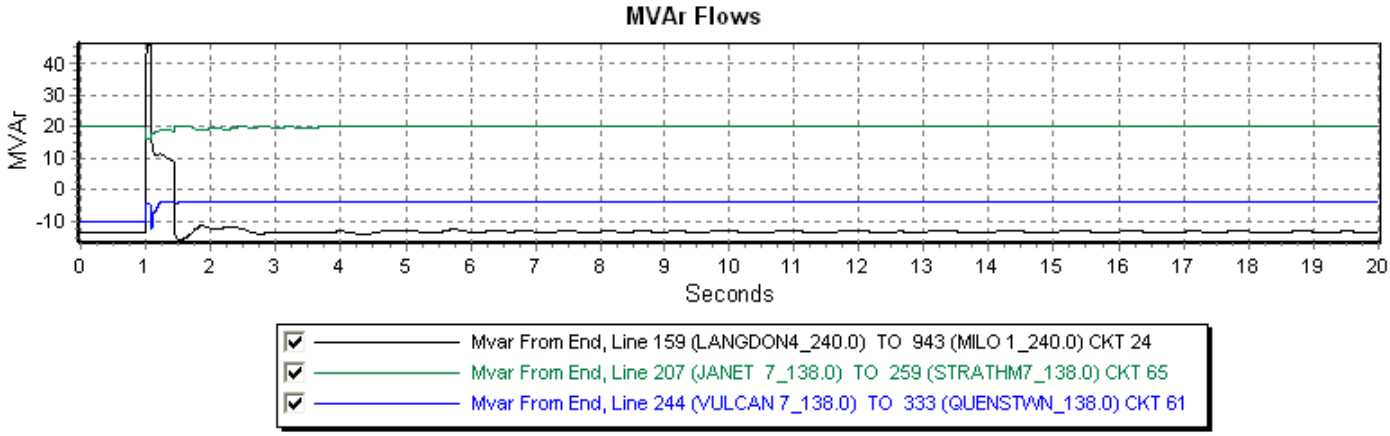
Contingency: 180L Ft.McLeod 15S to Vulcan 255S

Sheppard
Queenstown Generating Plant Output: 90MW

September 26, 2014 15:16:59

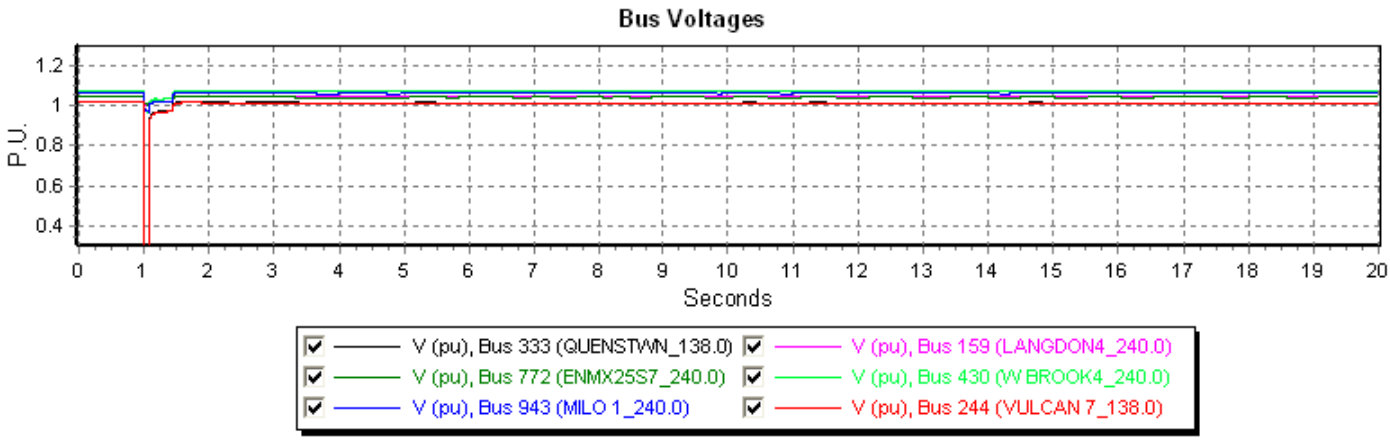
Branch Flows

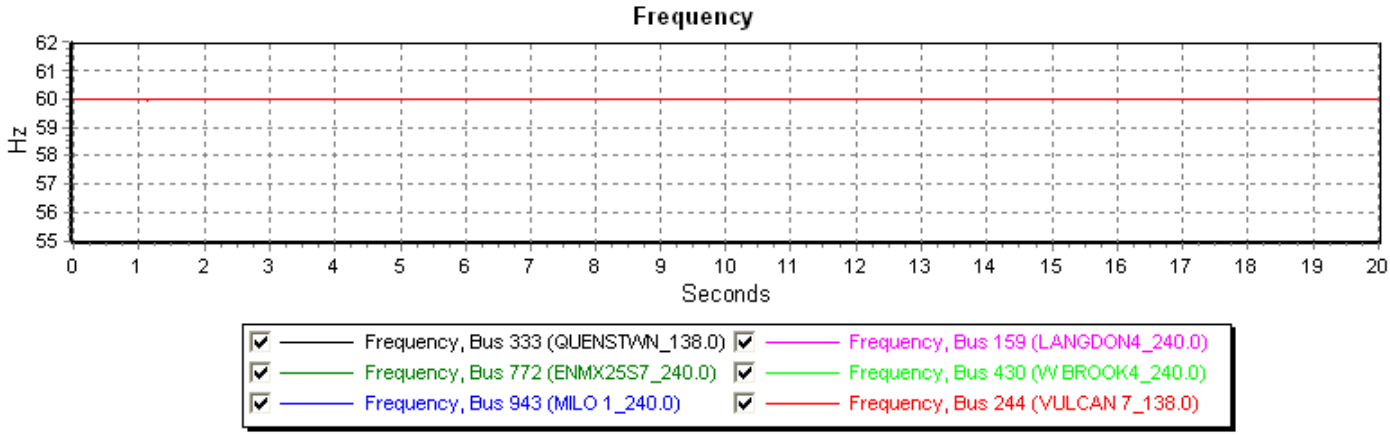




	Contingency: 180L Vulcan 255S to Ft.McLeod 15S	Branch Flows Queenstown Generating Plant Output: 90MW September 26, 2014 15:15:01

Bus Voltages and Frequency



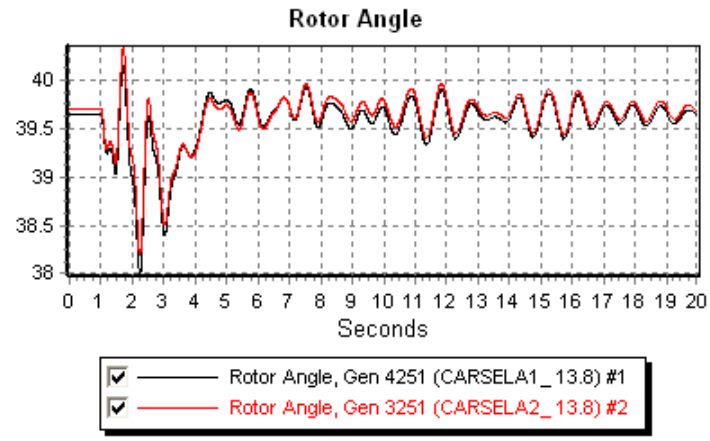


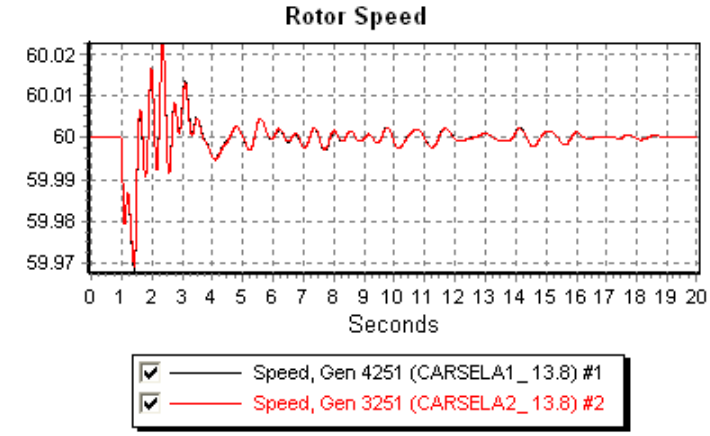
Contingency: 180L Vulcan 255S to Ft.McLeod 15S

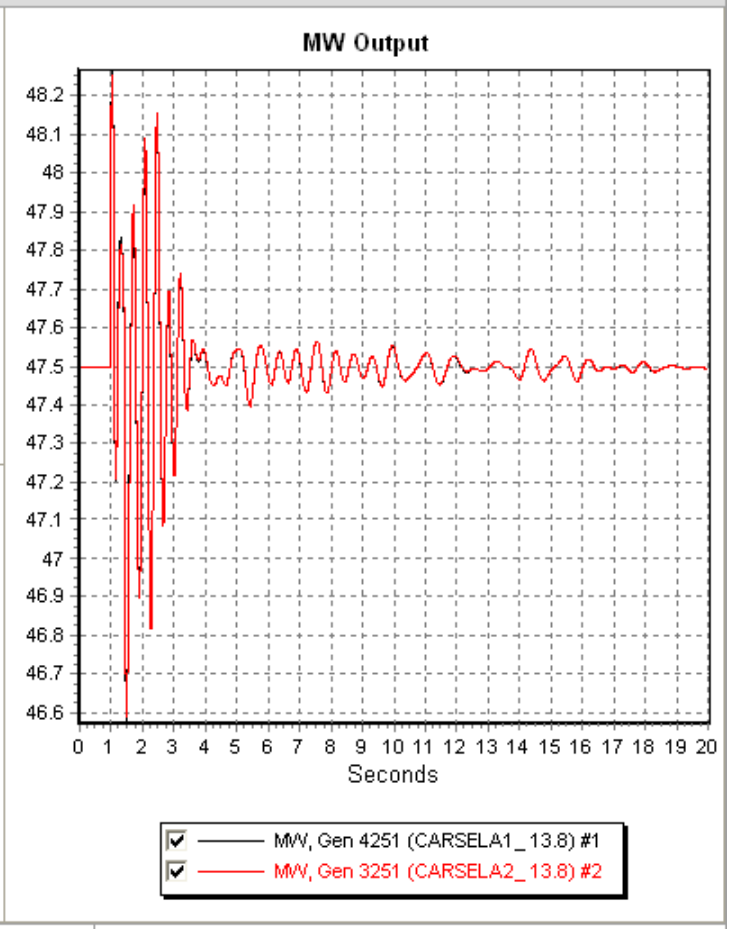
Bus Voltages and Frequency
Queenstown Generating Plant Output: 90MW

September 26, 2014 15:15:02

Carseland





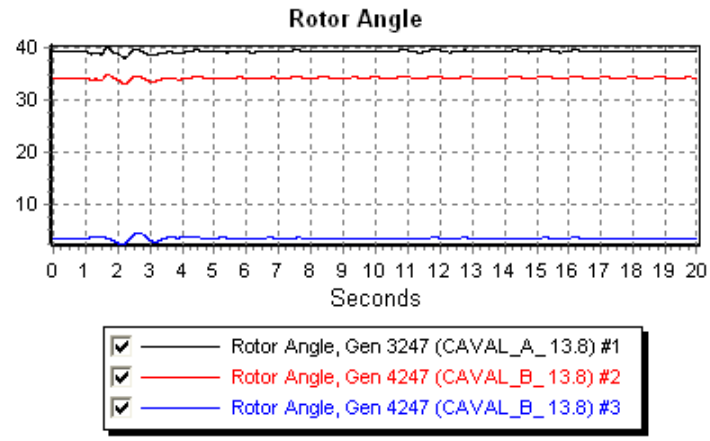


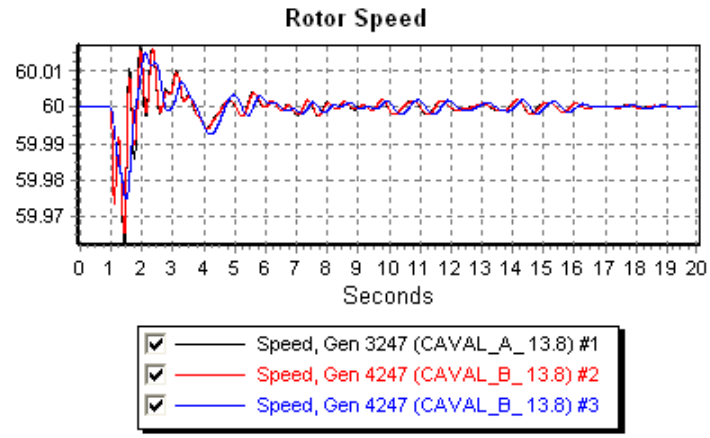
Contingency: 180L Vulcan 255S to Ft.McLeod 15S

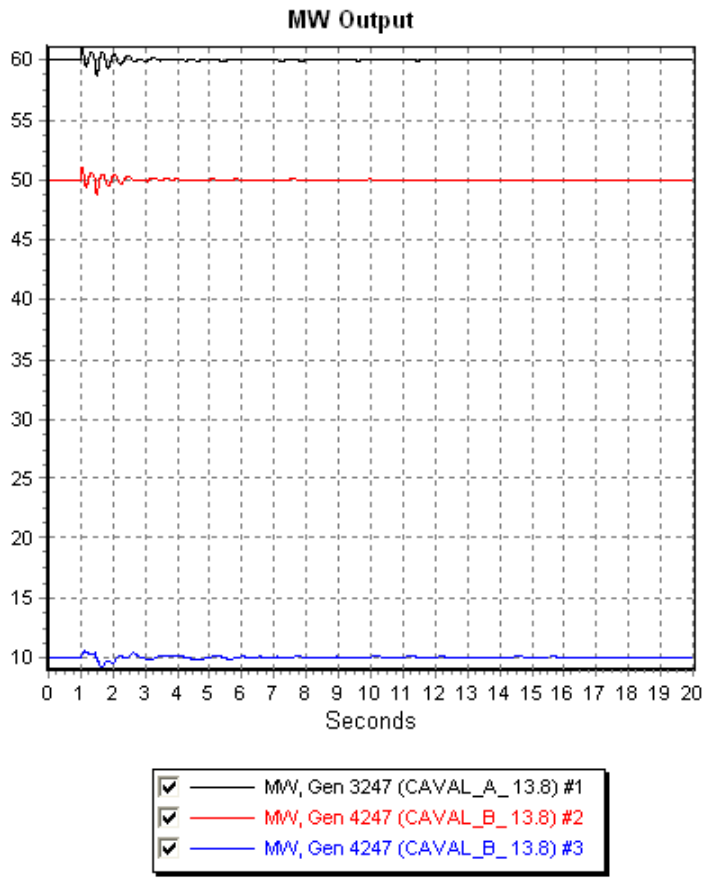
Carseland
Queenstown Generating Plant Output: 90MW

September 26, 2014 15:14:59

Cavalier





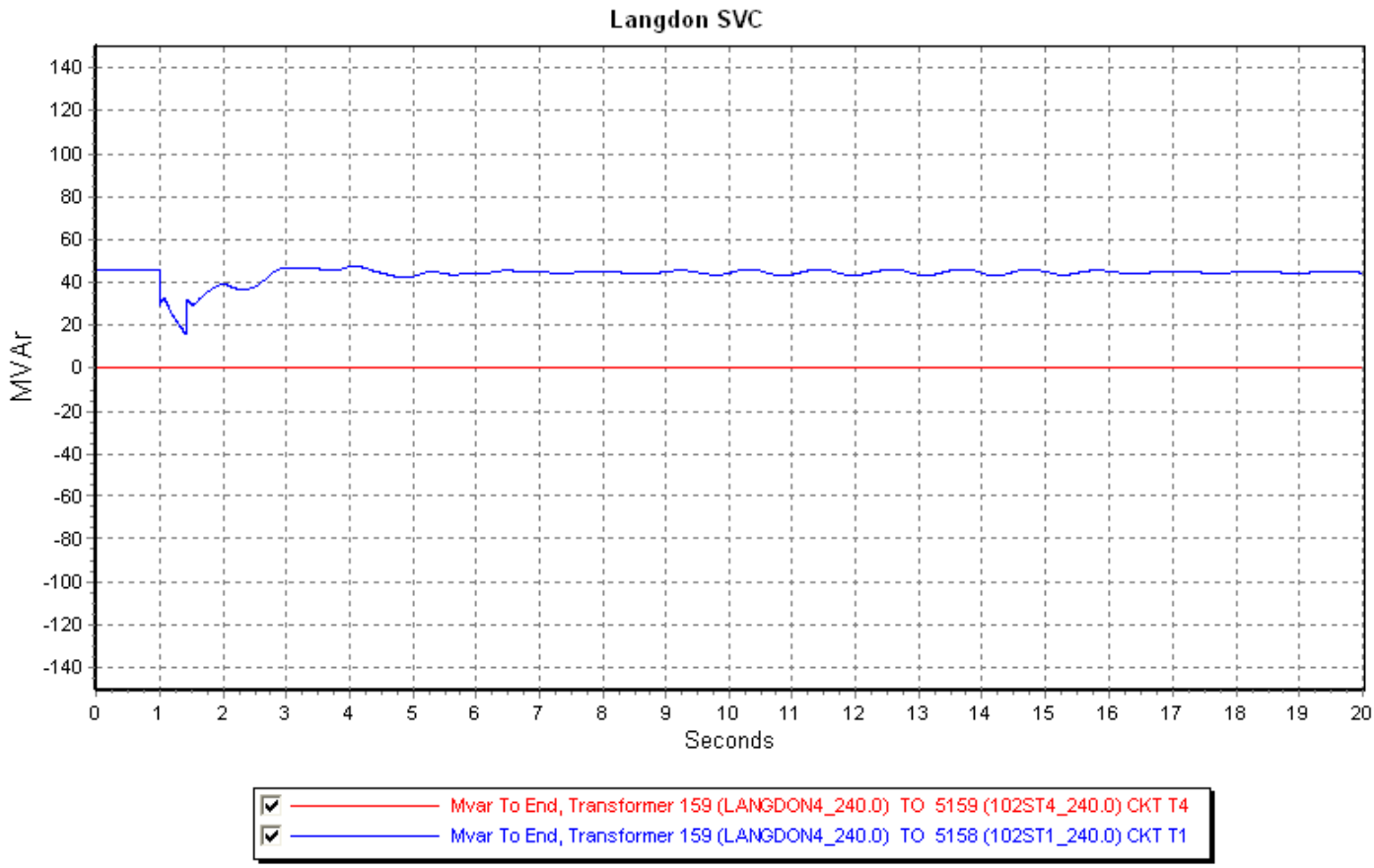


Contingency: 180L Vulcan 255S to Ft.McLeod 15S

Cavalier
Queenstown Generating Plant Output: 90MW

September 26, 2014 15:15:00

Langdon SVC



Contingency: 180L Vulcan 255S to Ft.McLeod 15S

Langdon SVC
Queenstown Generating Plant Output: 90MW

September 26, 2014 15:15:02

Queenstown Gen

Rotor Angle

Seconds

MW Output

Seconds

Rotor Speed

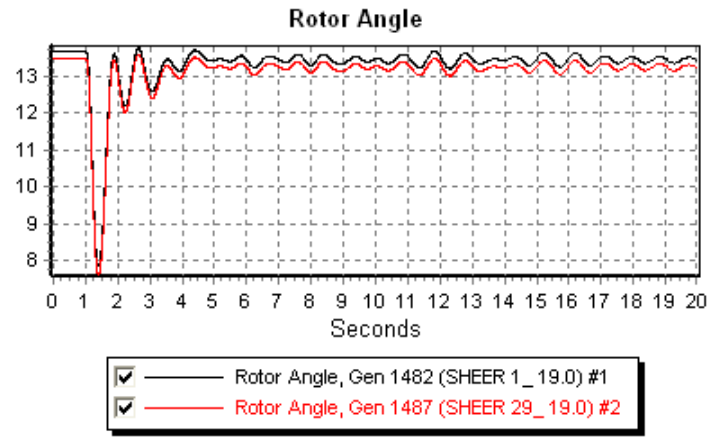
Seconds

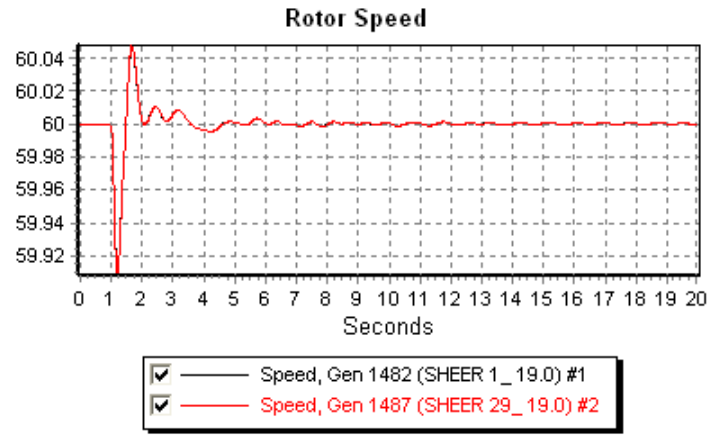
Contingency: 180L Vulcan 255S to Ft.McLeod 15S

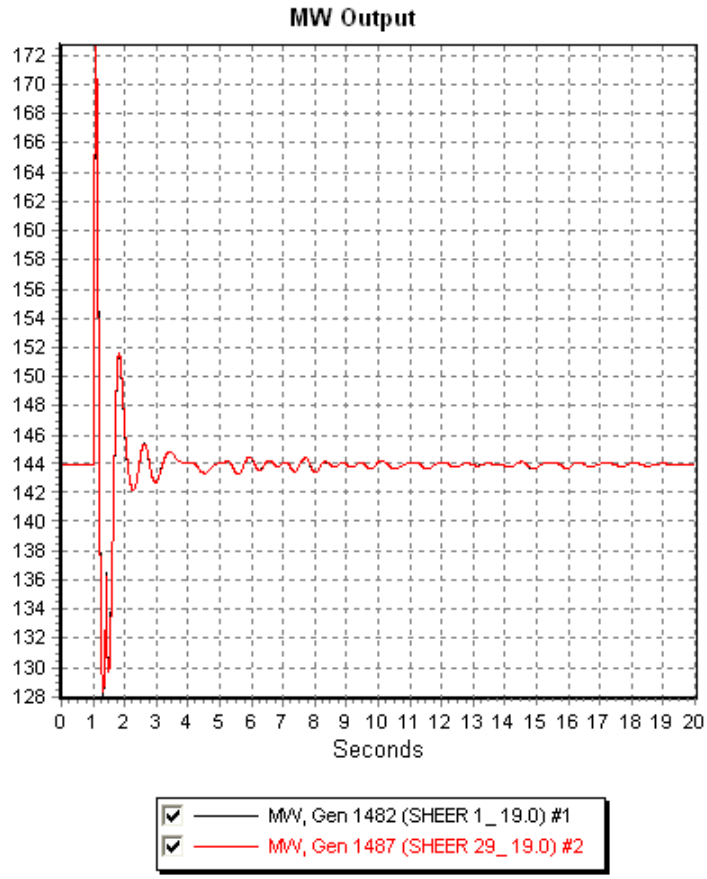
P1336
Queenstown Generating Plant
Output: 90MW

September 26, 2014 15:15:00

Sheerness





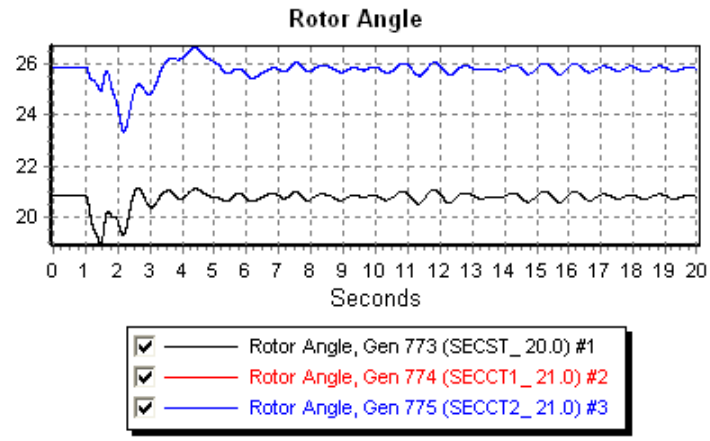


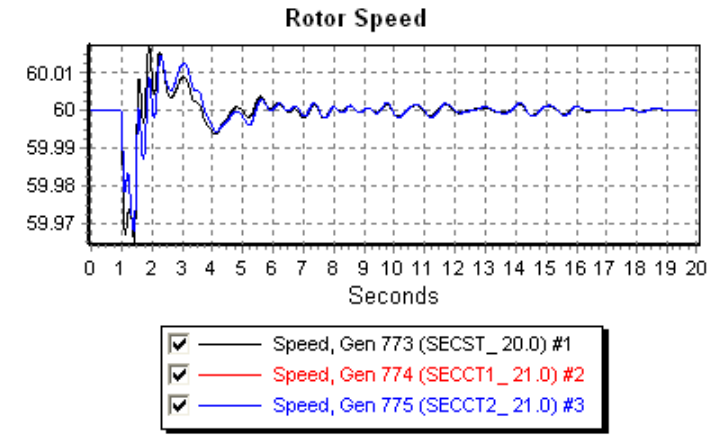
Contingency: 180L Vulcan 255S to Ft.McLeod 15S

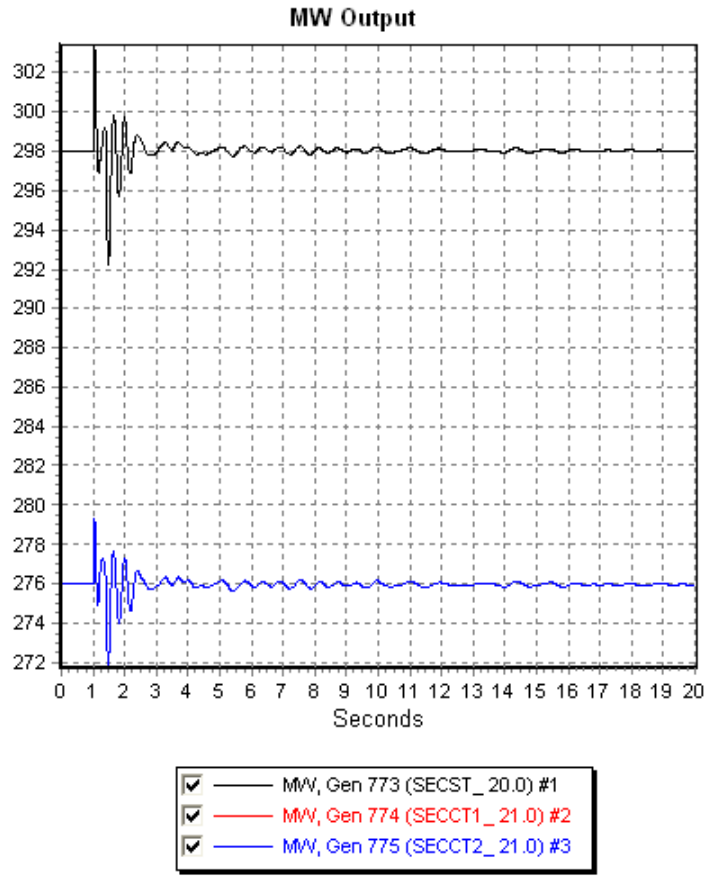
Sheerness
Queenstown Generating Plant Output: 90MW

September 26, 2014 15:14:58

Sheppard







Contingency: 180L Vulcan 255S to Ft.McLeod 15S

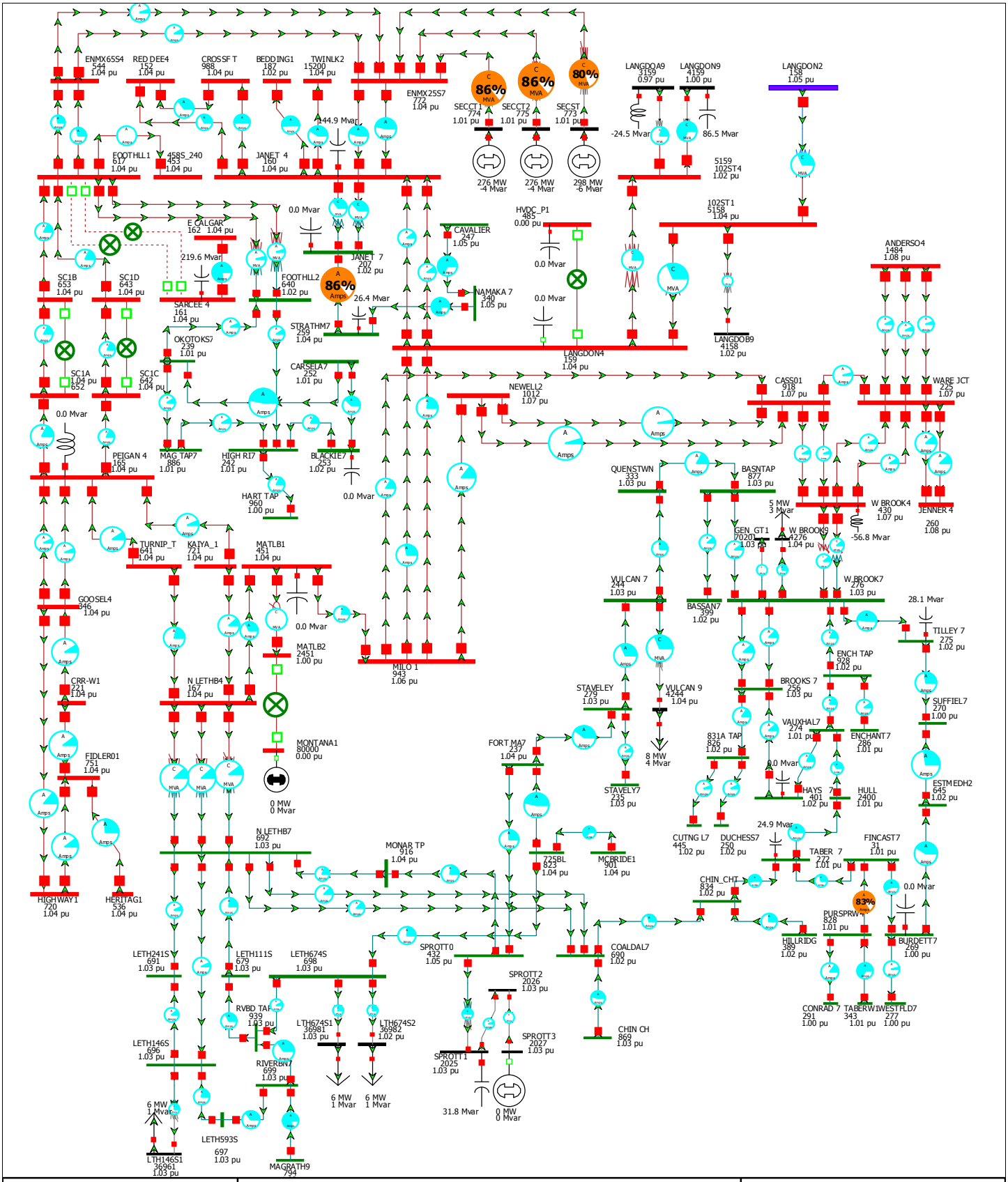
Sheppard
Queenstown Generating Plant Output: 90MW

September 26, 2014 15:14:59

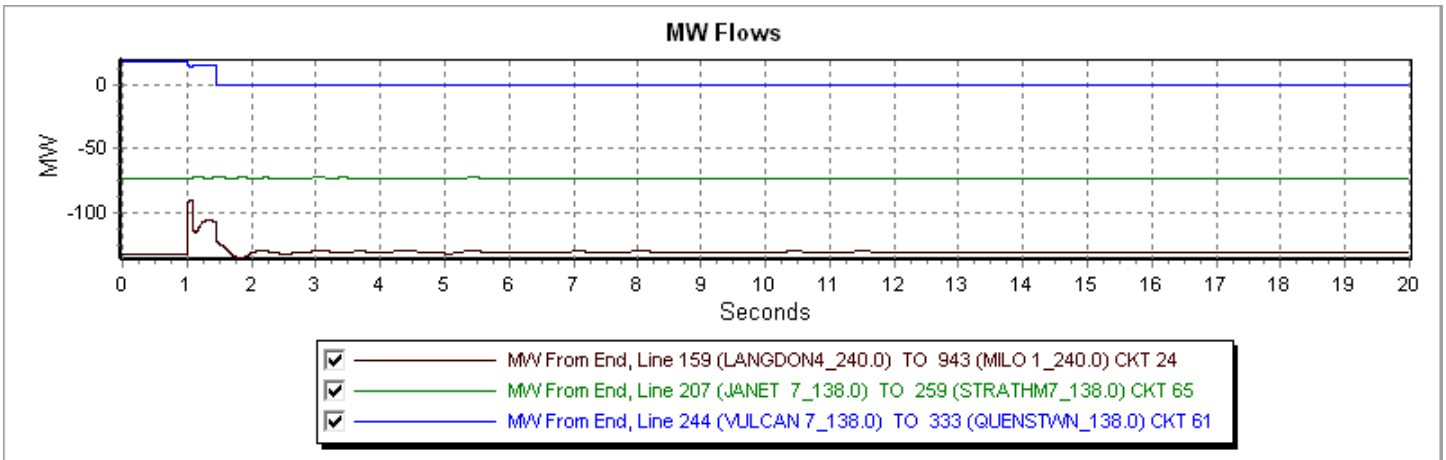
Attachment E

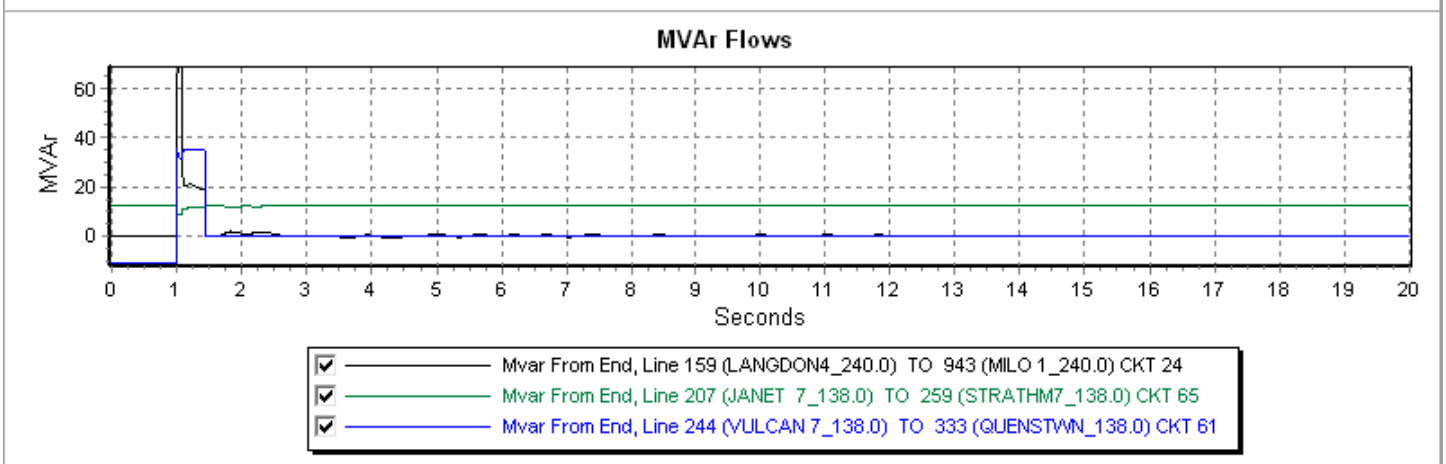
Pre-Connection Transient Stability Analysis Results

2017SL Study Cases

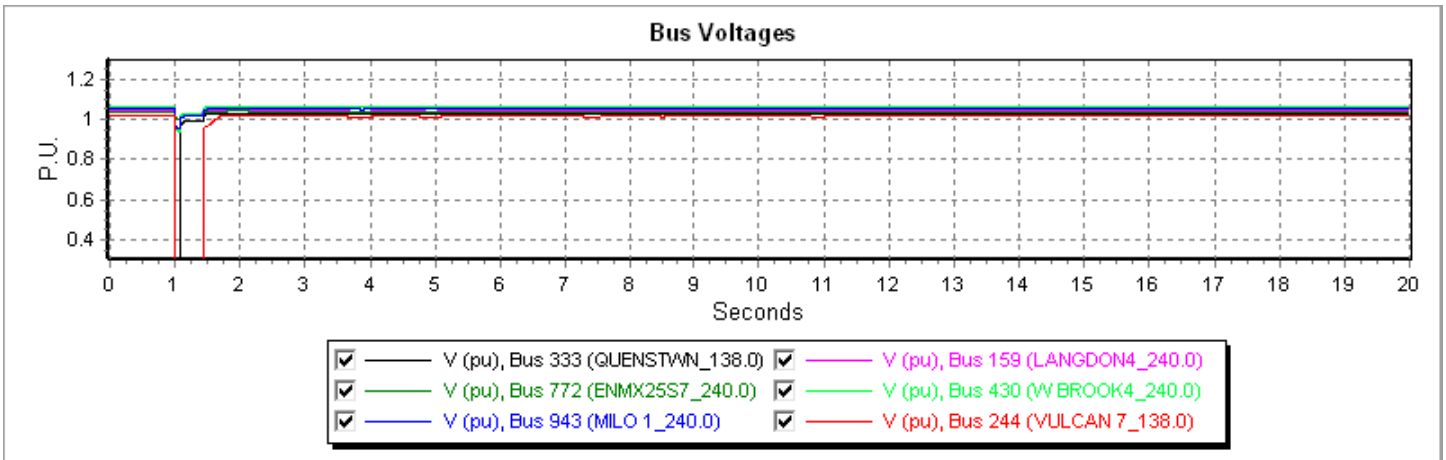


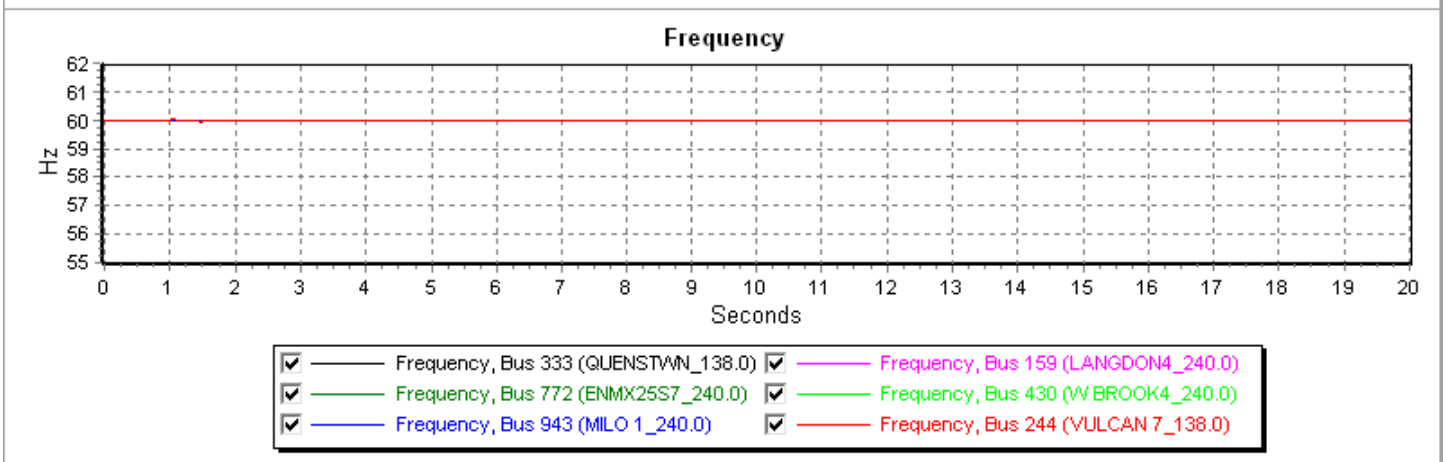
PowerEN Corporation D.Brankovich	Pre-connection system state Initial conditions for transient stability simulation Study case: 2017SL	System Initial Conditions TS0-02 3/29/2014



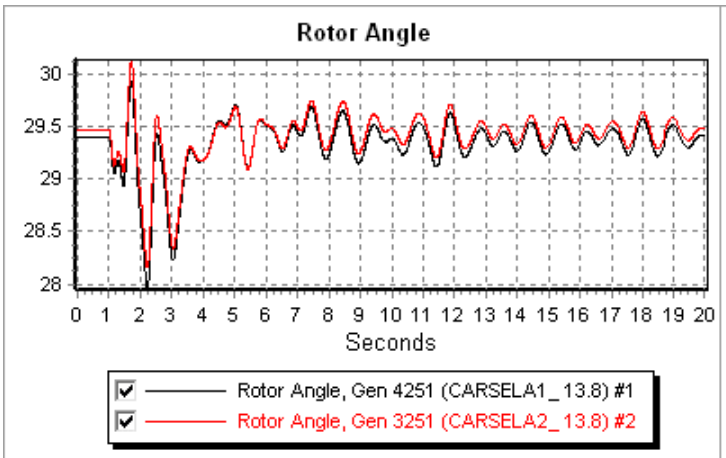


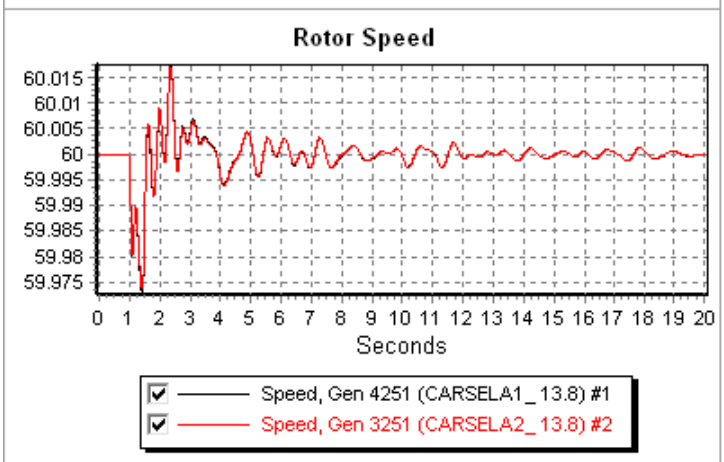
Contingency: 161L QUEENSTOWN 504S - VULCAN 255S	Branch Flows Queenstown Generating Plant Output: 90MW
	May 11, 2014 00:06:41

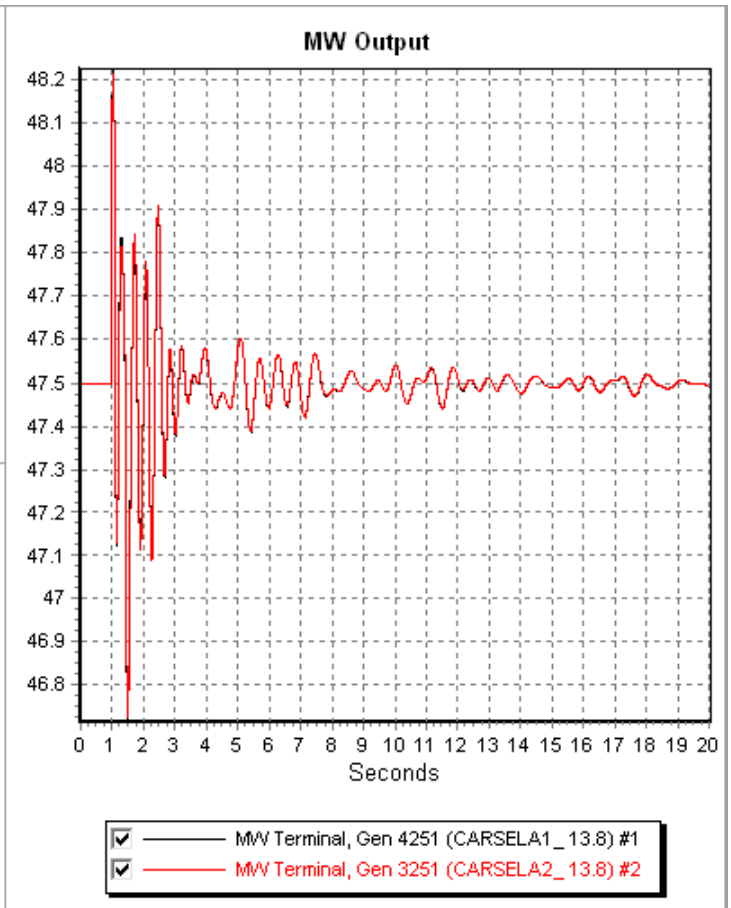




Contingency: 161L QUEENSTOWN 504S - VULCAN 255S	Bus Voltages and Frequency Queenstown Generating Plant Output: 90MW
	May 11, 2014 00:06:42



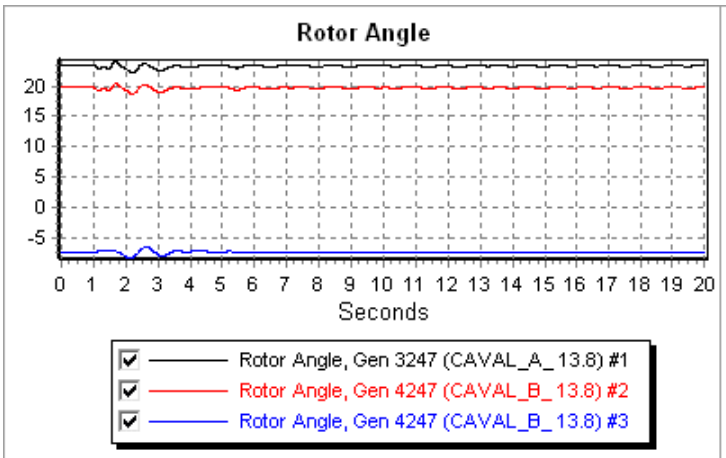


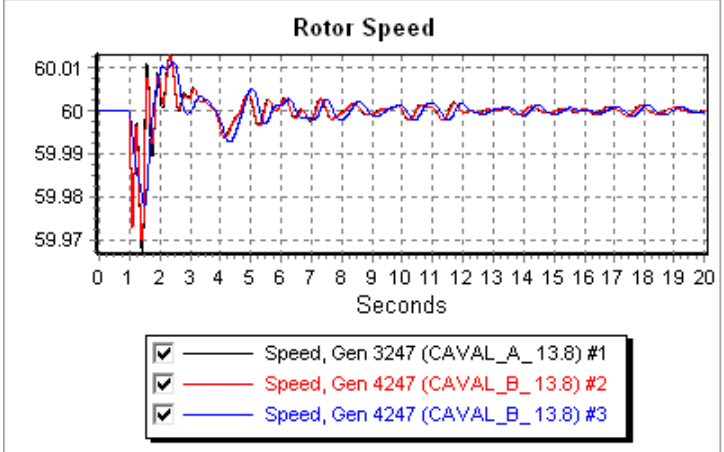


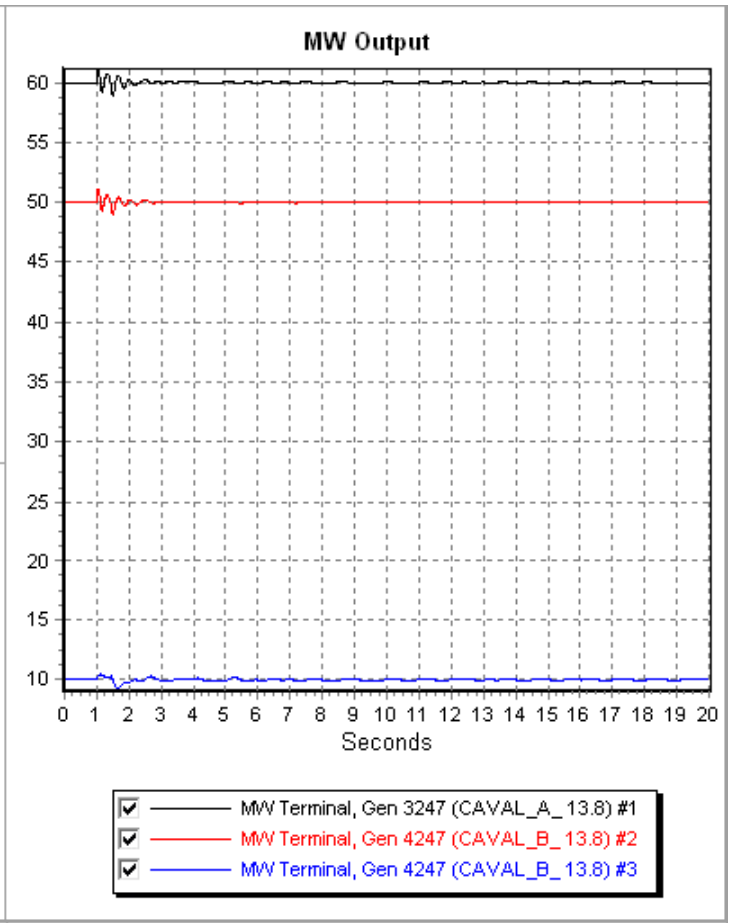
Contingency: 161L QUEENSTOWN 504S - VULCAN 255S

Carseland
Queenstown Generating Plant Output: 90MW

May 11, 2014 00:06:39



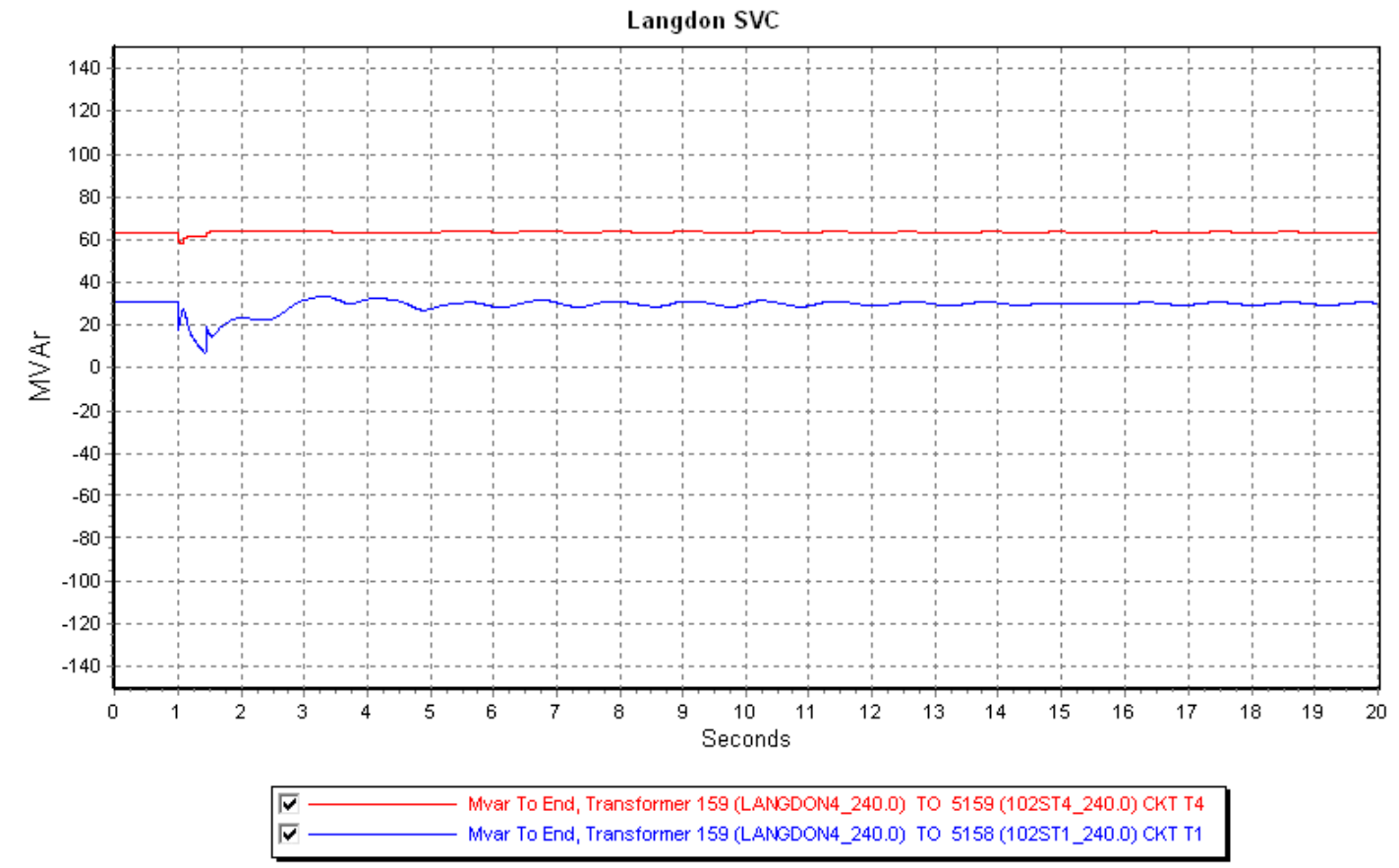




Contingency: 161L QUEENSTOWN 504S - VULCAN 255S

Cavalier
Queenstown Generating Plant Output: 90MW

May 11, 2014 00:06:41



Contingency: 161L QUEENSTOWN 504S - VULCAN 255S	Langdon SVC Queenstown Generating Plant Output: 90MW
	May 11, 2014 00:06:42

Rotor Angle

Seconds

Rotor Speed

Seconds

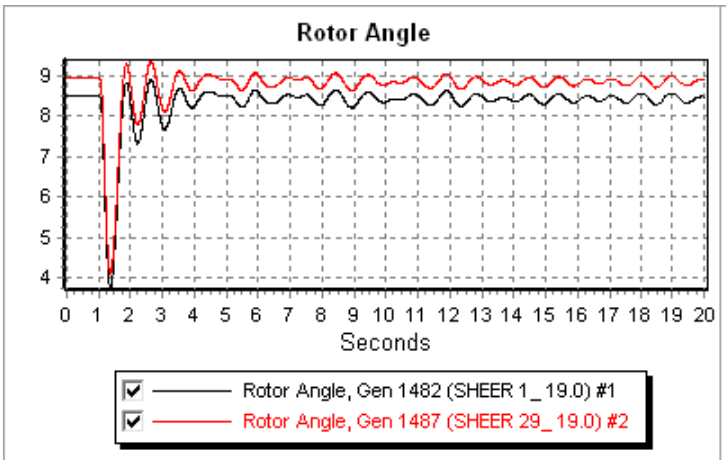
MW Output

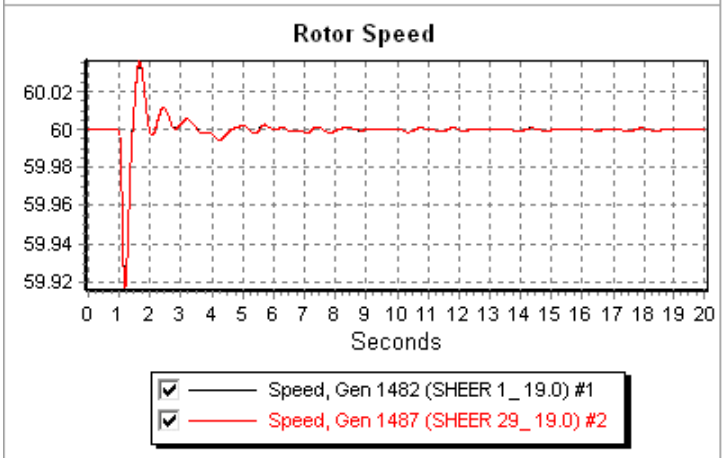
Seconds

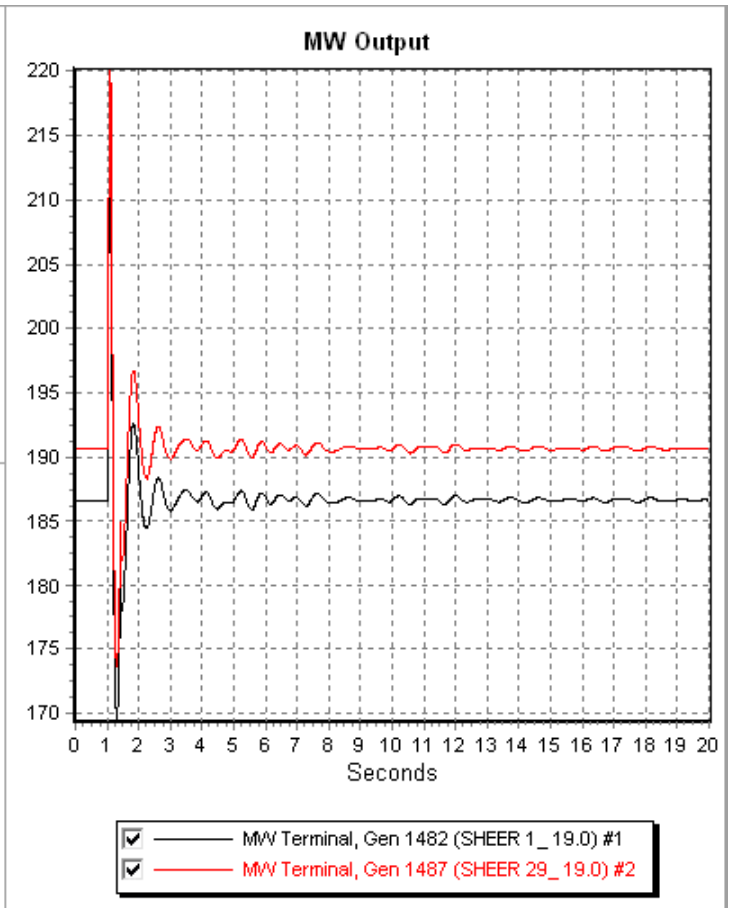
Contingency: 161L QUEENSTOWN 504S - VULCAN 255S

P1336
Queenstown Generating Plant
Output: 90MW

May 11, 2014 00:06:40



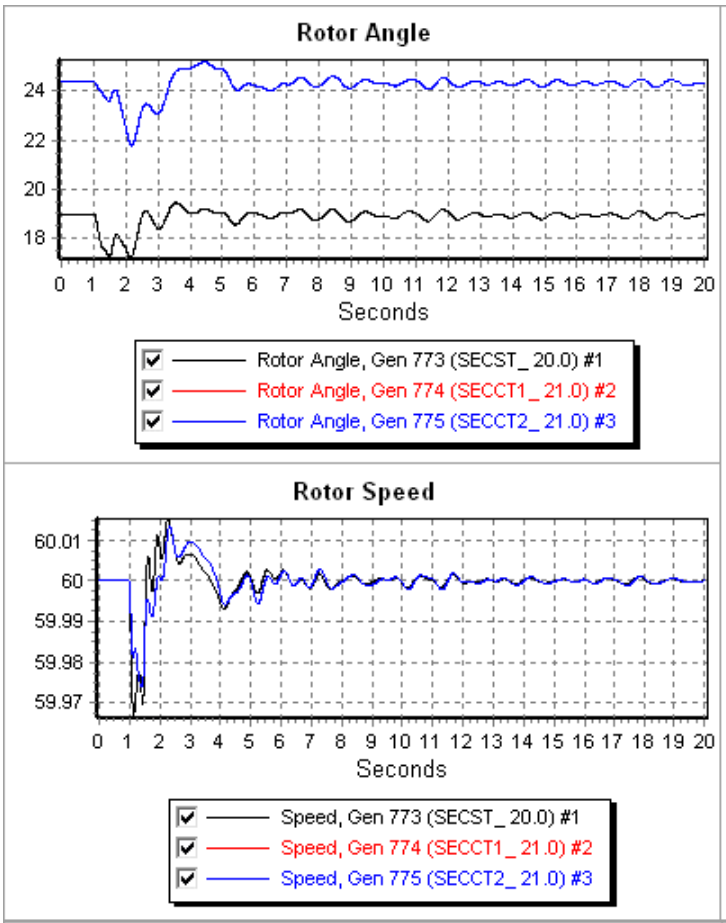


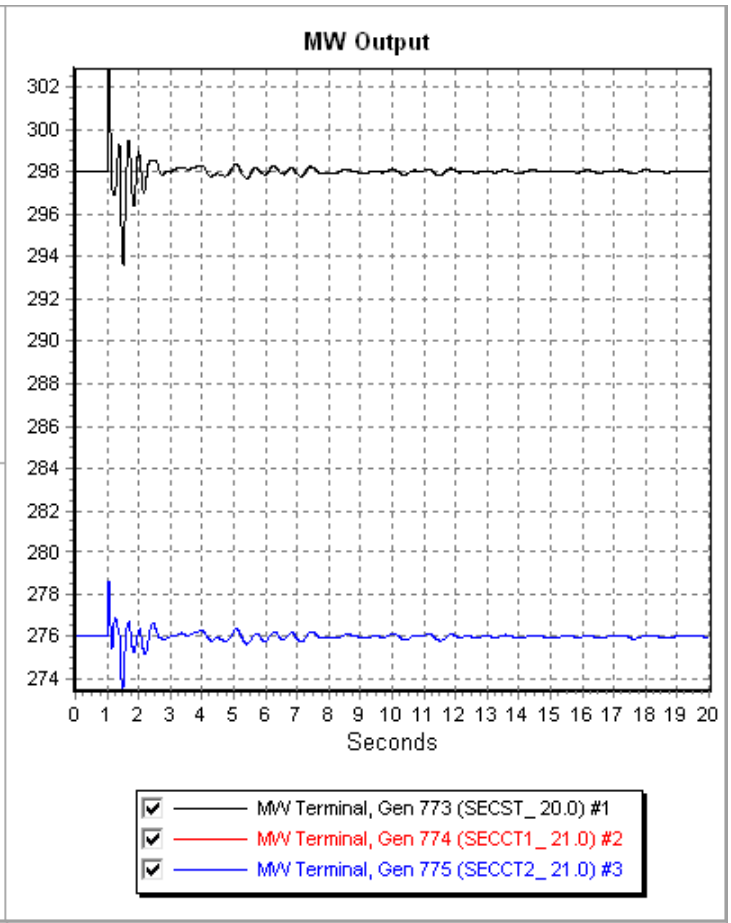


Contingency: 161L QUEENSTOWN 504S - VULCAN 255S

Sheerness
Queenstown Generating Plant Output: 90MW

May 11, 2014 00:06:39

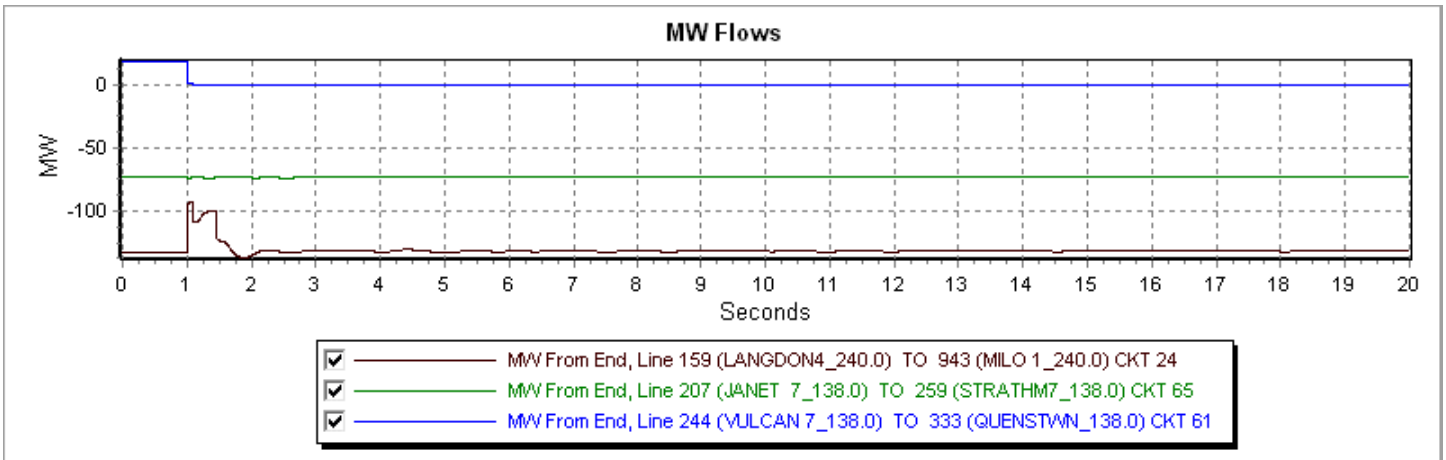


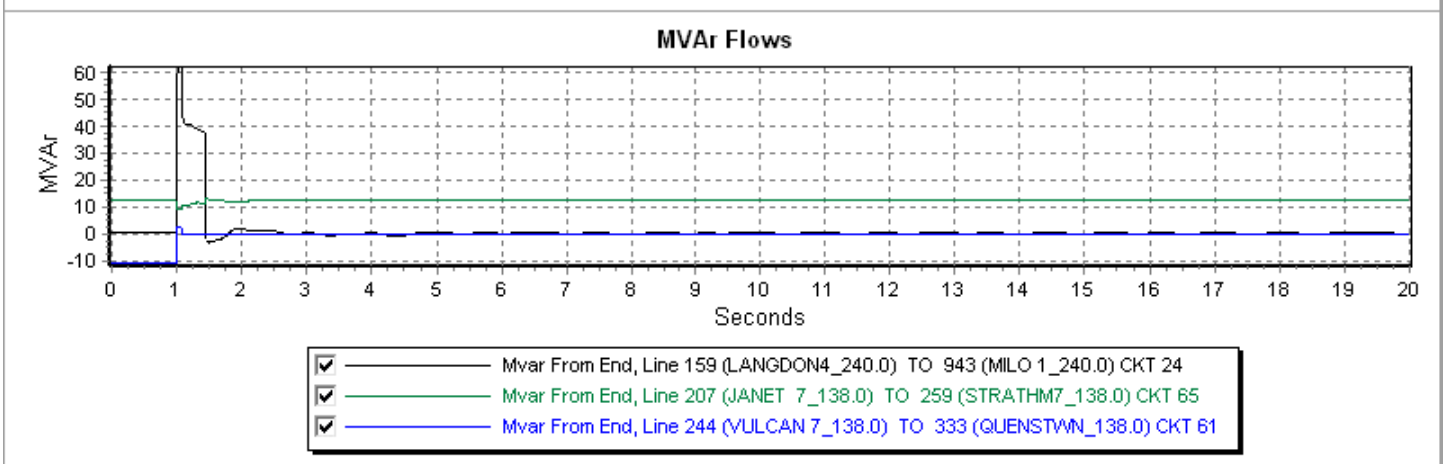


Contingency: 161L QUEENSTOWN 504S - VULCAN 255S

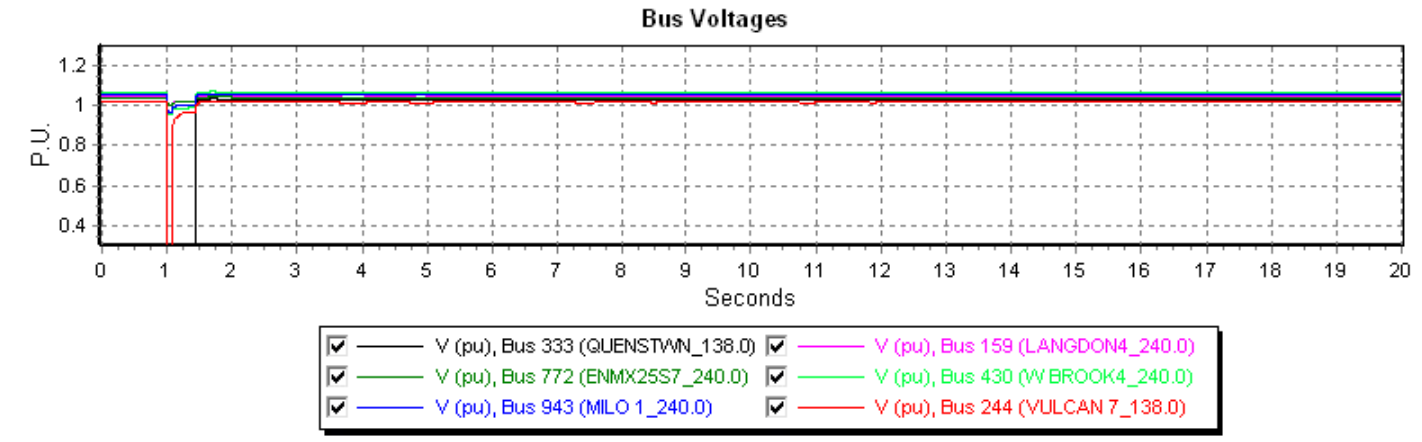
Sheppard
Queenstown Generating Plant Output: 90MW

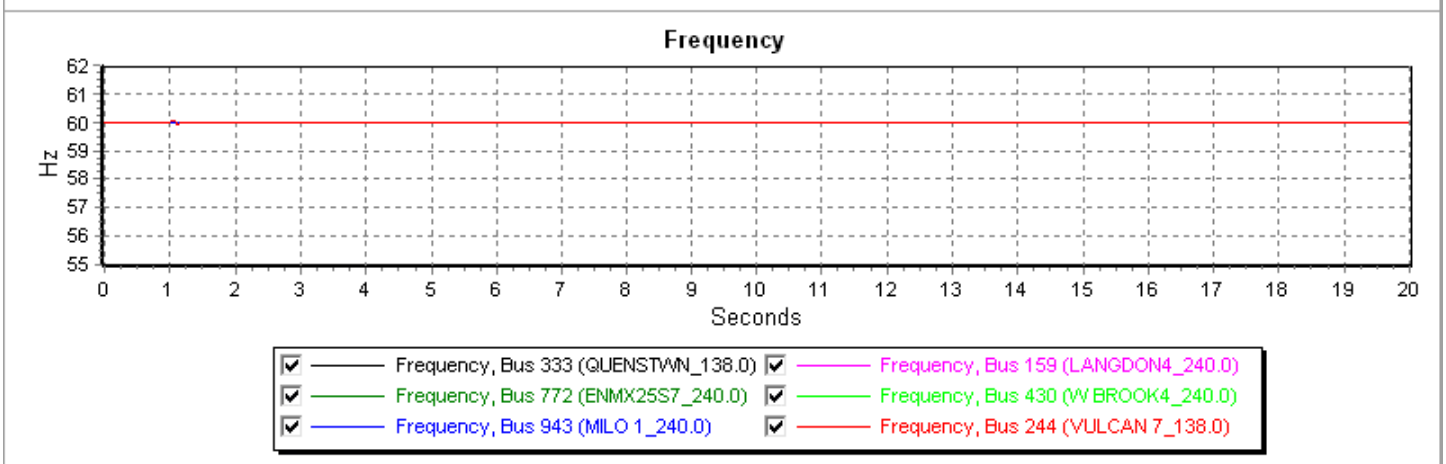
May 11, 2014 00:06:40



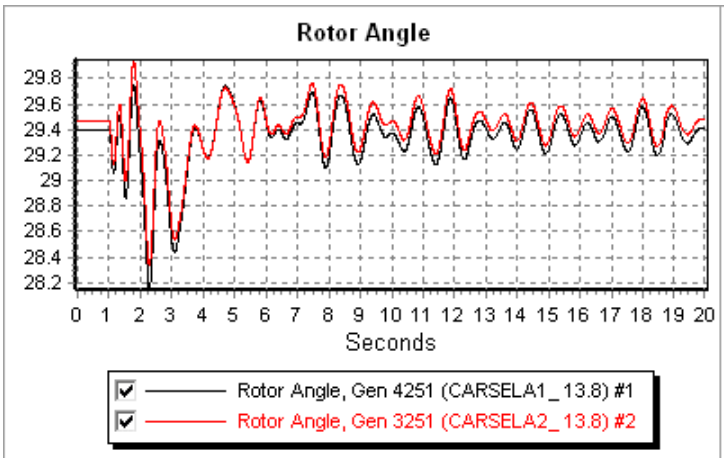


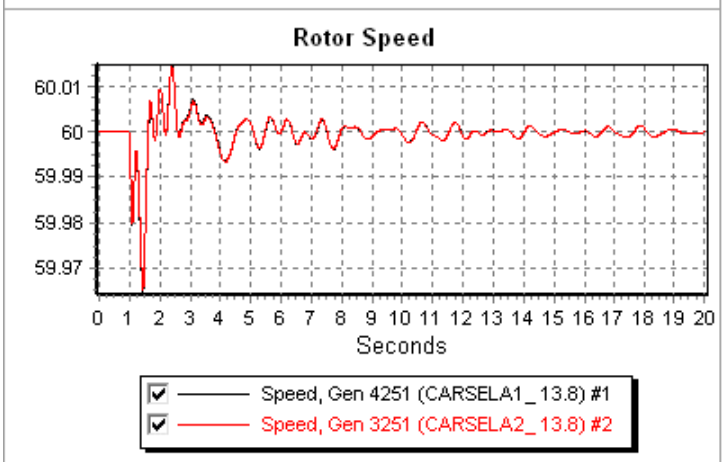
Contingency: 161L VULCAN 255S - QUEENSTOWN 504S	Branch Flows Queenstown Generating Plant Output: 90MW
	May 11, 2014 00:07:30

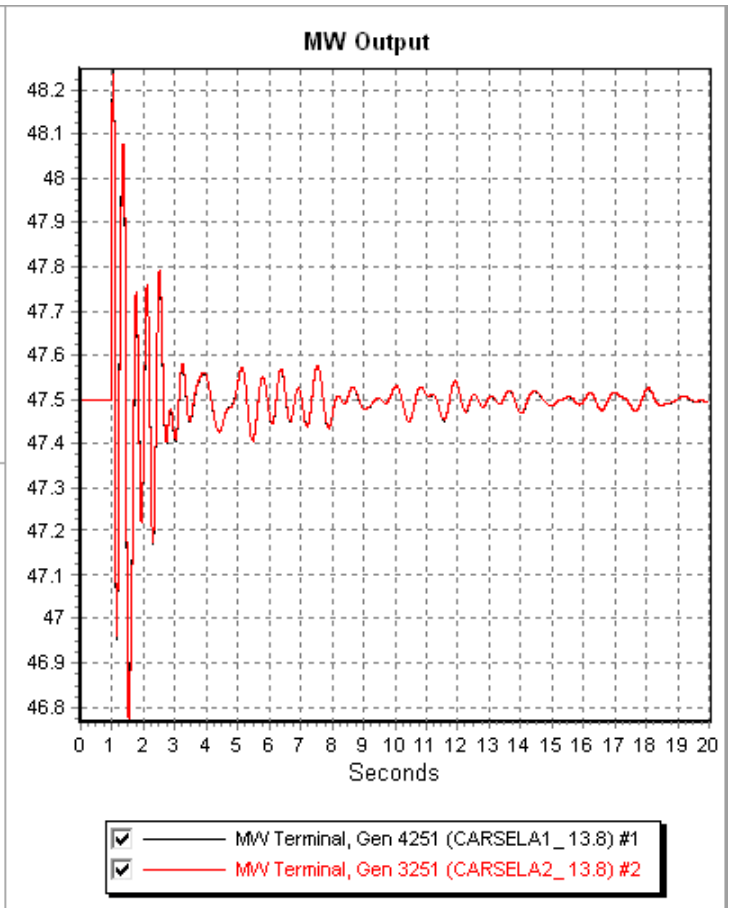




Contingency: 161L VULCAN 255S - QUEENSTOWN 504S	Bus Voltages and Frequency Queenstown Generating Plant Output: 90MW
	May 11, 2014 00:07:31



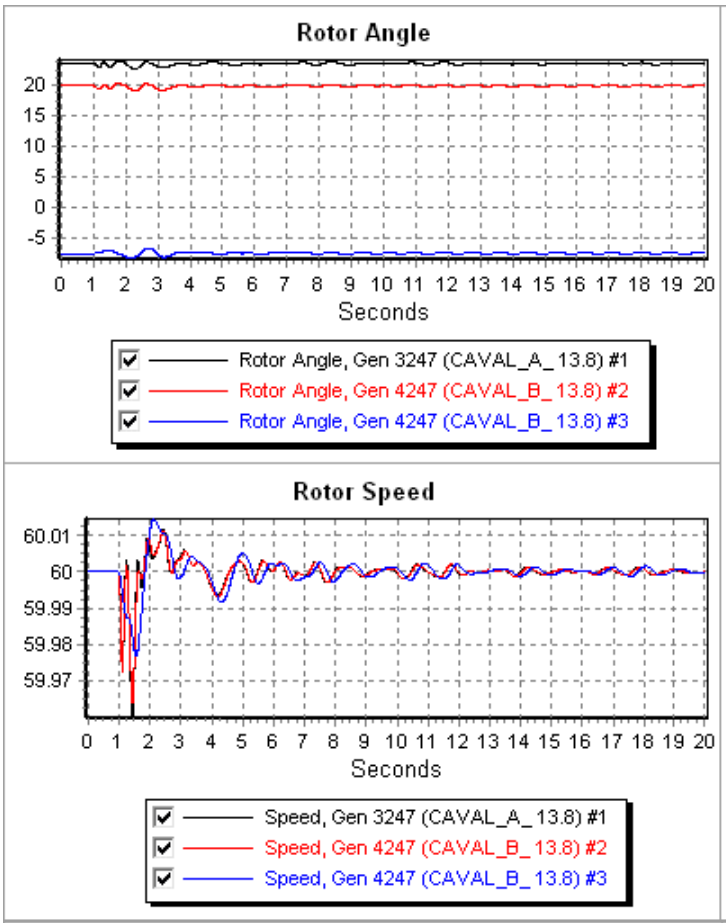


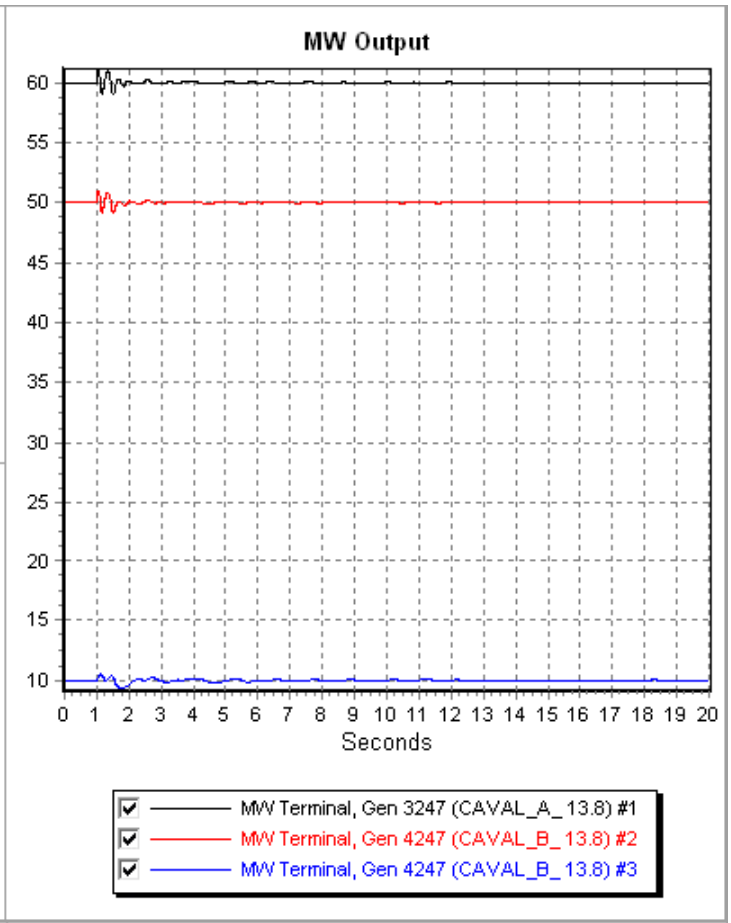


Contingency: 161L VULCAN 255S - QUEENSTOWN 504S

Carseland
Queenstown Generating Plant Output: 90MW

May 11, 2014 00:07:28

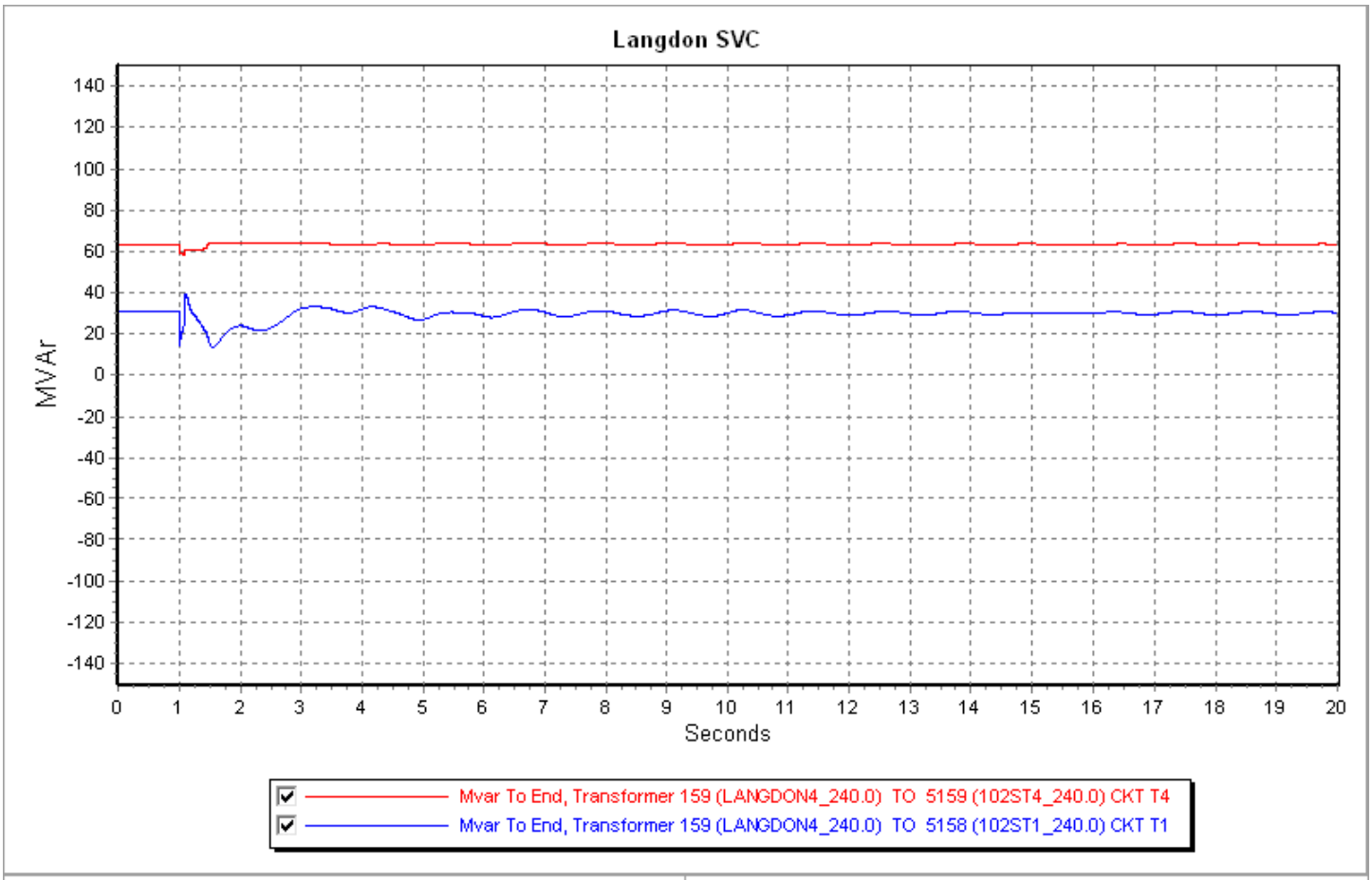




Contingency: 161L VULCAN 255S - QUEENSTOWN 504S

Cavalier
Queenstown Generating Plant Output: 90MW

May 11, 2014 00:07:30



Contingency: 161L VULCAN 255S - QUEENSTOWN 504S	Langdon SVC Queenstown Generating Plant Output: 90MW
	May 11, 2014 00:07:31

Rotor Angle

Seconds

Rotor Speed

Seconds

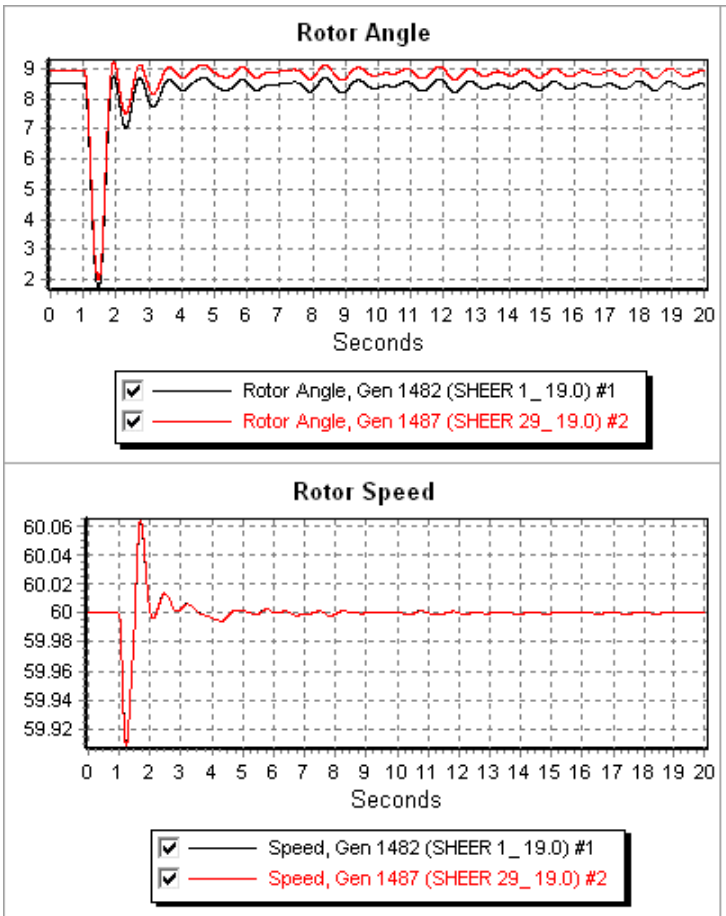
MW Output

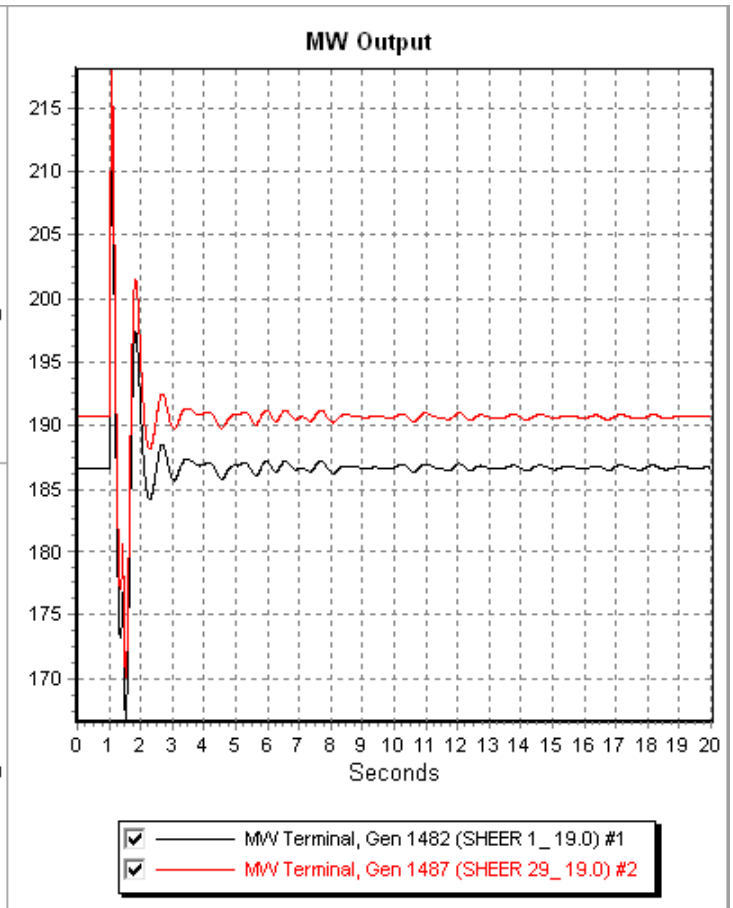
Seconds

Contingency: 161L VULCAN 255S - QUEENSTOWN 504S

P1336
Queenstown Generating Plant
Output: 90MW

May 11, 2014 00:07:29

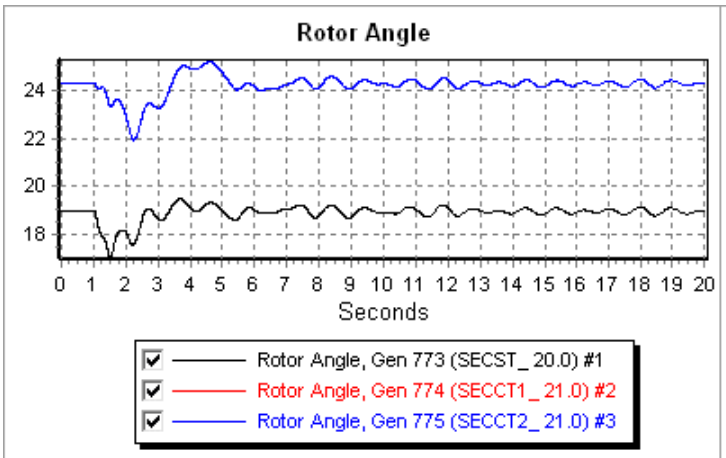


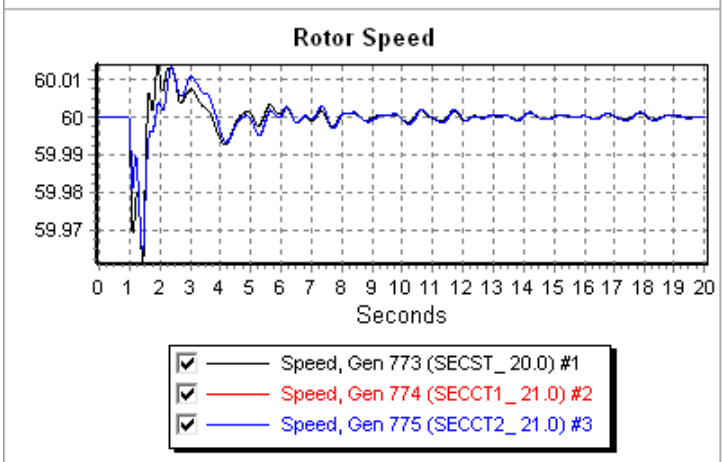


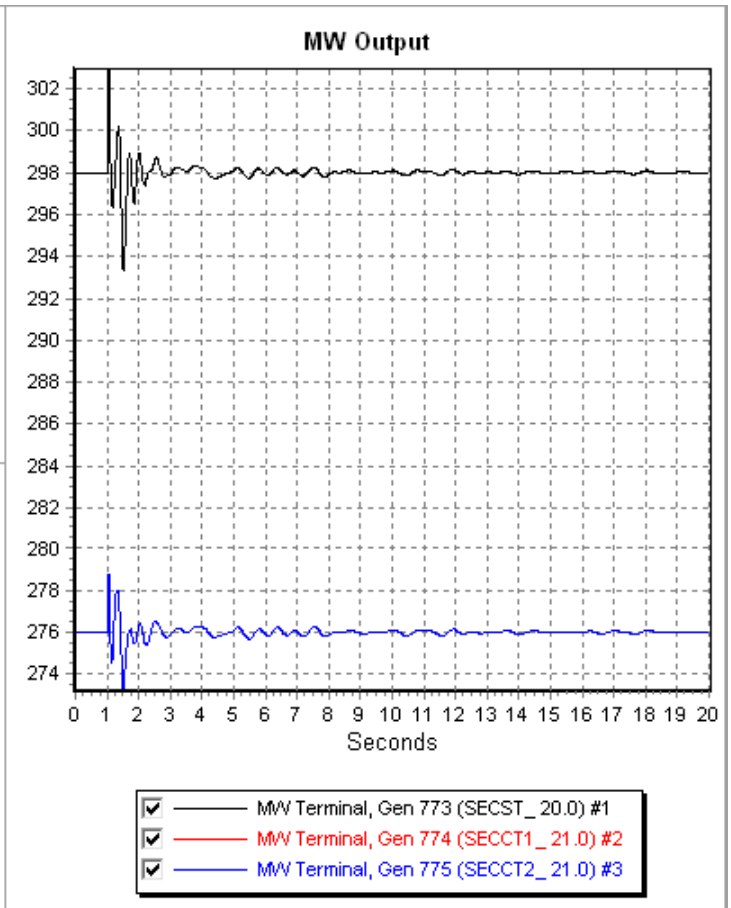
Contingency: 161L VULCAN 255S - QUEENSTOWN 504S

Sheerness
Queenstown Generating Plant Output: 90MW

May 11, 2014 00:07:27



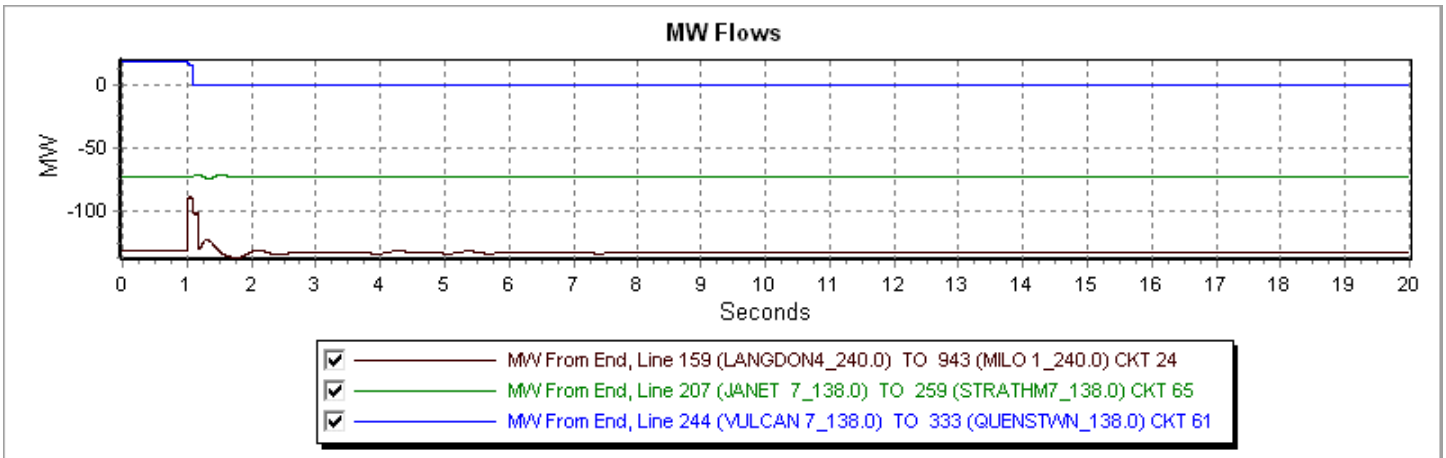


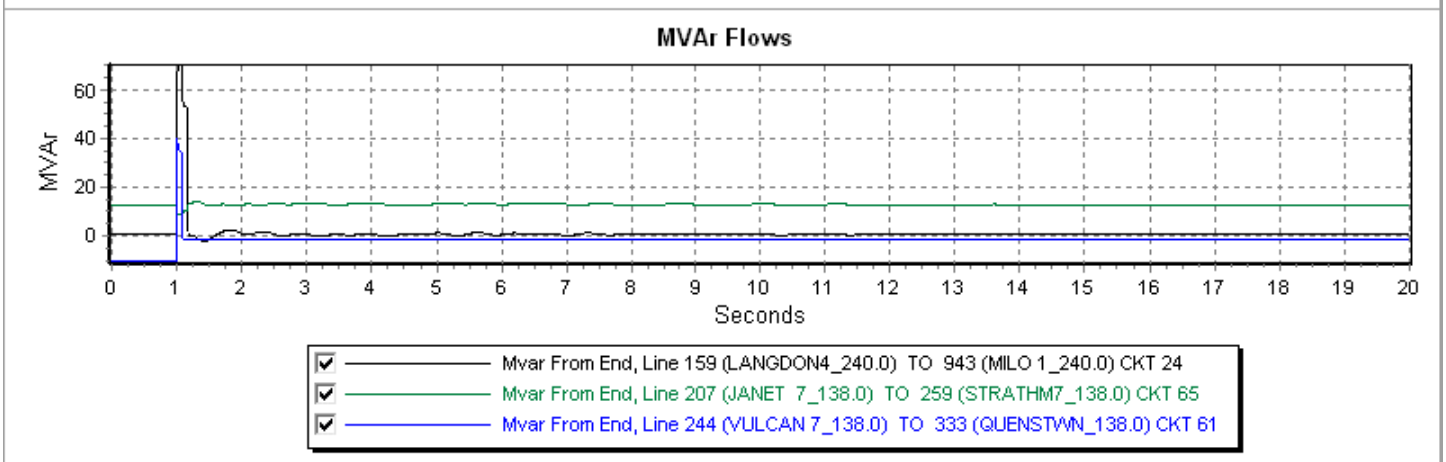


Contingency: 161L VULCAN 255S - QUEENSTOWN 504S

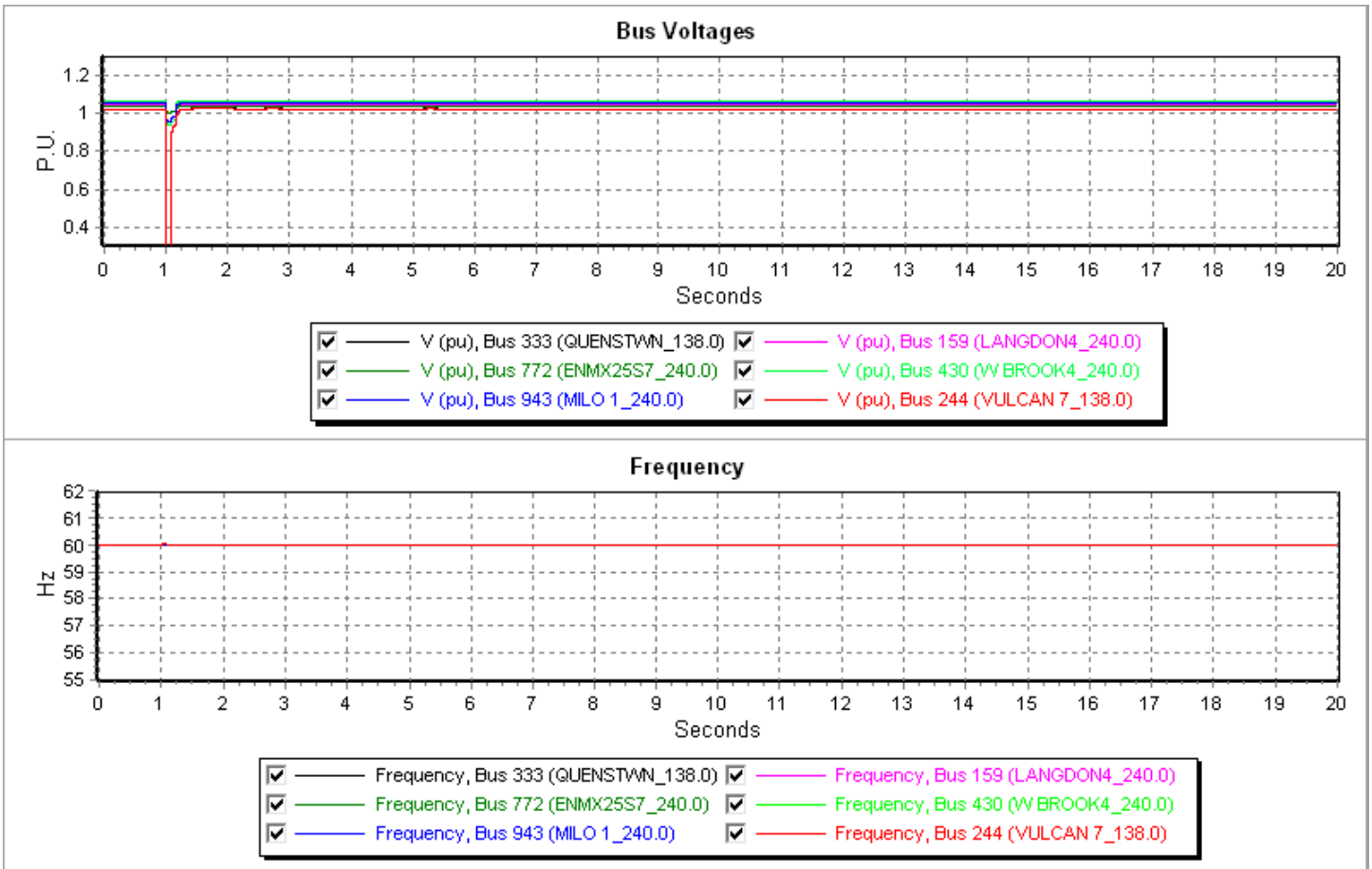
Sheppard
Queenstown Generating Plant Output: 90MW

May 11, 2014 00:07:29





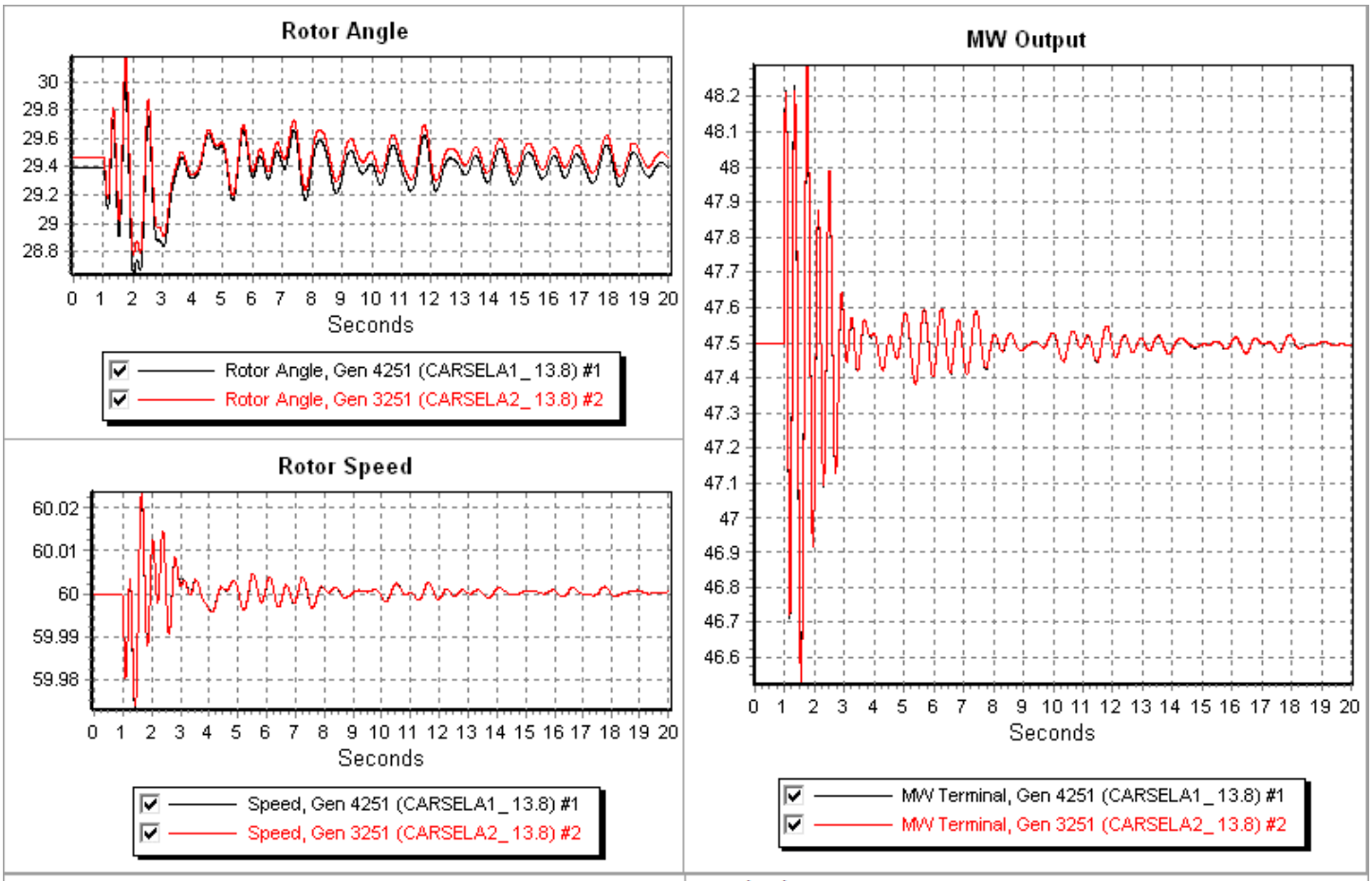
Contingency: 853L QUEENSTOWN 504S - WEST BROOKS 28S	Branch Flows Queenstown Generating Plant Output: 90MW
	May 11, 2014 00:11:14



Contingency: 853L QUEENSTOWN 504S - WEST BROOKS 28S

Bus Voltages and Frequency
Queenstown Generating Plant Output: 90MW

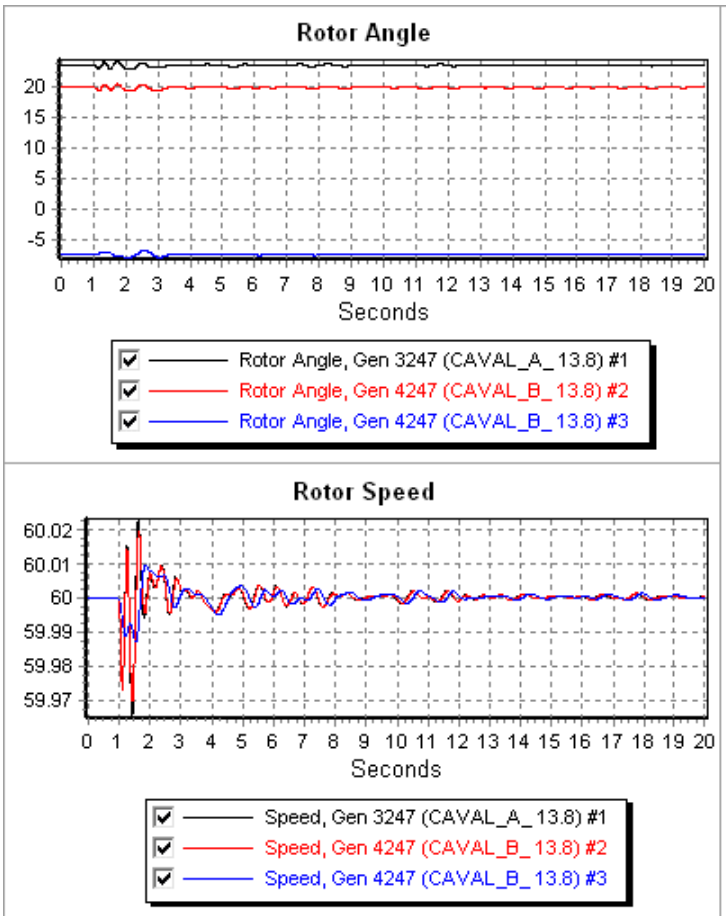
May 11, 2014 00:11:15

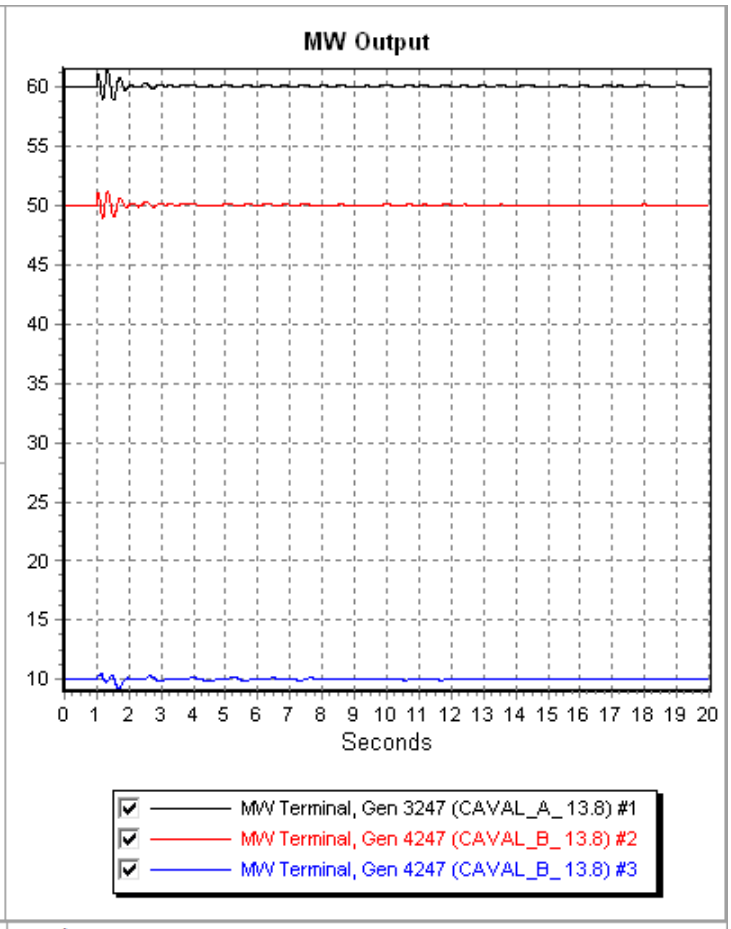


Contingency: 853L QUEENSTOWN 504S - WEST BROOKS 28S

Carseland
Queenstown Generating Plant Output: 90MW

May 11, 2014 00:11:12

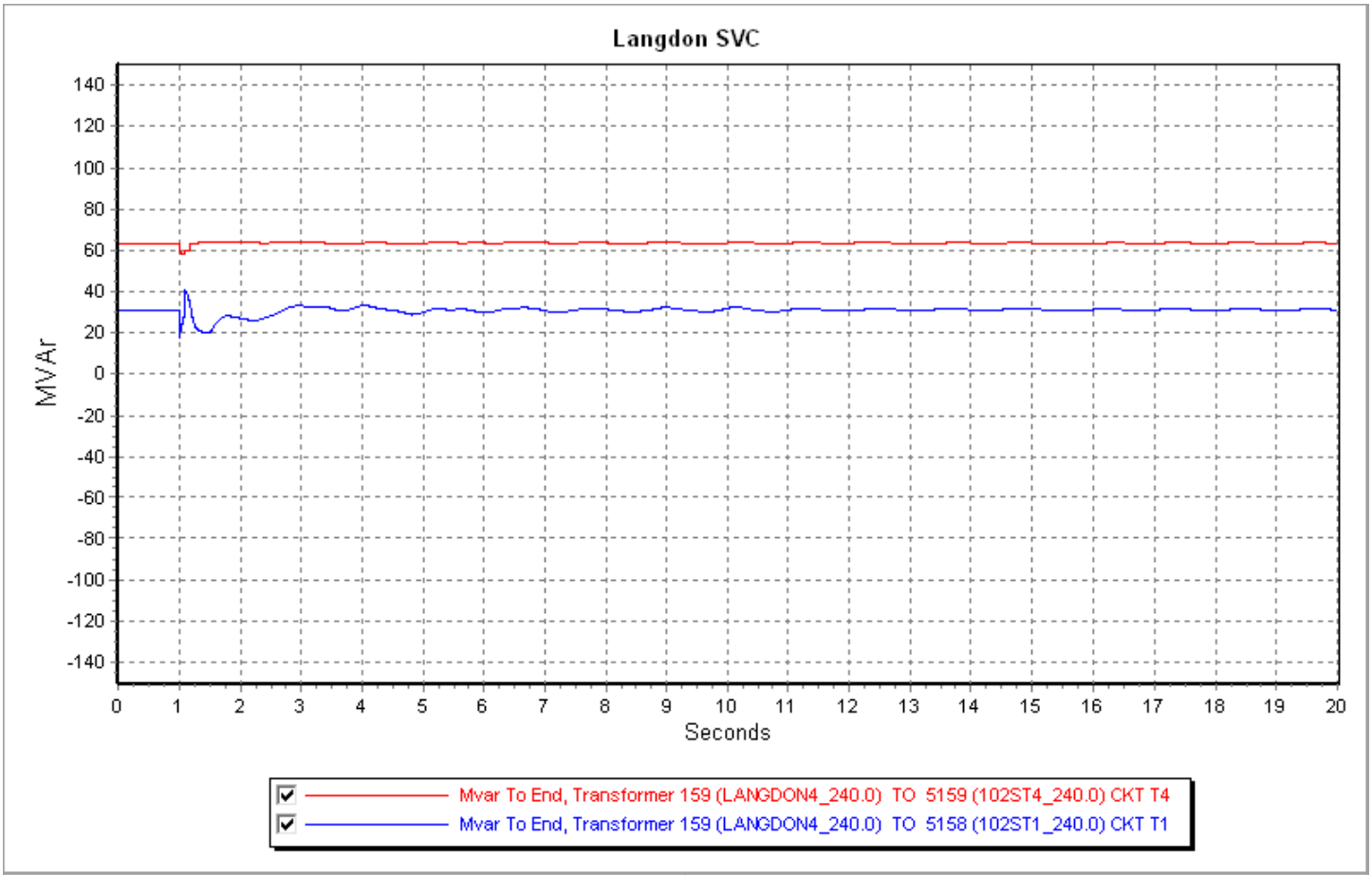




Contingency: 853L QUEENSTOWN 504S - WEST BROOKS 28S

Cavalier
Queenstown Generating Plant Output: 90MW

May 11, 2014 00:11:14



Contingency: 853L QUEENSTOWN 504S - WEST BROOKS 28S	Langdon SVC Queenstown Generating Plant Output: 90MW May 11, 2014 00:11:15

Rotor Angle

Seconds

Rotor Speed

Seconds

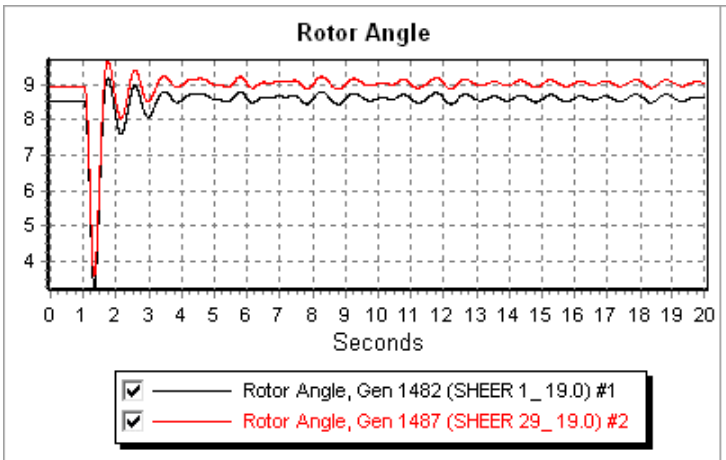
MW Output

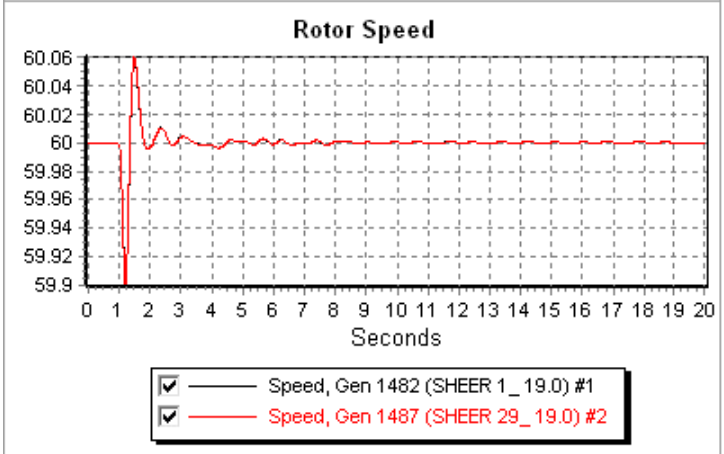
Seconds

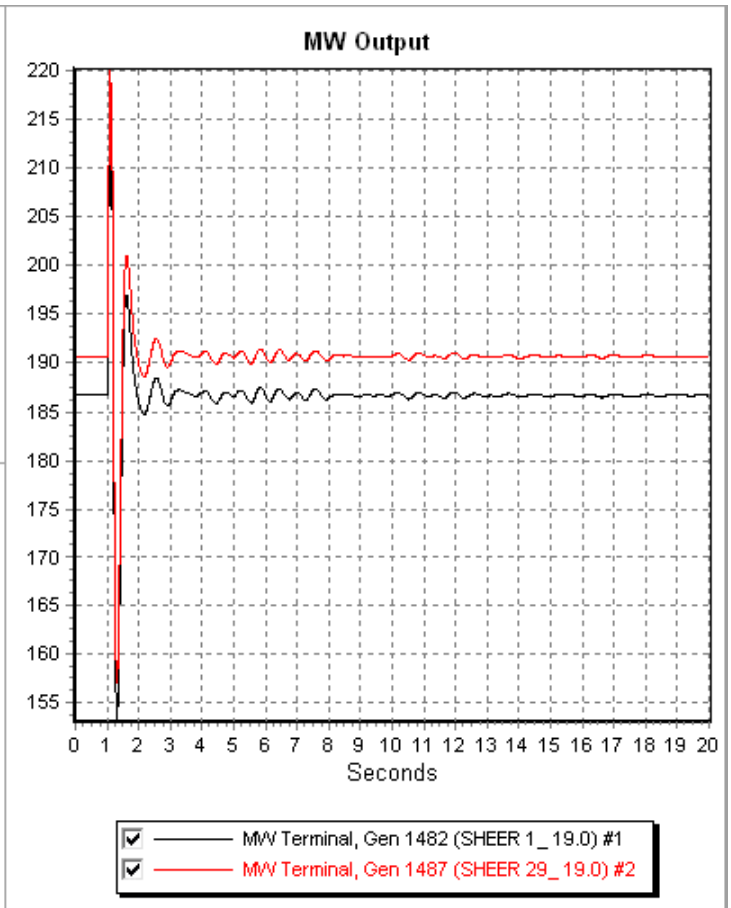
Contingency: 853L QUEENSTOWN 504S - WEST BROOKS 28S

P1336
Queenstown Generating Plant
Output: 90MW

May 11, 2014 00:11:13



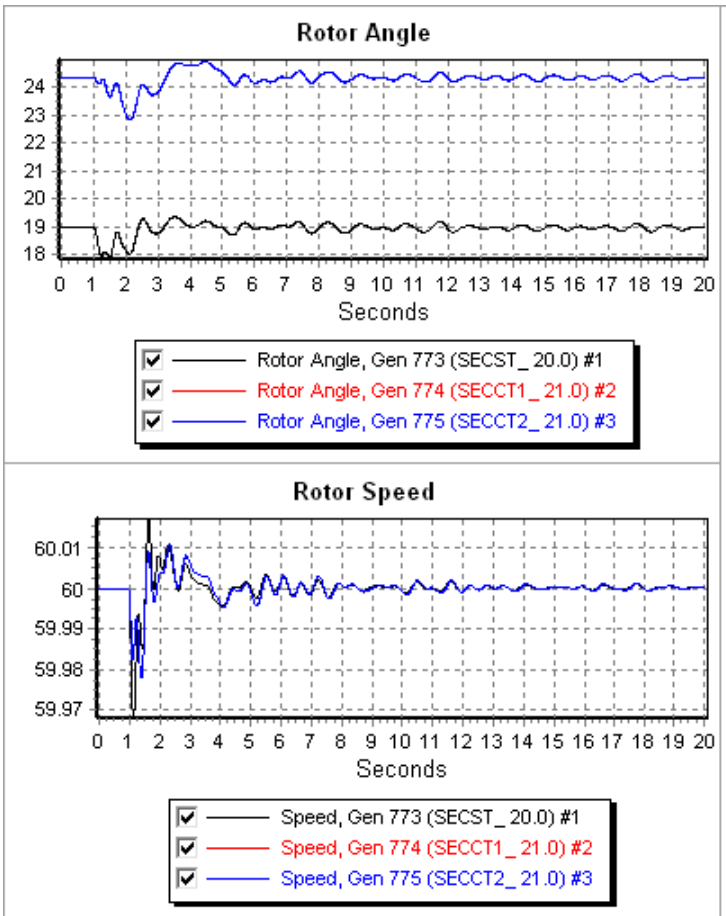


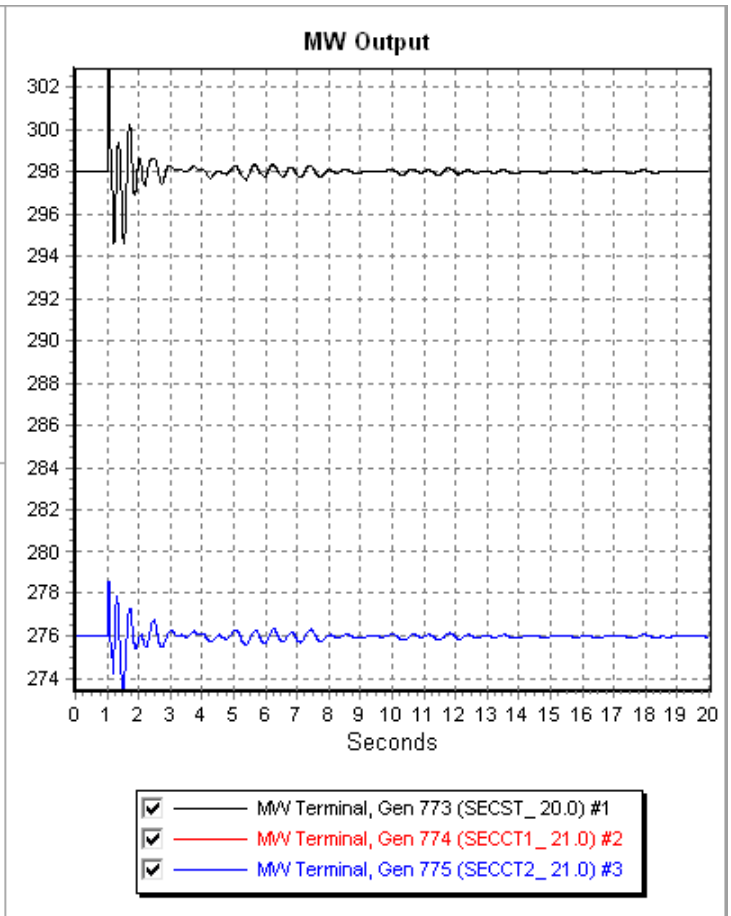


Contingency: 853L QUEENSTOWN 504S - WEST BROOKS 28S

Sheerness
Queenstown Generating Plant Output: 90MW

May 11, 2014 00:11:12

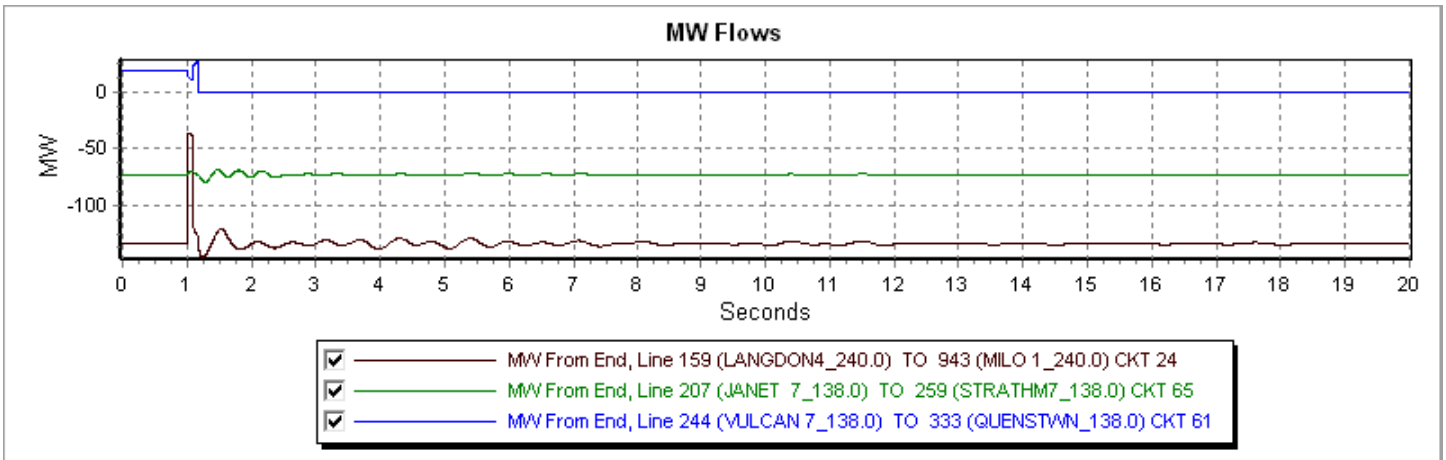


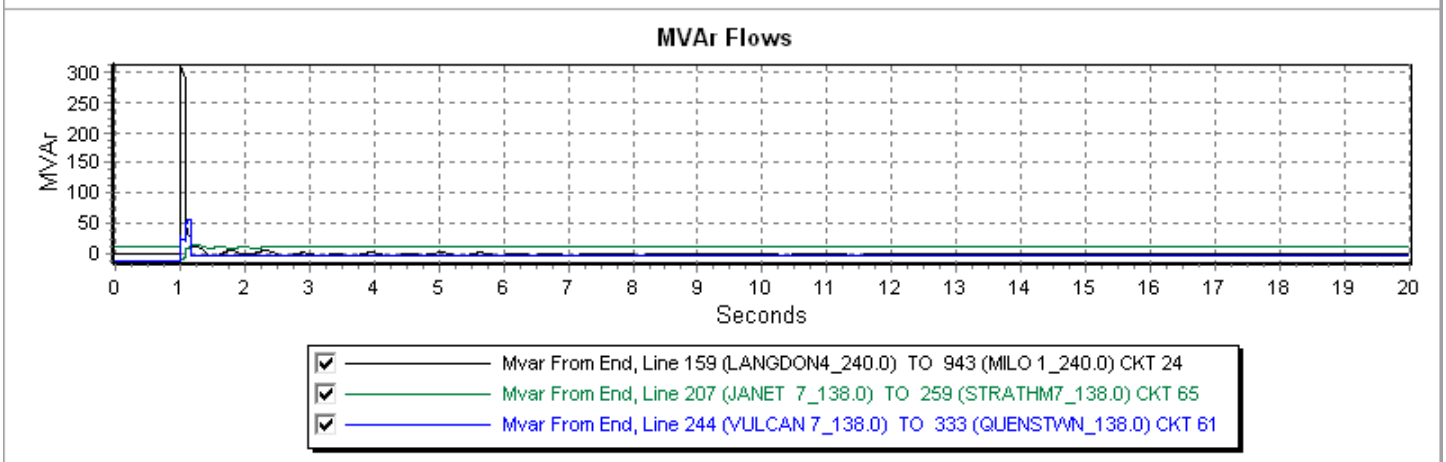


Contingency: 853L QUEENSTOWN 504S - WEST BROOKS 28S

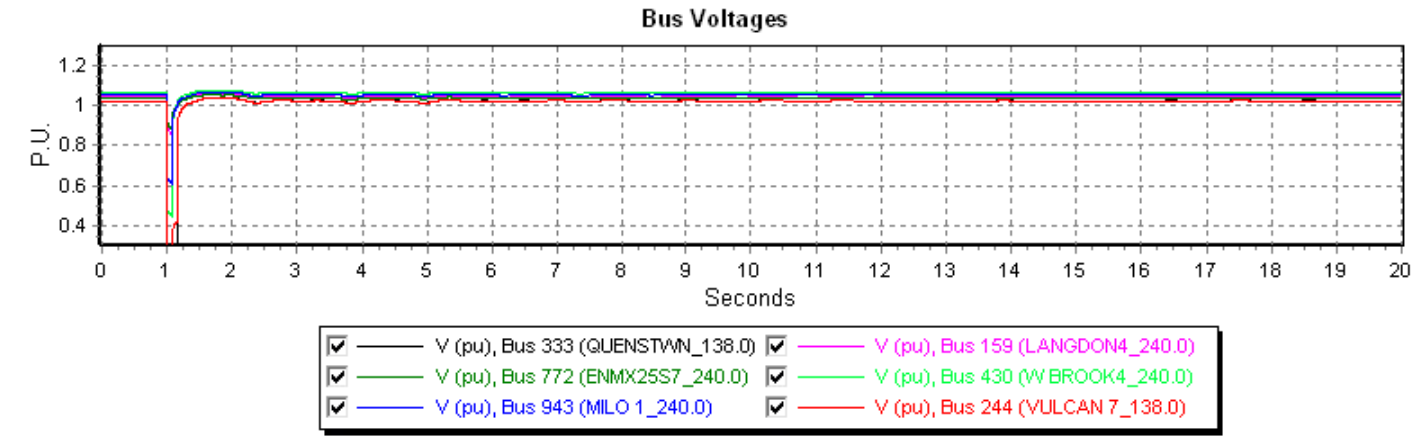
Sheppard
Queenstown Generating Plant Output: 90MW

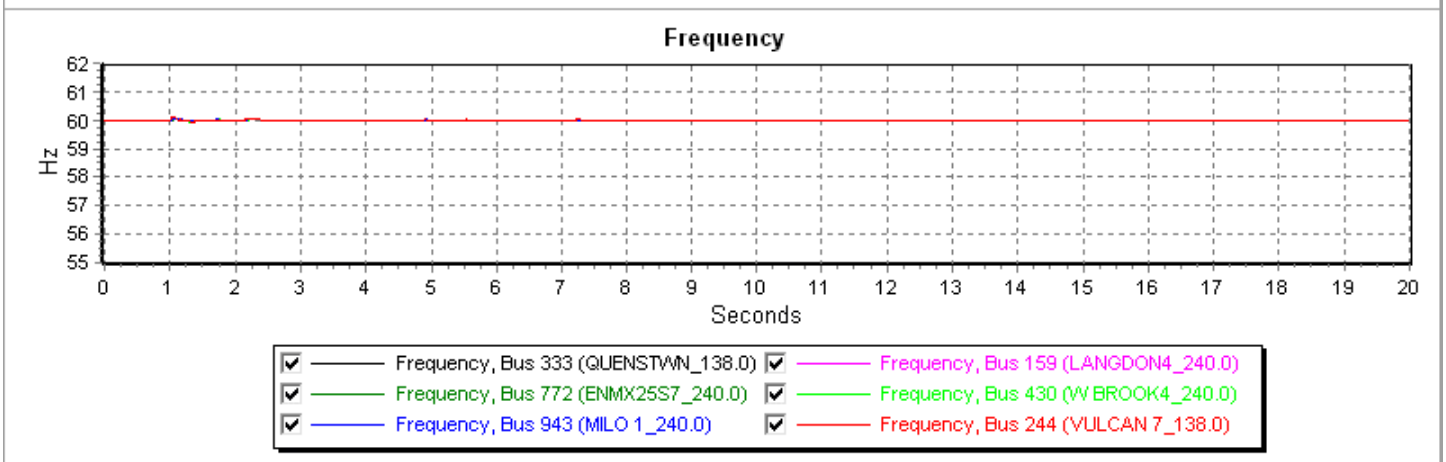
May 11, 2014 00:11:13



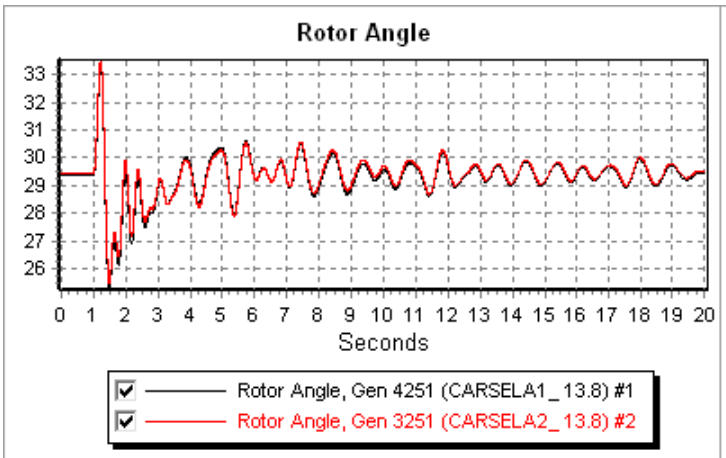


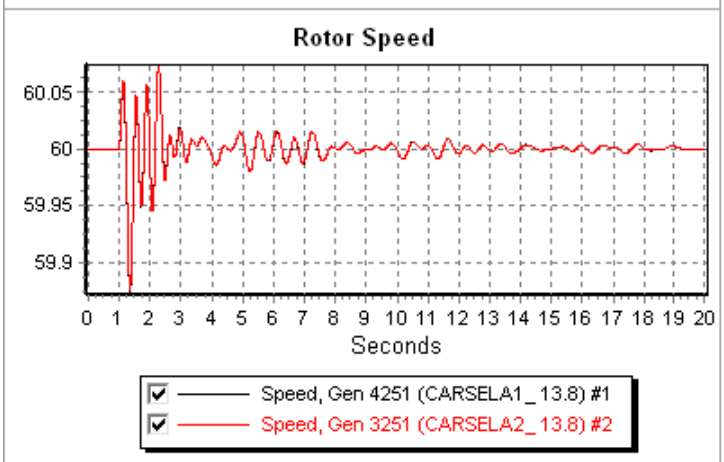
Contingency: 853L WEST BROOKS 28S - QUEENSTOWN 504S	Branch Flows Queenstown Generating Plant Output: 90MW
	May 11, 2014 00:12:00

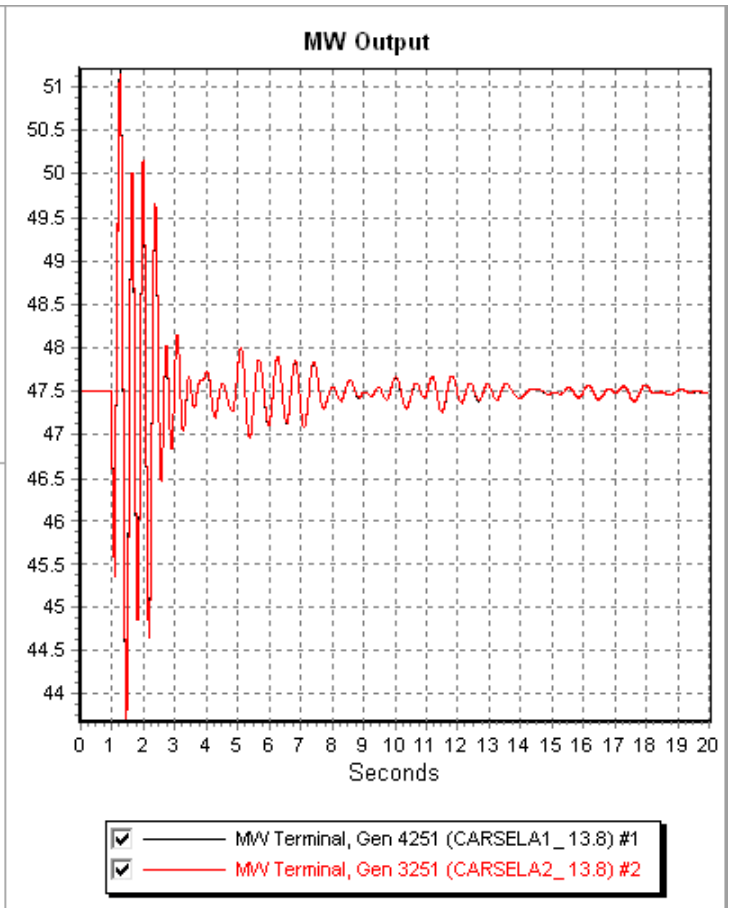




Contingency: 853L WEST BROOKS 28S - QUEENSTOWN 504S	Bus Voltages and Frequency Queenstown Generating Plant Output: 90MW May 11, 2014 00:12:00



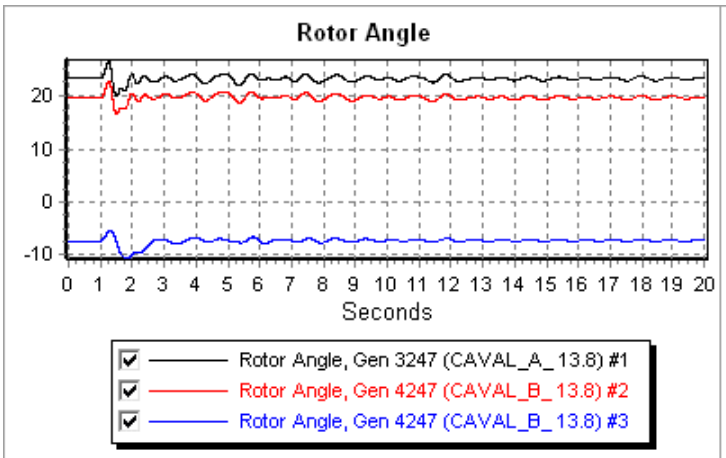


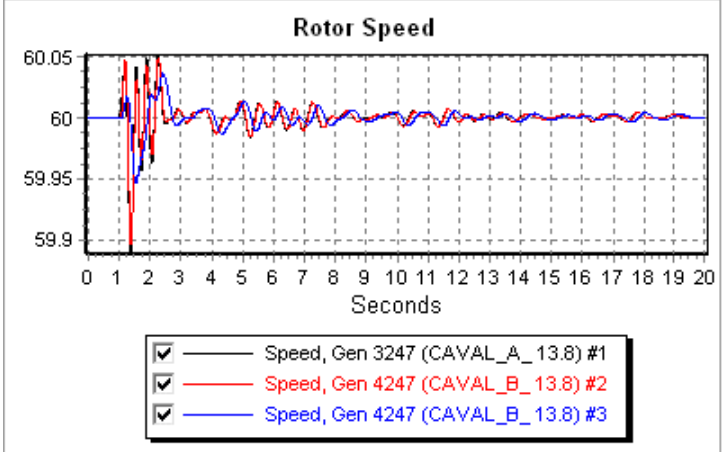


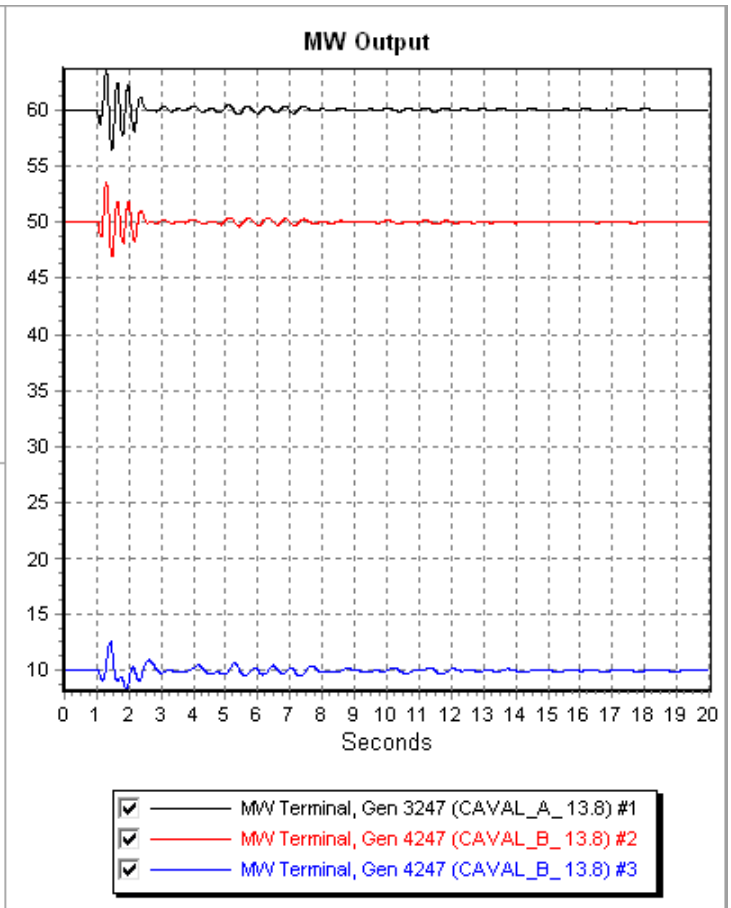
Contingency: 853L WEST BROOKS 28S - QUEENSTOWN 504S

Carseland
Queenstown Generating Plant Output: 90MW

May 11, 2014 00:11:57



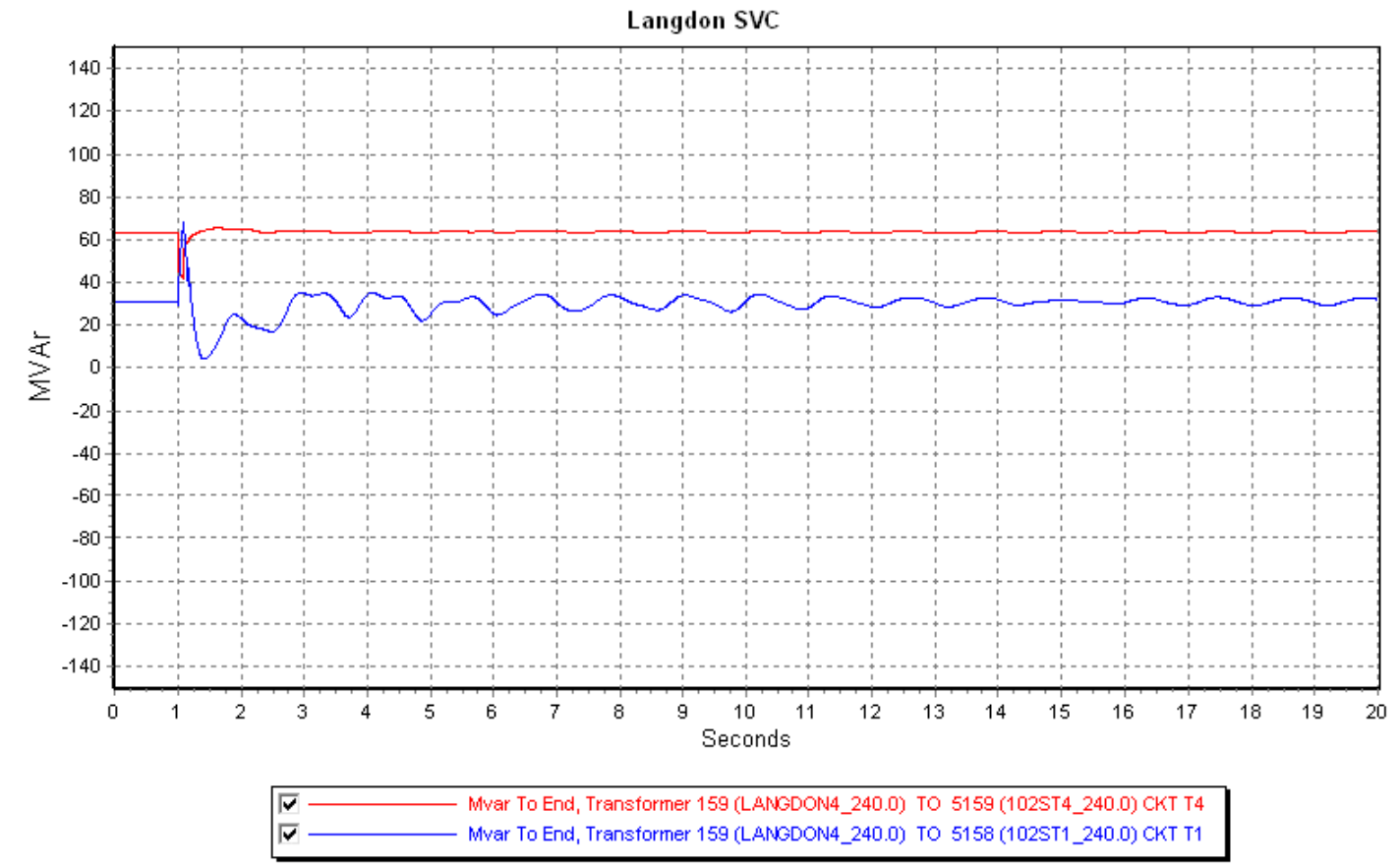




Contingency: 853L WEST BROOKS 28S - QUEENSTOWN 504S

Cavalier
Queenstown Generating Plant Output: 90MW

May 11, 2014 00:11:59



Contingency: 853L WEST BROOKS 28S - QUEENSTOWN 504S	Langdon SVC Queenstown Generating Plant Output: 90MW May 11, 2014 00:12:01

Rotor Angle

Seconds

Rotor Speed

Seconds

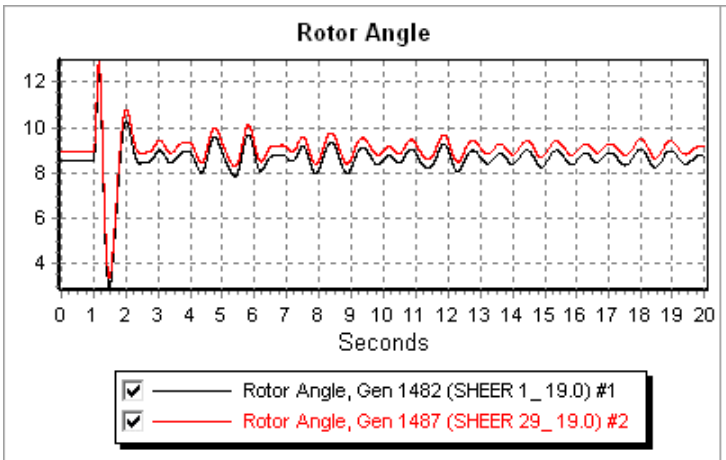
MW Output

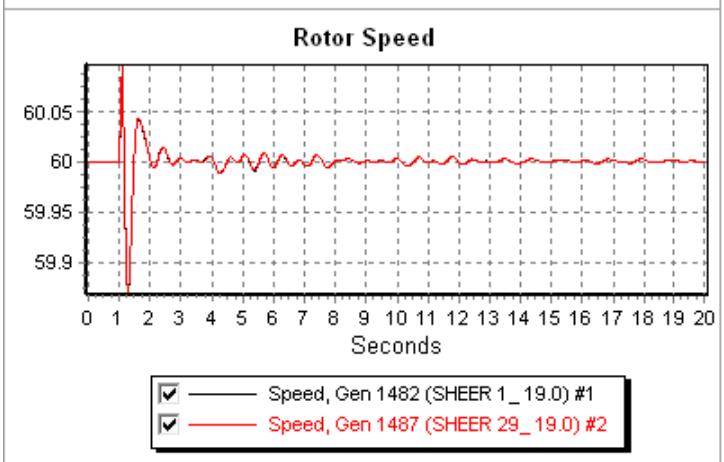
Seconds

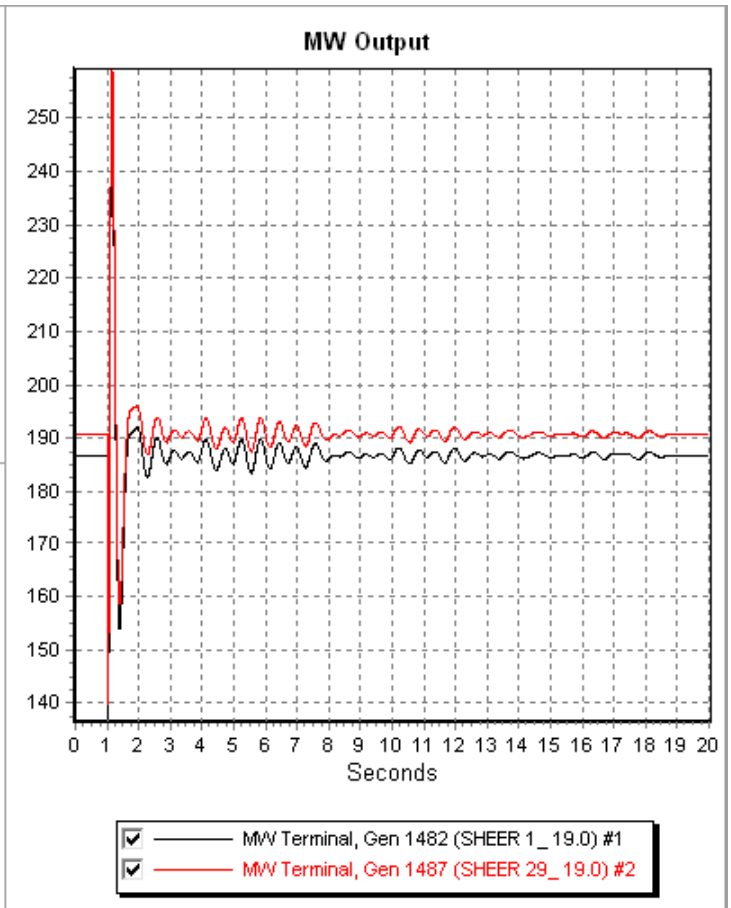
Contingency: 853L WEST BROOKS 28S - QUEENSTOWN 504S

P1336
Queenstown Generating Plant
Output: 90MW

May 11, 2014 00:11:59



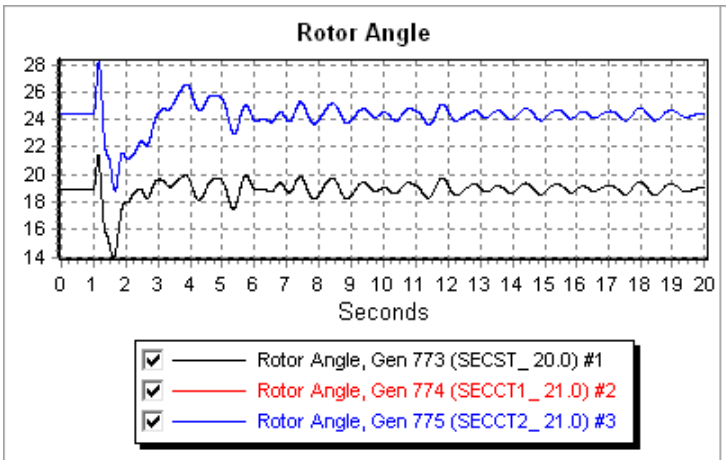


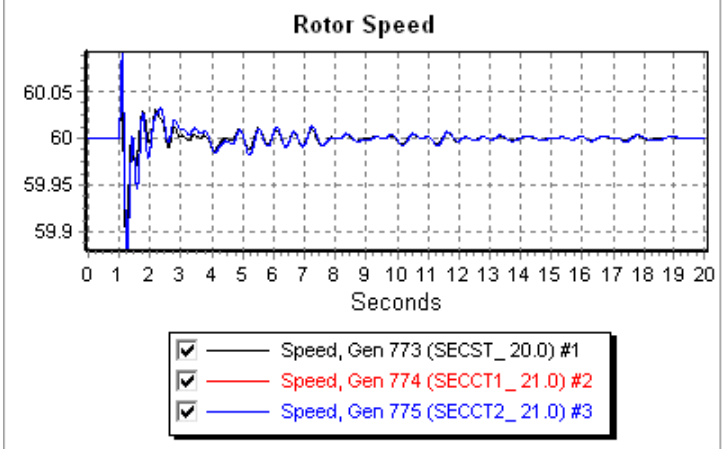


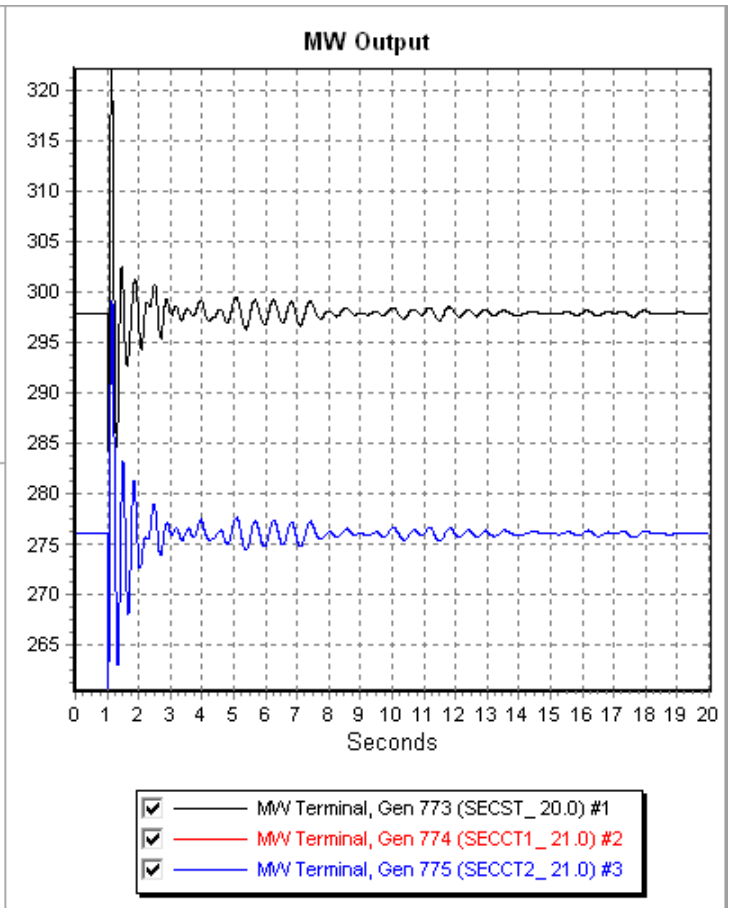
Contingency: 853L WEST BROOKS 28S - QUEENSTOWN 504S

Sheerness
Queenstown Generating Plant Output: 90MW

May 11, 2014 00:11:57





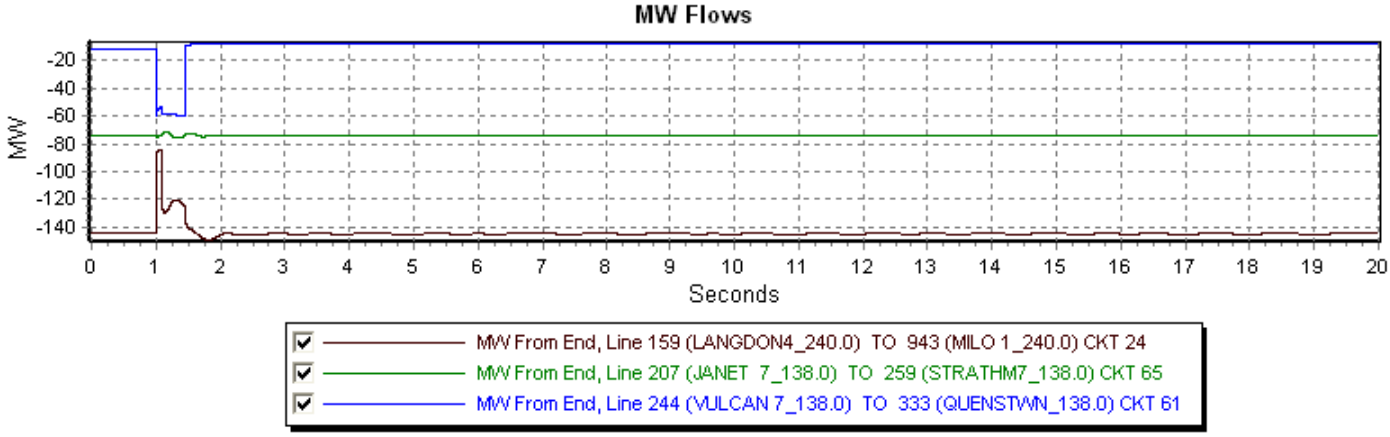


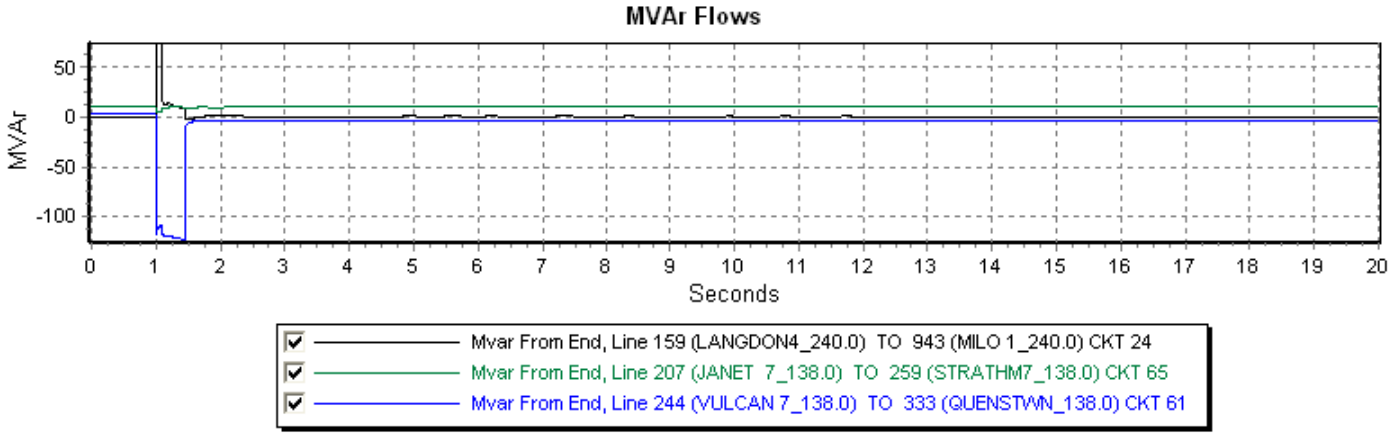
Contingency: 853L WEST BROOKS 28S - QUEENSTOWN 504S

Sheppard
Queenstown Generating Plant Output: 90MW

May 11, 2014 00:11:58

Branch Flows



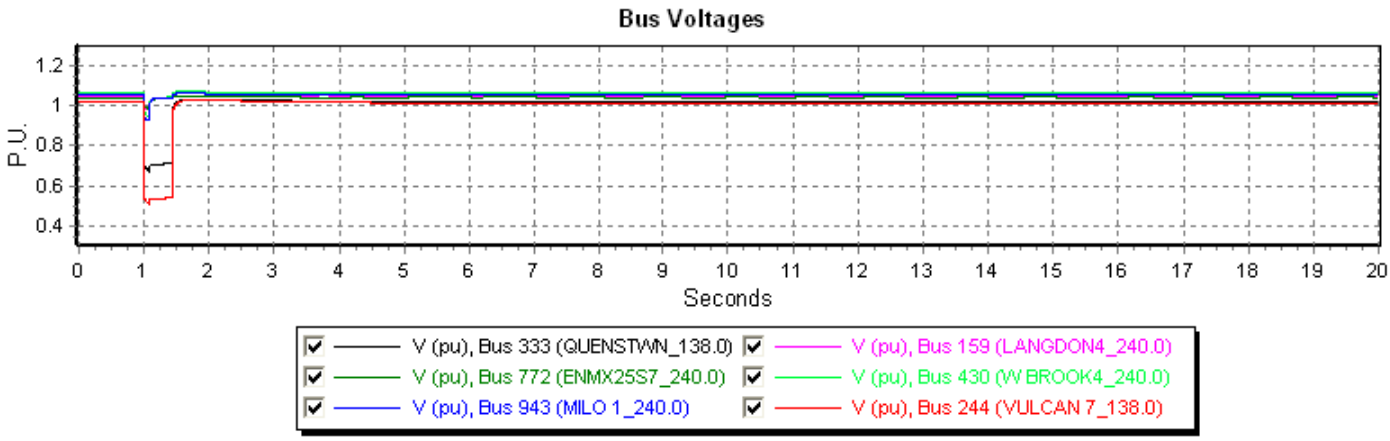


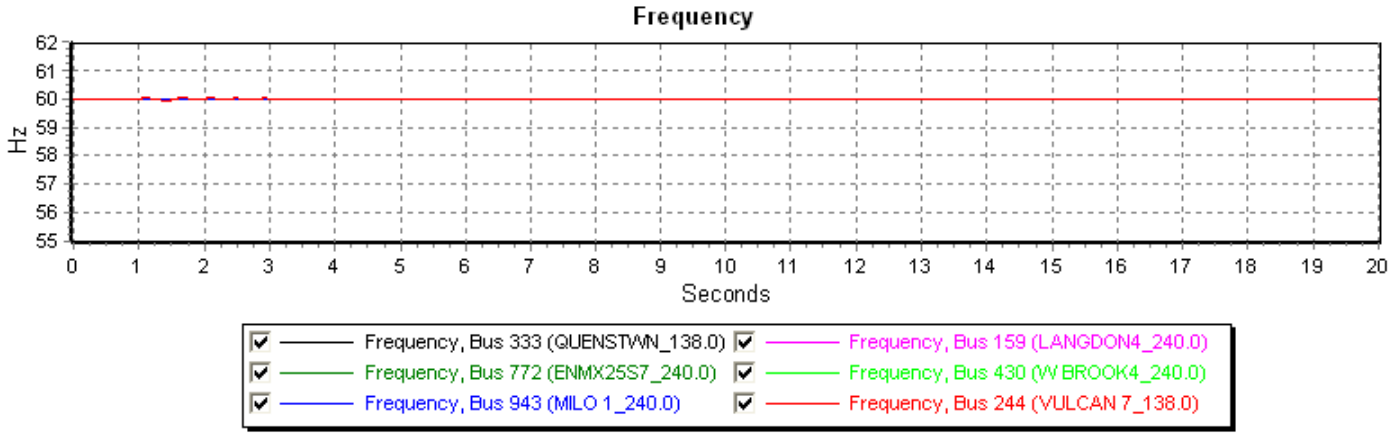
Contingency: 180L Ft.McLeod 15S to Vulcan 255S

Branch Flows
Queenstown Generating Plant Output: 90MW

September 26, 2014 15:46:52

Bus Voltages and Frequency



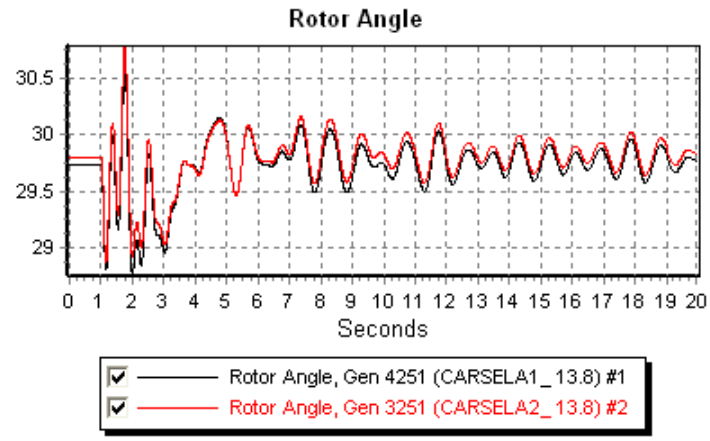


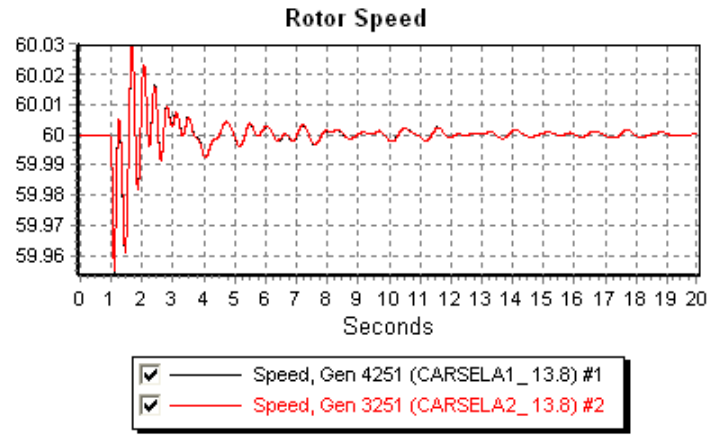
Contingency: 180L Ft.McLeod 15S to Vulcan 255S

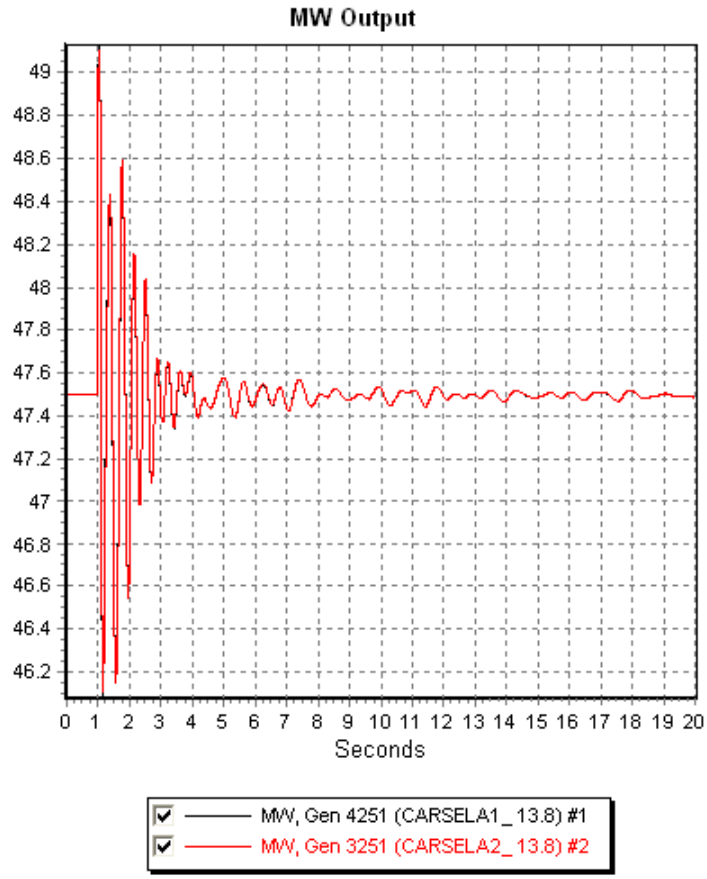
Bus Voltages and Frequency
Queenstown Generating Plant Output: 90MW

September 26, 2014 15:46:53

Carseland





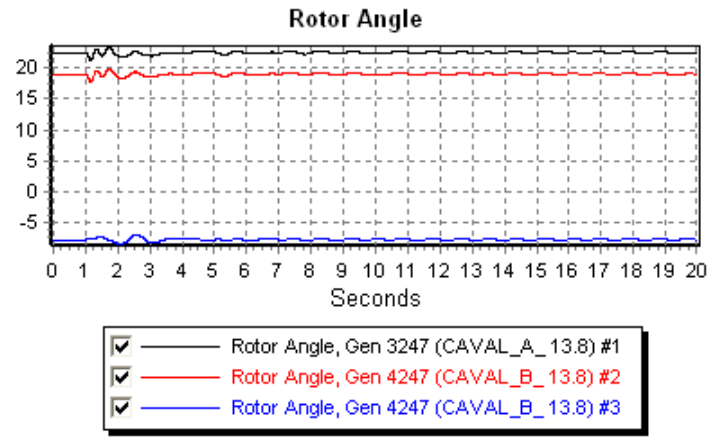


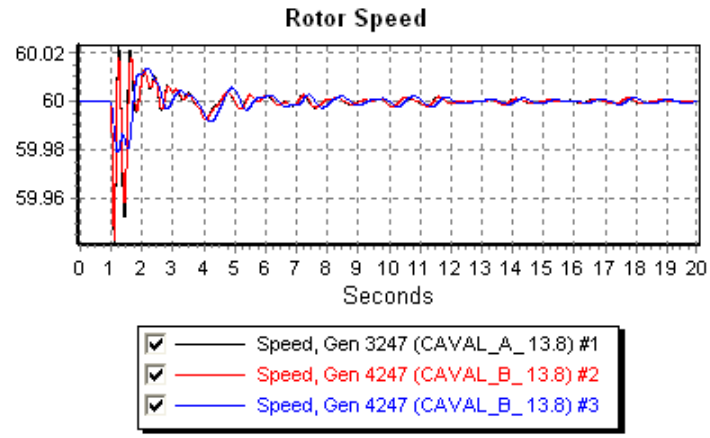
Contingency: 180L Ft.McLeod 15S to Vulcan 255S

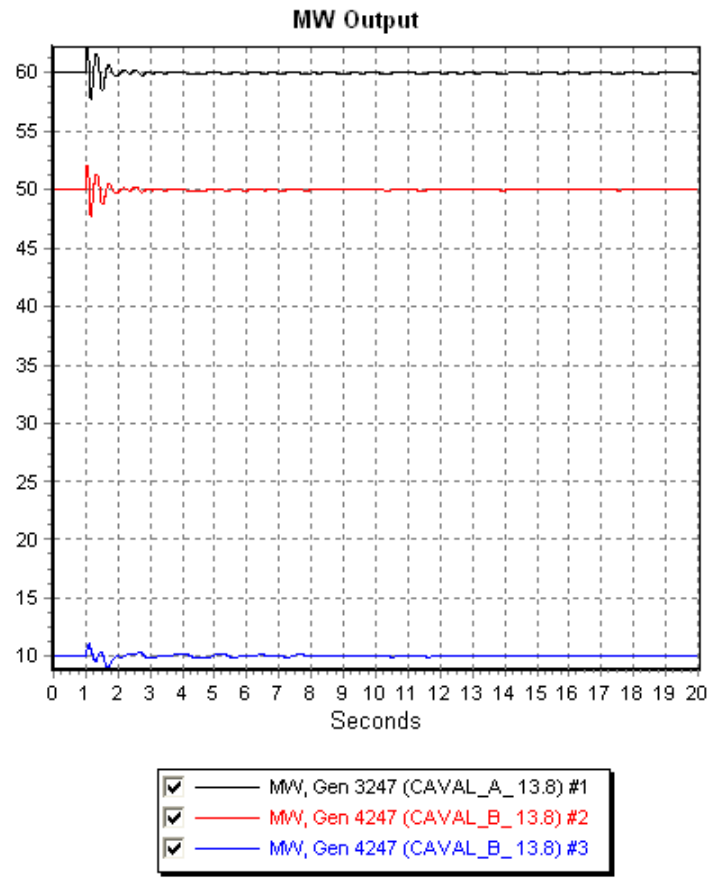
Carseland
Queenstown Generating Plant Output: 90MW

September 26, 2014 15:46:50

Cavalier





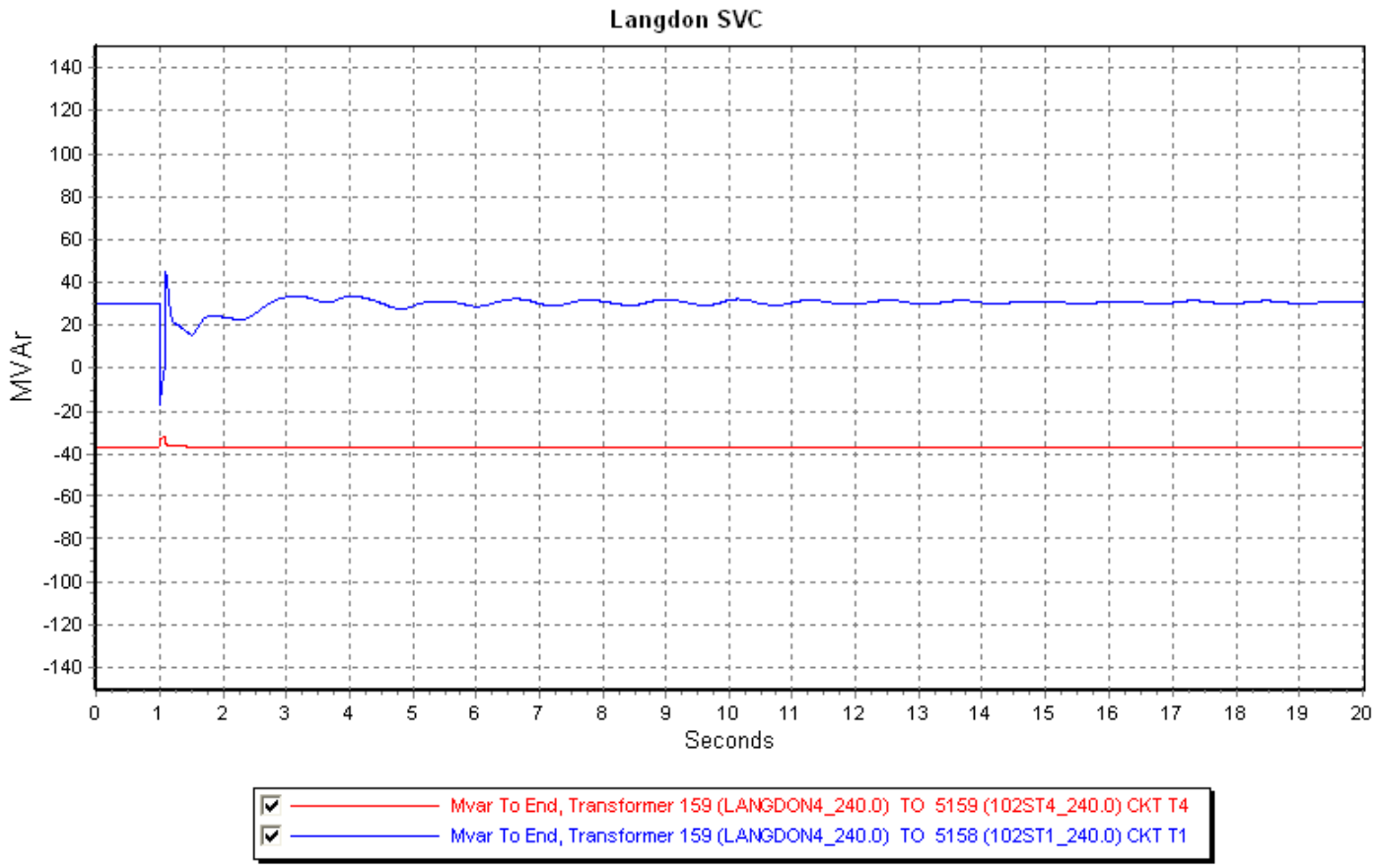


Contingency: 180L Ft.McLeod 15S to Vulcan 255S

Cavalier
Queenstown Generating Plant Output: 90MW

September 26, 2014 15:46:52

Langdon SVC

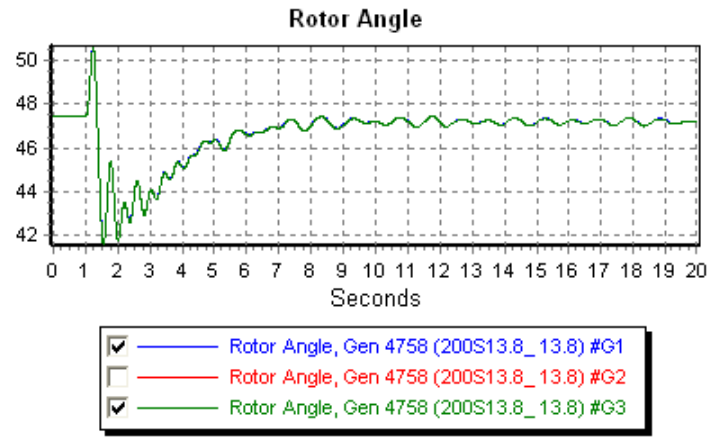


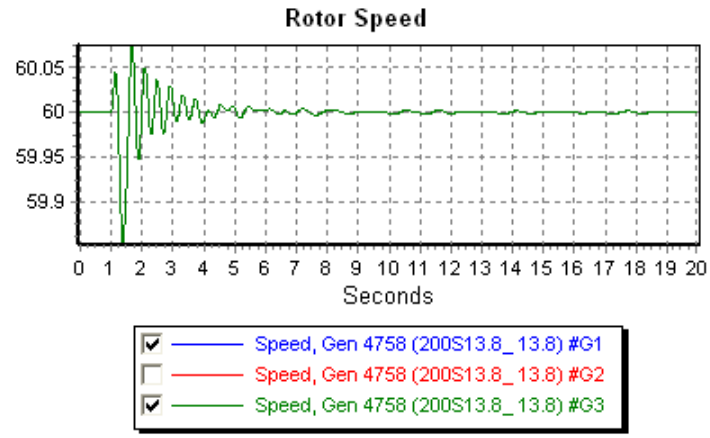
Contingency: 180L Ft.McLeod 15S to Vulcan 255S

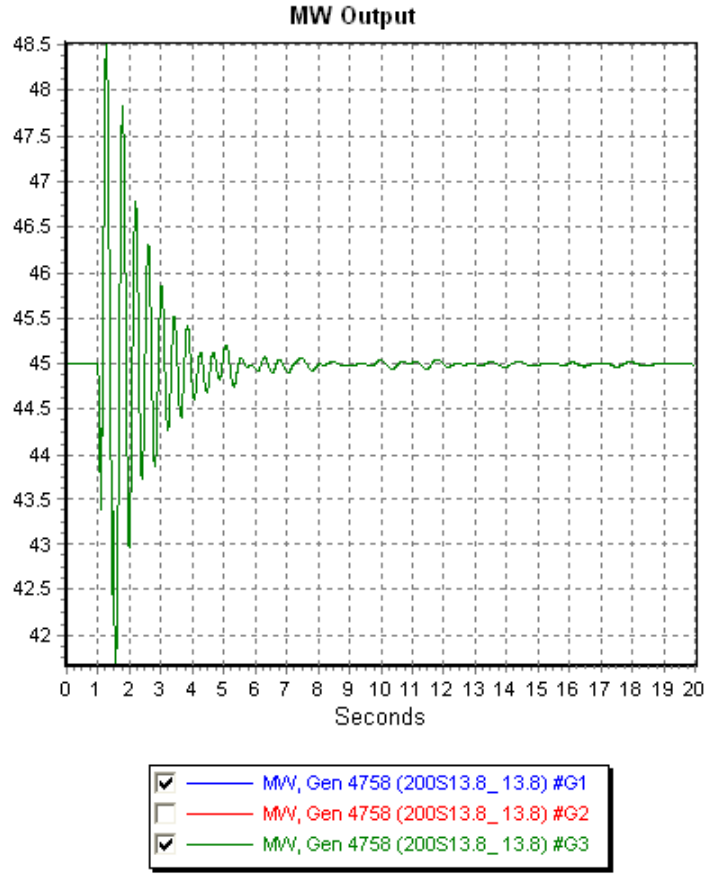
Langdon SVC
Queenstown Generating Plant Output: 90MW

September 26, 2014 15:46:53

Queenstown Gen





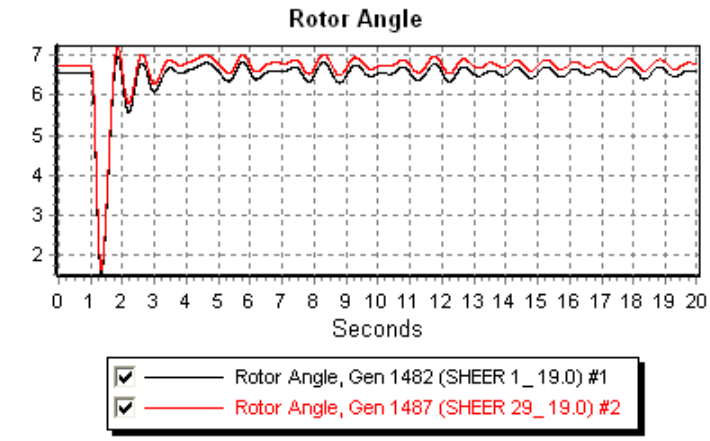


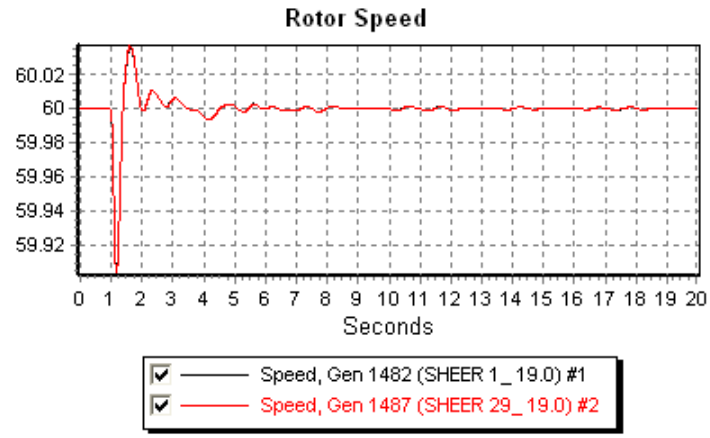
Contingency: 180L Ft.McLeod 15S to Vulcan 255S

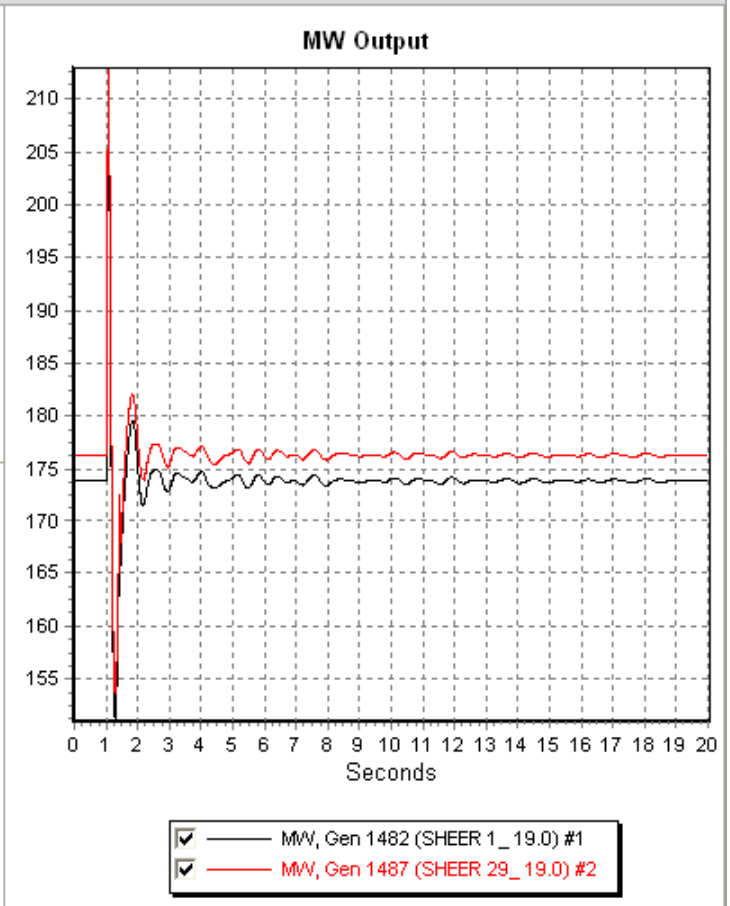
P1336
Queenstown Generating Plant
Output: 90MW

September 26, 2014 15:46:51

Sheerness





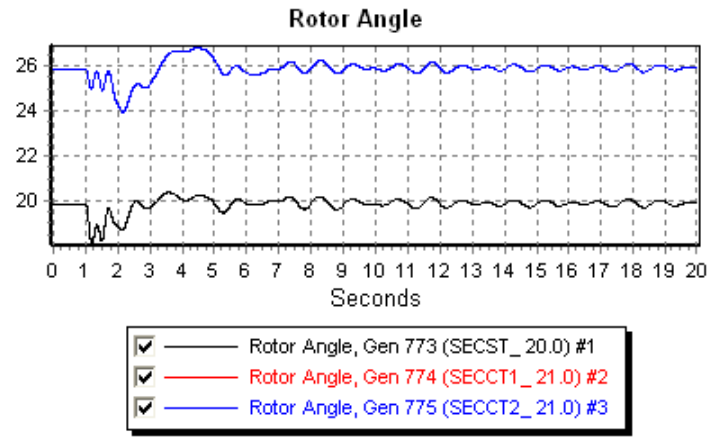


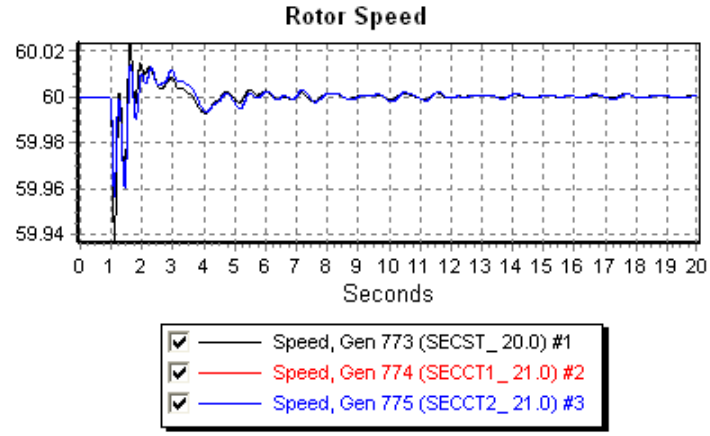
Contingency: 180L Ft.McLeod 15S to Vulcan 255S

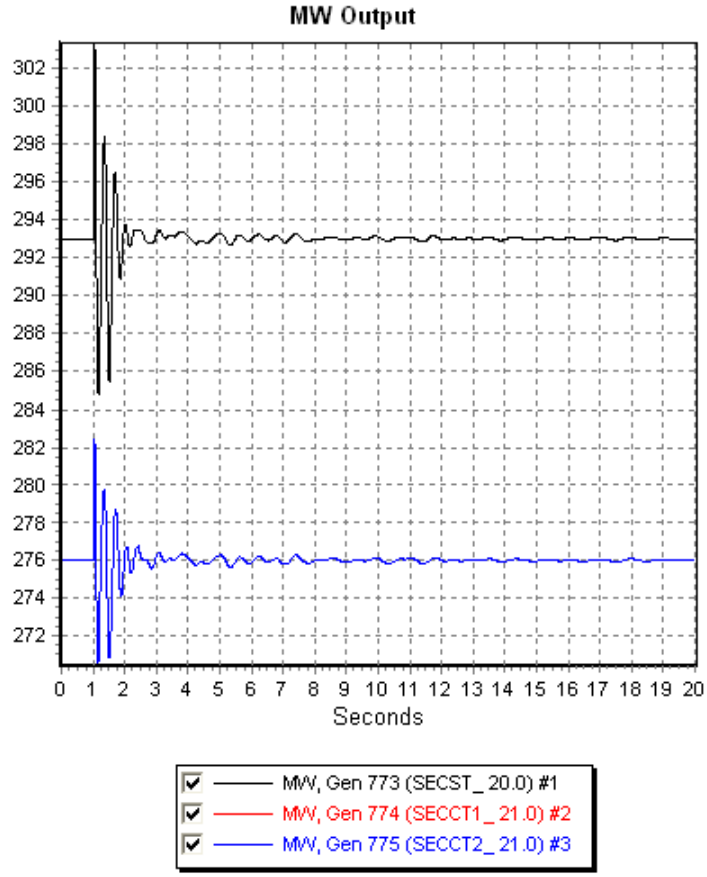
Sheerness
Queenstown Generating Plant Output: 90MW

September 26, 2014 15:46:50

Sheppard





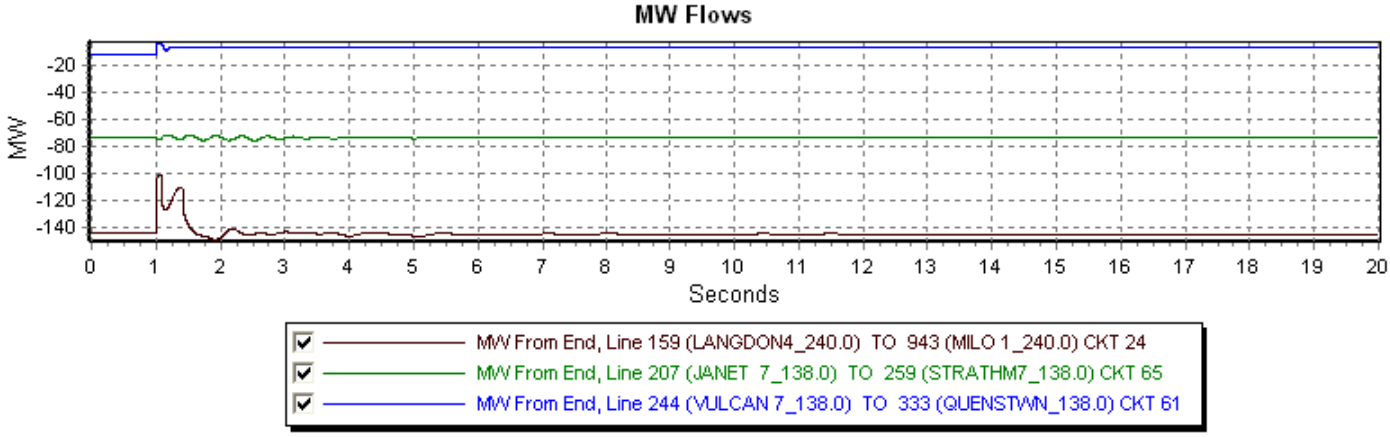


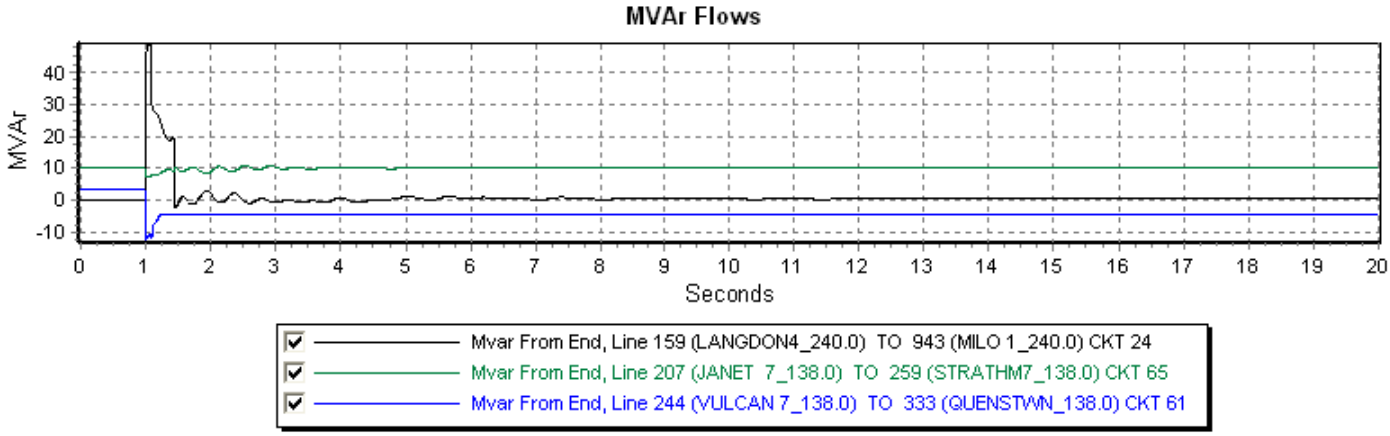
Contingency: 180L Ft.McLeod 15S to Vulcan 255S

Sheppard
Queenstown Generating Plant Output: 90MW

September 26, 2014 15:46:51

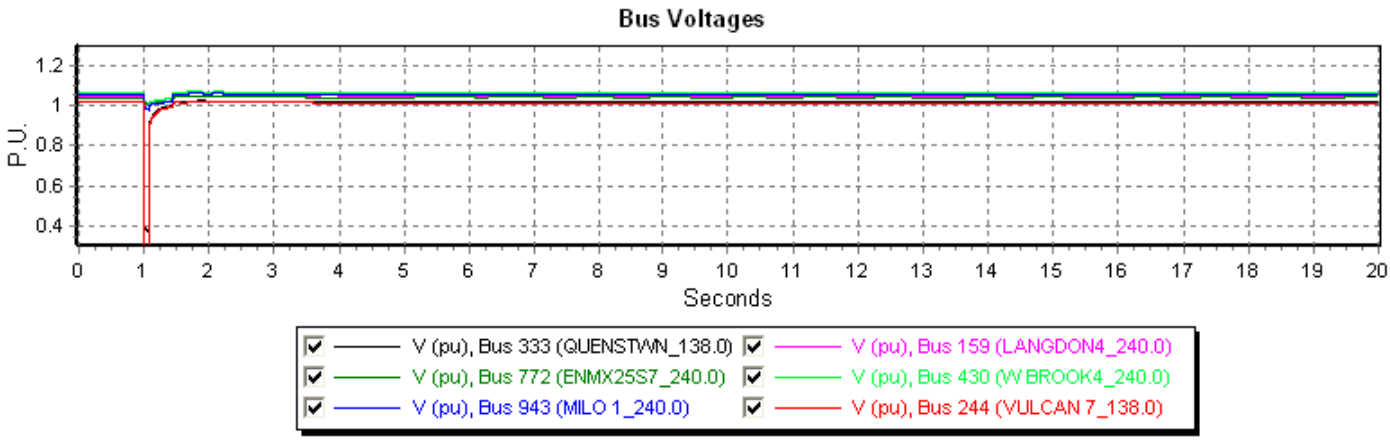
Branch Flows

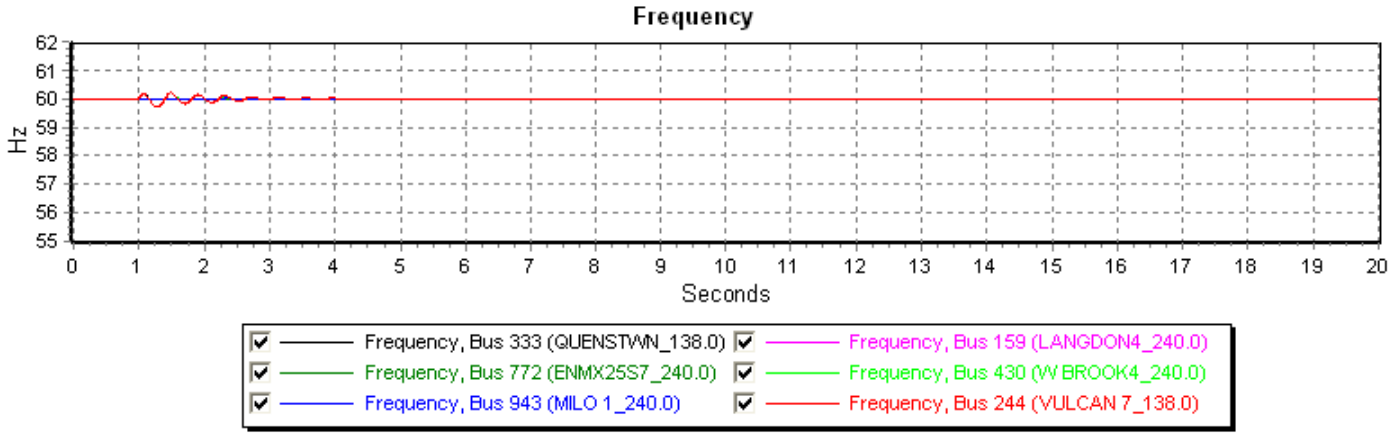




	Contingency: 180L Vulcan 255S to Ft.McLeod 15S	Branch Flows Queenstown Generating Plant Output: 90MW September 26, 2014 15:52:13

Bus Voltages and Frequency



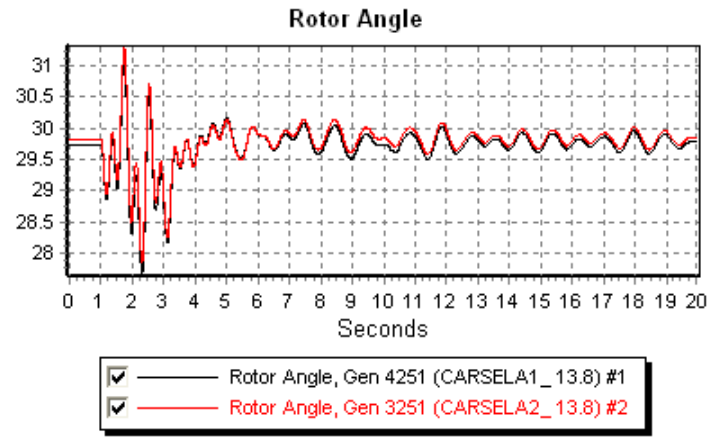


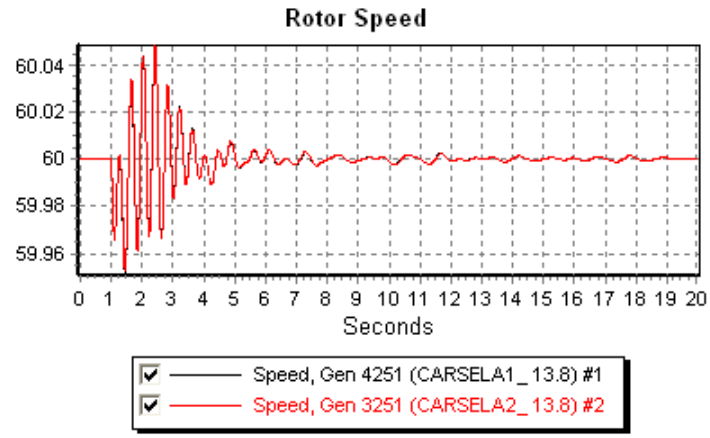
Contingency: 180L Vulcan 255S to Ft.McLeod 15S

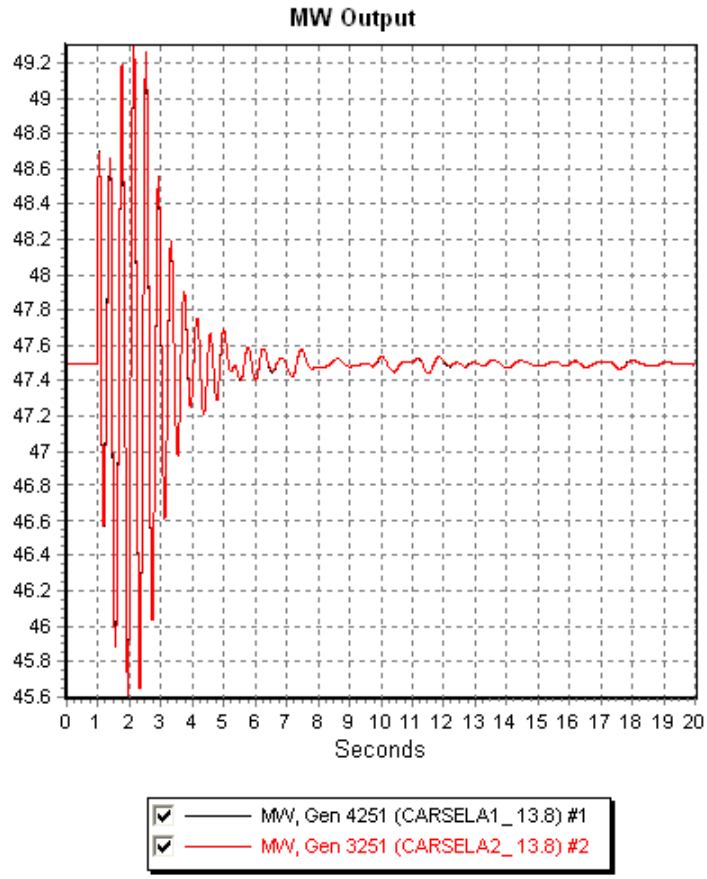
Bus Voltages and Frequency
Queenstown Generating Plant Output: 90MW

September 26, 2014 15:52:14

Carseland





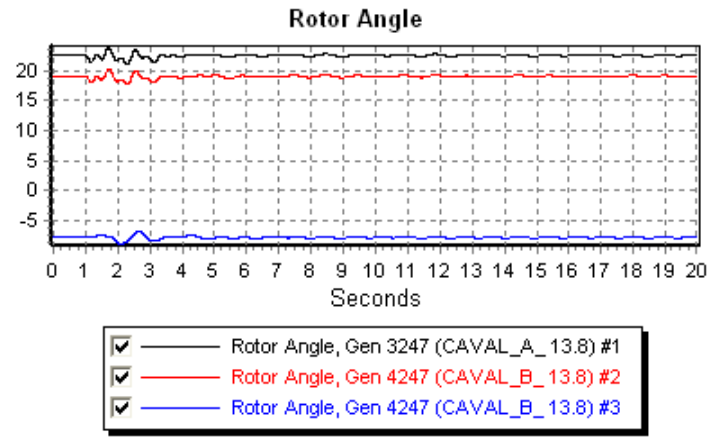


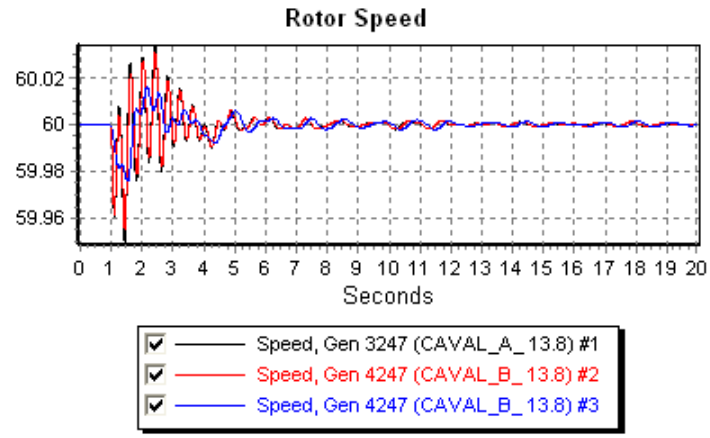
Contingency: 180L Vulcan 255S to Ft.McLeod 15S

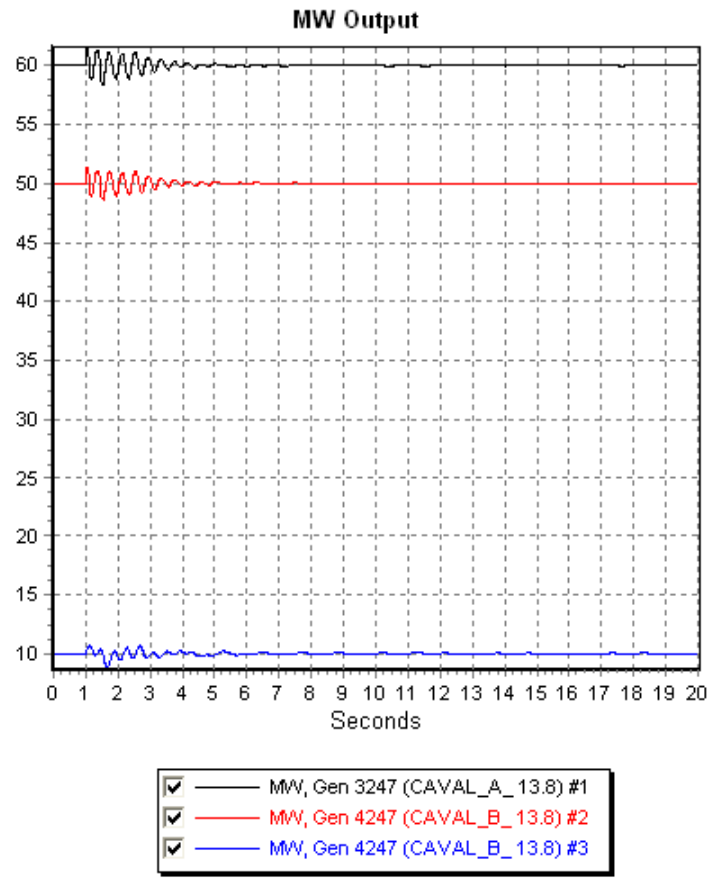
Carseland
Queenstown Generating Plant Output: 90MW

September 26, 2014 15:52:11

Cavalier





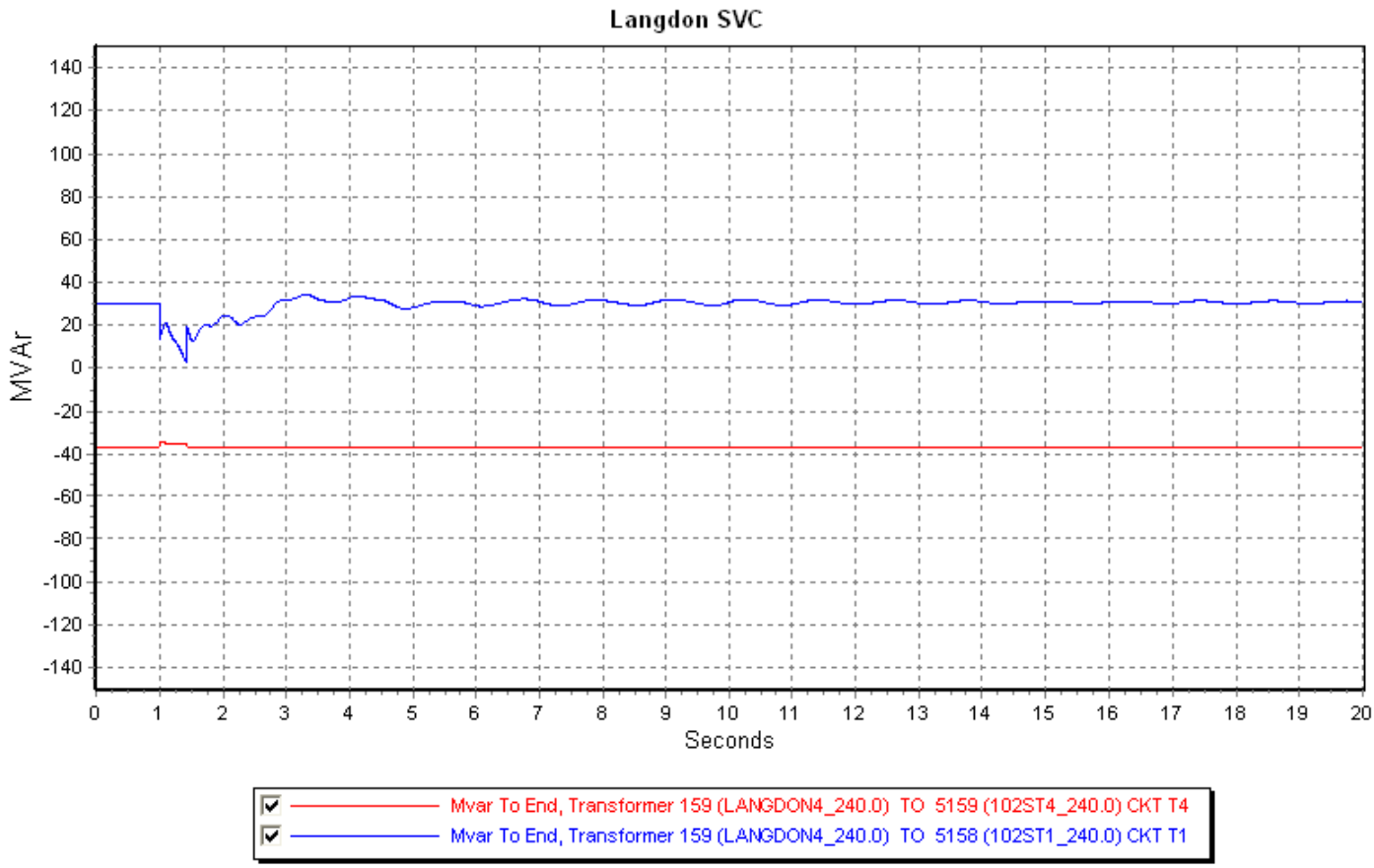


Contingency: 180L Vulcan 255S to Ft.McLeod 15S

Cavalier
Queenstown Generating Plant Output: 90MW

September 26, 2014 15:52:13

Langdon SVC

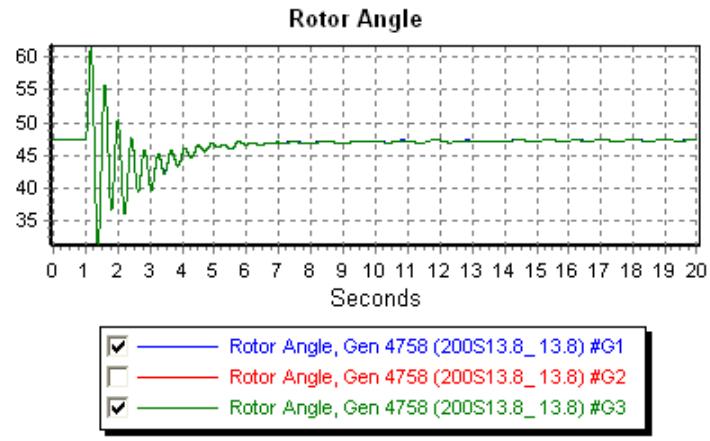


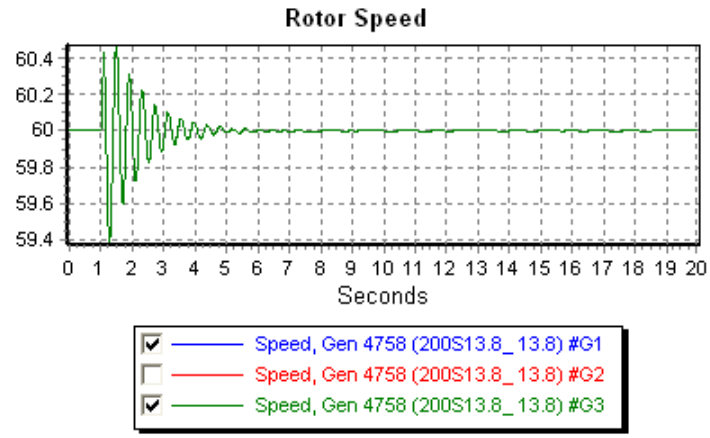
Contingency: 180L Vulcan 255S to Ft.McLeod 15S

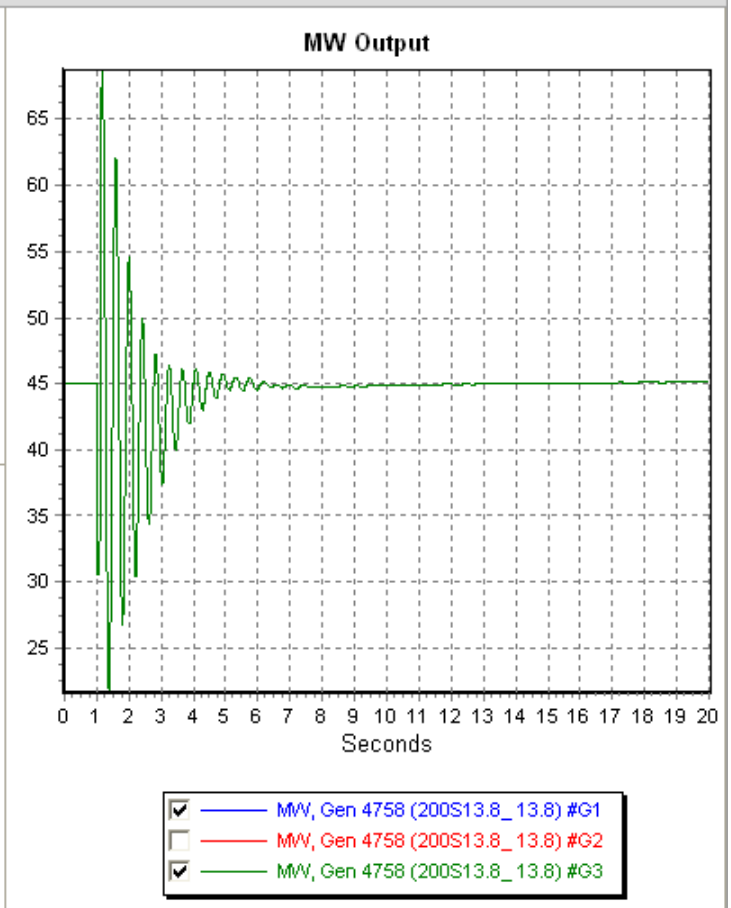
Langdon SVC
Queenstown Generating Plant Output: 90MW

September 26, 2014 15:52:14

Queenstown Gen





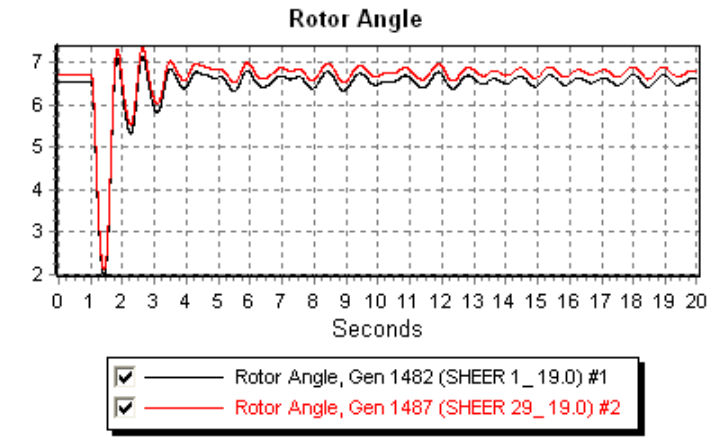


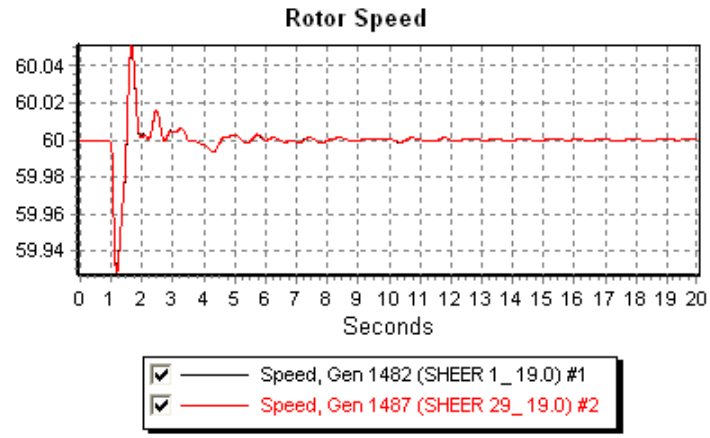
Contingency: 180L Vulcan 255S to Ft.McLeod 15S

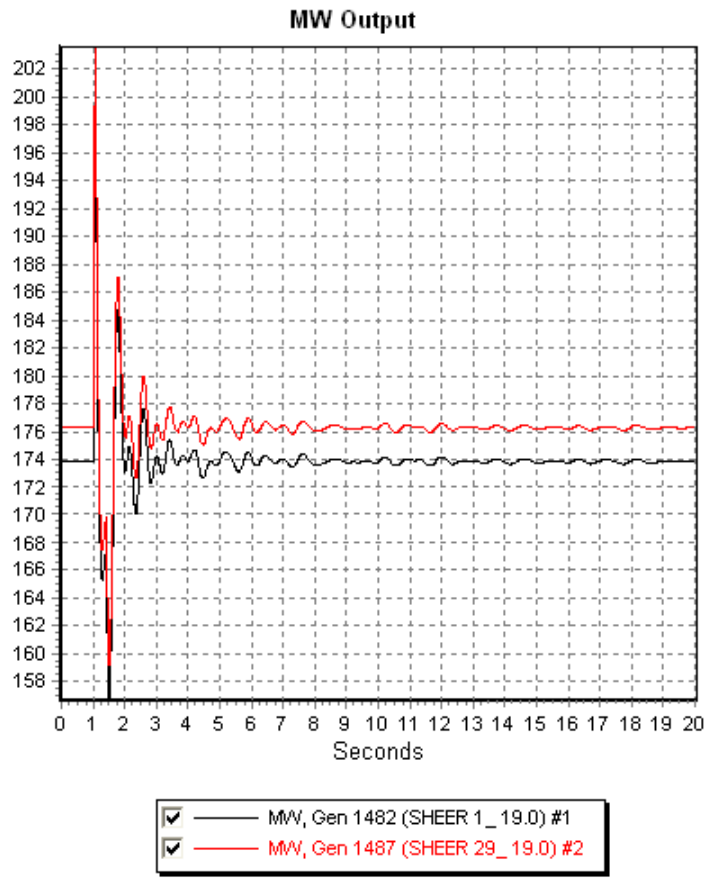
P1336
Queenstown Generating Plant
Output: 90MW

September 26, 2014 15:52:12

Sheerness





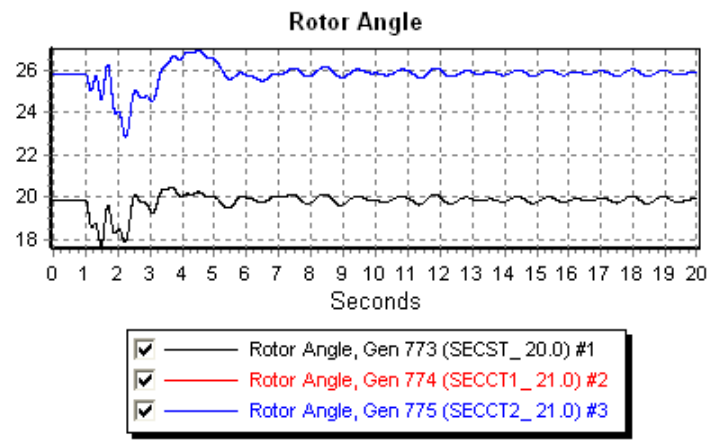


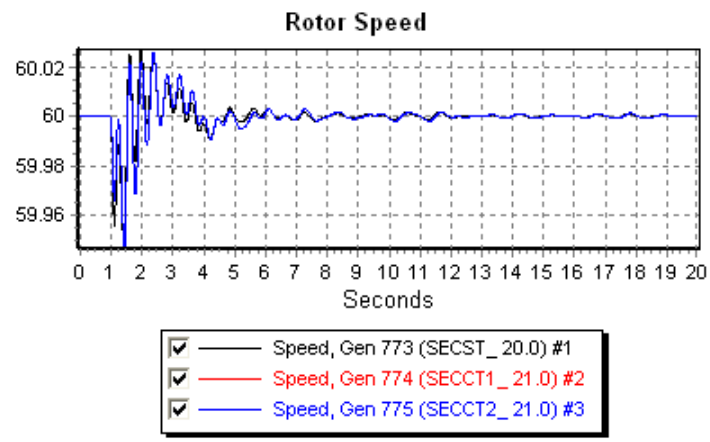
Contingency: 180L Vulcan 255S to Ft.McLeod 15S

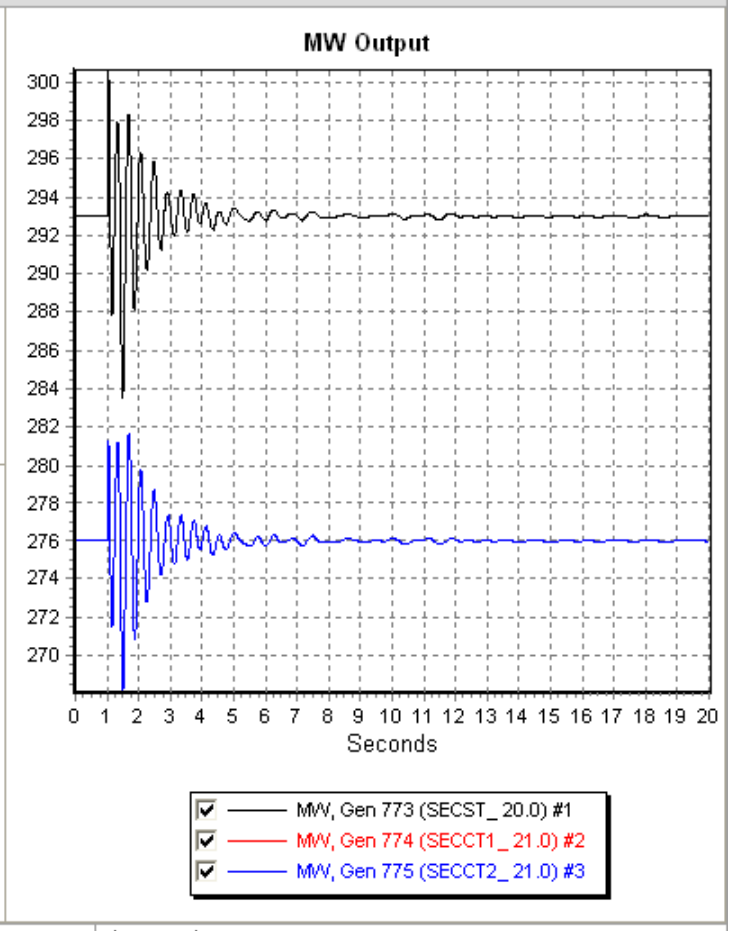
Sheerness
Queenstown Generating Plant Output: 90MW

September 26, 2014 15:52:10

Sheppard







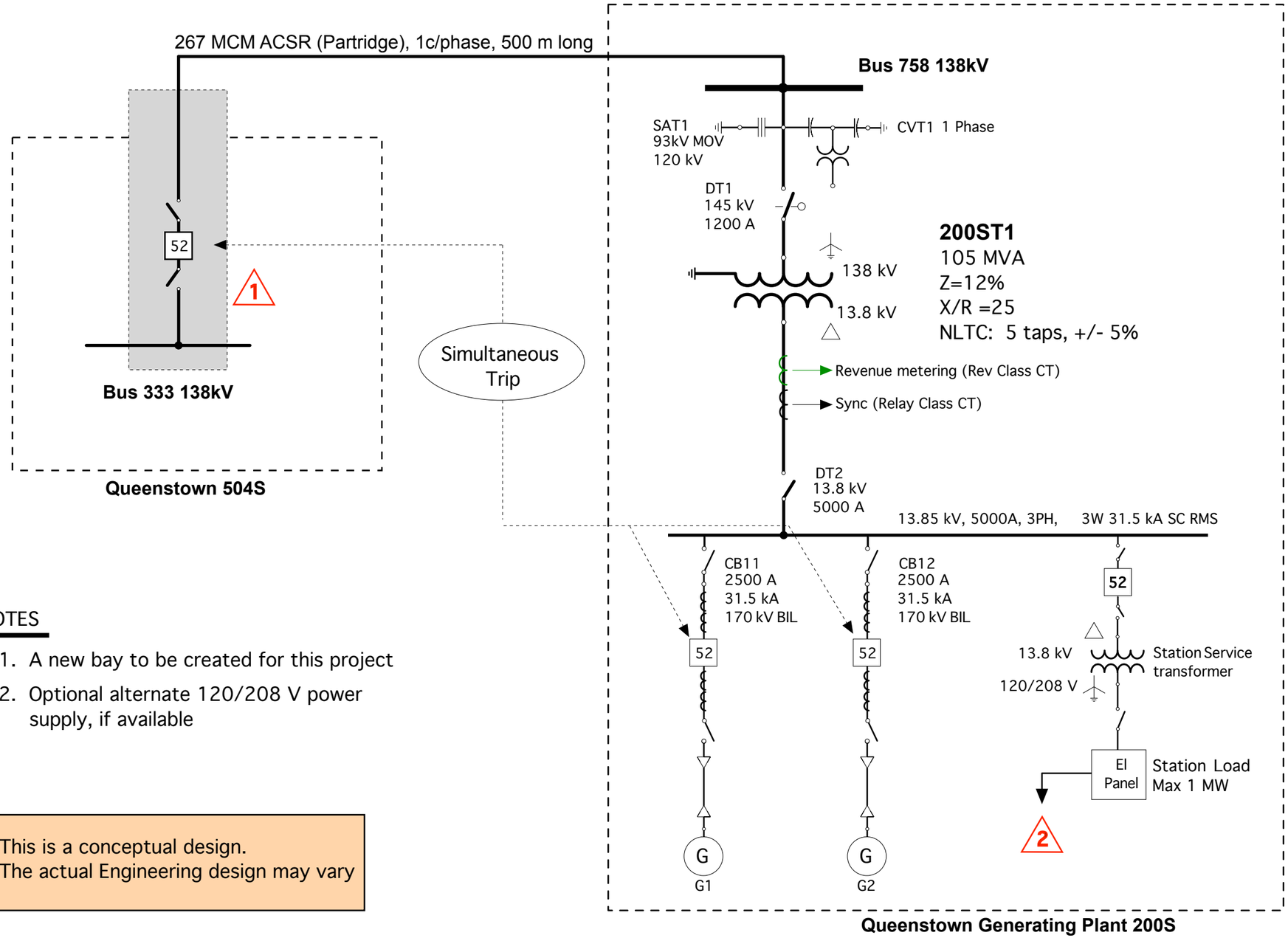
Contingency: 180L Vulcan 255S to Ft.McLeod 15S

Sheppard
Queenstown Generating Plant Output: 90MW

September 26, 2014 15:52:11

Attachment F

Queenstown Generation Plant Connection SLD



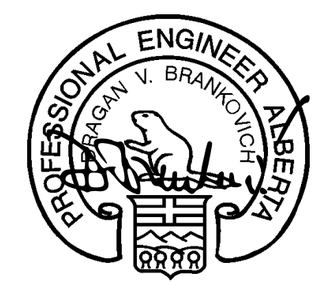
LEGEND

- Underground Cable
- Transformer
- 52 Circuit Breaker
- Air Break Switch
- # Note

NOTES

1. A new bay to be created for this project
2. Optional alternate 120/208 V power supply, if available

This is a conceptual design.
The actual Engineering design may vary



March 5, 2013

Rev	Date	Description	Designed By	Reviewed By
0	Feb 23, 2013		D.Brankovich, P.Eng.	D. Brankovich, P.Eng.

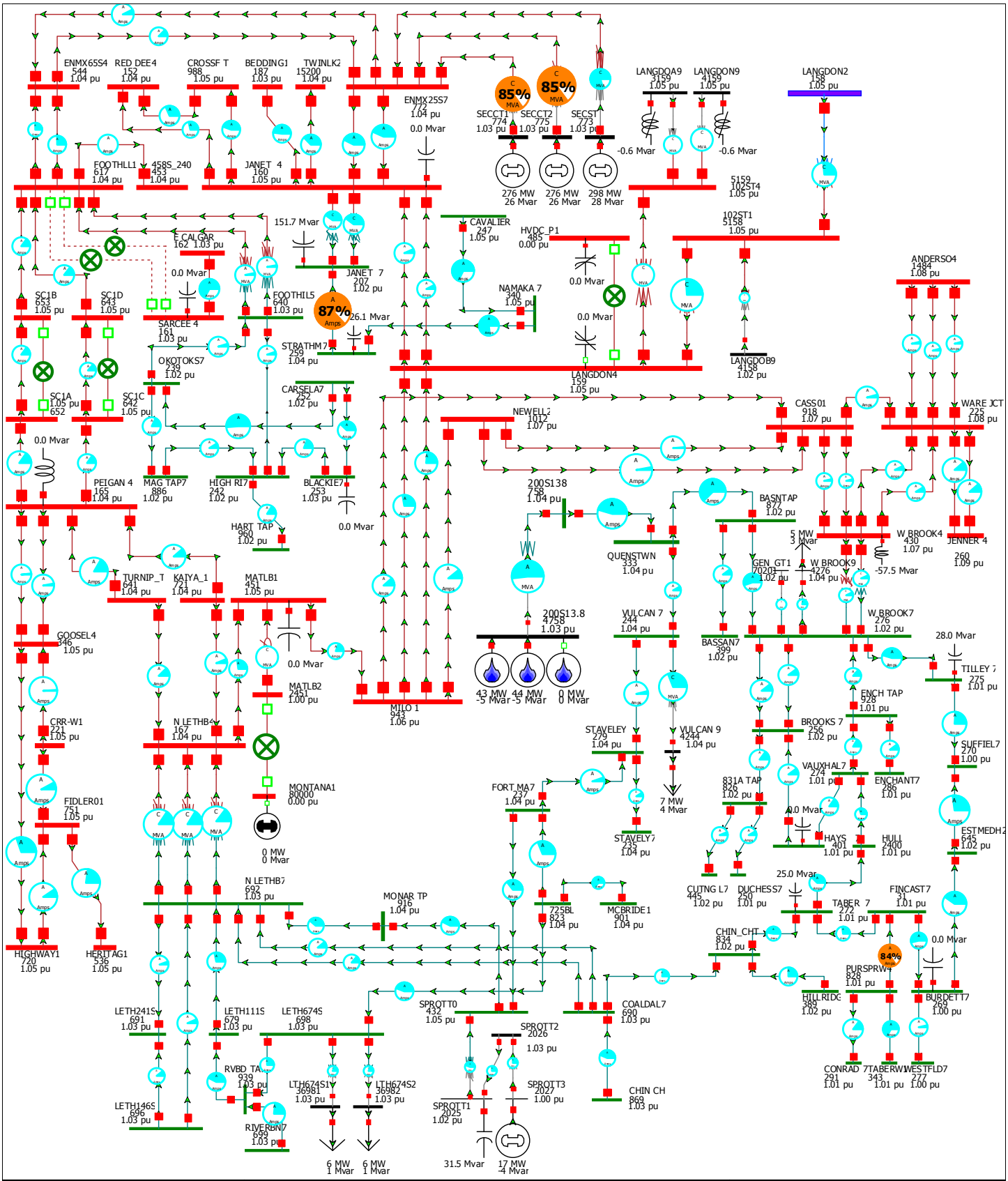
NOT FOR CONSTRUCTION

Client	Project	Drawing Title	Drawing No
BowArk Energy Ltd.	Queenstown Generation Plant	Substation 200S-Conceptual SLD	EL-1

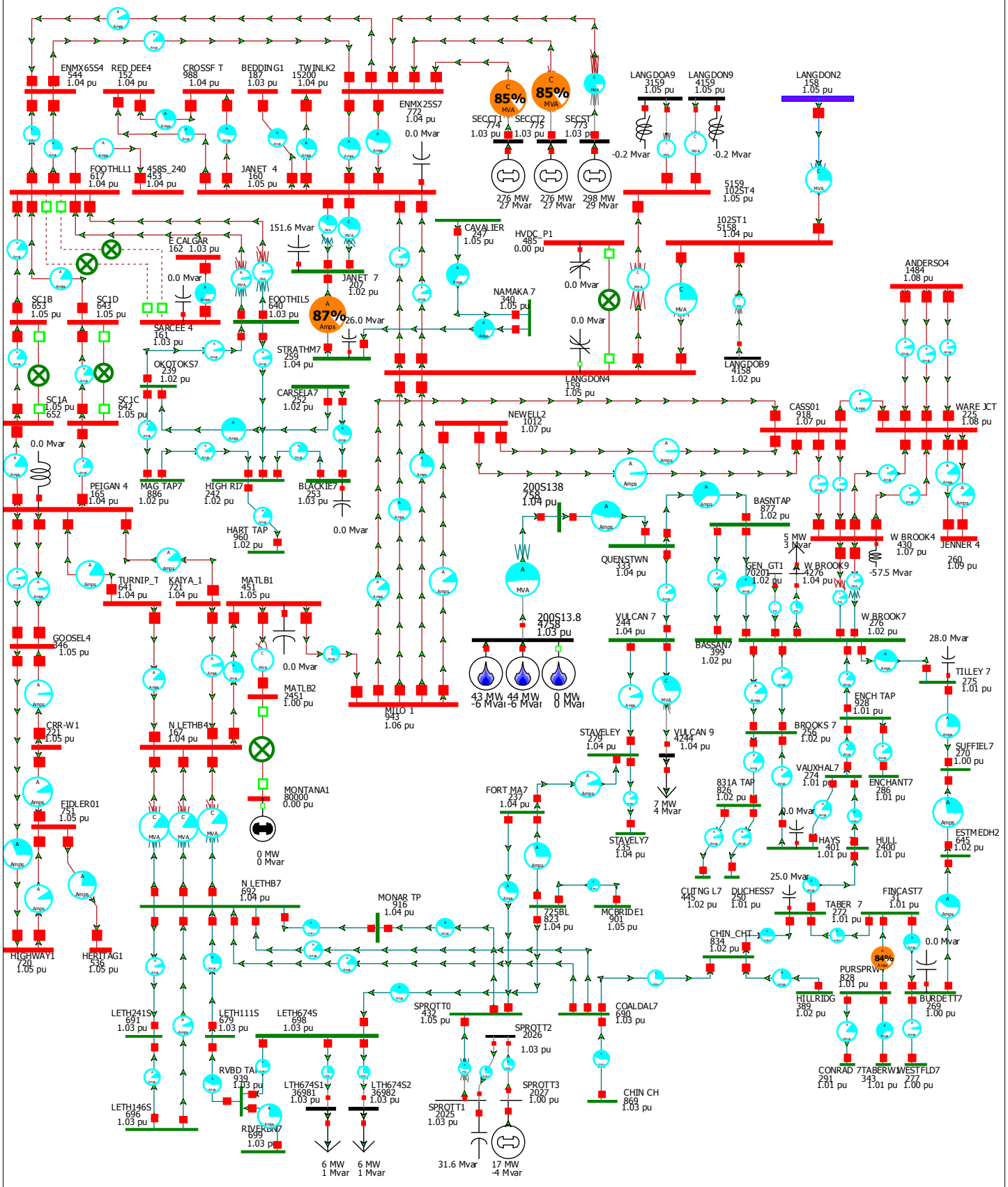
PowerEN Corporation

Attachment G

Connection Alternative 1: Power Flow Analysis Results



PowerEN Corporation D.Brankovich	Post-connection system state, Alternative 1, Study case: 2015SL	Category A Power Flows PF-03 11/5/2014



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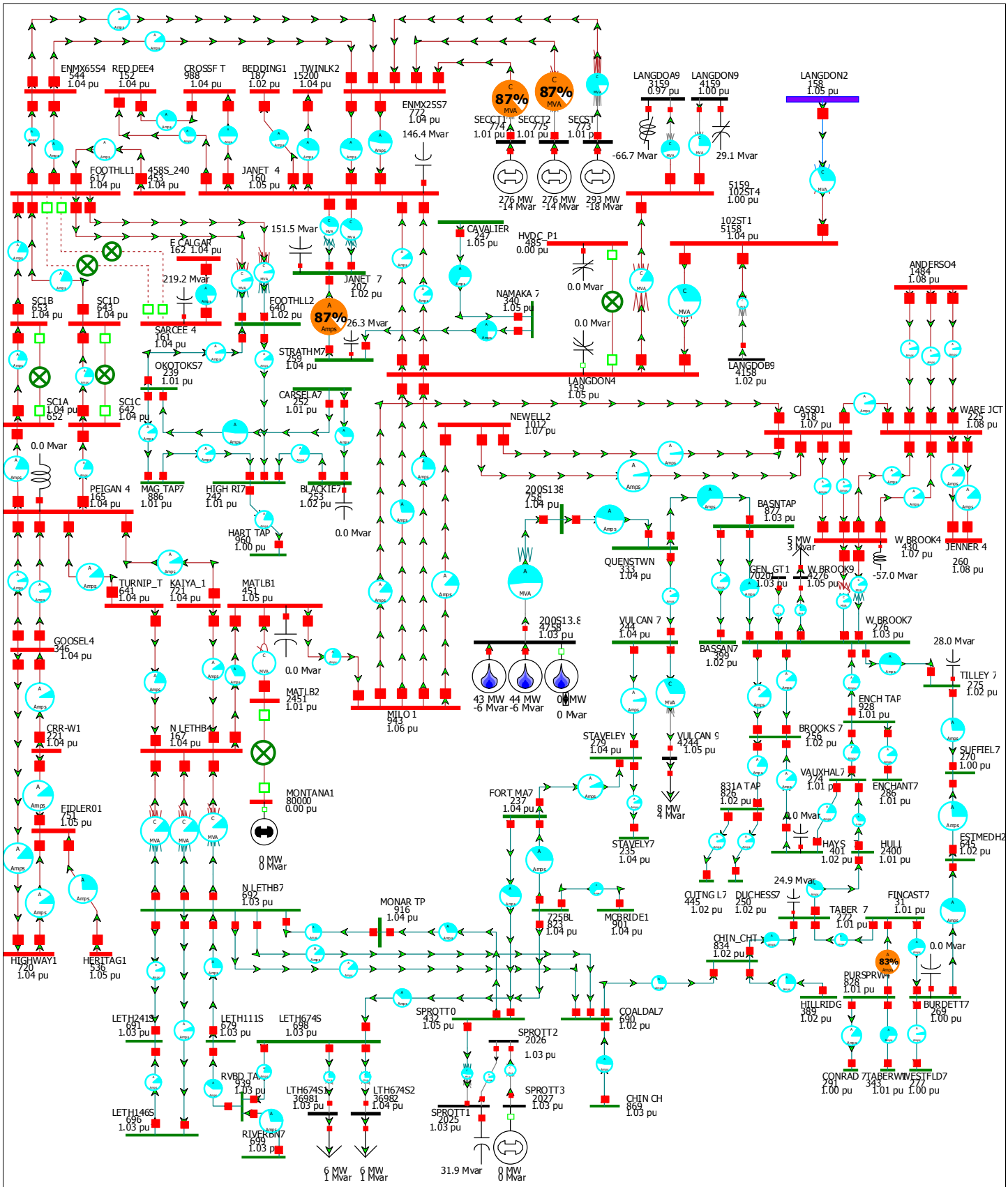
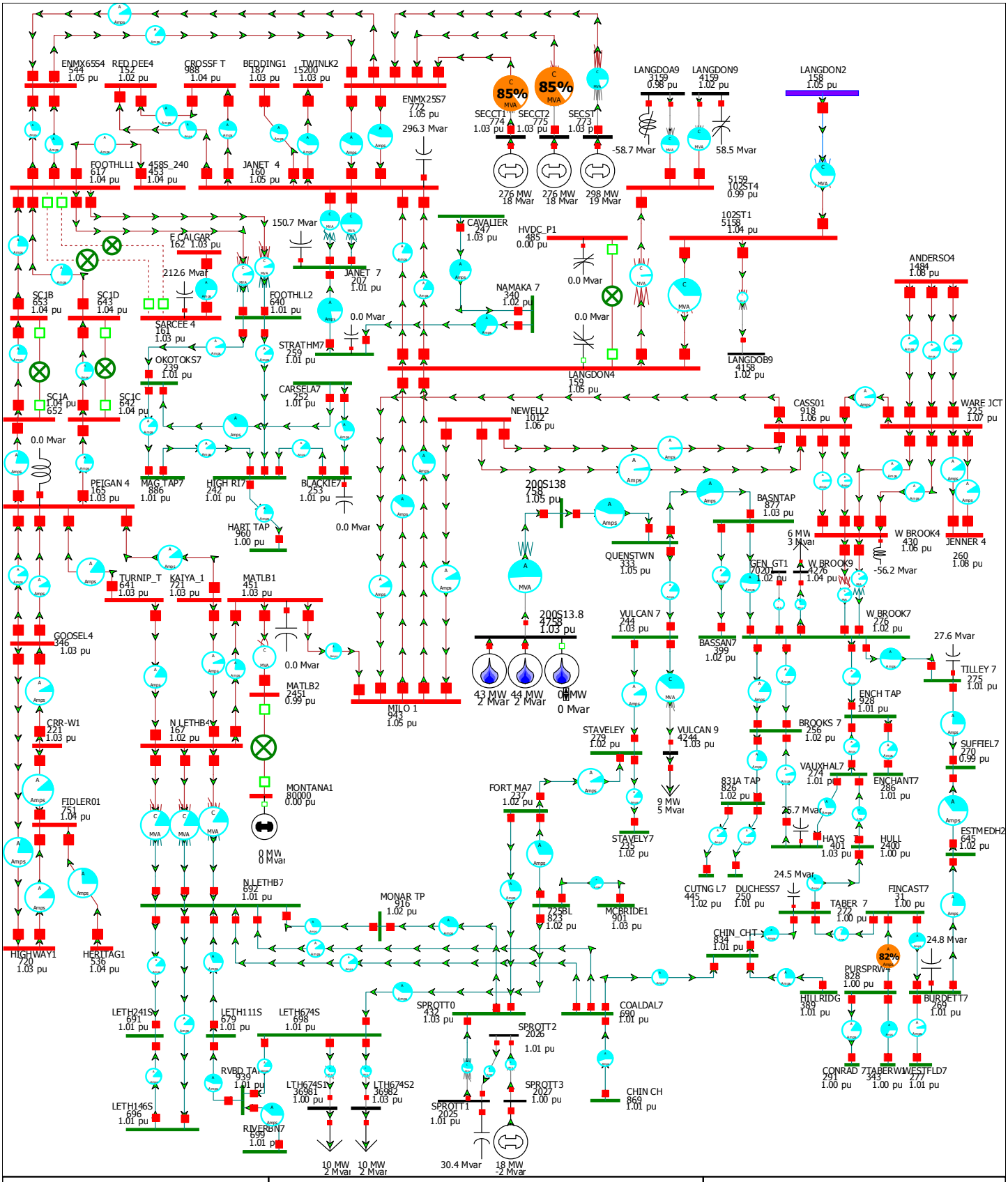


PowerEN Corporation D.Brankovich	Post-connection stste, Alternative 1 Study case: 2017SL	Category A Power Flows PF-05 11/5/2014



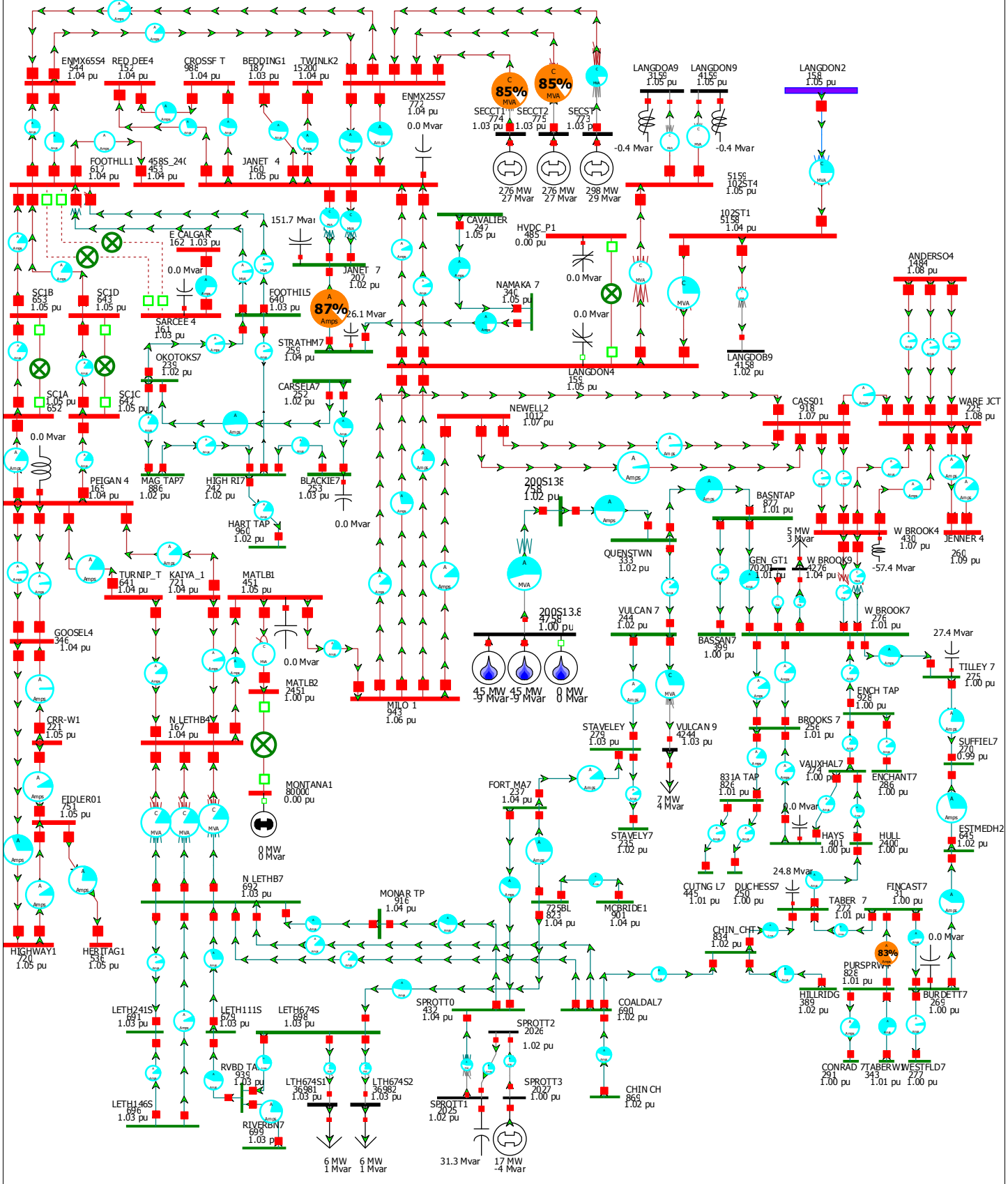
PowerEN Corporation D.Brankovich	Post-connection state, Alternative 1 Sudy Case: 2017SP	Category A Power Flows PF-06 11/5/2014

Attachment I

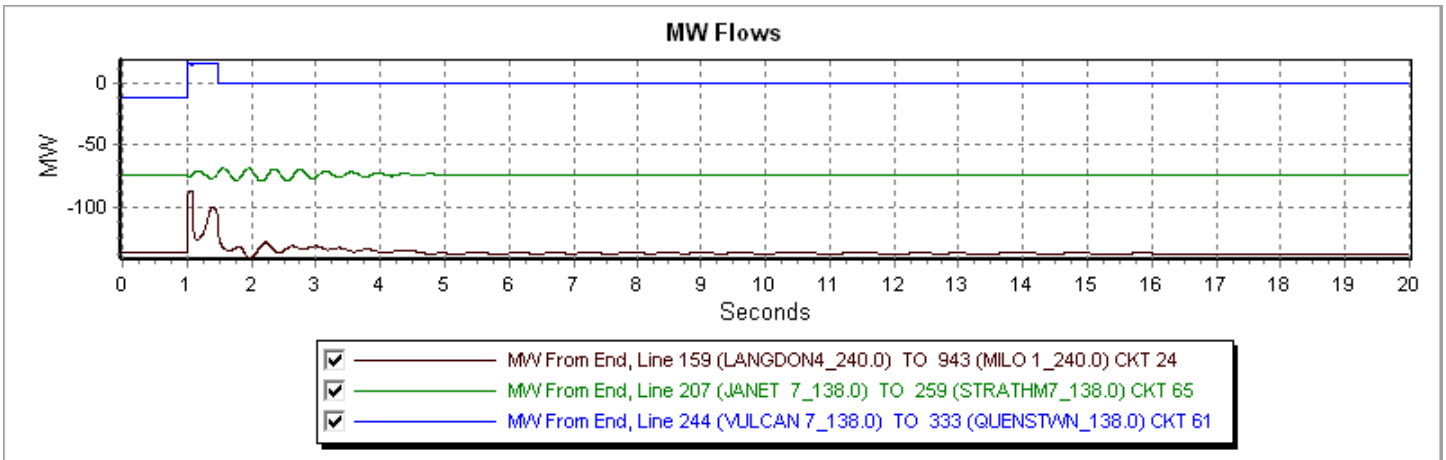
Transient Stability Analysis Results for Connection Alternative 1 after Blackie Area Upgrade

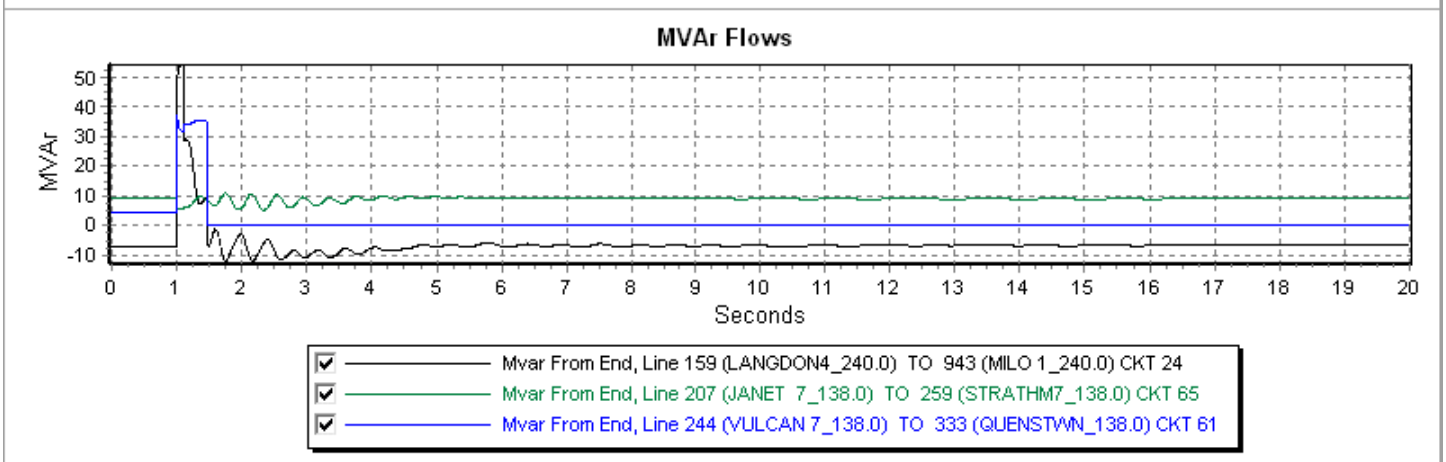
2015

2015 SL

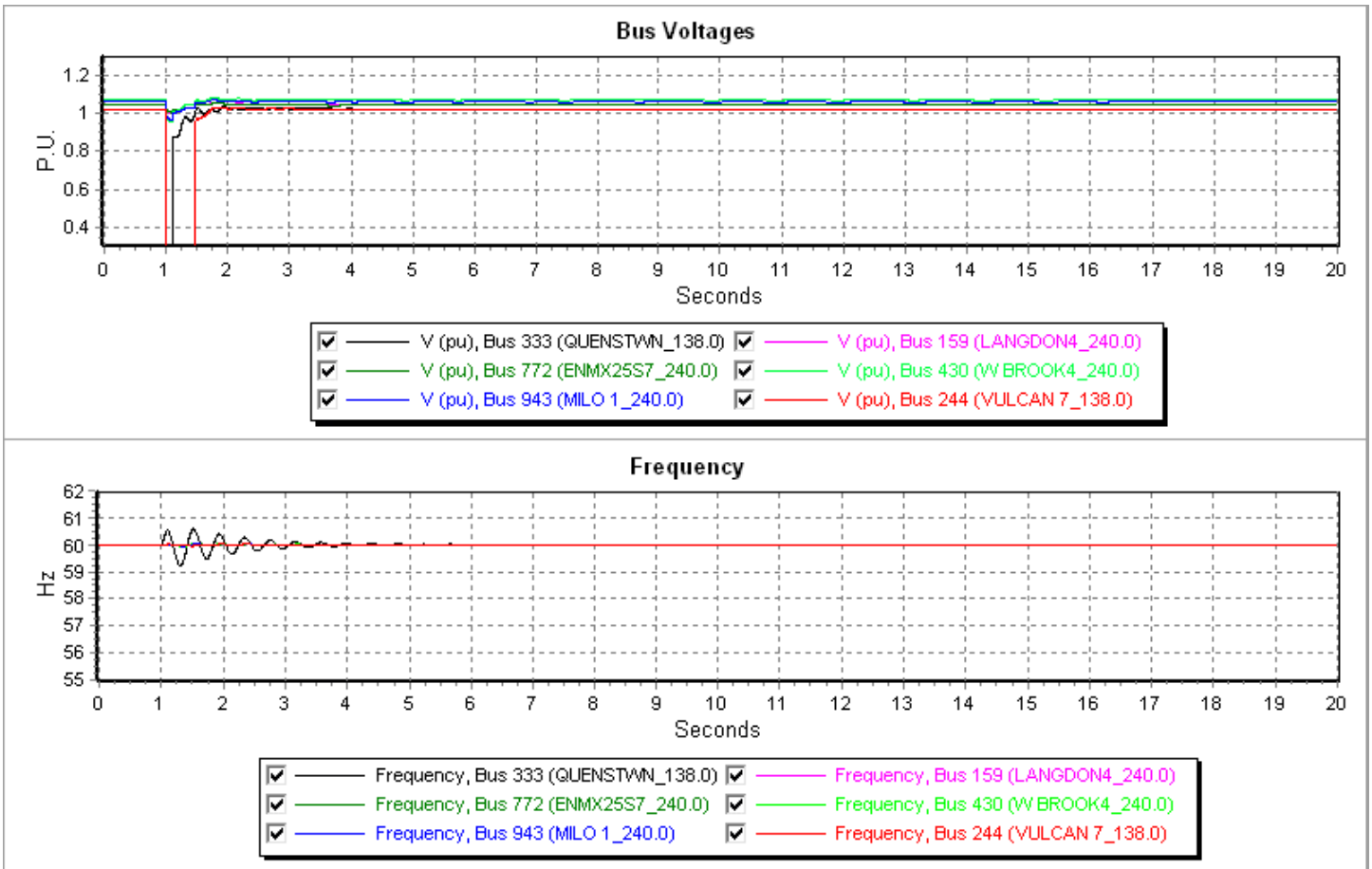


PowerEN Corporation D.Brankovich	Post-connection sate, Alternative1 Study Case: 2015SL	Transient Stability Initial Conditions TS-01 11/5/2014





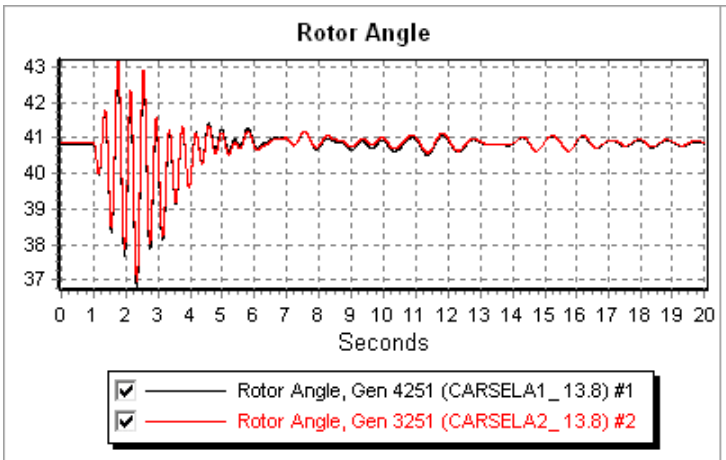
Contingency: 161L QUEENSTOWN 504S - VULCAN 255S	Branch Flows Queenstown Generating Plant Output: 90MW
	May 11, 2014 08:25:32

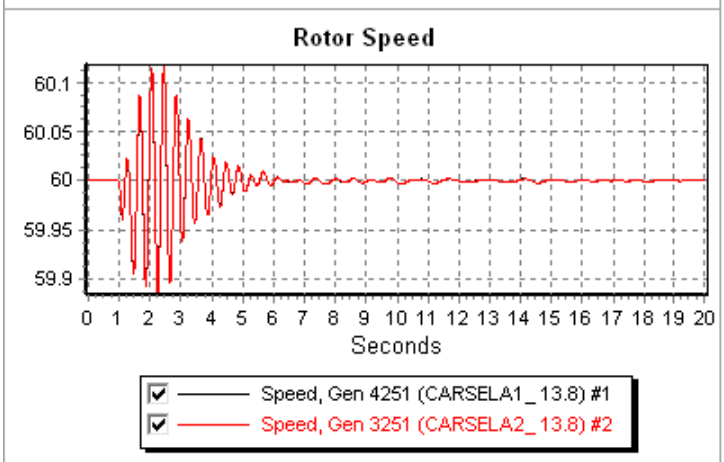


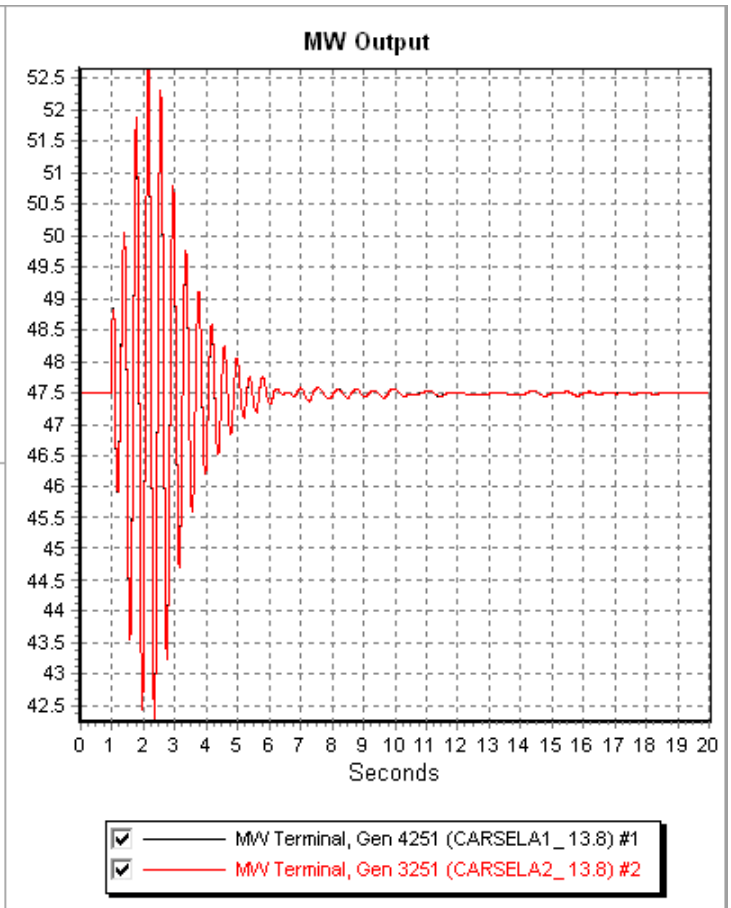
Contingency: 161L QUEENSTOWN 504S - VULCAN 255S

Bus Voltages and Frequency
Queenstown Generating Plant Output: 90MW

May 11, 2014 08:25:32



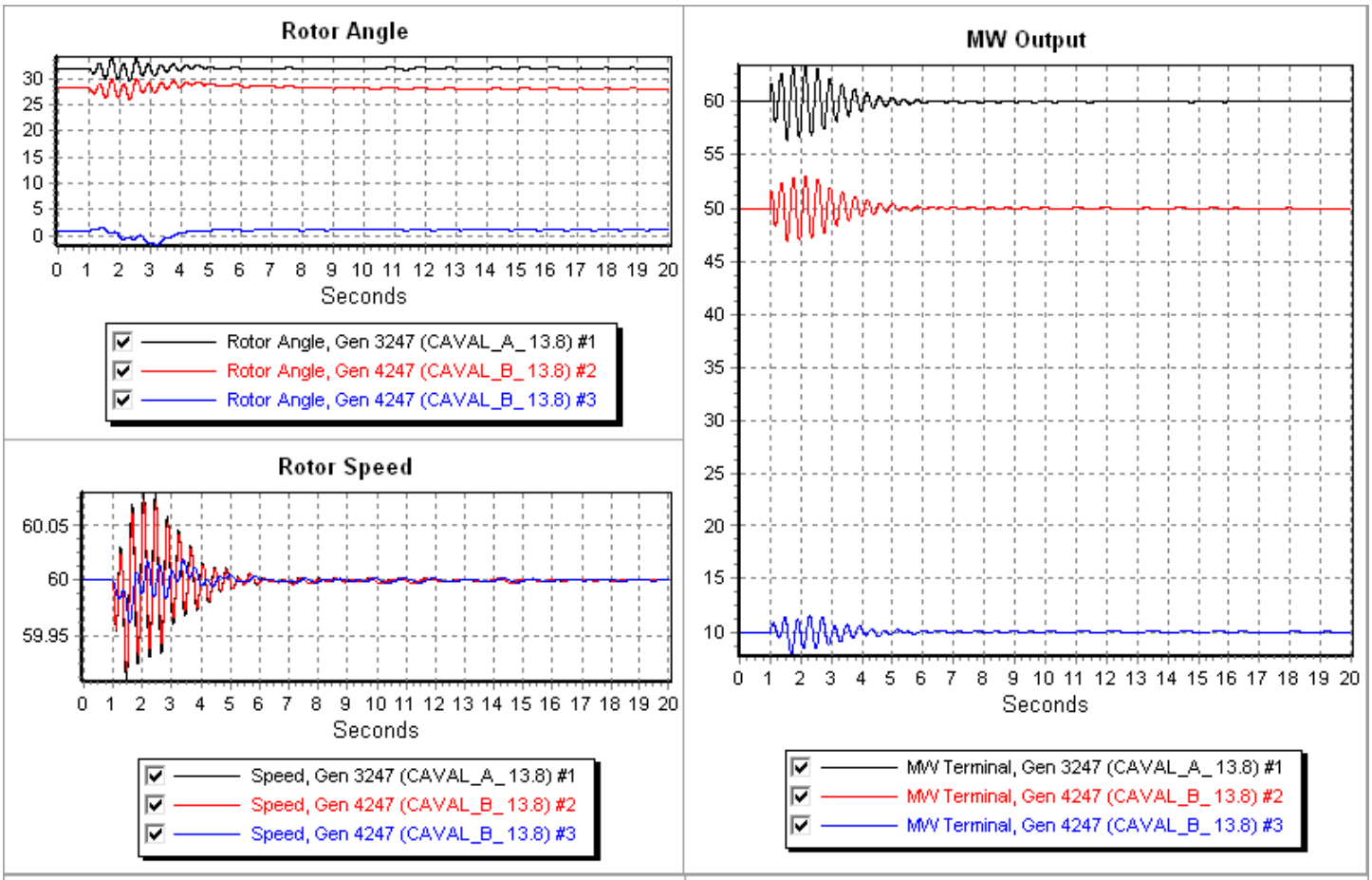




Contingency: 161L QUEENSTOWN 504S - VULCAN 255S

Carseland
Queenstown Generating Plant Output: 90MW

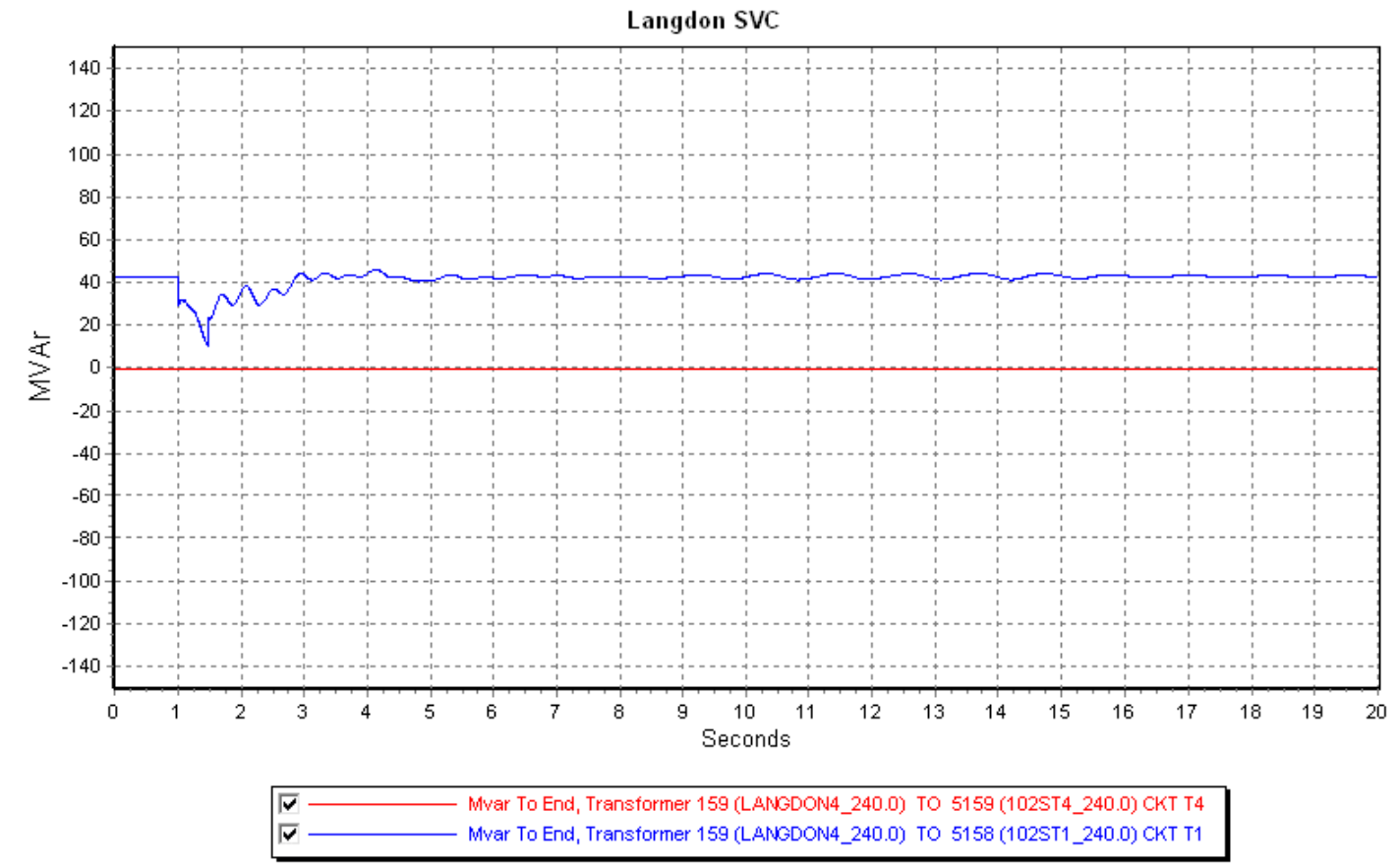
May 11, 2014 08:25:29



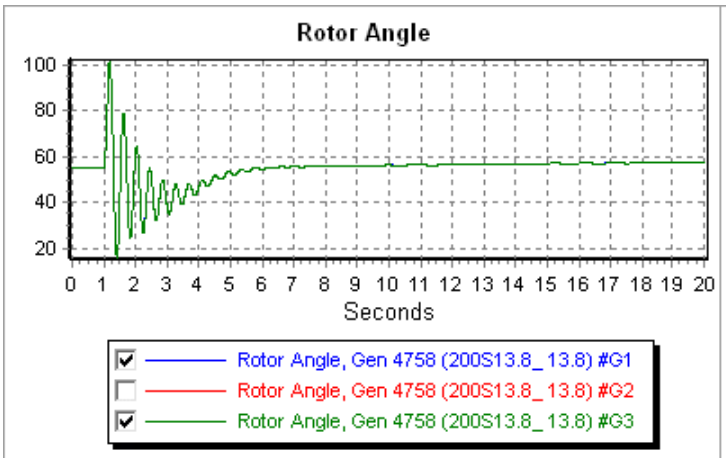
Contingency: 161L QUEENSTOWN 504S - VULCAN 255S

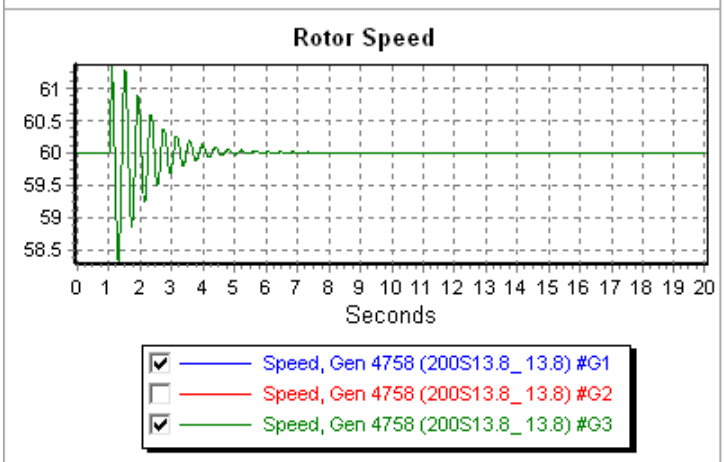
Cavalier
Queenstown Generating Plant Output: 90MW

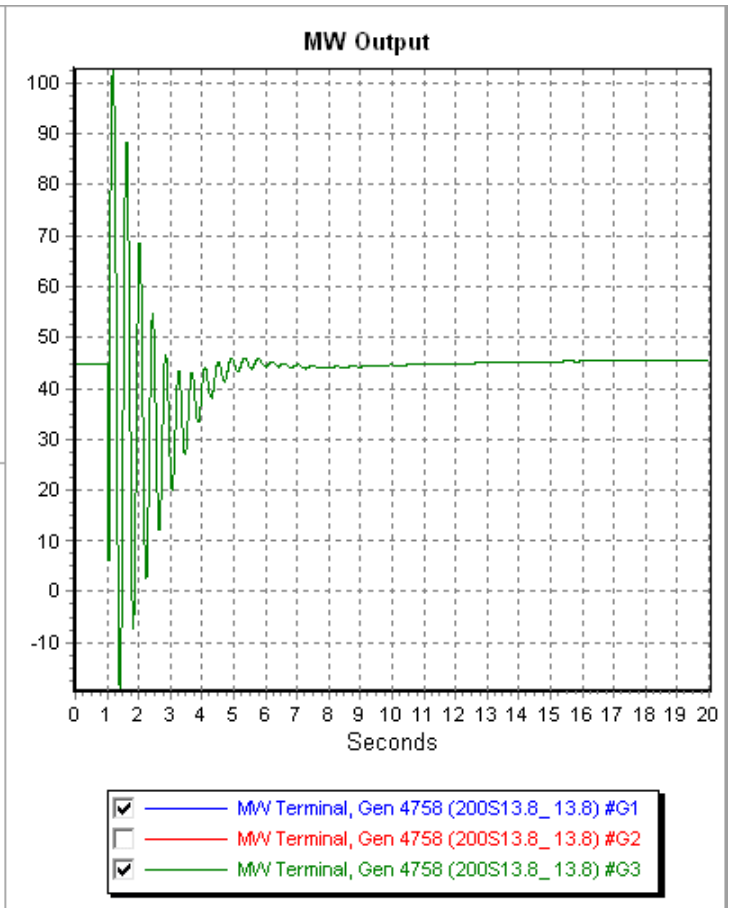
May 11, 2014 08:25:31



Contingency: 161L QUEENSTOWN 504S - VULCAN 255S	Langdon SVC Queenstown Generating Plant Output: 90MW
	May 11, 2014 08:25:33



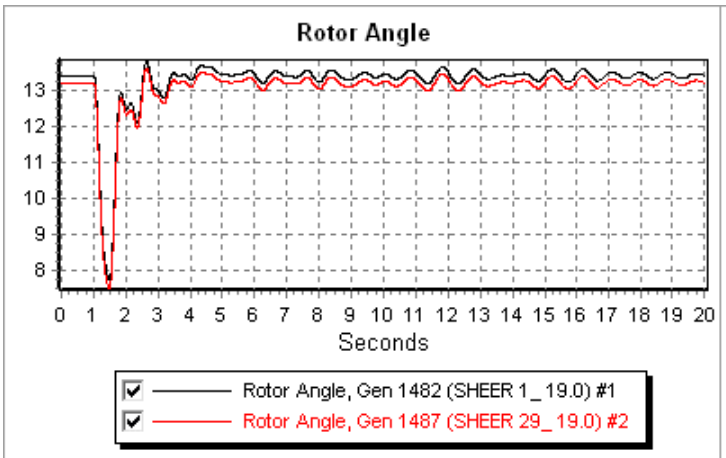


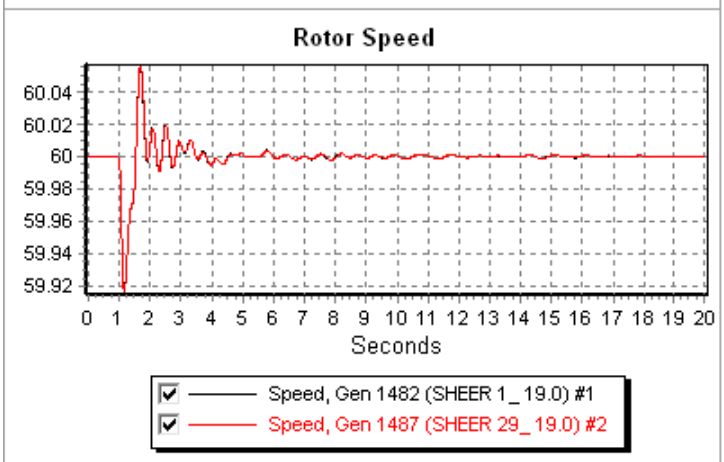


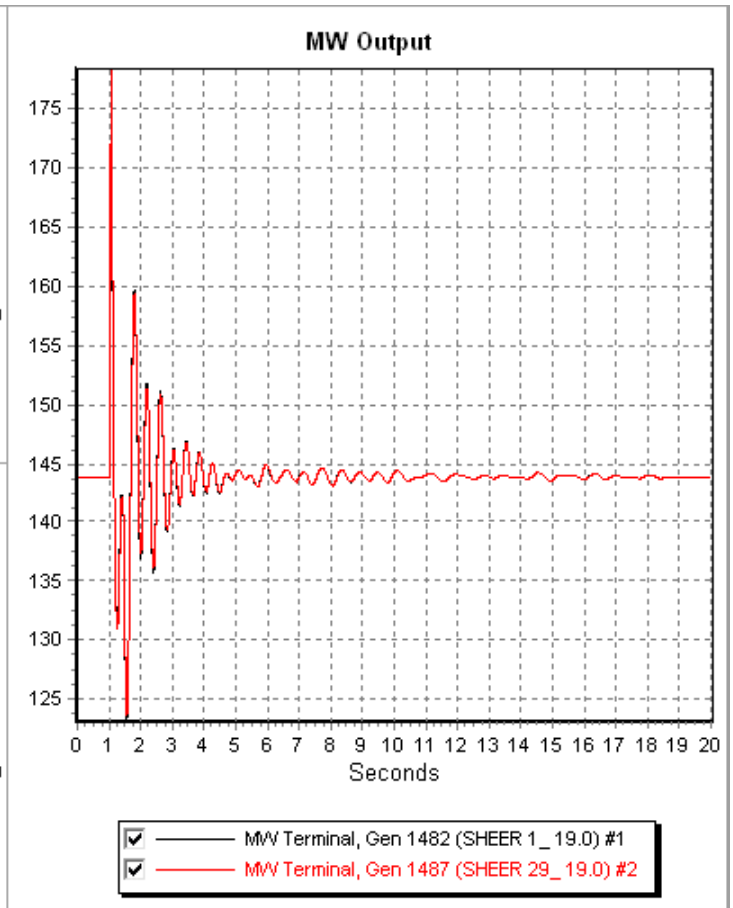
Contingency: 161L QUEENSTOWN 504S - VULCAN 255S

P1336
Queenstown Generating Plant
Output: 90MW

May 11, 2014 08:25:31



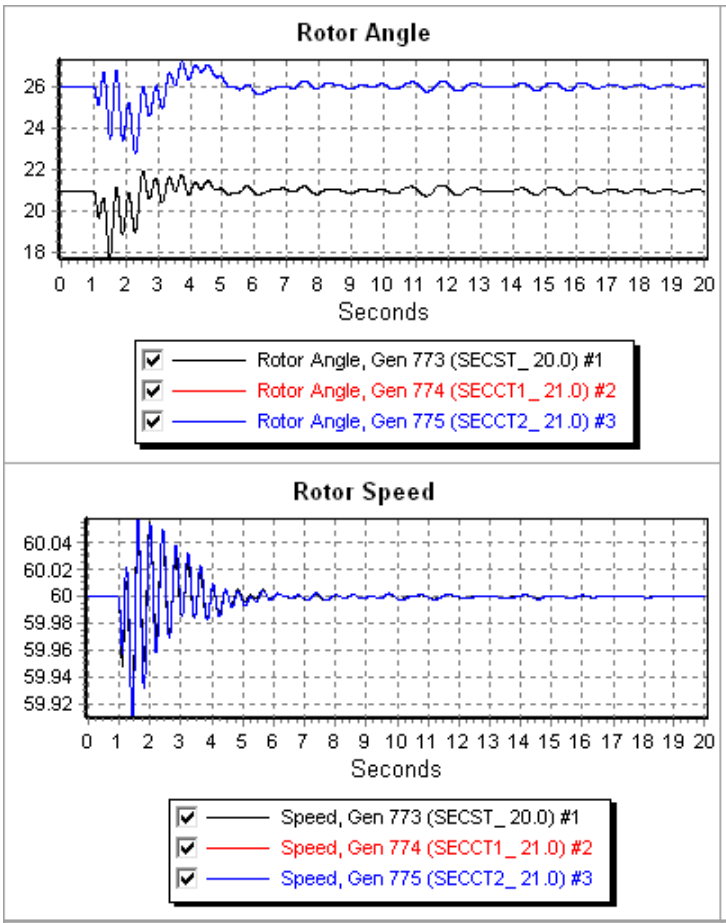


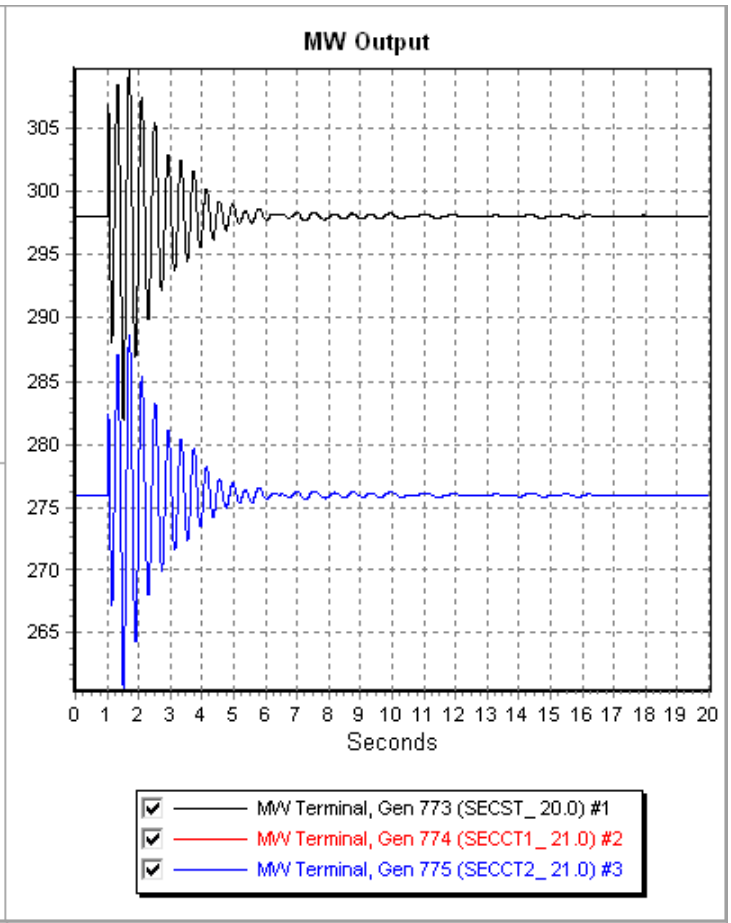


Contingency: 161L QUEENSTOWN 504S - VULCAN 255S

Sheerness
Queenstown Generating Plant Output: 90MW

May 11, 2014 08:25:29



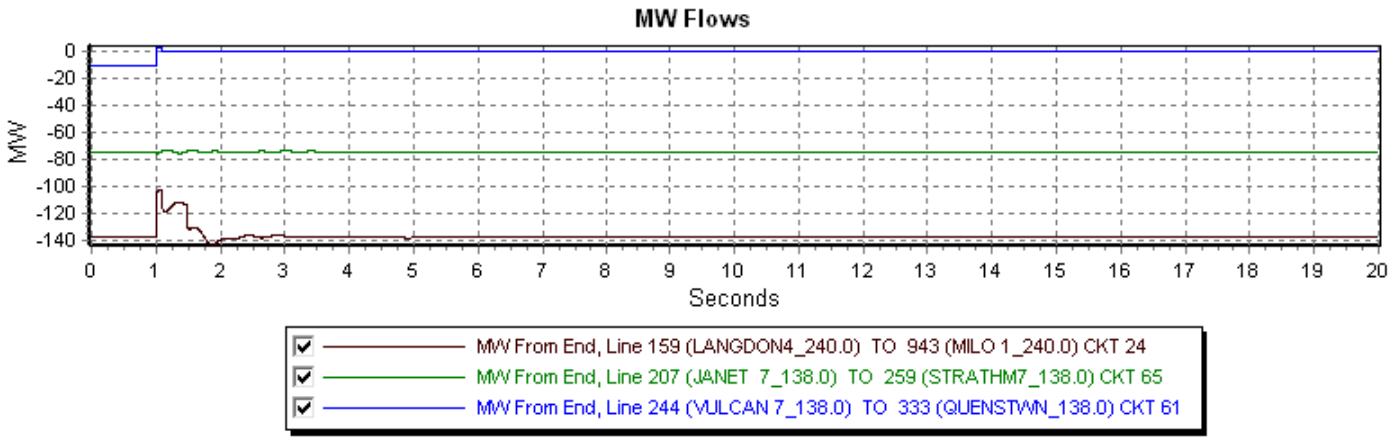


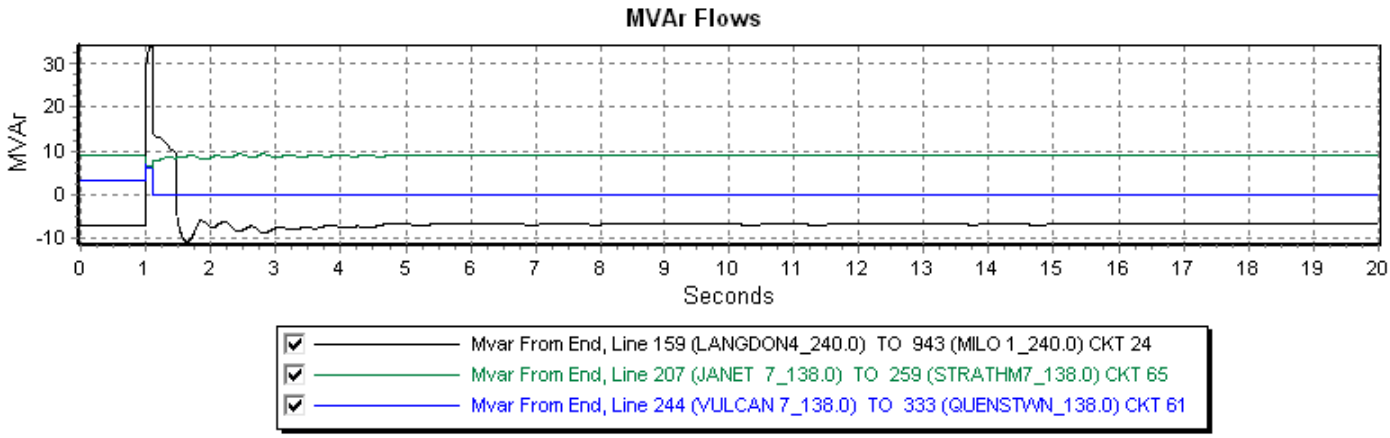
Contingency: 161L QUEENSTOWN 504S - VULCAN 255S

Sheppard
Queenstown Generating Plant Output: 90MW

May 11, 2014 08:25:30

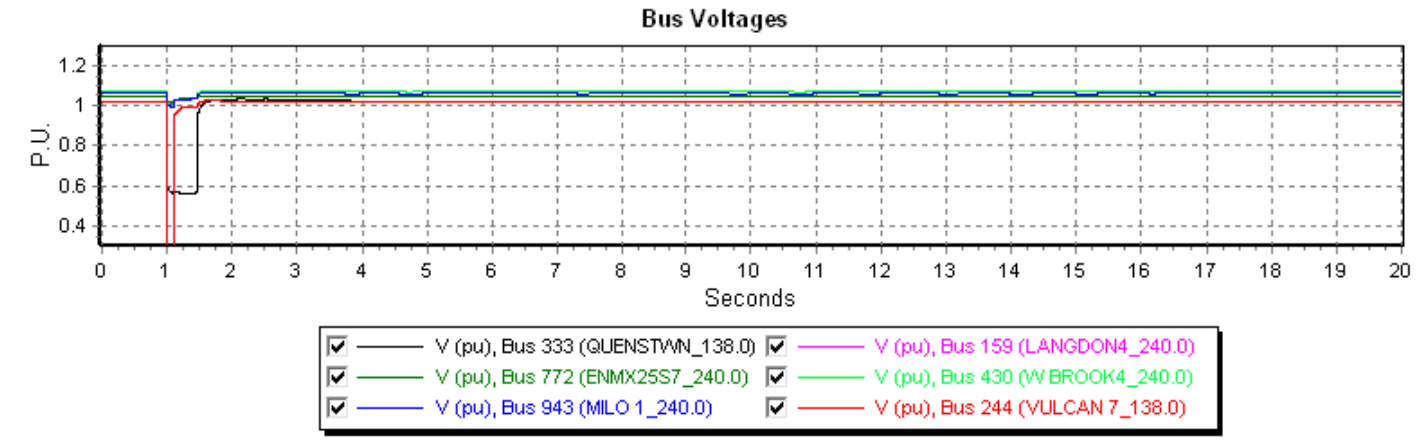
Branch Flows

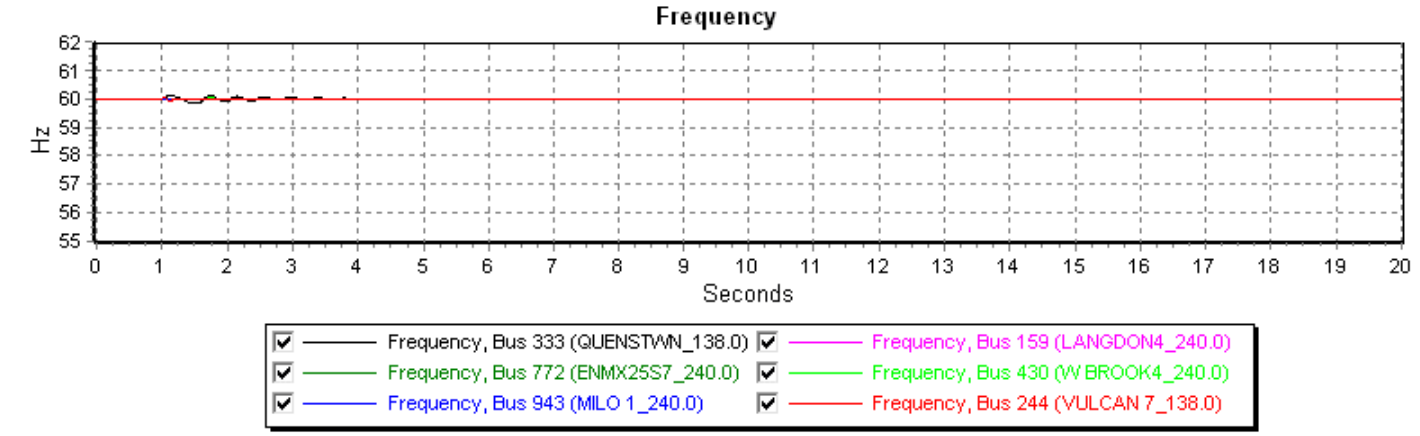




Contingency: 161L VULCAN 255S - QUEENSTOWN 504S	Branch Flows Queenstown Generating Plant Output: 90MW
	November 02, 2014 09:11:48

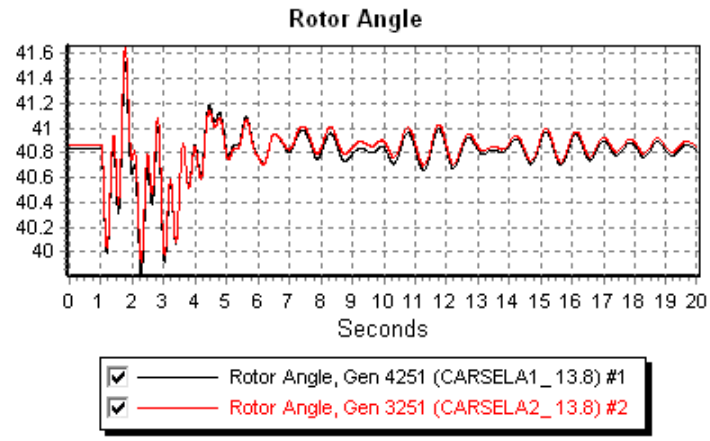
Bus Voltages and Frequency

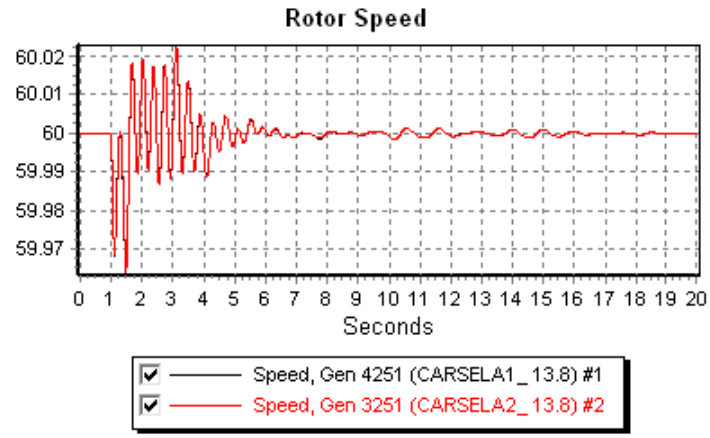


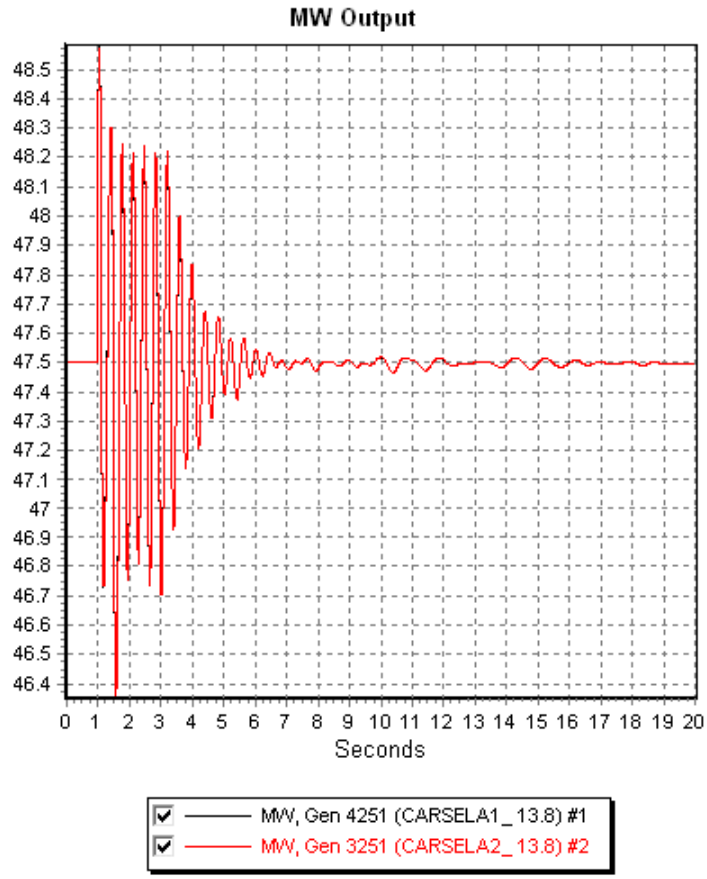


Contingency: 161L VULCAN 255S - QUEENSTOWN 504S	Bus Voltages and Frequency Queenstown Generating Plant Output: 90MW November 02, 2014 09:11:49

Carseland





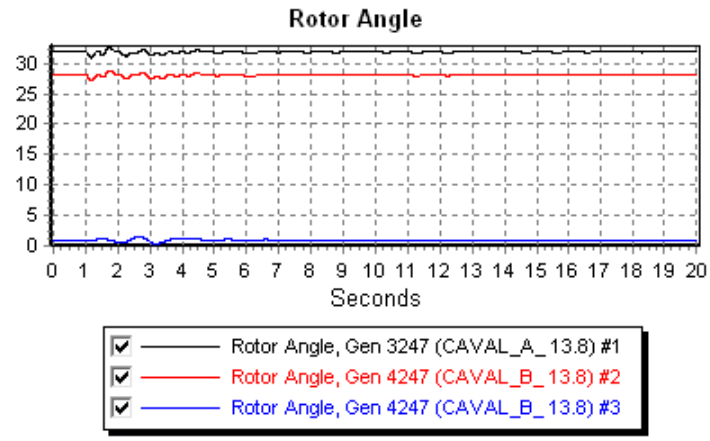


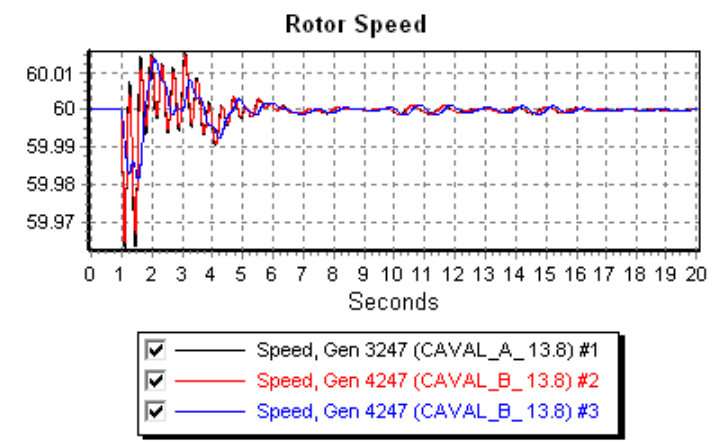
Contingency: 161L VULCAN 255S - QUEENSTOWN 504S

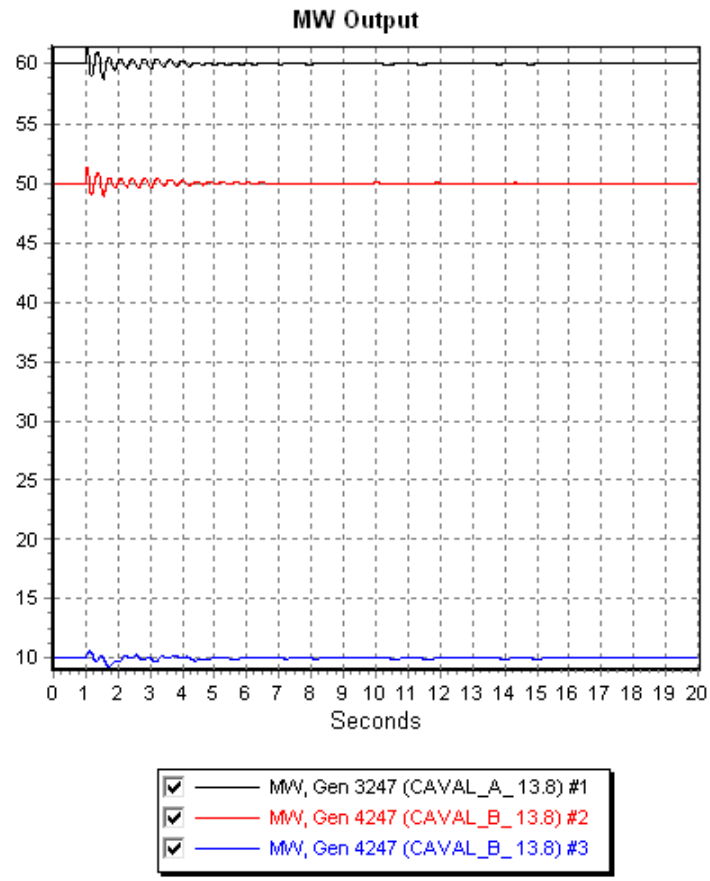
Carseland
Queenstown Generating Plant Output: 90MW

November 02, 2014 09:11:46

Cavalier





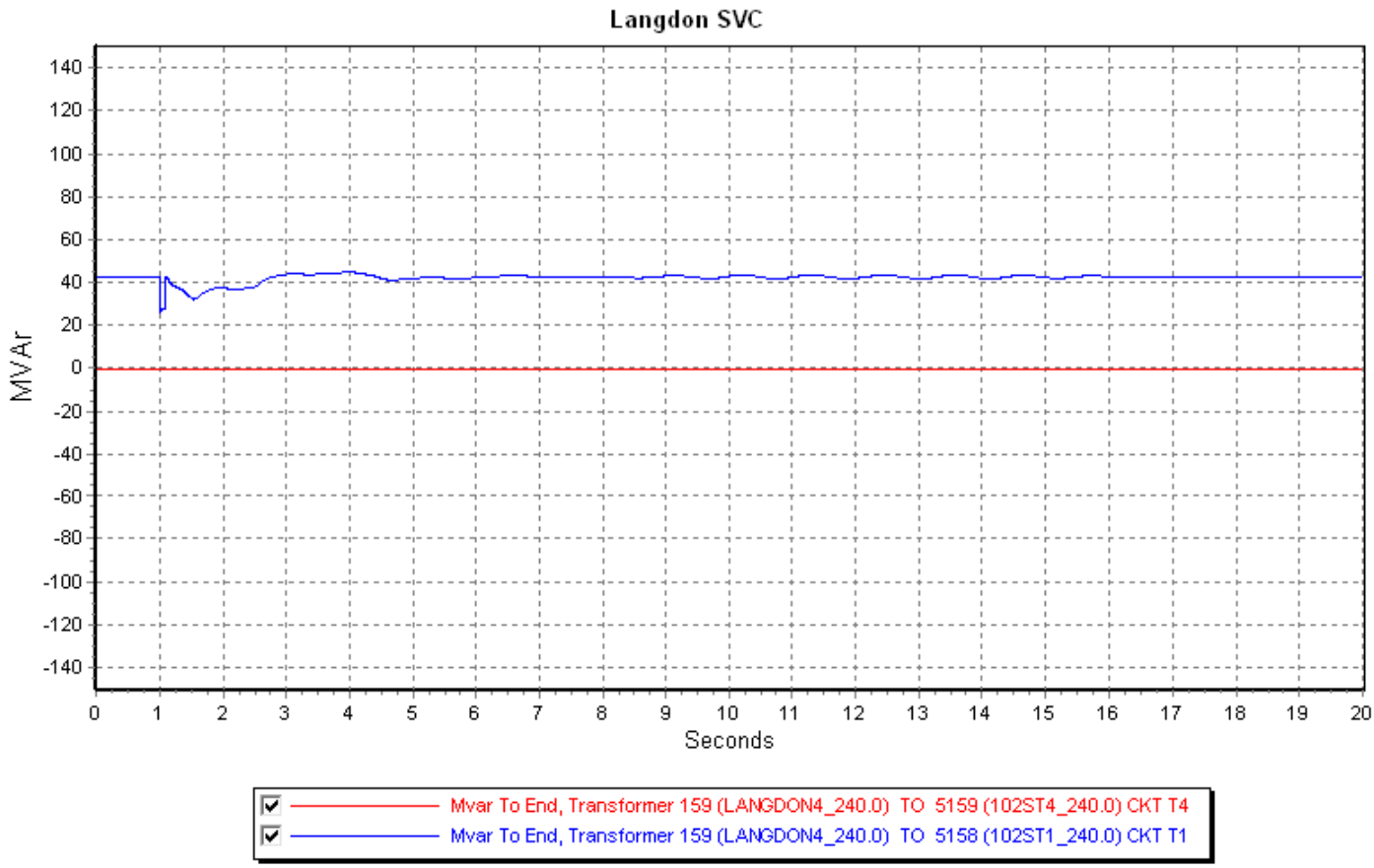


Contingency: 161L VULCAN 255S - QUEENSTOWN 504S

Cavalier
Queenstown Generating Plant Output: 90MW

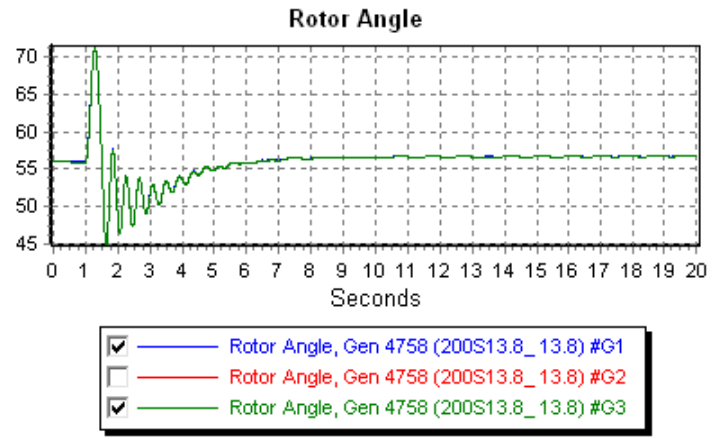
November 02, 2014 09:11:48

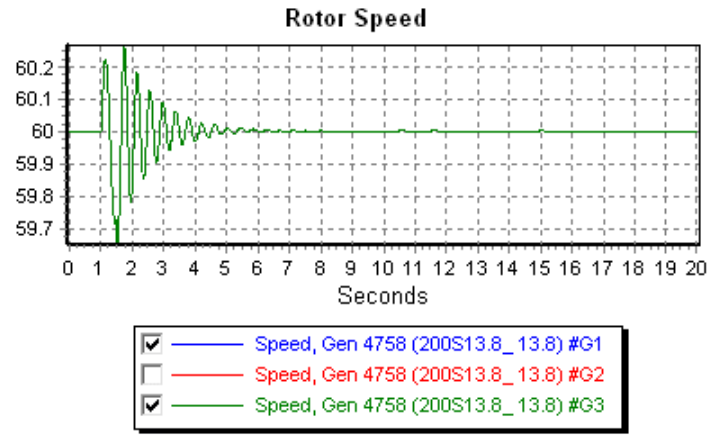
Langdon SVC

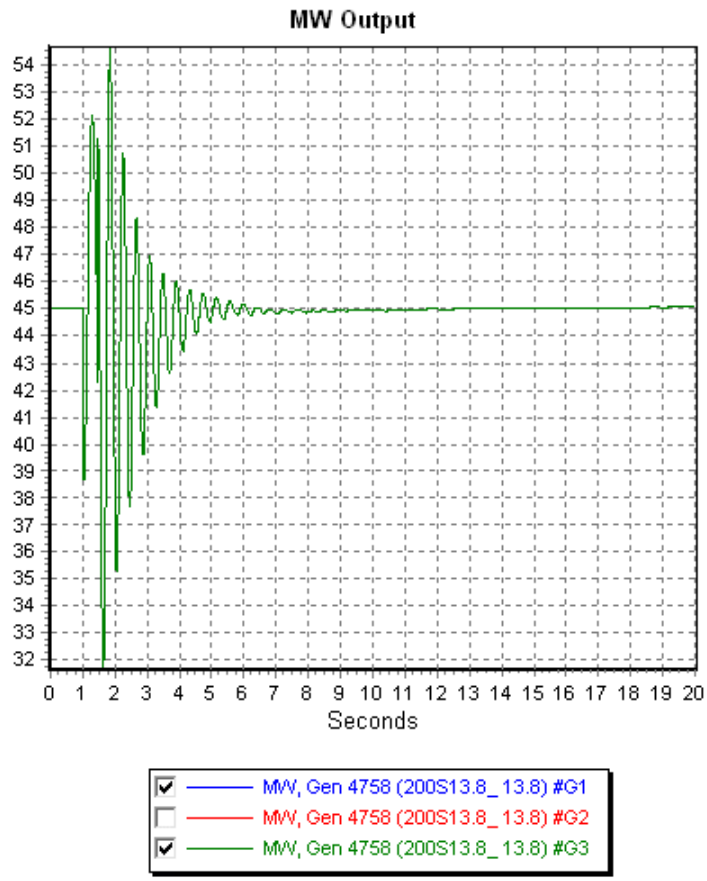


Contingency: 161L VULCAN 255S - QUEENSTOWN 504S	Langdon SVC Queenstown Generating Plant Output: 90MW
	November 02, 2014 09:11:49

Queenstown Gen





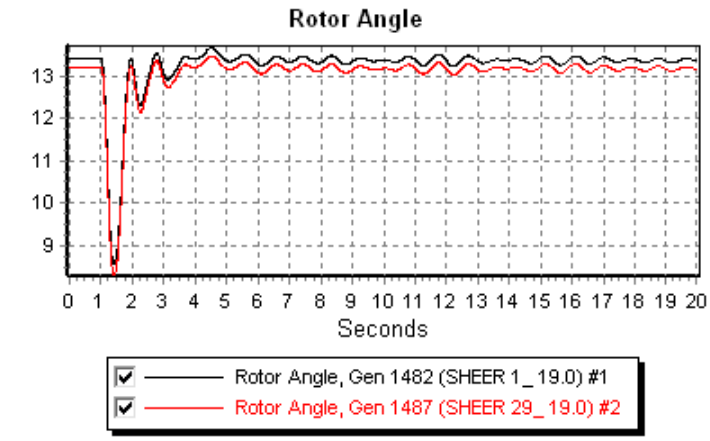


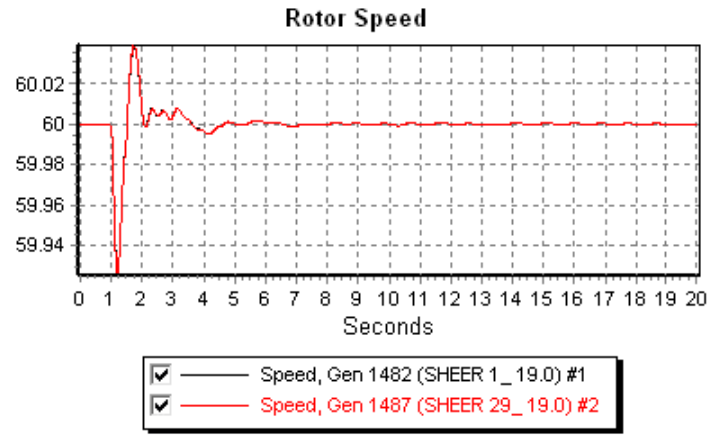
Contingency: 161L VULCAN 255S - QUEENSTOWN 504S

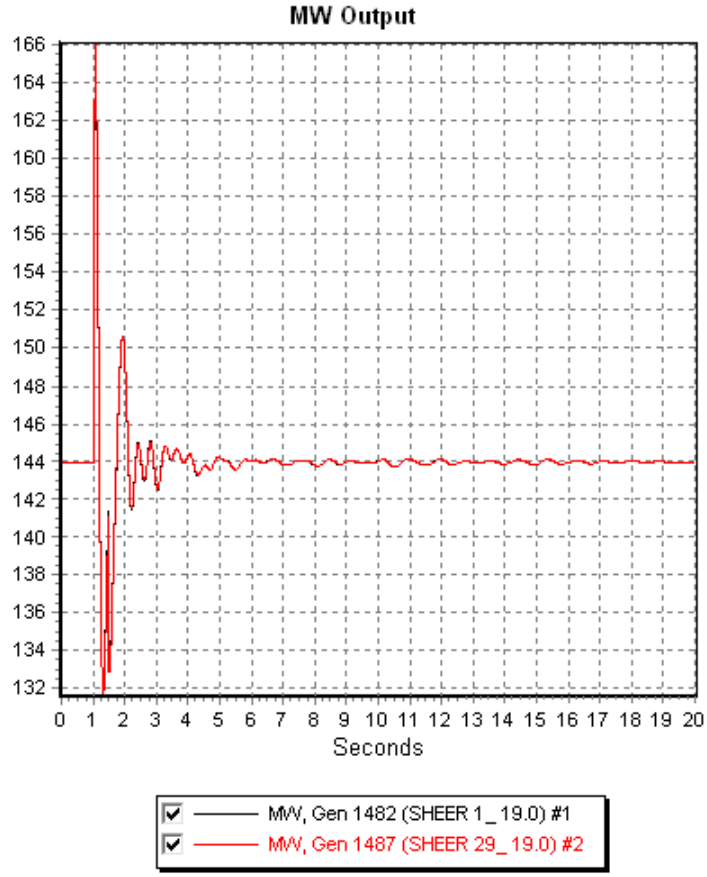
P1336
Queenstown Generating Plant
Output: 90MW

November 02, 2014 09:11:47

Sheerness





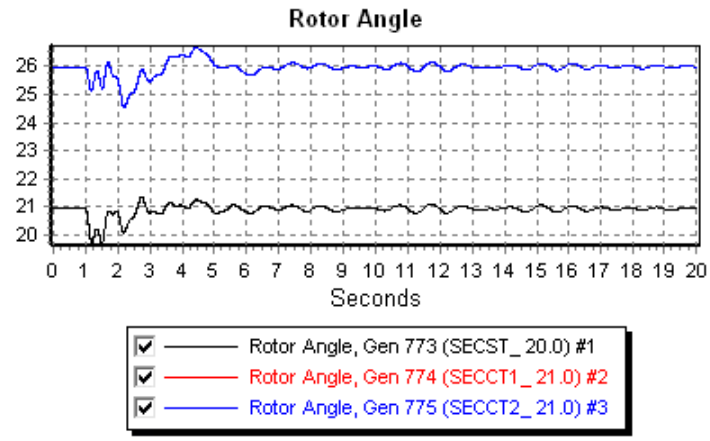


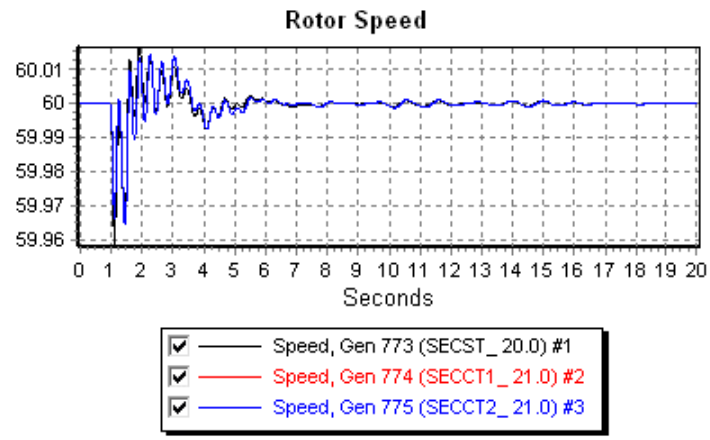
Contingency: 161L VULCAN 255S - QUEENSTOWN 504S

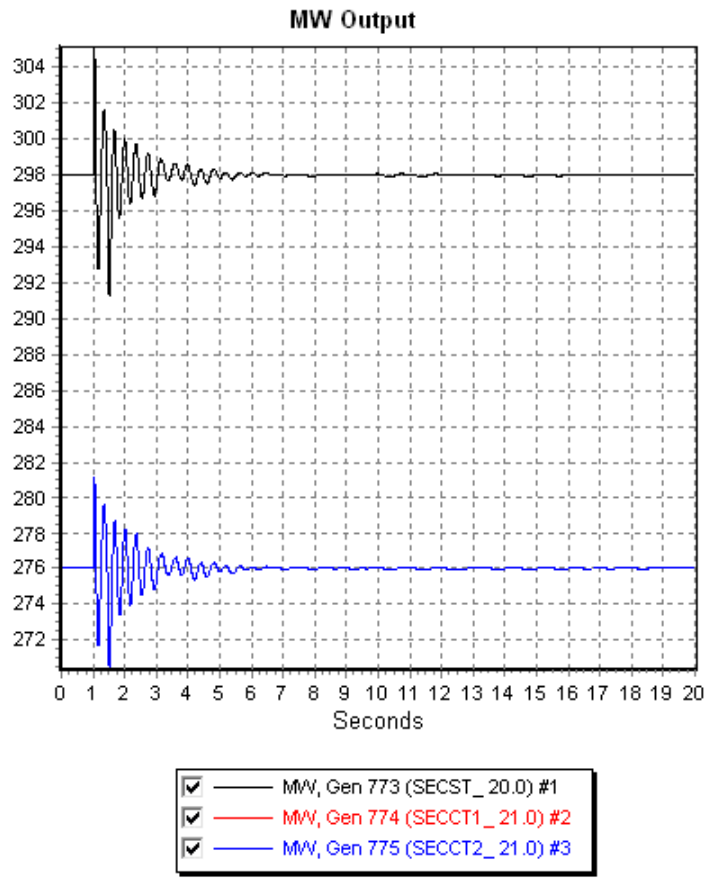
Sheerness
Queenstown Generating Plant Output: 90MW

November 02, 2014 09:11:45

Sheppard





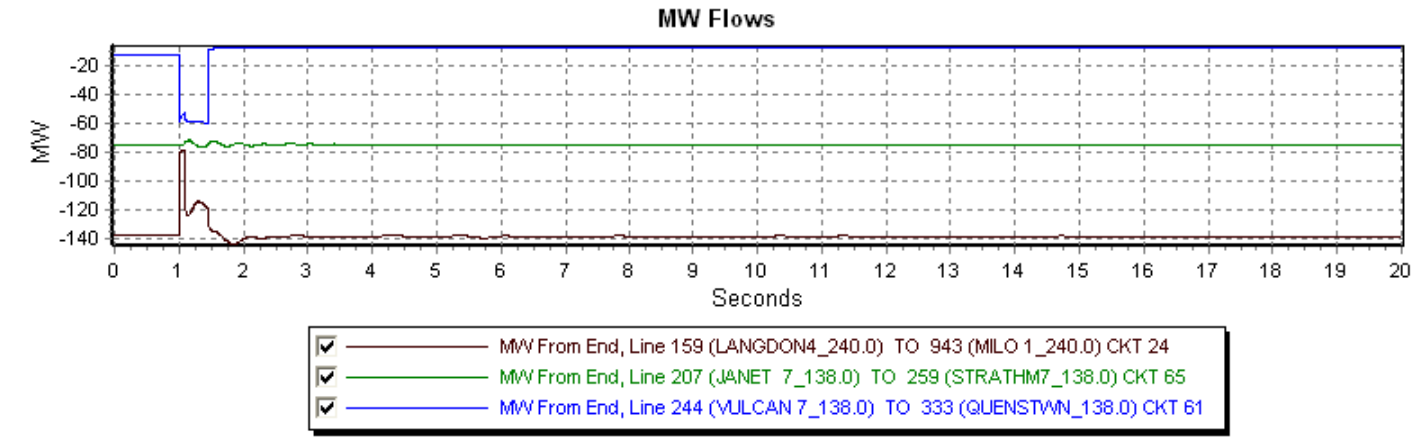


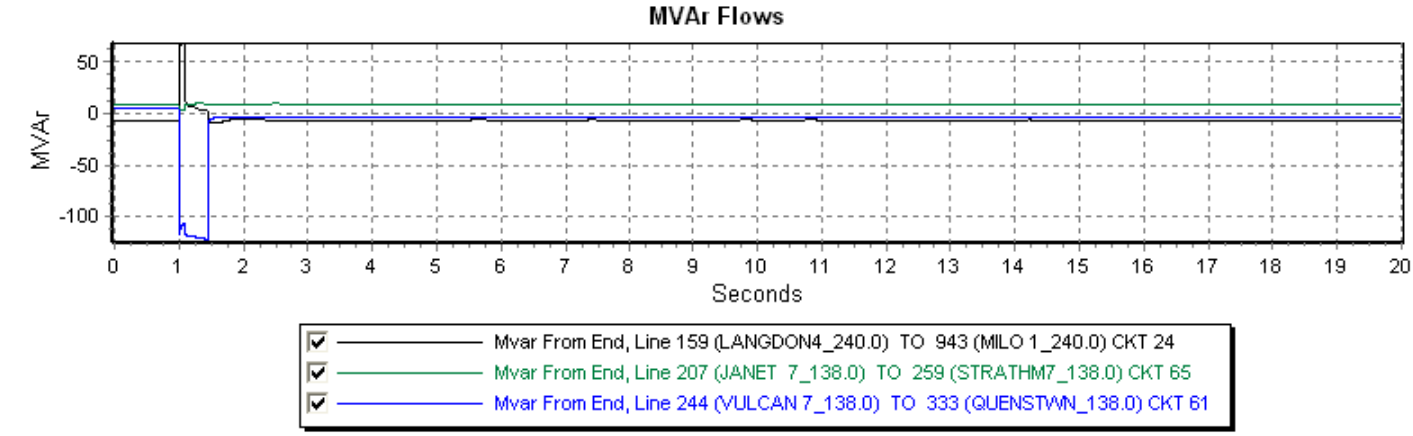
Contingency: 161L VULCAN 255S - QUEENSTOWN 504S

Sheppard
Queenstown Generating Plant Output: 90MW

November 02, 2014 09:11:47

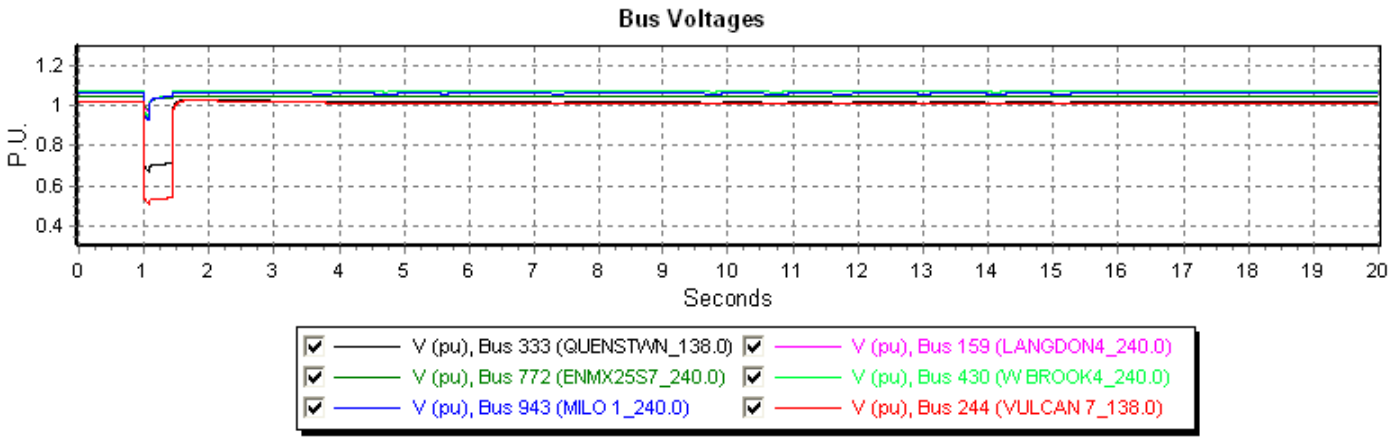
Branch Flows

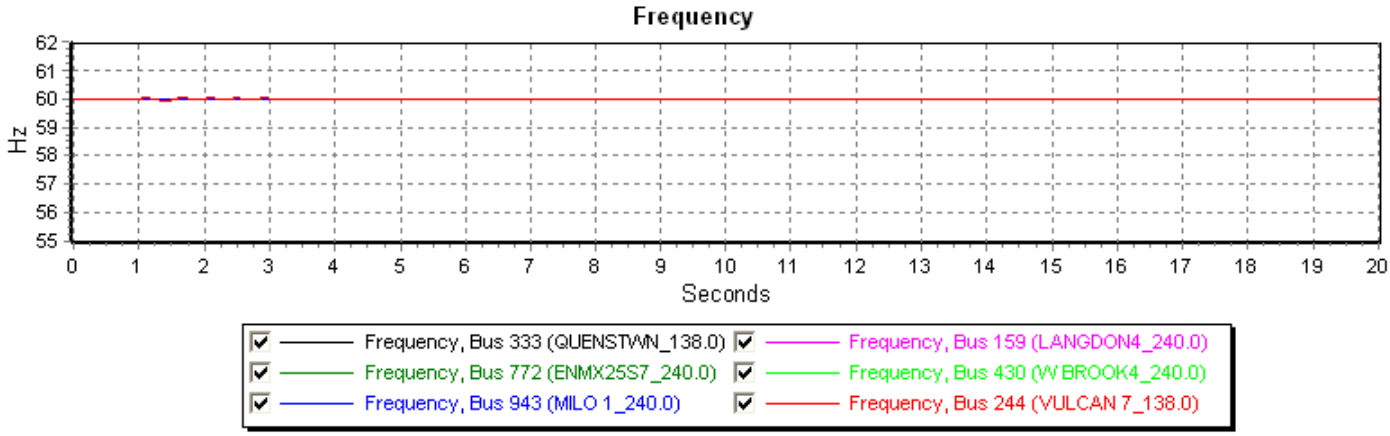




Contingency: 180L Ft.McLeod 15S to Vulcan 255S	Branch Flows Queenstown Generating Plant Output: 90MW
	September 26, 2014 14:42:51

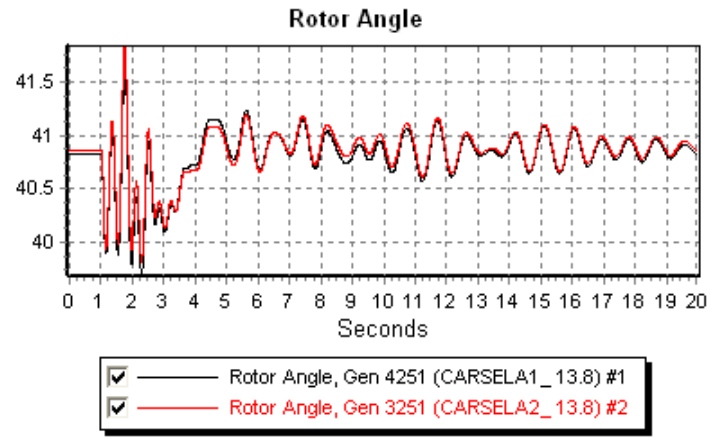
Bus Voltages and Frequency

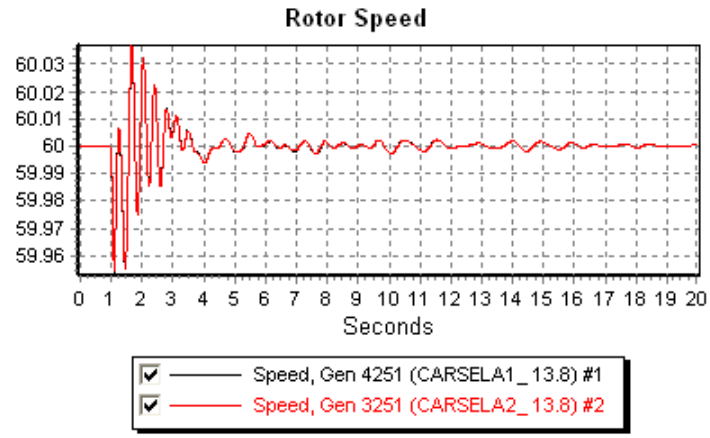


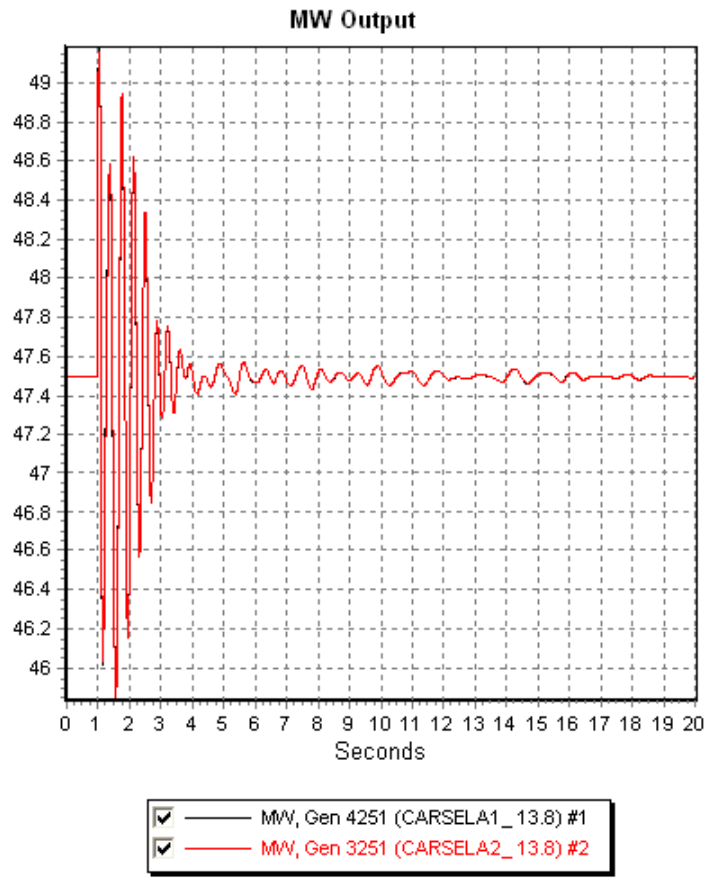


Contingency: 180L Ft.McLeod 15S to Vulcan 255S	Bus Voltages and Frequency Queenstown Generating Plant Output: 90MW September 26, 2014 14:42:52

Carseland





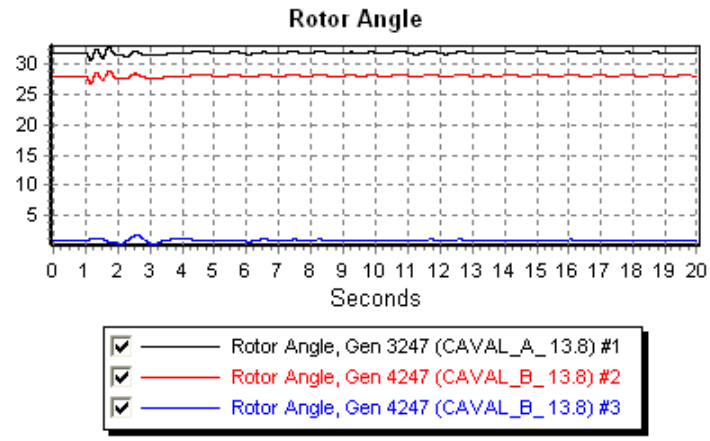


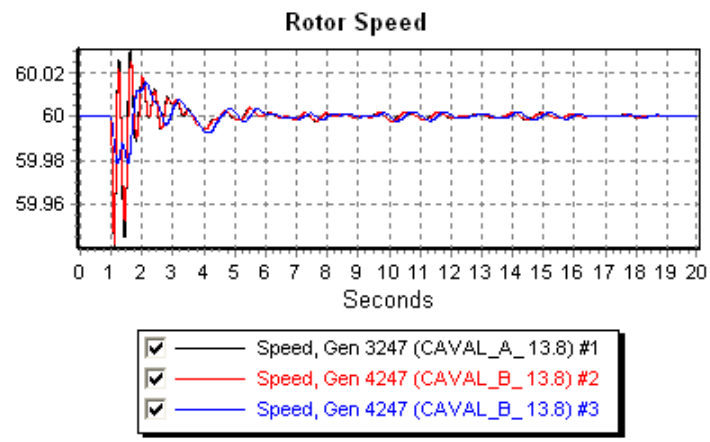
Contingency: 180L Ft.McLeod 15S to Vulcan 255S

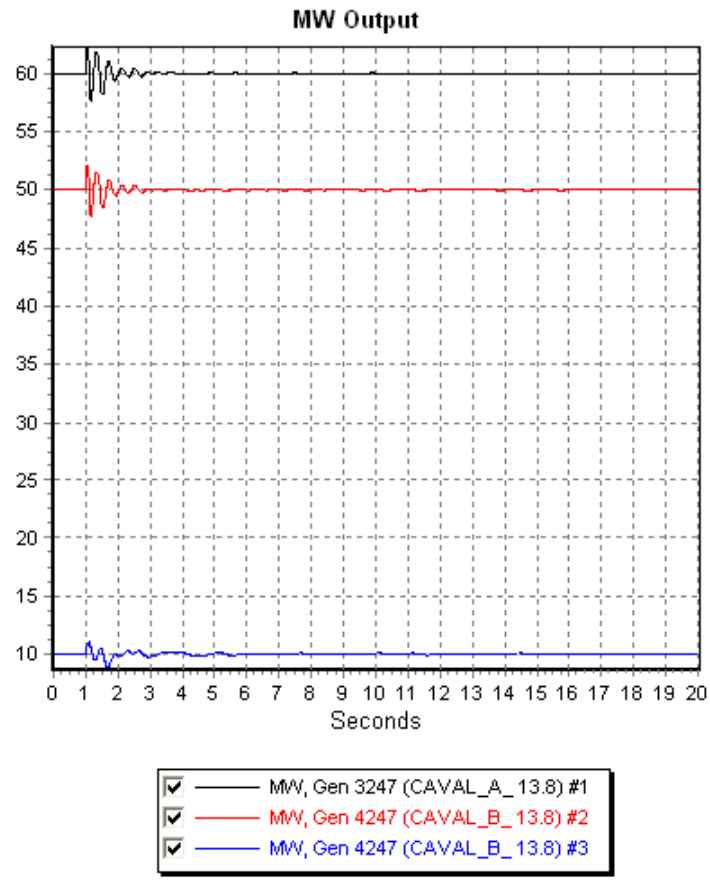
Carseland
Queenstown Generating Plant Output: 90MW

September 26, 2014 14:42:49

Cavalier





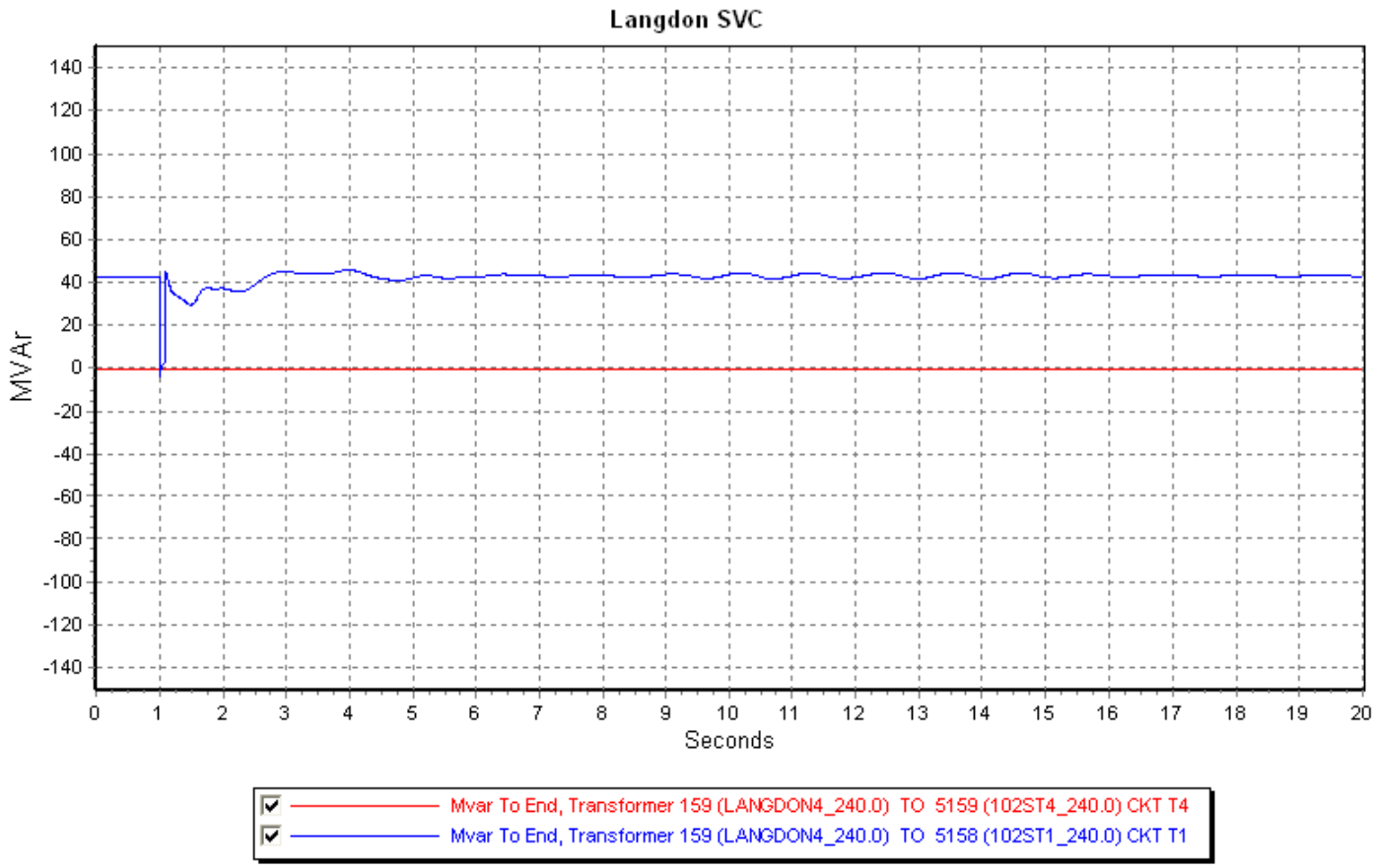


Contingency: 180L Ft.McLeod 15S to Vulcan 255S

Cavalier
Queenstown Generating Plant Output: 90MW

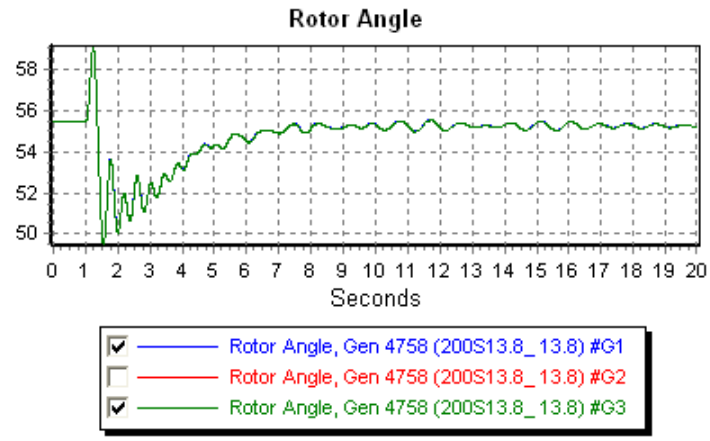
September 26, 2014 14:42:51

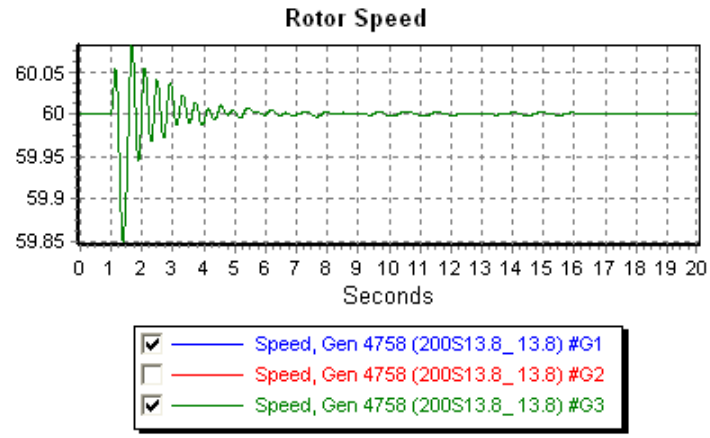
Langdon SVC

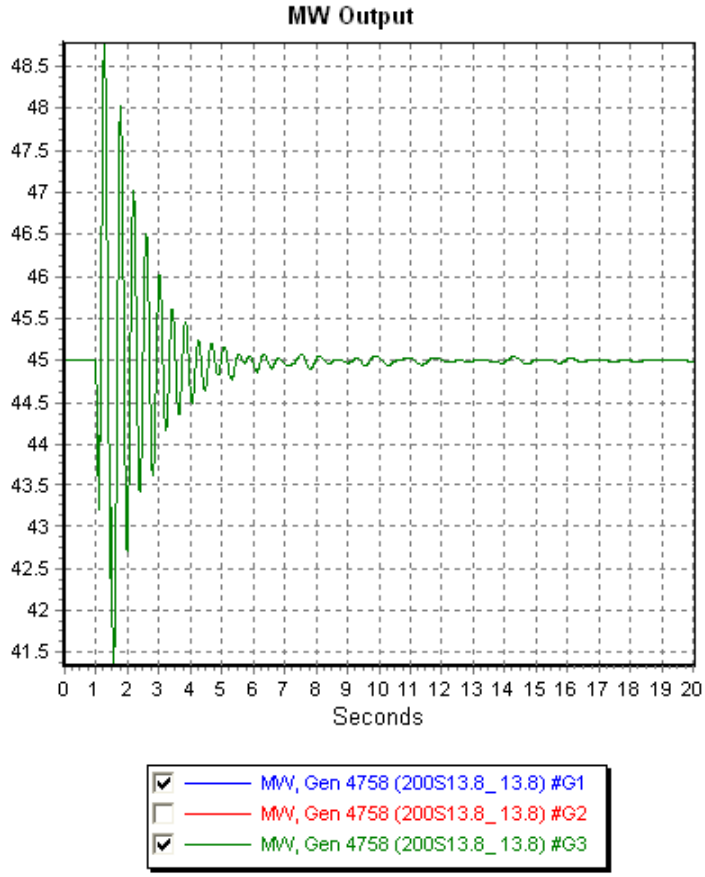


Contingency: 180L Ft.McLeod 15S to Vulcan 255S	Langdon SVC Queenstown Generating Plant Output: 90MW
	September 26, 2014 14:42:52

Queenstown Gen





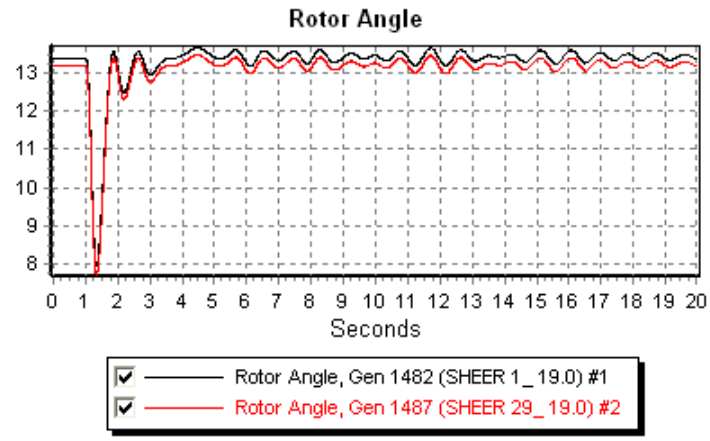


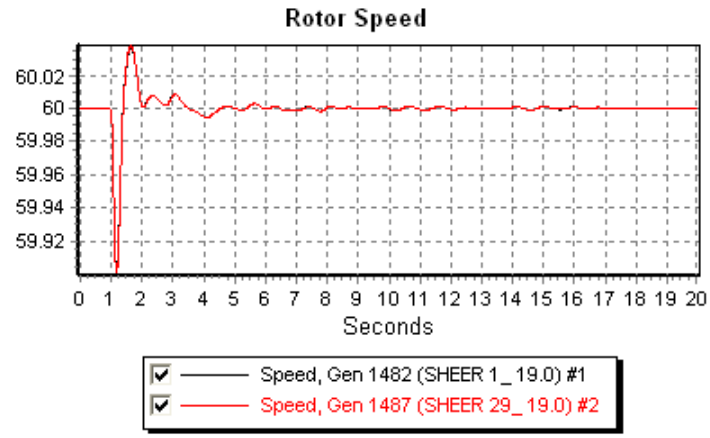
Contingency: 180L Ft.McLeod 15S to Vulcan 255S

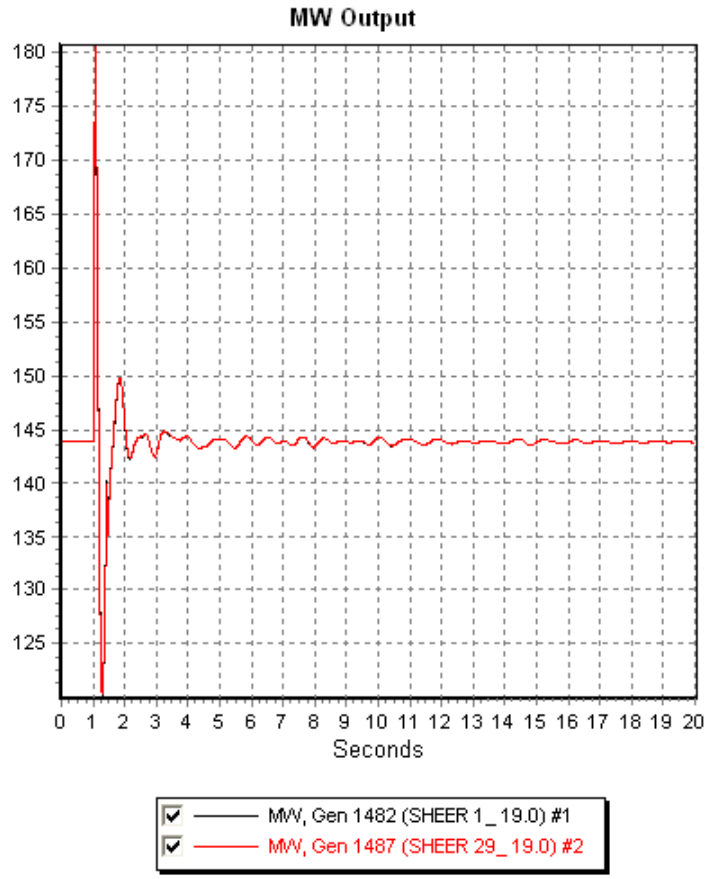
P1336
Queenstown Generating Plant
Output: 90MW

September 26, 2014 14:42:50

Sheerness





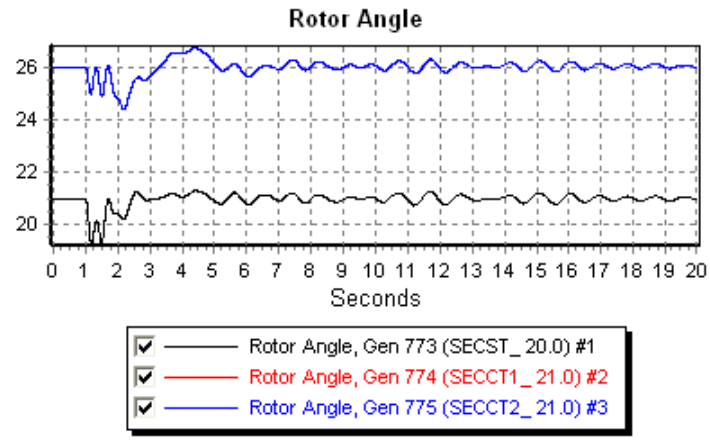


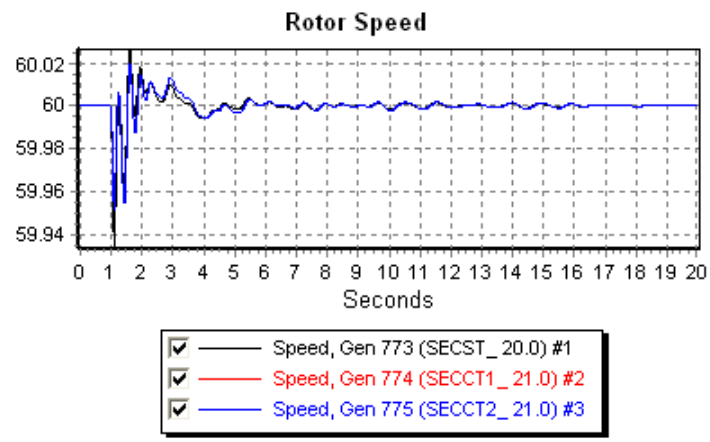
Contingency: 180L Ft.McLeod 15S to Vulcan 255S

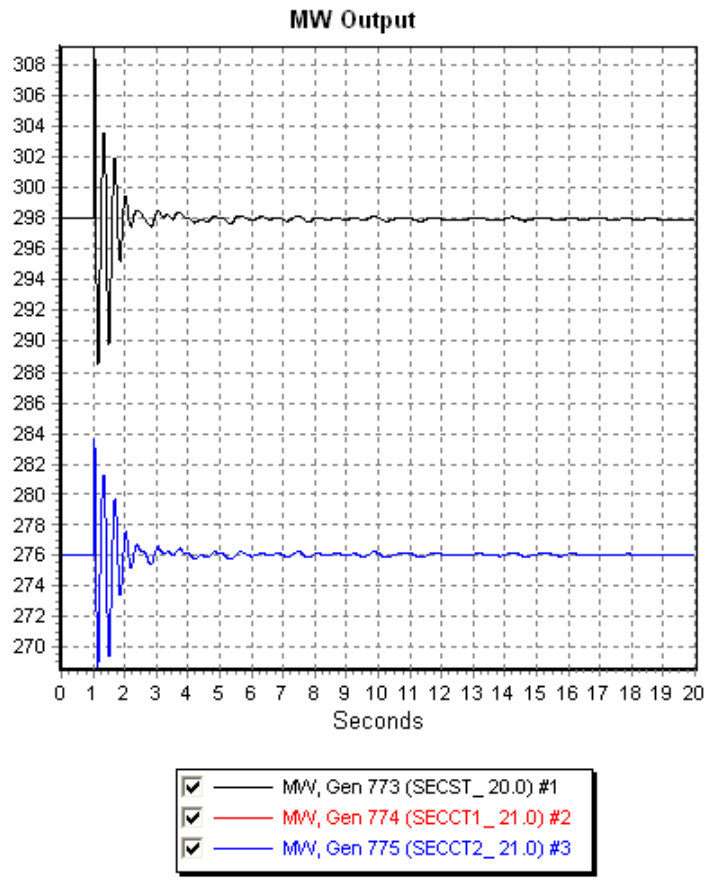
Sheerness
Queenstown Generating Plant Output: 90MW

September 26, 2014 14:42:49

Sheppard





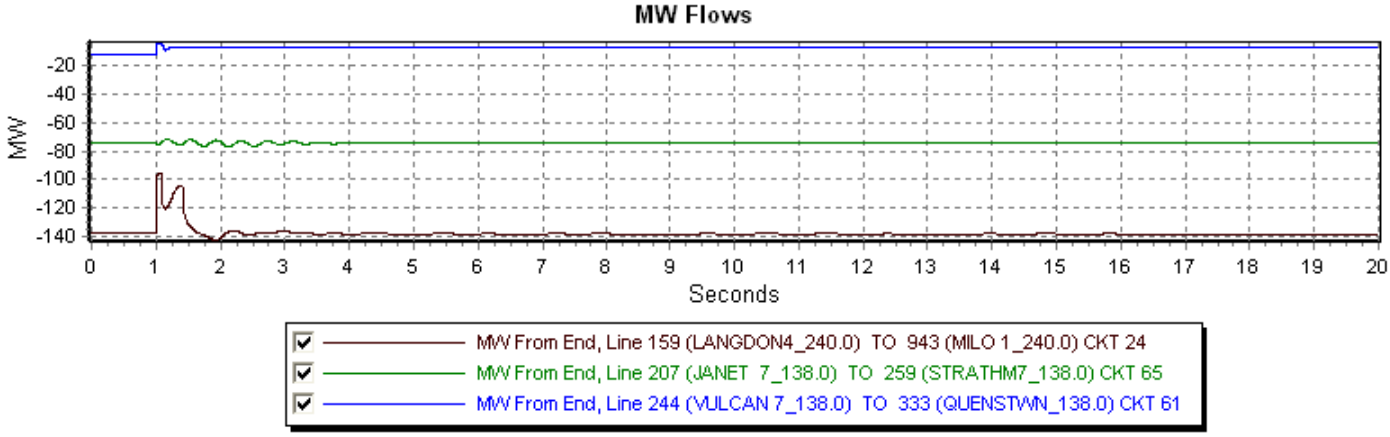


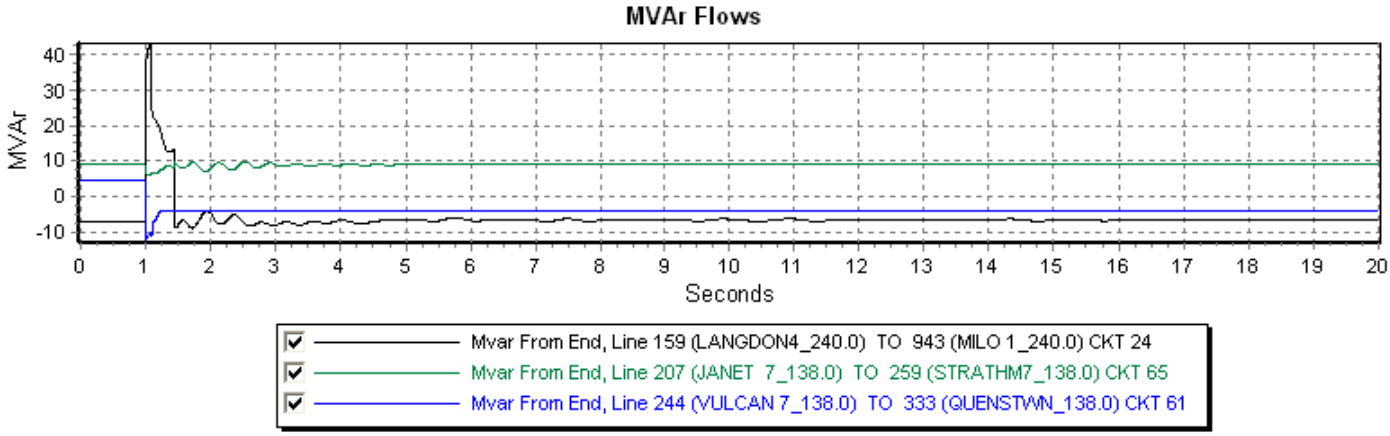
Contingency: 180L Ft.McLeod 15S to Vulcan 255S

Sheppard
Queenstown Generating Plant Output: 90MW

September 26, 2014 14:42:50

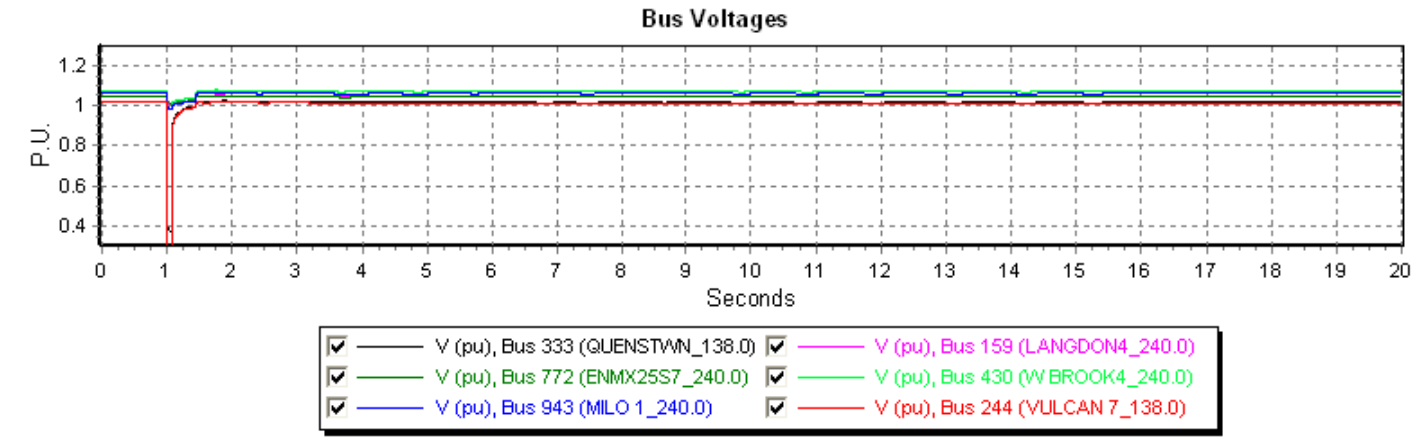
Branch Flows

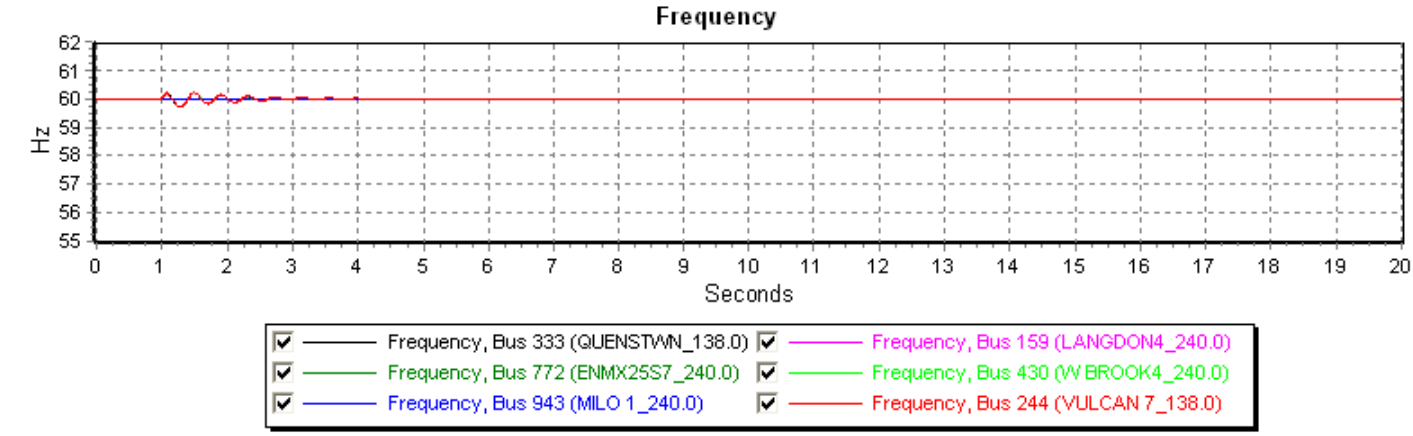




Contingency: 180L Vulcan 255S to Ft.McLeod 15S	Branch Flows Queenstown Generating Plant Output: 90MW September 26, 2014 14:45:22

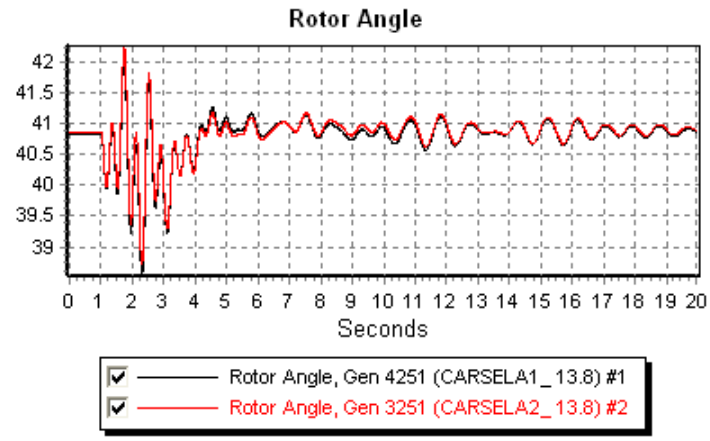
Bus Voltages and Frequency

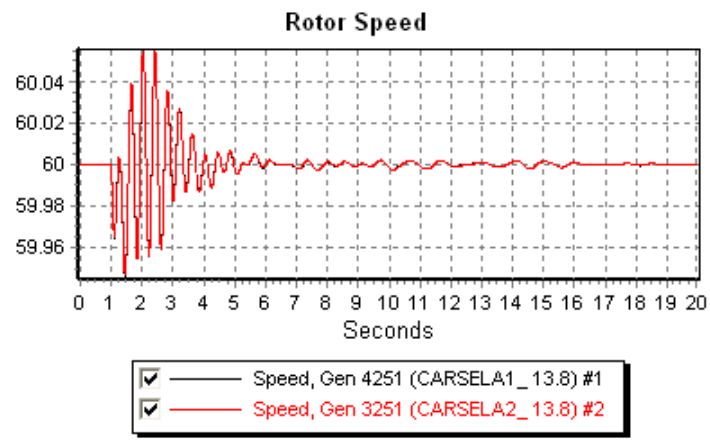


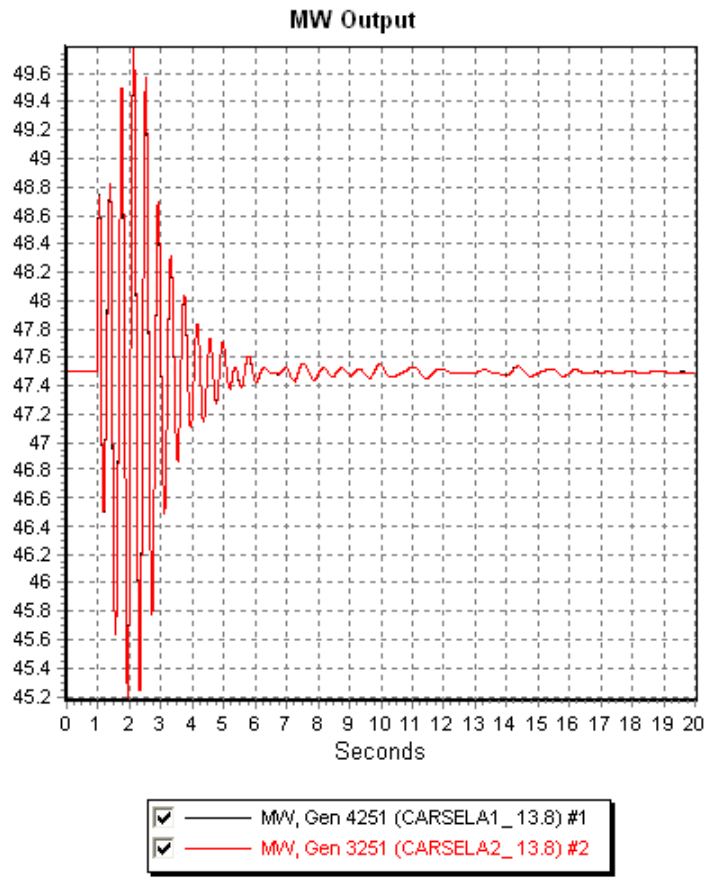


Contingency: 180L Vulcan 255S to Ft.McLeod 15S	Bus Voltages and Frequency Queenstown Generating Plant Output: 90MW September 26, 2014 14:45:23

Carseland





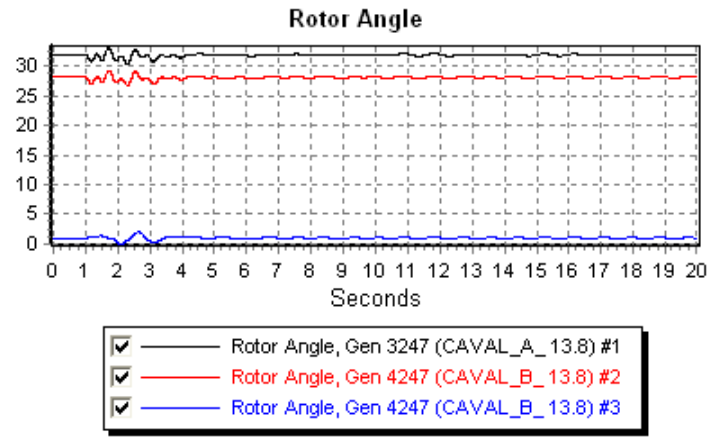


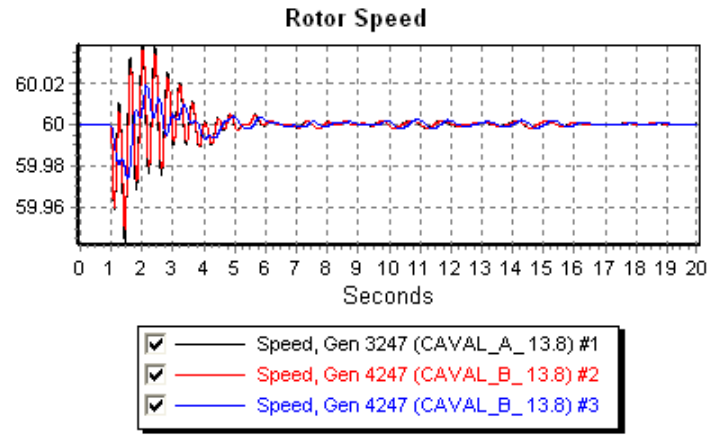
Contingency: 180L Vulcan 255S to Ft.McLeod 15S

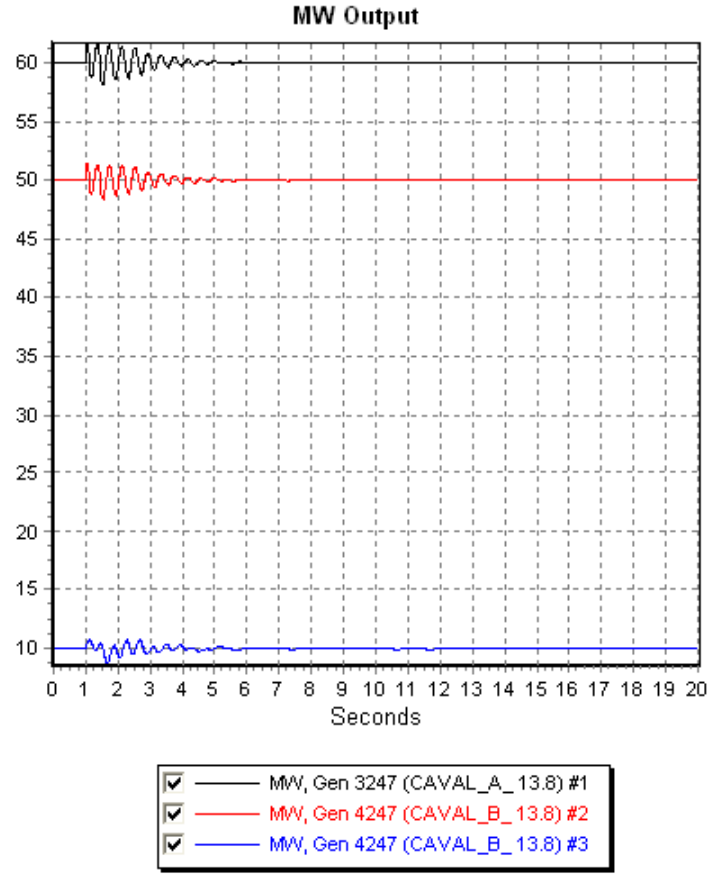
Carseland
Queenstown Generating Plant Output: 90MW

September 26, 2014 14:45:19

Cavalier





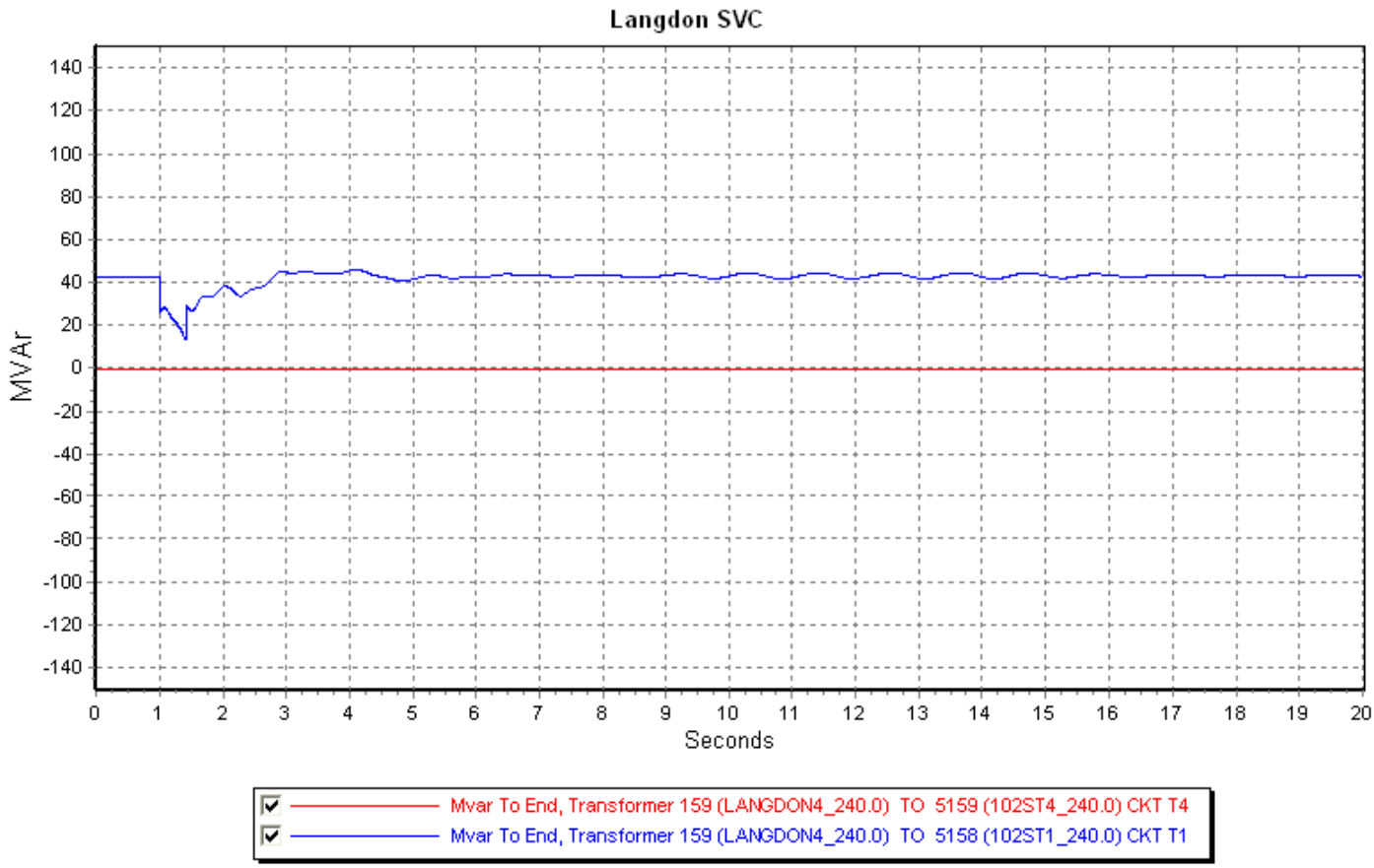


Contingency: 180L Vulcan 255S to Ft.McLeod 15S

Cavalier
Queenstown Generating Plant Output: 90MW

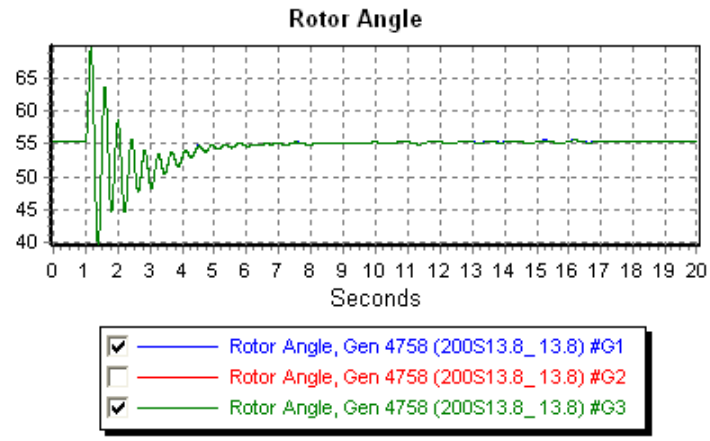
September 26, 2014 14:45:21

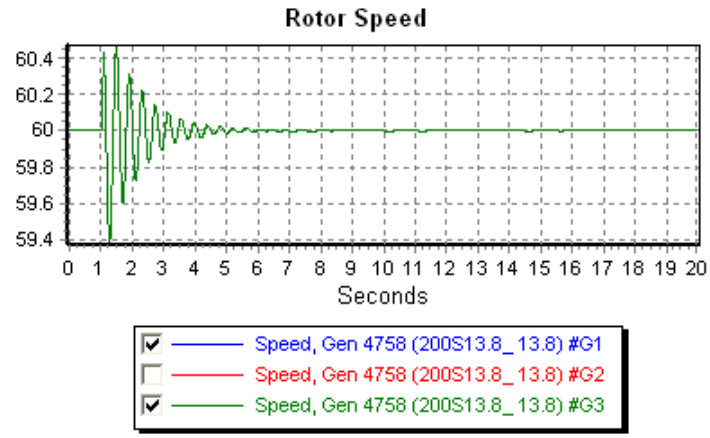
Langdon SVC

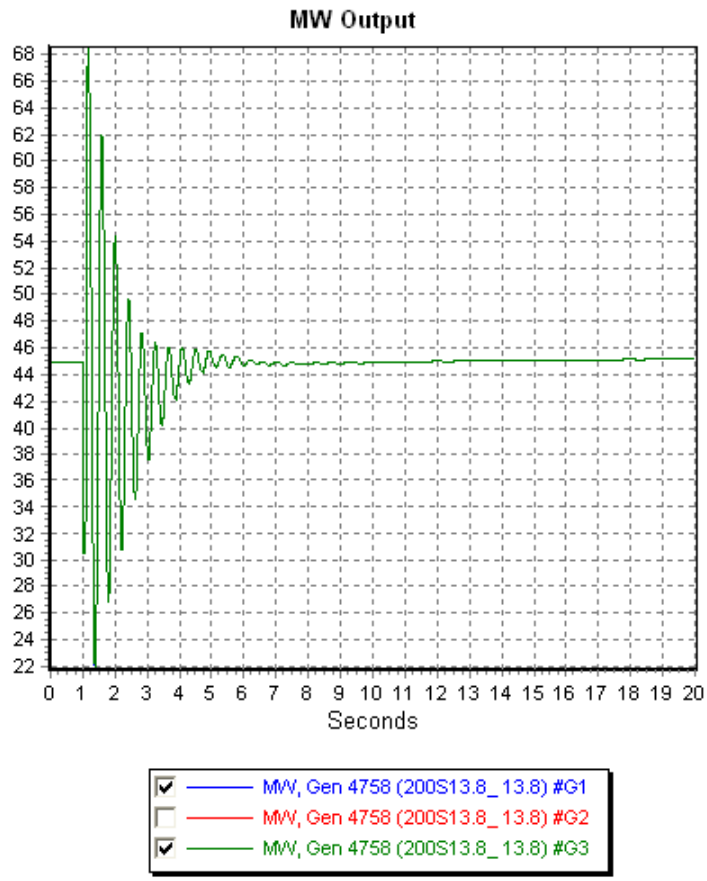


Contingency: 180L Vulcan 255S to Ft.McLeod 15S	Langdon SVC Queenstown Generating Plant Output: 90MW September 26, 2014 14:45:30

Queenstown Gen





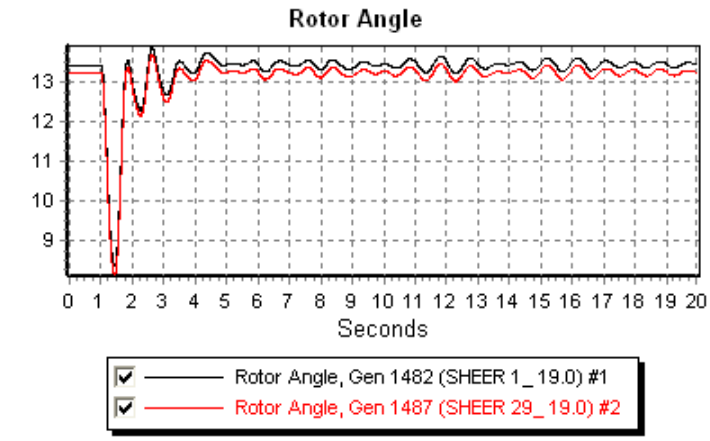


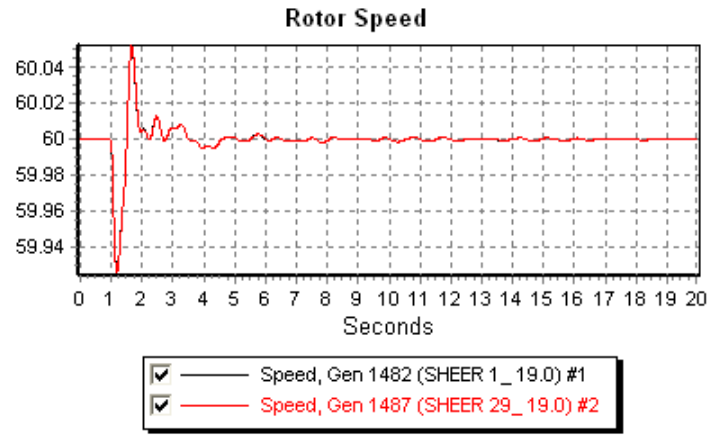
Contingency: 180L Vulcan 255S to Ft.McLeod 15S

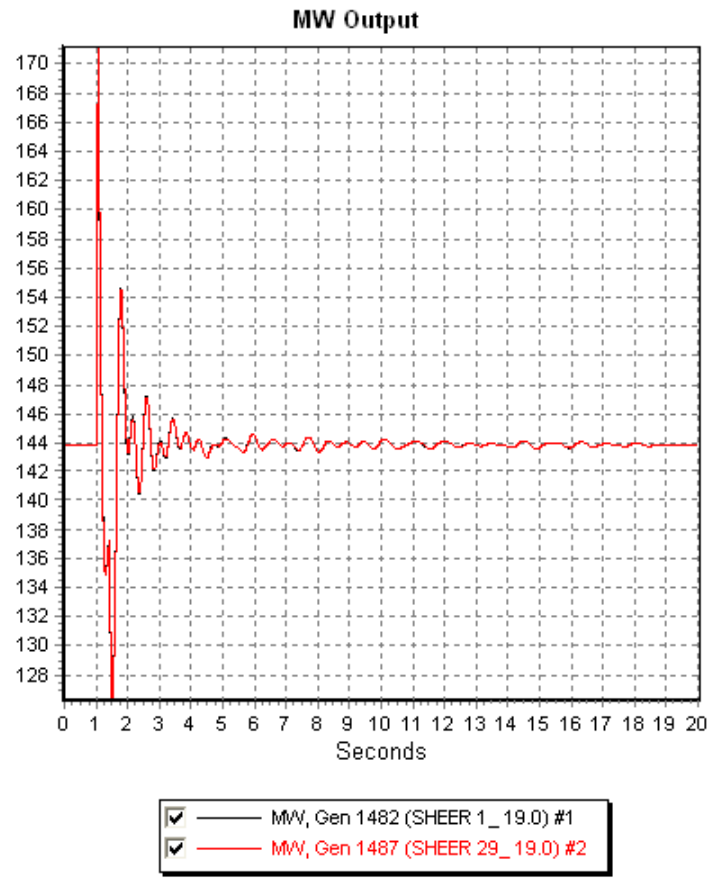
P1336
Queenstown Generating Plant
Output: 90MW

September 26, 2014 14:45:20

Sheerness





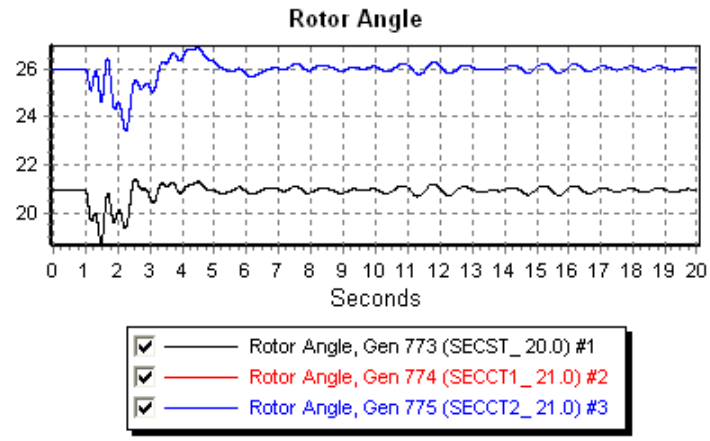


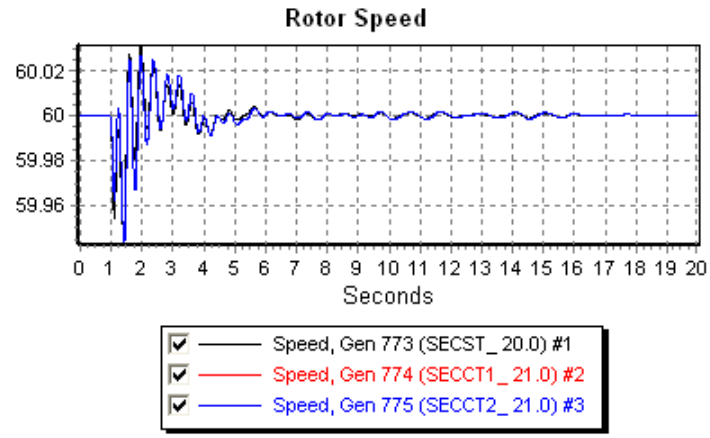
Contingency: 180L Vulcan 255S to Ft.McLeod 15S

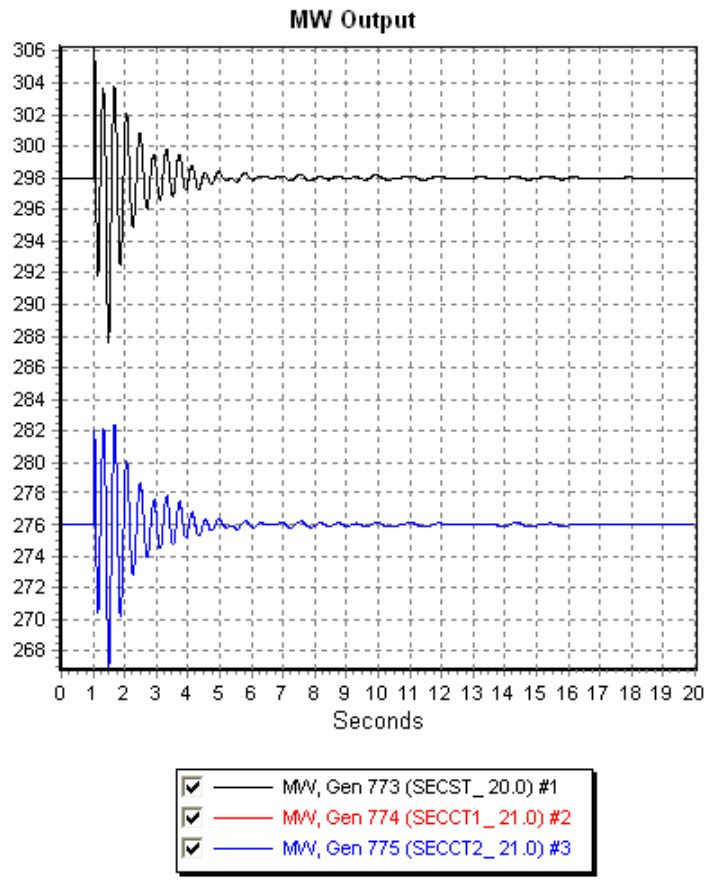
Sheerness
Queenstown Generating Plant Output: 90MW

September 26, 2014 14:45:18

Sheppard



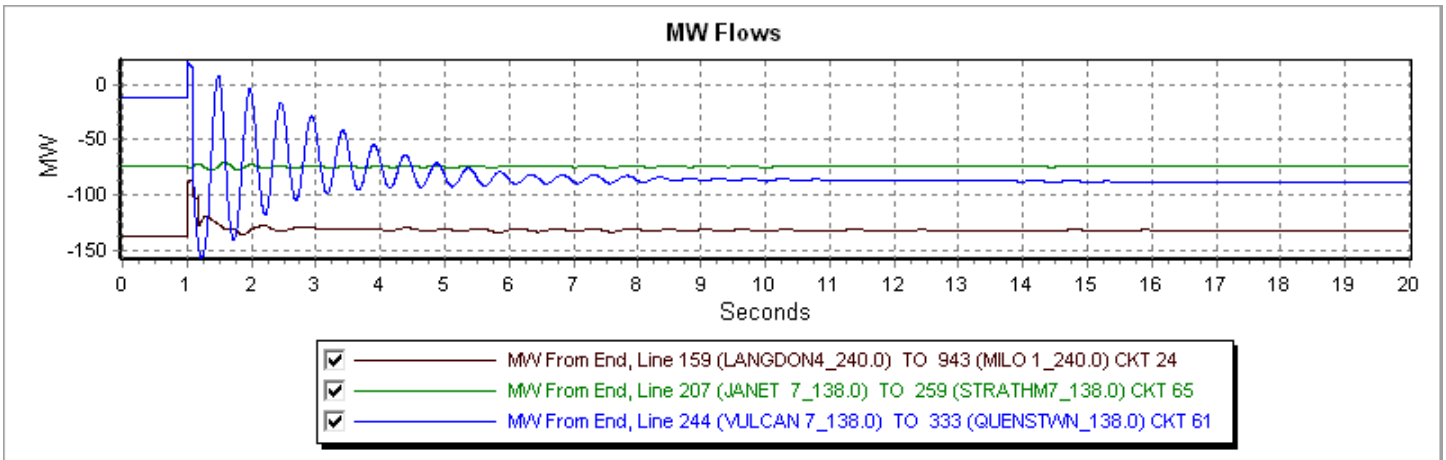


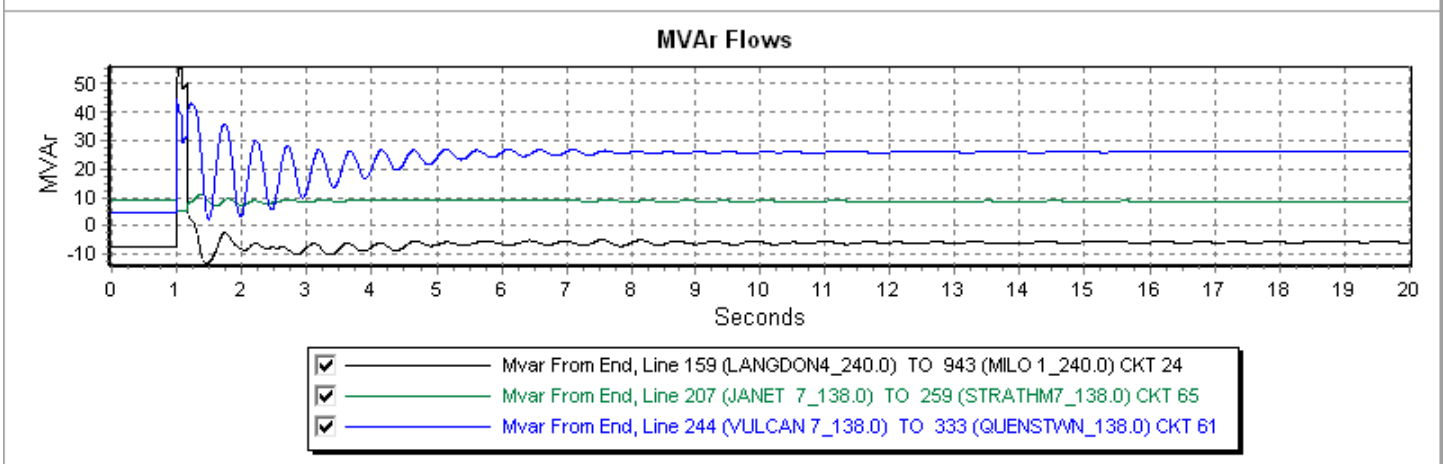


Contingency: 180L Vulcan 255S to Ft.McLeod 15S

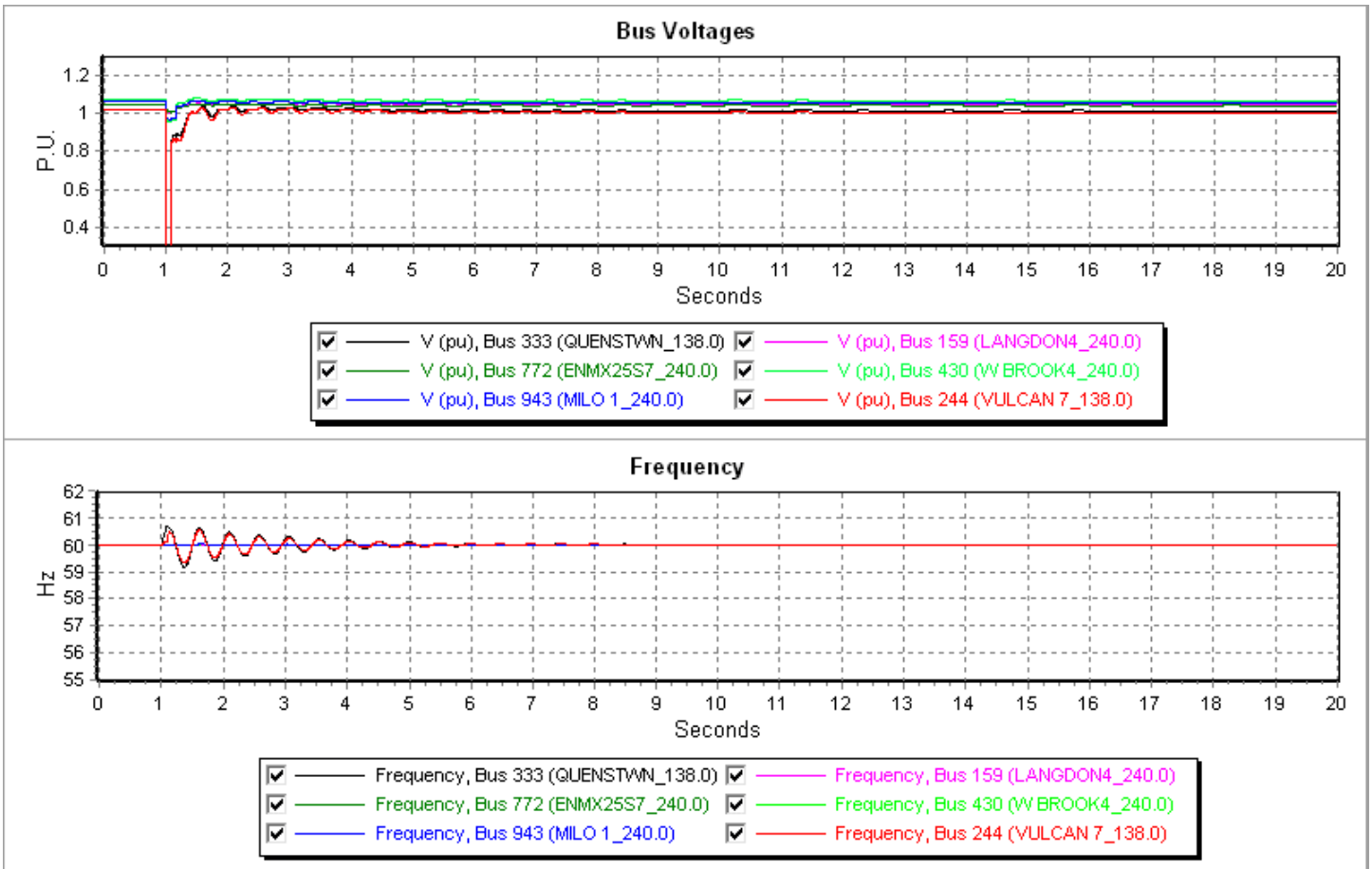
Sheppard
Queenstown Generating Plant Output: 90MW

September 26, 2014 14:45:20





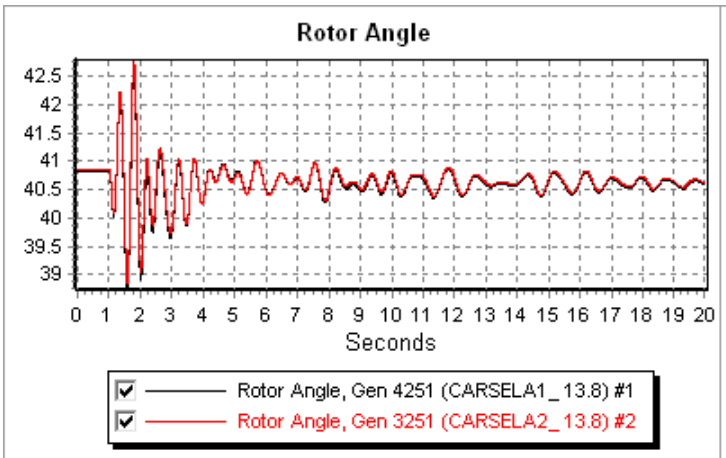
Contingency: 853L QUEENSTOWN 504S - WEST BROOKS 28S	Branch Flows Queenstown Generating Plant Output: 90MW
	May 11, 2014 08:30:05

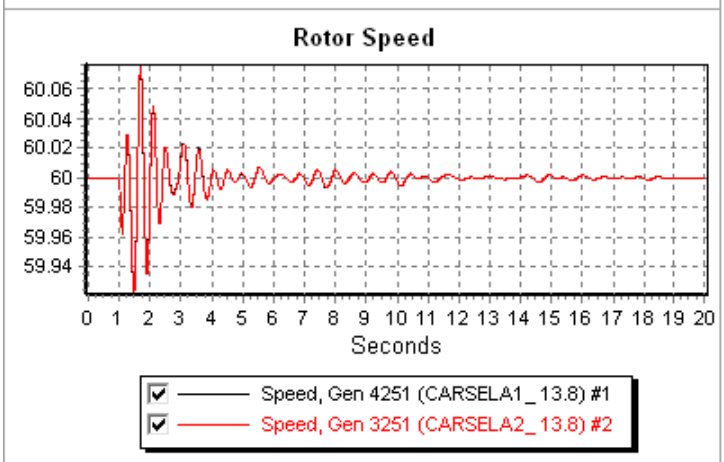


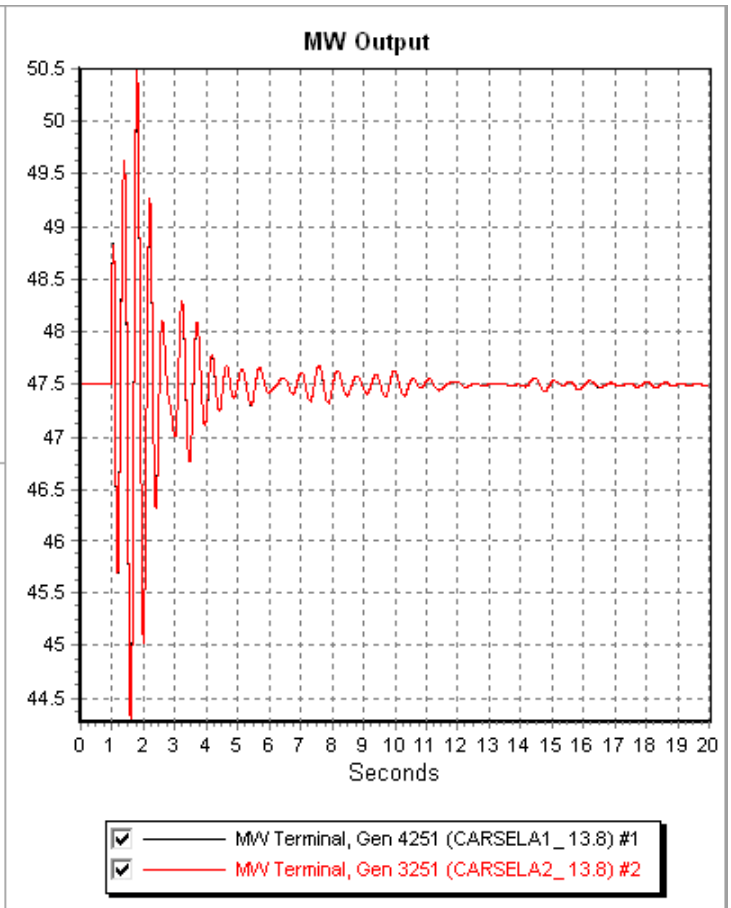
Contingency: 853L QUEENSTOWN 504S - WEST BROOKS 28S

Bus Voltages and Frequency
Queenstown Generating Plant Output: 90MW

May 11, 2014 08:30:06



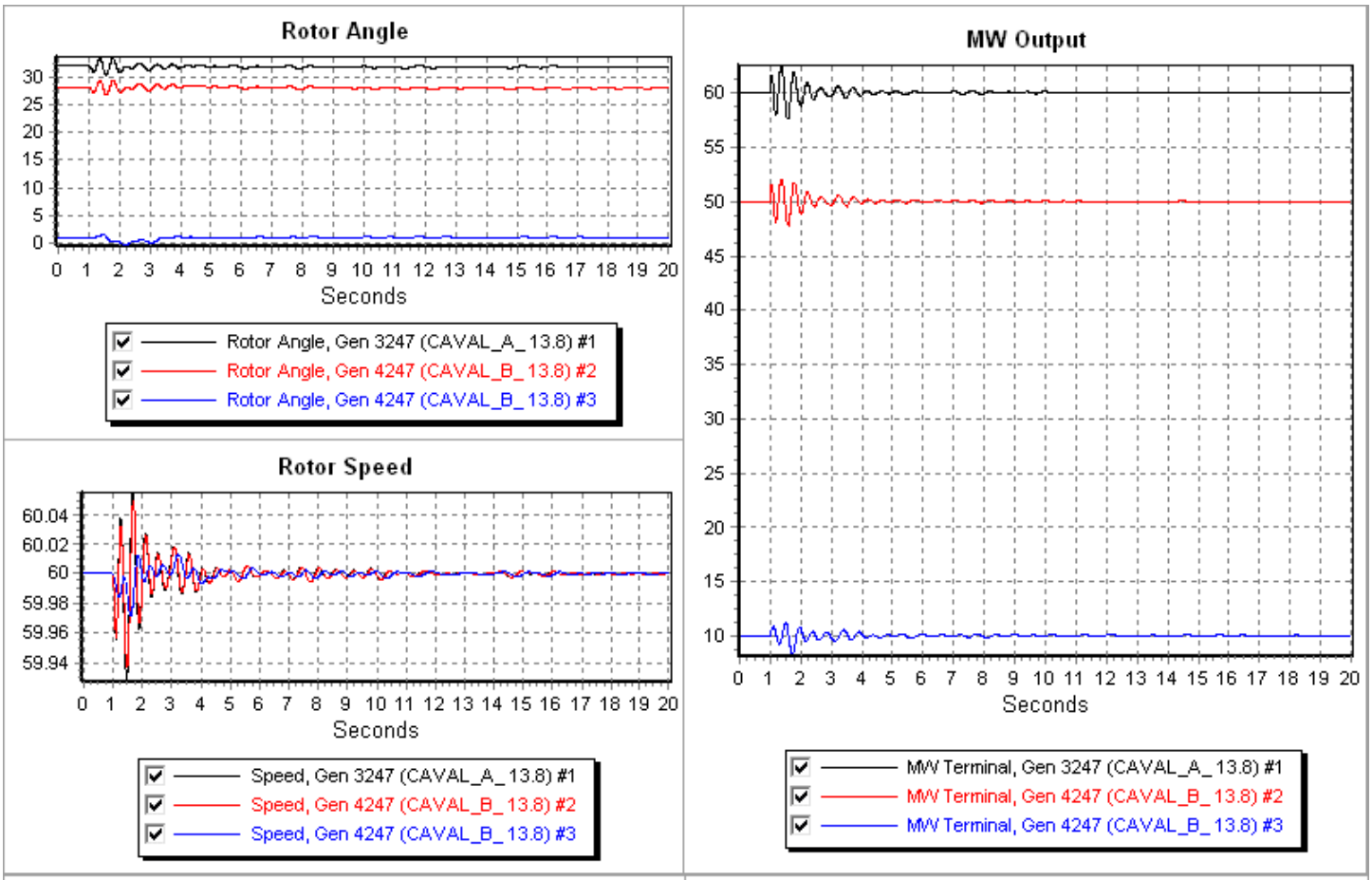




Contingency: 853L QUEENSTOWN 504S - WEST BROOKS 28S

Carseland
Queenstown Generating Plant Output: 90MW

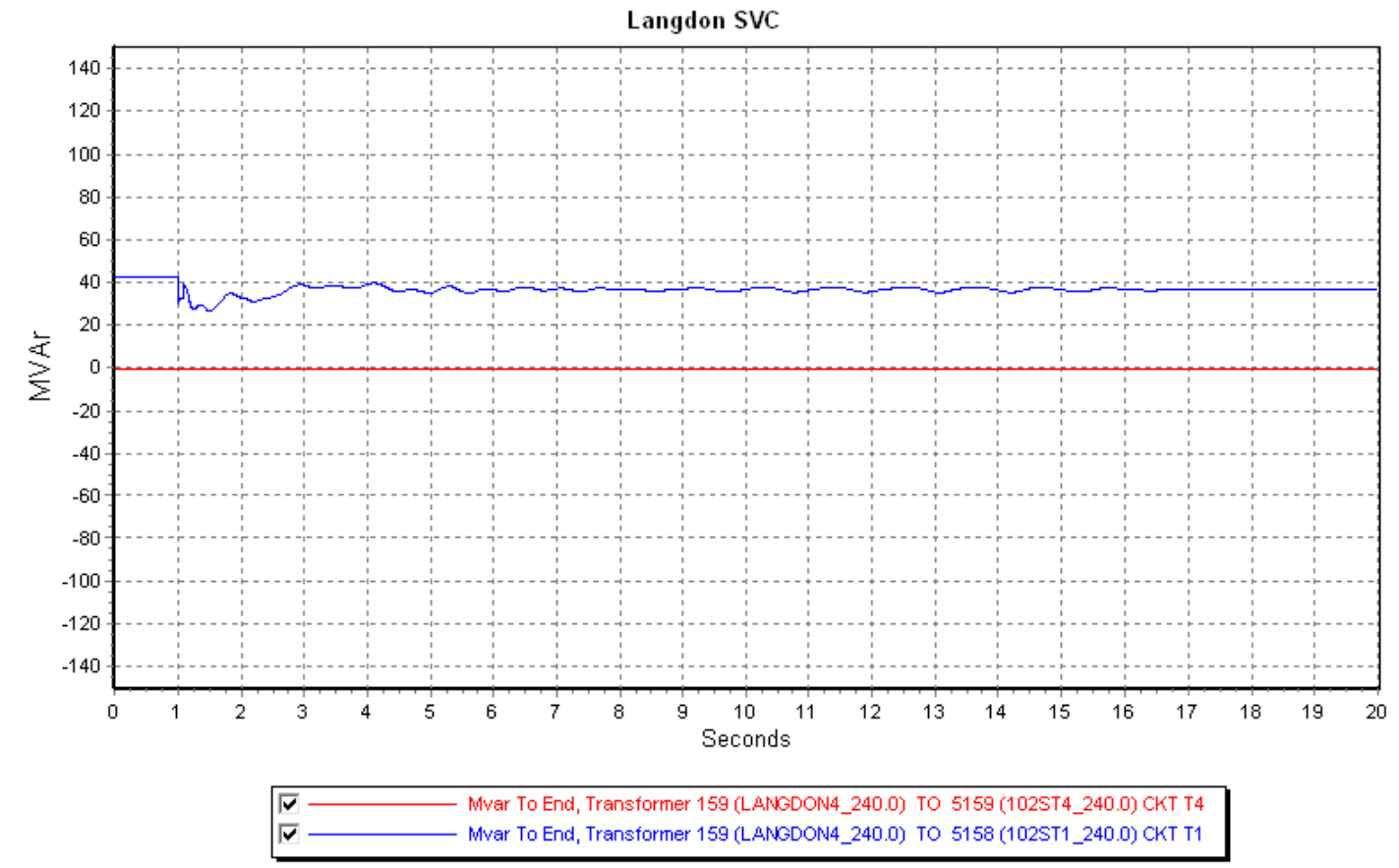
May 11, 2014 08:30:03



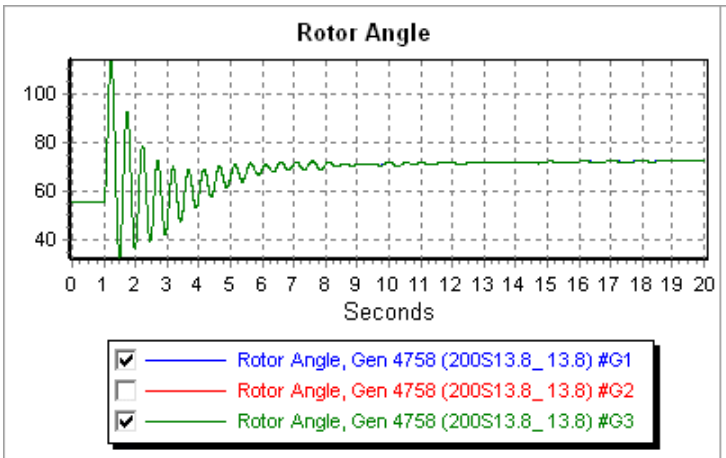
Contingency: 853L QUEENSTOWN 504S - WEST BROOKS 28S

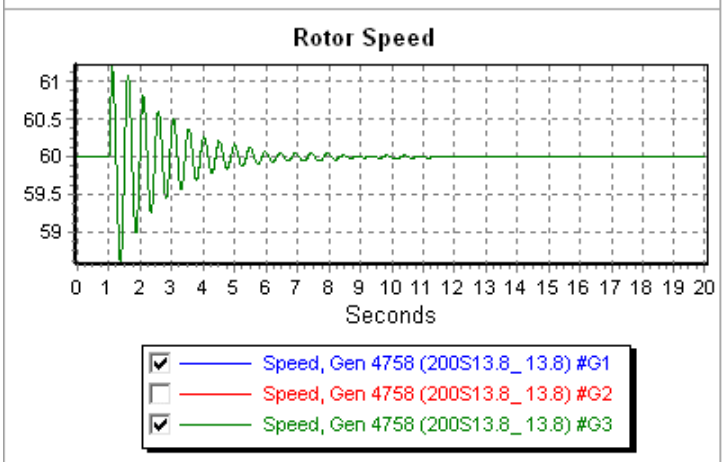
Cavalier
Queenstown Generating Plant Output: 90MW

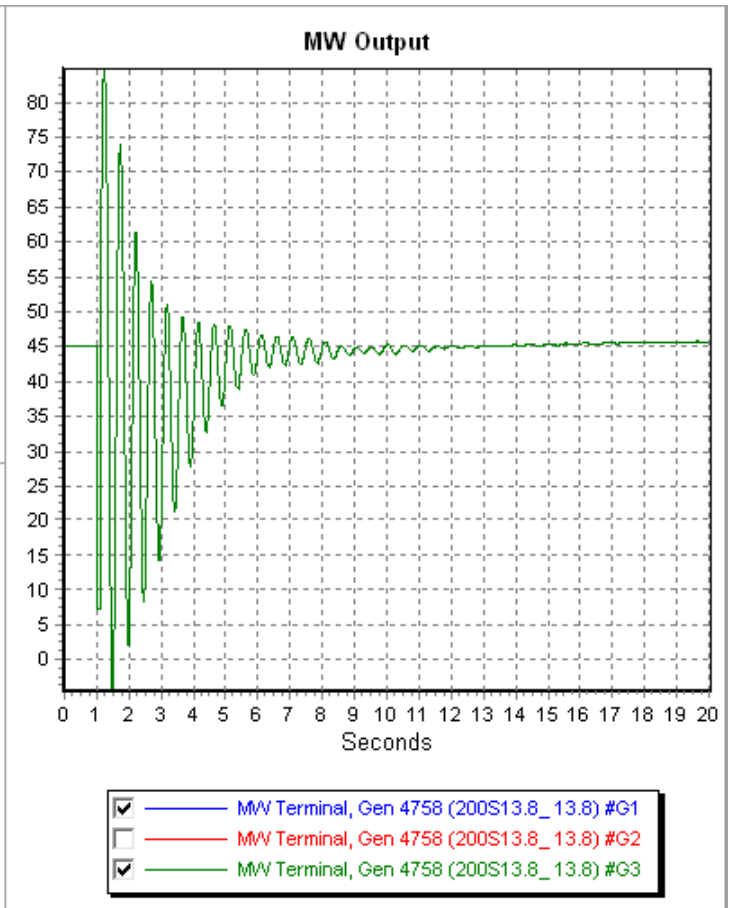
May 11, 2014 08:30:04



Contingency: 853L QUEENSTOWN 504S - WEST BROOKS 28S	Langdon SVC Queenstown Generating Plant Output: 90MW May 11, 2014 08:30:06



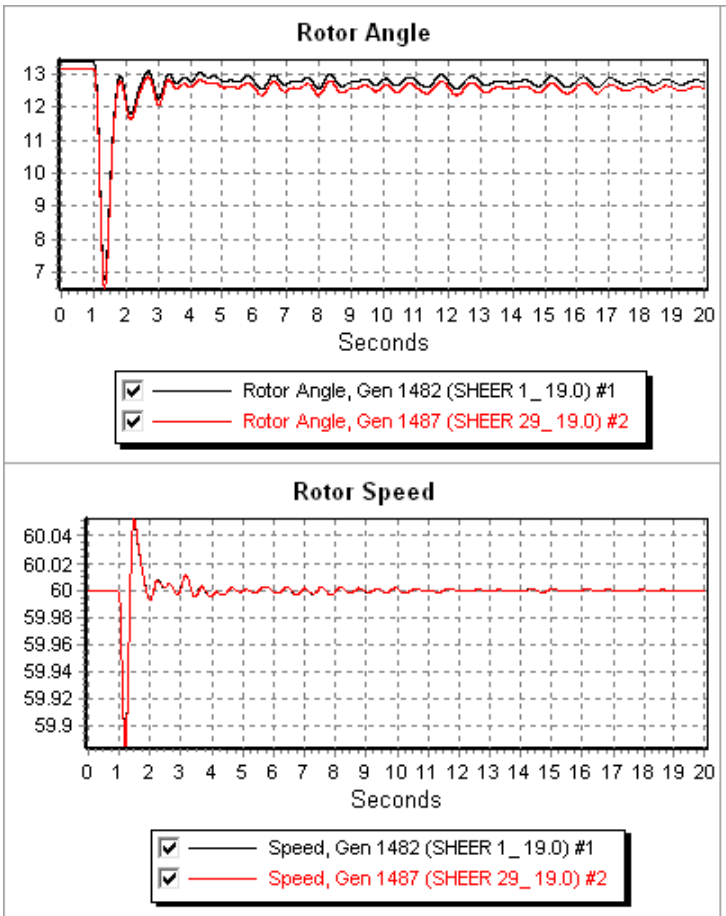


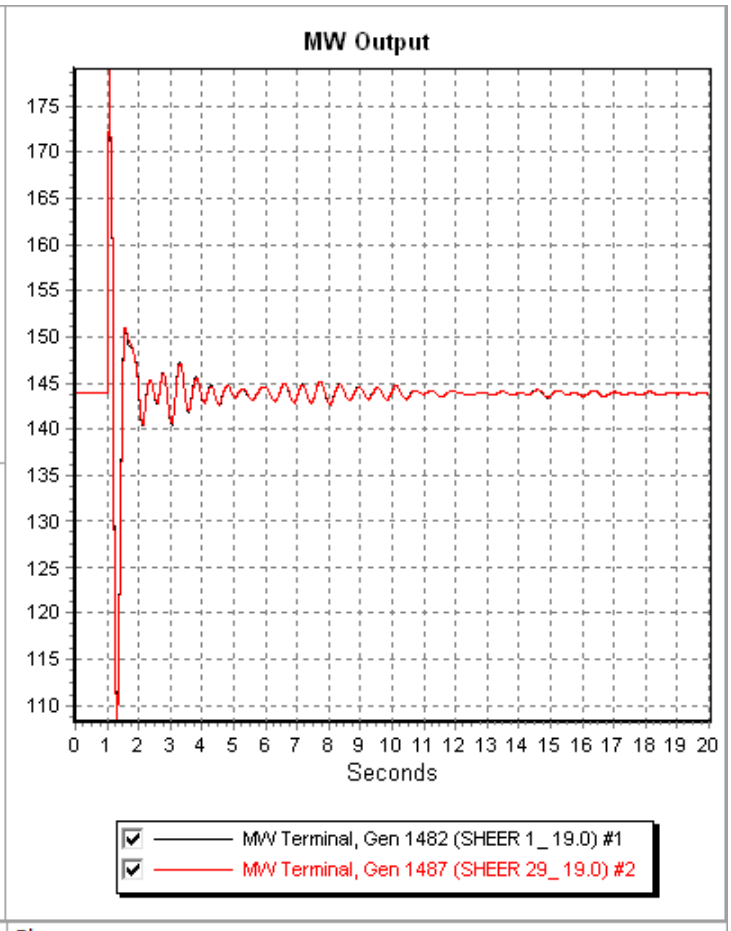


Contingency: 853L QUEENSTOWN 504S - WEST BROOKS 28S

P1336
Queenstown Generating Plant
Output: 90MW

May 11, 2014 08:30:04

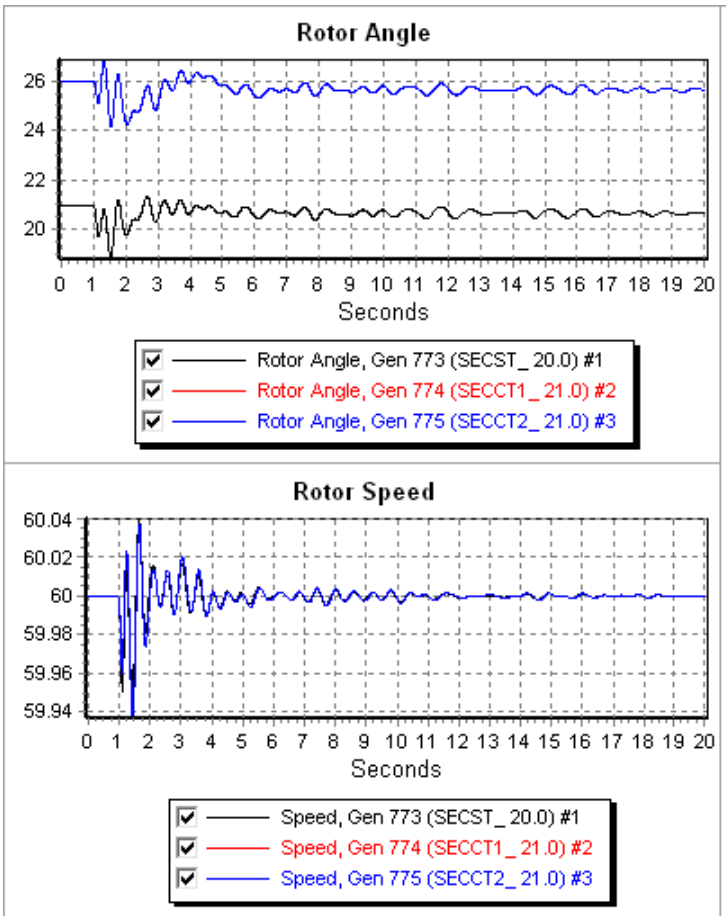


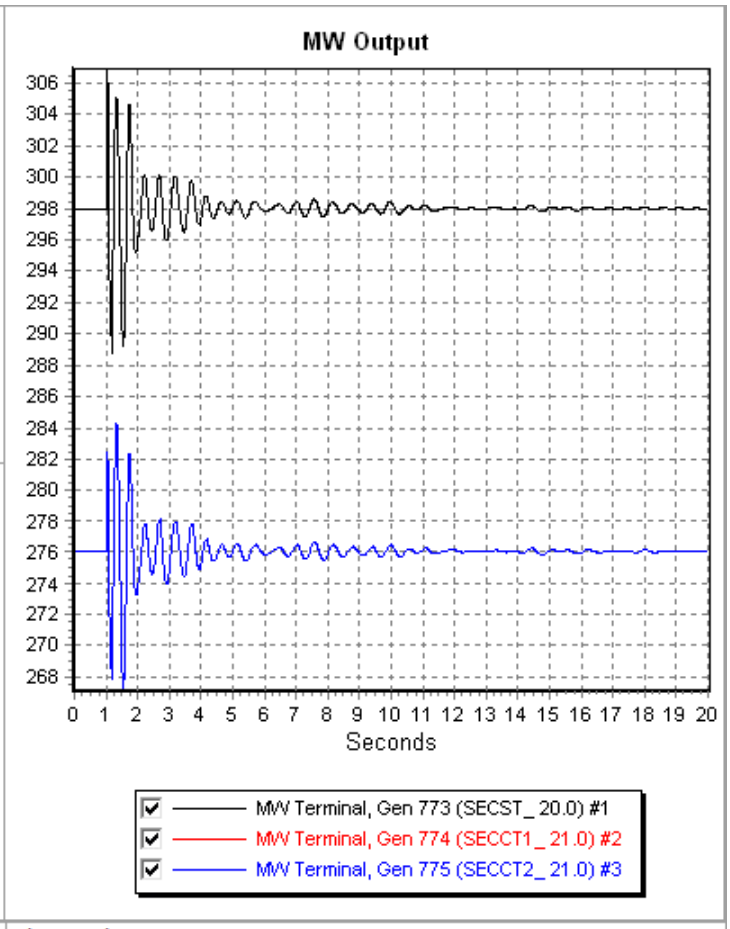


Contingency: 853L QUEENSTOWN 504S - WEST BROOKS 28S

Sheerness
Queenstown Generating Plant Output: 90MW

May 11, 2014 08:30:02

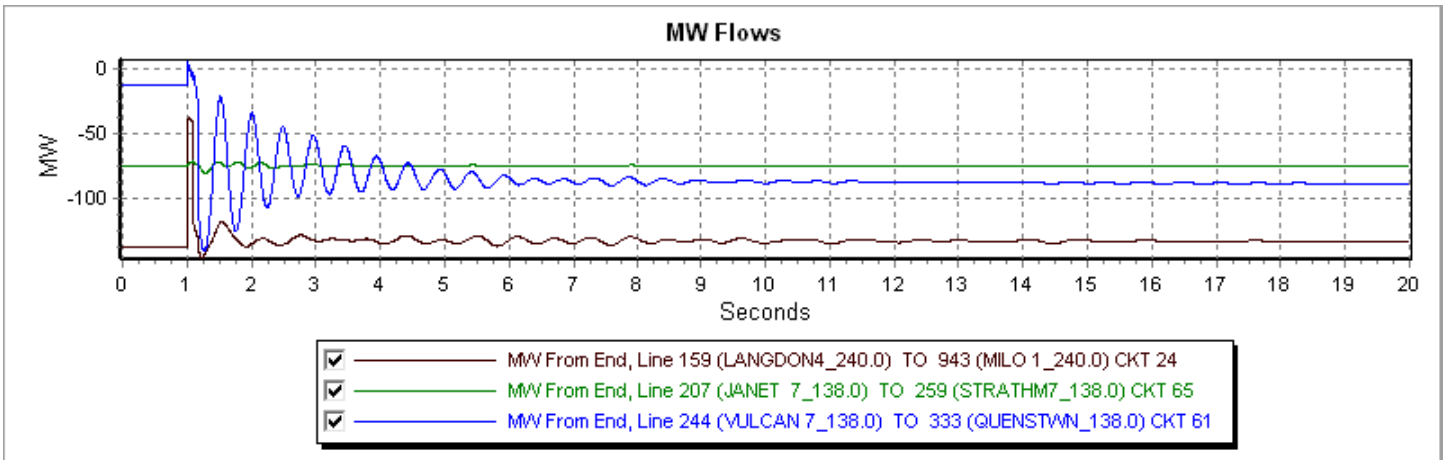


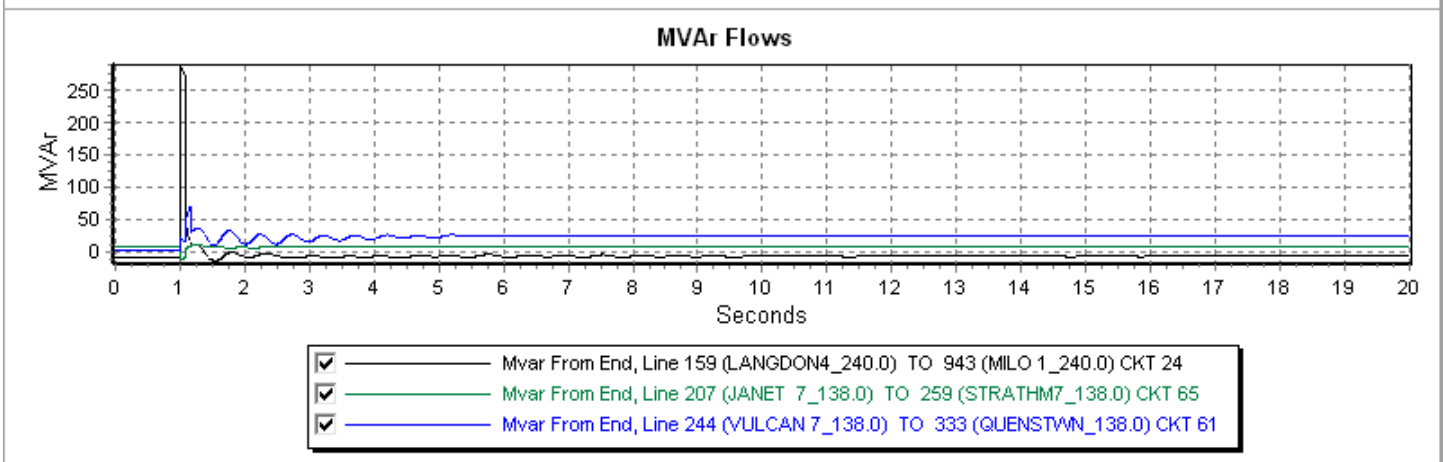


Contingency: 853L QUEENSTOWN 504S - WEST BROOKS 28S

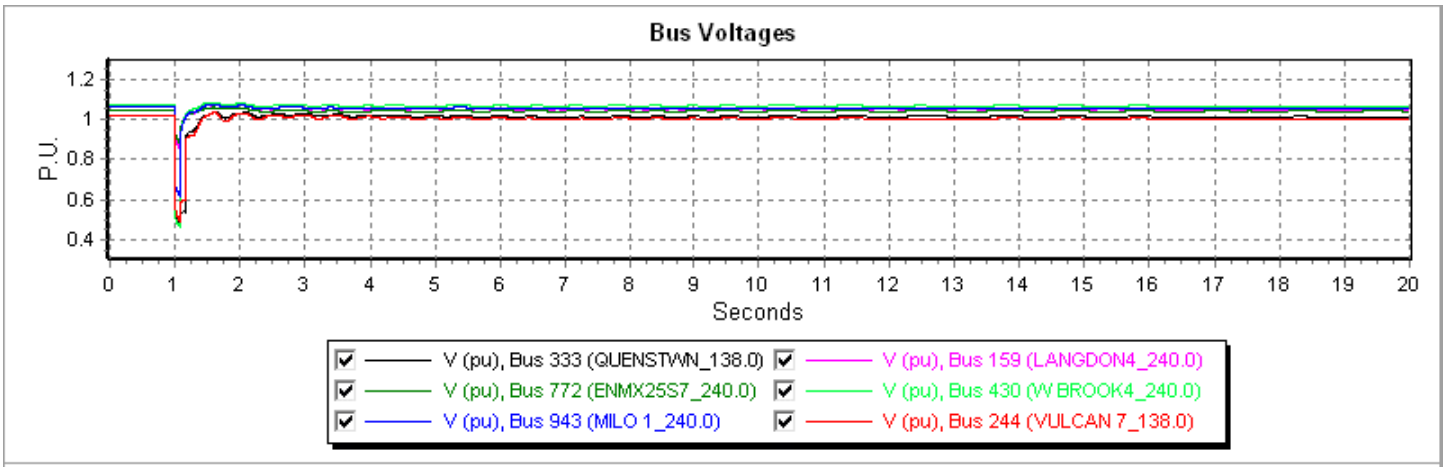
Sheppard
Queenstown Generating Plant Output: 90MW

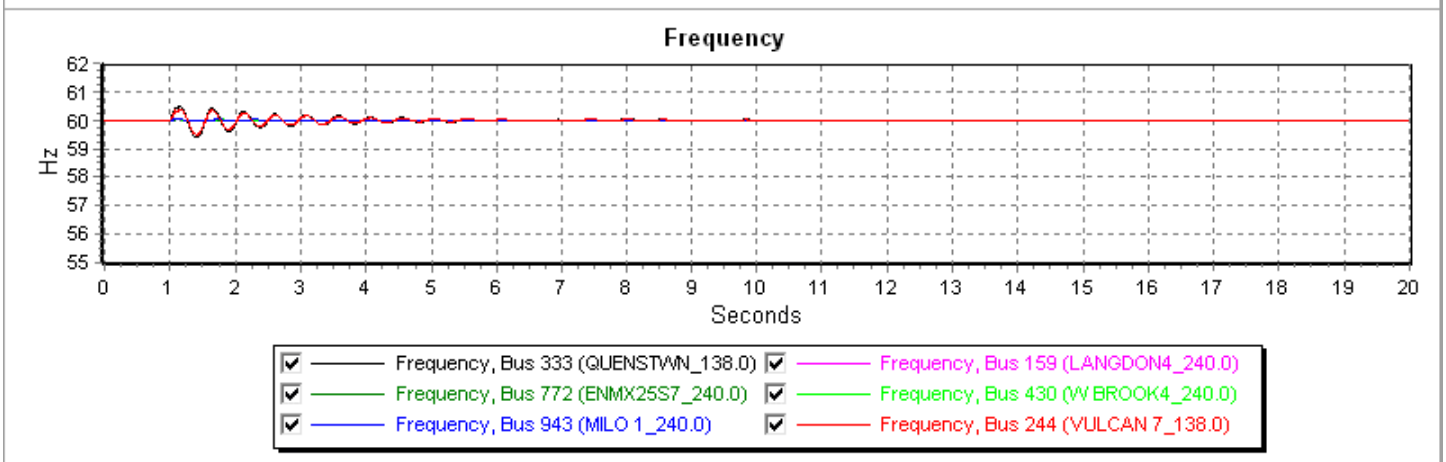
May 11, 2014 08:30:03



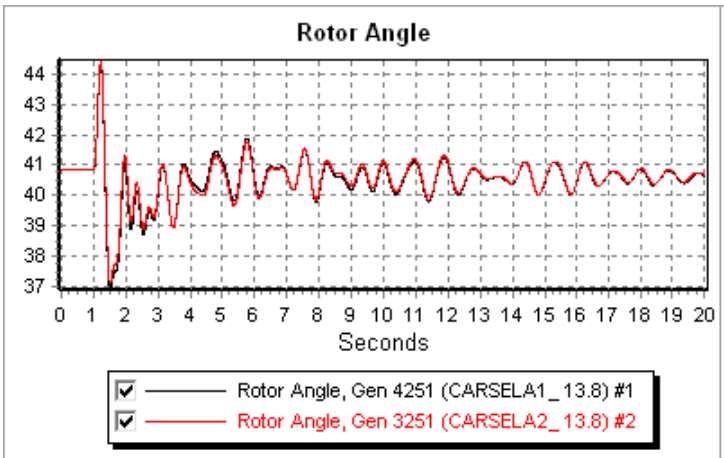


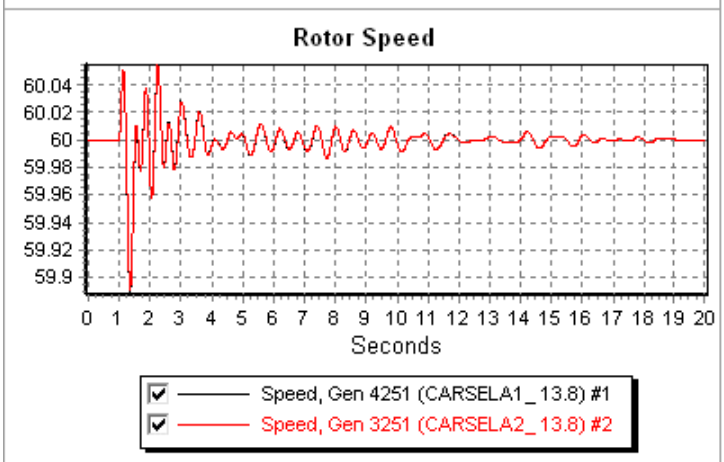
Contingency: 853L WEST BROOKS 28S - QUEENSTOWN 504S	Branch Flows Queenstown Generating Plant Output: 90MW
	May 11, 2014 08:30:53

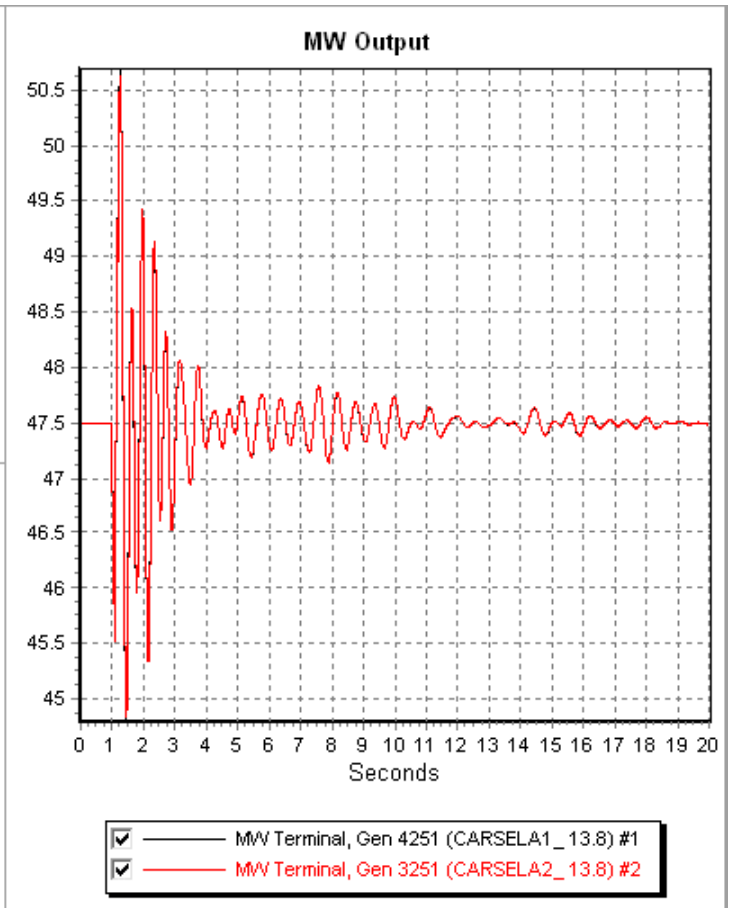




Contingency: 853L WEST BROOKS 28S - QUEENSTOWN 504S	Bus Voltages and Frequency Queenstown Generating Plant Output: 90MW
	May 11, 2014 08:30:54



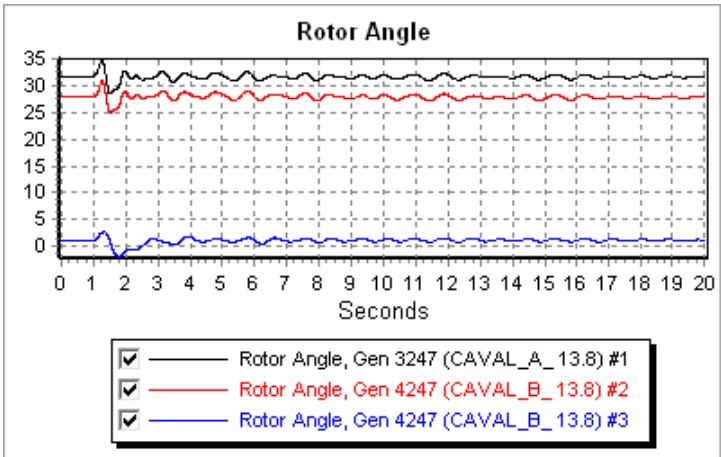


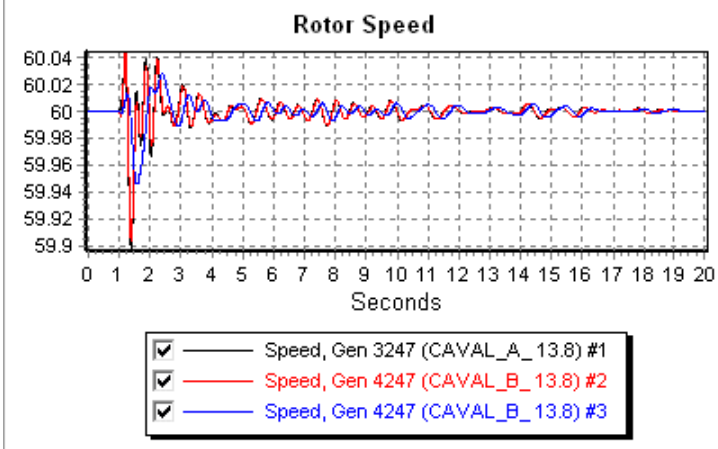


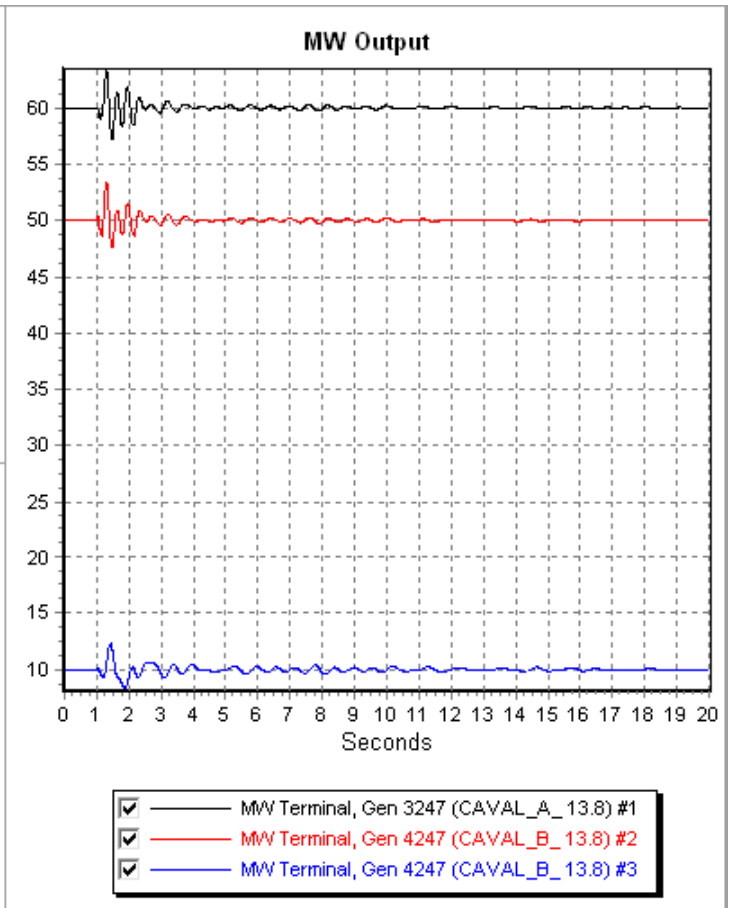
Contingency: 853L WEST BROOKS 28S - QUEENSTOWN 504S

Carseland
Queenstown Generating Plant Output: 90MW

May 11, 2014 08:30:51



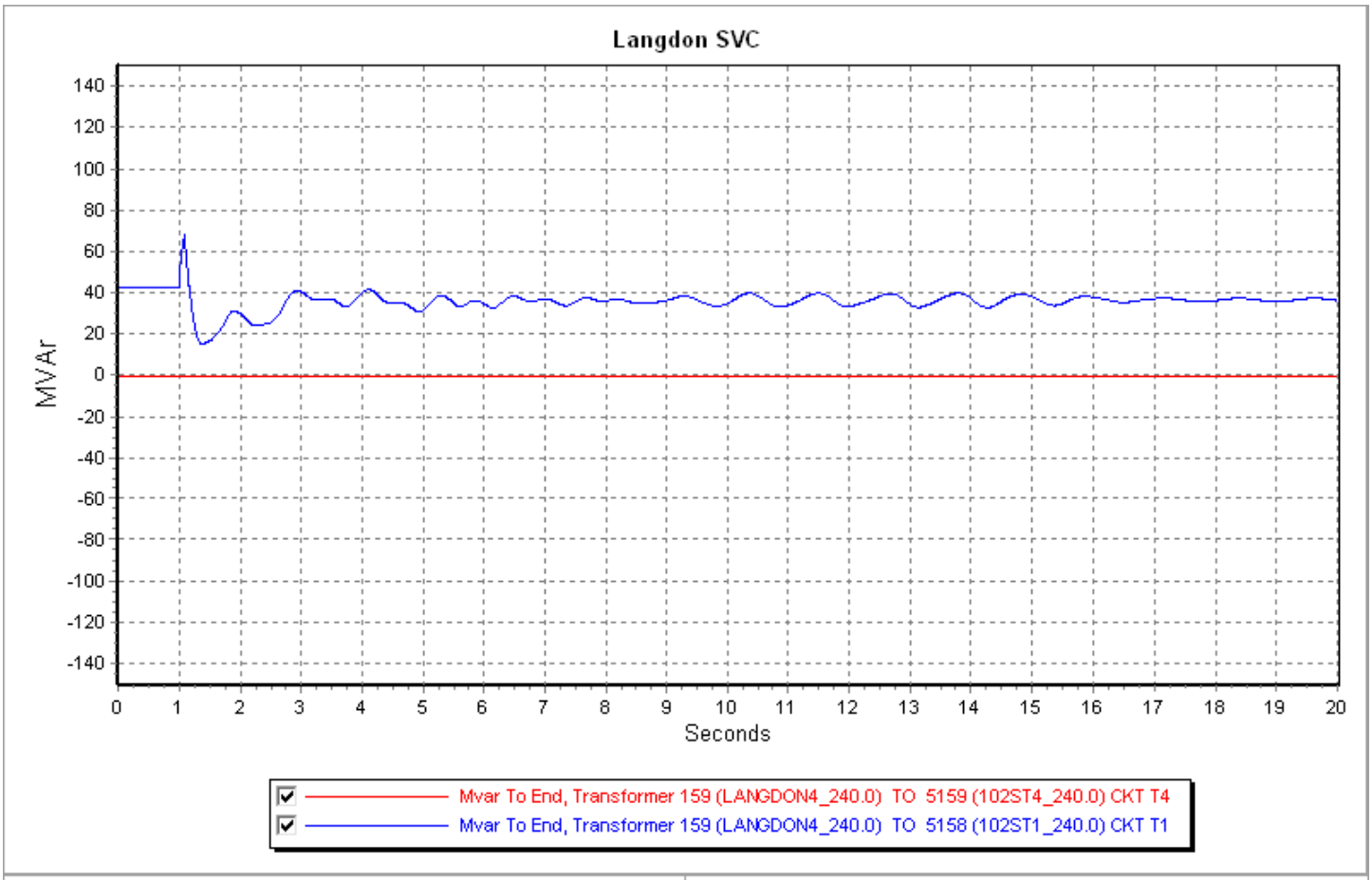




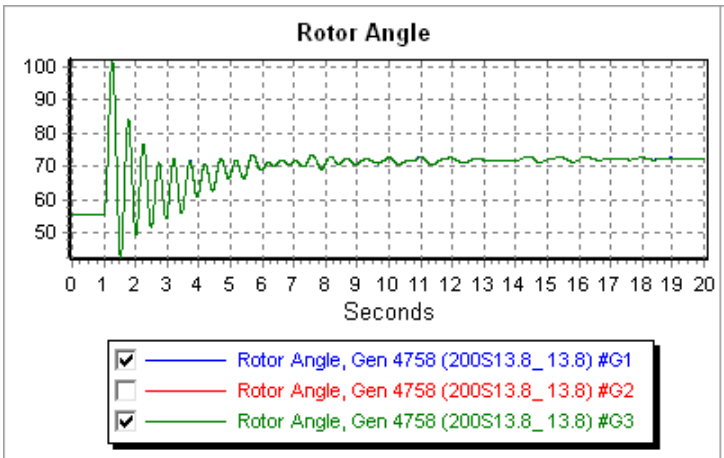
Contingency: 853L WEST BROOKS 28S - QUEENSTOWN 504S

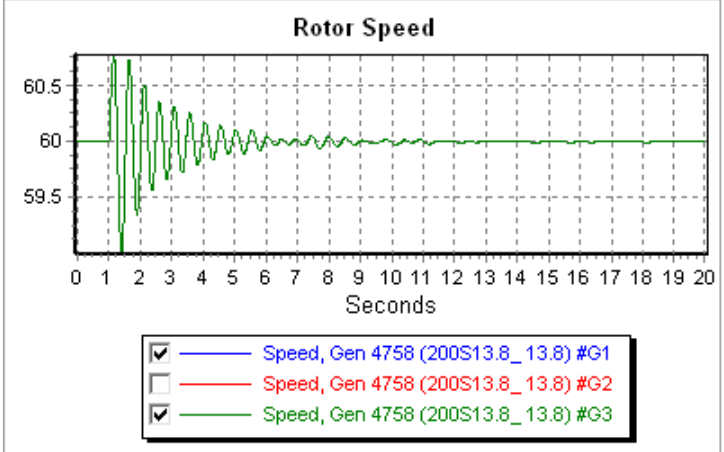
Cavalier
Queenstown Generating Plant Output: 90MW

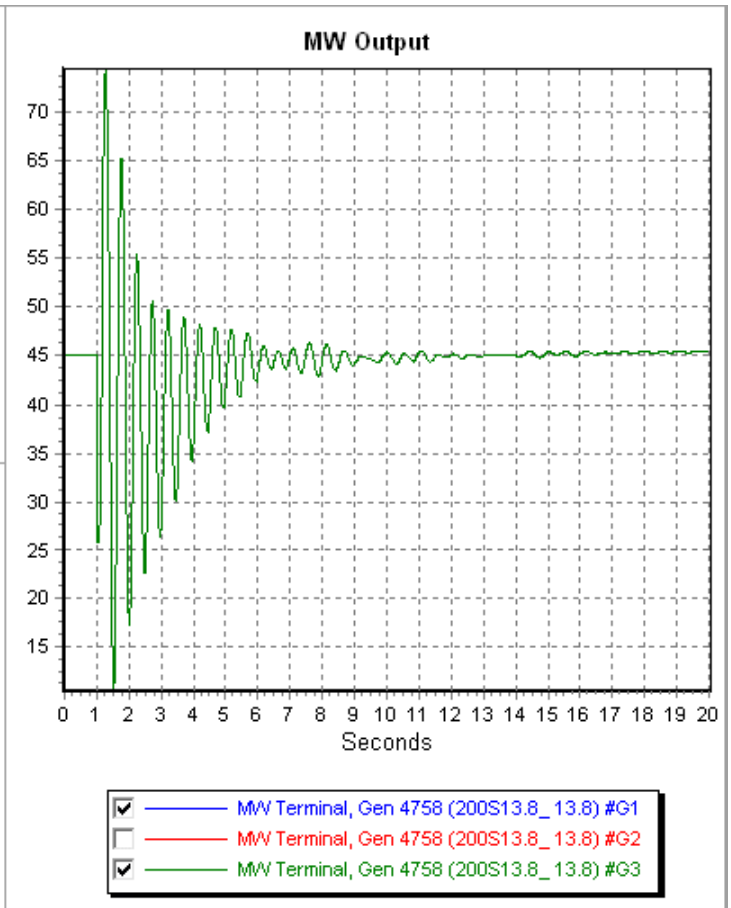
May 11, 2014 08:30:52



Contingency: 853L WEST BROOKS 28S - QUEENSTOWN 504S	Langdon SVC Queenstown Generating Plant Output: 90MW May 11, 2014 08:30:54



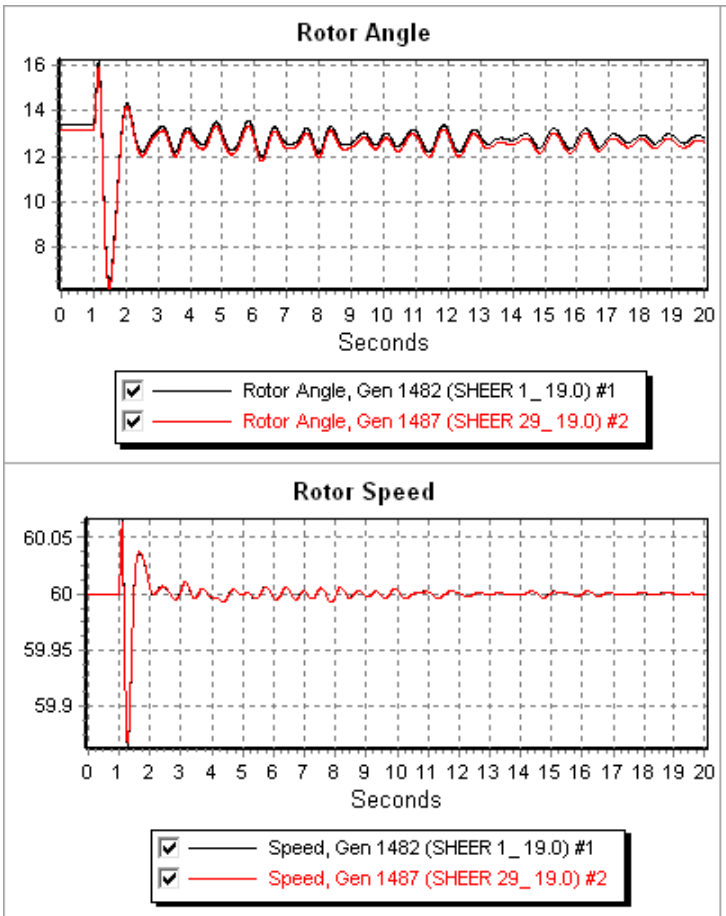


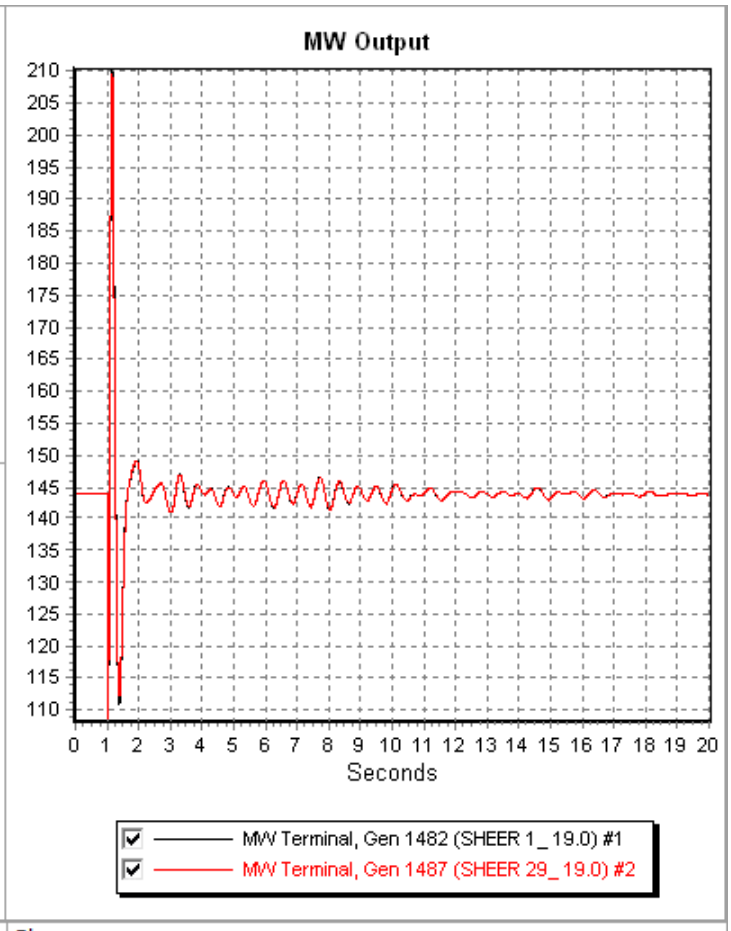


Contingency: 853L WEST BROOKS 28S - QUEENSTOWN 504S

P1336
Queenstown Generating Plant
Output: 90MW

May 11, 2014 08:30:52

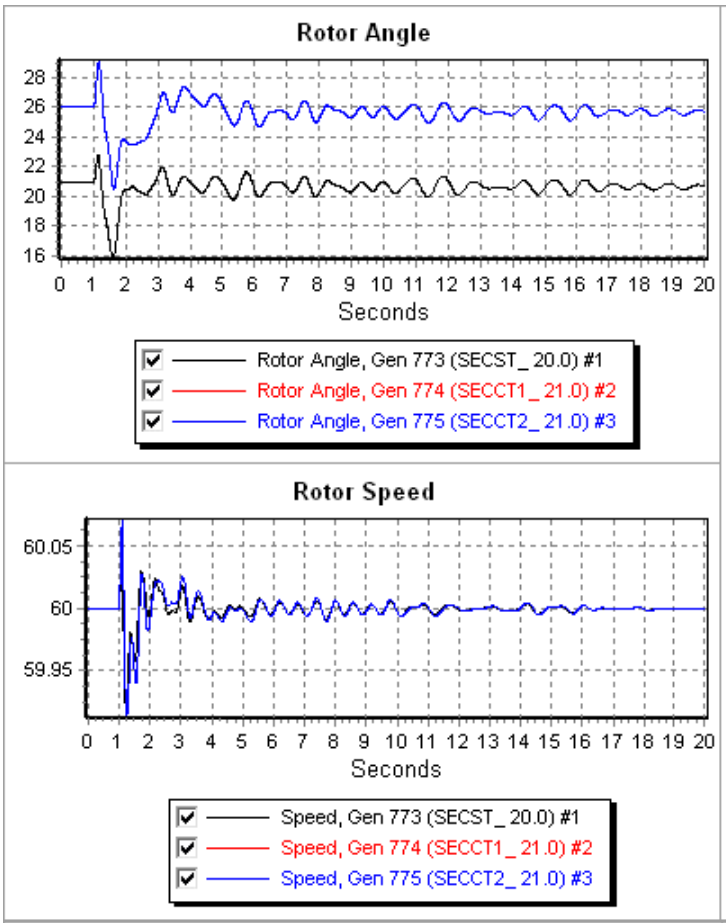


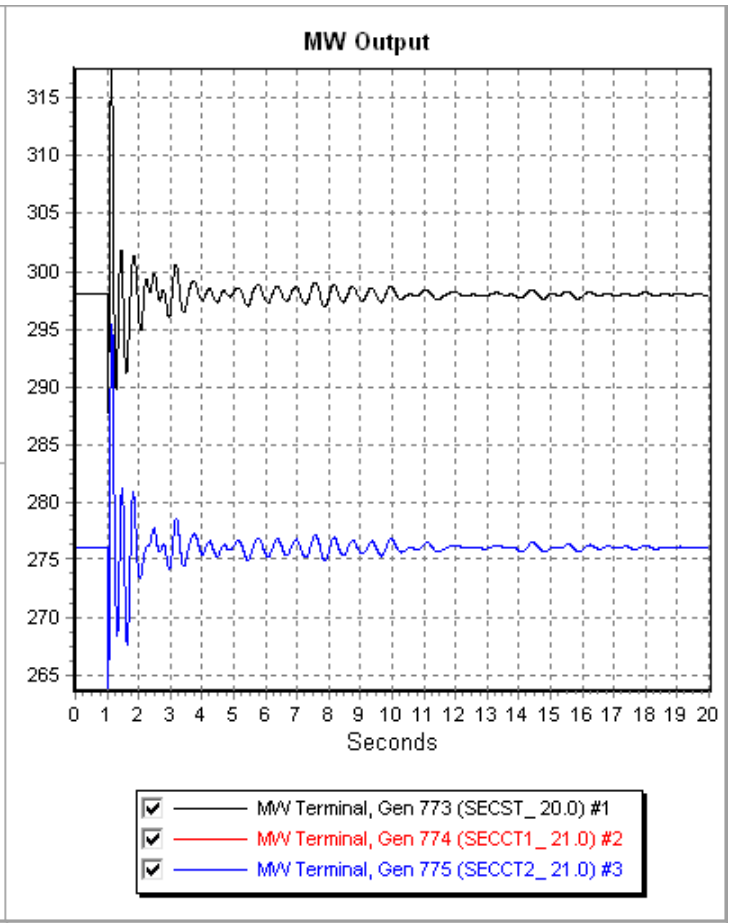


Contingency: 853L WEST BROOKS 28S - QUEENSTOWN 504S

Sheerness
Queenstown Generating Plant Output: 90MW

May 11, 2014 08:30:50



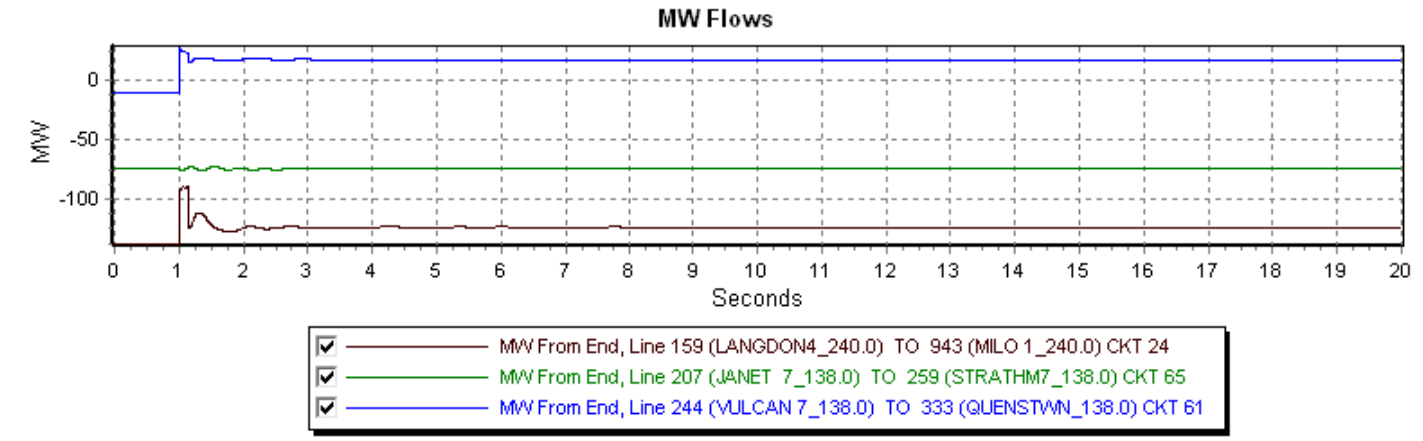


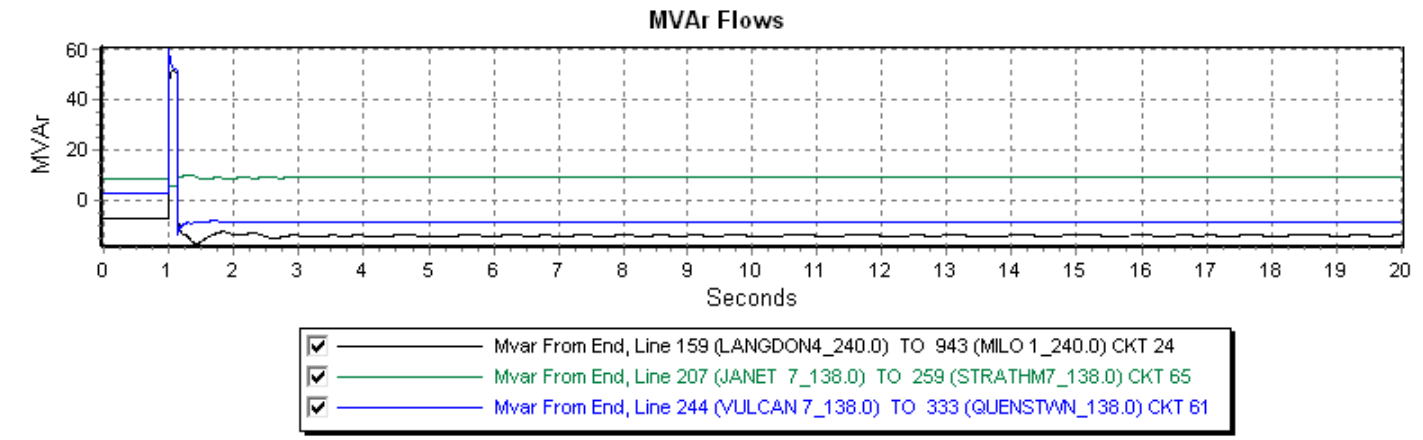
Contingency: 853L WEST BROOKS 28S - QUEENSTOWN 504S

Sheppard
Queenstown Generating Plant Output: 90MW

May 11, 2014 08:30:51

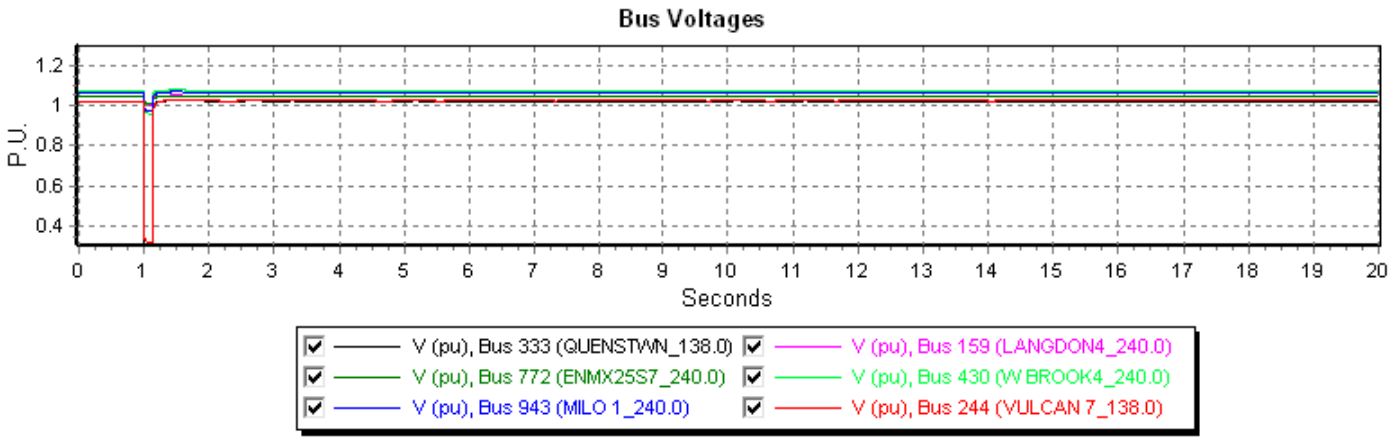
Branch Flows

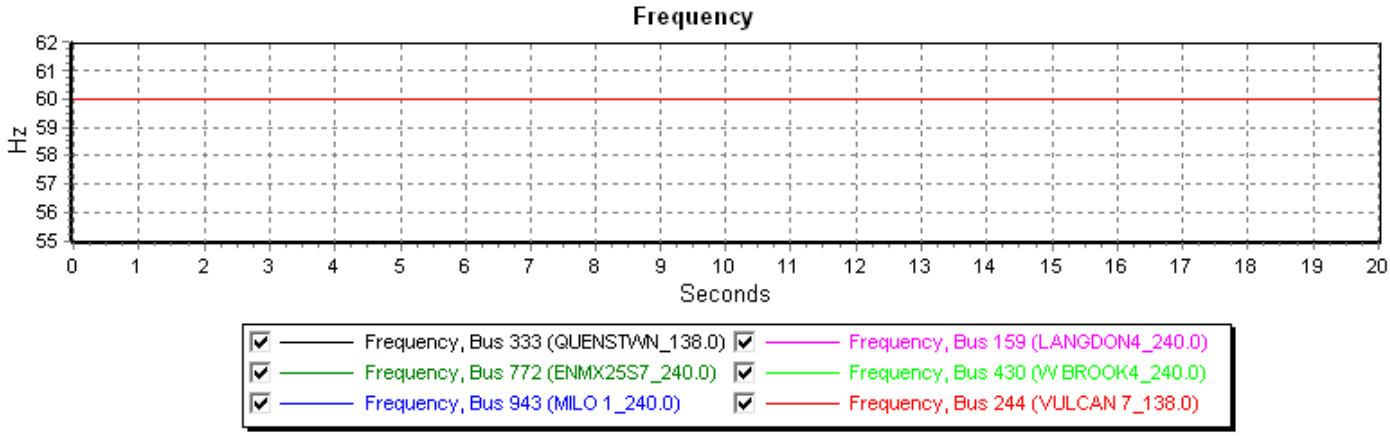




Contingency: Queenstown Plant _McGregor200s 138 kV Bus	Branch Flows Queenstown Generating Plant Output: 90MW
	November 05, 2014 12:23:15

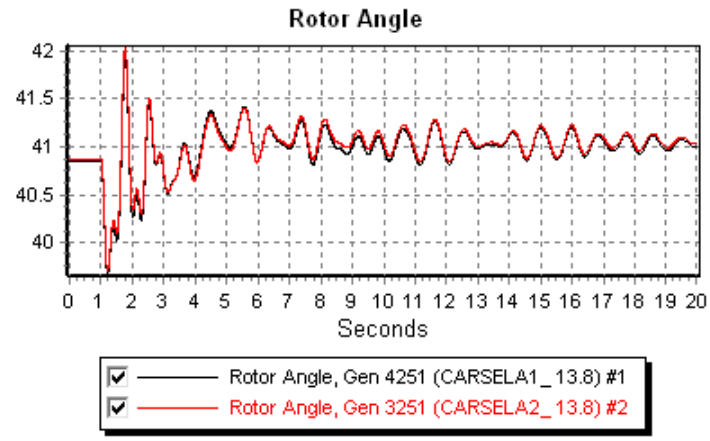
Bus Voltages and Frequency

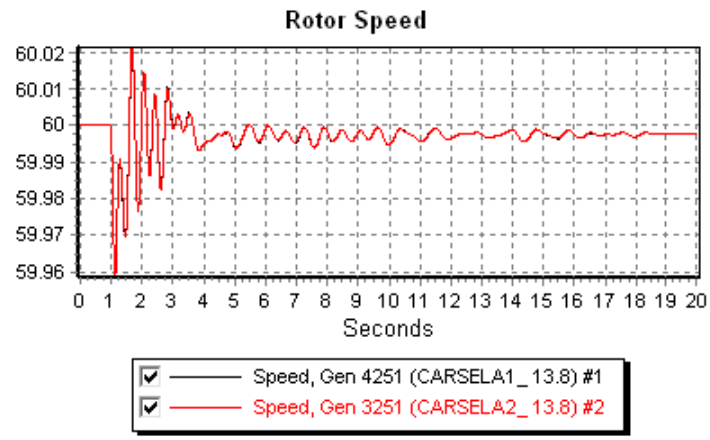


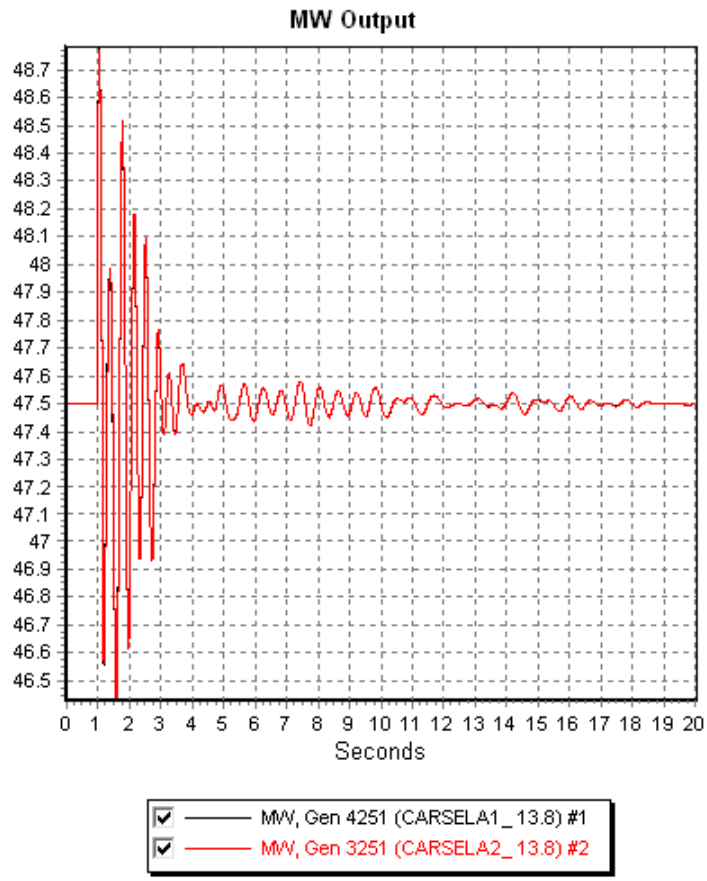


Contingency: Queenstown Plant _McGregor200s 138 kV Bus	Bus Voltages and Frequency Queenstown Generating Plant Output: 90MW November 05, 2014 12:23:15

Carseland





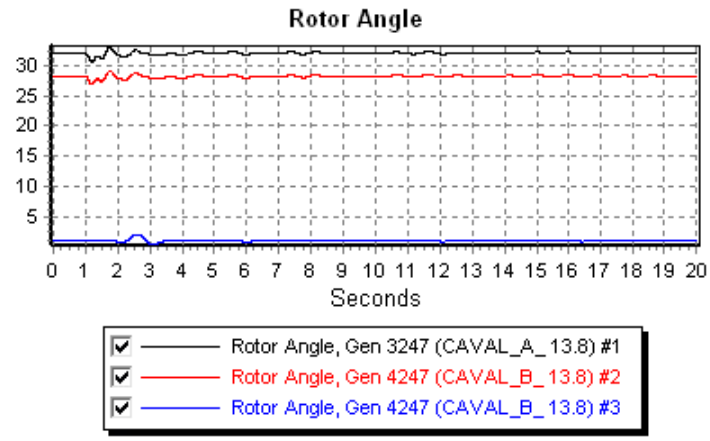


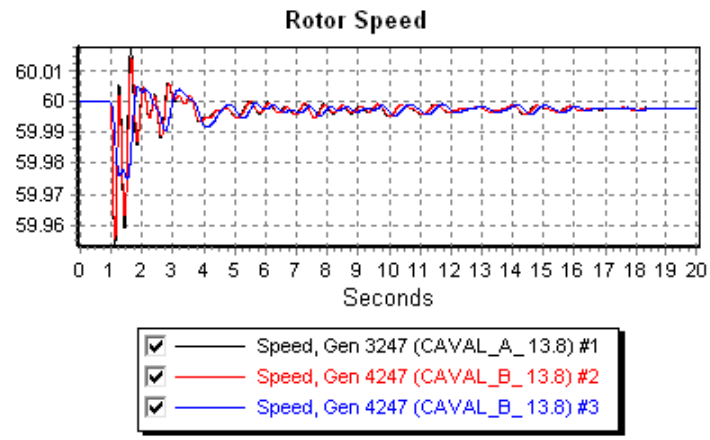
Contingency: Queenstown Plant _McGregor200s 138 kV Bus

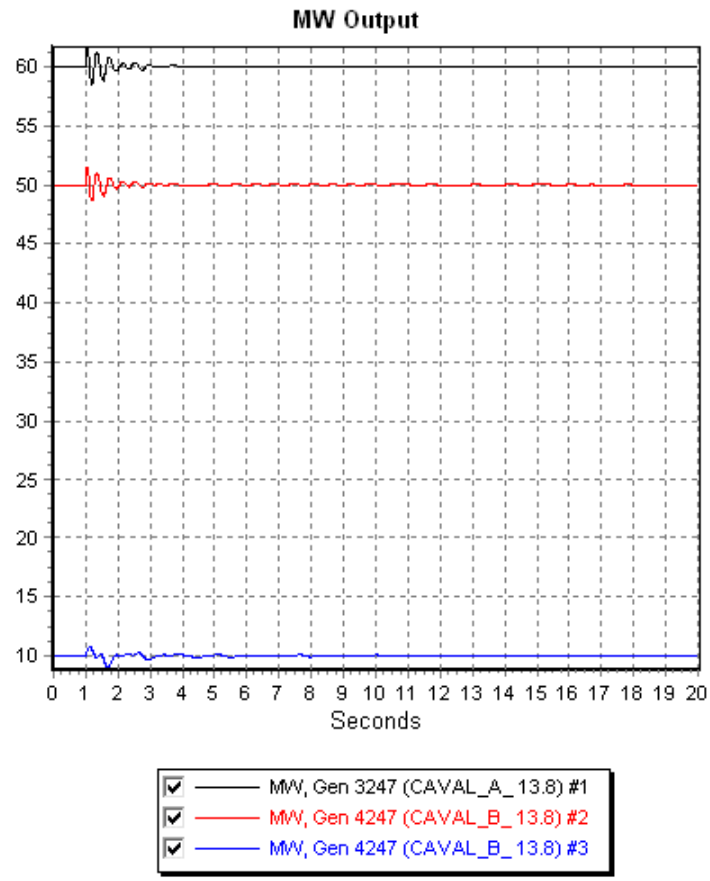
Carseland
Queenstown Generating Plant Output: 90MW

November 05, 2014 12:23:12

Cavalier





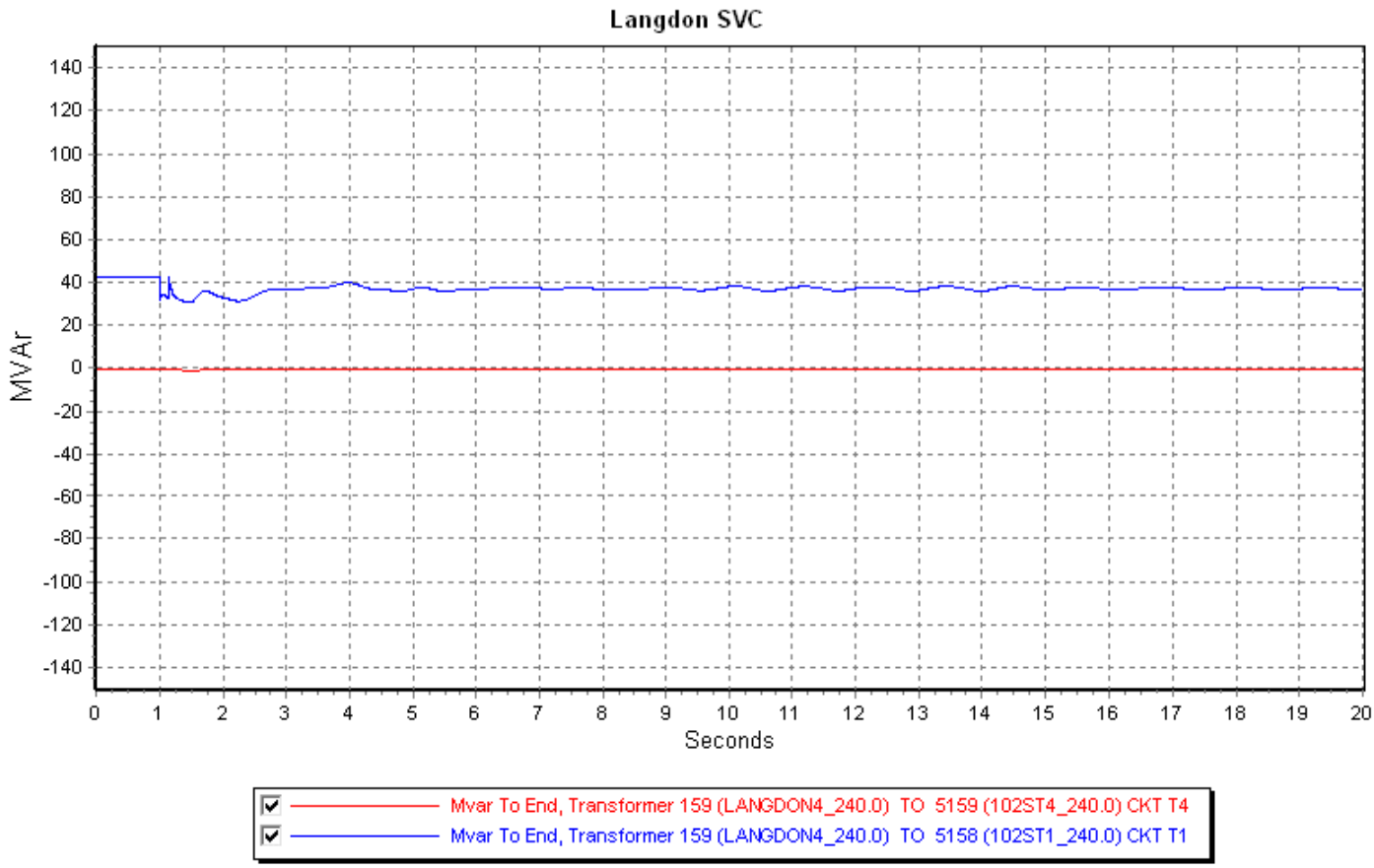


Contingency: Queenstown Plant _McGregor200s 138 kV Bus

Cavalier
Queenstown Generating Plant Output: 90MW

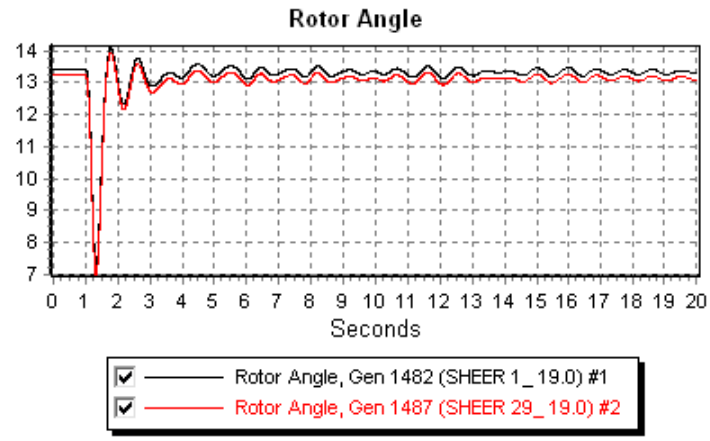
November 05, 2014 12:23:14

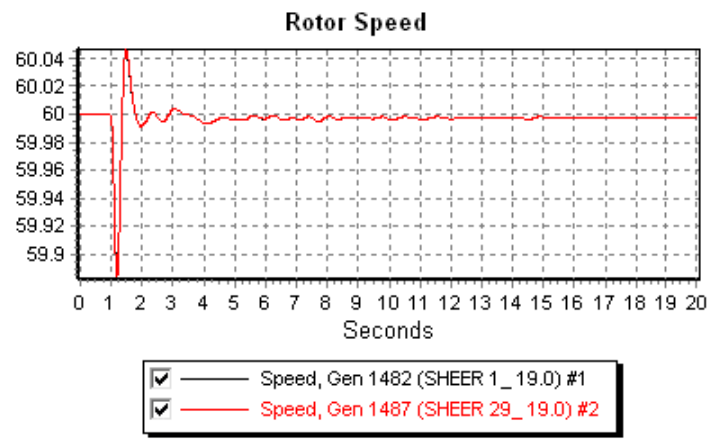
Langdon SVC

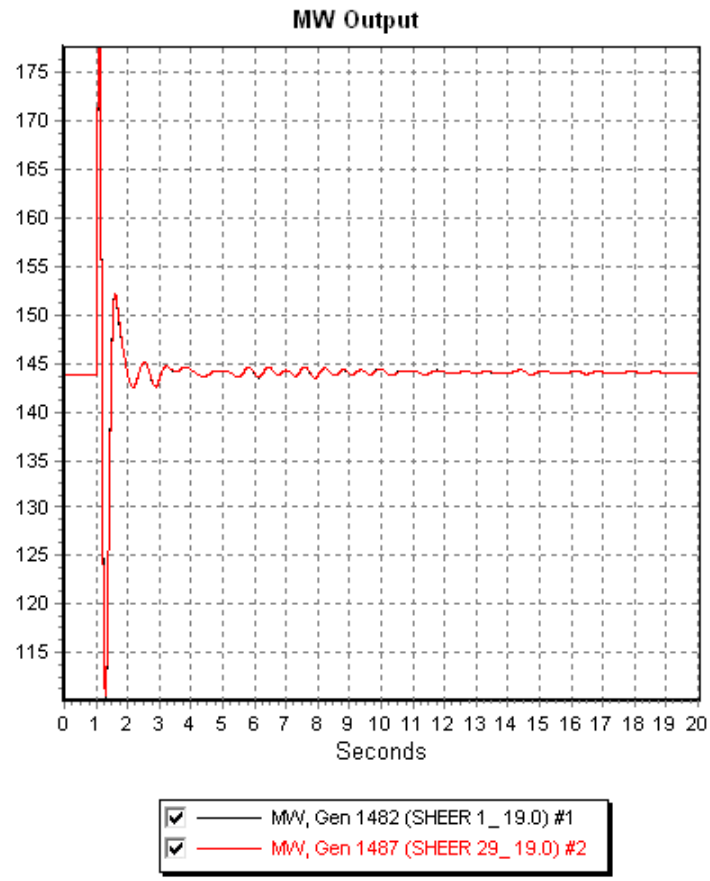


Contingency: Queenstown Plant _McGregor200s 138 kV Bus	Langdon SVC Queenstown Generating Plant Output: 90MW
	November 05, 2014 12:23:16

Sheerness





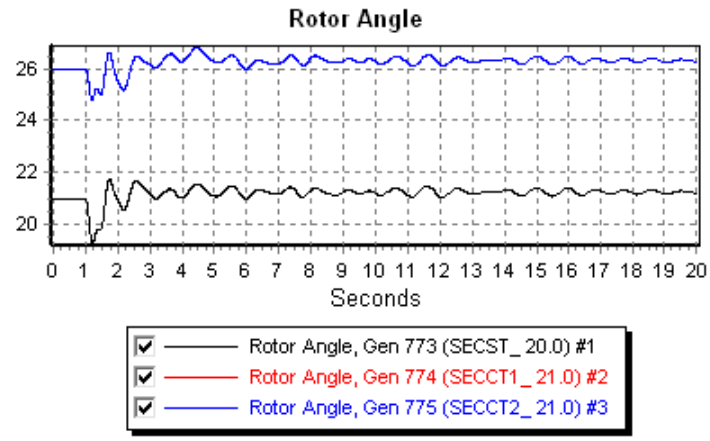


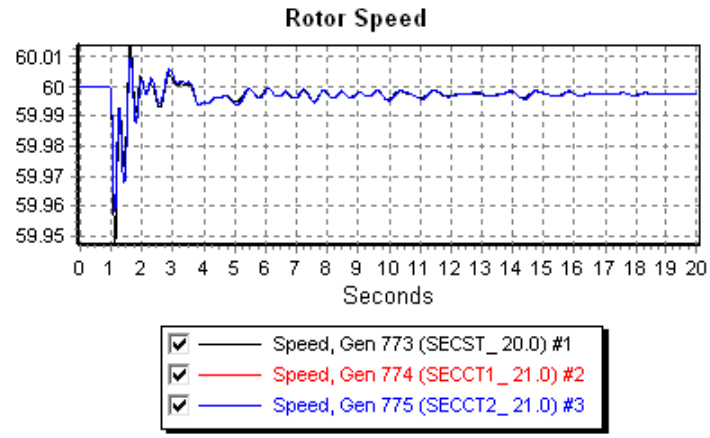
Contingency: Queenstown Plant _McGregor200s 138 kV Bus

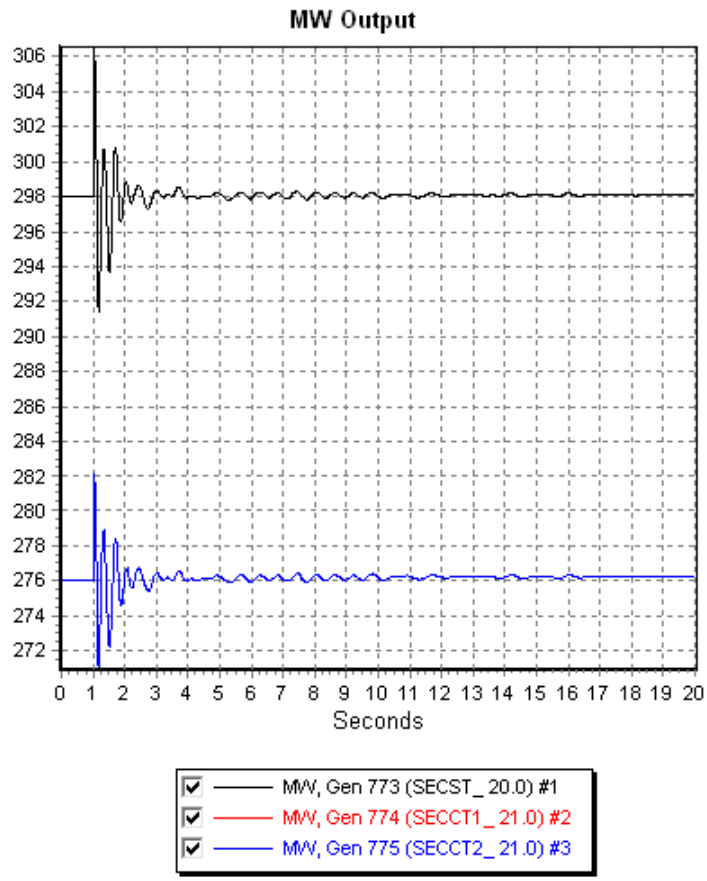
Sheerness
Queenstown Generating Plant Output: 90MW

November 05, 2014 12:23:12

Sheppard





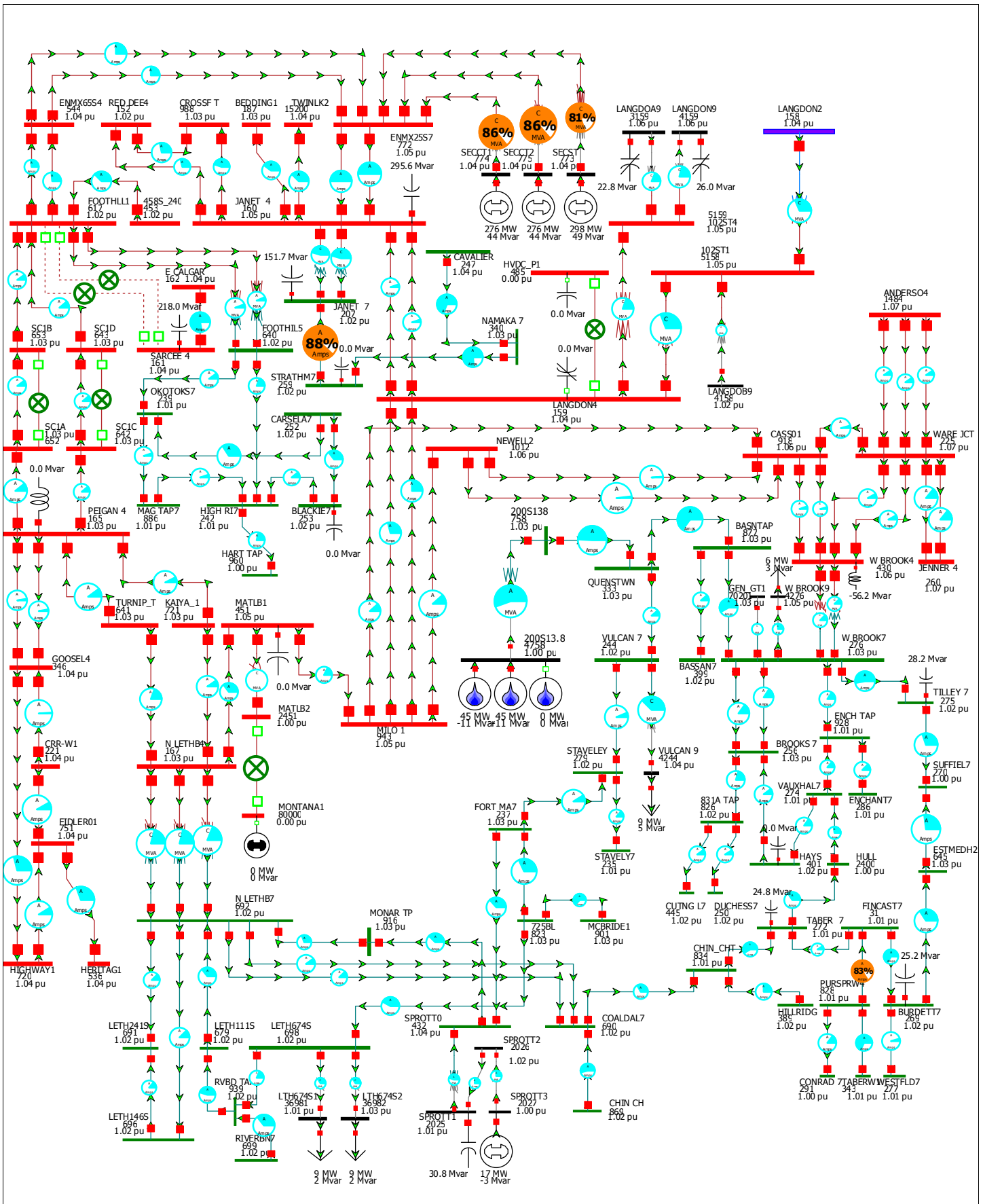


Contingency: Queenstown Plant _McGregor200s 138 kV Bus

Sheppard
Queenstown Generating Plant Output: 90MW

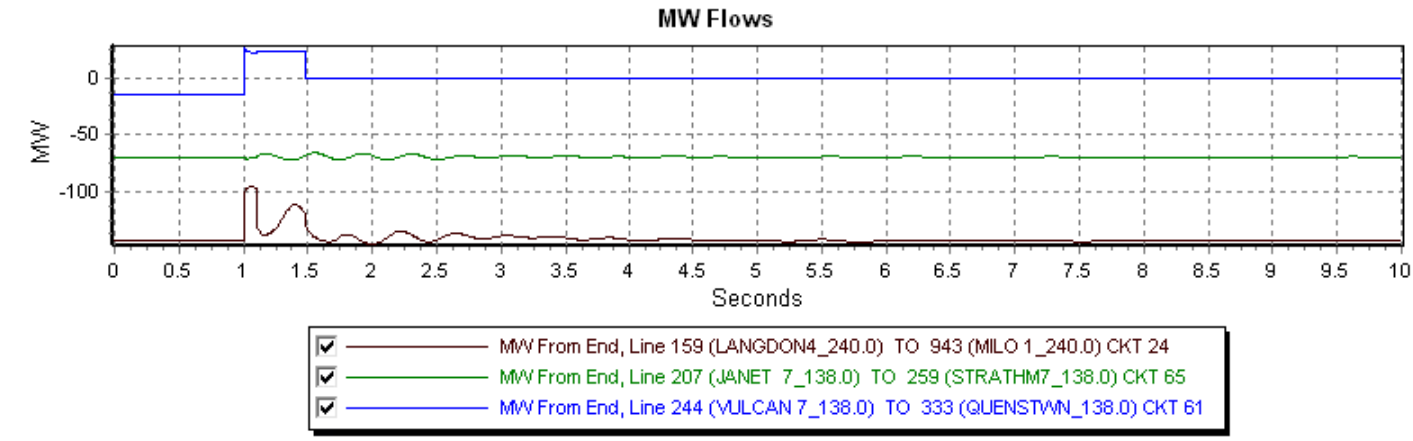
November 05, 2014 12:23:13

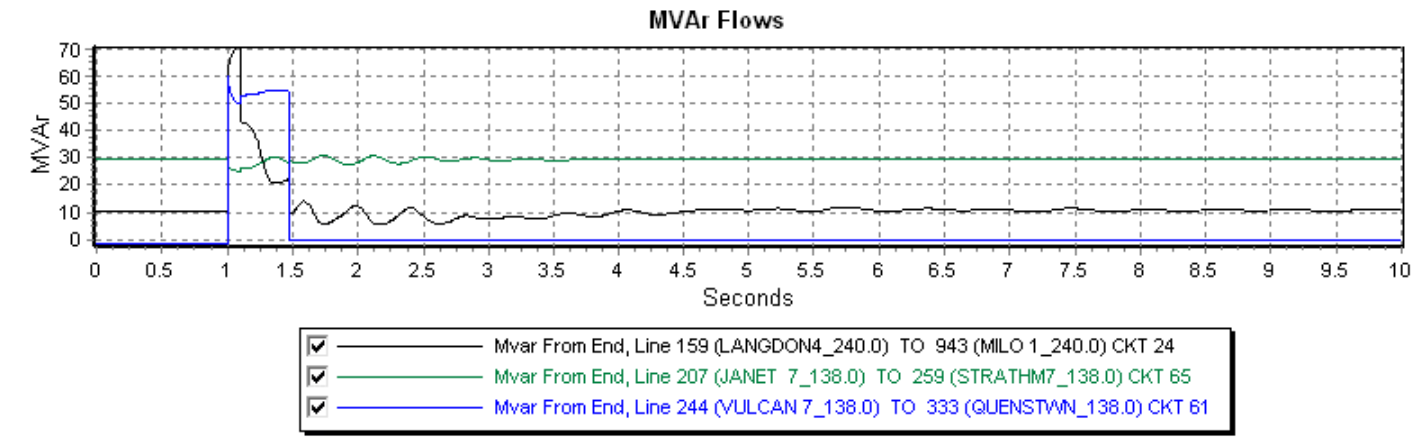
2015 SP



PowerEN Corporation D.Brankovich	Post-connection state, Alternative 1 Study Case: 2015SP	Transient Stability Initial Conditions TS-02 11/5/2014

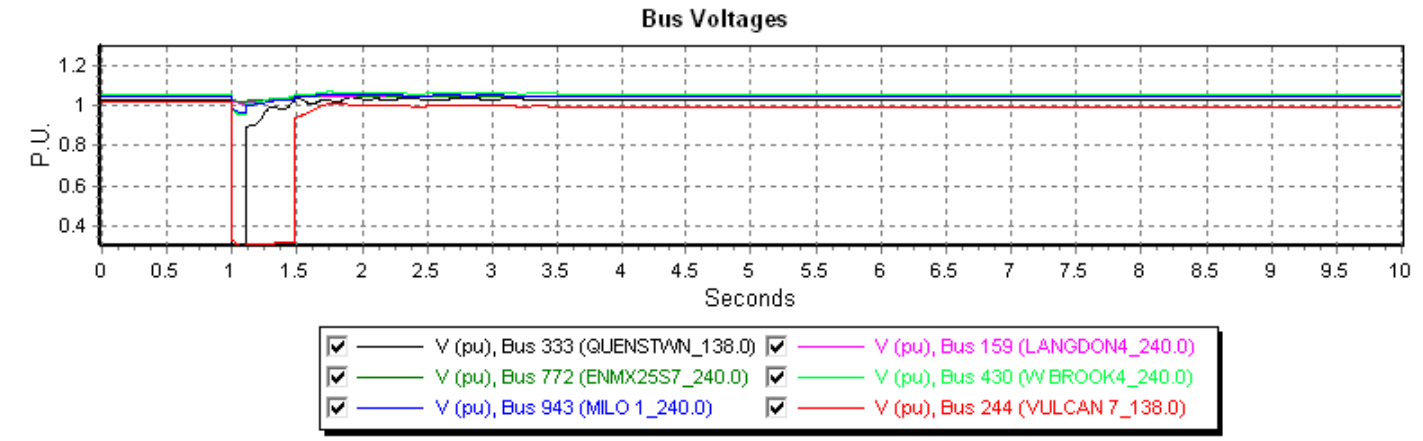
Branch Flows

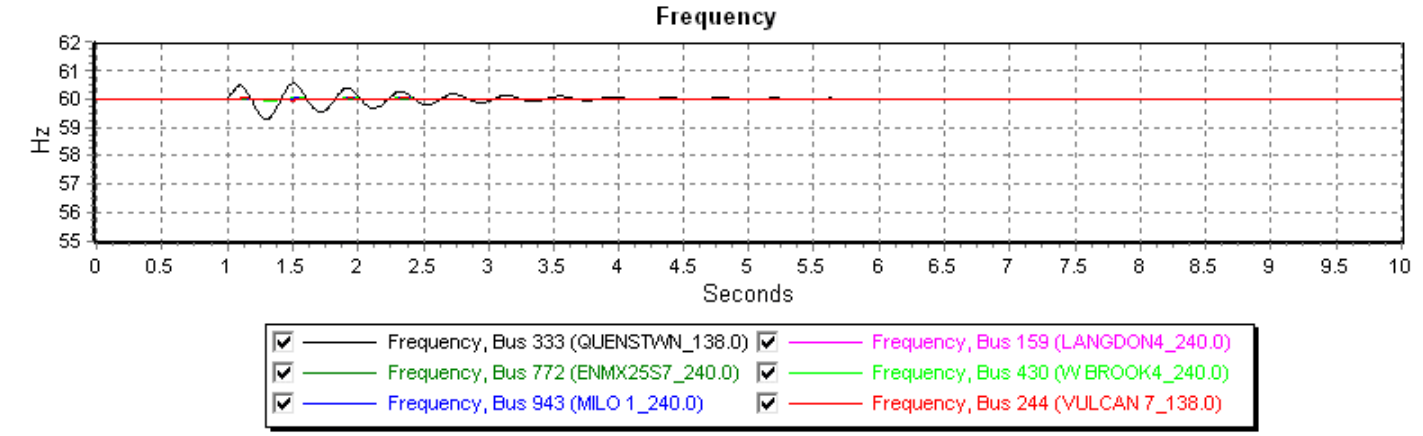




Contingency: 161L QUEENSTOWN 504S - VULCAN 255S	Branch Flows Queenstown Generating Plant Output: 90MW
	November 05, 2014 12:34:52

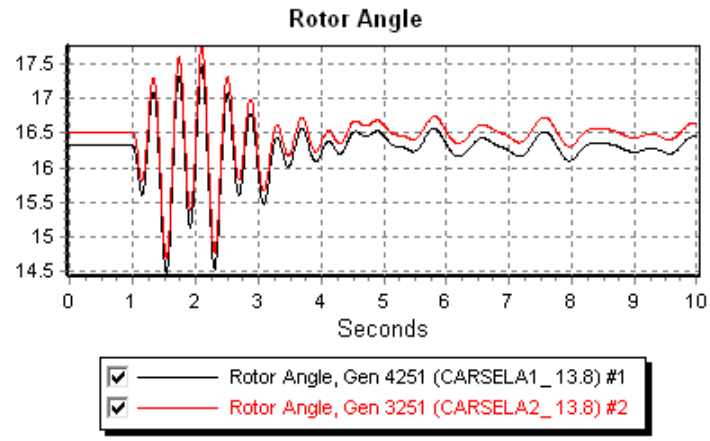
Bus Voltages and Frequency

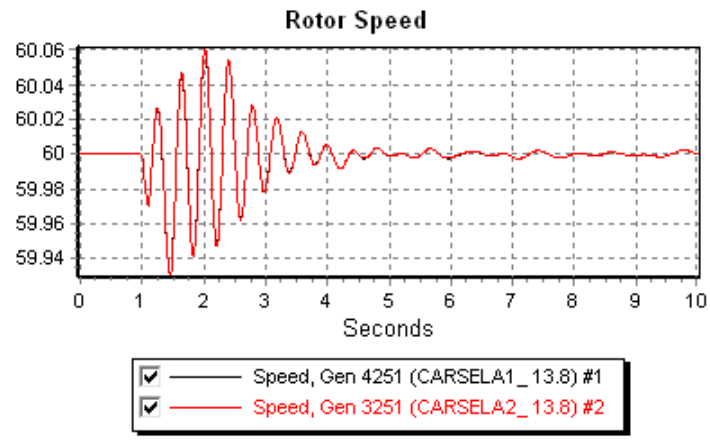


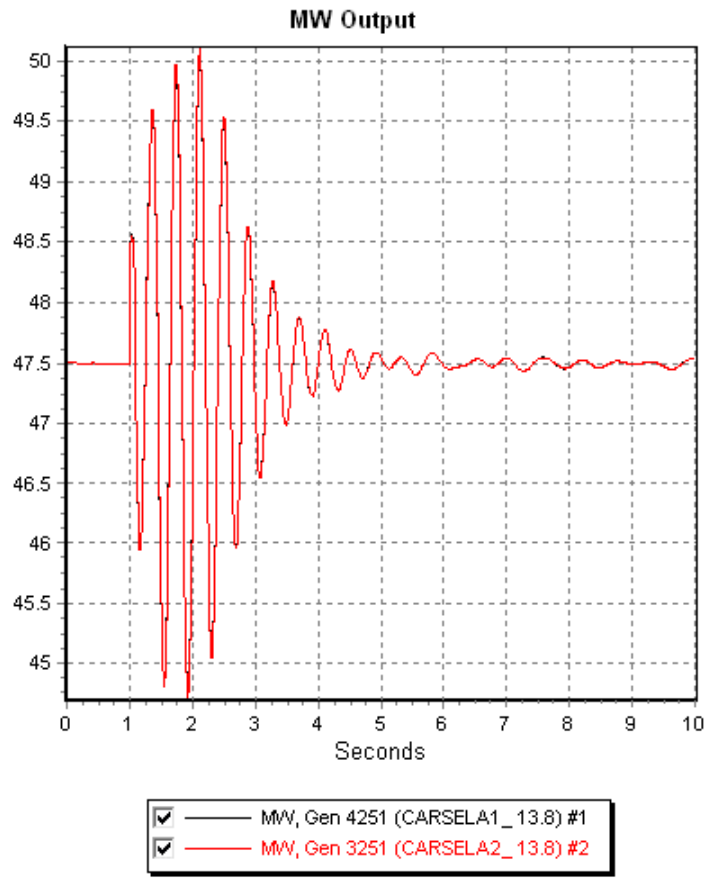


Contingency: 161L QUEENSTOWN 504S - VULCAN 255S	Bus Voltages and Frequency Queenstown Generating Plant Output: 90MW
	November 05, 2014 12:34:53

Carseland





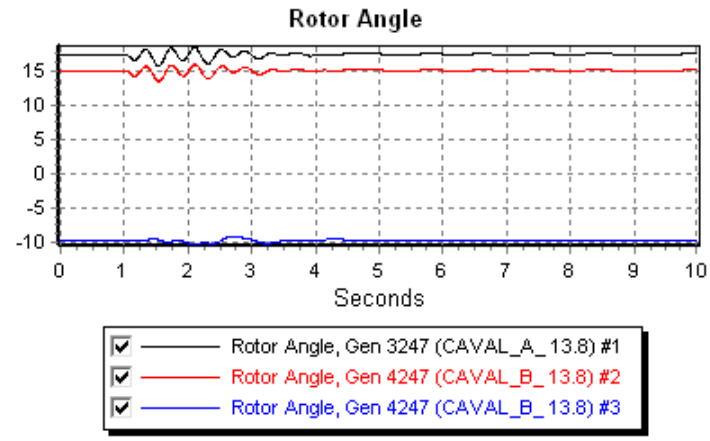


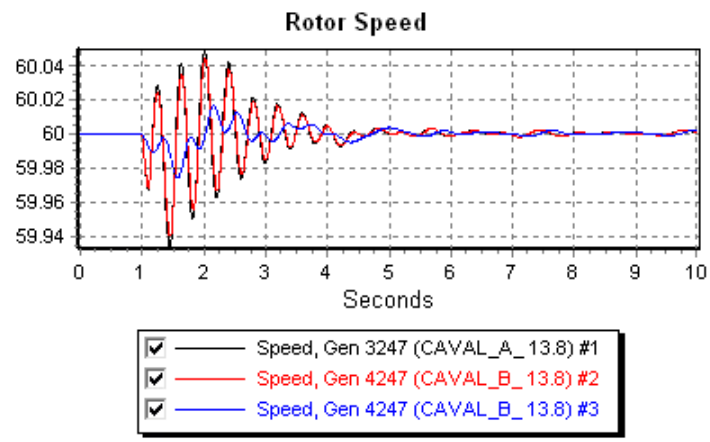
Contingency: 161L QUEENSTOWN 504S - VULCAN 255S

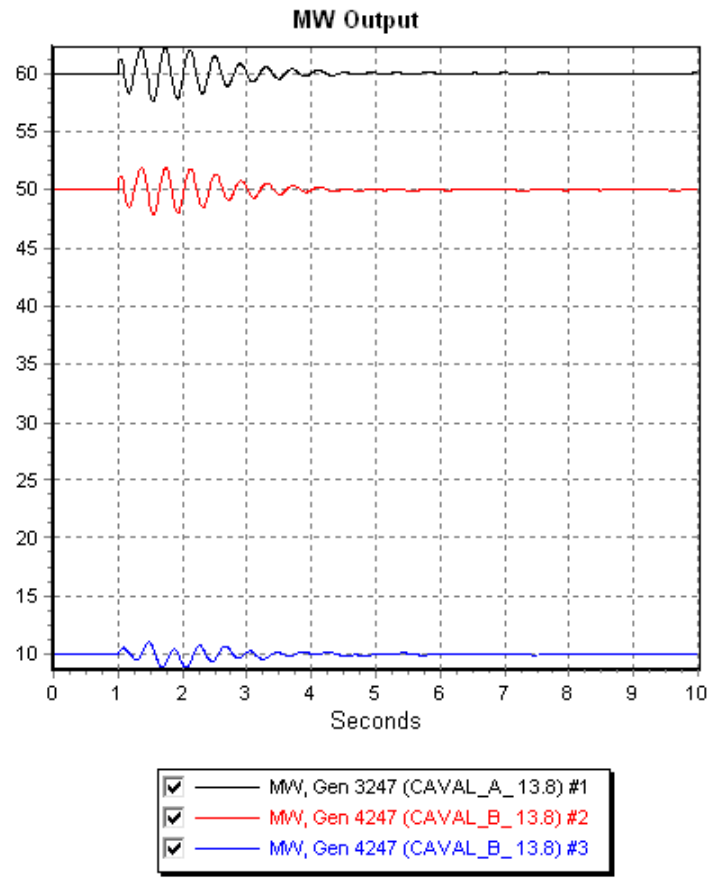
Carseland
Queenstown Generating Plant Output: 90MW

November 05, 2014 12:34:50

Cavalier





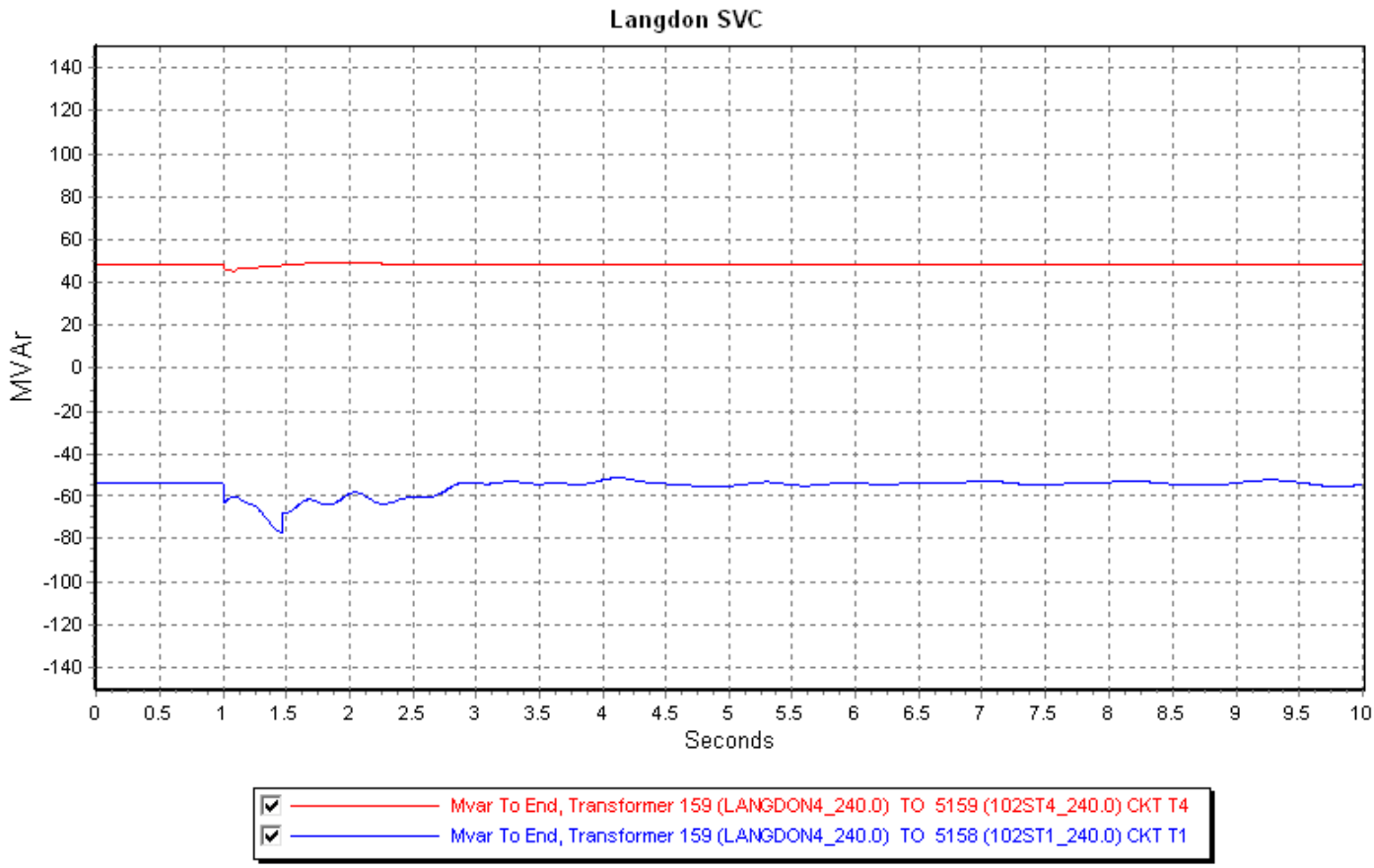


Contingency: 161L QUEENSTOWN 504S - VULCAN 255S

Cavalier
Queenstown Generating Plant Output: 90MW

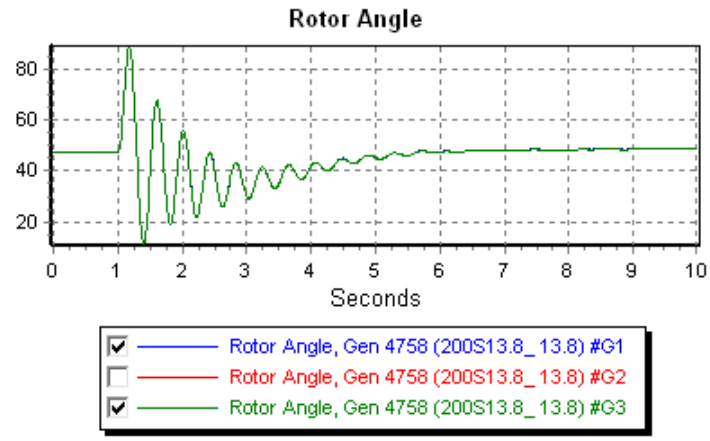
November 05, 2014 12:34:52

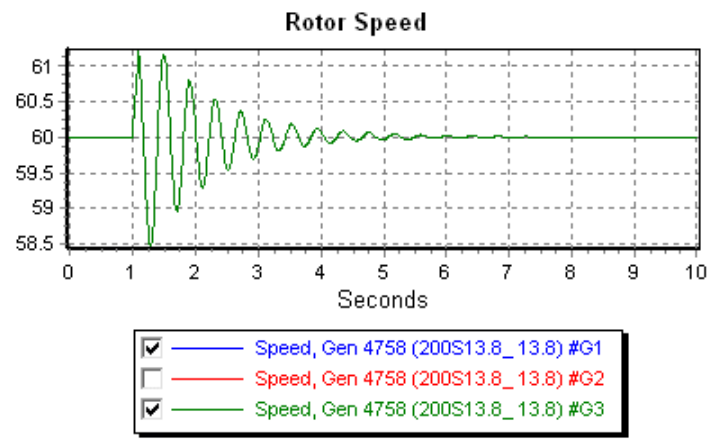
Langdon SVC

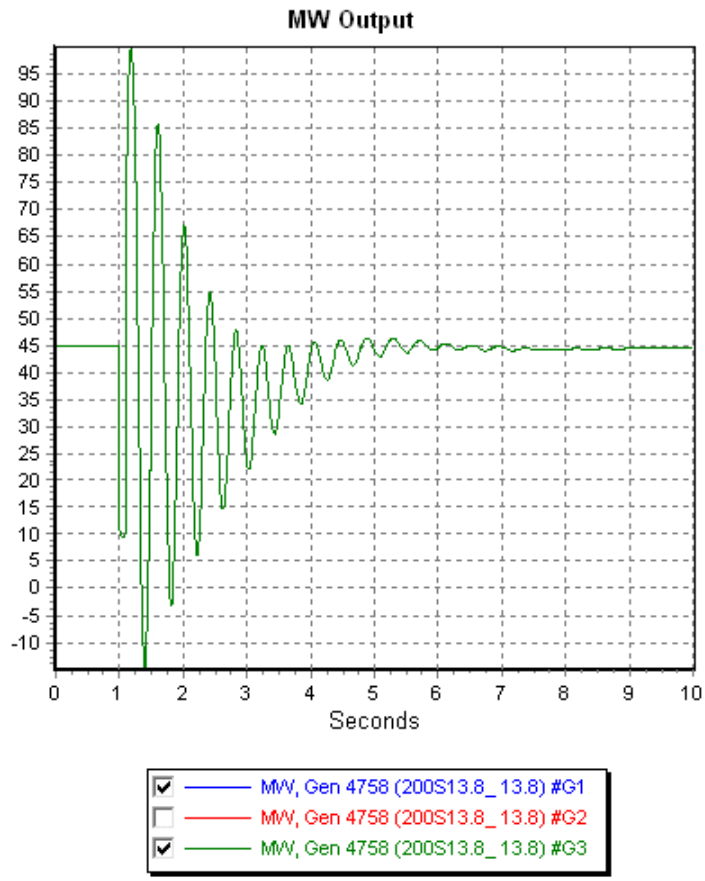


Contingency: 161L QUEENSTOWN 504S - VULCAN 255S	Langdon SVC Queenstown Generating Plant Output: 90MW
	November 05, 2014 12:34:53

Queenstown Gen





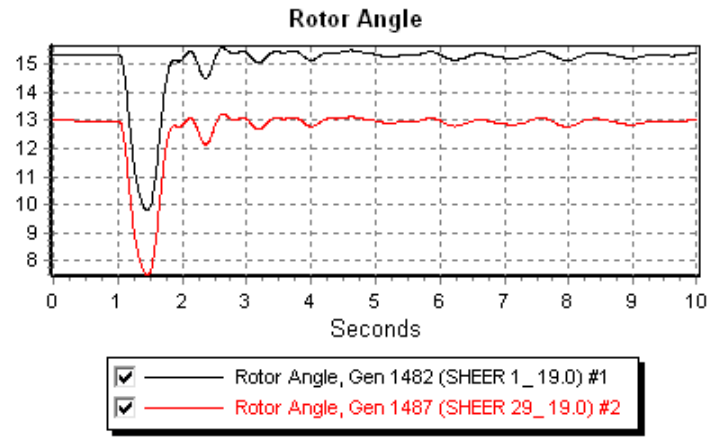


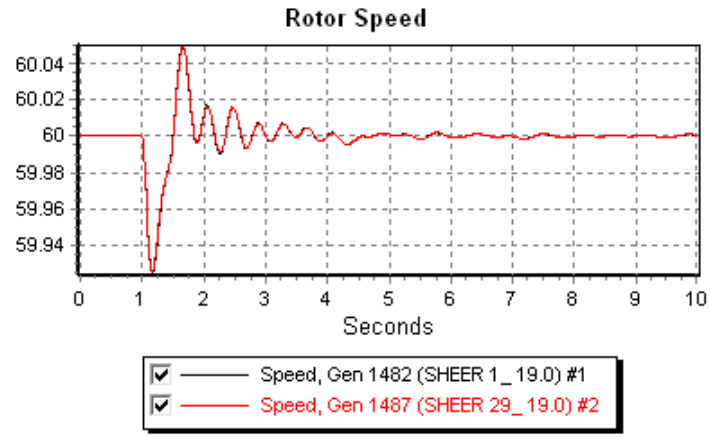
Contingency: 161L QUEENSTOWN 504S - VULCAN 255S

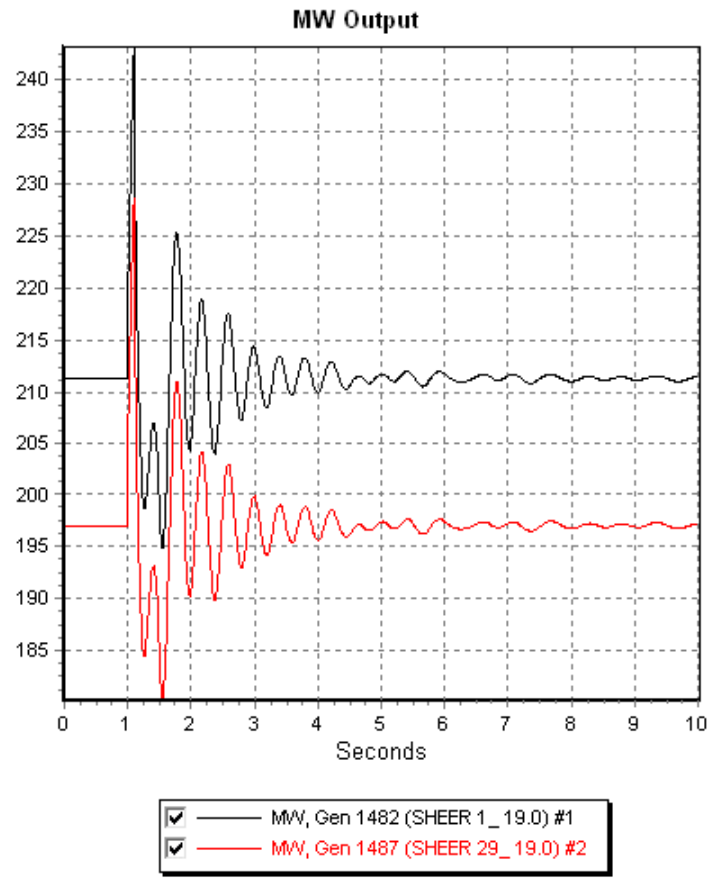
P1336
Queenstown Generating Plant
Output: 90MW

November 05, 2014 12:34:51

Sheerness





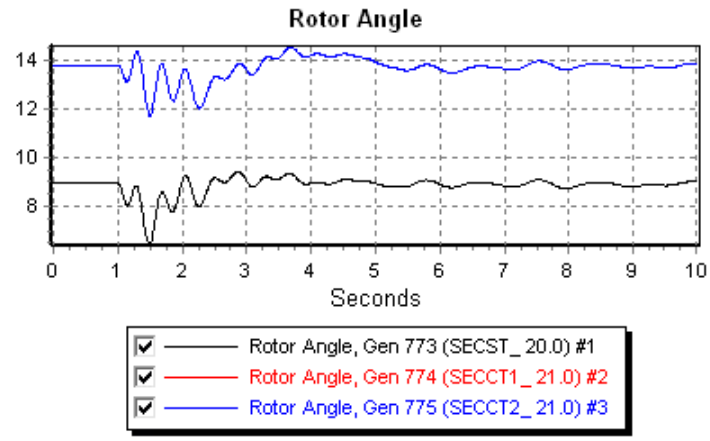


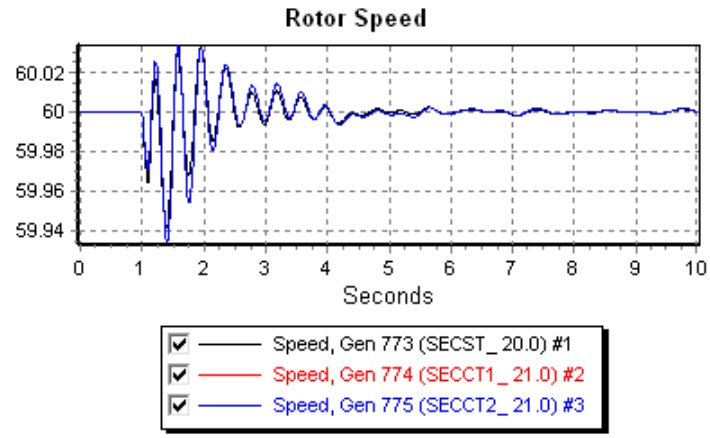
Contingency: 161L QUEENSTOWN 504S - VULCAN 255S

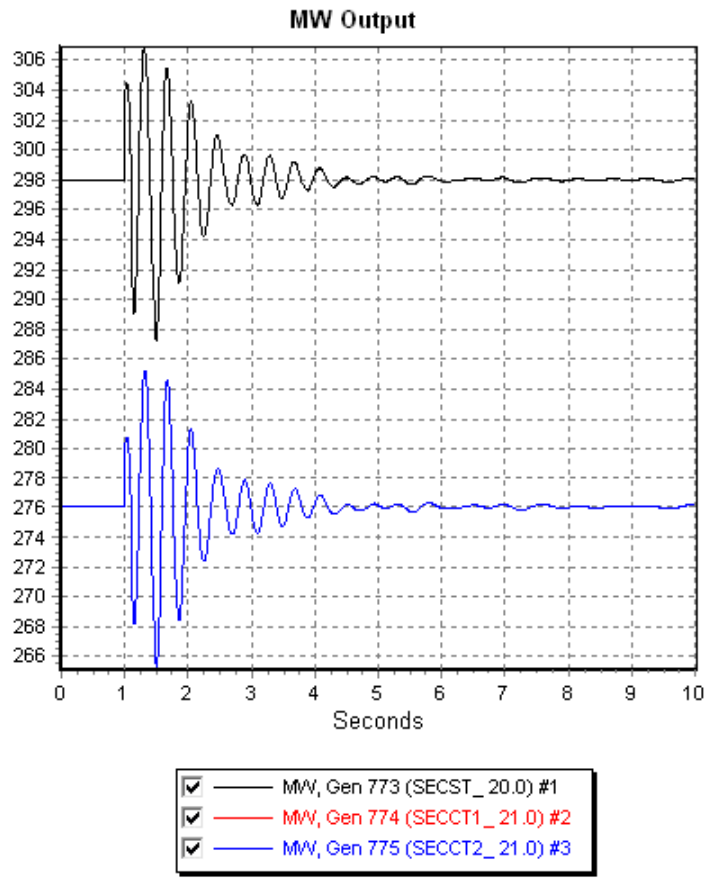
Sheerness
Queenstown Generating Plant Output: 90MW

November 05, 2014 12:34:50

Sheppard





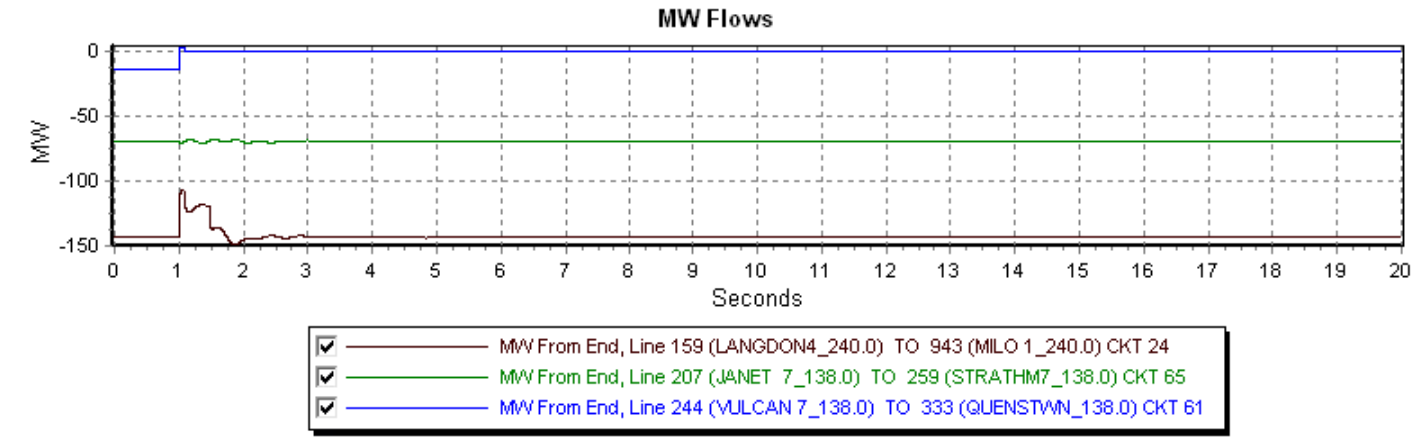


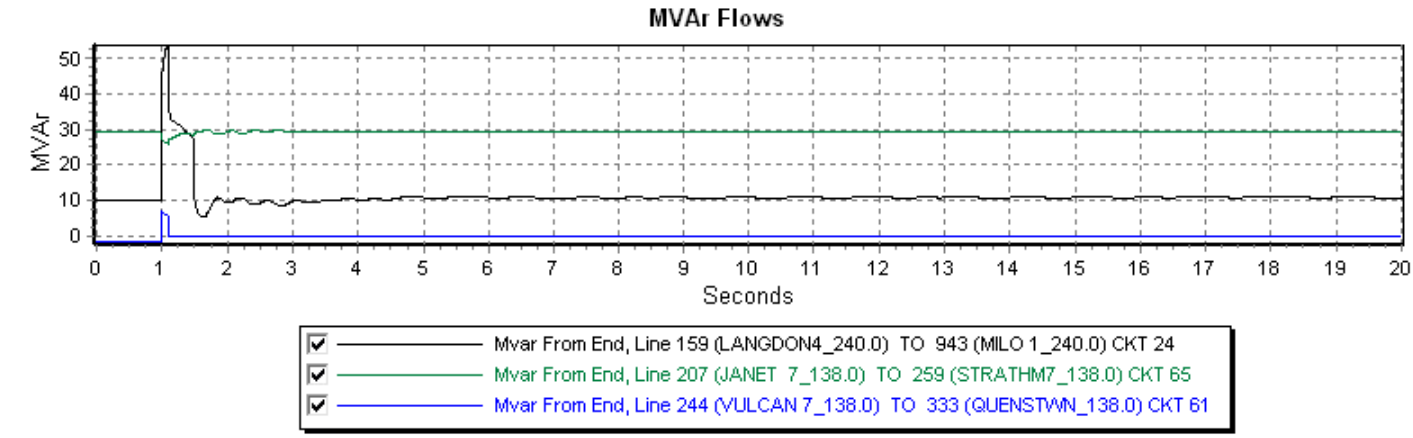
Contingency: 161L QUEENSTOWN 504S - VULCAN 255S

Sheppard
Queenstown Generating Plant Output: 90MW

November 05, 2014 12:34:51

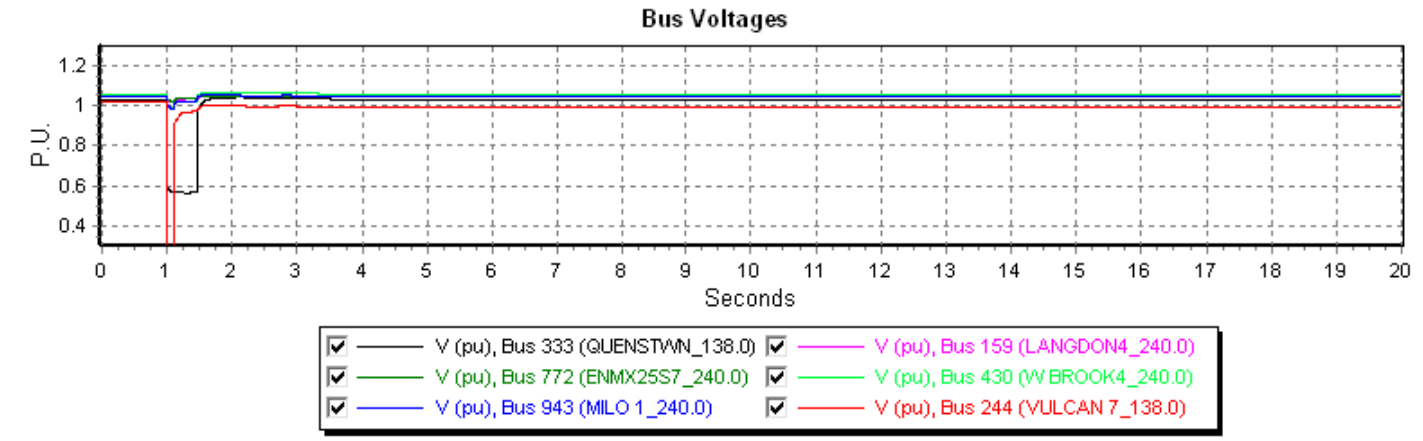
Branch Flows

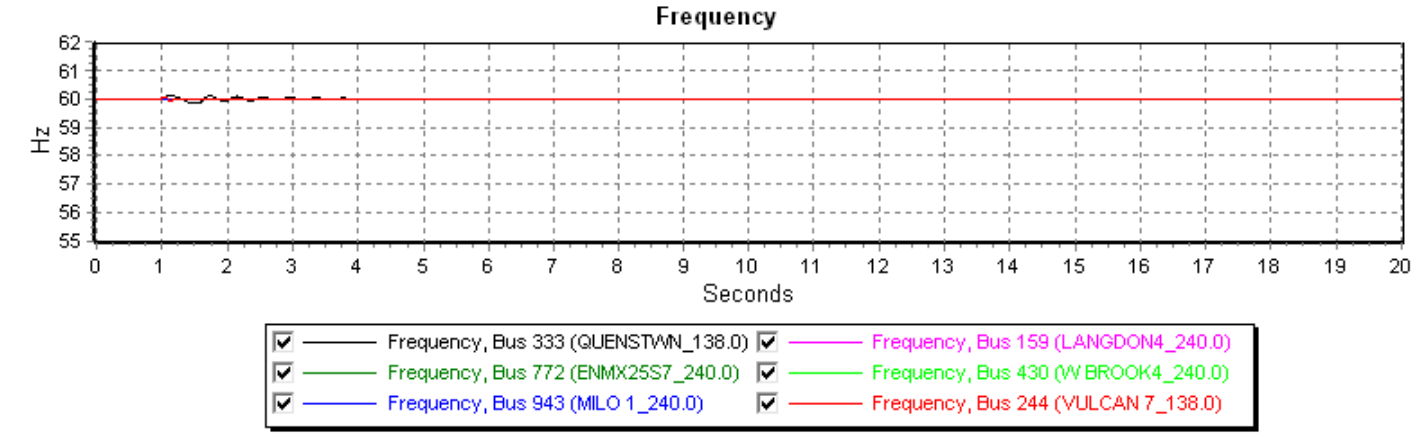




Contingency: 161L VULCAN 255S - QUEENSTOWN 504S	Branch Flows Queenstown Generating Plant Output: 90MW
	November 05, 2014 12:35:34

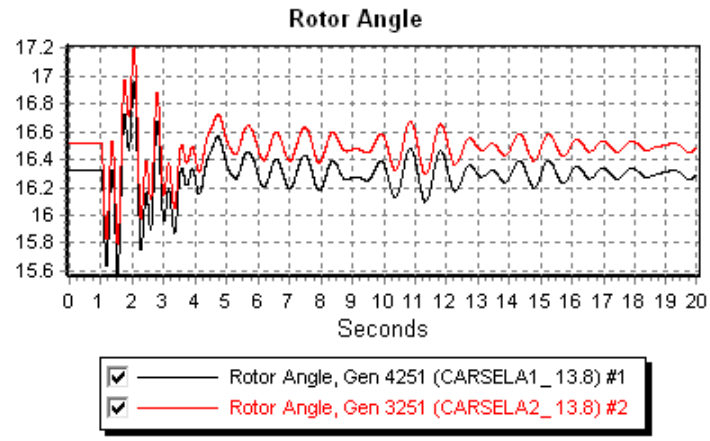
Bus Voltages and Frequency

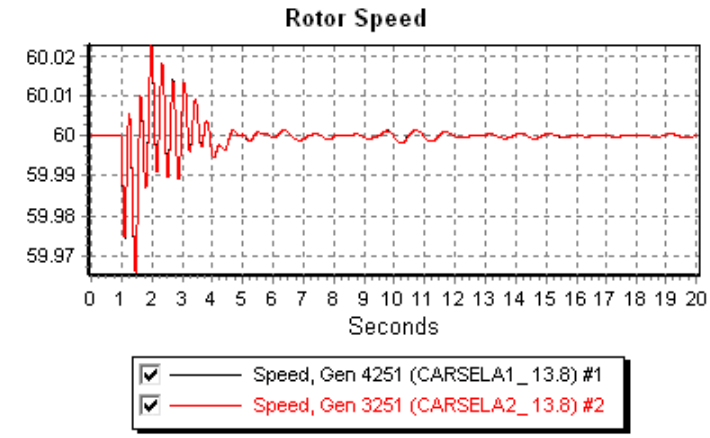


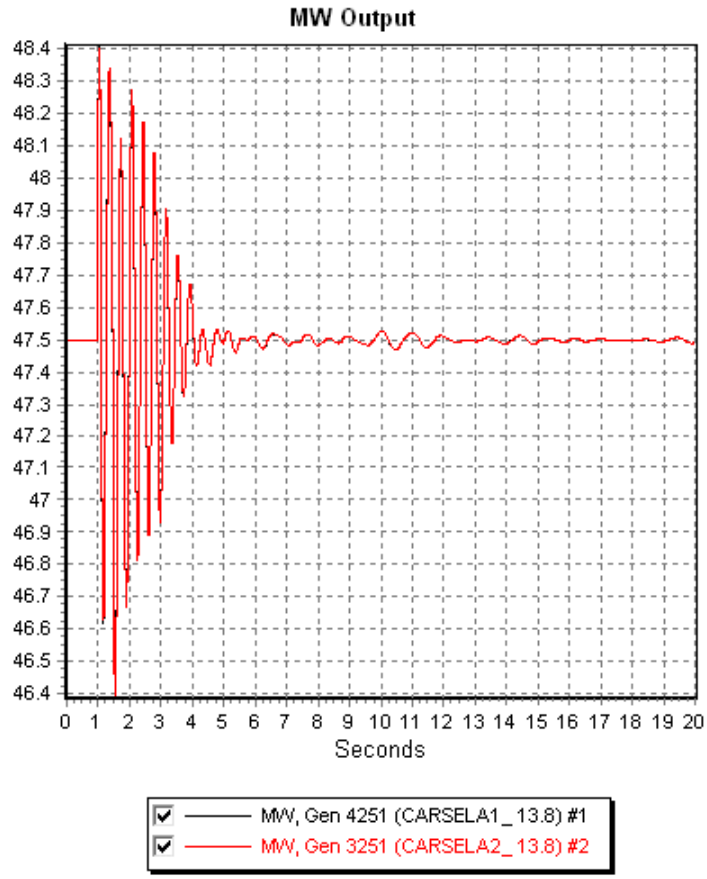


Contingency: 161L VULCAN 255S - QUEENSTOWN 504S	Bus Voltages and Frequency Queenstown Generating Plant Output: 90MW
	November 05, 2014 12:35:35

Carseland





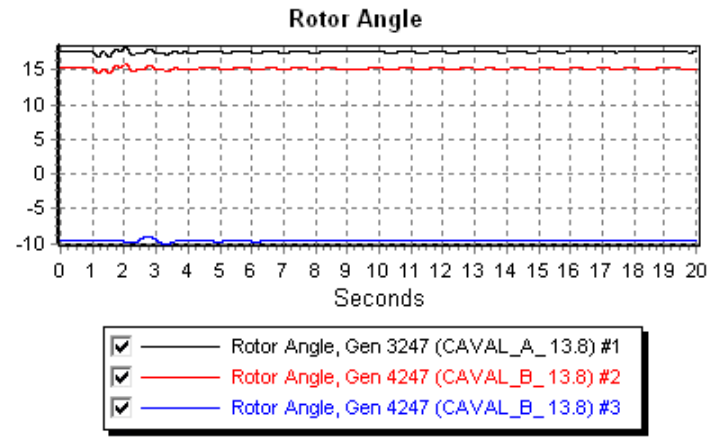


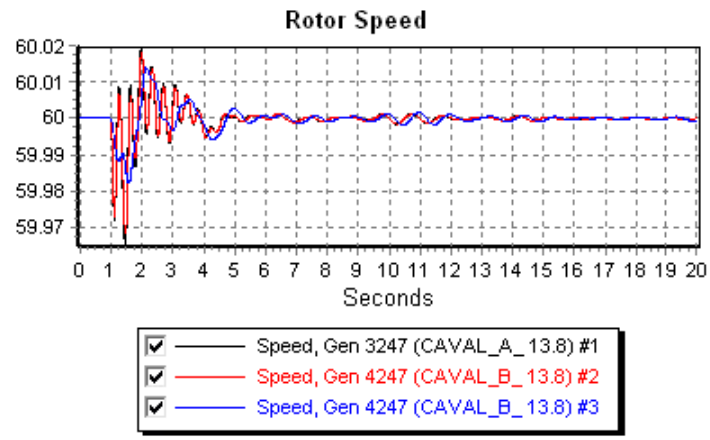
Contingency: 161L VULCAN 255S - QUEENSTOWN 504S

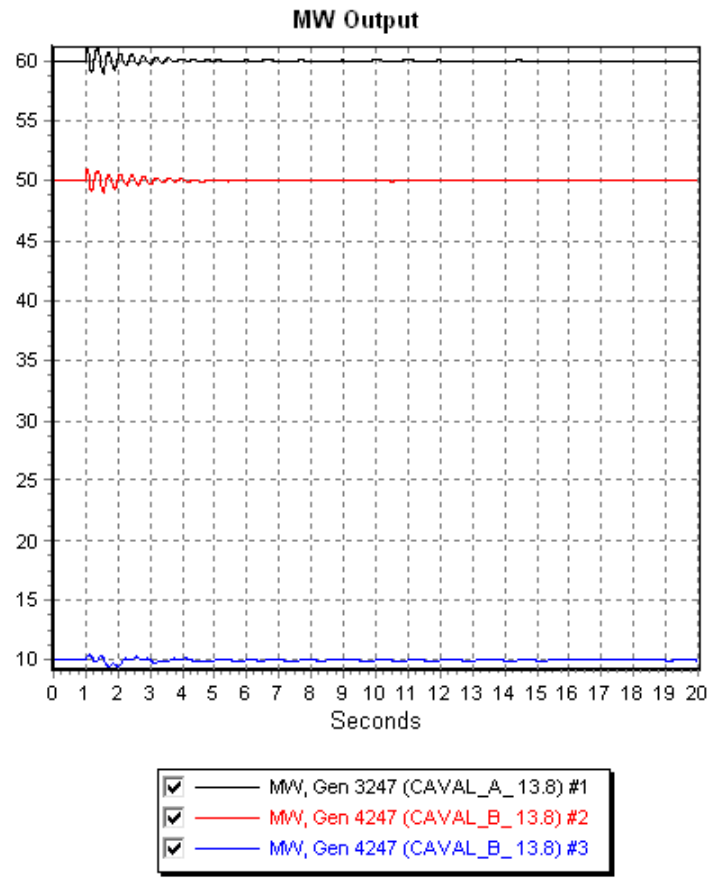
Carseland
Queenstown Generating Plant Output: 90MW

November 05, 2014 12:35:32

Cavalier





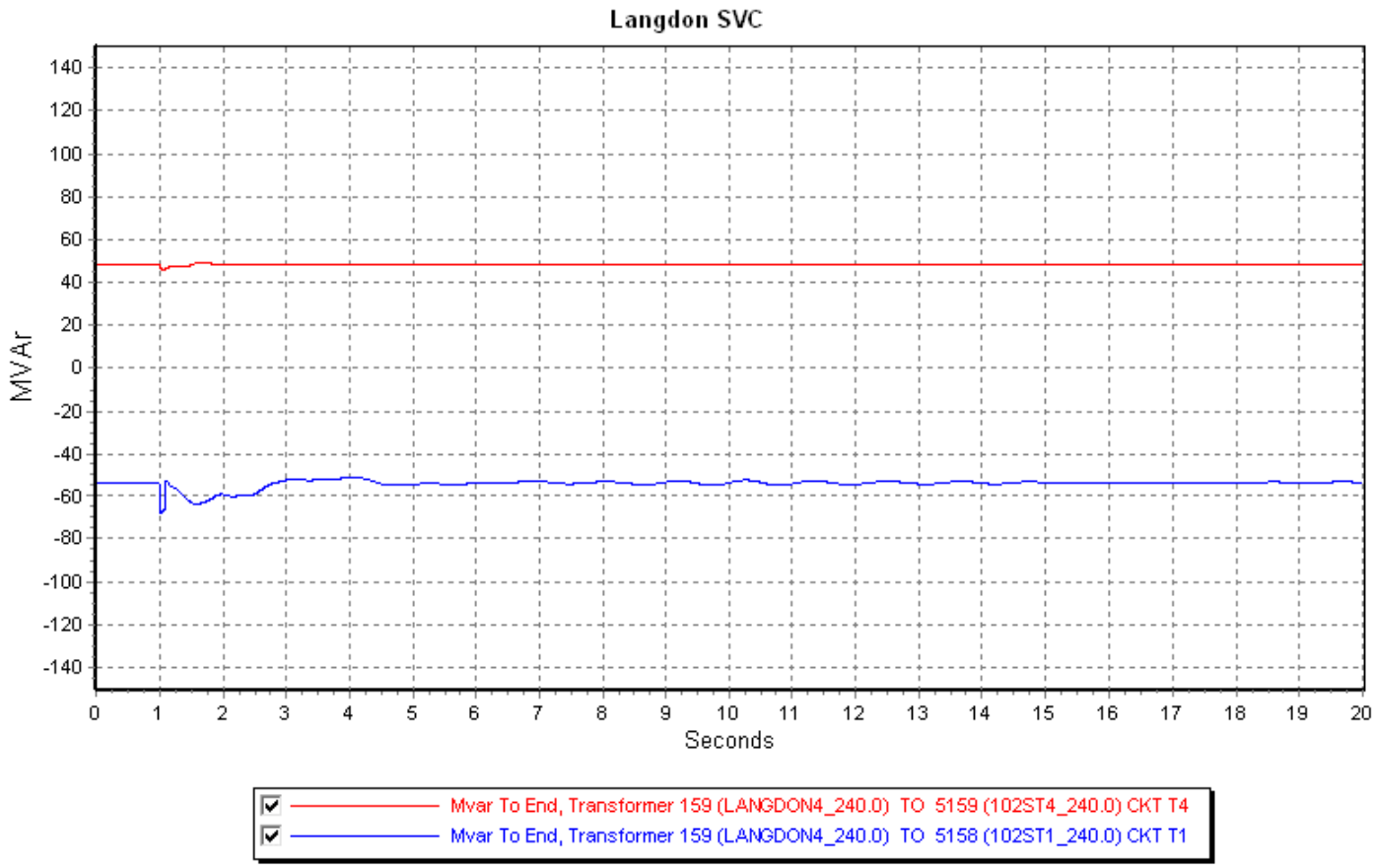


Contingency: 161L VULCAN 255S - QUEENSTOWN 504S

Cavalier
Queenstown Generating Plant Output: 90MW

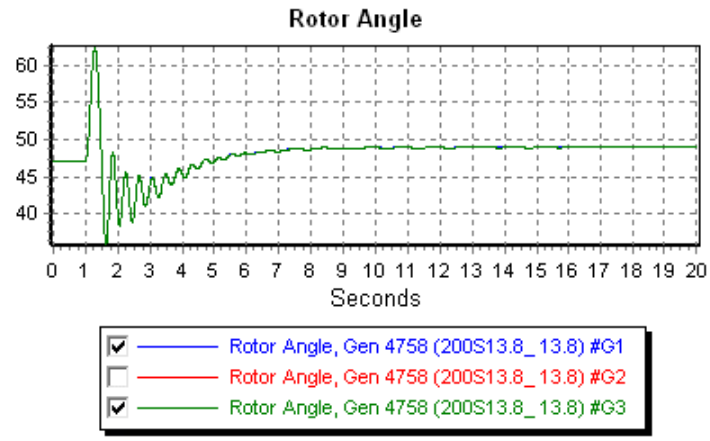
November 05, 2014 12:35:34

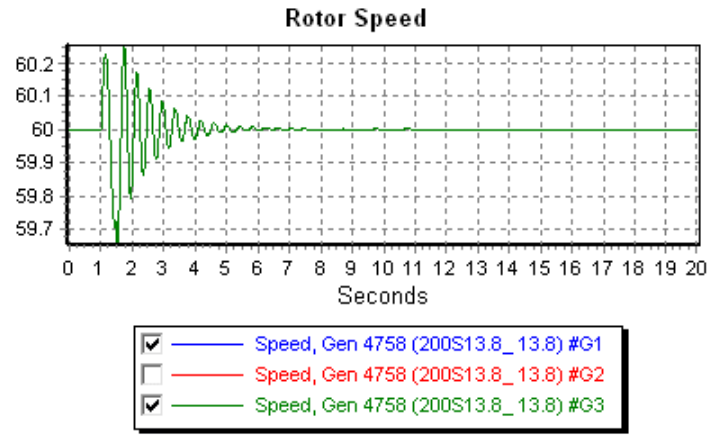
Langdon SVC

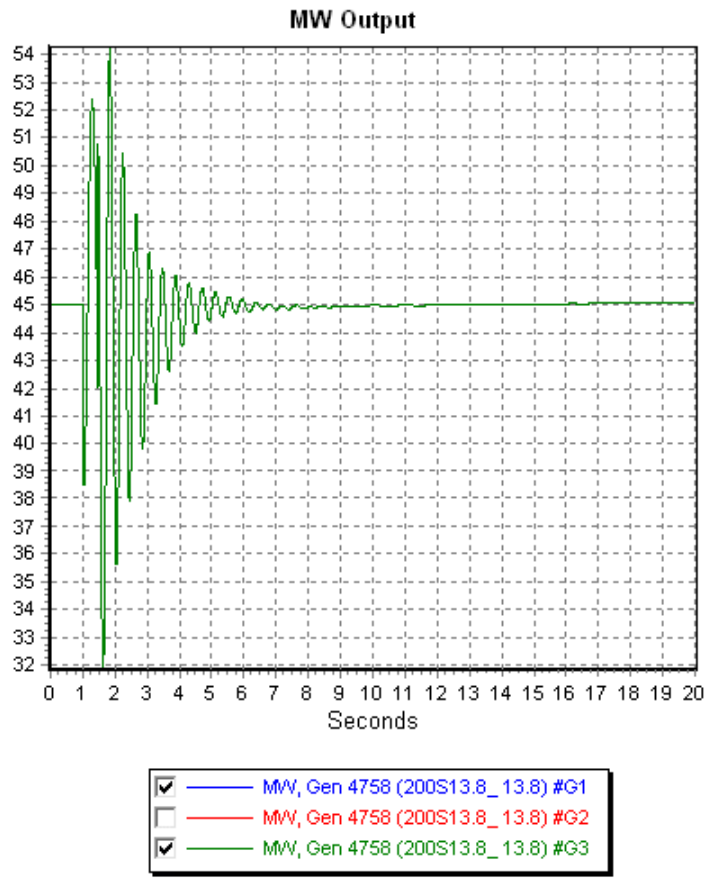


Contingency: 161L VULCAN 255S - QUEENSTOWN 504S	Langdon SVC Queenstown Generating Plant Output: 90MW
	November 05, 2014 12:35:35

Queenstown Gen





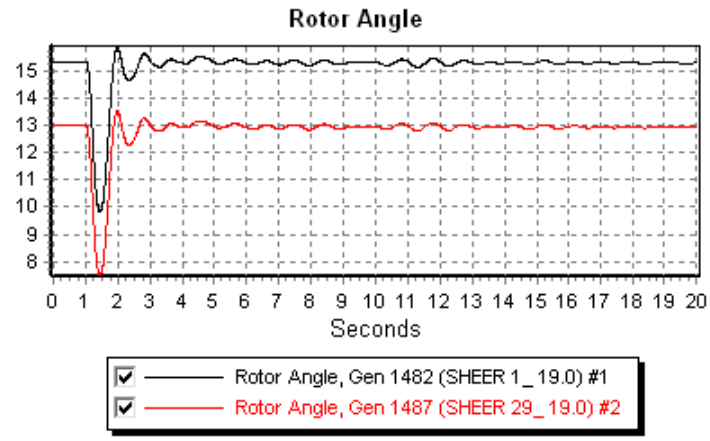


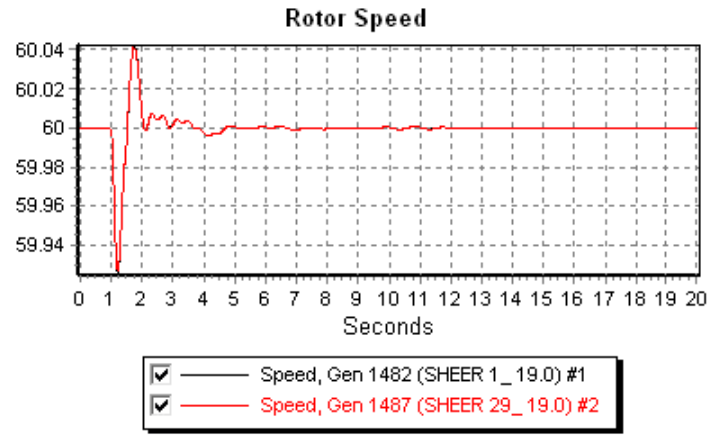
Contingency: 161L VULCAN 255S - QUEENSTOWN 504S

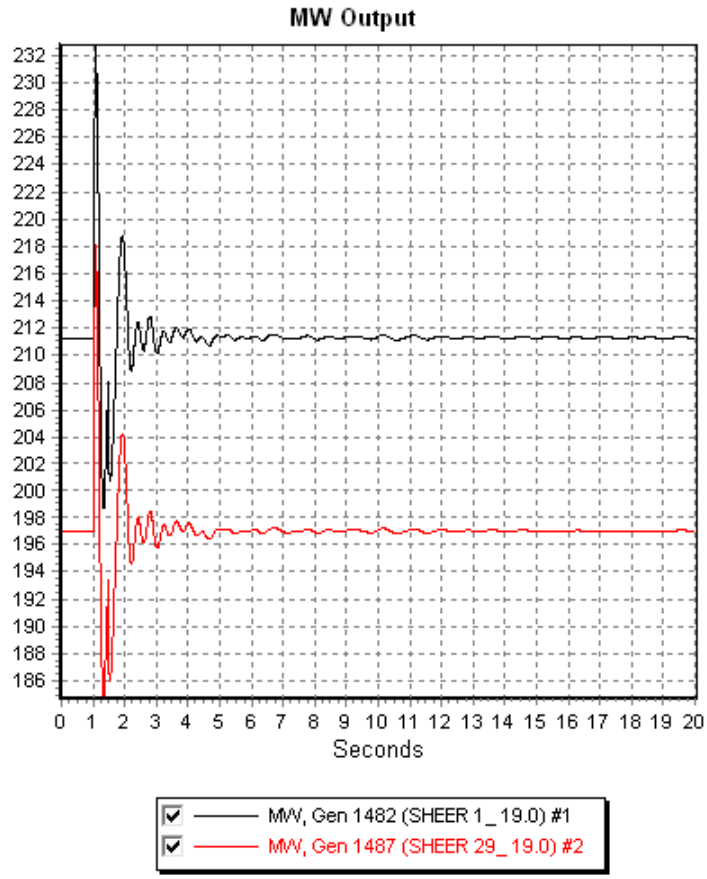
P1336
Queenstown Generating Plant
Output: 90MW

November 05, 2014 12:35:33

Sheerness





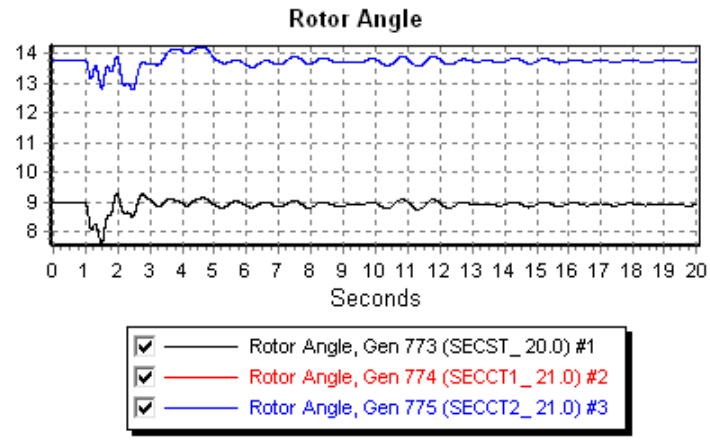


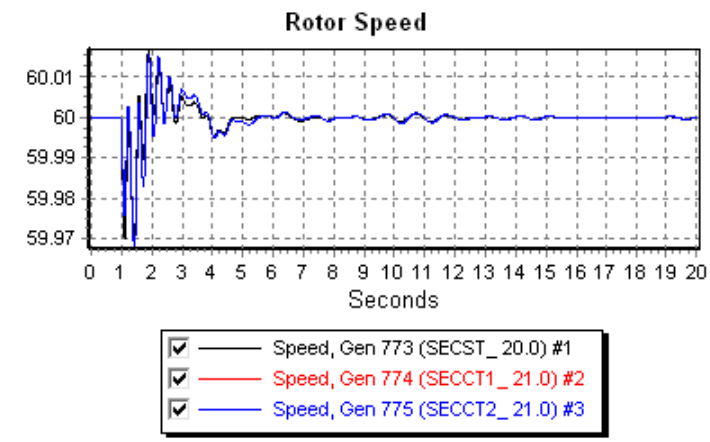
Contingency: 161L VULCAN 255S - QUEENSTOWN 504S

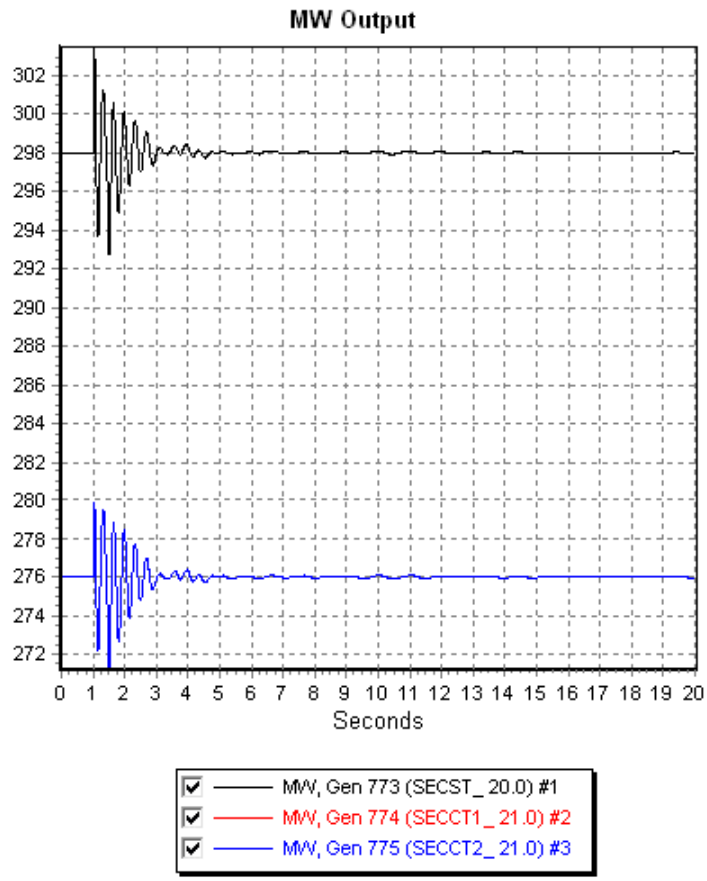
Sheerness
Queenstown Generating Plant Output: 90MW

November 05, 2014 12:35:31

Sheppard





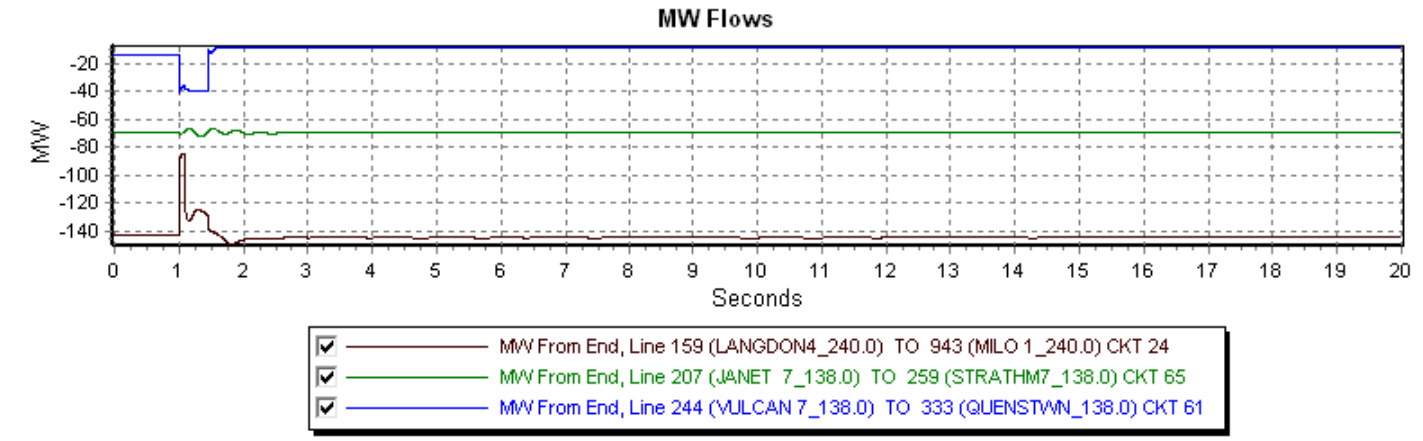


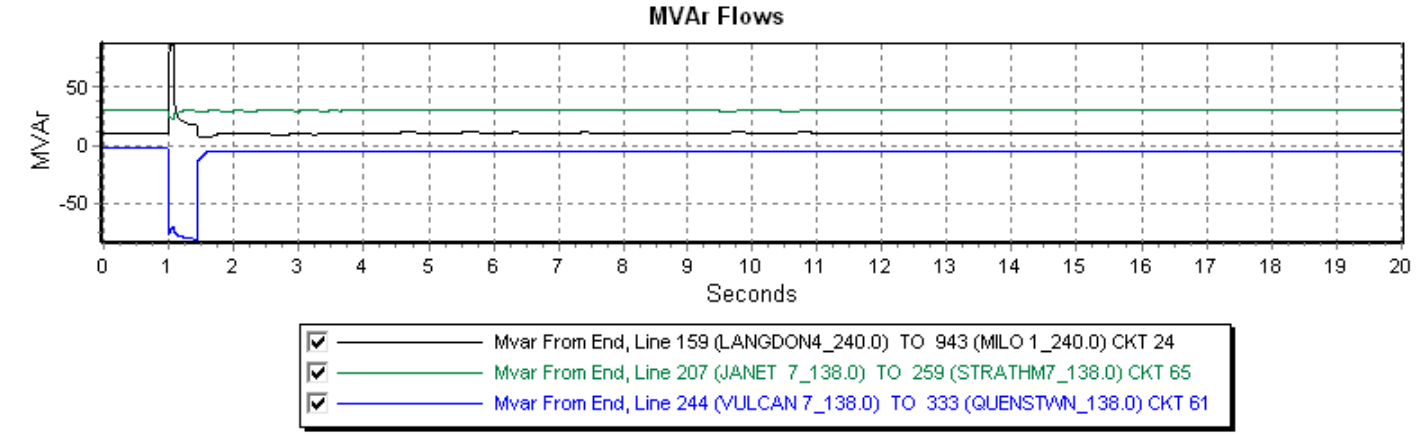
Contingency: 161L VULCAN 255S - QUEENSTOWN 504S

Sheppard
Queenstown Generating Plant Output: 90MW

November 05, 2014 12:35:32

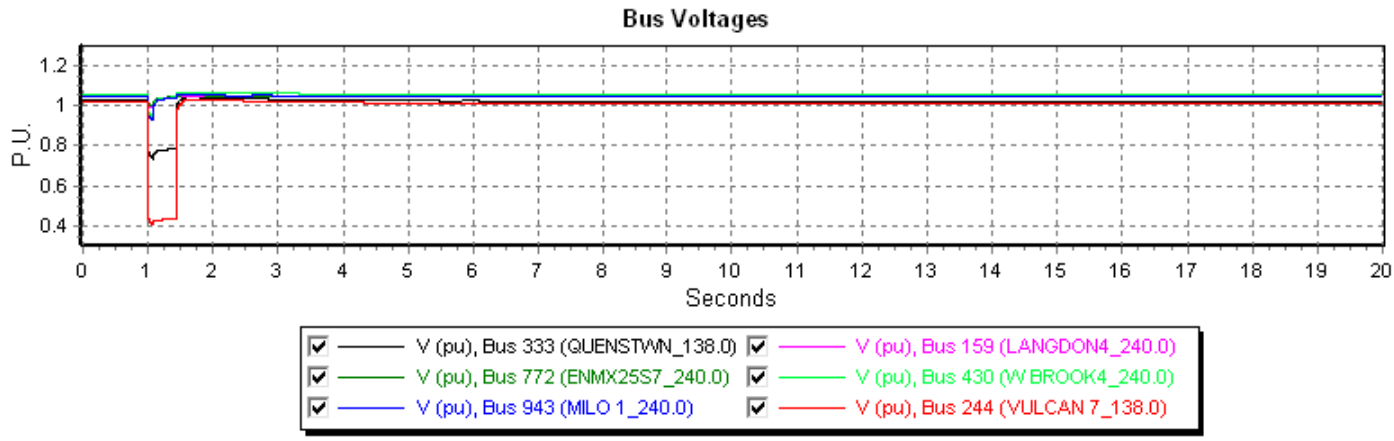
Branch Flows

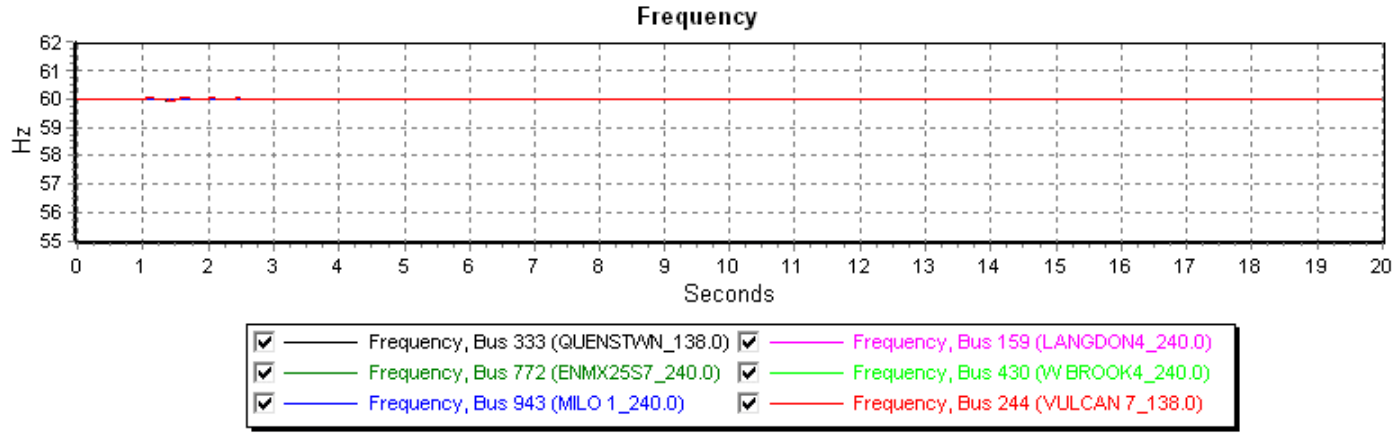




Contingency: 180L Ft.McLeod 15S to Vulcan 255S	Branch Flows Queenstown Generating Plant Output: 90MW
	November 05, 2014 12:36:18

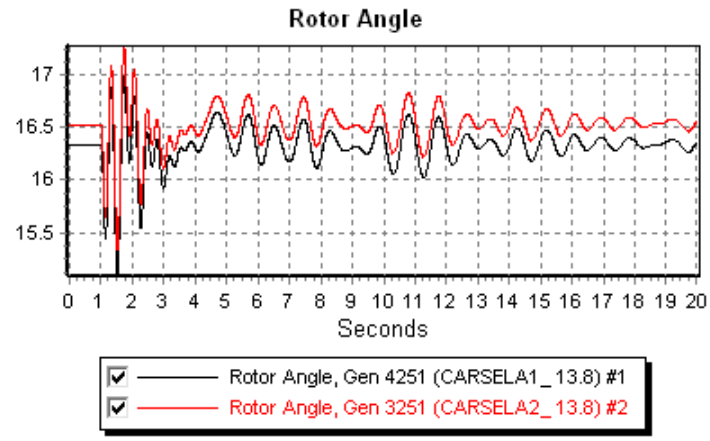
Bus Voltages and Frequency

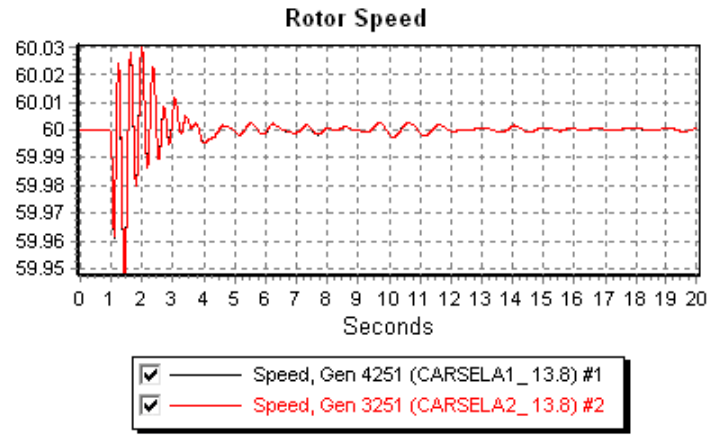


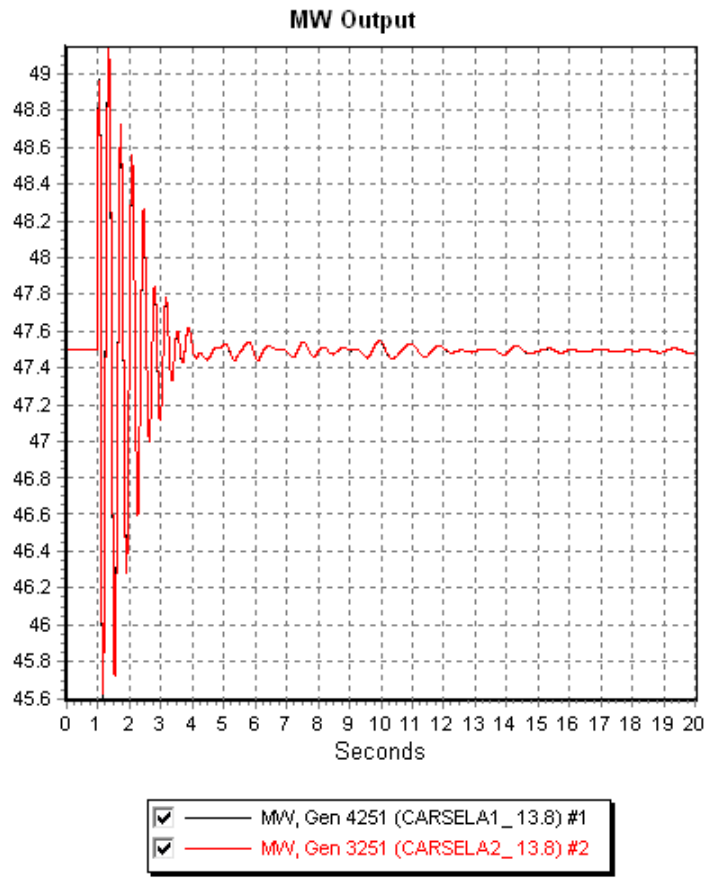


Contingency: 180L Ft.McLeod 15S to Vulcan 255S	Bus Voltages and Frequency Queenstown Generating Plant Output: 90MW November 05, 2014 12:36:19

Carseland





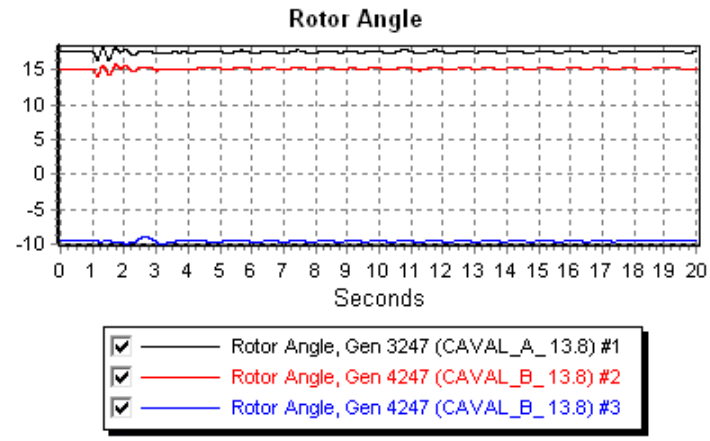


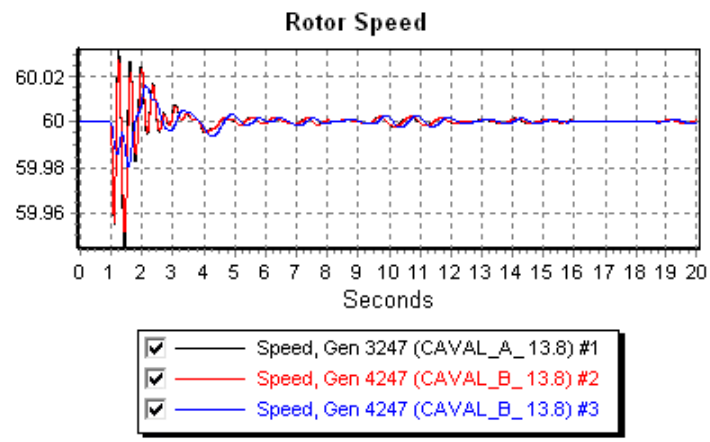
Contingency: 180L Ft.McLeod 15S to Vulcan 255S

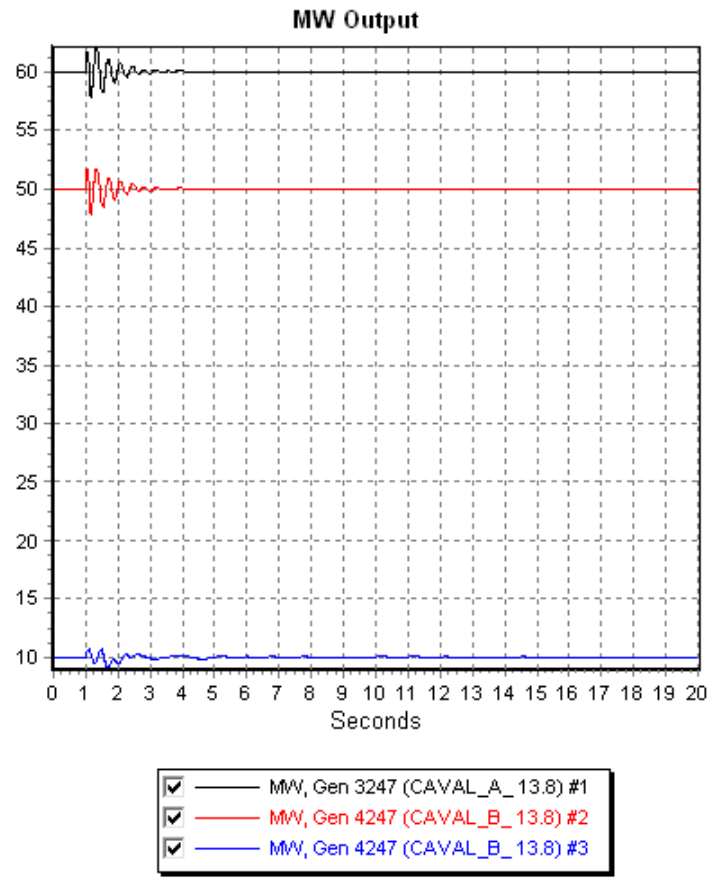
Carseland
Queenstown Generating Plant Output: 90MW

November 05, 2014 12:36:16

Cavalier





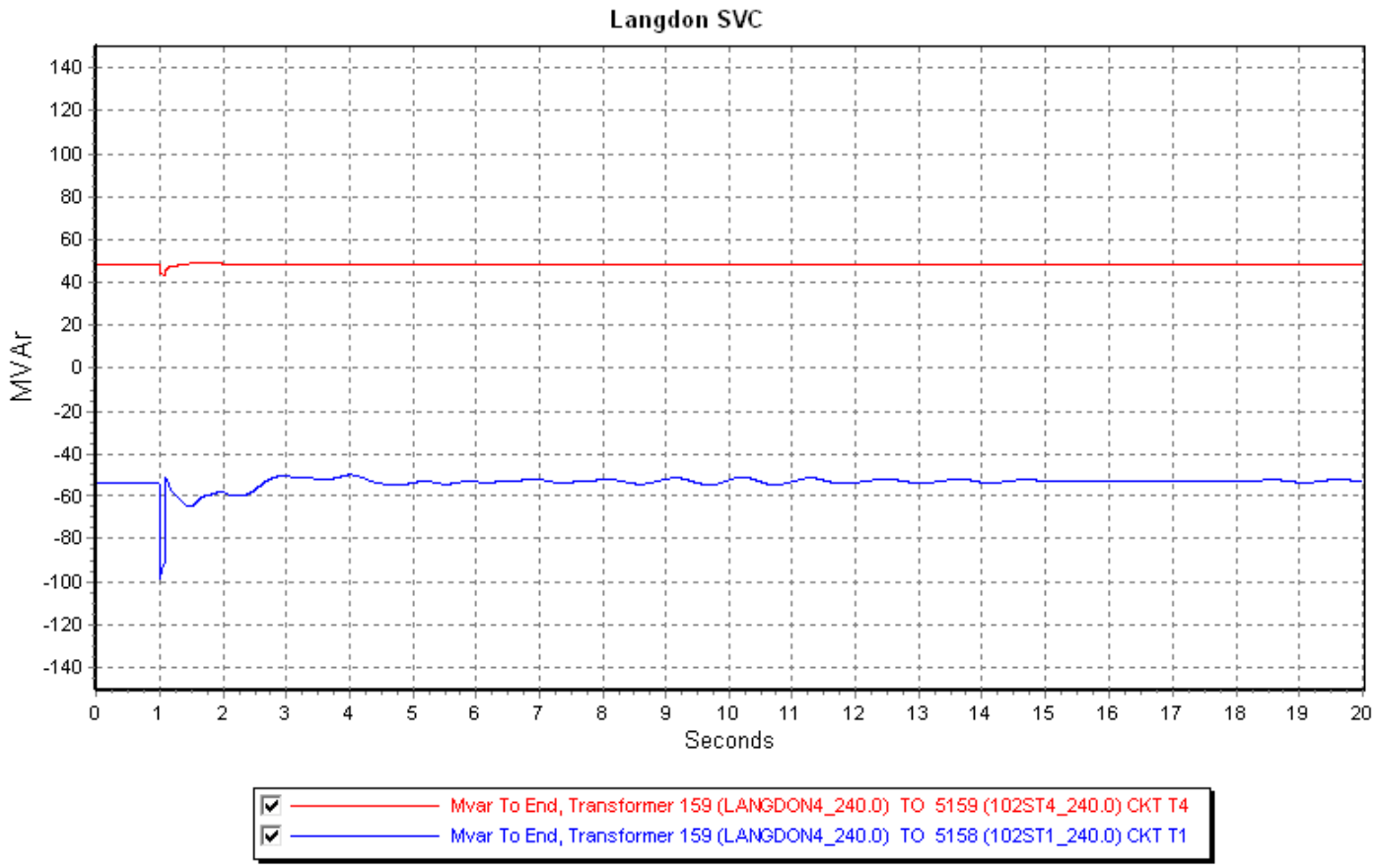


Contingency: 180L Ft.McLeod 15S to Vulcan 255S

Cavalier
Queenstown Generating Plant Output: 90MW

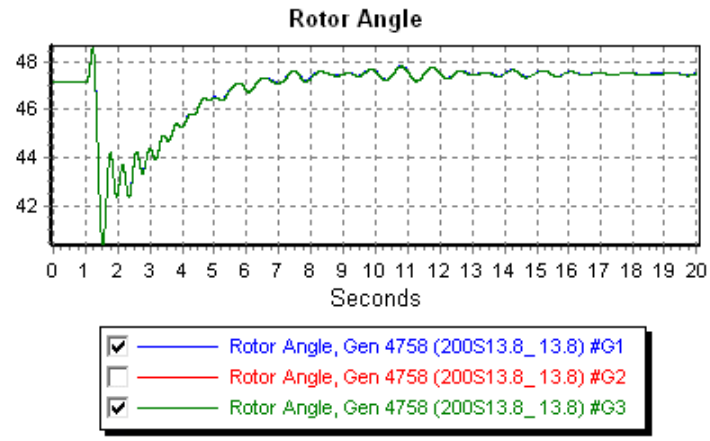
November 05, 2014 12:36:18

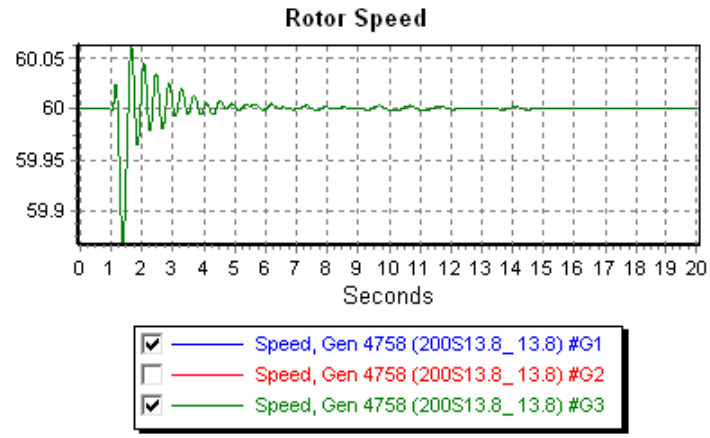
Langdon SVC

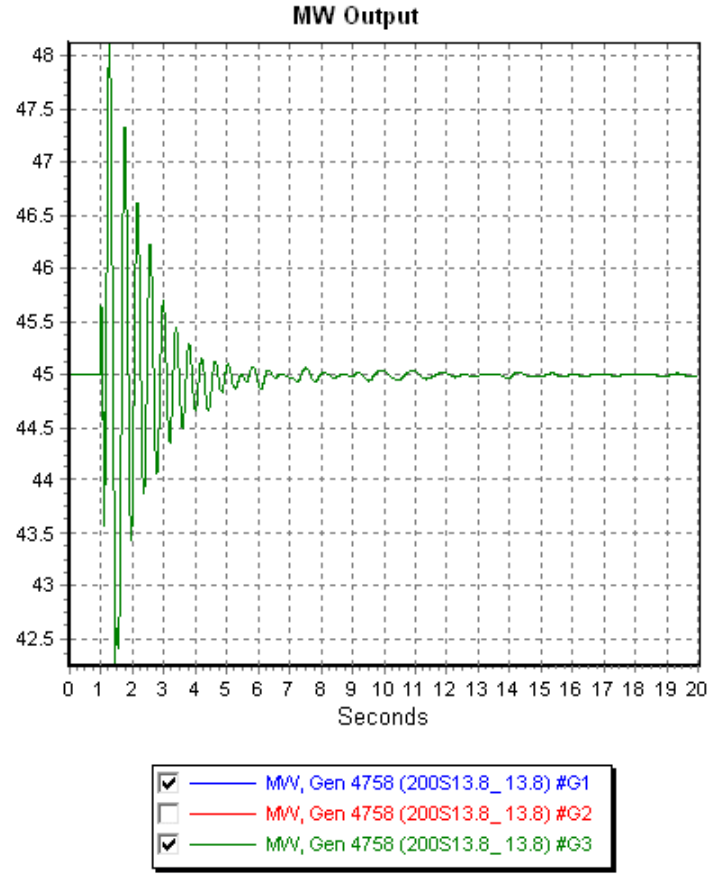


Contingency: 180L Ft.McLeod 15S to Vulcan 255S	Langdon SVC Queenstown Generating Plant Output: 90MW
	November 05, 2014 12:36:19

Queenstown Gen





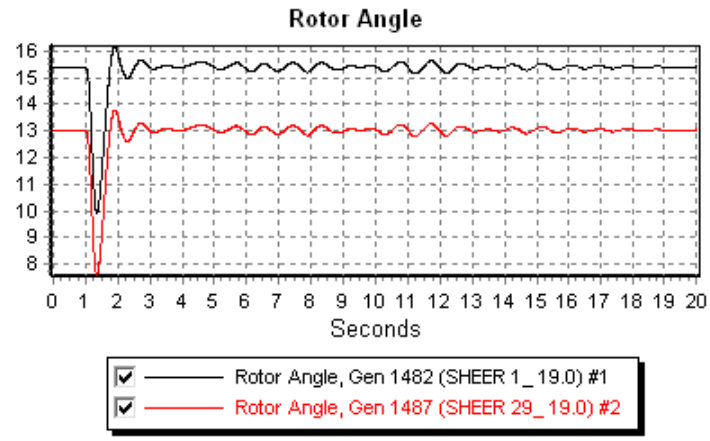


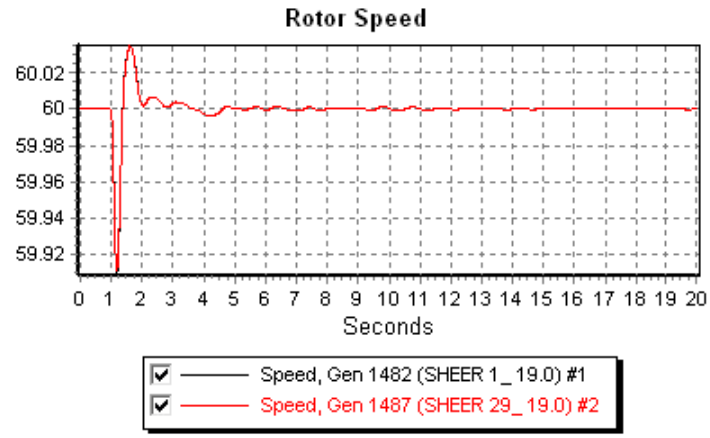
Contingency: 180L Ft.McLeod 15S to Vulcan 255S

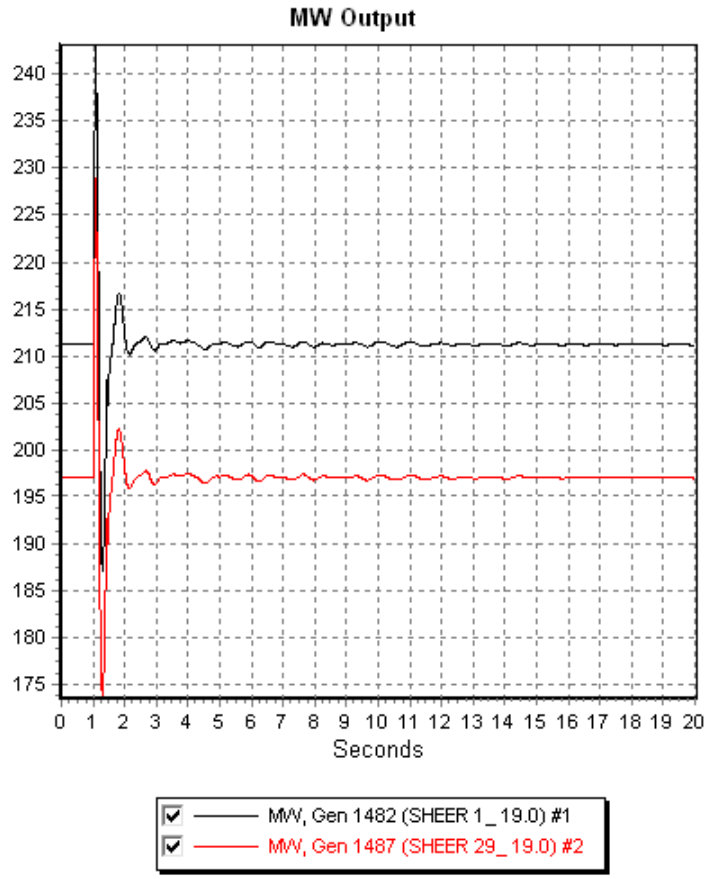
P1336
Queenstown Generating Plant
Output: 90MW

November 05, 2014 12:36:17

Sheerness





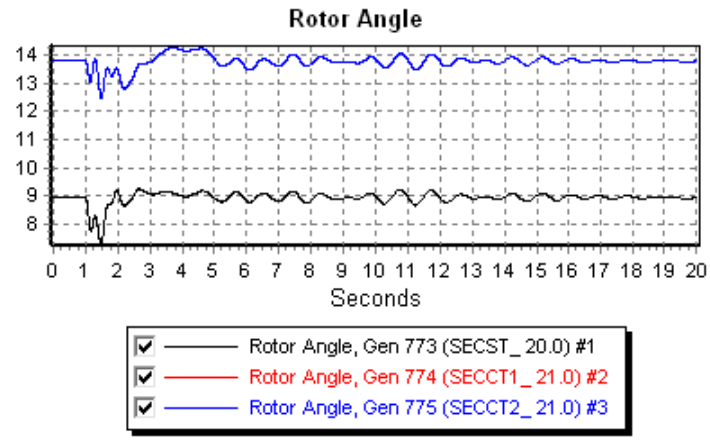


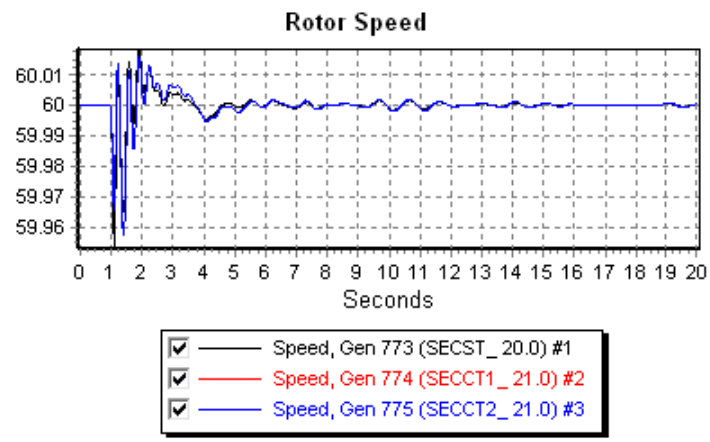
Contingency: 180L Ft.McLeod 15S to Vulcan 255S

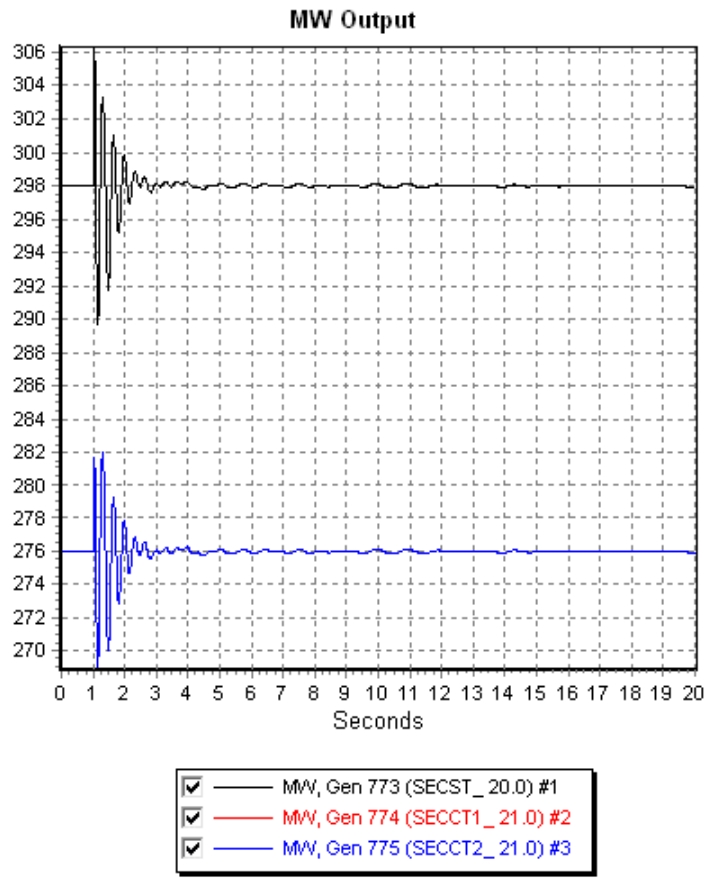
Sheerness
Queenstown Generating Plant Output: 90MW

November 05, 2014 12:36:15

Sheppard





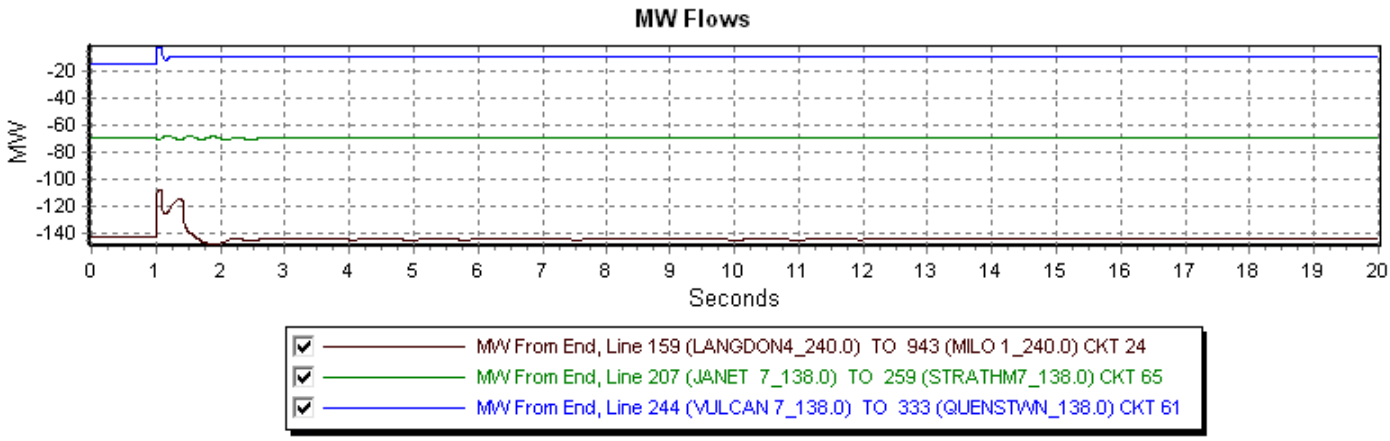


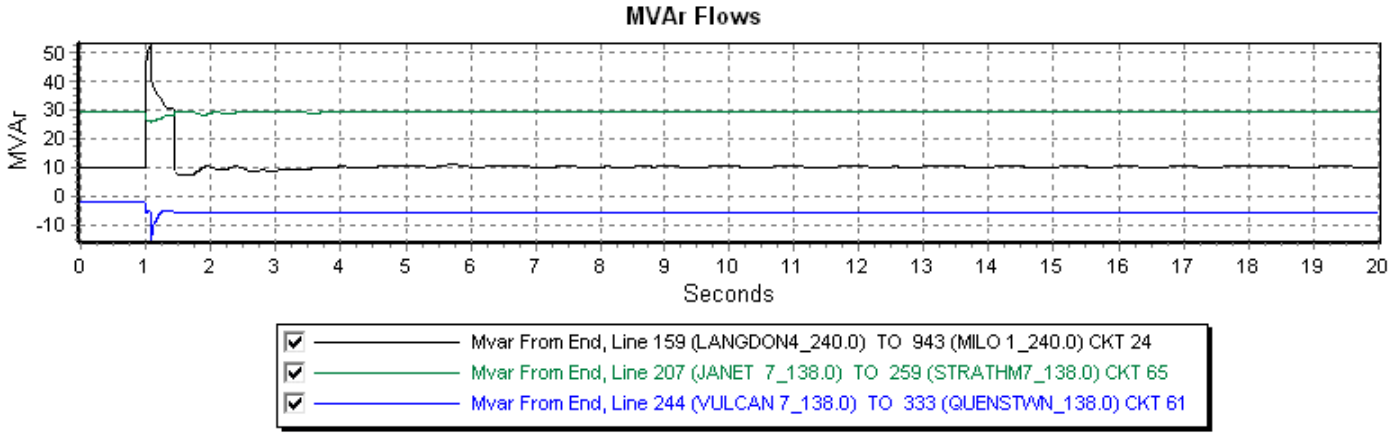
Contingency: 180L Ft.McLeod 15S to Vulcan 255S

Sheppard
Queenstown Generating Plant Output: 90MW

November 05, 2014 12:36:17

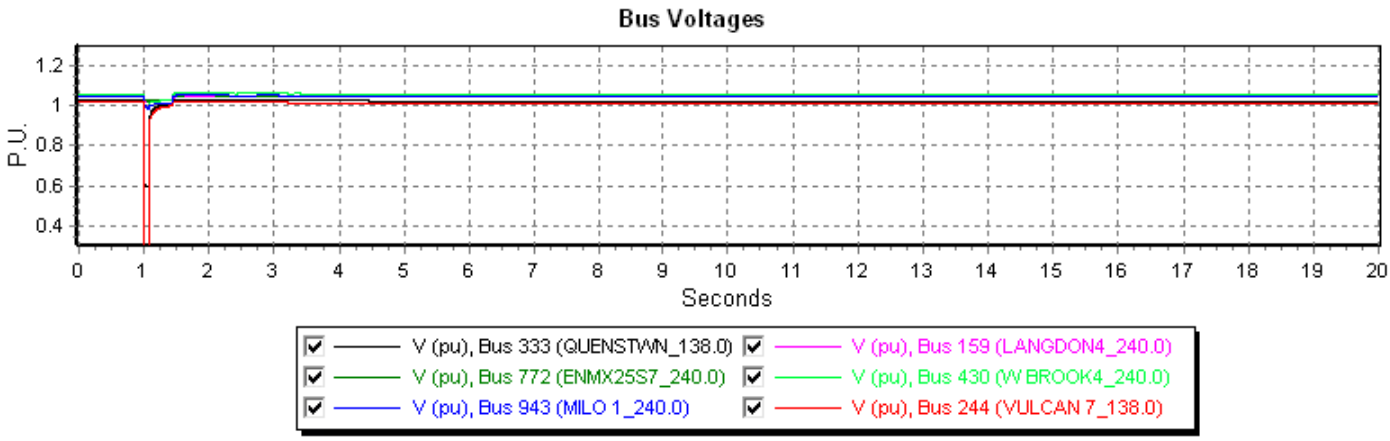
Branch Flows

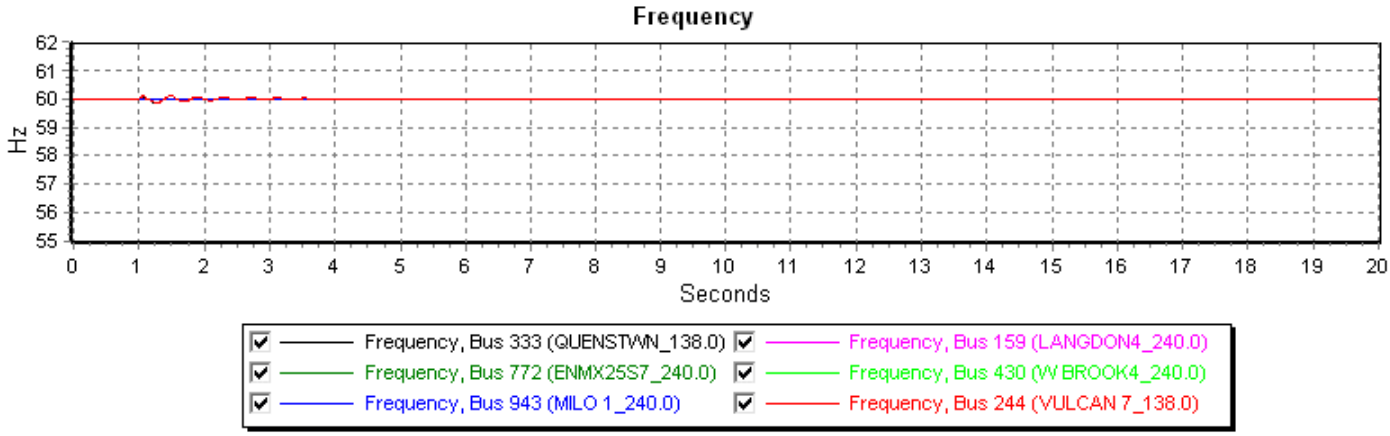




Contingency: 180L Vulcan 255S to Ft.McLeod 15S	Branch Flows Queenstown Generating Plant Output: 90MW
	November 05, 2014 12:36:48

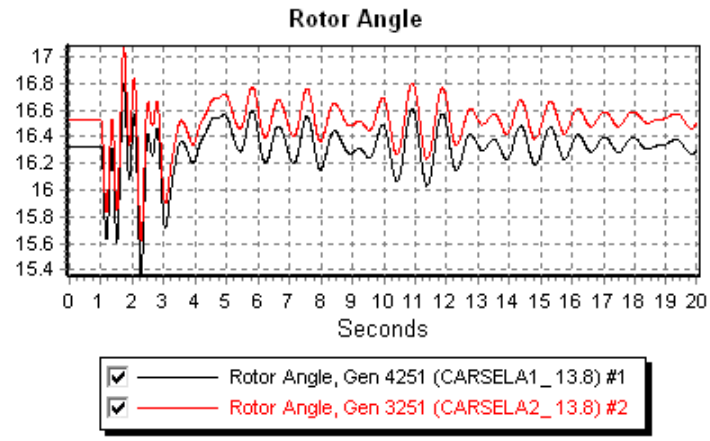
Bus Voltages and Frequency

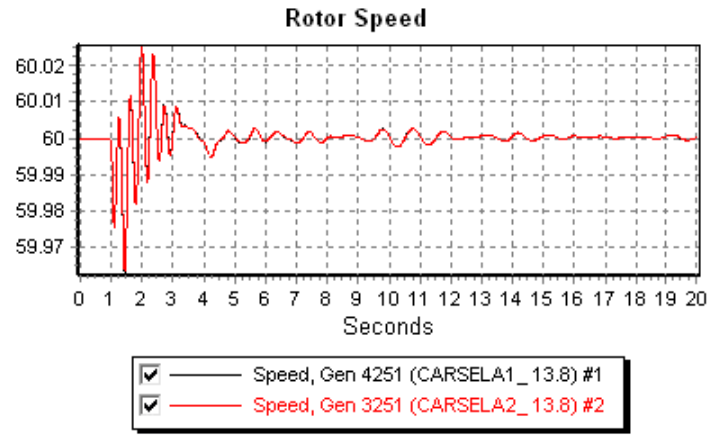


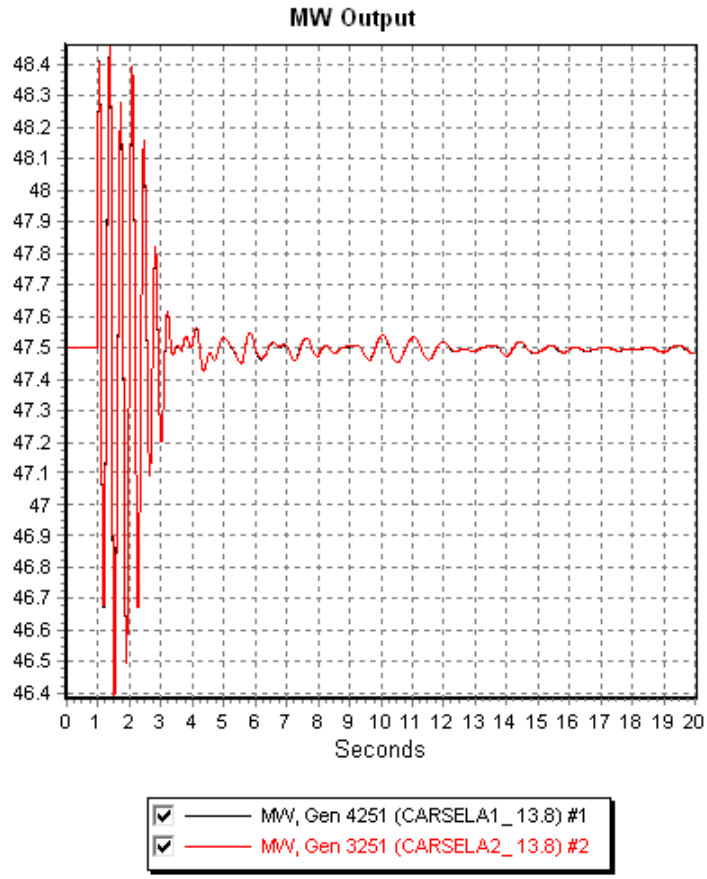


Contingency: 180L Vulcan 255S to Ft.McLeod 15S	Bus Voltages and Frequency Queenstown Generating Plant Output: 90MW November 05, 2014 12:36:48

Carseland





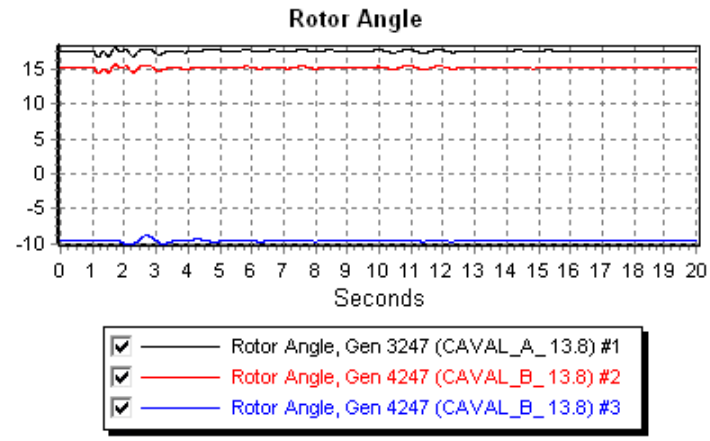


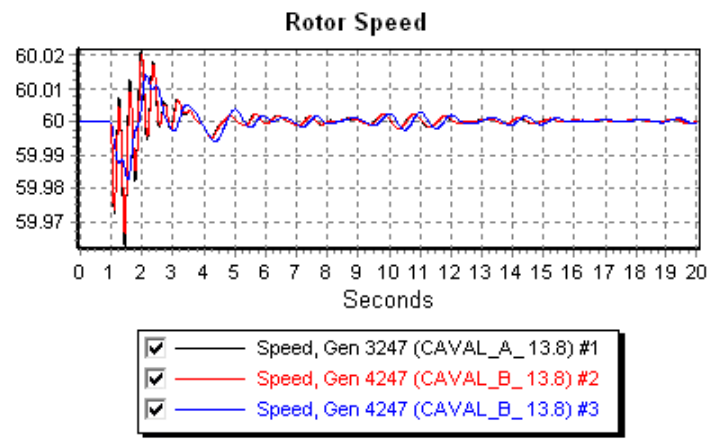
Contingency: 180L Vulcan 255S to Ft.McLeod 15S

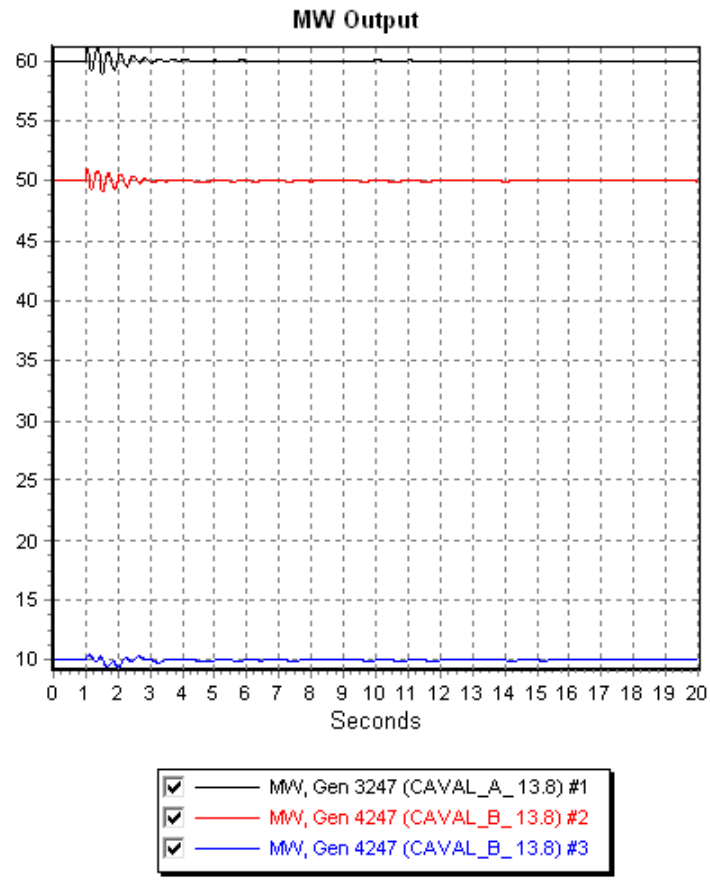
Carseland
Queenstown Generating Plant Output: 90MW

November 05, 2014 12:36:46

Cavalier





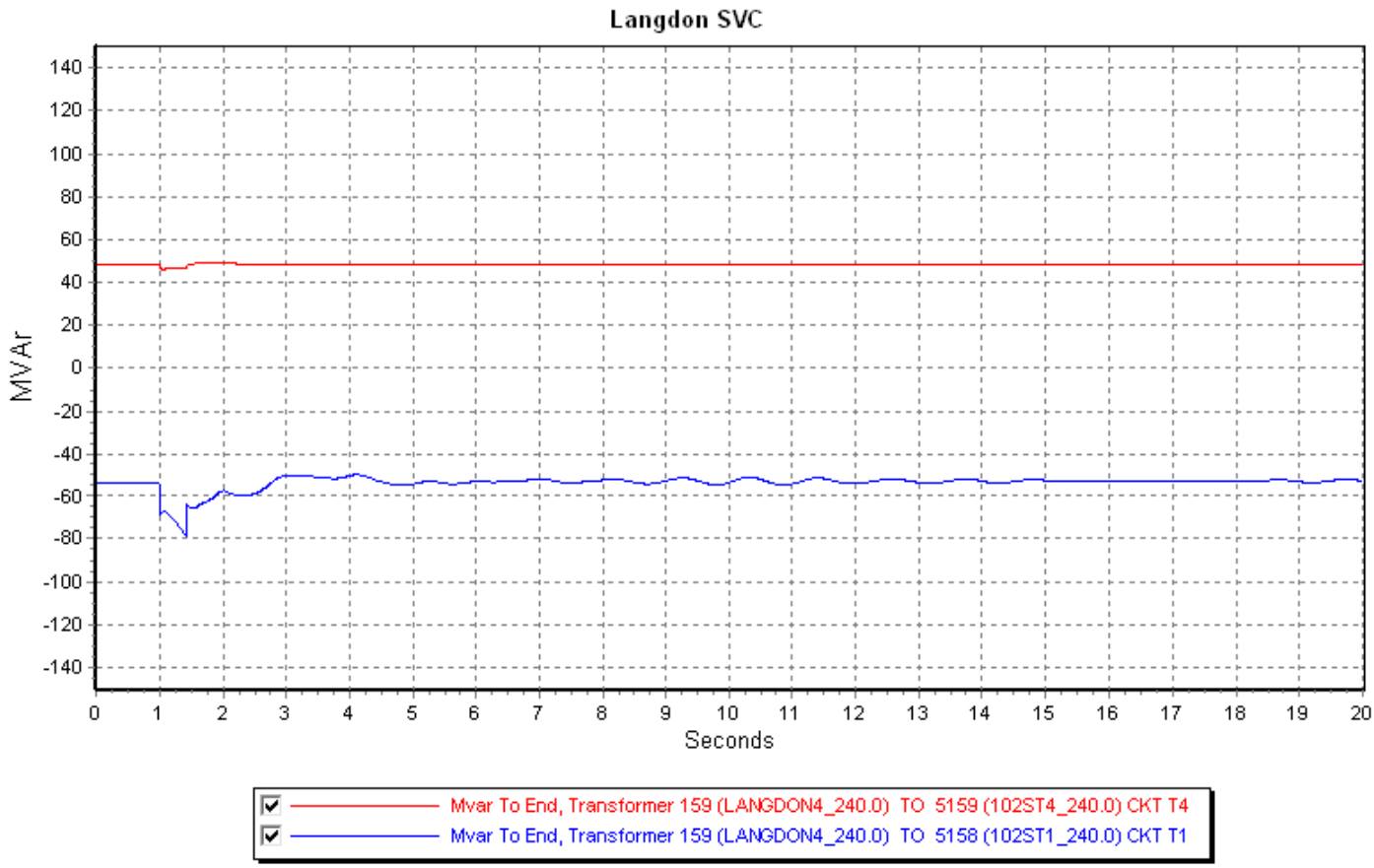


Contingency: 180L Vulcan 255S to Ft.McLeod 15S

Cavalier
Queenstown Generating Plant Output: 90MW

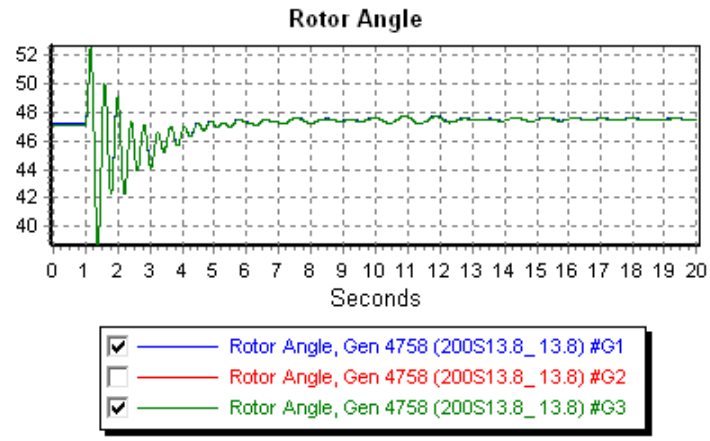
November 05, 2014 12:36:47

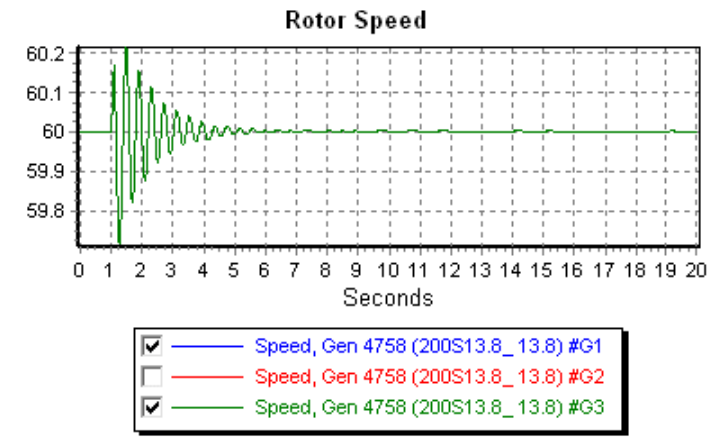
Langdon SVC

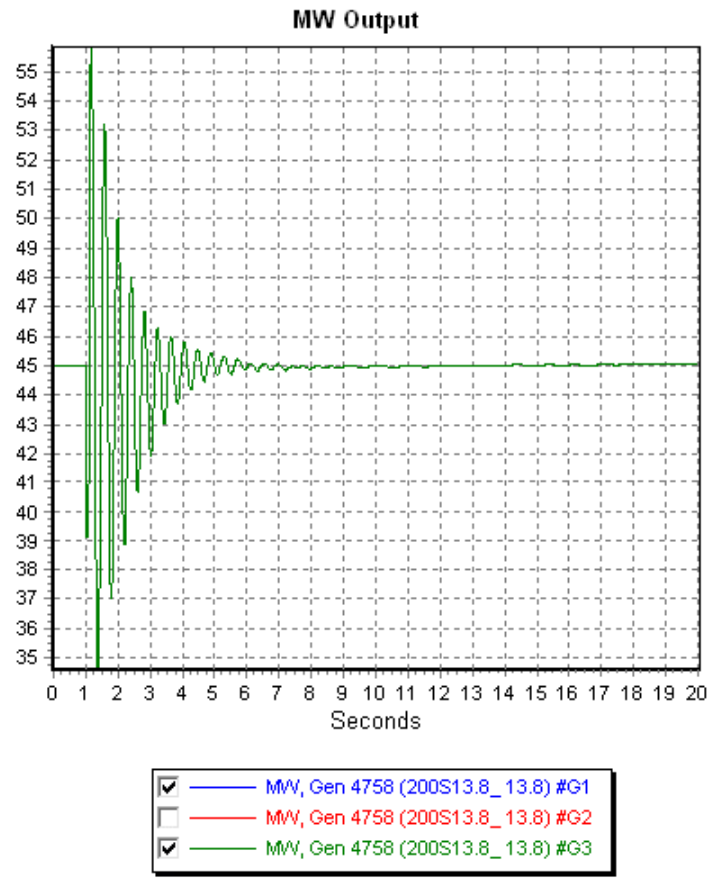


Contingency: 180L Vulcan 255S to Ft.McLeod 15S	Langdon SVC Queenstown Generating Plant Output: 90MW
	November 05, 2014 12:36:49

Queenstown Gen





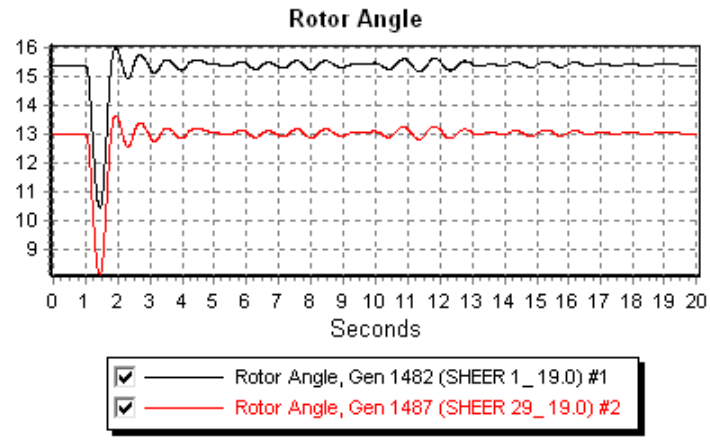


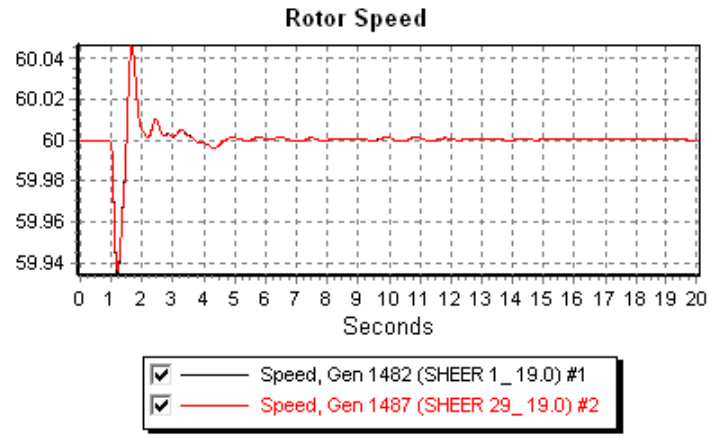
Contingency: 180L Vulcan 255S to Ft.McLeod 15S

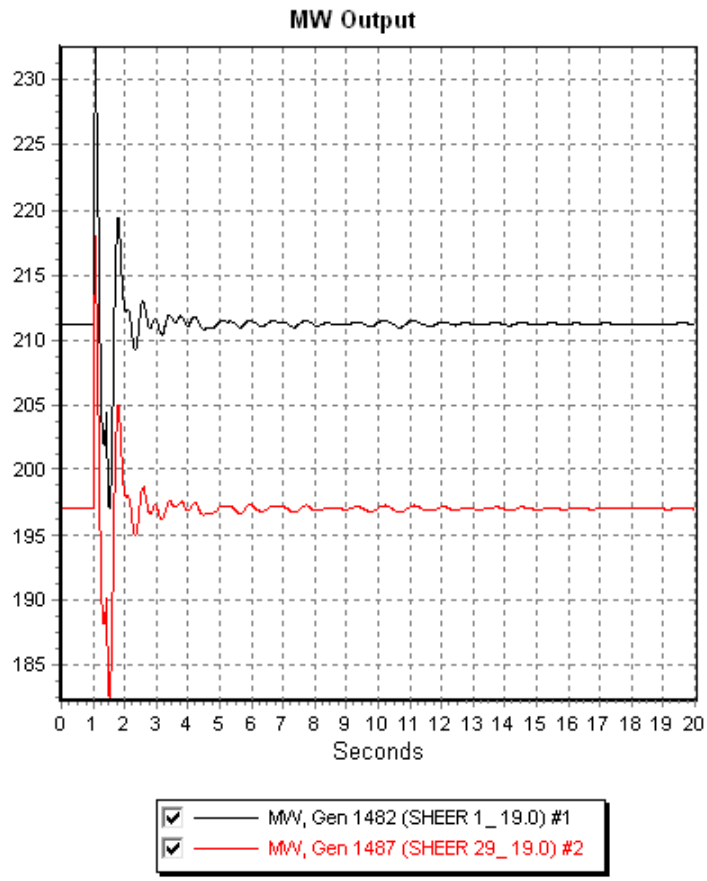
P1336
Queenstown Generating Plant
Output: 90MW

November 05, 2014 12:36:47

Sheerness





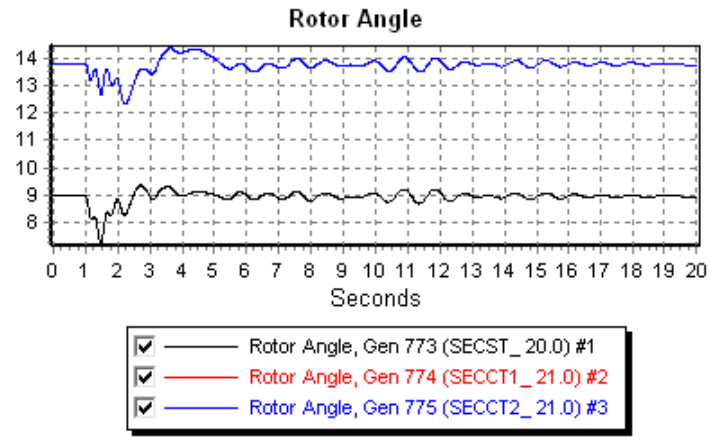


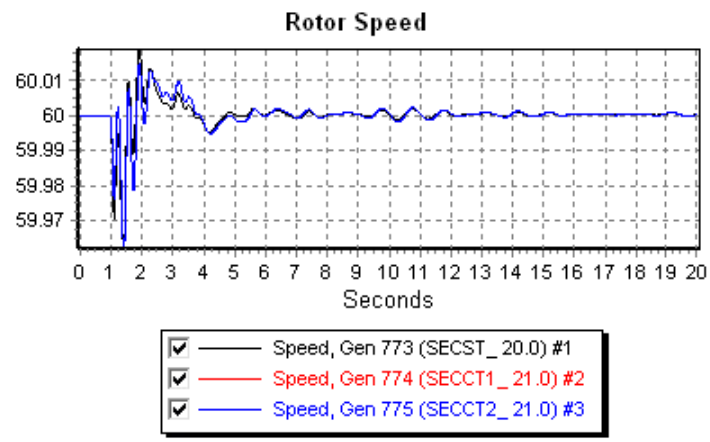
Contingency: 180L Vulcan 255S to Ft.McLeod 15S

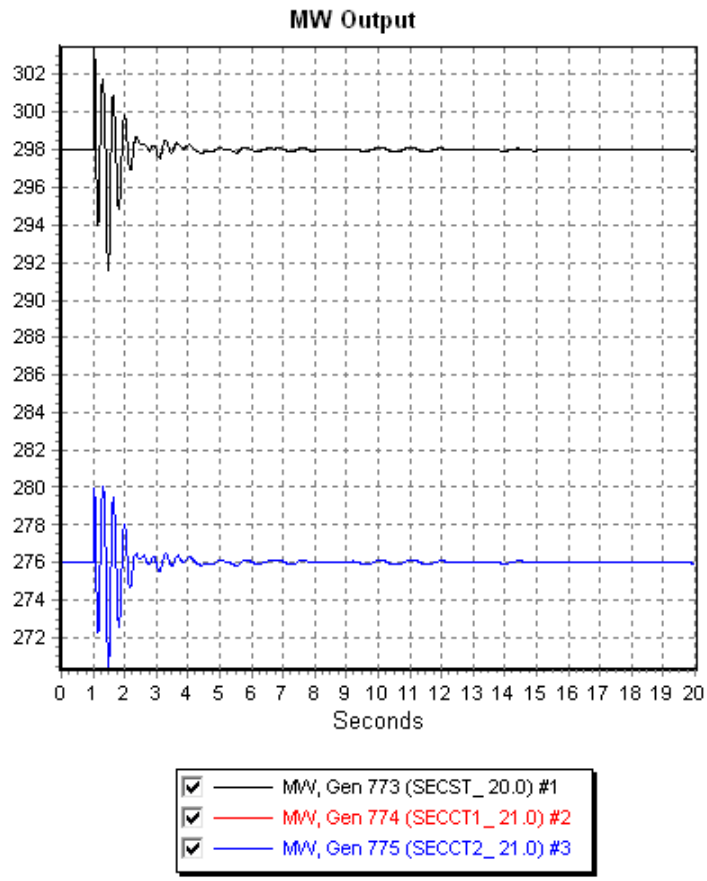
Sheerness
Queenstown Generating Plant Output: 90MW

November 05, 2014 12:36:45

Sheppard





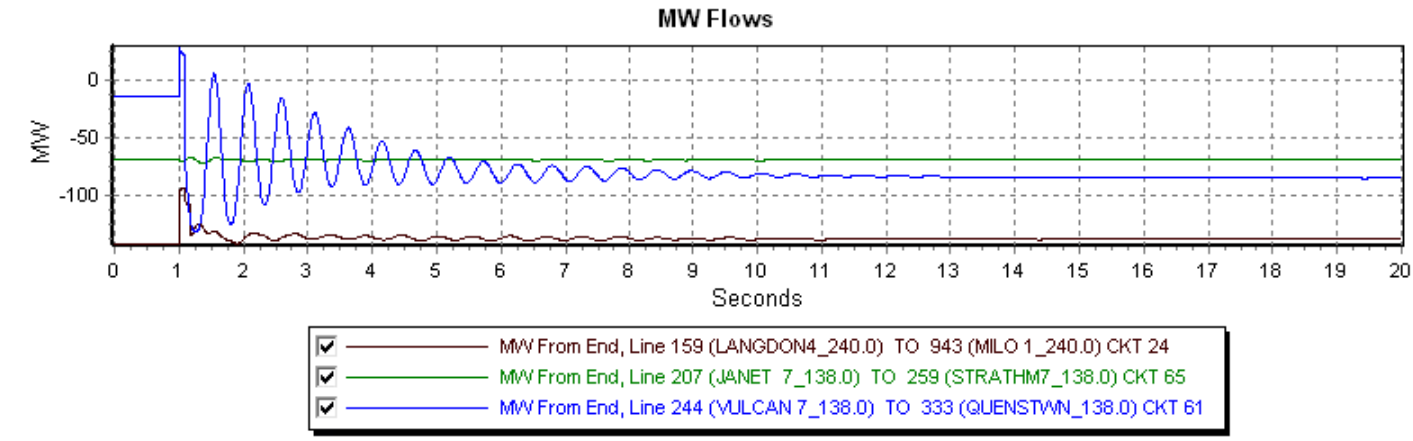


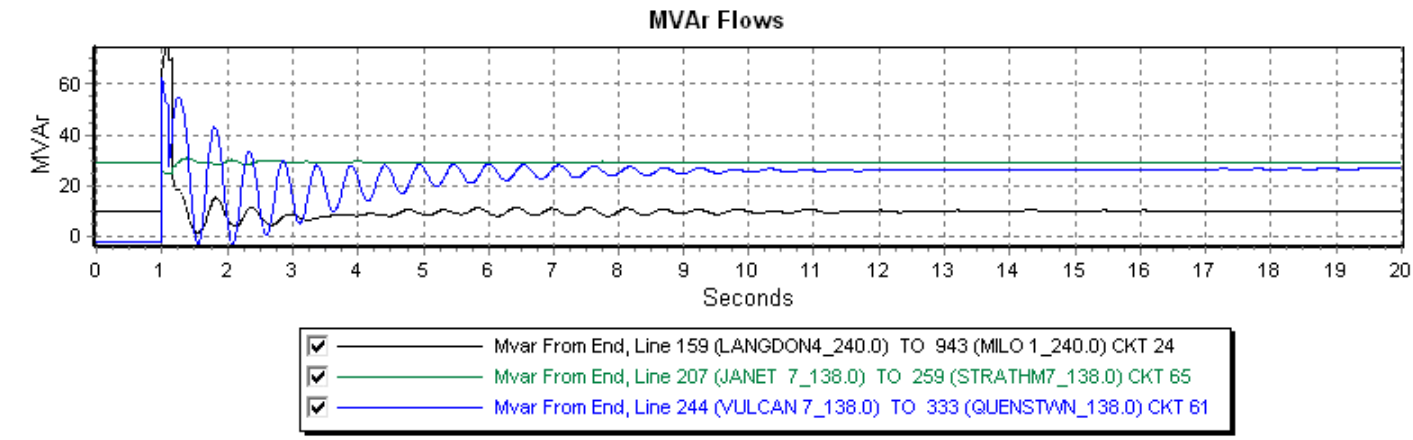
Contingency: 180L Vulcan 255S to Ft.McLeod 15S

Sheppard
Queenstown Generating Plant Output: 90MW

November 05, 2014 12:36:46

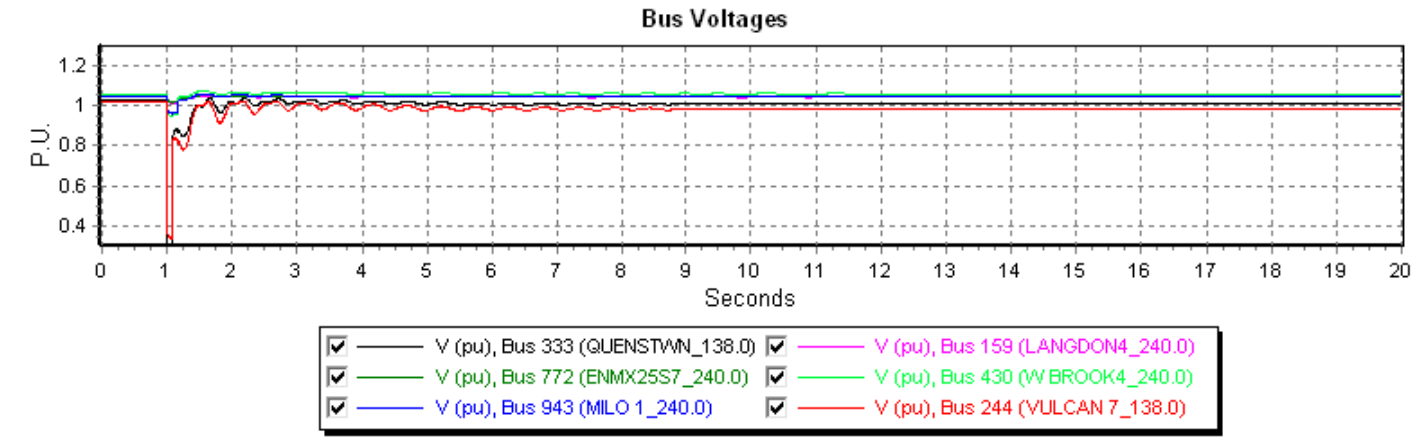
Branch Flows

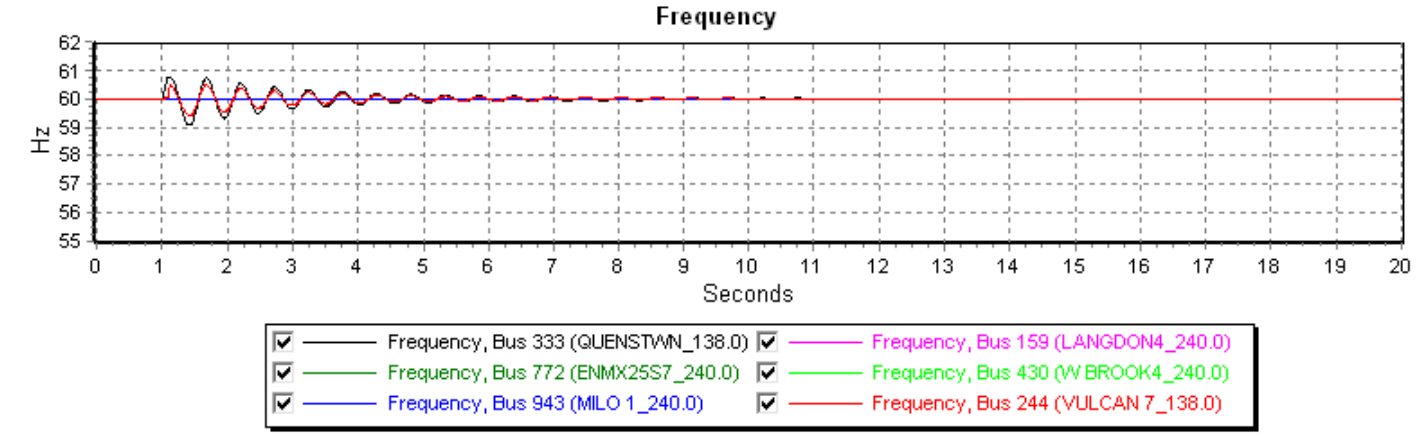




Contingency: 853L QUEENSTOWN 504S - WEST BROOKS 28S	Branch Flows Queenstown Generating Plant Output: 90MW
	November 05, 2014 12:37:18

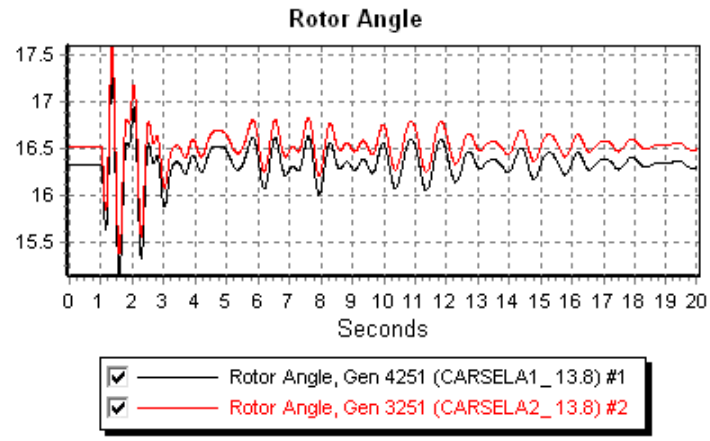
Bus Voltages and Frequency

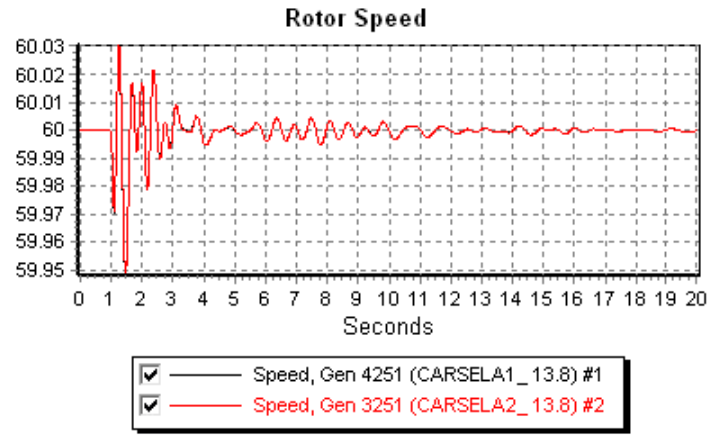


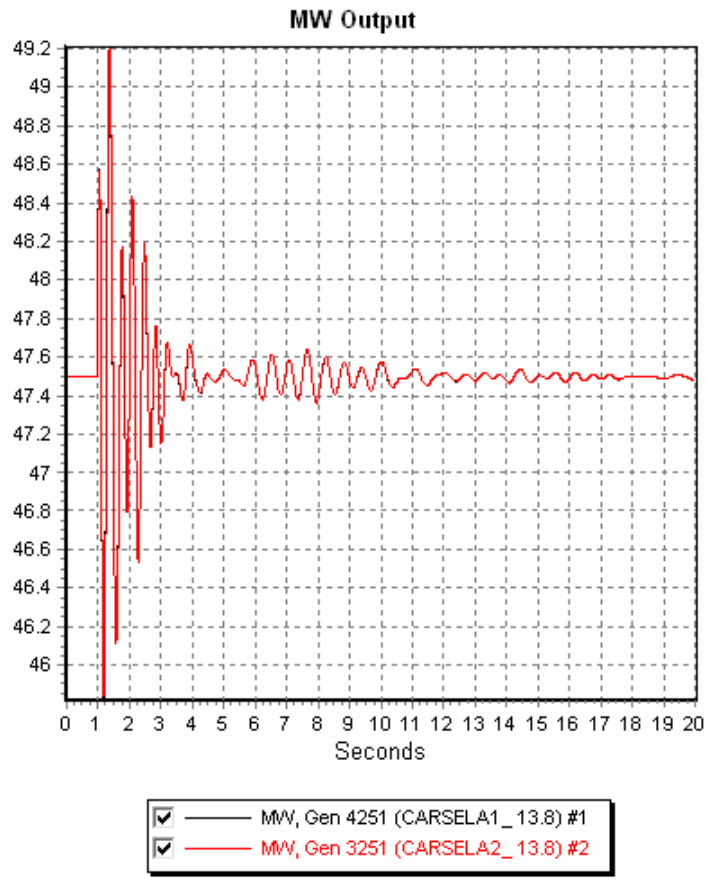


Contingency: 853L QUEENSTOWN 504S - WEST BROOKS 28S	Bus Voltages and Frequency Queenstown Generating Plant Output: 90MW
	November 05, 2014 12:37:18

Carseland





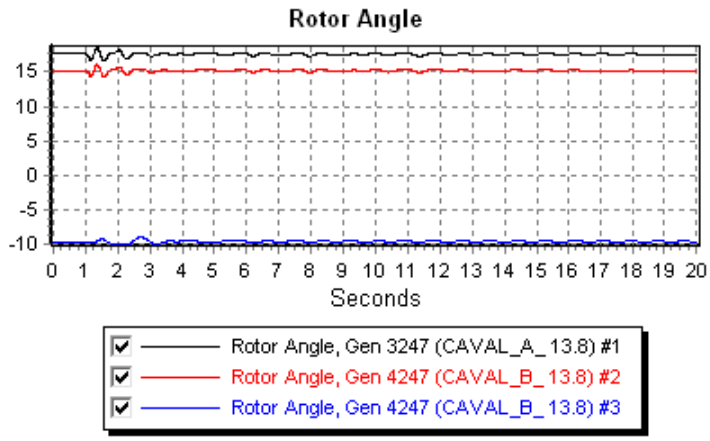


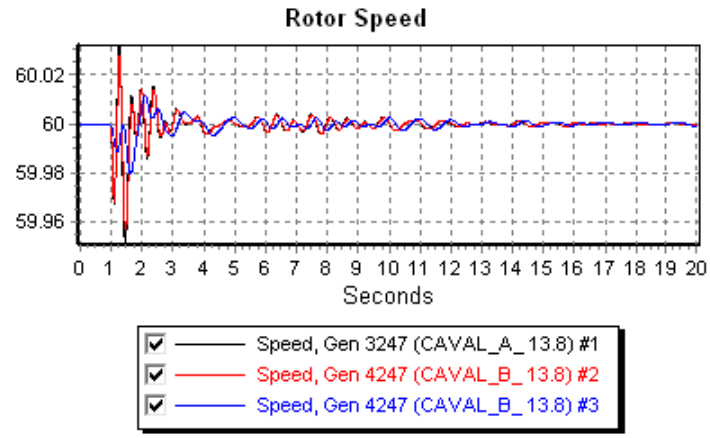
Contingency: 853L QUEENSTOWN 504S - WEST BROOKS 28S

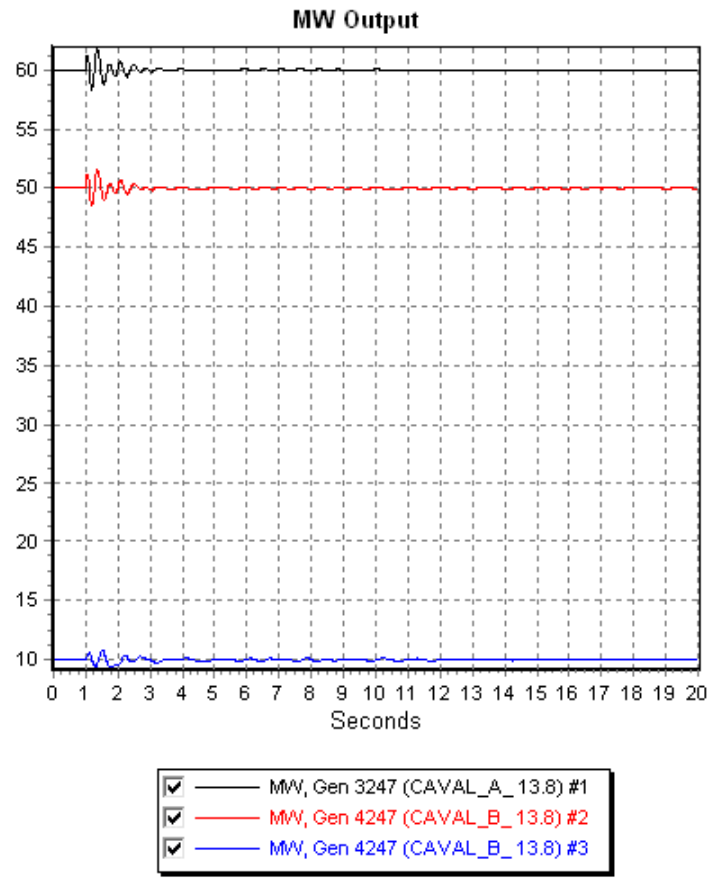
Carseland
Queenstown Generating Plant Output: 90MW

November 05, 2014 12:37:15

Cavalier





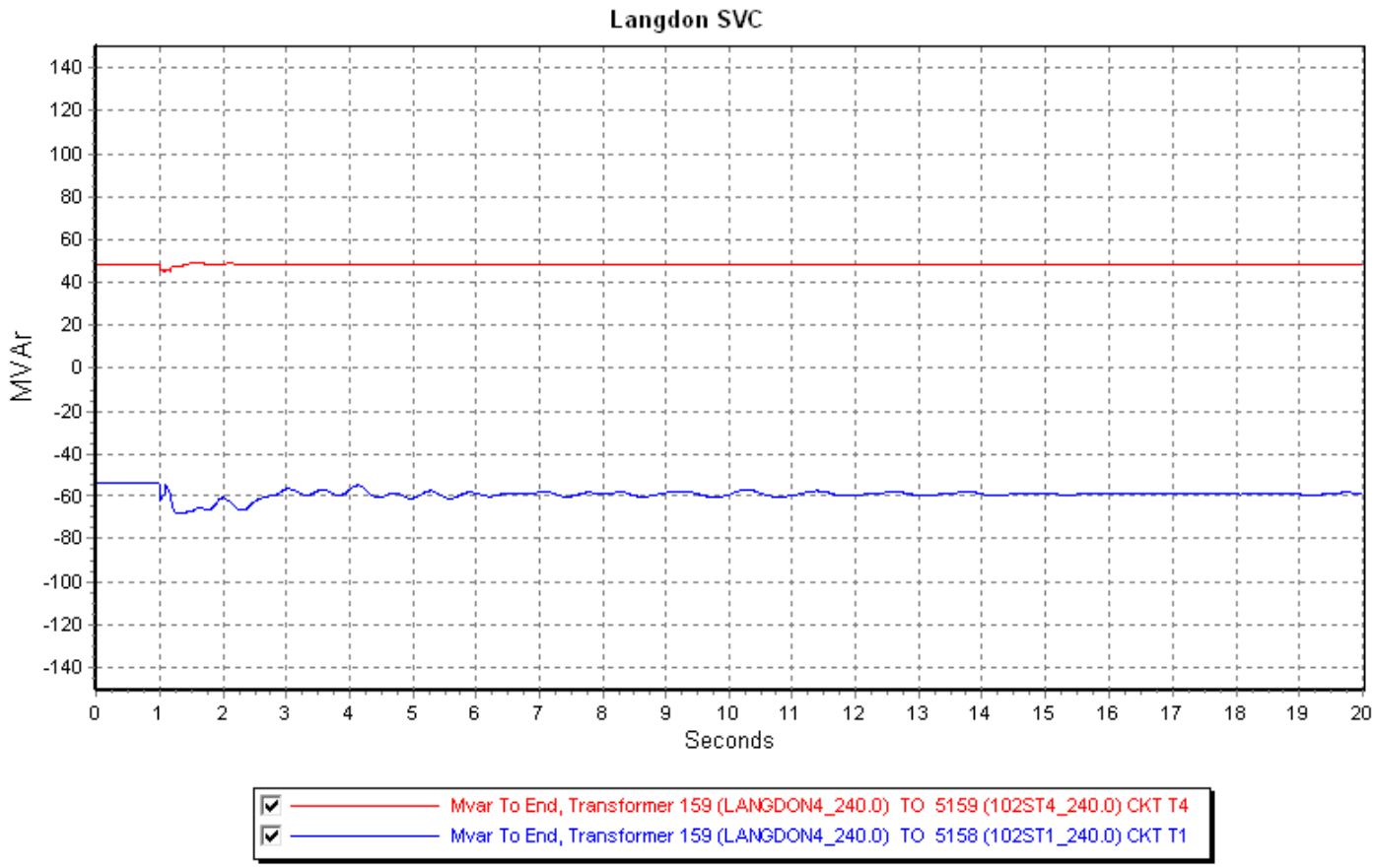


Contingency: 853L QUEENSTOWN 504S - WEST BROOKS 28S

Cavalier
Queenstown Generating Plant Output: 90MW

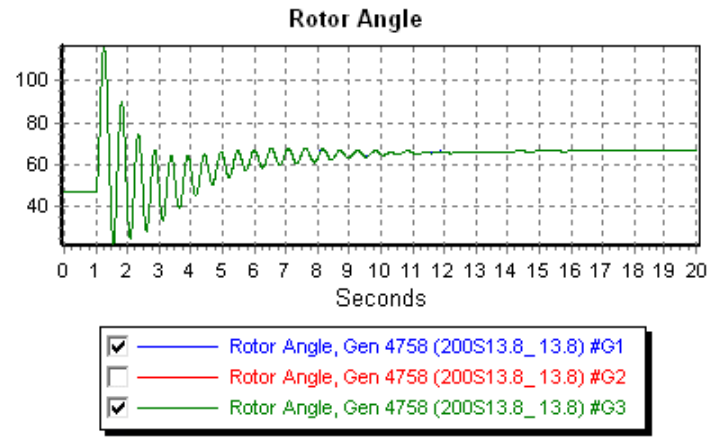
November 05, 2014 12:37:17

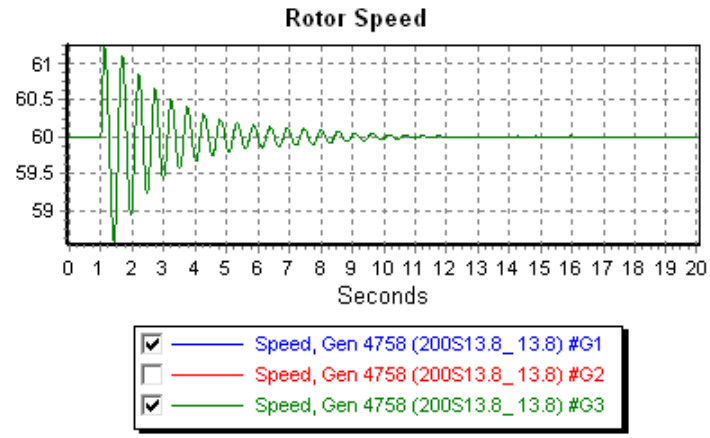
Langdon SVC

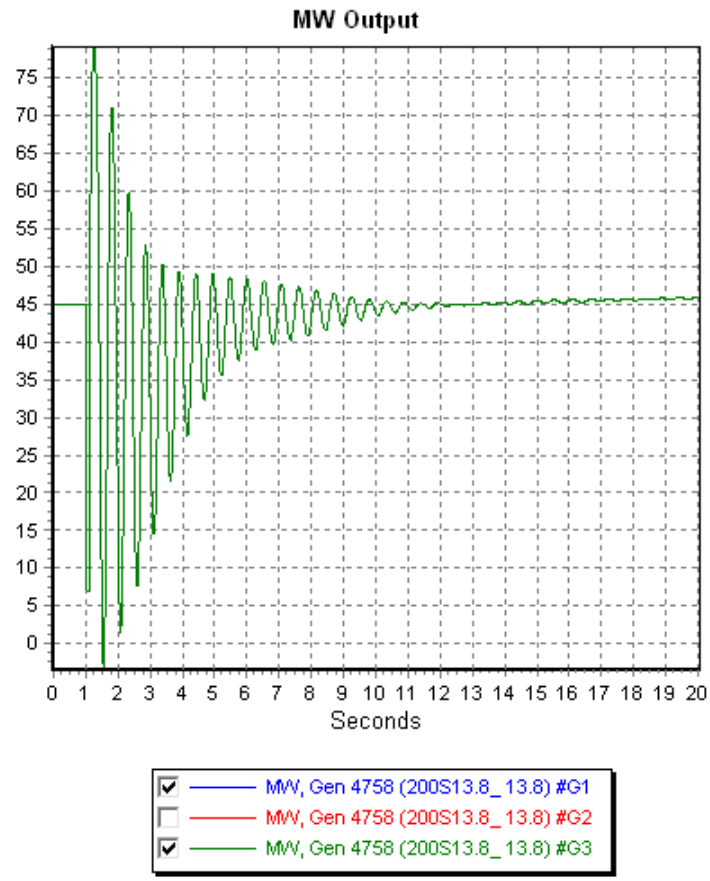


Contingency: 853L QUEENSTOWN 504S - WEST BROOKS 28S	Langdon SVC Queenstown Generating Plant Output: 90MW November 05, 2014 12:37:19

Queenstown Gen





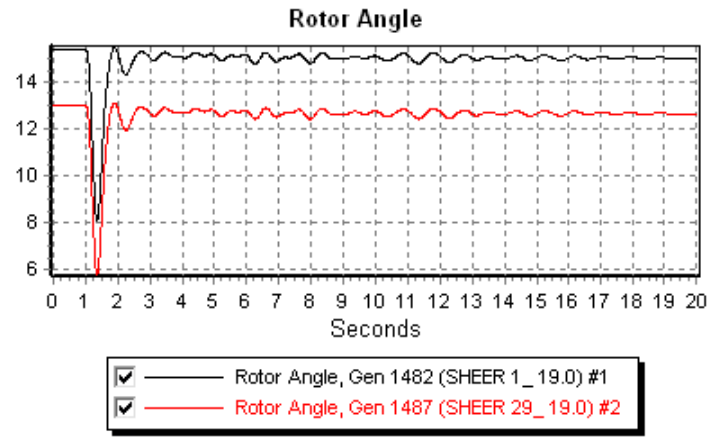


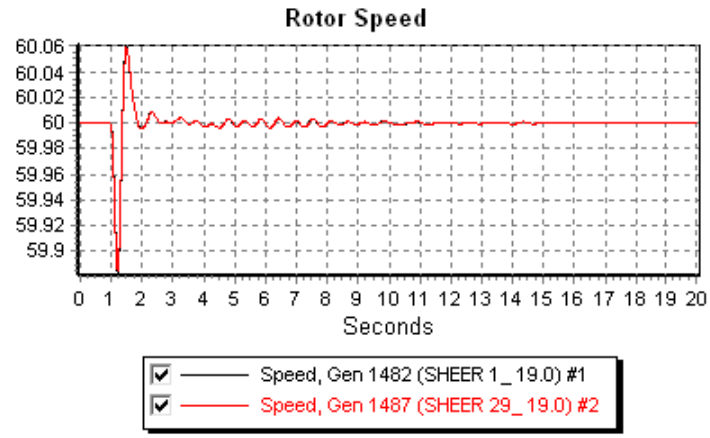
Contingency: 853L QUEENSTOWN 504S - WEST BROOKS 28S

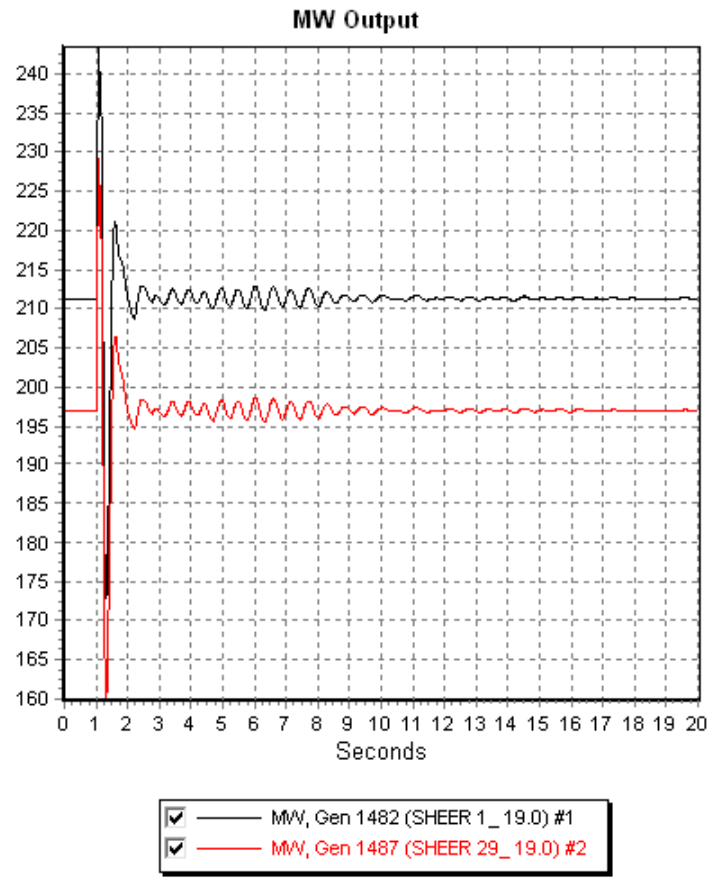
P1336
Queenstown Generating Plant
Output: 90MW

November 05, 2014 12:37:17

Sheerness





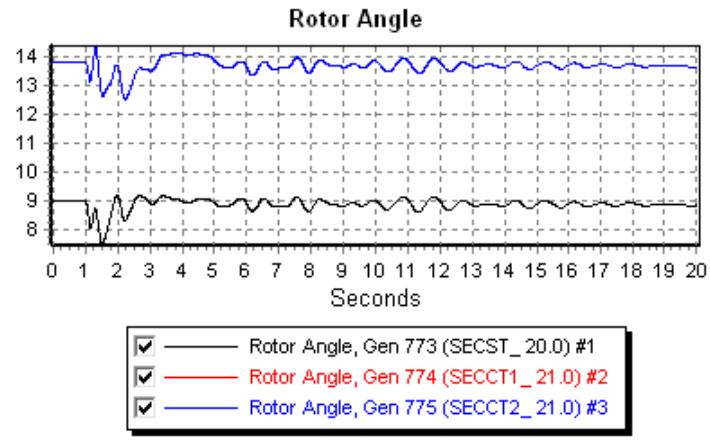


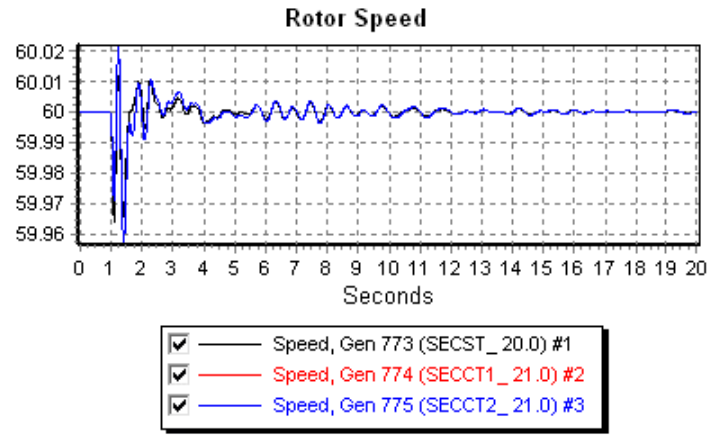
Contingency: 853L QUEENSTOWN 504S - WEST BROOKS 28S

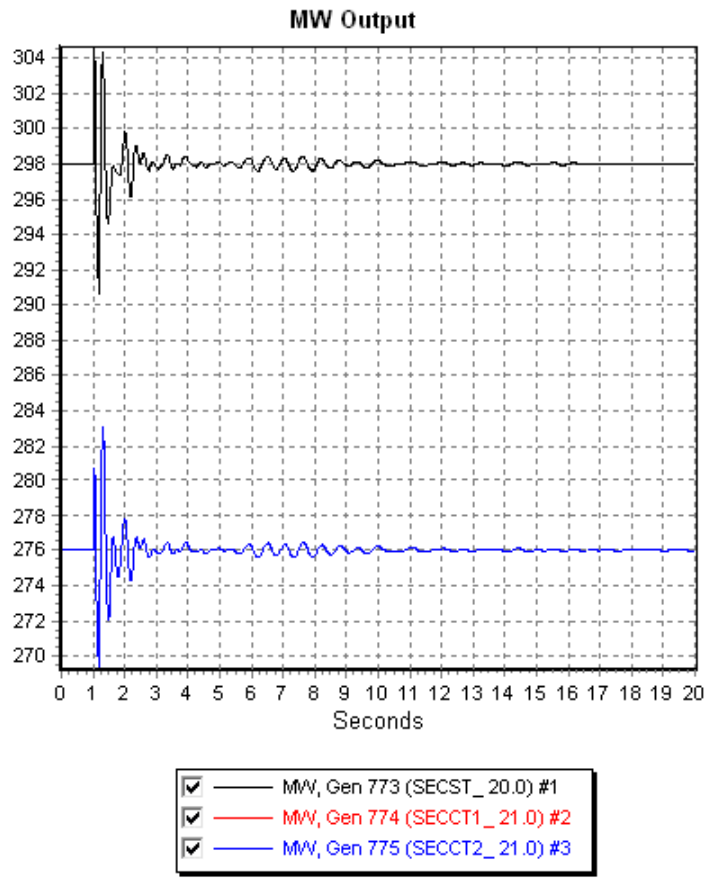
Sheerness
Queenstown Generating Plant Output: 90MW

November 05, 2014 12:37:15

Sheppard





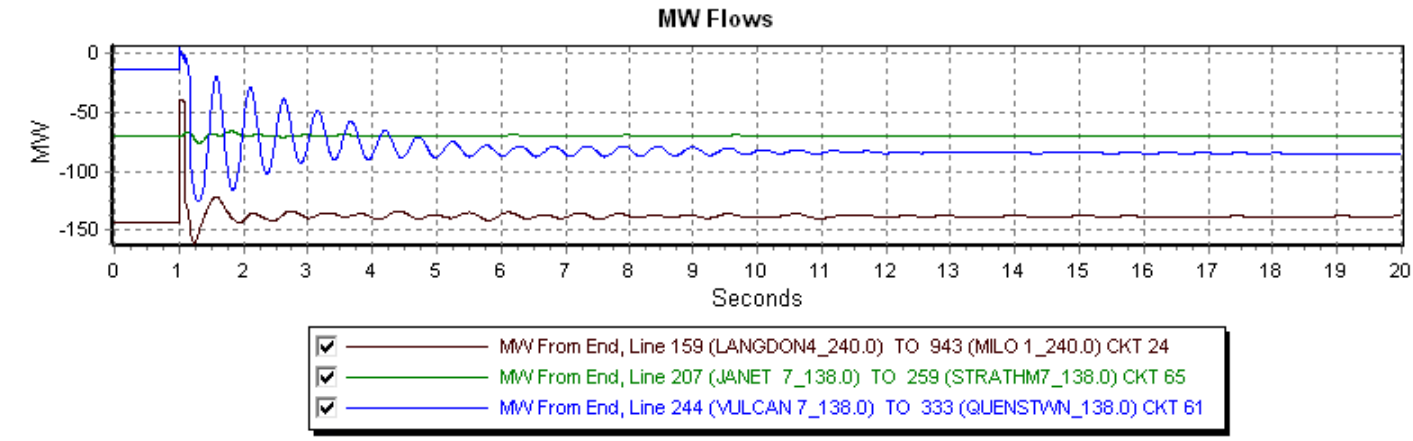


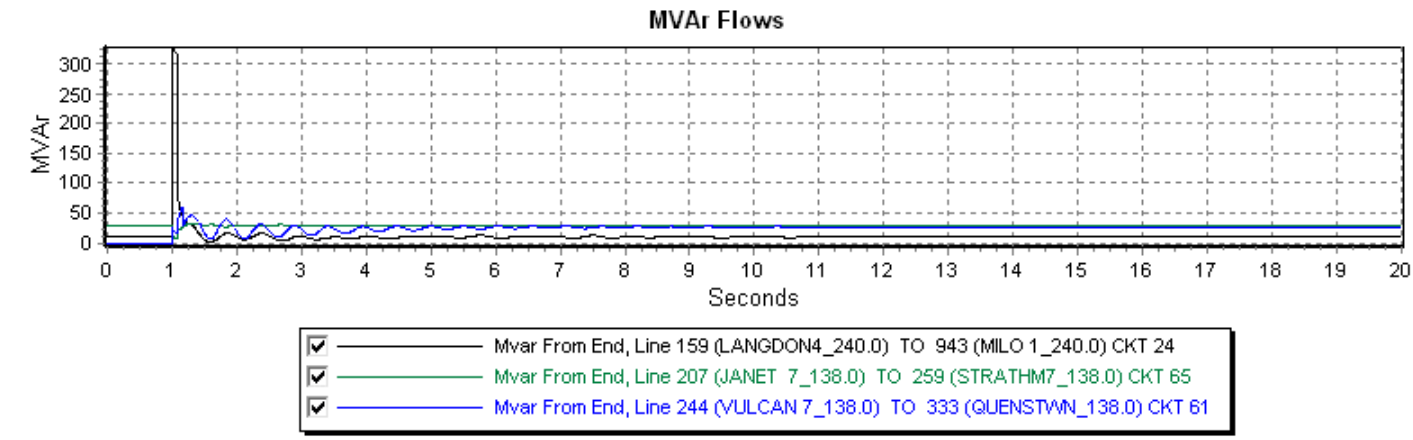
Contingency: 853L QUEENSTOWN 504S - WEST BROOKS 28S

Sheppard
Queenstown Generating Plant Output: 90MW

November 05, 2014 12:37:16

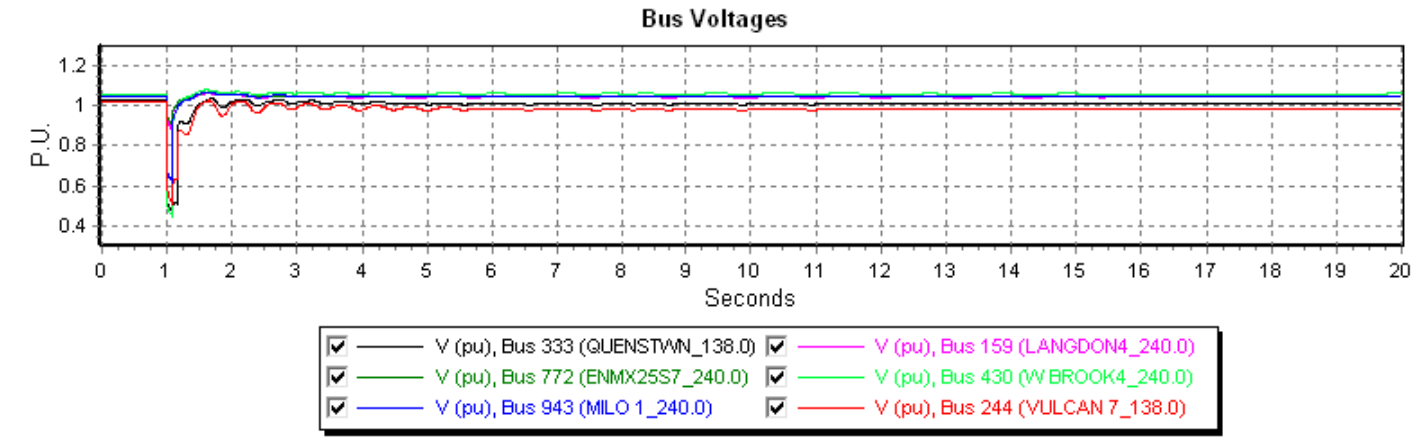
Branch Flows

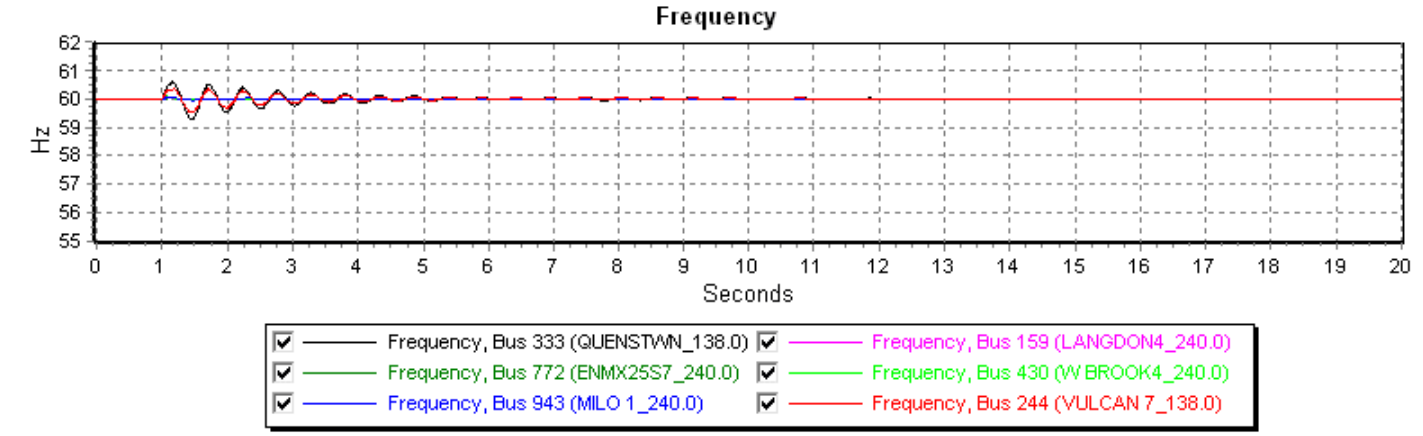




Contingency: 853L WEST BROOKS 28S - QUEENSTOWN 504S	Branch Flows Queenstown Generating Plant Output: 90MW
	November 05, 2014 12:37:49

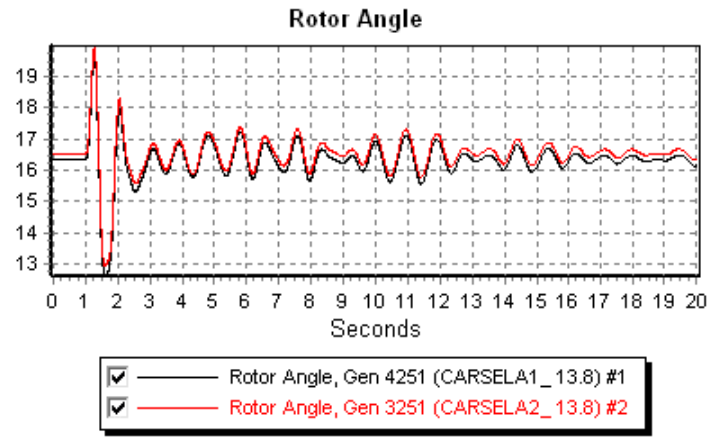
Bus Voltages and Frequency

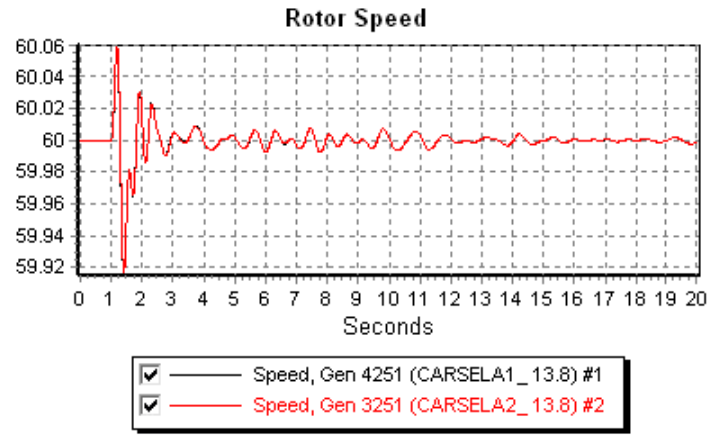


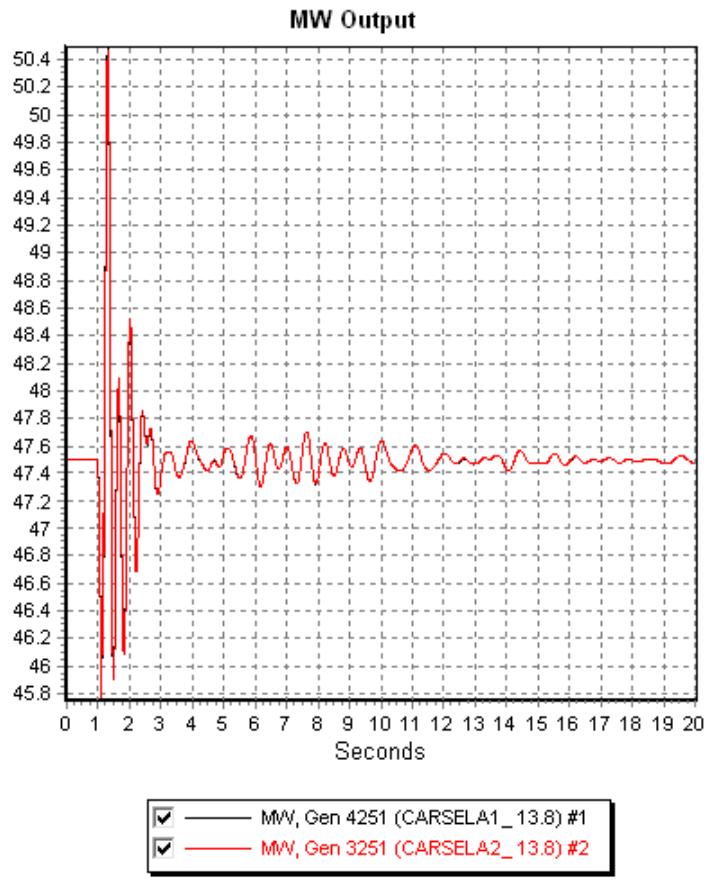


Contingency: 853L WEST BROOKS 28S - QUEENSTOWN 504S	Bus Voltages and Frequency Queenstown Generating Plant Output: 90MW November 05, 2014 12:37:49

Carseland





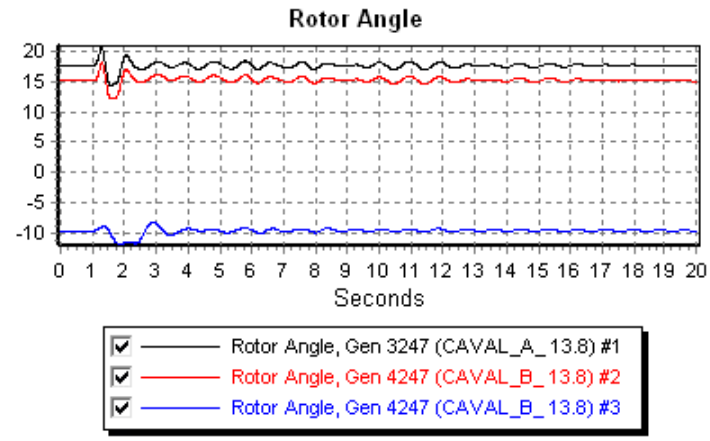


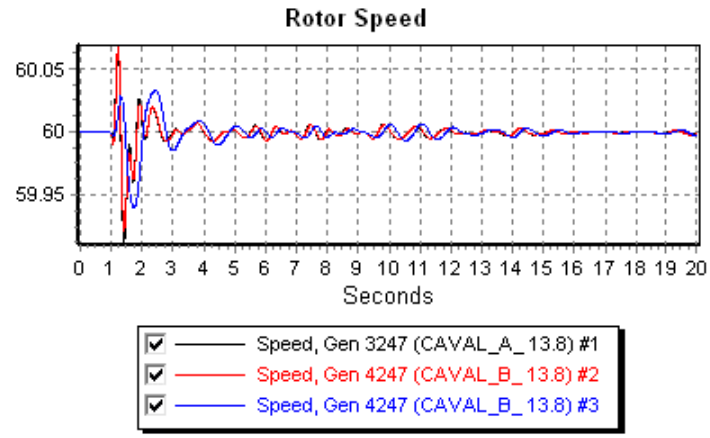
Contingency: 853L WEST BROOKS 28S - QUEENSTOWN 504S

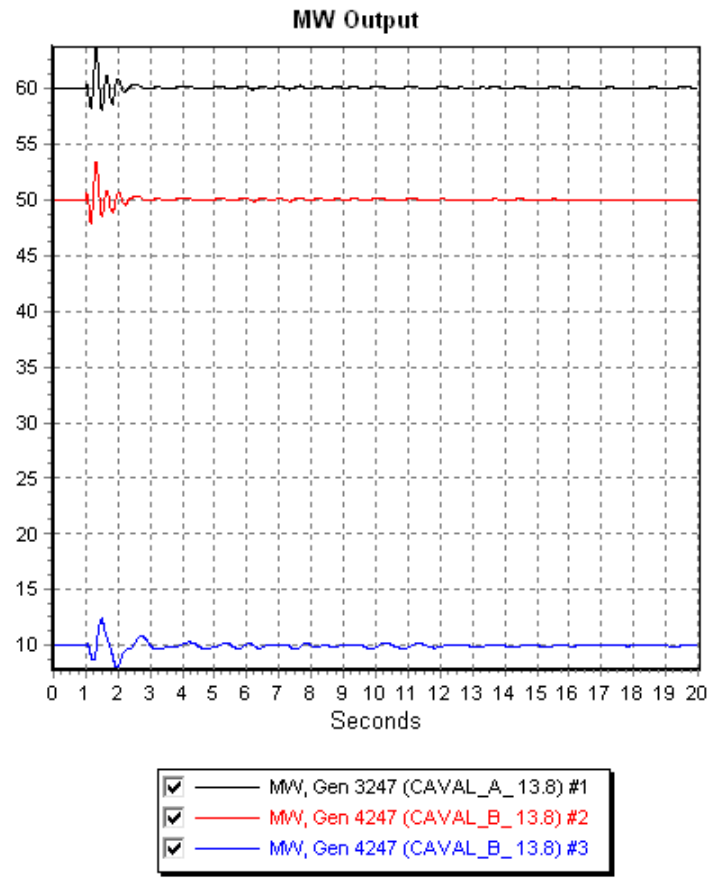
Carseland
Queenstown Generating Plant Output: 90MW

November 05, 2014 12:37:47

Cavalier





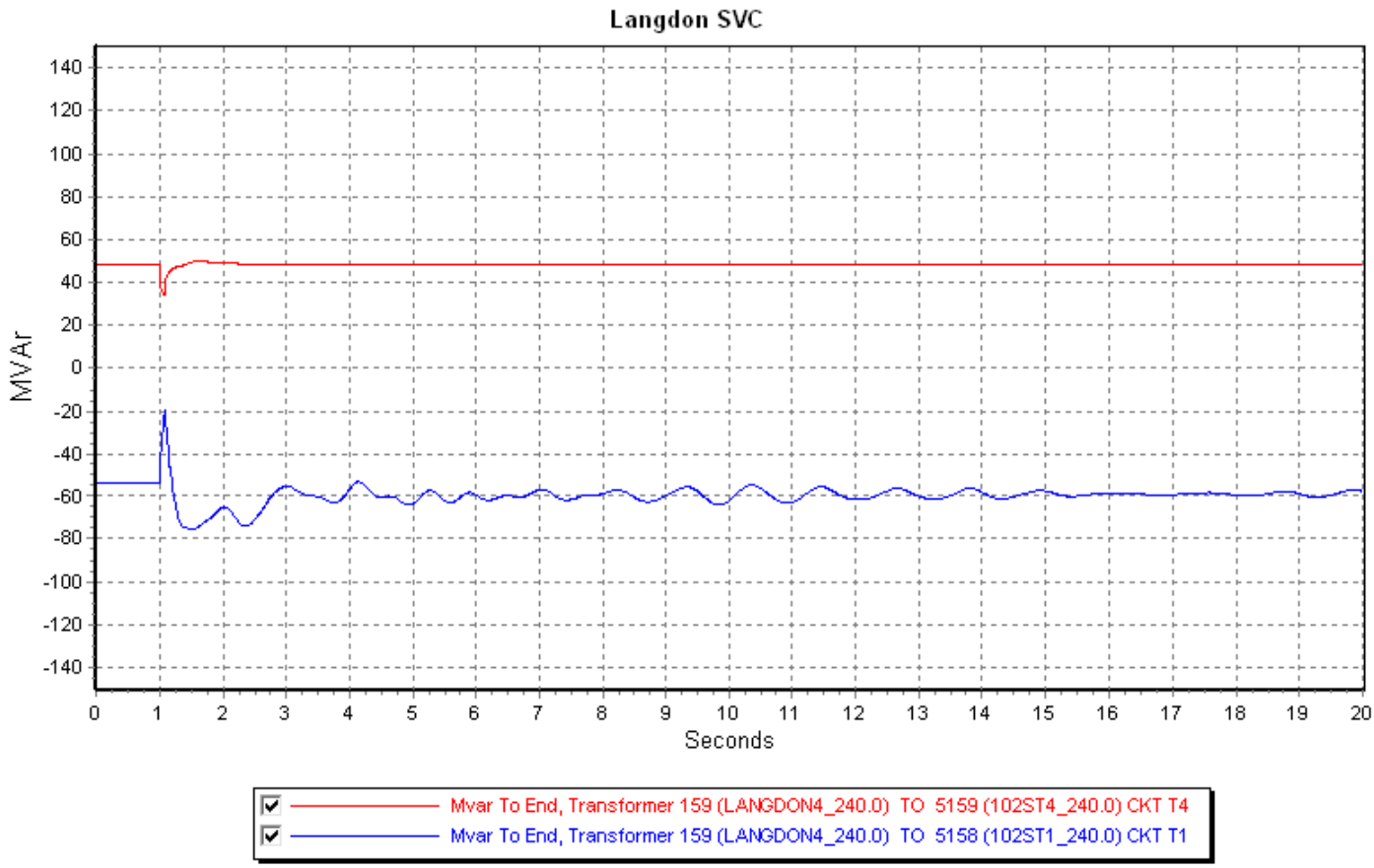


Contingency: 853L WEST BROOKS 28S - QUEENSTOWN 504S

Cavalier
Queenstown Generating Plant Output: 90MW

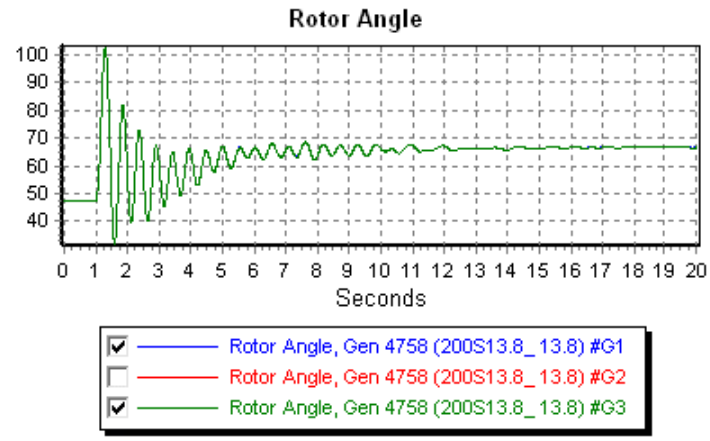
November 05, 2014 12:37:48

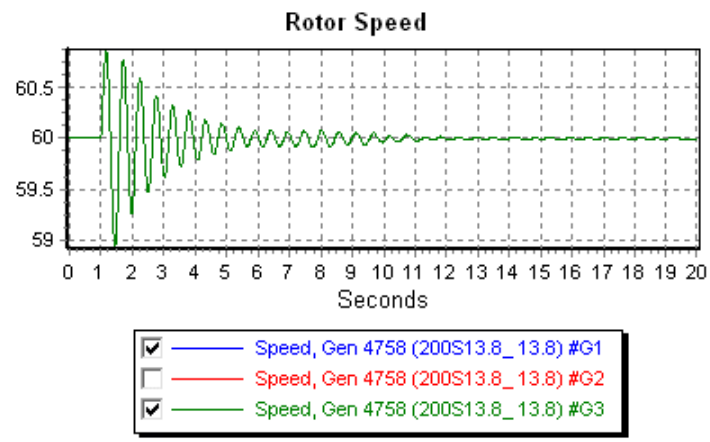
Langdon SVC

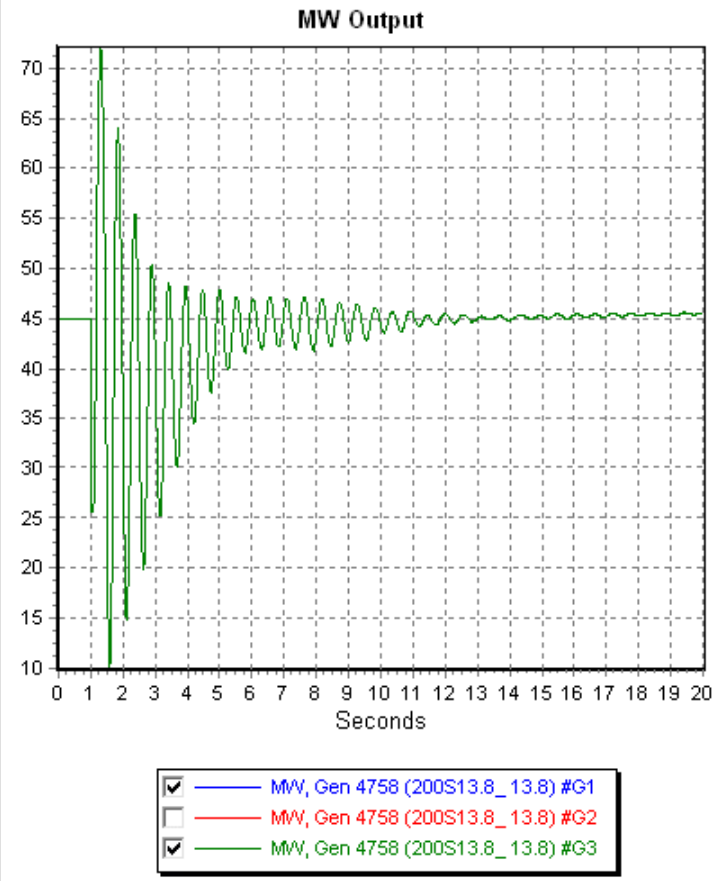


Contingency: 853L WEST BROOKS 28S - QUEENSTOWN 504S	Langdon SVC Queenstown Generating Plant Output: 90MW
	November 05, 2014 12:37:50

Queenstown Gen





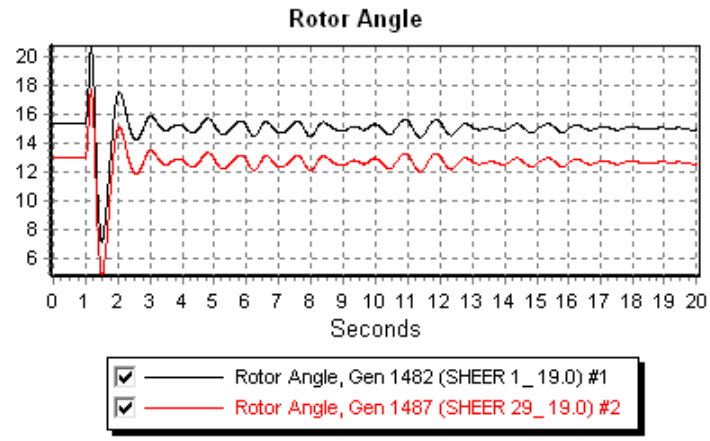


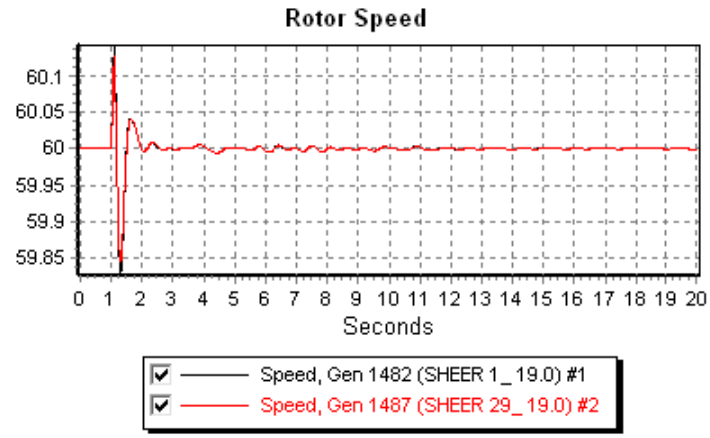
Contingency: 853L WEST BROOKS 28S - QUEENSTOWN 504S

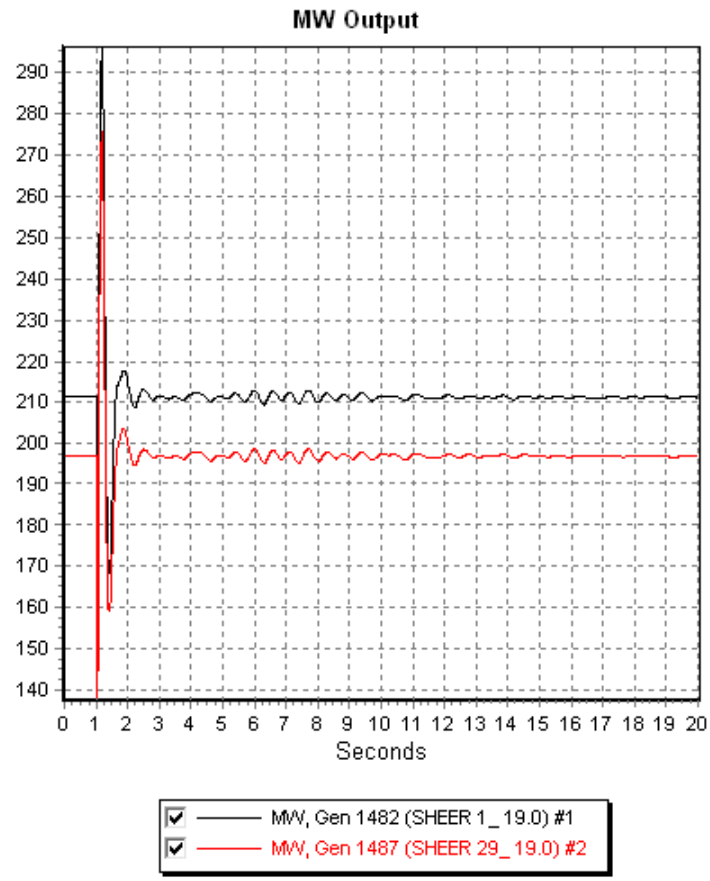
P1336
Queenstown Generating Plant
Output: 90MW

November 05, 2014 12:37:48

Sheerness





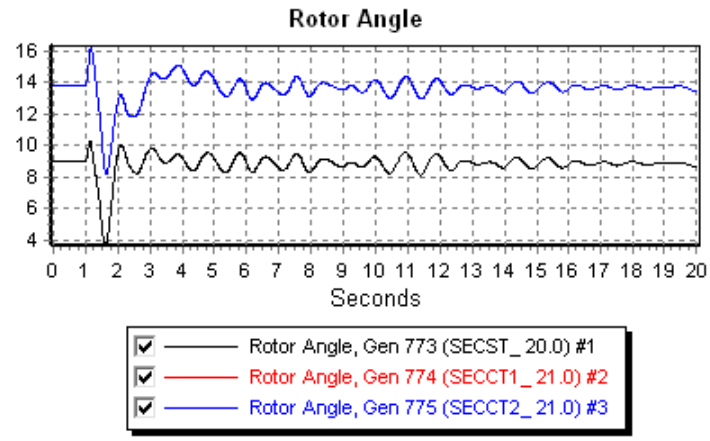


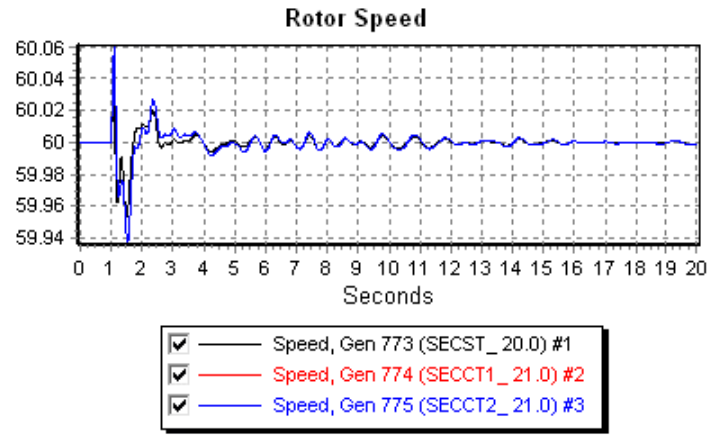
Contingency: 853L WEST BROOKS 28S - QUEENSTOWN 504S

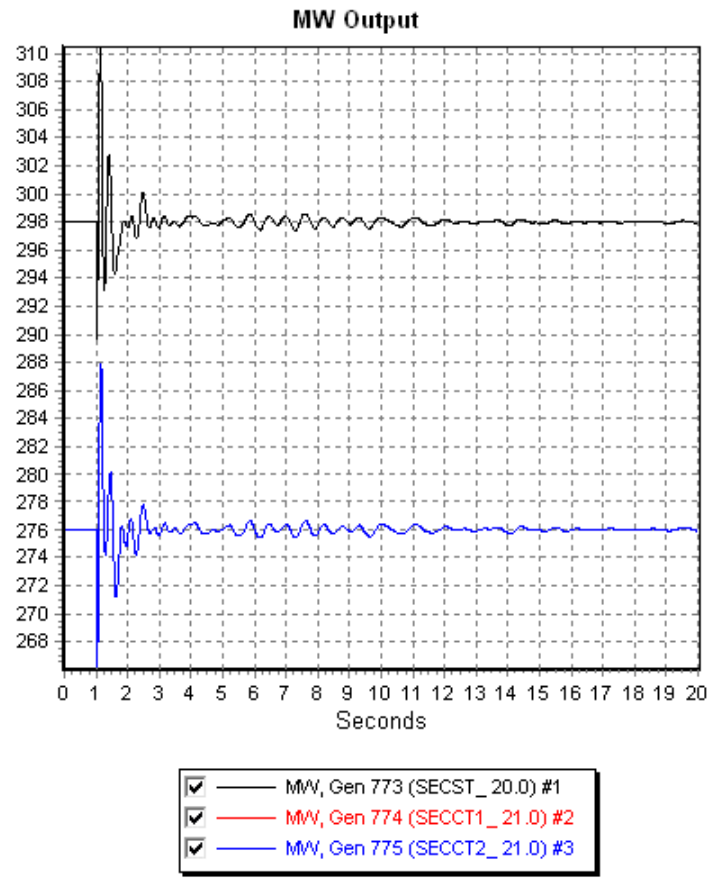
Sheerness
Queenstown Generating Plant Output: 90MW

November 05, 2014 12:37:46

Sheppard





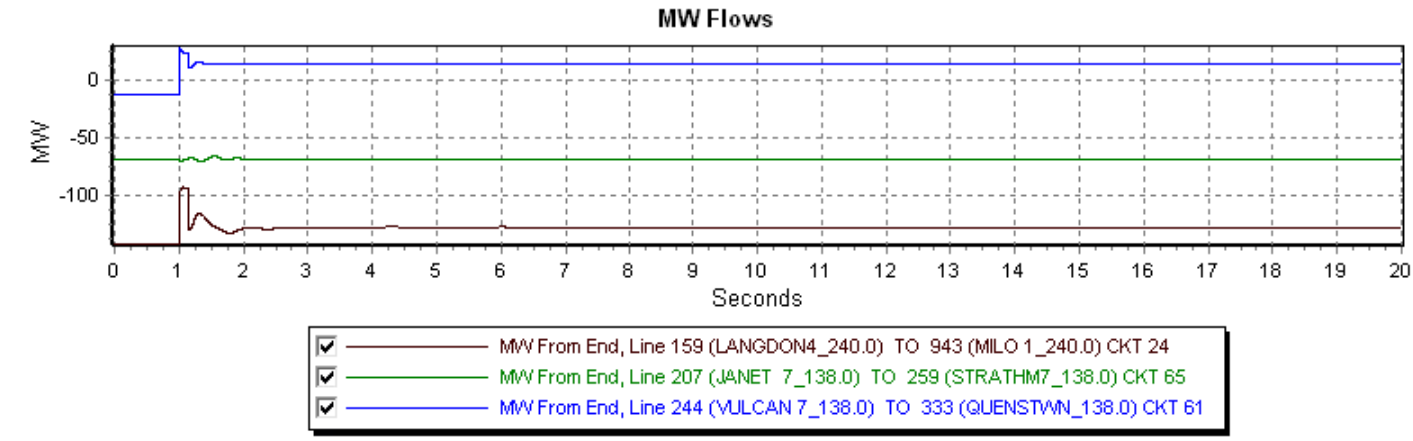


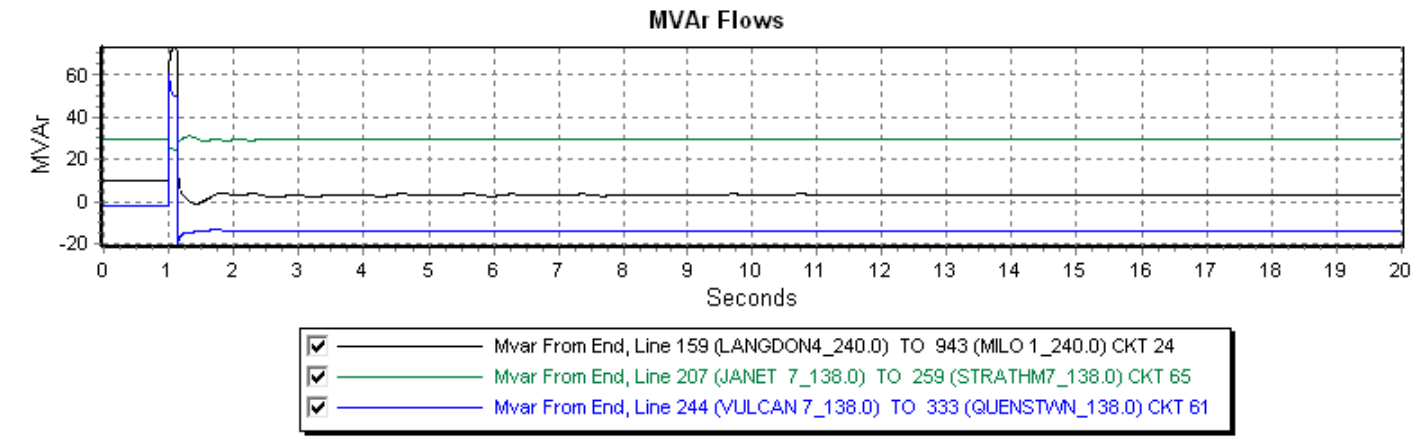
Contingency: 853L WEST BROOKS 28S - QUEENSTOWN 504S

Sheppard
Queenstown Generating Plant Output: 90MW

November 05, 2014 12:37:47

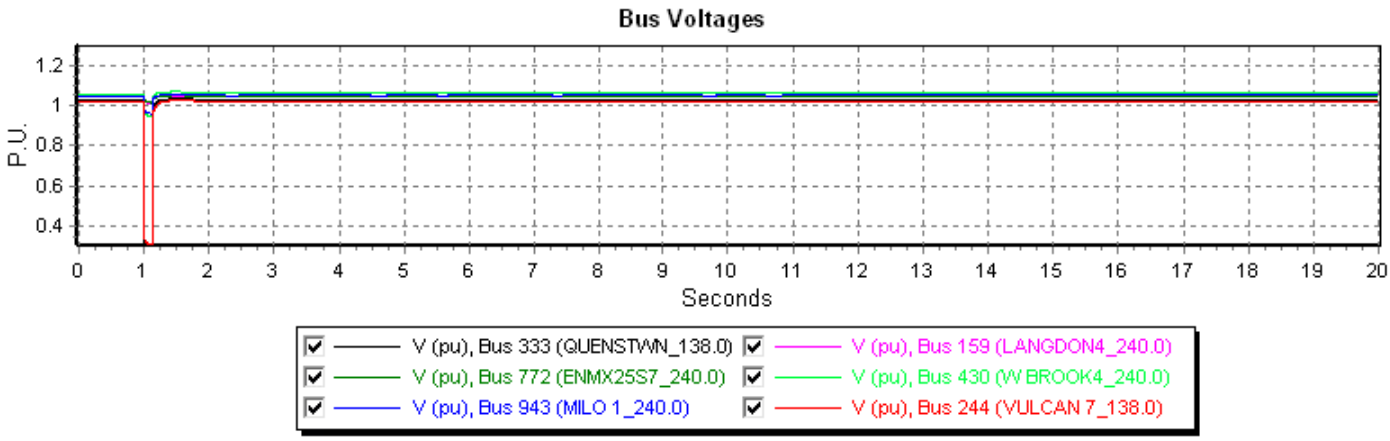
Branch Flows

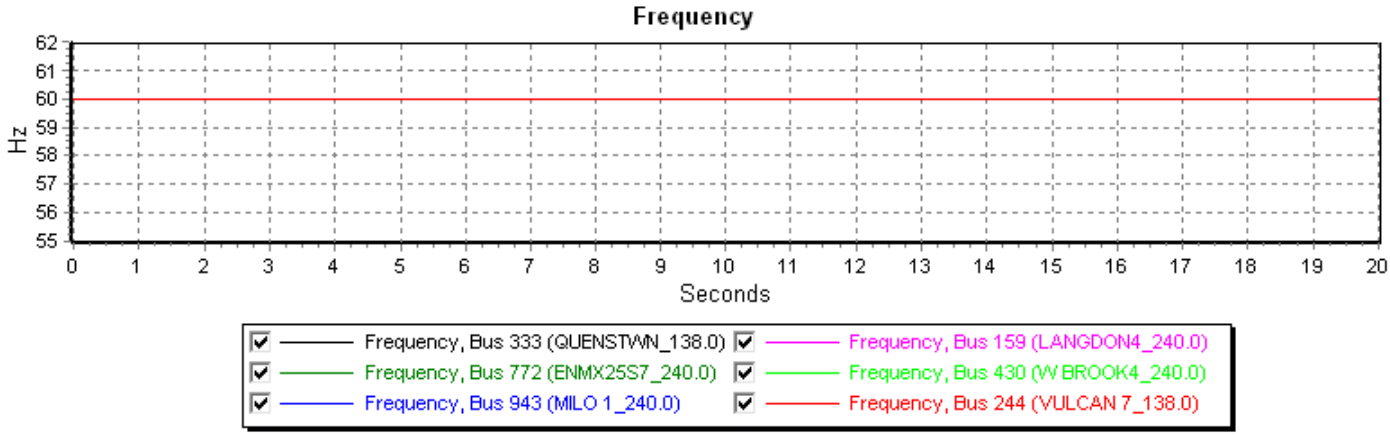




Contingency: Queenstown Plant _McGregor200s 138 kV Bus	Branch Flows Queenstown Generating Plant Output: 90MW
	November 05, 2014 12:50:32

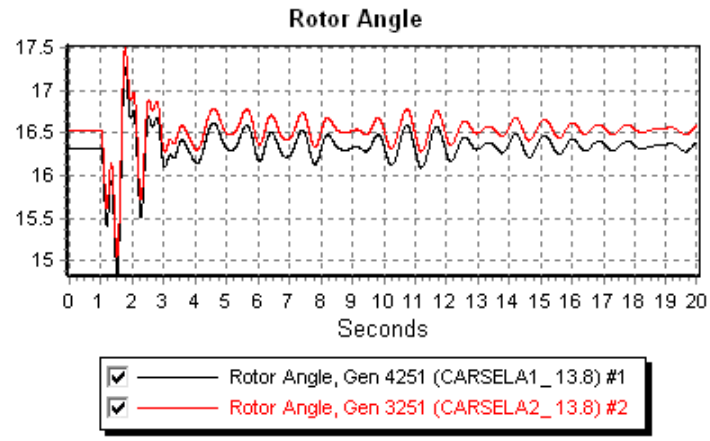
Bus Voltages and Frequency

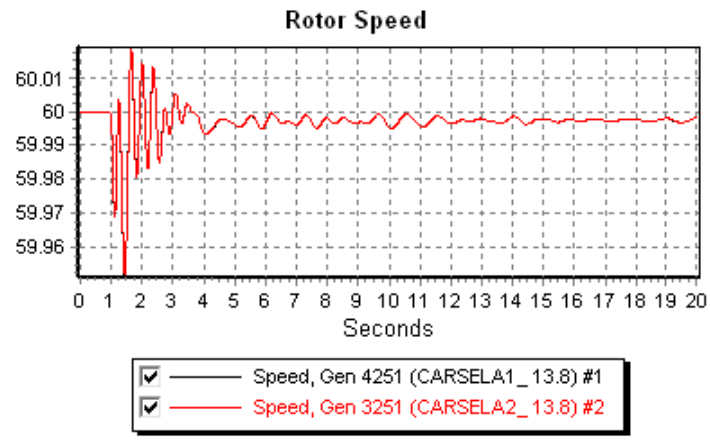


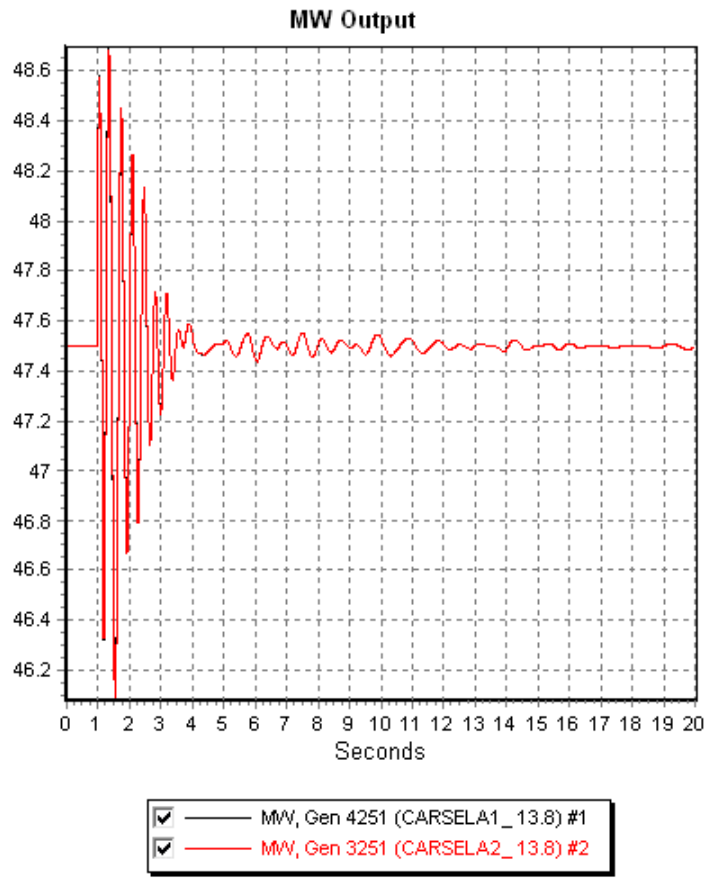


Contingency: Queenstown Plant _McGregor200s 138 kV Bus	Bus Voltages and Frequency Queenstown Generating Plant Output: 90MW November 05, 2014 12:50:33

Carseland





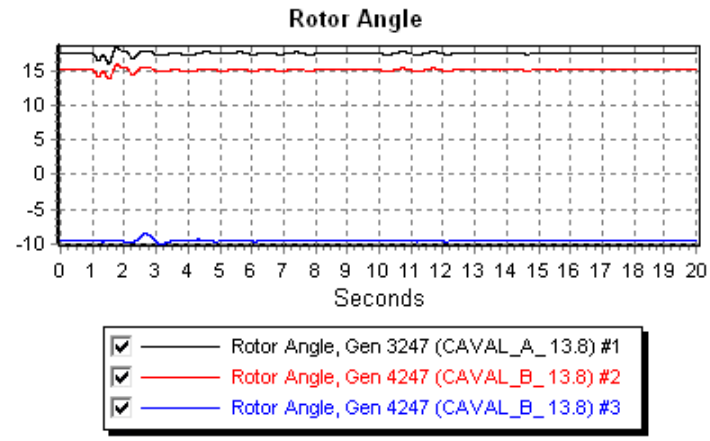


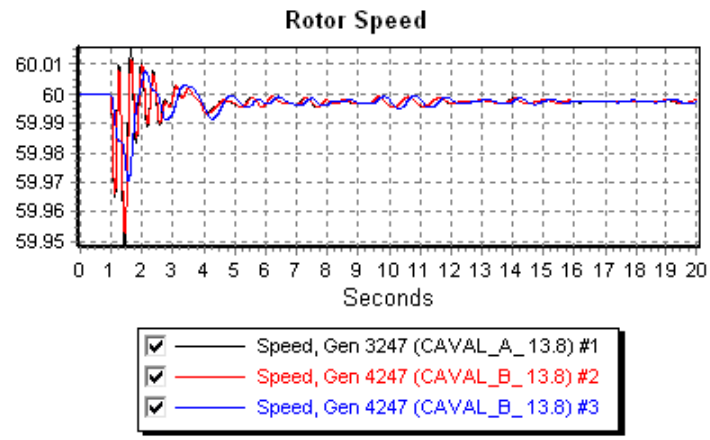
Contingency: Queenstown Plant _McGregor200s 138 kV Bus

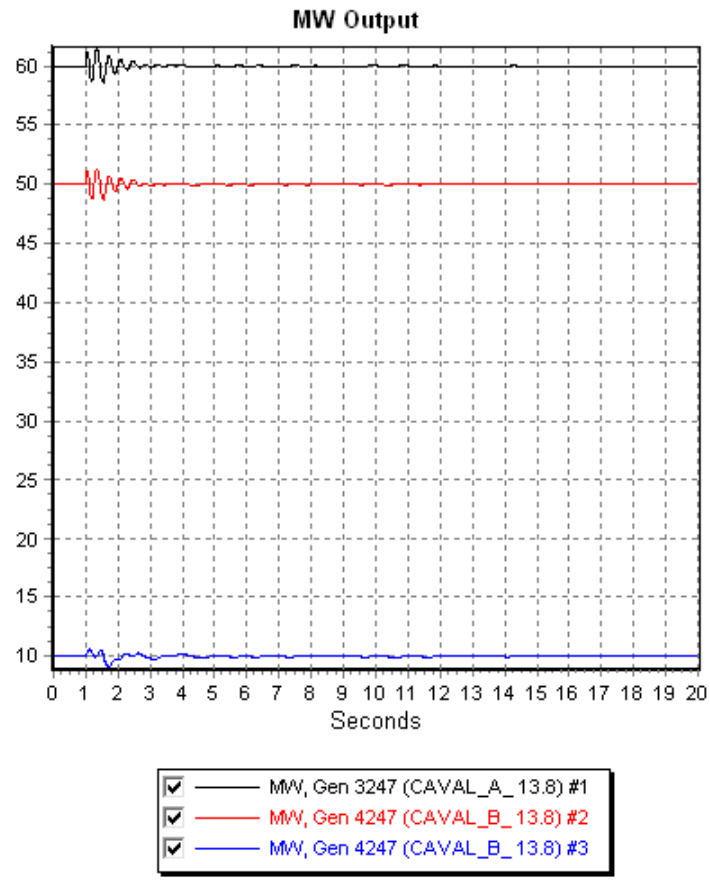
Carseland
Queenstown Generating Plant Output: 90MW

November 05, 2014 12:50:31

Cavalier





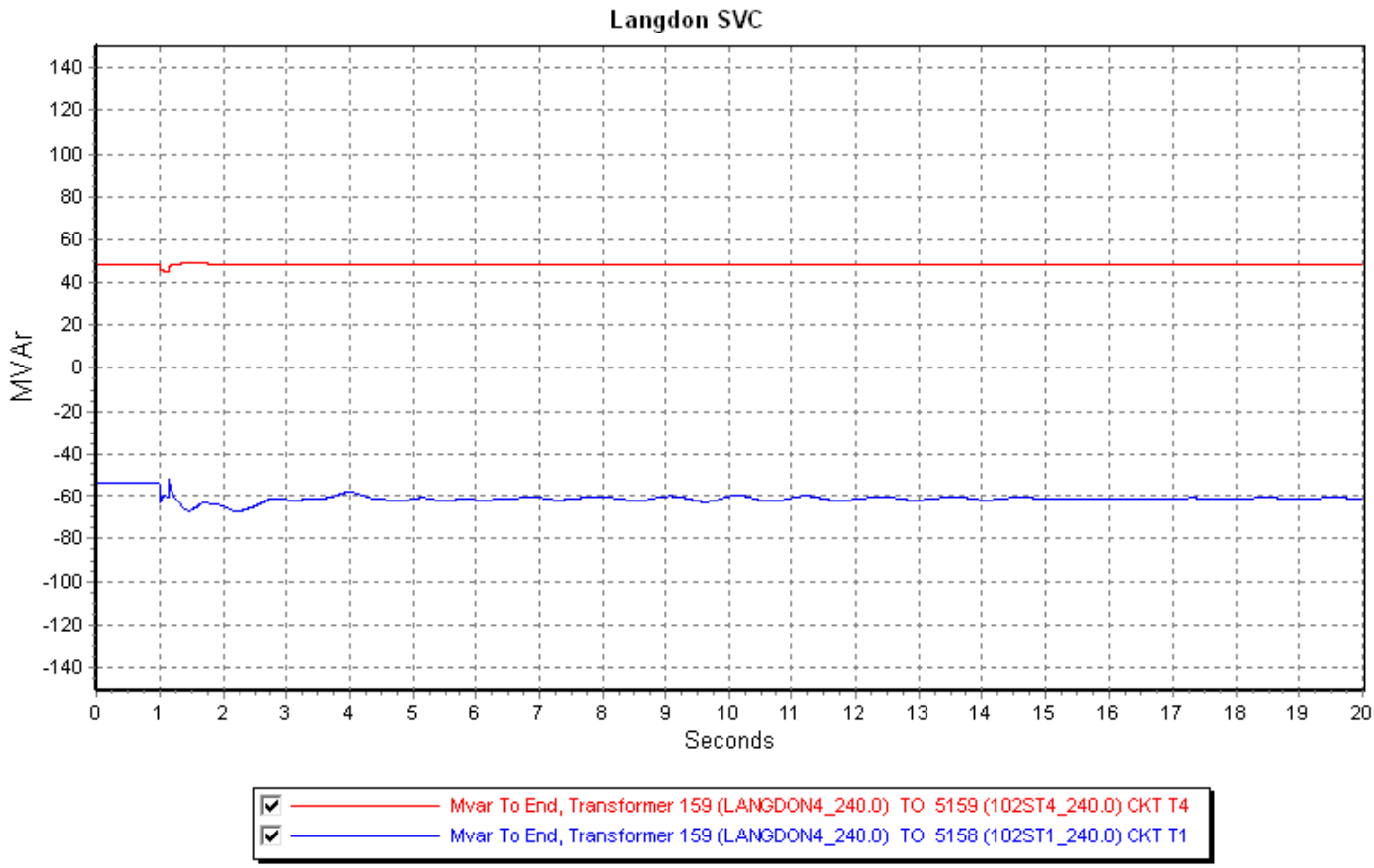


Contingency: Queenstown Plant _McGregor200s 138 kV Bus

Cavalier
Queenstown Generating Plant Output: 90MW

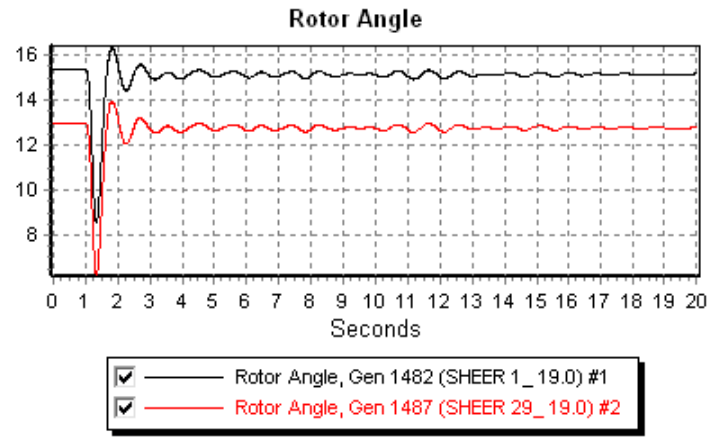
November 05, 2014 12:50:32

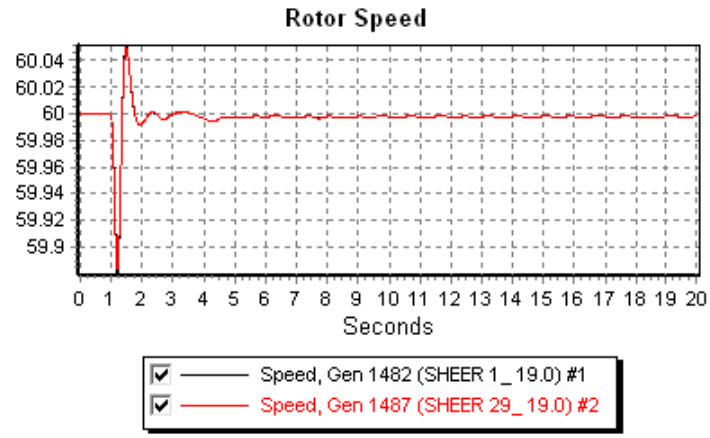
Langdon SVC

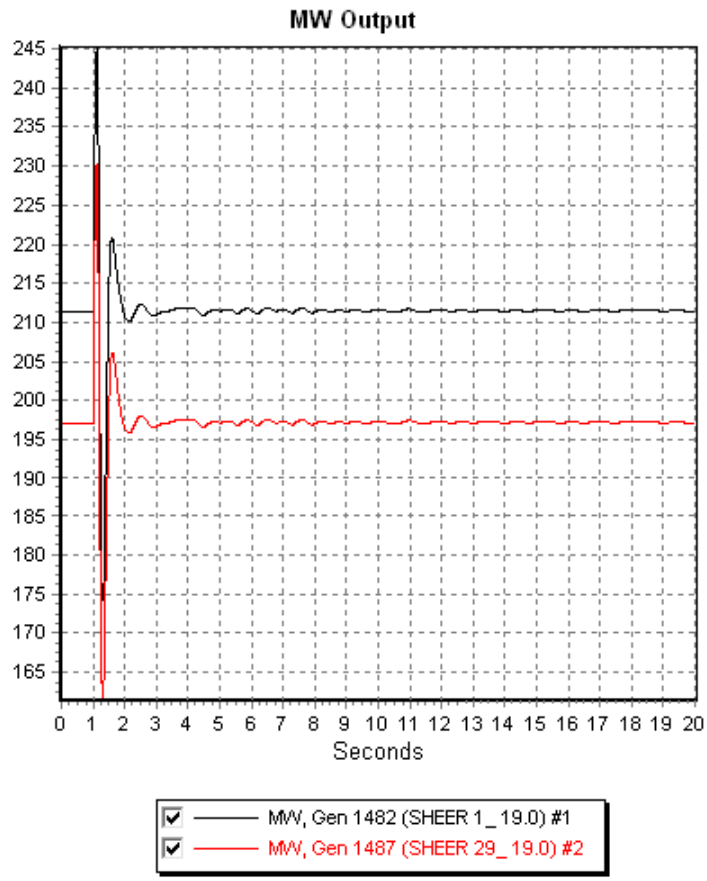


Contingency: Queenstown Plant _McGregor200s 138 kV Bus	Langdon SVC Queenstown Generating Plant Output: 90MW November 05, 2014 12:50:33

Sheerness





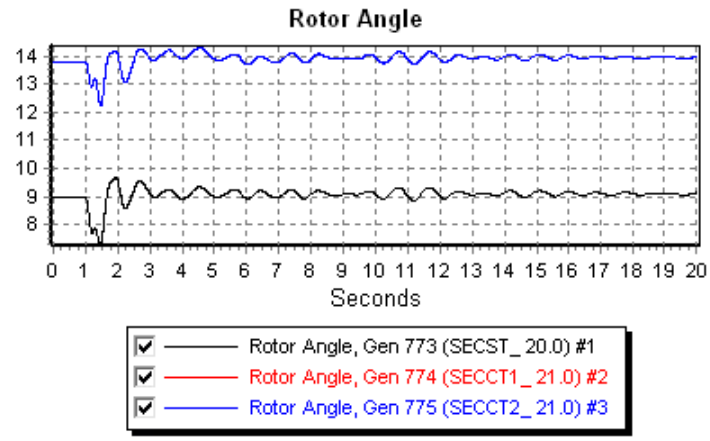


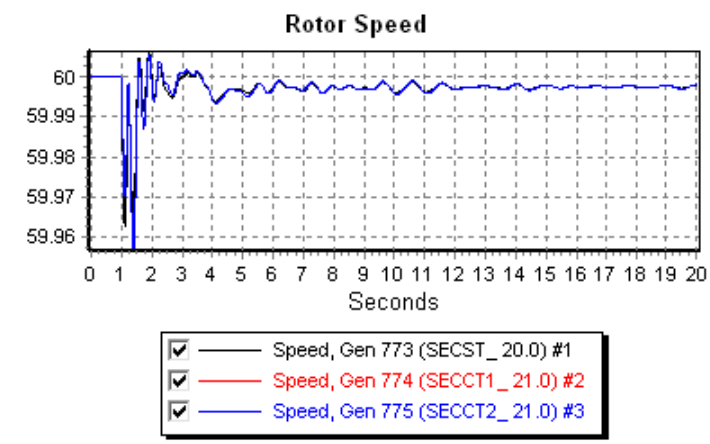
Contingency: Queenstown Plant _McGregor200s 138 kV Bus

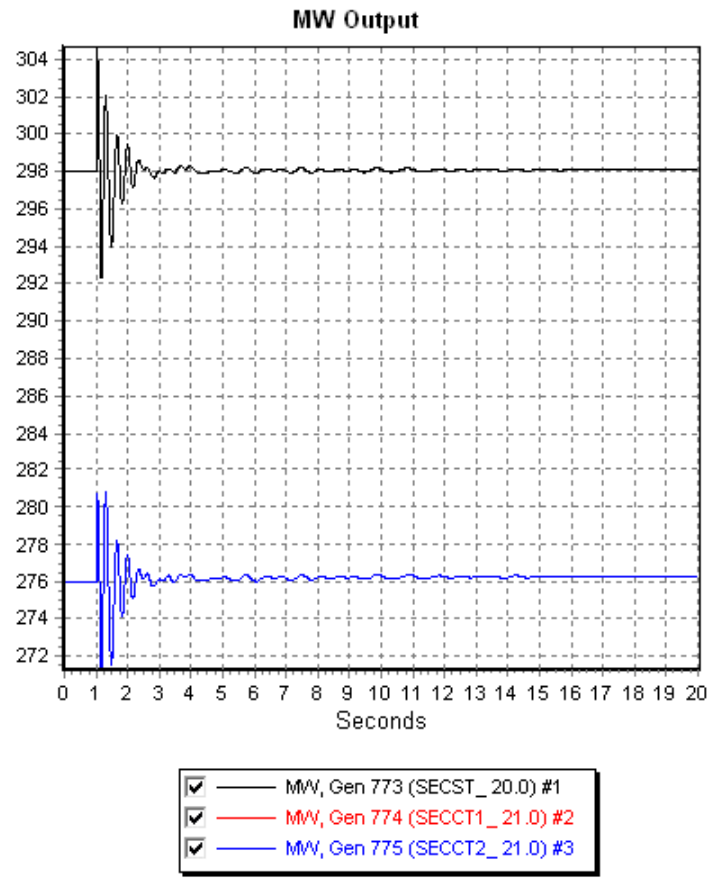
Sheerness
Queenstown Generating Plant Output: 90MW

November 05, 2014 12:50:31

Sheppard







Contingency: Queenstown Plant _McGregor200s 138 kV Bus

Sheppard
Queenstown Generating Plant Output: 90MW

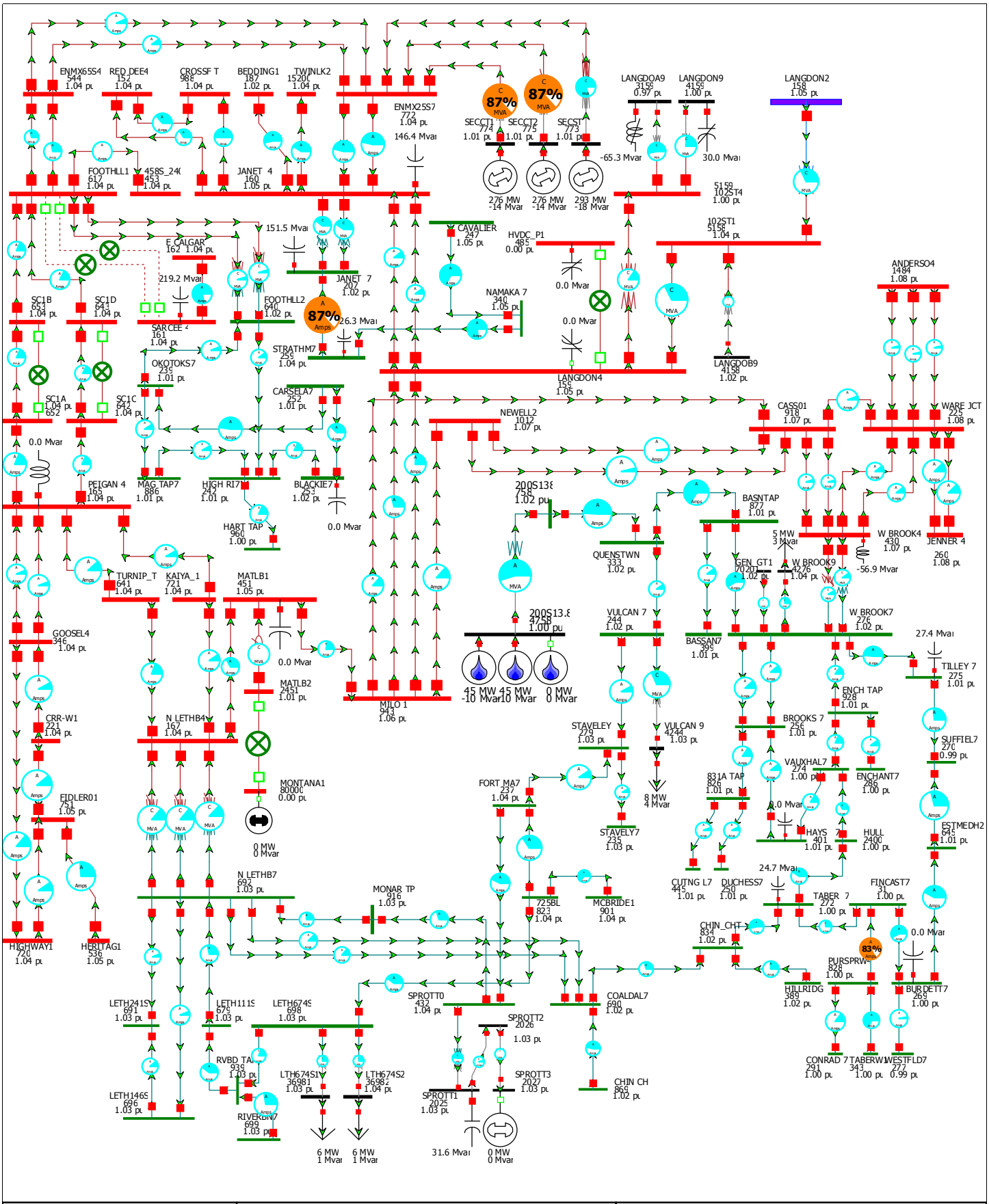
November 05, 2014 12:50:31

Attachment J

Transient Stability Analysis Results for Connection Alternative 1 after Blackie Area Upgrade

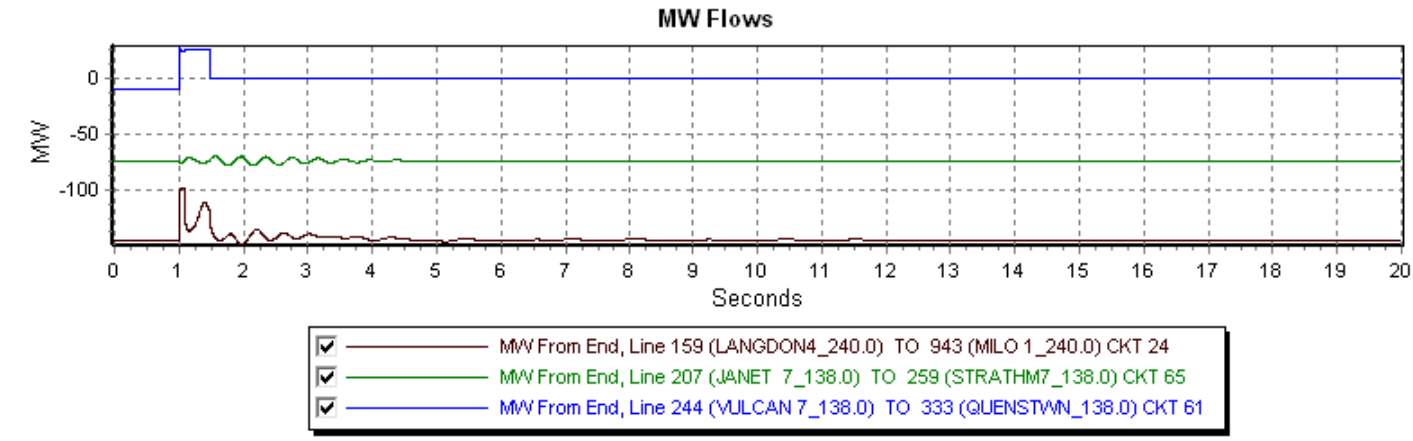
2017

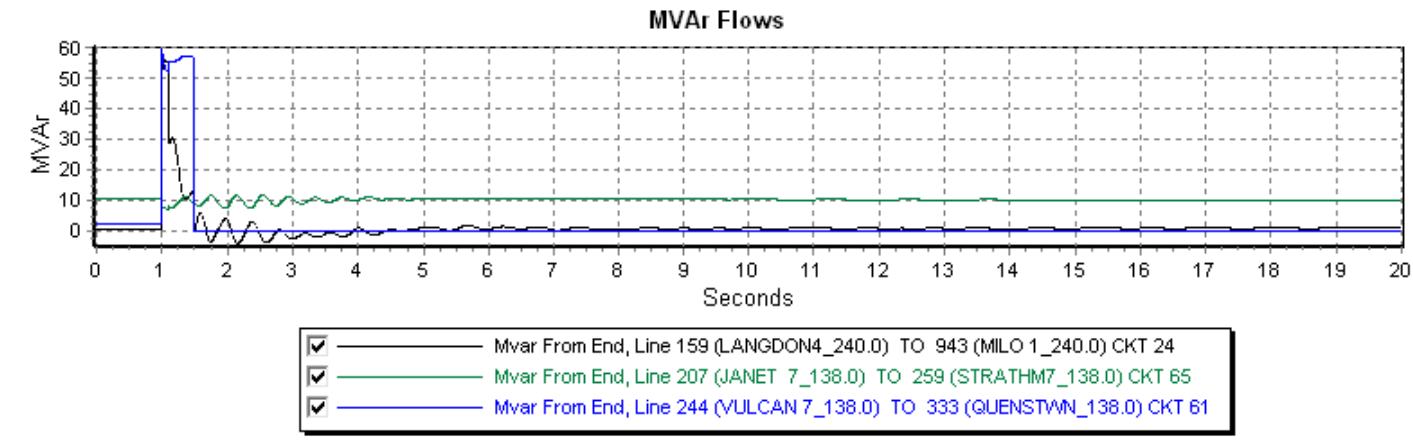
2017 SL



PowerEN Corporation D.Brankovich	Post-connection state, Alternative 1 Study Case: 2017SL	Transient Stability Initial Conditions TS-03 11/5/2014

Branch Flows



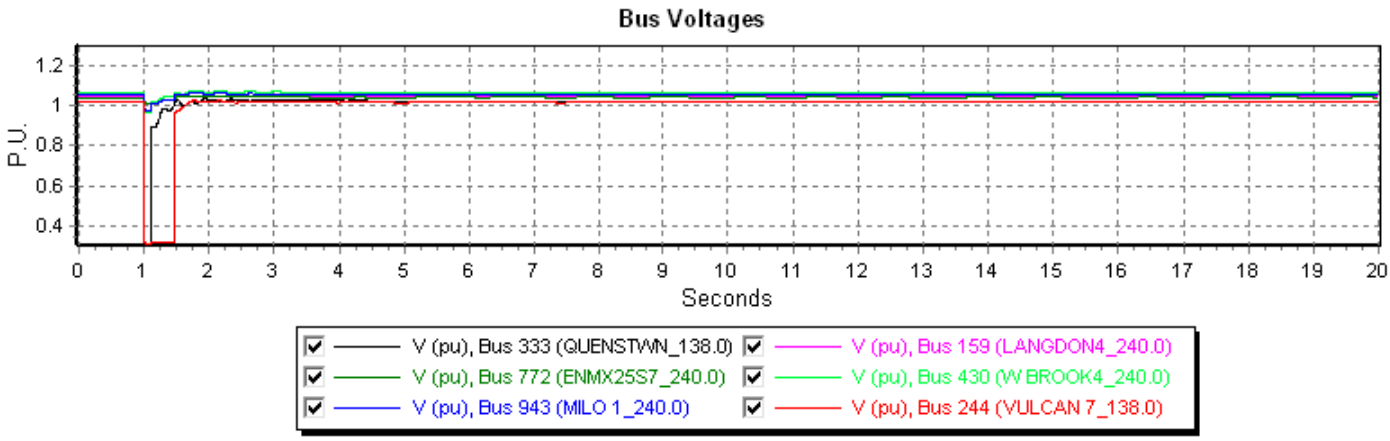


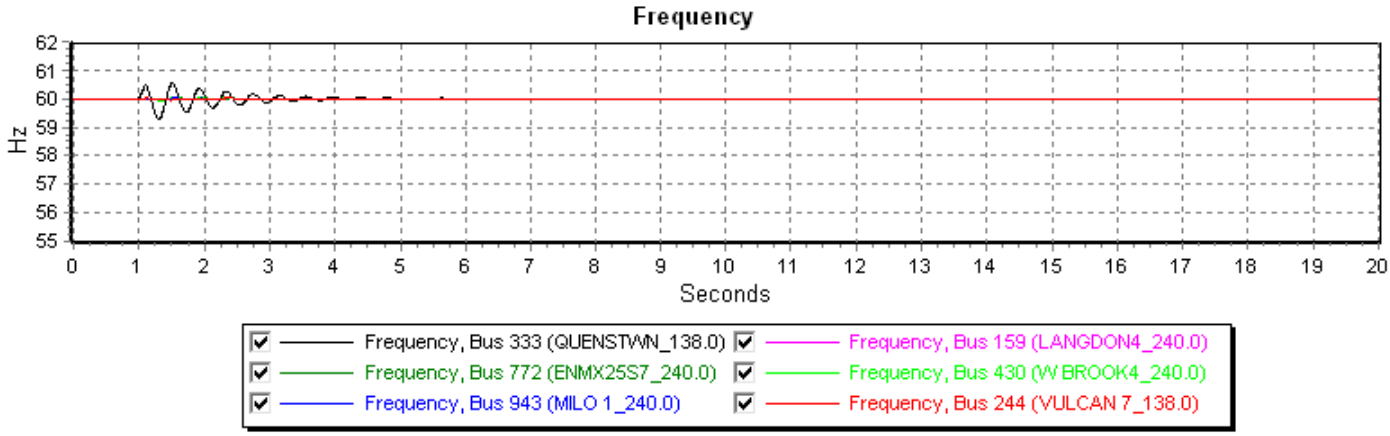
Contingency: 161L QUEENSTOWN 504S - VULCAN 255S

Branch Flows
Queenstown Generating Plant Output: 90MW

November 12, 2014 13:37:12

Bus Voltages and Frequency



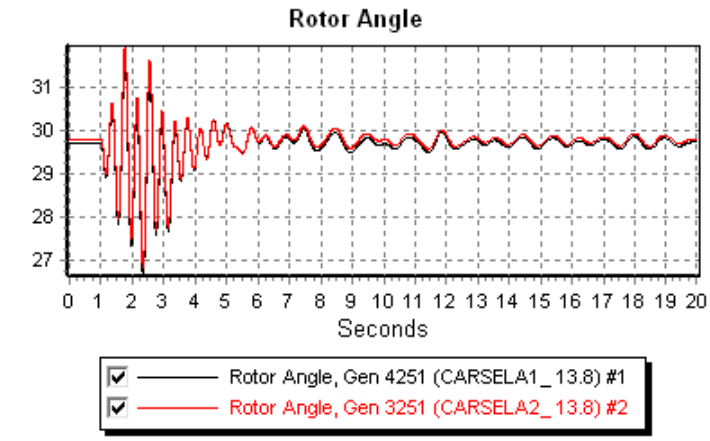


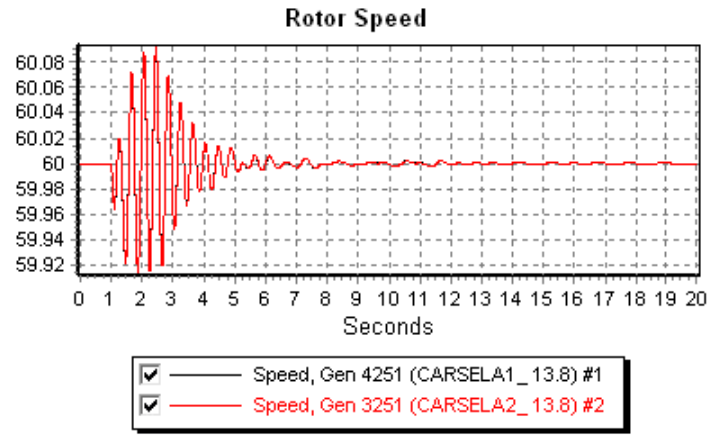
Contingency: 161L QUEENSTOWN 504S - VULCAN 255S

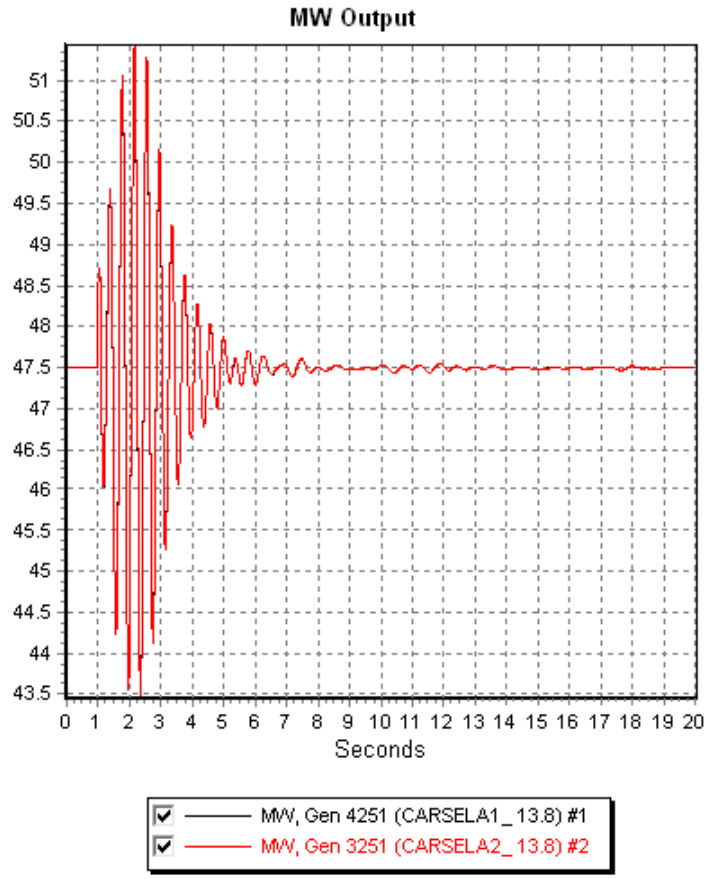
Bus Voltages and Frequency
Queenstown Generating Plant Output: 90MW

November 12, 2014 13:37:13

Carseland





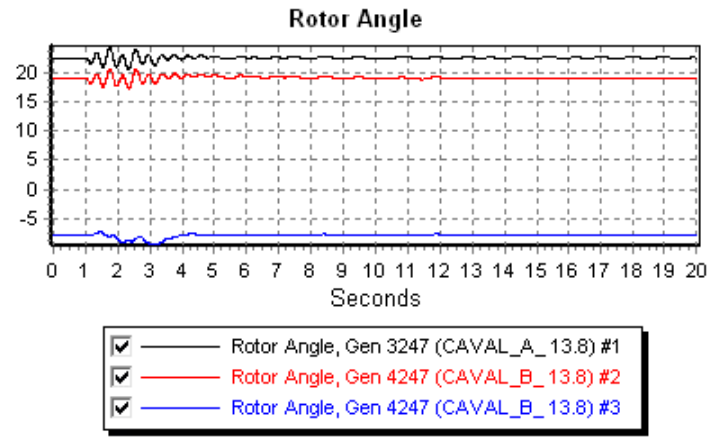


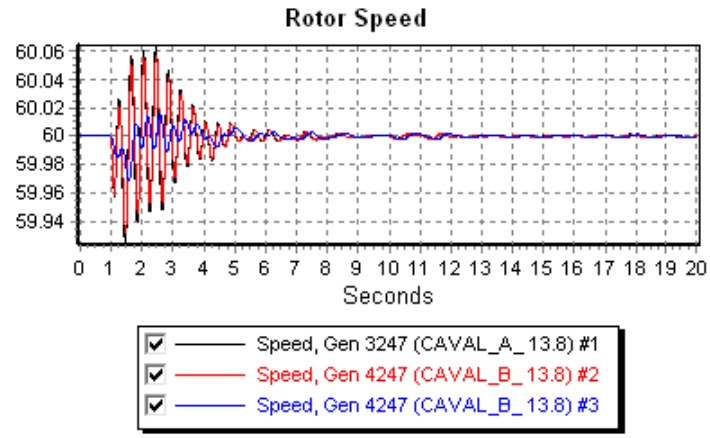
Contingency: 161L QUEENSTOWN 504S - VULCAN 255S

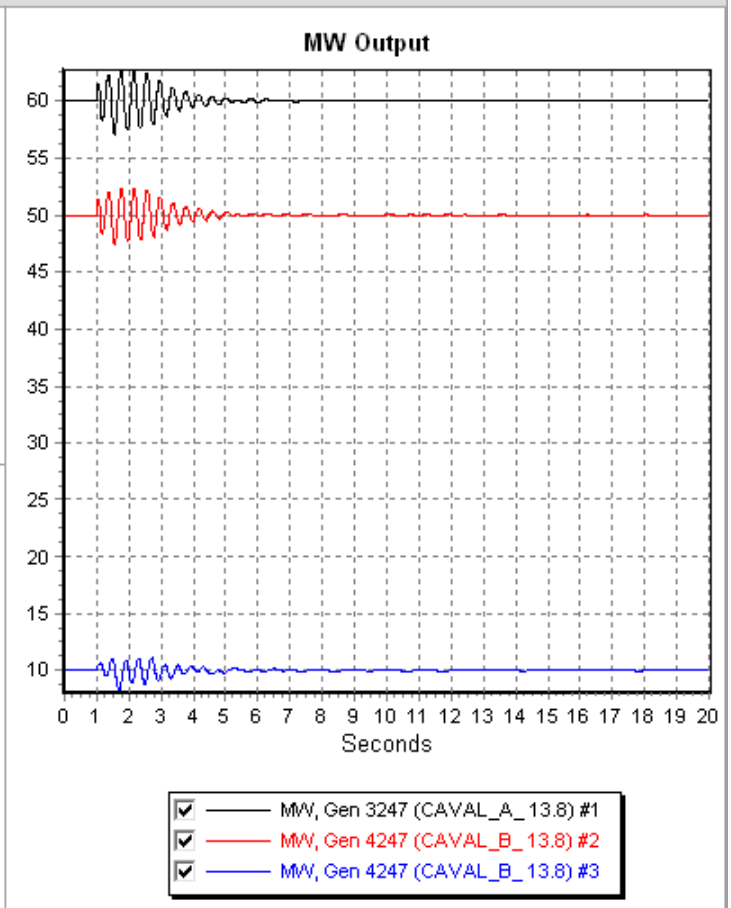
Carseland
Queenstown Generating Plant Output: 90MW

November 12, 2014 13:37:10

Cavalier





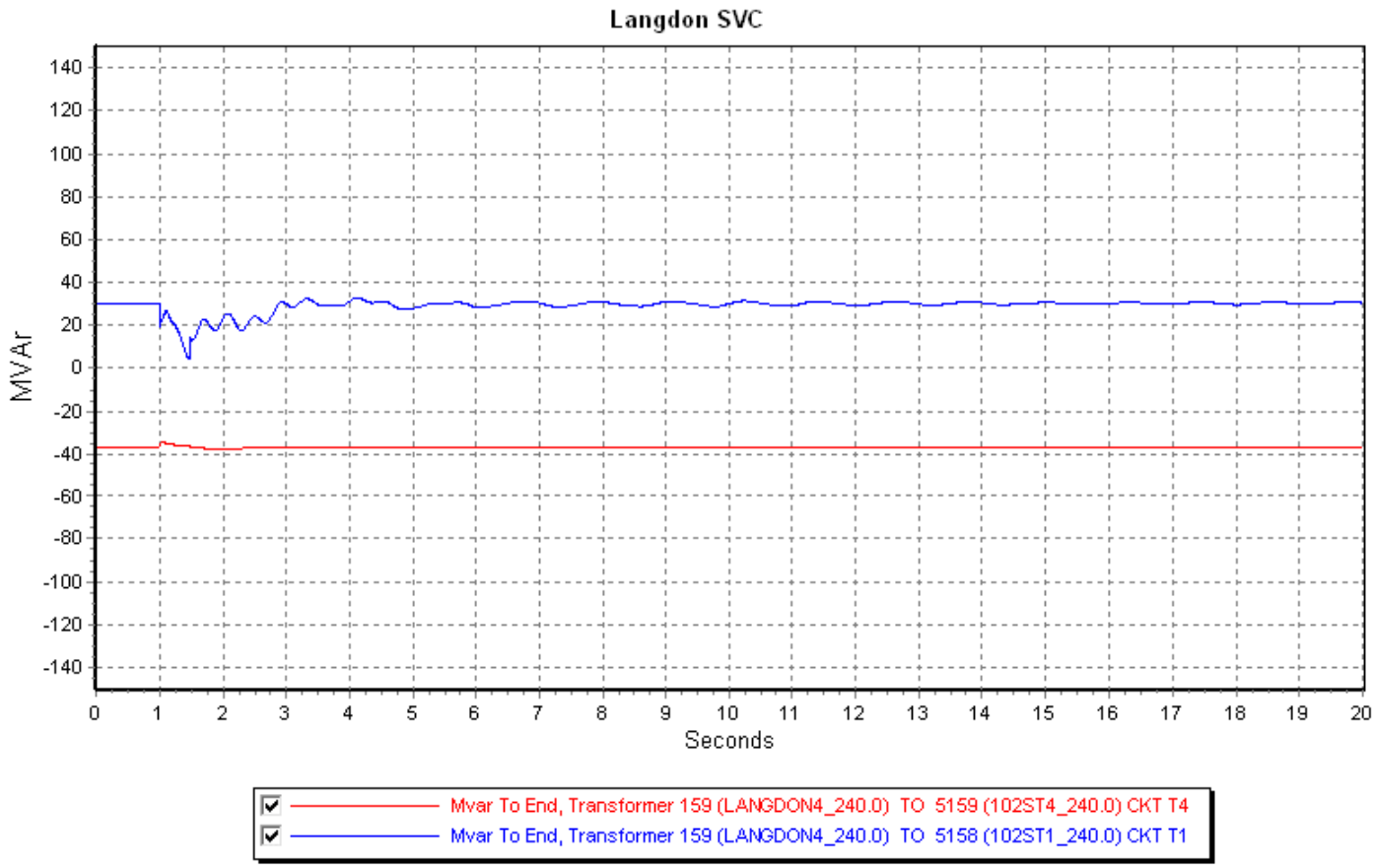


Contingency: 161L QUEENSTOWN 504S - VULCAN 255S

Cavalier
Queenstown Generating Plant Output: 90MW

November 12, 2014 13:37:12

Langdon SVC

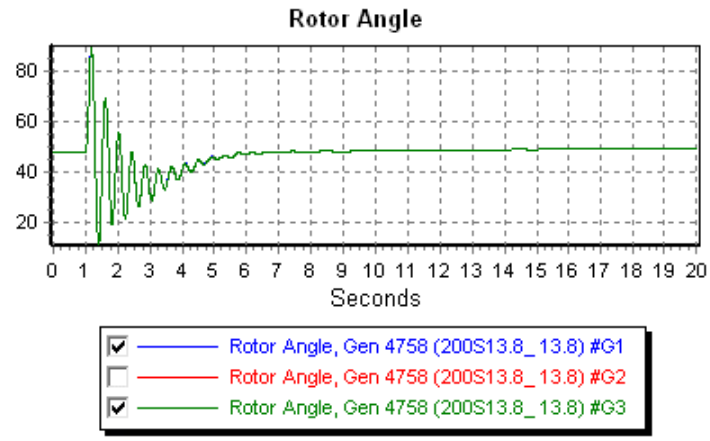


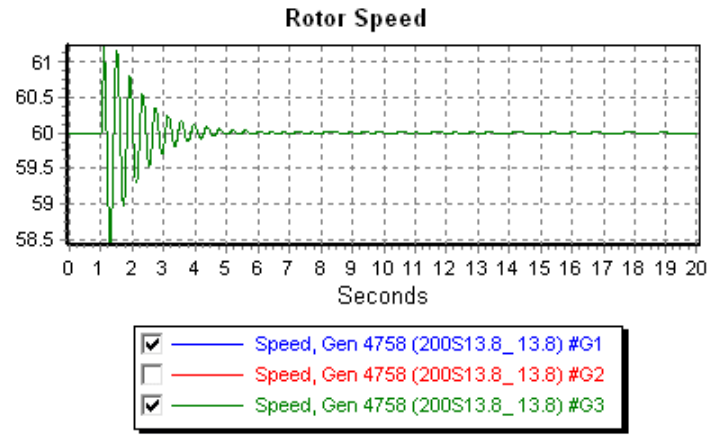
Contingency: 161L QUEENSTOWN 504S - VULCAN 255S

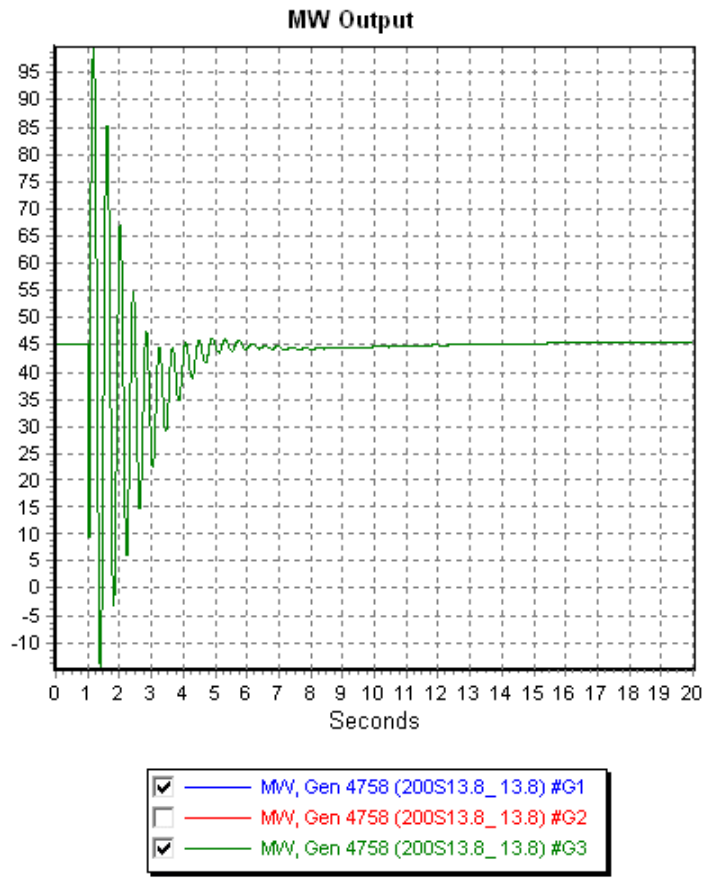
Langdon SVC
Queenstown Generating Plant Output: 90MW

November 12, 2014 13:37:13

Queenstown Gen





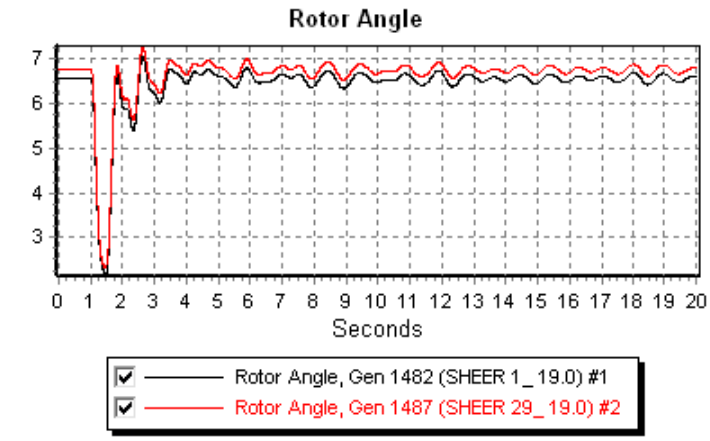


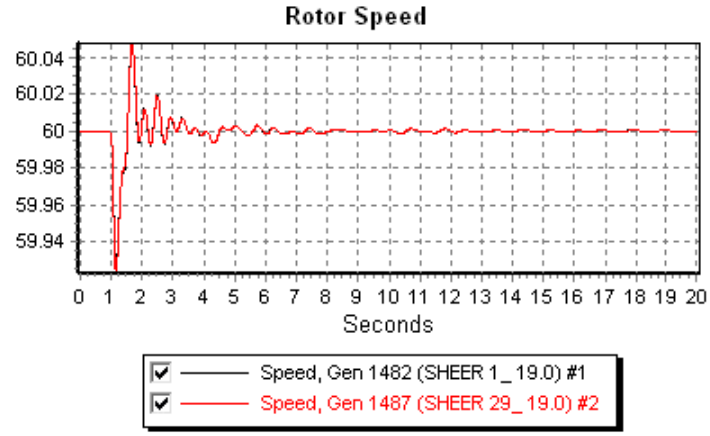
Contingency: 161L QUEENSTOWN 504S - VULCAN 255S

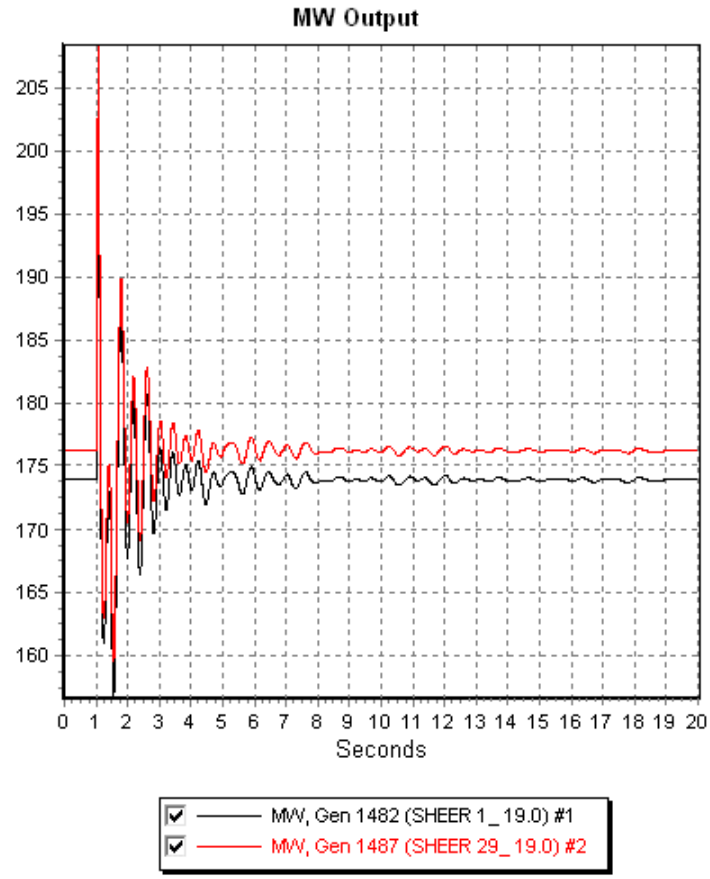
P1336
Queenstown Generating Plant
Output: 90MW

November 12, 2014 13:37:11

Sheerness





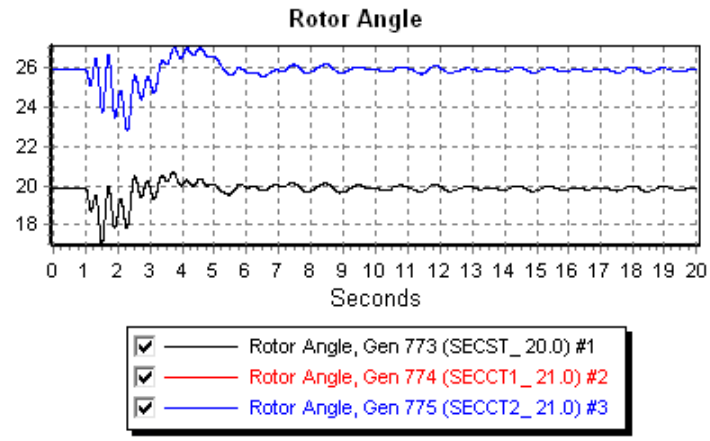


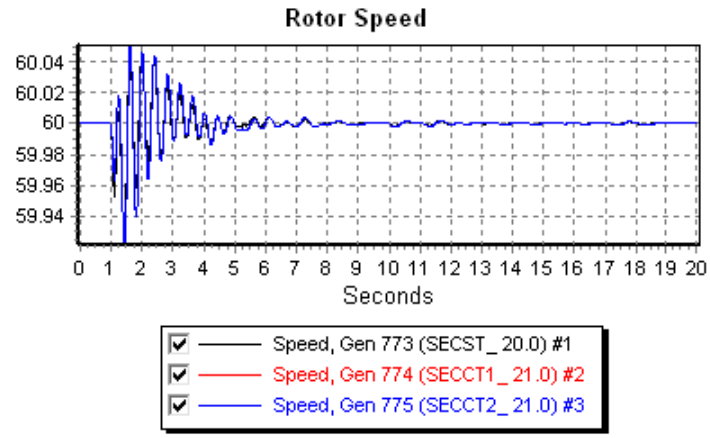
Contingency: 161L QUEENSTOWN 504S - VULCAN 255S

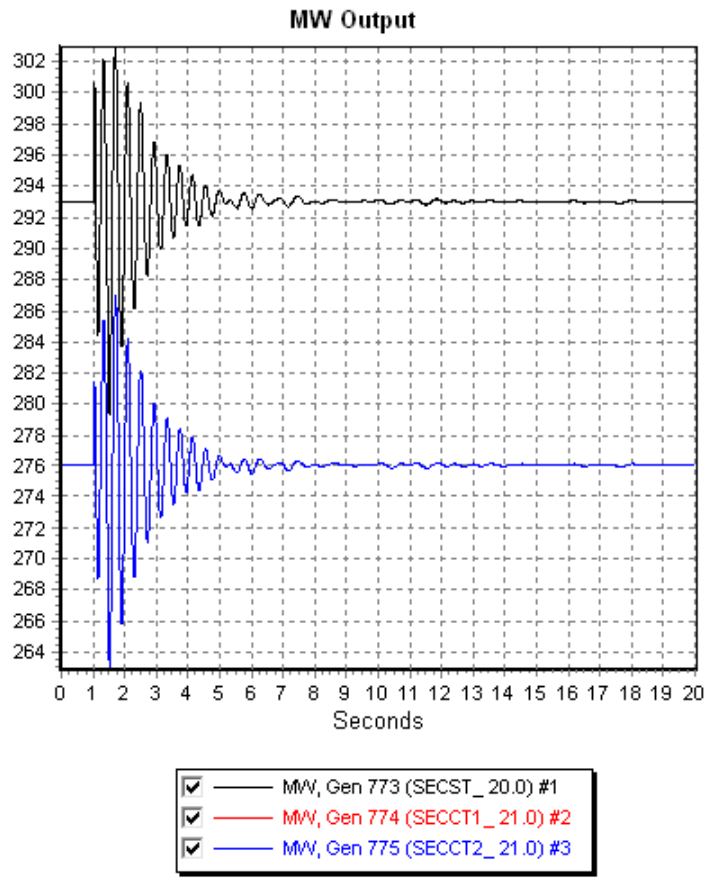
Sheerness
Queenstown Generating Plant Output: 90MW

November 12, 2014 13:37:09

Sheppard





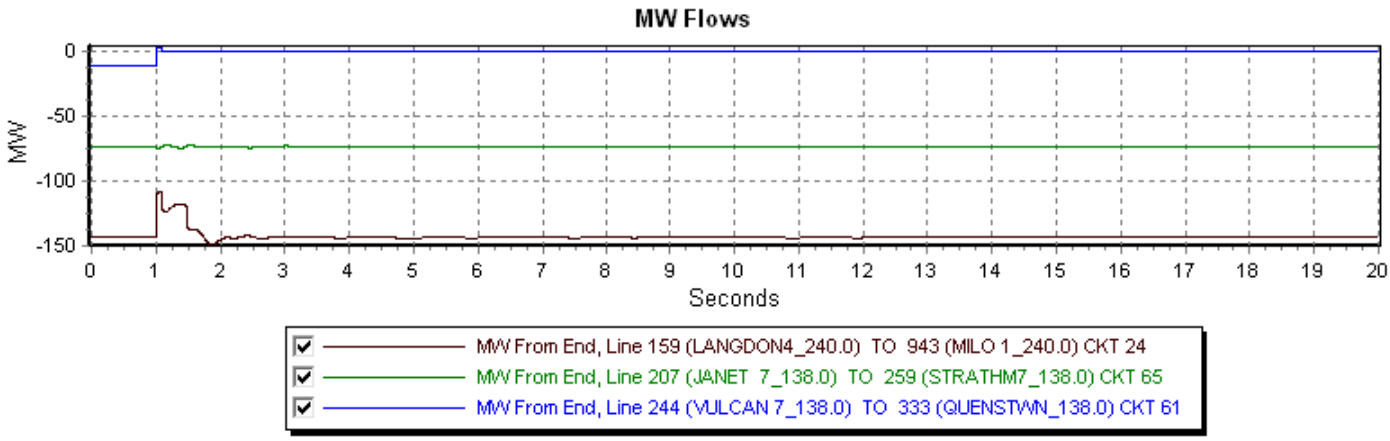


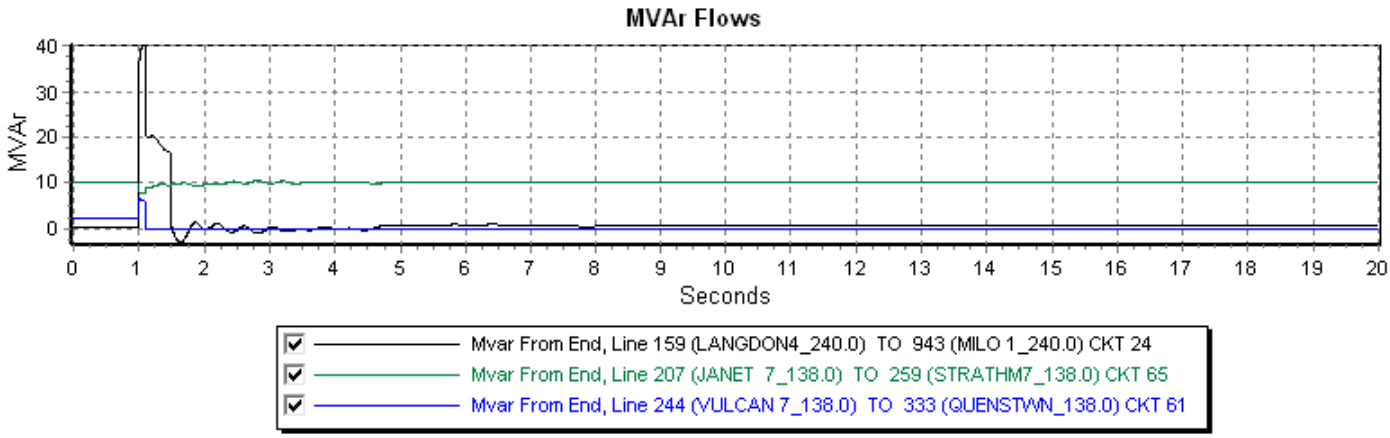
Contingency: 161L QUEENSTOWN 504S - VULCAN 255S

Sheppard
Queenstown Generating Plant Output: 90MW

November 12, 2014 13:37:11

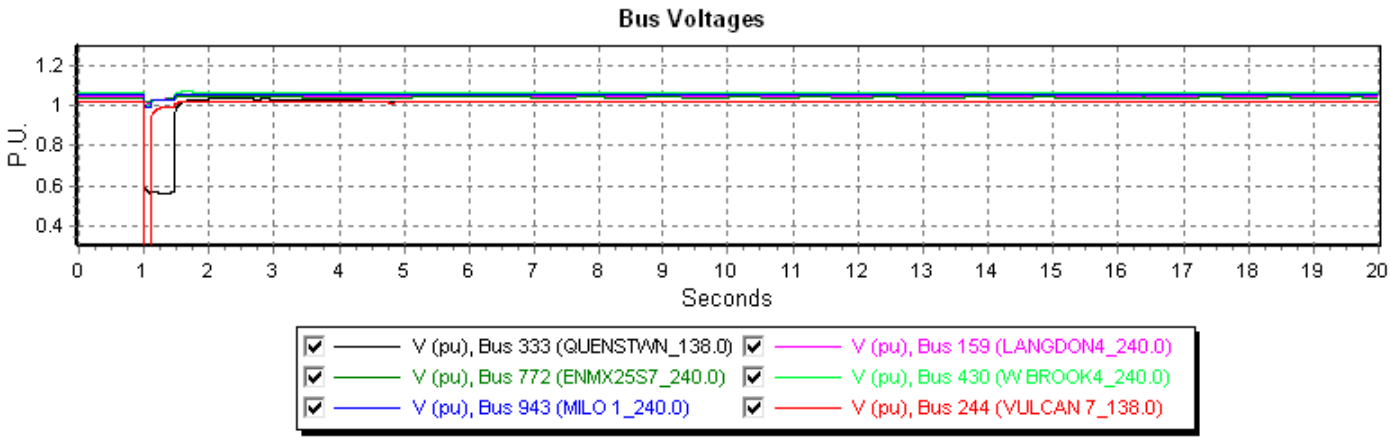
Branch Flows

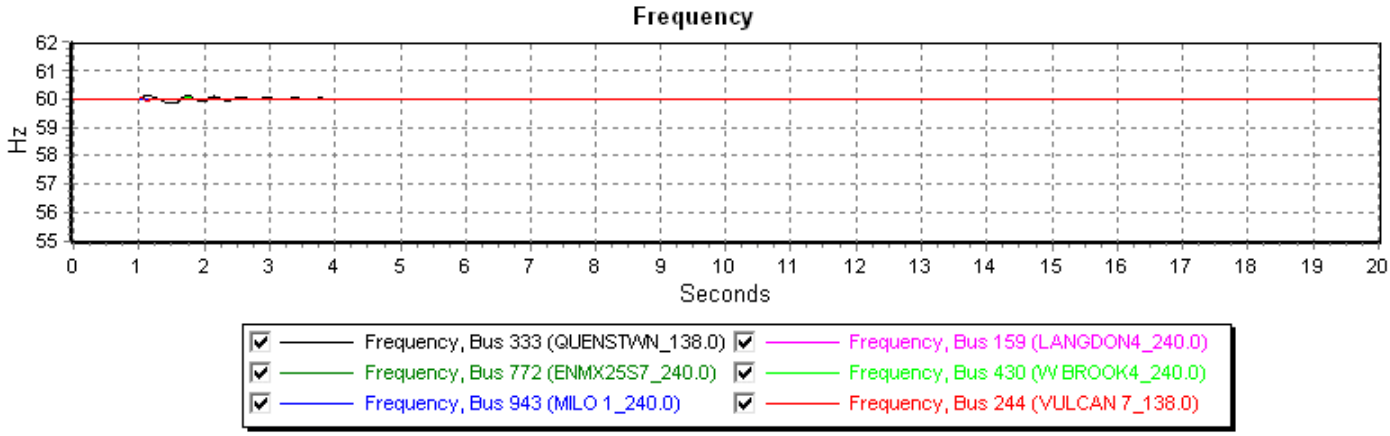




	Contingency: 161L VULCAN 255S - QUEENSTOWN 504S	Branch Flows Queenstown Generating Plant Output: 90MW November 12, 2014 13:37:53

Bus Voltages and Frequency



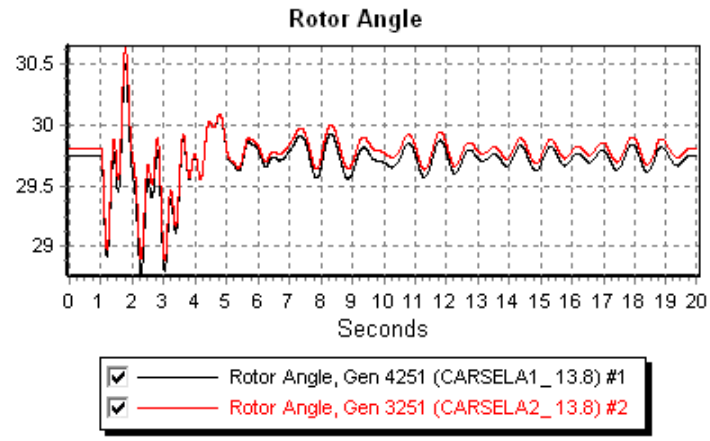


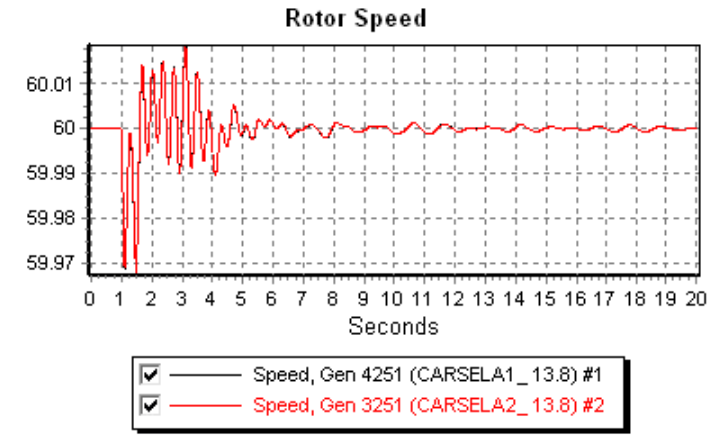
Contingency: 161L VULCAN 255S - QUEENSTOWN 504S

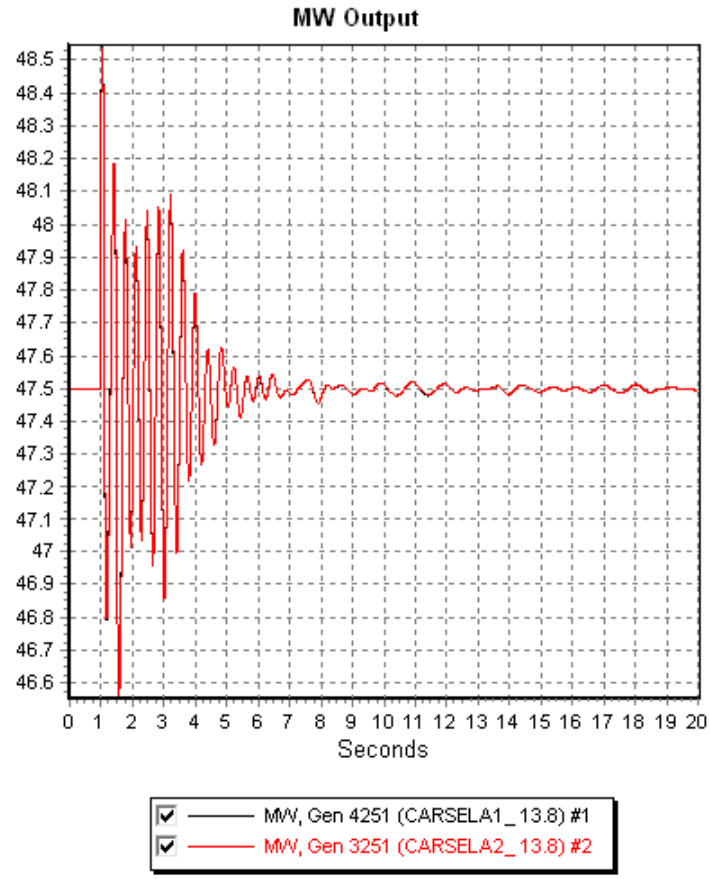
Bus Voltages and Frequency
Queenstown Generating Plant Output: 90MW

November 12, 2014 13:37:54

Carseland





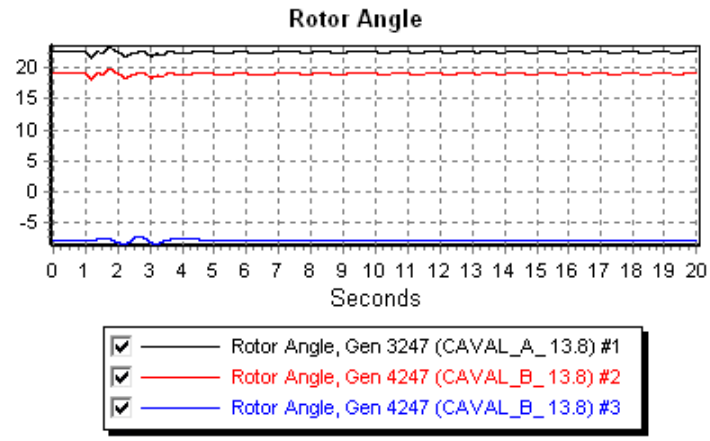


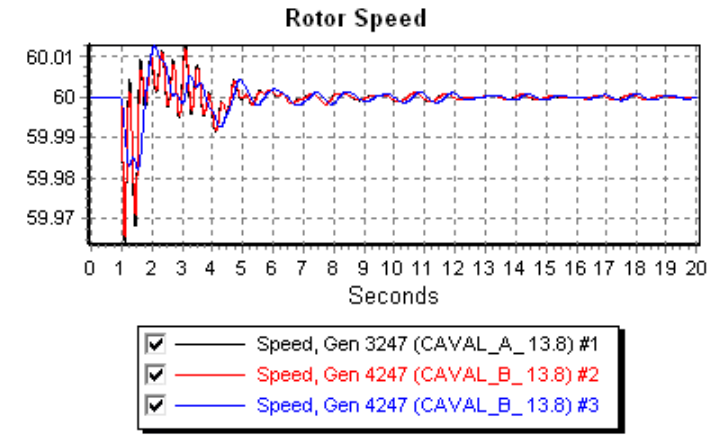
Contingency: 161L VULCAN 255S - QUEENSTOWN 504S

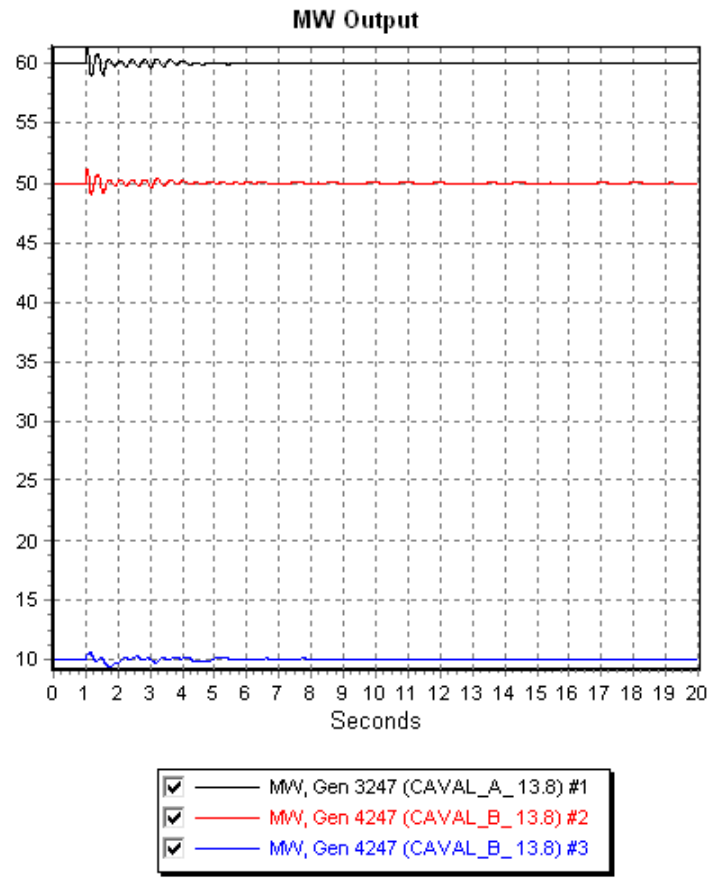
Carseland
Queenstown Generating Plant Output: 90MW

November 12, 2014 13:37:51

Cavalier





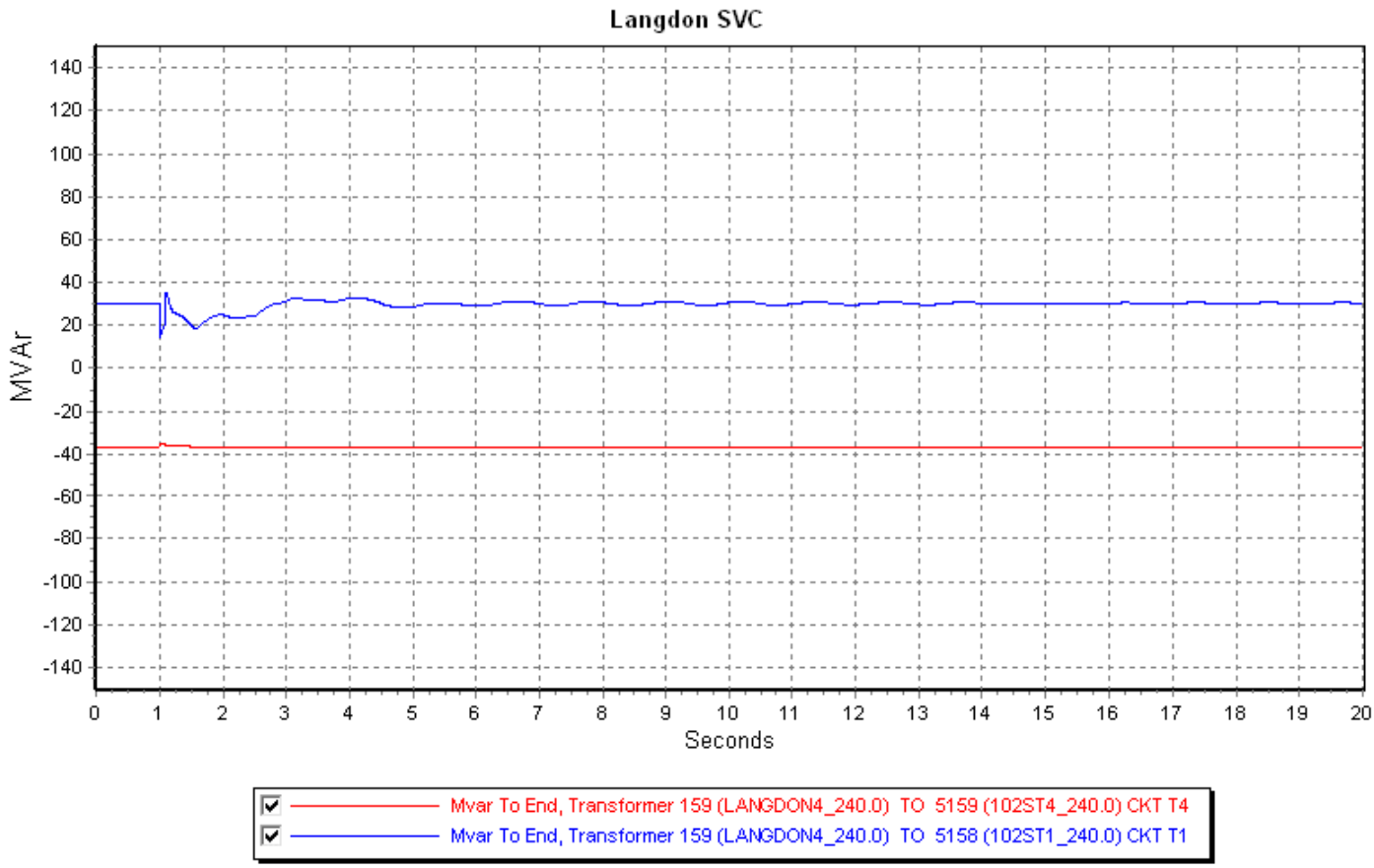


Contingency: 161L VULCAN 255S - QUEENSTOWN 504S

Cavalier
Queenstown Generating Plant Output: 90MW

November 12, 2014 13:37:53

Langdon SVC

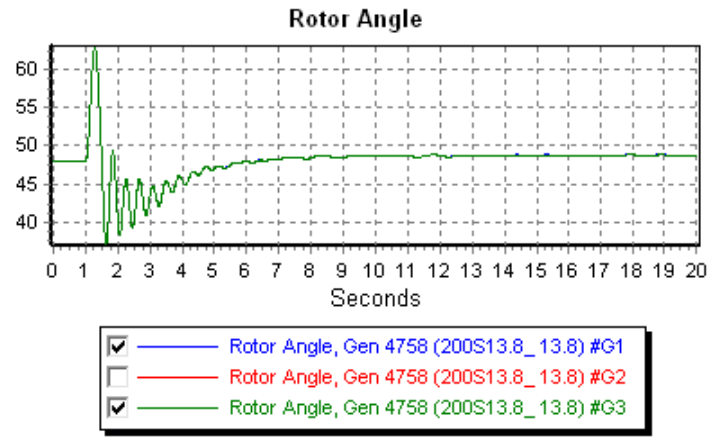


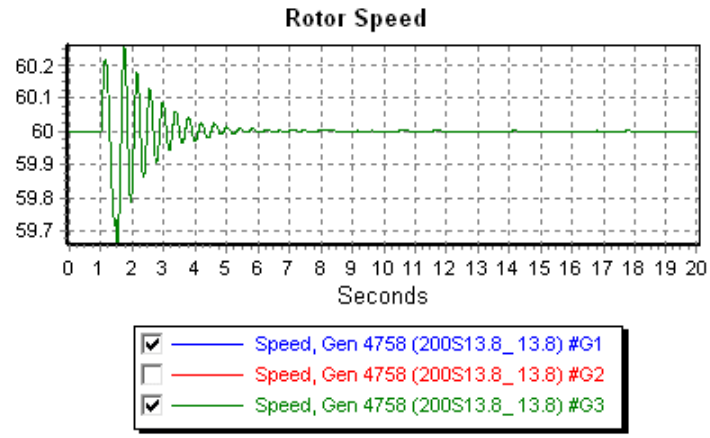
Contingency: 161L VULCAN 255S - QUEENSTOWN 504S

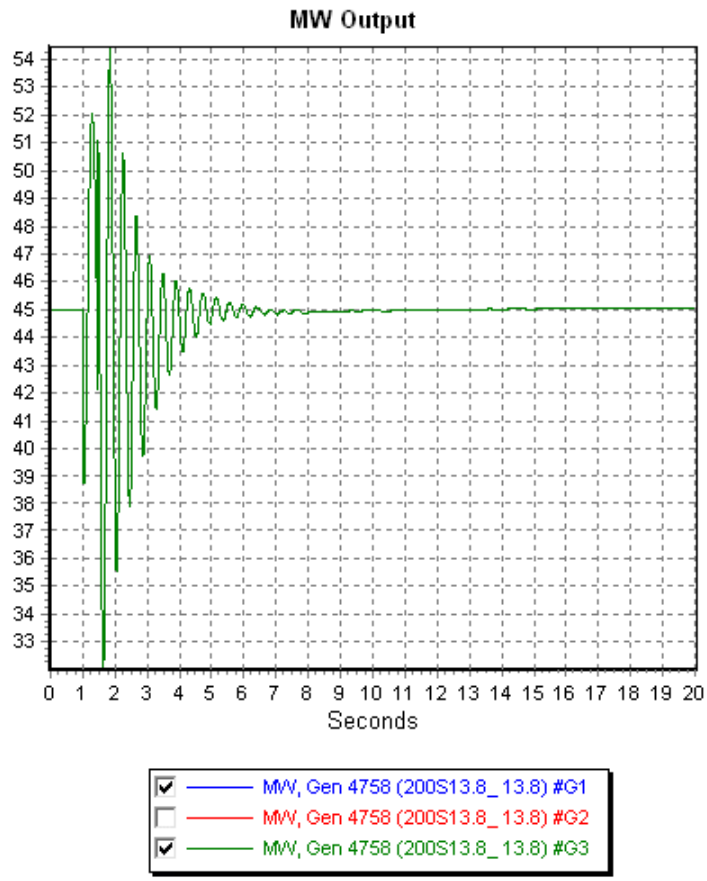
Langdon SVC
Queenstown Generating Plant Output: 90MW

November 12, 2014 13:37:55

Queenstown Gen





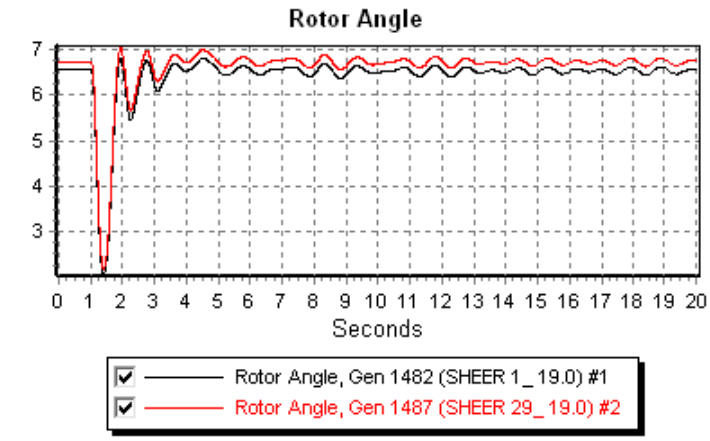


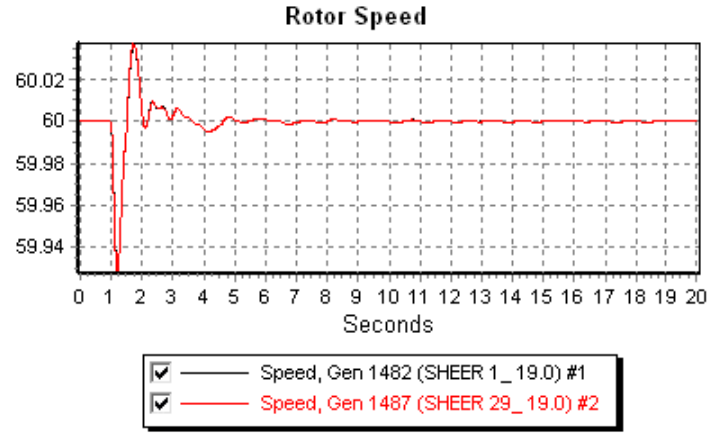
Contingency: 161L VULCAN 255S - QUEENSTOWN 504S

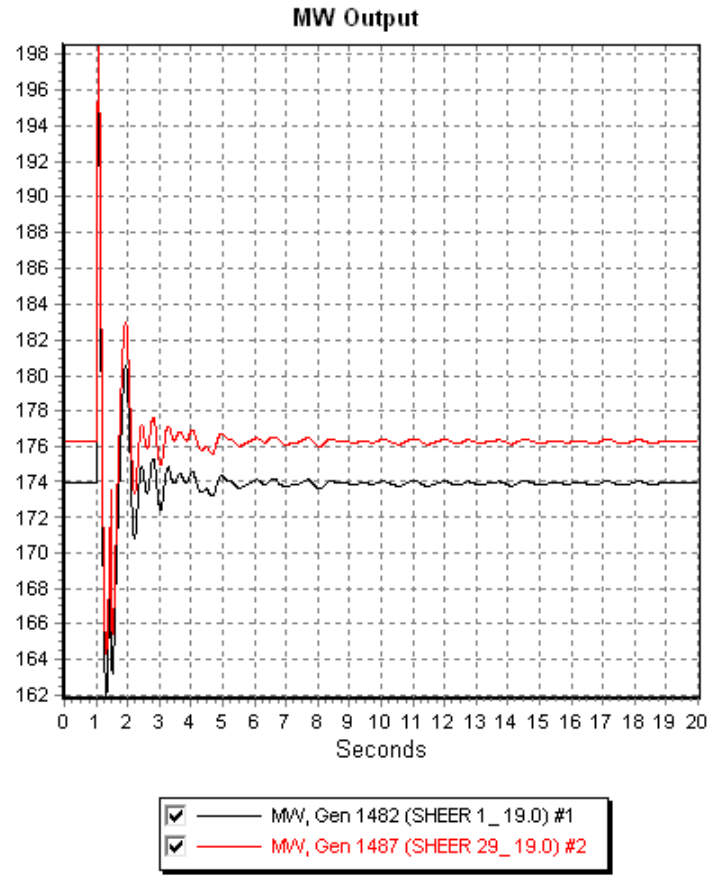
P1336
Queenstown Generating Plant
Output: 90MW

November 12, 2014 13:37:52

Sheerness





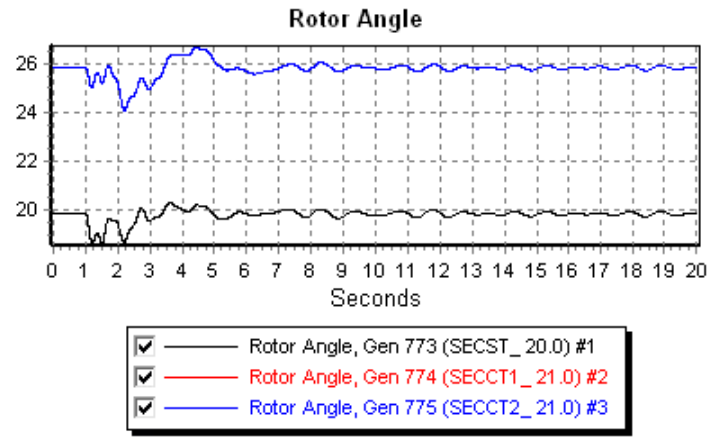


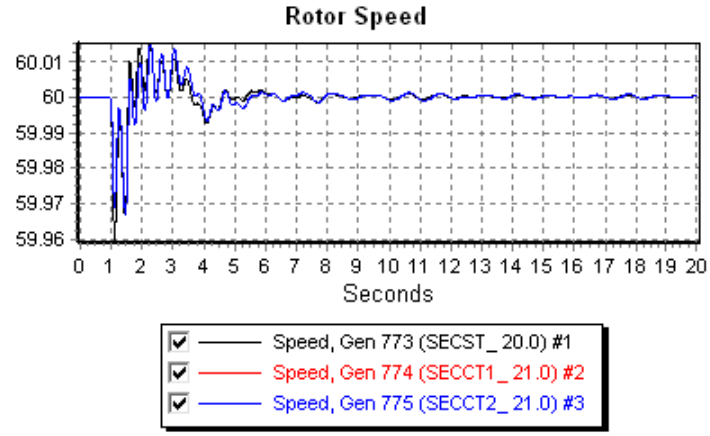
Contingency: 161L VULCAN 255S - QUEENSTOWN 504S

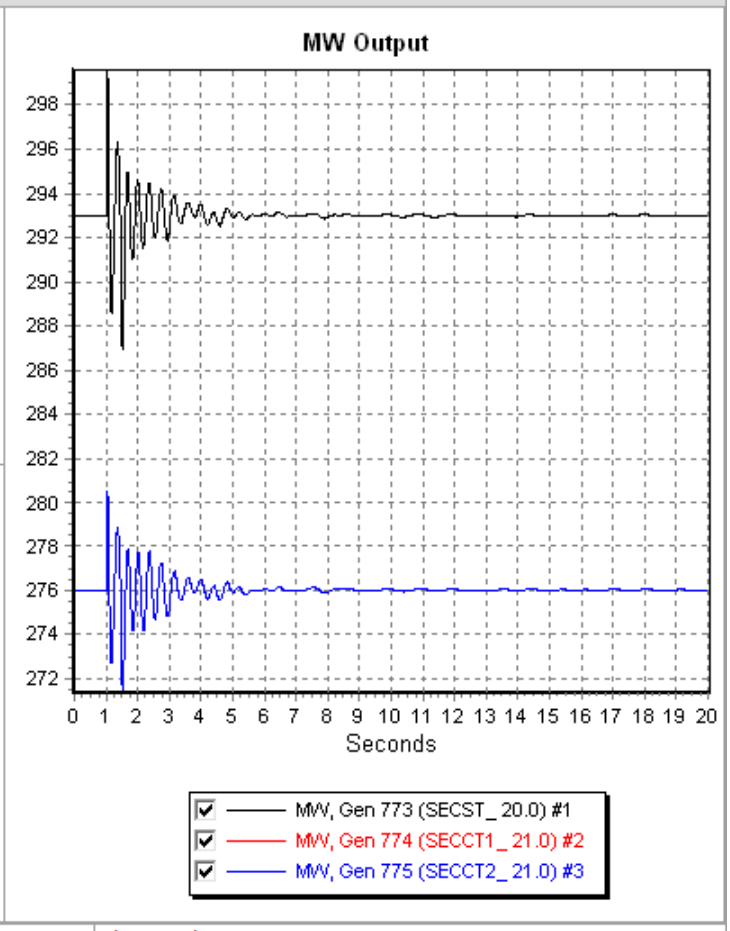
Sheerness
Queenstown Generating Plant Output: 90MW

November 12, 2014 13:37:51

Sheppard





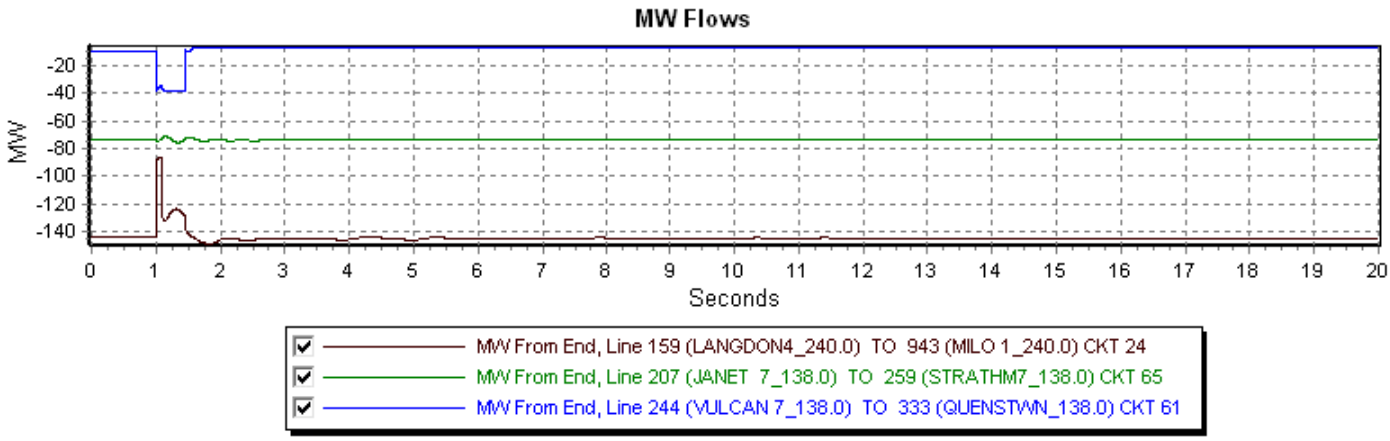


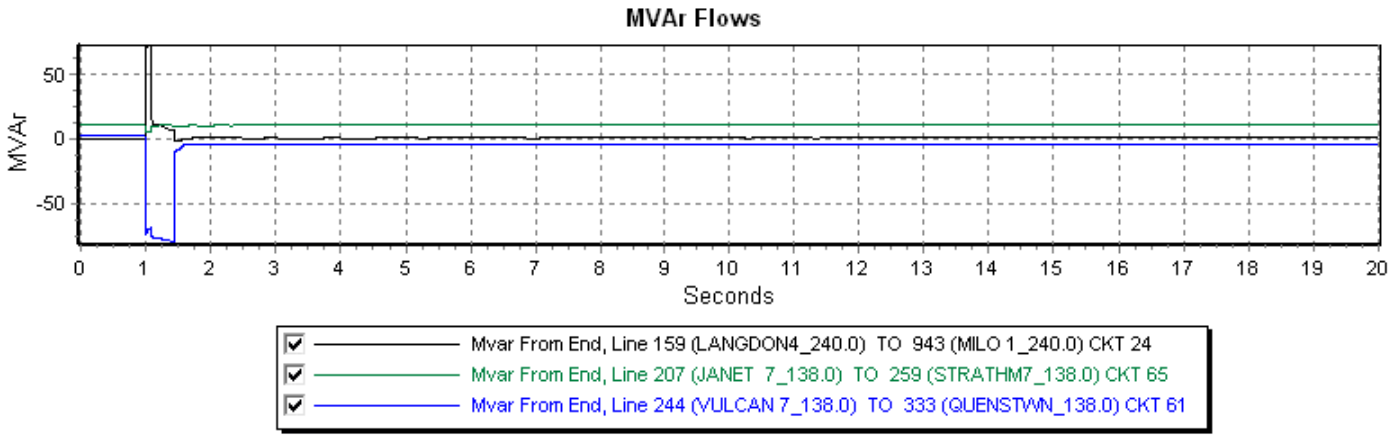
Contingency: 161L VULCAN 255S - QUEENSTOWN 504S

Sheppard
Queenstown Generating Plant Output: 90MW

November 12, 2014 13:37:52

Branch Flows



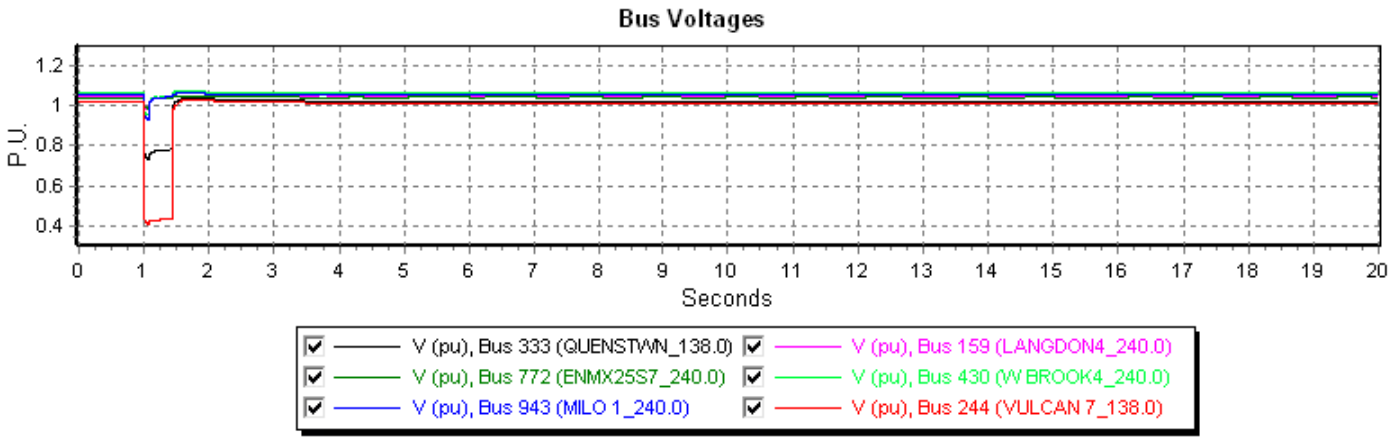


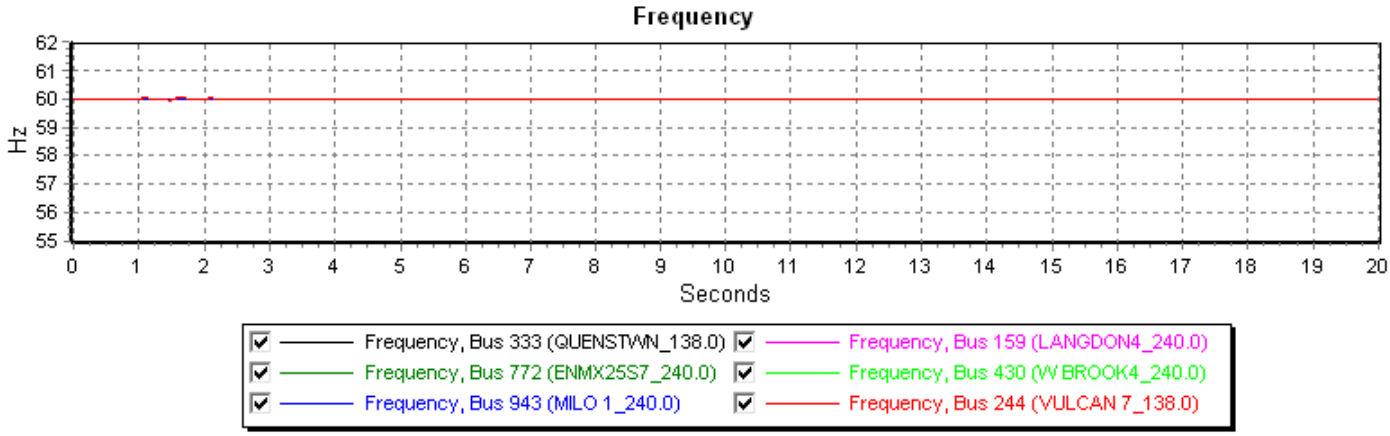
Contingency: 180L Ft.McLeod 15S to Vulcan 255S

Branch Flows
Queenstown Generating Plant Output: 90MW

November 12, 2014 13:38:36

Bus Voltages and Frequency



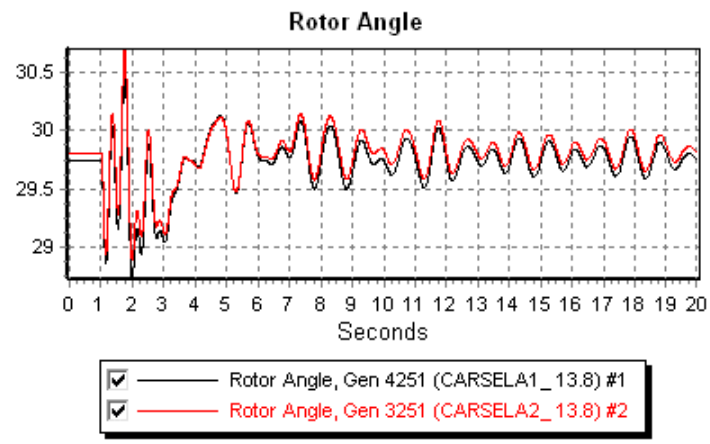


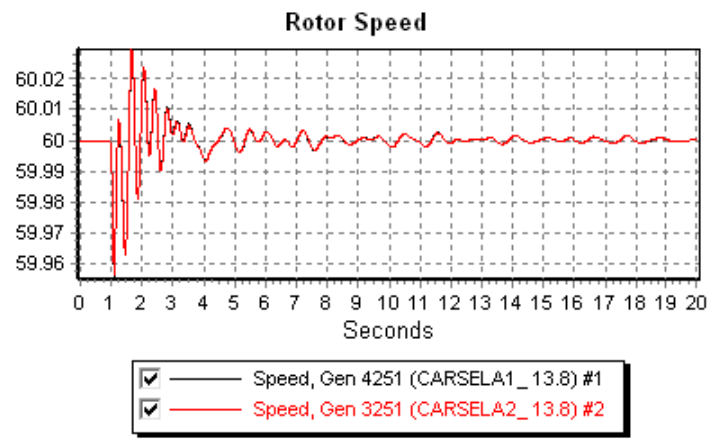
Contingency: 180L Ft.McLeod 15S to Vulcan 255S

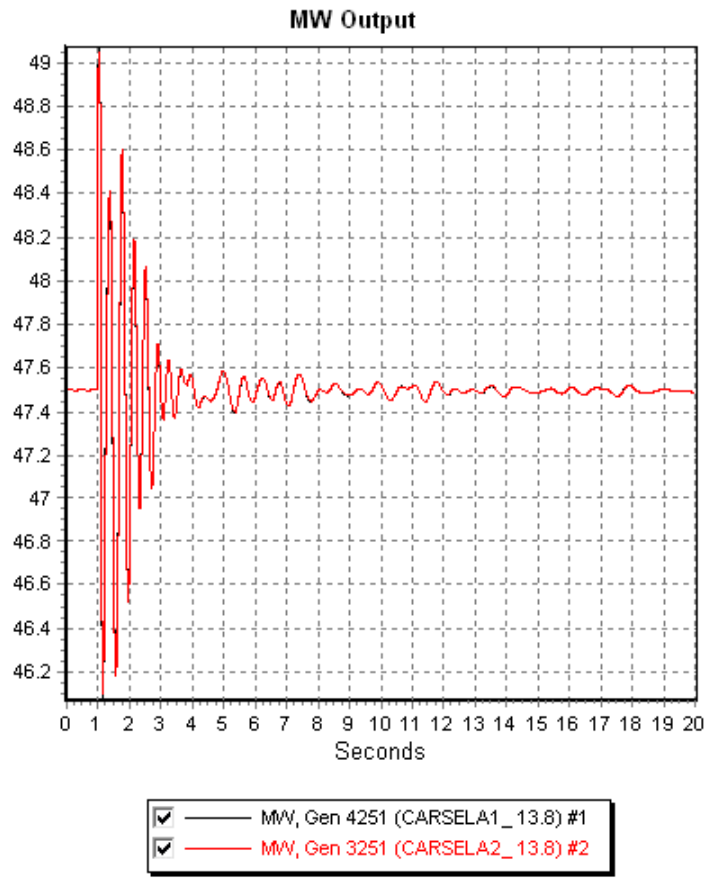
Bus Voltages and Frequency
Queenstown Generating Plant Output: 90MW

November 12, 2014 13:38:37

Carseland





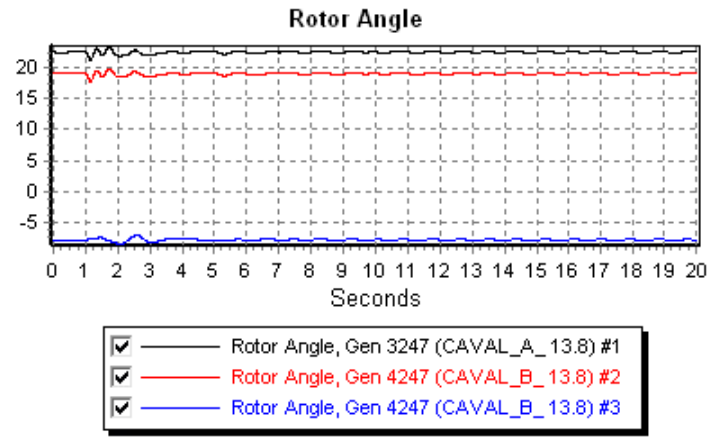


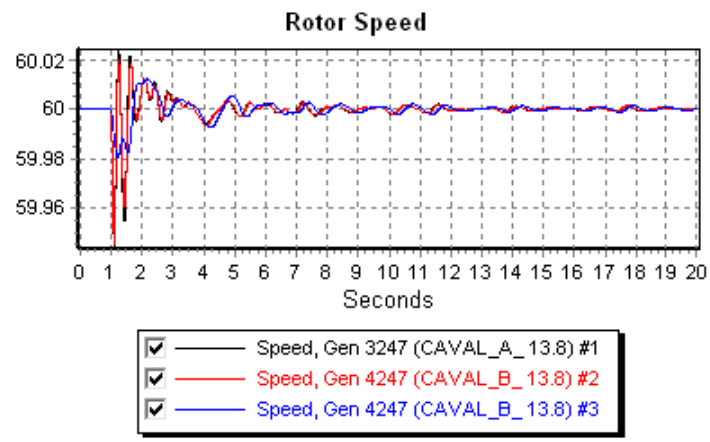
Contingency: 180L Ft.McLeod 15S to Vulcan 255S

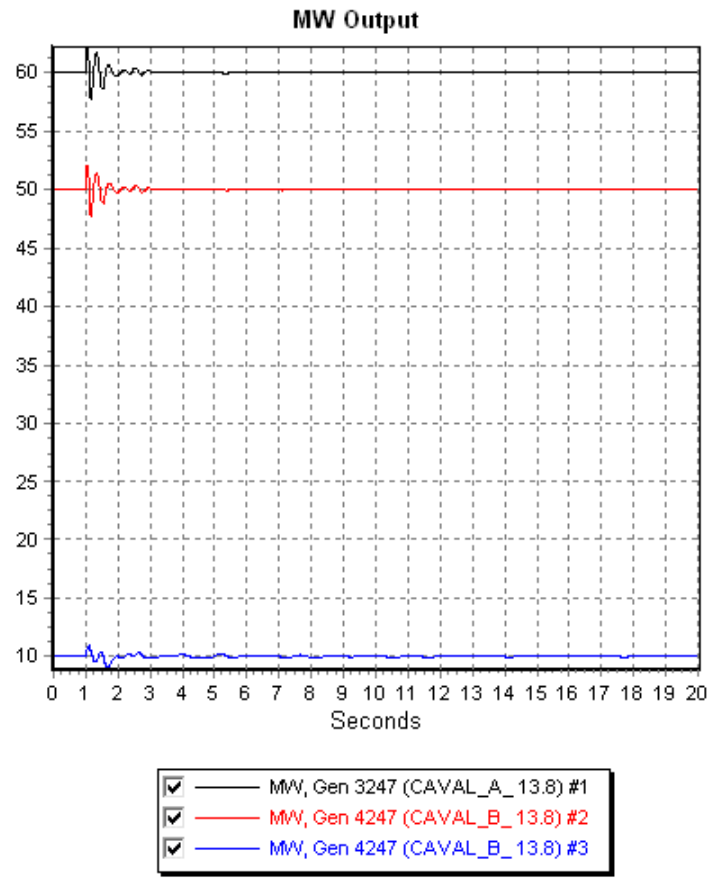
Carseland
Queenstown Generating Plant Output: 90MW

November 12, 2014 13:38:34

Cavalier





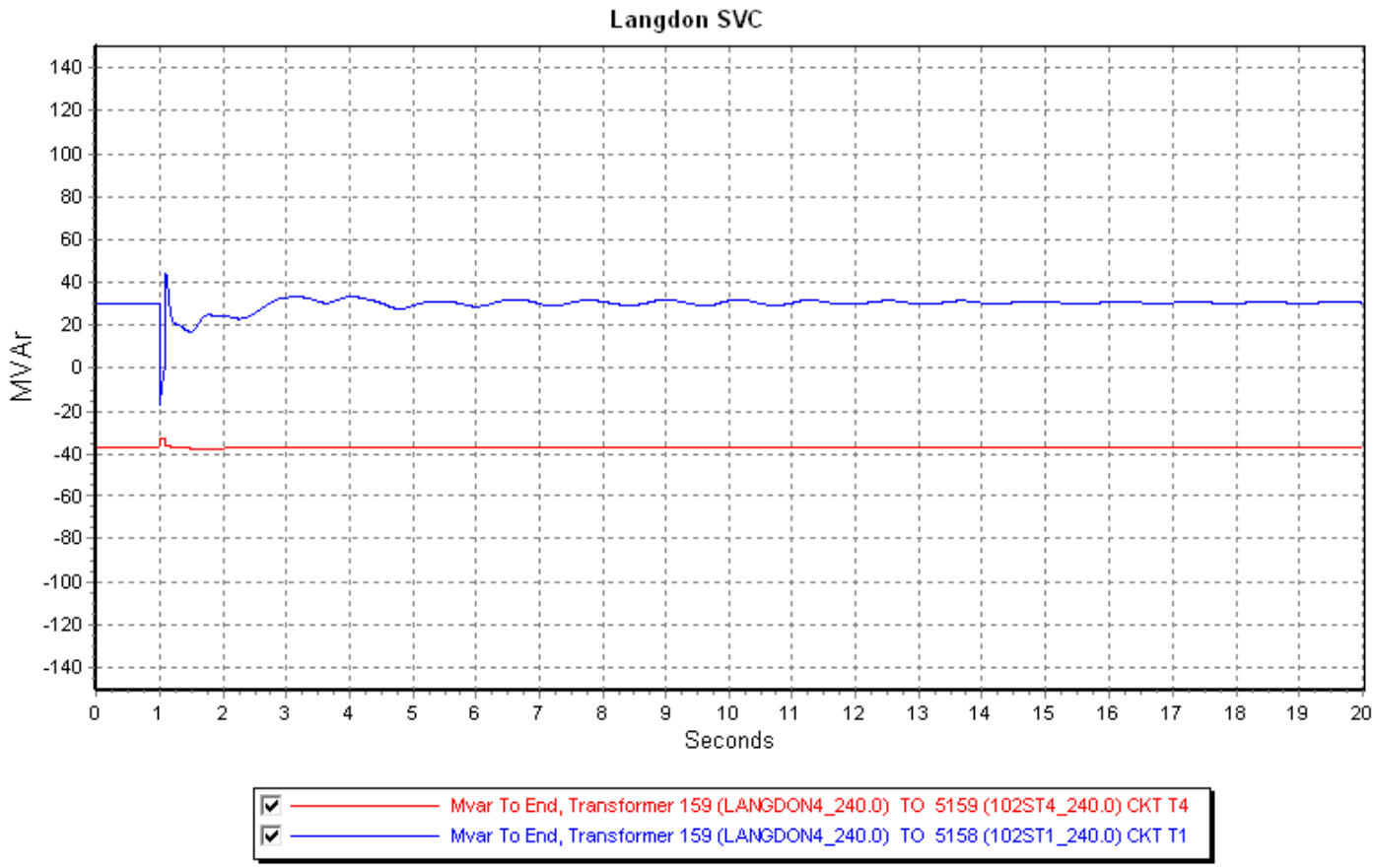


Contingency: 180L Ft.McLeod 15S to Vulcan 255S

Cavalier
Queenstown Generating Plant Output: 90MW

November 12, 2014 13:38:36

Langdon SVC

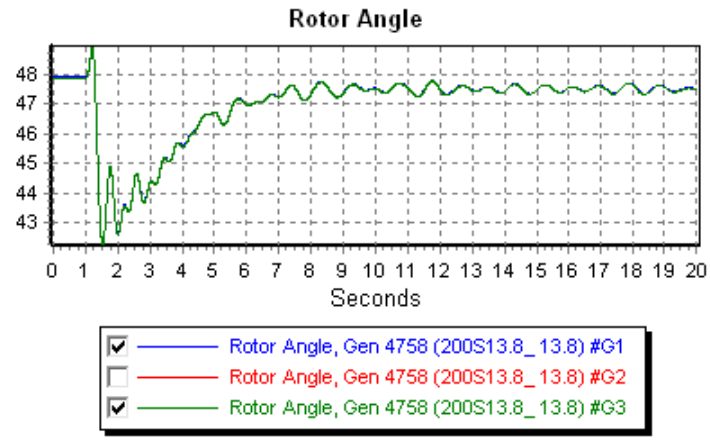


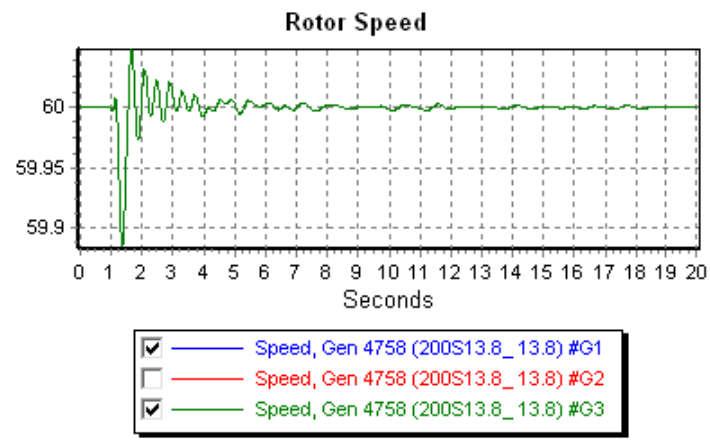
Contingency: 180L Ft.McLeod 15S to Vulcan 255S

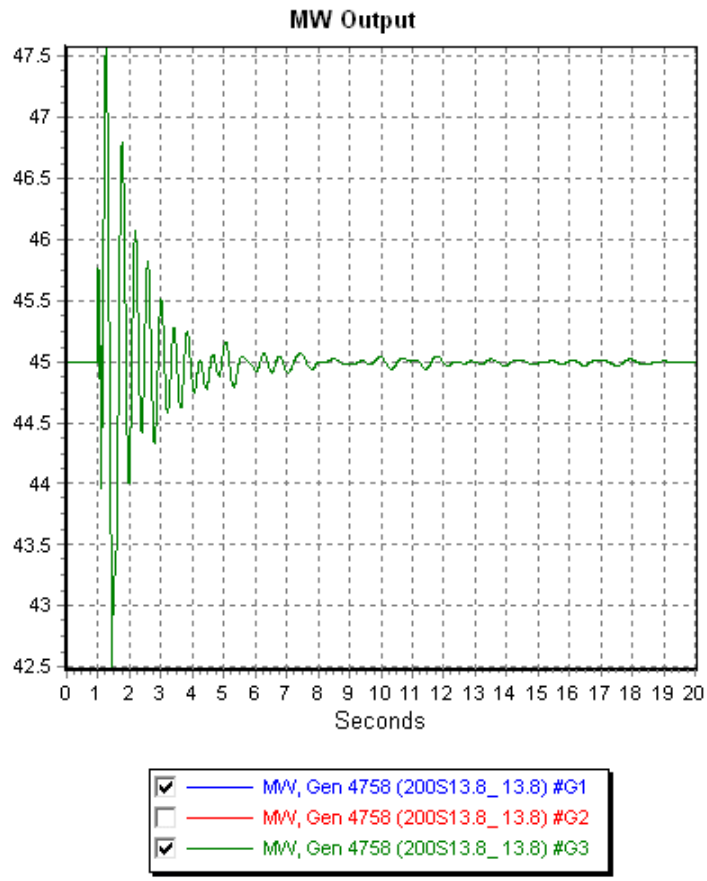
Langdon SVC
Queenstown Generating Plant Output: 90MW

November 12, 2014 13:38:37

Queenstown Gen





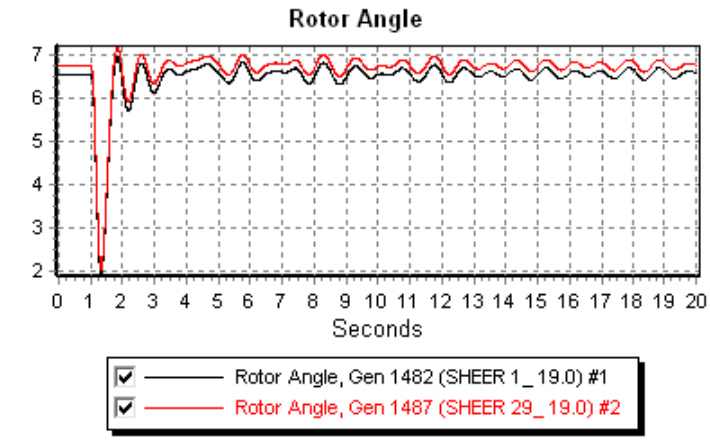


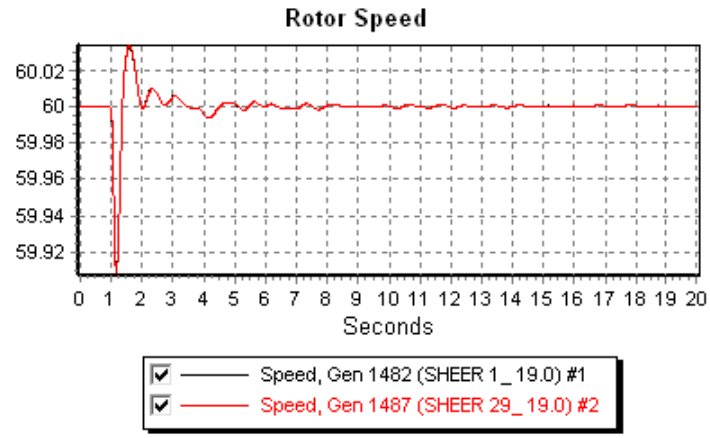
Contingency: 180L Ft.McLeod 15S to Vulcan 255S

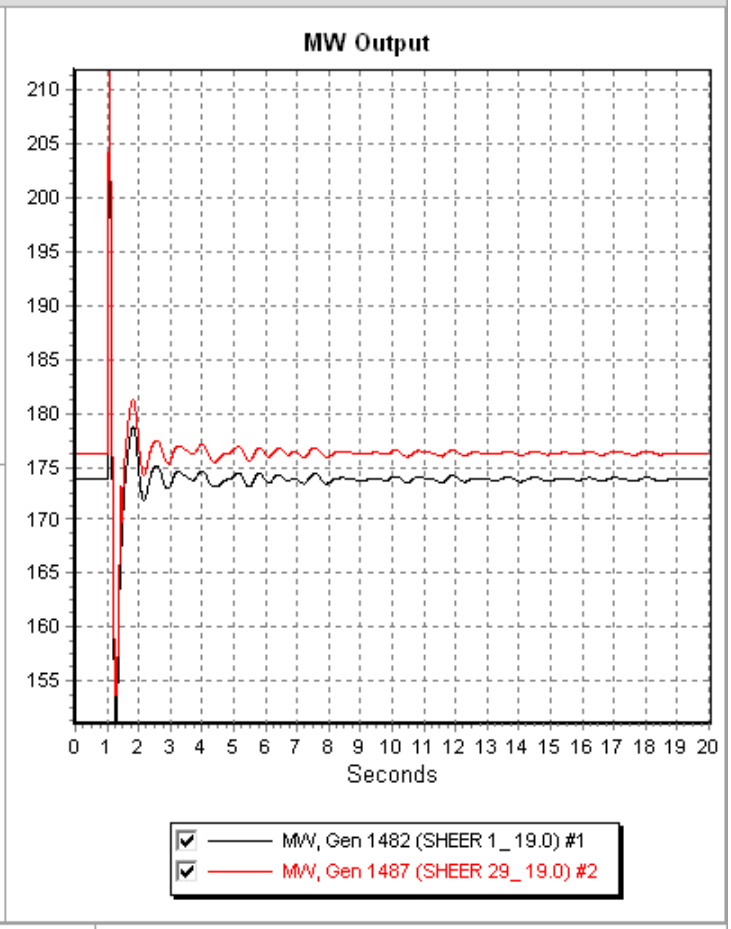
P1336
Queenstown Generating Plant
Output: 90MW

November 12, 2014 13:38:35

Sheerness





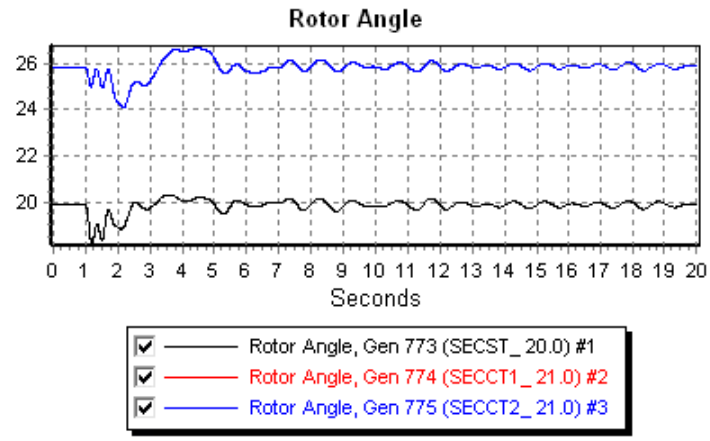


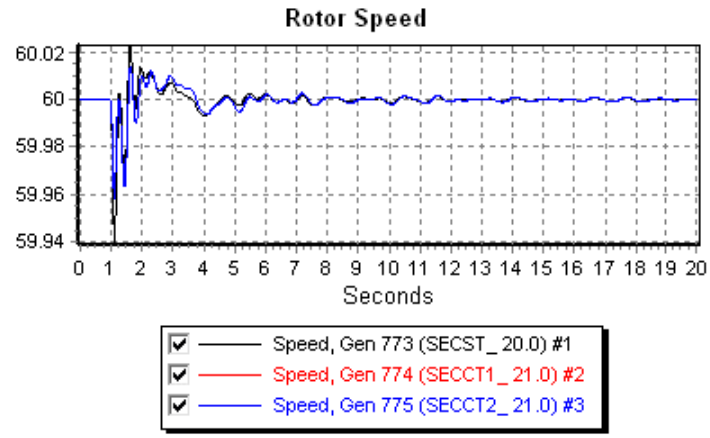
Contingency: 180L Ft.McLeod 15S to Vulcan 255S

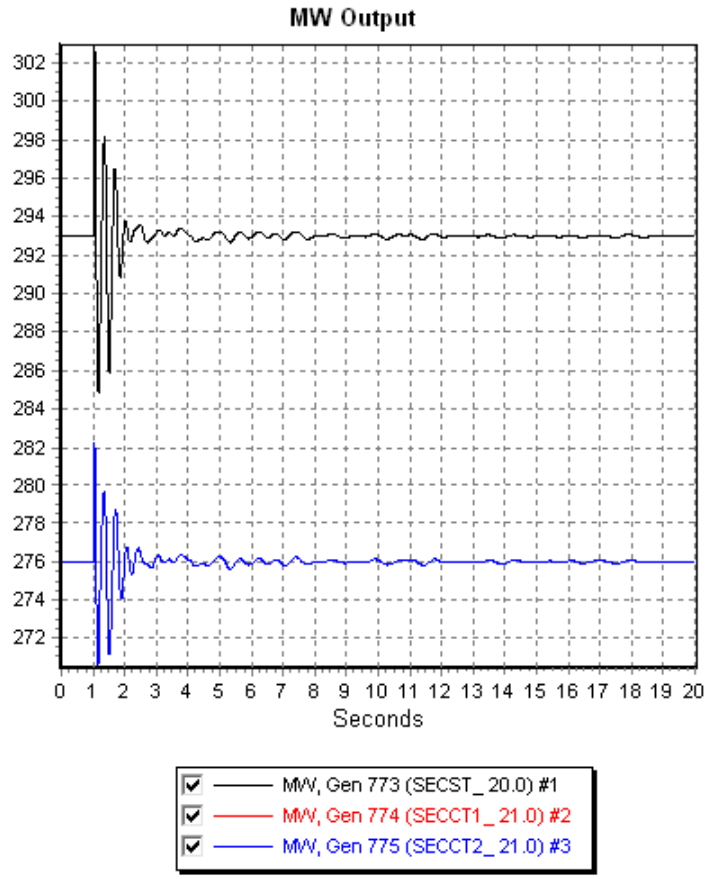
Sheerness
Queenstown Generating Plant Output: 90MW

November 12, 2014 13:38:33

Sheppard





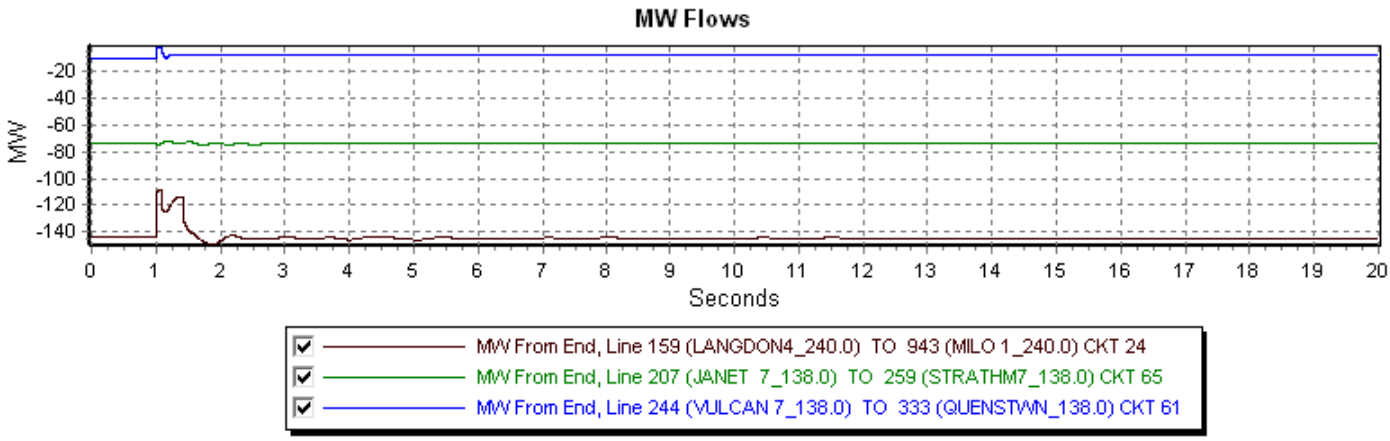


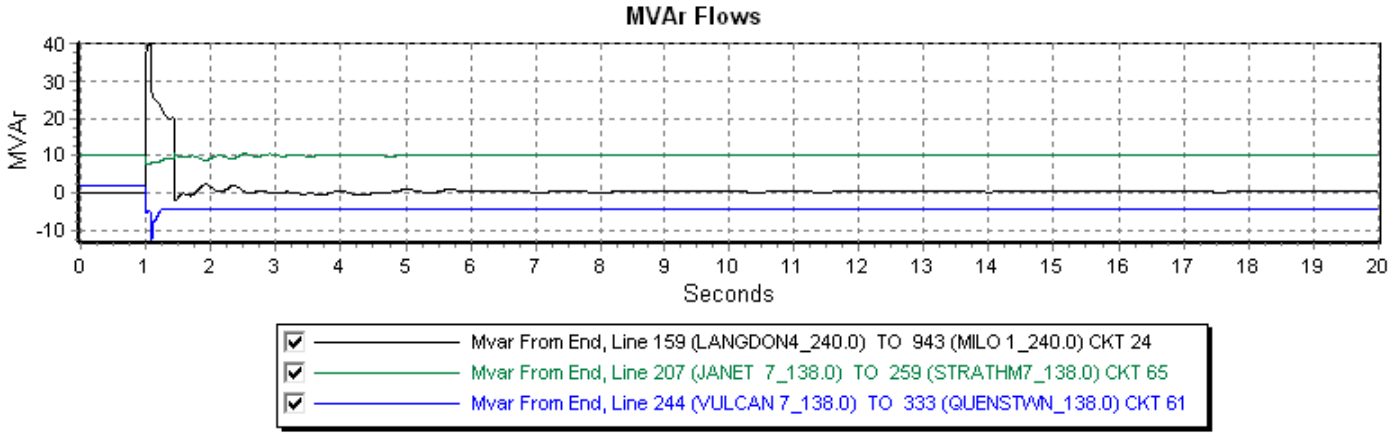
Contingency: 180L Ft.McLeod 15S to Vulcan 255S

Sheppard
Queenstown Generating Plant Output: 90MW

November 12, 2014 13:38:35

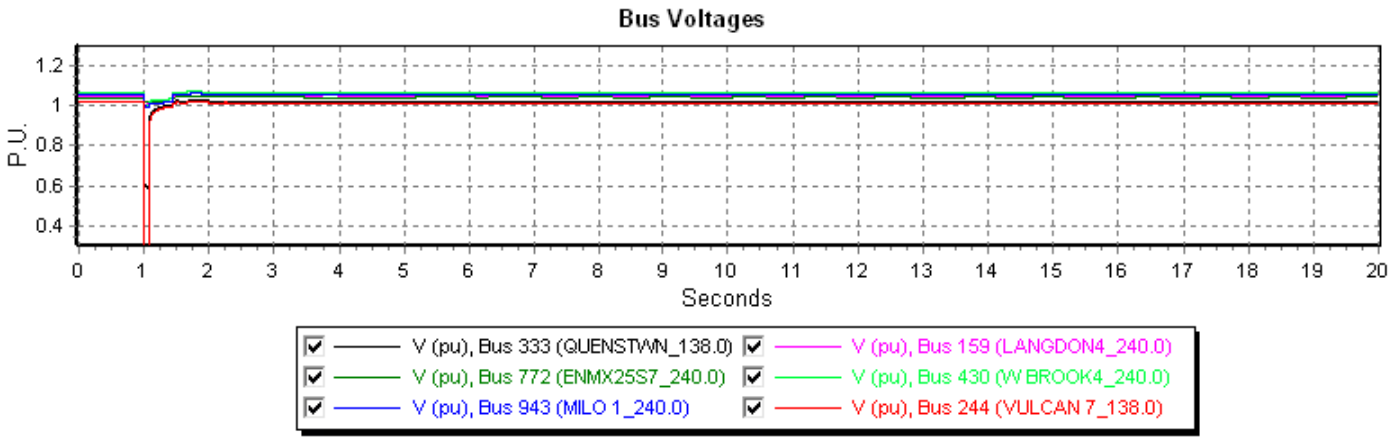
Branch Flows

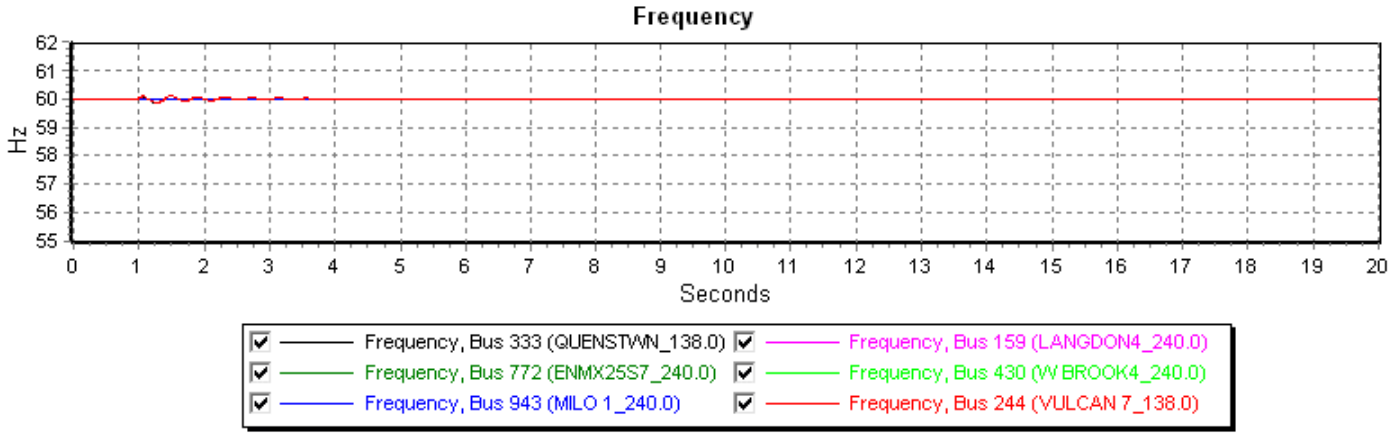




	Contingency: 180L Vulcan 255S to Ft.McLeod 15S	Branch Flows Queenstown Generating Plant Output: 90MW November 12, 2014 13:39:19

Bus Voltages and Frequency



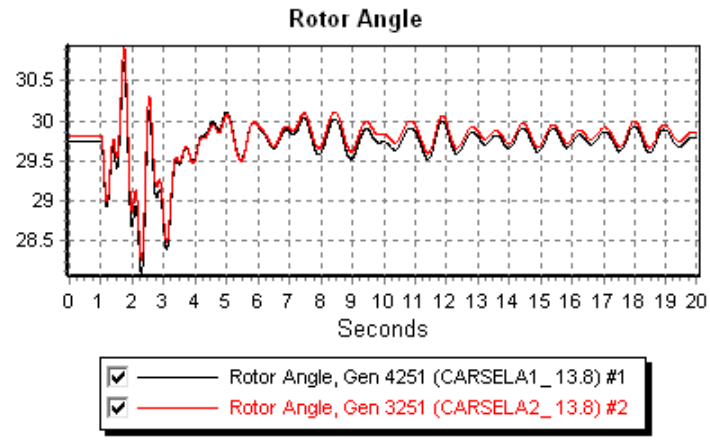


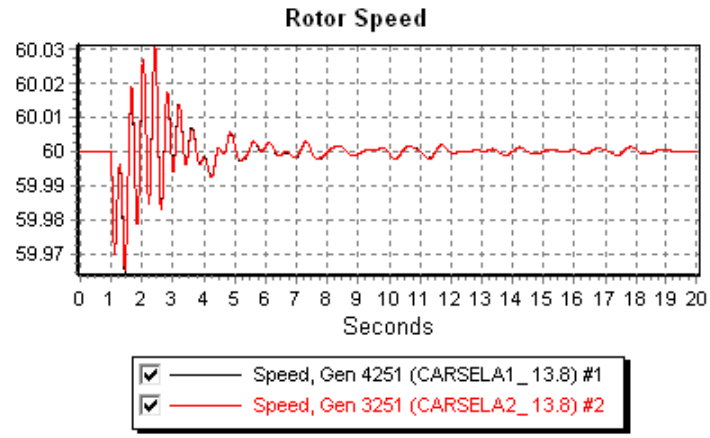
Contingency: 180L Vulcan 255S to Ft.McLeod 15S

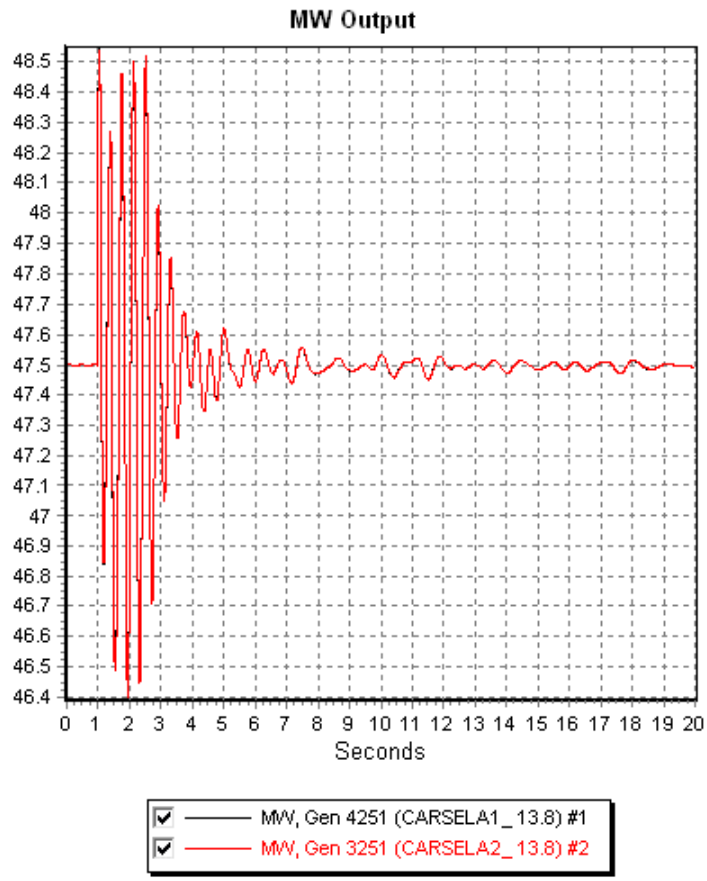
Bus Voltages and Frequency
Queenstown Generating Plant Output: 90MW

November 12, 2014 13:39:20

Carseland





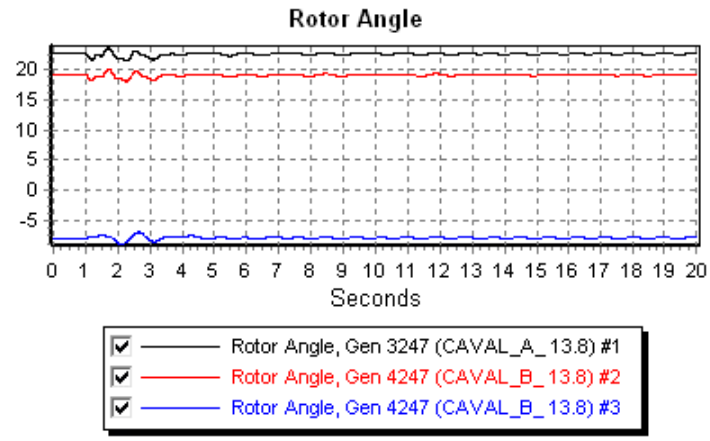


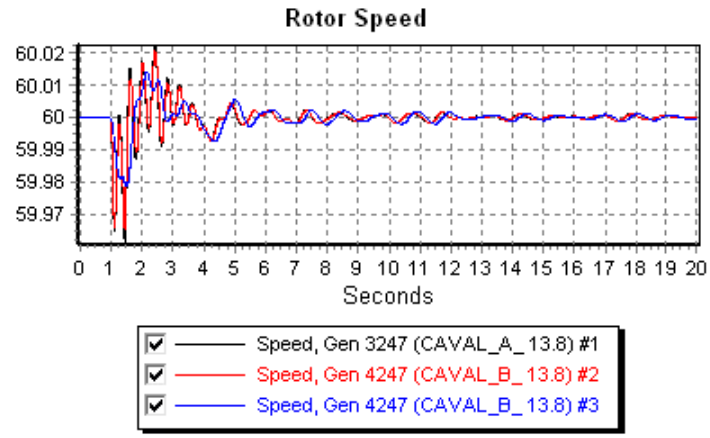
Contingency: 180L Vulcan 255S to Ft.McLeod 15S

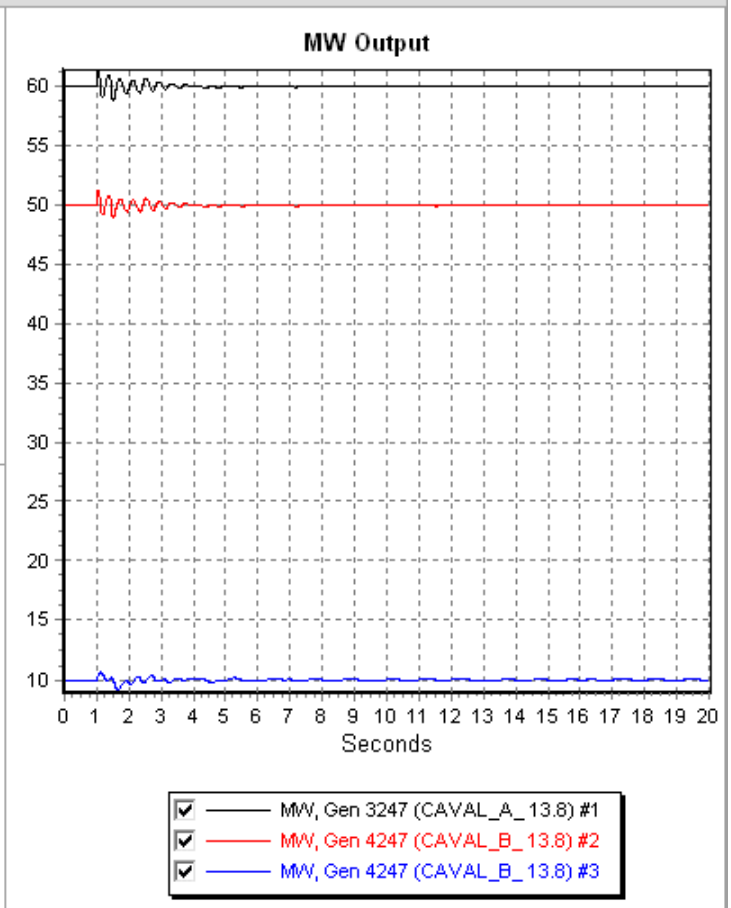
Carseland
Queenstown Generating Plant Output: 90MW

November 12, 2014 13:39:17

Cavalier





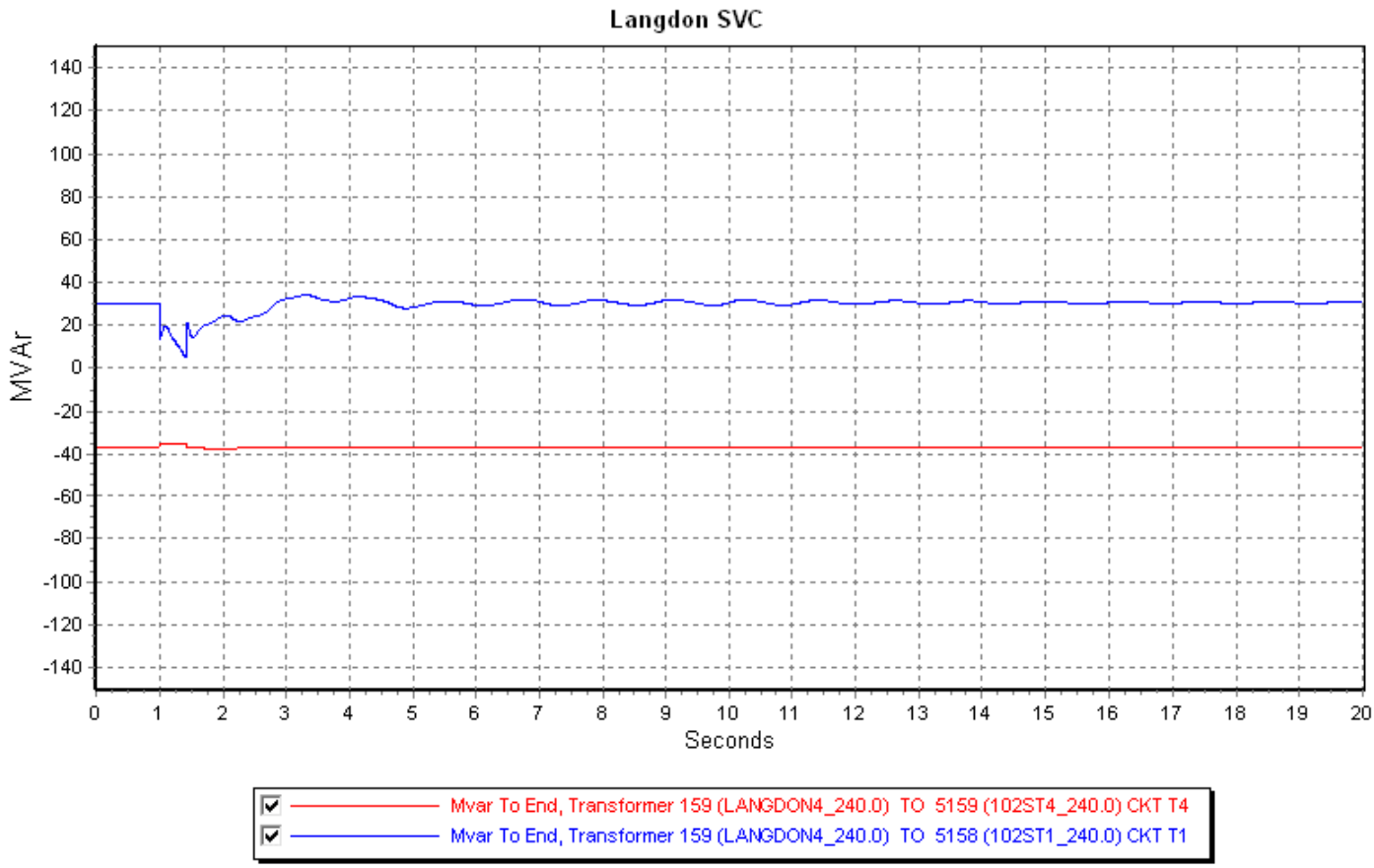


Contingency: 180L Vulcan 255S to Ft.McLeod 15S

Cavalier
Queenstown Generating Plant Output: 90MW

November 12, 2014 13:39:19

Langdon SVC

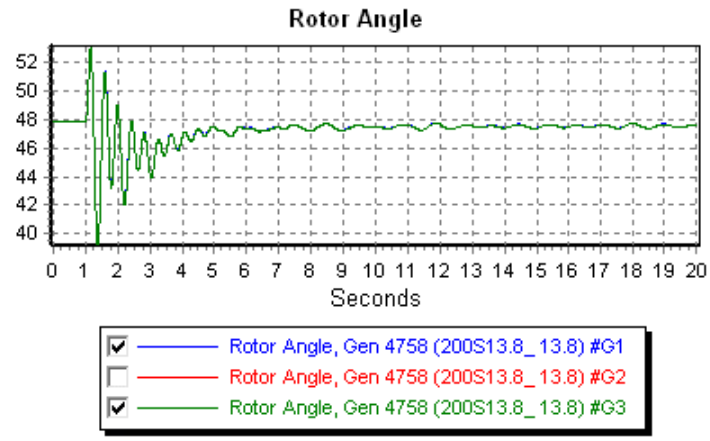


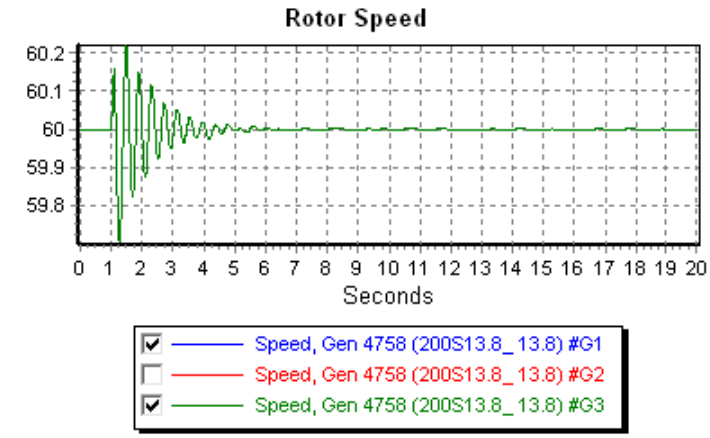
Contingency: 180L Vulcan 255S to Ft.McLeod 15S

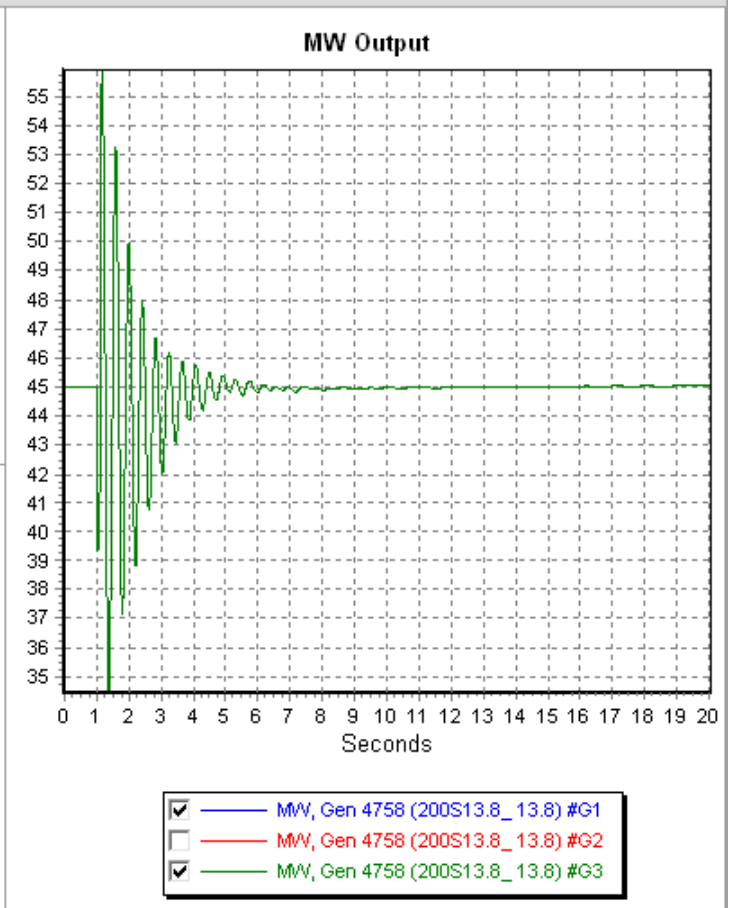
Langdon SVC
Queenstown Generating Plant Output: 90MW

November 12, 2014 13:39:20

Queenstown Gen





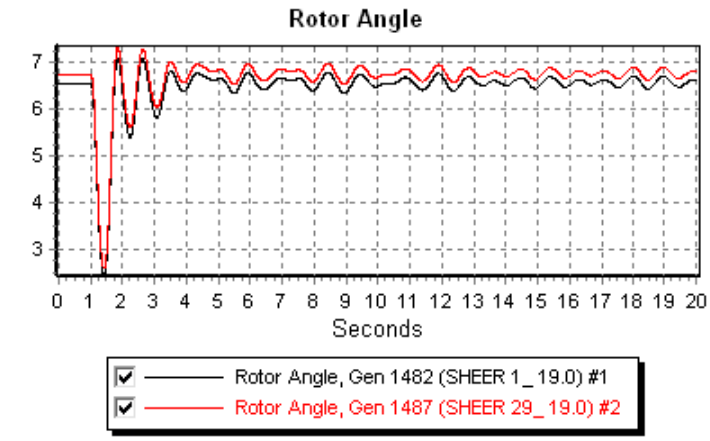


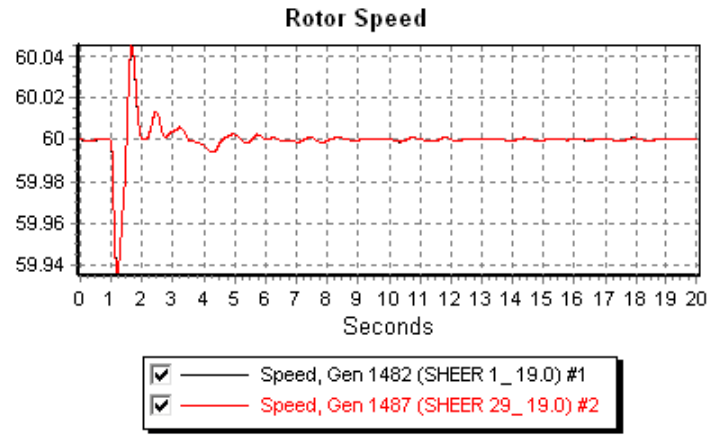
Contingency: 180L Vulcan 255S to Ft.McLeod 15S

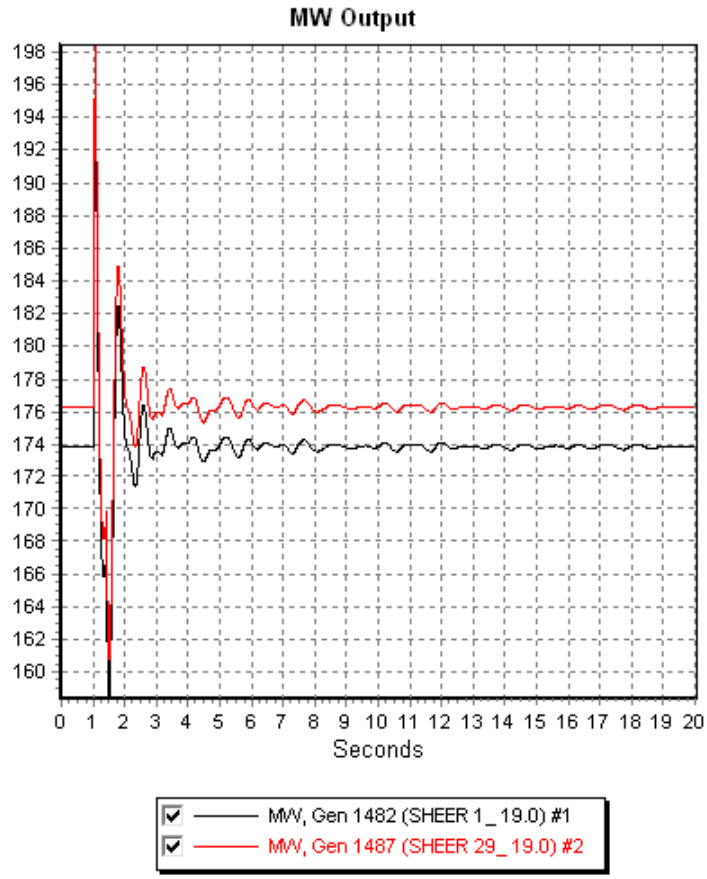
P1336
Queenstown Generating Plant
Output: 90MW

November 12, 2014 13:39:18

Sheerness





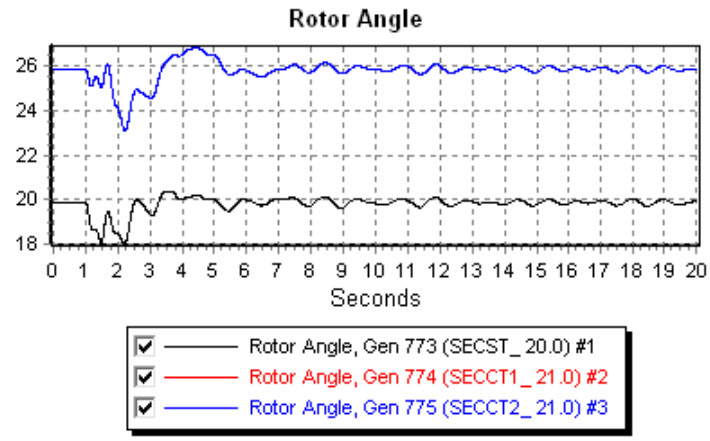


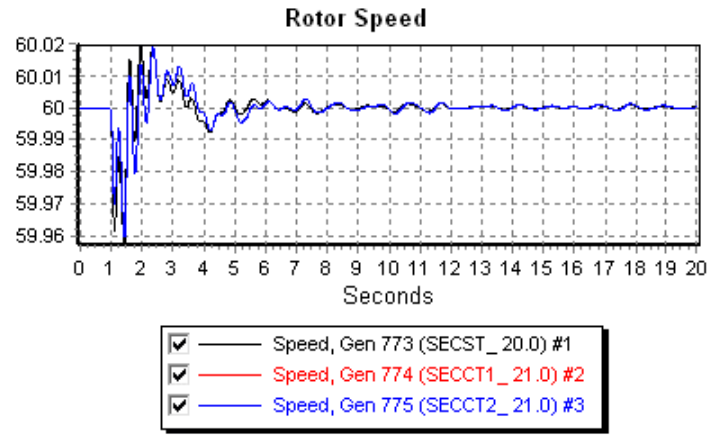
Contingency: 180L Vulcan 255S to Ft.McLeod 15S

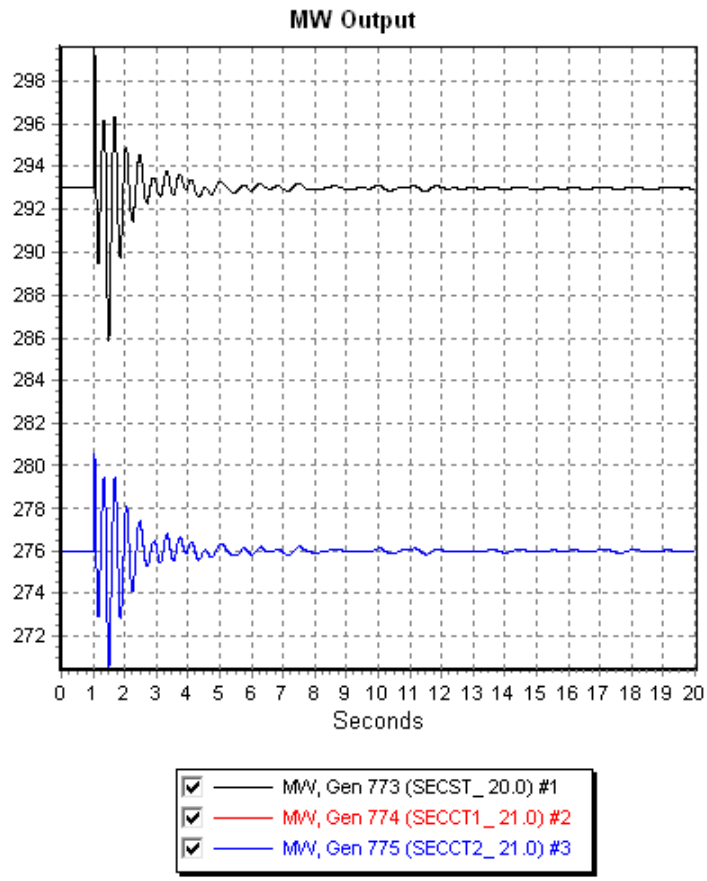
Sheerness
Queenstown Generating Plant Output: 90MW

November 12, 2014 13:39:16

Sheppard





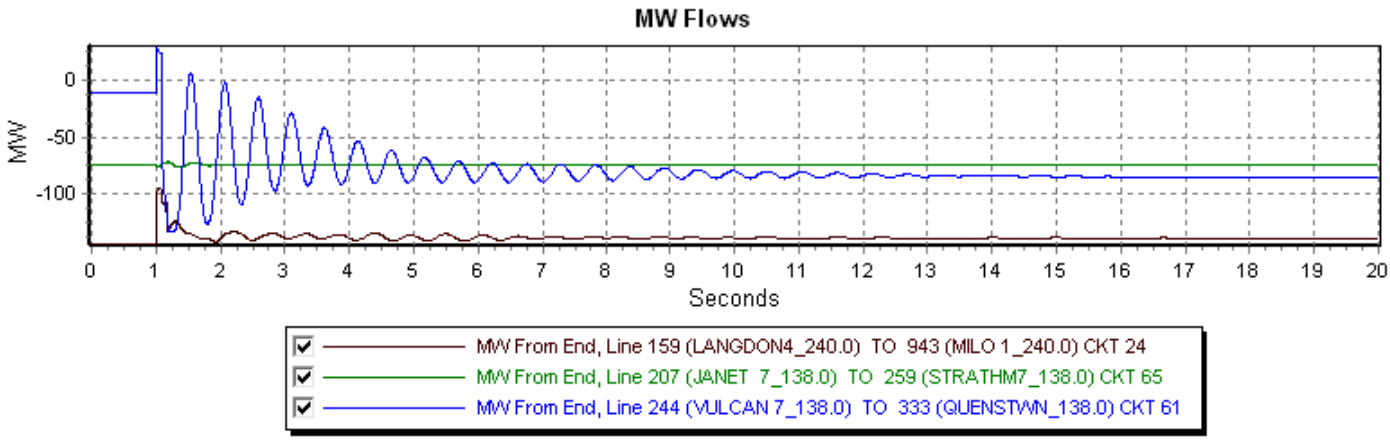


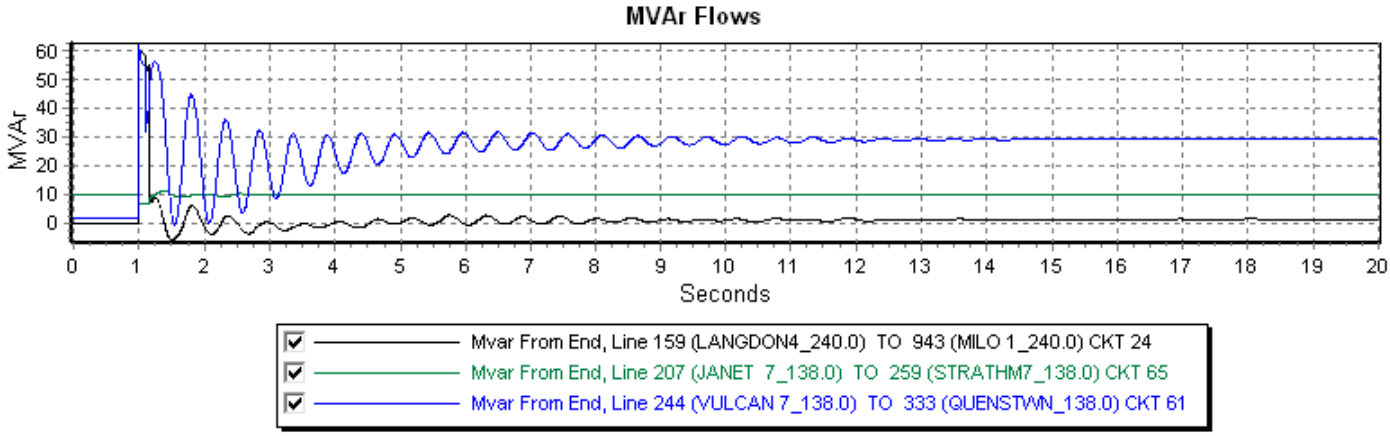
Contingency: 180L Vulcan 255S to Ft.McLeod 15S

Sheppard
Queenstown Generating Plant Output: 90MW

November 12, 2014 13:39:18

Branch Flows



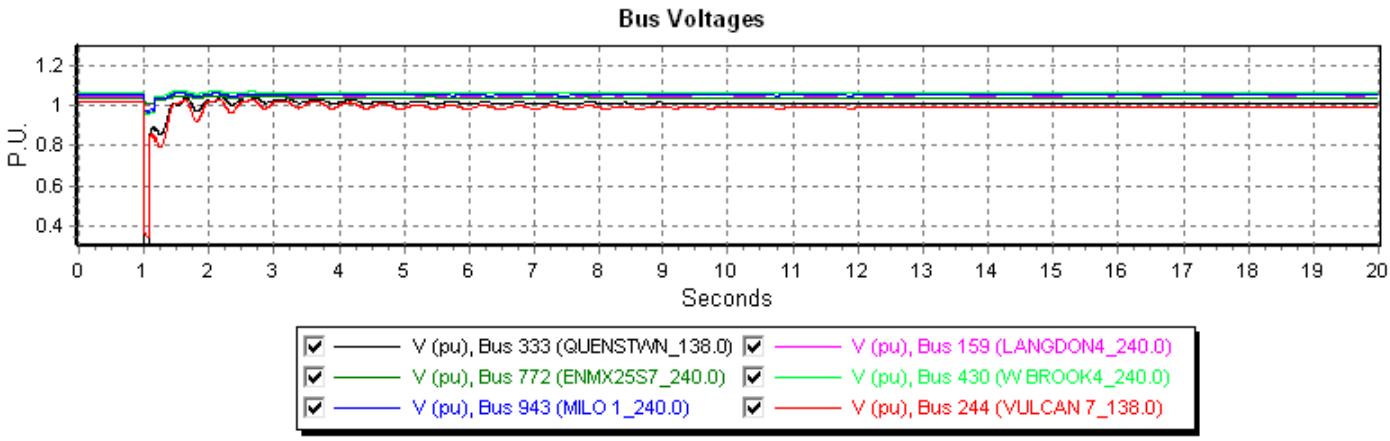


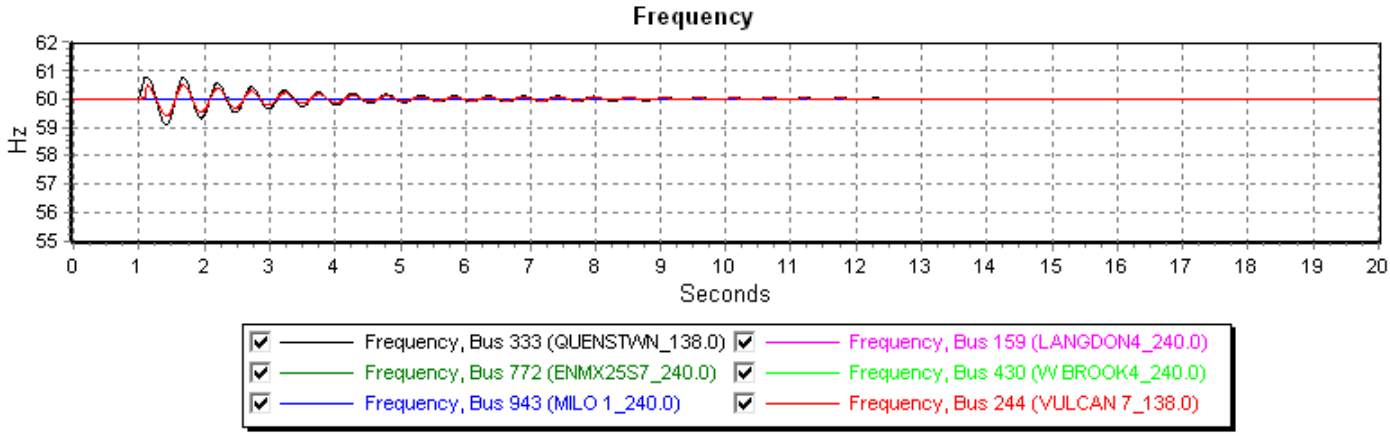
Contingency: 853L QUEENSTOWN 504S - WEST BROOKS 28

Branch Flows
Queenstown Generating Plant Output: 90MW

November 12, 2014 13:40:03

Bus Voltages and Frequency



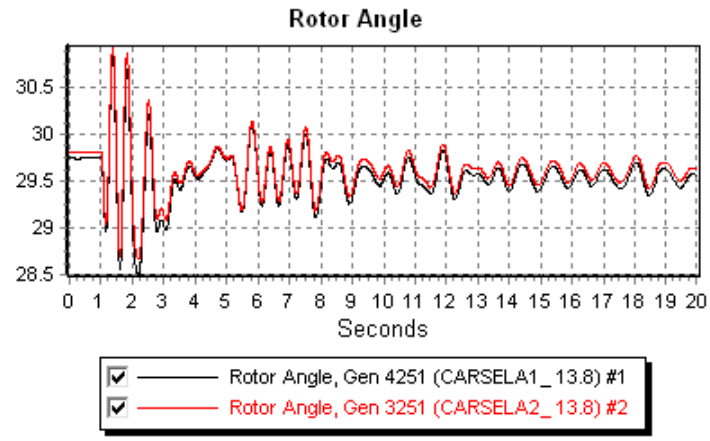


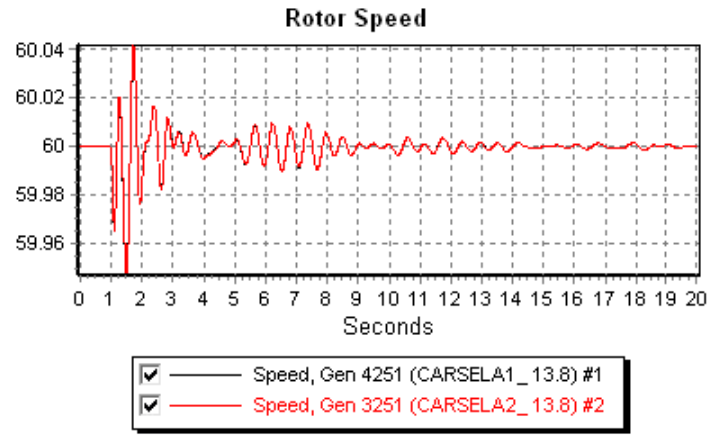
Contingency: 853L QUEENSTOWN 504S - WEST BROOKS 28

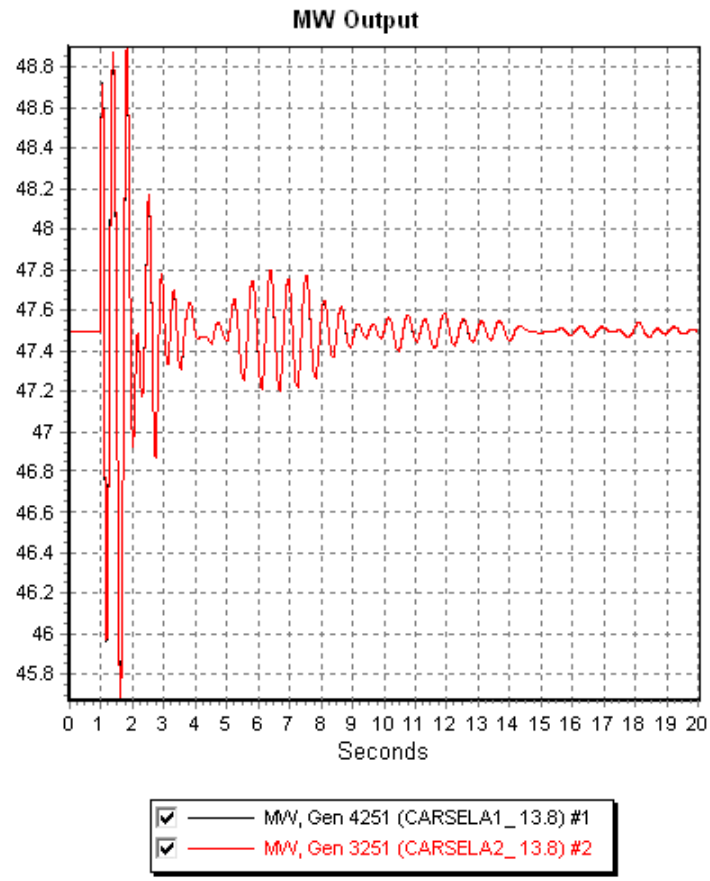
Bus Voltages and Frequency
Queenstown Generating Plant Output: 90MW

November 12, 2014 13:40:03

Carseland





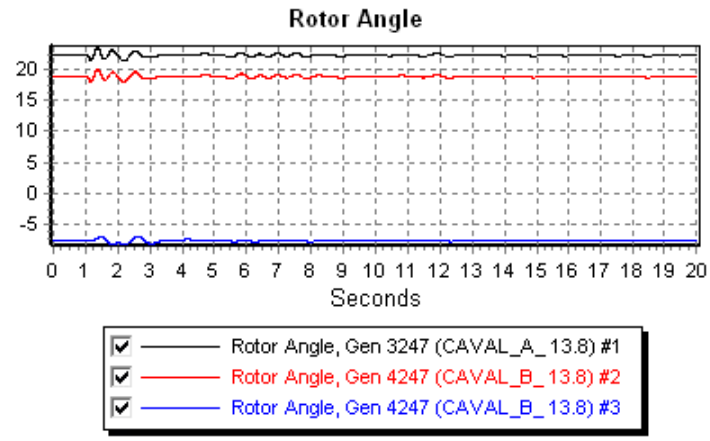


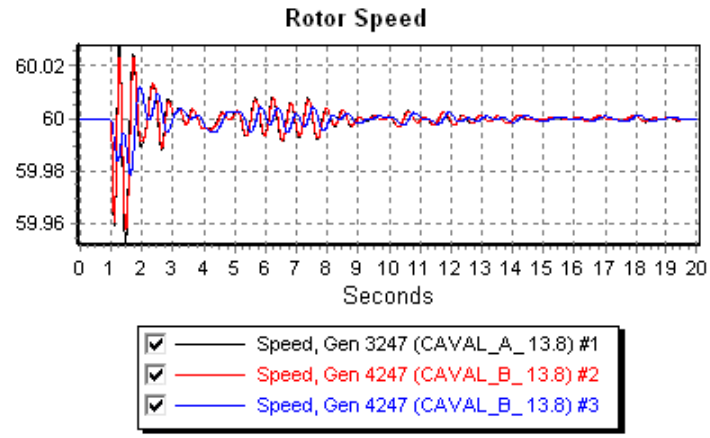
Contingency: 853L QUEENSTOWN 504S - WEST BROOKS 28

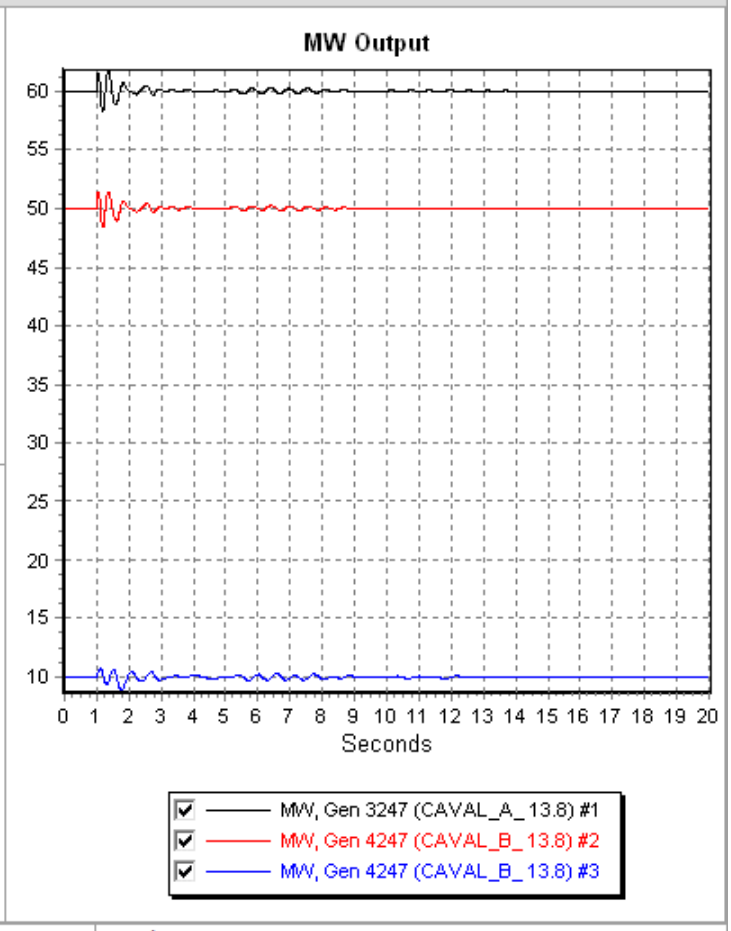
Carseland
Queenstown Generating Plant Output: 90MW

November 12, 2014 13:40:01

Cavalier





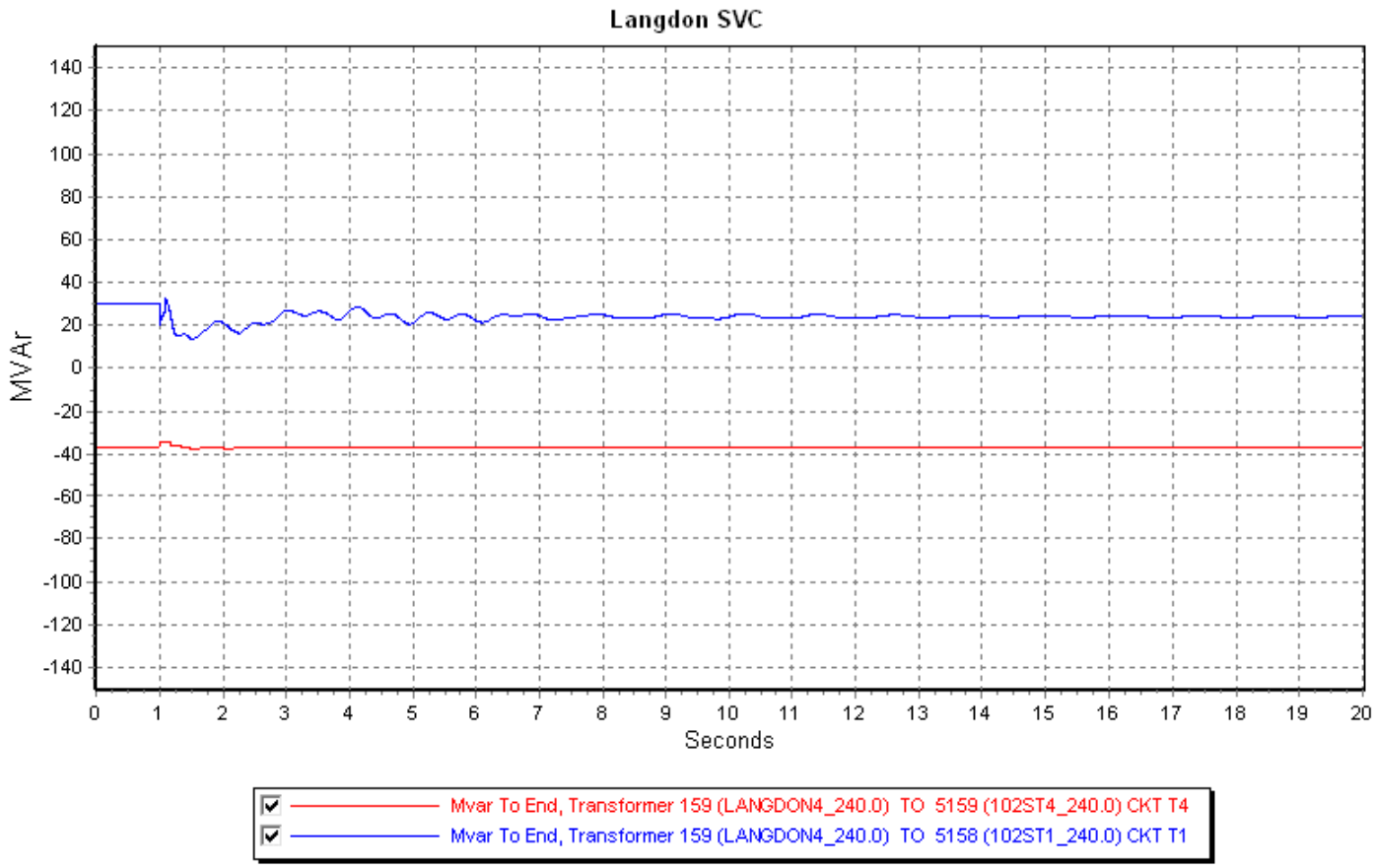


Contingency: 853L QUEENSTOWN 504S - WEST BROOKS 28

Cavalier
Queenstown Generating Plant Output: 90MW

November 12, 2014 13:40:02

Langdon SVC

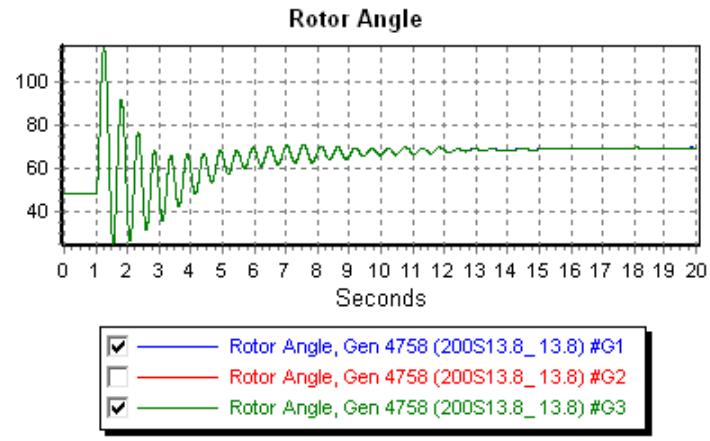


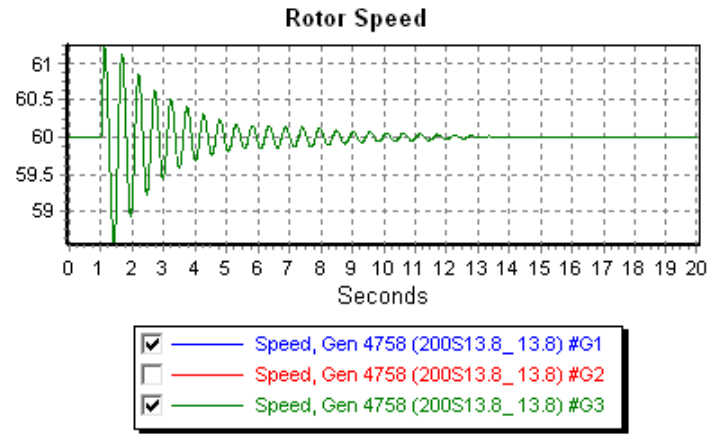
Contingency: 853L QUEENSTOWN 504S - WEST BROOKS 28

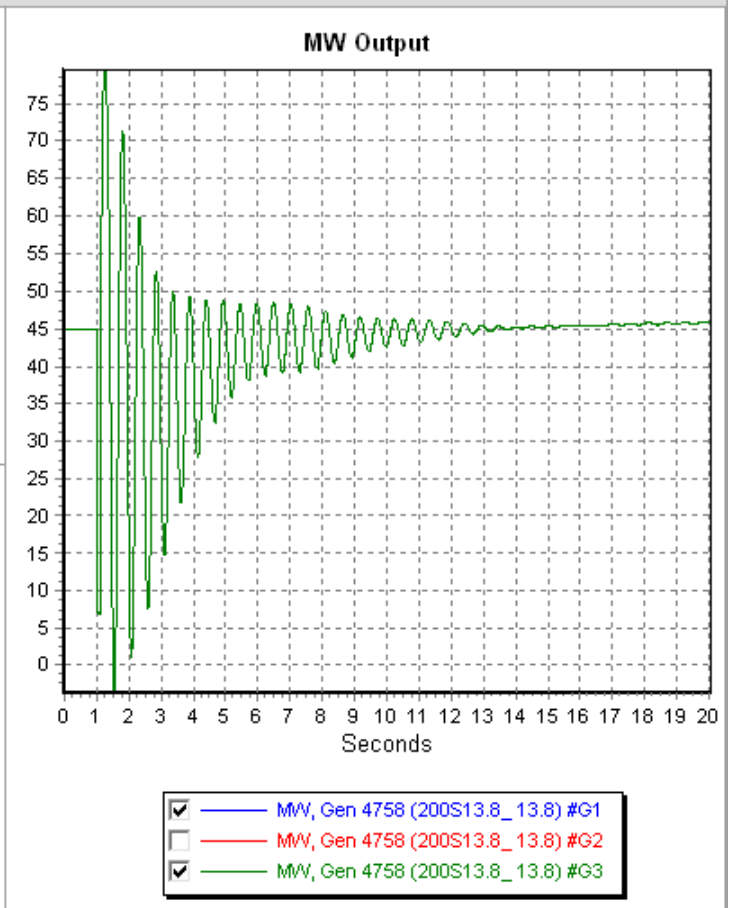
Langdon SVC
Queenstown Generating Plant Output: 90MW

November 12, 2014 13:40:04

Queenstown Gen





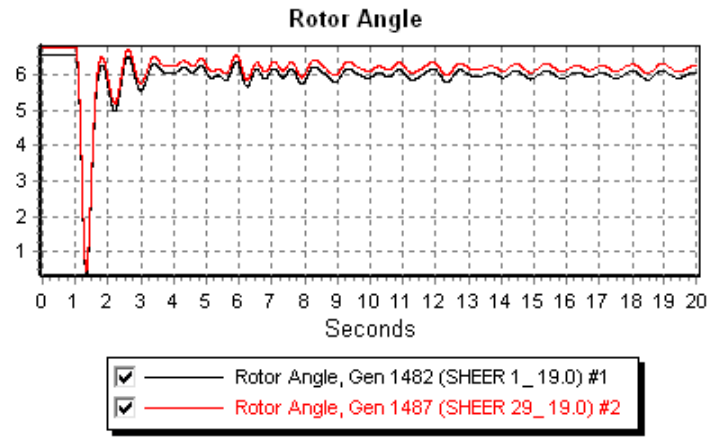


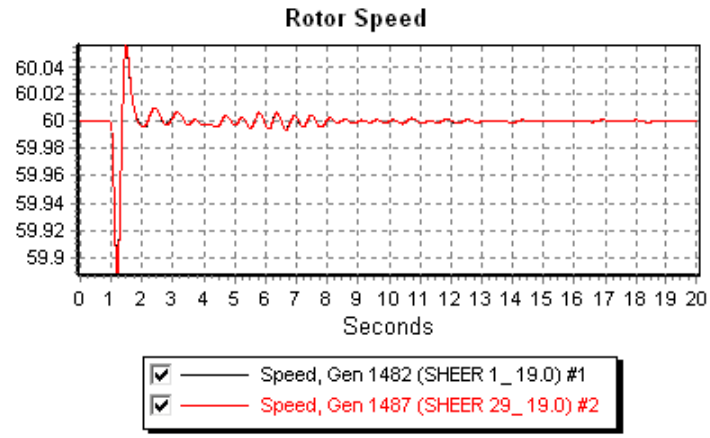
Contingency: 853L QUEENSTOWN 504S - WEST BROOKS 28

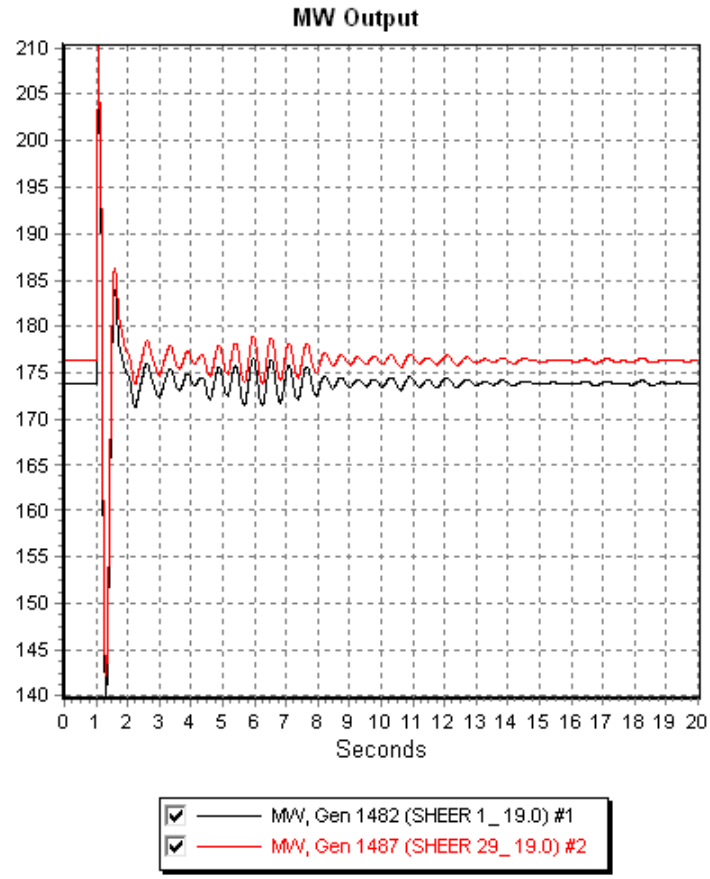
P1336
Queenstown Generating Plant
Output: 90MW

November 12, 2014 13:40:02

Sheerness





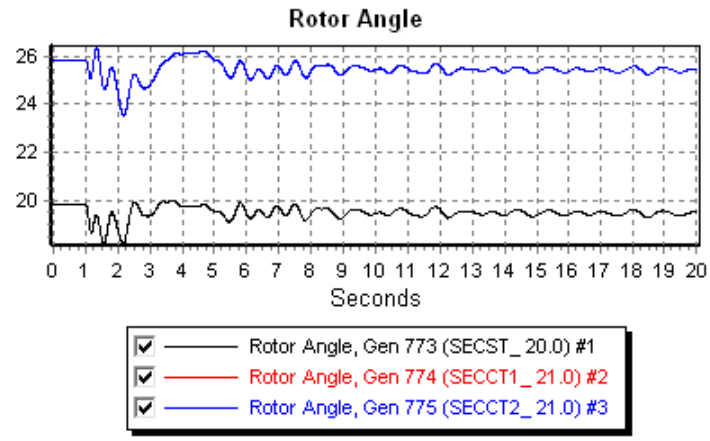


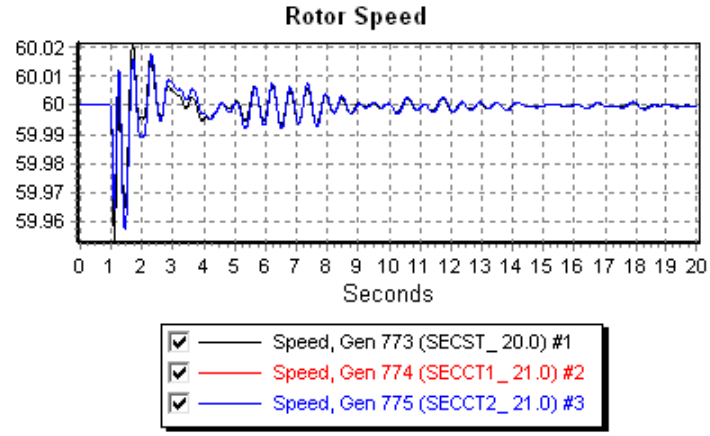
Contingency: 853L QUEENSTOWN 504S - WEST BROOKS 28

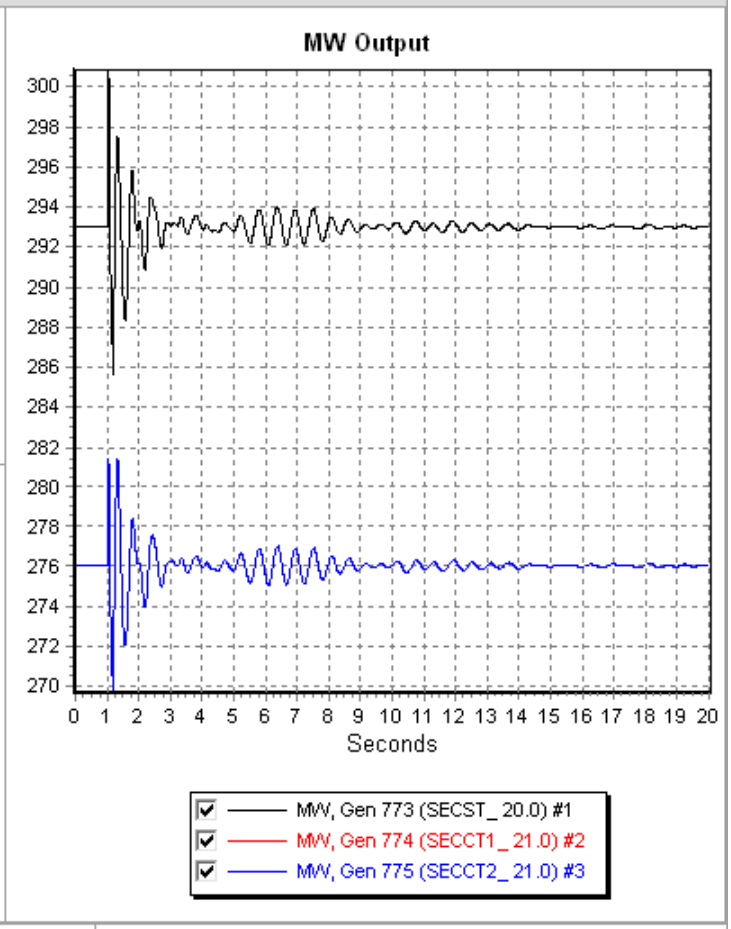
Sheerness
Queenstown Generating Plant Output: 90MW

November 12, 2014 13:40:00

Sheppard





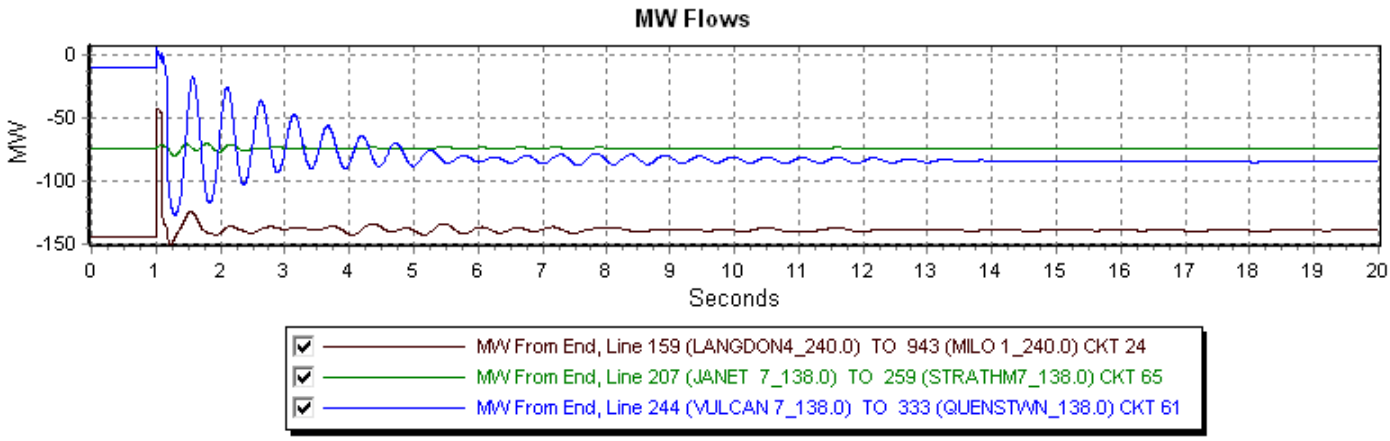


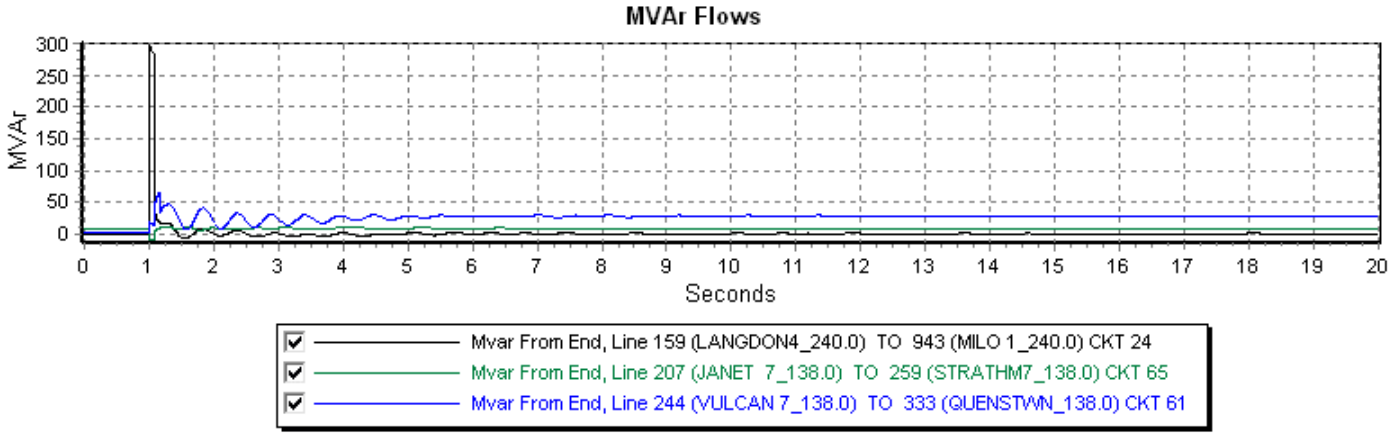
Contingency: 853L QUEENSTOWN 504S - WEST BROOKS 28

Sheppard
Queenstown Generating Plant Output: 90MW

November 12, 2014 13:40:01

Branch Flows



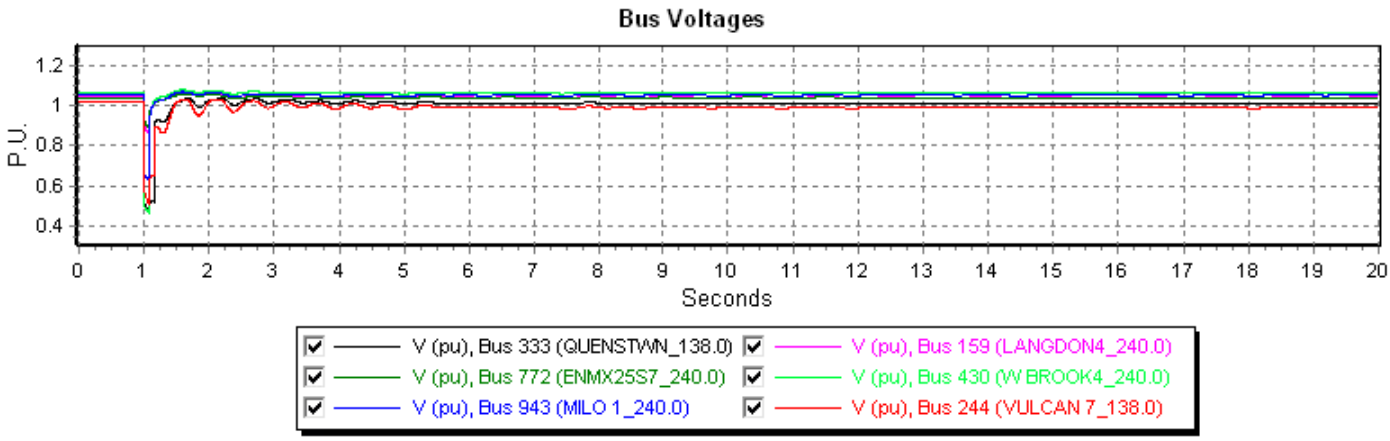


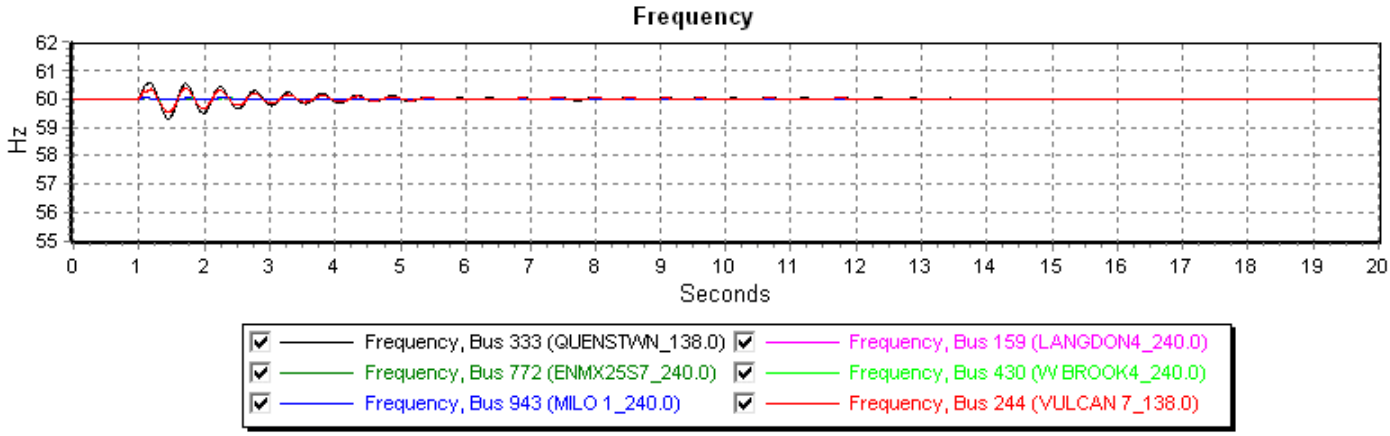
Contingency: 853L WEST BROOKS 28S - QUEENSTOWN 504S

Branch Flows
Queenstown Generating Plant Output: 90MW

November 12, 2014 13:40:49

Bus Voltages and Frequency



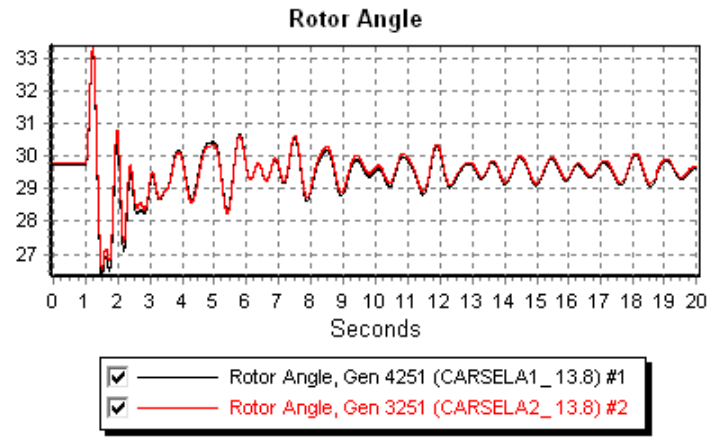


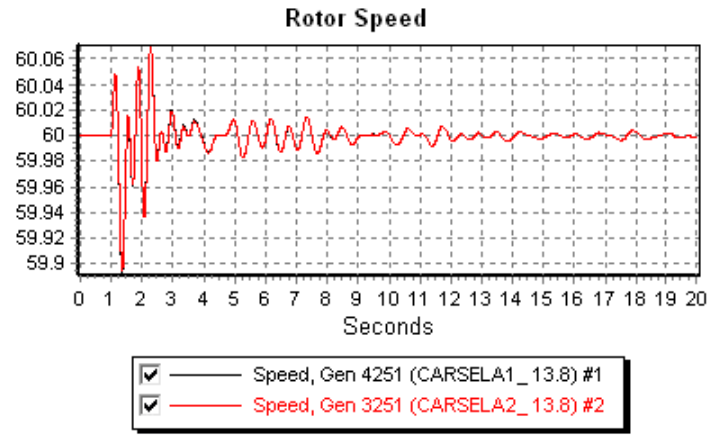
Contingency: 853L WEST BROOKS 28S - QUEENSTOWN 504S

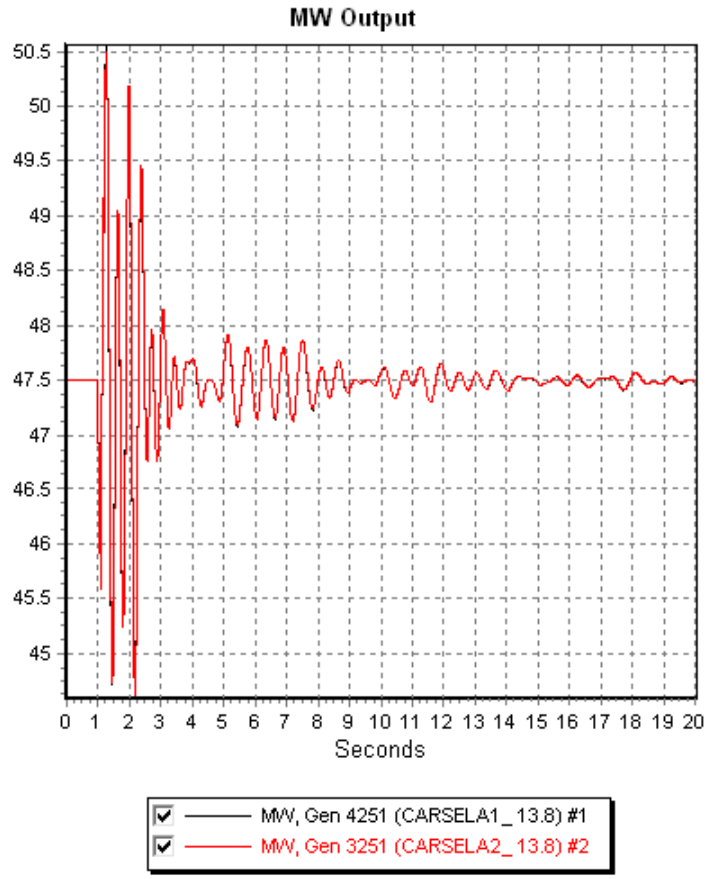
Bus Voltages and Frequency
Queenstown Generating Plant Output: 90MW

November 12, 2014 13:40:50

Carseland





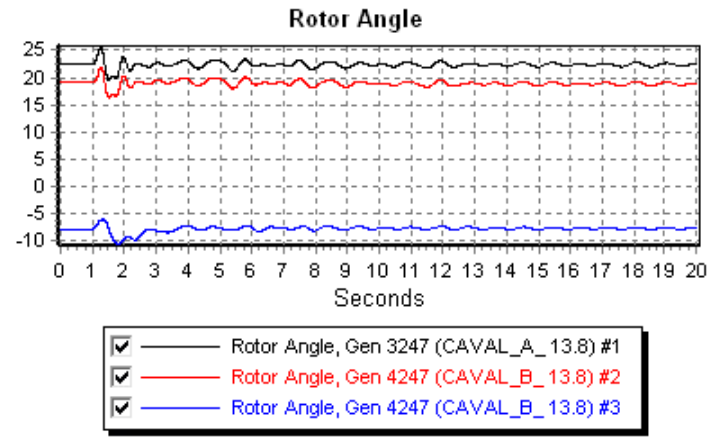


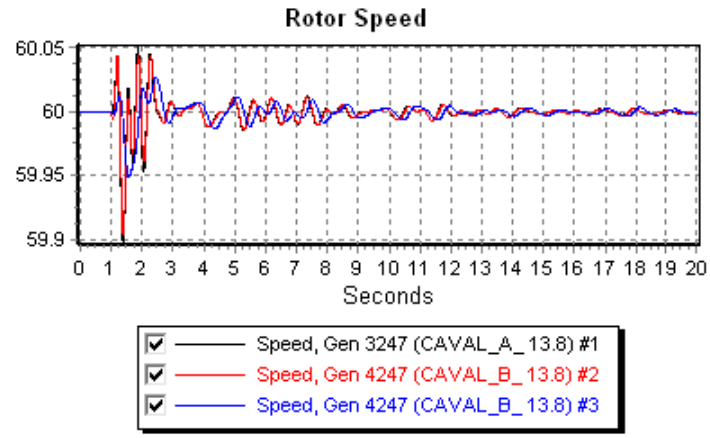
Contingency: 853L WEST BROOKS 28S - QUEENSTOWN 504S

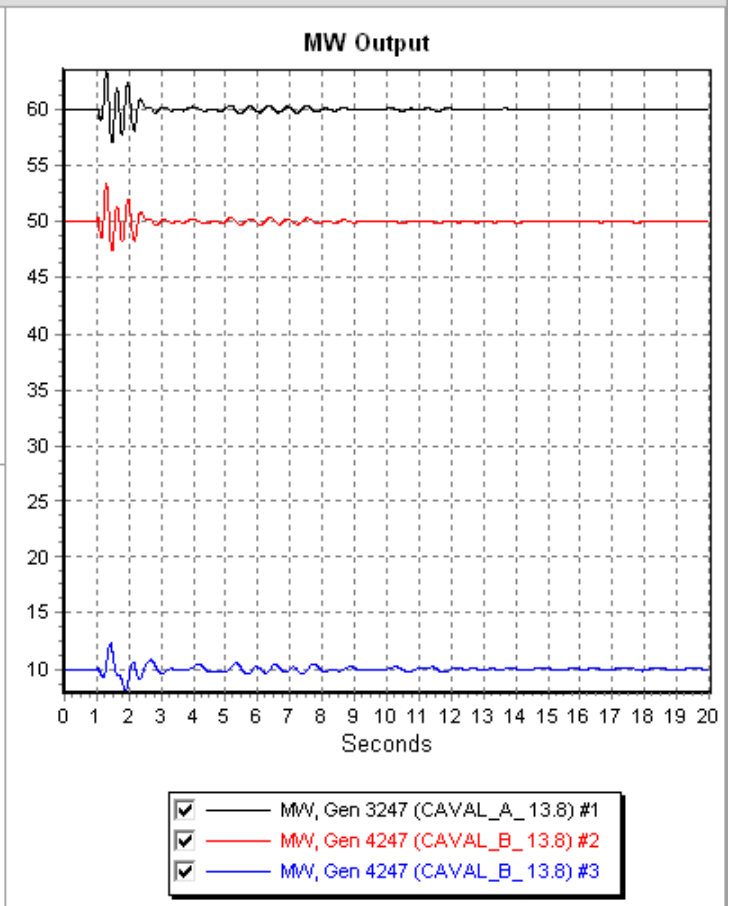
Carseland
Queenstown Generating Plant Output: 90MW

November 12, 2014 13:40:47

Cavalier





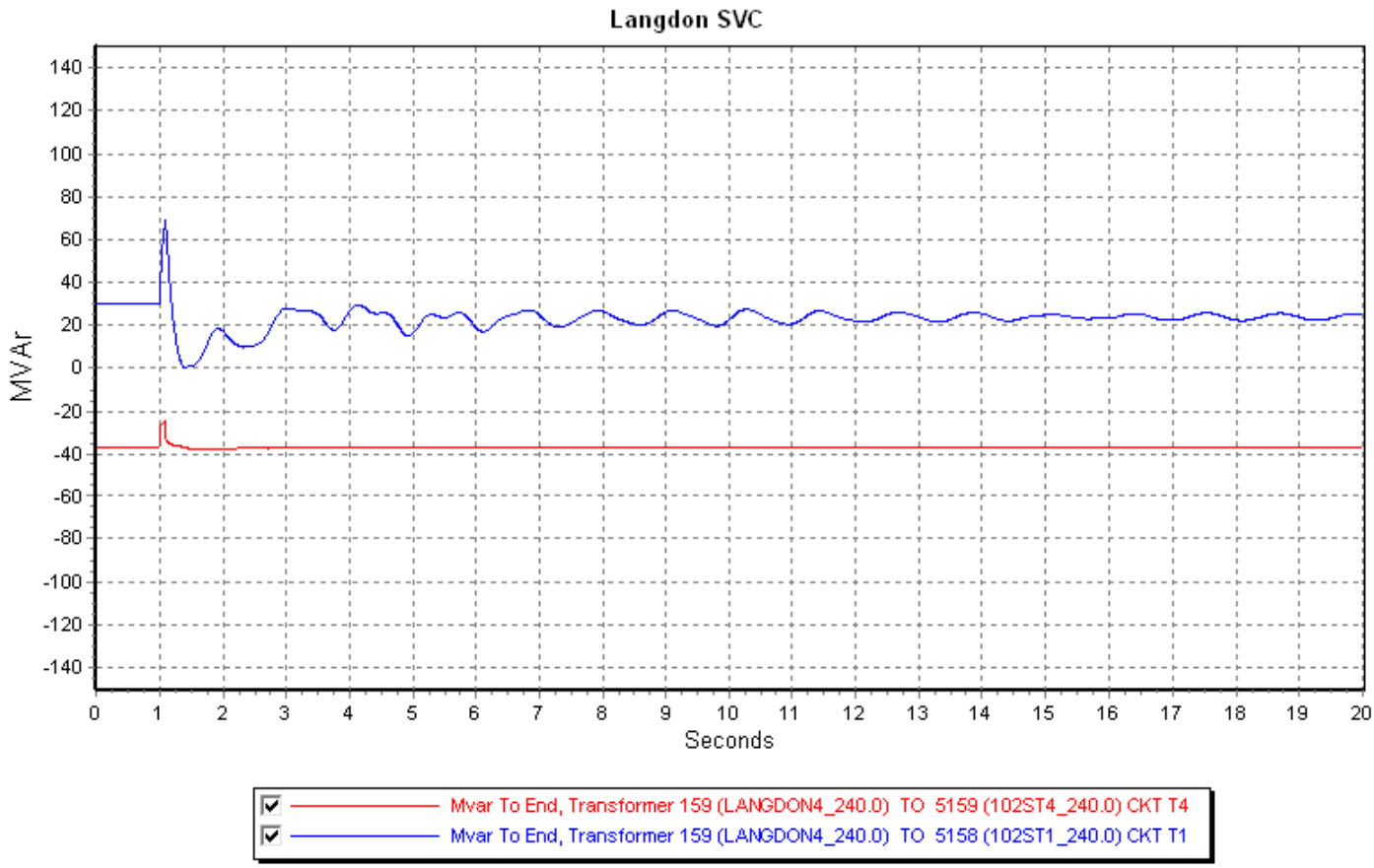


Contingency: 853L WEST BROOKS 28S - QUEENSTOWN 504S

Cavalier
Queenstown Generating Plant Output: 90MW

November 12, 2014 13:40:49

Langdon SVC

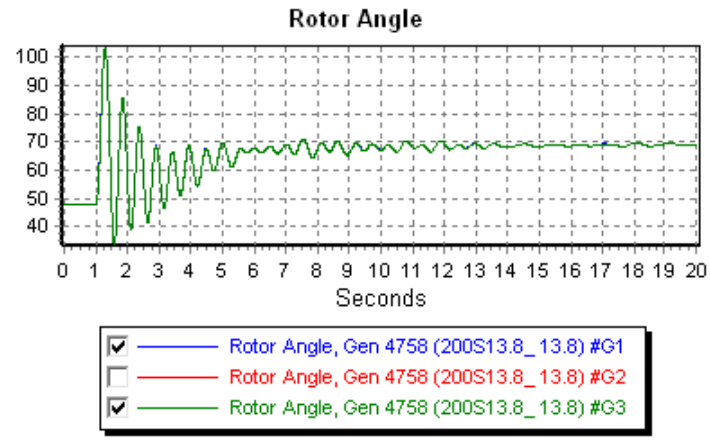


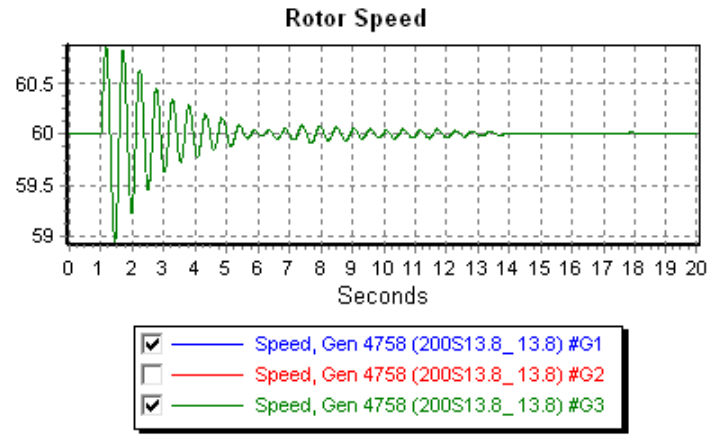
Contingency: 853L WEST BROOKS 28S - QUEENSTOWN 504S

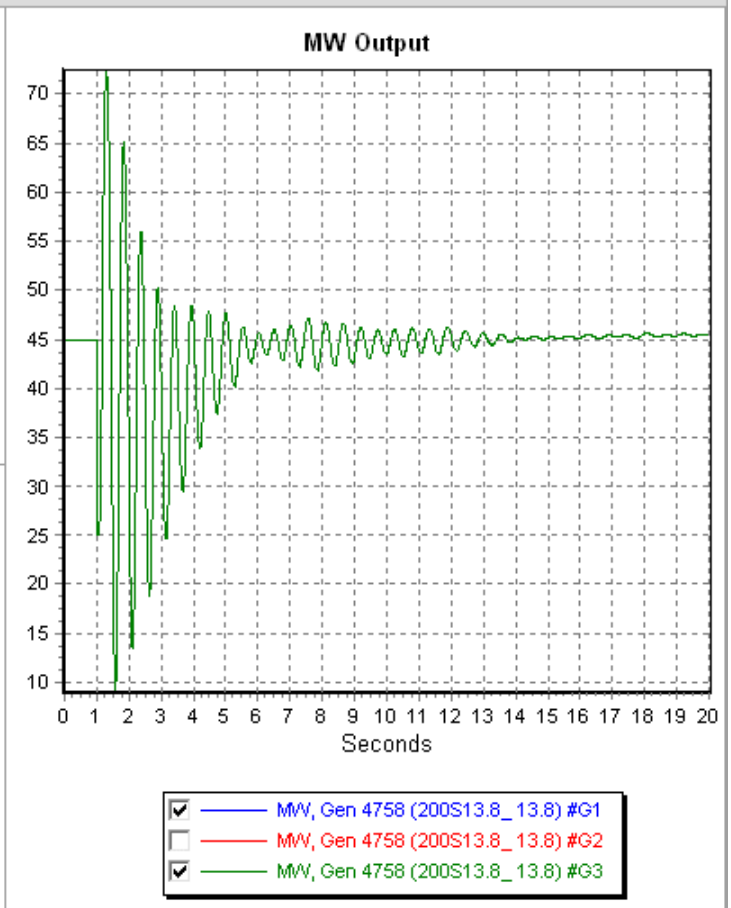
Langdon SVC
Queenstown Generating Plant Output: 90MW

November 12, 2014 13:40:51

Queenstown Gen





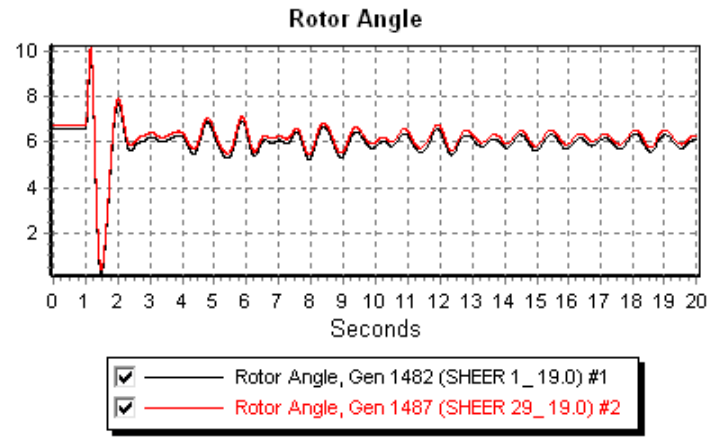


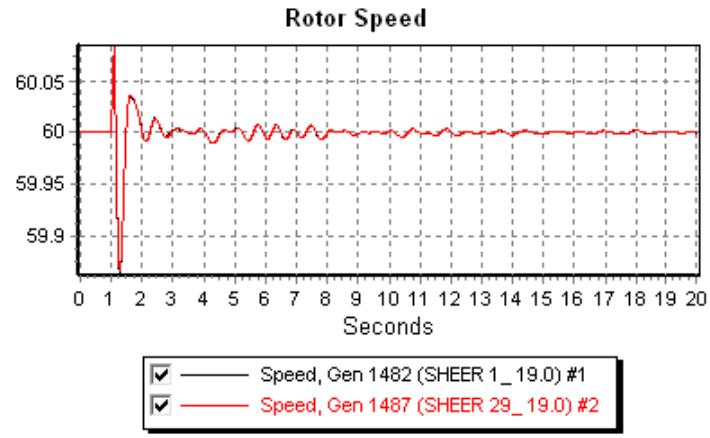
Contingency: 853L WEST BROOKS 28S - QUEENSTOWN 504

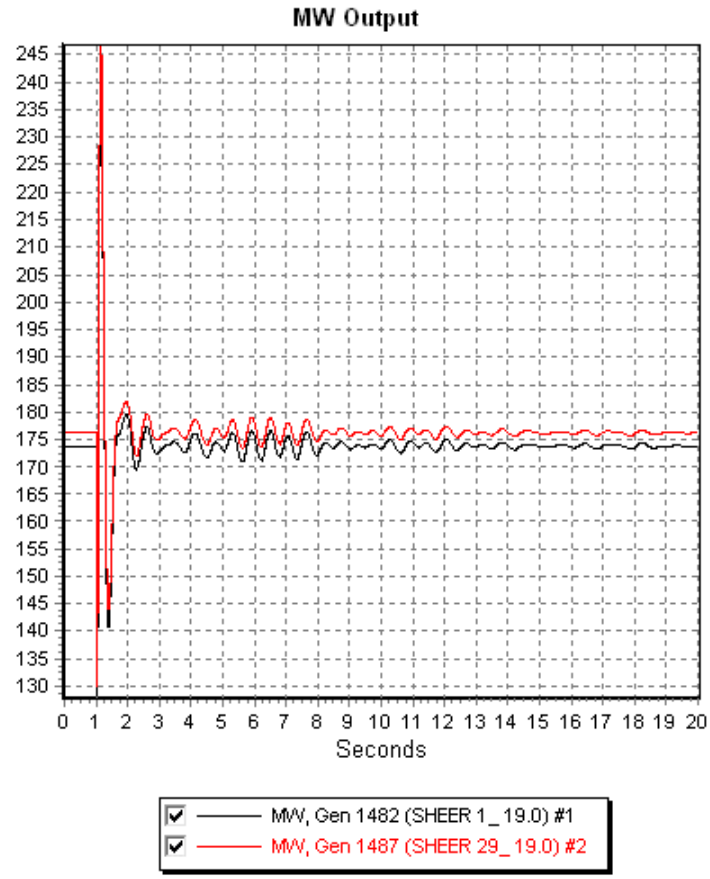
P1336
Queenstown Generating Plant
Output: 90MW

November 12, 2014 13:40:48

Sheerness





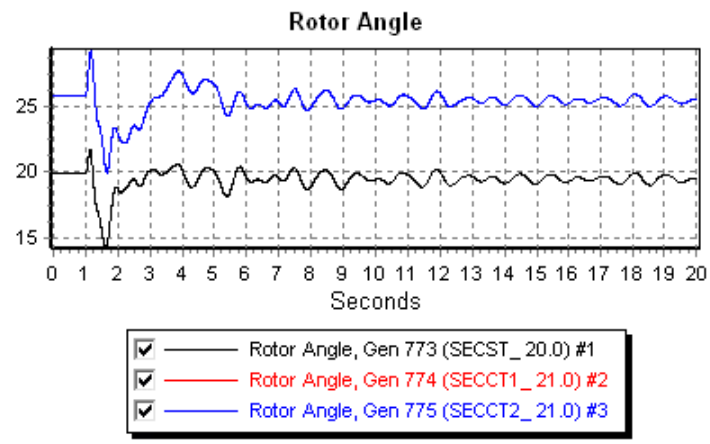


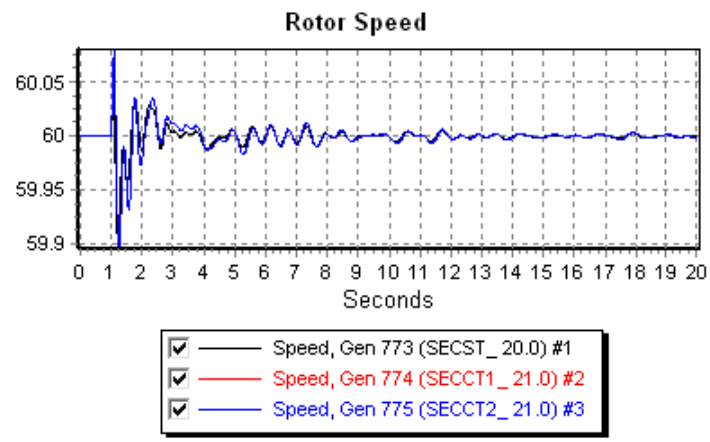
Contingency: 853L WEST BROOKS 28S - QUEENSTOWN 504S

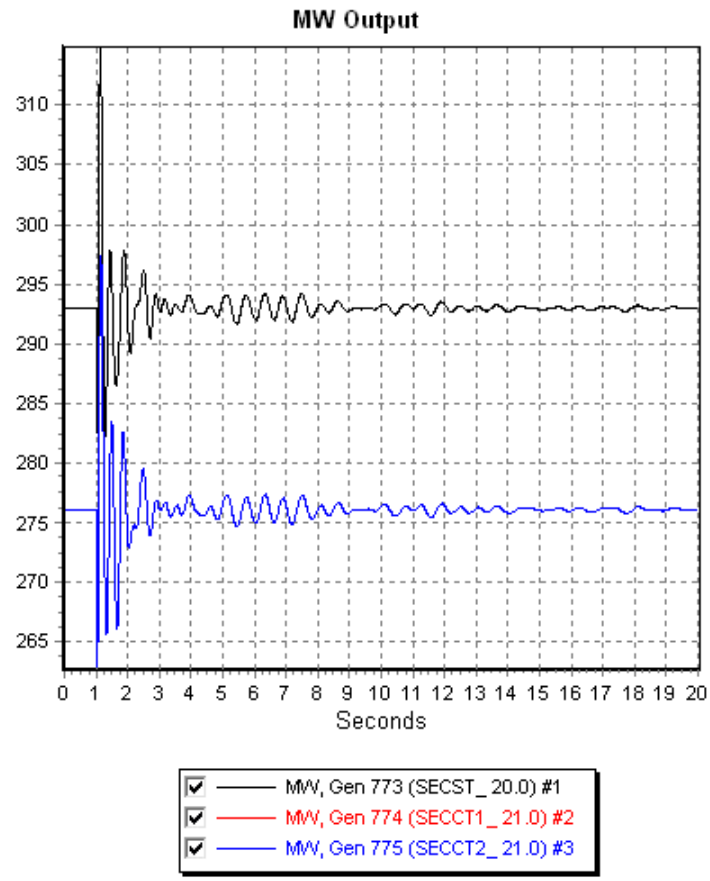
Sheerness
Queenstown Generating Plant Output: 90MW

November 12, 2014 13:40:47

Sheppard





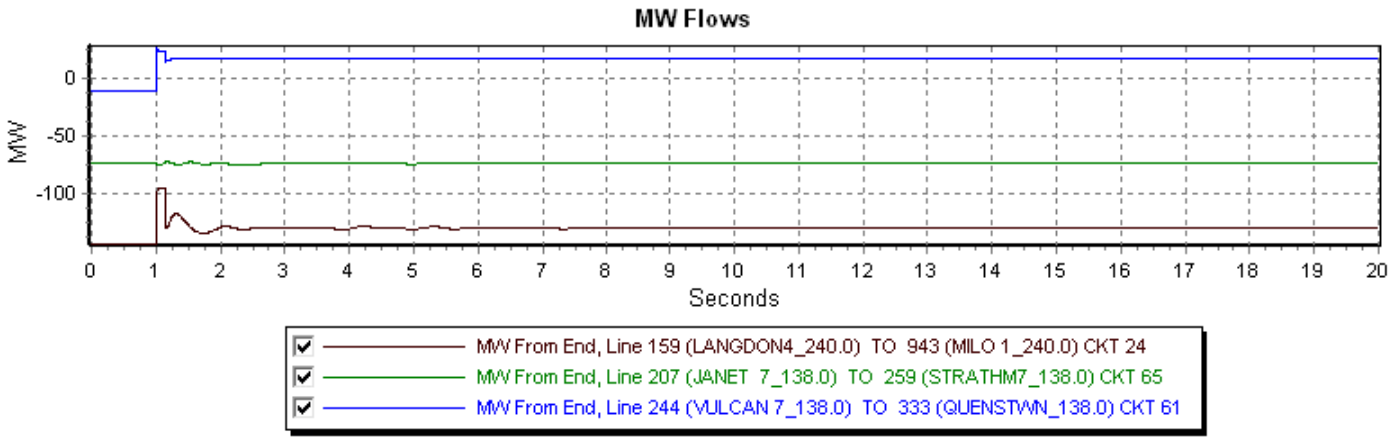


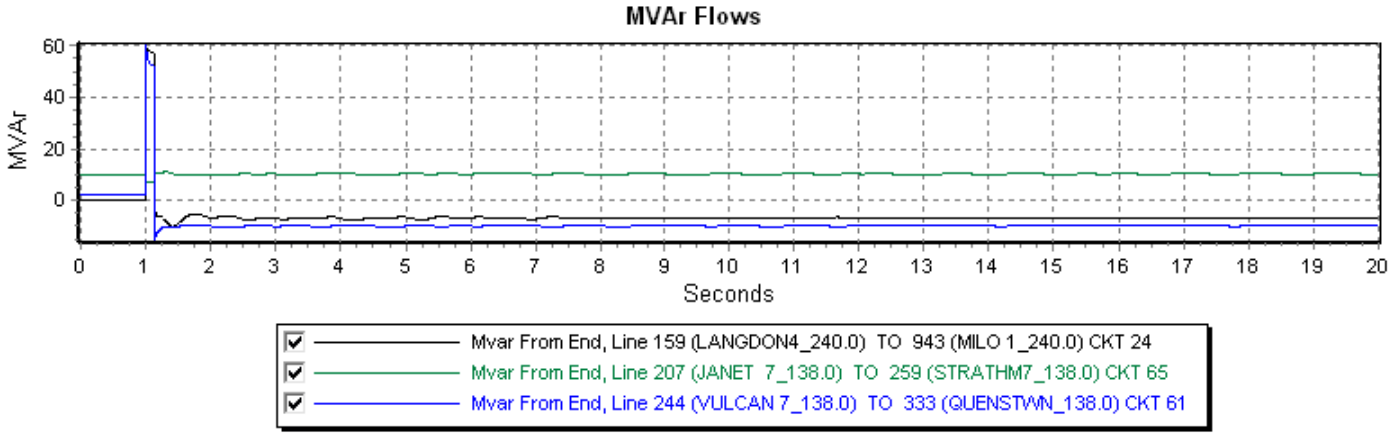
Contingency: 853L WEST BROOKS 28S - QUEENSTOWN 504S

Sheppard
Queenstown Generating Plant Output: 90MW

November 12, 2014 13:40:48

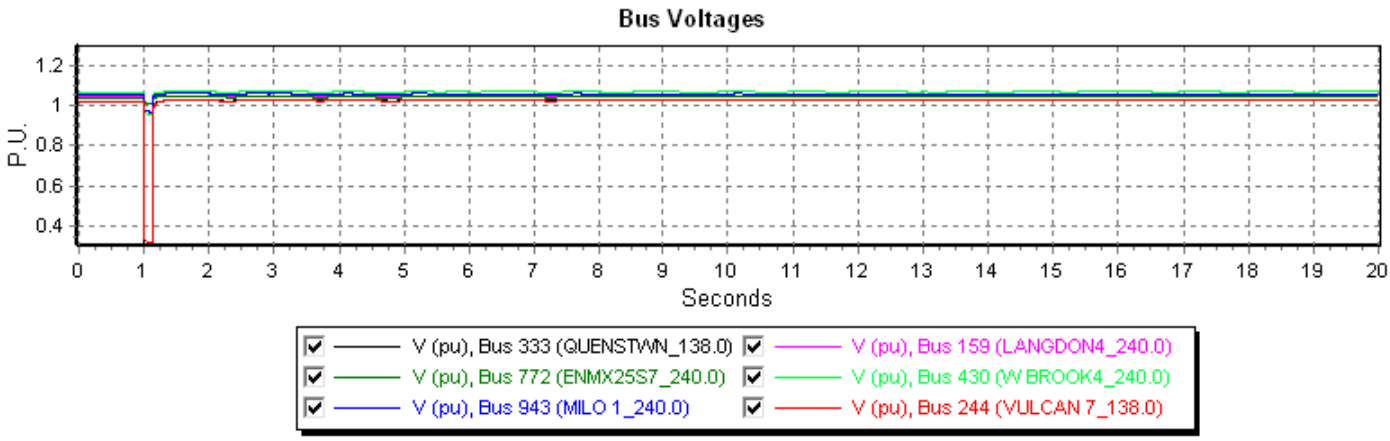
Branch Flows

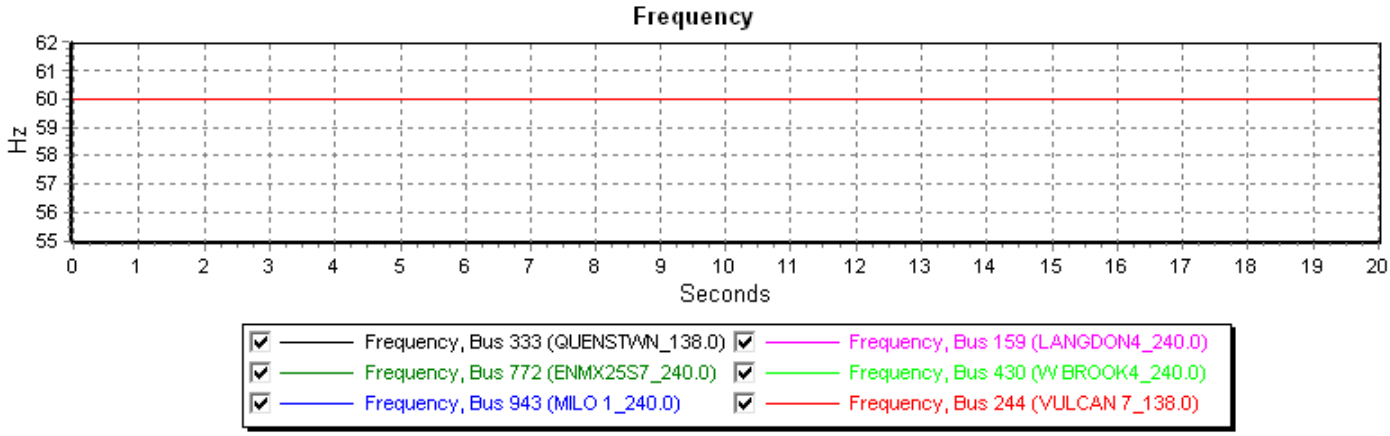




	Contingency: Queenstown Plant _McGregor200s 138 kV Bus	Branch Flows Queenstown Generating Plant Output: 90MW
		November 14, 2014 06:42:29

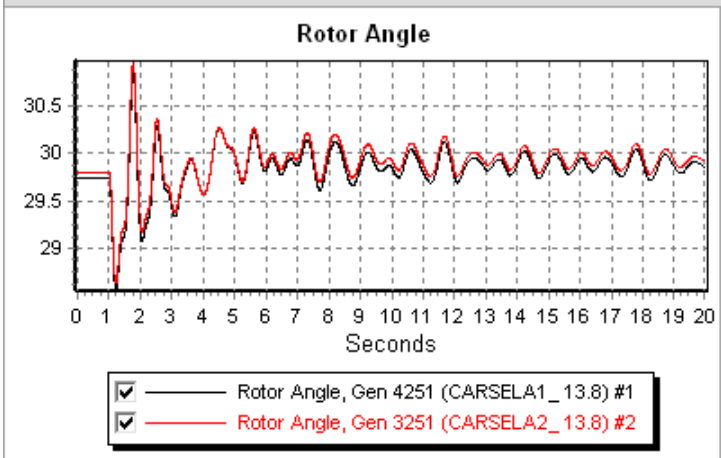
Bus Voltages and Frequency

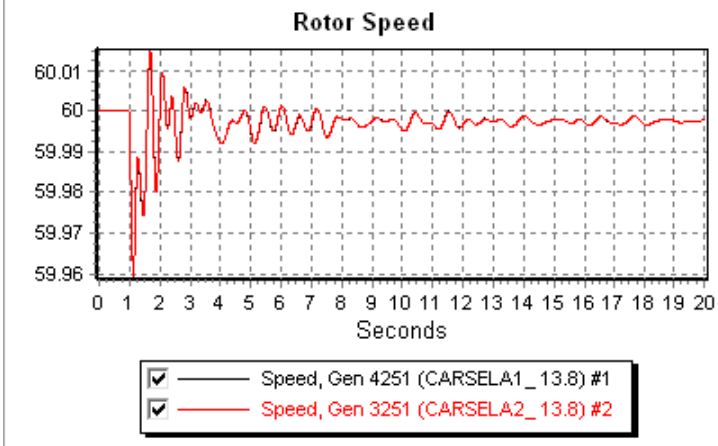


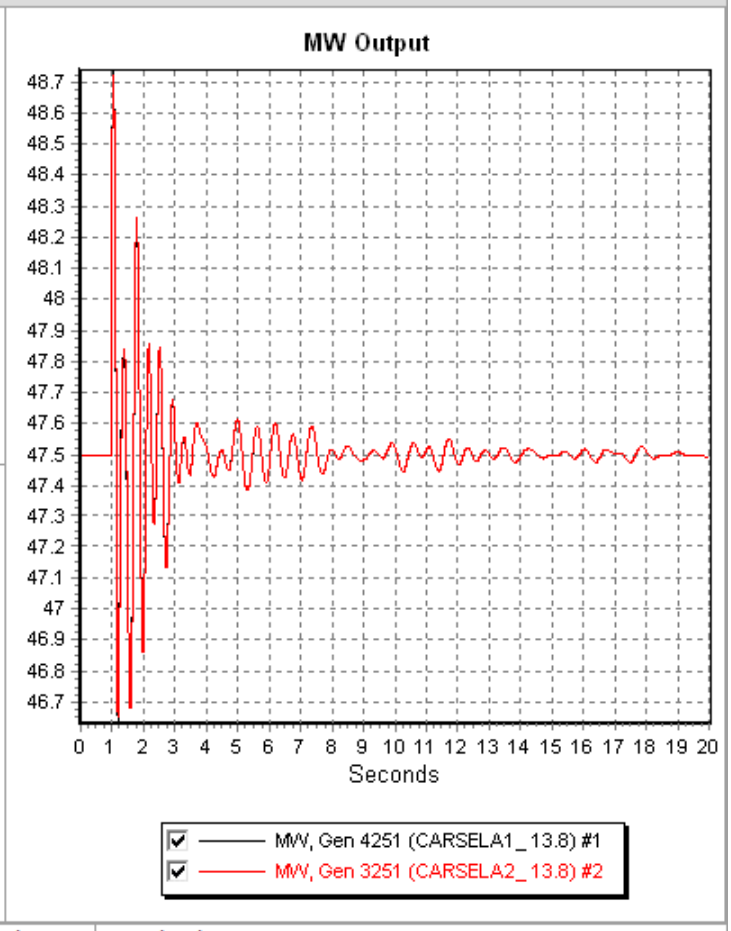


	Contingency: Queenstown Plant _McGregor200s 138 kV Bus	Bus Voltages and Frequency Queenstown Generating Plant Output: 90MW November 14, 2014 06:42:29

Carseland





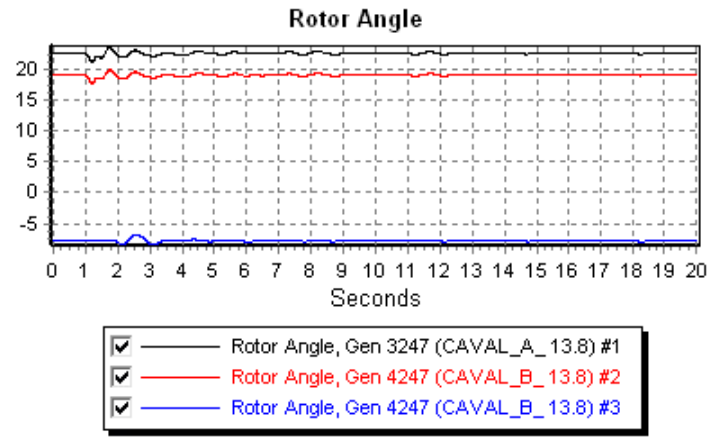


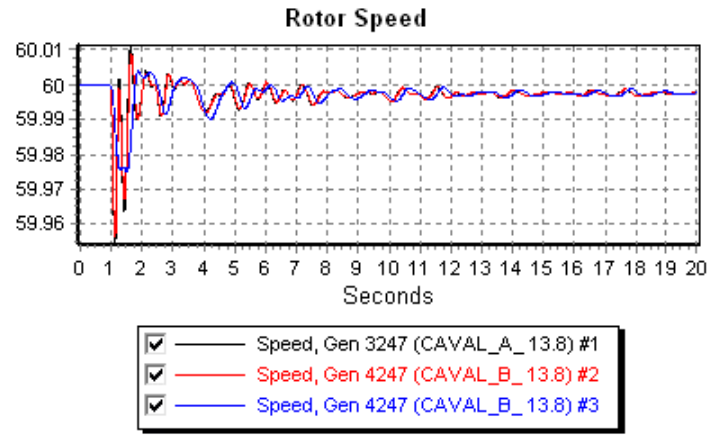
Contingency: Queenstown Plant _McGregor200s 138 kV Bus

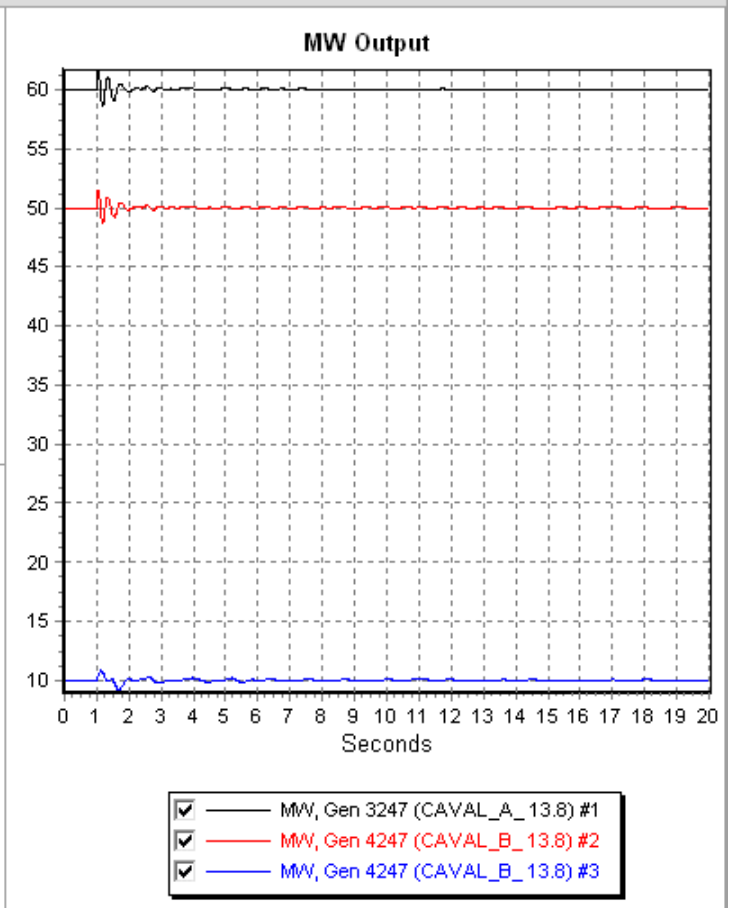
Carseland
Queenstown Generating Plant Output: 90MW

November 14, 2014 06:42:27

Cavalier





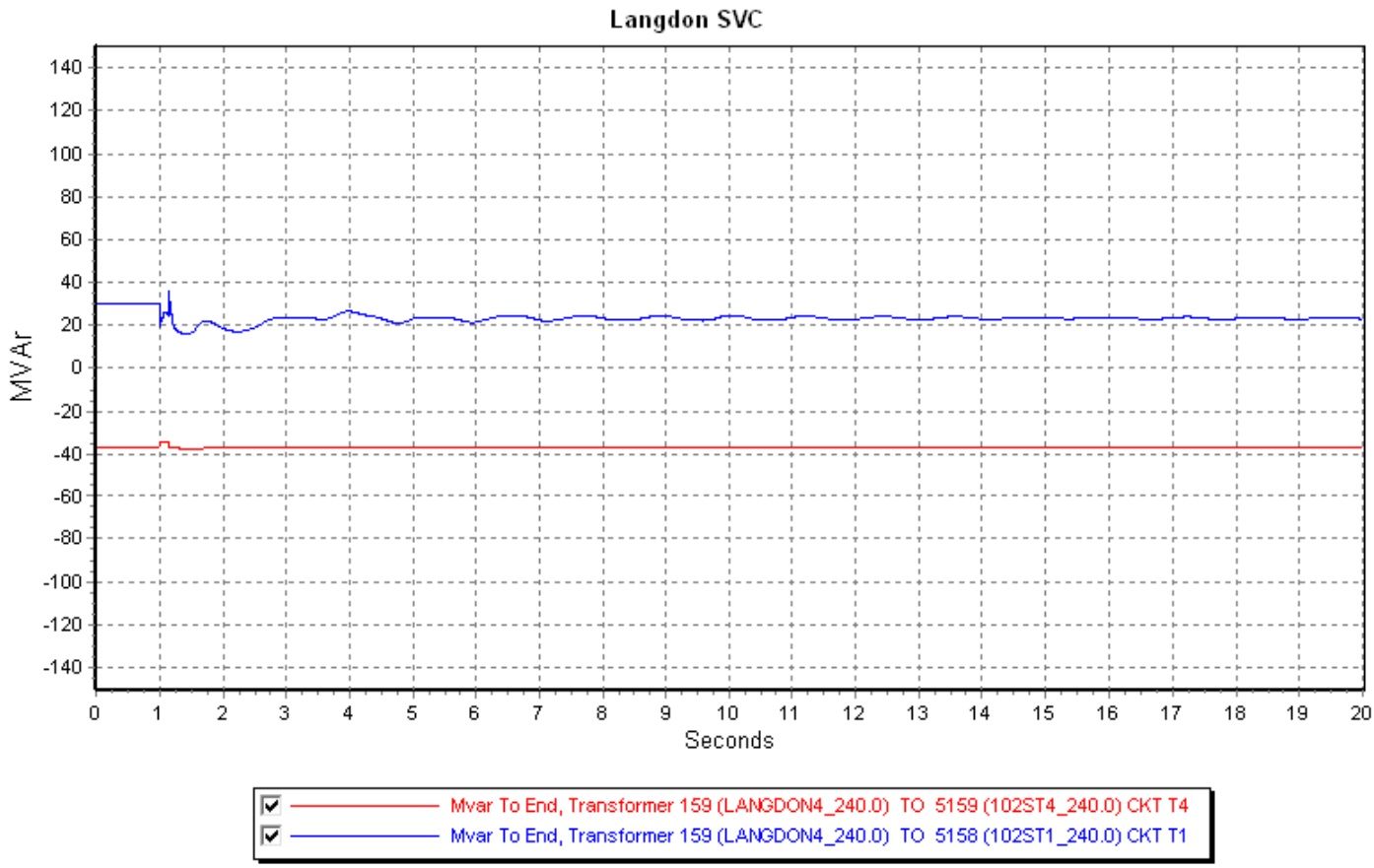


Contingency: Queenstown Plant _McGregor200s 138 kV Bus

Cavalier
Queenstown Generating Plant Output: 90MW

November 14, 2014 06:42:28

Langdon SVC

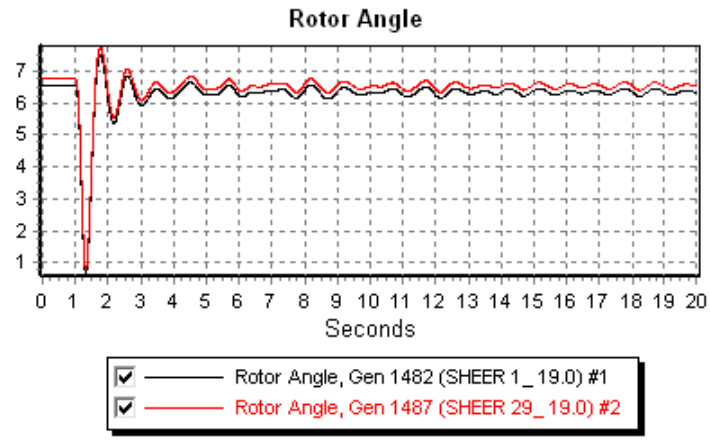


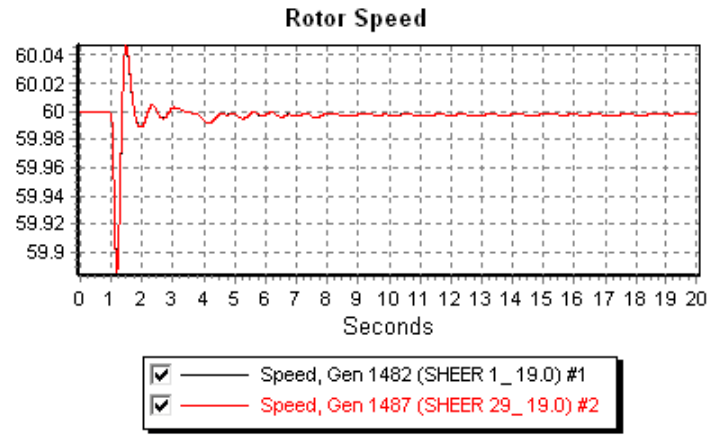
Contingency: Queenstown Plant _McGregor200s 138 kV Bus

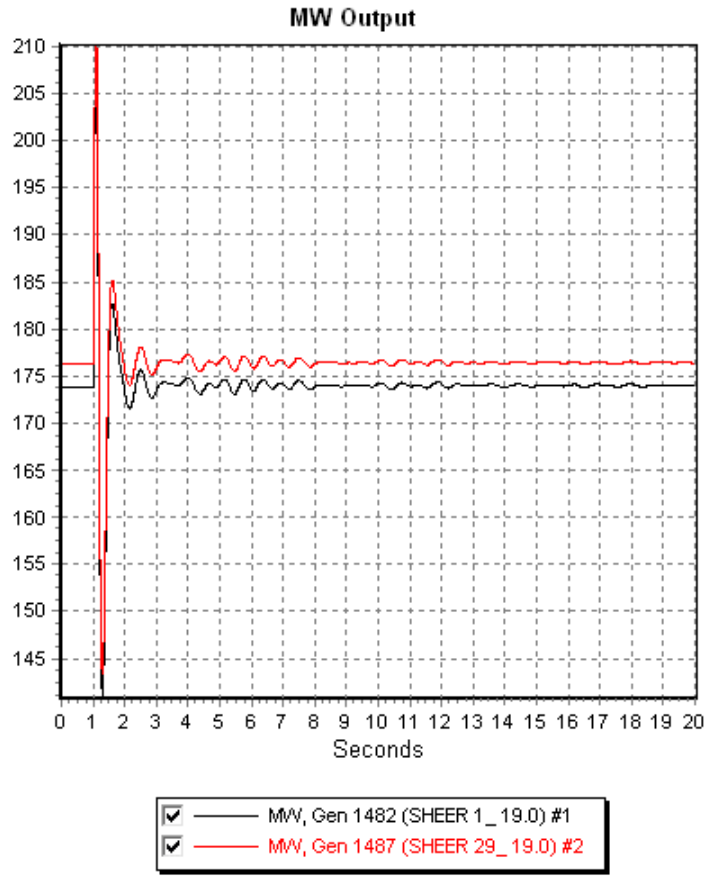
Langdon SVC
Queenstown Generating Plant Output: 90MW

November 14, 2014 06:42:31

Sheerness





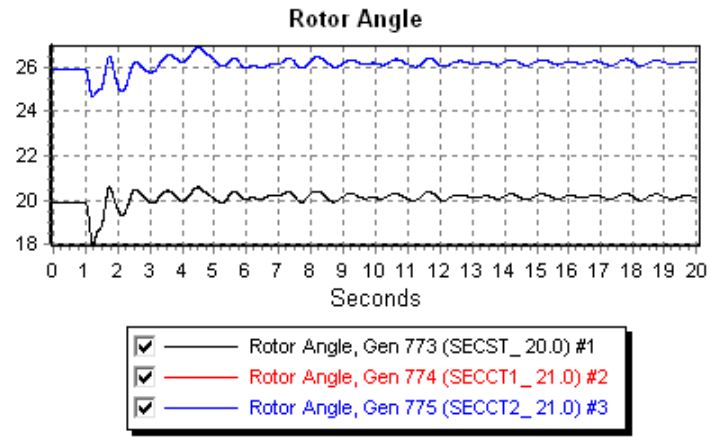


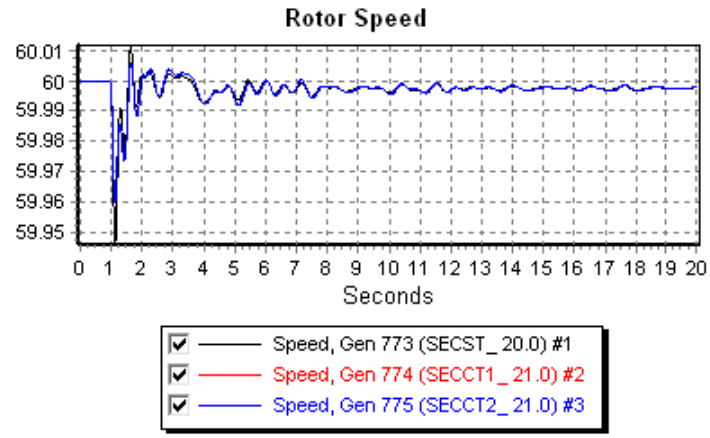
Contingency: Queenstown Plant _McGregor200s 138 kV Bus

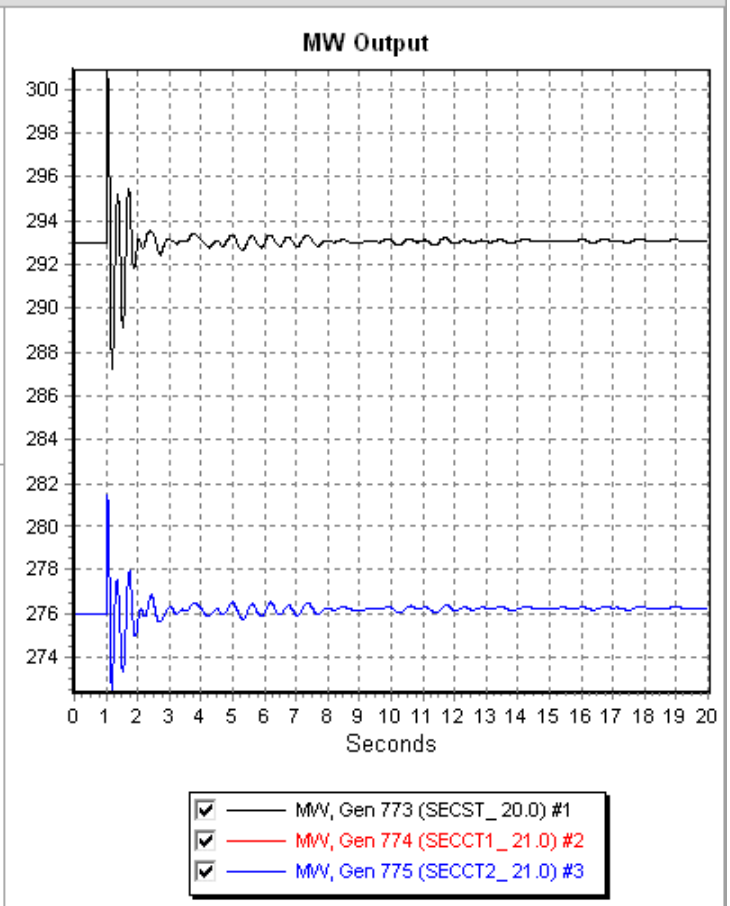
Sheerness
Queenstown Generating Plant Output: 90MW

November 14, 2014 06:42:26

Sheppard





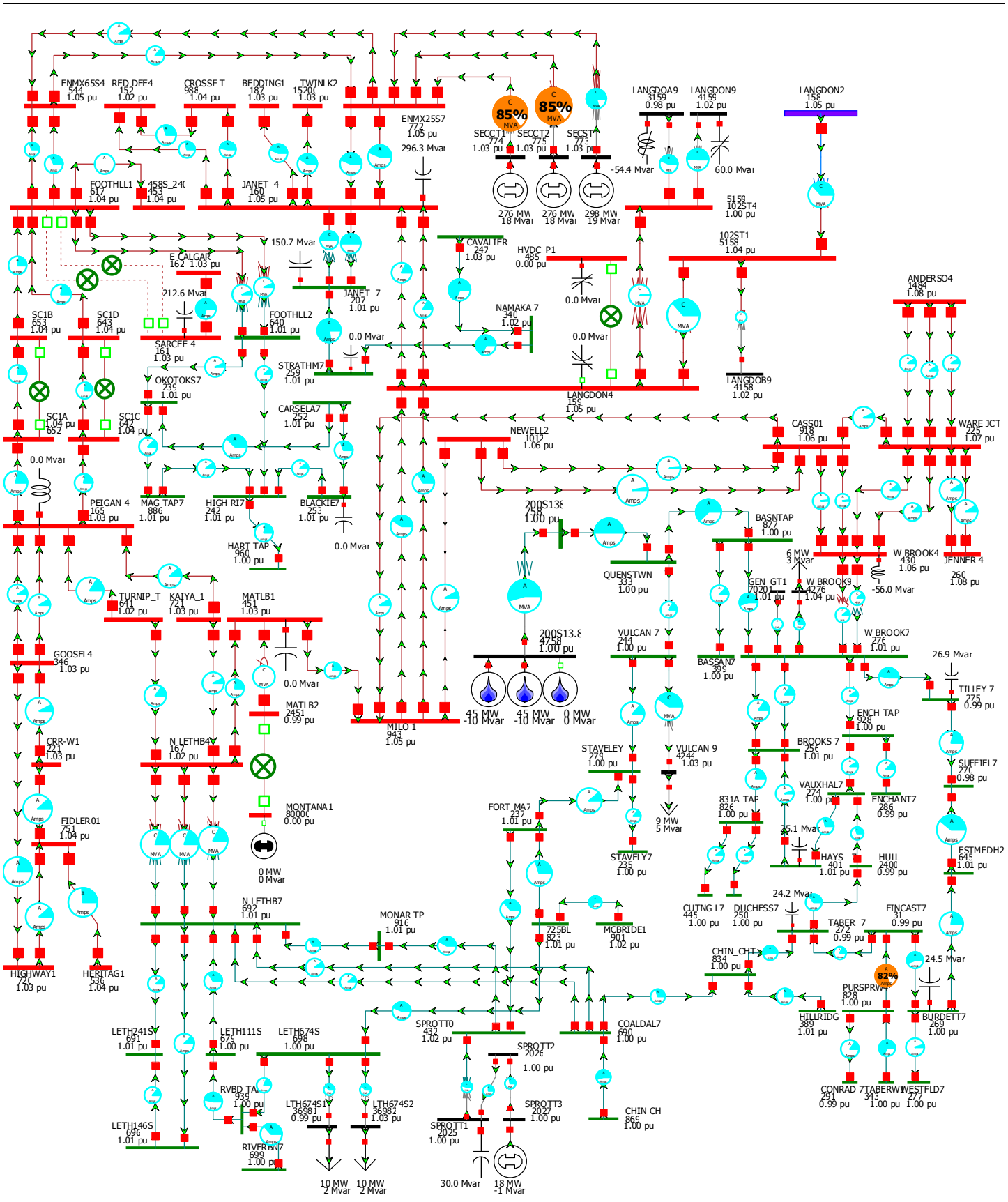


Contingency: Queenstown Plant _McGregor200s 138 kV Bus

Sheppard
Queenstown Generating Plant Output: 90MW

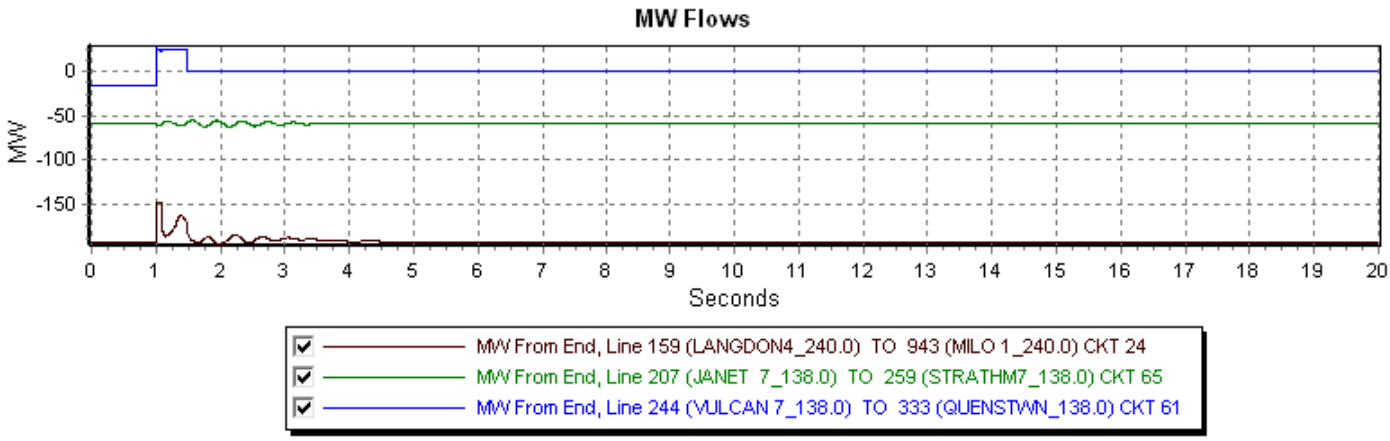
November 14, 2014 06:42:27

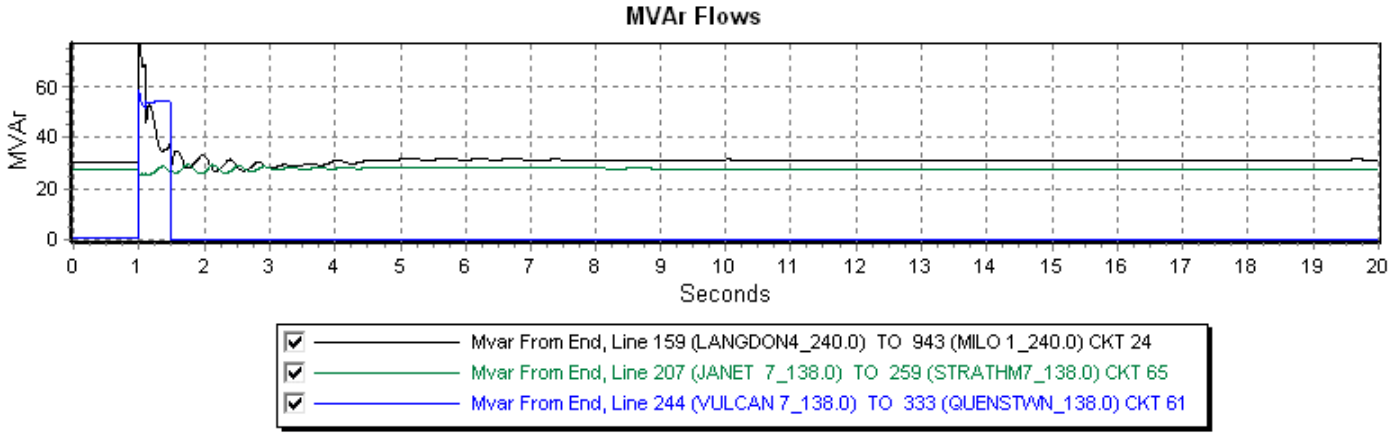
2017 SP



PowerEN Corporation D.Brankovich	Post-connection state, Alternative 1 Study case: 2017SP	Transient Stability Initial Conditions TS-04 11/5/2014

Branch Flows



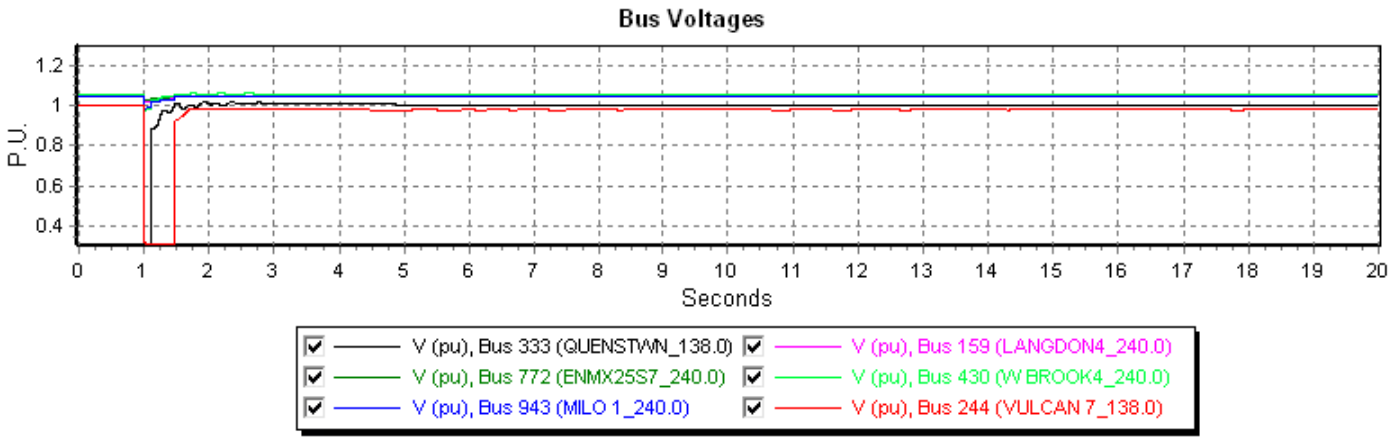


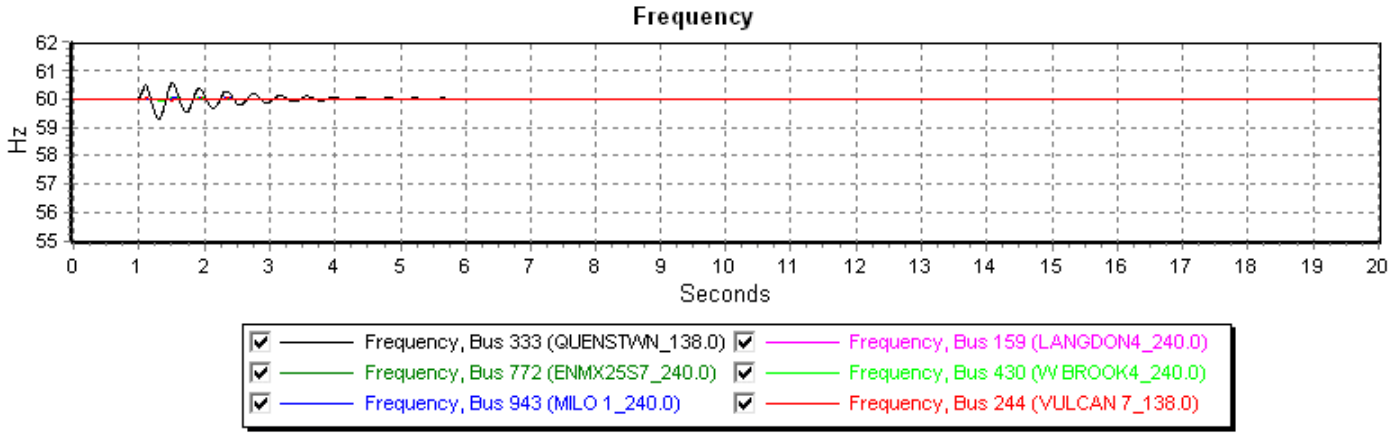
Contingency: 161L QUEENSTOWN 504S - VULCAN 255S

Branch Flows
Queenstown Generating Plant Output: 90MW

November 14, 2014 07:11:54

Bus Voltages and Frequency



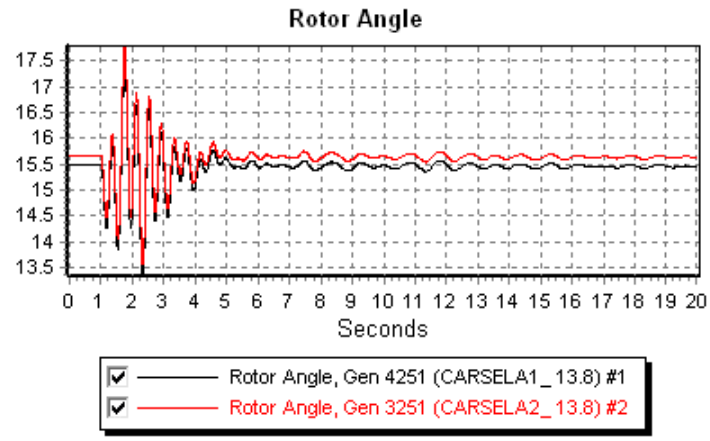


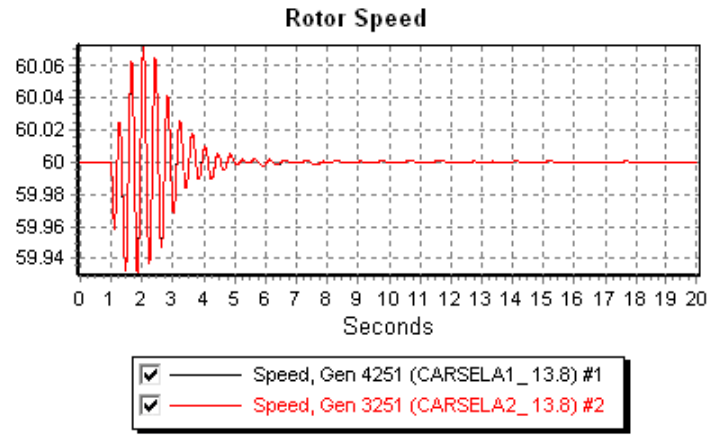
Contingency: 161L QUEENSTOWN 504S - VULCAN 255S

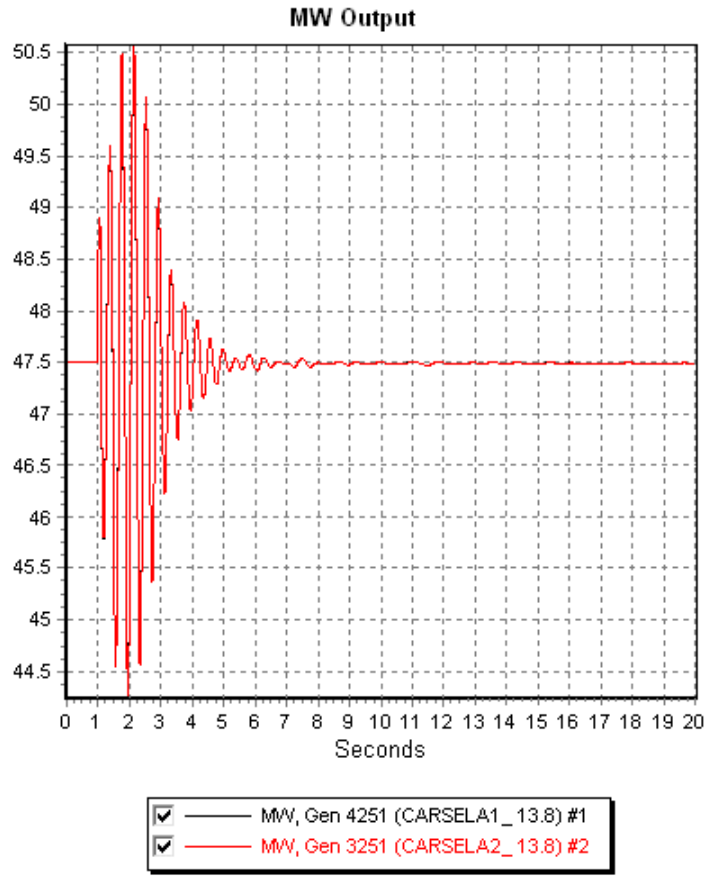
Bus Voltages and Frequency
Queenstown Generating Plant Output: 90MW

November 14, 2014 07:11:55

Carseland





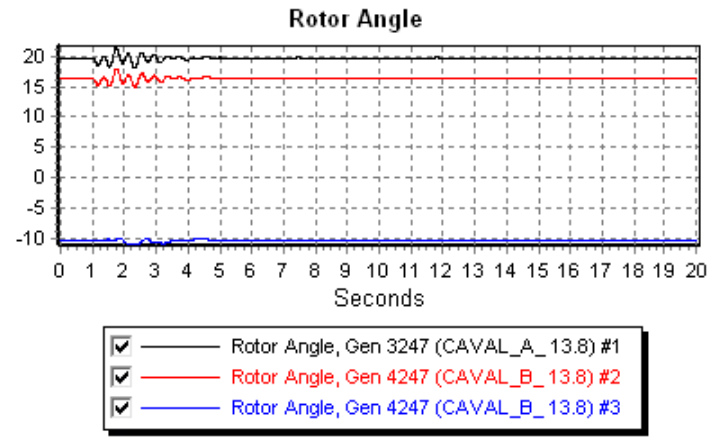


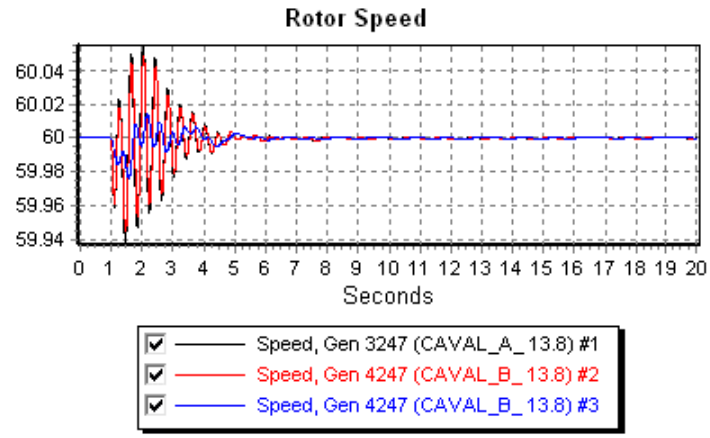
Contingency: 161L QUEENSTOWN 504S - VULCAN 255S

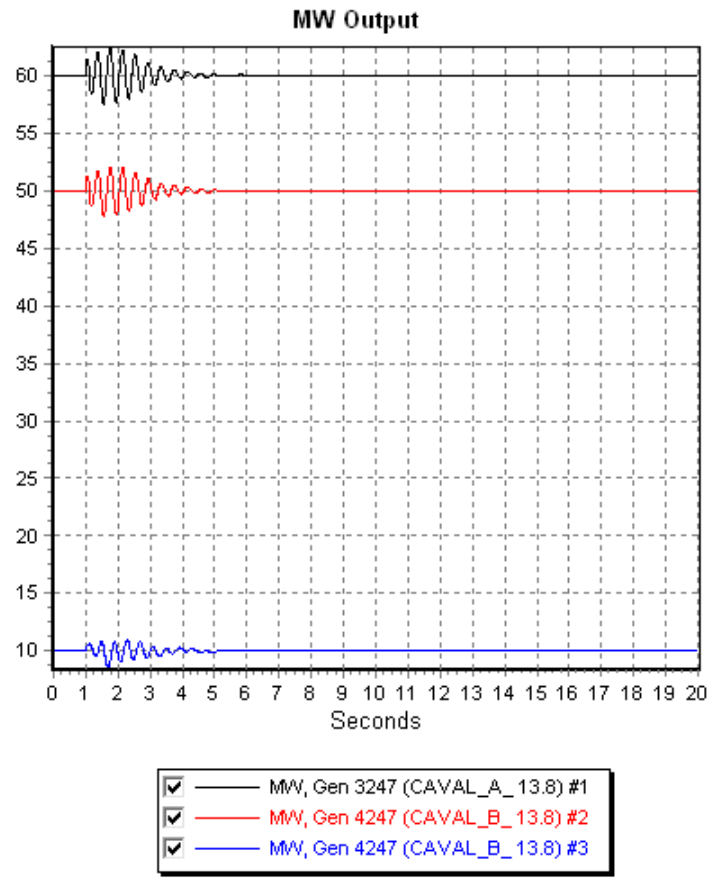
Carseland
Queenstown Generating Plant Output: 90MW

November 14, 2014 07:11:52

Cavalier





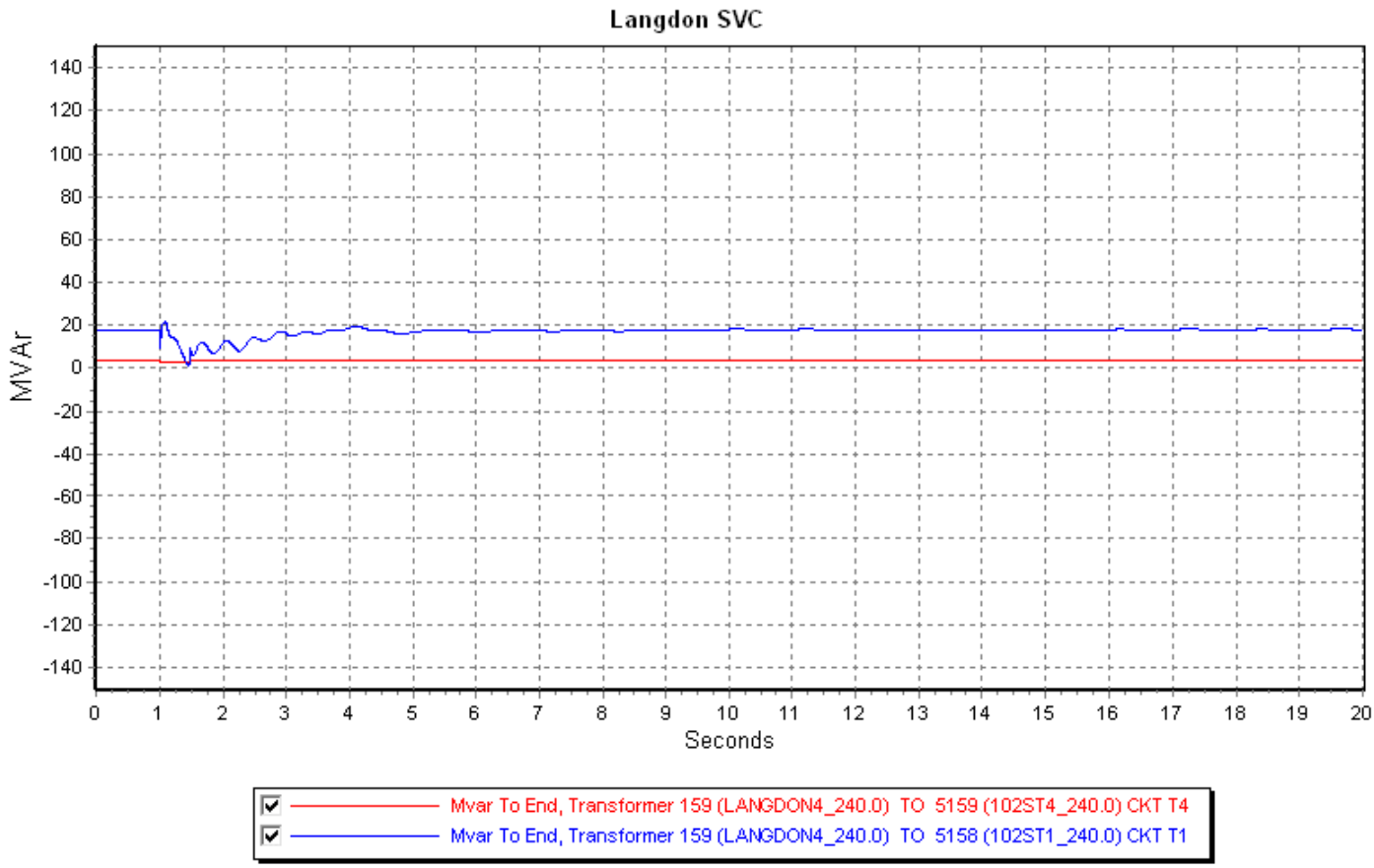


Contingency: 161L QUEENSTOWN 504S - VULCAN 255S

Cavalier
Queenstown Generating Plant Output: 90MW

November 14, 2014 07:11:54

Langdon SVC

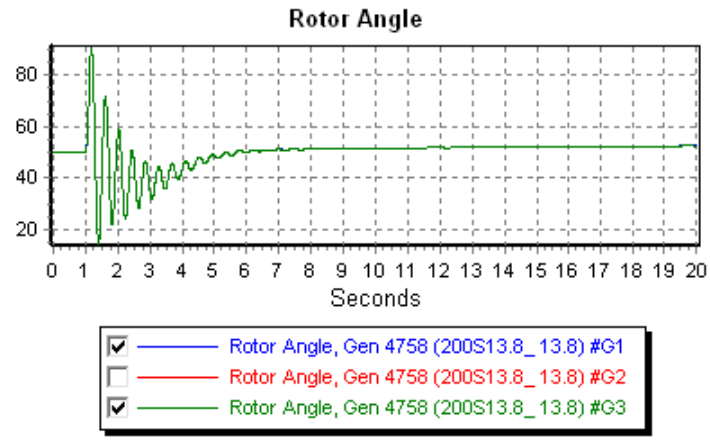


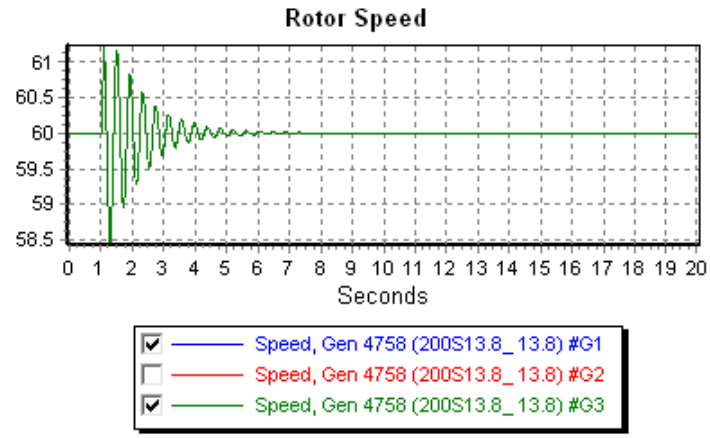
Contingency: 161L QUEENSTOWN 504S - VULCAN 255S

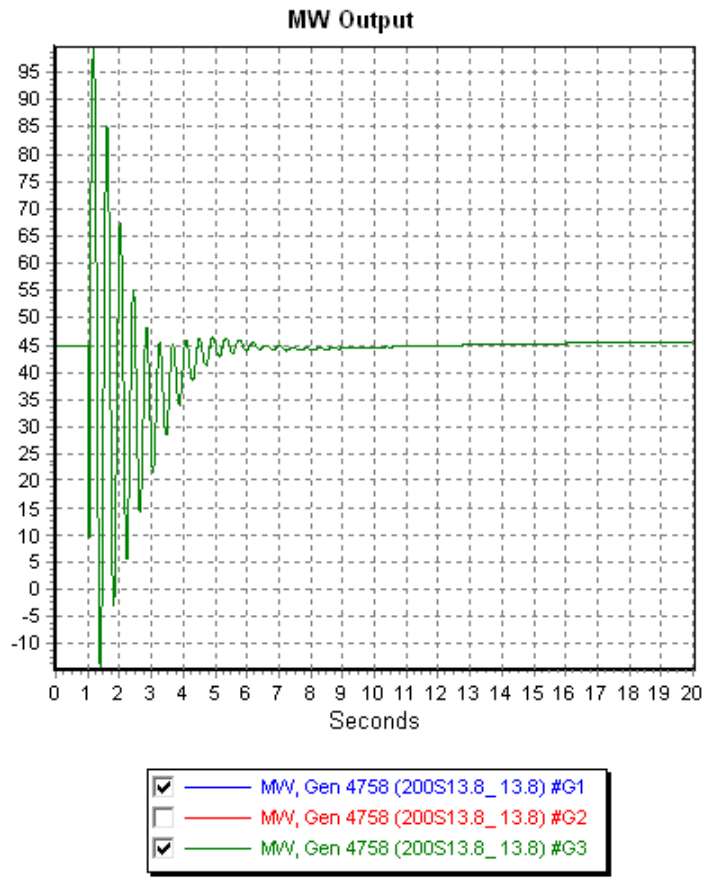
Langdon SVC
Queenstown Generating Plant Output: 90MW

November 14, 2014 07:11:56

Queenstown Gen





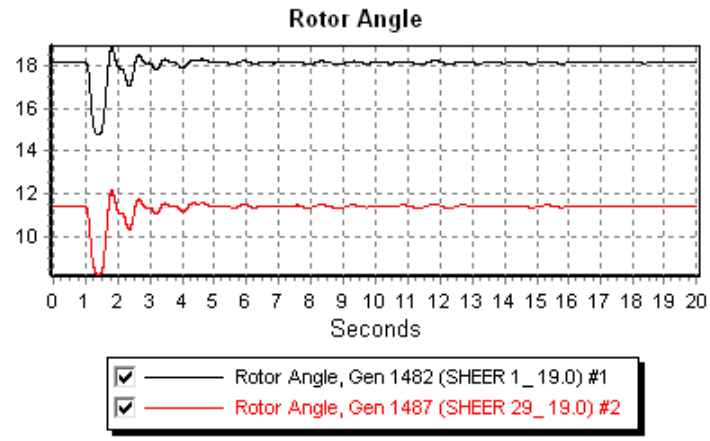


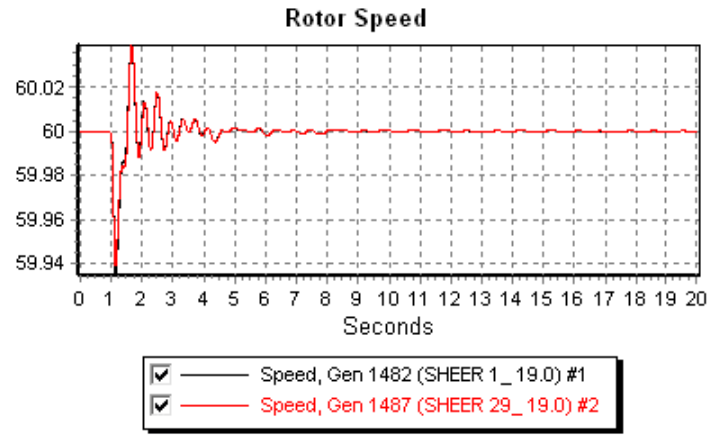
Contingency: 161L QUEENSTOWN 504S - VULCAN 255S

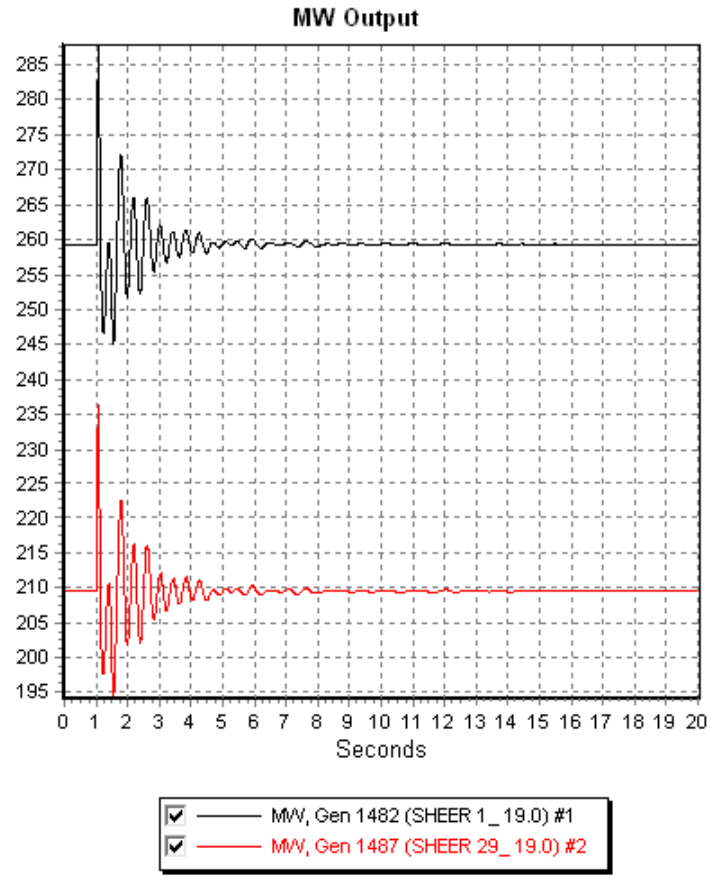
P1336
Queenstown Generating Plant
Output: 90MW

November 14, 2014 07:11:53

Sheerness





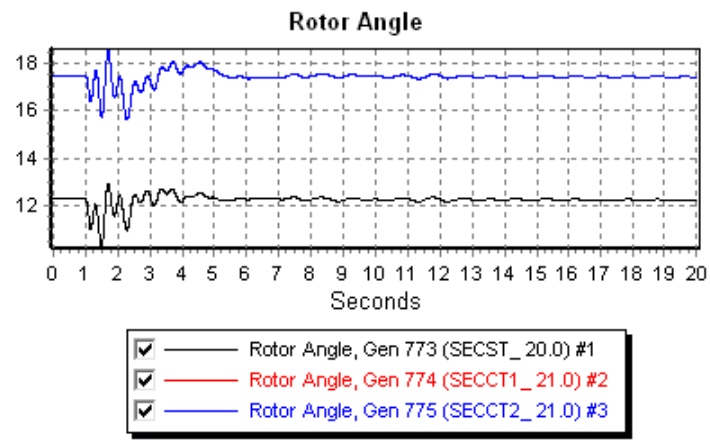


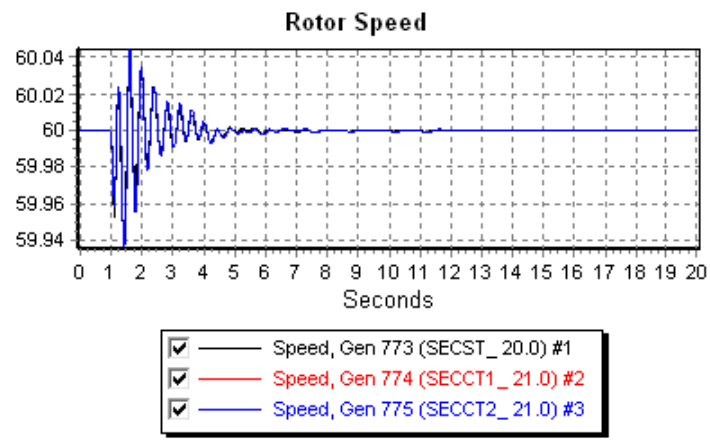
Contingency: 161L QUEENSTOWN 504S - VULCAN 255S

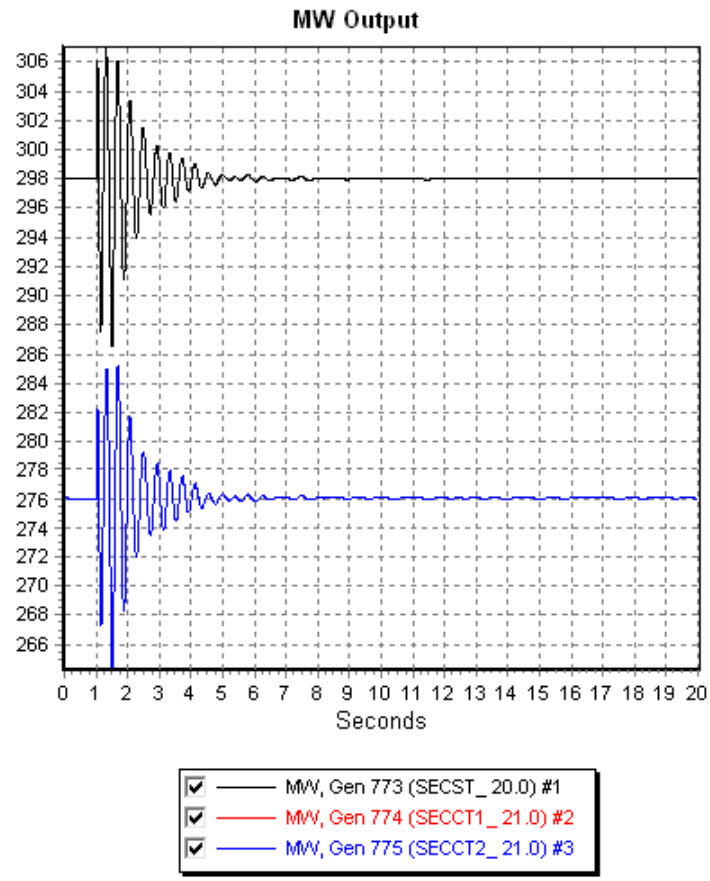
Sheerness
Queenstown Generating Plant Output: 90MW

November 14, 2014 07:11:52

Sheppard





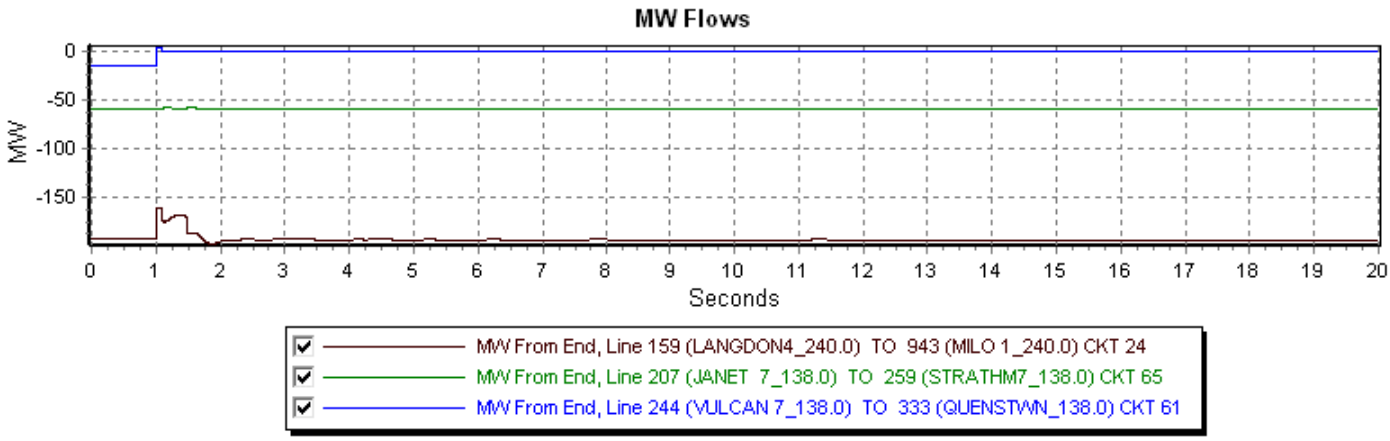


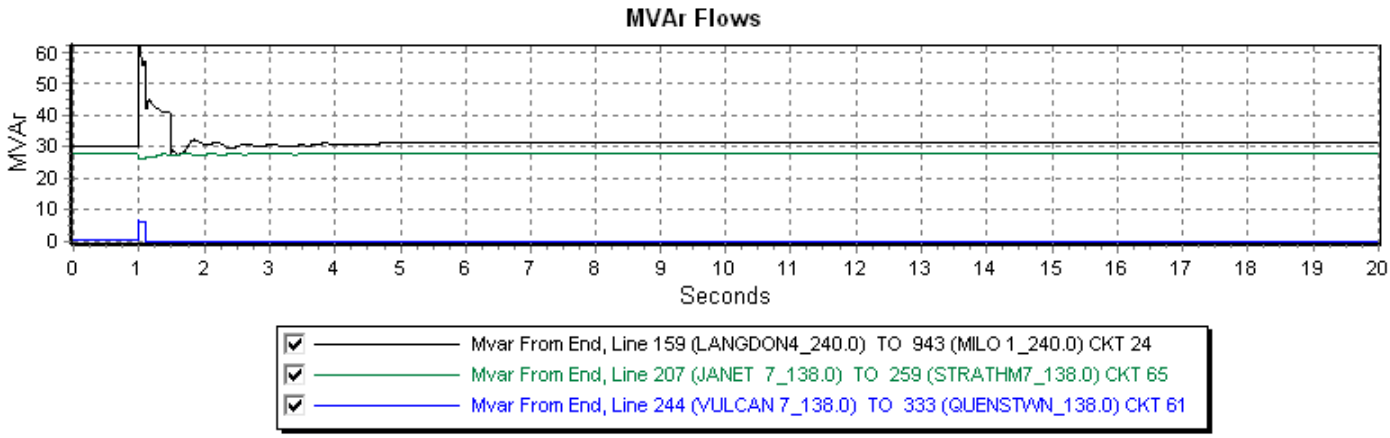
Contingency: 161L QUEENSTOWN 504S - VULCAN 255S

Sheppard
Queenstown Generating Plant Output: 90MW

November 14, 2014 07:11:53

Branch Flows



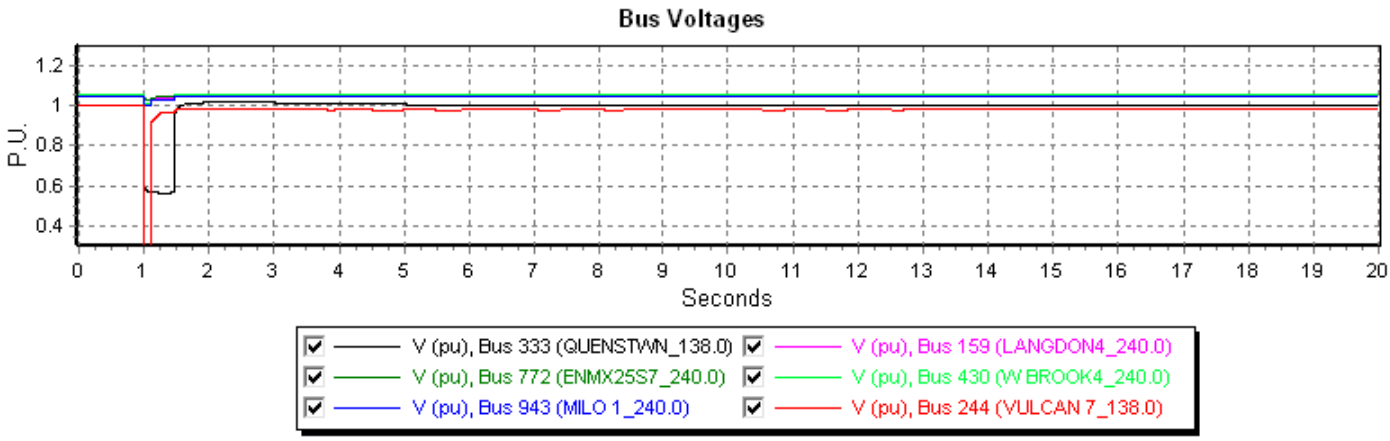


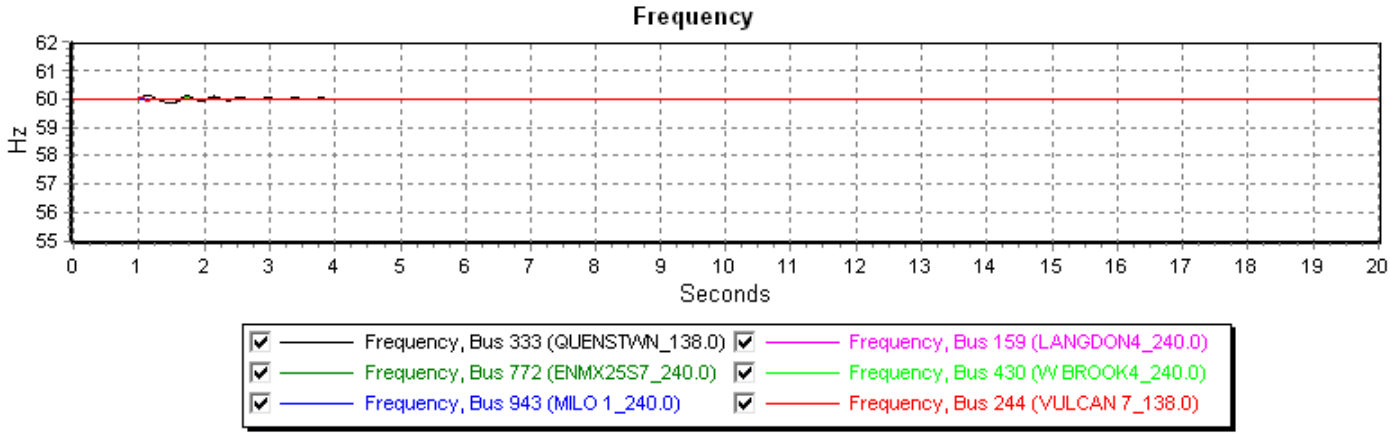
Contingency: 161L VULCAN 255S - QUEENSTOWN 504S

Branch Flows
Queenstown Generating Plant Output: 90MW

November 14, 2014 07:13:13

Bus Voltages and Frequency



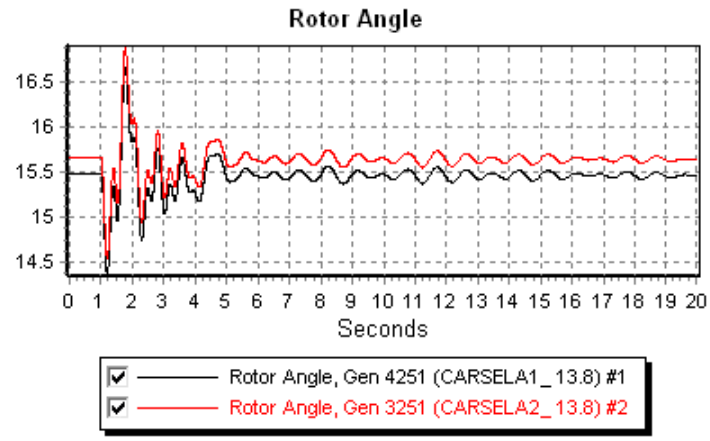


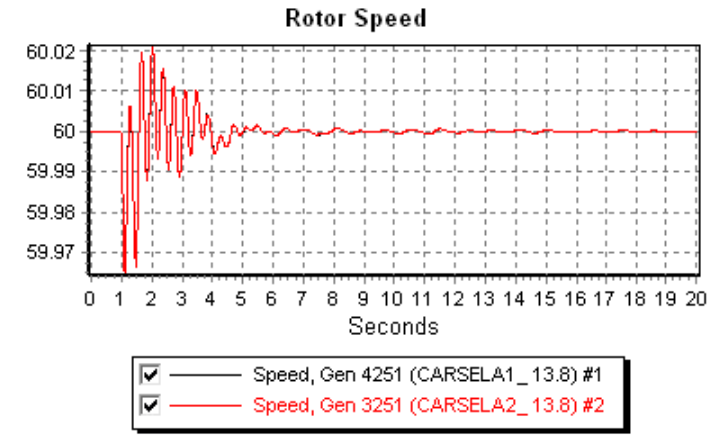
Contingency: 161L VULCAN 255S - QUEENSTOWN 504S

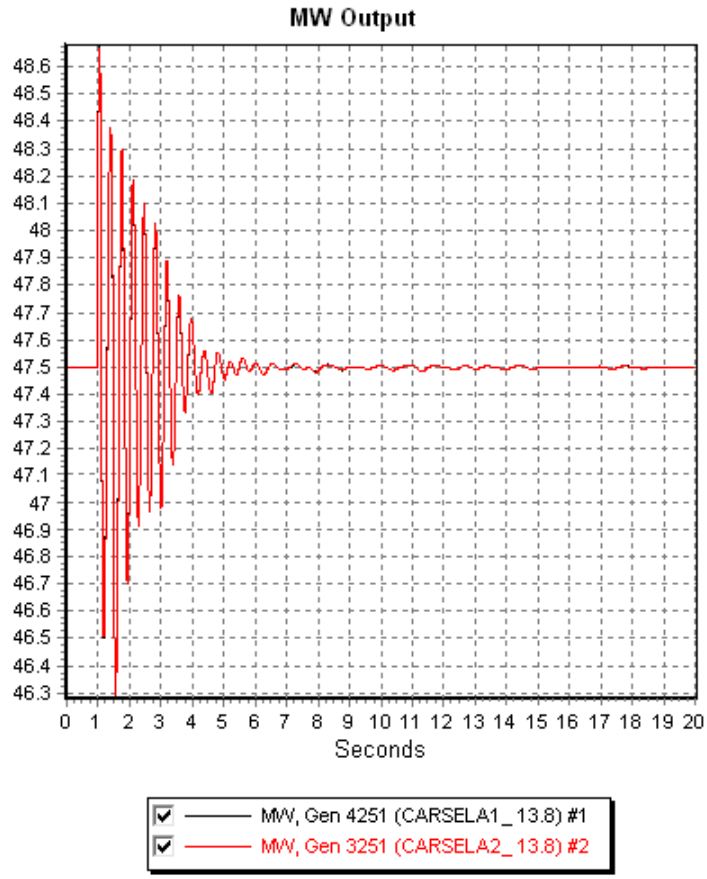
Bus Voltages and Frequency
Queenstown Generating Plant Output: 90MW

November 14, 2014 07:13:14

Carseland





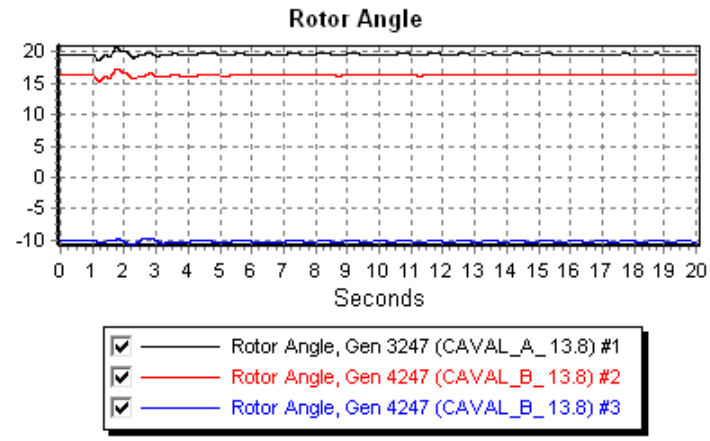


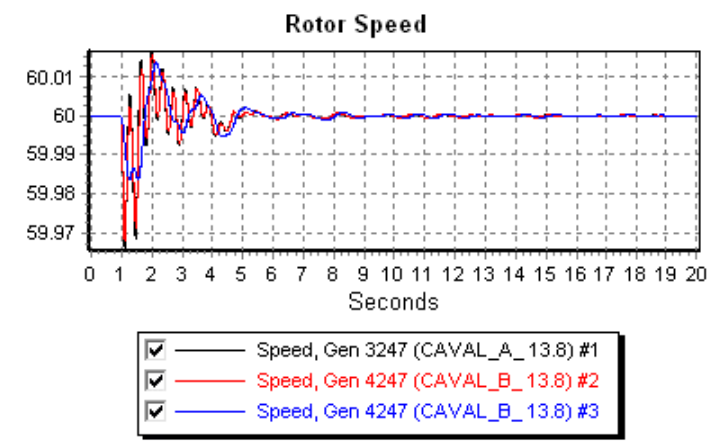
Contingency: 161L VULCAN 255S - QUEENSTOWN 504S

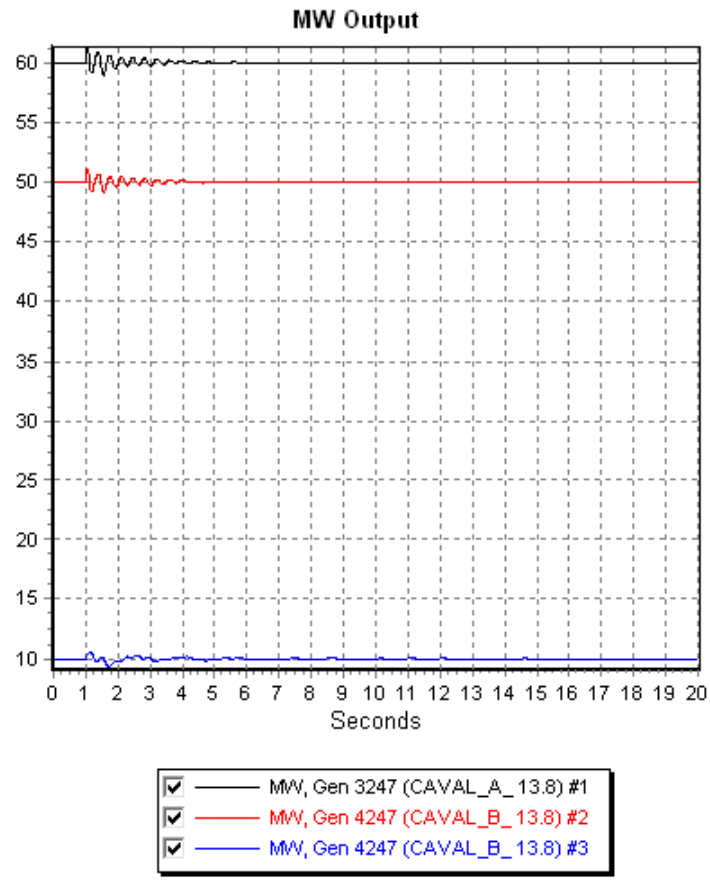
Carseland
Queenstown Generating Plant Output: 90MW

November 14, 2014 07:13:11

Cavalier





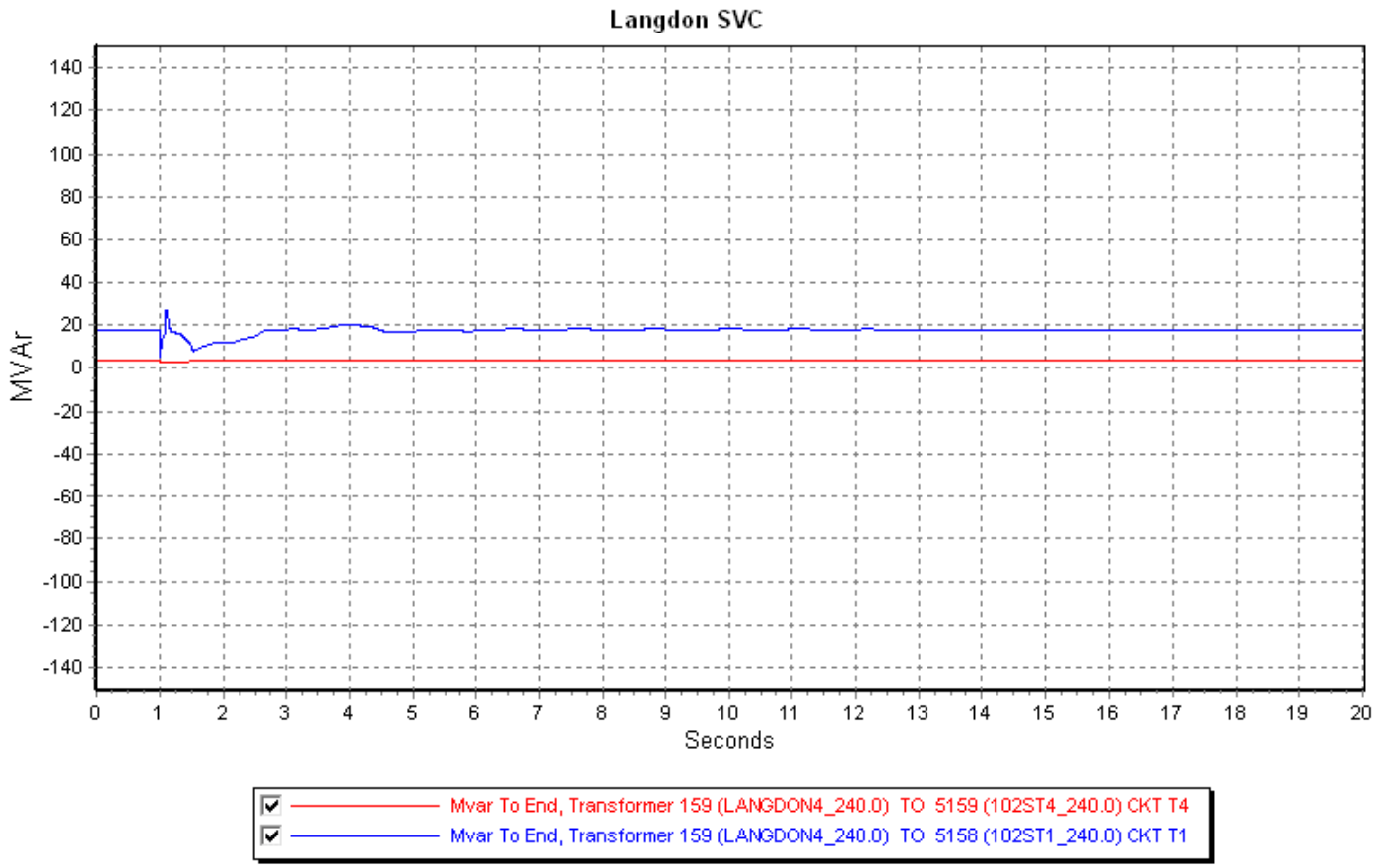


Contingency: 161L VULCAN 255S - QUEENSTOWN 504S

Cavalier
Queenstown Generating Plant Output: 90MW

November 14, 2014 07:13:13

Langdon SVC

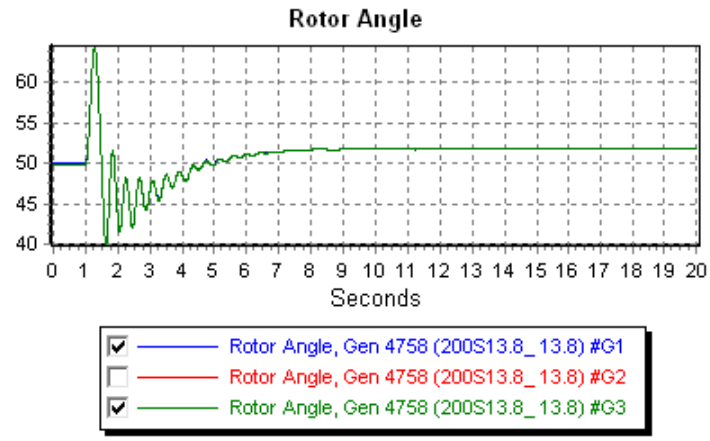


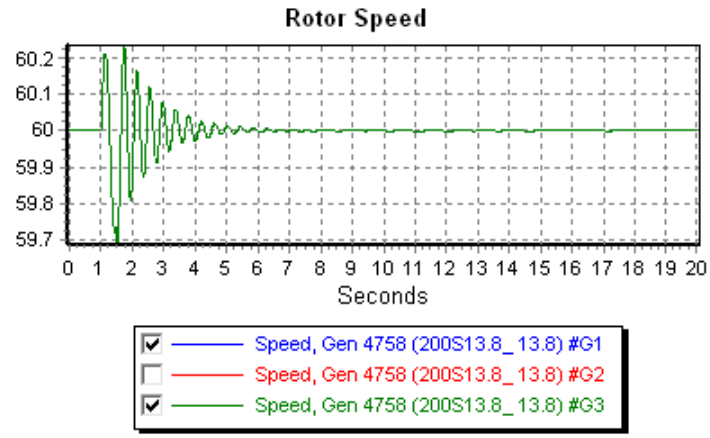
Contingency: 161L VULCAN 255S - QUEENSTOWN 504S

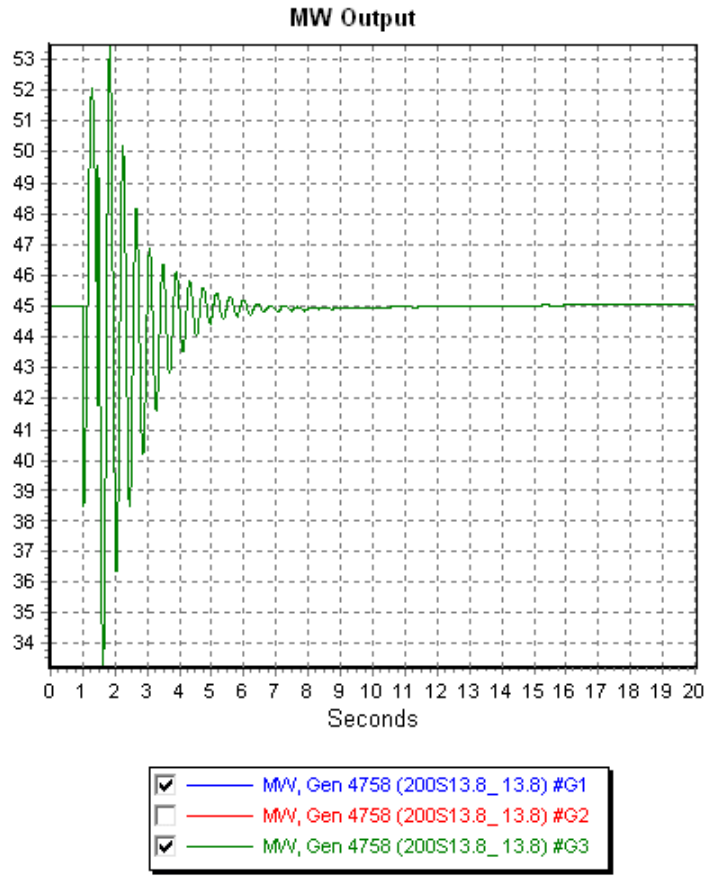
Langdon SVC
Queenstown Generating Plant Output: 90MW

November 14, 2014 07:13:14

Queenstown Gen





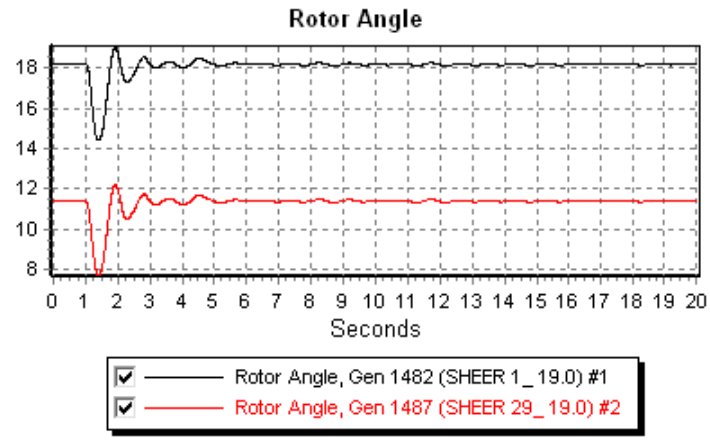


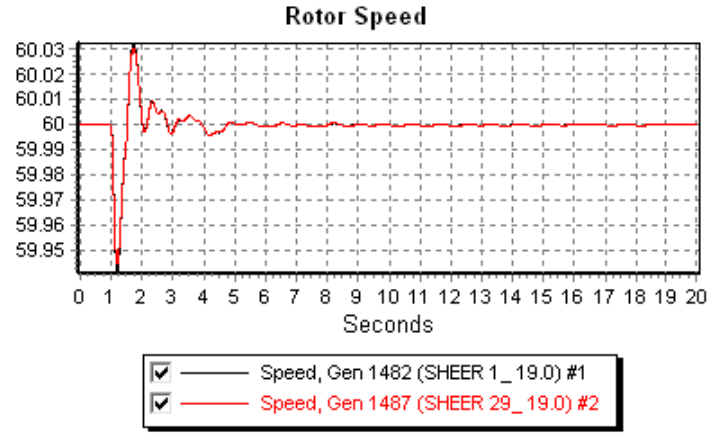
Contingency: 161L VULCAN 255S - QUEENSTOWN 504S

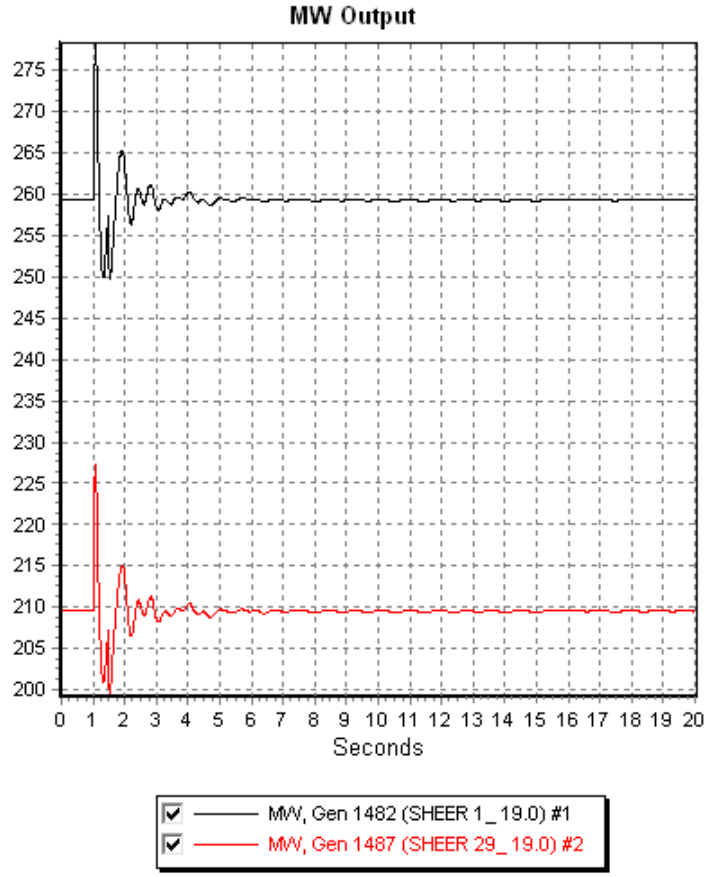
P1336
Queenstown Generating Plant
Output: 90MW

November 14, 2014 07:13:12

Sheerness





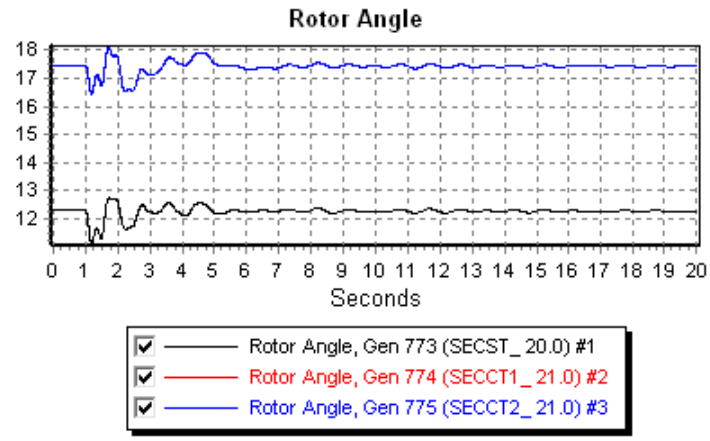


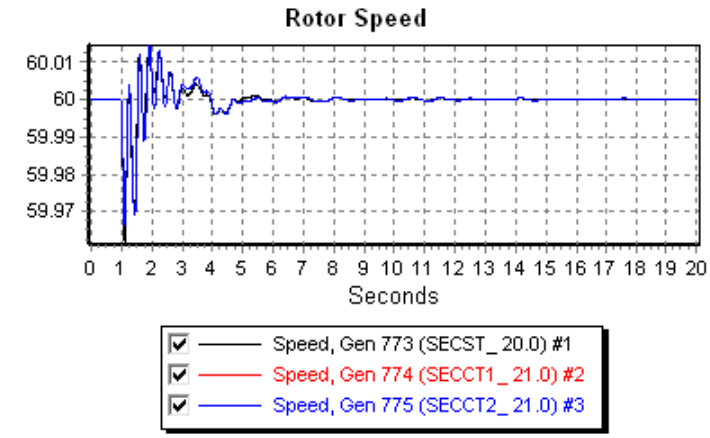
Contingency: 161L VULCAN 255S - QUEENSTOWN 504S

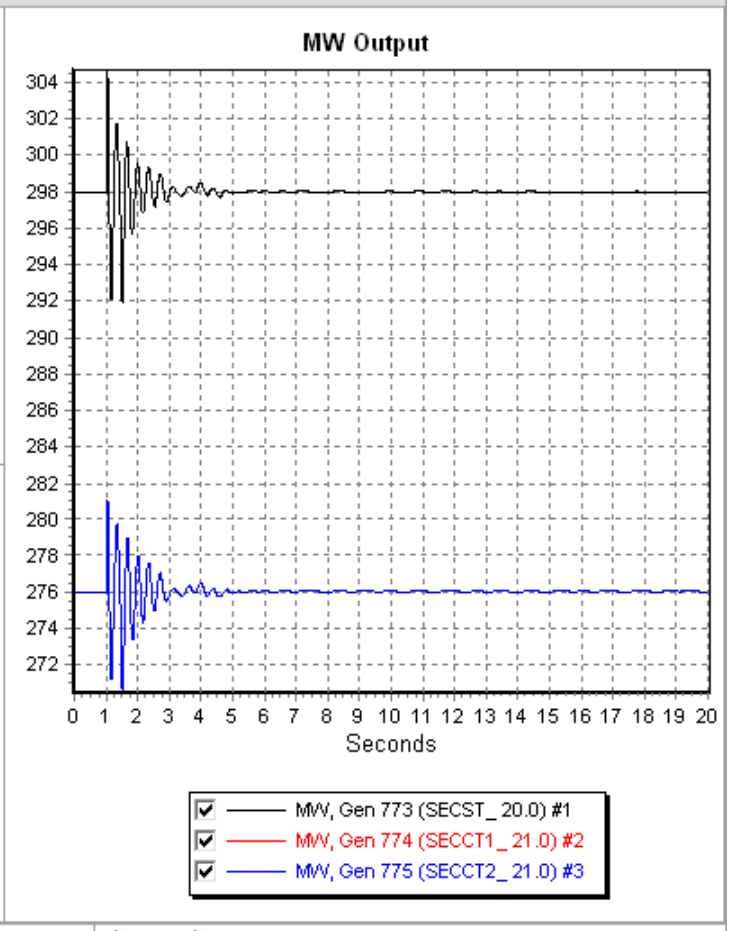
Sheerness
Queenstown Generating Plant Output: 90MW

November 14, 2014 07:13:11

Sheppard





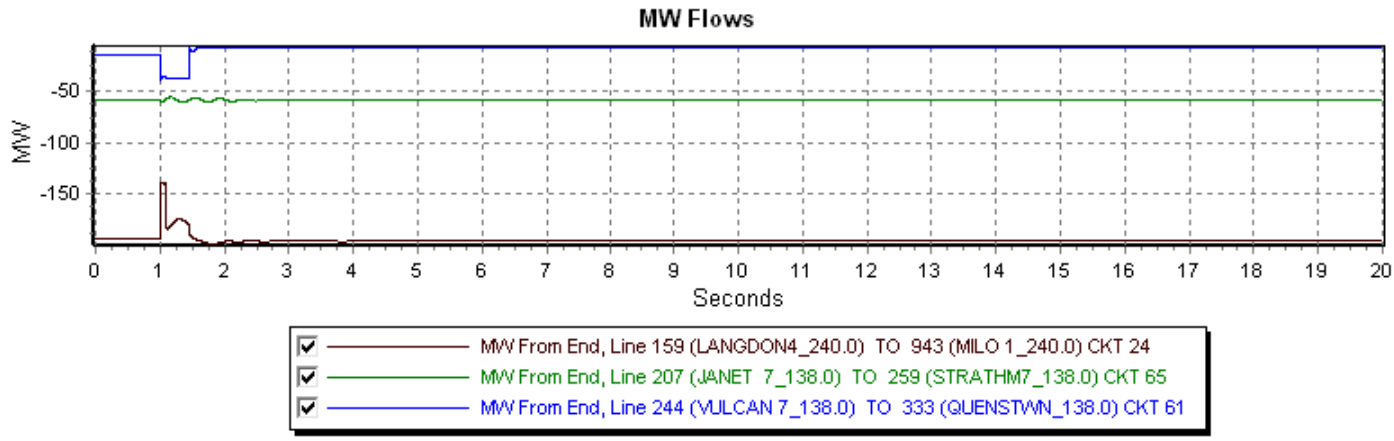


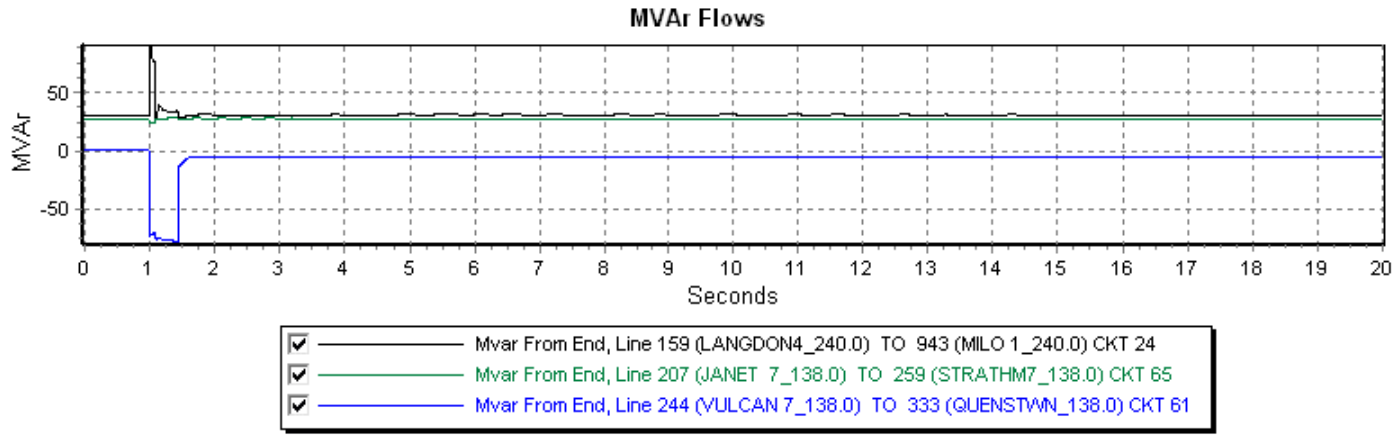
Contingency: 161L VULCAN 255S - QUEENSTOWN 504S

Sheppard
Queenstown Generating Plant Output: 90MW

November 14, 2014 07:13:12

Branch Flows



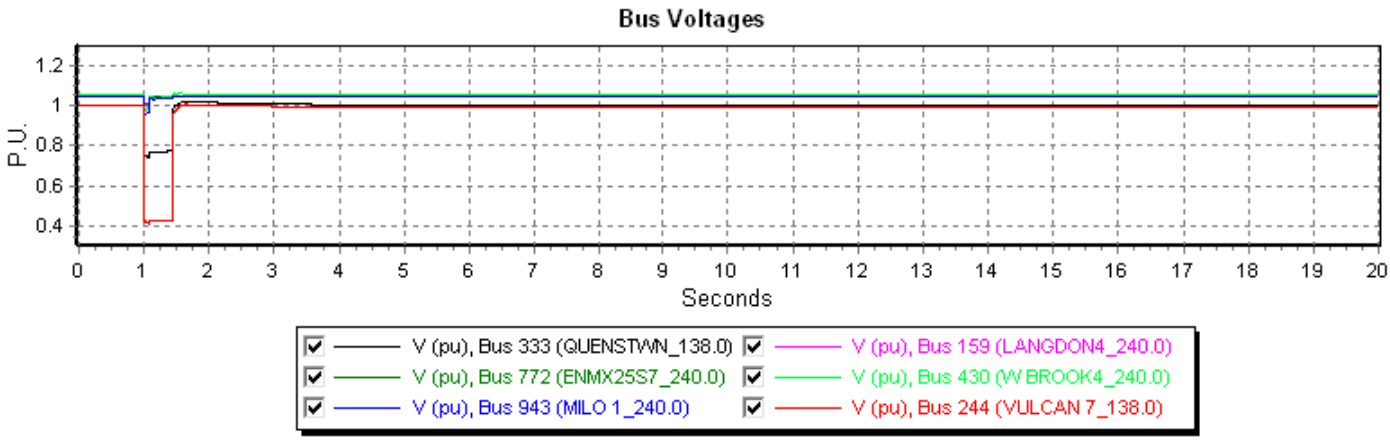


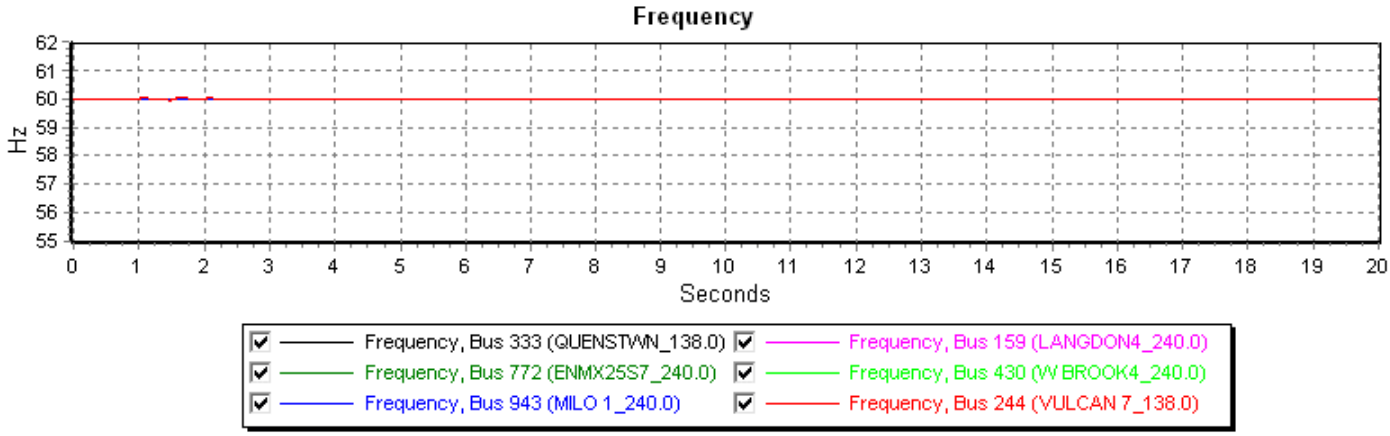
Contingency: 180L Ft.McLeod 15S to Vulcan 255S

Branch Flows
Queenstown Generating Plant Output: 90MW

November 14, 2014 07:14:18

Bus Voltages and Frequency



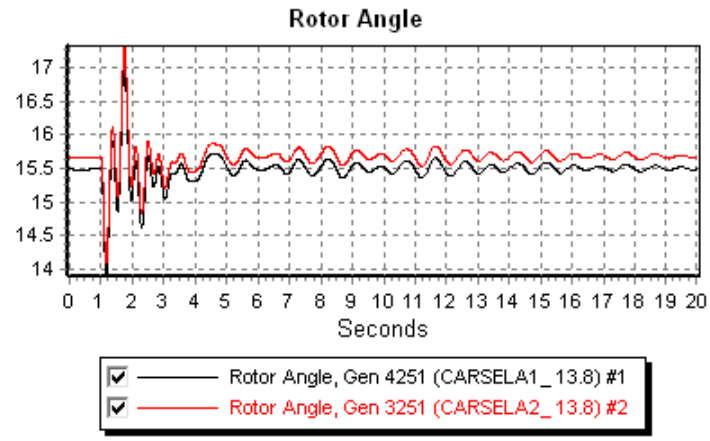


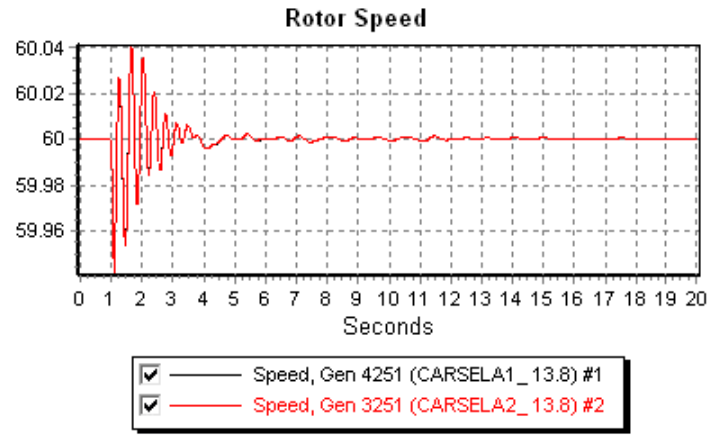
Contingency: 180L Ft.McLeod 15S to Vulcan 255S

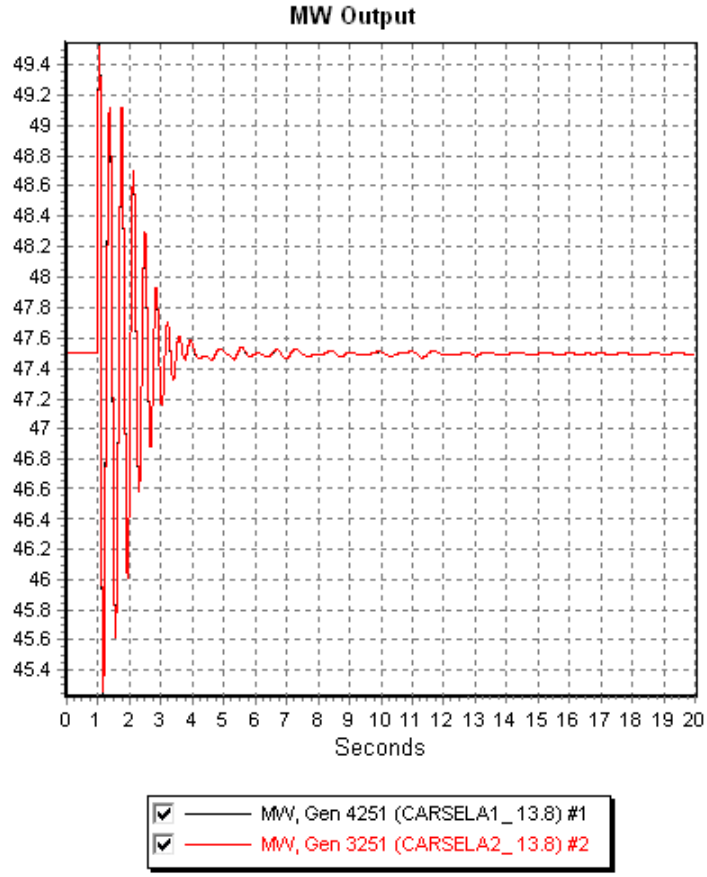
Bus Voltages and Frequency
Queenstown Generating Plant Output: 90MW

November 14, 2014 07:14:18

Carseland





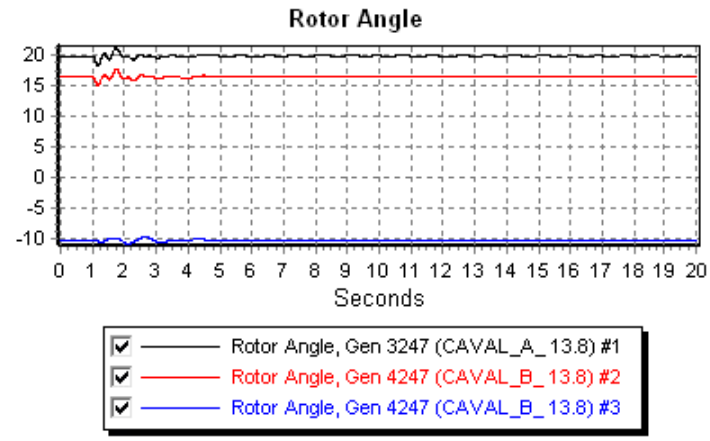


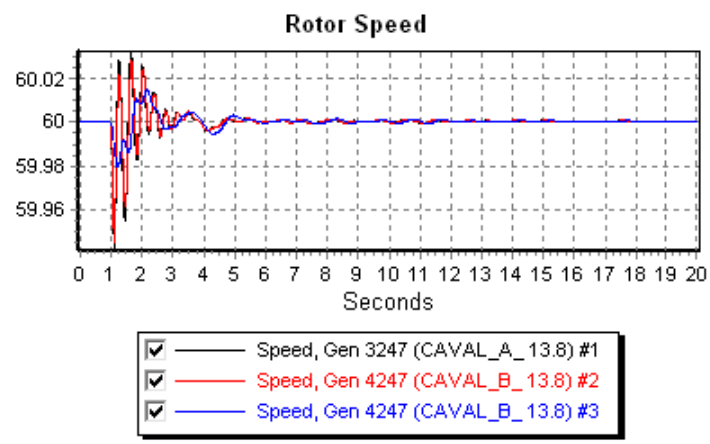
Contingency: 180L Ft.McLeod 15S to Vulcan 255S

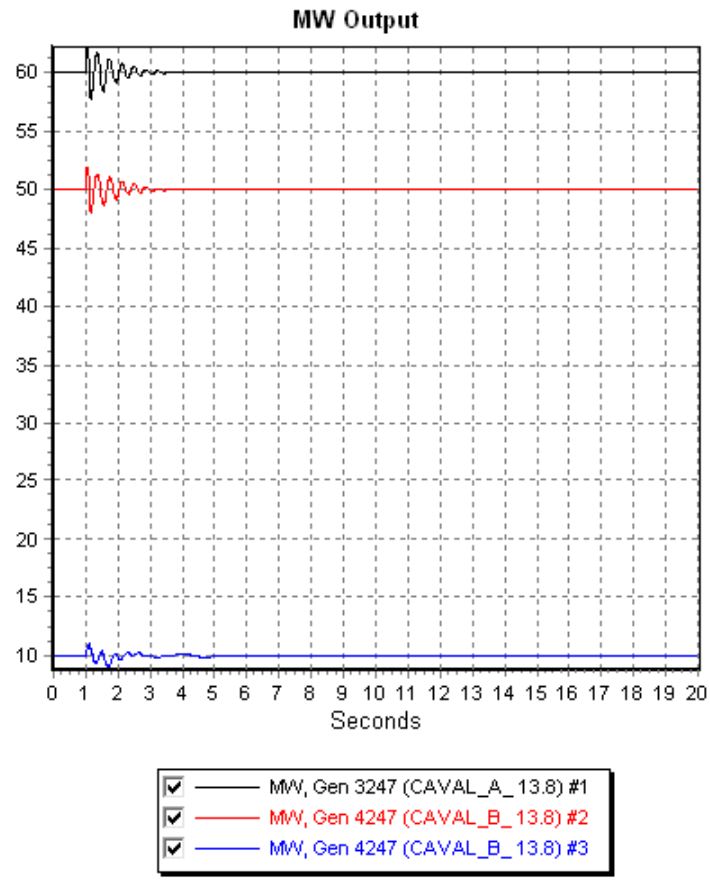
Carseland
Queenstown Generating Plant Output: 90MW

November 14, 2014 07:14:15

Cavalier





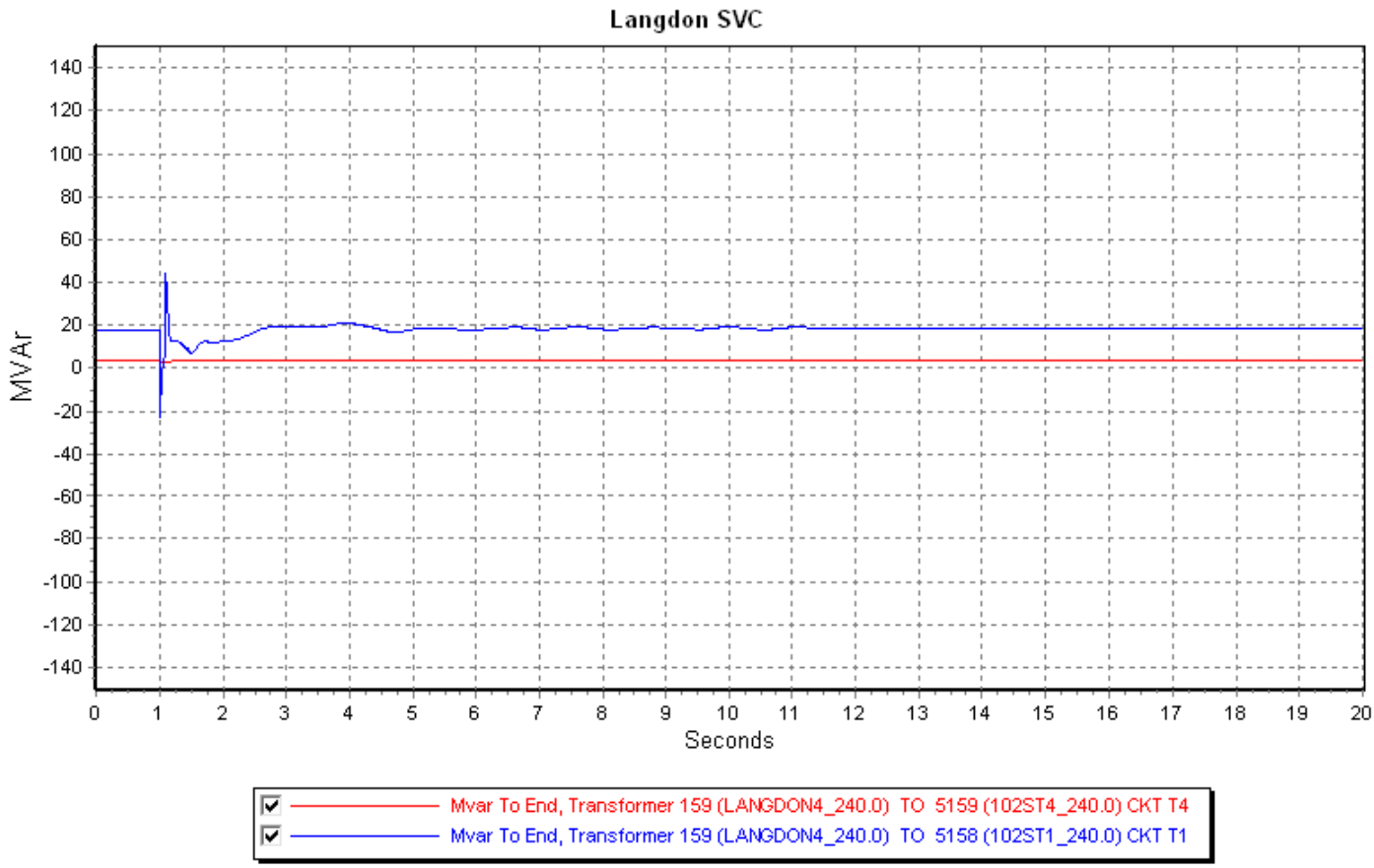


Contingency: 180L Ft.McLeod 15S to Vulcan 255S

Cavalier
Queenstown Generating Plant Output: 90MW

November 14, 2014 07:14:17

Langdon SVC

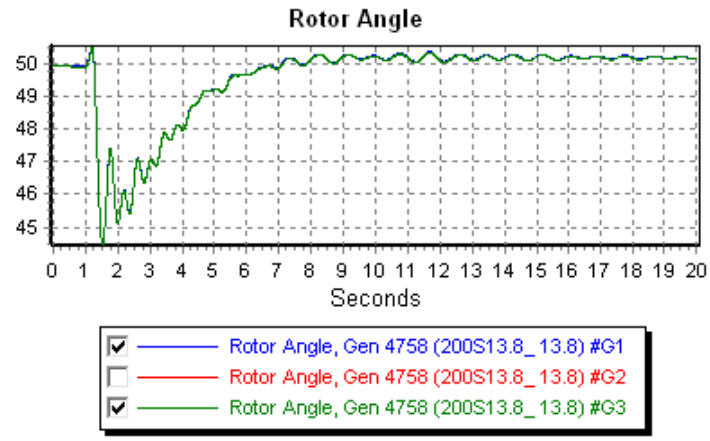


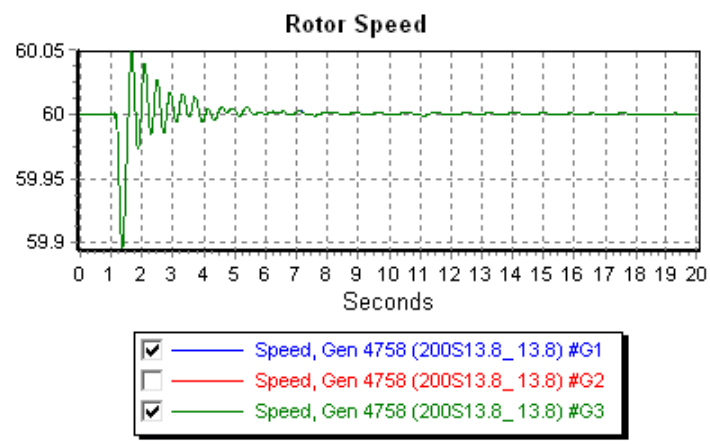
Contingency: 180L Ft.McLeod 15S to Vulcan 255S

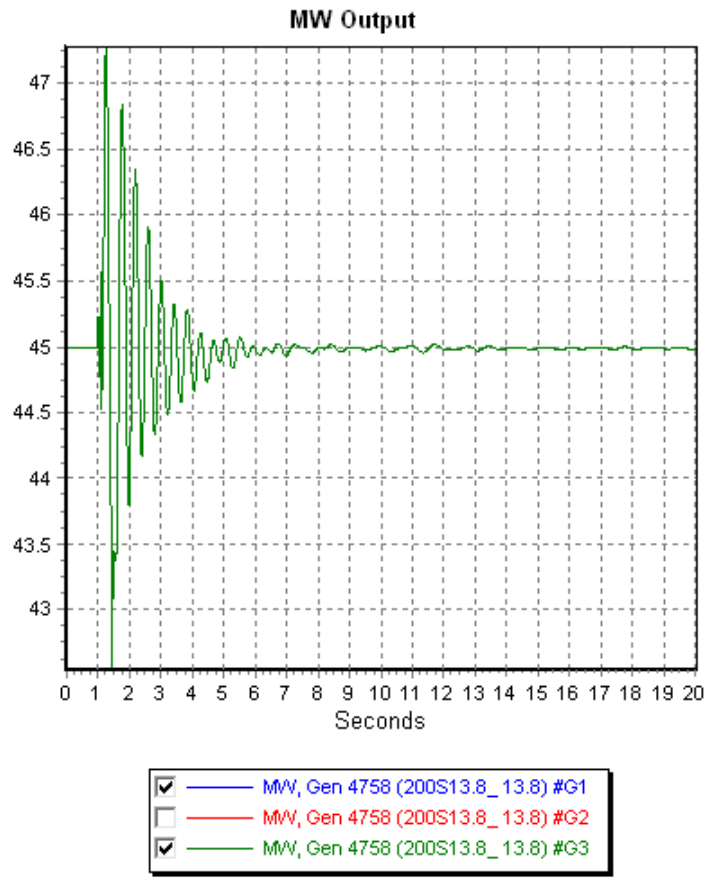
Langdon SVC
Queenstown Generating Plant Output: 90MW

November 14, 2014 07:14:19

Queenstown Gen





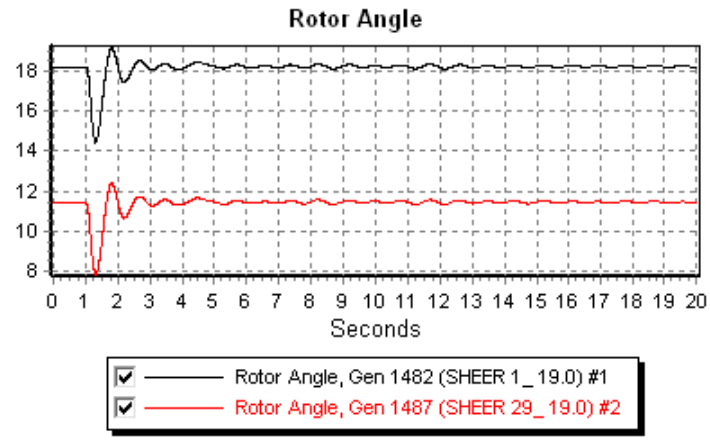


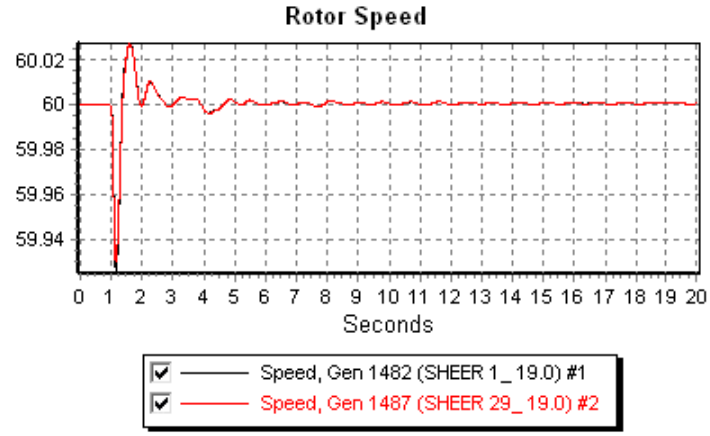
Contingency: 180L Ft.McLeod 15S to Vulcan 255S

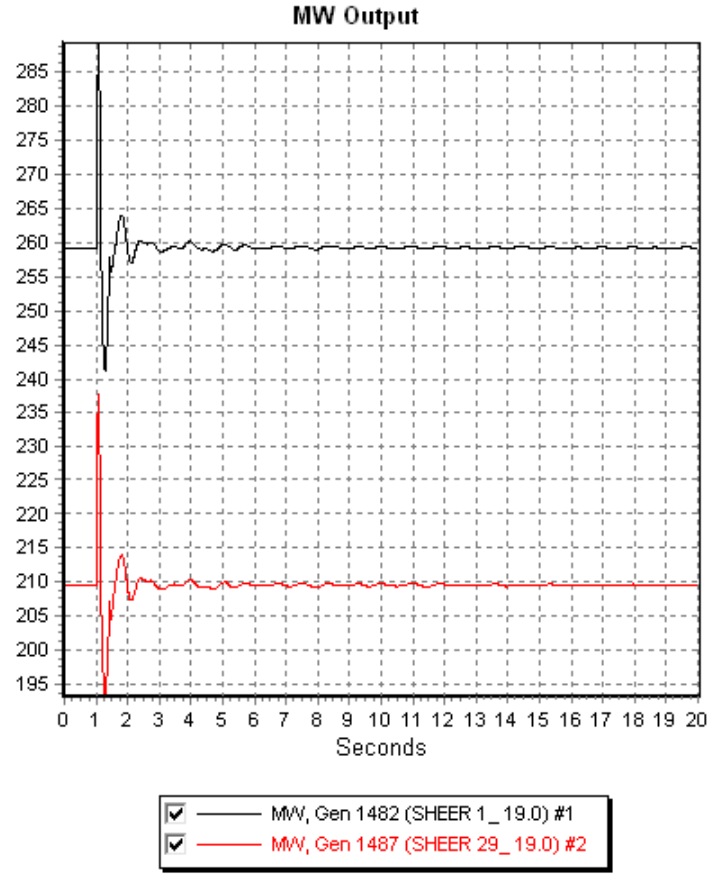
P1336
Queenstown Generating Plant
Output: 90MW

November 14, 2014 07:14:16

Sheerness





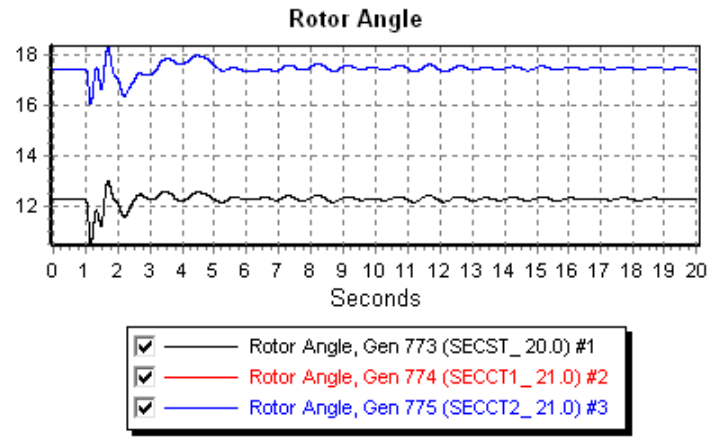


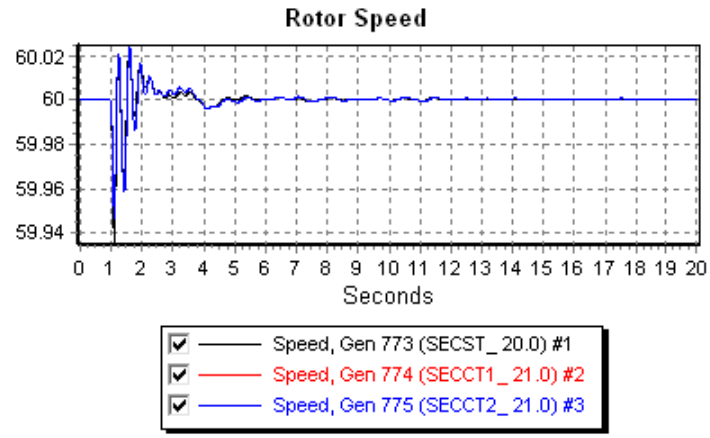
Contingency: 180L Ft.McLeod 15S to Vulcan 255S

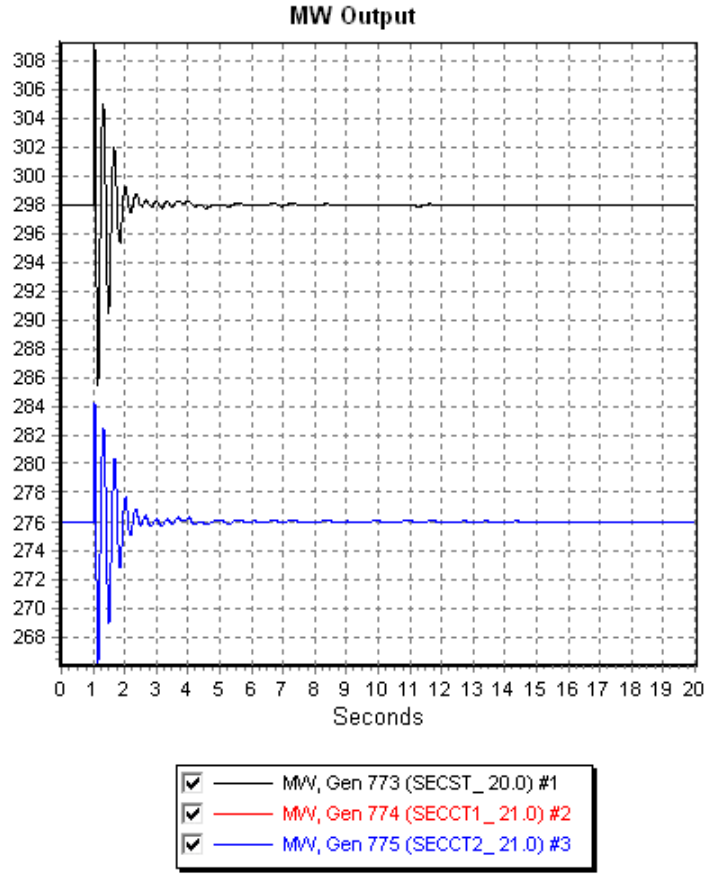
Sheerness
Queenstown Generating Plant Output: 90MW

November 14, 2014 07:14:15

Sheppard





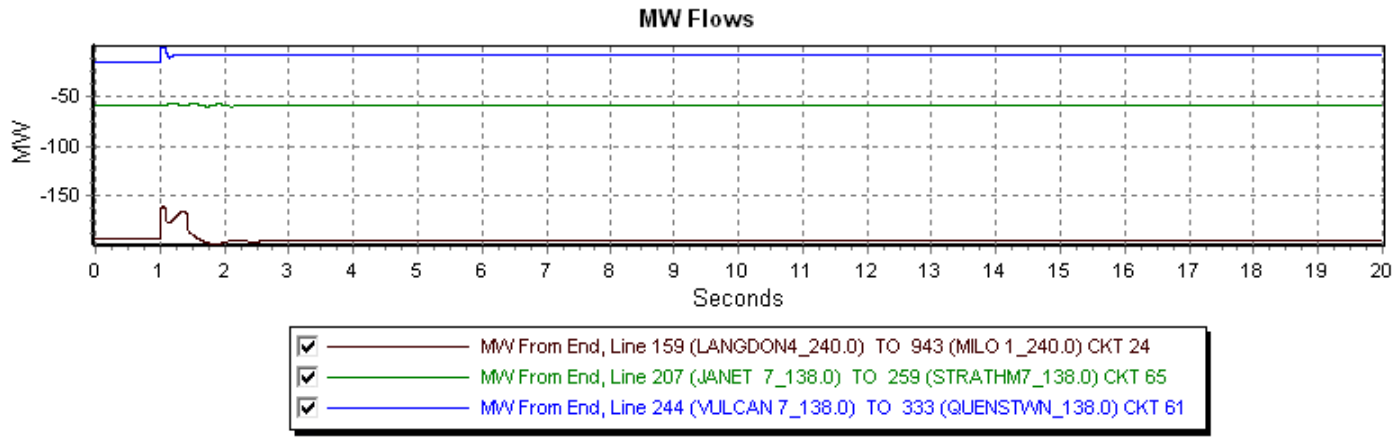


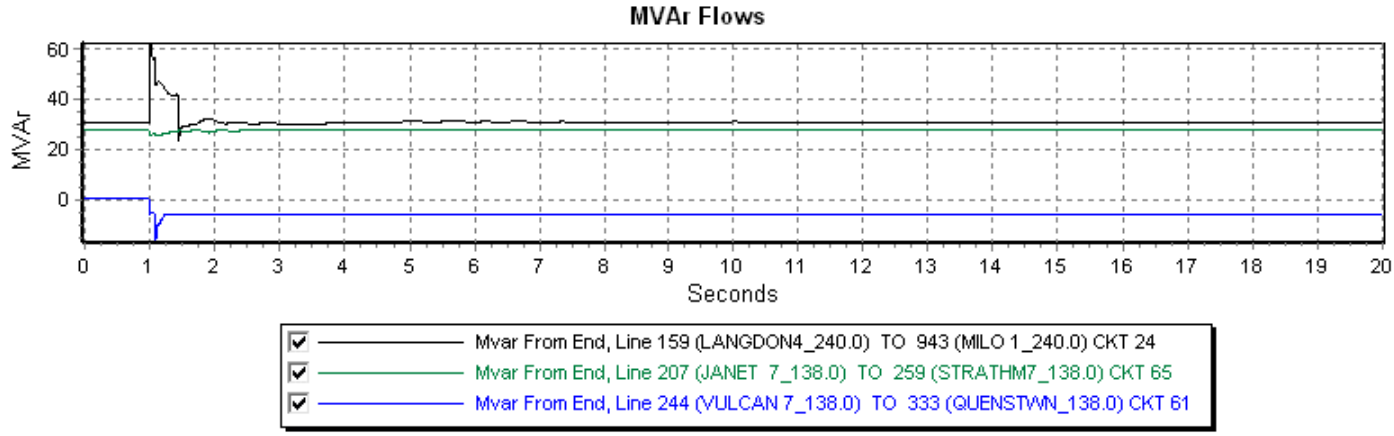
Contingency: 180L Ft.McLeod 15S to Vulcan 255S

Sheppard
Queenstown Generating Plant Output: 90MW

November 14, 2014 07:14:16

Branch Flows



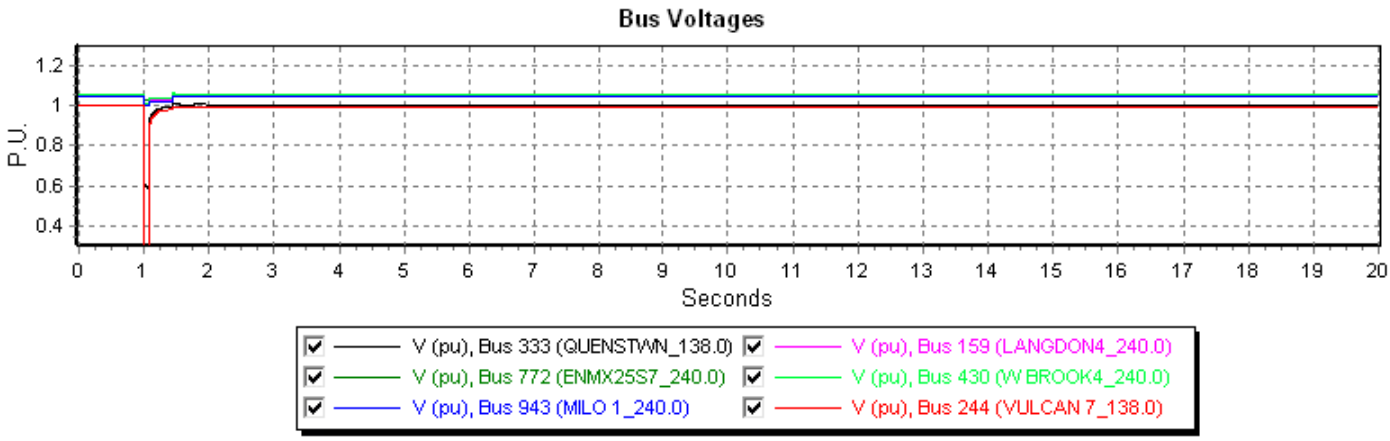


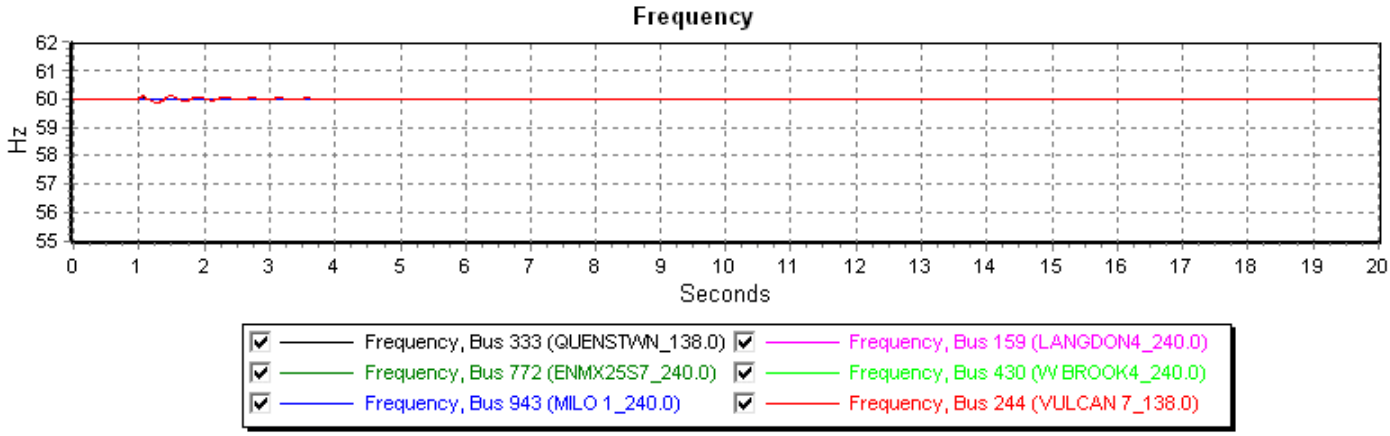
Contingency: 180L Vulcan 255S to Ft.McLeod 15S

Branch Flows
Queenstown Generating Plant Output: 90MW

November 14, 2014 07:15:21

Bus Voltages and Frequency



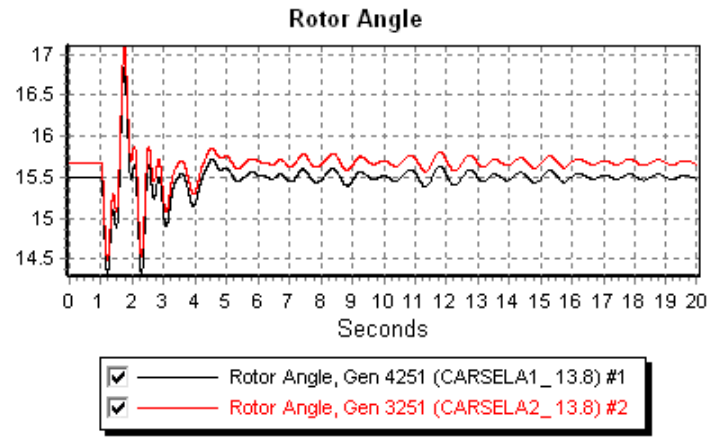


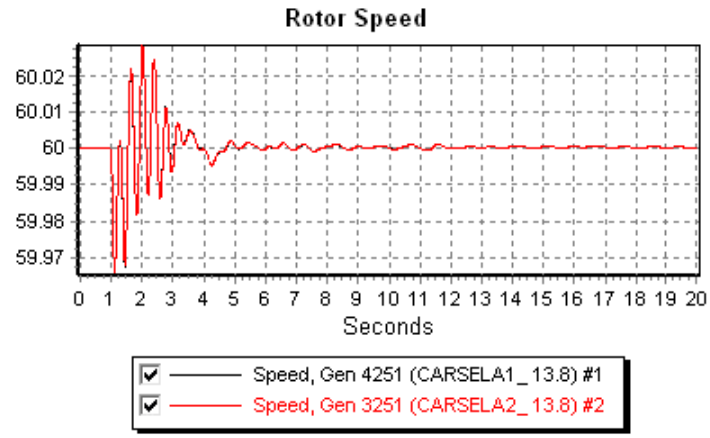
Contingency: 180L Vulcan 255S to Ft.McLeod 15S

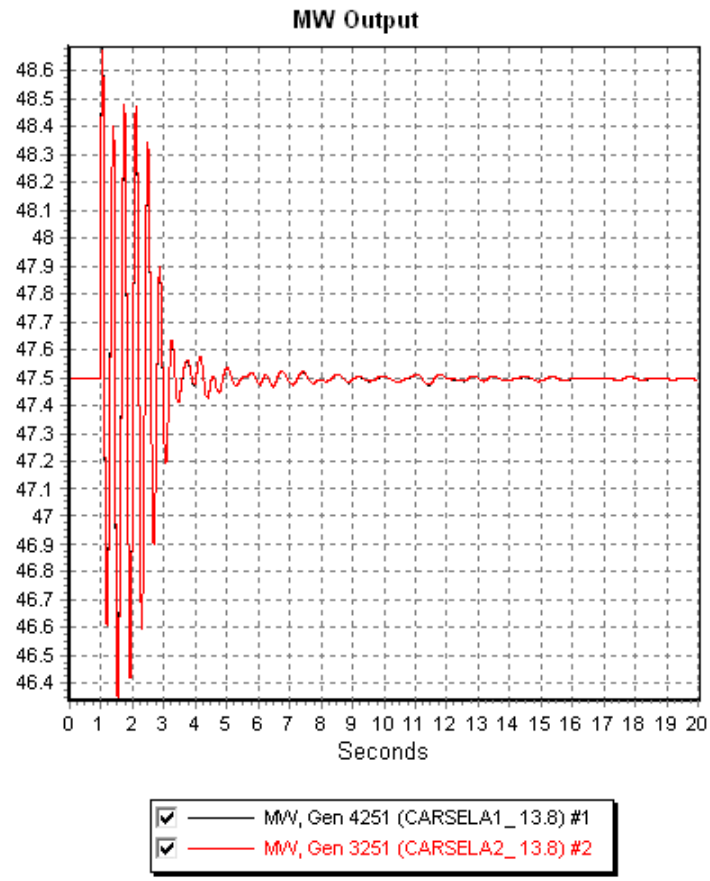
Bus Voltages and Frequency
Queenstown Generating Plant Output: 90MW

November 14, 2014 07:15:21

Carseland





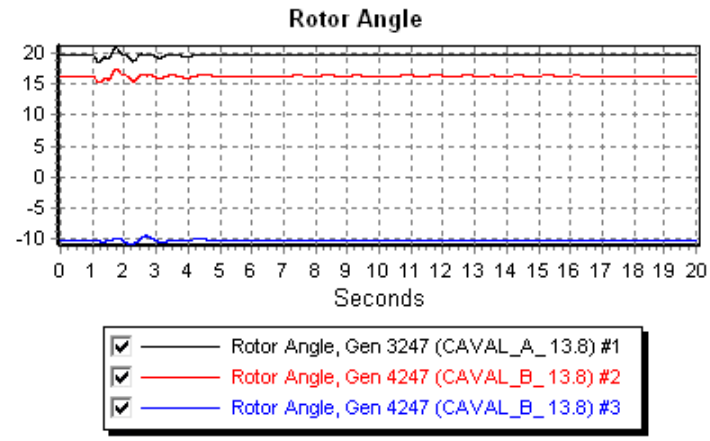


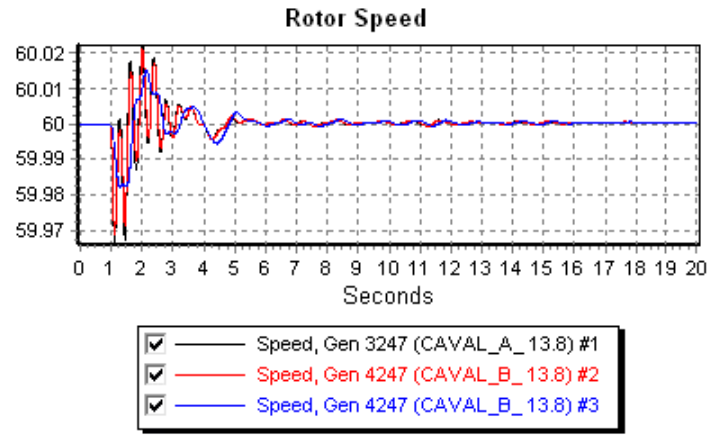
Contingency: 180L Vulcan 255S to Ft.McLeod 15S

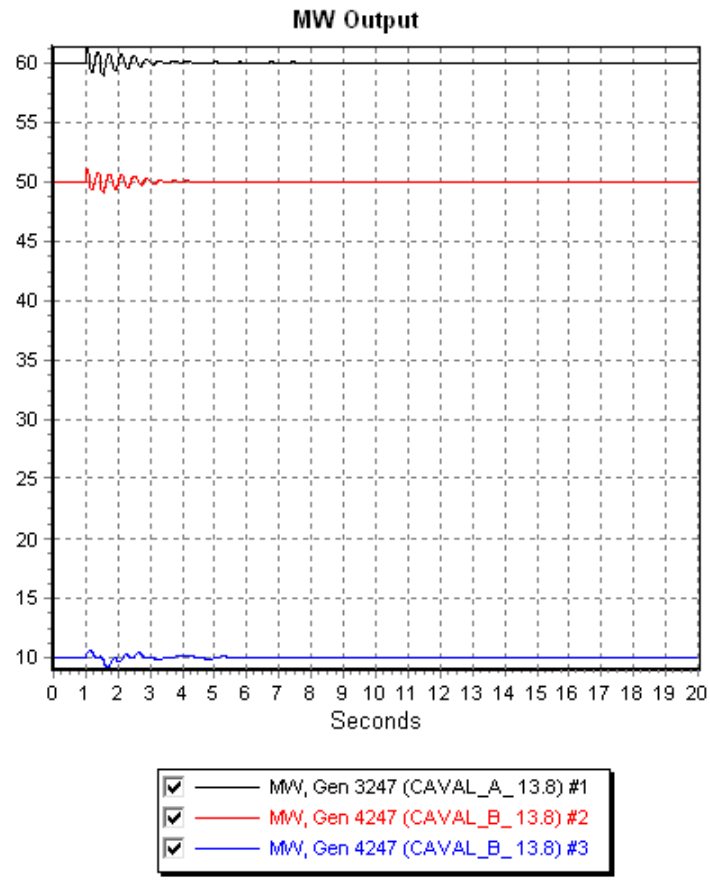
Carseland
Queenstown Generating Plant Output: 90MW

November 14, 2014 07:15:18

Cavalier





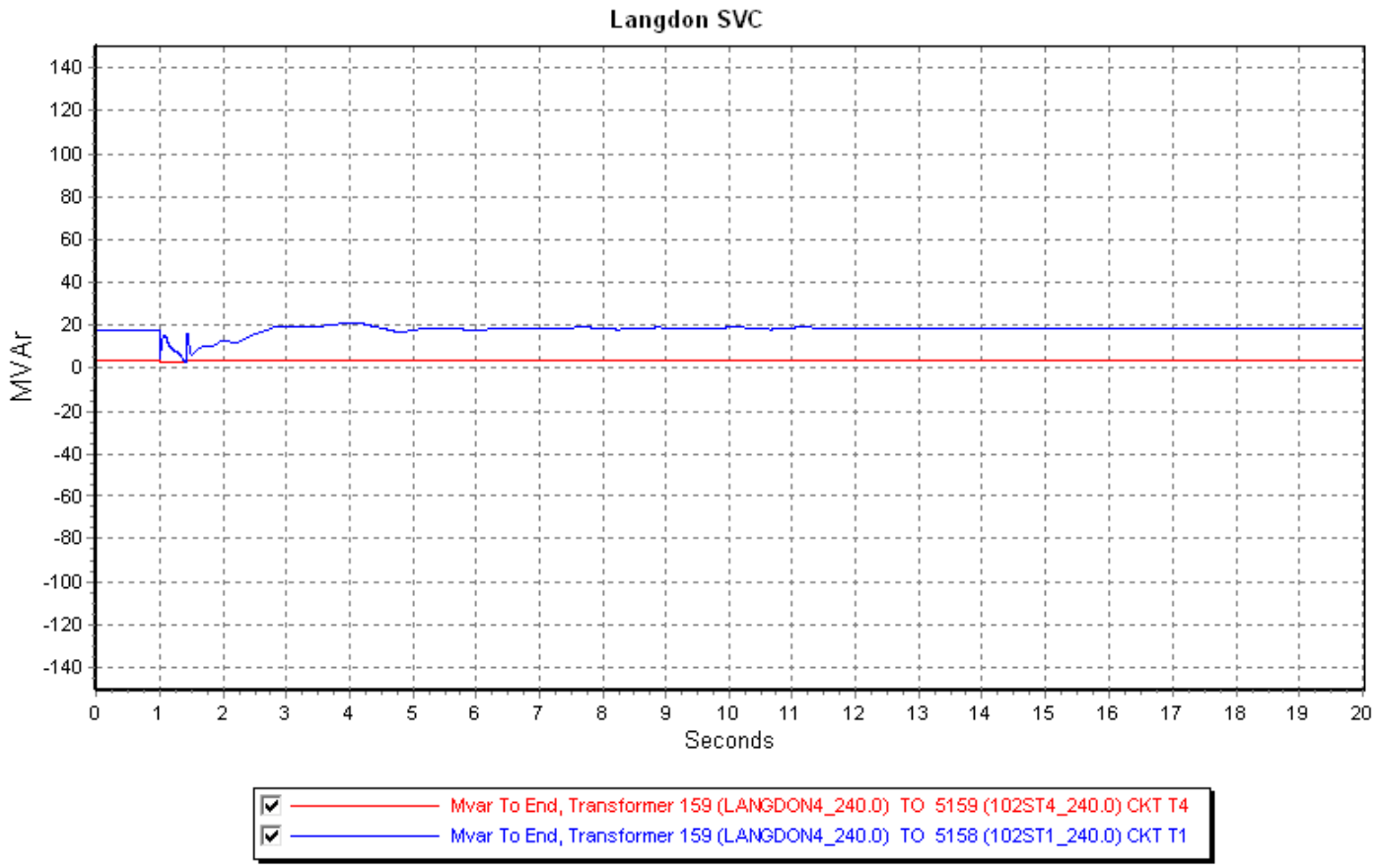


Contingency: 180L Vulcan 255S to Ft.McLeod 15S

Cavalier
Queenstown Generating Plant Output: 90MW

November 14, 2014 07:15:20

Langdon SVC

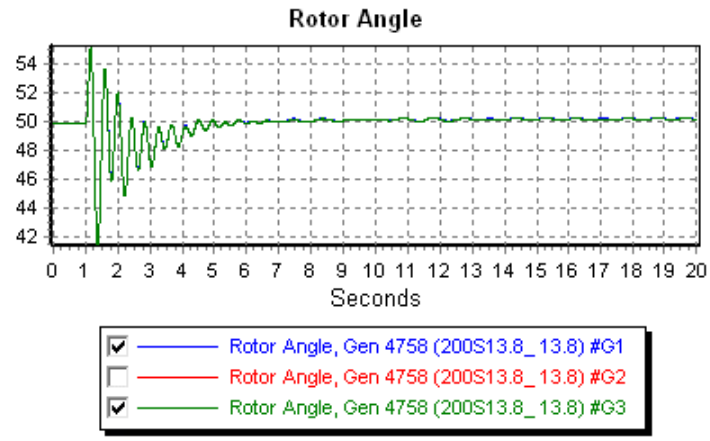


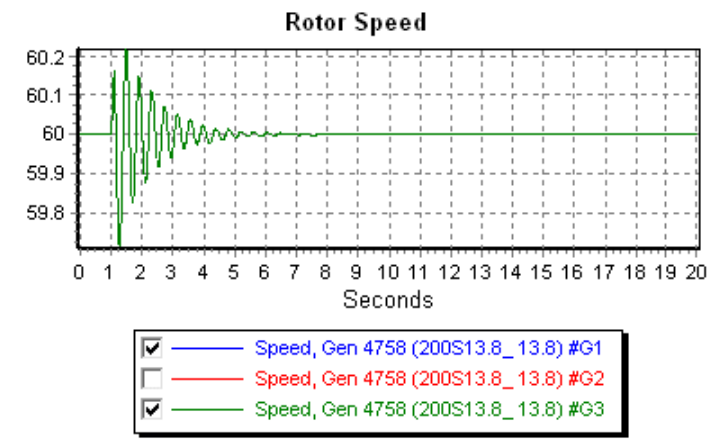
Contingency: 180L Vulcan 255S to Ft.McLeod 15S

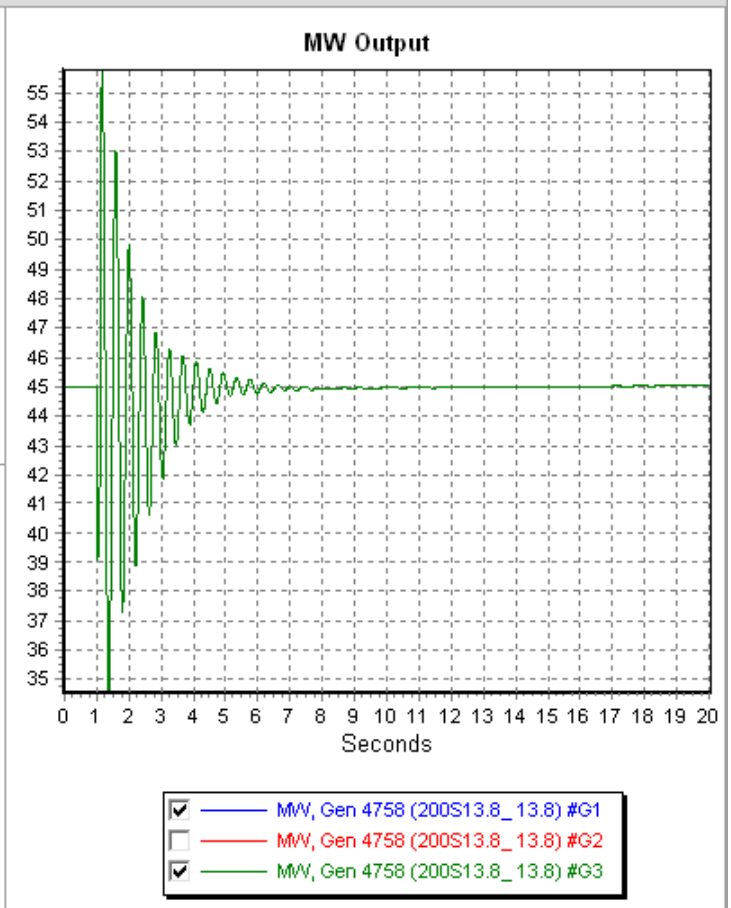
Langdon SVC
Queenstown Generating Plant Output: 90MW

November 14, 2014 07:15:22

Queenstown Gen





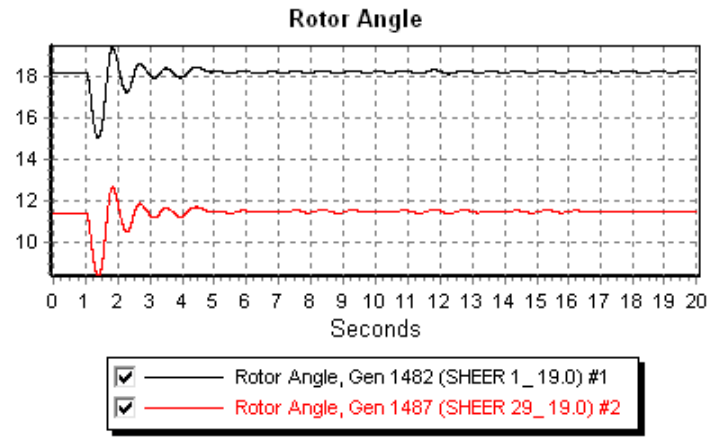


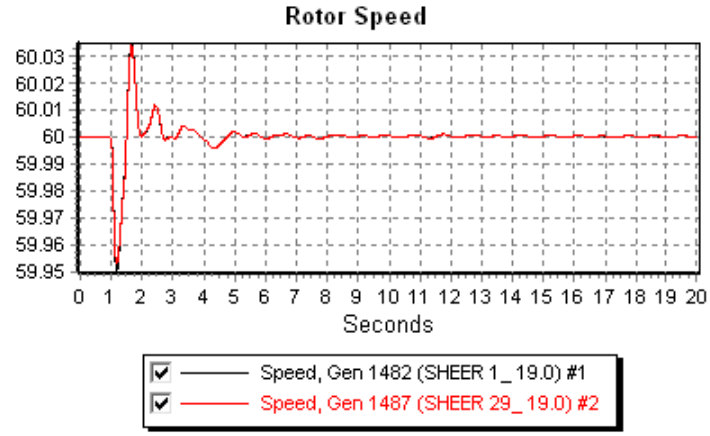
Contingency: 180L Vulcan 255S to Ft.McLeod 15S

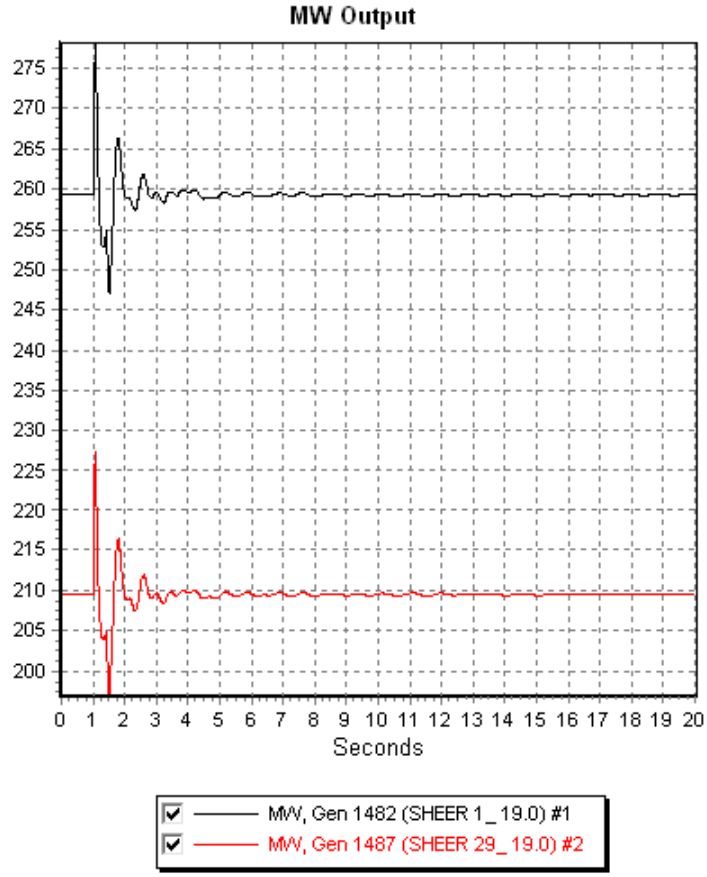
P1336
Queenstown Generating Plant
Output: 90MW

November 14, 2014 07:15:19

Sheerness





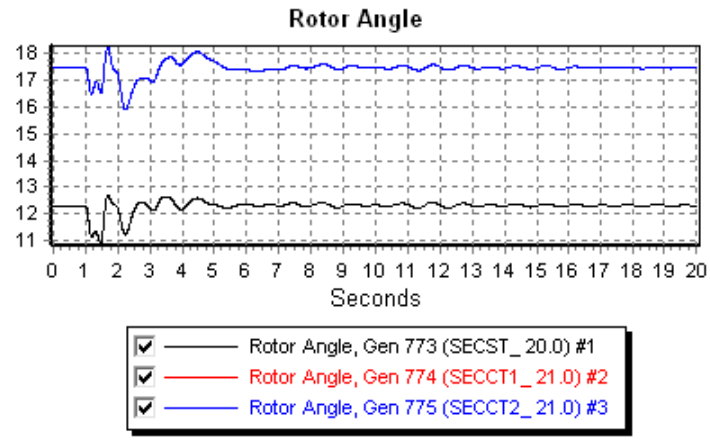


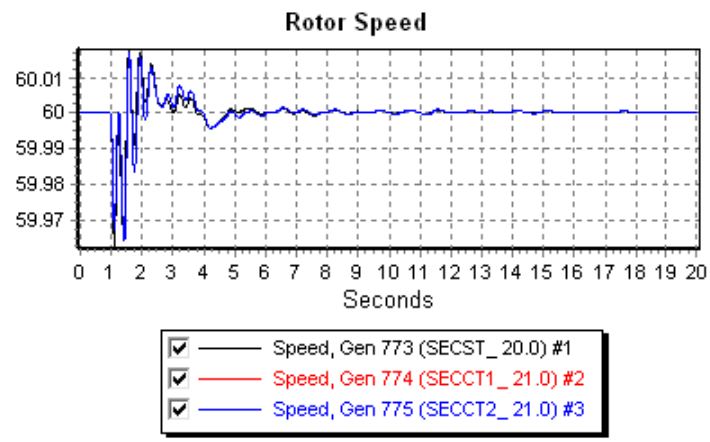
Contingency: 180L Vulcan 255S to Ft.McLeod 15S

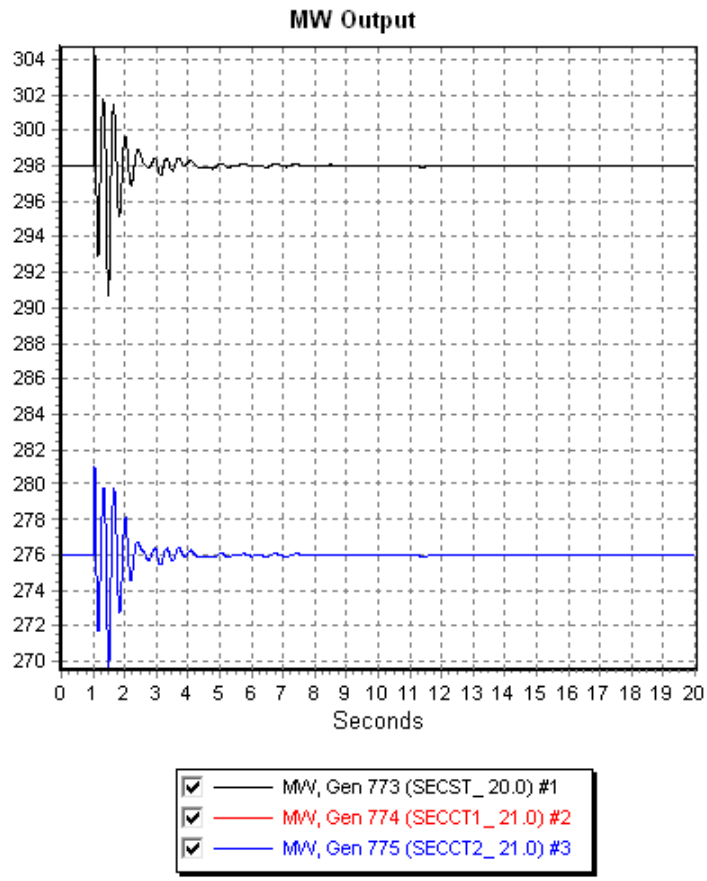
Sheerness
Queenstown Generating Plant Output: 90MW

November 14, 2014 07:15:18

Sheppard





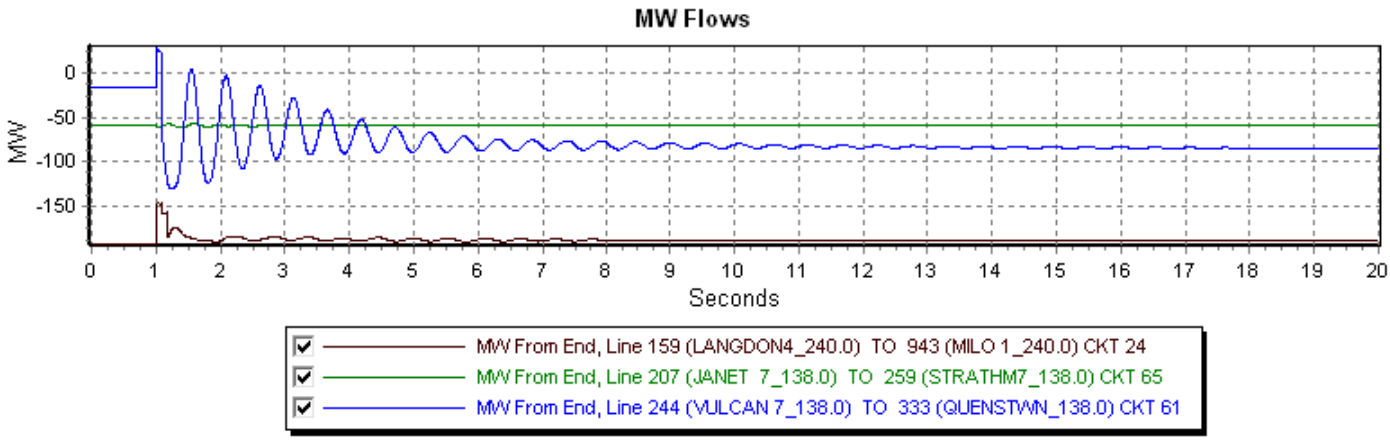


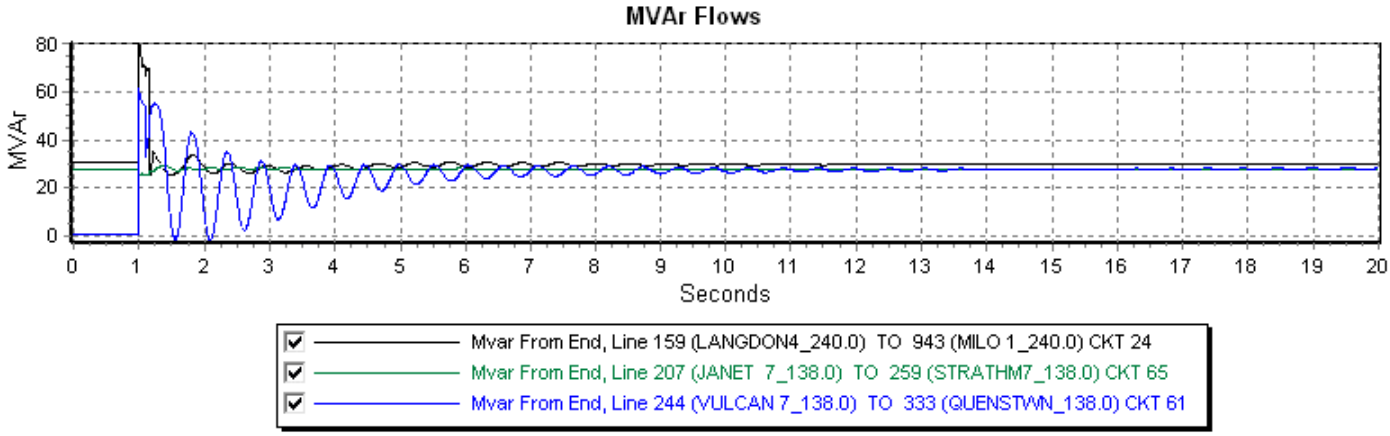
Contingency: 180L Vulcan 255S to Ft.McLeod 15S

Sheppard
Queenstown Generating Plant Output: 90MW

November 14, 2014 07:15:19

Branch Flows



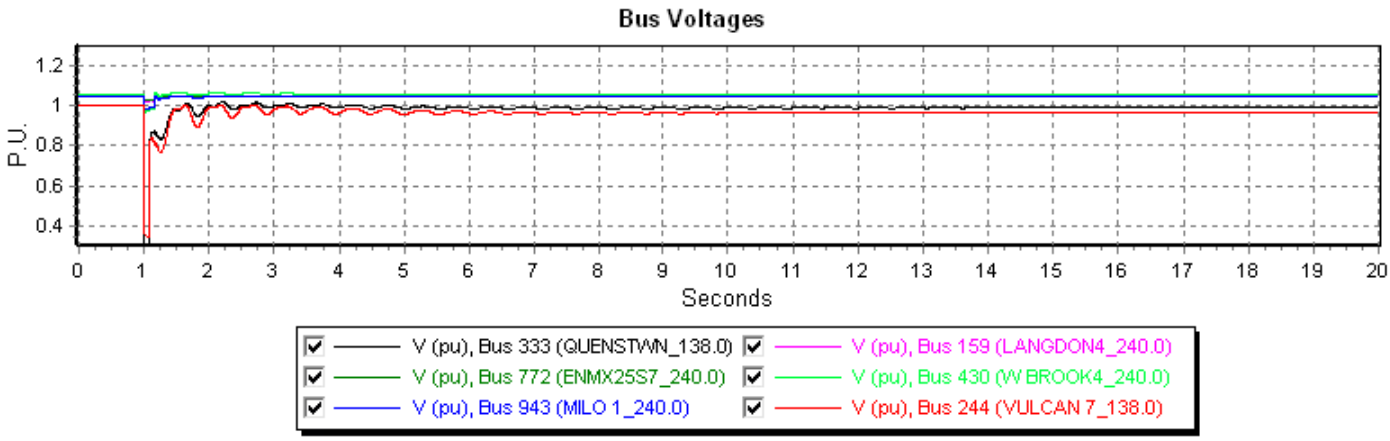


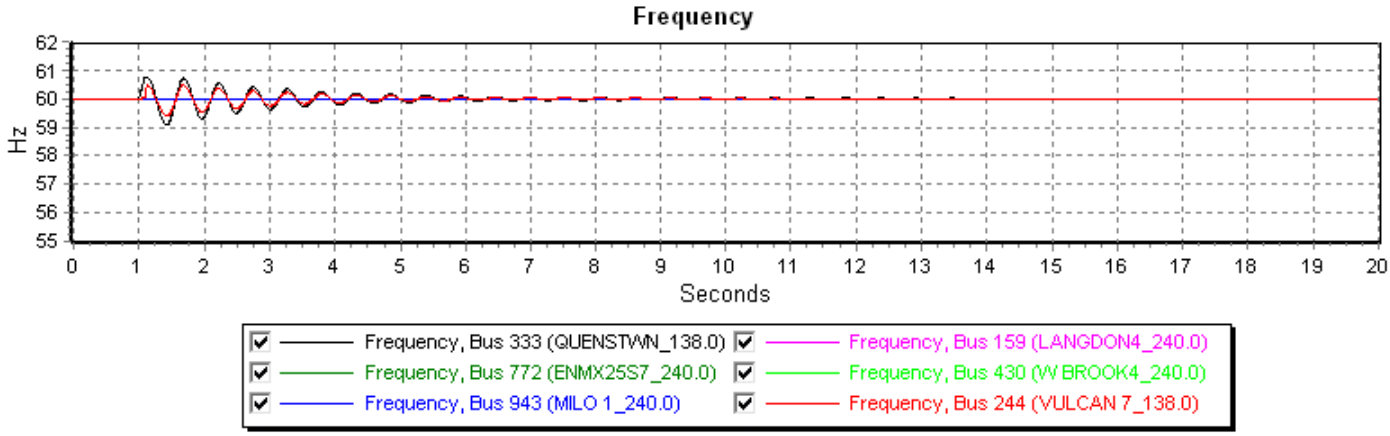
Contingency: 853L QUEENSTOWN 504S - WEST BROOKS 28

Branch Flows
Queenstown Generating Plant Output: 90MW

November 14, 2014 07:16:21

Bus Voltages and Frequency



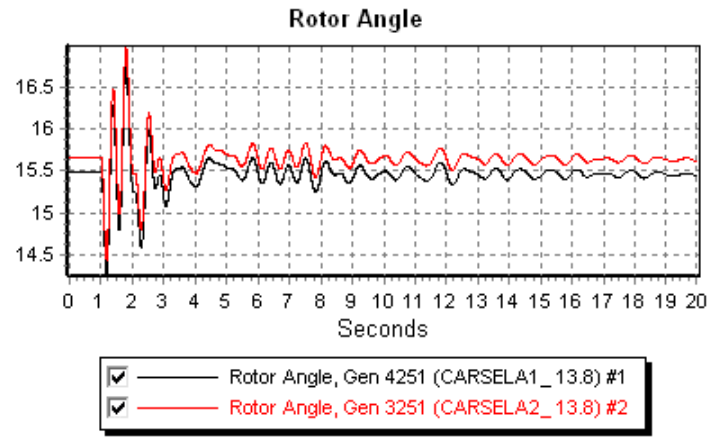


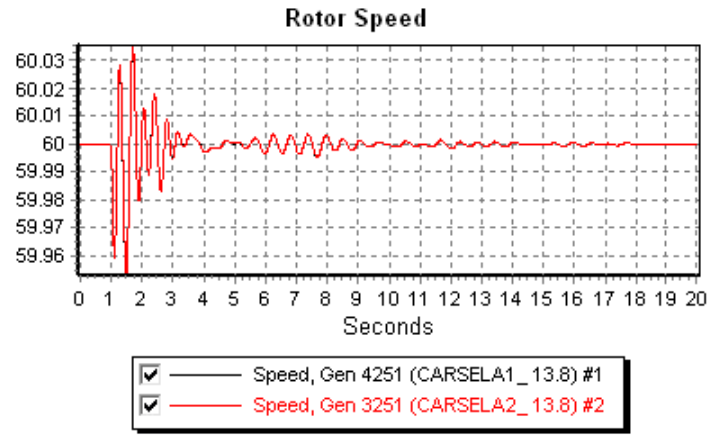
Contingency: 853L QUEENSTOWN 504S - WEST BROOKS 28

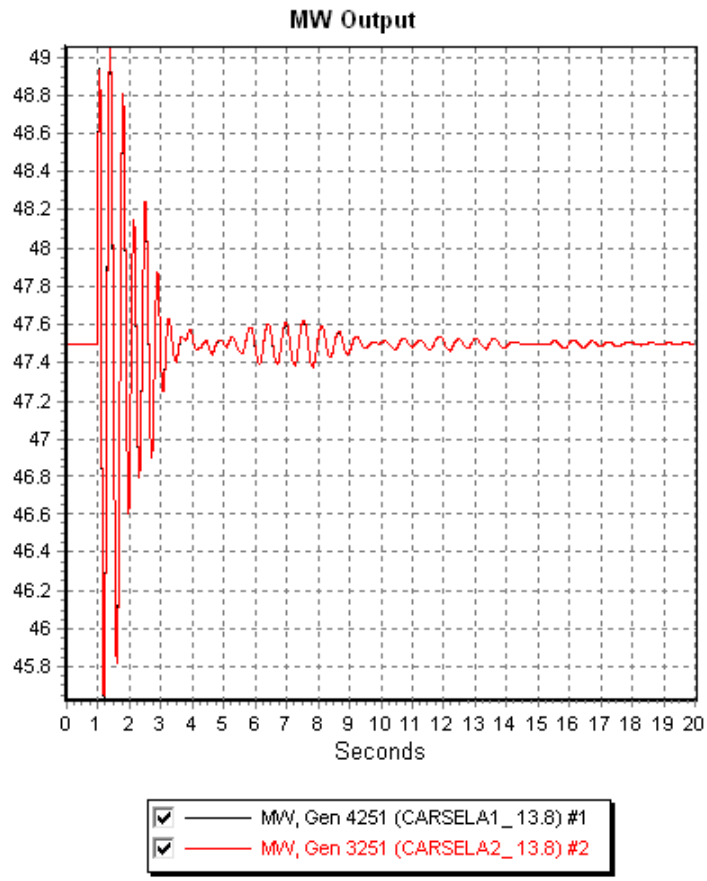
Bus Voltages and Frequency
Queenstown Generating Plant Output: 90MW

November 14, 2014 07:16:22

Carseland





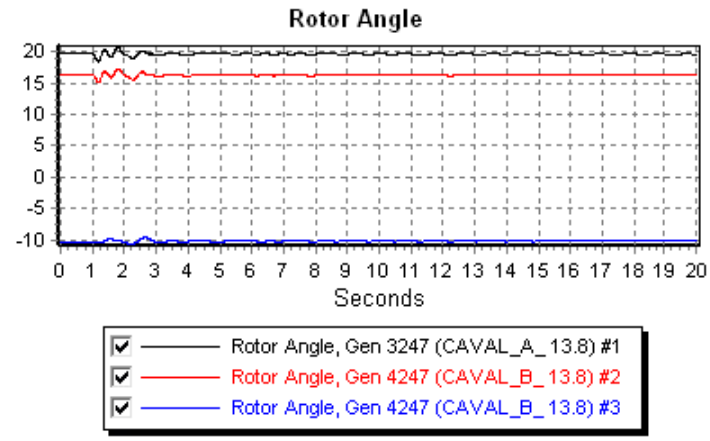


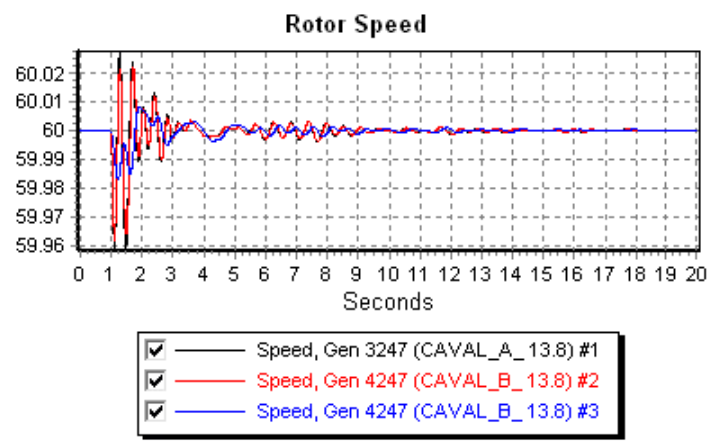
Contingency: 853L QUEENSTOWN 504S - WEST BROOKS 28

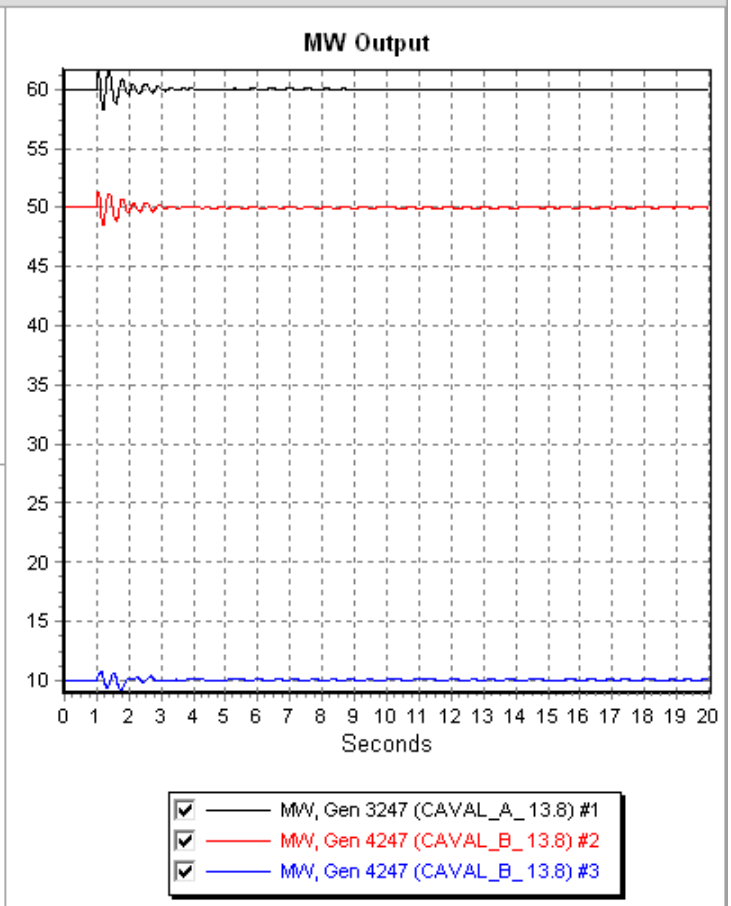
Carseland
Queenstown Generating Plant Output: 90MW

November 14, 2014 07:16:19

Cavalier





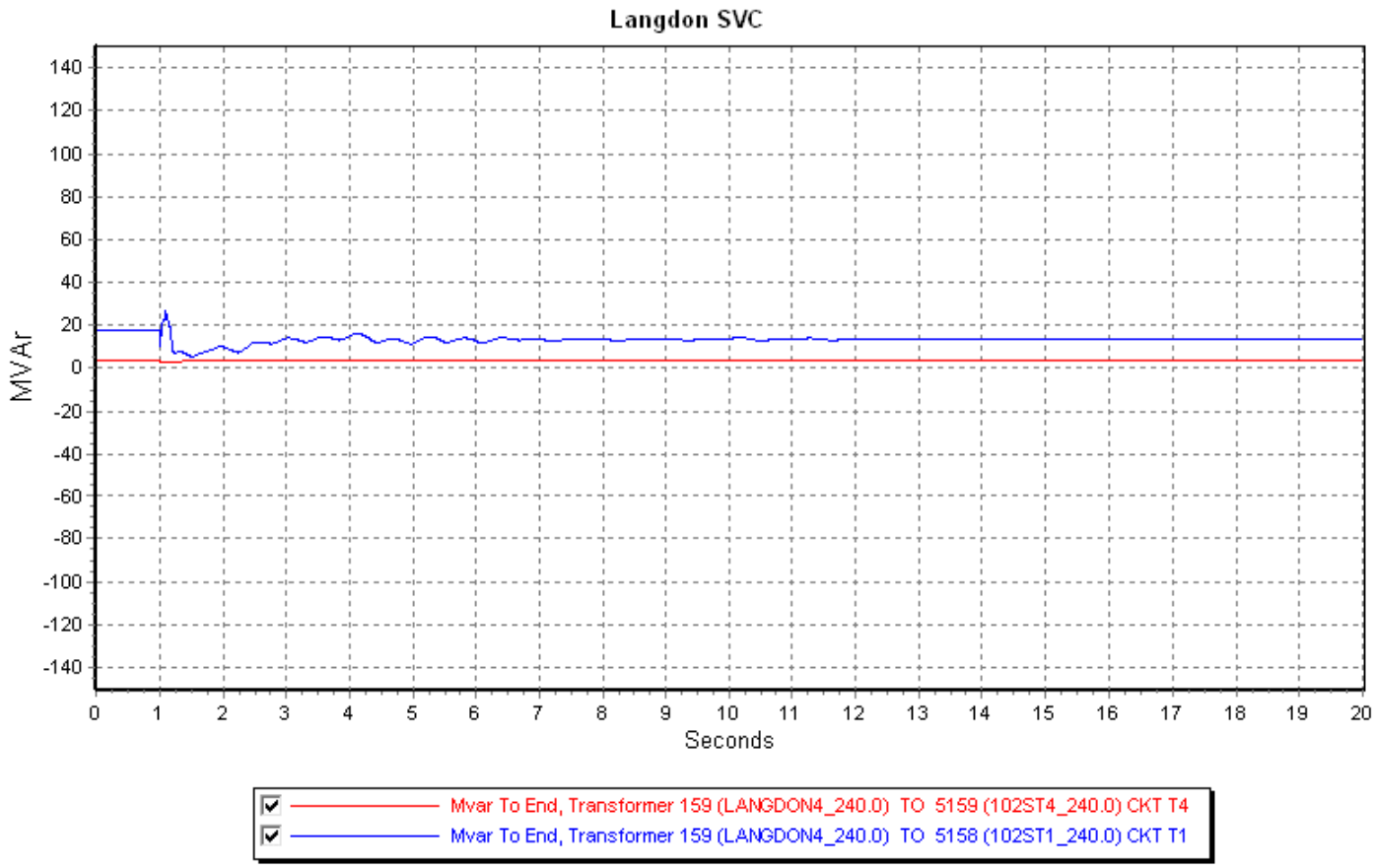


Contingency: 853L QUEENSTOWN 504S - WEST BROOKS 28

Cavalier
Queenstown Generating Plant Output: 90MW

November 14, 2014 07:16:20

Langdon SVC

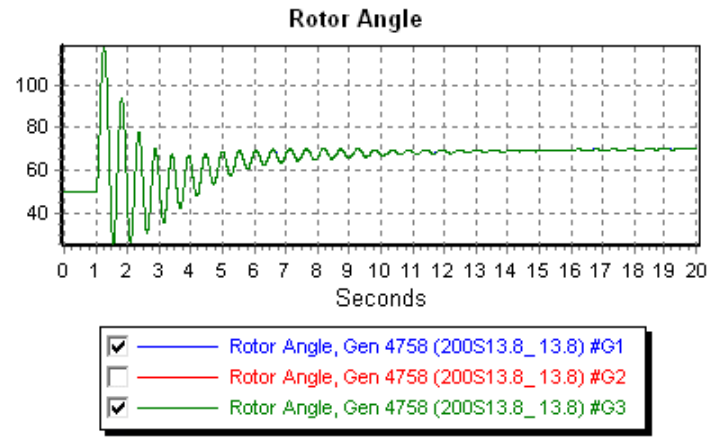


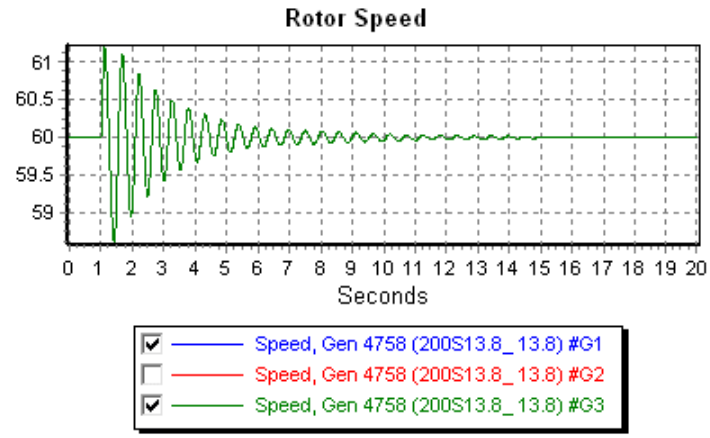
Contingency: 853L QUEENSTOWN 504S - WEST BROOKS 28

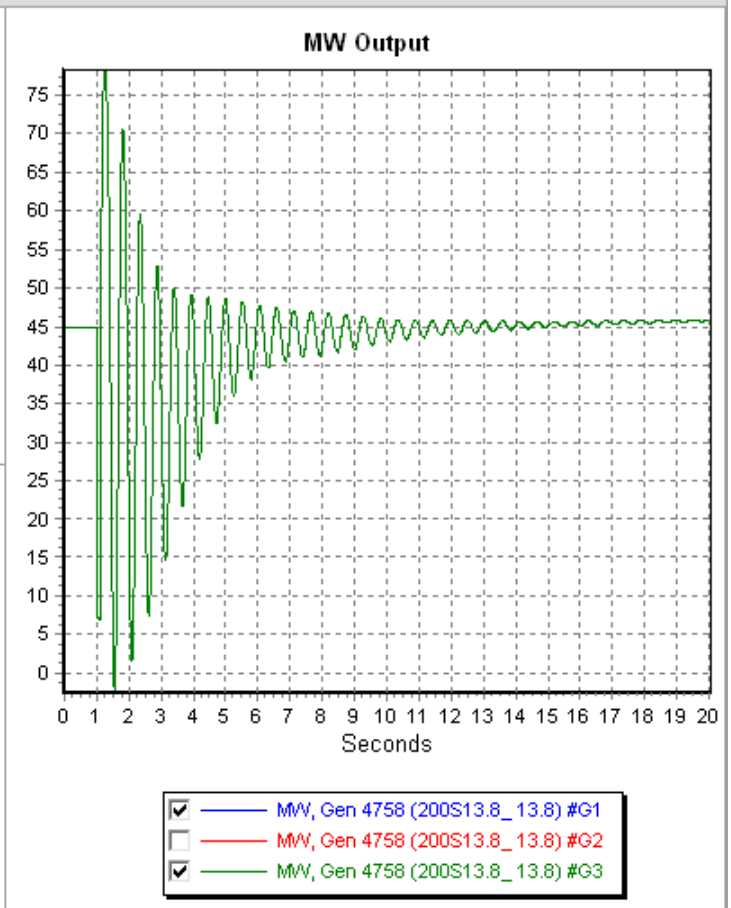
Langdon SVC
Queenstown Generating Plant Output: 90MW

November 14, 2014 07:16:22

Queenstown Gen







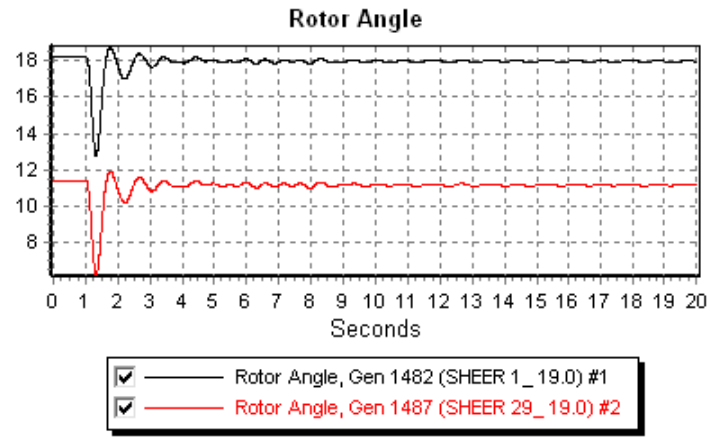
Contingency: 853L QUEENSTOWN 504S - WEST BROOKS 28P1336

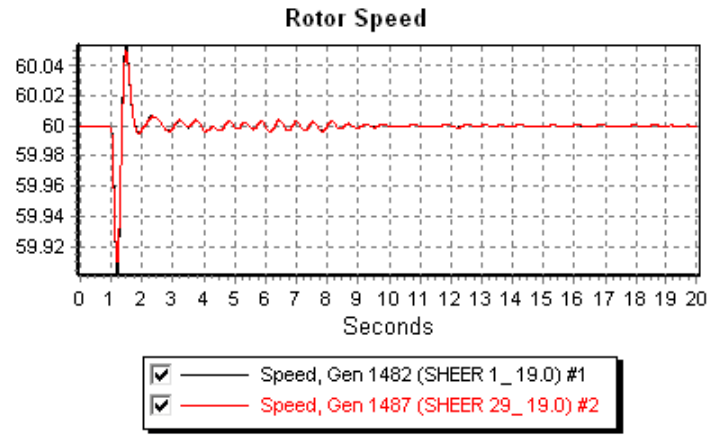
Queenstown Generating Plant

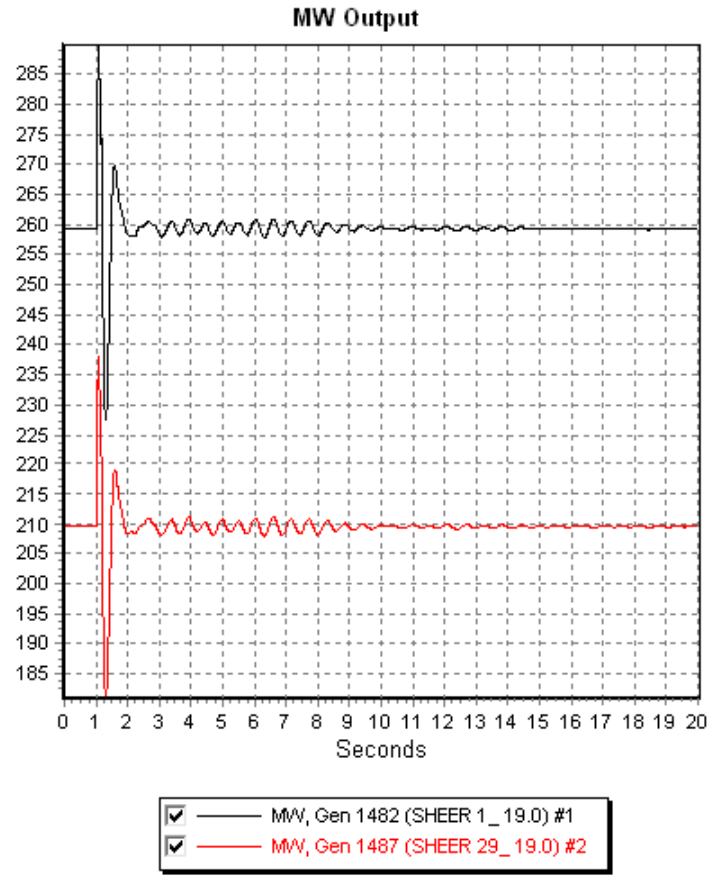
Output: 90MW

November 14, 2014 07:16:20

Sheerness





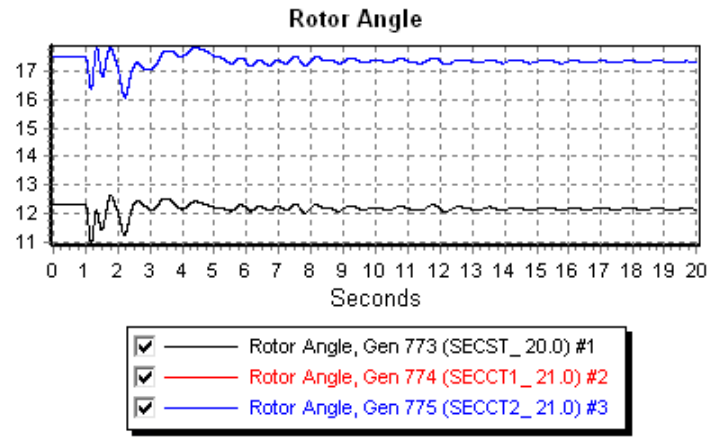


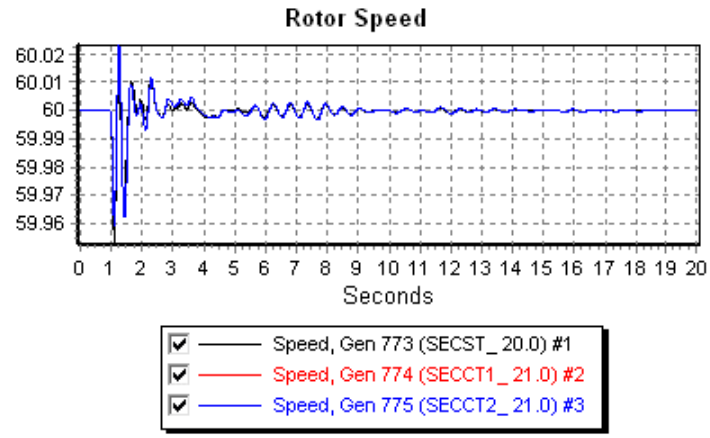
Contingency: 853L QUEENSTOWN 504S - WEST BROOKS 28

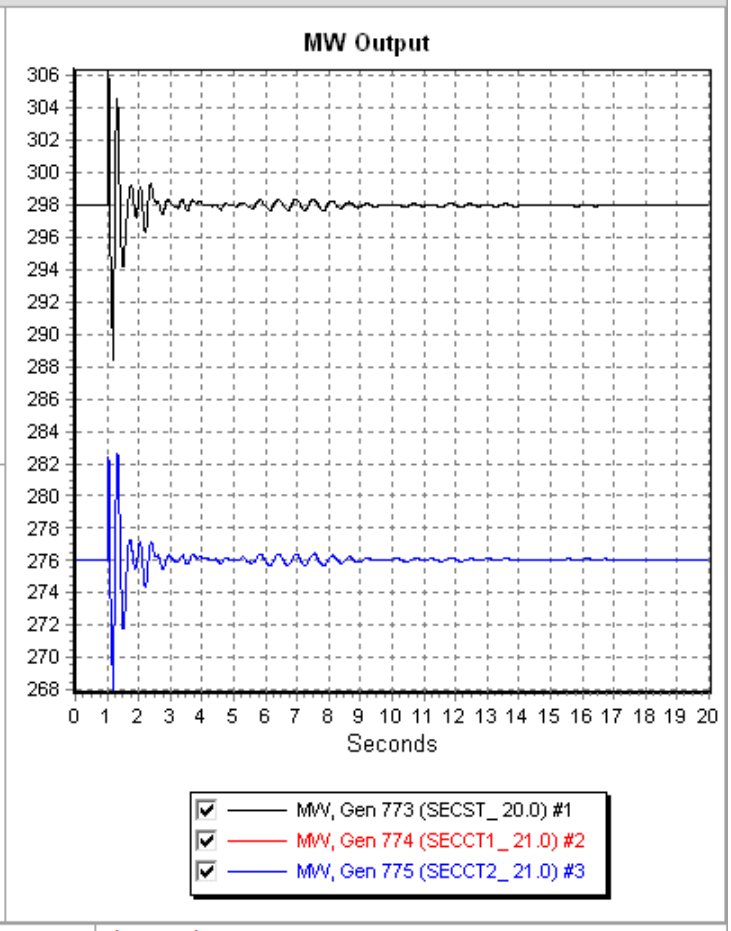
Sheerness
Queenstown Generating Plant Output: 90MW

November 14, 2014 07:16:18

Sheppard





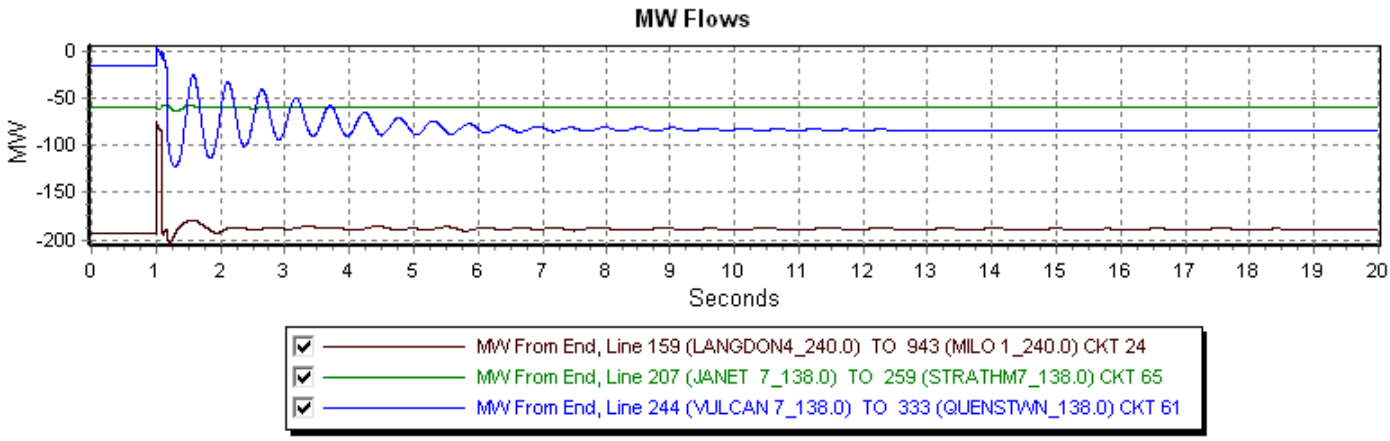


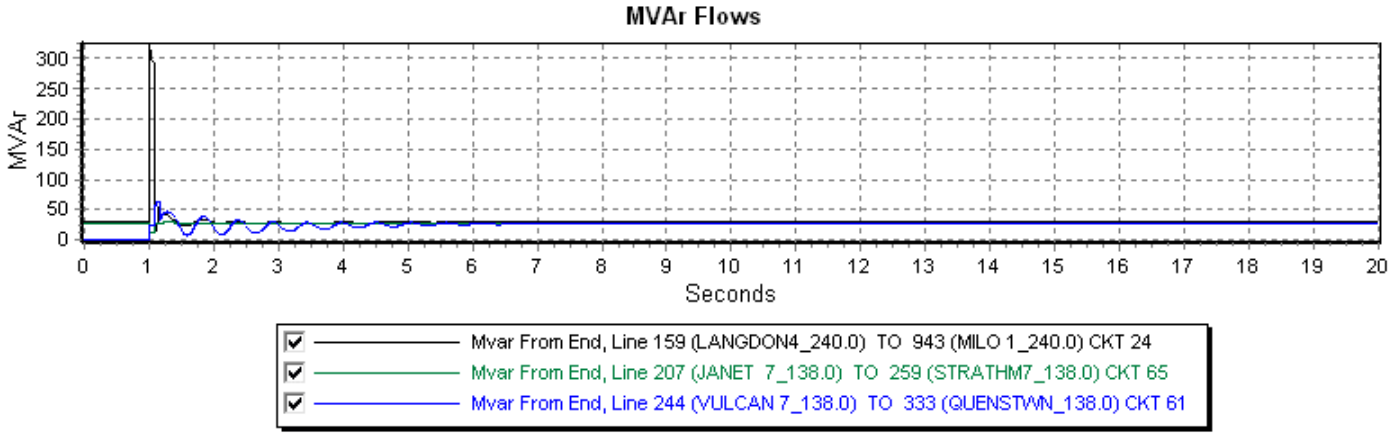
Contingency: 853L QUEENSTOWN 504S - WEST BROOKS 28

Sheppard
Queenstown Generating Plant Output: 90MW

November 14, 2014 07:16:19

Branch Flows



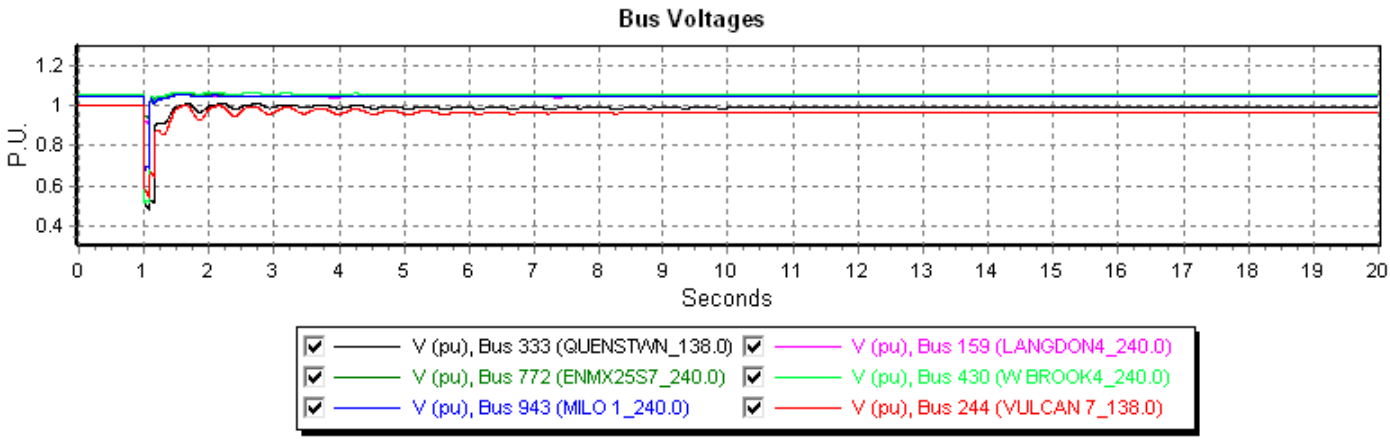


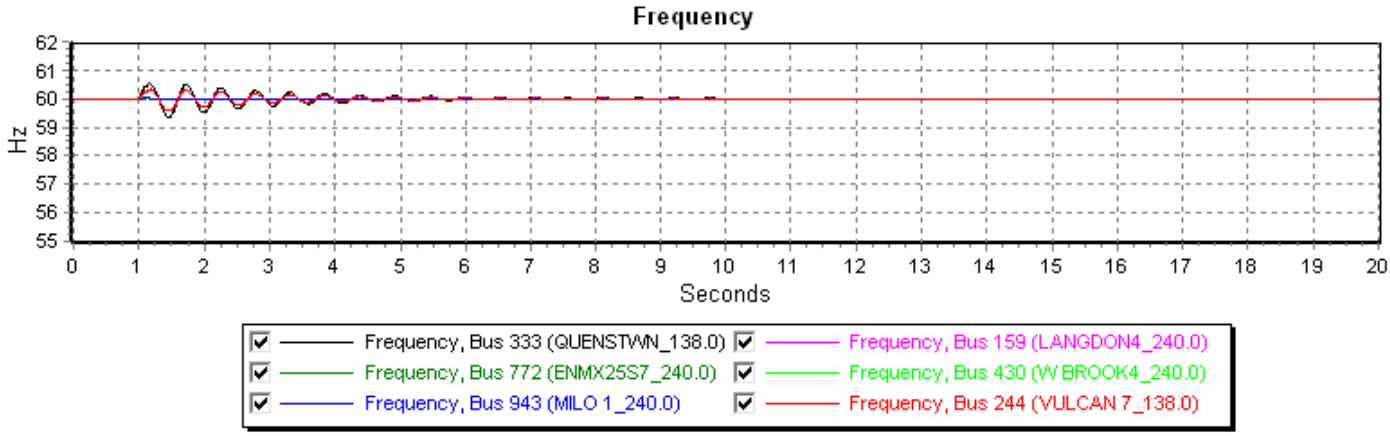
Contingency: 853L WEST BROOKS 28S - QUEENSTOWN 504S

Branch Flows
Queenstown Generating Plant Output: 90MW

November 14, 2014 07:17:55

Bus Voltages and Frequency



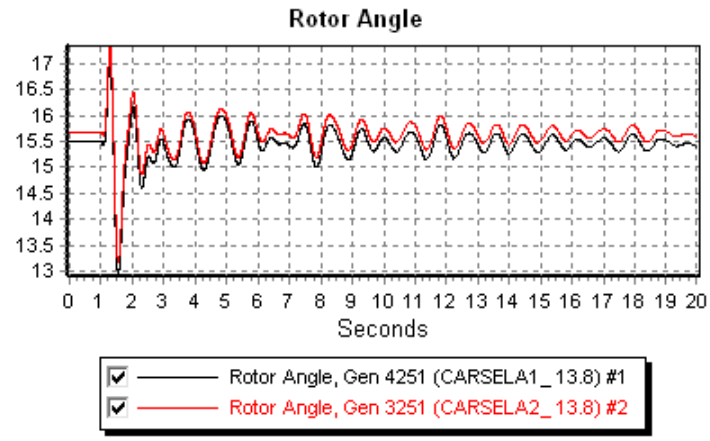


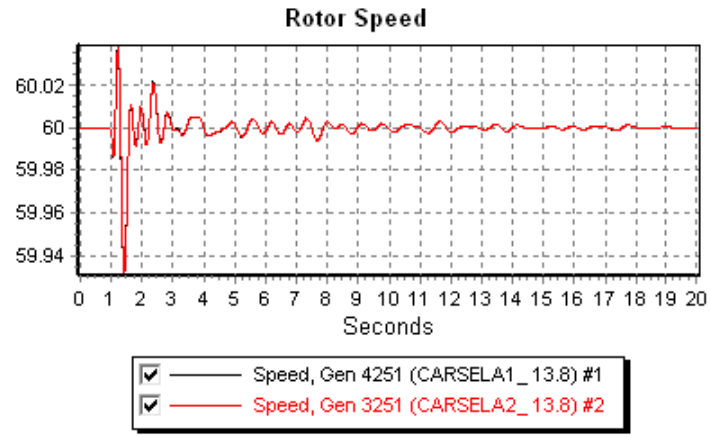
Contingency: 853L WEST BROOKS 28S - QUEENSTOWN 504S

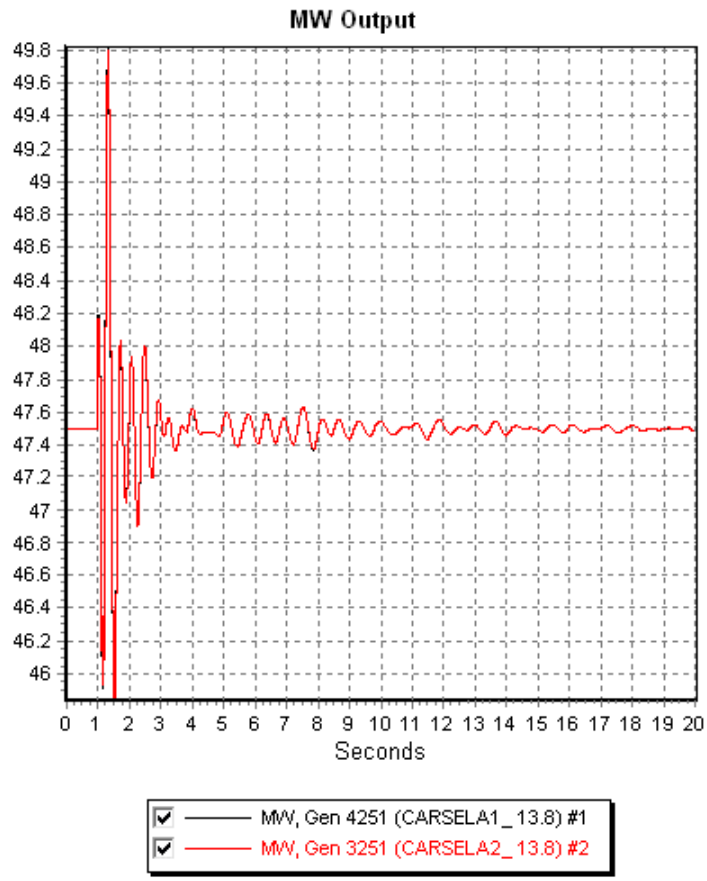
Bus Voltages and Frequency
Queenstown Generating Plant Output: 90MW

November 14, 2014 07:17:56

Carseland





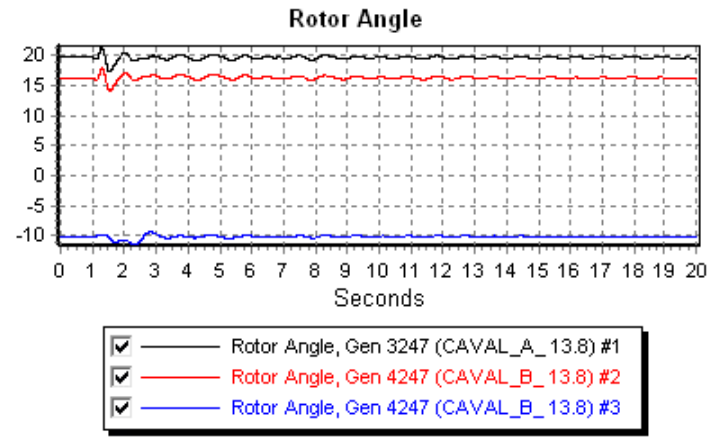


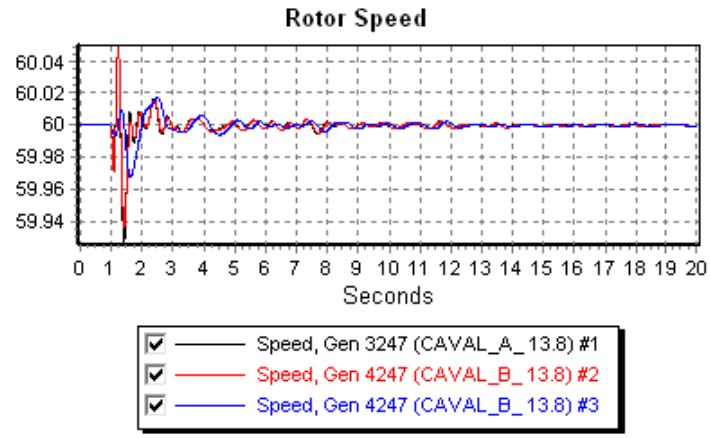
Contingency: 853L WEST BROOKS 28S - QUEENSTOWN 504S

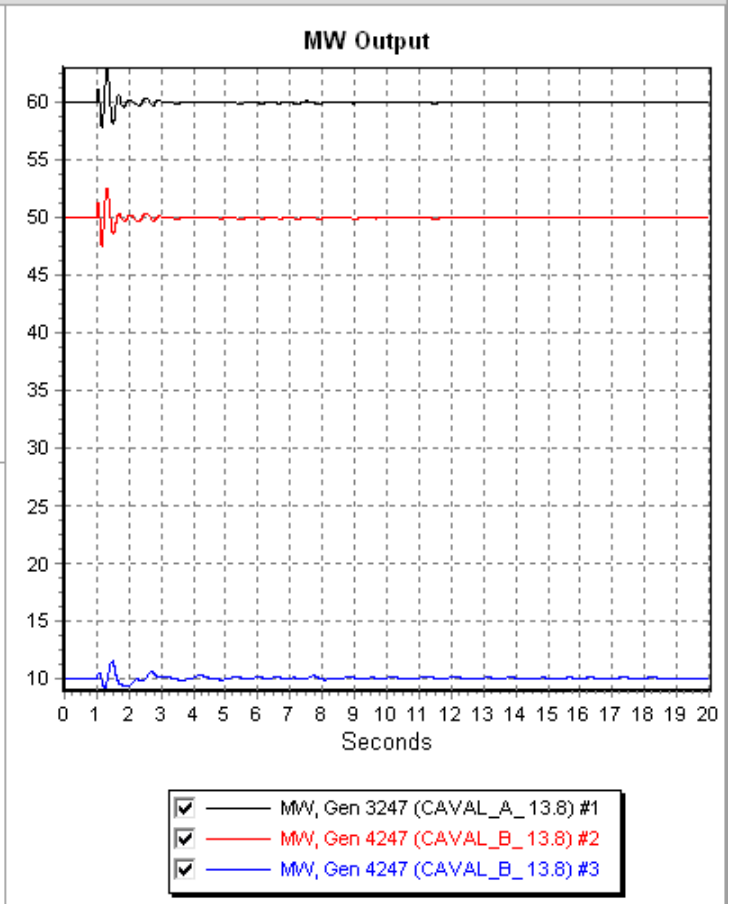
Carseland
Queenstown Generating Plant Output: 90MW

November 14, 2014 07:17:53

Cavalier





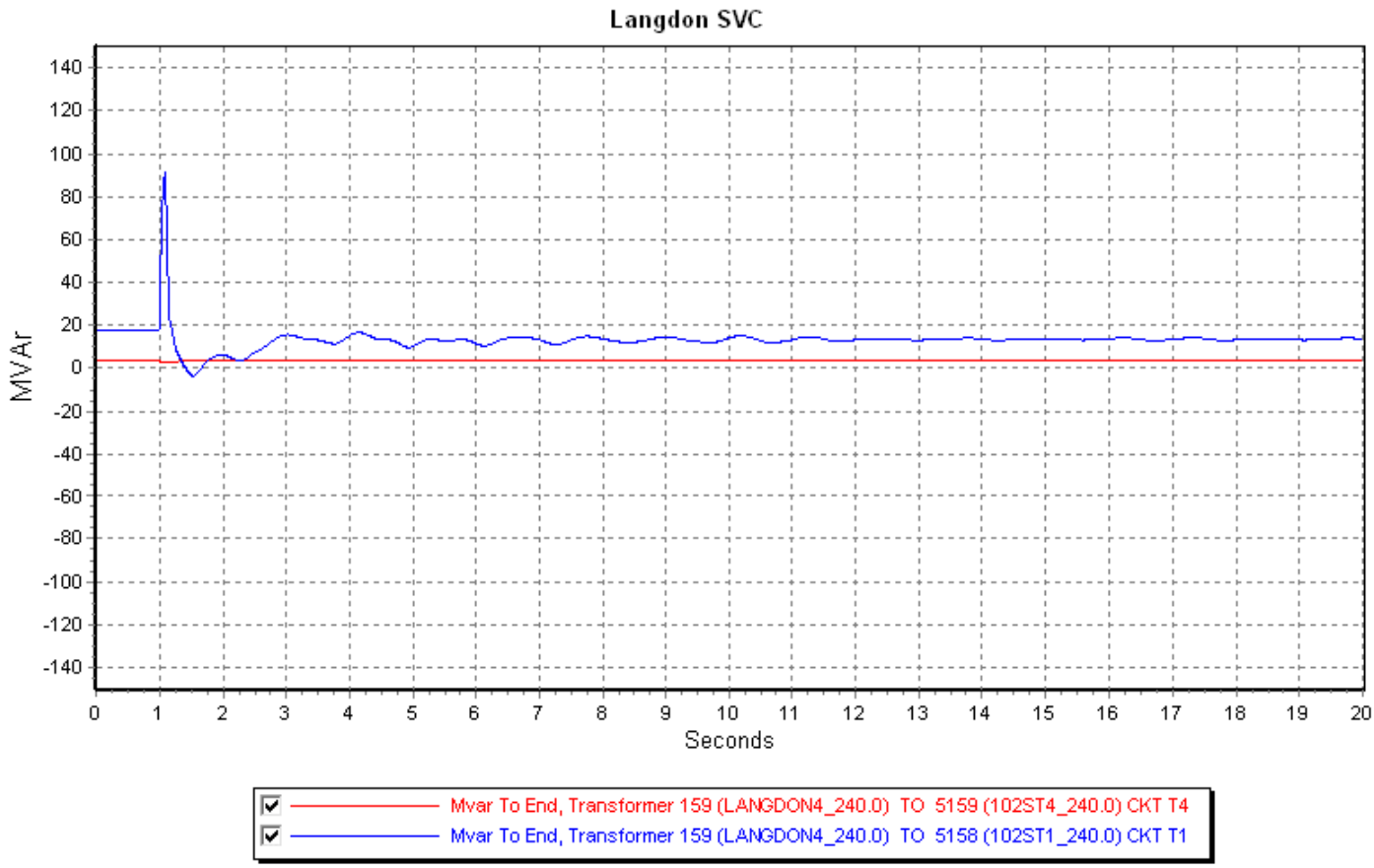


Contingency: 853L WEST BROOKS 28S - QUEENSTOWN 504S

Cavalier
Queenstown Generating Plant Output: 90MW

November 14, 2014 07:17:55

Langdon SVC

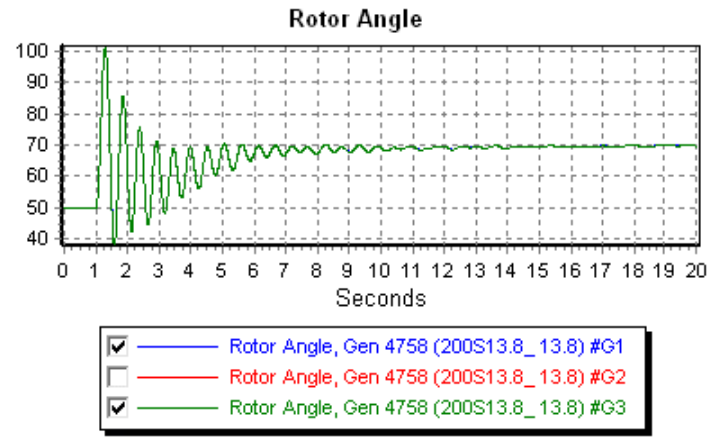


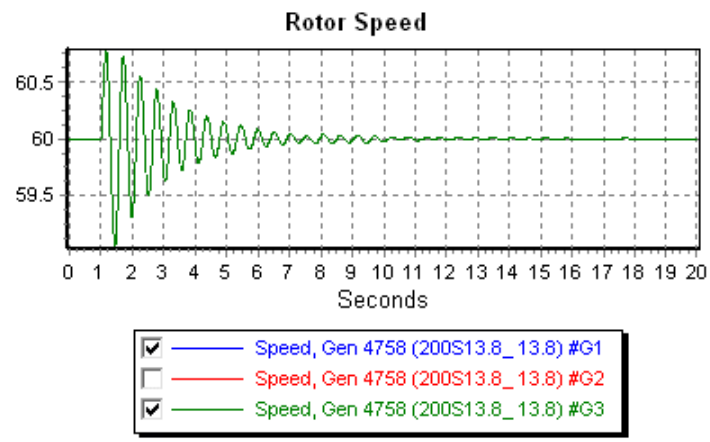
Contingency: 853L WEST BROOKS 28S - QUEENSTOWN 504S

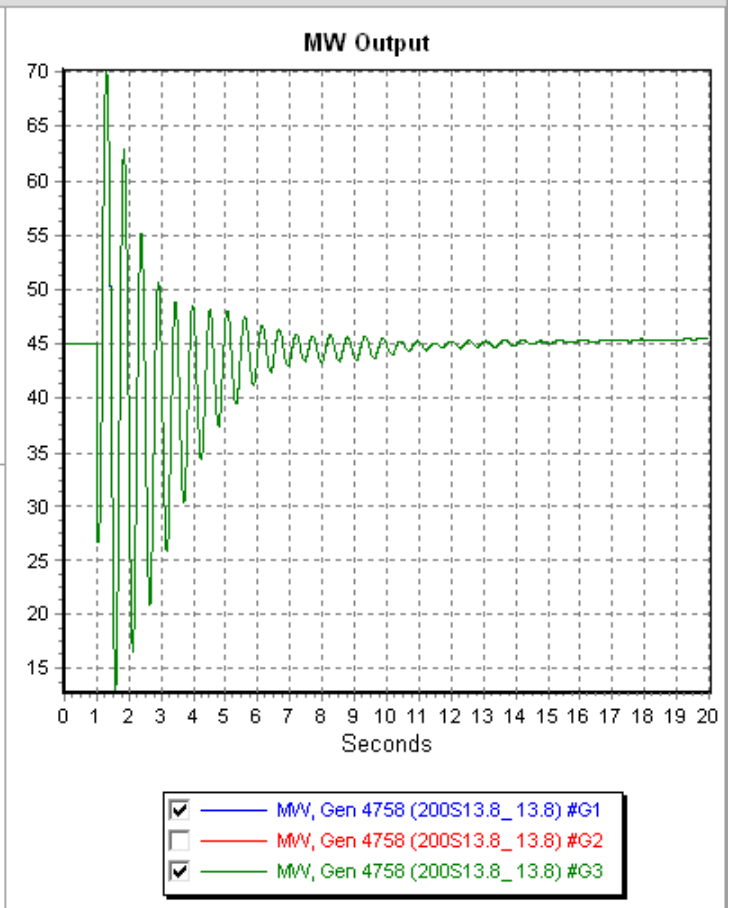
Langdon SVC
Queenstown Generating Plant Output: 90MW

November 14, 2014 07:17:56

Queenstown Gen





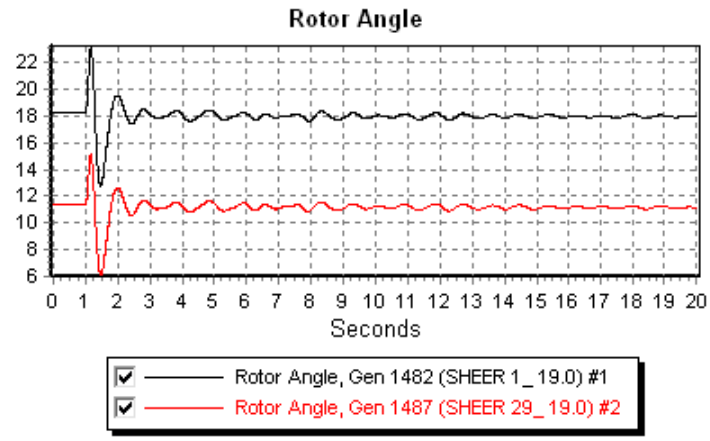


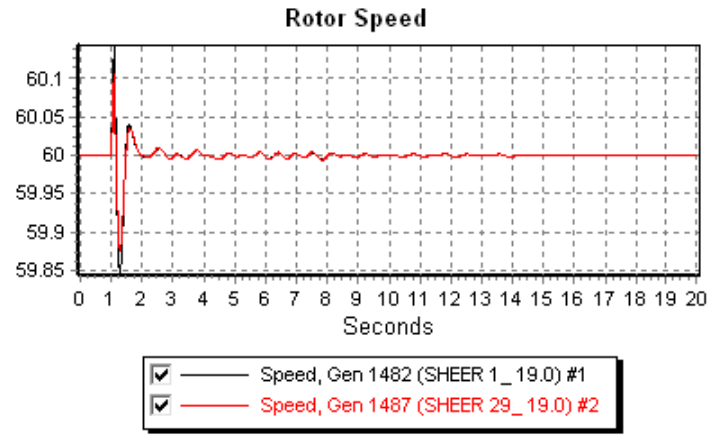
Contingency: 853L WEST BROOKS 28S - QUEENSTOWN 504

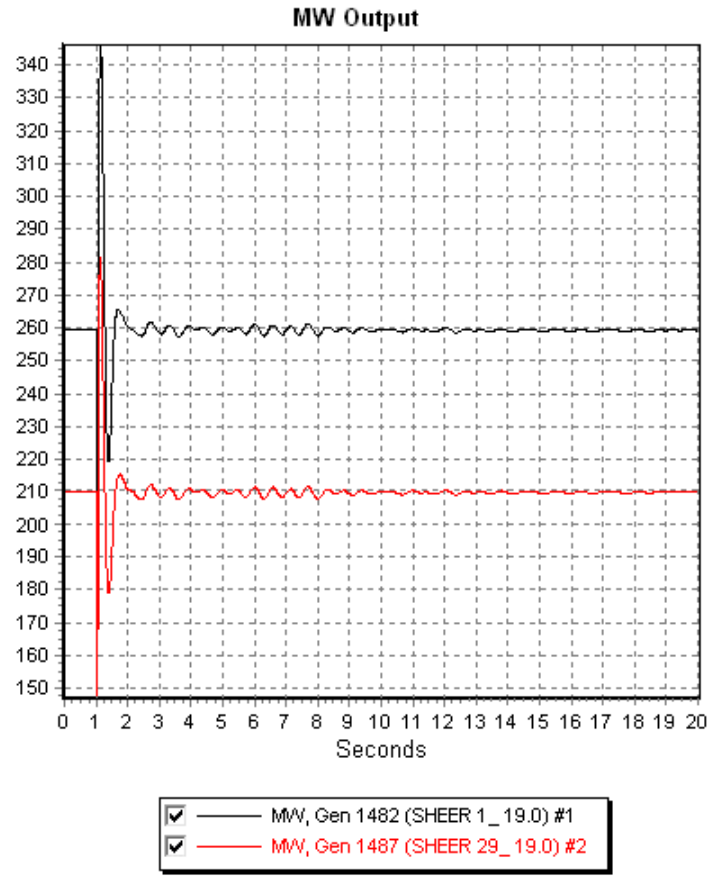
P1336
Queenstown Generating Plant
Output: 90MW

November 14, 2014 07:17:54

Sheerness





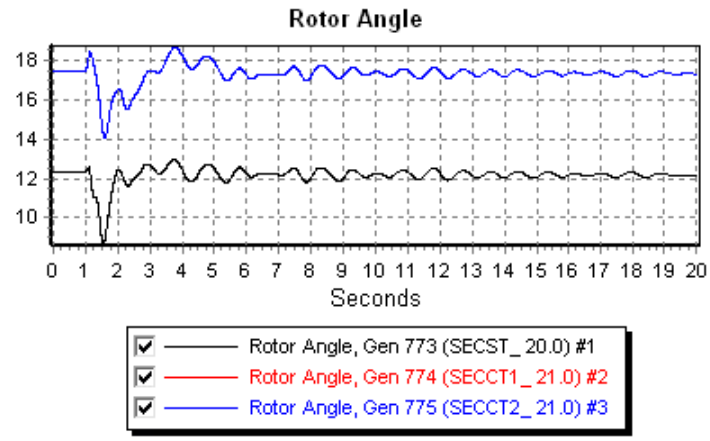


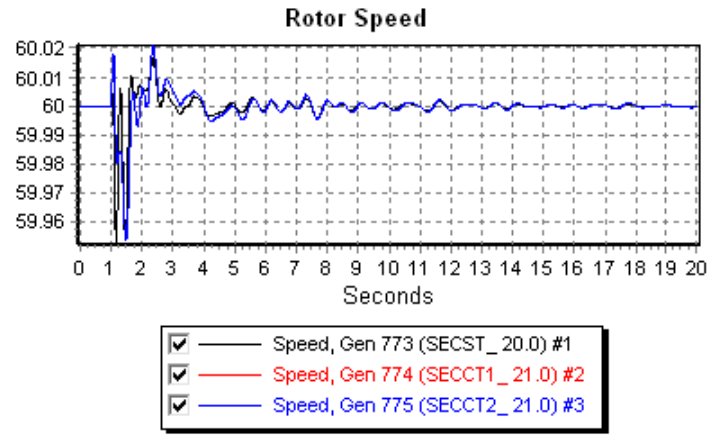
Contingency: 853L WEST BROOKS 28S - QUEENSTOWN 504S

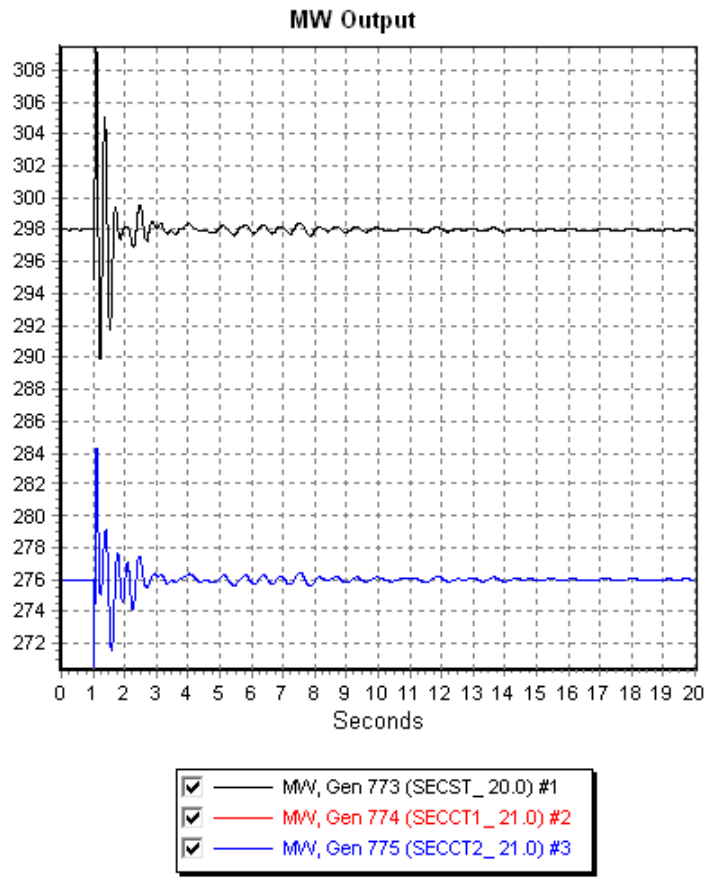
Sheerness
Queenstown Generating Plant Output: 90MW

November 14, 2014 07:17:52

Sheppard





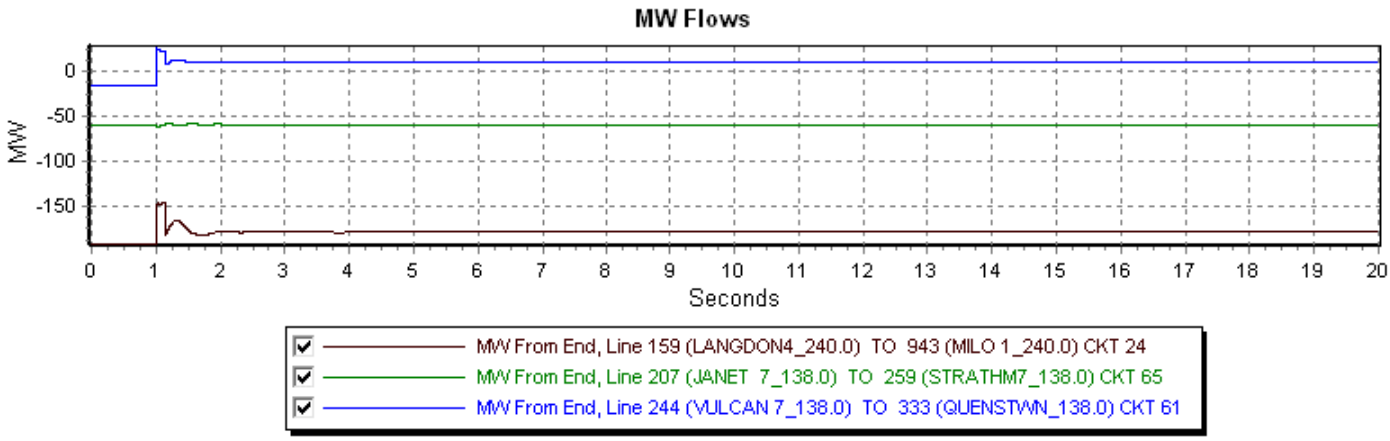


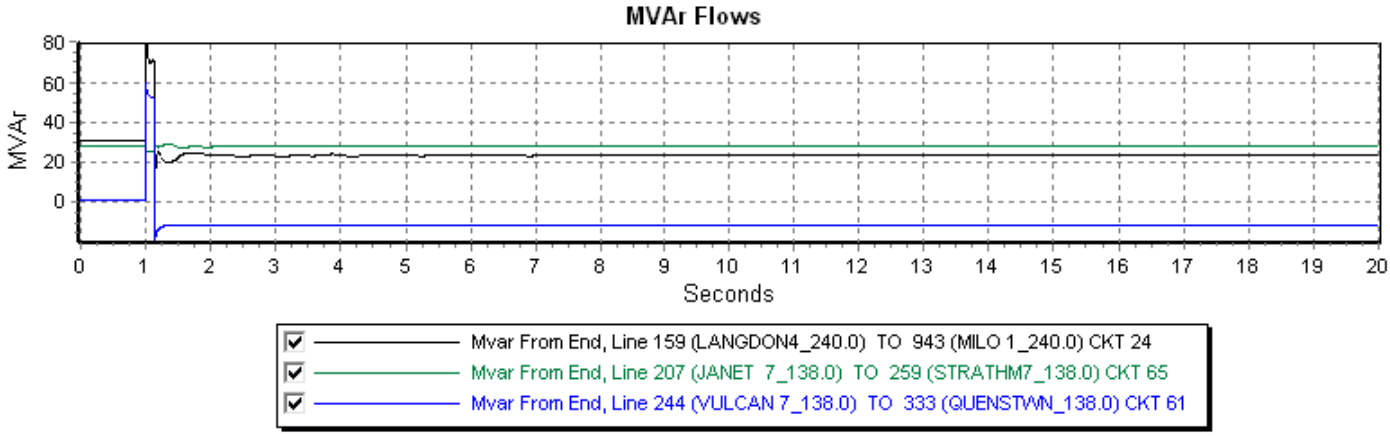
Contingency: 853L WEST BROOKS 28S - QUEENSTOWN 504S

Sheppard
Queenstown Generating Plant Output: 90MW

November 14, 2014 07:17:53

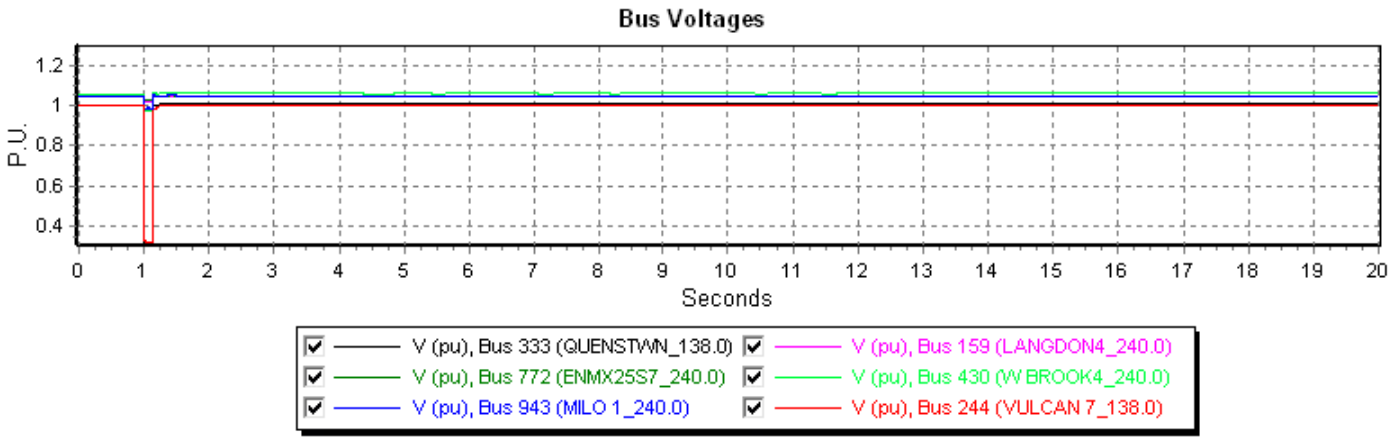
Branch Flows

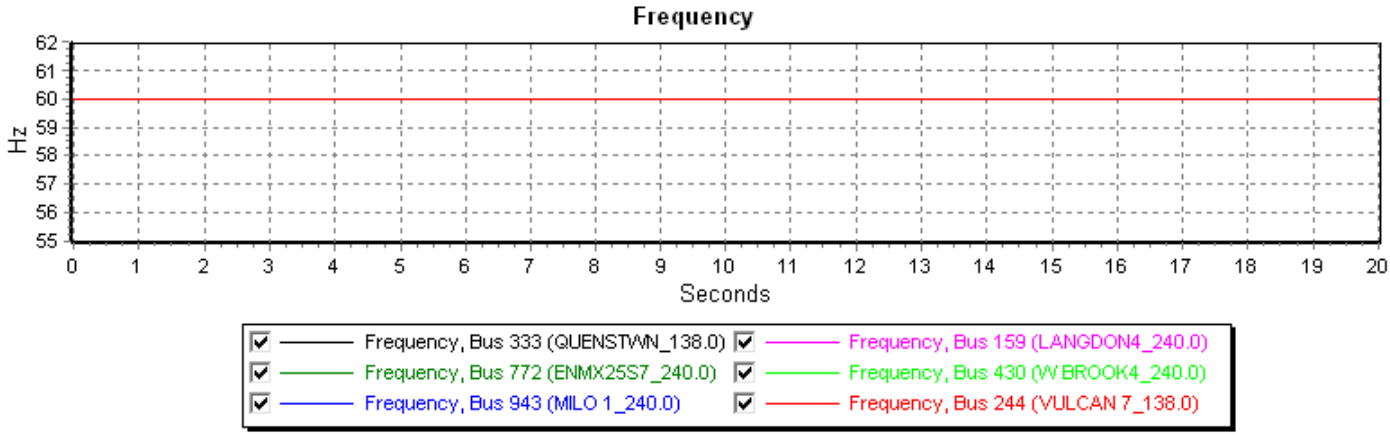




	Contingency: Queenstown Plant _McGregor200s 138 kV Bus	Branch Flows Queenstown Generating Plant Output: 90MW
		November 14, 2014 06:57:41

Bus Voltages and Frequency



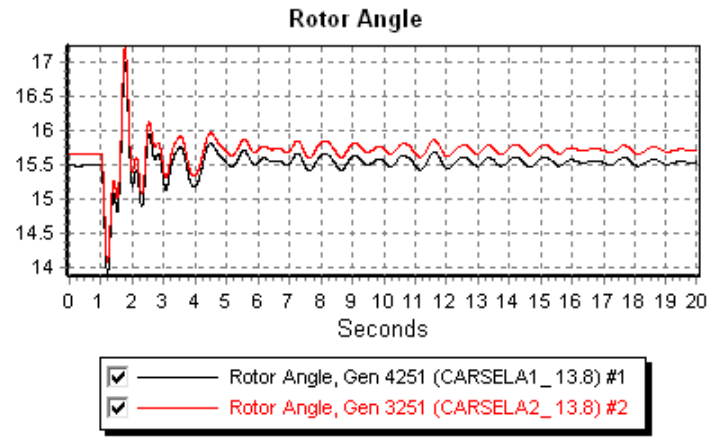


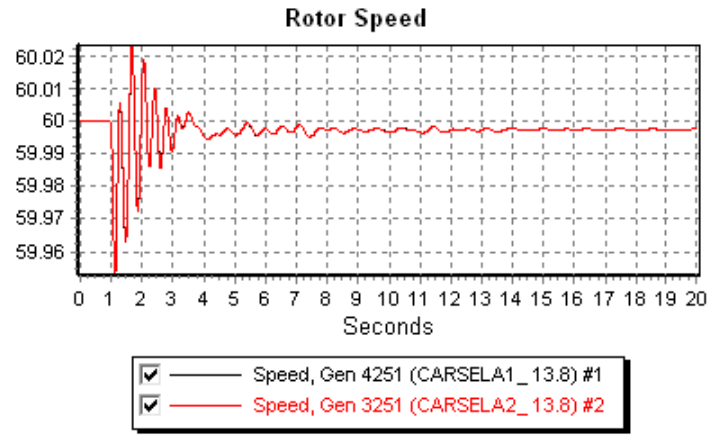
Contingency: Queenstown Plant _McGregor200s 138 kV Bus

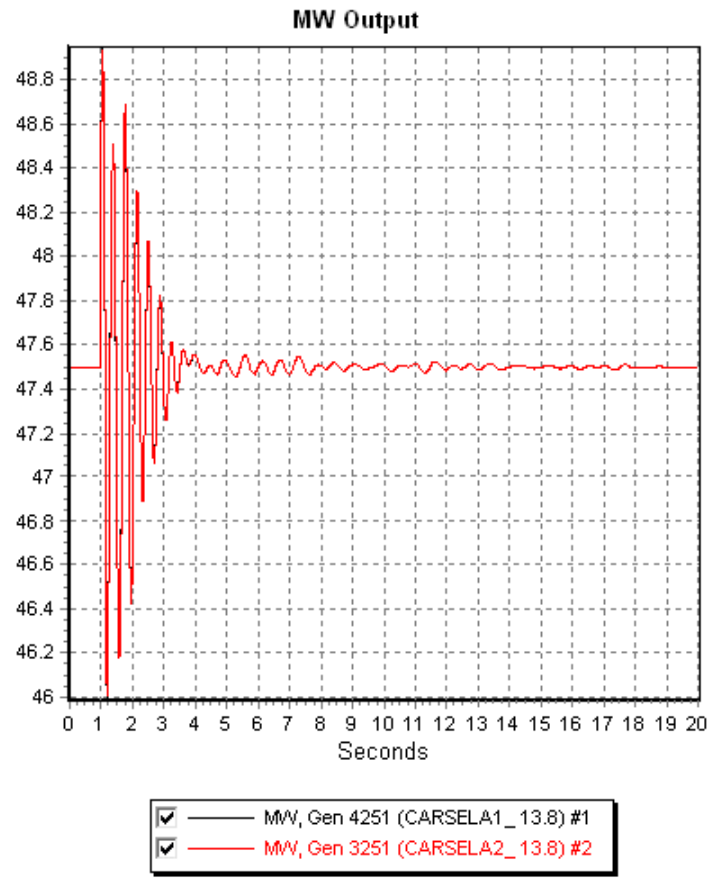
Bus Voltages and Frequency
Queenstown Generating Plant Output: 90MW

November 14, 2014 06:57:42

Carseland





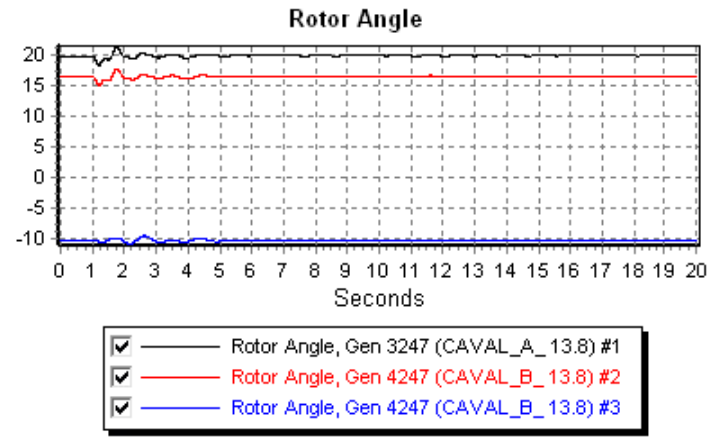


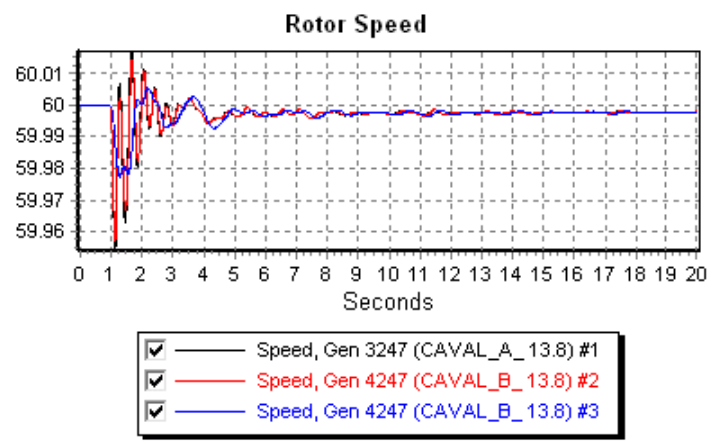
Contingency: Queenstown Plant _McGregor200s 138 kV Bus

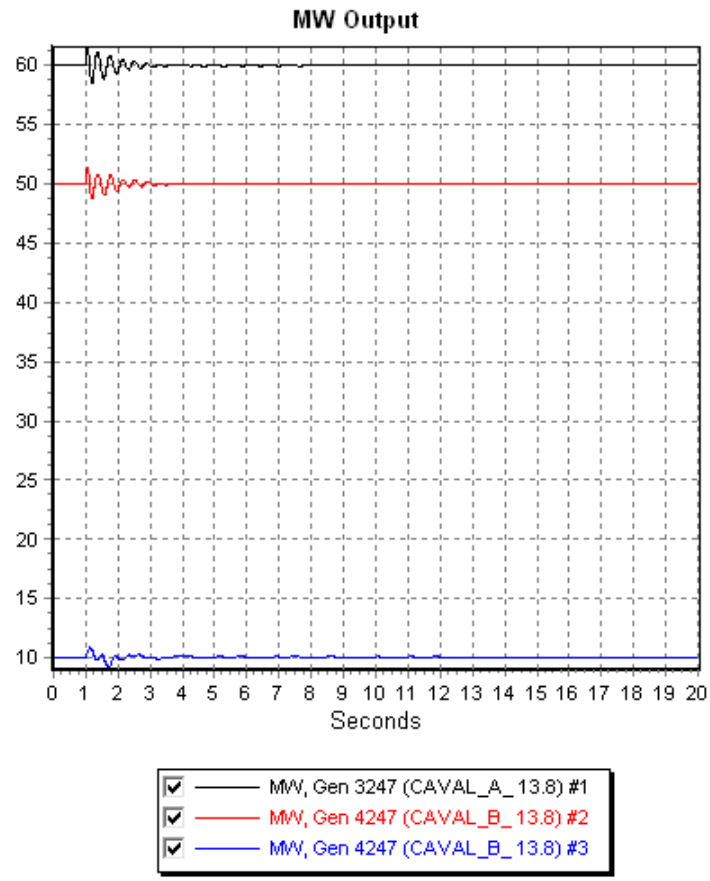
Carseland
Queenstown Generating Plant Output: 90MW

November 14, 2014 06:57:39

Cavalier





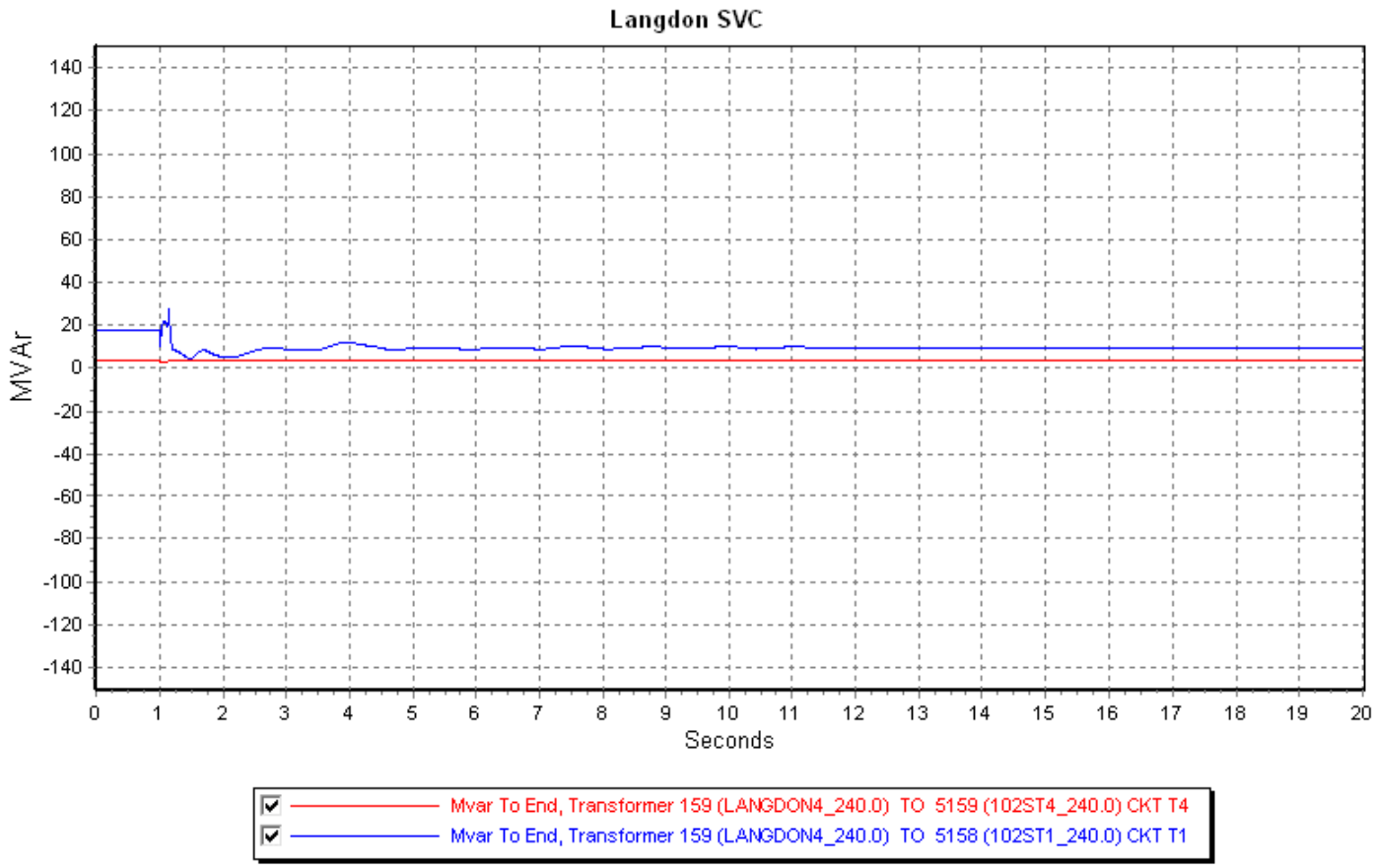


Contingency: Queenstown Plant _McGregor200s 138 kV Bus

Cavalier
Queenstown Generating Plant Output: 90MW

November 14, 2014 06:57:41

Langdon SVC

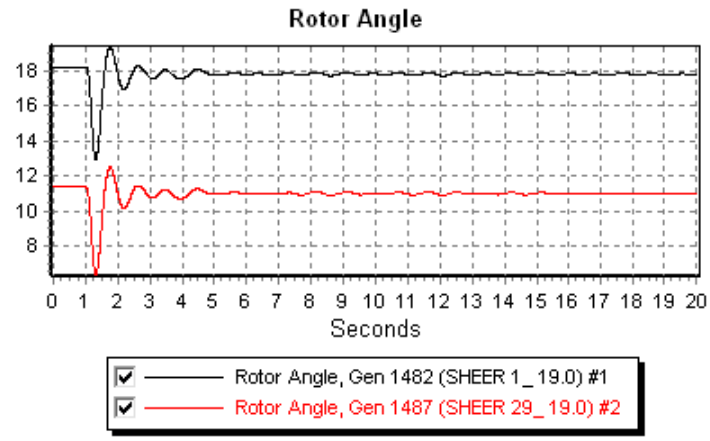


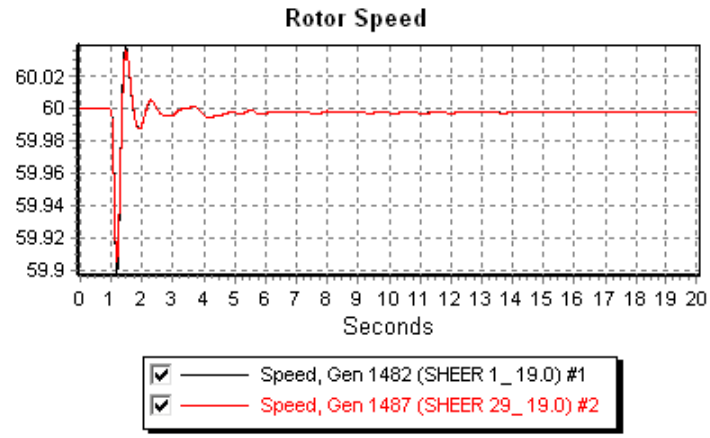
Contingency: Queenstown Plant _McGregor200s 138 kV Bus

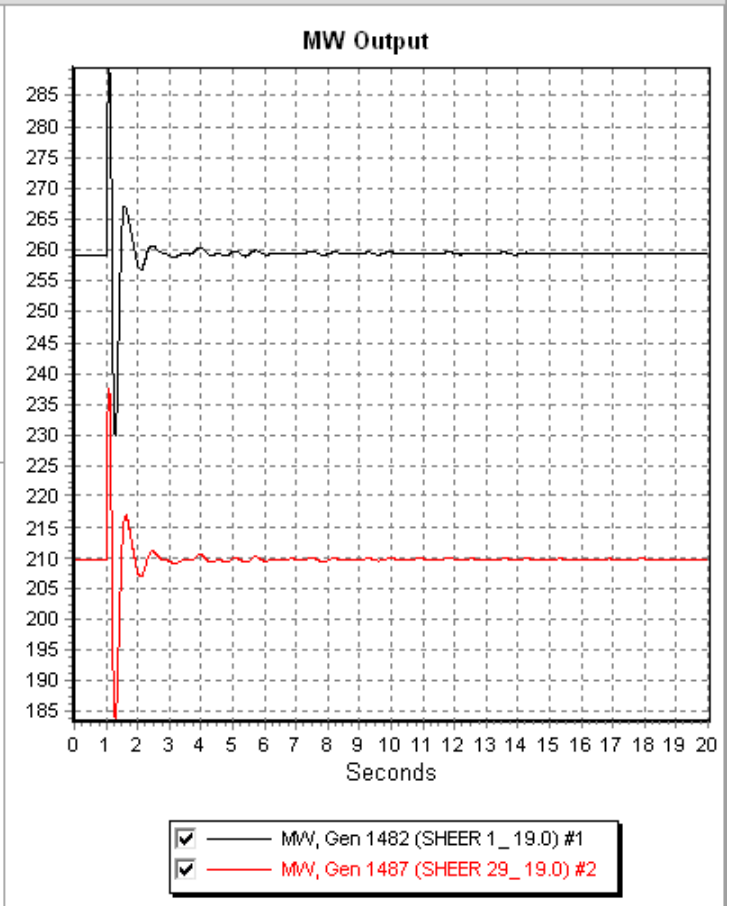
Langdon SVC
Queenstown Generating Plant Output: 90MW

November 14, 2014 06:57:42

Sheerness





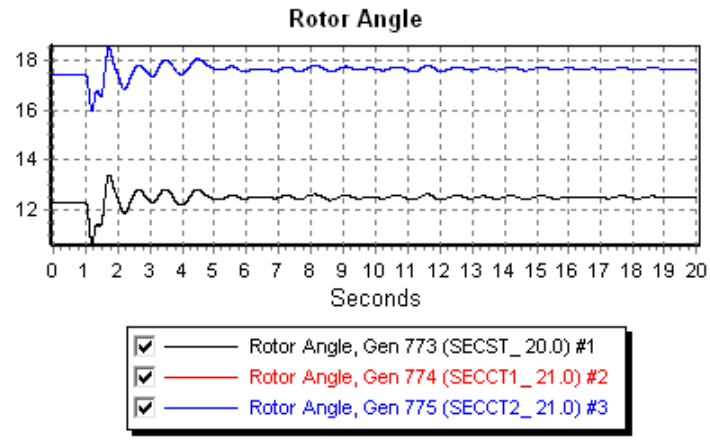


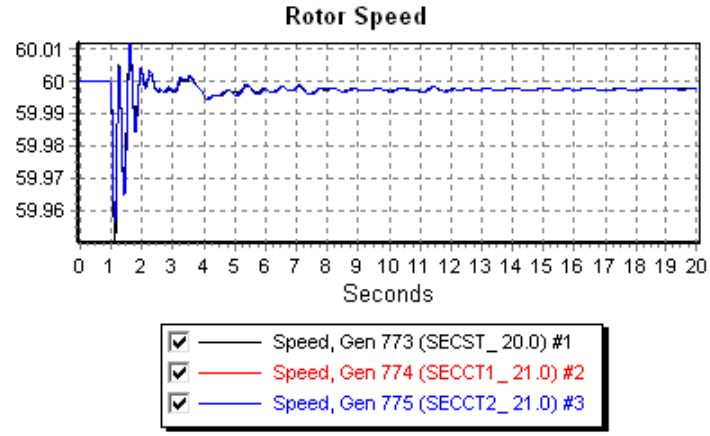
Contingency: Queenstown Plant _McGregor200s 138 kV Bus

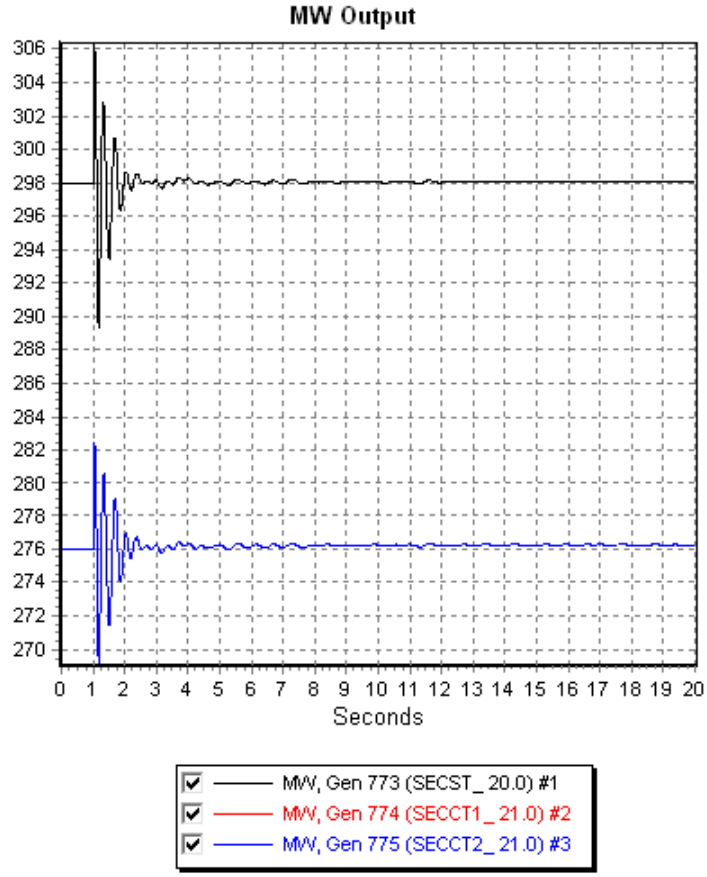
Sheerness
Queenstown Generating Plant Output: 90MW

November 14, 2014 06:57:39

Sheppard







Contingency: Queenstown Plant _McGregor200s 138 kV Bus

Sheppard
Queenstown Generating Plant Output: 90MW

November 14, 2014 06:57:40