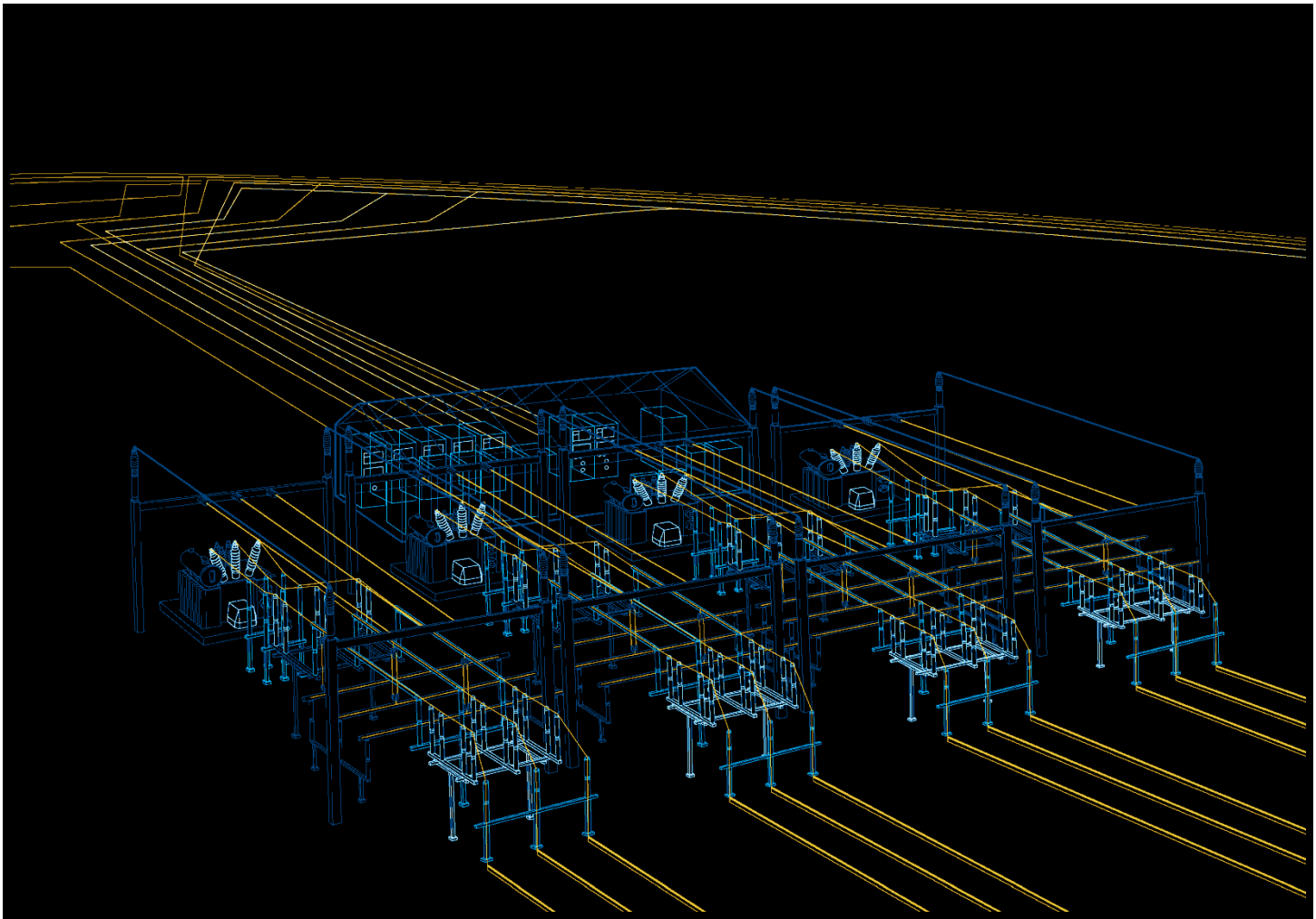

ABB Inc.

Public Service of New Mexico

Broadview PSLF Study

Final Report

Report Number: 2015-E16009-1.0.R01

ABB Power Systems Consulting

Sept. 25, 2015

Power and productivity for a better world™

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Prepared for: Public Service Company of New Mexico
Original Issue Date: Sept. 25, 2015

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ABB Inc.	2015-E16009-1.0.R01		
Public Service Company of New Mexico **Broadview PSLF Study**	**Dept.** **Consulting**	Date Sept. 25, 2015	Pages 31

Executive Summary:
PNM has requested ABB to perform technical powerflow/stability studies to access redirecting an existing firm transmission service reservation (TSR) on the PNM transmission system from the Blackwater 230 kV station to the Blackwater 345 kV station, in accordance with PNM's Business Practice for Redirect of Short-Term Firm and Long-Term Firm Point-to-Point Transmission Service. The total power injections at Blackwater 345 kV station will be 297 MW for a proposed wind generating facility (Broadview) interconnecting to PNM's Blackwater 345 kV station adjacent to PNM's HVDC converter station located in the Clovis-Portales area of eastern New Mexico. The transmission path of interest for this study is PNM's 216-mile, 345 kV transmission line between Blackwater and PNM's BA station north of Bernalillo, New Mexico. Excluding line losses, previously technical studies indicated that the available transmission capacity on the requested transmission path is limited to 662 MW, based on a 5% margin from the all-lines-in-service N-0 voltage stability limitation. The base power flow conditions requested by PNM for this study are:

- Broadview at Blackwater 345 kV: 297 MW
- Blackwater HVDC: 75 MW E-W
- Taiban Mesa: 200 MW
- Aragonne Mesa: 90 MW

Based primarily on steady-state voltage requirements, the analysis has shown that no additional dynamic reactive support or other network upgrades are required in order to support the 297 MW power injections at Blackwater 345 kV station. In addition, PSCAD studies are being performed in a separate study to evaluate whether a synchronous condenser at Blackwater 345 kV station will be required to support the transmission service conditions as shown above.

No system upgrades are required to accommodate the 297 MW Broadview power injection. However, as noted in this and previous studies, the BA-Rio Puerco double circuit outage, will require the development of a Remedial Action Scheme (RAS) in order to accommodate the 662 MW on this transmission path. The corresponding costs and development effort, as provided by PNM, are estimated as $200K and 6 months, respectively.

Rev #	Revision	Date	Author	Reviewed	Approved
1	Incorporated PNM comments	9/25/2015	K. Timko		
DISTRIBUTION Public Service Company of New Mexico					

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1 Introduction

PNM has requested ABB to perform technical powerflow/stability studies to access redirecting an existing firm transmission service reservation (TSR) on the PNM transmission system from the Blackwater 230 kV station to the Blackwater 345 kV station, in accordance with PNM's Business Practice for Redirect of Short-Term Firm and Long-Term Firm Point-to-Point Transmission Service. The total power injections at Blackwater 345 kV station will be 297 MW for a proposed wind generating facility (Broadview) interconnecting to PNM's Blackwater 345 kV station adjacent to PNM's HVDC[1] converter station located in the Clovis-Portales area of eastern New Mexico. The transmission path of interest for this study is PNM's 216-mile, 345 kV transmission line between Blackwater and PNM's BA station north of Bernalillo, New Mexico (BB transmission path). Excluding line losses, previously technical studies indicated that the available transmission capacity on the requested transmission path is limited to 662 MW, based on a 5% margin from the all-lines-in-service N-0 voltage stability limitation. The base power flow conditions requested by PNM for this study are:

- Broadview at Blackwater 345 kV: 297 MW
- Blackwater HVDC: 75 MW E-W
- Taiban Mesa: 200 MW
- Aragonne Mesa: 90 MW

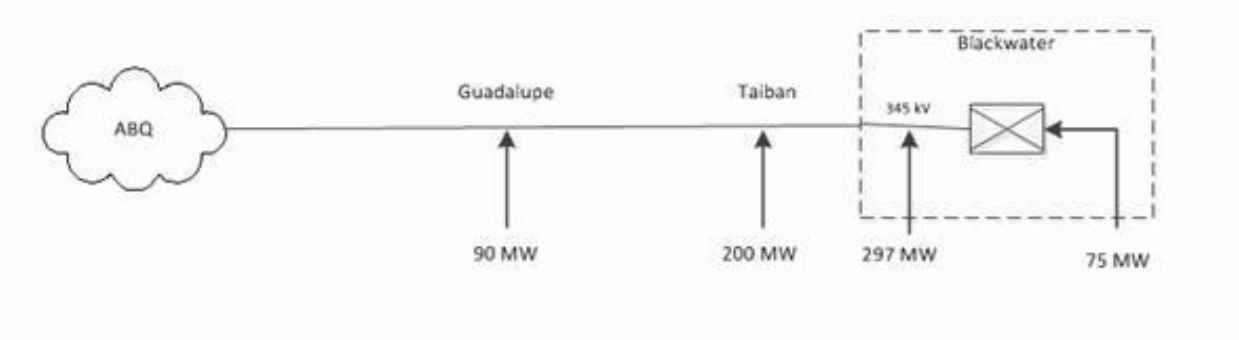


Figure 1: Transmission commitments on the Blackwater-BA 345kV Line

In order to confirm the adequacy of the BB transmission path to support the proposed wind generation at Broadview, the following approach consistent with prior studies was followed for the present study:

(1) Perform power flow analysis to confirm the reactive support requirements, if any, for the configuration shown in Figure 1. QV analysis at the Guadalupe 345 kV bus for the

[1] The Blackwater HVDC station interconnections with Southwestern Public Service Company ("SPS") that permits bidirectional flows of power between the Southwest Power Pool ("SPP") and the Western Electricity Coordinating Council ("WECC") grids,

base case and for select contingency scenarios will be used to determine reactive margins at Guadalupe.

(2) As a confirmation of the reactive support requirements for this study, transfer limits for the configuration shown in Figure 1 are determined using PV analysis. The WECC planning criteria for voltage stability [3, 4] require that the loading level of an interface be no more than 95% of the collapse point of the PV curve for the worst N-1 outage, or 97.5% of the collapse point for the worst N-2 outage. This implies that the maximum allowable transfers on the BB transmission path are limited to 95% (97.5%) of the PV collapse point that results in divergence of the powerflow solution under the worst N-1 (N-2) outage condition.

(3) Finally, dynamic simulations of selected contingencies are used to confirm adequate system dynamic performance and post-fault voltage recovery, and that all the existing wind power plants on the BB transmission path will ride through the fault based on the LVRT curves and the voltage recovery. For the dynamic analysis, the Broadview power injection at the Blackwater 345 kV station is modeled as a wind generator configured with 100% Type 4 wind turbines. The wind farm collector system and dynamic models have been provided by PNM. The wind generation is assumed to hold close to unity power factor at the point of common coupling at the Blackwater 345 kV bus.

2 Modeling Approach and Assumptions

2.1 Original PSLF Flow Model

The overall background and tasks of this study have been presented in the Section 1. This section will discuss the detailed study approach starting from the original model supplied by PNM. The original PSLF model that formed the basis for the studies described in this report is shown in Figure 2a. The system data from PNM were provided in PSLF version 18 format.

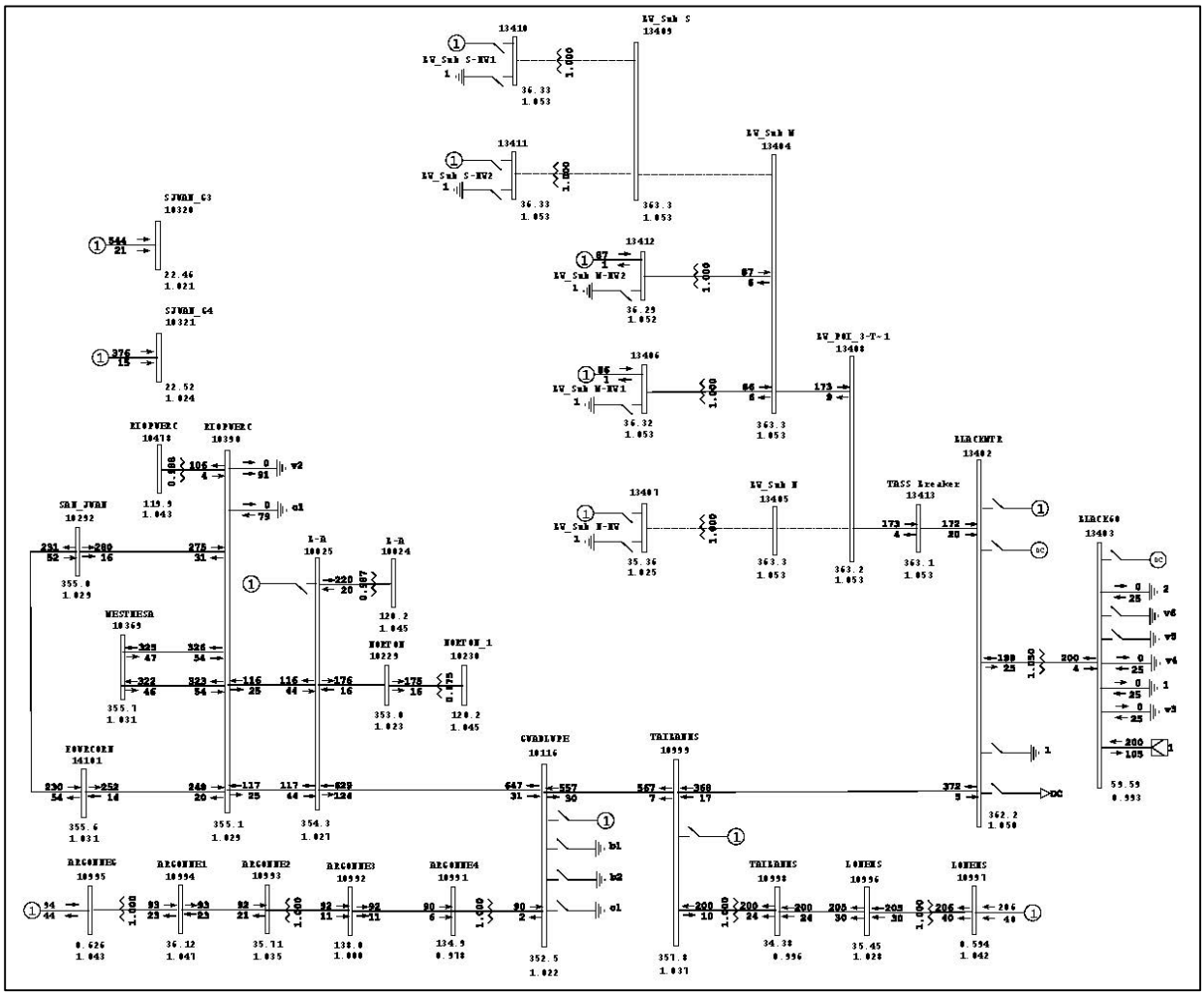


Figure 2a: 172 MW Broadview Pre-project Configuration

The following PNM equipment is included in the 297 MW Broadview model:

- Broadview Generation Injection at Blackwater 345 kV: 297 MW
- Blackwater 230 kV HVDC: 75 MW E-W
- Taiban Mesa: 200 MW
- Aragonne Mesa: 90 MW

The project model is shown below in Figure 2b.

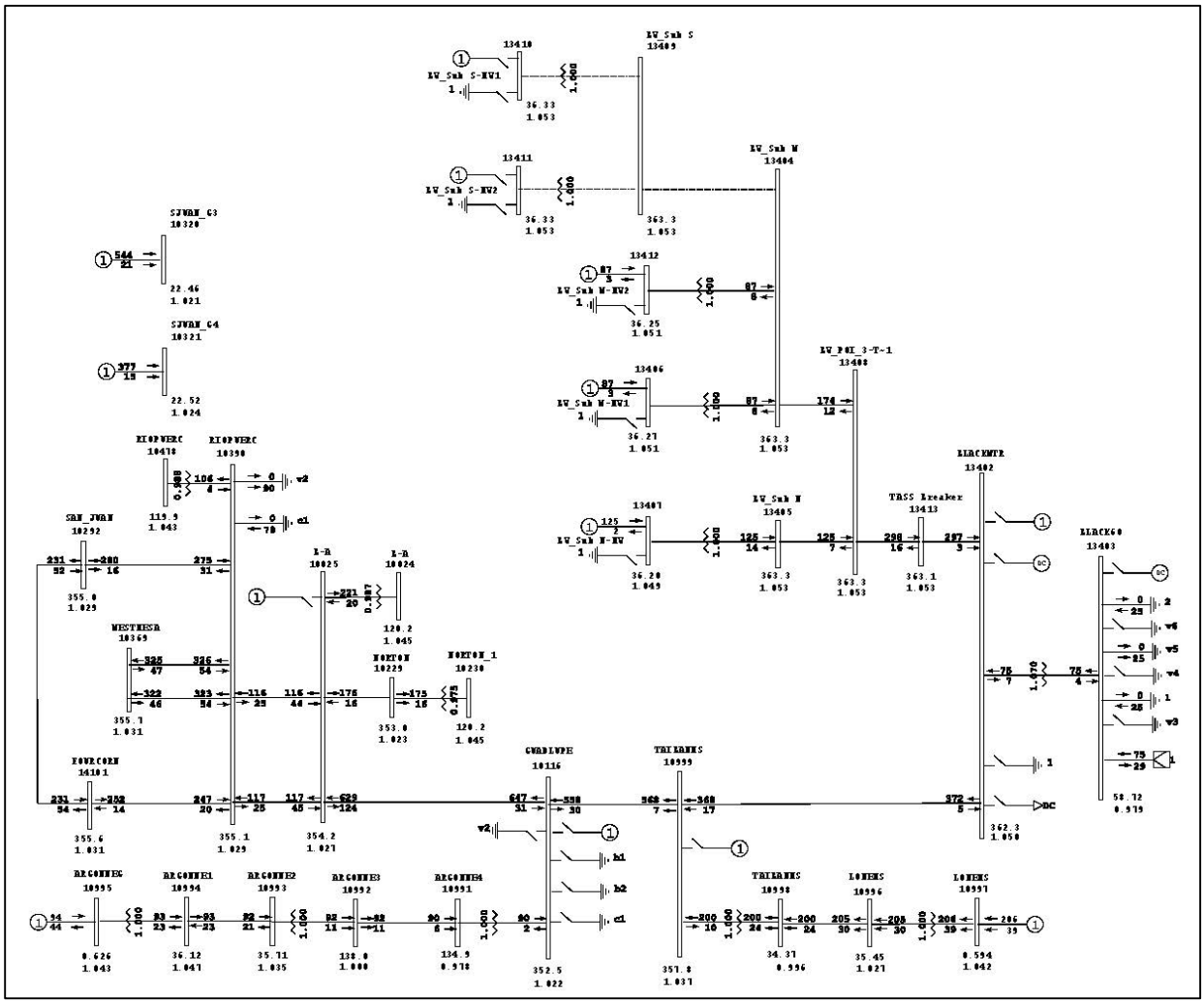


Figure 2b: 297 MW Broadview Configuration

2.2 Study Approach

With consideration to PNM's request [1], the approach taken for the study is outlined below.

2.2.1 Power flow study

In order to make an initial determination of the reactive compensation required at Guadalupe, if any, to support the Broadview project, a power flow study was performed using PSLF SSTOOLS. The methodology used for the power flow study is as follows:

(1) Starting from the system model provided by PNM, the 297 MW Broadview was added at the Blackwater 345 kV bus and the Blackwater HVDC power schedule was reduced to 75 MW. The base conditions for the study are shown above in Figure 2b.

(2) In order to identify the minimum amount of reactive compensation required, if any, to achieve steady-state convergence and to meet the planning voltage criteria described in Table 2, a QV (maximum reactive margin) analysis was performed at the Guadalupe 345 kV bus for the configuration and the contingency scenarios listed in Table 1. Note the following:

- QV analysis is used to determine the amount of reactive power required to hold a given voltage at a given bus, with consideration given to contingencies. Each point on the QV curve is a separate power flow solution. The presence of reactive power reserves is indicated by a curve that goes below zero, and the amount of reserves for a given bus voltage is the distance from the Q axis to the QV curve at that bus voltage.
- The QV curve is useful in identifying systems near voltage collapse. As the shape of the curve becomes flat (low dQ/dV), the system is approaching the voltage stability limit. Stable system performance is indicated when the QV curve has positive slope (positive dQ/dV) while unstable system performance is identified when the QV curve has negative slope (negative dQ/dV). The point where the QV curve flattens out and reaches a minimum value is an area of voltage instability, i.e., a small change in reactive power will result in a large voltage change. At the minimum point, an increase in reactive power can result in either an increase or a decrease in the voltage.
- The bottom of the QV curve, in addition to identifying the stability limit, defines the minimum reactive power requirement for stable operation. When the minimum point on the QV curve is above the Q axis, the power flow case will not solve without the addition of this amount of reactive power. In this event, the minimum point indicates the reactive power required at the designated bus to maintain the minimum voltage. The lack of sufficient reactive power reserves will collapse the voltage and the power flow case will not solve.

QV runs were made to determine the amount of reactive compensation required at the Guadalupe 345 kV bus in order to solve the power flow for test voltages in the range from 0.90 pu to 1.05 pu.

Table 1: Contingencies Studied

Contingency	Name	Description
0	N-0	System intact
1	BA-RP	BA to Rio Puerco 345 kV
2	BA345/115 TX	BA 345/115 kV Transformer
3	BA-NR	BA to Norton 345 kV
4	RP-WM	Rio Puerco – West Mesa 345 kV
5	RP-SJ	Rio Puerco – San Juan 345 kV
6	RP-FC	Rio Puerco – Four Corners 345 kV
7	BAHBALRP	N-2: BA 345/115 kV Transformer and BA – Rio Puerco 345 kV line
8	RPWMHL2	N-2: Rio Puerco-West Mesa & West Mesa 345/115 kV Transformer
9	BA-RP-N2	N-2: BA to Rio Puerco 345 kV Double Circuit outage

Table 2 – Power Flow Performance Criteria

Area	Conditions	Loading Limits	Voltage (p.u.)	Voltage Drop	Application
EPEC (Area 11)	Normal	< Normal Rating	0.95 - 1.05		69kV and above
			0.95 - 1.10		Artesia 345 kV
			0.95 - 1.08		Arroyo 345 kV PST source side
			0.90 - 1.05		Alamo, Sierra Blanca and Van Horn 69kV
	Contingency	< Emergency Rating	0.925 - 1.05	7%	60 kV to 115 kV
			0.95 - 1.07	7%	Artesia 345kV
			0.95 - 1.08	7%	Arroyo 345kV PST source side
			0.90 - 1.05		Alamo, Sierra Blanca and Van Horn 69kV
			0.95 - 1.05	7%	Hidalgo, Luna, or other 345 kV buses
PNM (Area 10)	Normal ALIS	< Normal Rating	0.95 - 1.05		46 kV and above*
	Contingency N-1	< Emergency Rating	0.925 - 1.08***	6%**	46 kV to 115 kV
			0.90 – 1.08***	6%**	230 kV and above
	Contingency N-2	< Emergency Rating	0.90 - 1.08***	10%	46 kV and above*
Tri- State (Zones 120-123)	Normal ALIS	< Normal Rating	0.95 - 1.05		All buses
	Contingency N-1	< Emergency Rating	0.90 - 1.1	6%**	69 kV and above except Northeastern NM and Southern NM
			0.90 - 1.1	7%**	69 kV and above in Northeastern NM and Southern NM
	Contingency N-2	< Emergency Rating	0.90 - 1.1	10%	All buses

* Guadalupe 345 kV voltage 0.90 and 1.1 p.u. under normal and contingency conditions.
**Tri-State Voltage Criteria, April 2008 – Correspondence to TSS.
*** Provided operator action can be utilized to adjust voltages back down to 1.05

(3) For the power flow cases described at the beginning of section 2.2.1, a PV (maximum load ability) analysis was performed for the BB transmission path for the contingency scenarios listed in Table 1.

- A "generation shift" method was used for the PV analysis. The source of the generation shift was set as the Broadview wind farm at the Blackwater 345 kV bus while the sink was the PNM area swing bus San Juan G4 near the Four Corners area.

- The Broadview project is assumed to hold close to unity power factor at the point of common coupling at the Blackwater 345 kV bus without controlling the voltage.

- In order to establish an initial operating point on PV curve below the available transmission capacity of the BB transmission path, the initial power injection at the Blackwater 345 kV bus was reduced by 167 MW, from 297 MW to 130 MW, with a corresponding increase in the generation at the San Juan G4 swing bus to near the P_{MAX} value for the machine.

- The power injection at the Blackwater location of the Broadview generation was then increased in steps of 10 MW until a base case solution was no longer possible. Note that the P_{MAX} values of the three Broadview units was increased to allow for transfer levels on the BB transmission path in excess of the facility rating.

- At each step, the solution is checked for steady-state convergence and that the planning voltage criteria as given in Table 2 are satisfied.

- Also, at each step, the solution is checked against the WECC planning criteria for voltage stability. This implies that the maximum allowable transfers on the BB transmission path are limited to 95% of the value that results in divergence of the power flow solution under the worst N-1 outage condition. For N-2 outages the criteria is 97.5% of the collapse point of the PV curve.

2.2.2 Stability Study

Dynamic stability studies were performed using PSLF DYTOOLS to help ensure that:

- System dynamic performance and post-fault voltage recovery is adequate.

- All existing wind power plants on the BB transmission path will ride-through the fault, based on the simulated voltage recovery and the LVRT curves.

The Broadview project has been tested in dynamic simulations based on the assumption that the new power injection at Blackwater is wind generation utilizing 100% Type 4 wind turbines. Dynamic cases have been run for all Table 1 contingencies.

2.3 PSLF Dynamic Model

The Broadview project wind farm dynamic model have been developed prior to running the power flow analysis. From the study proposal, the desired wind turbine type is limited to 100% Type 4 turbines. PNM has supplied a detailed model of the Broadview wind farm including:

- The wind farm collector system

- Wind turbine generator dynamic models based on the PSLF regc_a, reec_a, and wtgt_a models.

The power flow wind farm model is represented by aggregate models and the parameters used for the models are listed below in Table 3.

Table 3. Type 4 Wind Farm Parameters

Parameter	BV Sub N	BV Sub W1	BV Sub W2	Note
Turbine rating, individual [MVA]	2.556	2.556	2.556	Siemens SWT 2.3 VS
Turbine rating, individual [MW]	2.300	2.300	2.300	Aggregate 297 MW
Wind farm step-up transformer MVA rating [MVA]	100	100	100	Aggregate
Wind farm step-up transformer impedance R [pu]	0.002	0.003	0.000	X/R ratio = 40 (from pf data)

Wind farm step-up transformer impedance X [pu]	0.0800	0.0800	0.0008	
Turbine step-up transformer MVA rating, individual [MVA]	2.556	2.556	2.556	From Siemans Document ID E W TE-40-0000-B488-02, "Reactive Power Capability, 60 Hz Power Boost Functionality Siemens G2"
Turbine step-up transformer impedance R [pu]	0.0009	0.0009	0.0009	
Turbine step-up transformer impedance X [pu]	0.060	0.060	0.060	
Collector System Voltage [kV]	34.5	34.5	34.5	From Power Flow
Collector System R (100 MVA)	0.0017	0.0016	0.0016	
Collector System X (100 MVA)	0.0155	0.0145	0.0145	
Collector System B (100 MVA)	0.3503	0.3300	0.3300	
Turbine power factor	0.9	0.9	0.9	Leading or lagging
Point of common coupling (PCC) power factor	1.0	1.0	1.0	Near
Low voltage ride-through (LVRT)	Typical	Typical	Typical	Same as Taiban Mesa

Dynamic parameters for the wind farm model is presented in Appendix C.

3 Power Flow Study Results

3.1 QV Analysis

As described in Section 2.2, QV analysis has been performed. Assumptions and definitions for the QV analysis are listed below:

- A single power flow case was used with the test point at the Guadalupe 345 kV Station.
- The AC voltage at the QV test point was varied over the range from 1.05 pu to 0.90 pu, using an infinite reactive source at the test point.
- A separate QV run has been made for each of the contingencies listed in Table 1.
- The wind farm model included for QV analysis was set to 297 MW. The wind farm aggregate generator MVAr limits were set so as to have a 0.97 power factor at the nominal injection level of 297 MW. This means that when the injection level was below the nominal level, the effective power factor range was increased; when the injection level was above the nominal level, the effective power factor range was decreased.

The base configurations provided by PNM are shown above in Figures 2a and 2b.

3.1.1 QV Analysis Results

Results from QV analysis are presented below in the plots of Figures 3 through 5. As illustrated in Figures 3 and 4 for the pre-project configuration, the slope of the QV curves for all outages indicates stable system performance for voltages of 0.96 pu and greater with the Blackwater 345 kV bus scheduled at 1.05 pu, and 0.95 pu and greater with the Broadview project operating at unity power factor. The minimum reactive margin for both cases is in the neighborhood of 98 MW, with reactive margin available up to and including 1.01 pu voltage. No additional reactive compensation is required for the pre-project system.

With Broadview 297 MW power injections, there is a significant increase in the reactive margin, up to 151 MW for the N-2 outage of the BA 345/115 kV transformer and the BA–Rio Puerco 345 kV line. As illustrated in Figure 5, the slope of the QV curves is positive down to 0.915 pu for all outages, indicating stable system performance over the range of voltages tested. Disregarding the BA-Rio Puerco 345 kV double-circuit outage, reactive reserves are available at the Guadalupe 345 kV bus for voltages up to approximately 1.015 pu for all remaining outages. As expected, no additional reactive compensation is required for the post-project system.

Table 4 summarizes the reactive margins available for the pre- and post-project system configurations. Note that a negative number indicates the presence of reactive power reserves while a positive number indicates that reactive power support is required to obtain a stable solution.

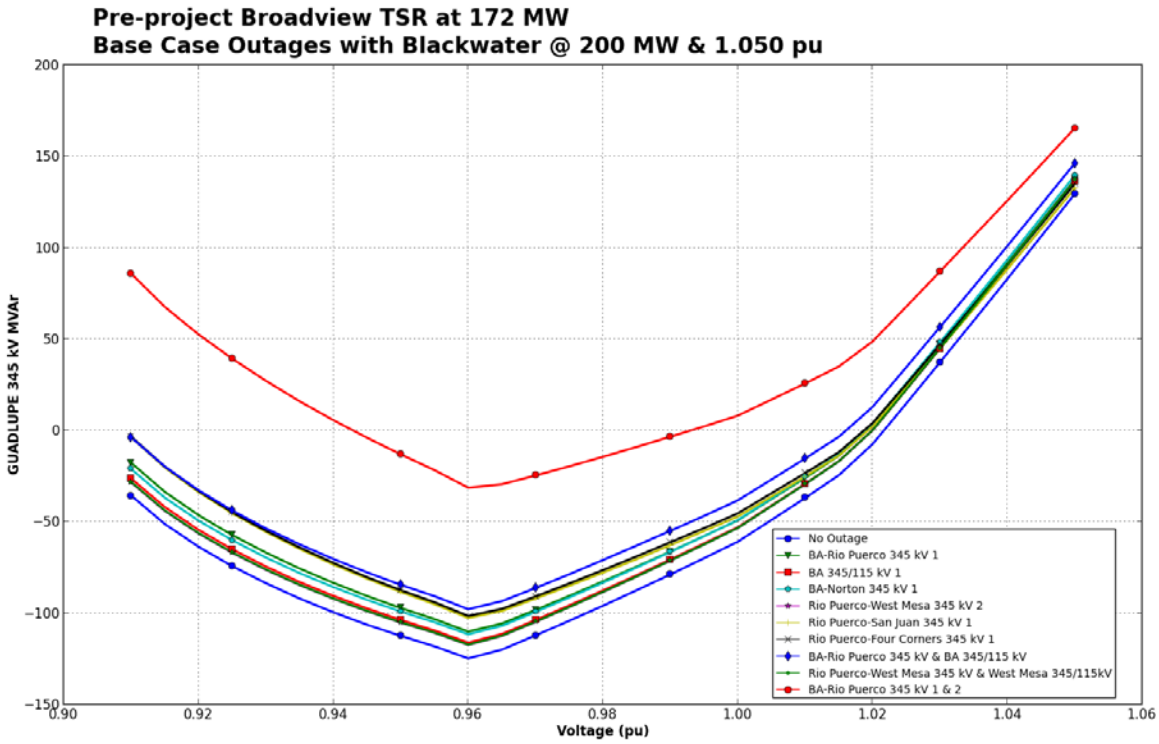


Figure 3: Guadalupe 345 kV Bus QV Analysis – Pre-project 172 MW

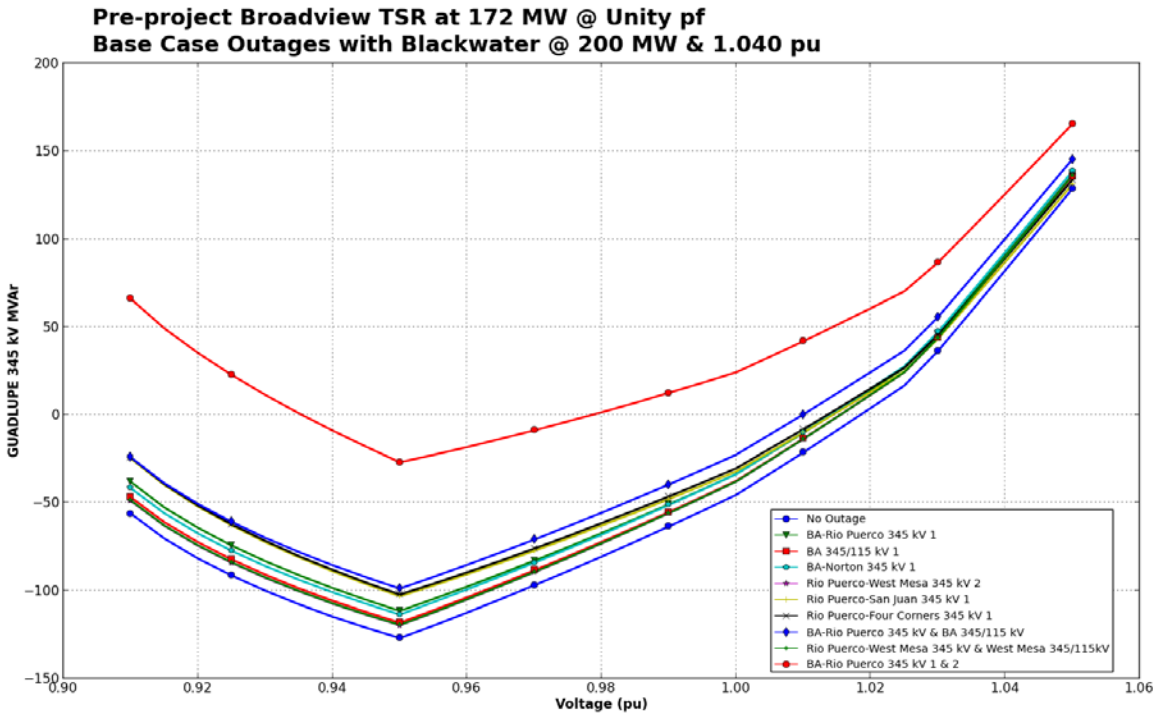


Figure 4: Guadalupe 345 kV Bus QV Analysis – Pre-project 172 MW @ Unity Power Factor

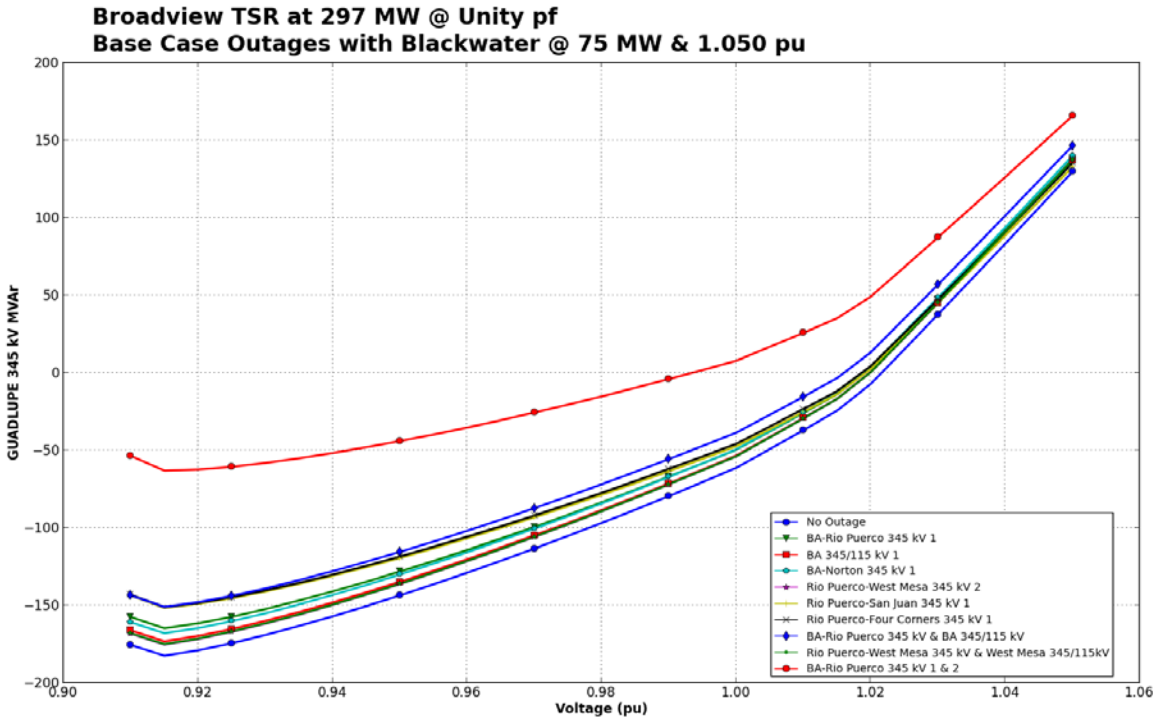


Figure 5: Guadalupe 345 kV Bus QV Analysis – 297 MW @ Unity Power Factor

Table 4: Guadalupe 345 kV Bus QV Analysis

Outage/s	Minimum Reactive Margin					
	Pre-project Broadview 172 MW		Pre-project Broadview 172 MW @ Unity pf		Broadview 297 MW @ Unity pf	
	MVAr	Voltage	MVAr	Voltage	MVAr	Voltage
No Outage	-124.8	0.960	-127.0	0.950	-182.5	0.915
BA-Rio Puerco 345 kV 1	-110.1	0.960	-111.6	0.950	-164.8	0.915
BA 345/115 kV 1	-116.2	0.960	-118.2	0.950	-173.2	0.915
BA-Norton 345 kV 1	-111.6	0.960	-113.6	0.950	-168.0	0.915
Rio Puerco-West Mesa 345 kV 2	-117.4	0.960	-119.6	0.950	-175.2	0.915
Rio Puerco-San Juan 345 kV 1	-102.6	0.960	-103.3	0.950	-151.6	0.915
Rio Puerco-Four Corners 345 kV 1	-101.5	0.960	-102.3	0.950	-151.1	0.915
BA-Rio Puerco 345 kV & BA 345/115 kV	**-97.8**	**0.960**	**-98.9**	**0.950**	**-151.0**	**0.915**
Rio Puerco-West Mesa 345 kV & West Mesa 345/115kV	-117.3	0.960	-119.5	0.950	-175.0	0.915
BA-Rio Puerco 345 kV 1 & 2	-31.3	0.960	-27.0	0.950	-63.1	0.915

Based on the QV analysis, therefore, the following conclusions can be made:

- For the pre-project system configuration, the BB transmission path is loaded to 629 MW, as measured at the BA 345 kV bus, with the Blackwater HVDC schedule at 200 MW and with 172 MW of Broadview wind generation. The minimum reactive margin is 97.8 MVAr for an outage of the BA-Rio Puerco 345 kV circuit and the BA 345/115 kV transformer, and no additional reactive compensation is required at the Guadalupe 345 kV bus for voltages up to 1.015 pu. Unstable operation is indicated for Guadalupe voltages below 0.96 pu.

- With the Broadview at 297 MW and the Blackwater HVDC scheduled at 75 MW, the BB transmission path is again loaded to 629 MW. However, for this system configuration, the minimum reactive margin is increased to 151 MVAr, again for an outage of the BA-Rio Puerco 345 kV circuit and the BA 345/115 kV transformer. The region of unstable operation, as indicated by the QV curves for the Guadalupe 345 kV voltage is now at 0.915 pu and below.

- As can be seen in Figures 3 through 5, the BA-Rio Puerco 345 kV double-circuit outage does result in significantly lower reactive margins in both the pre- and post-project system configurations. However, due to the severity of this contingency, the post-contingency system is generally too weak to maintain acceptable post-fault system performance, even with additional reactive compensation at Guadalupe. A RAS is required to trip either the TB line (Taiban to Blackwater) or the entire BB (BA to Blackwater) line. For this reason, the BA-Rio Puerco 345 kV double-circuit outage is currently not considered to be decisive in determining the system reactive requirements.

3.2 PV Analysis

In order to insure that the proposed 297 MW power injection satisfies the WECC planning criteria for voltage stability, a PV (maximum load ability) analysis as described in Section 2.2 was performed at the Blackwater 345 kV bus for the contingency scenarios listed in Table 1. Assumptions and definitions for the PV analysis are listed below:

- A "generation shift" PV analysis method was used, where the PNM system swing bus at San Juan (near Four Corners) was allowed to absorb the injected power, essentially transferring the power from the Project injection site through BA to the Four Corners area.
- In order to establish an initial operating point on PV curve below the available transmission capacity of the BB transmission path, the initial power injection at the Blackwater 345 kV bus was reduced to 130 MW, with the generation at the San Juan G4 bus increased to the P_{MAX} value for the area swing machine. The Broadview wind farm real power was then increased in increments of 10 MW until the system intact case would no longer reach a valid solution.
- The Broadview wind farm aggregate generator MVAr limits were set so as to have a 0.97 power factor at the nominal injection level. This means that when the injection level was below the nominal level the effective power factor range was increased; when the injection level was above the nominal level, the effective power factor range was decreased.

3.2.1 PV Analysis Results

Results from PV analysis of the 297 MW Broadview project at Blackwater are presented in Table 5 below and in the plots of Appendix A.

Table 5: Guadalupe 345 kV Bus PV Analysis - 297 MW

Contingency Name		Contingency Description	Blackwater Injection (MW)	BA-Blackwater Line			
				P @ Collapse (MW)	95% (97.5%) Of Collapse (MW)	Available Capacity (MW)	Margin (MW)
Base	N-0	System Intact	497.18	792.64	753.01	662.00	91.01
BA-RP	N-1	BA-Rio Puerco 345 kV	487.28	782.59	743.46	662.00	81.46
BA345/115 TX	N-1	BA 345/115 kV Transformer	497.18	791.62	752.04	662.00	90.04
BA-NR	N-1	BA to Norton 345 kV	497.17	791.11	751.55	662.00	89.55
RP-WM	N-1	Rio Puerco–West Mesa 345 kV	497.19	791.95	752.35	662.00	90.35
RP-SJ	N-1	Rio Puerco–San Juan 345 kV	487.30	783.66	744.48	662.00	82.48
RP-FC	N-1	Rio Puerco–Four Corners 345 kV	487.29	783.42	744.25	662.00	82.25
BAHBALRP	N-2	BA 345/115 kV Transformer and BA–Rio Puerco 345 kV Line	477.37	773.15	753.82	662.00	91.82
RPWMHL2	N-2	Rio Puerco-West Mesa & West Mesa 345/115 kV Transformer	497.19	791.93	772.13	662.00	110.13
BA-RP-N2	N-2	BA-Rio Puerco 345 kV Double-Circuit Outage	358.44	673.16	656.33	662.00	-5.67

The WECC planning criteria for voltage stability [2, 3] require that the loading level of an interface be no more than 95% of the collapse point of the PV curve for the worst N-1 outage and 97.5% for an N-2 outage. This implies that the maximum allowable transfers on the BB transmission path are limited to 95% and 97.5% of the PV collapse point that results in divergence of the powerflow solution under the worst N-1 and N-2 outage conditions, respectively. As shown in Table 5, the target Broadview injection of 297 MW is met for all contingencies examined without additional reactive support at the Guadalupe 345 kV bus.

3.3 Power Flow Analysis Conclusions

From the QV and PV results discussed above, the following conclusions can be reached:

- For both the pre- and post-project configurations, no additional reactive compensation is required at the Guadalupe 345 kV bus to solve the N-0, N-1, and all but one of the N-2 powerflows studied for the 297 MW Broadview injection at Blackwater. Due to the severity of the BA-Rio Puerco 345 kV double-circuit outage, a RAS is required to trip either the TB line or the entire BB transmission path.
- Based on a 662 MW transmission capability for the BB transmission path, the WECC planning criteria for voltage stability can be satisfied without additional reactive support at the Guadalupe 345 kV bus. The target Broadview injection of 297 MW is met for all contingencies examined.

4 Dynamic Simulations

Based on the previous power flow analysis, it has been determined that additional reactive support is not required for the proposed 297 MW Broadview. In this section to follow, dynamics simulations are examined for the N-1 and N-2 scenarios listed in Table 1 in order to ensure that:

- System dynamic performance and post-fault voltage recovery are adequate.
- Existing wind power plants on this line will ride-through the fault based on the machine LVRT curves and the simulated voltage recovery.

The models used for dynamic simulations are presented in Appendix C. The system configuration and case list are presented in Section 4.1 below, while the results are discussed in Section 4.2.

4.1 Dynamic Simulation Configurations and Case List

The PSLF dynamic model was developed for the system configuration shown in Figure 2b. The case list for each configuration is repeated below in Table 6. It should be noted that the dynamic simulations of the Rio Puerco and BA faults highlighted in Table 6 terminated prematurely immediately upon fault application due to non-convergence issues resulting from

the series compensation modeled on the Rio Puerco-San Juan and Rio Puerco-Four Corners 345 kV circuits. The fault location was therefore modified from a PSLF line fault with 4/6 cycle clearing (local vs. remote) to a bus fault with 4 cycle clearing in order to allow the dynamic simulations to proceed beyond the initial application of the fault.

Table 6. Dynamics Case List

Contingency	Name	Description
0	N-0	System intact
1	BA-RP	BA to Rio Puerco 345 kV
2	BA345/115 TX	BA 345/115 kV Transformer
3*	BA-NR	BA to Norton 345 kV
4*	RP-WM	Rio Puerco – West Mesa 345 kV
5*	RP-SJ	Rio Puerco – San Juan 345 kV
6*	RP-FC	Rio Puerco – Four Corners 345 kV
7	BAHBALRP	N-2: BA 345/115 kV Transformer and BA – Rio Puerco 345 kV line
8	RPWMHL2	N-2: Rio Puerco-West Mesa & West Mesa 345/115 kV Transformer
9	BA-RP-N2	N-2: BA to Rio Puerco 345 kV Double Circuit outage

* Original line fault scenario non-convergent upon fault application.

4.2 Dynamic Simulation Results

Plots for the dynamic simulations are available in Appendix B. The results show that with the 297 MW Broadview project wind farm in service at the Blackwater 345 kV station and without any additional reactive support at the Guadalupe 345 kV station, system stability is maintained for all N-1 and all N-2 contingencies, with one exception. For the BA-Rio Puerco 345 kV double circuit outage, the post-contingency system is too weak to maintain acceptable post-fault system performance. A RAS would be required to trip either the TB line (Taiban to Blackwater) or the entire BB (BA to Blackwater) line for this contingency.

5 Conclusions and Recommendations

The purpose of this study was to determine the necessary transmission upgrades to accommodate redirecting an existing firm TSR on the PNM transmission system from the Blackwater 230 kV station to the Blackwater 345 kV station, in accordance with PNM's Business Practice for Redirect of Short-Term Firm and Long-Term Firm Point-to-Point Transmission Service. The total power injections at Blackwater 345 kV station will be 297 MW for a proposed wind generating facility (Broadview) interconnecting to PNM's Blackwater 345 kV station. The other PNM transmission commitments on the BB transmission path include 75 MW injected by the HVDC at Blackwater, 90 MW injected at Guadalupe by the Aragonne Mesa wind power plant, and 200 MW injected at Taiban Mesa by the Lone Mesa wind power plant. With the 297 MW Broadview at Blackwater, PNM will reach the 662 MW capacity, excluding line losses, that can be committed on the BA–Blackwater line. The 662 MW level was determined by a voltage stability limit (using a 5% margin from the all-lines in-service, N-0, limit).

For the present study, the Broadview 297 MW injection at Blackwater consists of Type 4 wind generation technology with sufficient reactive capability to maintain at least unity power factor at the point of common coupling, i.e., the 345 kV interconnection. The analysis has shown that no additional dynamic reactive support is required. System stability is maintained for all but the BA-Rio Puerco 345 kV double circuit outage. For the BA-Rio Puerco double circuit outage, the post-contingency system will require a RAS to trip either the TB line or the entire BB transmission path.

No transmission system upgrades are required to accommodate the 297 MW Broadview power injection. However, as noted in this and previous studies, the BA-Rio Puerco double circuit outage, will require the development of a RAS in order to accommodate the 662 MW on this transmission path. The corresponding costs and development effort, as provided by PNM, are estimated as $200K and 6 months, respectively. In addition, PSCAD studies are being performed in a separate study to evaluate whether a synchronous condenser at Blackwater 345 kV station will be required to support the transmission service conditions as stated above.

Finally, as noted in previous studies, the following observation regarding operational issues on the BB transmission path are still applicable to the present study. Specifically, there are many dynamic devices on this line, i.e.,

- The HVDC at Blackwater, which has an ac voltage control loop
- The Taiban Mesa wind power plant regulates the voltage at Taiban Mesa using the GE WindVAR system
- The shunt reactors at Guadalupe
- The STATCOM at Argonne Mesa
- The Broadview wind power plant power plant regulating the voltage

All these devices are attempting, in one way or another, to regulate voltage on the same line, admittedly at different points of the line. It is essential that all of these devices are properly coordinated and a clear operating strategy is established to coordinate the voltage set points on all devices.

6 References

[1] “Broadview PSLF Study Proposal”, ABB, June 26, 2015.

[2] “Voltage Stability Criteria, Undervoltage Load Shedding Strategy, and Reactive Power Reserve Monitoring Methodology”, WECC, May 1998.

[3] “Guide to WECC/NERC Planning Standards I.D: Voltage Support and Reactive Power, WECC, March 2006.

[4] PNM Technical Report, “Cargill Power Markets LLC Transmission Service Study” (Oasis TSR 72608299 and 72827161), Prepared by Electric Power Research Institute (EPRI), April 10, 2014.

[5] PNM Technical Report, “Public Service of New Mexico GA Solar PSLF Study”, Prepared by ABB, Report No. 2015-E14906-1.0.R02, May 5, 2015.

Appendix A. PV Plots

Configuration 1: Broadview MW Injection at Blackwater 345 kV Bus

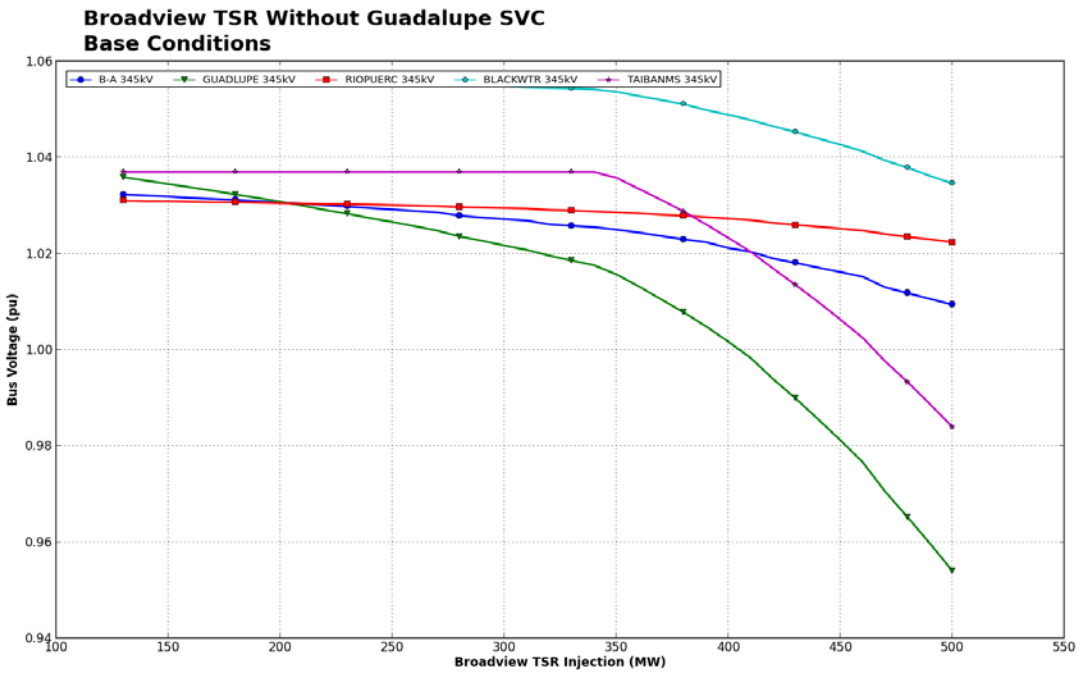


Figure A-1. System Intact

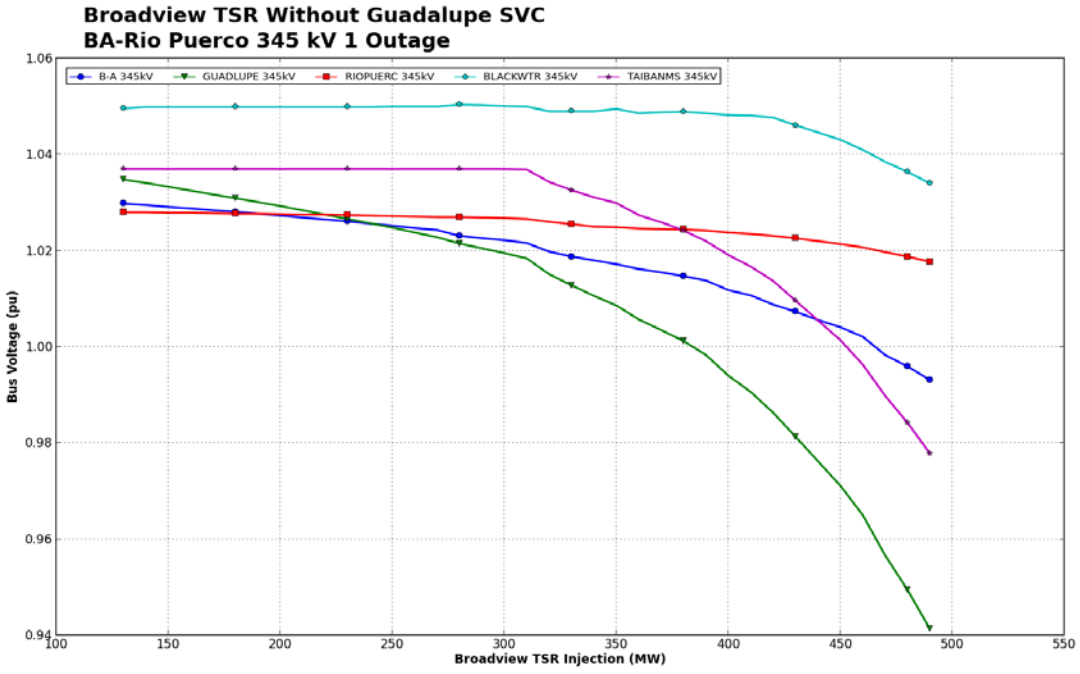


Figure A-2. BA-Rio Puerco 345 kV Line Outage

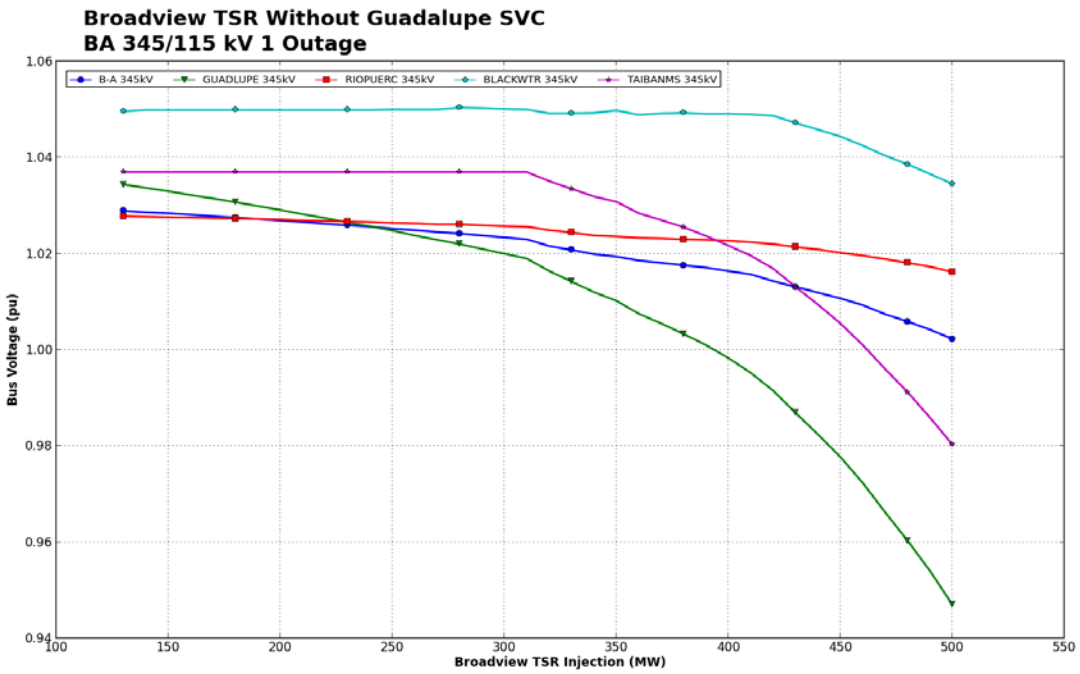


Figure A-3. BA 345 kV/115 kV Transformer Outage

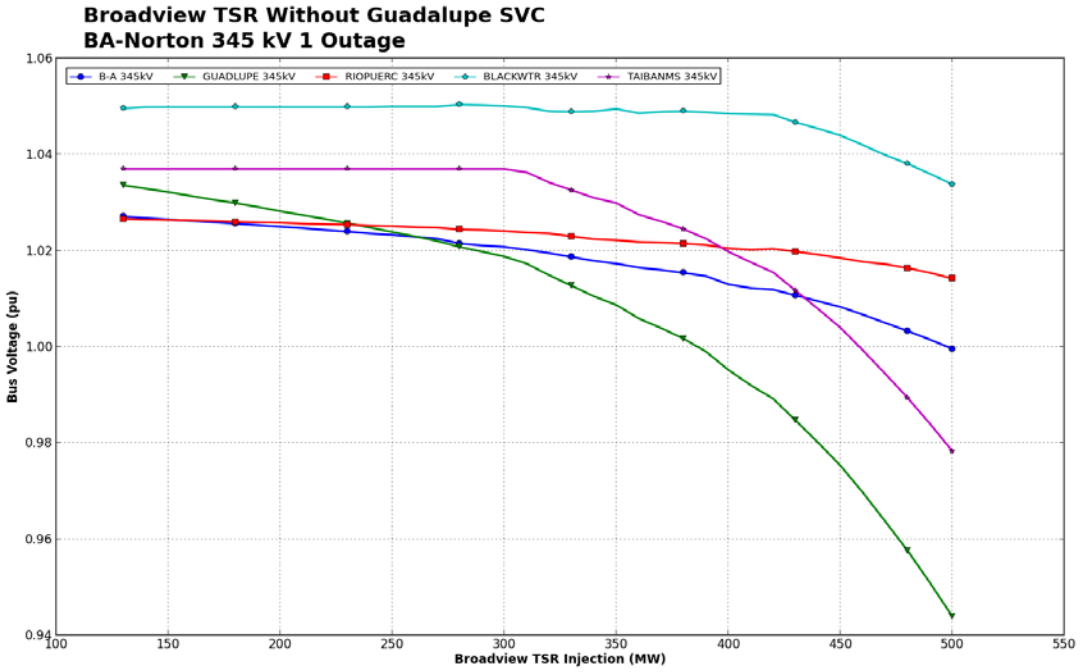


Figure A-4. BA-Norton 345 kV Line Outage

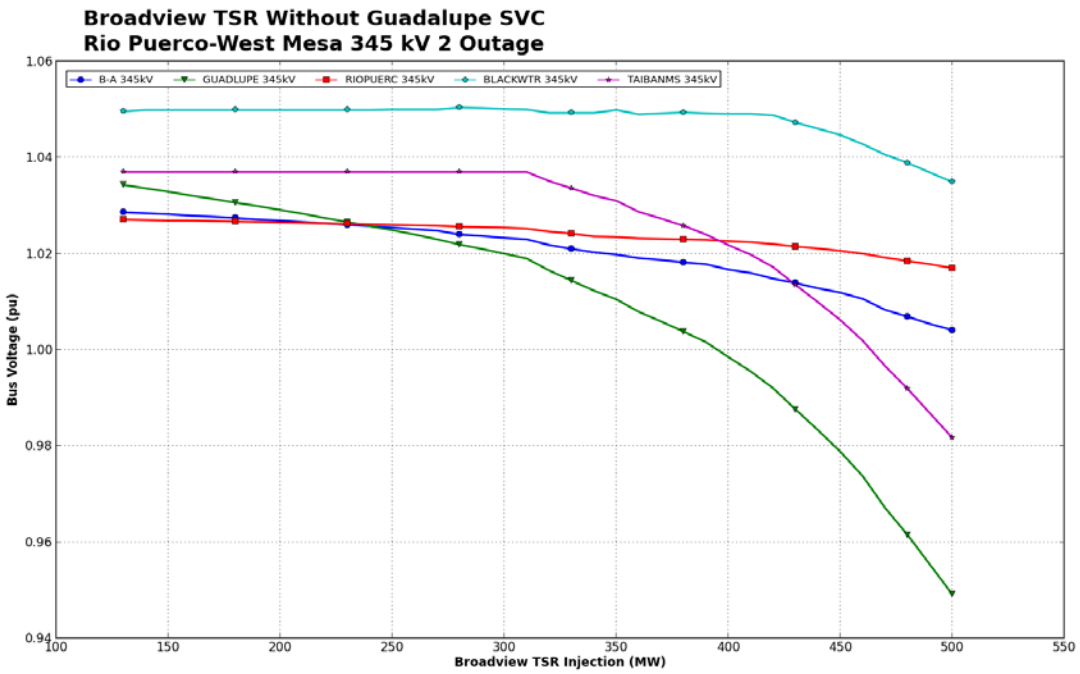


Figure A-5. RIO PUERCO-WEST MESA 345 kV Line Outage

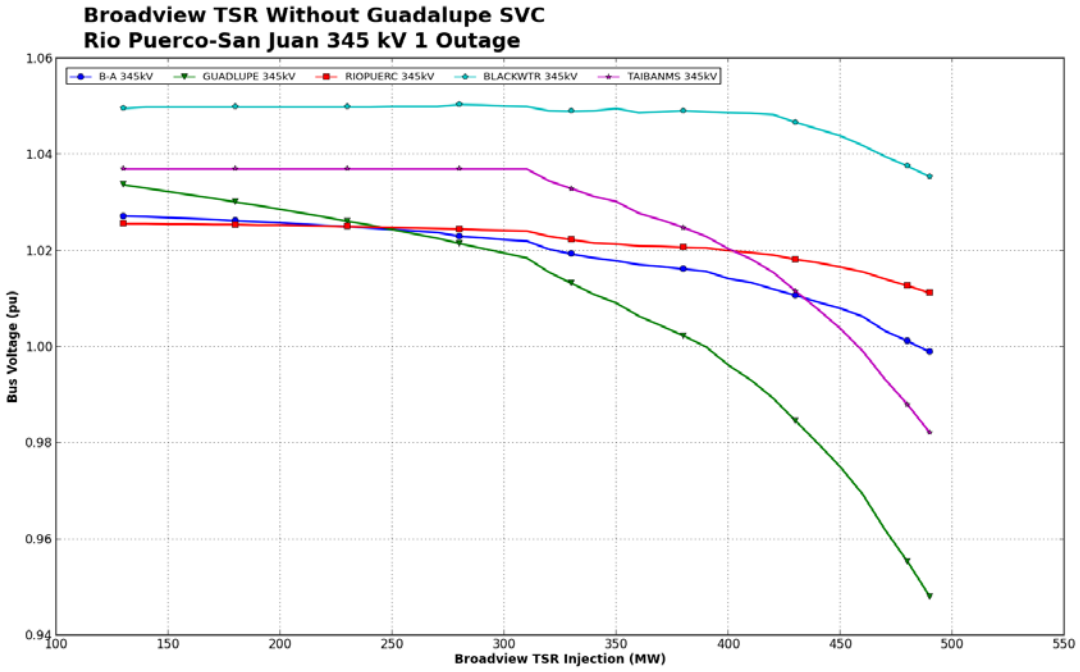


Figure A-6. RIO PUERCO-SAN JUAN 345 kV Line Outage

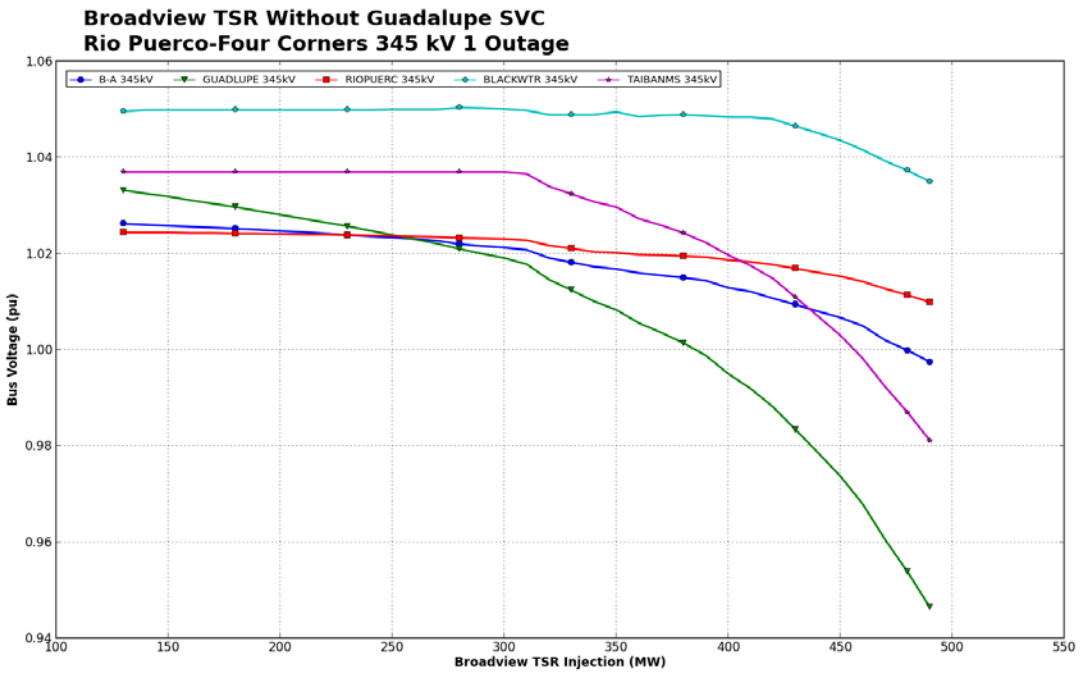


Figure A-2. RIO PUERCO-FOUR CORNERS 345 kV Line Outage

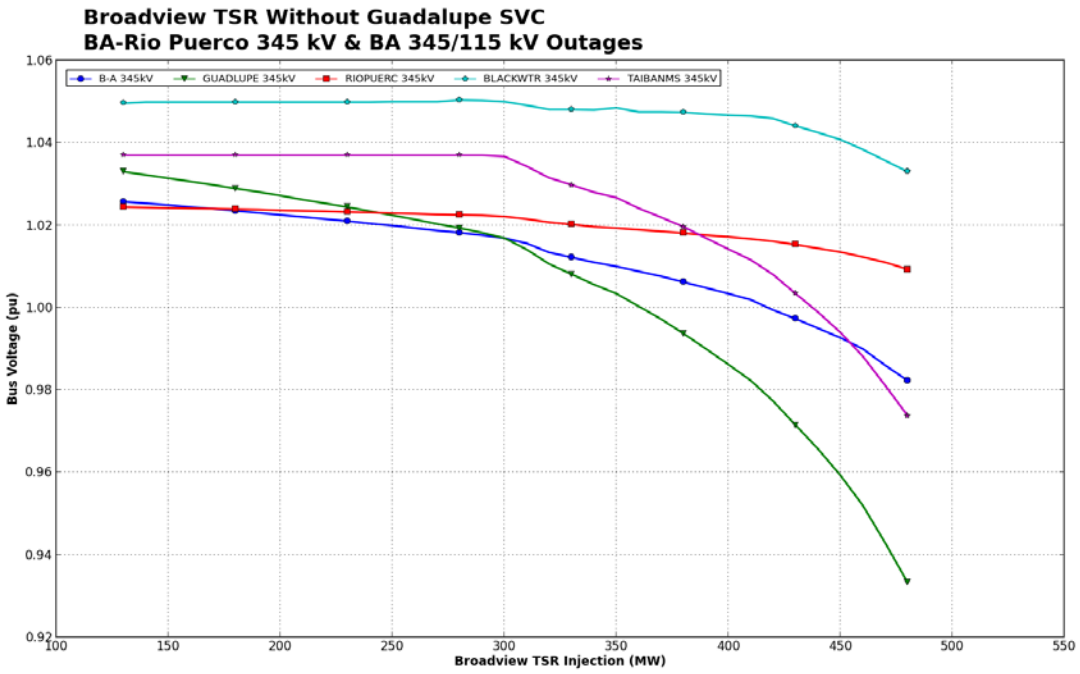


Figure A-3. BA 345/115 kV Transformer & BA-RIO PUERCO 345 kV Line Outage

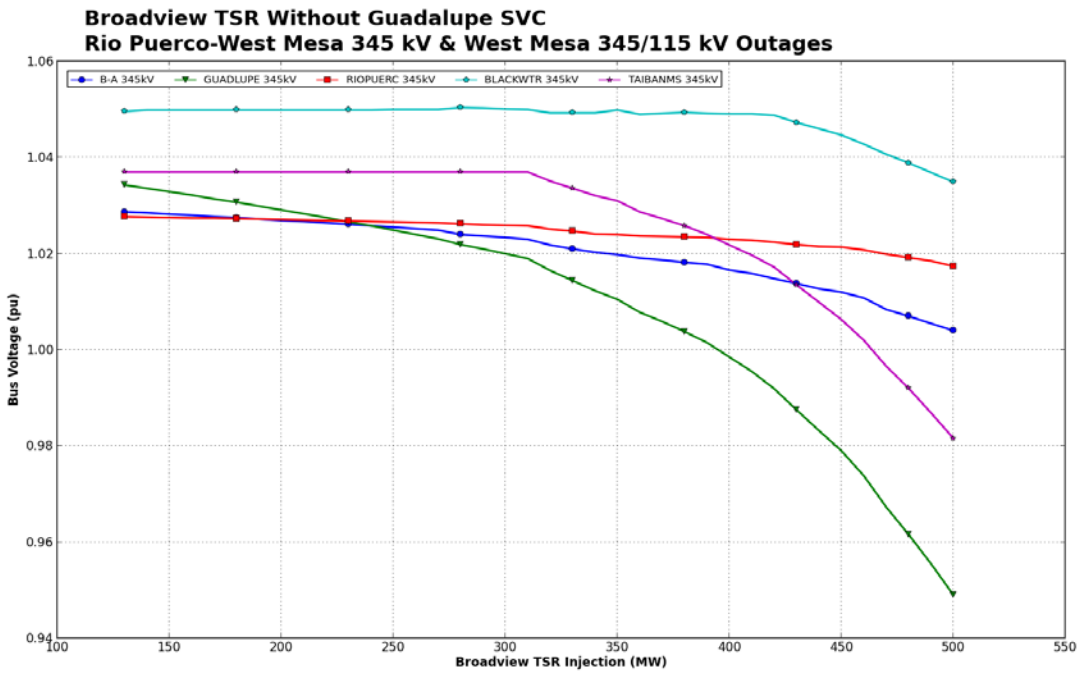


Figure A-4. RIO PUERCO–WEST MESA 345 kV Line & WEST MESA 345/115 kV Transformer Outages

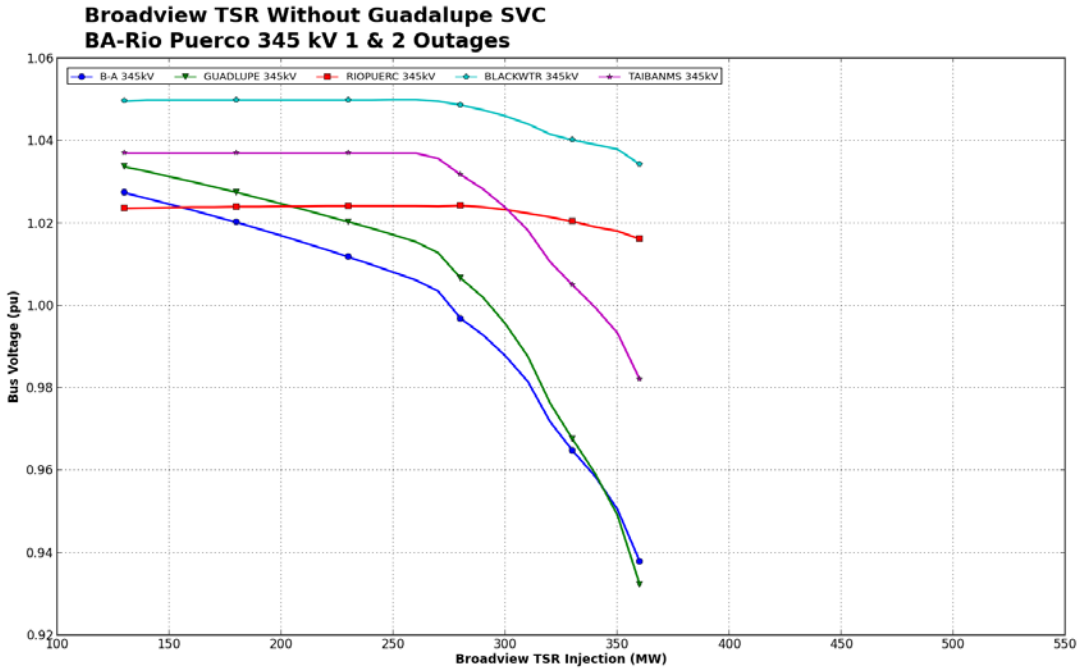


Figure A-10. BA-RIO PUERCO 345 kV 1 & 2 Line Outages

Appendix B. Dynamic Simulation Plots

The Appendix B dynamic simulation plots can be found in documents:

PNM Broadview PSLF Study Final Report - Appendix B

Appendix C. Dynamic Models

Broadview Windfarm Dynamic Model

PNM has provided the dynamics data for the Broadview wind farm in the data file "UserDefModel_SWT.dyd". The aggregate data for the three wind machines at buses BV_Sub N-MV, BV_Sub W-MV1, and BV_Sub W-MV2 are repeated below.

BUS		regc_a		reec_a		wtgt_a		repc_a	
		Generator/Converter Model		Renewable Energy Electrical Control Model		Drive Train Model		Power Plant Controller	
13407	BV_Sub N-MV 34.5 #1	mva	150.0	mvab	0	mvab	0	mvab	150.0
		lvplsw	1	vdip	0.9	ht	5.3	tfltr	1.25
		rrpwr	2	vup	1.2	hg	1	kp	0.9
		brkpt	0.9	trv	0	dshaft	0.92	ki	0.72
		zerox	0.05	dbd1	-0.05	kshaft	1.85	tft	0
		lvpl1	1.22	dbd2	0.05	wo	0.05	tfv	0.05
		vtmax	1.2	kqv	0			refflg	1
		lvpnt1	0.8	iqh1	1.05			vfrz	0
		lvpnt0	-0.4	iql1	-1.05			rc	0
		qmin	-1.3	vref0	0			xc	0
		accel	1	iqfrz	0			kc	0.04
		tg	0.02	thld	-0.05			vcmpflg	0
		tfltr	0.02	thld2	0			emax	0.1
		iqrmax	9999	tp	-0.05			emin	-0.1
		iqrmin	-9999	qmax	0.4			dbd	0.015
		xe	0	qmin	-0.4			qmax	62
				vmax	1.1			qmin	-62
				vmin	0.9			kpg	0.6
				kqp	0			kig	0.67
				kqi	0.1			tp	0.125
				kvp	1			fdbd1	-0.015
				kvi	120			fdbd2	0.015
				vref1	0			femax	99
				tiq	0.02			femin	-99
				dpmax	99			pmax	99
				dpmin	-99			pmin	-99
				pmax	1			tlag	0.2
				pmin	0			ddn	0.04
				imax	1.11			dup	0.04
				tpord	-0.04			frqflg	0
				pfflag	0			outflag	1
				vflag	1				
				qflag	1				
				pflag	0				
				pqflag	0				
				vq1	-0.05				
				iq1	1.07				
				vq2	0.2				

BUS		regc_a		reec_a		wtgt_a		repc_a	
		Generator/Converter Model		Renewable Energy Electrical Control Model		Drive Train Model		Power Plant Controller	
				iq2	0.9				
				vq3	0.35				
				iq3	0.85				
				vq4	0.7				
				iq4	0.5				
				vp1	0.05				
				ip1	0.19				
				vp2	0.2				
				ip2	0.6				
				vp3	0.35				
				ip3	0.52				
				vp4	0.7				
				ip4	0.99				
13406	BV_Sub W-MV1 34.5 #1	mva	100.0	mvab	0	mvab	0	mvab	100.0
		lvplsw	1	vdip	0.9	ht	5.3	tfltr	1.25
		rrpwr	2	vup	1.2	hg	1	kp	0.9
		brkpt	0.9	trv	0	dshaft	0.92	ki	0.72
		zerox	0.05	dbd1	-0.05	kshaft	1.85	tft	0
		lvpl1	1.22	dbd2	0.05	wo	0.05	tfv	0.05
		vtmax	1.2	kqv	0			refflg	1
		lvpnt1	0.8	iqh1	1.05			vfrz	0
		lvpnt0	-0.4	iql1	-1.05			rc	0
		qmin	-1.3	vref0	0			xc	0
		accel	1	iqfrz	0			kc	0.04
		tg	0.02	thld	-0.05			vcmpflg	0
		tfltr	0.02	thld2	0			emax	0.1
		iqrmax	9999	tp	-0.05			emin	-0.1
		iqrmin	-9999	qmax	0.4			dbd	0.015
		xe	0	qmin	-0.4			qmax	43
				vmax	1.1			qmin	-43
				vmin	0.9			kpg	0.6
				kqp	0			kig	0.67
				kqi	0.1			tp	0.125
				kvp	1			fdbd1	-0.015
				kvi	120			fdbd2	0.015
				vref1	0			femax	99
				tiq	0.02			femin	-99
				dpmax	99			pmax	99
				dpmin	-99			pmin	-99
				pmax	1			tlag	0.2
				pmin	0			ddn	0.04
				imax	1.11			dup	0.04
				tpord	-0.04			frqflg	0
				pfflag	0			outflag	1
				vflag	1				
				qflag	1				
				pflag	0				
				pqflag	0				
				vq1	-0.05				
				iq1	1.07				

BUS		regc_a		reec_a		wtgt_a		repc_a	
		Generator/Converter Model		Renewable Energy Electrical Control Model		Drive Train Model		Power Plant Controller	
				vq2	0.2				
				iq2	0.9				
				vq3	0.35				
				iq3	0.85				
				vq4	0.7				
				iq4	0.5				
				vp1	0.05				
				ip1	0.19				
				vp2	0.2				
				ip2	0.6				
				vp3	0.35				
				ip3	0.52				
				vp4	0.7				
				ip4	0.99				
13412	BV_Sub W-MV2 34.5 #1	mva	100.0	mvab	0	mvab	0	mvab	100.0
		lvplsw	1	vdip	0.9	ht	5.3	tfltr	1.25
		rrpwr	2	vup	1.2	hg	1	kp	0.9
		brkpt	0.9	trv	0	dshaft	0.92	ki	0.72
		zerox	0.05	dbd1	-0.05	kshaft	1.85	tft	0
		lvpl1	1.22	dbd2	0.05	wo	0.05	tfv	0.05
		vtmax	1.2	kqv	0			refflg	1
		lvpnt1	0.8	iqh1	1.05			vfrz	0
		lvpnt0	-0.4	iql1	-1.05			rc	0
		qmin	-1.3	vref0	0			xc	0
		accel	1	iqfrz	0			kc	0.04
		tg	0.02	thld	-0.05			vcmpflg	0
		tfltr	0.02	thld2	0			emax	0.1
		iqrmax	9999	tp	-0.05			emin	-0.1
		iqrmin	-9999	qmax	0.4			dbd	0.015
		xe	0	qmin	-0.4			qmax	43
				vmax	1.1			qmin	-43
				vmin	0.9			kpg	0.6
				kqp	0			kig	0.67
				kqi	0.1			tp	0.125
				kvp	1			fdbd1	-0.015
				kvi	120			fdbd2	0.015
				vref1	0			femax	99
				tiq	0.02			femin	-99
				dpmax	99			pmax	99
				dpmin	-99			pmin	-99
				pmax	1			tlag	0.2
				pmin	0			ddn	0.04
				imax	1.11			dup	0.04
				tpord	-0.04			frqflg	0
				pfflag	0			outflag	1
				vflag	1				
				qflag	1				
				pflag	0				
				pqflag	0				
				vq1	-0.05				

BUS		regc_a		reec_a		wtgt_a		repc_a	
		Generator/Converter Model		Renewable Energy Electrical Control Model		Drive Train Model		Power Plant Controller	
				iq1	1.07				
				vq2	0.2				
				iq2	0.9				
				vq3	0.35				
				iq3	0.85				
				vq4	0.7				
				iq4	0.5				
				vp1	0.05				
				ip1	0.19				
				vp2	0.2				
				ip2	0.6				
				vp3	0.35				
				ip3	0.52				
				vp4	0.7				
				ip4	0.99				

Blackwater HVDC Dynamic Model

The data for the Blackwater HVDC using the latest BCS_OBFS_v4_00.p model is listed below.

```
Dcmt 99993 "SPS EQ60" 60.0 "1 " 13403 "BLACK60 " 60.00 "1 " 1 : /
  #9 "BCS_OBFS_v4_00.p" 3.0
```

ABB Inc.	2015-E16009-1.0.R01		
Public Service Company of New Mexico **Broadview PSLF Study – Appendix B**	**Dept.** **Consulting**	Date Sept. 25, 2015	Pages

Executive Summary:

The following appendix documents the results for the stability simulations of the 297 MW Broadview TSR at the Blackwater 345 kV bus. The configuration 1 plots shown below include:

Blackwater HVDC : **75 MW E-W**

Taiban Mesa Wind Farm : **200 MW**

Aragonne Mesa Wind Farm: **90 MW**

Guadalupe SVC: **0 MVAr**

Broadview 345 kV Wind Farm: **297 MW**

The case list for each configuration is repeated below.

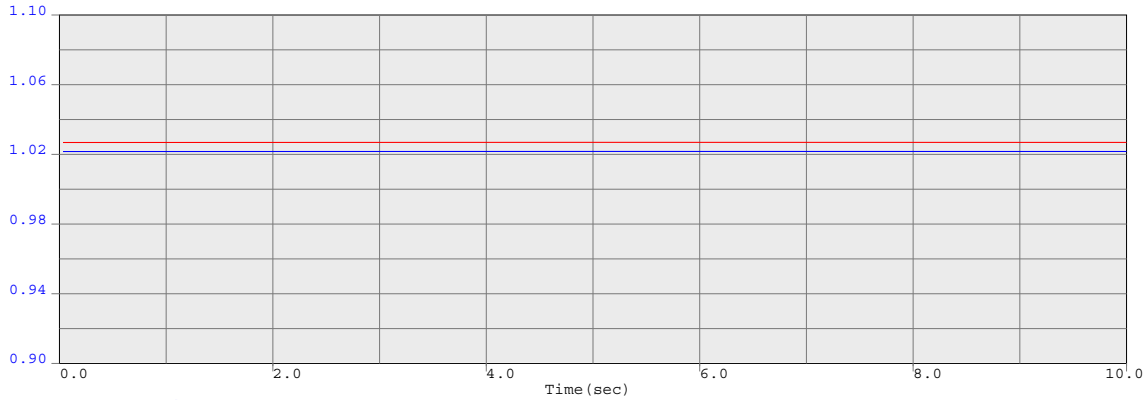
Contingency	Name	Description
0	N-0	System Intact
1	BA-RP	BA to Rio Puerco 345 kV
2	BA345/115 TX	BA 345/115 kV Transformer
3*	BA-NR	BA to Norton 345 kV
4*	RP-WM	Rio Puerco – West Mesa 345 kV
5*	RP-SJ	Rio Puerco – San Juan 345 kV
6*	RP-FC	Rio Puerco – Four Corners 345 kV
7	BAHBALRP	BA 345/115 kV Transformer and BA – Rio Puerco 345 kV line
8	RPWMHL2	Rio Puerco-West Mesa & West Mesa 345/115 kV Transformer
9	BA-RP-N2*	BA to Rio Puerco 345 kV Double Circuit outage

*: Original line fault scenario non-convergent upon fault application.

Contingency 0 - System Intact (N-0)

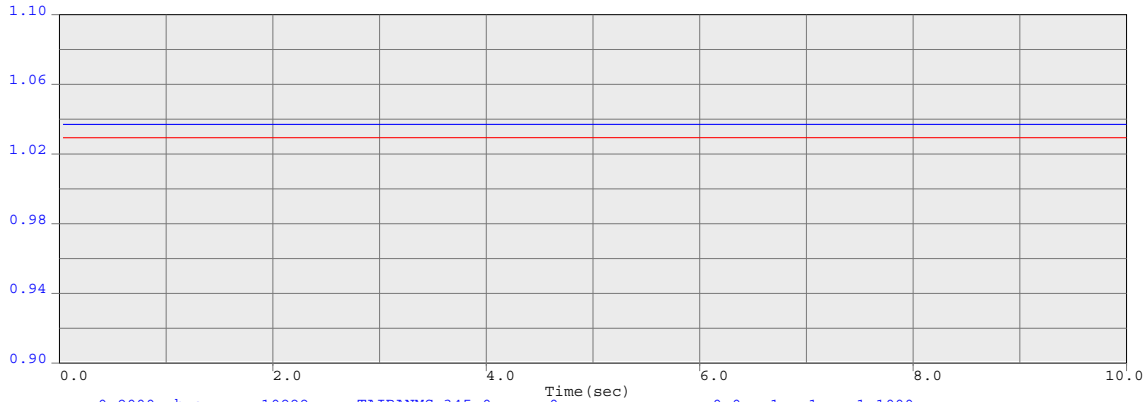
Broadview 297 MW Type 4 TSR

BUS VOLTAGE



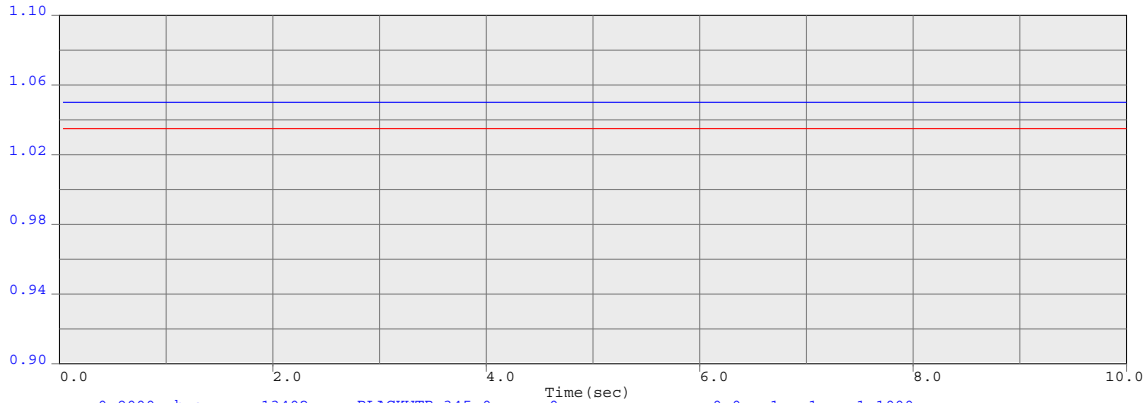
0.9000 vbug	10116	GUADLUPE 345.0	0	0.0	1	1	1.1000
0.9000 vbug	10025	B-A 345.0	0	0.0	1	1	1.1000

BUS VOLTAGE



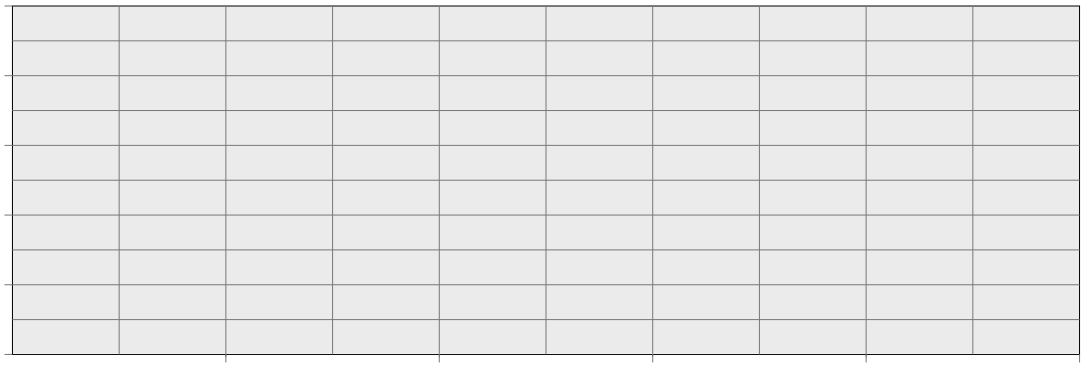
0.9000 vbug	10999	TAIBANMS 345.0	0	0.0	1	1	1.1000
0.9000 vbus	10390	RIOPUERC 345.0	0	0.0	1	1	1.1000

BUS VOLTAGE

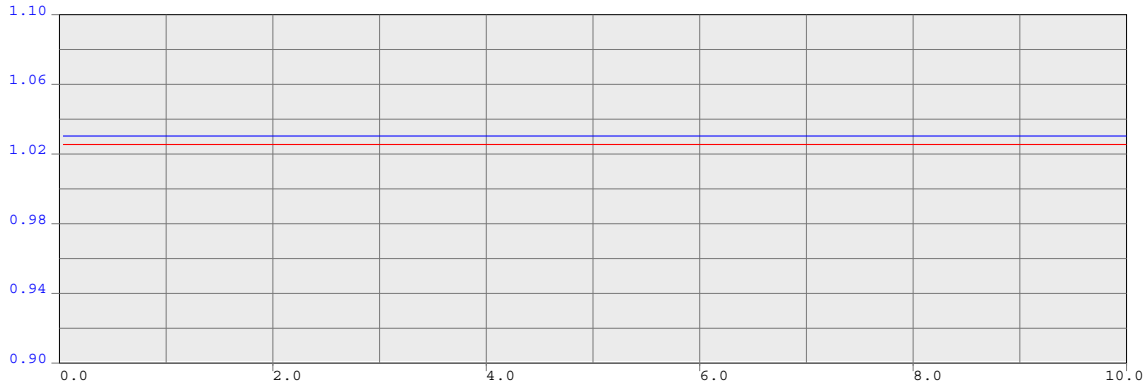


0.9000 vbug	13402	BLACKWTR 345.0	0	0.0	1	1	1.1000
0.9000 vbus	10011	AMBROSIA 230.0	0	0.0	1	1	1.1000

SPP 2000SC MODEL. 2001CASE 8/14/00
Base Case
WESTERN ELECTRICITY COORDINATING COUNCIL
2013-14 HW1A APPROVED BASE CASE
JANUARY 16, 2009
ALL COMMENTS FROM THE TSS REVIEW ARE INCLUDED
10 Second Flat Run

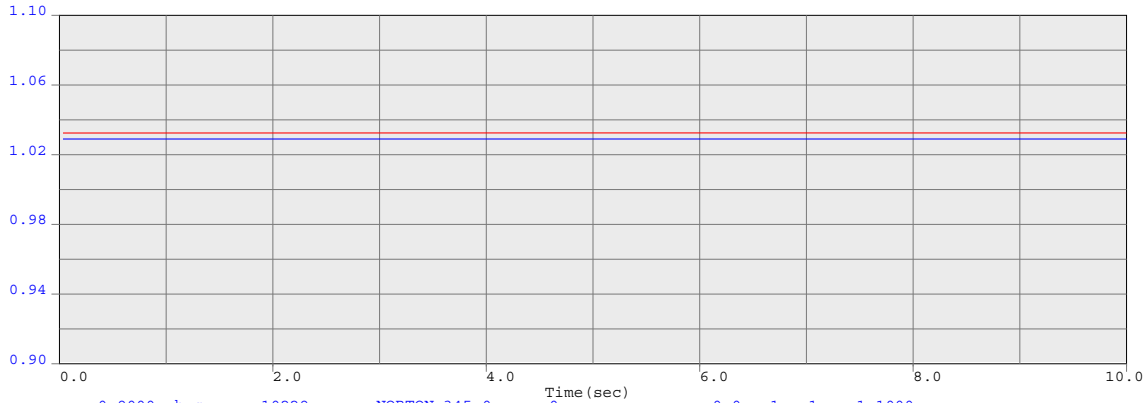


BUS VOLTAGE



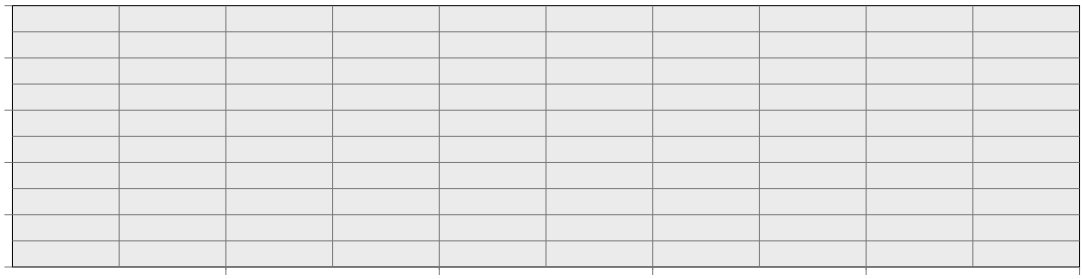
0.9000 vbus	10248	PILLAR 230.0	0	0.0	1	1	1.1000
0.9000 vbus	10291	SAN_JUAN 230.0	0	0.0	1	1	1.1000

BUS VOLTAGE

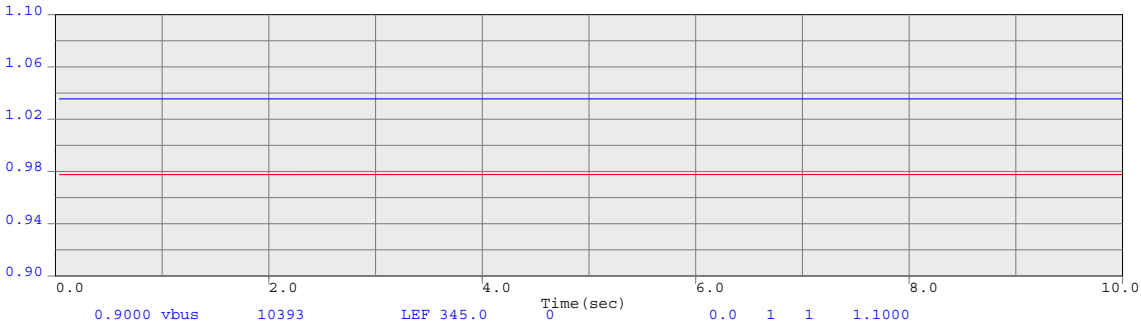


0.9000 vbus	10229	NORTON 345.0	0	0.0	1	1	1.1000
0.9000 vbus	10232	OJO 345.0	0	0.0	1	1	1.1000
0.9000 vbus	10292	SAN_JUAN 345.0	0	0.0	1	1	1.1000
0.9000 vbus	10294	SANDIA 345.0	0	0.0	1	1	1.1000

SPP 2000SC MODEL. 2001CASE 8/14/00
Base Case
WESTERN ELECTRICITY COORDINATING COUNCIL
2013-14 HW1A APPROVED BASE CASE
JANUARY 16, 2009
ALL COMMENTS FROM THE TSS REVIEW ARE INCLUDED
10 Second Flat Run

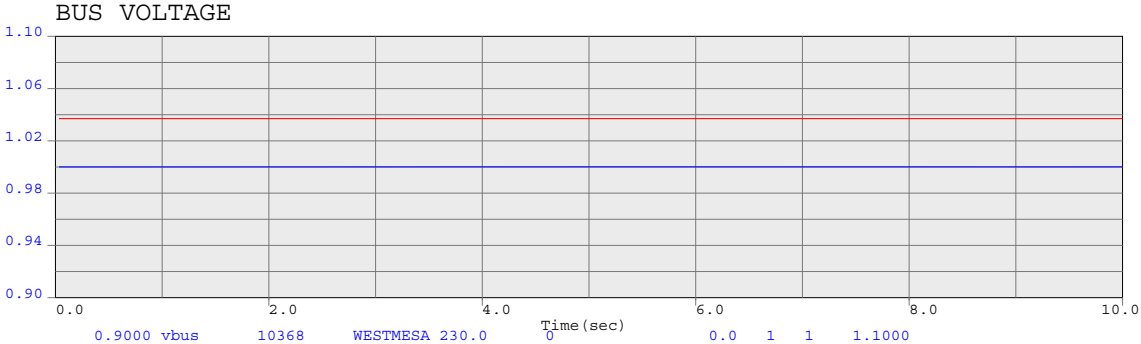


BUS VOLTAGE



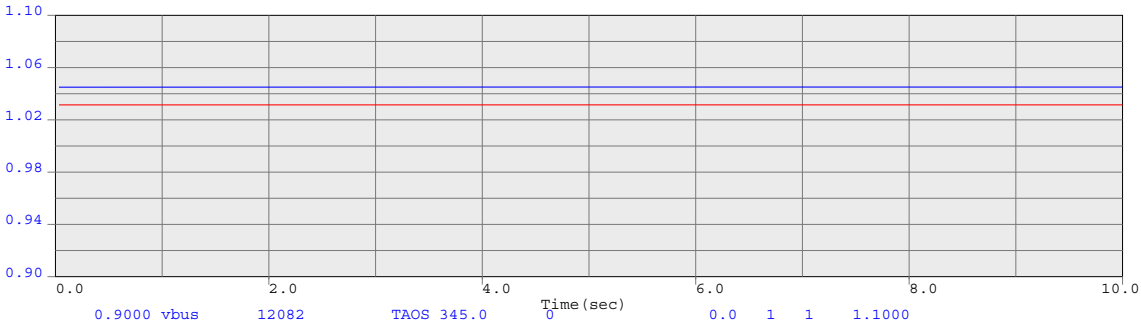
0.9000 vbus	10393	LEF 345.0	0	0.0	1	1	1.1000
0.9000 vbus	10991	ARGONNE4 138.0	0	0.0	1	1	1.1000

BUS VOLTAGE



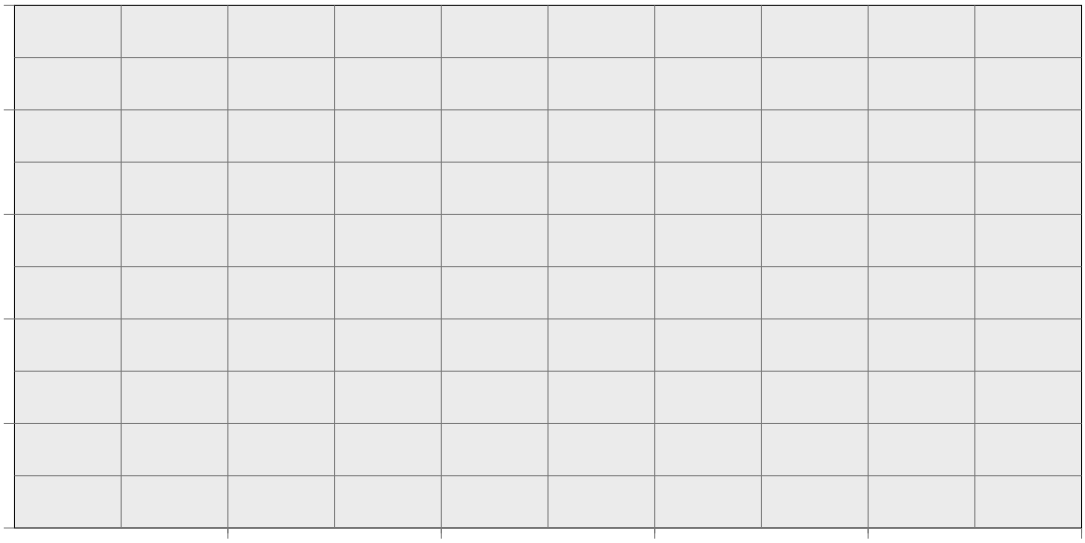
0.9000 vbus	10368	WESTMESA 230.0	0	0.0	1	1	1.1000
0.9000 vbus	10369	WESTMESA 345.0	0	0.0	1	1	1.1000
0.9000 vbus	10992	ARGONNE3 138.0	0	0.0	1	1	1.1000
0.9000 vbus	12057	PEGS 230.0	0	0.0	1	1	1.1000

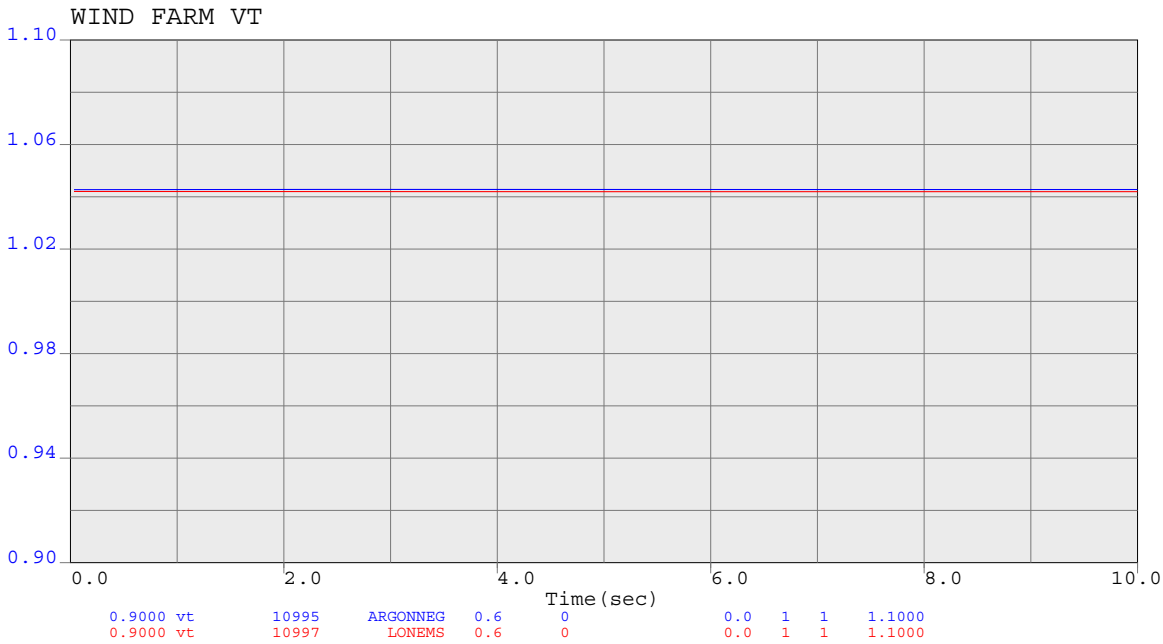
BUS VOLTAGE



0.9000 vbus	12082	TAOS 345.0	0	0.0	1	1	1.1000
0.9000 vbus	12101	GLADSTON 230.0	0	0.0	1	1	1.1000

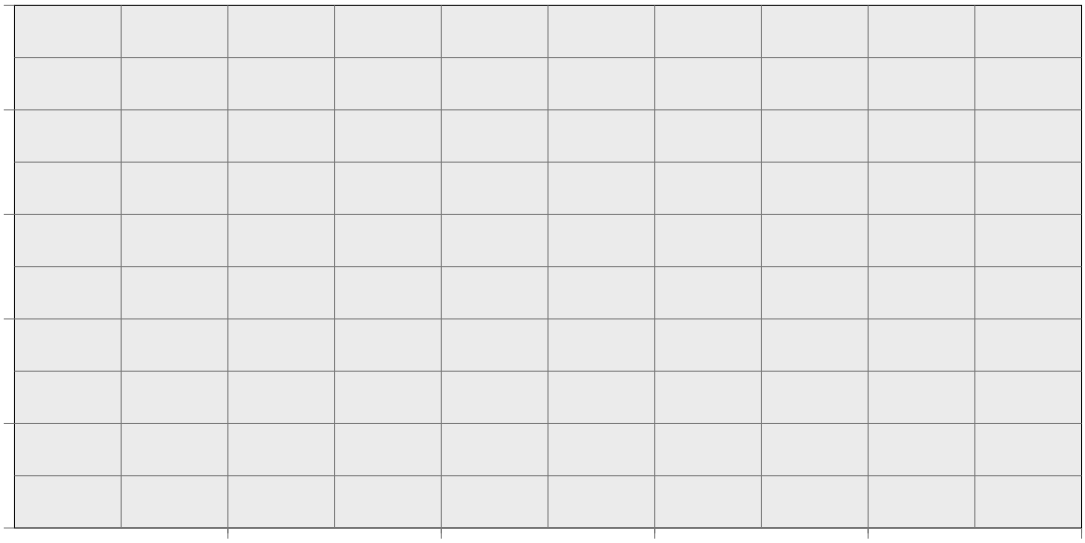
SPP 2000SC MODEL. 2001CASE 8/14/00
Base Case
WESTERN ELECTRICITY COORDINATING COUNCIL
2013-14 HW1A APPROVED BASE CASE
JANUARY 16, 2009
ALL COMMENTS FROM THE TSS REVIEW ARE INCLUDED
10 Second Flat Run

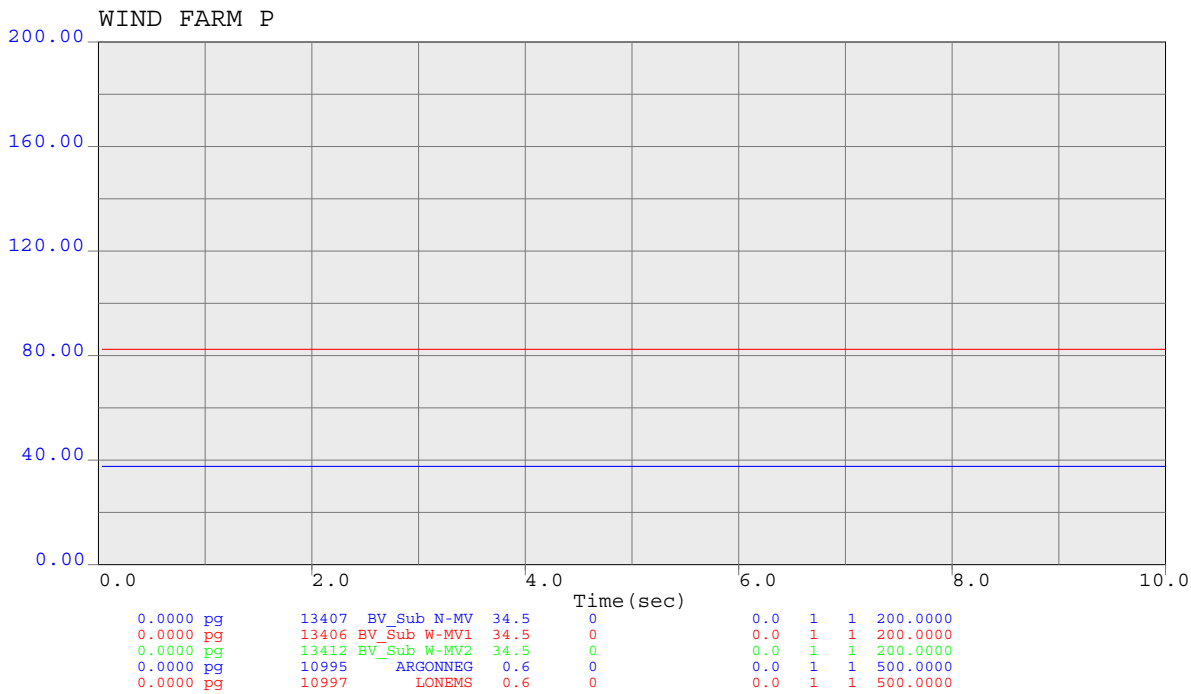




SPP 2000SC MODEL. 2001CASE 8/14/00
Base Case
WESTERN ELECTRICITY COORDINATING COUNCIL
2013-14 HW1A APPROVED BASE CASE
JANUARY 16, 2009
ALL COMMENTS FROM THE TSS REVIEW ARE INCLUDED
10 Second Flat Run

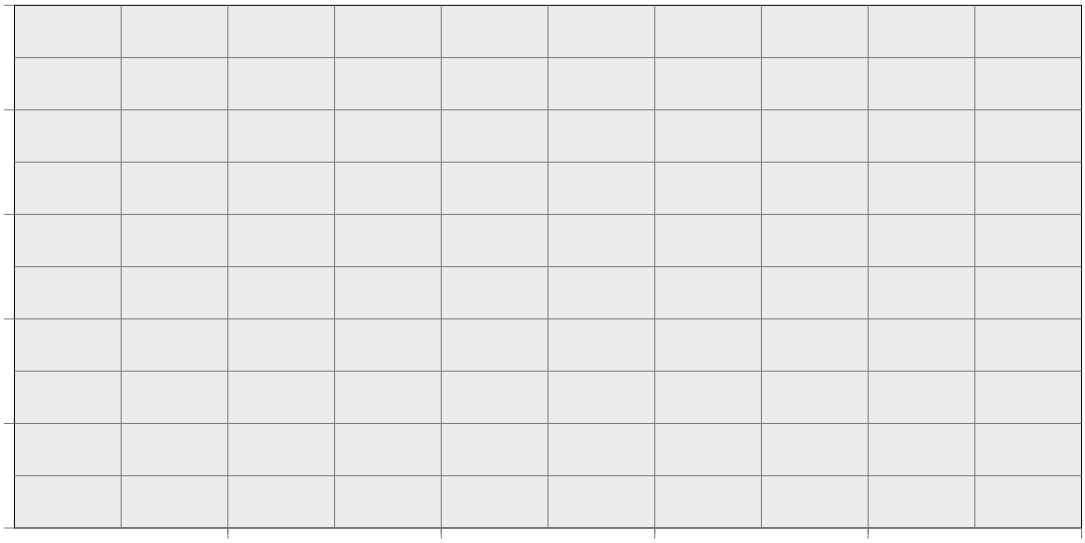
Broadview 297 MW Type 4 TSR

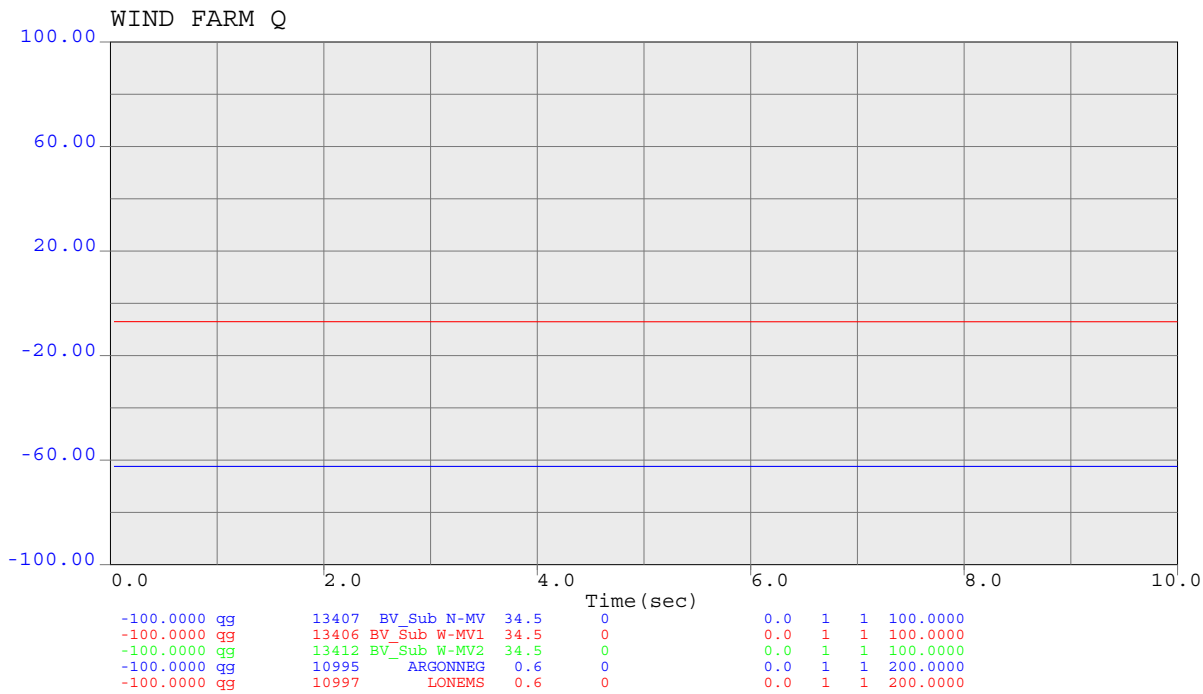




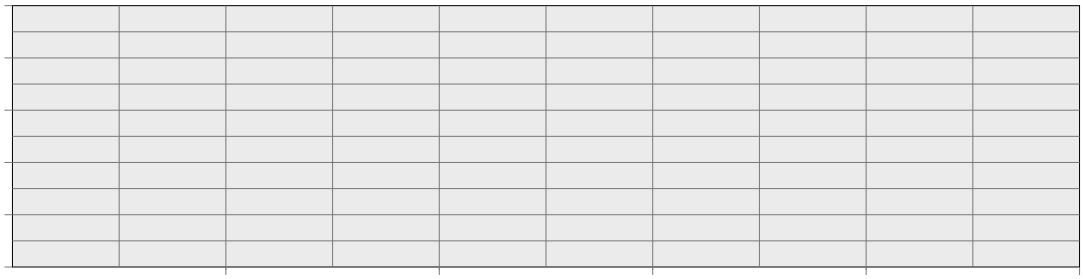
SPP 2000SC MODEL. 2001CASE 8/14/00
Base Case
WESTERN ELECTRICITY COORDINATING COUNCIL
2013-14 HW1A APPROVED BASE CASE
JANUARY 16, 2009
ALL COMMENTS FROM THE TSS REVIEW ARE INCLUDED
10 Second Flat Run

Broadview 297 MW Type 4 TSR

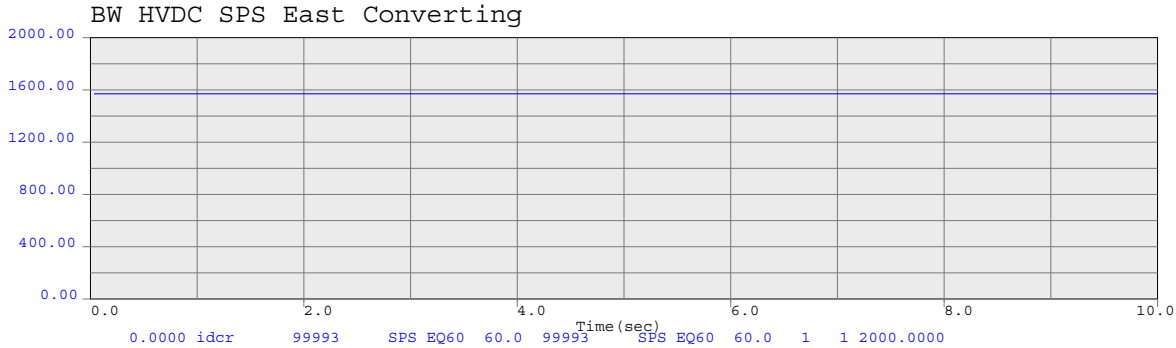




SPP 2000SC MODEL. 2001CASE 8/14/00
Base Case
WESTERN ELECTRICITY COORDINATING COUNCIL
2013-14 HW1A APPROVED BASE CASE
JANUARY 16, 2009
ALL COMMENTS FROM THE TSS REVIEW ARE INCLUDED
10 Second Flat Run

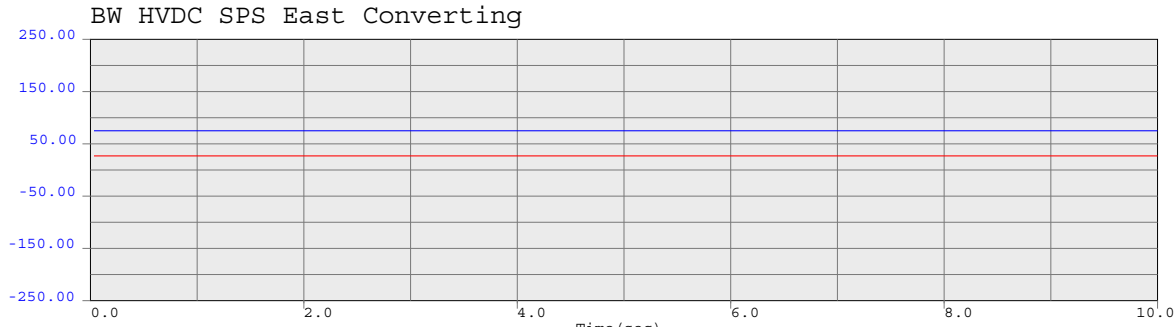


BW HVDC SPS East Converting



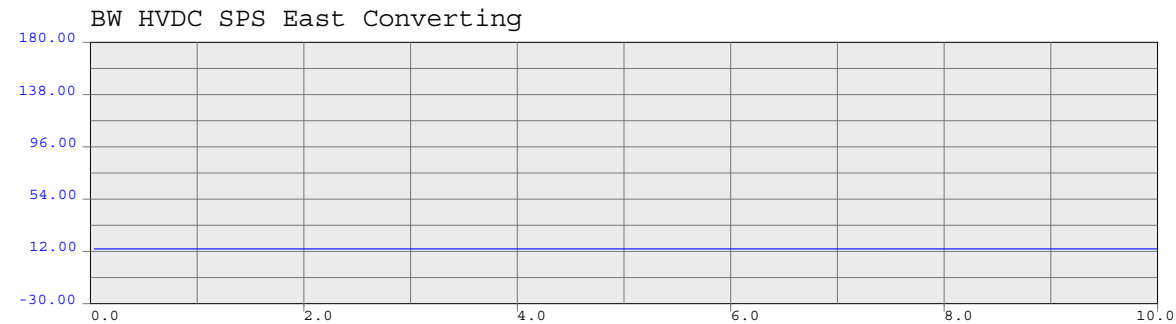
0.0000 idcr 99993 SPS EQ60 60.0 99993 SPS EQ60 60.0 1 1 2000.0000
-100.0000 vdcr 99993 SPS EQ60 60.0 99993 SPS EQ60 60.0 1 1 100.0000

BW HVDC SPS East Converting



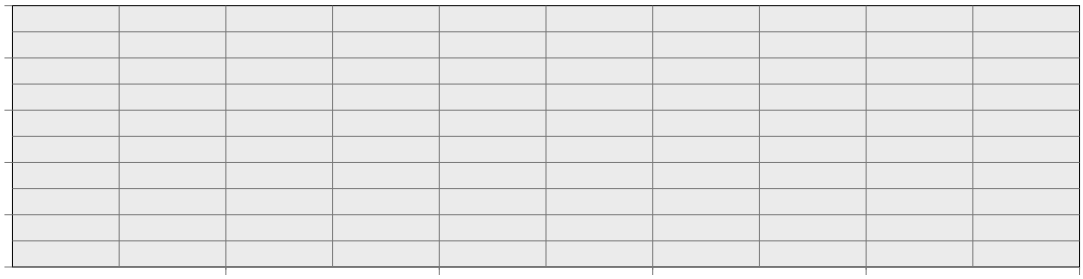
-250.0000 pacr 99993 SPS EQ60 60.0 99993 SPS EQ60 60.0 1 1 250.0000
-250.0000 qacr 99993 SPS EQ60 60.0 99993 SPS EQ60 60.0 1 1 250.0000

BW HVDC SPS East Converting

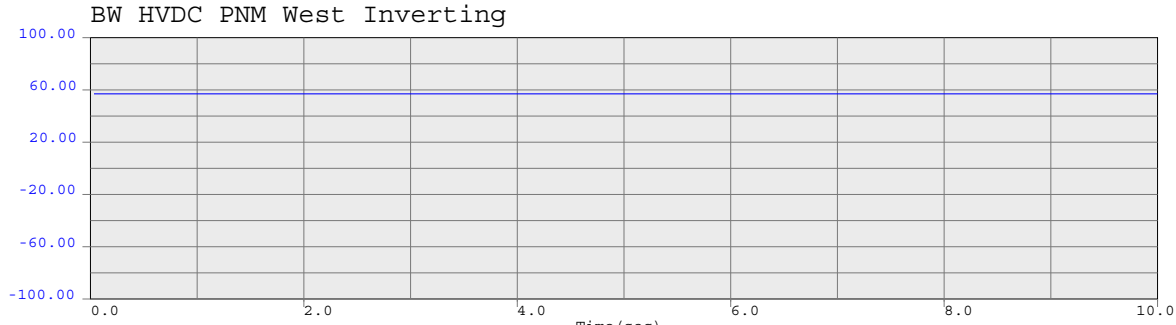


-30.0000 alpa 99993 SPS EQ60 60.0 99993 SPS EQ60 60.0 1 1 180.0000

SPP 2000SC MODEL. 2001CASE 8/14/00
Base Case
WESTERN ELECTRICITY COORDINATING COUNCIL
2013-14 HW1A APPROVED BASE CASE
JANUARY 16, 2009
ALL COMMENTS FROM THE TSS REVIEW ARE INCLUDED
10 Second Flat Run

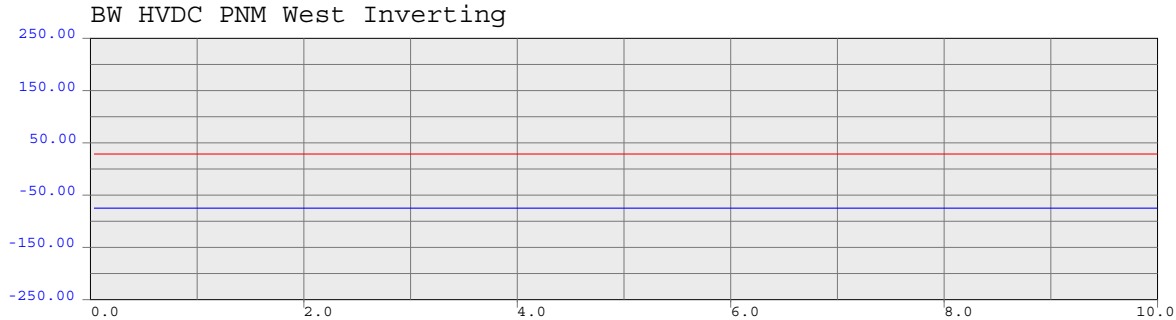


BW HVDC PNM West Inverting



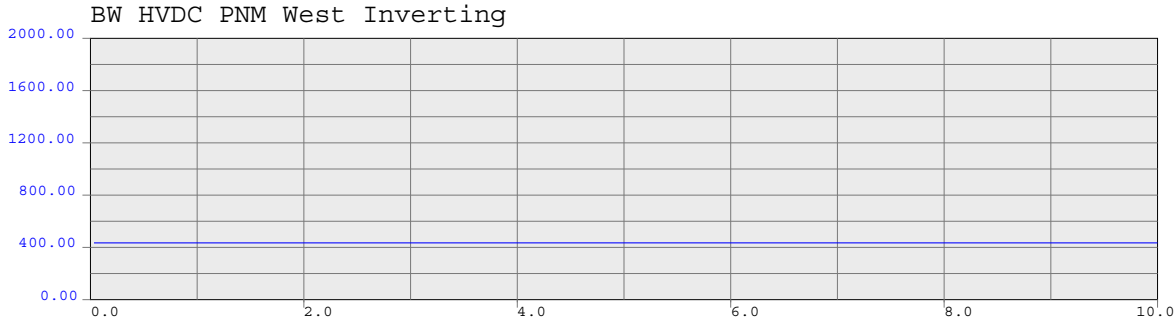
-100.0000 vdci 99993 SPS EQ60 60.0 13403 BLACK60 60.0 1 1 100.0000

BW HVDC PNM West Inverting



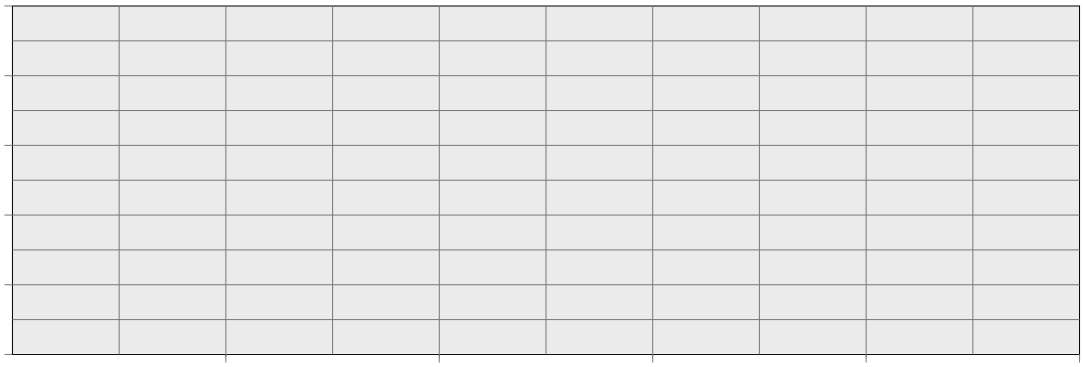
-250.0000 paci 99993 SPS EQ60 60.0 13403 BLACK60 60.0 1 1 250.0000
-250.0000 qaci 99993 SPS EQ60 60.0 13403 BLACK60 60.0 1 1 250.0000

BW HVDC PNM West Inverting

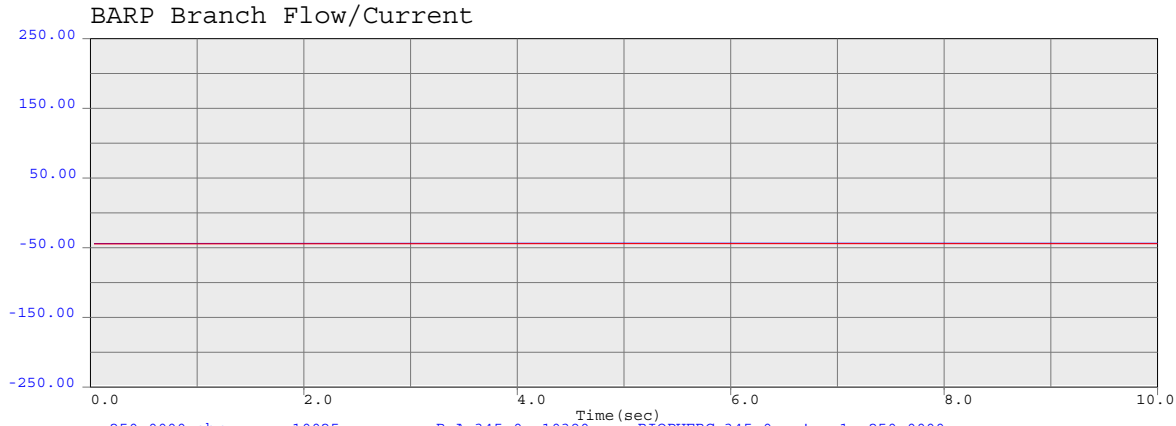


0.0000 idci 99993 SPS EQ60 60.0 13403 BLACK60 60.0 1 1 2000.0000
-30.0000 gama 99993 SPS EQ60 60.0 13403 BLACK60 60.0 1 1 180.0000

SPP 2000SC MODEL. 2001CASE 8/14/00
Base Case
WESTERN ELECTRICITY COORDINATING COUNCIL
2013-14 HW1A APPROVED BASE CASE
JANUARY 16, 2009
ALL COMMENTS FROM THE TSS REVIEW ARE INCLUDED
10 Second Flat Run

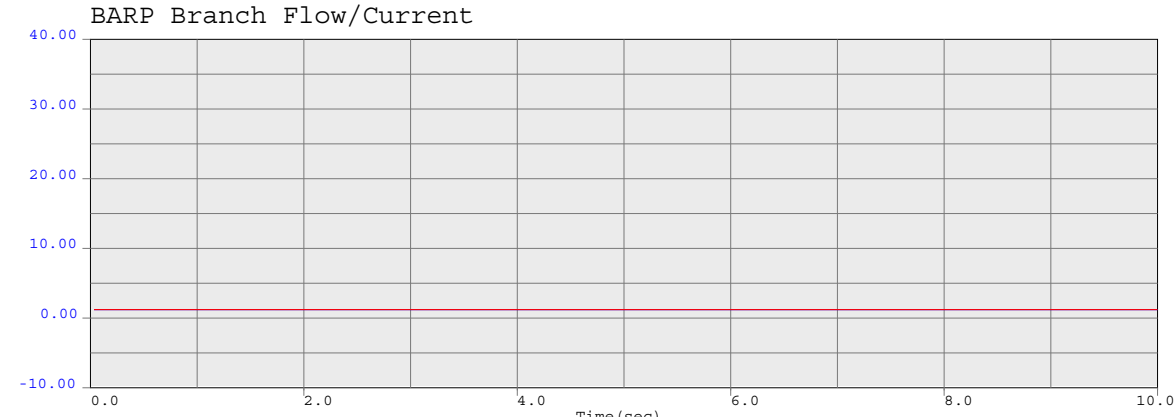


BARP Branch Flow/Current



-250.0000 qbr 10025 B-A 345.0 10390 RIOPUERC 345.0 ! 1 250.0000
-250.0000 qbr 10025 B-A 345.0 10390 RIOPUERC 345.0 ! 2 250.0000

BARP Branch Flow/Current



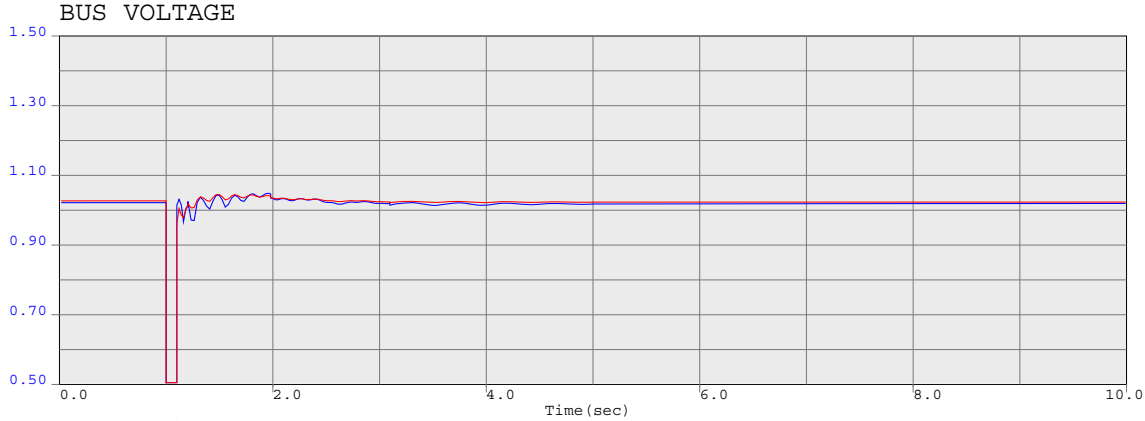
-10.0000 ibr 10025 B-A 345.0 10390 RIOPUERC 345.0 ! 1 40.0000
-10.0000 ibr 10025 B-A 345.0 10390 RIOPUERC 345.0 ! 2 40.0000

SPP 2000SC MODEL. 2001CASE 8/14/00
Base Case
WESTERN ELECTRICITY COORDINATING COUNCIL
2013-14 HW1A APPROVED BASE CASE
JANUARY 16, 2009
ALL COMMENTS FROM THE TSS REVIEW ARE INCLUDED
10 Second Flat Run

Contingency 1 - BA to Rio Puerco 345 kV (BA-RP)

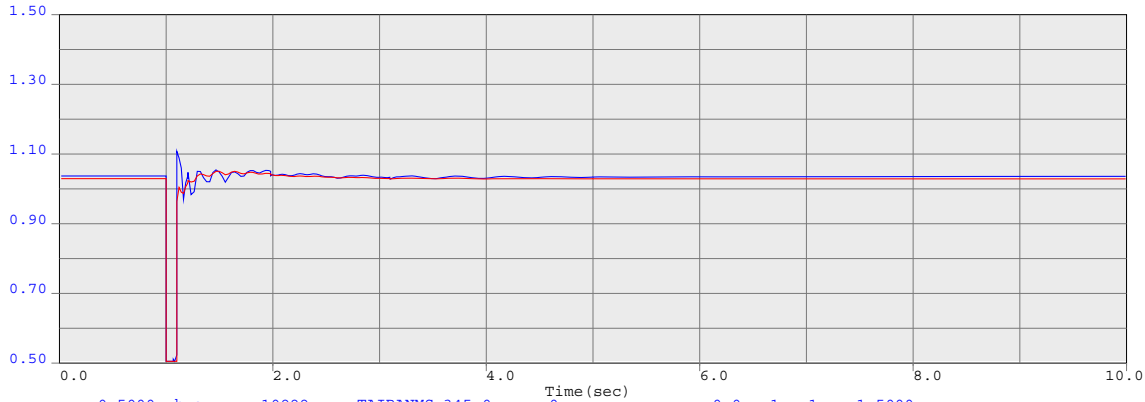
Broadview 297 MW Type 4 TSR

BUS VOLTAGE



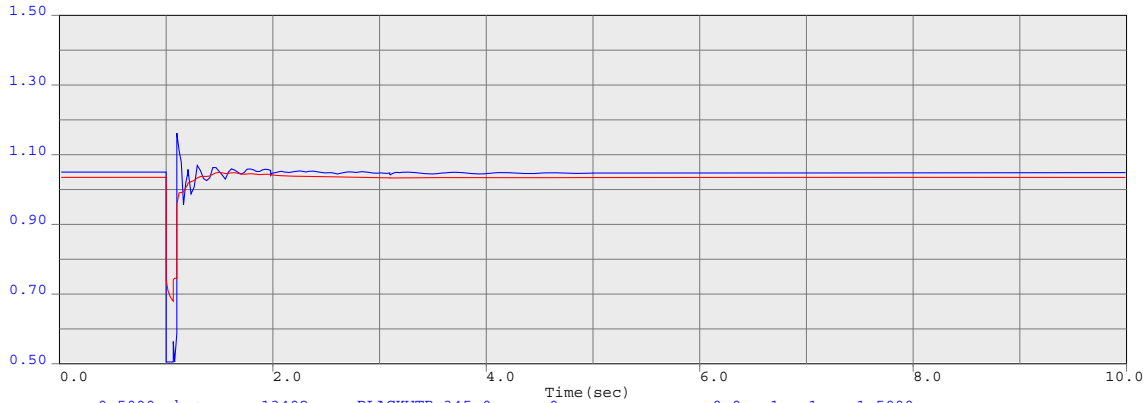
0.5000 vbug	10116	GUADLUPE 345.0	0	0.0	1	1	1.5000
0.5000 vbug	10025	B-A 345.0	0	0.0	1	1	1.5000

BUS VOLTAGE



0.5000 vbug	10999	TAIBANMS 345.0	0	0.0	1	1	1.5000
0.5000 vbus	10390	RIOPUERC 345.0	0	0.0	1	1	1.5000

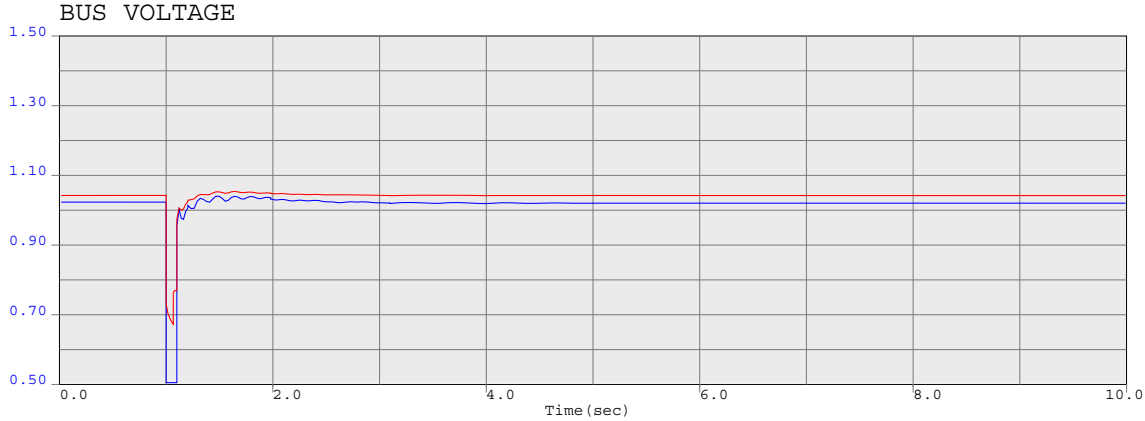
BUS VOLTAGE



0.5000 vbug	13402	BLACKWTR 345.0	0	0.0	1	1	1.5000
0.5000 vbus	10011	AMBROSIA 230.0	0	0.0	1	1	1.5000

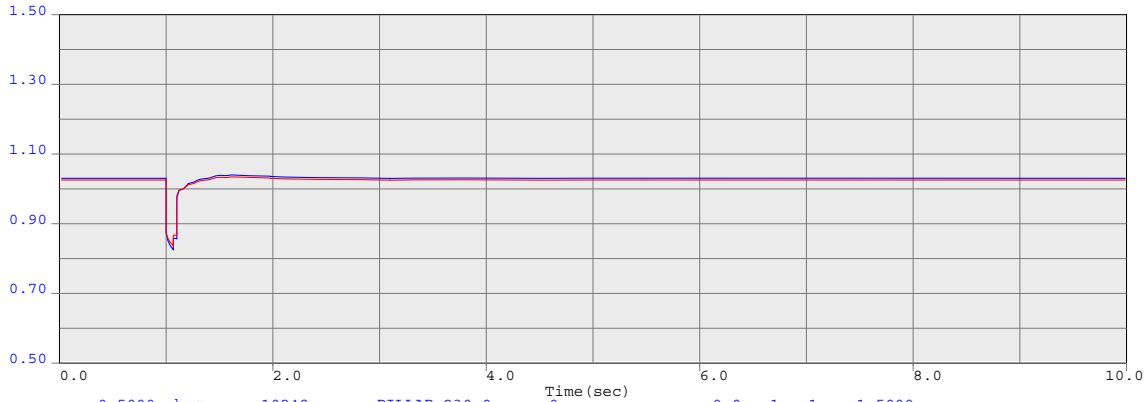
SPP 2000SC MODEL. 2001CASE 8/14/00
Base Case
WESTERN ELECTRICITY COORDINATING COUNCIL
2013-14 HW1A APPROVED BASE CASE
JANUARY 16, 2009
ALL COMMENTS FROM THE TSS REVIEW ARE INCLUDED
3-Phase fault near the BA end of the BA-RP 345 kV line
Clear BA end in 4 cycles, Clear RP end in 6 cycles

BUS VOLTAGE



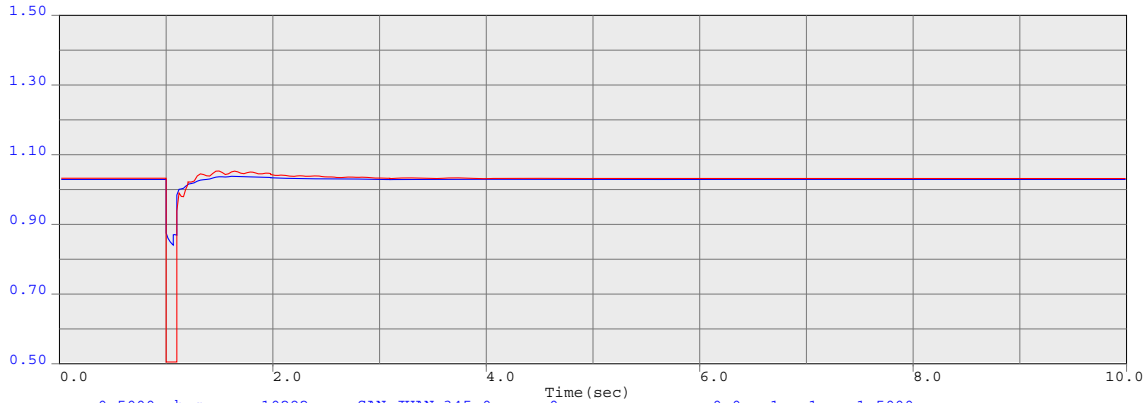
0.5000 vbus 10229 NORTON 345.0 0 0.0 1 1 1.5000
0.5000 vbus 10232 OJO 345.0 0 0.0 1 1 1.5000

BUS VOLTAGE



0.5000 vbus 10248 PILLAR 230.0 0 0.0 1 1 1.5000
0.5000 vbus 10291 SAN_JUAN 230.0 0 0.0 1 1 1.5000

BUS VOLTAGE

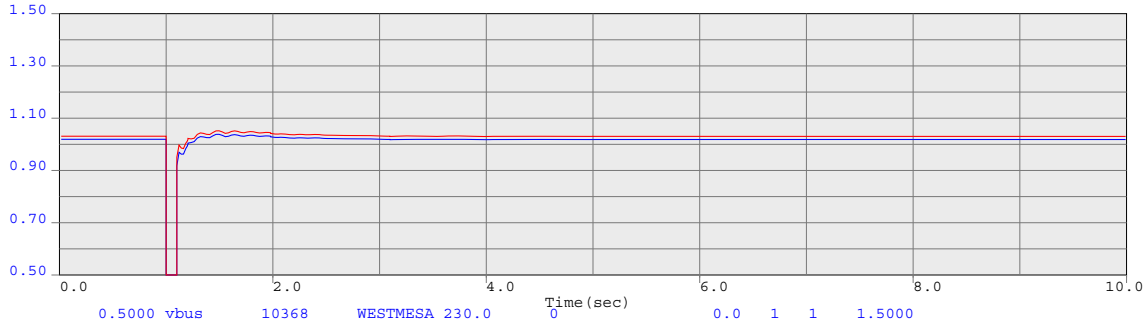


0.5000 vbus 10292 SAN_JUAN 345.0 0 0.0 1 1 1.5000
0.5000 vbus 10294 SANDIA 345.0 0 0.0 1 1 1.5000

SPP 2000SC MODEL. 2001CASE 8/14/00
Base Case
WESTERN ELECTRICITY COORDINATING COUNCIL
2013-14 HW1A APPROVED BASE CASE
JANUARY 16, 2009
ALL COMMENTS FROM THE TSS REVIEW ARE INCLUDED
3-Phase fault near the BA end of the BA-RP 345 kV line
Clear BA end in 4 cycles, Clear RP end in 6 cycles

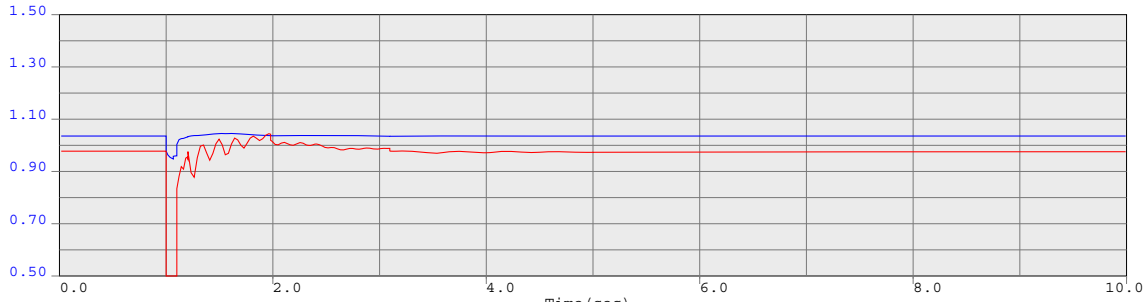
Broadview 297 MW Type 4 TSR

BUS VOLTAGE



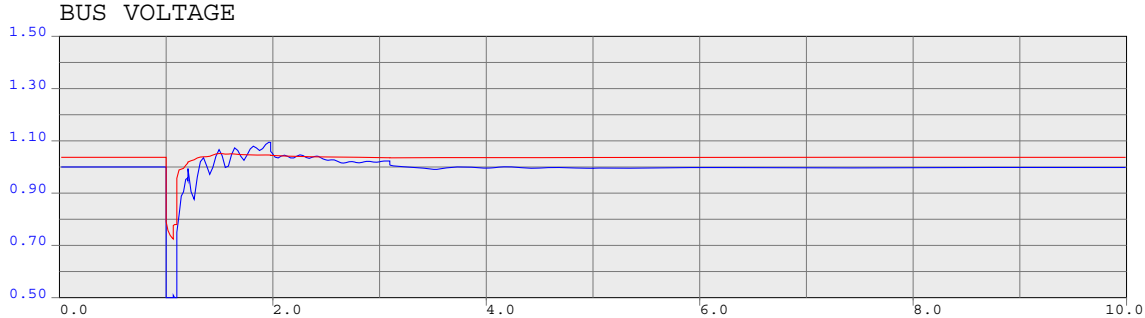
0.5000 vbus 10368 WESTMESA 230.0 0 0.0 1 1 1.5000
0.5000 vbus 10369 WESTMESA 345.0 0 0.0 1 1 1.5000

BUS VOLTAGE



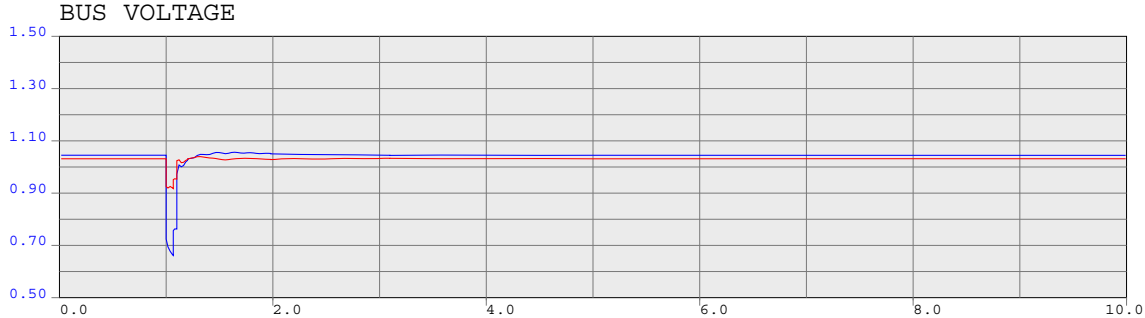
0.5000 vbus 10393 LEF 345.0 0 0.0 1 1 1.5000
0.5000 vbus 10991 ARGONNE4 138.0 0 0.0 1 1 1.5000

BUS VOLTAGE



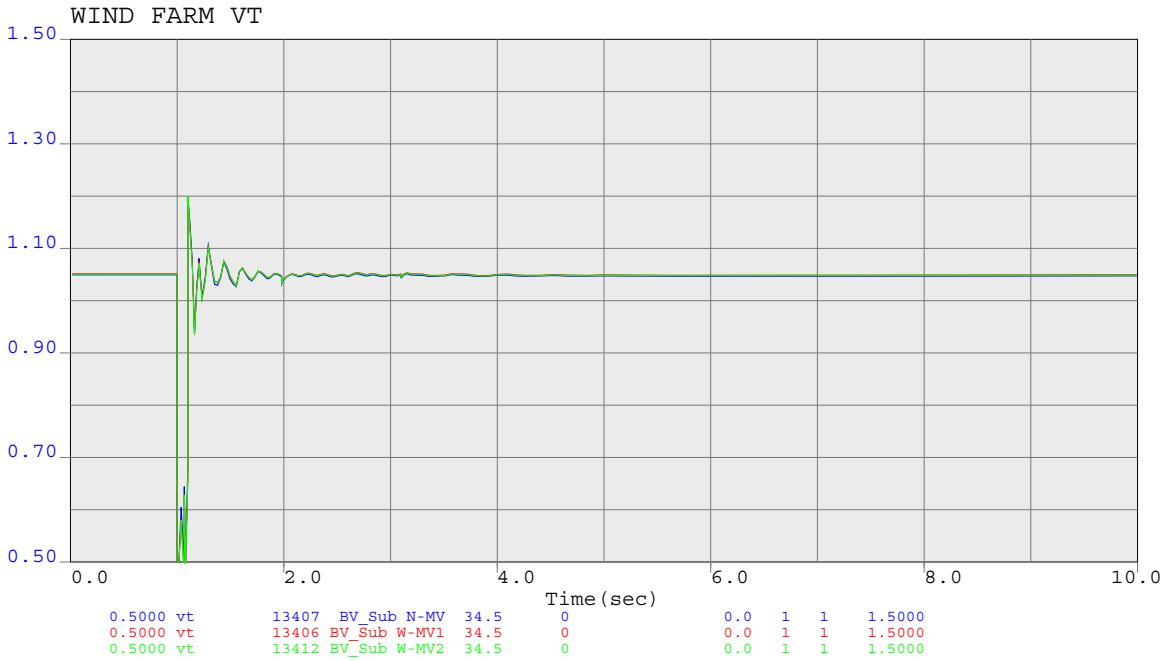
0.5000 vbus 10992 ARGONNE3 138.0 0 0.0 1 1 1.5000
0.5000 vbus 12057 PEGS 230.0 0 0.0 1 1 1.5000

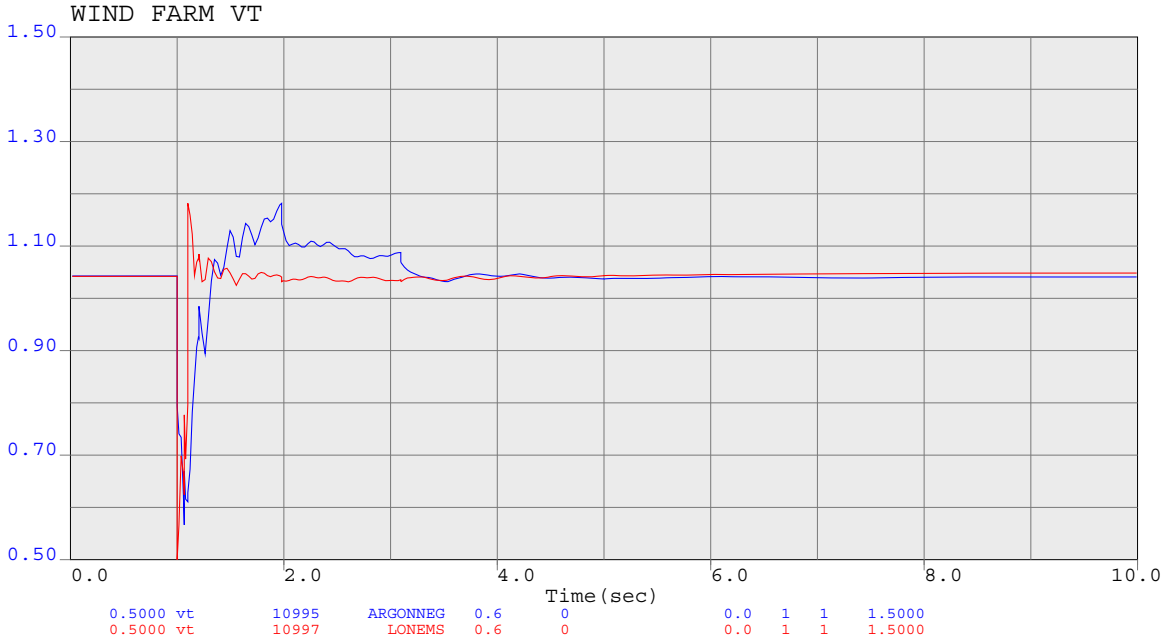
BUS VOLTAGE

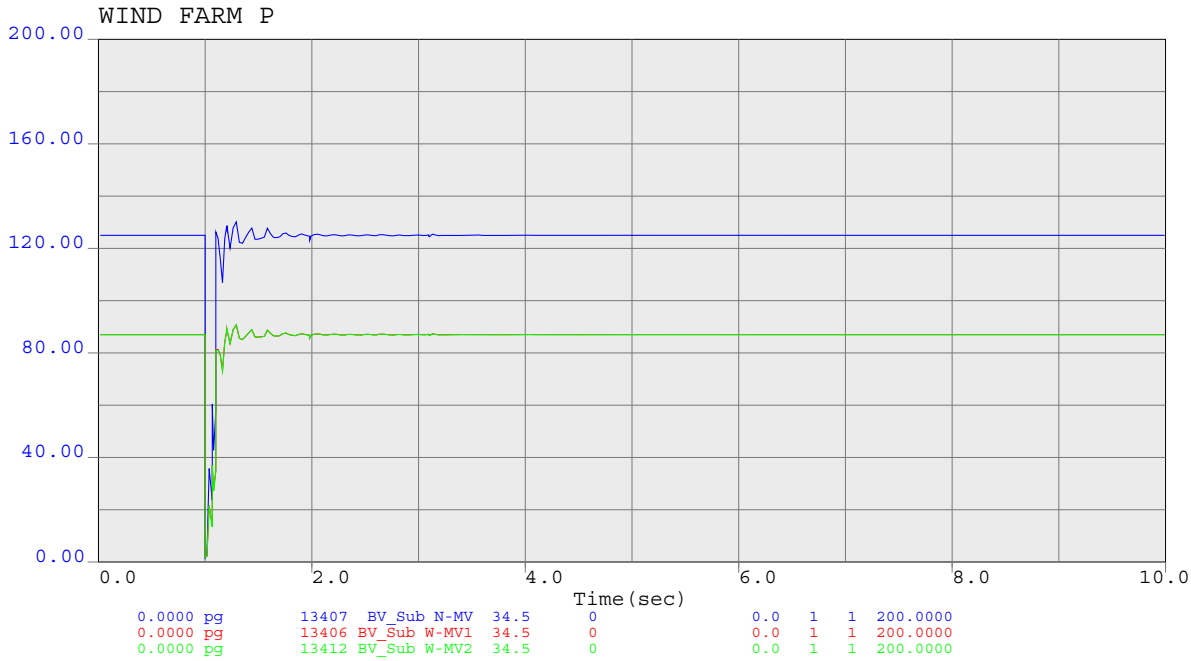


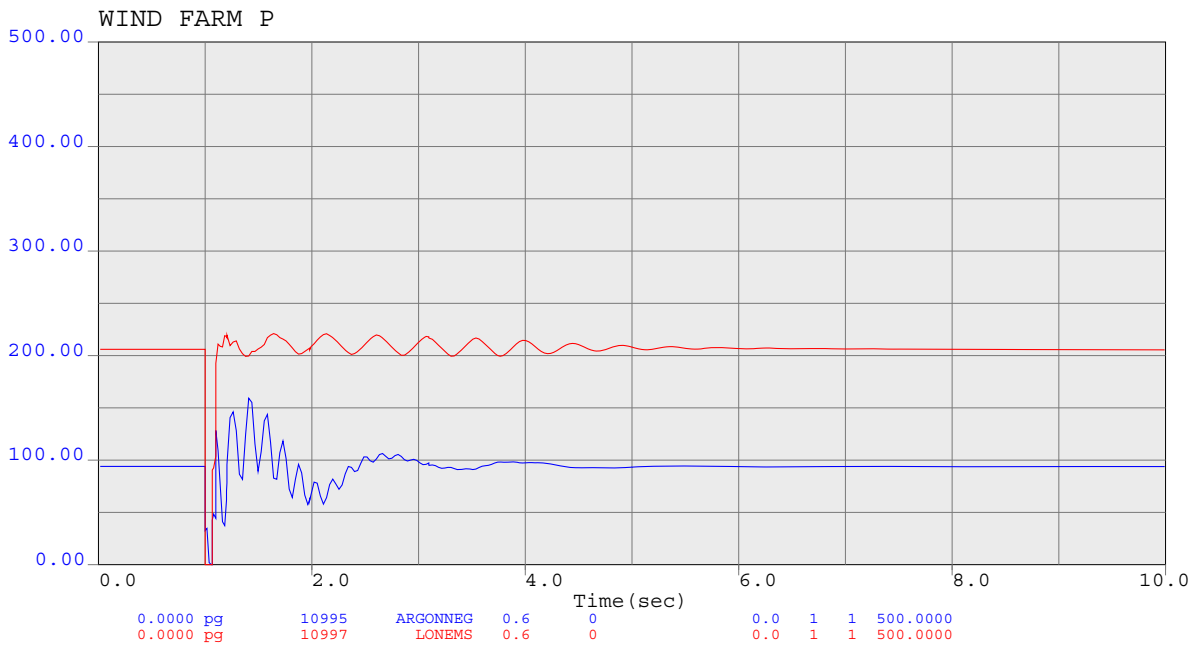
0.5000 vbus 12082 TAOS 345.0 0 0.0 1 1 1.5000
0.5000 vbus 12101 GLADSTON 230.0 0 0.0 1 1 1.5000

SPP 2000SC MODEL. 2001CASE 8/14/00
Base Case
WESTERN ELECTRICITY COORDINATING COUNCIL
2013-14 HW1A APPROVED BASE CASE
JANUARY 16, 2009
ALL COMMENTS FROM THE TSS REVIEW ARE INCLUDED
3-Phase fault near the BA end of the BA-RP 345 kV line
Clear BA end in 4 cycles, Clear RP end in 6 cycles

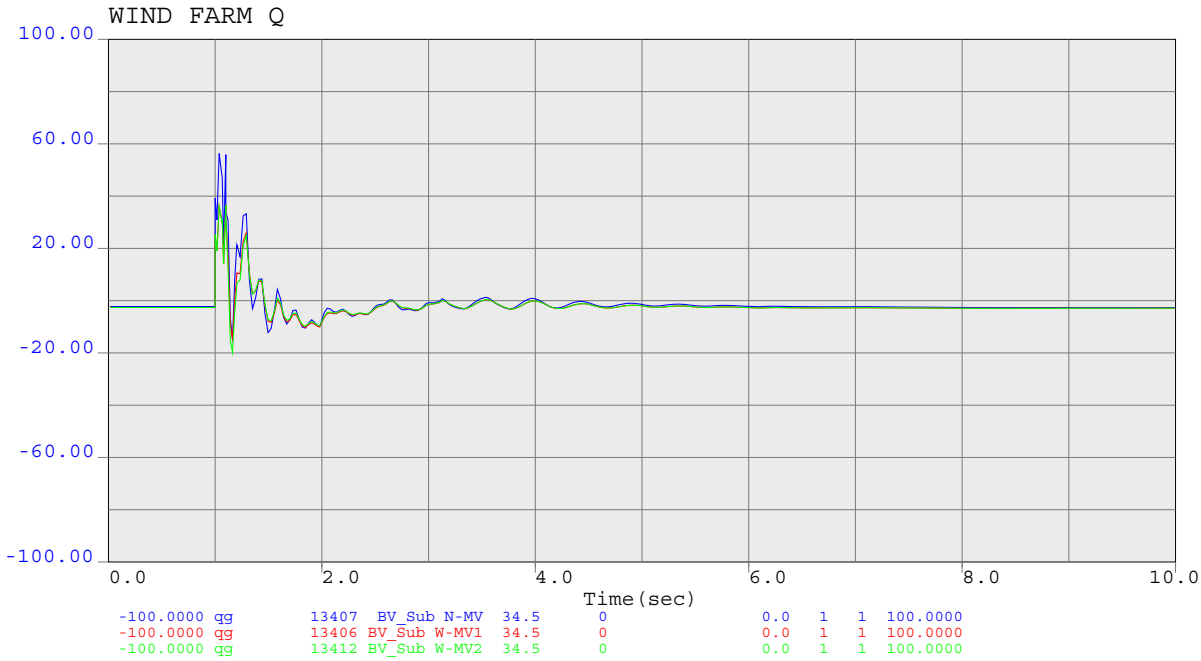

WIND FARM VT
1.50
1.30
1.10
0.90
0.70
0.50
0.0
2.0
4.0
6.0
8.0
10.0
Time(sec)
0.5000 vt 13407 BV_Sub N-MV 34.5 0 0.0 1 1 1.5000
0.5000 vt 13406 BV_Sub W-MV1 34.5 0 0.0 1 1 1.5000
0.5000 vt 13412 BV_Sub W-MV2 34.5 0 0.0 1 1 1.5000

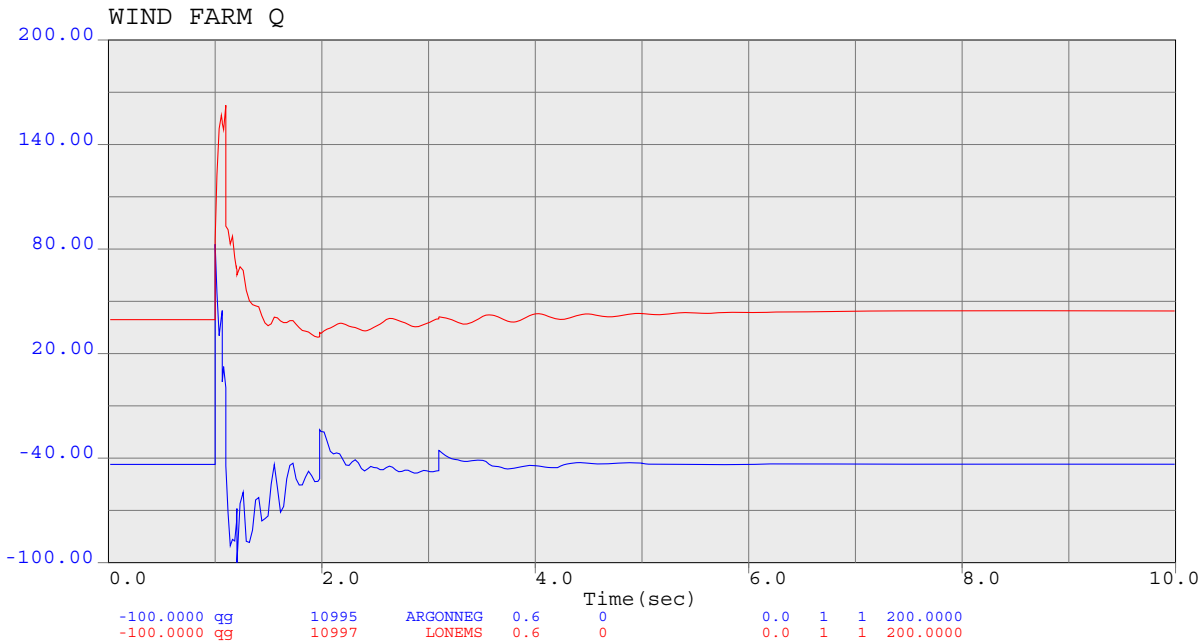

WIND FARM VT
1.50
1.30
1.10
0.90
0.70
0.50
0.0
2.0
4.0
6.0
8.0
10.0
Time(sec)
0.5000 vt 10995 ARGONNEG 0.6 0 0.0 1 1 1.5000
0.5000 vt 10997 LONEMS 0.6 0 0.0 1 1 1.5000





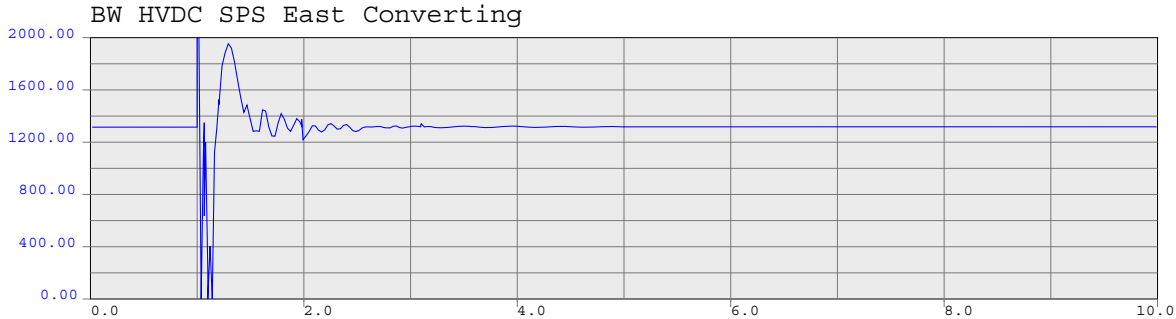
SPP 2000SC MODEL. 2001CASE 8/14/00
Base Case
WESTERN ELECTRICITY COORDINATING COUNCIL
2013-14 HW1A APPROVED BASE CASE
JANUARY 16, 2009
ALL COMMENTS FROM THE TSS REVIEW ARE INCLUDED
3-Phase fault near the BA end of the BA-RP 345 kV line
Clear BA end in 4 cycles, Clear RP end in 6 cycles





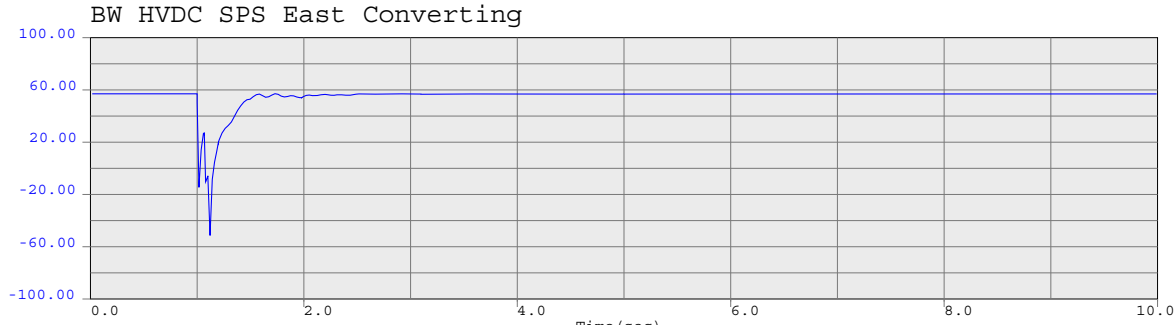
SPP 2000SC MODEL. 2001CASE 8/14/00
Base Case
WESTERN ELECTRICITY COORDINATING COUNCIL
2013-14 HW1A APPROVED BASE CASE
JANUARY 16, 2009
ALL COMMENTS FROM THE TSS REVIEW ARE INCLUDED
3-Phase fault near the BA end of the BA-RP 345 kV line
Clear BA end in 4 cycles, Clear RP end in 6 cycles

BW HVDC SPS East Converting



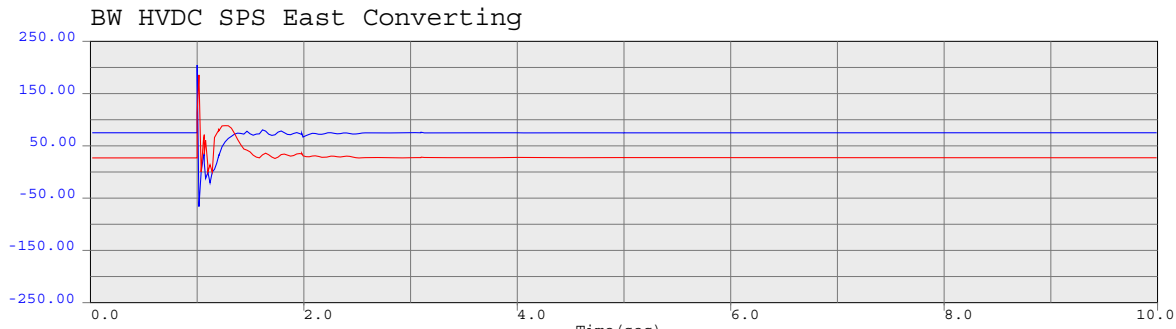
0.0000 idcr 99993 SPS EQ60 60.0 99993 SPS EQ60 60.0 1 1 2000.0000

BW HVDC SPS East Converting



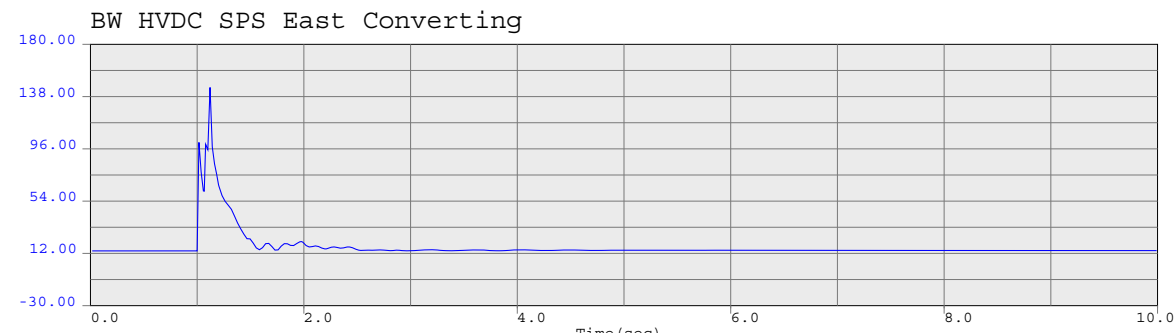
-100.0000 vdcr 99993 SPS EQ60 60.0 99993 SPS EQ60 60.0 1 1 100.0000

BW HVDC SPS East Converting



-250.0000 pacr 99993 SPS EQ60 60.0 99993 SPS EQ60 60.0 1 1 250.0000
-250.0000 qacr 99993 SPS EQ60 60.0 99993 SPS EQ60 60.0 1 1 250.0000

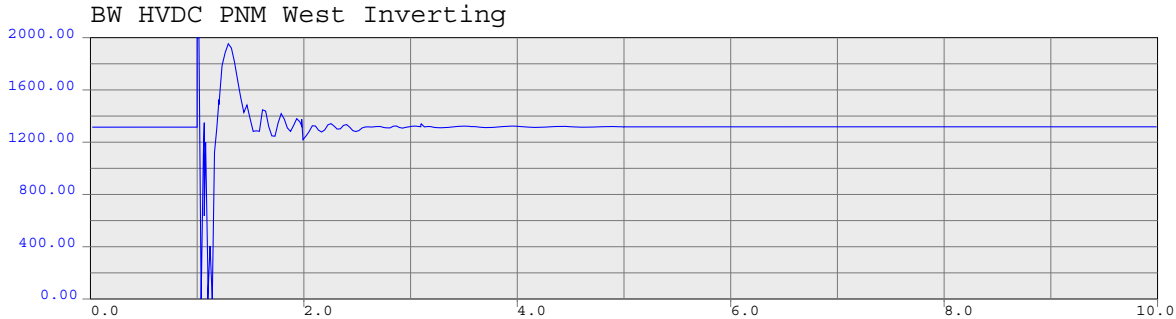
BW HVDC SPS East Converting



-30.0000 alpa 99993 SPS EQ60 60.0 99993 SPS EQ60 60.0 1 1 180.0000

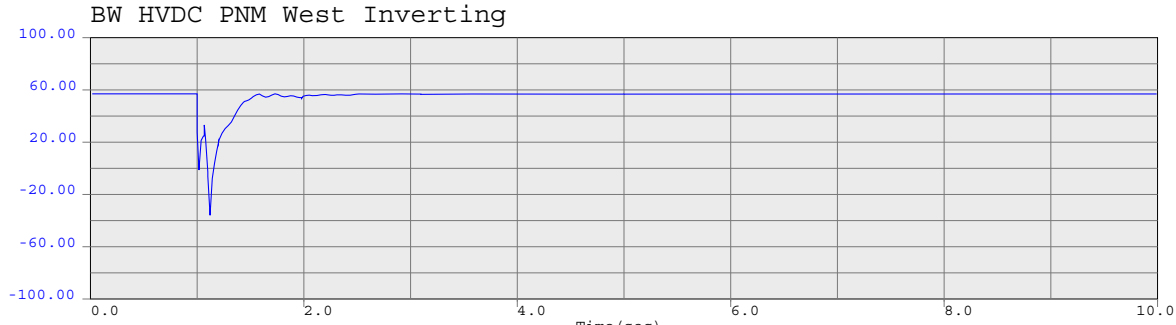
SPP 2000SC MODEL. 2001CASE 8/14/00
Base Case
WESTERN ELECTRICITY COORDINATING COUNCIL
2013-14 HW1A APPROVED BASE CASE
JANUARY 16, 2009
ALL COMMENTS FROM THE TSS REVIEW ARE INCLUDED
3-Phase fault near the BA end of the BA-RP 345 kV line
Clear BA end in 4 cycles, Clear RP end in 6 cycles

BW HVDC PNM West Inverting



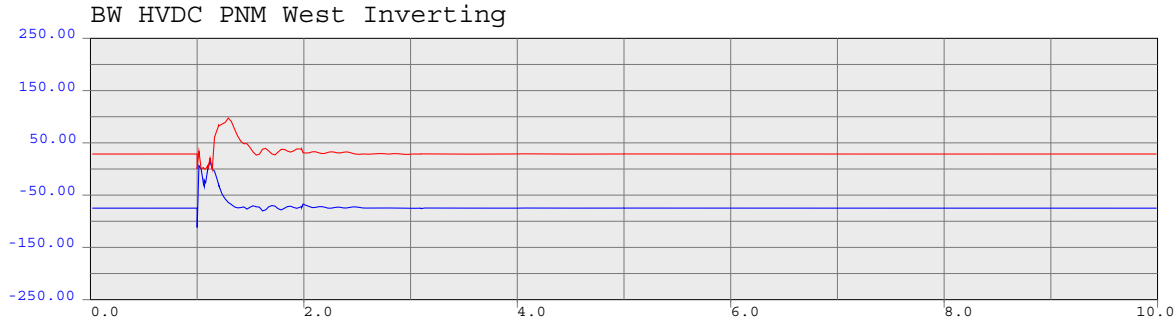
0.0000 idci 99993 SPS EQ60 60.0 13403 BLACK60 60.0 1 1 2000.0000

BW HVDC PNM West Inverting



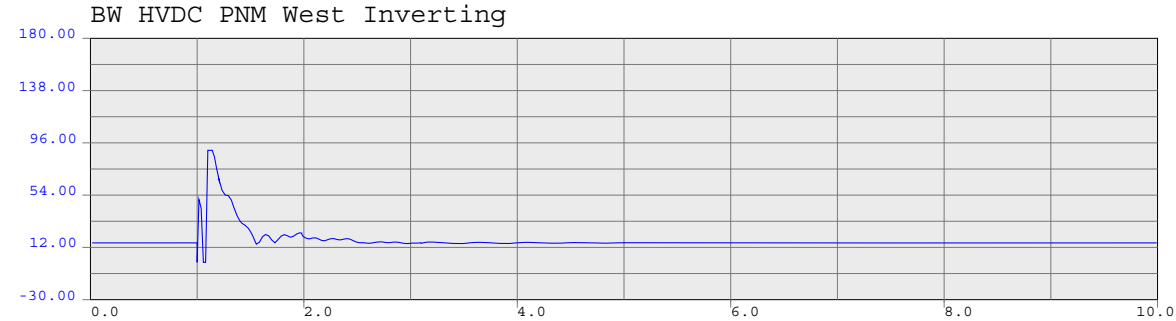
-100.0000 vdci 99993 SPS EQ60 60.0 13403 BLACK60 60.0 1 1 100.0000

BW HVDC PNM West Inverting



-250.0000 paci 99993 SPS EQ60 60.0 13403 BLACK60 60.0 1 1 250.0000
-250.0000 qaci 99993 SPS EQ60 60.0 13403 BLACK60 60.0 1 1 250.0000

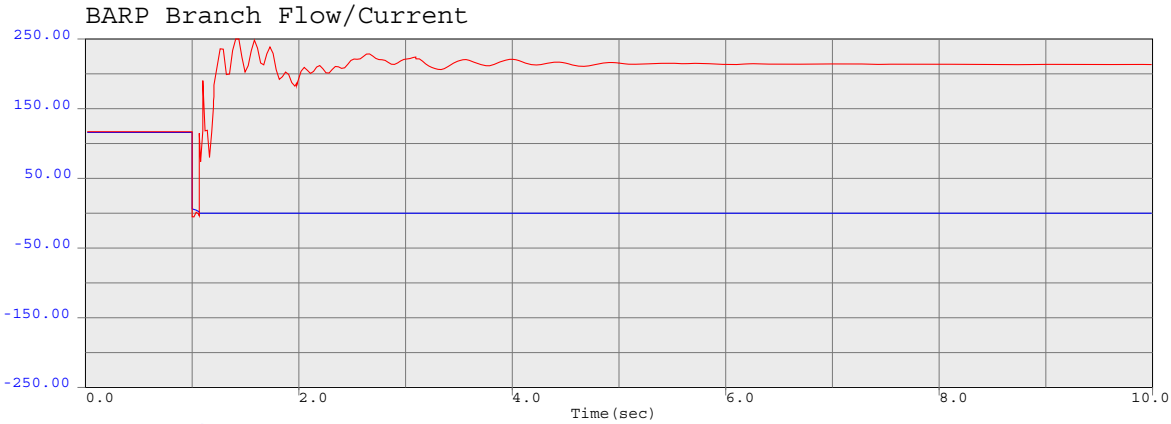
BW HVDC PNM West Inverting



-30.0000 gama 99993 SPS EQ60 60.0 13403 BLACK60 60.0 1 1 180.0000

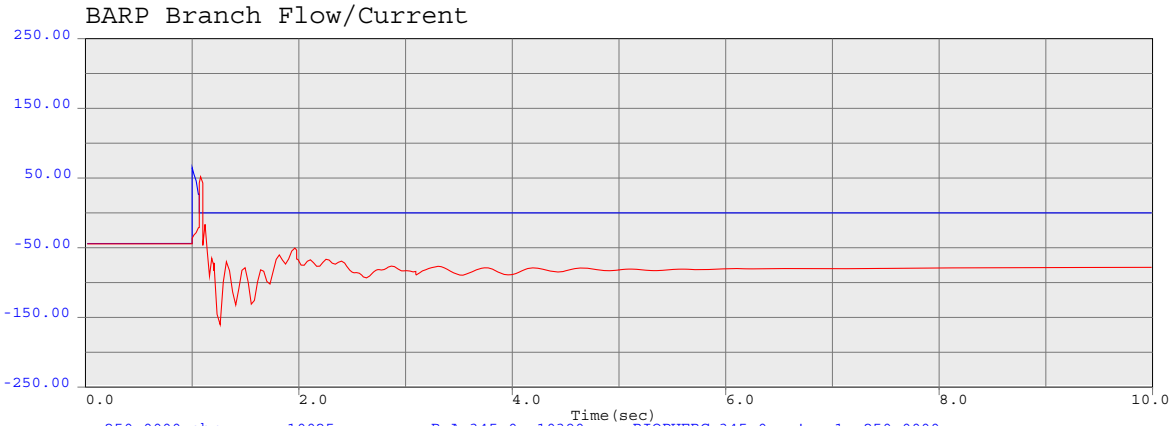
SPP 2000SC MODEL. 2001CASE 8/14/00
Base Case
WESTERN ELECTRICITY COORDINATING COUNCIL
2013-14 HW1A APPROVED BASE CASE
JANUARY 16, 2009
ALL COMMENTS FROM THE TSS REVIEW ARE INCLUDED
3-Phase fault near the BA end of the BA-RP 345 kV line
Clear BA end in 4 cycles, Clear RP end in 6 cycles

BARP Branch Flow/Current



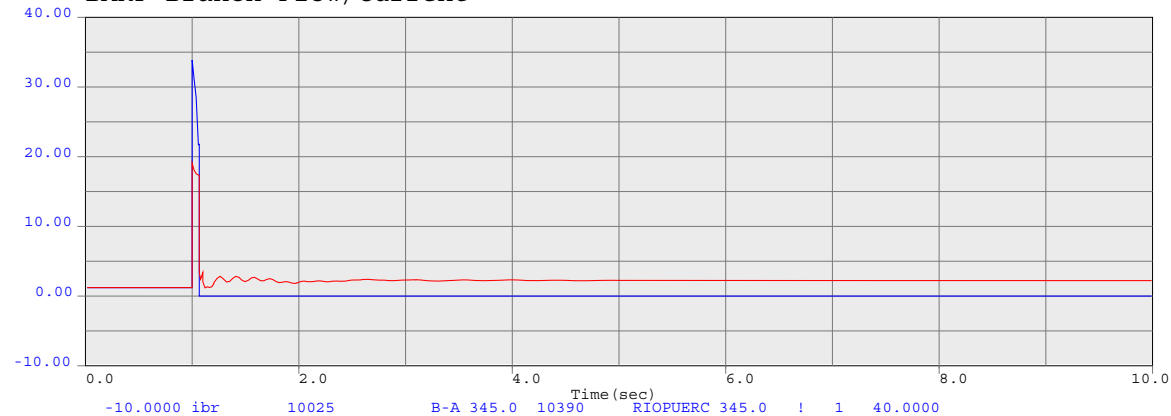
-250.0000 pbr 10025 B-A 345.0 10390 RIOPUERC 345.0 ! 1 250.0000
-250.0000 pbr 10025 B-A 345.0 10390 RIOPUERC 345.0 ! 2 250.0000

BARP Branch Flow/Current



-250.0000 qbr 10025 B-A 345.0 10390 RIOPUERC 345.0 ! 1 250.0000
-250.0000 qbr 10025 B-A 345.0 10390 RIOPUERC 345.0 ! 2 250.0000

BARP Branch Flow/Current



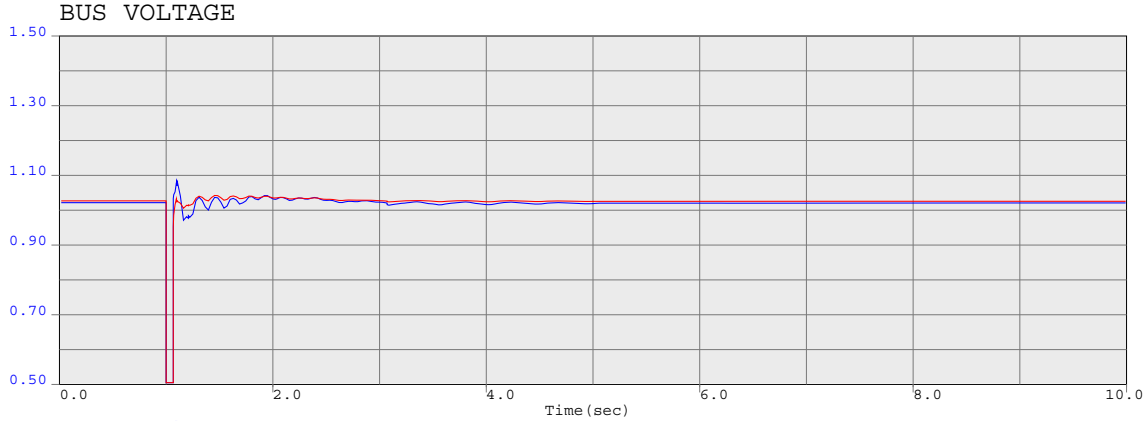
-10.0000 ibr 10025 B-A 345.0 10390 RIOPUERC 345.0 ! 1 40.0000
-10.0000 ibr 10025 B-A 345.0 10390 RIOPUERC 345.0 ! 2 40.0000

SPP 2000SC MODEL. 2001CASE 8/14/00
Base Case
WESTERN ELECTRICITY COORDINATING COUNCIL
2013-14 HW1A APPROVED BASE CASE
JANUARY 16, 2009
ALL COMMENTS FROM THE TSS REVIEW ARE INCLUDED
3-Phase fault near the BA end of the BA-RP 345 kV line
Clear BA end in 4 cycles, Clear RP end in 6 cycles

Contingency 2 - BA 345/115 kV Transformer (BA345/115 TX)

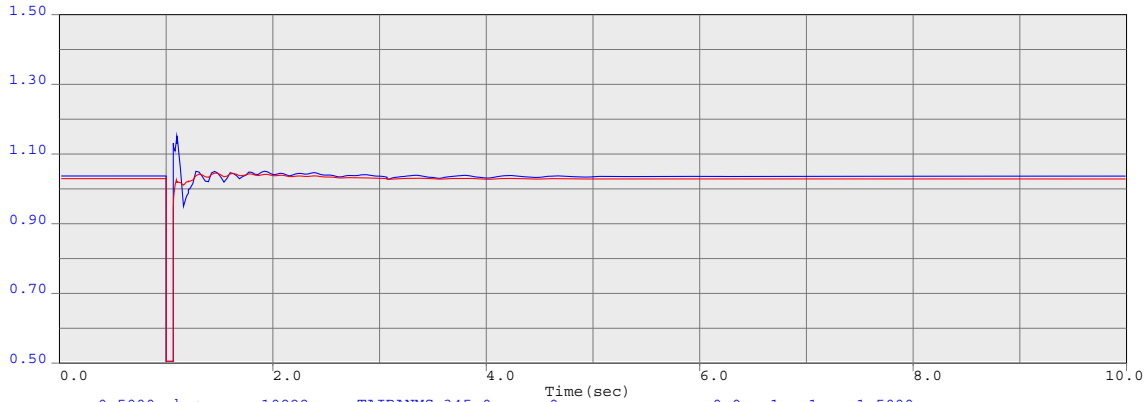
Broadview 297 MW Type 4 TSR

BUS VOLTAGE



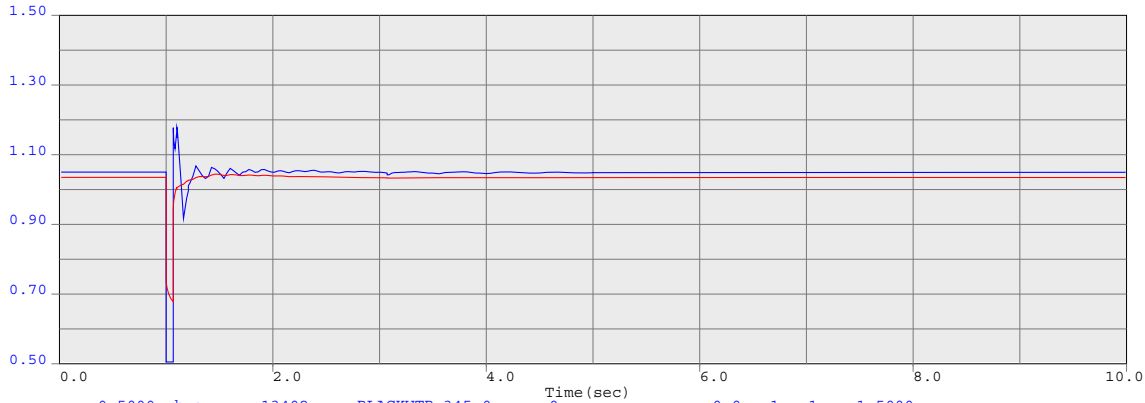
0.5000 vbug 10116 GUADLUPE 345.0 0 0.0 1 1 1.5000
0.5000 vbug 10025 B-A 345.0 0 0.0 1 1 1.5000

BUS VOLTAGE



0.5000 vbug 10999 TAIBANMS 345.0 0 0.0 1 1 1.5000
0.5000 vbus 10390 RIOPUERC 345.0 0 0.0 1 1 1.5000

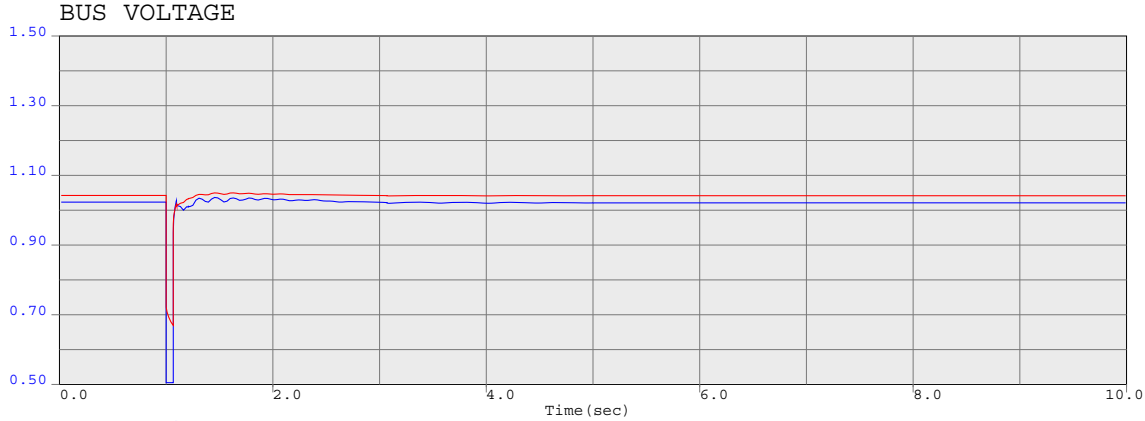
BUS VOLTAGE



0.5000 vbug 13402 BLACKWTR 345.0 0 0.0 1 1 1.5000
0.5000 vbus 10011 AMBROSIA 230.0 0 0.0 1 1 1.5000

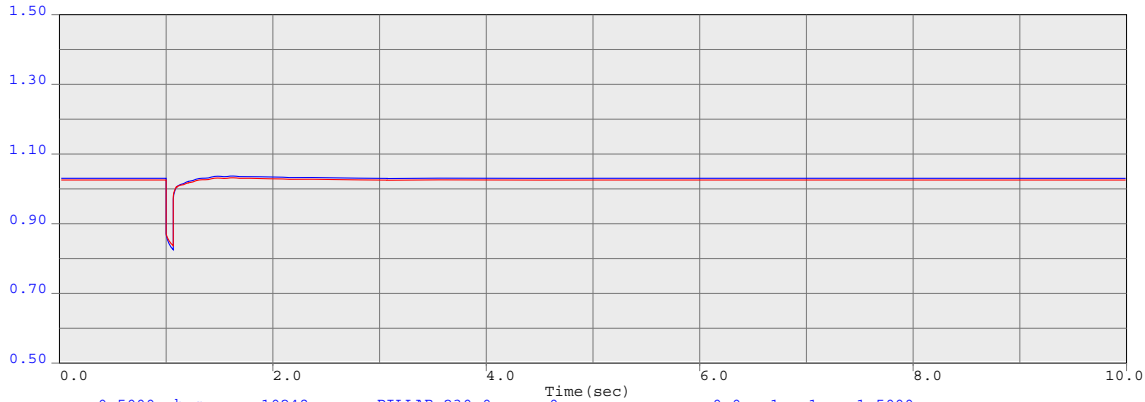
SPP 2000SC MODEL. 2001CASE 8/14/00
Base Case
WESTERN ELECTRICITY COORDINATING COUNCIL
2013-14 HW1A APPROVED BASE CASE
JANUARY 16, 2009
ALL COMMENTS FROM THE TSS REVIEW ARE INCLUDED
3-Phase Fault on the 345 kV bus of the BA 345/115 kV transformer
Clear BA 345/115 kV transformer in 4 cycles

BUS VOLTAGE



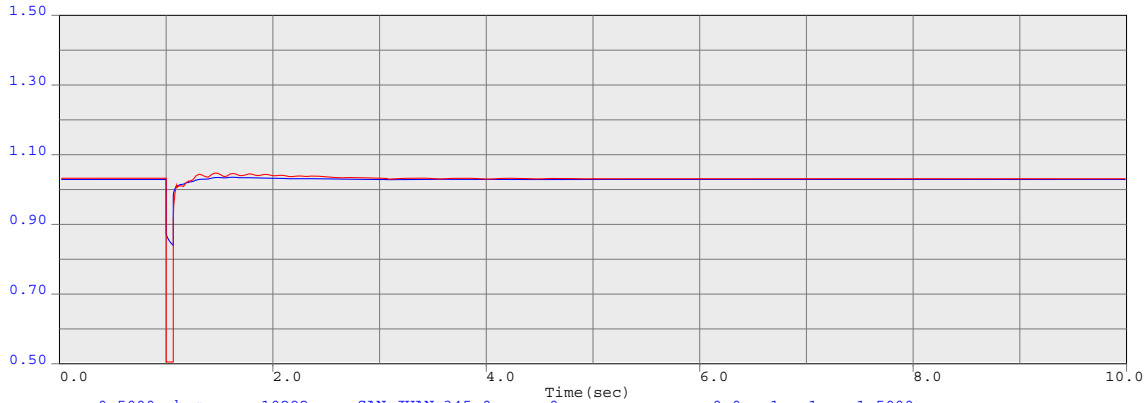
0.5000 vbus 10229 NORTON 345.0 0 0.0 1 1 1.5000
0.5000 vbus 10232 OJO 345.0 0 0.0 1 1 1.5000

BUS VOLTAGE



0.5000 vbus 10248 PILLAR 230.0 0 0.0 1 1 1.5000
0.5000 vbus 10291 SAN_JUAN 230.0 0 0.0 1 1 1.5000

BUS VOLTAGE

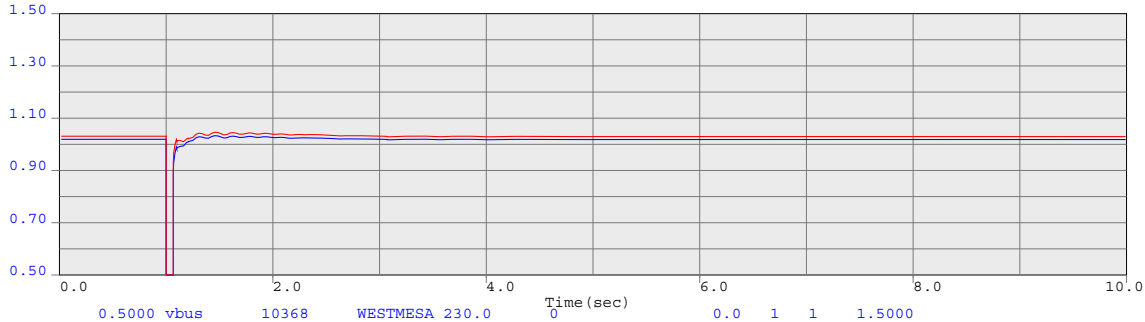


0.5000 vbus 10292 SAN_JUAN 345.0 0 0.0 1 1 1.5000
0.5000 vbus 10294 SANDIA 345.0 0 0.0 1 1 1.5000

SPP 2000SC MODEL. 2001CASE 8/14/00
Base Case
WESTERN ELECTRICITY COORDINATING COUNCIL
2013-14 HW1A APPROVED BASE CASE
JANUARY 16, 2009
ALL COMMENTS FROM THE TSS REVIEW ARE INCLUDED
3-Phase Fault on the 345 kV bus of the BA 345/115 kV transformer
Clear BA 345/115 kV transformer in 4 cycles

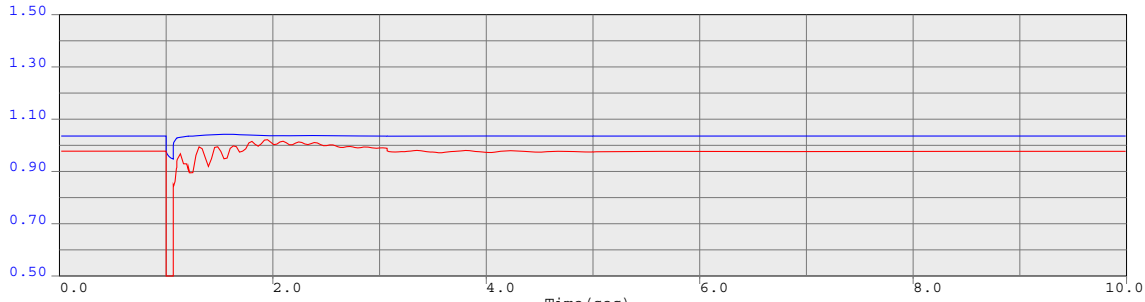
Broadview 297 MW Type 4 TSR

BUS VOLTAGE



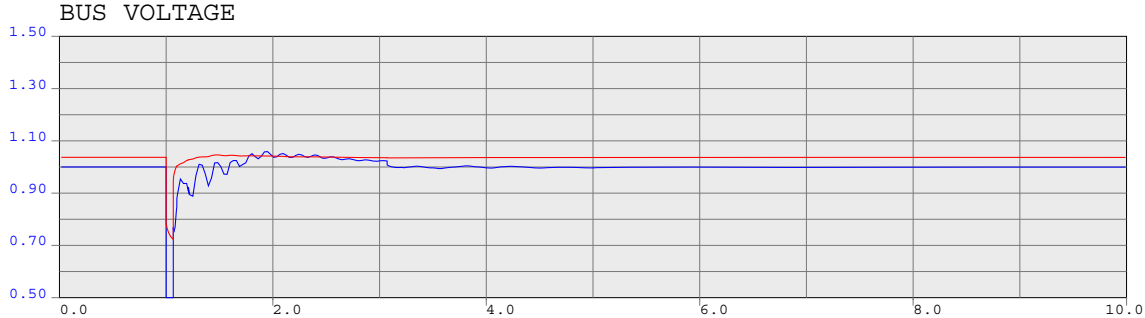
0.5000 vbus 10368 WESTMESA 230.0 0 0.0 1 1 1.5000
0.5000 vbus 10369 WESTMESA 345.0 0 0.0 1 1 1.5000

BUS VOLTAGE



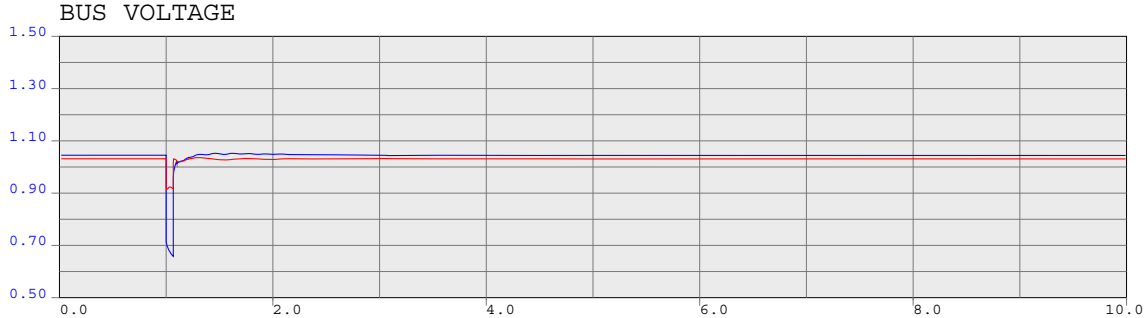
0.5000 vbus 10393 LEF 345.0 0 0.0 1 1 1.5000
0.5000 vbus 10991 ARGONNE4 138.0 0 0.0 1 1 1.5000

BUS VOLTAGE



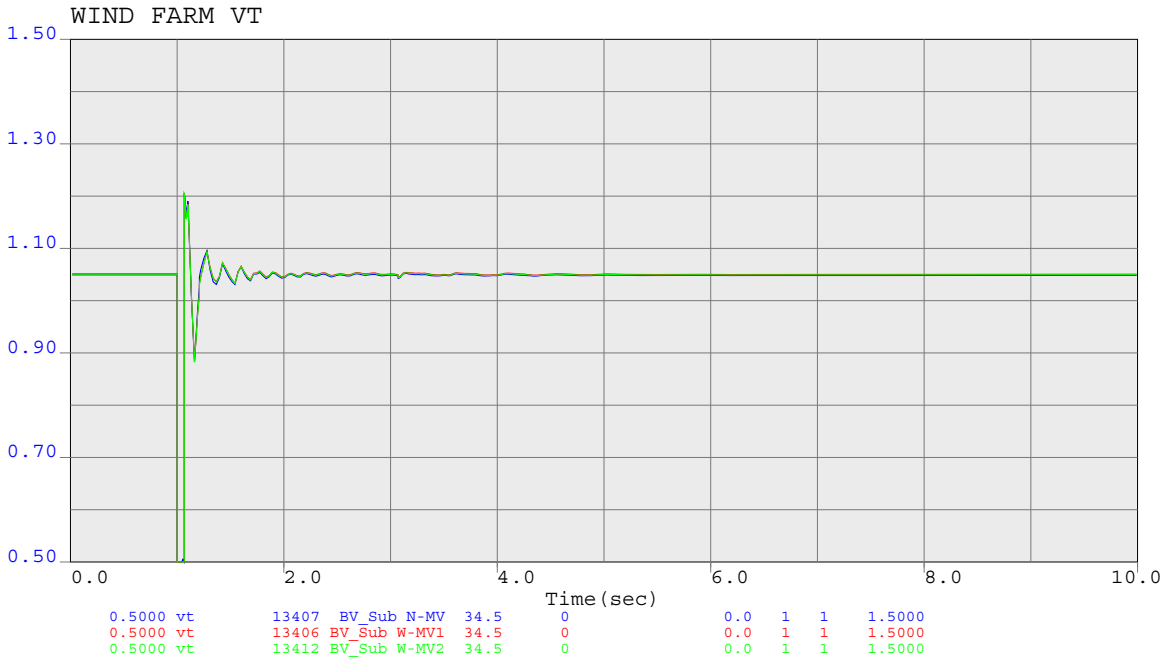
0.5000 vbus 10992 ARGONNE3 138.0 0 0.0 1 1 1.5000
0.5000 vbus 12057 PEGS 230.0 0 0.0 1 1 1.5000

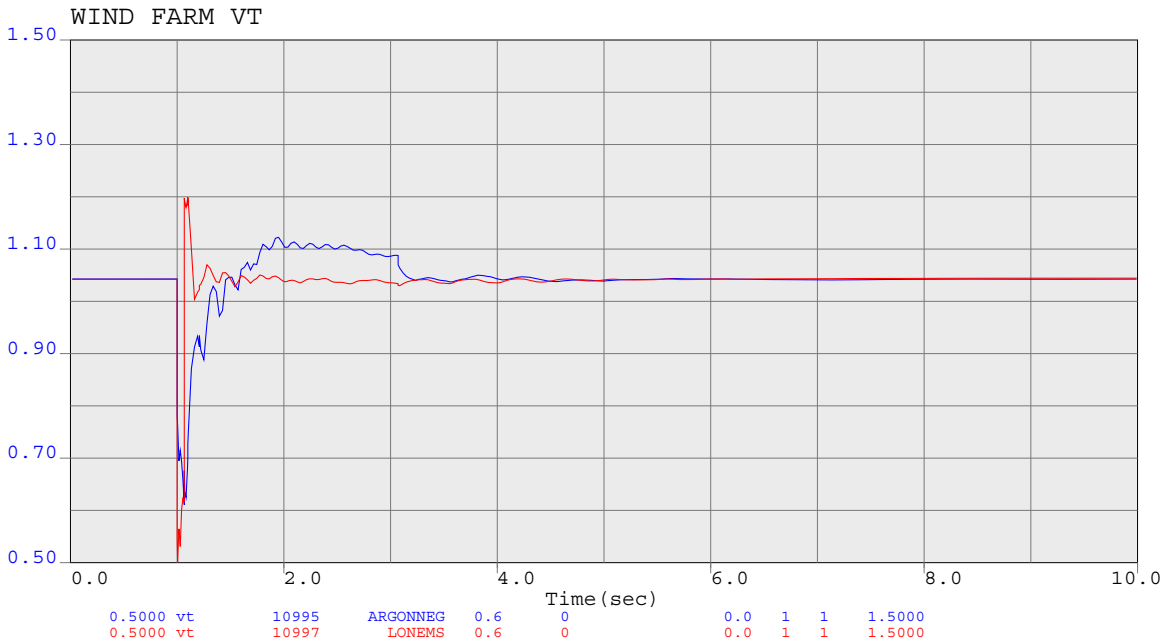
BUS VOLTAGE

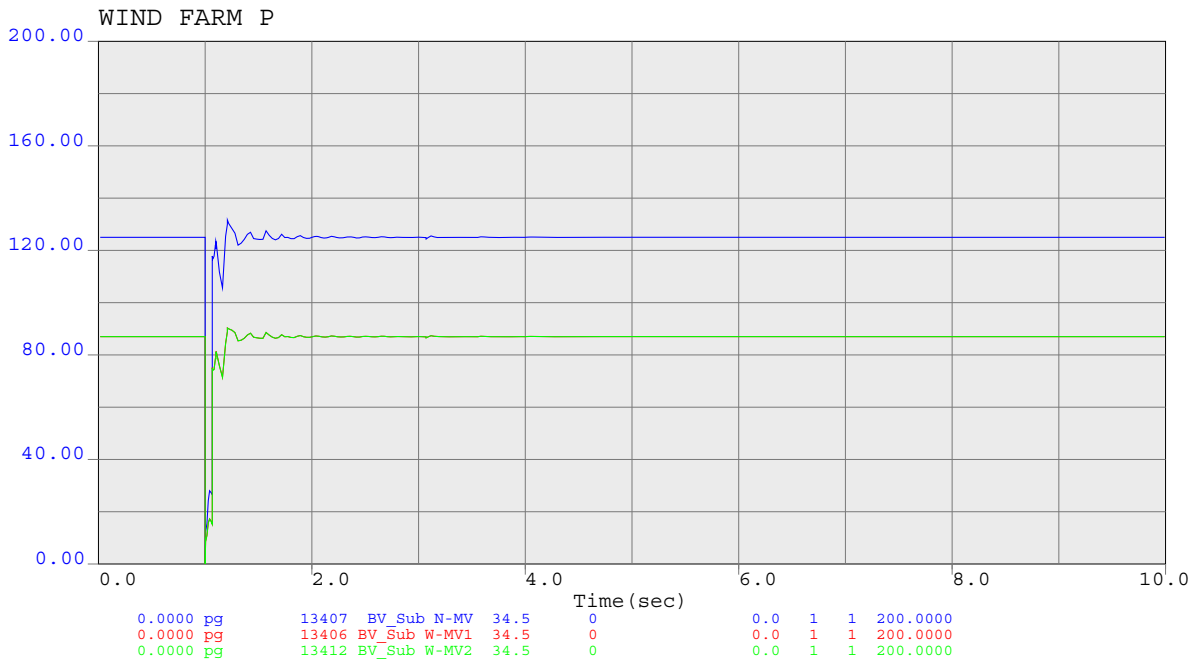


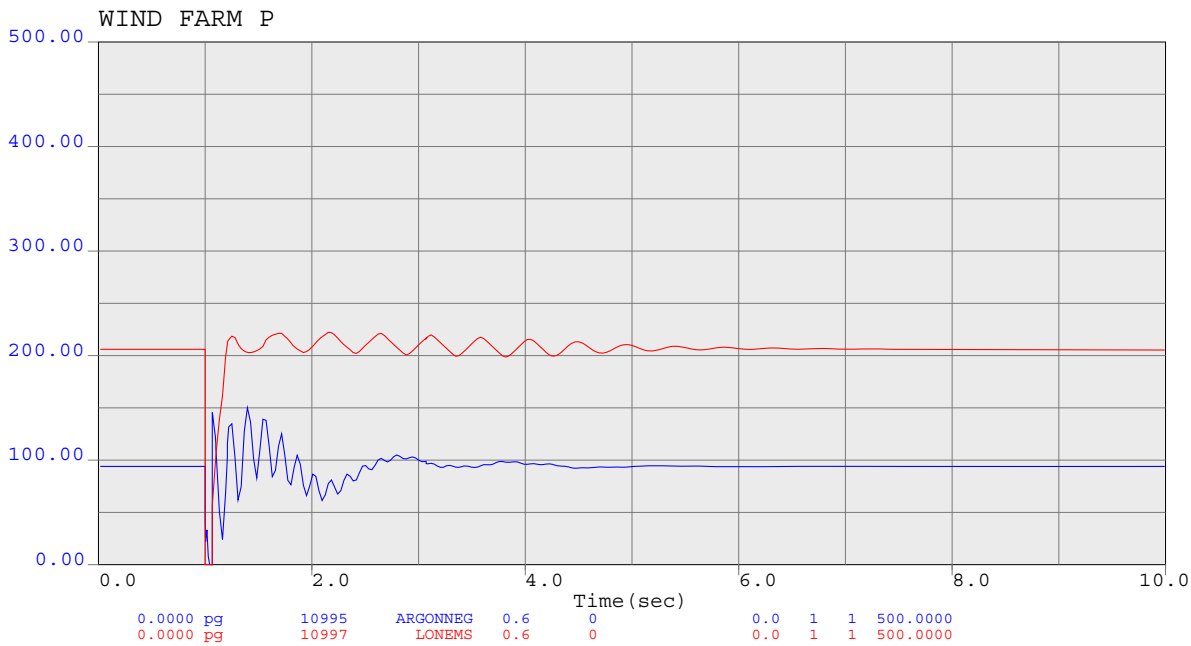
0.5000 vbus 12082 TAOS 345.0 0 0.0 1 1 1.5000
0.5000 vbus 12101 GLADSTON 230.0 0 0.0 1 1 1.5000

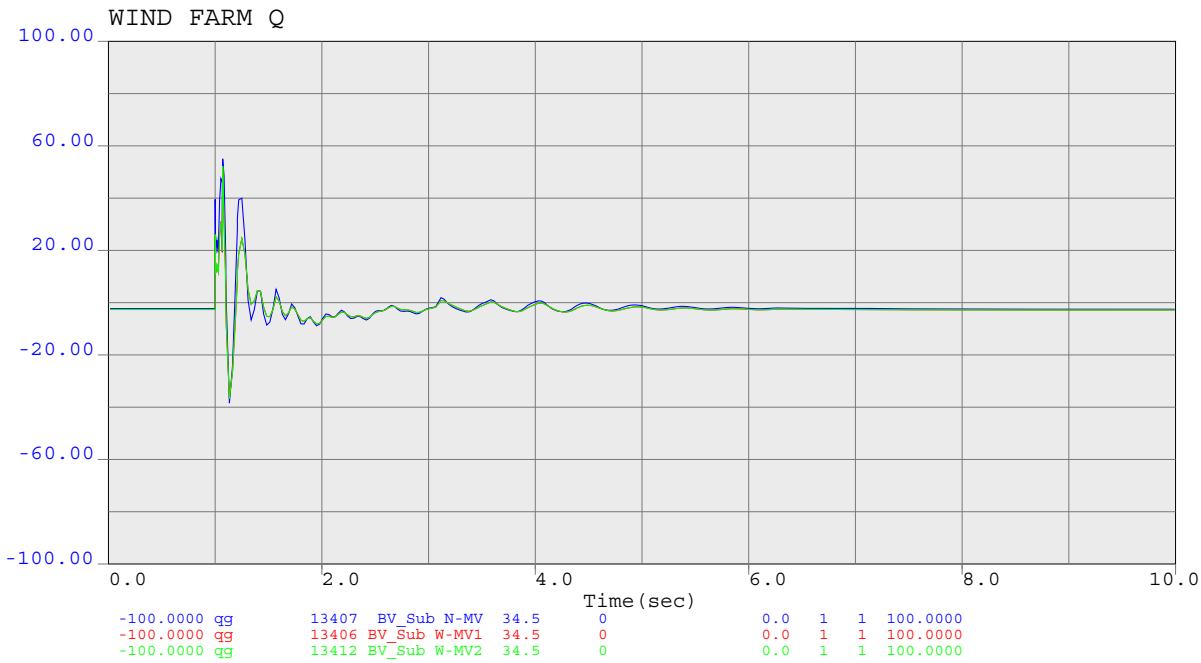
SPP 2000SC MODEL. 2001CASE 8/14/00
Base Case
WESTERN ELECTRICITY COORDINATING COUNCIL
2013-14 HW1A APPROVED BASE CASE
JANUARY 16, 2009
ALL COMMENTS FROM THE TSS REVIEW ARE INCLUDED
3-Phase Fault on the 345 kV bus of the BA 345/115 kV transformer
Clear BA 345/115 kV transformer in 4 cycles

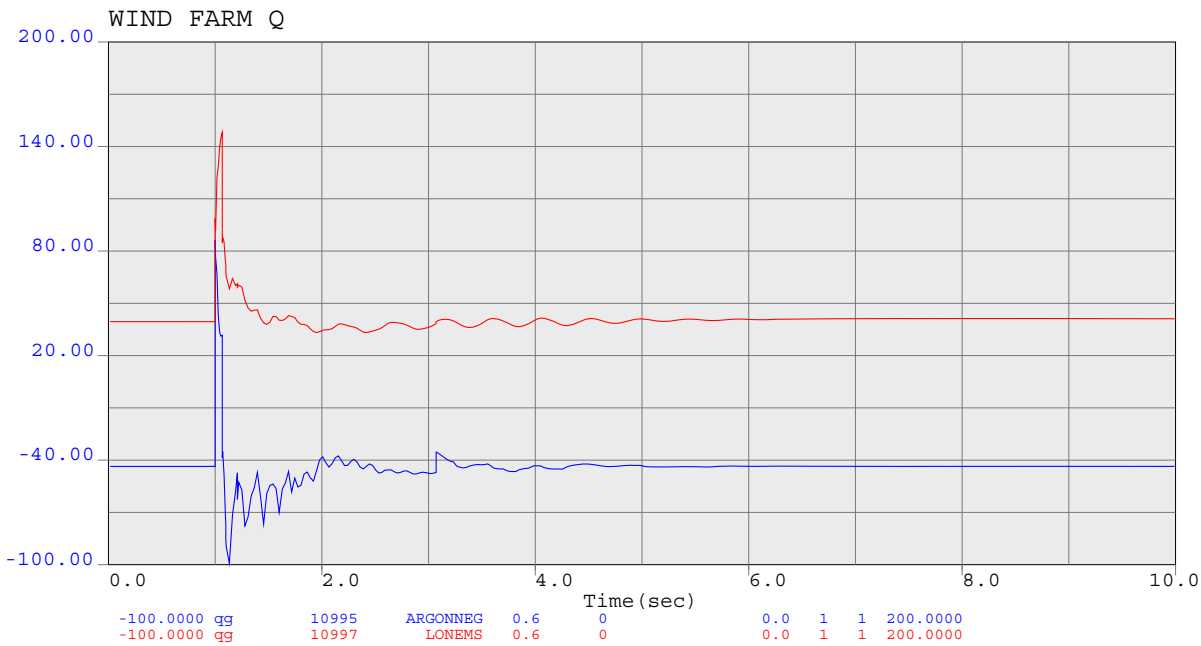

WIND FARM VT
1.50
1.30
1.10
0.90
0.70
0.50
0.0
2.0
4.0
6.0
8.0
10.0
Time(sec)
0.5000 vt 13407 BV_Sub N-MV 34.5 0 0.0 1 1 1.5000
0.5000 vt 13406 BV_Sub W-MV1 34.5 0 0.0 1 1 1.5000
0.5000 vt 13412 BV_Sub W-MV2 34.5 0 0.0 1 1 1.5000


WIND FARM VT
1.50
1.30
1.10
0.90
0.70
0.50
0.0
2.0
4.0
6.0
8.0
10.0
Time(sec)
0.5000 vt 10995 ARGONNEG 0.6 0 0.0 1 1 1.5000
0.5000 vt 10997 LONEMS 0.6 0 0.0 1 1 1.5000

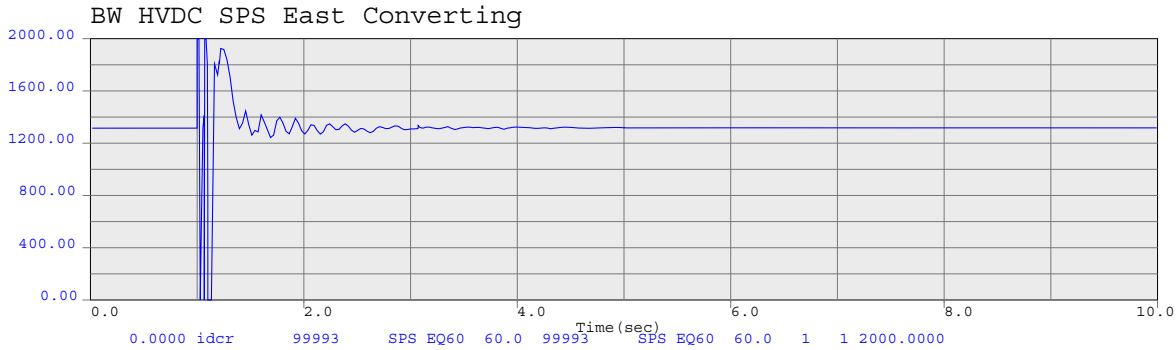

WIND FARM P
200.00
160.00
120.00
80.00
40.00
0.00
0.0
2.0
4.0
6.0
8.0
10.0
Time(sec)
0.0000 pg 13407 BV_Sub N-MV 34.5 0 0.0 1 1 200.0000
0.0000 pg 13406 BV_Sub W-MV1 34.5 0 0.0 1 1 200.0000
0.0000 pg 13412 BV_Sub W-MV2 34.5 0 0.0 1 1 200.0000

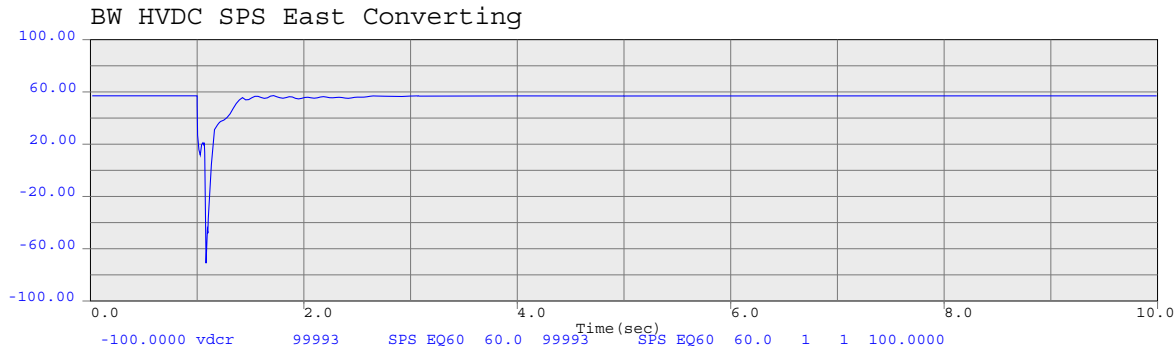

WIND FARM P
500.00
400.00
300.00
200.00
100.00
0.00
0.0
2.0
4.0
6.0
8.0
10.0
Time(sec)
0.0000 pg 10995 ARGONNEG 0.6 0 0.0 1 1 500.0000
0.0000 pg 10997 LONEMS 0.6 0 0.0 1 1 500.0000

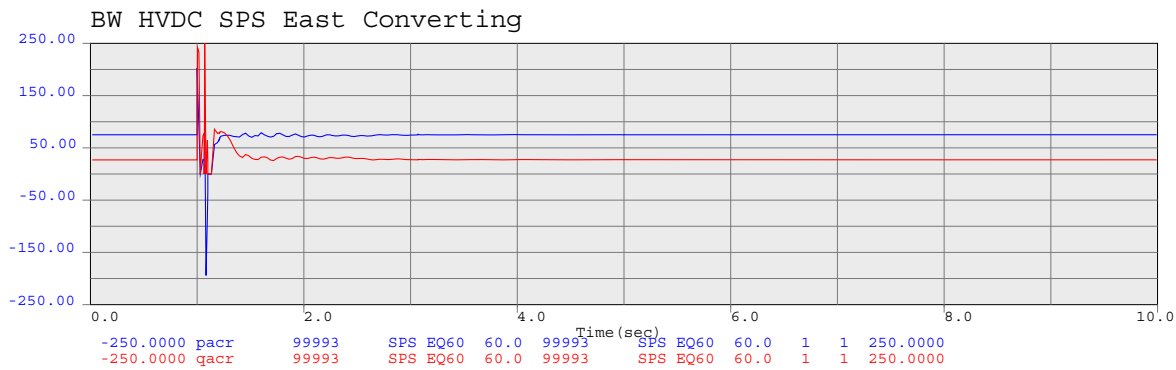

WIND FARM Q
100.00
60.00
20.00
-20.00
-60.00
-100.00
0.0
2.0
4.0
6.0
8.0
10.0
Time(sec)
-100.0000 qg 13407 BV_Sub N-MV 34.5 0 0.0 1 1 100.0000
-100.0000 qg 13406 BV_Sub W-MV1 34.5 0 0.0 1 1 100.0000
-100.0000 qg 13412 BV_Sub W-MV2 34.5 0 0.0 1 1 100.0000

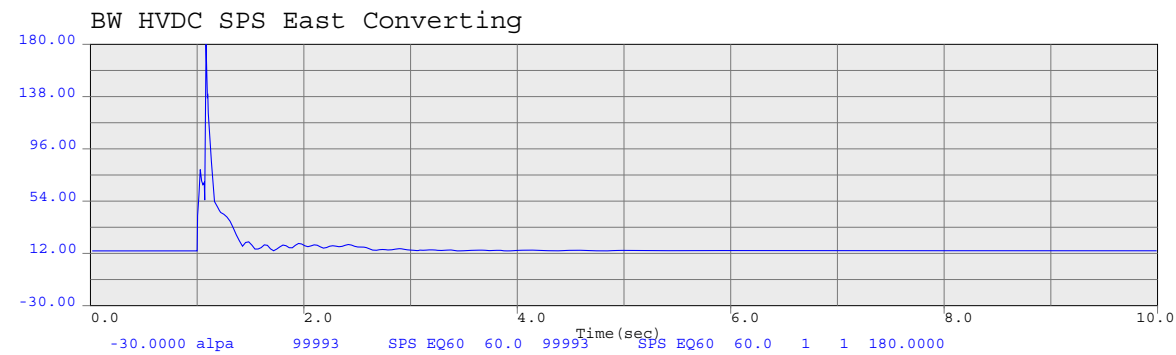

WIND FARM Q
200.00
140.00
80.00
20.00
-40.00
-100.00
0.0
2.0
4.0
6.0
8.0
10.0
Time(sec)
-100.0000 qg 10995 ARGONNEG 0.6 0 0.0 1 1 200.0000
-100.0000 qg 10997 LONEMS 0.6 0 0.0 1 1 200.0000

Broadview 297 MW Type 4 TSR



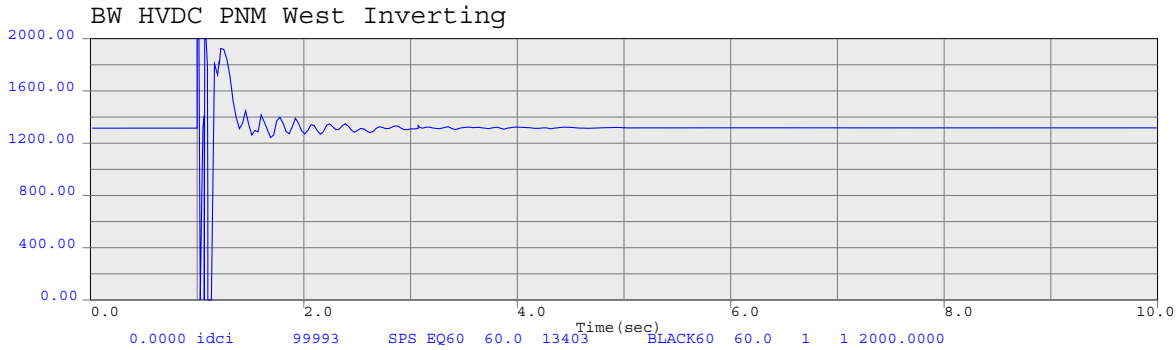


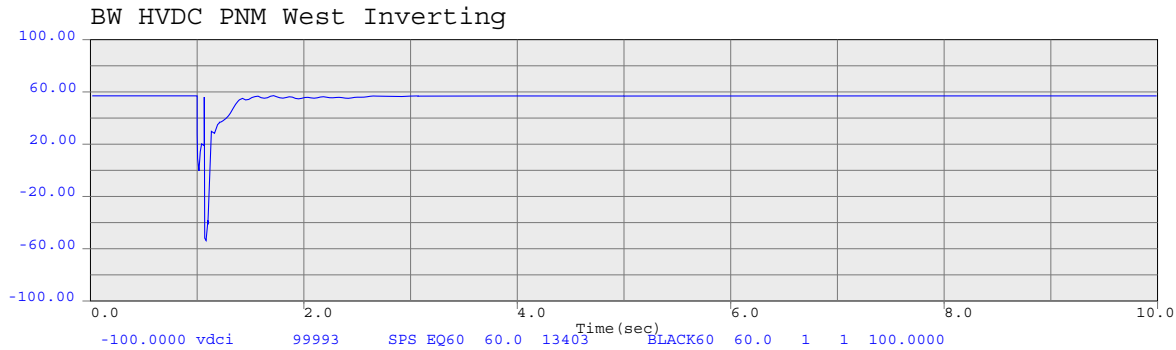


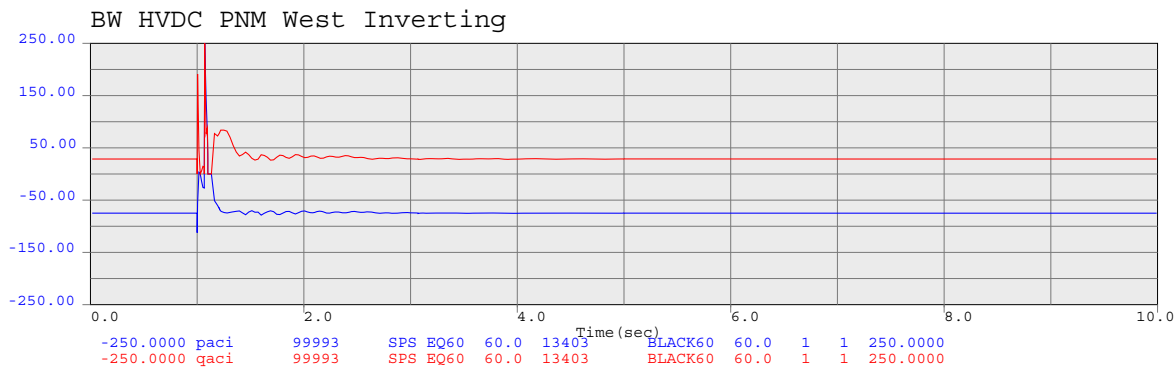


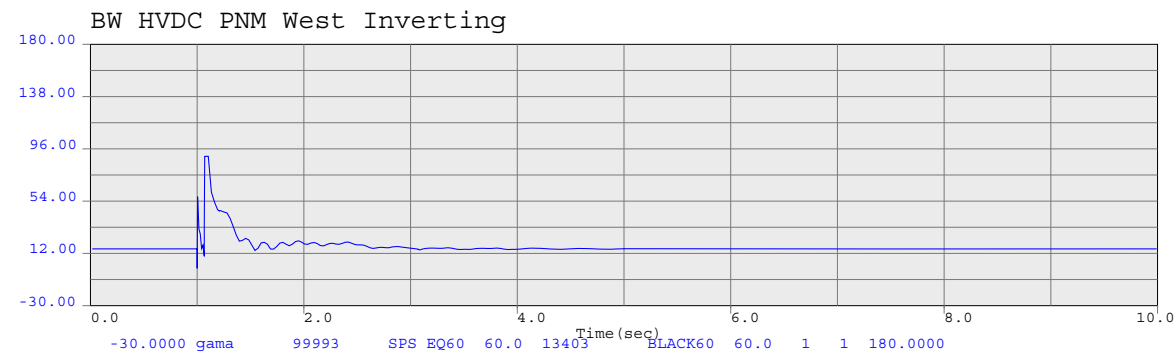
SPP 2000SC MODEL. 2001CASE 8/14/00
Base Case
WESTERN ELECTRICITY COORDINATING COUNCIL
2013-14 HW1A APPROVED BASE CASE
JANUARY 16, 2009
ALL COMMENTS FROM THE TSS REVIEW ARE INCLUDED
3-Phase Fault on the 345 kV bus of the BA 345/115 kV transformer
Clear BA 345/115 kV transformer in 4 cycles

Broadview 297 MW Type 4 TSR



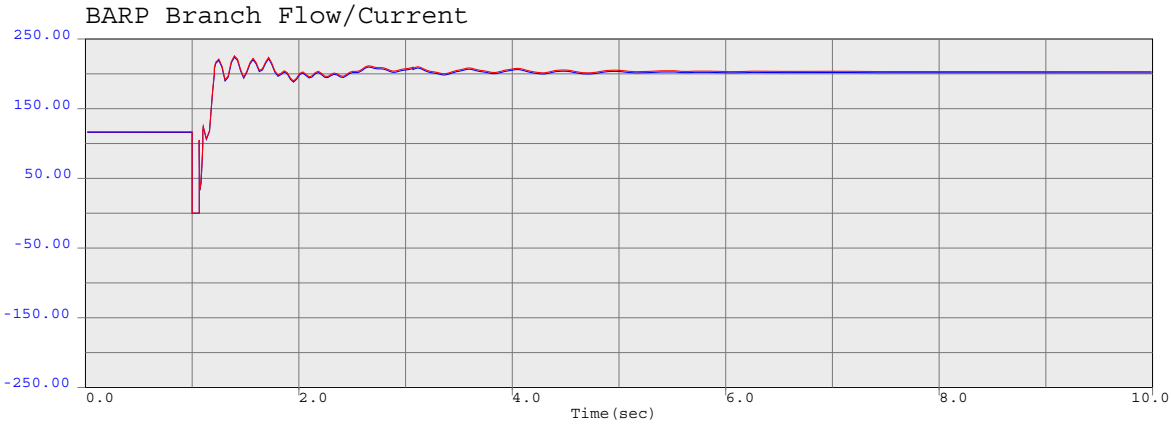






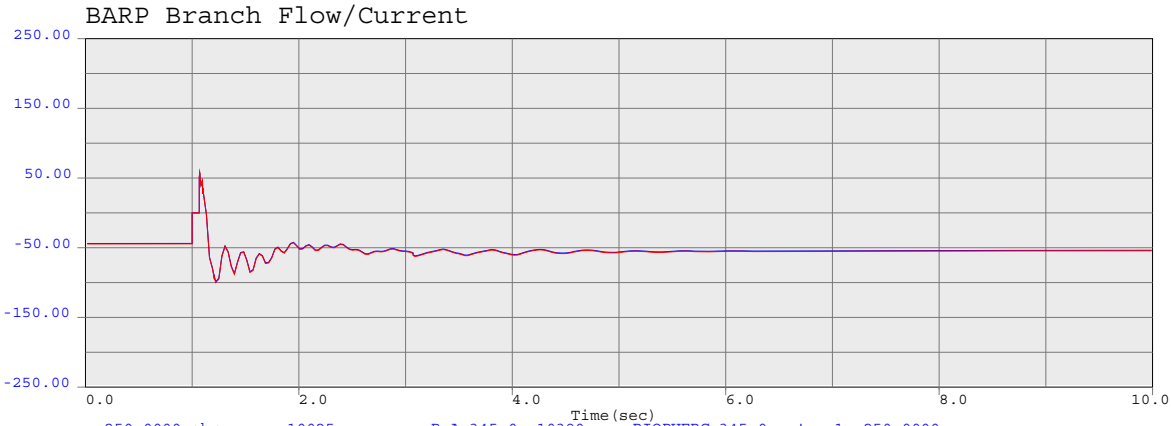
SPP 2000SC MODEL. 2001CASE 8/14/00
Base Case
WESTERN ELECTRICITY COORDINATING COUNCIL
2013-14 HW1A APPROVED BASE CASE
JANUARY 16, 2009
ALL COMMENTS FROM THE TSS REVIEW ARE INCLUDED
3-Phase Fault on the 345 kV bus of the BA 345/115 kV transformer
Clear BA 345/115 kV transformer in 4 cycles

BARP Branch Flow/Current



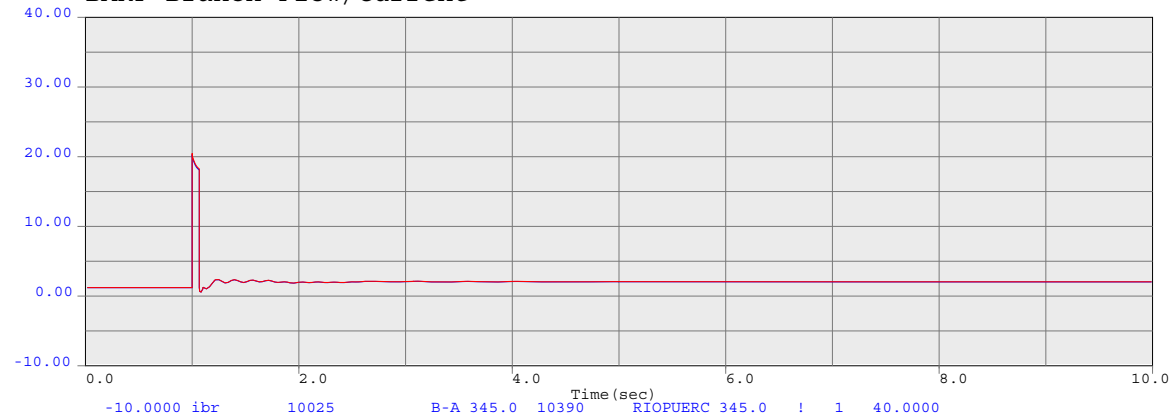
-250.0000 pbr 10025 B-A 345.0 10390 RIOPUERC 345.0 ! 1 250.0000
-250.0000 pbr 10025 B-A 345.0 10390 RIOPUERC 345.0 ! 2 250.0000

BARP Branch Flow/Current



-250.0000 qbr 10025 B-A 345.0 10390 RIOPUERC 345.0 ! 1 250.0000
-250.0000 qbr 10025 B-A 345.0 10390 RIOPUERC 345.0 ! 2 250.0000

BARP Branch Flow/Current



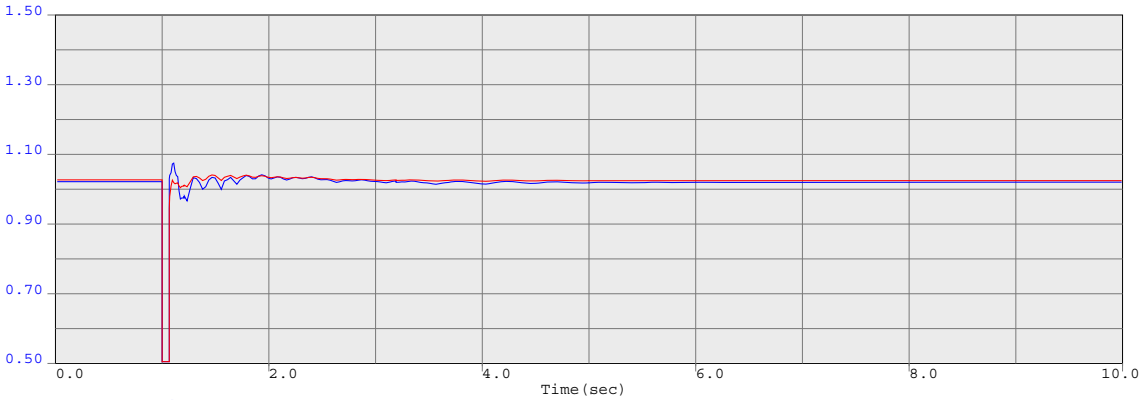
-10.0000 ibr 10025 B-A 345.0 10390 RIOPUERC 345.0 ! 1 40.0000
-10.0000 ibr 10025 B-A 345.0 10390 RIOPUERC 345.0 ! 2 40.0000

SPP 2000SC MODEL. 2001CASE 8/14/00
Base Case
WESTERN ELECTRICITY COORDINATING COUNCIL
2013-14 HW1A APPROVED BASE CASE
JANUARY 16, 2009
ALL COMMENTS FROM THE TSS REVIEW ARE INCLUDED
3-Phase Fault on the 345 kV bus of the BA 345/115 kV transformer
Clear BA 345/115 kV transformer in 4 cycles

Contingency 3 - BA to Norton 345 kV (BA-NR)

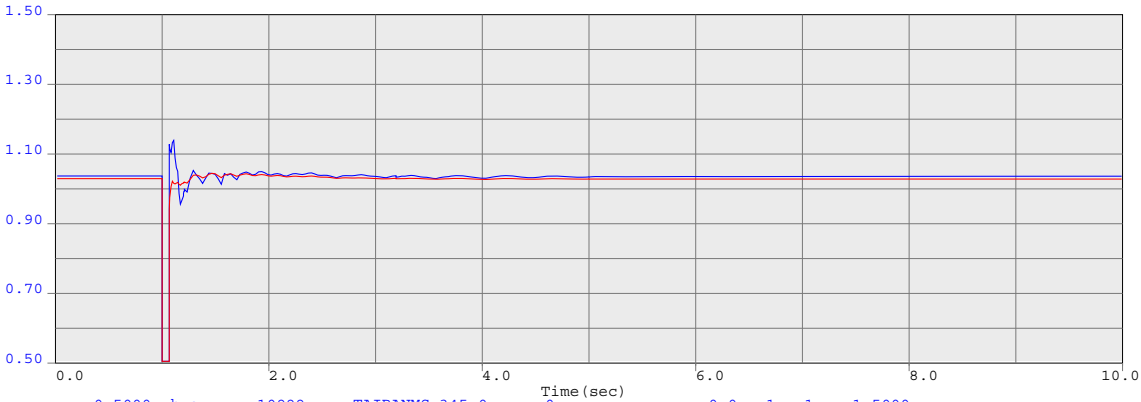
Broadview 297 MW Type 4 TSR

BUS VOLTAGE



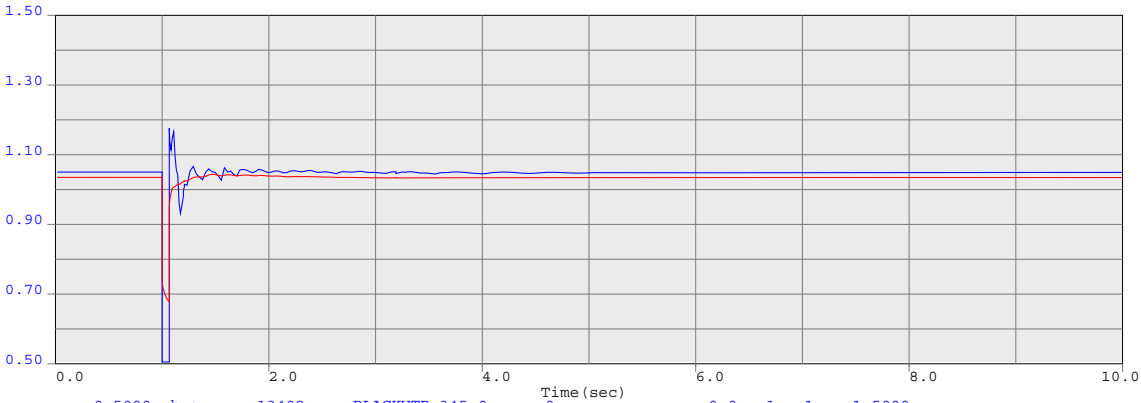
0.5000 vbug	10116	GUADLUPE 345.0	0	0.0	1	1	1.5000
0.5000 vbug	10025	B-A 345.0	0	0.0	1	1	1.5000

BUS VOLTAGE



0.5000 vbug	10999	TAIBANMS 345.0	0	0.0	1	1	1.5000
0.5000 vbus	10390	RIOPUERC 345.0	0	0.0	1	1	1.5000

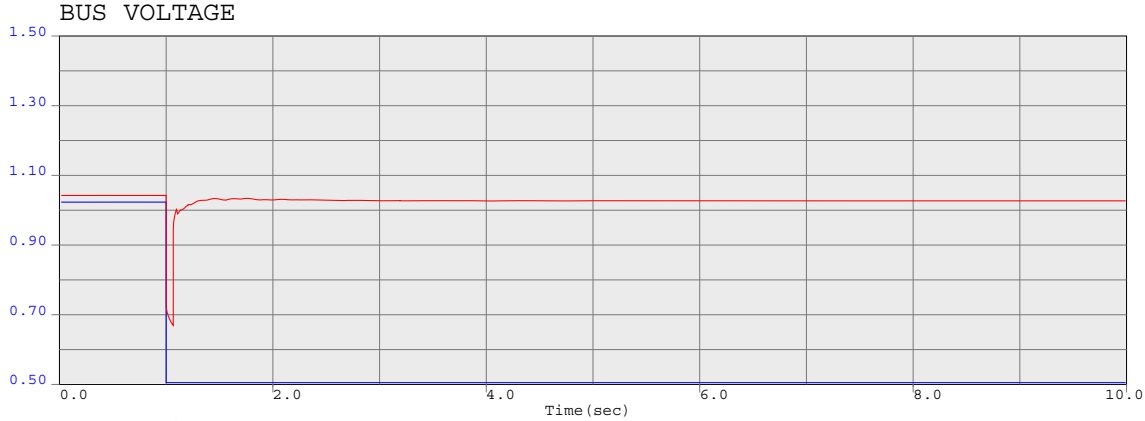
BUS VOLTAGE



0.5000 vbug	13402	BLACKWTR 345.0	0	0.0	1	1	1.5000
0.5000 vbus	10011	AMBROSIA 230.0	0	0.0	1	1	1.5000

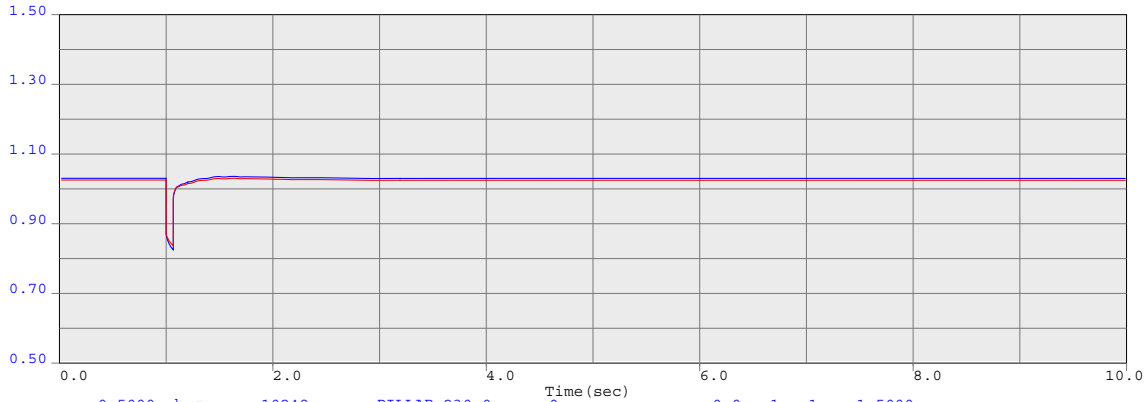
SPP 2000SC MODEL. 2001CASE 8/14/00
Base Case
WESTERN ELECTRICITY COORDINATING COUNCIL
2013-14 HW1A APPROVED BASE CASE
JANUARY 16, 2009
ALL COMMENTS FROM THE TSS REVIEW ARE INCLUDED
3-Phase fault near the BA end of the BA-NR 345 kV line
Clear BA-NR 345 kV line in 4 cycles

BUS VOLTAGE



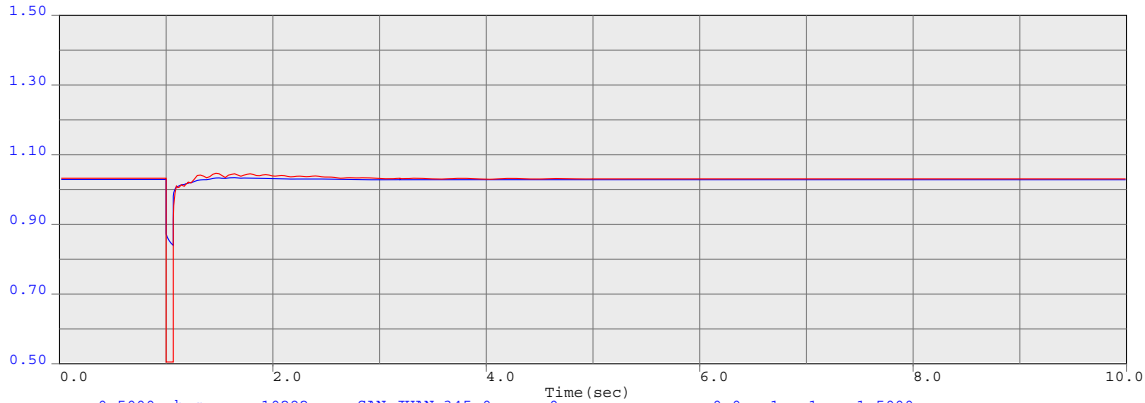
0.5000 vbus	10229	NORTON 345.0	0	0.0	1	1	1.5000
0.5000 vbus	10232	OJO 345.0	0	0.0	1	1	1.5000

BUS VOLTAGE



0.5000 vbus	10248	PILLAR 230.0	0	0.0	1	1	1.5000
0.5000 vbus	10291	SAN_JUAN 230.0	0	0.0	1	1	1.5000

BUS VOLTAGE

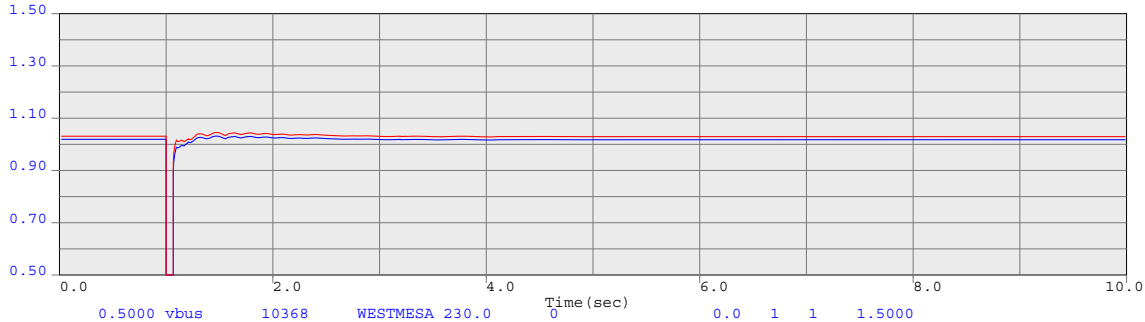


0.5000 vbus	10292	SAN_JUAN 345.0	0	0.0	1	1	1.5000
0.5000 vbus	10294	SANDIA 345.0	0	0.0	1	1	1.5000

SPP 2000SC MODEL. 2001CASE 8/14/00
Base Case
WESTERN ELECTRICITY COORDINATING COUNCIL
2013-14 HW1A APPROVED BASE CASE
JANUARY 16, 2009
ALL COMMENTS FROM THE TSS REVIEW ARE INCLUDED
3-Phase fault near the BA end of the BA-NR 345 kV line
Clear BA-NR 345 kV line in 4 cycles

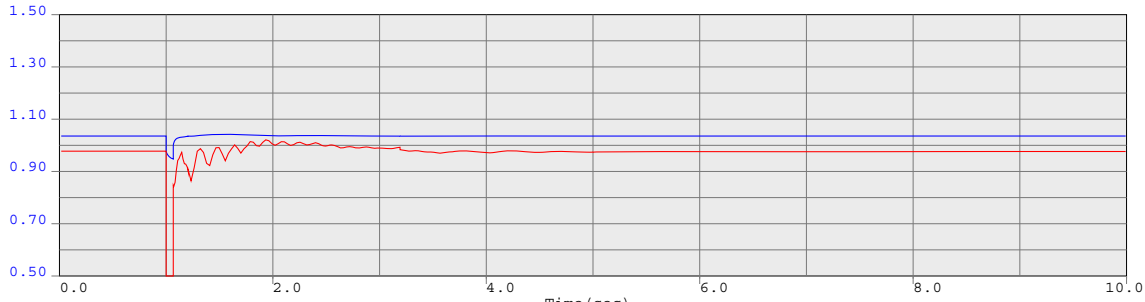
Broadview 297 MW Type 4 TSR

BUS VOLTAGE



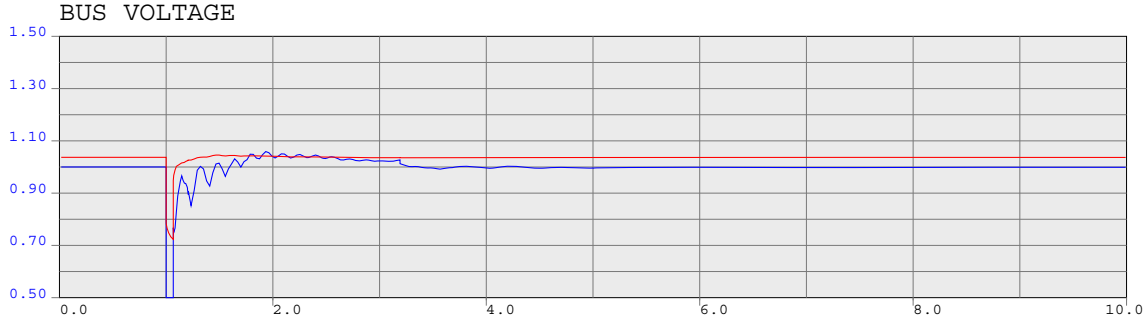
0.5000 vbus 10368 WESTMESA 230.0 0 0.0 1 1 1.5000
0.5000 vbus 10369 WESTMESA 345.0 0 0.0 1 1 1.5000

BUS VOLTAGE



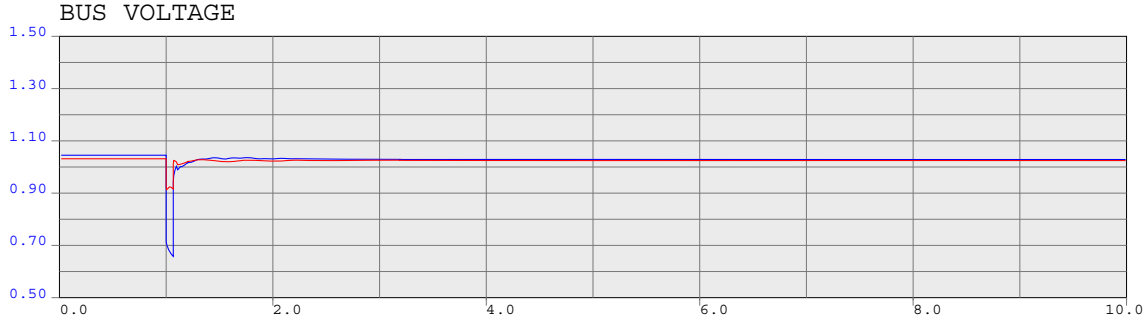
0.5000 vbus 10393 LEF 345.0 0 0.0 1 1 1.5000
0.5000 vbus 10991 ARGONNE4 138.0 0 0.0 1 1 1.5000

BUS VOLTAGE



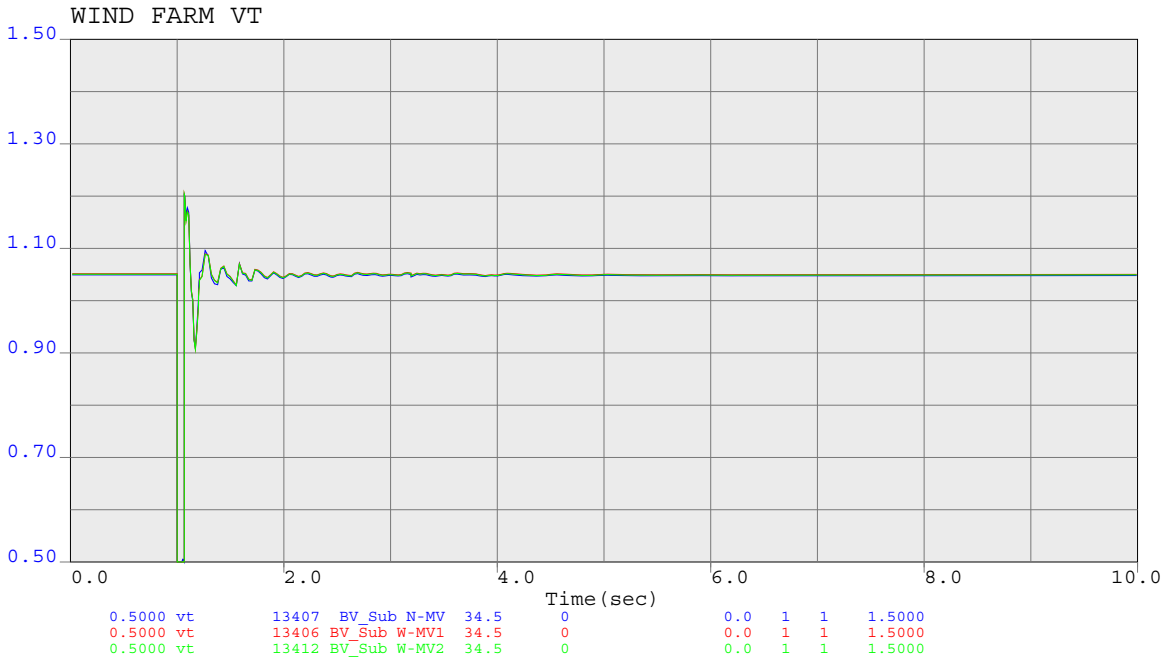
0.5000 vbus 10992 ARGONNE3 138.0 0 0.0 1 1 1.5000
0.5000 vbus 12057 PEGS 230.0 0 0.0 1 1 1.5000

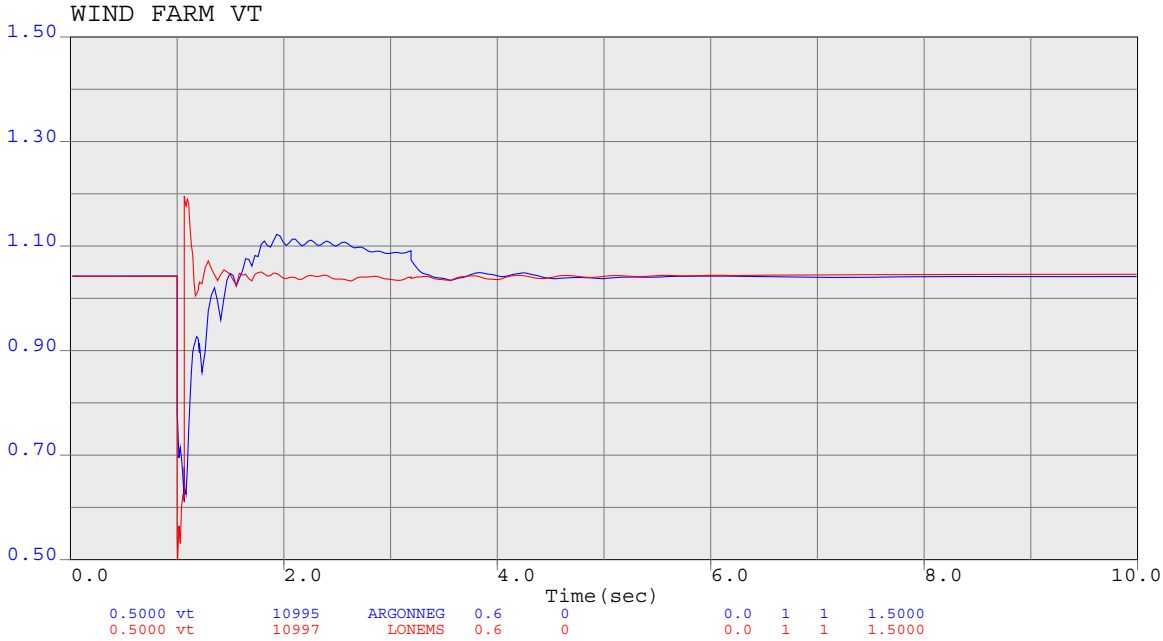
BUS VOLTAGE



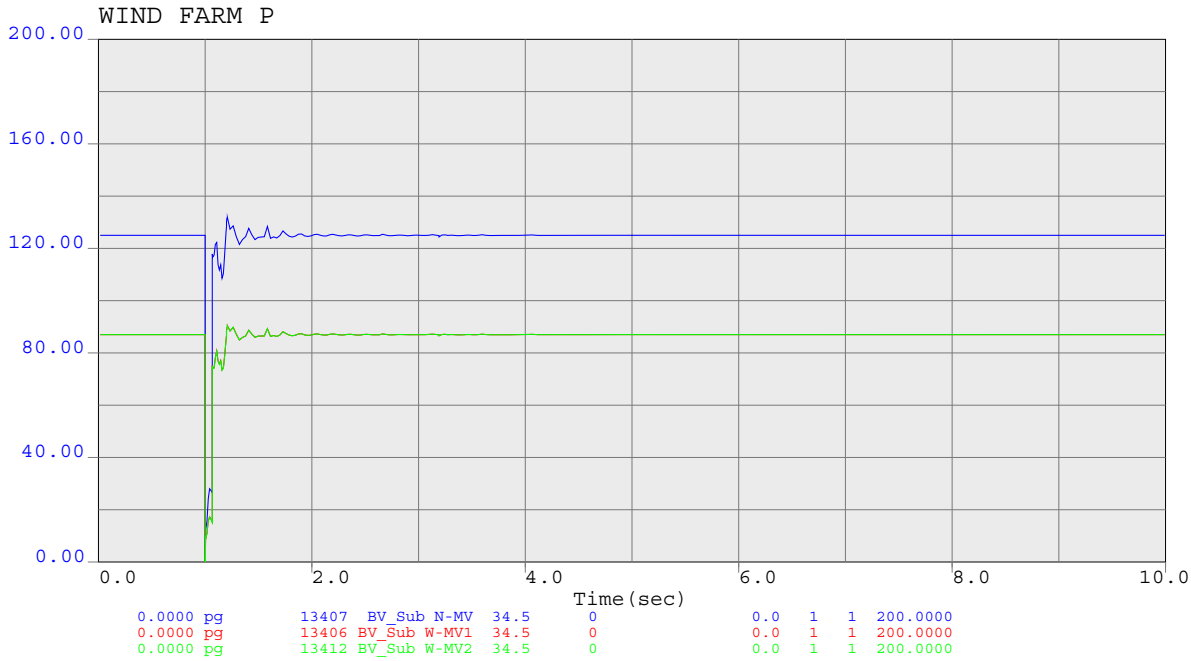
0.5000 vbus 12082 TAOS 345.0 0 0.0 1 1 1.5000
0.5000 vbus 12101 GLADSTON 230.0 0 0.0 1 1 1.5000

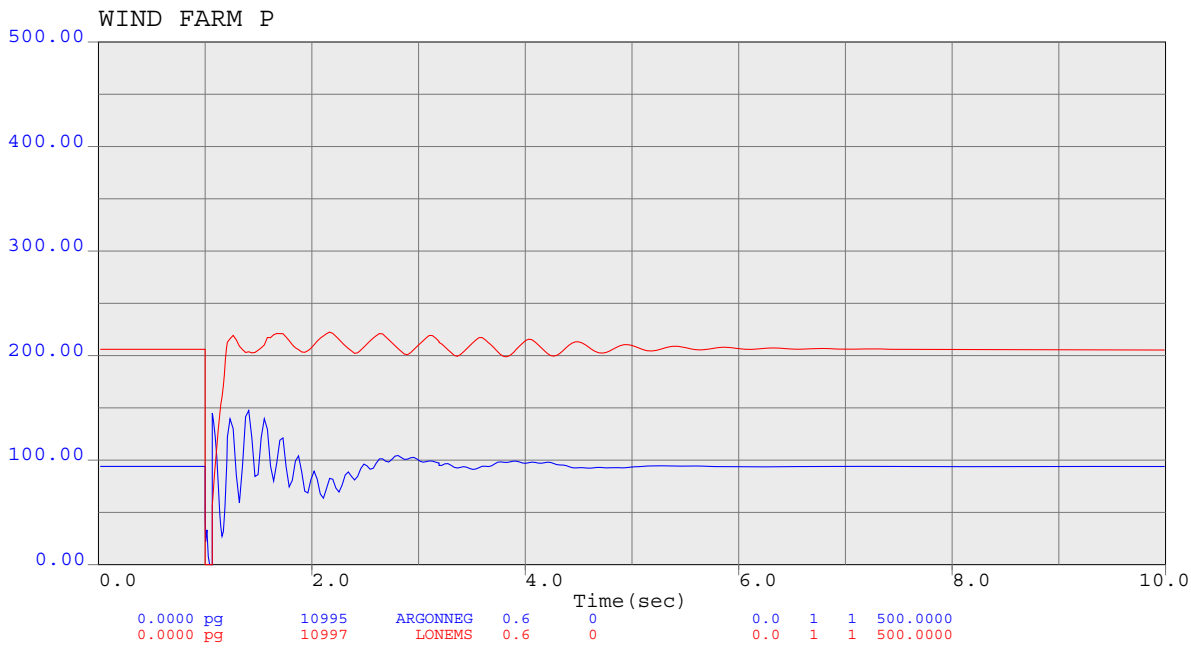
SPP 2000SC MODEL. 2001CASE 8/14/00
Base Case
WESTERN ELECTRICITY COORDINATING COUNCIL
2013-14 HW1A APPROVED BASE CASE
JANUARY 16, 2009
ALL COMMENTS FROM THE TSS REVIEW ARE INCLUDED
3-Phase fault near the BA end of the BA-NR 345 kV line
Clear BA-NR 345 kV line in 4 cycles



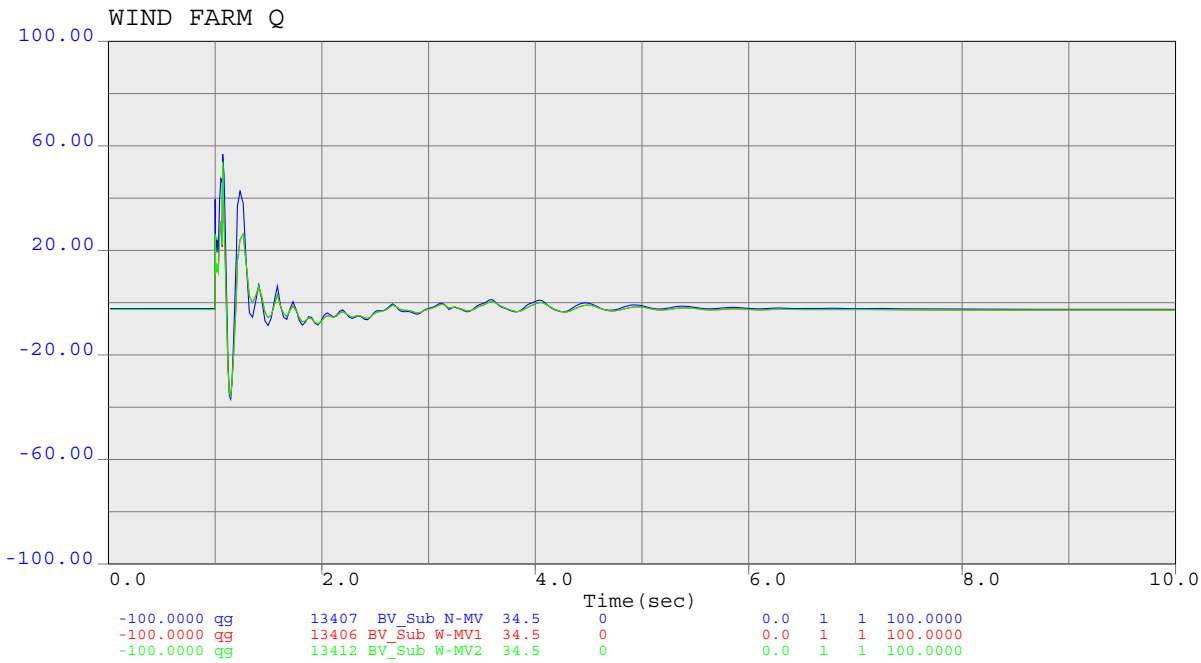


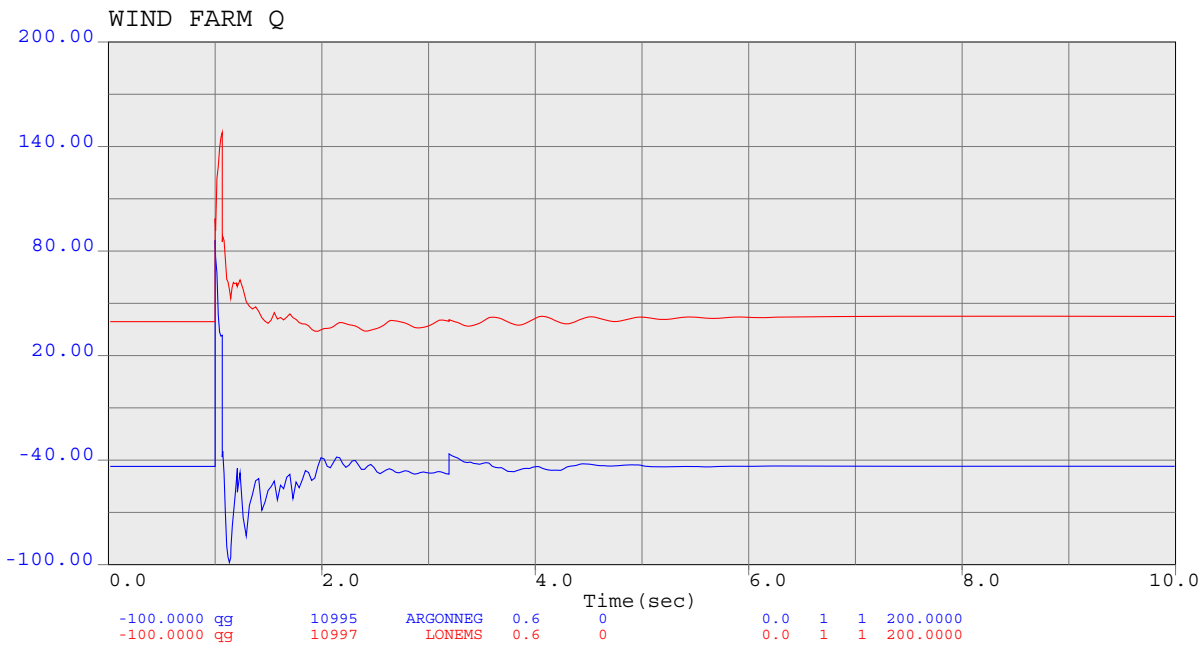
SPP 2000SC MODEL. 2001CASE 8/14/00
Base Case
WESTERN ELECTRICITY COORDINATING COUNCIL
2013-14 HW1A APPROVED BASE CASE
JANUARY 16, 2009
ALL COMMENTS FROM THE TSS REVIEW ARE INCLUDED
3-Phase fault near the BA end of the BA-NR 345 kV line
Clear BA-NR 345 kV line in 4 cycles





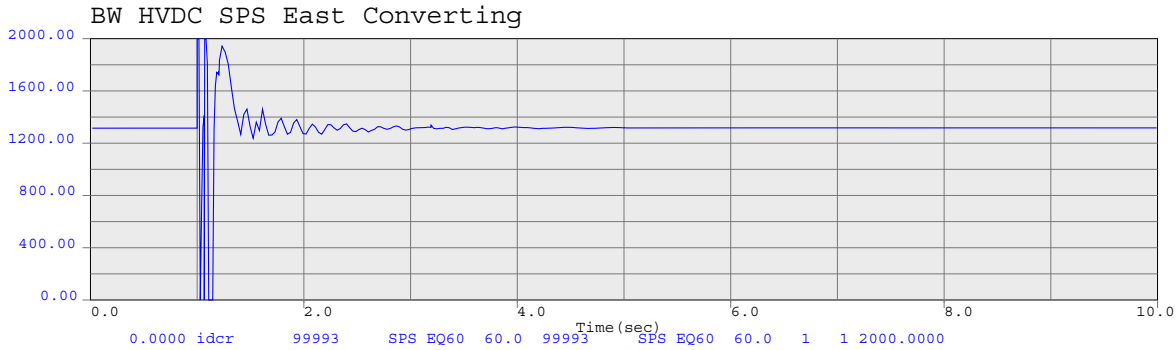
SPP 2000SC MODEL. 2001CASE 8/14/00
Base Case
WESTERN ELECTRICITY COORDINATING COUNCIL
2013-14 HW1A APPROVED BASE CASE
JANUARY 16, 2009
ALL COMMENTS FROM THE TSS REVIEW ARE INCLUDED
3-Phase fault near the BA end of the BA-NR 345 kV line
Clear BA-NR 345 kV line in 4 cycles

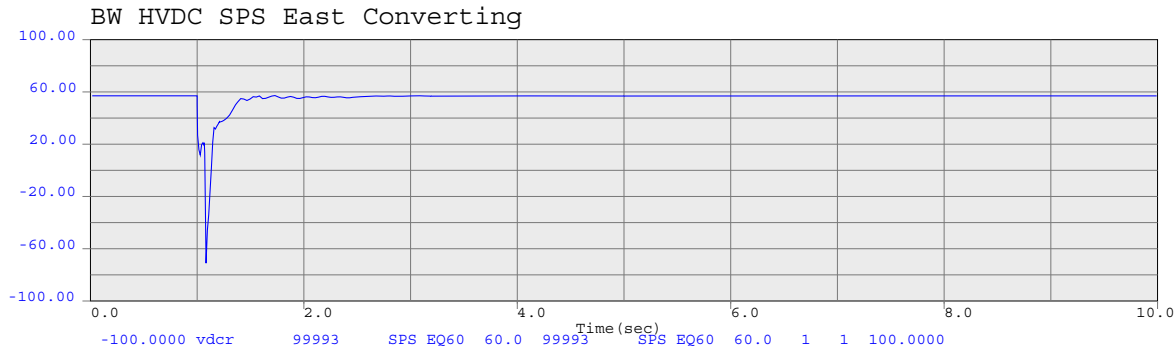


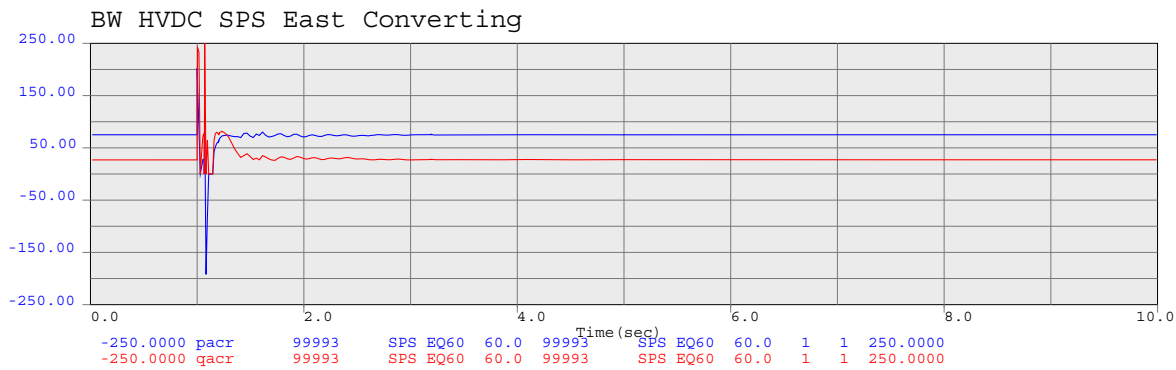


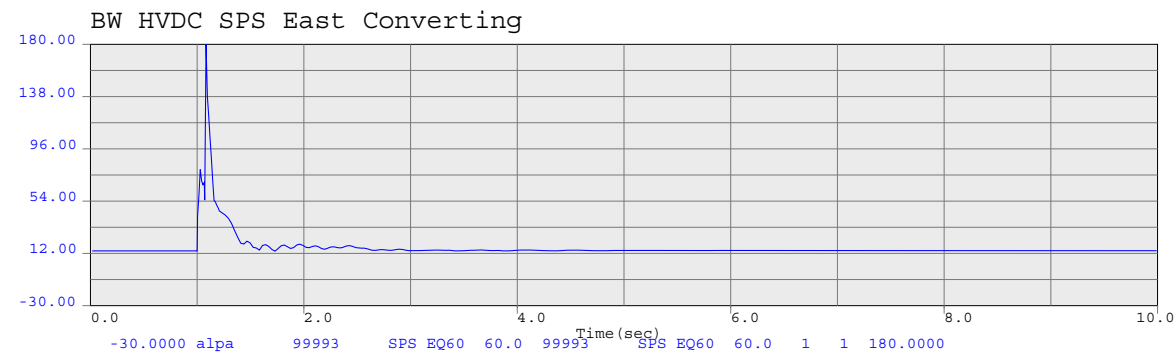
SPP 2000SC MODEL. 2001CASE 8/14/00
Base Case
WESTERN ELECTRICITY COORDINATING COUNCIL
2013-14 HW1A APPROVED BASE CASE
JANUARY 16, 2009
ALL COMMENTS FROM THE TSS REVIEW ARE INCLUDED
3-Phase fault near the BA end of the BA-NR 345 kV line
Clear BA-NR 345 kV line in 4 cycles

Broadview 297 MW Type 4 TSR



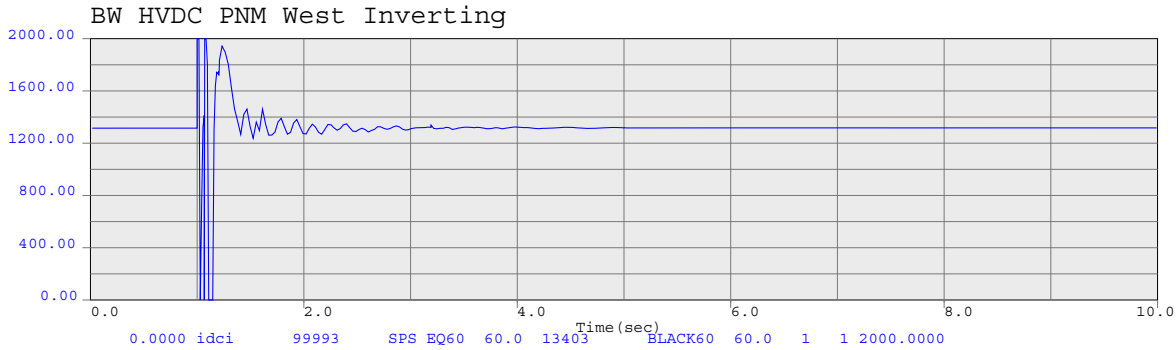


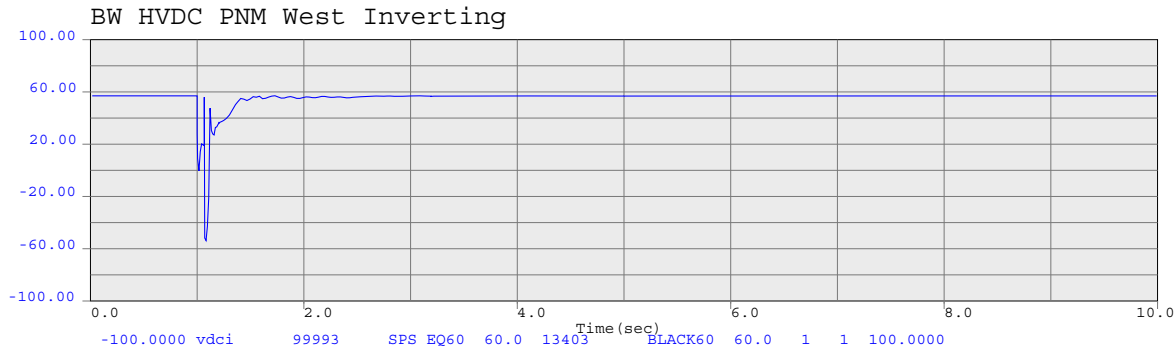


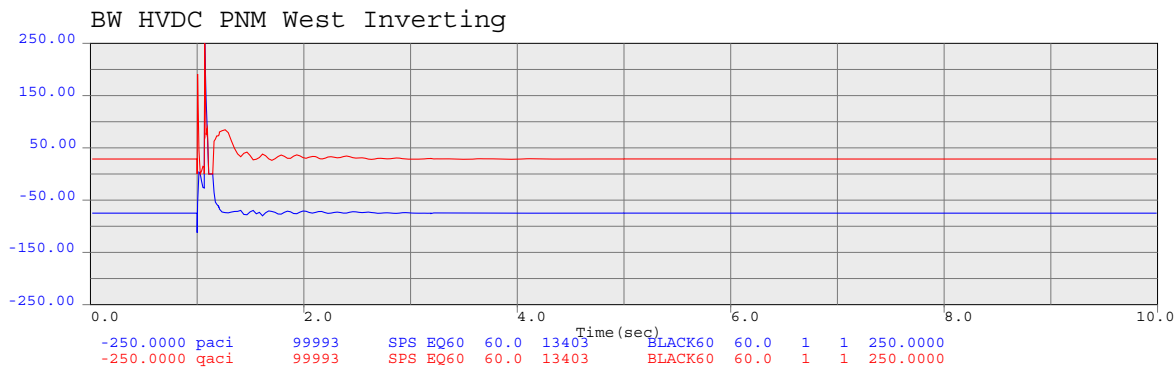


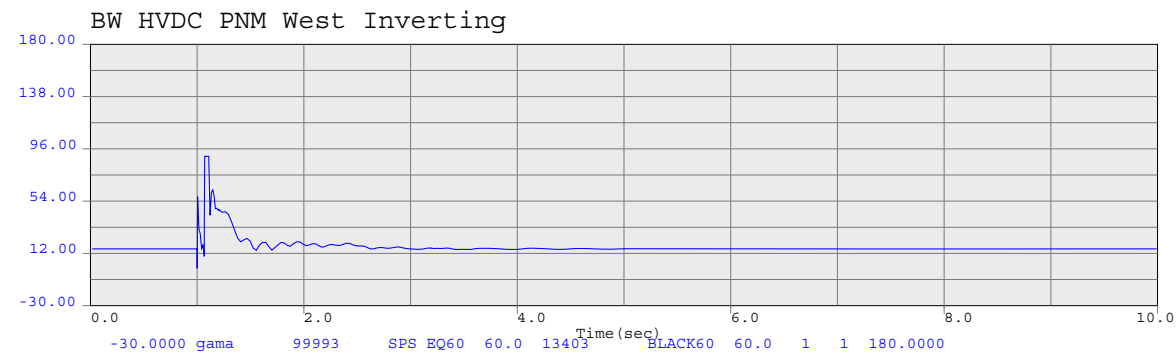
SPP 2000SC MODEL. 2001CASE 8/14/00
Base Case
WESTERN ELECTRICITY COORDINATING COUNCIL
2013-14 HW1A APPROVED BASE CASE
JANUARY 16, 2009
ALL COMMENTS FROM THE TSS REVIEW ARE INCLUDED
3-Phase fault near the BA end of the BA-NR 345 kV line
Clear BA-NR 345 kV line in 4 cycles

Broadview 297 MW Type 4 TSR



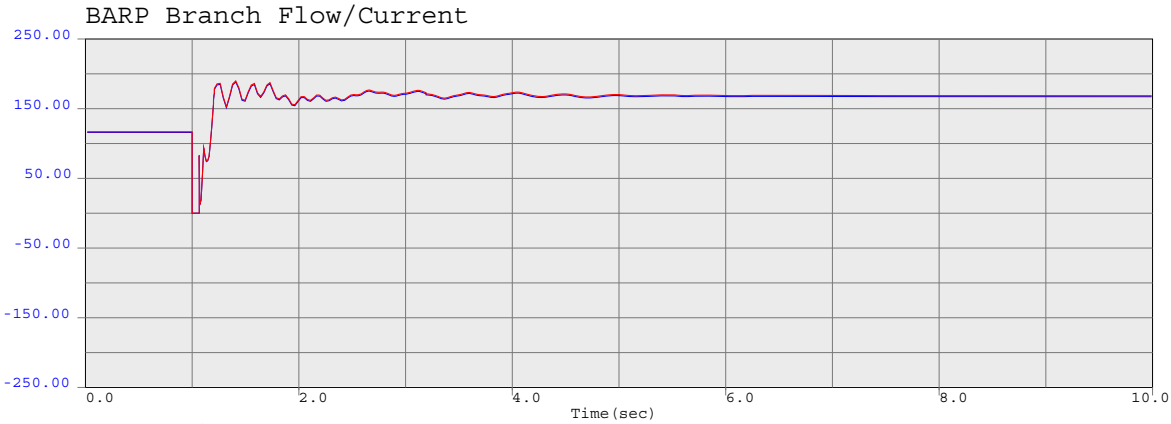






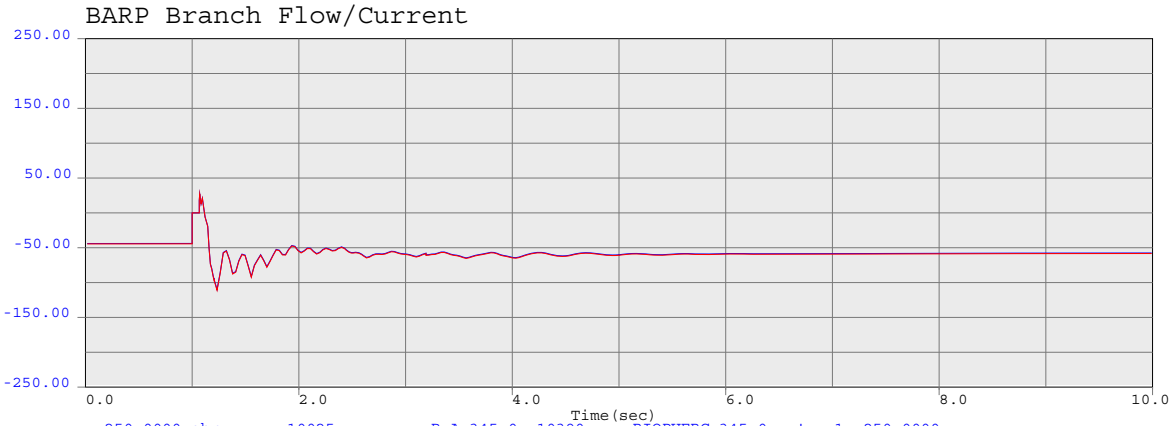
SPP 2000SC MODEL. 2001CASE 8/14/00
Base Case
WESTERN ELECTRICITY COORDINATING COUNCIL
2013-14 HW1A APPROVED BASE CASE
JANUARY 16, 2009
ALL COMMENTS FROM THE TSS REVIEW ARE INCLUDED
3-Phase fault near the BA end of the BA-NR 345 kV line
Clear BA-NR 345 kV line in 4 cycles

BARP Branch Flow/Current



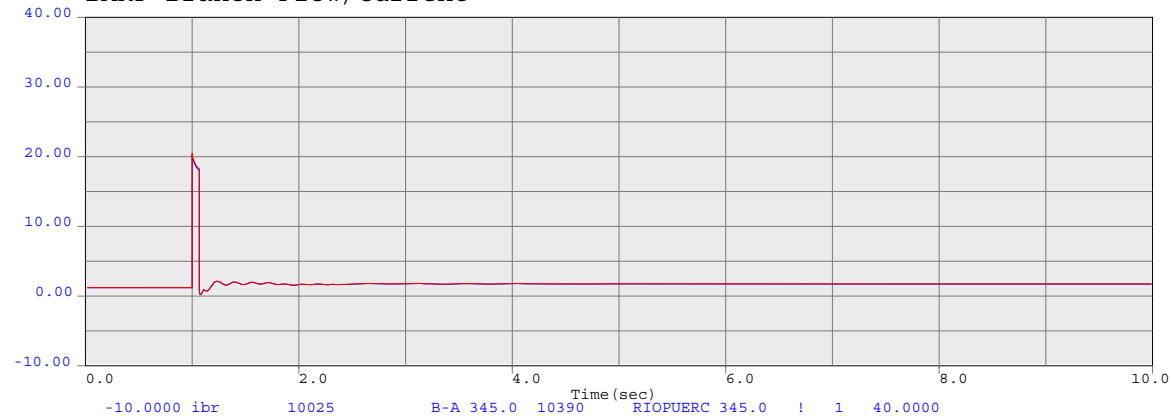
-250.0000 pbr 10025 B-A 345.0 10390 RIOPUERC 345.0 ! 1 250.0000
-250.0000 pbr 10025 B-A 345.0 10390 RIOPUERC 345.0 ! 2 250.0000

BARP Branch Flow/Current



-250.0000 qbr 10025 B-A 345.0 10390 RIOPUERC 345.0 ! 1 250.0000
-250.0000 qbr 10025 B-A 345.0 10390 RIOPUERC 345.0 ! 2 250.0000

BARP Branch Flow/Current



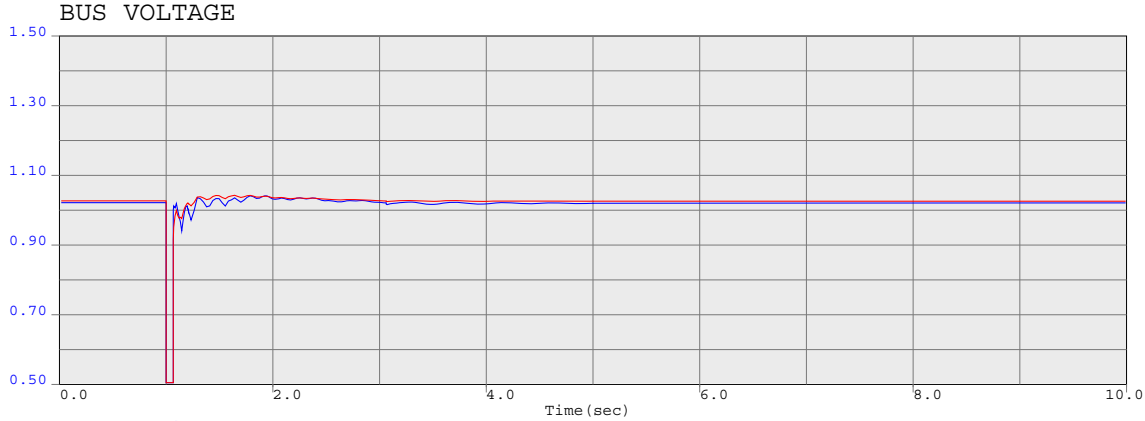
-10.0000 ibr 10025 B-A 345.0 10390 RIOPUERC 345.0 ! 1 40.0000
-10.0000 ibr 10025 B-A 345.0 10390 RIOPUERC 345.0 ! 2 40.0000

SPP 2000SC MODEL. 2001CASE 8/14/00
Base Case
WESTERN ELECTRICITY COORDINATING COUNCIL
2013-14 HW1A APPROVED BASE CASE
JANUARY 16, 2009
ALL COMMENTS FROM THE TSS REVIEW ARE INCLUDED
3-Phase fault near the BA end of the BA-NR 345 kV line
Clear BA-NR 345 kV line in 4 cycles

Contingency 4 - Rio Puerco – West Mesa 345 kV (RP-WM)

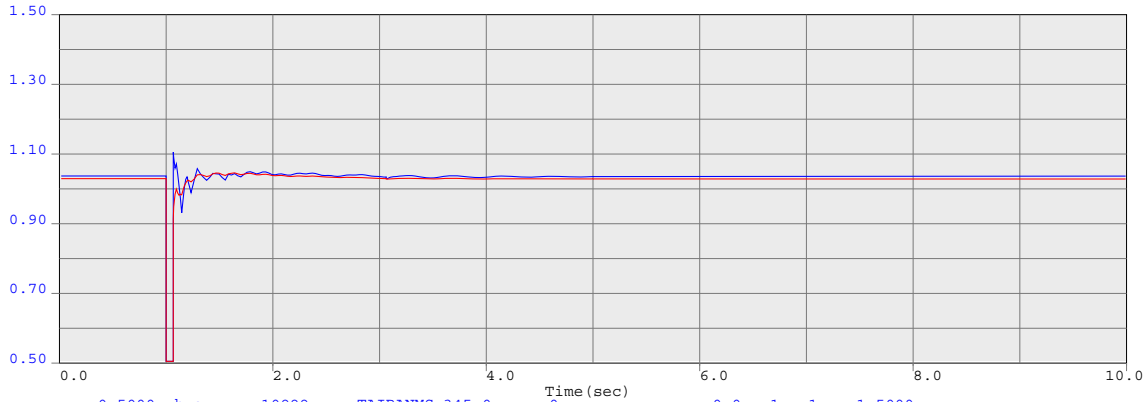
Broadview 297 MW Type 4 TSR

BUS VOLTAGE



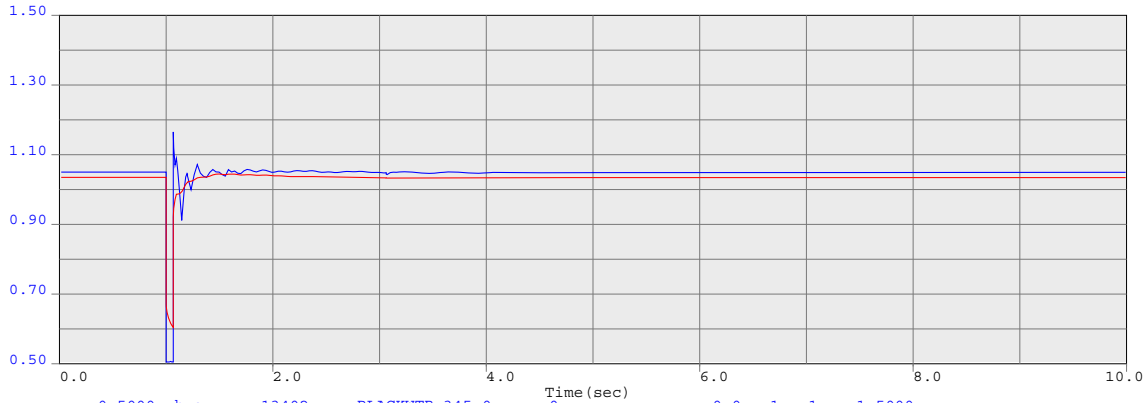
0.5000 vbug	10116	GUADLUPE 345.0	0	0.0	1	1	1.5000
0.5000 vbug	10025	B-A 345.0	0	0.0	1	1	1.5000

BUS VOLTAGE



0.5000 vbug	10999	TAIBANMS 345.0	0	0.0	1	1	1.5000
0.5000 vbus	10390	RIOPUERC 345.0	0	0.0	1	1	1.5000

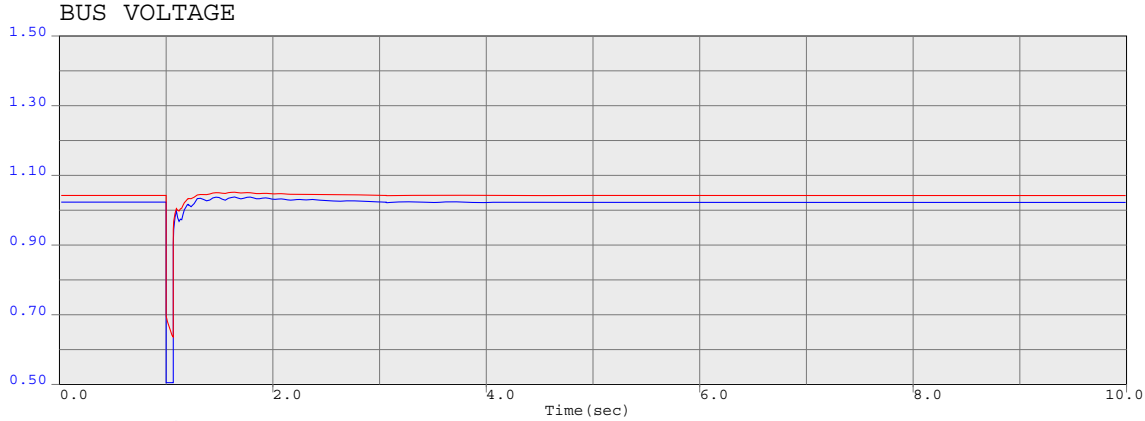
BUS VOLTAGE



0.5000 vbug	13402	BLACKWTR 345.0	0	0.0	1	1	1.5000
0.5000 vbus	10011	AMBROSIA 230.0	0	0.0	1	1	1.5000

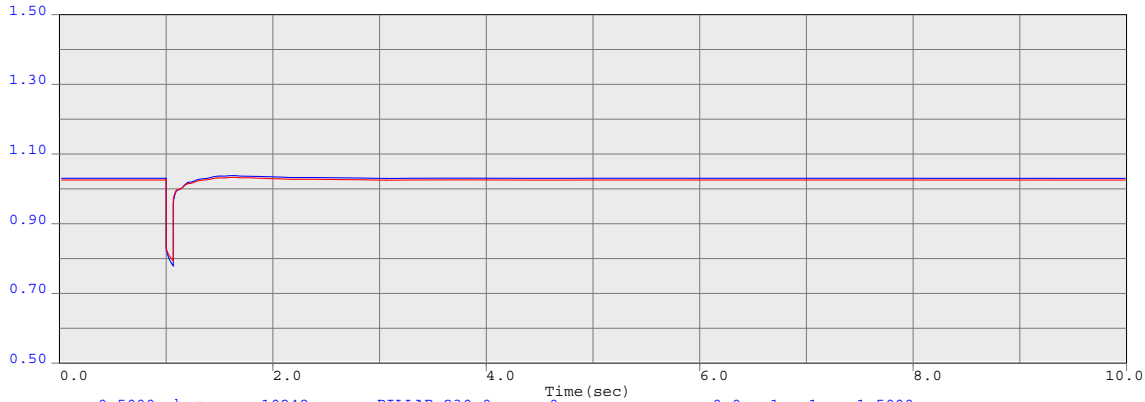
SPP 2000SC MODEL. 2001CASE 8/14/00
Base Case
WESTERN ELECTRICITY COORDINATING COUNCIL
2013-14 HW1A APPROVED BASE CASE
JANUARY 16, 2009
ALL COMMENTS FROM THE TSS REVIEW ARE INCLUDED
3-Phase fault near the Rio Puerco end of the WM-RP 345 kV line
Clear WM-RP 345 kV line in 4 cycles

BUS VOLTAGE



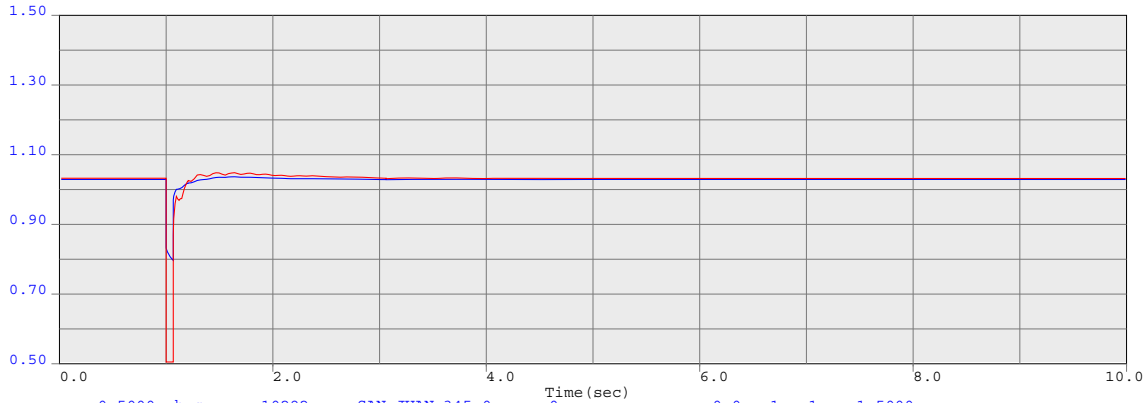
0.5000 vbus 10229 NORTON 345.0 0 0.0 1 1 1.5000
0.5000 vbus 10232 OJO 345.0 0 0.0 1 1 1.5000

BUS VOLTAGE



0.5000 vbus 10248 PILLAR 230.0 0 0.0 1 1 1.5000
0.5000 vbus 10291 SAN_JUAN 230.0 0 0.0 1 1 1.5000

BUS VOLTAGE

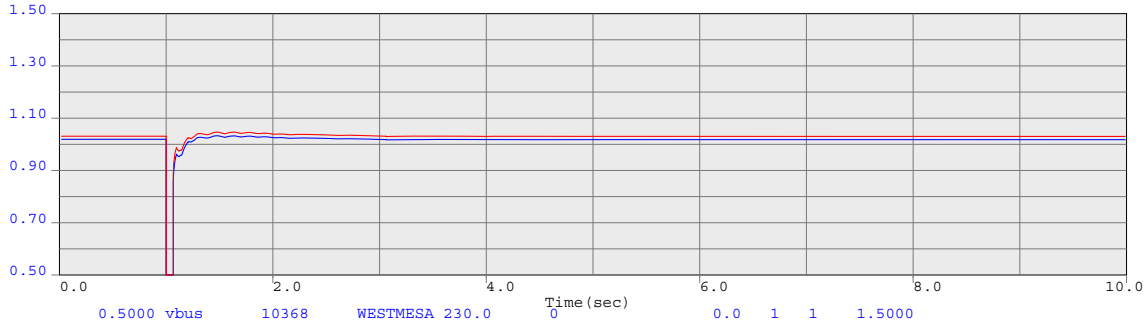


0.5000 vbus 10292 SAN_JUAN 345.0 0 0.0 1 1 1.5000
0.5000 vbus 10294 SANDIA 345.0 0 0.0 1 1 1.5000

SPP 2000SC MODEL. 2001CASE 8/14/00
Base Case
WESTERN ELECTRICITY COORDINATING COUNCIL
2013-14 HW1A APPROVED BASE CASE
JANUARY 16, 2009
ALL COMMENTS FROM THE TSS REVIEW ARE INCLUDED
3-Phase fault near the Rio Puerco end of the WM-RP 345 kV line
Clear WM-RP 345 kV line in 4 cycles

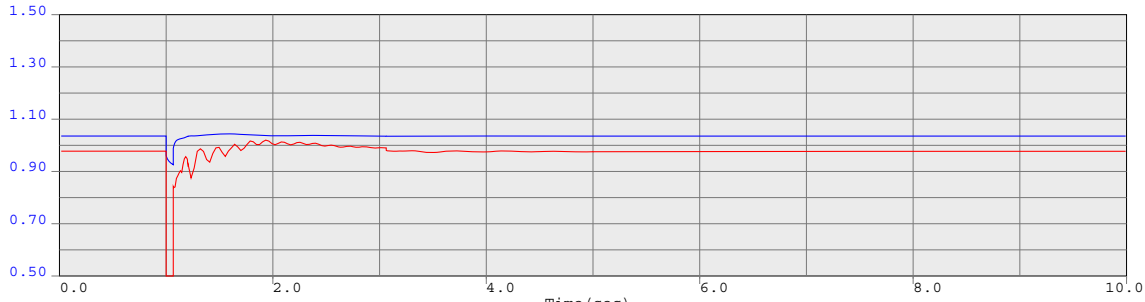
Broadview 297 MW Type 4 TSR

BUS VOLTAGE



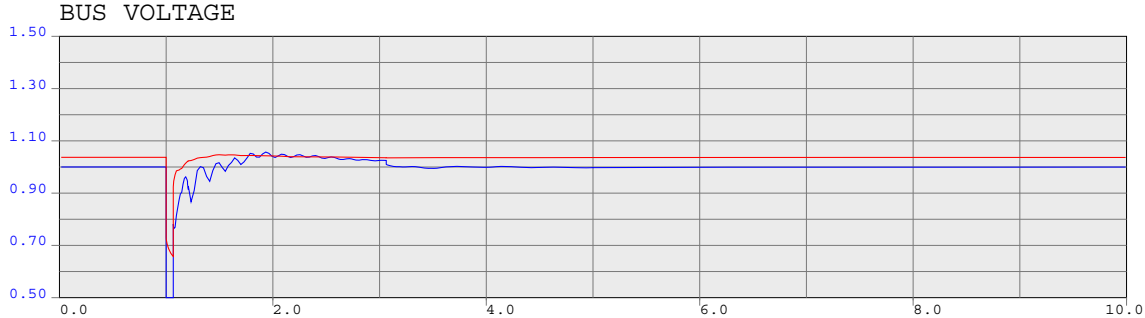
0.5000 vbus 10368 WESTMESA 230.0 0 0.0 1 1 1.5000
0.5000 vbus 10369 WESTMESA 345.0 0 0.0 1 1 1.5000

BUS VOLTAGE



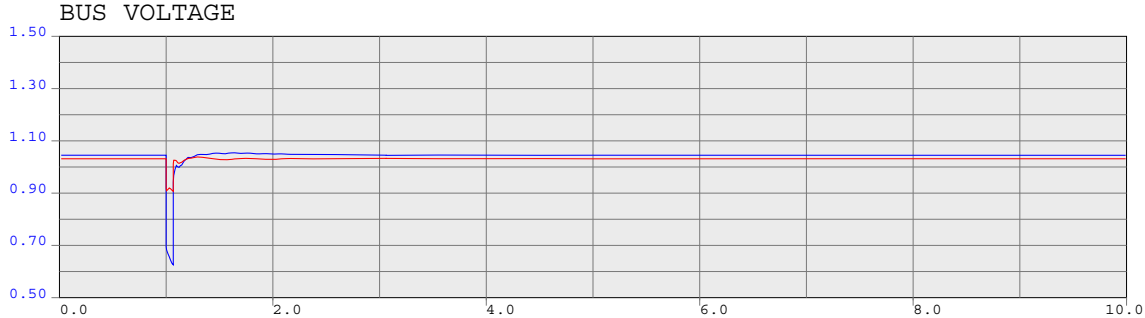
0.5000 vbus 10393 LEF 345.0 0 0.0 1 1 1.5000
0.5000 vbus 10991 ARGONNE4 138.0 0 0.0 1 1 1.5000

BUS VOLTAGE



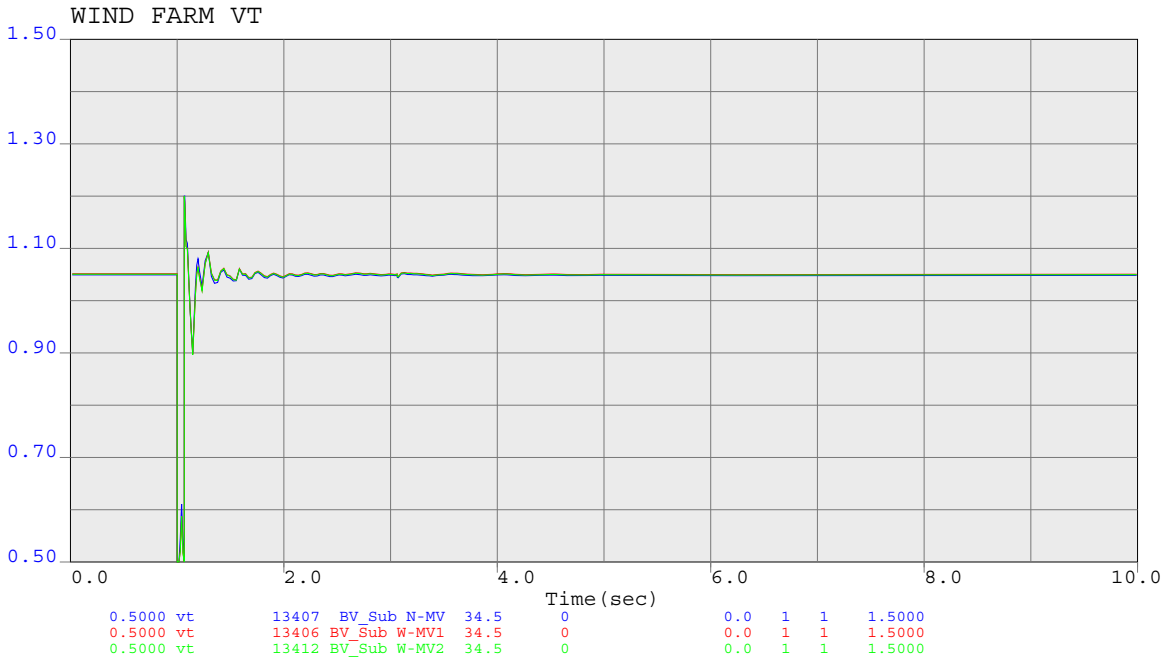
0.5000 vbus 10992 ARGONNE3 138.0 0 0.0 1 1 1.5000
0.5000 vbus 12057 PEGS 230.0 0 0.0 1 1 1.5000

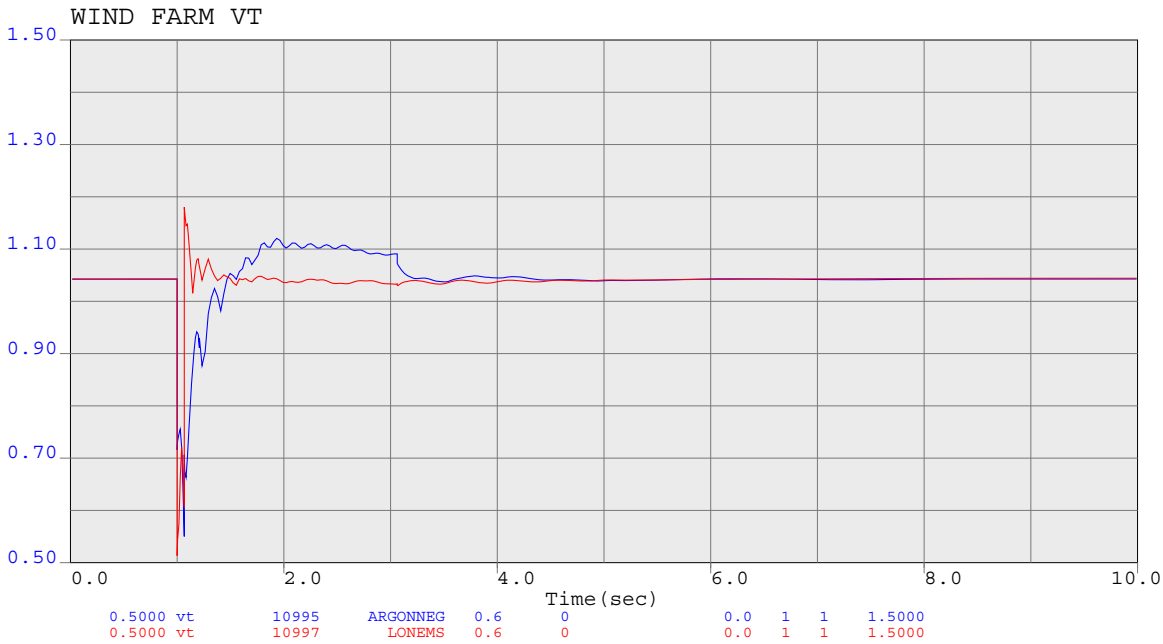
BUS VOLTAGE

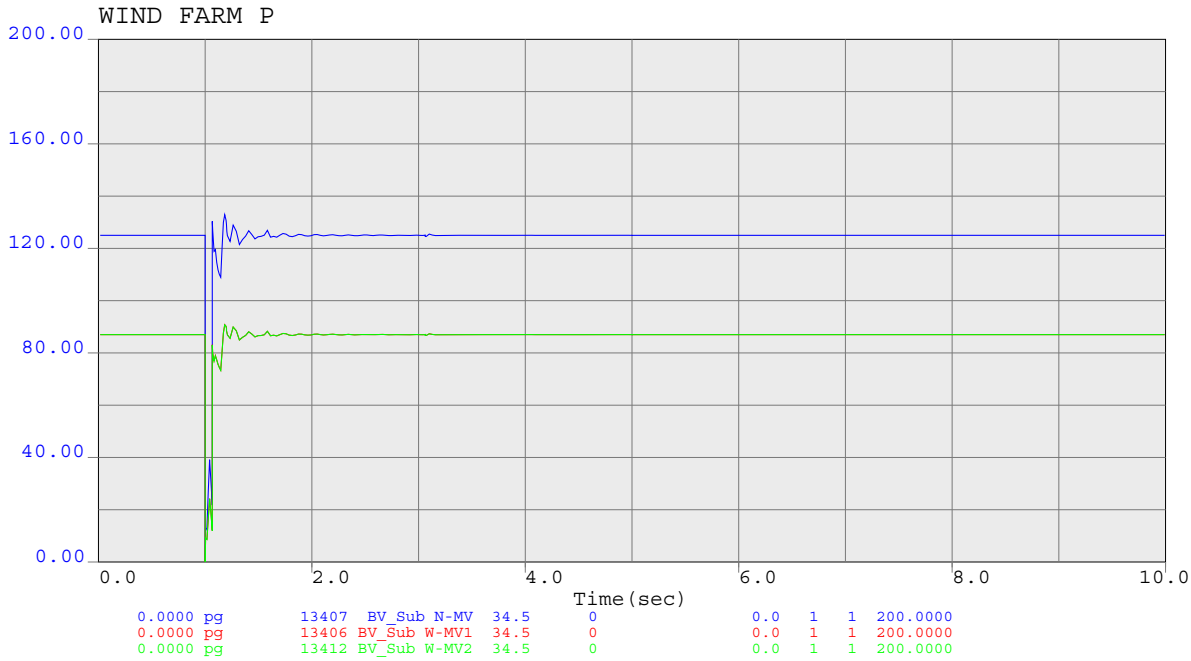


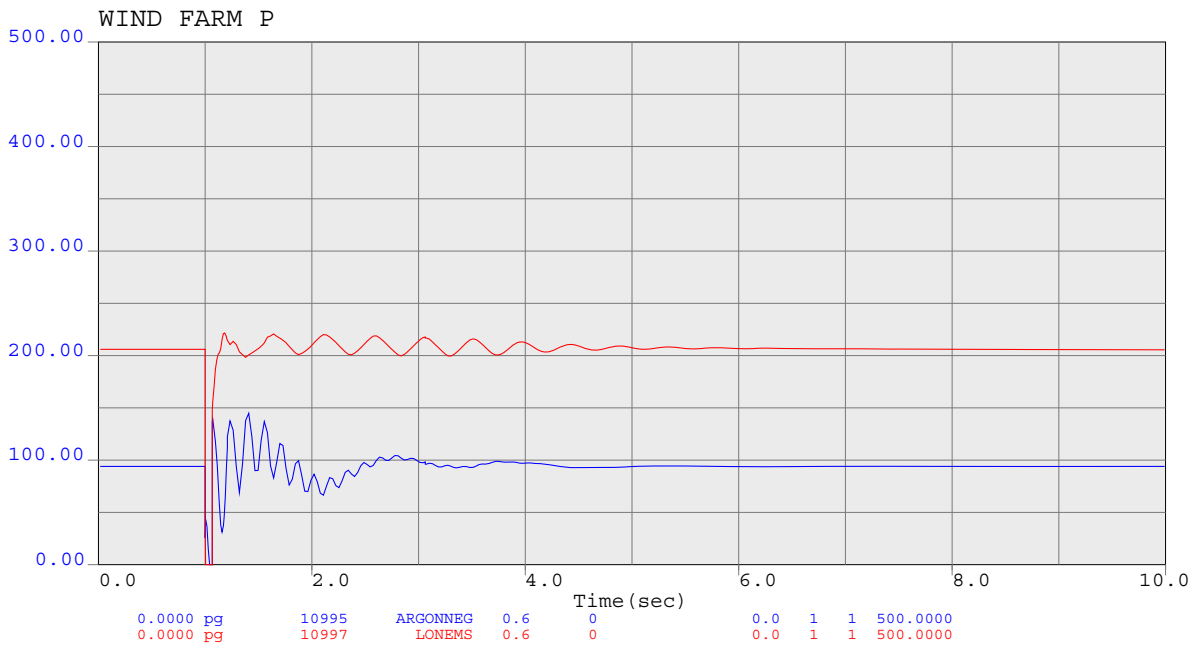
0.5000 vbus 12082 TAOS 345.0 0 0.0 1 1 1.5000
0.5000 vbus 12101 GLADSTON 230.0 0 0.0 1 1 1.5000

SPP 2000SC MODEL. 2001CASE 8/14/00
Base Case
WESTERN ELECTRICITY COORDINATING COUNCIL
2013-14 HW1A APPROVED BASE CASE
JANUARY 16, 2009
ALL COMMENTS FROM THE TSS REVIEW ARE INCLUDED
3-Phase fault near the Rio Puerco end of the WM-RP 345 kV line
Clear WM-RP 345 kV line in 4 cycles

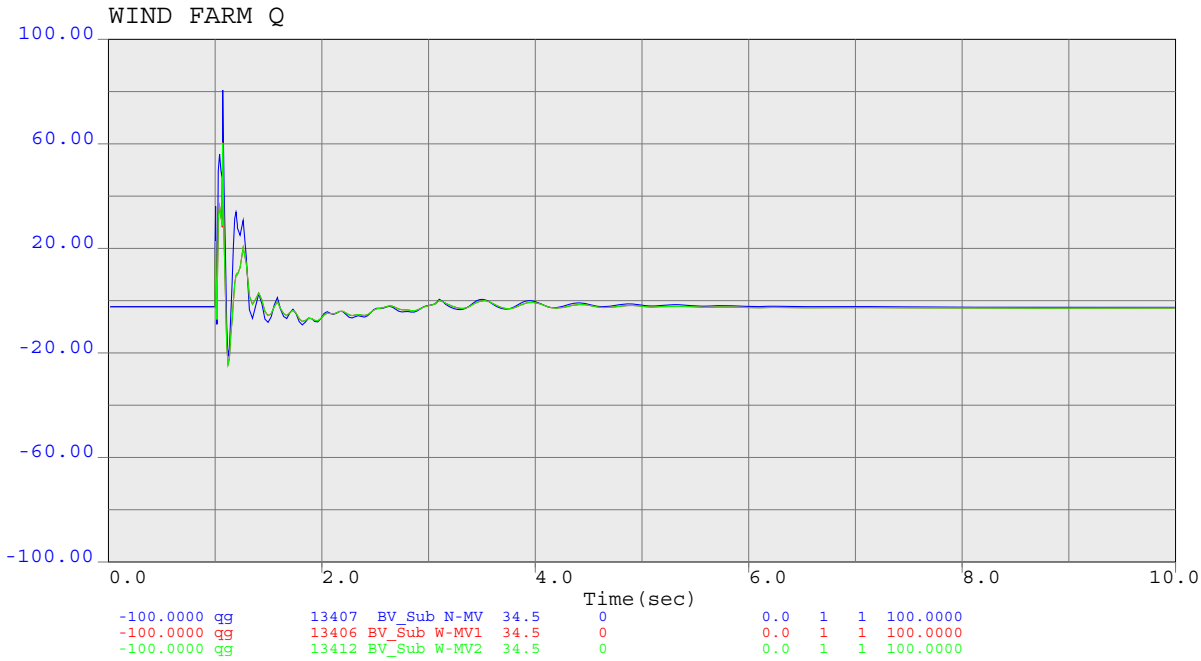

WIND FARM VT
1.50
1.30
1.10
0.90
0.70
0.50
0.0
2.0
4.0
6.0
8.0
10.0
Time(sec)
0.5000 vt 13407 BV_Sub N-MV 34.5 0 0.0 1 1 1.5000
0.5000 vt 13406 BV_Sub W-MV1 34.5 0 0.0 1 1 1.5000
0.5000 vt 13412 BV_Sub W-MV2 34.5 0 0.0 1 1 1.5000

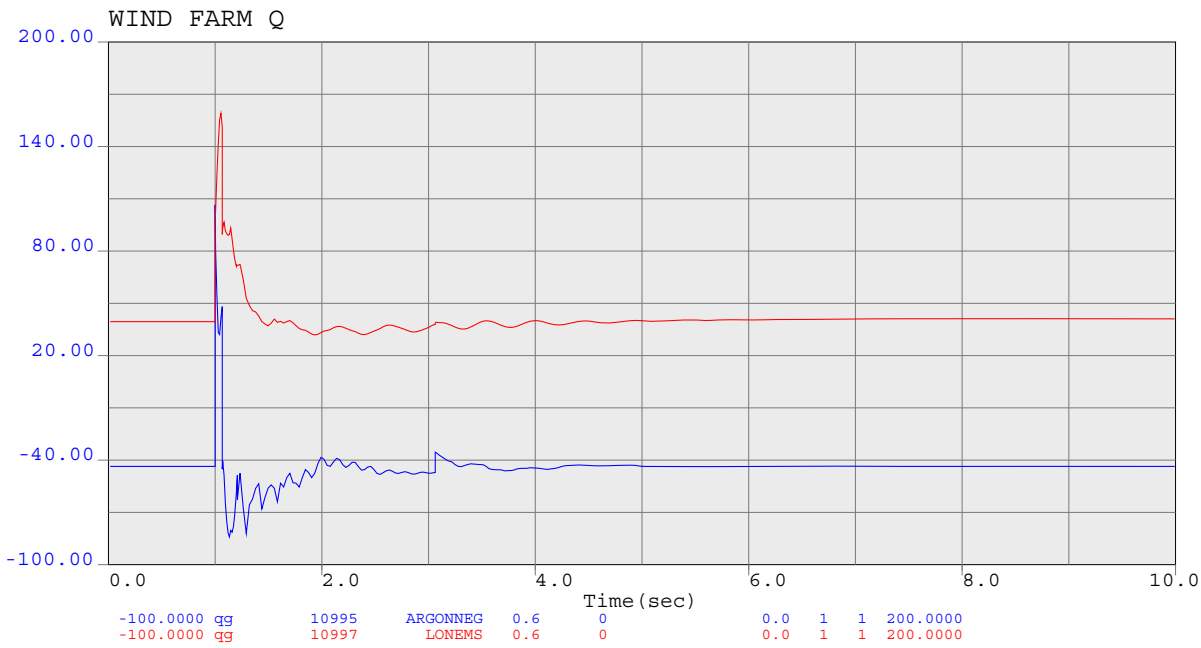

WIND FARM VT
1.50
1.30
1.10
0.90
0.70
0.50
0.0
2.0
4.0
6.0
8.0
10.0
Time(sec)
0.5000 vt 10995 ARGONNEG 0.6 0 0.0 1 1 1.5000
0.5000 vt 10997 LONEMS 0.6 0 0.0 1 1 1.5000



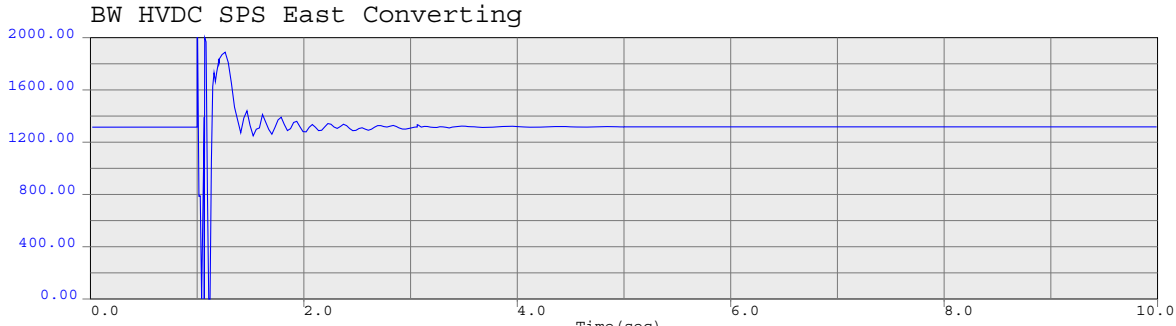


SPP 2000SC MODEL. 2001CASE 8/14/00
Base Case
WESTERN ELECTRICITY COORDINATING COUNCIL
2013-14 HW1A APPROVED BASE CASE
JANUARY 16, 2009
ALL COMMENTS FROM THE TSS REVIEW ARE INCLUDED
3-Phase fault near the Rio Puerco end of the WM-RP 345 kV line
Clear WM-RP 345 kV line in 4 cycles

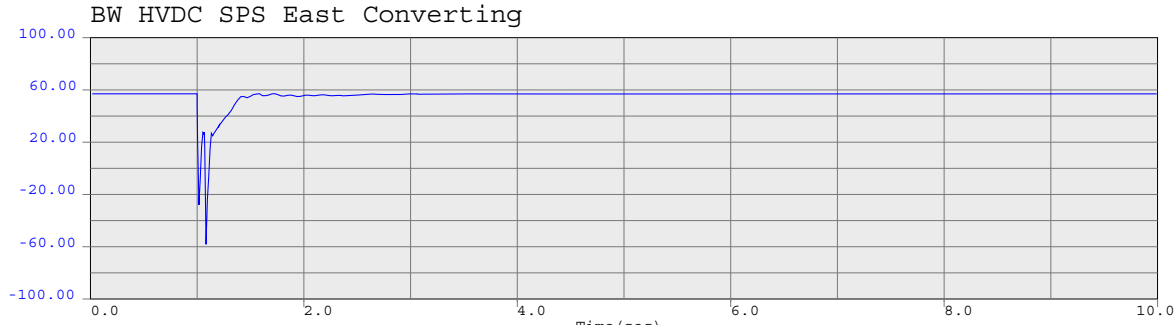

WIND FARM Q
100.00
60.00
20.00
-20.00
-60.00
-100.00
0.0
2.0
4.0
6.0
8.0
10.0
Time(sec)
-100.0000 qg 13407 BV_Sub N-MV 34.5 0 0.0 1 1 100.0000
-100.0000 qg 13406 BV_Sub W-MV1 34.5 0 0.0 1 1 100.0000
-100.0000 qg 13412 BV_Sub W-MV2 34.5 0 0.0 1 1 100.0000


WIND FARM Q
200.00
140.00
80.00
20.00
-40.00
-100.00
0.0
2.0
4.0
6.0
8.0
10.0
Time(sec)
-100.0000 qg 10995 ARGONNEG 0.6 0 0.0 1 1 200.0000
-100.0000 qg 10997 LONEMS 0.6 0 0.0 1 1 200.0000

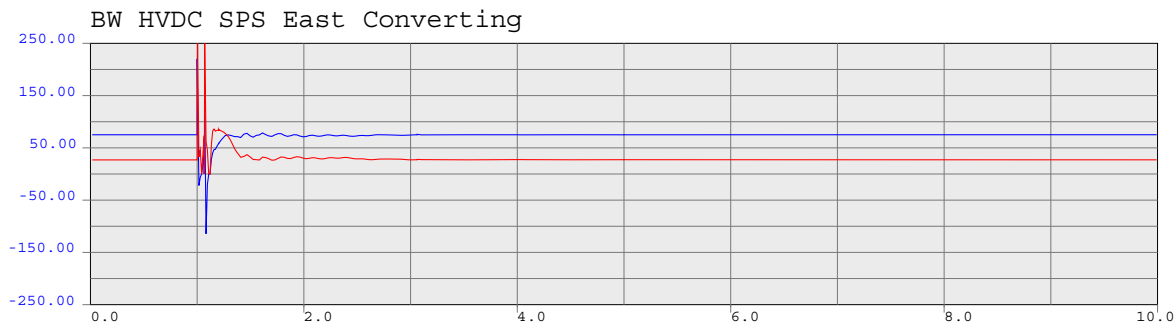
BW HVDC SPS East Converting



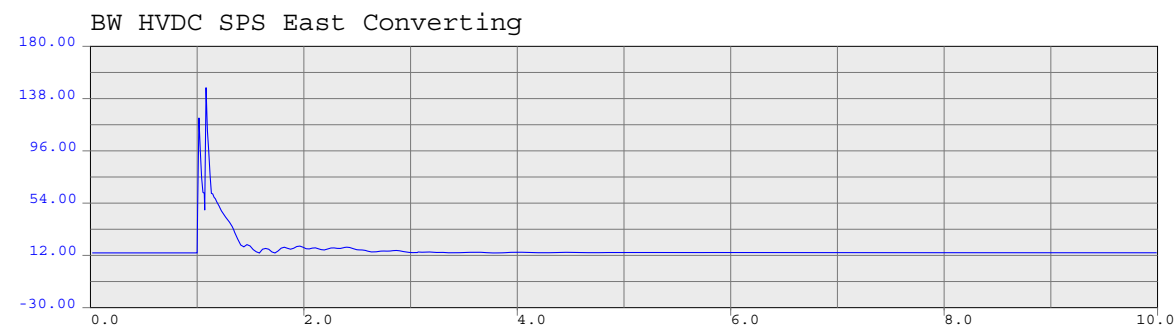
BW HVDC SPS East Converting



BW HVDC SPS East Converting

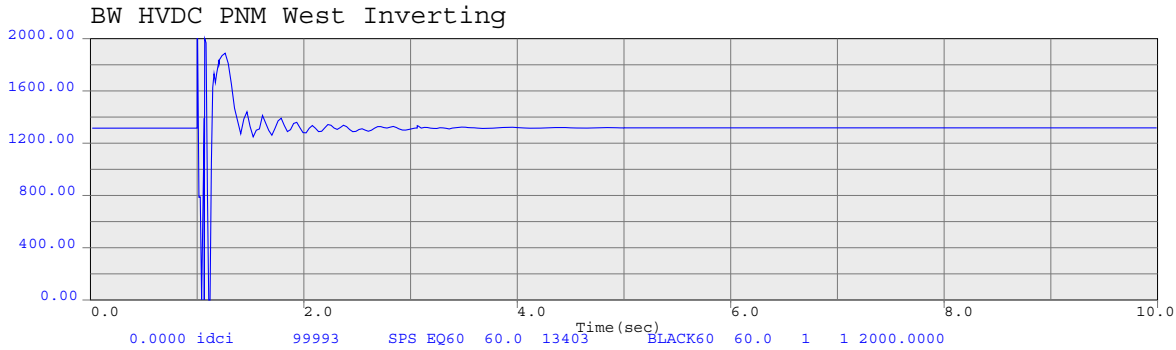


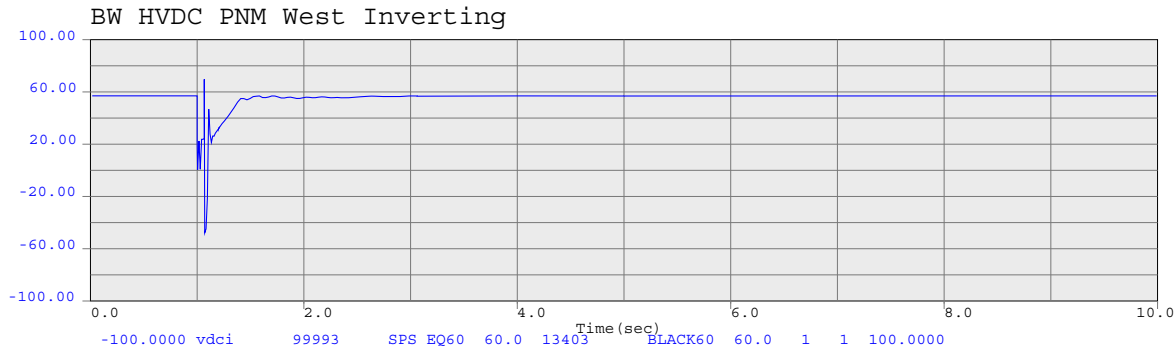
BW HVDC SPS East Converting

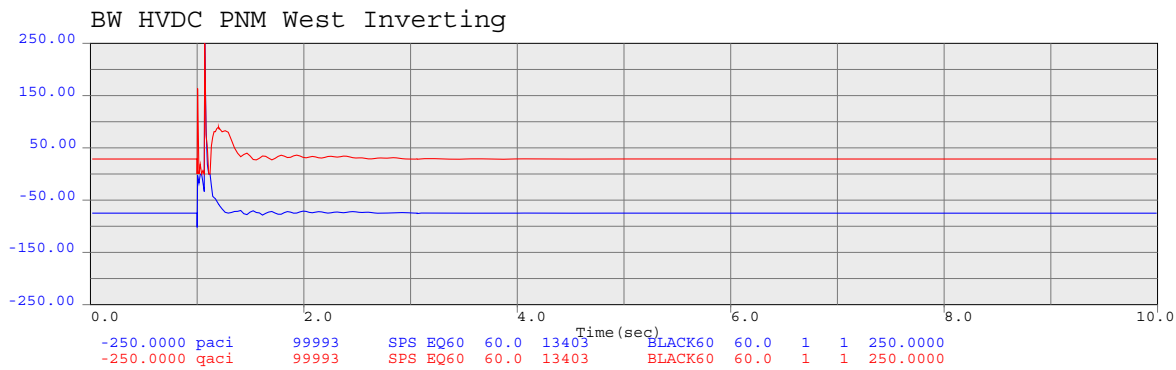


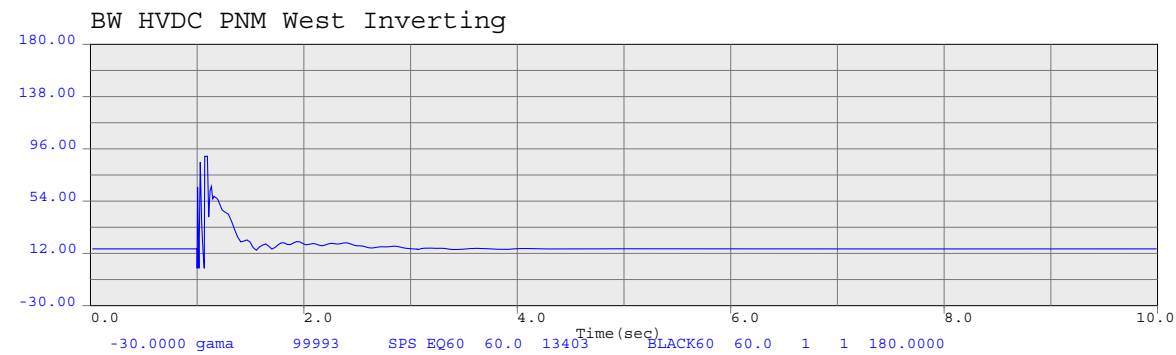
SPP 2000SC MODEL. 2001CASE 8/14/00
Base Case
WESTERN ELECTRICITY COORDINATING COUNCIL
2013-14 HW1A APPROVED BASE CASE
JANUARY 16, 2009
ALL COMMENTS FROM THE TSS REVIEW ARE INCLUDED
3-Phase fault near the Rio Puerco end of the WM-RP 345 kV line
Clear WM-RP 345 kV line in 4 cycles

Broadview 297 MW Type 4 TSR



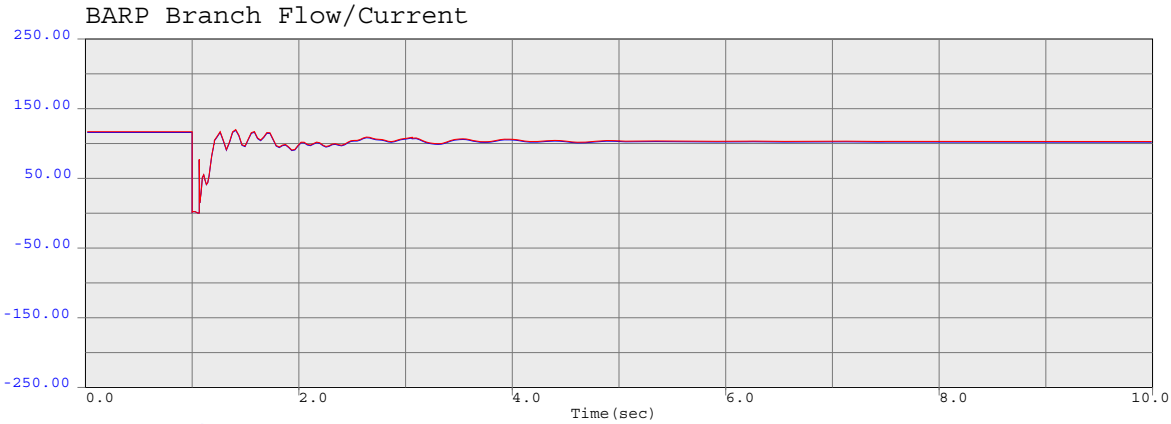






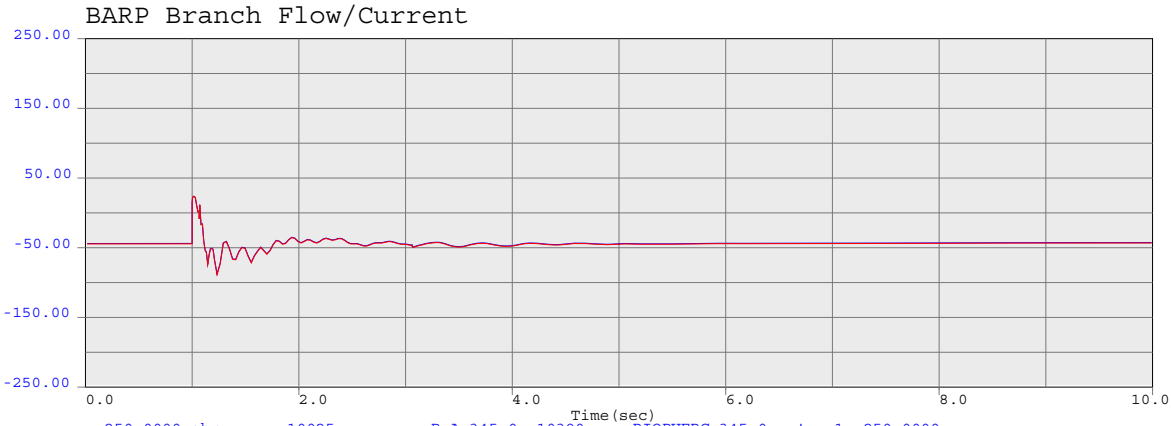
SPP 2000SC MODEL. 2001CASE 8/14/00
Base Case
WESTERN ELECTRICITY COORDINATING COUNCIL
2013-14 HW1A APPROVED BASE CASE
JANUARY 16, 2009
ALL COMMENTS FROM THE TSS REVIEW ARE INCLUDED
3-Phase fault near the Rio Puerco end of the WM-RP 345 kV line
Clear WM-RP 345 kV line in 4 cycles

BARP Branch Flow/Current



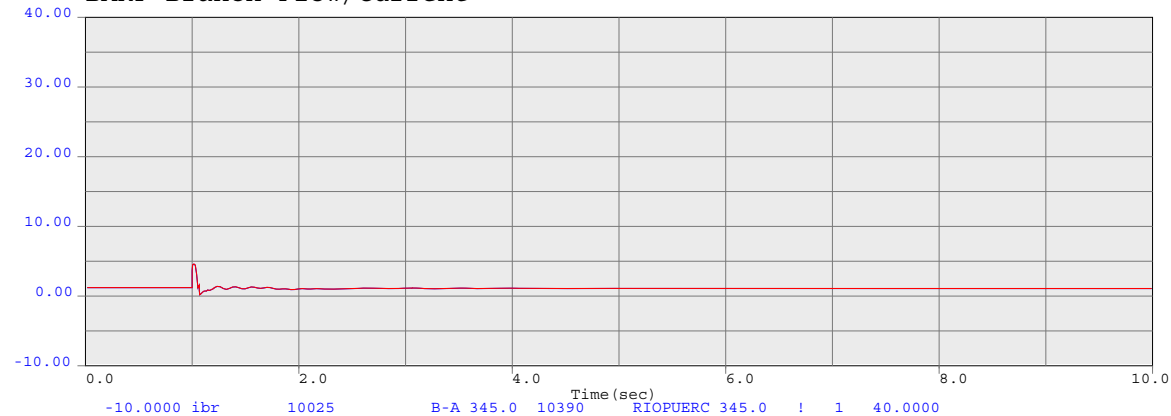
-250.0000 pbr 10025 B-A 345.0 10390 RIOPUERC 345.0 ! 1 250.0000
-250.0000 pbr 10025 B-A 345.0 10390 RIOPUERC 345.0 ! 2 250.0000

BARP Branch Flow/Current



-250.0000 qbr 10025 B-A 345.0 10390 RIOPUERC 345.0 ! 1 250.0000
-250.0000 qbr 10025 B-A 345.0 10390 RIOPUERC 345.0 ! 2 250.0000

BARP Branch Flow/Current



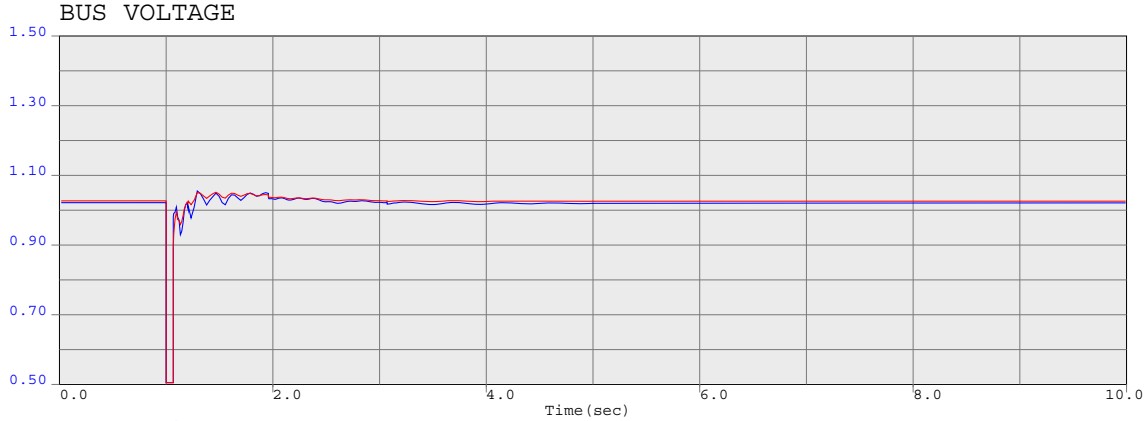
-10.0000 ibr 10025 B-A 345.0 10390 RIOPUERC 345.0 ! 1 40.0000
-10.0000 ibr 10025 B-A 345.0 10390 RIOPUERC 345.0 ! 2 40.0000

SPP 2000SC MODEL. 2001CASE 8/14/00
Base Case
WESTERN ELECTRICITY COORDINATING COUNCIL
2013-14 HW1A APPROVED BASE CASE
JANUARY 16, 2009
ALL COMMENTS FROM THE TSS REVIEW ARE INCLUDED
3-Phase fault near the Rio Puerco end of the WM-RP 345 kV line
Clear WM-RP 345 kV line in 4 cycles

Contingency 5 - Rio Puerco – San Juan 345 kV (RP-SJ)

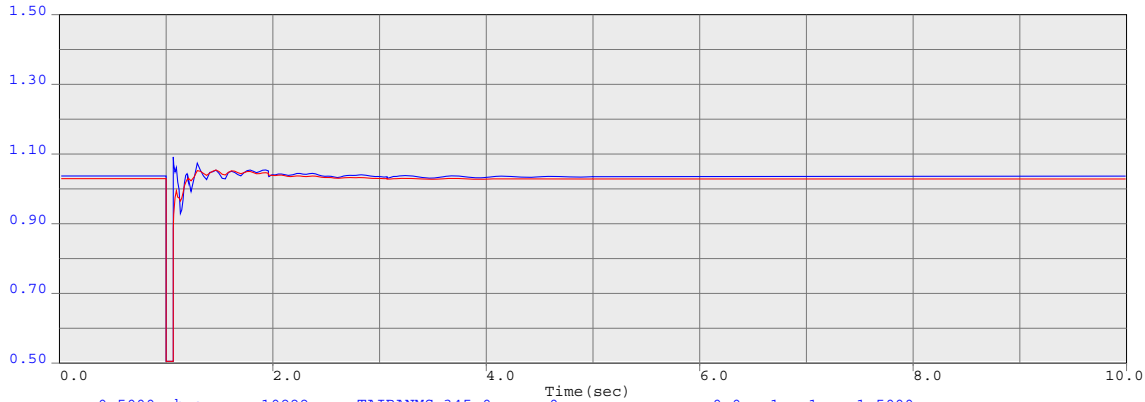
Broadview 297 MW Type 4 TSR

BUS VOLTAGE



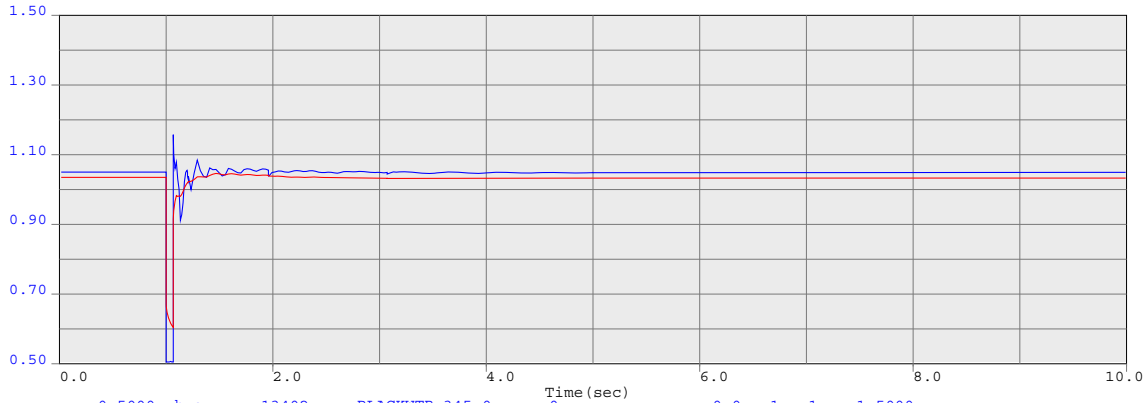
0.5000 vbug 10116 GUADLUPE 345.0 0 0.0 1 1 1.5000
0.5000 vbug 10025 B-A 345.0 0 0.0 1 1 1.5000

BUS VOLTAGE



0.5000 vbug 10999 TAIBANMS 345.0 0 0.0 1 1 1.5000
0.5000 vbus 10390 RIOPUERC 345.0 0 0.0 1 1 1.5000

BUS VOLTAGE

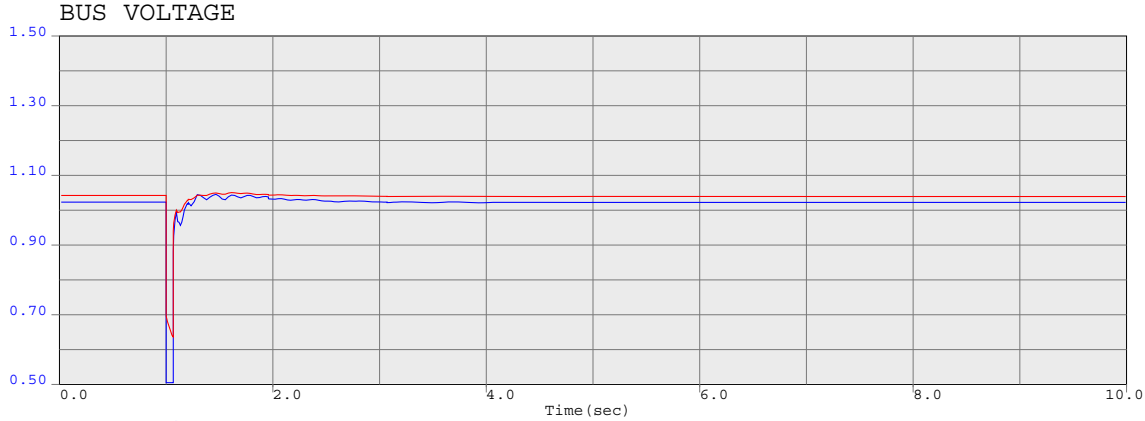


0.5000 vbug 13402 BLACKWTR 345.0 0 0.0 1 1 1.5000
0.5000 vbus 10011 AMBROSIA 230.0 0 0.0 1 1 1.5000

SPP 2000SC MODEL. 2001CASE 8/14/00
Base Case
WESTERN ELECTRICITY COORDINATING COUNCIL
2013-14 HW1A APPROVED BASE CASE
JANUARY 16, 2009
ALL COMMENTS FROM THE TSS REVIEW ARE INCLUDED
3-Phase fault near the Rio Puerco end of the RP-SJ 345 kV line
Clear RP-SJ 345 kV line in 4 cycles

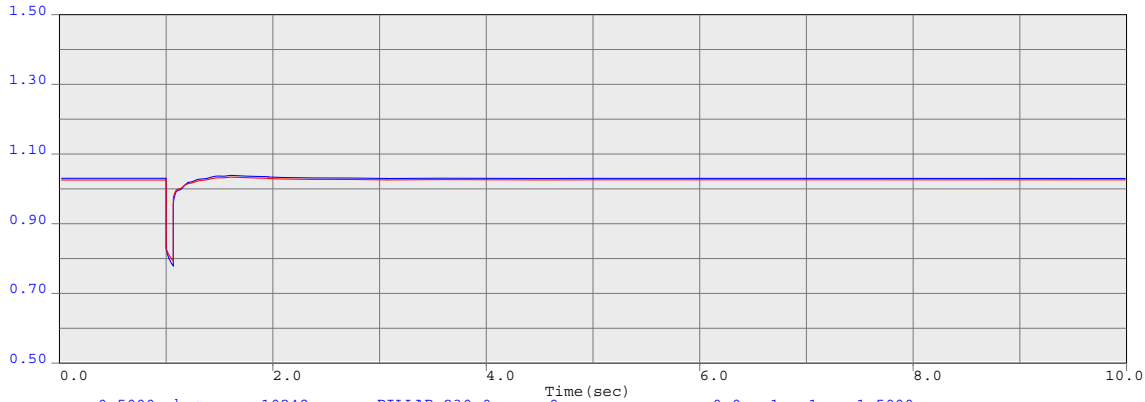
Broadview 297 MW Type 4 TSR

BUS VOLTAGE



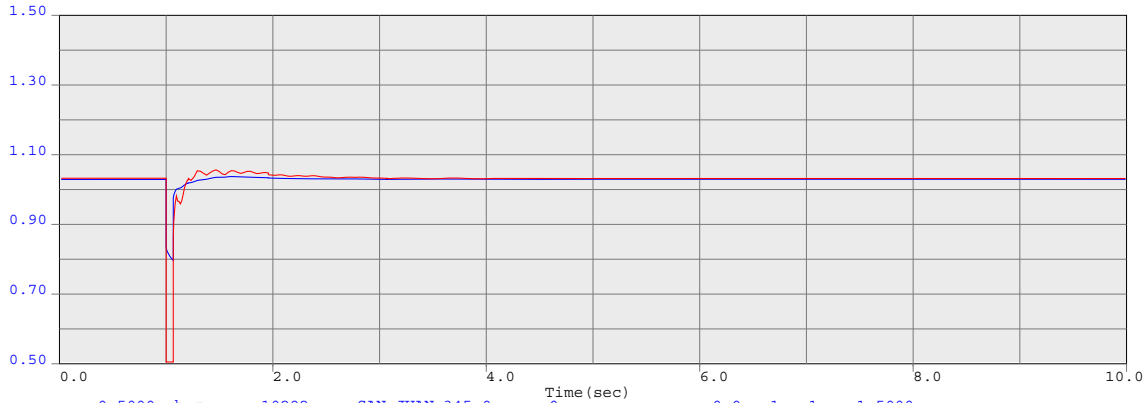
0.5000 vbus 10229 NORTON 345.0 0 0.0 1 1 1.5000
0.5000 vbus 10232 OJO 345.0 0 0.0 1 1 1.5000

BUS VOLTAGE



0.5000 vbus 10248 PILLAR 230.0 0 0.0 1 1 1.5000
0.5000 vbus 10291 SAN_JUAN 230.0 0 0.0 1 1 1.5000

BUS VOLTAGE

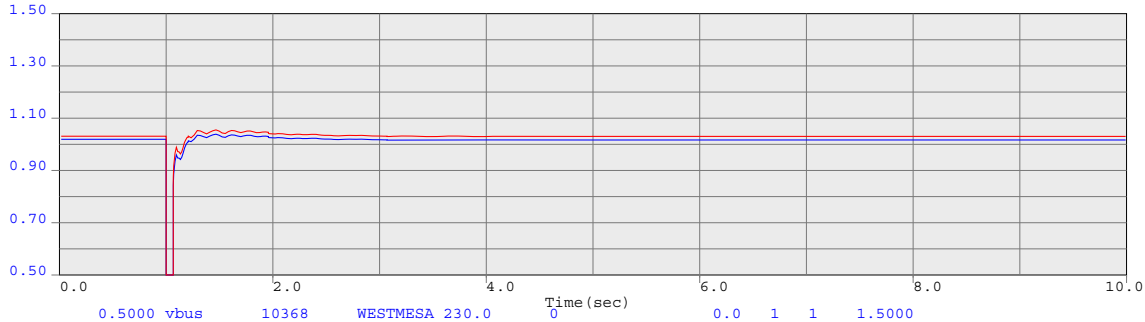


0.5000 vbus 10292 SAN_JUAN 345.0 0 0.0 1 1 1.5000
0.5000 vbus 10294 SANDIA 345.0 0 0.0 1 1 1.5000

SPP 2000SC MODEL. 2001CASE 8/14/00
Base Case
WESTERN ELECTRICITY COORDINATING COUNCIL
2013-14 HW1A APPROVED BASE CASE
JANUARY 16, 2009
ALL COMMENTS FROM THE TSS REVIEW ARE INCLUDED
3-Phase fault near the Rio Puerco end of the RP-SJ 345 kV line
Clear RP-SJ 345 kV line in 4 cycles

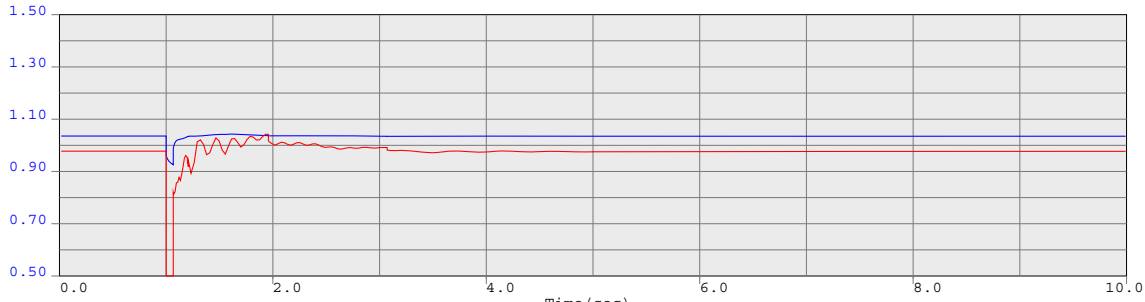
Broadview 297 MW Type 4 TSR

BUS VOLTAGE



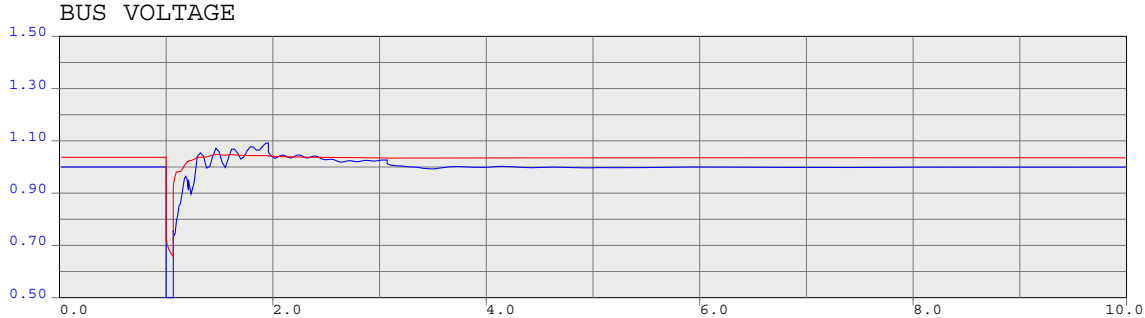
0.5000 vbus 10368 WESTMESA 230.0 0 0.0 1 1 1.5000
0.5000 vbus 10369 WESTMESA 345.0 0 0.0 1 1 1.5000

BUS VOLTAGE



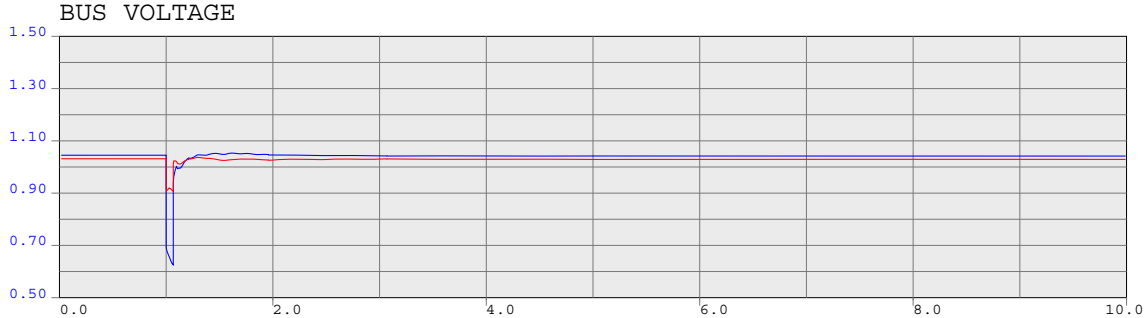
0.5000 vbus 10393 LEF 345.0 0 0.0 1 1 1.5000
0.5000 vbus 10991 ARGONNE4 138.0 0 0.0 1 1 1.5000

BUS VOLTAGE



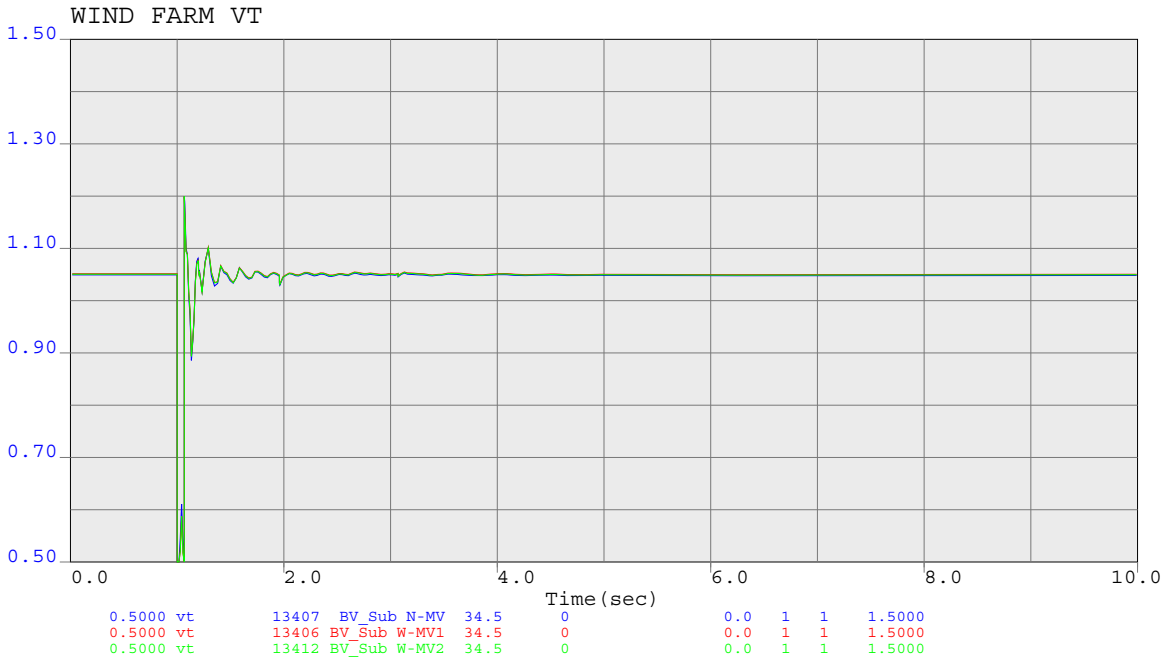
0.5000 vbus 10992 ARGONNE3 138.0 0 0.0 1 1 1.5000
0.5000 vbus 12057 PEGS 230.0 0 0.0 1 1 1.5000

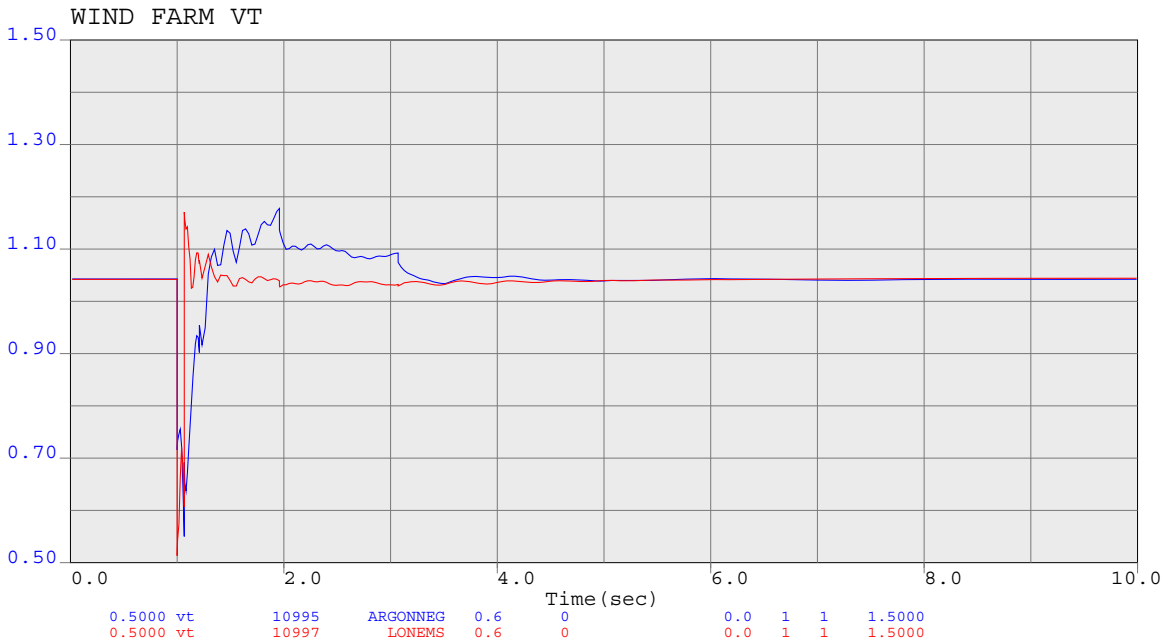
BUS VOLTAGE

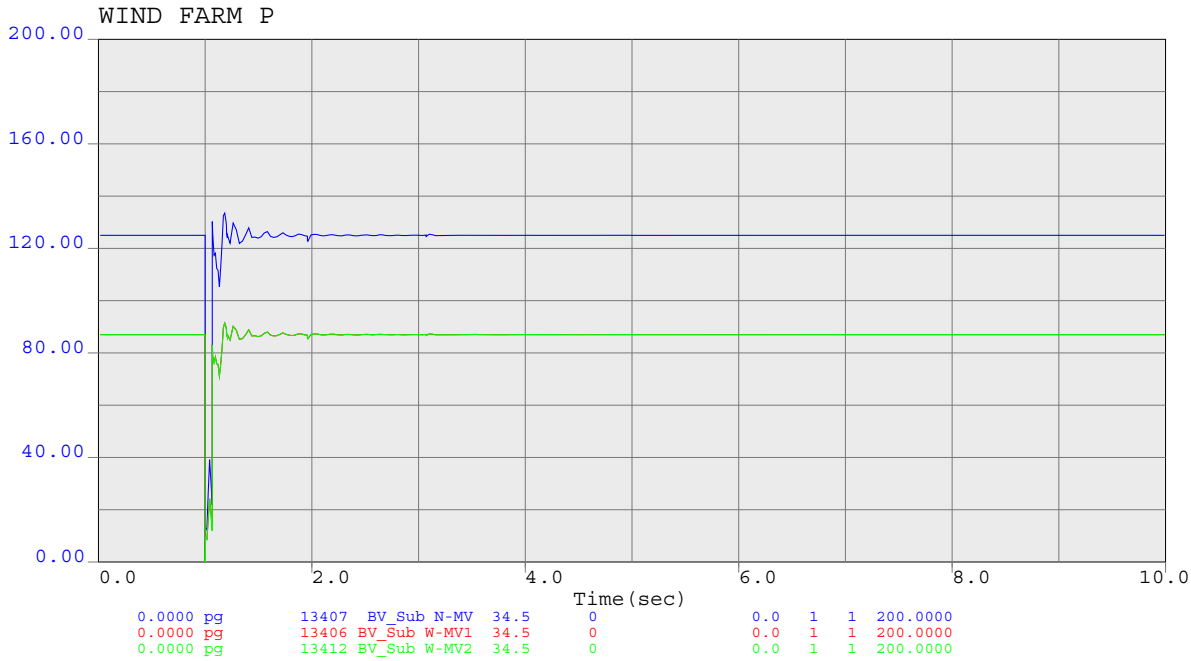


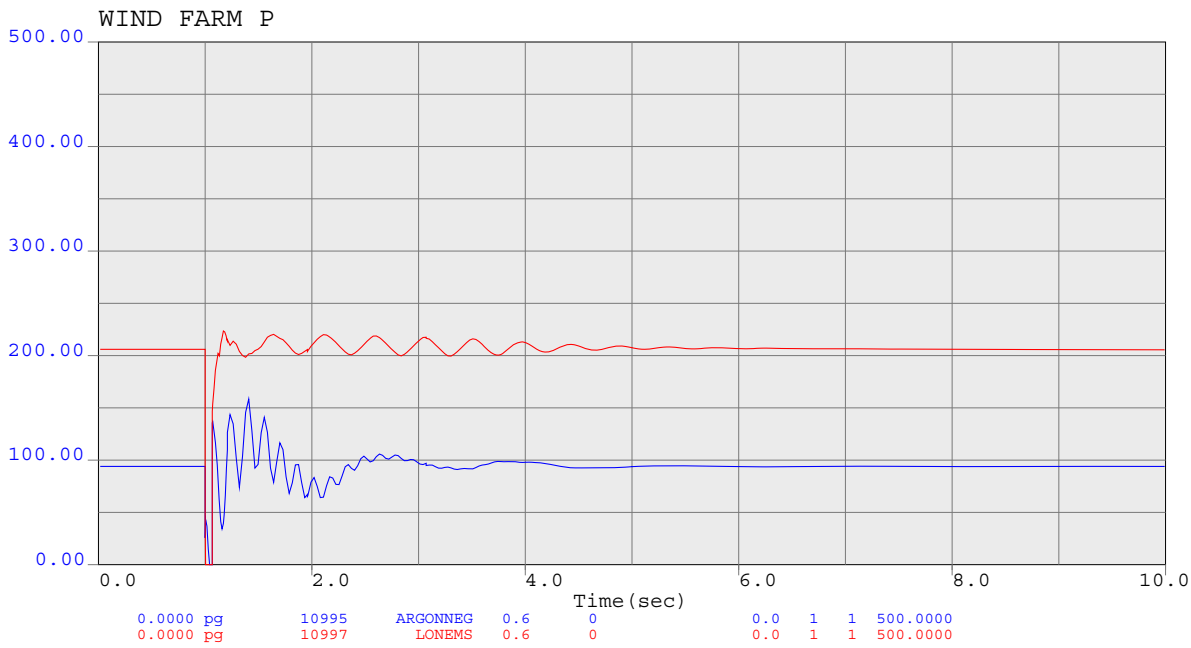
0.5000 vbus 12082 TAOS 345.0 0 0.0 1 1 1.5000
0.5000 vbus 12101 GLADSTON 230.0 0 0.0 1 1 1.5000

SPP 2000SC MODEL. 2001CASE 8/14/00
Base Case
WESTERN ELECTRICITY COORDINATING COUNCIL
2013-14 HW1A APPROVED BASE CASE
JANUARY 16, 2009
ALL COMMENTS FROM THE TSS REVIEW ARE INCLUDED
3-Phase fault near the Rio Puerco end of the RP-SJ 345 kV line
Clear RP-SJ 345 kV line in 4 cycles

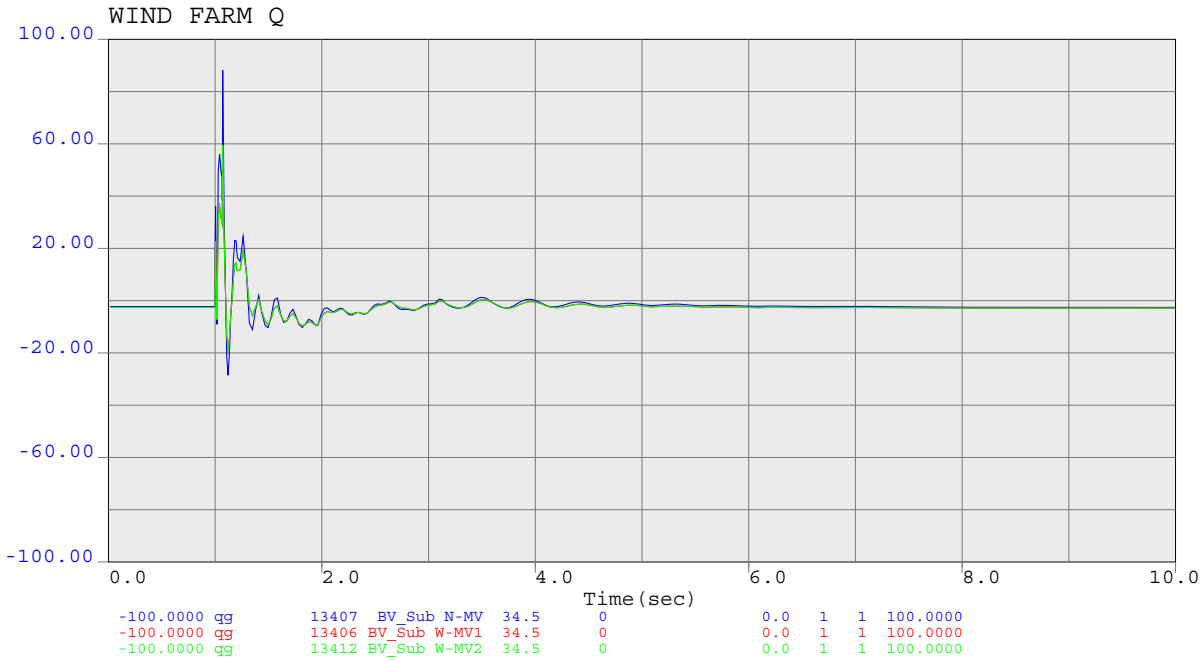

WIND FARM VT
1.50
1.30
1.10
0.90
0.70
0.50
0.0
2.0
4.0
6.0
8.0
10.0
Time(sec)
0.5000 vt 13407 BV_Sub N-MV 34.5 0 0.0 1 1 1.5000
0.5000 vt 13406 BV_Sub W-MV1 34.5 0 0.0 1 1 1.5000
0.5000 vt 13412 BV_Sub W-MV2 34.5 0 0.0 1 1 1.5000

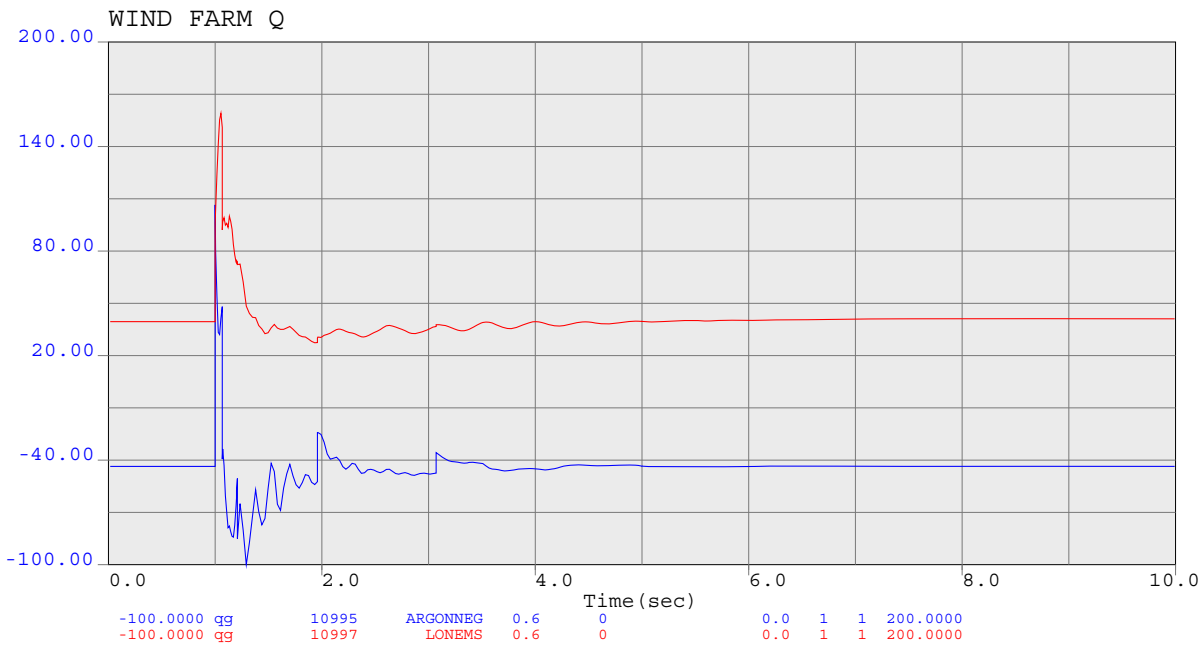

WIND FARM VT
1.50
1.30
1.10
0.90
0.70
0.50
0.0
2.0
4.0
6.0
8.0
10.0
Time(sec)
0.5000 vt 10995 ARGONNEG 0.6 0 0.0 1 1 1.5000
0.5000 vt 10997 LONEMS 0.6 0 0.0 1 1 1.5000





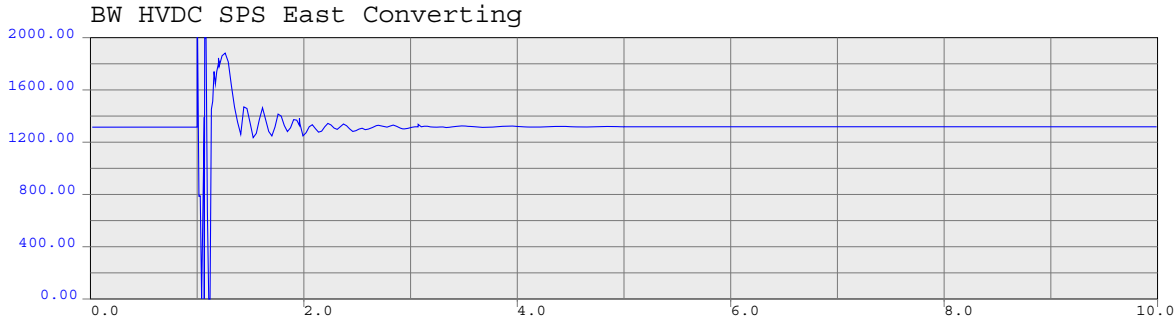
SPP 2000SC MODEL. 2001CASE 8/14/00
Base Case
WESTERN ELECTRICITY COORDINATING COUNCIL
2013-14 HW1A APPROVED BASE CASE
JANUARY 16, 2009
ALL COMMENTS FROM THE TSS REVIEW ARE INCLUDED
3-Phase fault near the Rio Puerco end of the RP-SJ 345 kV line
Clear RP-SJ 345 kV line in 4 cycles





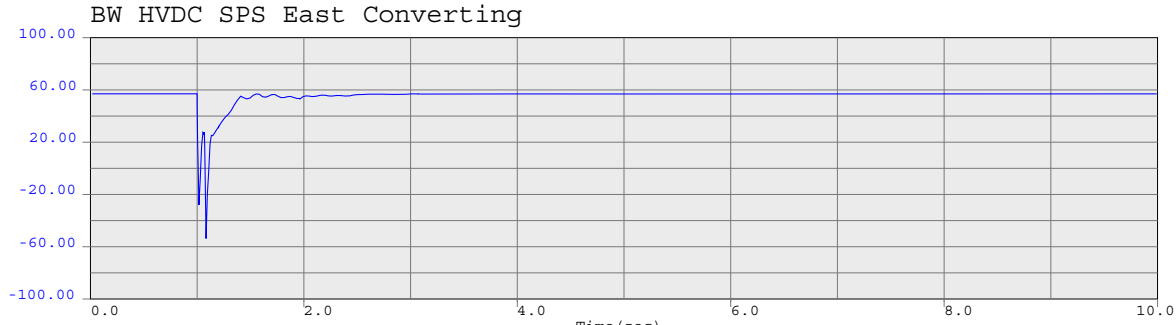
SPP 2000SC MODEL. 2001CASE 8/14/00
Base Case
WESTERN ELECTRICITY COORDINATING COUNCIL
2013-14 HW1A APPROVED BASE CASE
JANUARY 16, 2009
ALL COMMENTS FROM THE TSS REVIEW ARE INCLUDED
3-Phase fault near the Rio Puerco end of the RP-SJ 345 kV line
Clear RP-SJ 345 kV line in 4 cycles

BW HVDC SPS East Converting



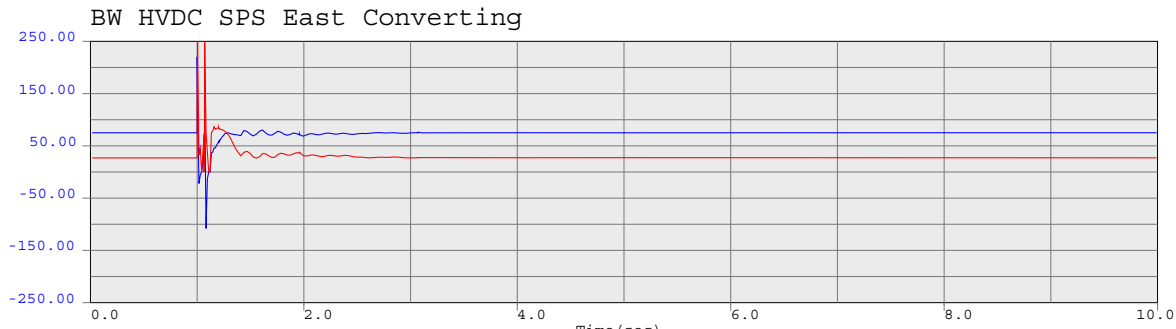
0.0000 idcr 99993 SPS EQ60 60.0 99993 SPS EQ60 60.0 1 1 2000.0000

BW HVDC SPS East Converting



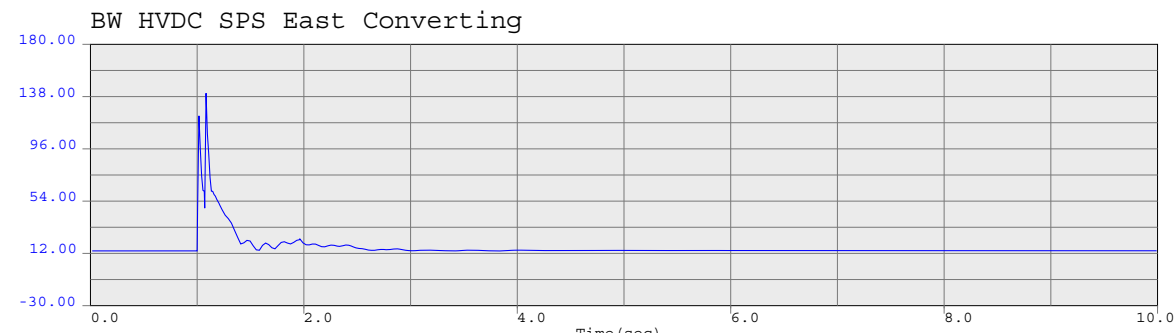
-100.0000 vdcr 99993 SPS EQ60 60.0 99993 SPS EQ60 60.0 1 1 100.0000

BW HVDC SPS East Converting



-250.0000 pacr 99993 SPS EQ60 60.0 99993 SPS EQ60 60.0 1 1 250.0000
-250.0000 qacr 99993 SPS EQ60 60.0 99993 SPS EQ60 60.0 1 1 250.0000

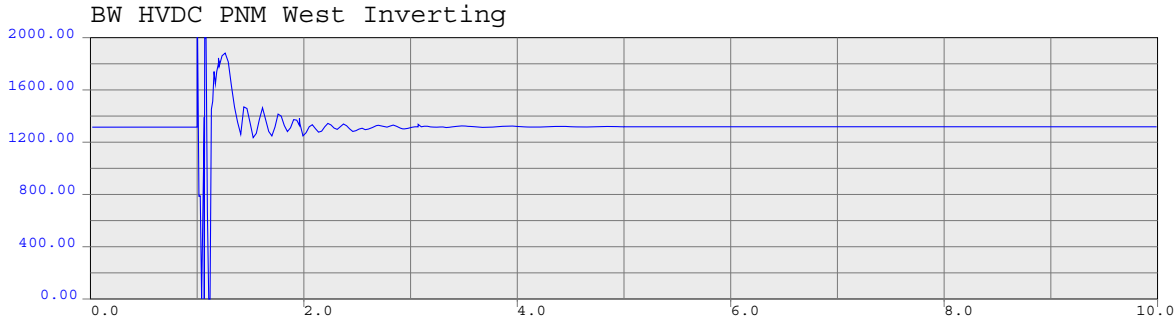
BW HVDC SPS East Converting



-30.0000 alpa 99993 SPS EQ60 60.0 99993 SPS EQ60 60.0 1 1 180.0000

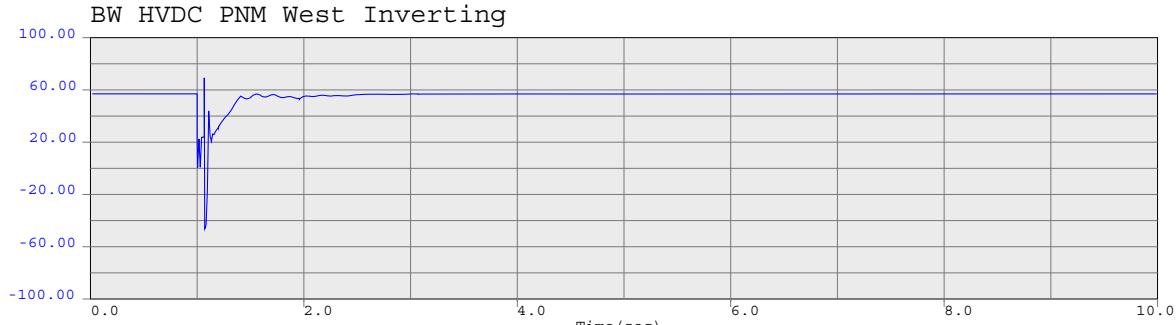
SPP 2000SC MODEL. 2001CASE 8/14/00
Base Case
WESTERN ELECTRICITY COORDINATING COUNCIL
2013-14 HW1A APPROVED BASE CASE
JANUARY 16, 2009
ALL COMMENTS FROM THE TSS REVIEW ARE INCLUDED
3-Phase fault near the Rio Puerco end of the RP-SJ 345 kV line
Clear RP-SJ 345 kV line in 4 cycles

BW HVDC PNM West Inverting



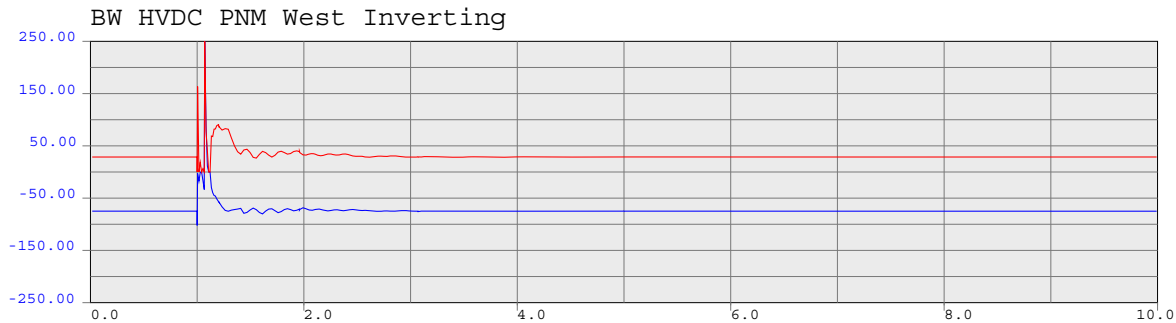
0.0000 idci 99993 SPS EQ60 60.0 13403 BLACK60 60.0 1 1 2000.0000

BW HVDC PNM West Inverting



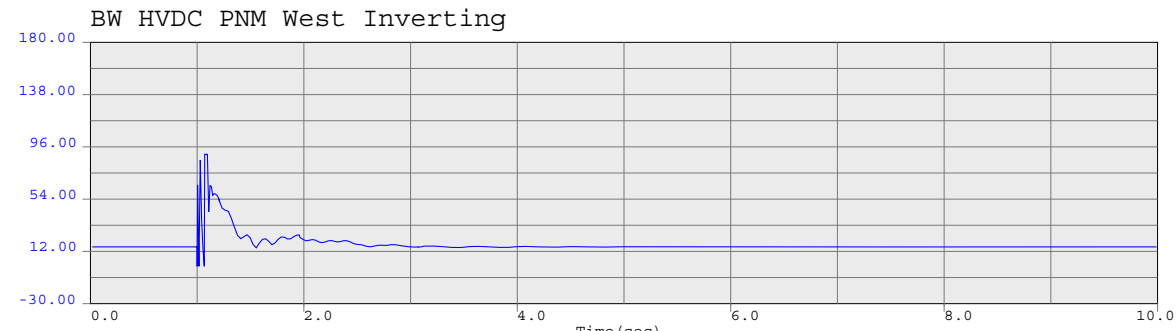
-100.0000 vdci 99993 SPS EQ60 60.0 13403 BLACK60 60.0 1 1 100.0000

BW HVDC PNM West Inverting



-250.0000 paci 99993 SPS EQ60 60.0 13403 BLACK60 60.0 1 1 250.0000
-250.0000 qaci 99993 SPS EQ60 60.0 13403 BLACK60 60.0 1 1 250.0000

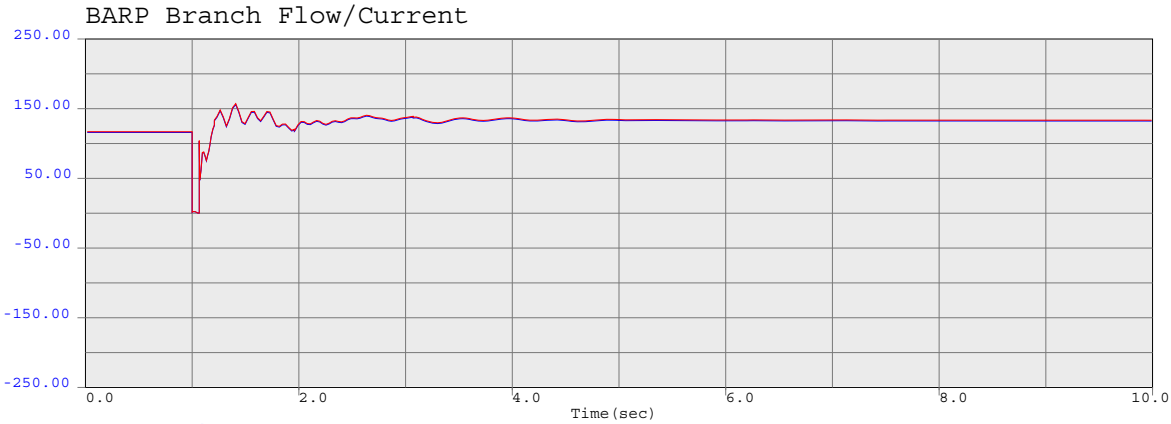
BW HVDC PNM West Inverting



-30.0000 gama 99993 SPS EQ60 60.0 13403 BLACK60 60.0 1 1 180.0000

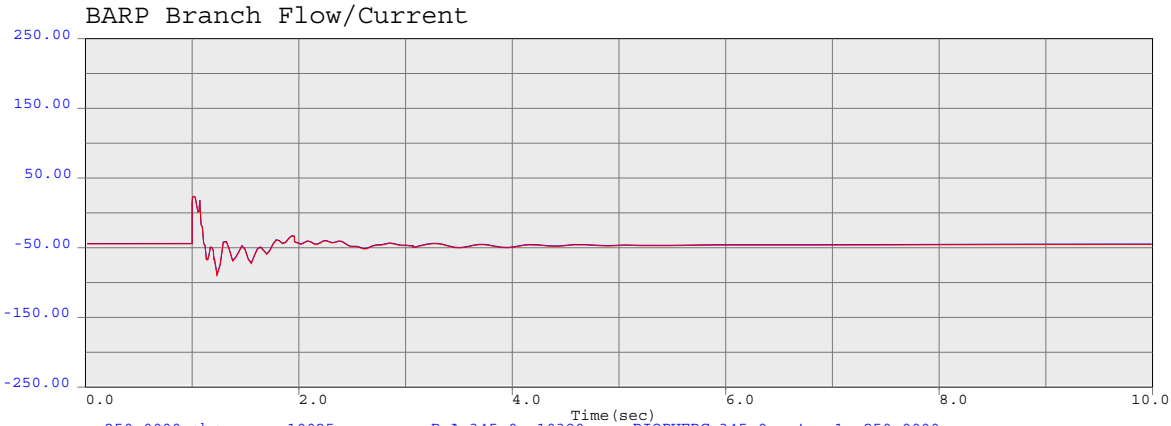
SPP 2000SC MODEL. 2001CASE 8/14/00
Base Case
WESTERN ELECTRICITY COORDINATING COUNCIL
2013-14 HW1A APPROVED BASE CASE
JANUARY 16, 2009
ALL COMMENTS FROM THE TSS REVIEW ARE INCLUDED
3-Phase fault near the Rio Puerco end of the RP-SJ 345 kV line
Clear RP-SJ 345 kV line in 4 cycles

BARP Branch Flow/Current



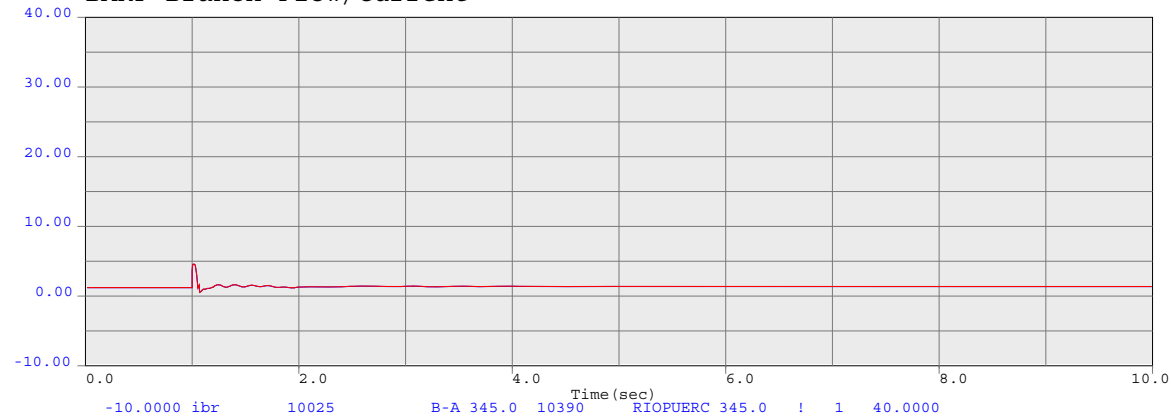
-250.0000 pbr 10025 B-A 345.0 10390 RIOPUERC 345.0 ! 1 250.0000
-250.0000 pbr 10025 B-A 345.0 10390 RIOPUERC 345.0 ! 2 250.0000

BARP Branch Flow/Current



-250.0000 qbr 10025 B-A 345.0 10390 RIOPUERC 345.0 ! 1 250.0000
-250.0000 qbr 10025 B-A 345.0 10390 RIOPUERC 345.0 ! 2 250.0000

BARP Branch Flow/Current



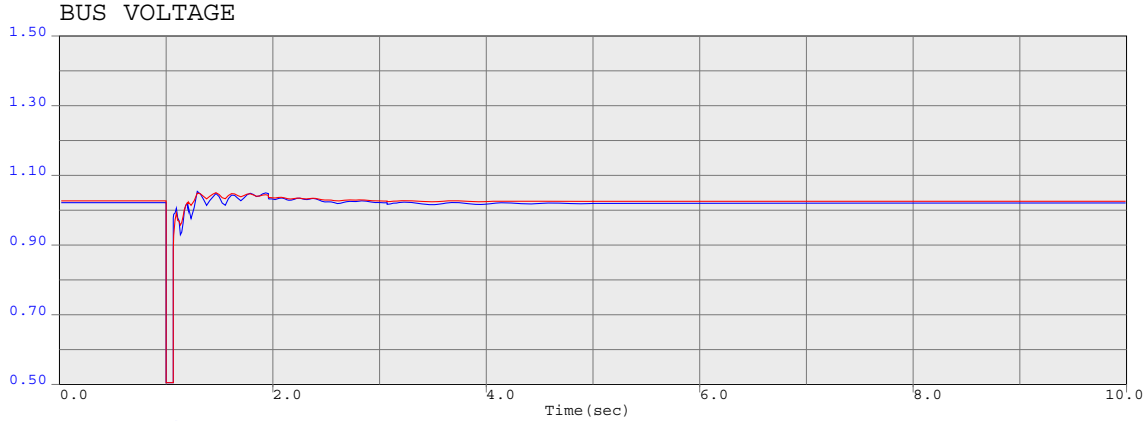
-10.0000 ibr 10025 B-A 345.0 10390 RIOPUERC 345.0 ! 1 40.0000
-10.0000 ibr 10025 B-A 345.0 10390 RIOPUERC 345.0 ! 2 40.0000

SPP 2000SC MODEL. 2001CASE 8/14/00
Base Case
WESTERN ELECTRICITY COORDINATING COUNCIL
2013-14 HW1A APPROVED BASE CASE
JANUARY 16, 2009
ALL COMMENTS FROM THE TSS REVIEW ARE INCLUDED
3-Phase fault near the Rio Puerco end of the RP-SJ 345 kV line
Clear RP-SJ 345 kV line in 4 cycles

Contingency 6 - Rio Puerco – Four Corners 345 kV (RP-FC)

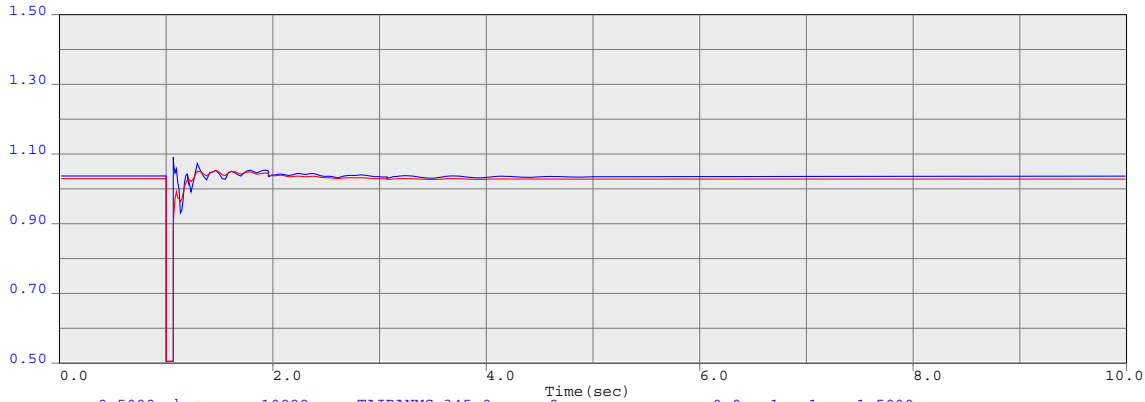
Broadview 297 MW Type 4 TSR

BUS VOLTAGE



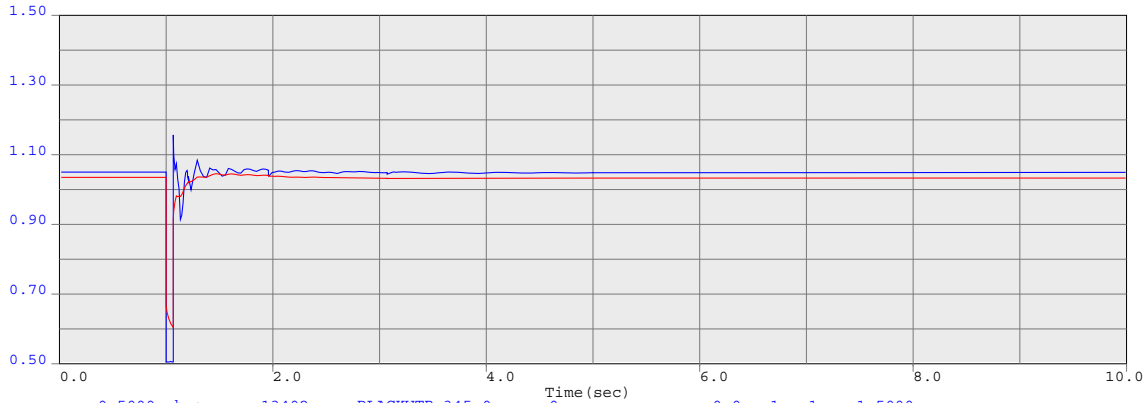
0.5000 vbug 10116 GUADLUPE 345.0 0 0.0 1 1 1.5000
0.5000 vbug 10025 B-A 345.0 0 0.0 1 1 1.5000

BUS VOLTAGE



0.5000 vbug 10999 TAIBANMS 345.0 0 0.0 1 1 1.5000
0.5000 vbus 10390 RIOPUERC 345.0 0 0.0 1 1 1.5000

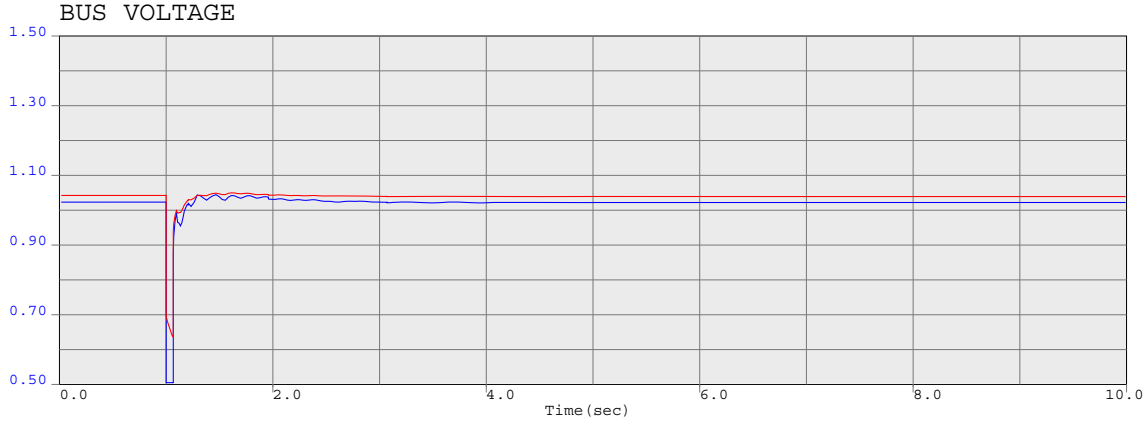
BUS VOLTAGE



0.5000 vbug 13402 BLACKWTR 345.0 0 0.0 1 1 1.5000
0.5000 vbus 10011 AMBROSIA 230.0 0 0.0 1 1 1.5000

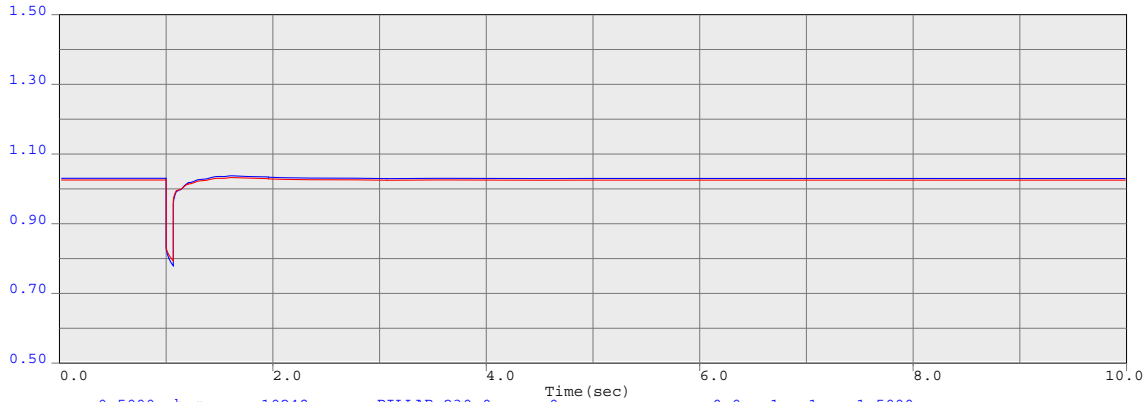
SPP 2000SC MODEL. 2001CASE 8/14/00
Base Case
WESTERN ELECTRICITY COORDINATING COUNCIL
2013-14 HW1A APPROVED BASE CASE
JANUARY 16, 2009
ALL COMMENTS FROM THE TSS REVIEW ARE INCLUDED
3-Phase fault near the Rio Puerco end of the RP-FC 345 kV line
Clear RP-FC 345 kV line in 4 cycles

BUS VOLTAGE



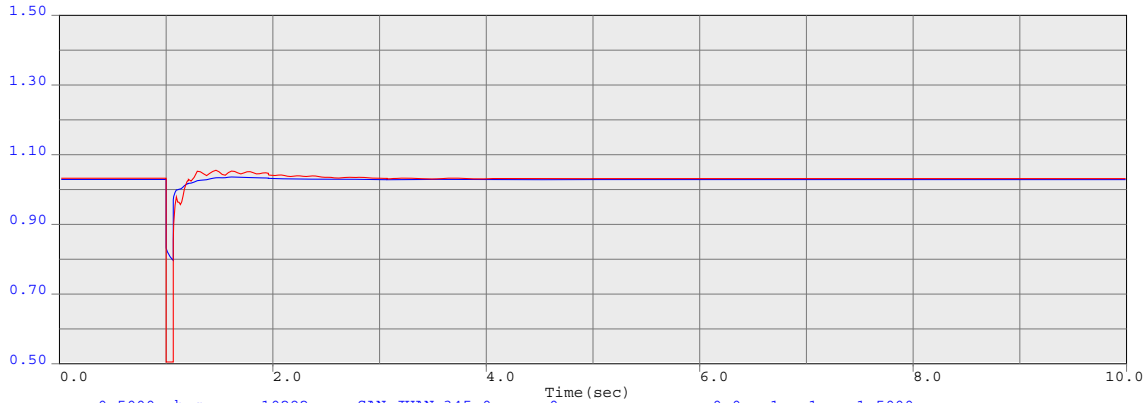
0.5000 vbus 10229 NORTON 345.0 0 0.0 1 1 1.5000
0.5000 vbus 10232 OJO 345.0 0 0.0 1 1 1.5000

BUS VOLTAGE



0.5000 vbus 10248 PILLAR 230.0 0 0.0 1 1 1.5000
0.5000 vbus 10291 SAN_JUAN 230.0 0 0.0 1 1 1.5000

BUS VOLTAGE

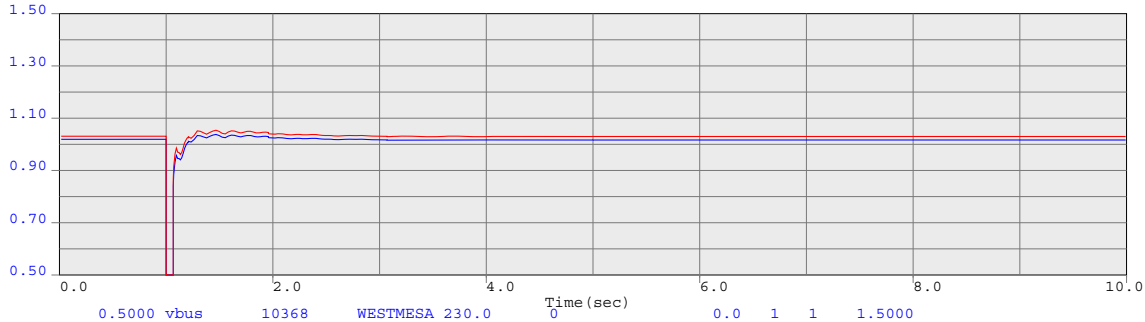


0.5000 vbus 10292 SAN_JUAN 345.0 0 0.0 1 1 1.5000
0.5000 vbus 10294 SANDIA 345.0 0 0.0 1 1 1.5000

SPP 2000SC MODEL. 2001CASE 8/14/00
Base Case
WESTERN ELECTRICITY COORDINATING COUNCIL
2013-14 HW1A APPROVED BASE CASE
JANUARY 16, 2009
ALL COMMENTS FROM THE TSS REVIEW ARE INCLUDED
3-Phase fault near the Rio Puerco end of the RP-FC 345 kV line
Clear RP-FC 345 kV line in 4 cycles

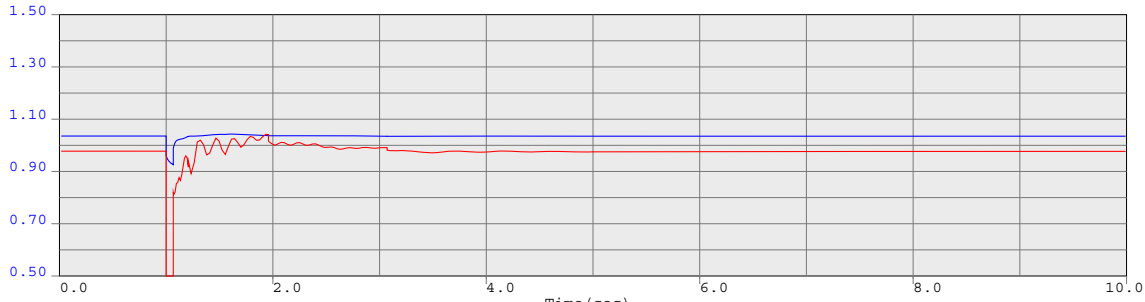
Broadview 297 MW Type 4 TSR

BUS VOLTAGE



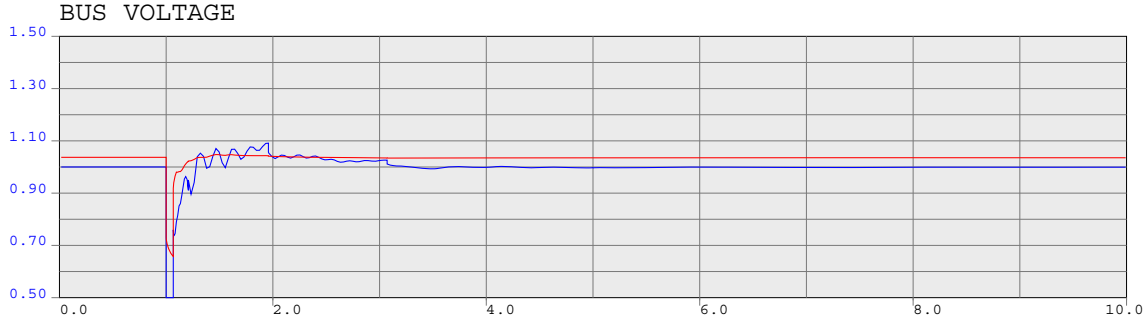
0.5000 vbus 10368 WESTMESA 230.0 0 0.0 1 1 1.5000
0.5000 vbus 10369 WESTMESA 345.0 0 0.0 1 1 1.5000

BUS VOLTAGE



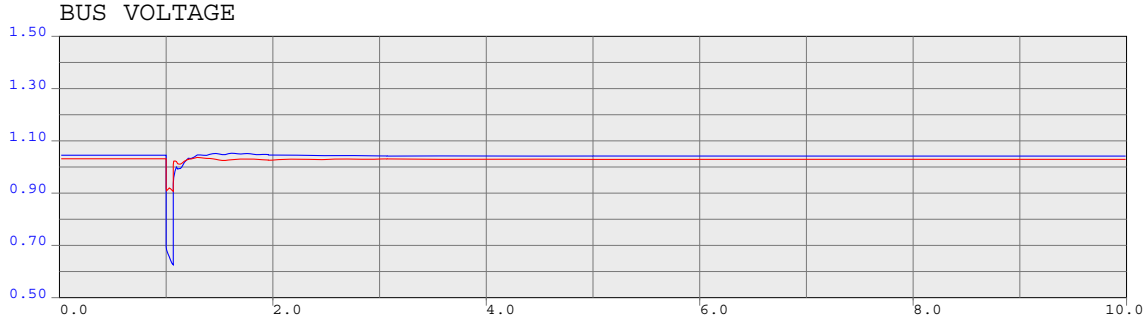
0.5000 vbus 10393 LEF 345.0 0 0.0 1 1 1.5000
0.5000 vbus 10991 ARGONNE4 138.0 0 0.0 1 1 1.5000

BUS VOLTAGE



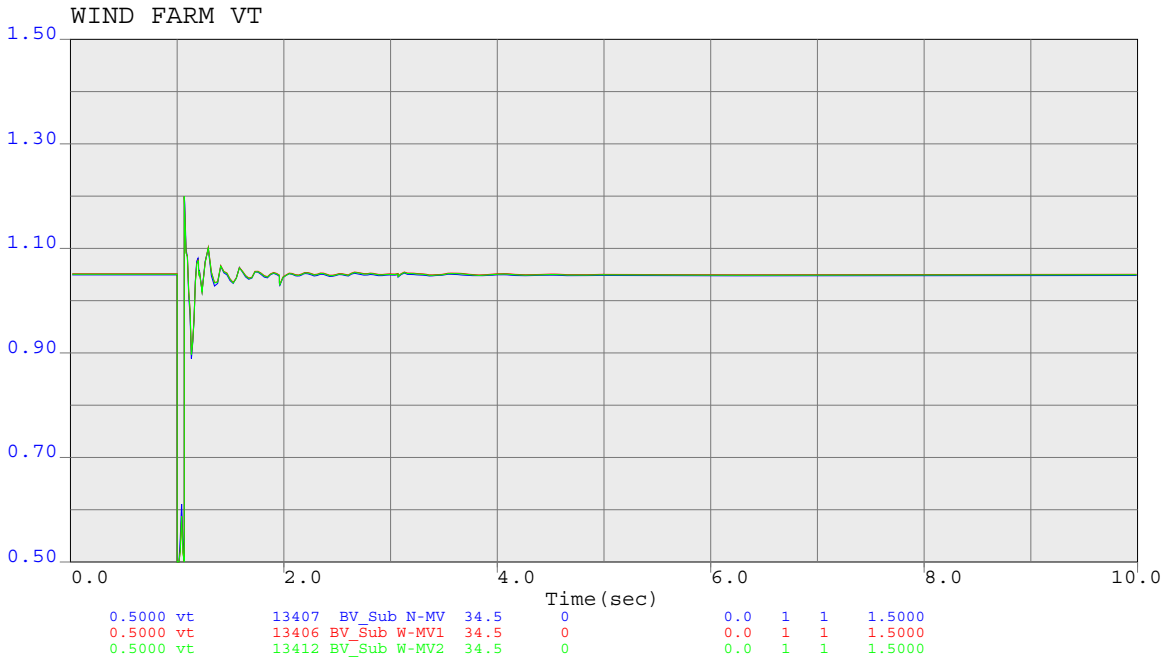
0.5000 vbus 10992 ARGONNE3 138.0 0 0.0 1 1 1.5000
0.5000 vbus 12057 PEGS 230.0 0 0.0 1 1 1.5000

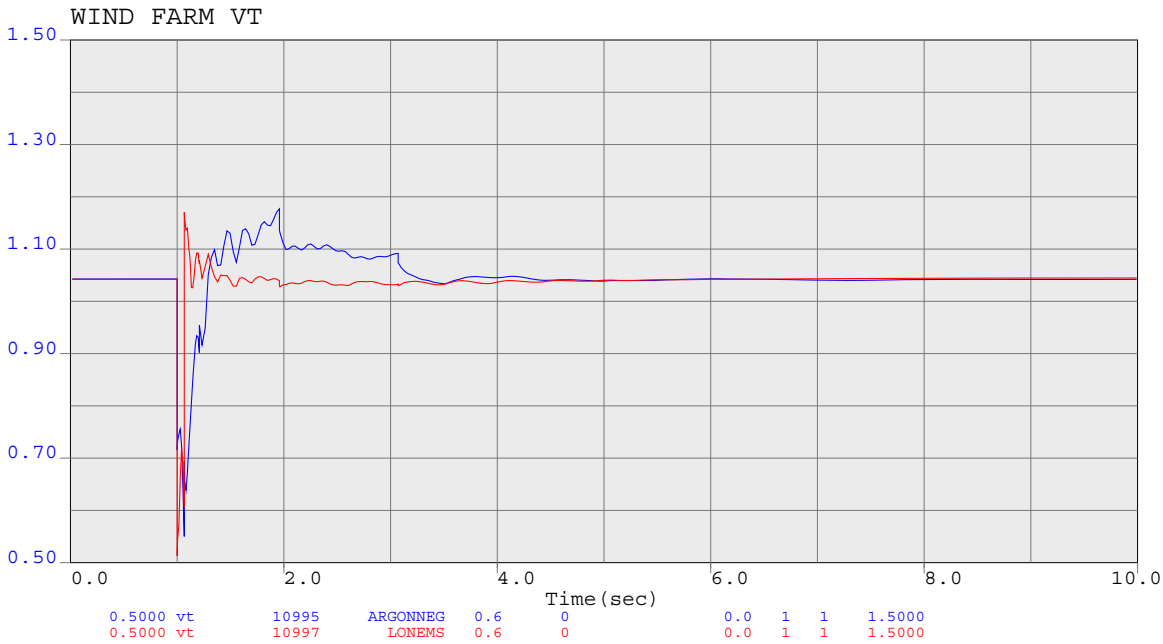
BUS VOLTAGE

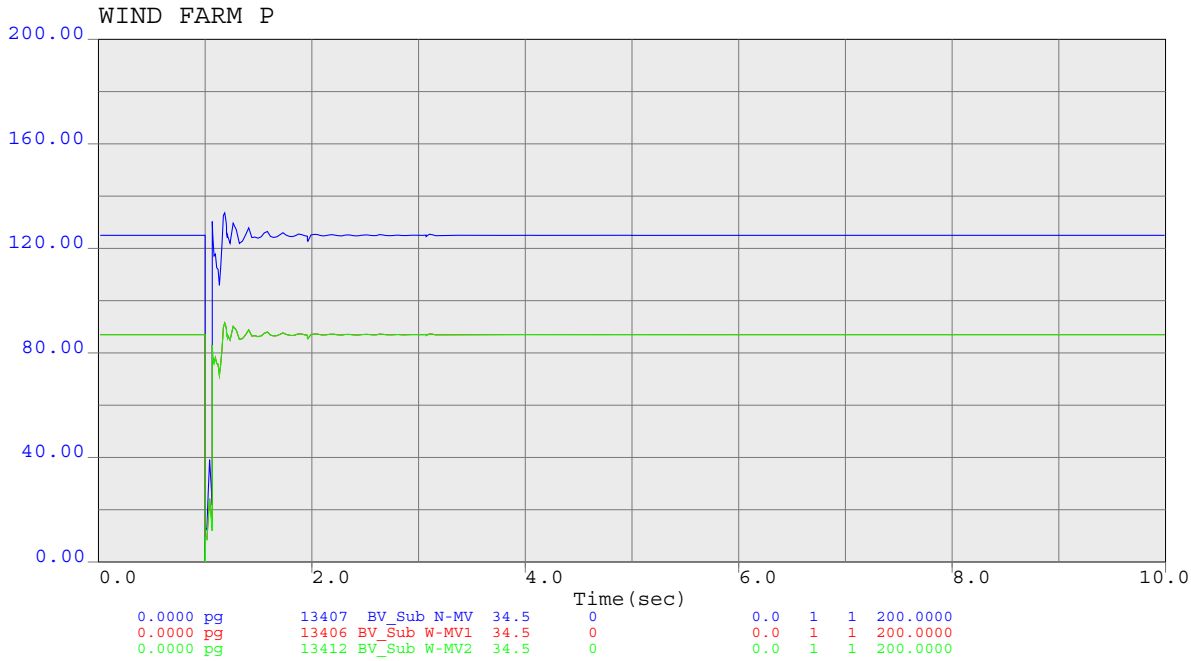


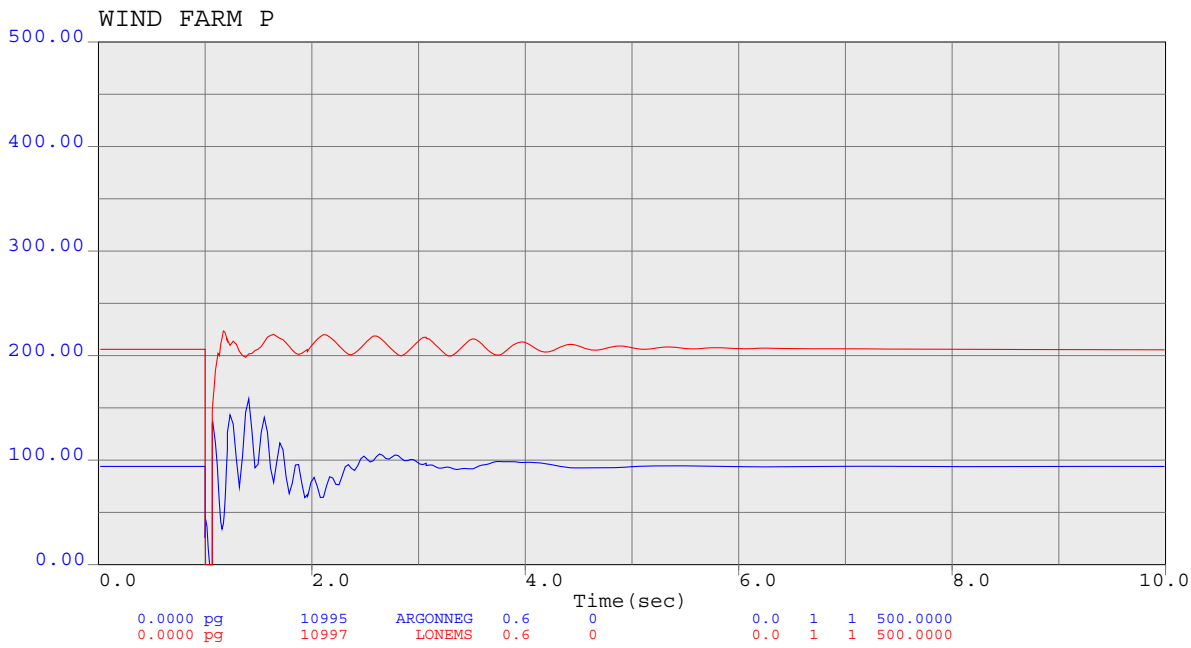
0.5000 vbus 12082 TAOS 345.0 0 0.0 1 1 1.5000
0.5000 vbus 12101 GLADSTON 230.0 0 0.0 1 1 1.5000

SPP 2000SC MODEL. 2001CASE 8/14/00
Base Case
WESTERN ELECTRICITY COORDINATING COUNCIL
2013-14 HW1A APPROVED BASE CASE
JANUARY 16, 2009
ALL COMMENTS FROM THE TSS REVIEW ARE INCLUDED
3-Phase fault near the Rio Puerco end of the RP-FC 345 kV line
Clear RP-FC 345 kV line in 4 cycles

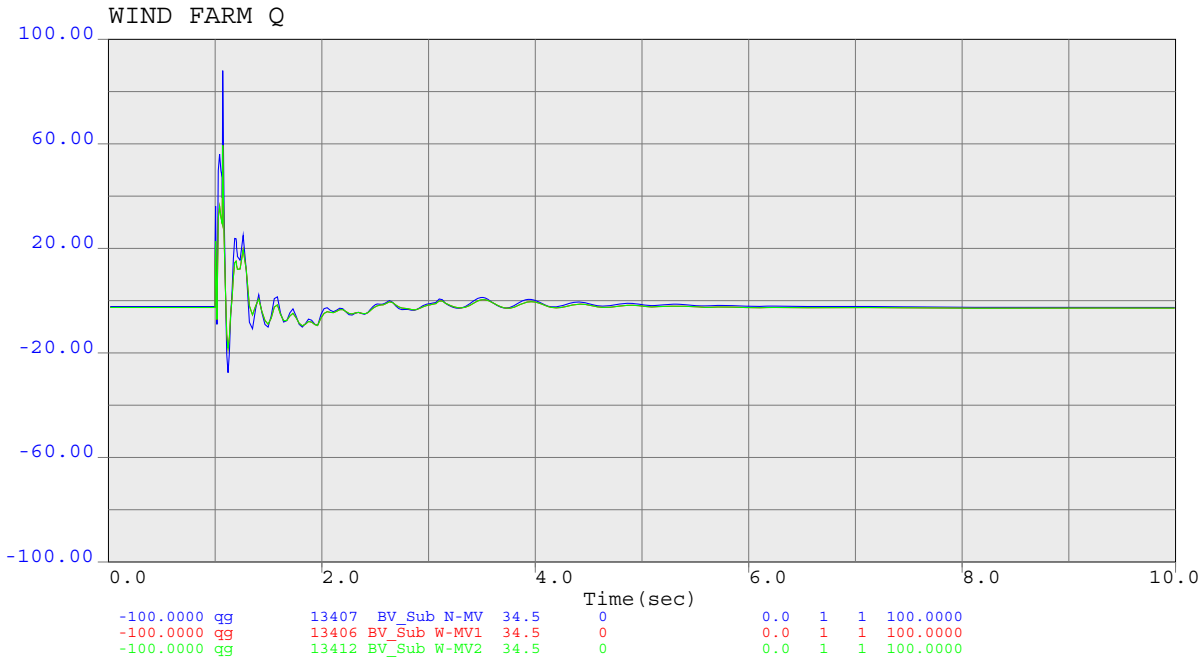

WIND FARM VT
1.50
1.30
1.10
0.90
0.70
0.50
0.0
2.0
4.0
6.0
8.0
10.0
Time(sec)
0.5000 vt 13407 BV_Sub N-MV 34.5 0 0.0 1 1 1.5000
0.5000 vt 13406 BV_Sub W-MV1 34.5 0 0.0 1 1 1.5000
0.5000 vt 13412 BV_Sub W-MV2 34.5 0 0.0 1 1 1.5000

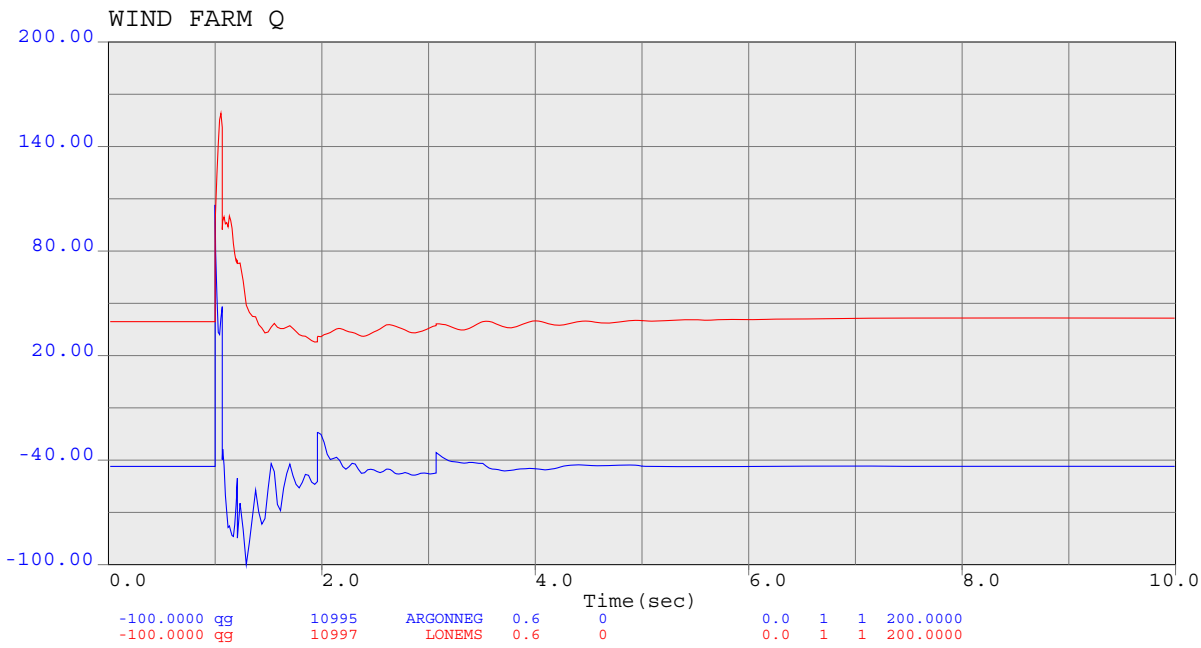

WIND FARM VT
1.50
1.30
1.10
0.90
0.70
0.50
0.0
2.0
4.0
6.0
8.0
10.0
Time(sec)
0.5000 vt 10995 ARGONNEG 0.6 0 0.0 1 1 1.5000
0.5000 vt 10997 LONEMS 0.6 0 0.0 1 1 1.5000



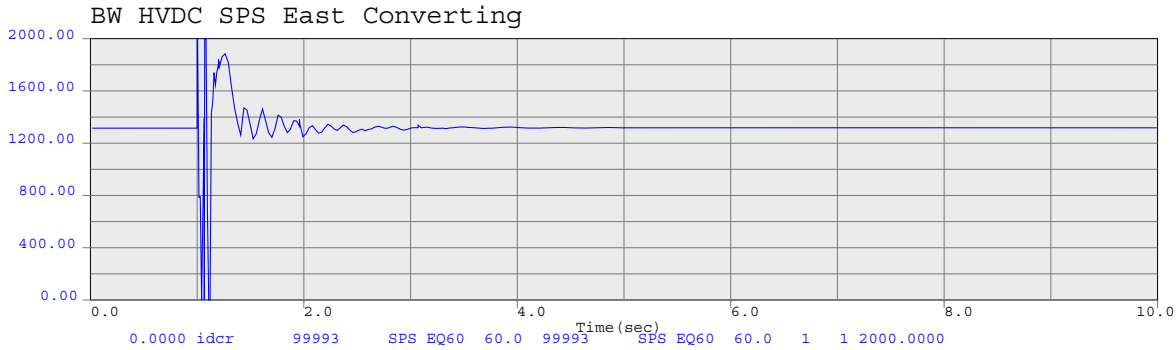


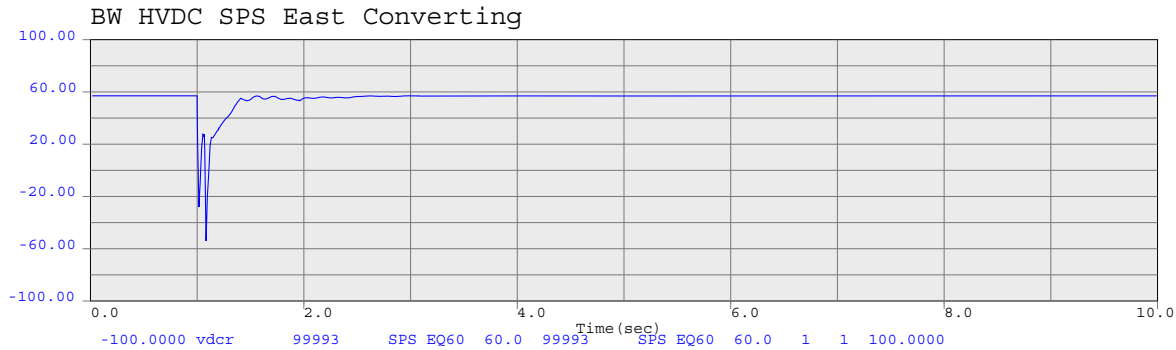
SPP 2000SC MODEL. 2001CASE 8/14/00
Base Case
WESTERN ELECTRICITY COORDINATING COUNCIL
2013-14 HW1A APPROVED BASE CASE
JANUARY 16, 2009
ALL COMMENTS FROM THE TSS REVIEW ARE INCLUDED
3-Phase fault near the Rio Puerco end of the RP-FC 345 kV line
Clear RP-FC 345 kV line in 4 cycles

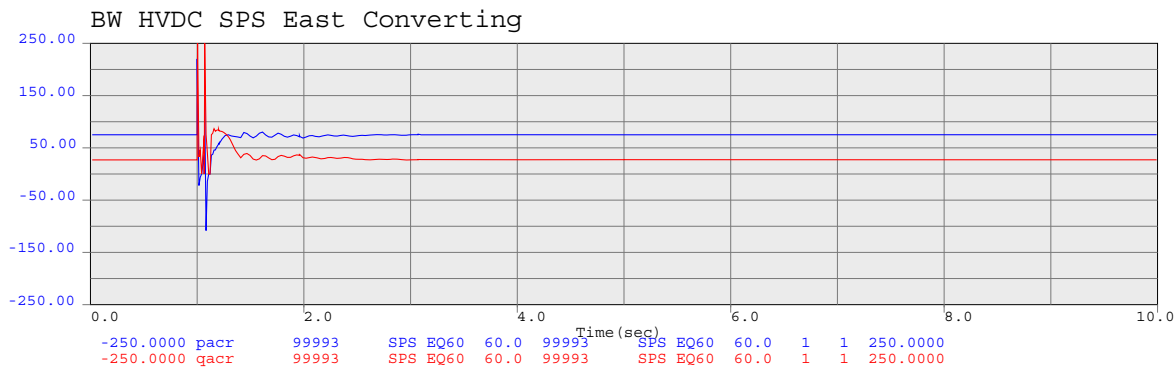


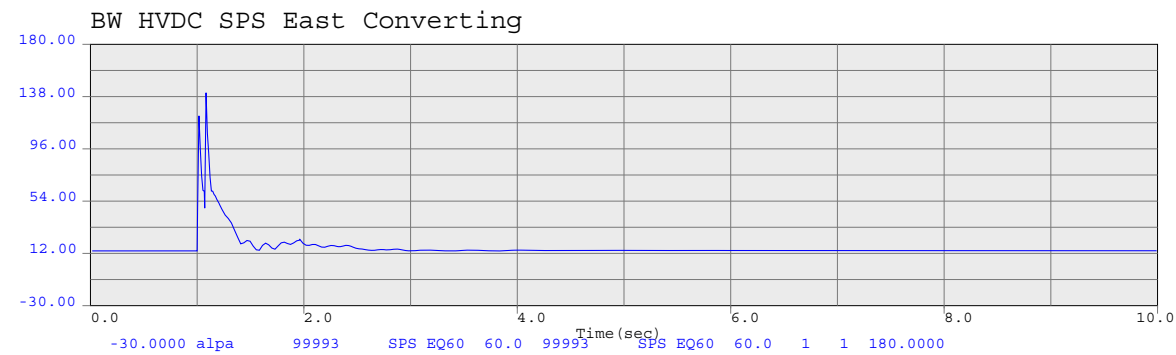


SPP 2000SC MODEL. 2001CASE 8/14/00
Base Case
WESTERN ELECTRICITY COORDINATING COUNCIL
2013-14 HW1A APPROVED BASE CASE
JANUARY 16, 2009
ALL COMMENTS FROM THE TSS REVIEW ARE INCLUDED
3-Phase fault near the Rio Puerco end of the RP-FC 345 kV line
Clear RP-FC 345 kV line in 4 cycles



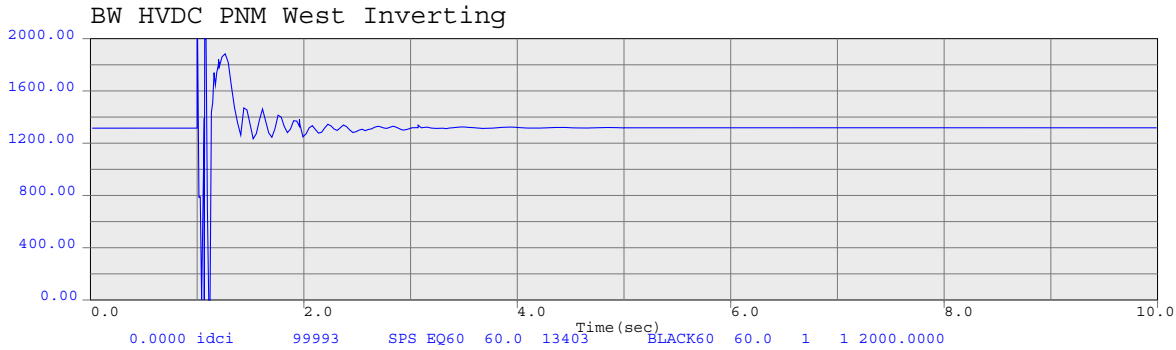


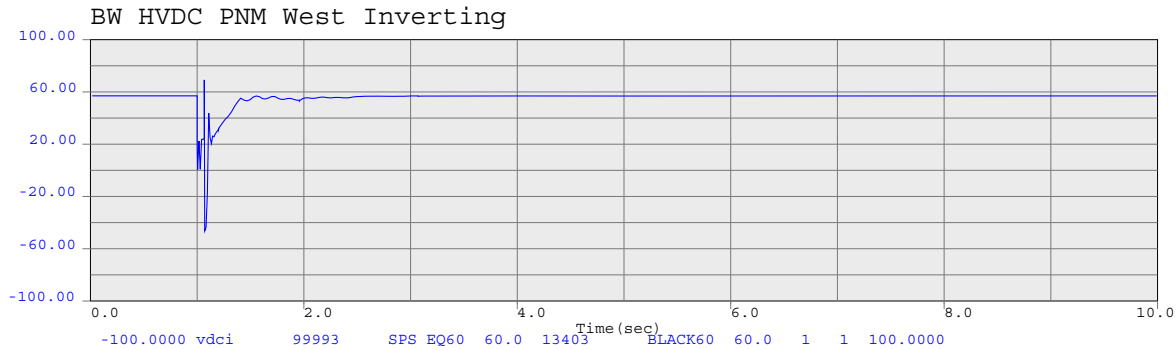


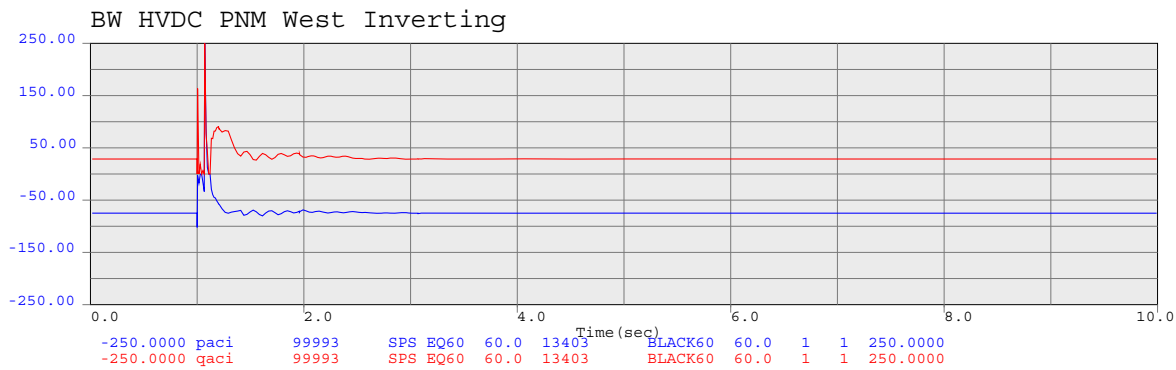


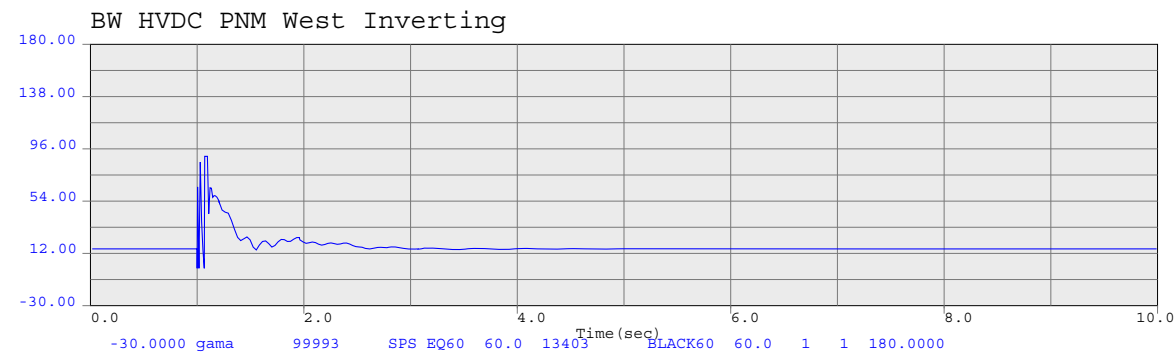
SPP 2000SC MODEL. 2001CASE 8/14/00
Base Case
WESTERN ELECTRICITY COORDINATING COUNCIL
2013-14 HW1A APPROVED BASE CASE
JANUARY 16, 2009
ALL COMMENTS FROM THE TSS REVIEW ARE INCLUDED
3-Phase fault near the Rio Puerco end of the RP-FC 345 kV line
Clear RP-FC 345 kV line in 4 cycles

Broadview 297 MW Type 4 TSR



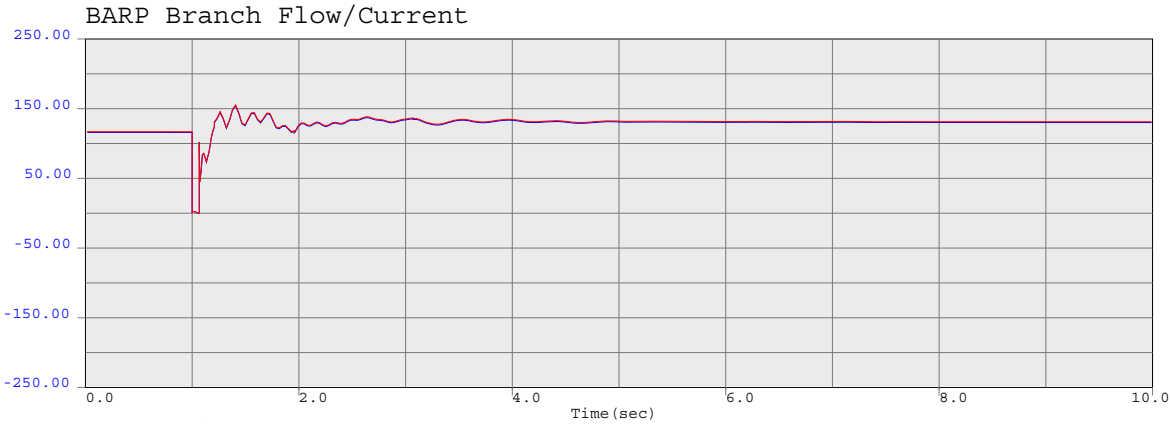






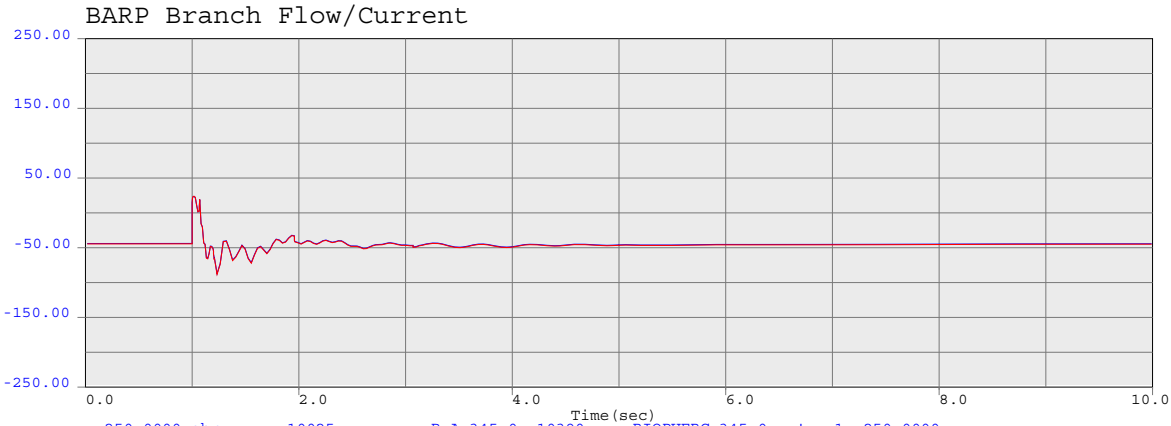
SPP 2000SC MODEL. 2001CASE 8/14/00
Base Case
WESTERN ELECTRICITY COORDINATING COUNCIL
2013-14 HW1A APPROVED BASE CASE
JANUARY 16, 2009
ALL COMMENTS FROM THE TSS REVIEW ARE INCLUDED
3-Phase fault near the Rio Puerco end of the RP-FC 345 kV line
Clear RP-FC 345 kV line in 4 cycles

BARP Branch Flow/Current



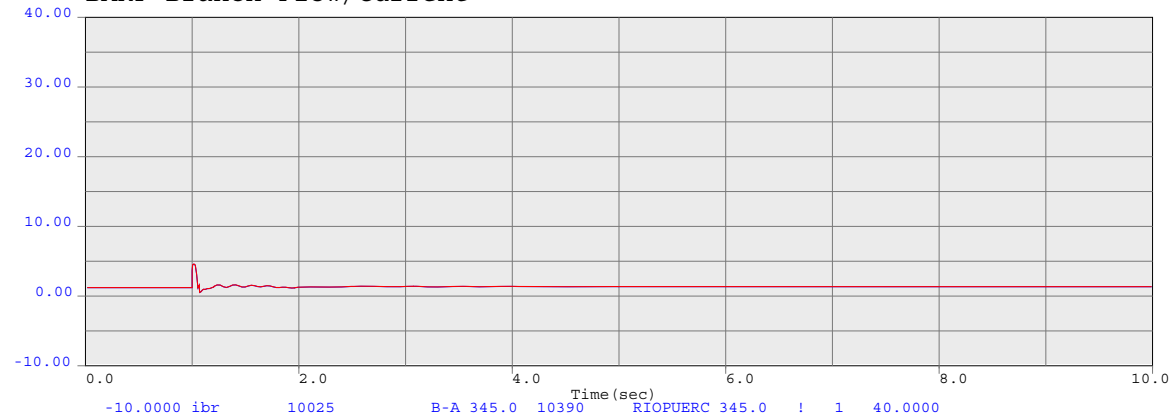
-250.0000 pbr 10025 B-A 345.0 10390 RIOPUERC 345.0 ! 1 250.0000
-250.0000 pbr 10025 B-A 345.0 10390 RIOPUERC 345.0 ! 2 250.0000

BARP Branch Flow/Current



-250.0000 qbr 10025 B-A 345.0 10390 RIOPUERC 345.0 ! 1 250.0000
-250.0000 qbr 10025 B-A 345.0 10390 RIOPUERC 345.0 ! 2 250.0000

BARP Branch Flow/Current



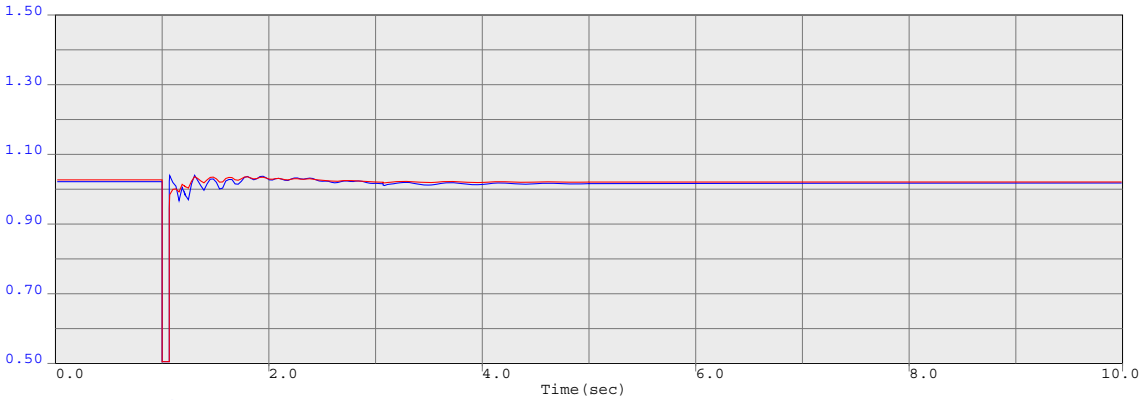
-10.0000 ibr 10025 B-A 345.0 10390 RIOPUERC 345.0 ! 1 40.0000
-10.0000 ibr 10025 B-A 345.0 10390 RIOPUERC 345.0 ! 2 40.0000

SPP 2000SC MODEL. 2001CASE 8/14/00
Base Case
WESTERN ELECTRICITY COORDINATING COUNCIL
2013-14 HW1A APPROVED BASE CASE
JANUARY 16, 2009
ALL COMMENTS FROM THE TSS REVIEW ARE INCLUDED
3-Phase fault near the Rio Puerco end of the RP-FC 345 kV line
Clear RP-FC 345 kV line in 4 cycles

Contingency 7 - BA 345/115 kV Transformer and BA – Rio Puerco 345 kV line (BAHBALRP)

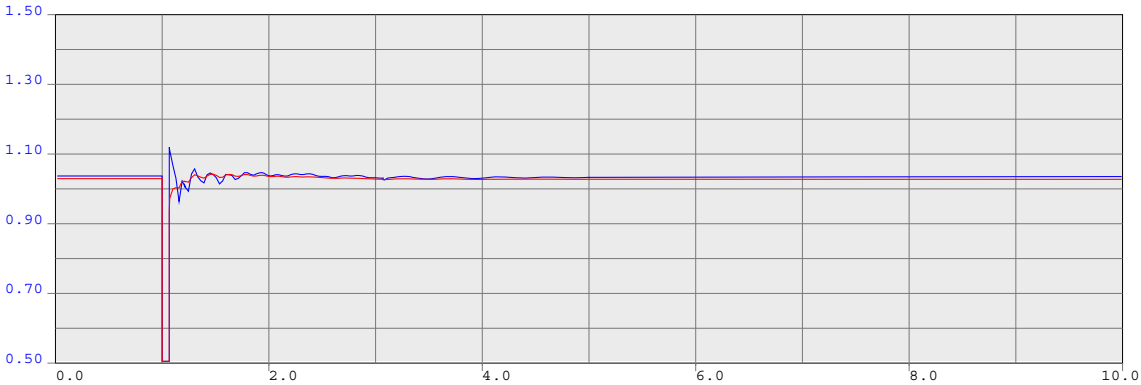
Broadview 297 MW Type 4 TSR

BUS VOLTAGE



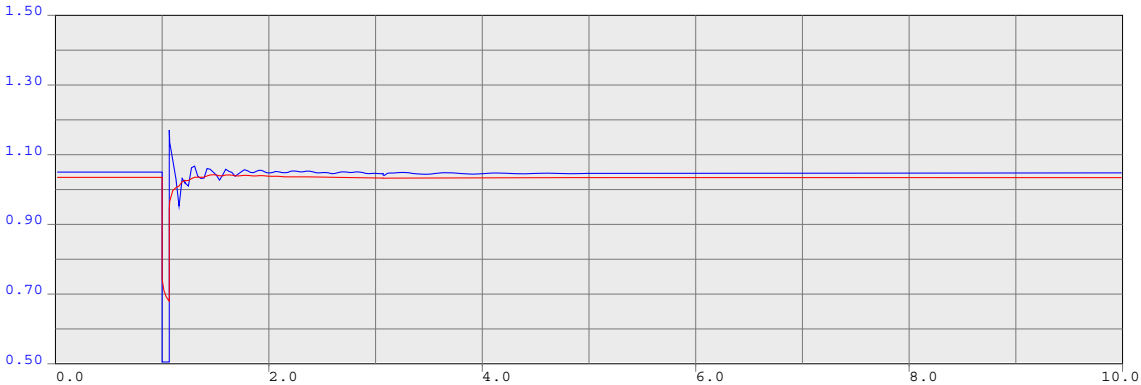
0.5000 vbug	10116	GUADLUPE 345.0	0	0.0	1	1	1.5000
0.5000 vbug	10025	B-A 345.0	0	0.0	1	1	1.5000

BUS VOLTAGE



0.5000 vbug	10999	TAIBANMS 345.0	0	0.0	1	1	1.5000
0.5000 vbus	10390	RIOPUERC 345.0	0	0.0	1	1	1.5000

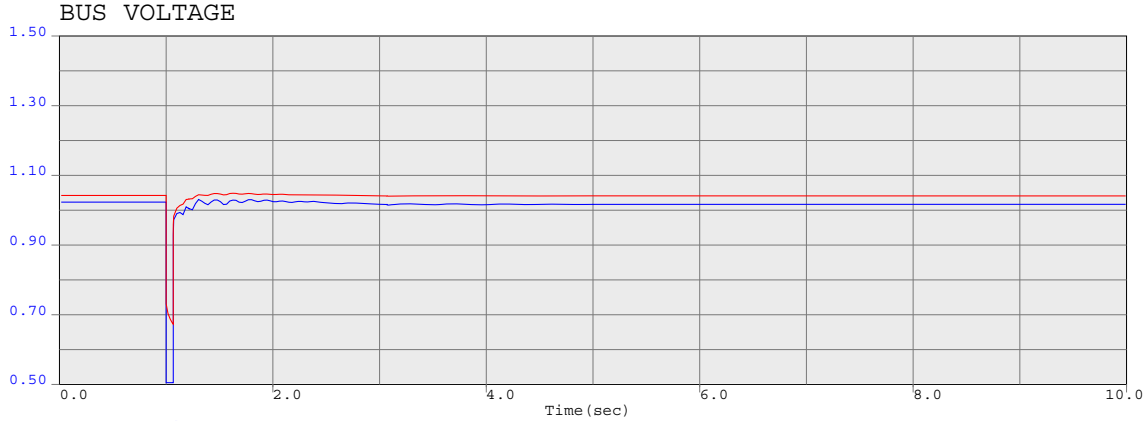
BUS VOLTAGE



0.5000 vbug	13402	BLACKWTR 345.0	0	0.0	1	1	1.5000
0.5000 vbus	10011	AMBROSIA 230.0	0	0.0	1	1	1.5000

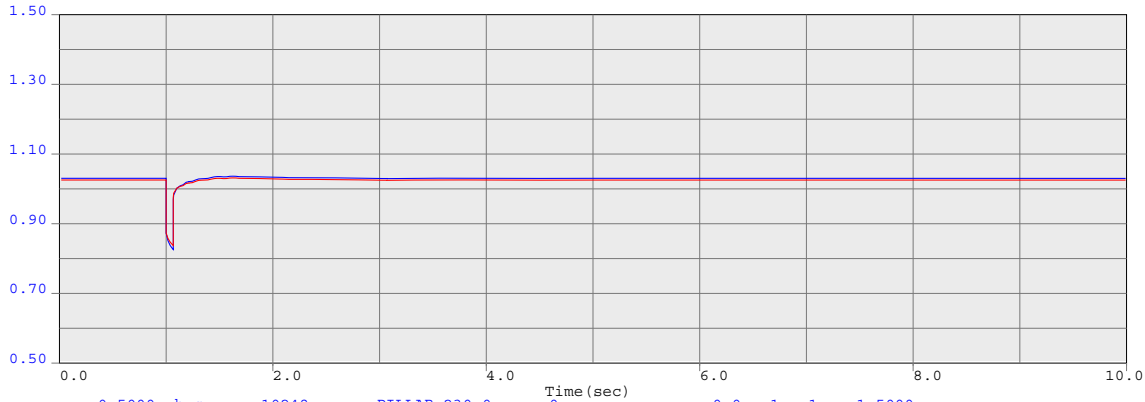
SPP 2000SC MODEL. 2001CASE 8/14/00
Base Case
WESTERN ELECTRICITY COORDINATING COUNCIL
2013-14 HW1A APPROVED BASE CASE
JANUARY 16, 2009
ALL COMMENTS FROM THE TSS REVIEW ARE INCLUDED
3-Phase fault near the BA end of the BA-RP 345 kV line
Trip BA-RP 345 kV line & BA 345/115 kV transformer in 4 cycles

BUS VOLTAGE



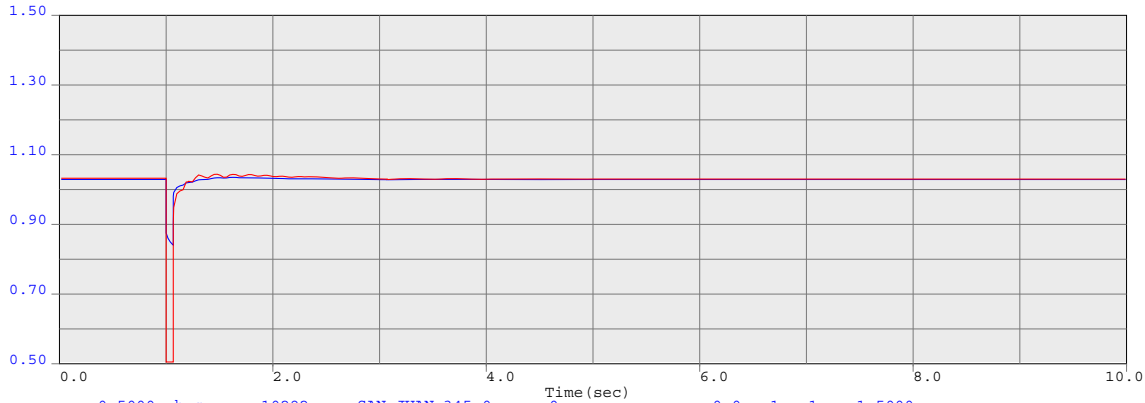
0.5000 vbus	10229	NORTON 345.0	0	0.0	1	1	1.5000
0.5000 vbus	10232	OJO 345.0	0	0.0	1	1	1.5000

BUS VOLTAGE



0.5000 vbus	10248	PILLAR 230.0	0	0.0	1	1	1.5000
0.5000 vbus	10291	SAN_JUAN 230.0	0	0.0	1	1	1.5000

BUS VOLTAGE

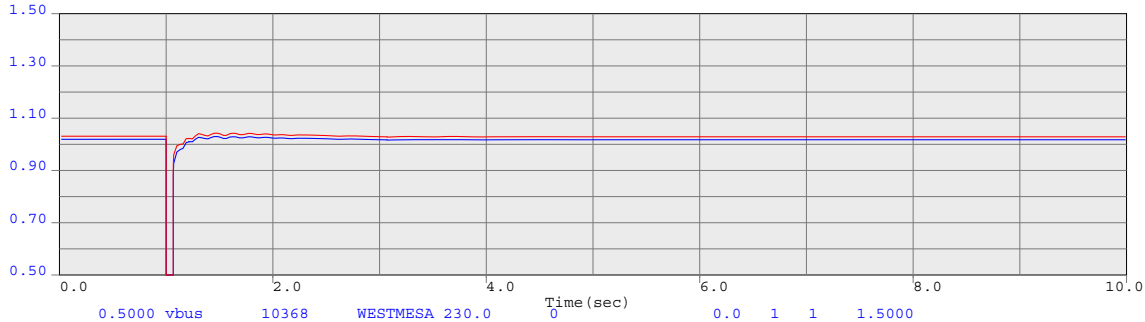


0.5000 vbus	10292	SAN_JUAN 345.0	0	0.0	1	1	1.5000
0.5000 vbus	10294	SANDIA 345.0	0	0.0	1	1	1.5000

SPP 2000SC MODEL. 2001CASE 8/14/00
Base Case
WESTERN ELECTRICITY COORDINATING COUNCIL
2013-14 HW1A APPROVED BASE CASE
JANUARY 16, 2009
ALL COMMENTS FROM THE TSS REVIEW ARE INCLUDED
3-Phase fault near the BA end of the BA-RP 345 kV line
Trip BA-RP 345 kV line & BA 345/115 kV transformer in 4 cycles

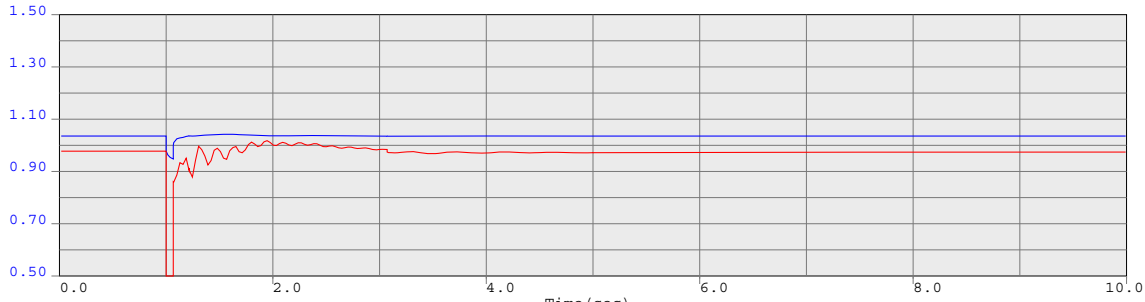
Broadview 297 MW Type 4 TSR

BUS VOLTAGE



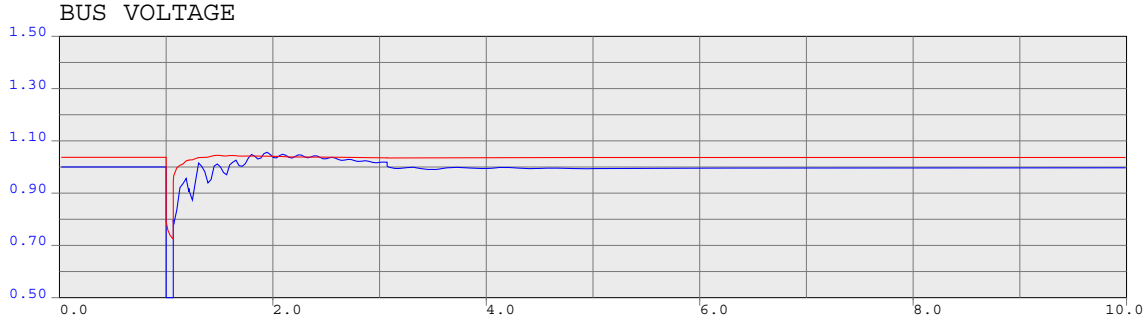
0.5000 vbus 10368 WESTMESA 230.0 0 0.0 1 1 1.5000
0.5000 vbus 10369 WESTMESA 345.0 0 0.0 1 1 1.5000

BUS VOLTAGE



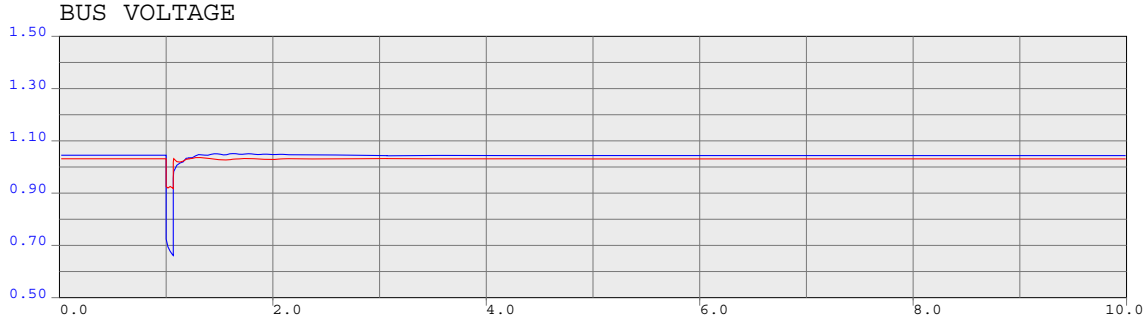
0.5000 vbus 10393 LEF 345.0 0 0.0 1 1 1.5000
0.5000 vbus 10991 ARGONNE4 138.0 0 0.0 1 1 1.5000

BUS VOLTAGE



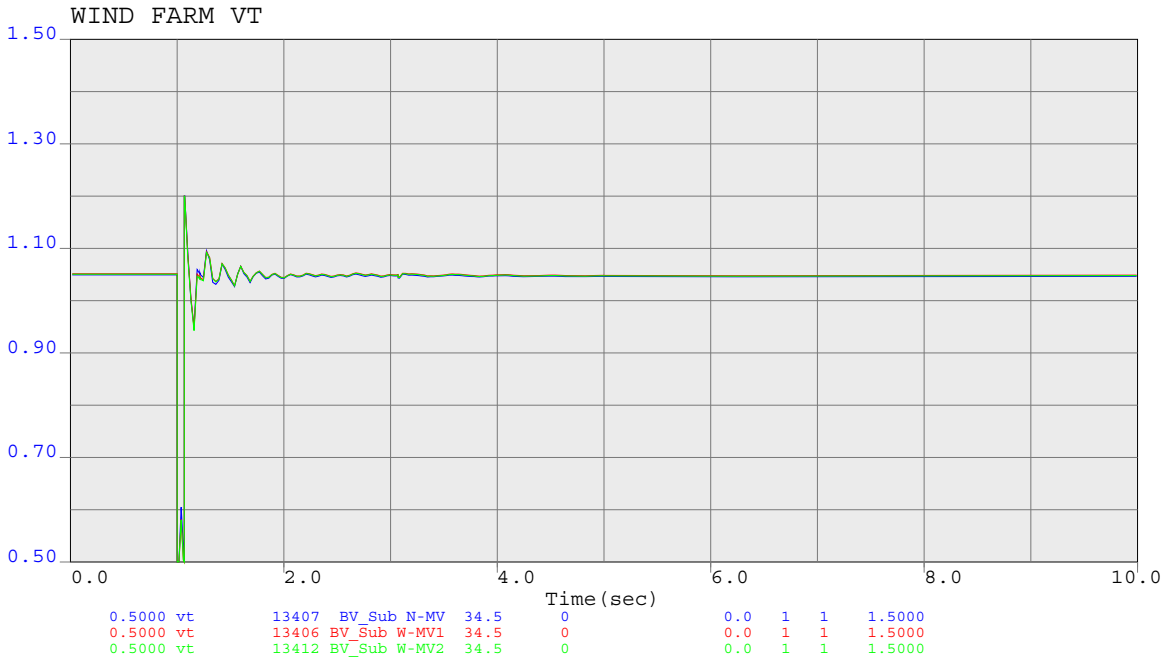
0.5000 vbus 10992 ARGONNE3 138.0 0 0.0 1 1 1.5000
0.5000 vbus 12057 PEGS 230.0 0 0.0 1 1 1.5000

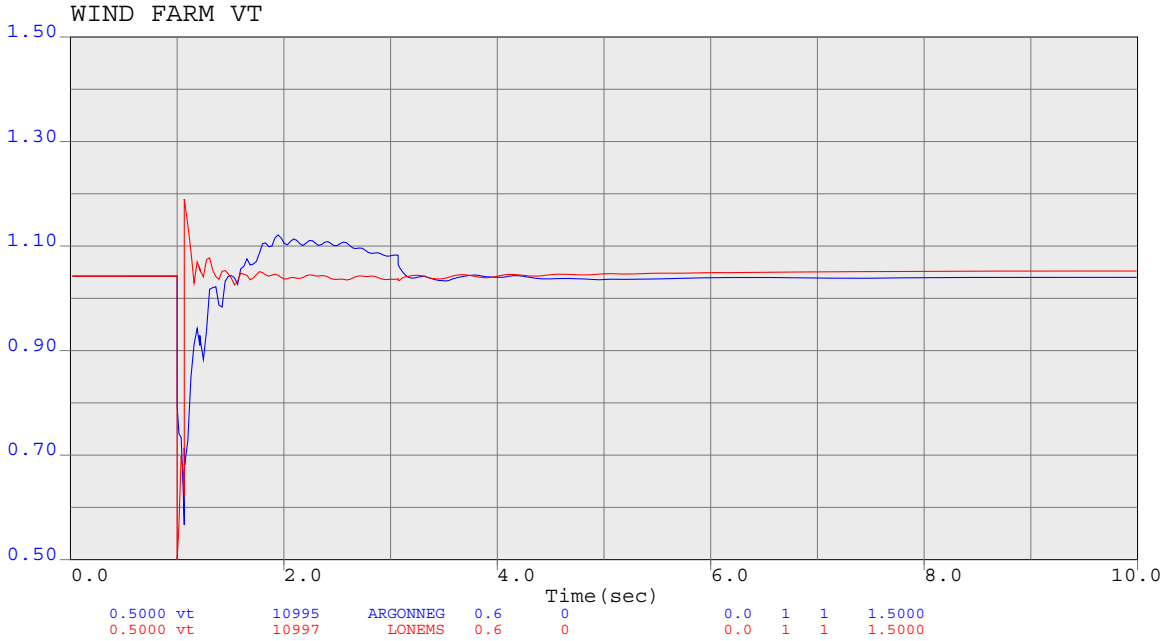
BUS VOLTAGE

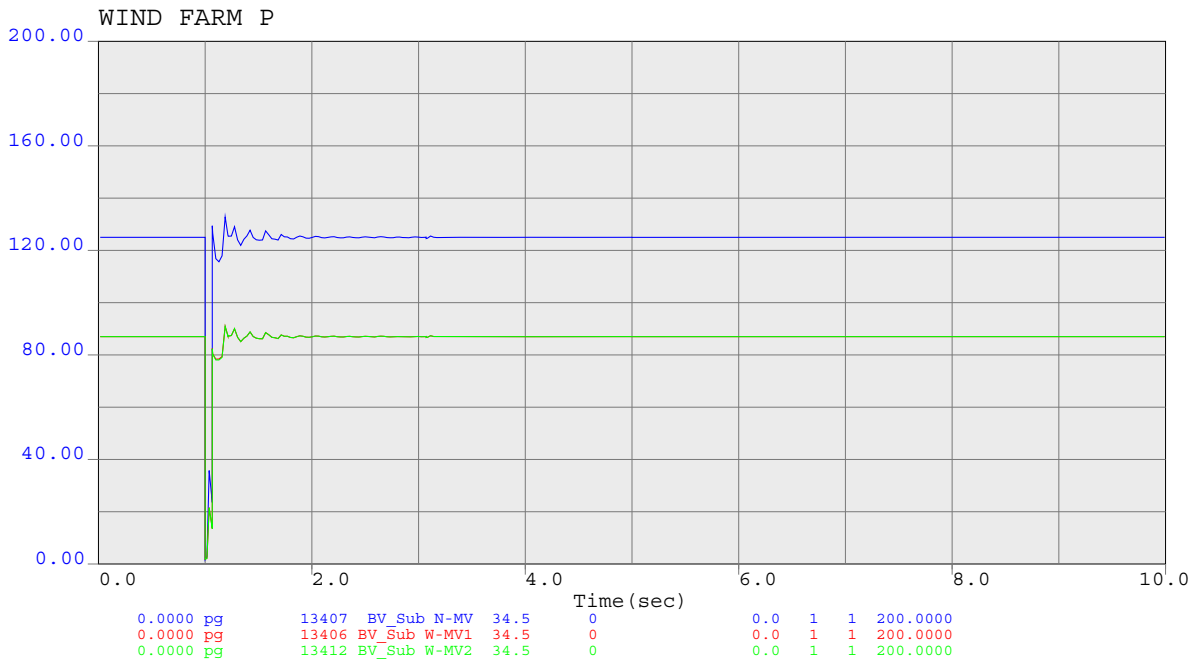


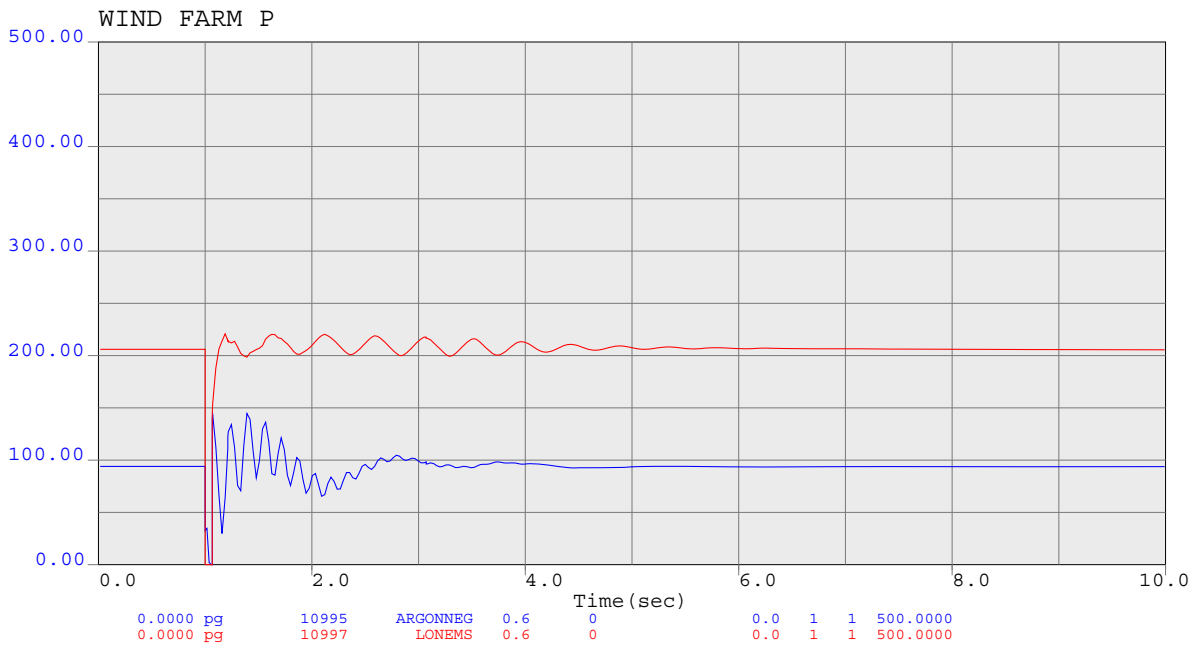
0.5000 vbus 12082 TAOS 345.0 0 0.0 1 1 1.5000
0.5000 vbus 12101 GLADSTON 230.0 0 0.0 1 1 1.5000

SPP 2000SC MODEL. 2001CASE 8/14/00
Base Case
WESTERN ELECTRICITY COORDINATING COUNCIL
2013-14 HW1A APPROVED BASE CASE
JANUARY 16, 2009
ALL COMMENTS FROM THE TSS REVIEW ARE INCLUDED
3-Phase fault near the BA end of the BA-RP 345 kV line
Trip BA-RP 345 kV line & BA 345/115 kV transformer in 4 cycles

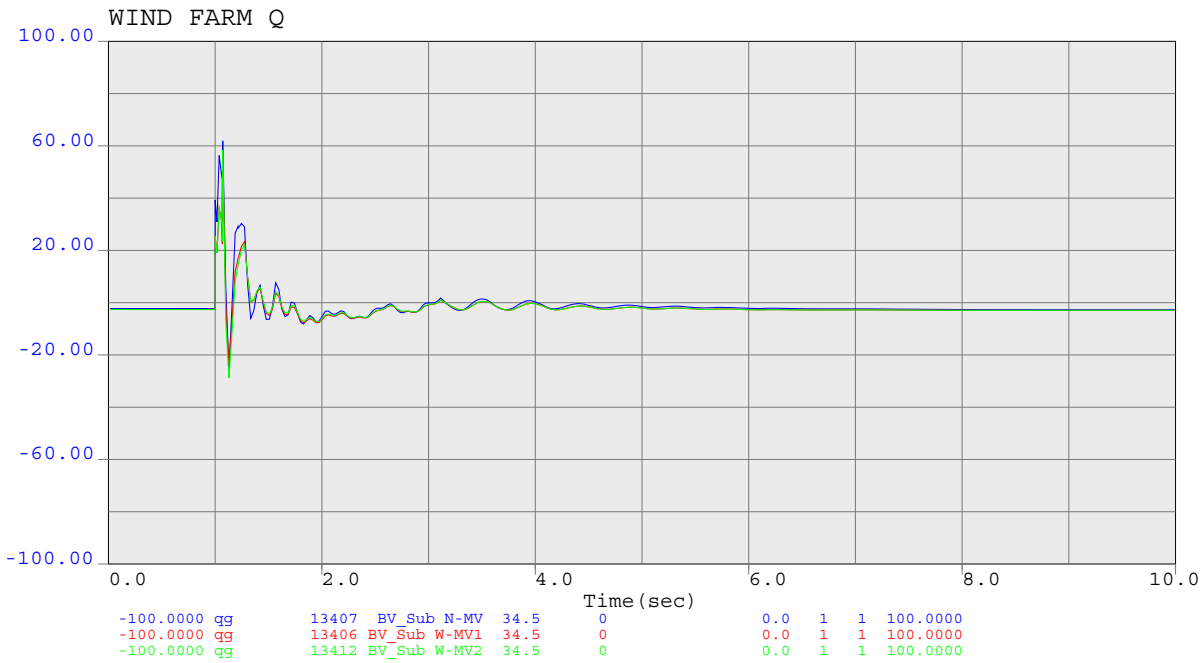

WIND FARM VT
1.50
1.30
1.10
0.90
0.70
0.50
0.0
2.0
4.0
6.0
8.0
10.0
Time(sec)
0.5000 vt 13407 BV_Sub N-MV 34.5 0 0.0 1 1 1.5000
0.5000 vt 13406 BV_Sub W-MV1 34.5 0 0.0 1 1 1.5000
0.5000 vt 13412 BV_Sub W-MV2 34.5 0 0.0 1 1 1.5000

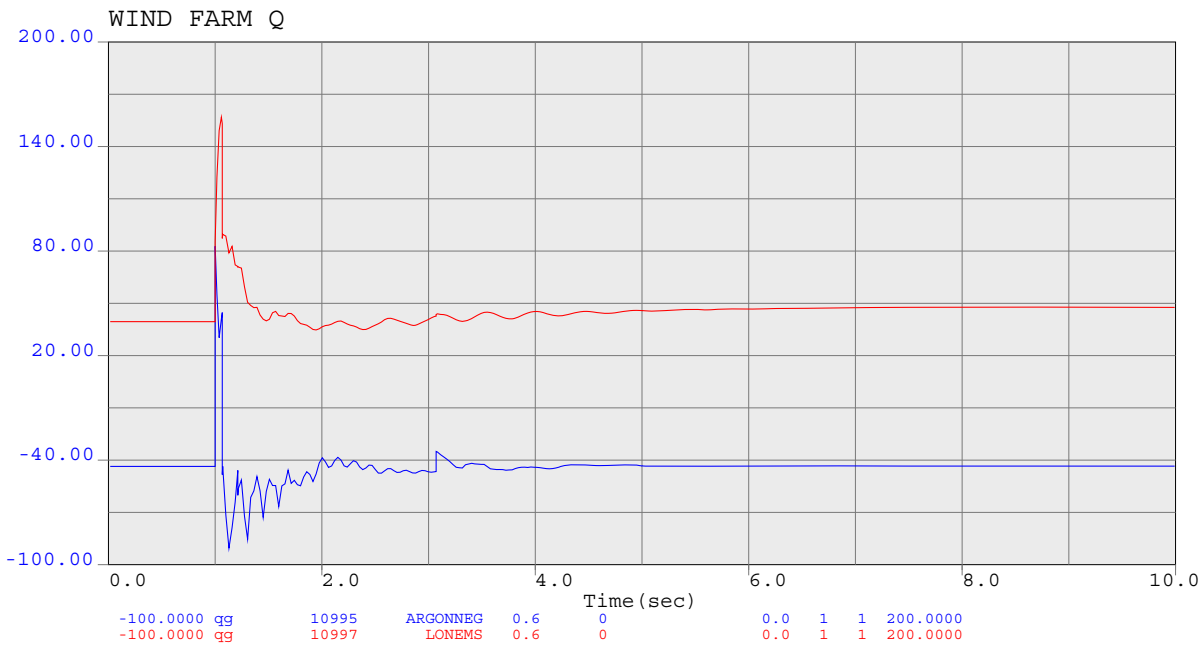

WIND FARM VT
1.50
1.30
1.10
0.90
0.70
0.50
0.0
2.0
4.0
6.0
8.0
10.0
Time(sec)
0.5000 vt 10995 ARGONNEG 0.6 0 0.0 1 1 1.5000
0.5000 vt 10997 LONEMS 0.6 0 0.0 1 1 1.5000





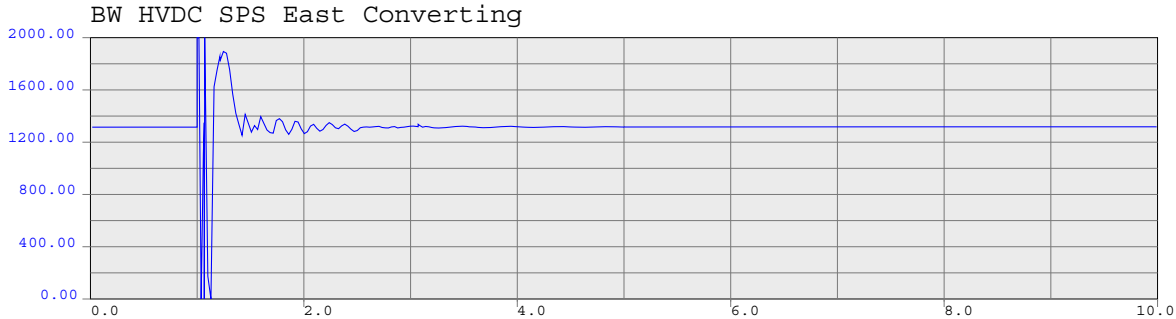
SPP 2000SC MODEL. 2001CASE 8/14/00
Base Case
WESTERN ELECTRICITY COORDINATING COUNCIL
2013-14 HW1A APPROVED BASE CASE
JANUARY 16, 2009
ALL COMMENTS FROM THE TSS REVIEW ARE INCLUDED
3-Phase fault near the BA end of the BA-RP 345 kV line
Trip BA-RP 345 kV line & BA 345/115 kV transformer in 4 cycles





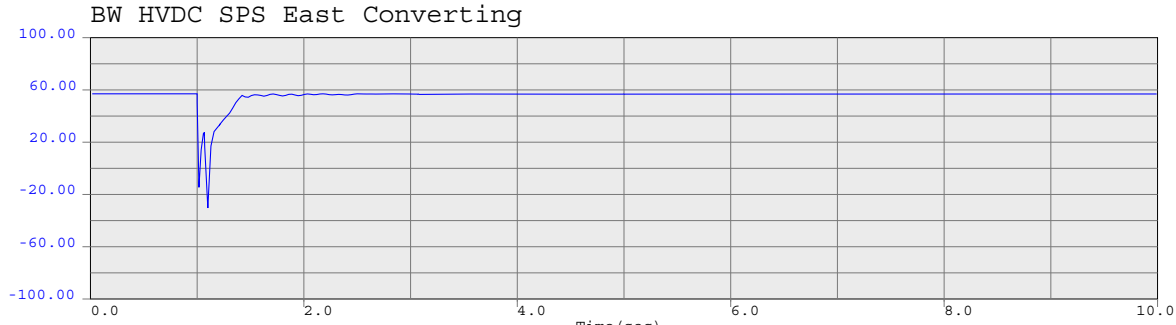
SPP 2000SC MODEL. 2001CASE 8/14/00
Base Case
WESTERN ELECTRICITY COORDINATING COUNCIL
2013-14 HW1A APPROVED BASE CASE
JANUARY 16, 2009
ALL COMMENTS FROM THE TSS REVIEW ARE INCLUDED
3-Phase fault near the BA end of the BA-RP 345 kV line
Trip BA-RP 345 kV line & BA 345/115 kV transformer in 4 cycles

BW HVDC SPS East Converting



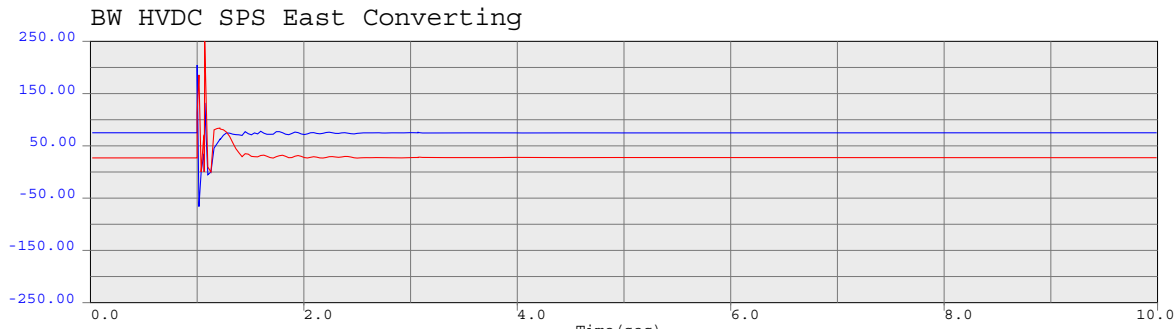
0.0000 idcr 99993 SPS EQ60 60.0 99993 SPS EQ60 60.0 1 1 2000.0000

BW HVDC SPS East Converting



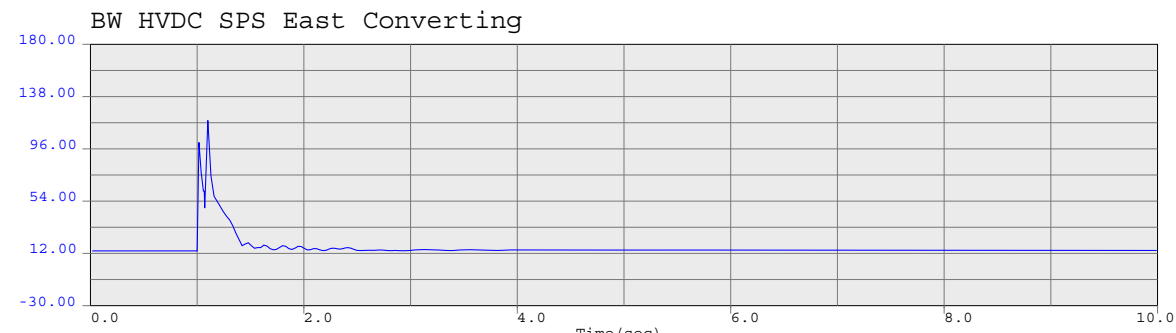
-100.0000 vdcr 99993 SPS EQ60 60.0 99993 SPS EQ60 60.0 1 1 100.0000

BW HVDC SPS East Converting



-250.0000 pacr 99993 SPS EQ60 60.0 99993 SPS EQ60 60.0 1 1 250.0000
-250.0000 qacr 99993 SPS EQ60 60.0 99993 SPS EQ60 60.0 1 1 250.0000

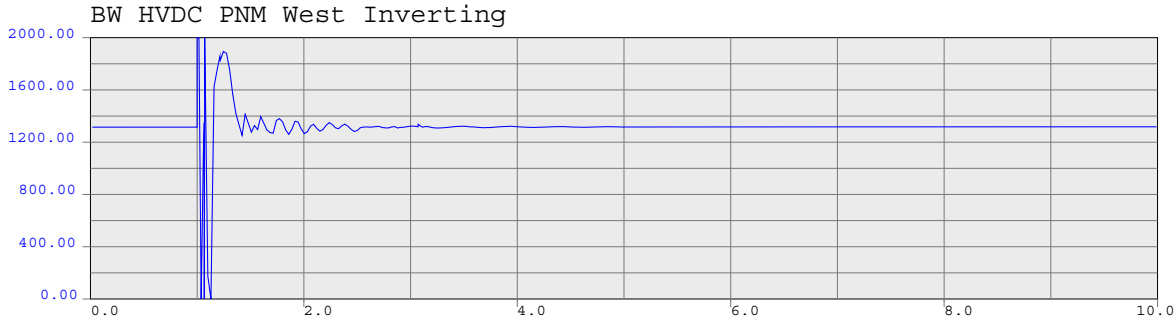
BW HVDC SPS East Converting



-30.0000 alpa 99993 SPS EQ60 60.0 99993 SPS EQ60 60.0 1 1 180.0000

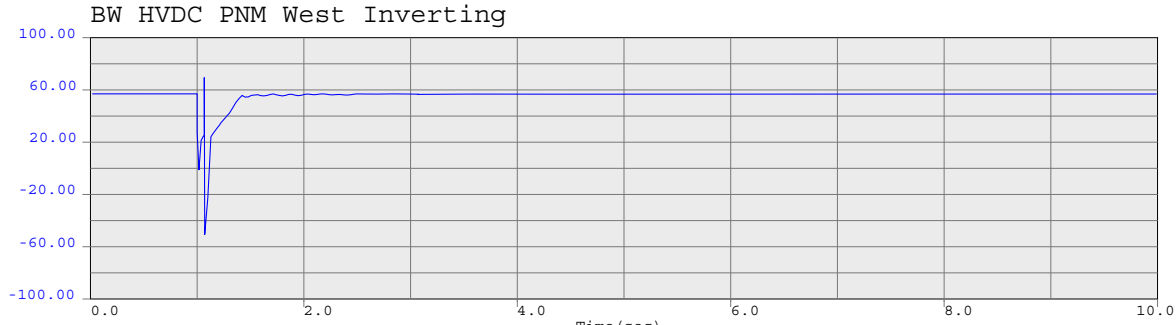
SPP 2000SC MODEL. 2001CASE 8/14/00
Base Case
WESTERN ELECTRICITY COORDINATING COUNCIL
2013-14 HW1A APPROVED BASE CASE
JANUARY 16, 2009
ALL COMMENTS FROM THE TSS REVIEW ARE INCLUDED
3-Phase fault near the BA end of the BA-RP 345 kV line
Trip BA-RP 345 kV line & BA 345/115 kV transformer in 4 cycles

BW HVDC PNM West Inverting



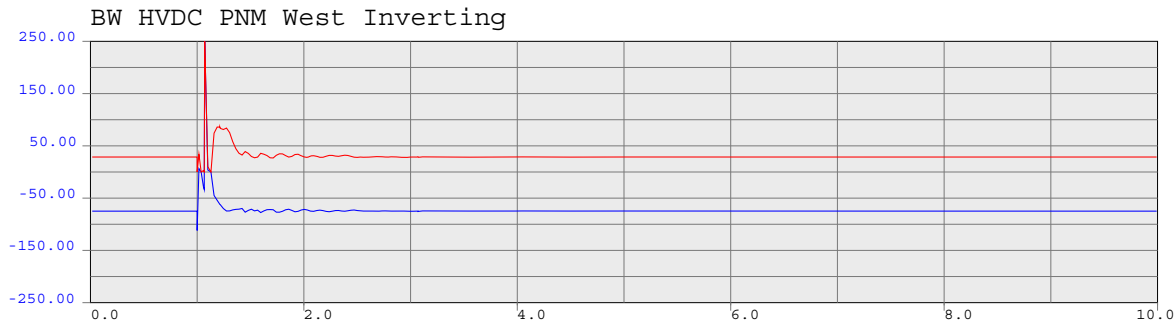
0.0000 idci 99993 SPS EQ60 60.0 13403 BLACK60 60.0 1 1 2000.0000

BW HVDC PNM West Inverting



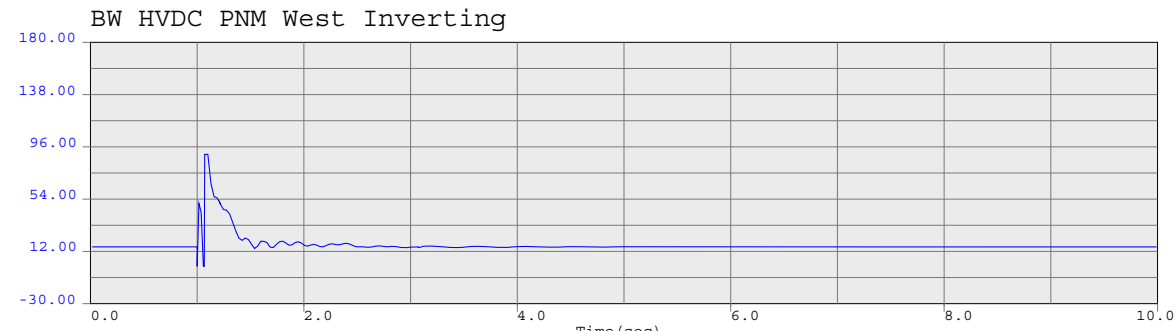
-100.0000 vdci 99993 SPS EQ60 60.0 13403 BLACK60 60.0 1 1 100.0000

BW HVDC PNM West Inverting



-250.0000 paci 99993 SPS EQ60 60.0 13403 BLACK60 60.0 1 1 250.0000
-250.0000 qaci 99993 SPS EQ60 60.0 13403 BLACK60 60.0 1 1 250.0000

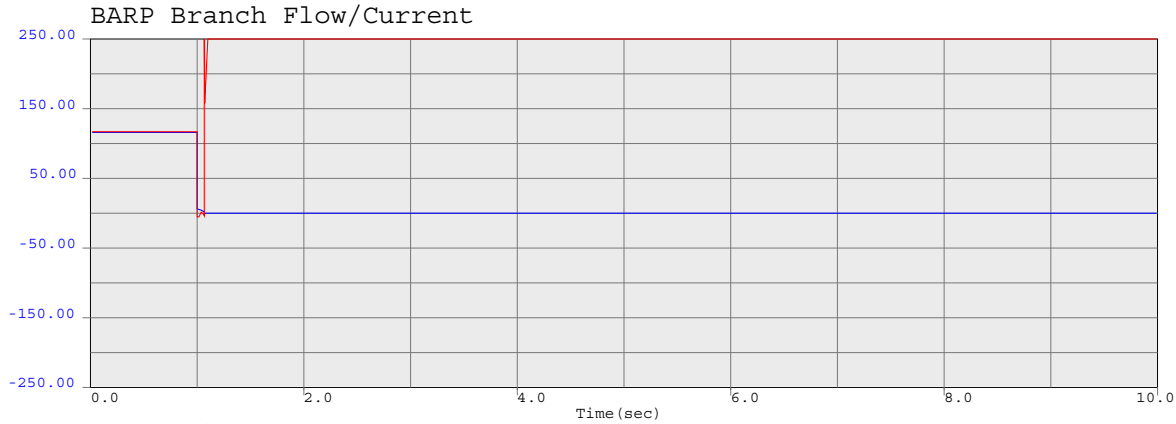
BW HVDC PNM West Inverting



-30.0000 gama 99993 SPS EQ60 60.0 13403 BLACK60 60.0 1 1 180.0000

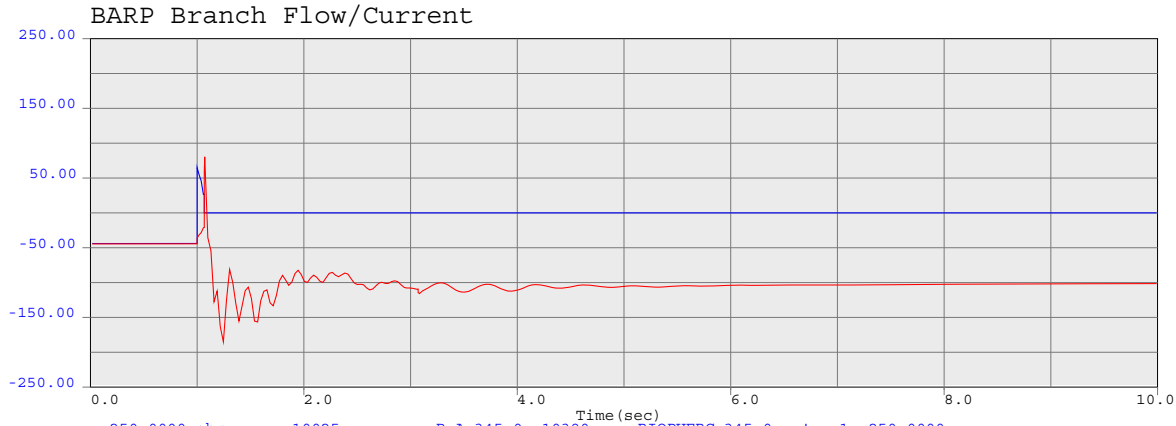
SPP 2000SC MODEL. 2001CASE 8/14/00
Base Case
WESTERN ELECTRICITY COORDINATING COUNCIL
2013-14 HW1A APPROVED BASE CASE
JANUARY 16, 2009
ALL COMMENTS FROM THE TSS REVIEW ARE INCLUDED
3-Phase fault near the BA end of the BA-RP 345 kV line
Trip BA-RP 345 kV line & BA 345/115 kV transformer in 4 cycles

BARP Branch Flow/Current



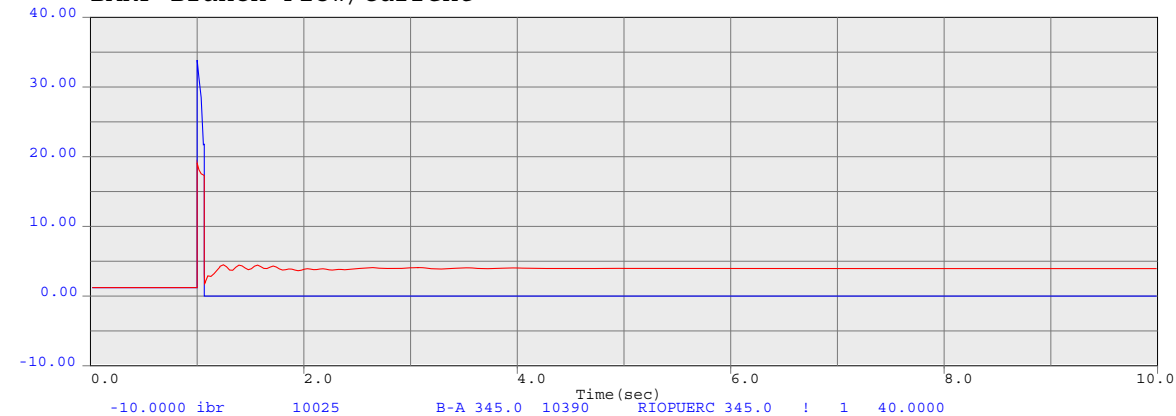
-250.0000 pbr 10025 B-A 345.0 10390 RIOPUERC 345.0 ! 1 250.0000
-250.0000 pbr 10025 B-A 345.0 10390 RIOPUERC 345.0 ! 2 250.0000

BARP Branch Flow/Current



-250.0000 qbr 10025 B-A 345.0 10390 RIOPUERC 345.0 ! 1 250.0000
-250.0000 qbr 10025 B-A 345.0 10390 RIOPUERC 345.0 ! 2 250.0000

BARP Branch Flow/Current



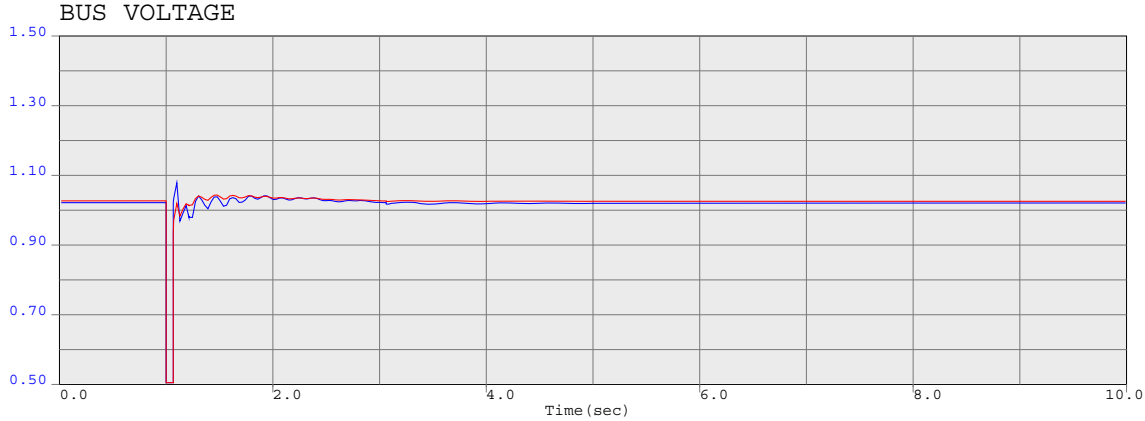
-10.0000 ibr 10025 B-A 345.0 10390 RIOPUERC 345.0 ! 1 40.0000
-10.0000 ibr 10025 B-A 345.0 10390 RIOPUERC 345.0 ! 2 40.0000

SPP 2000SC MODEL. 2001CASE 8/14/00
Base Case
WESTERN ELECTRICITY COORDINATING COUNCIL
2013-14 HW1A APPROVED BASE CASE
JANUARY 16, 2009
ALL COMMENTS FROM THE TSS REVIEW ARE INCLUDED
3-Phase fault near the BA end of the BA-RP 345 kV line
Trip BA-RP 345 kV line & BA 345/115 kV transformer in 4 cycles

Contingency 8 - Rio Puerco-West Mesa & West Mesa 345/115 kV Transformer (RPWMHL2)

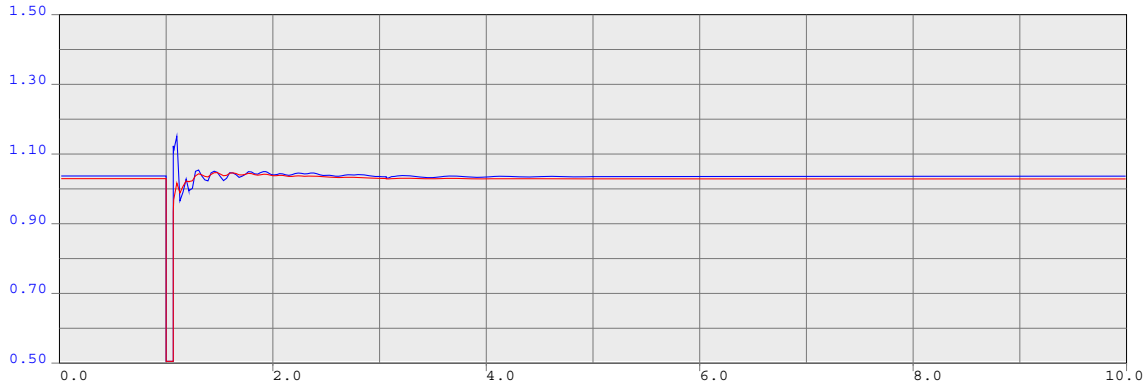
Broadview 297 MW Type 4 TSR

BUS VOLTAGE



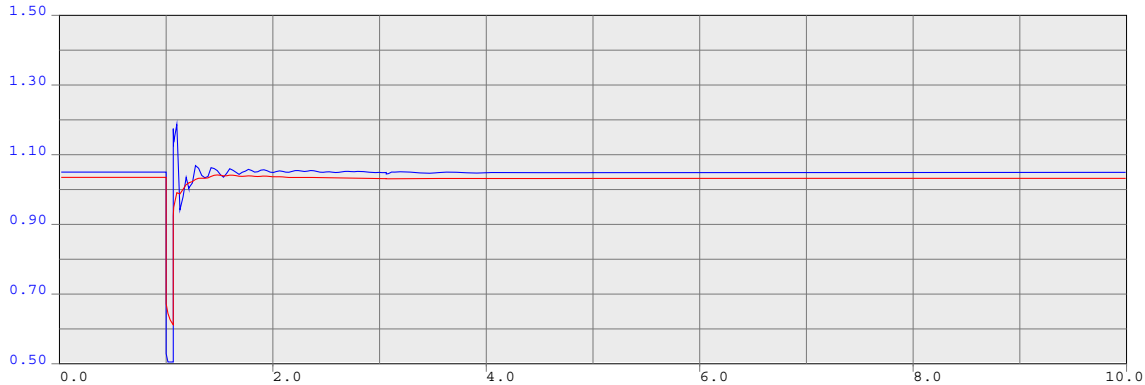
0.5000 vbug 10116 GUADLUPE 345.0 0 0.0 1 1 1.5000
0.5000 vbug 10025 B-A 345.0 0 0.0 1 1 1.5000

BUS VOLTAGE



0.5000 vbug 10999 TAIBANMS 345.0 0 0.0 1 1 1.5000
0.5000 vbus 10390 RIOPUERC 345.0 0 0.0 1 1 1.5000

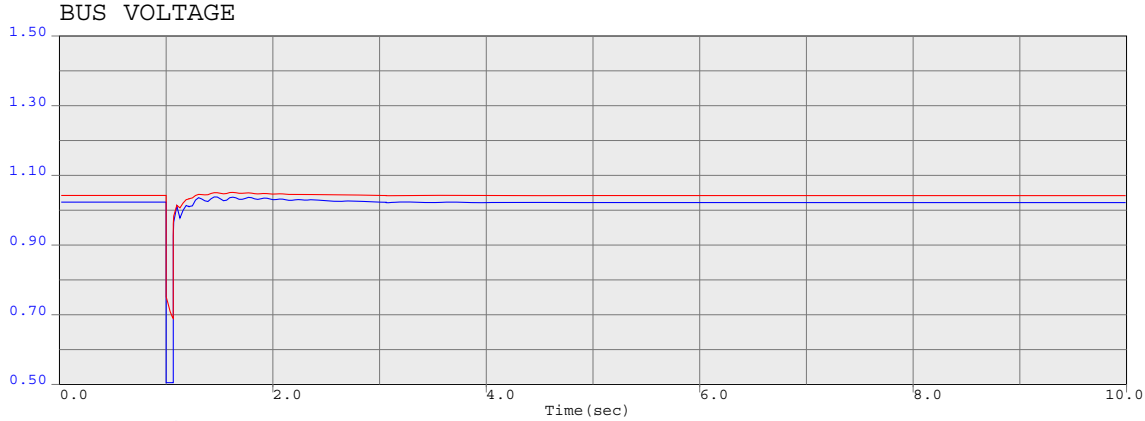
BUS VOLTAGE



0.5000 vbug 13402 BLACKWTR 345.0 0 0.0 1 1 1.5000
0.5000 vbus 10011 AMBROSIA 230.0 0 0.0 1 1 1.5000

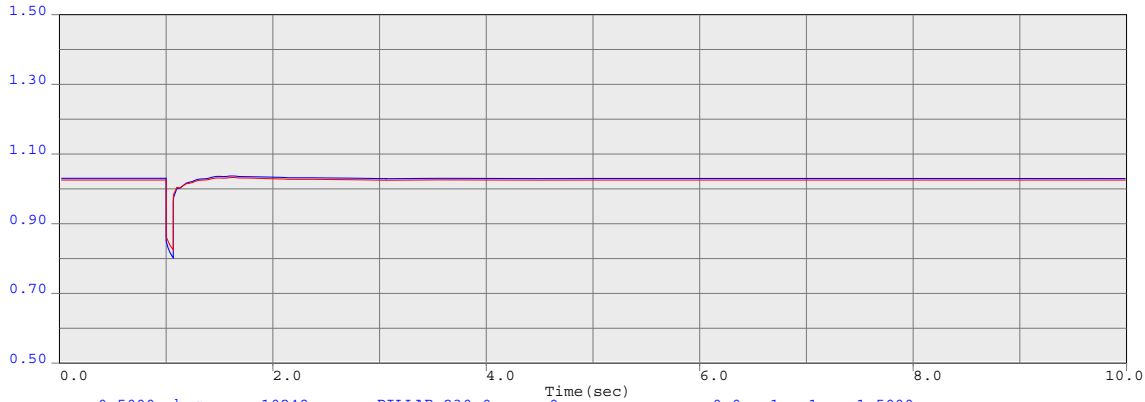
SPP 2000SC MODEL. 2001CASE 8/14/00
Base Case
WESTERN ELECTRICITY COORDINATING COUNCIL
2013-14 HW1A APPROVED BASE CASE
JANUARY 16, 2009
ALL COMMENTS FROM THE TSS REVIEW ARE INCLUDED
3-Phase fault near the WM end of the WM-RP 345 kV line
Trip WM-RP 345 kV line & WM 345/115 kV transformer in 4 cycles

BUS VOLTAGE



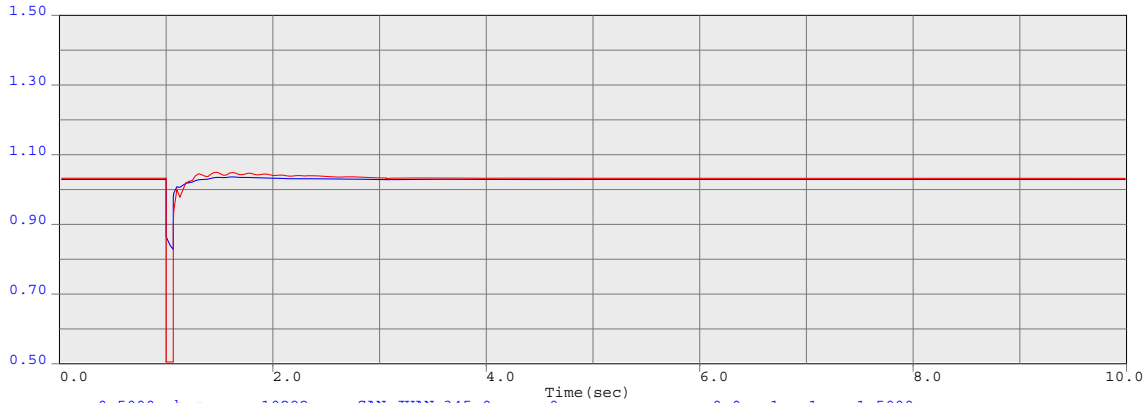
0.5000 vbus 10229 NORTON 345.0 0 0.0 1 1 1.5000
0.5000 vbus 10232 OJO 345.0 0 0.0 1 1 1.5000

BUS VOLTAGE



0.5000 vbus 10248 PILLAR 230.0 0 0.0 1 1 1.5000
0.5000 vbus 10291 SAN_JUAN 230.0 0 0.0 1 1 1.5000

BUS VOLTAGE

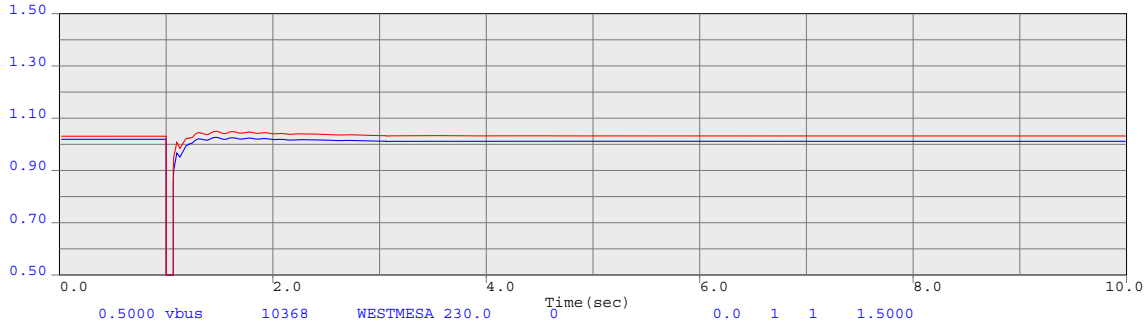


0.5000 vbus 10292 SAN_JUAN 345.0 0 0.0 1 1 1.5000
0.5000 vbus 10294 SANDIA 345.0 0 0.0 1 1 1.5000

SPP 2000SC MODEL. 2001CASE 8/14/00
Base Case
WESTERN ELECTRICITY COORDINATING COUNCIL
2013-14 HW1A APPROVED BASE CASE
JANUARY 16, 2009
ALL COMMENTS FROM THE TSS REVIEW ARE INCLUDED
3-Phase fault near the WM end of the WM-RP 345 kV line
Trip WM-RP 345 kV line & WM 345/115 kV transformer in 4 cycles

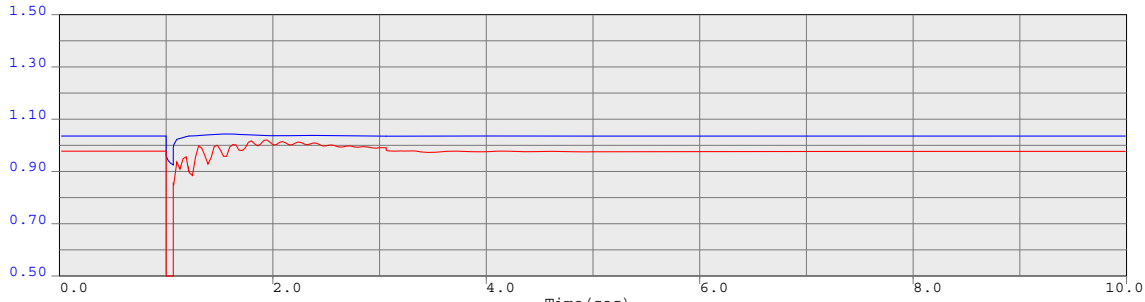
Broadview 297 MW Type 4 TSR

BUS VOLTAGE



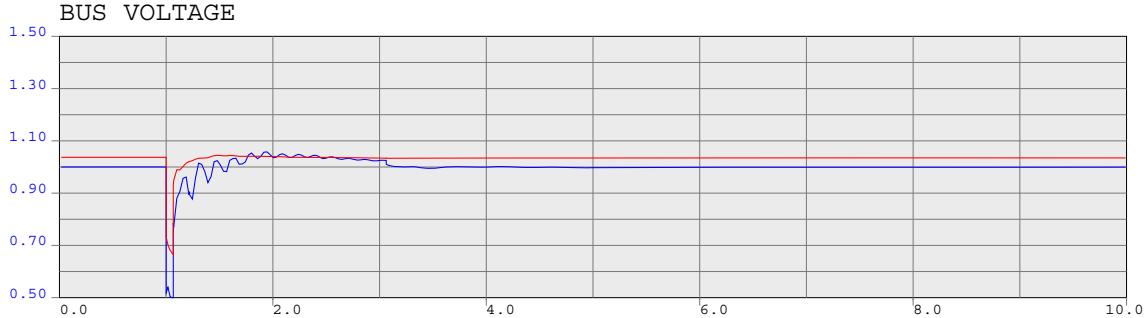
0.5000 vbus 10368 WESTMESA 230.0 0 0.0 1 1 1.5000
0.5000 vbus 10369 WESTMESA 345.0 0 0.0 1 1 1.5000

BUS VOLTAGE



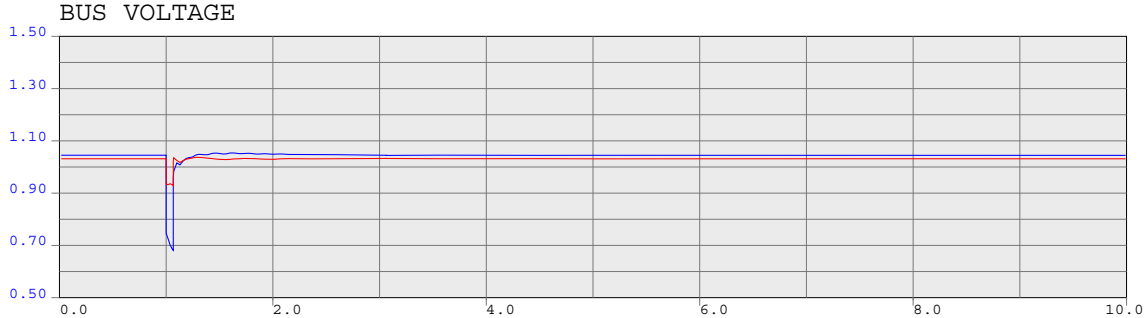
0.5000 vbus 10393 LEF 345.0 0 0.0 1 1 1.5000
0.5000 vbus 10991 ARGONNE4 138.0 0 0.0 1 1 1.5000

BUS VOLTAGE



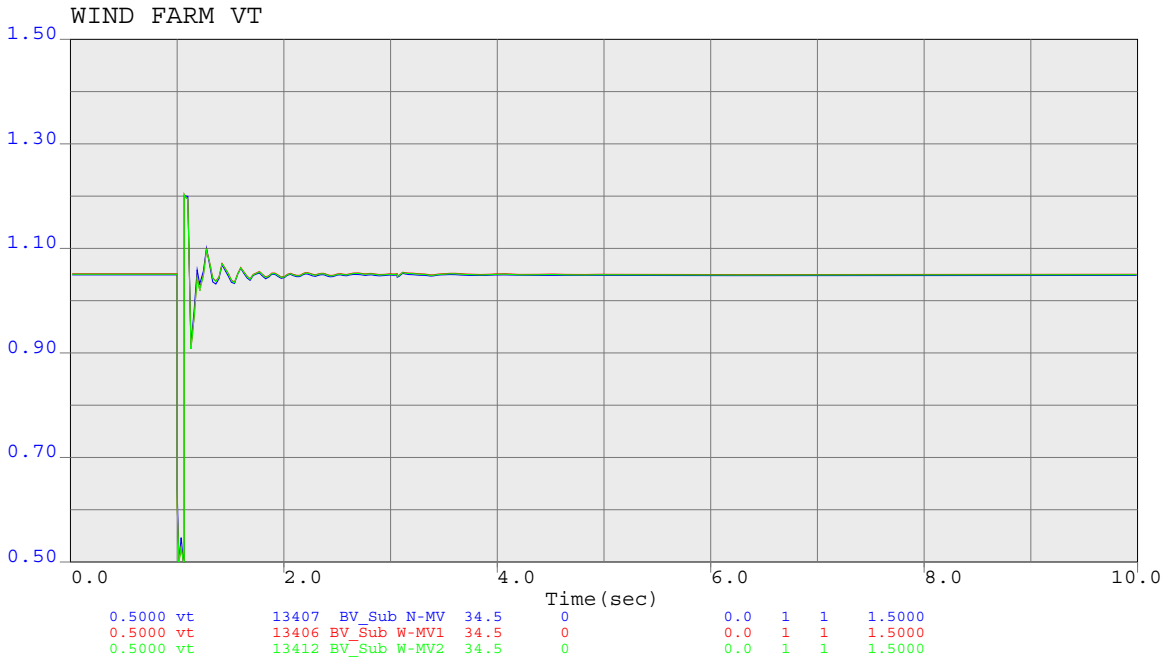
0.5000 vbus 10992 ARGONNE3 138.0 0 0.0 1 1 1.5000
0.5000 vbus 12057 PEGS 230.0 0 0.0 1 1 1.5000

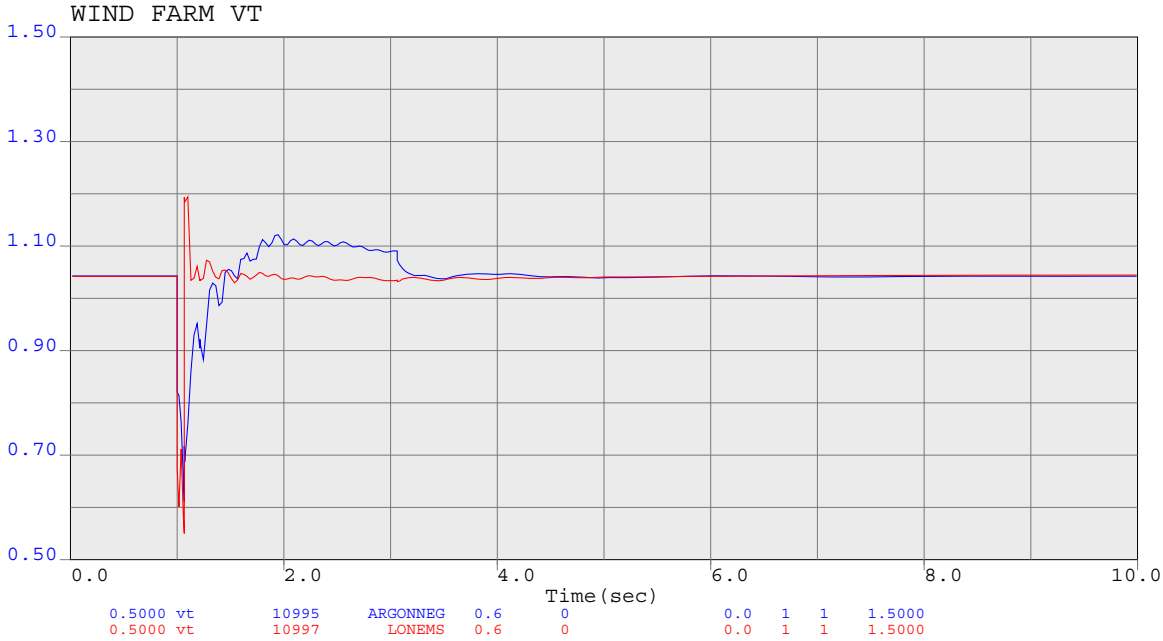
BUS VOLTAGE



0.5000 vbus 12082 TAOS 345.0 0 0.0 1 1 1.5000
0.5000 vbus 12101 GLADSTON 230.0 0 0.0 1 1 1.5000

SPP 2000SC MODEL. 2001CASE 8/14/00
Base Case
WESTERN ELECTRICITY COORDINATING COUNCIL
2013-14 HW1A APPROVED BASE CASE
JANUARY 16, 2009
ALL COMMENTS FROM THE TSS REVIEW ARE INCLUDED
3-Phase fault near the WM end of the WM-RP 345 kV line
Trip WM-RP 345 kV line & WM 345/115 kV transformer in 4 cycles





SPP 2000SC MODEL. 2001CASE 8/14/00
Base Case
WESTERN ELECTRICITY COORDINATING COUNCIL
2013-14 HW1A APPROVED BASE CASE
JANUARY 16, 2009
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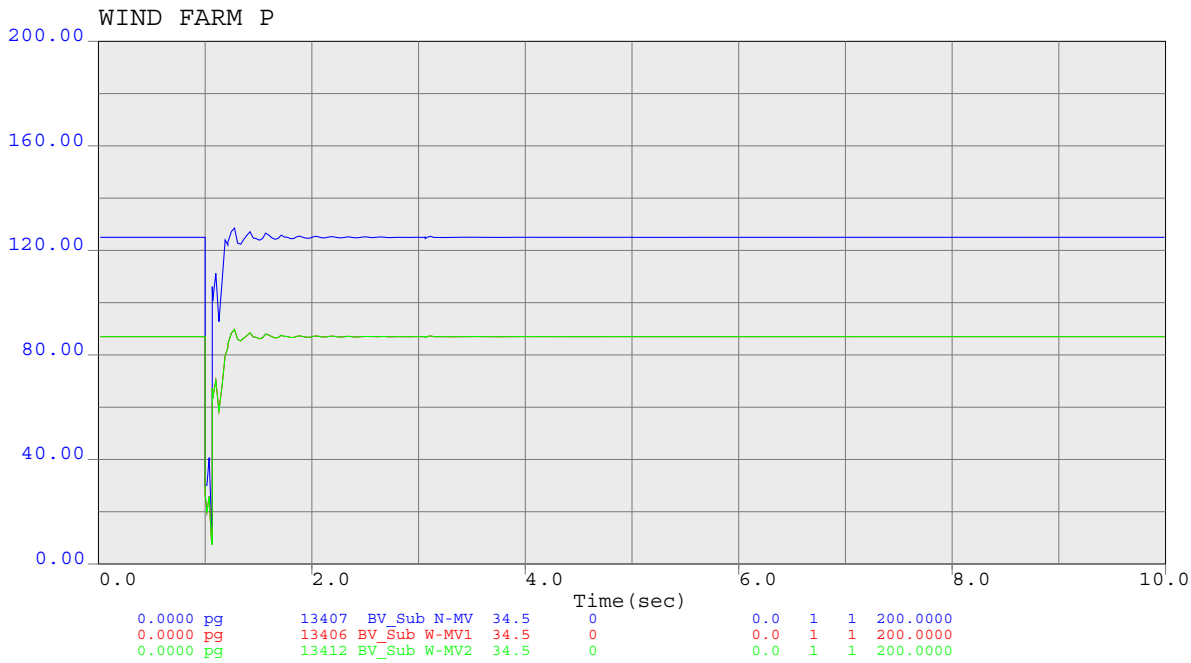
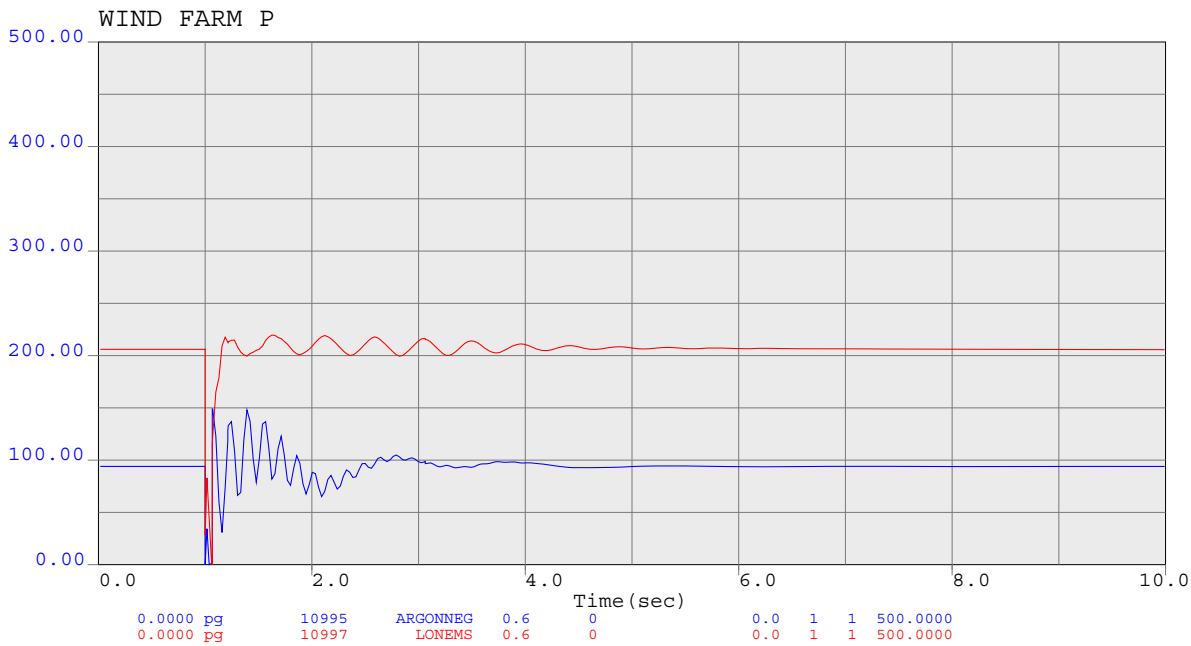
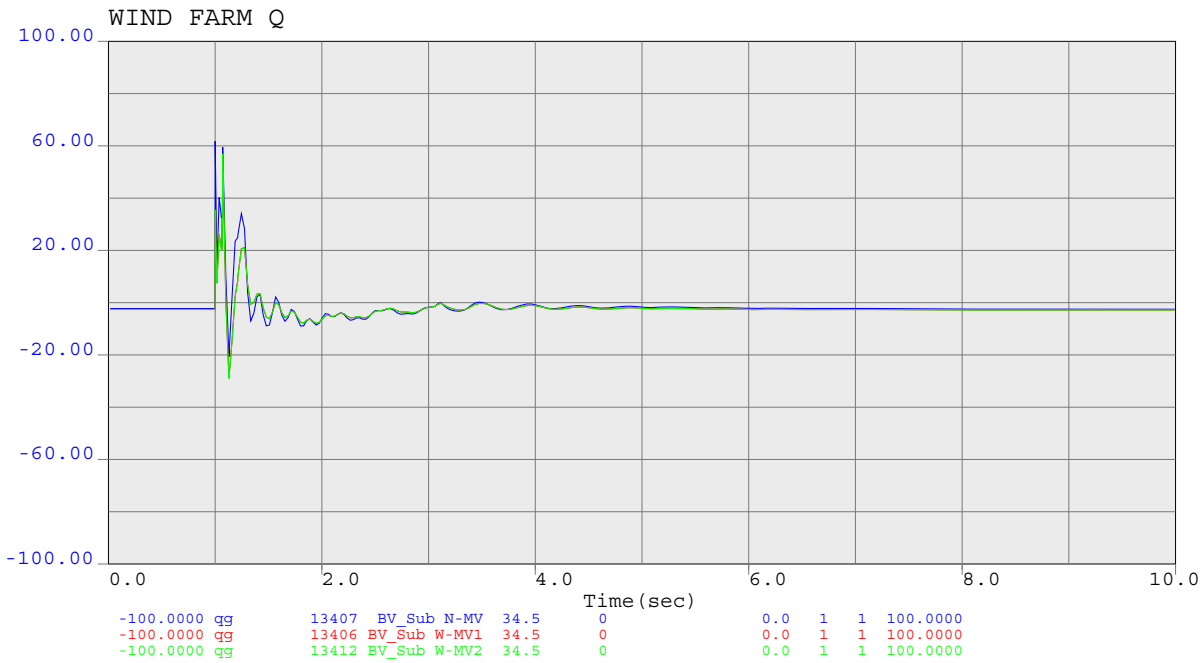
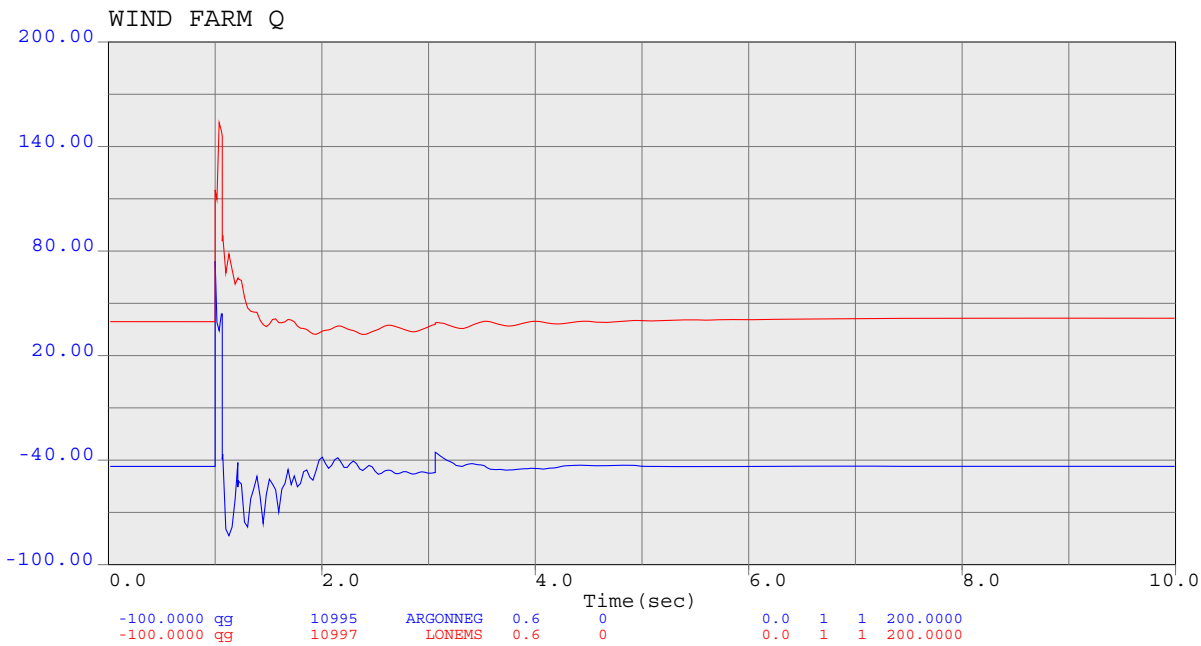
Trip WM-RP 345 kV line & WM 345/115 kV transformer in 4 cycles


WIND FARM P
200.00
160.00
120.00
80.00
40.00
0.00
0.0
2.0
4.0
6.0
8.0
10.0
Time(sec)
0.0000 pg 13407 BV_Sub N-MV 34.5 0 0.0 1 1 200.0000
0.0000 pg 13406 BV_Sub W-MV1 34.5 0 0.0 1 1 200.0000
0.0000 pg 13412 BV_Sub W-MV2 34.5 0 0.0 1 1 200.0000

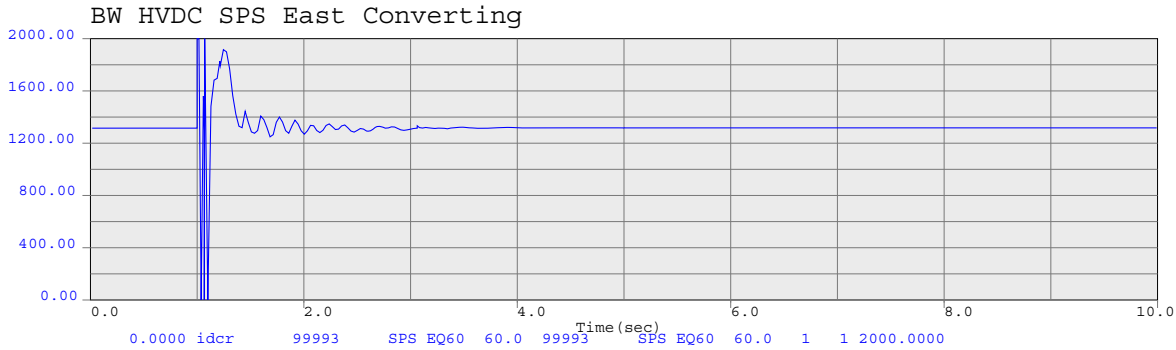

WIND FARM P
500.00
400.00
300.00
200.00
100.00
0.00
0.0
2.0
4.0
6.0
8.0
10.0
Time(sec)
0.0000 pg 10995 ARGONNEG 0.6 0 0.0 1 1 500.0000
0.0000 pg 10997 LONEMS 0.6 0 0.0 1 1 500.0000

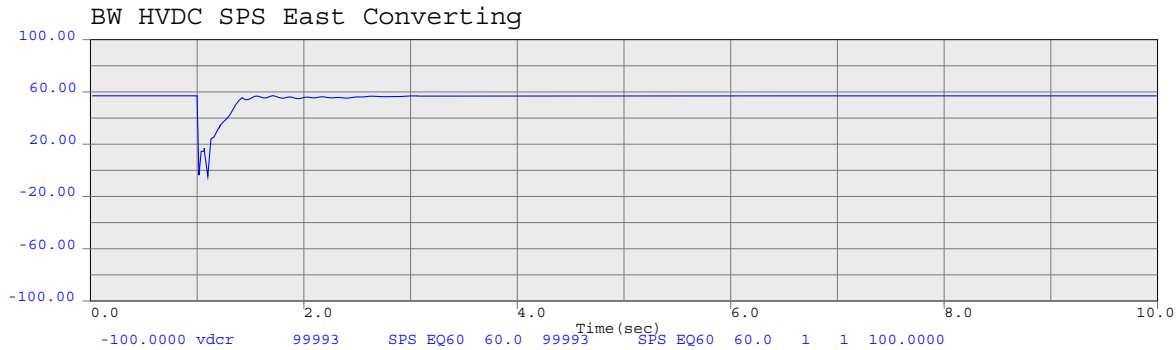


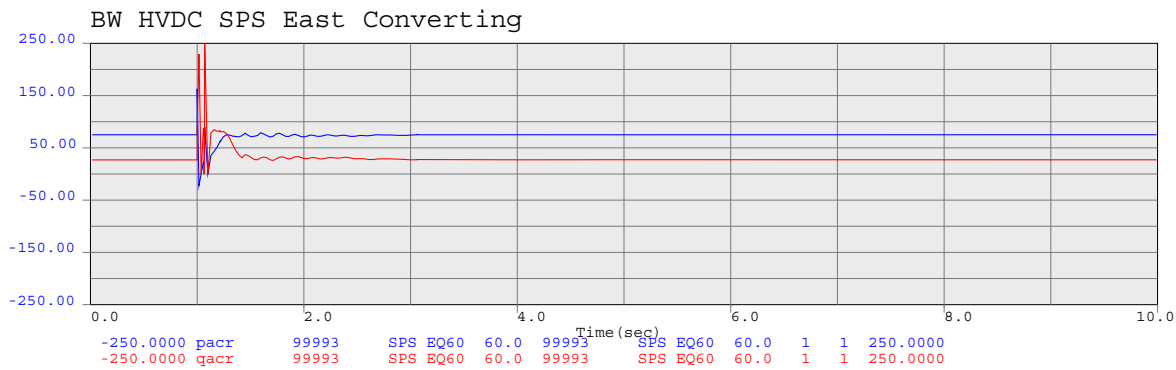


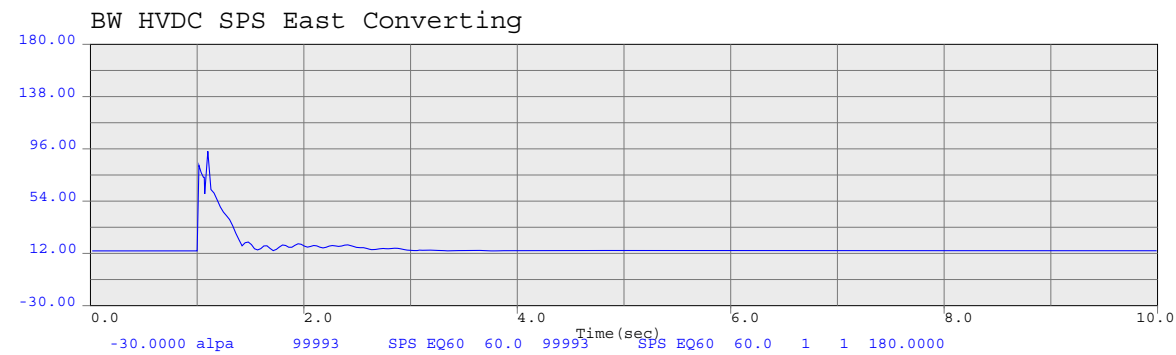
SPP 2000SC MODEL. 2001CASE 8/14/00
Base Case
WESTERN ELECTRICITY COORDINATING COUNCIL
2013-14 HW1A APPROVED BASE CASE
JANUARY 16, 2009
ALL COMMENTS FROM THE TSS REVIEW ARE INCLUDED
3-Phase fault near the WM end of the WM-RP 345 kV line
Trip WM-RP 345 kV line & WM 345/115 kV transformer in 4 cycles

Broadview 297 MW Type 4 TSR



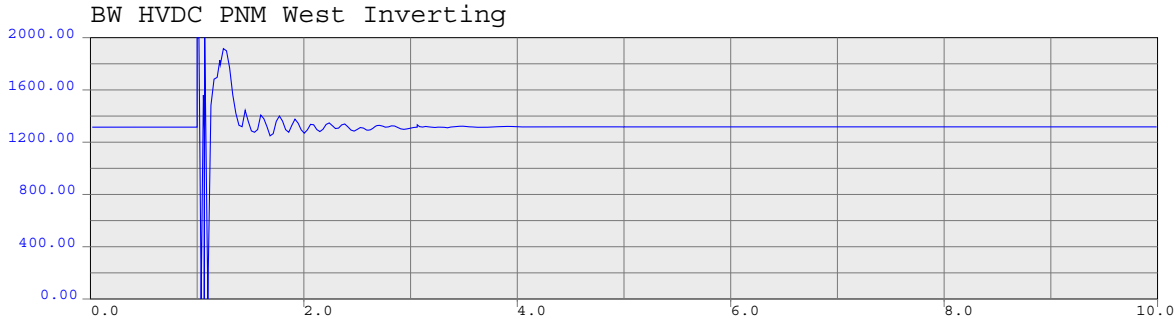






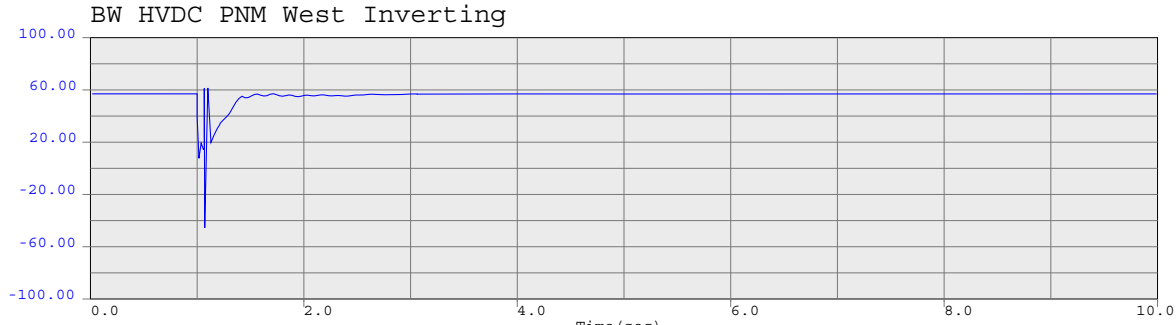
SPP 2000SC MODEL. 2001CASE 8/14/00
Base Case
WESTERN ELECTRICITY COORDINATING COUNCIL
2013-14 HW1A APPROVED BASE CASE
JANUARY 16, 2009
ALL COMMENTS FROM THE TSS REVIEW ARE INCLUDED
3-Phase fault near the WM end of the WM-RP 345 kV line
Trip WM-RP 345 kV line & WM 345/115 kV transformer in 4 cycles

BW HVDC PNM West Inverting



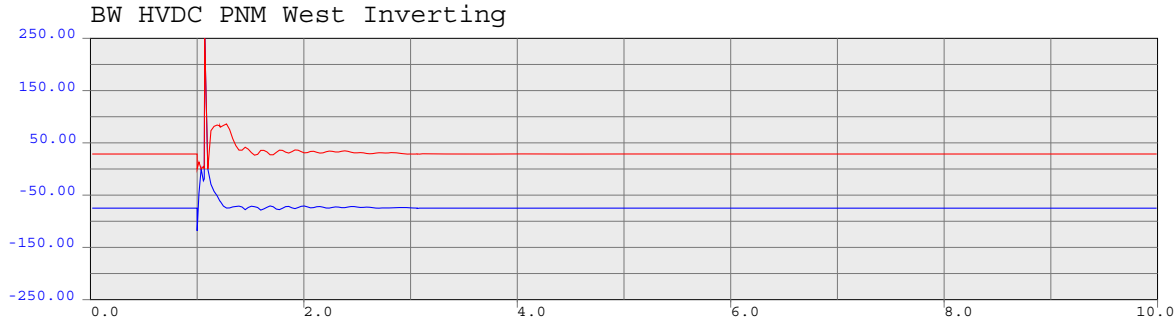
0.0000 idci 99993 SPS EQ60 60.0 13403 BLACK60 60.0 1 1 2000.0000

BW HVDC PNM West Inverting



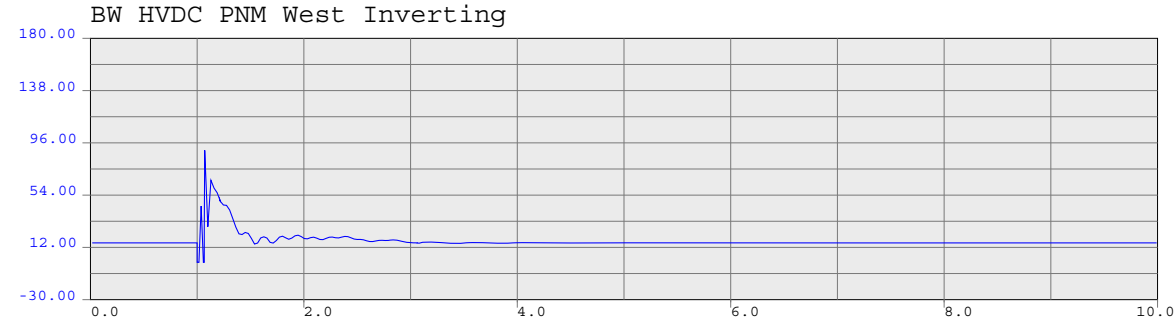
-100.0000 vdci 99993 SPS EQ60 60.0 13403 BLACK60 60.0 1 1 100.0000

BW HVDC PNM West Inverting



-250.0000 paci 99993 SPS EQ60 60.0 13403 BLACK60 60.0 1 1 250.0000
-250.0000 qaci 99993 SPS EQ60 60.0 13403 BLACK60 60.0 1 1 250.0000

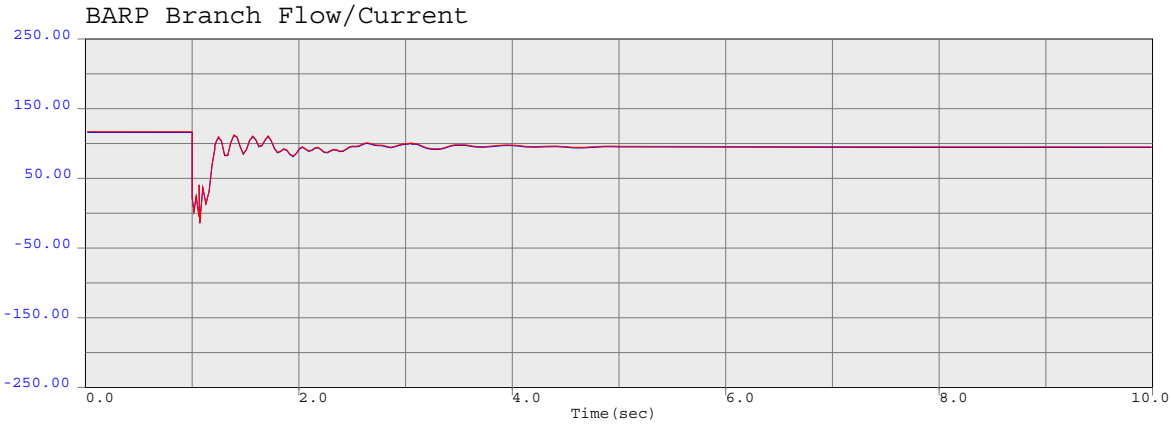
BW HVDC PNM West Inverting



-30.0000 gama 99993 SPS EQ60 60.0 13403 BLACK60 60.0 1 1 180.0000

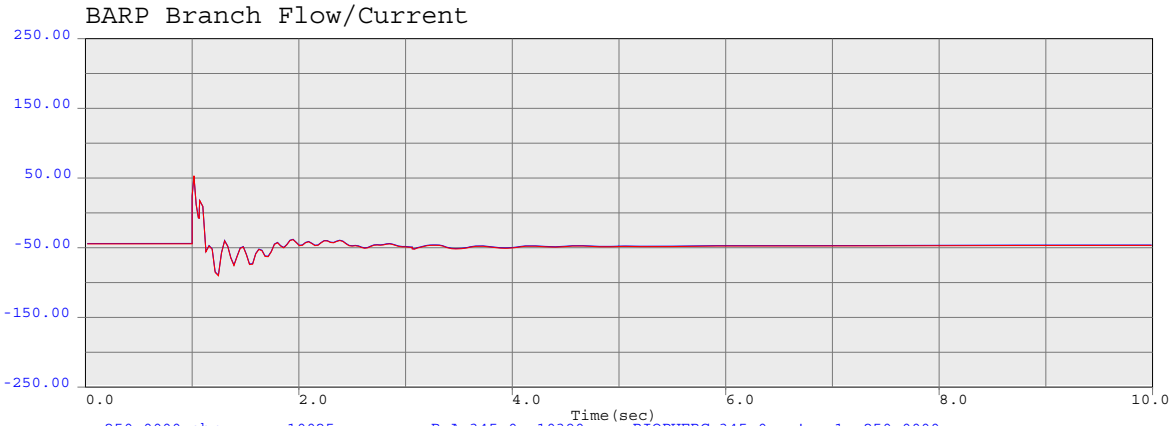
SPP 2000SC MODEL. 2001CASE 8/14/00
Base Case
WESTERN ELECTRICITY COORDINATING COUNCIL
2013-14 HW1A APPROVED BASE CASE
JANUARY 16, 2009
ALL COMMENTS FROM THE TSS REVIEW ARE INCLUDED
3-Phase fault near the WM end of the WM-RP 345 kV line
Trip WM-RP 345 kV line & WM 345/115 kV transformer in 4 cycles

BARP Branch Flow/Current



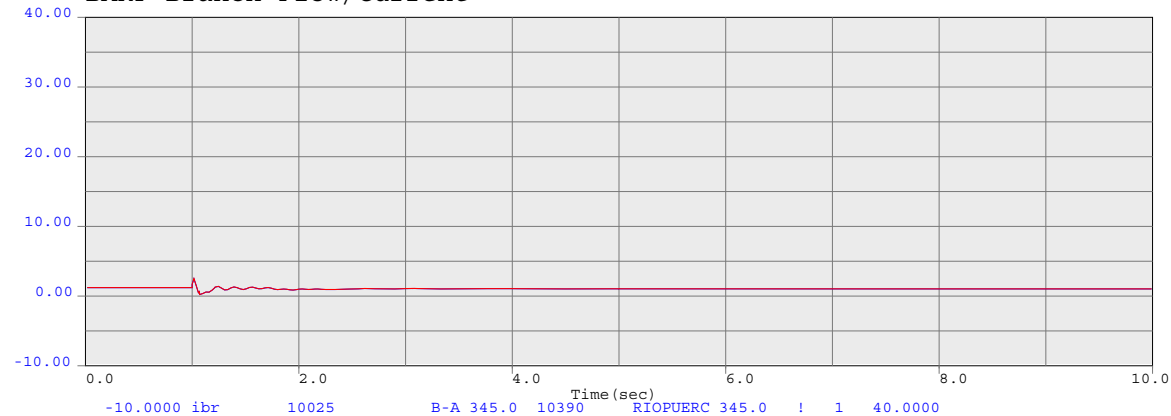
-250.0000 pbr 10025 B-A 345.0 10390 RIOPUERC 345.0 ! 1 250.0000
-250.0000 pbr 10025 B-A 345.0 10390 RIOPUERC 345.0 ! 2 250.0000

BARP Branch Flow/Current



-250.0000 qbr 10025 B-A 345.0 10390 RIOPUERC 345.0 ! 1 250.0000
-250.0000 qbr 10025 B-A 345.0 10390 RIOPUERC 345.0 ! 2 250.0000

BARP Branch Flow/Current



-10.0000 ibr 10025 B-A 345.0 10390 RIOPUERC 345.0 ! 1 40.0000
-10.0000 ibr 10025 B-A 345.0 10390 RIOPUERC 345.0 ! 2 40.0000

SPP 2000SC MODEL. 2001CASE 8/14/00
Base Case
WESTERN ELECTRICITY COORDINATING COUNCIL
2013-14 HW1A APPROVED BASE CASE
JANUARY 16, 2009
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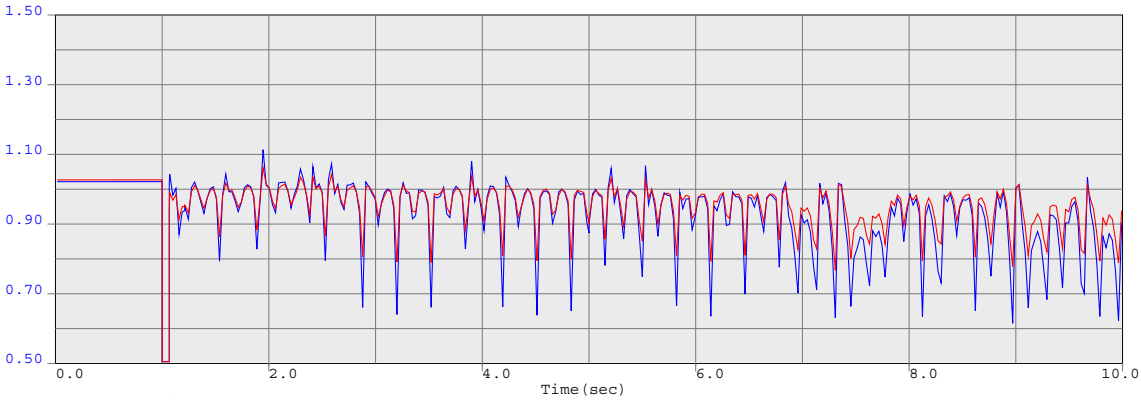
3-Phase fault near the WM end of the WM-RP 345 kV line
Trip WM-RP 345 kV line & WM 345/115 kV transformer in 4 cycles

Contingency 9 - BA to Rio Puerco 345 kV Double Circuit outage (BA-RP-N2)

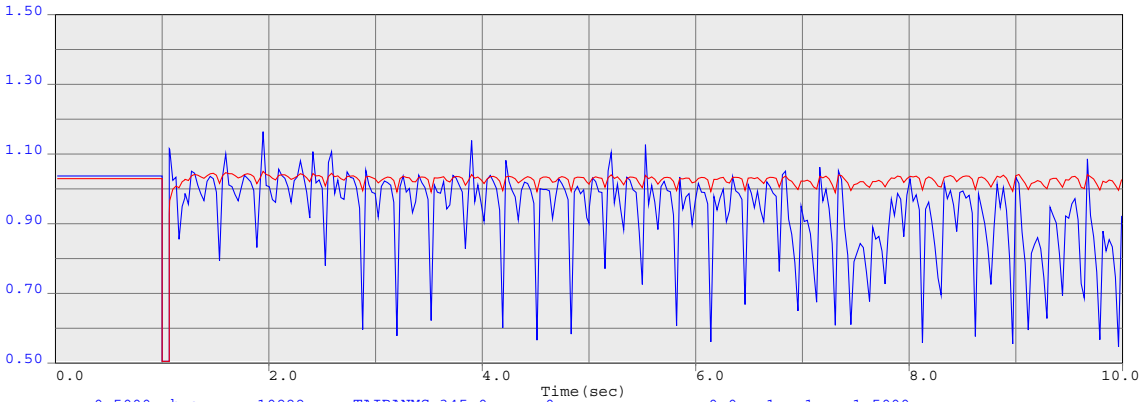
Broadview 297 MW Type 4 TSR

BUS VOLTAGE



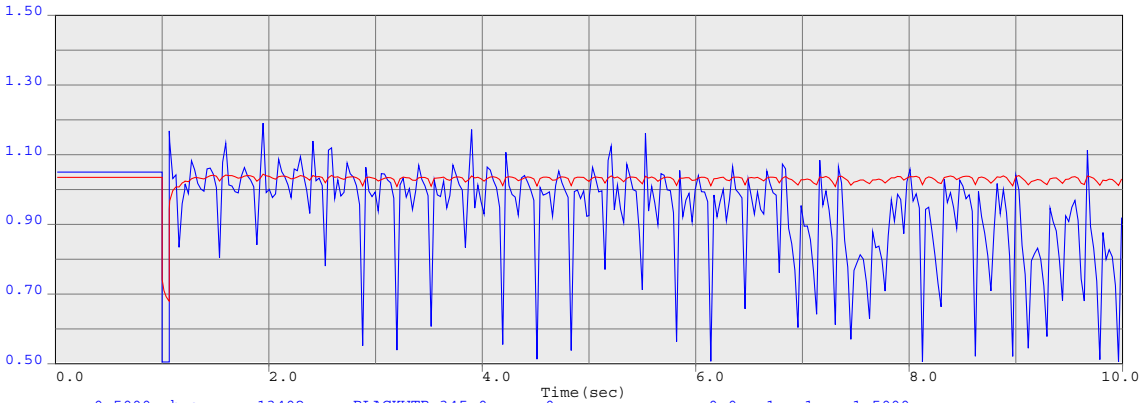
0.5000 vbug 10116 GUADLUPE 345.0 0 0.0 1 1 1.5000
0.5000 vbug 10025 B-A 345.0 0 0.0 1 1 1.5000

BUS VOLTAGE



0.5000 vbug 10999 TAIBANMS 345.0 0 0.0 1 1 1.5000
0.5000 vbus 10390 RIOPUERC 345.0 0 0.0 1 1 1.5000

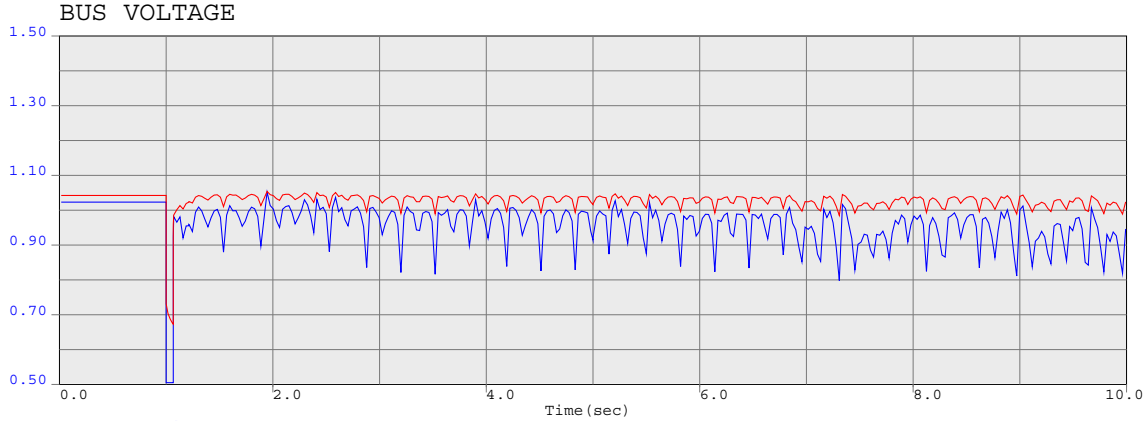
BUS VOLTAGE



0.5000 vbug 13402 BLACKWTR 345.0 0 0.0 1 1 1.5000
0.5000 vbus 10011 AMBROSIA 230.0 0 0.0 1 1 1.5000

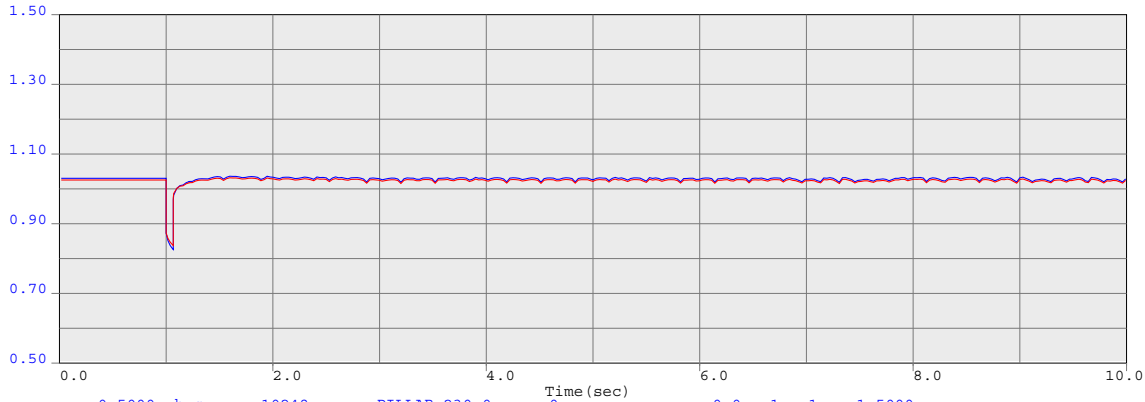
SPP 2000SC MODEL. 2001CASE 8/14/00
Base Case
WESTERN ELECTRICITY COORDINATING COUNCIL
2013-14 HW1A APPROVED BASE CASE
JANUARY 16, 2009
ALL COMMENTS FROM THE TSS REVIEW ARE INCLUDED
3-Phase fault near the BA end of the BA-RP 345 kV line
Trip BA-RP 345 kV circuits 1 & 2 at 4 cycles

BUS VOLTAGE



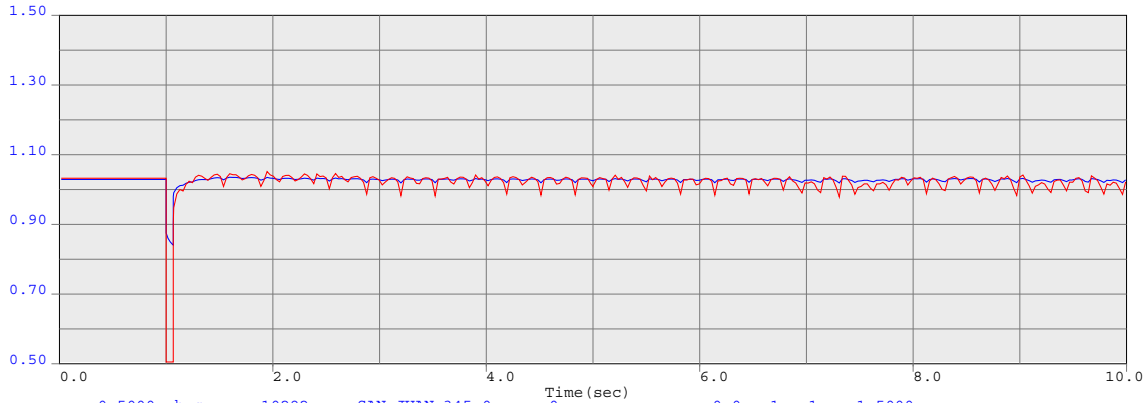
0.5000 vbus 10229 NORTON 345.0 0 0.0 1 1 1.5000
0.5000 vbus 10232 OJO 345.0 0 0.0 1 1 1.5000

BUS VOLTAGE



0.5000 vbus 10248 PILLAR 230.0 0 0.0 1 1 1.5000
0.5000 vbus 10291 SAN_JUAN 230.0 0 0.0 1 1 1.5000

BUS VOLTAGE



0.5000 vbus 10292 SAN_JUAN 345.0 0 0.0 1 1 1.5000
0.5000 vbus 10294 SANDIA 345.0 0 0.0 1 1 1.5000

SPP 2000SC MODEL. 2001CASE 8/14/00
Base Case
WESTERN ELECTRICITY COORDINATING COUNCIL
2013-14 HW1A APPROVED BASE CASE
JANUARY 16, 2009
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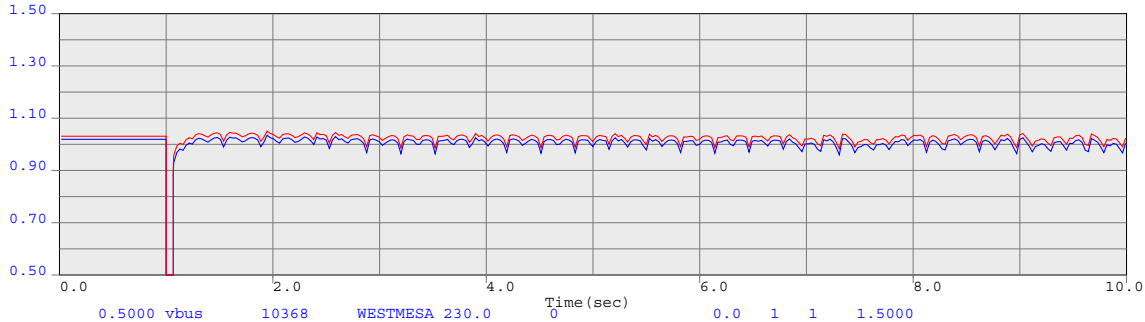
3-Phase fault near the BA end of the BA-RP 345 kV line
Trip BA-RP 345 kV circuits 1 & 2 at 4 cycles

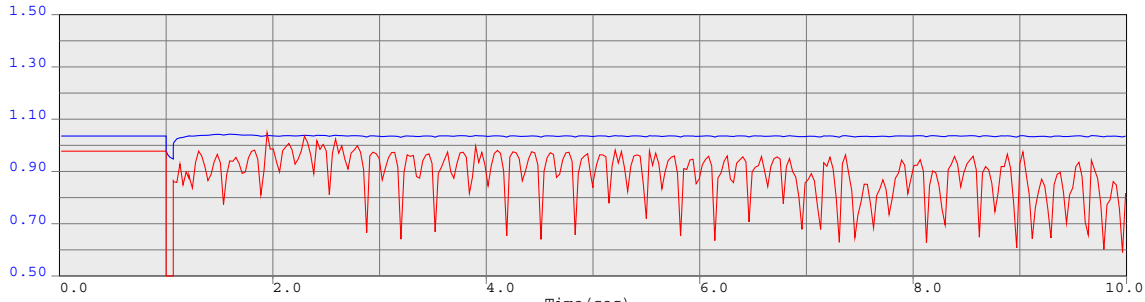
Broadview 297 MW Type 4 TSR

BUS VOLTAGE



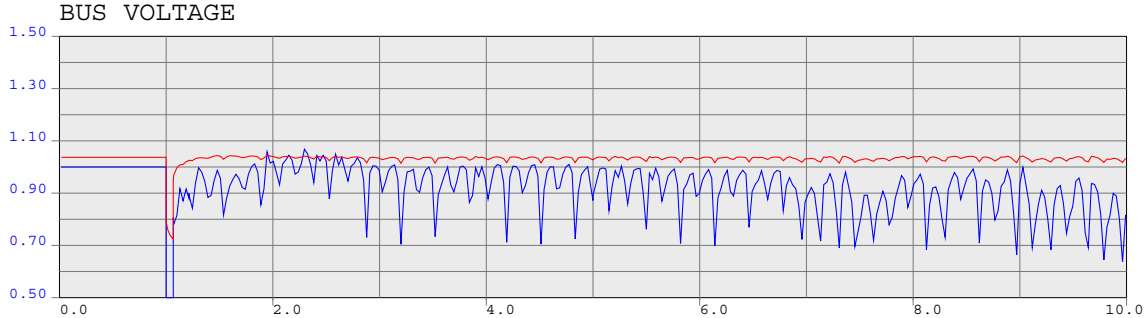
0.5000 vbus 10368 WESTMESA 230.0 0 0.0 1 1 1.5000
0.5000 vbus 10369 WESTMESA 345.0 0 0.0 1 1 1.5000

BUS VOLTAGE



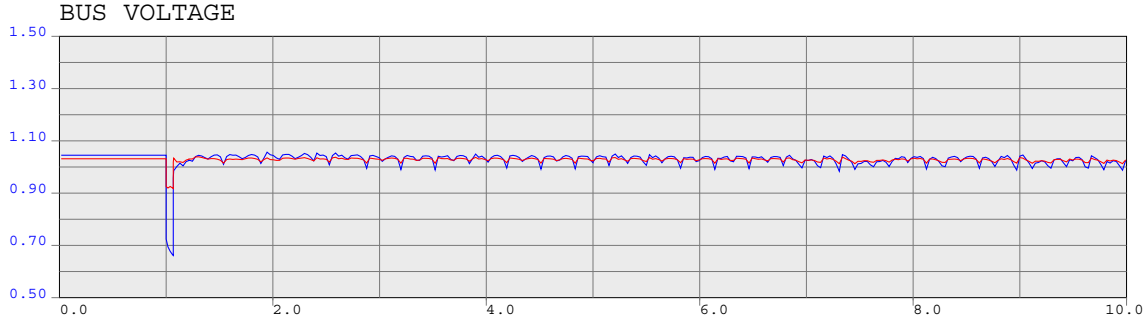
0.5000 vbus 10393 LEF 345.0 0 0.0 1 1 1.5000
0.5000 vbus 10991 ARGONNE4 138.0 0 0.0 1 1 1.5000

BUS VOLTAGE



0.5000 vbus 10992 ARGONNE3 138.0 0 0.0 1 1 1.5000
0.5000 vbus 12057 PEGS 230.0 0 0.0 1 1 1.5000

BUS VOLTAGE



0.5000 vbus 12082 TAOS 345.0 0 0.0 1 1 1.5000
0.5000 vbus 12101 GLADSTON 230.0 0 0.0 1 1 1.5000

SPP 2000SC MODEL. 2001CASE 8/14/00
Base Case
WESTERN ELECTRICITY COORDINATING COUNCIL
2013-14 HW1A APPROVED BASE CASE
JANUARY 16, 2009
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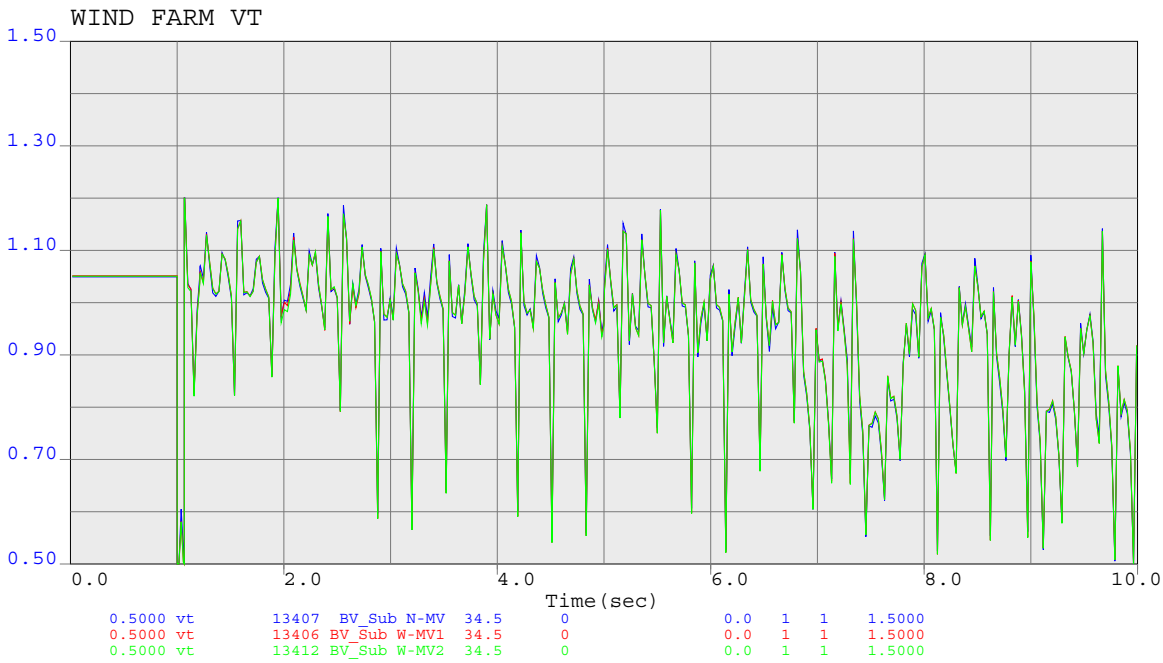
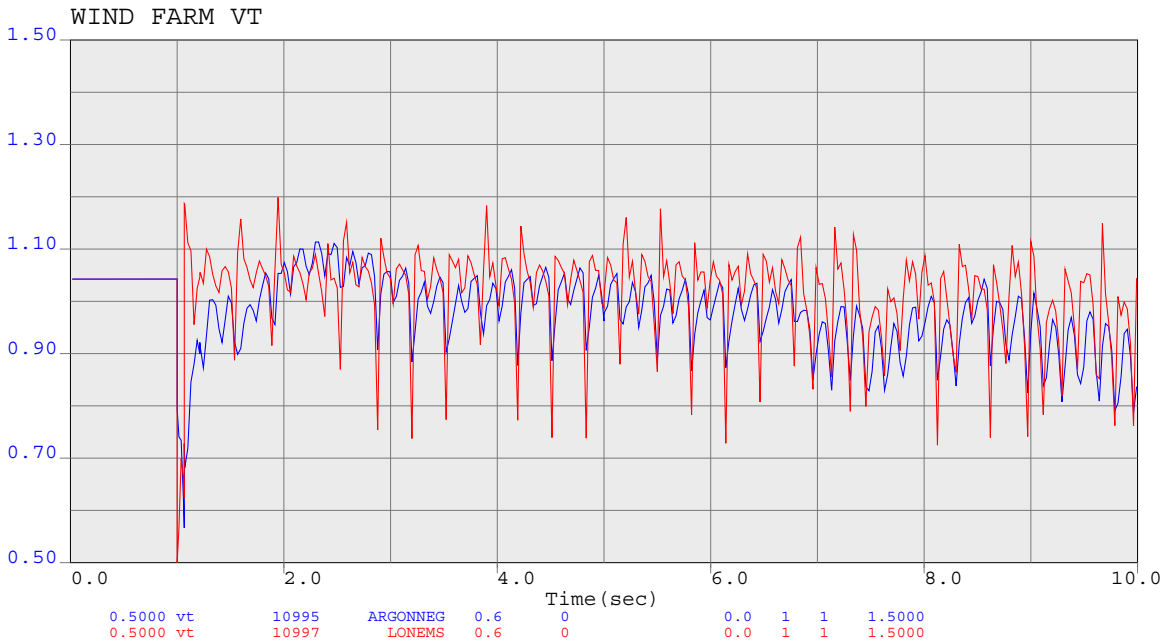
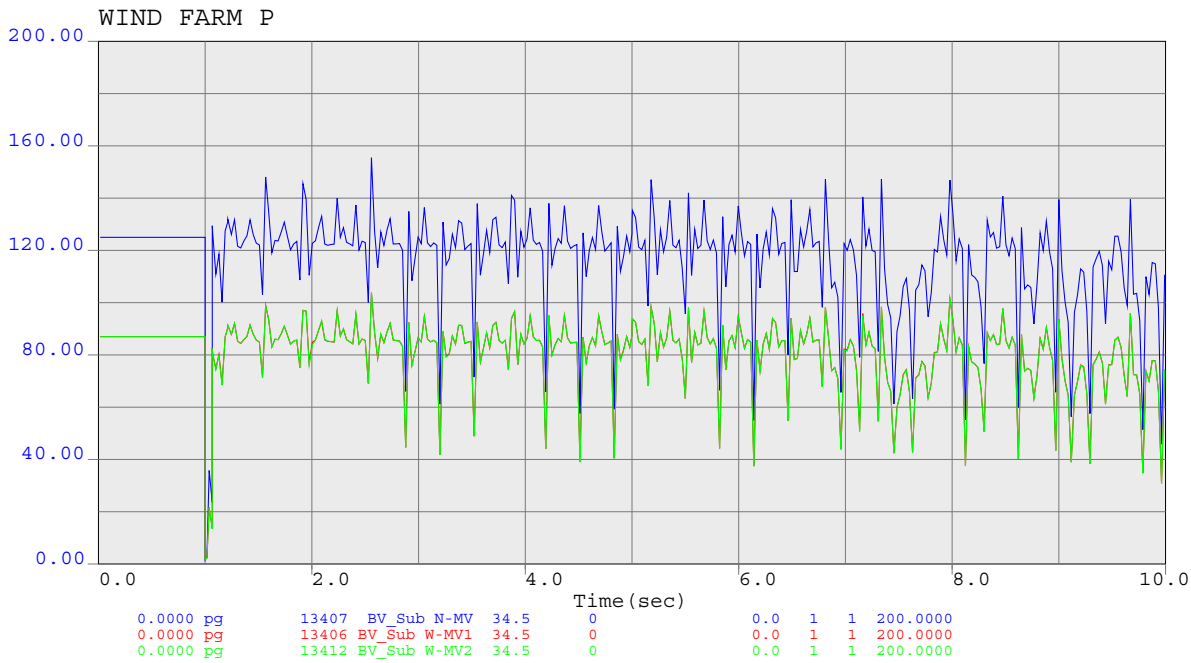
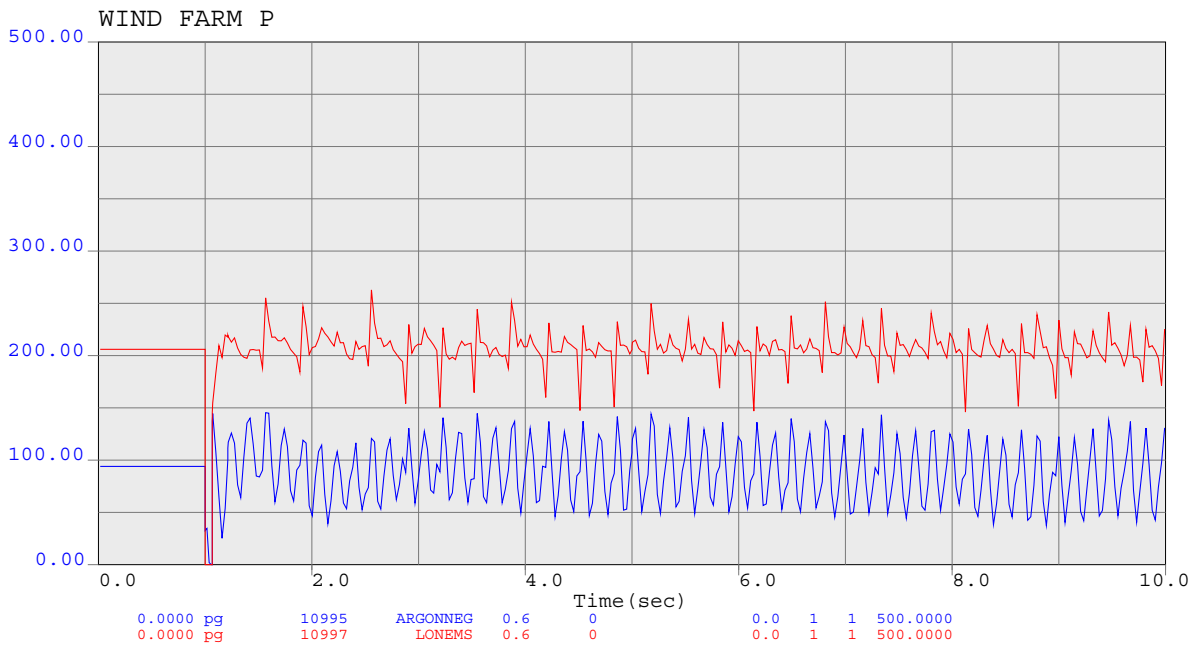
Trip BA-RP 345 kV circuits 1 & 2 at 4 cycles

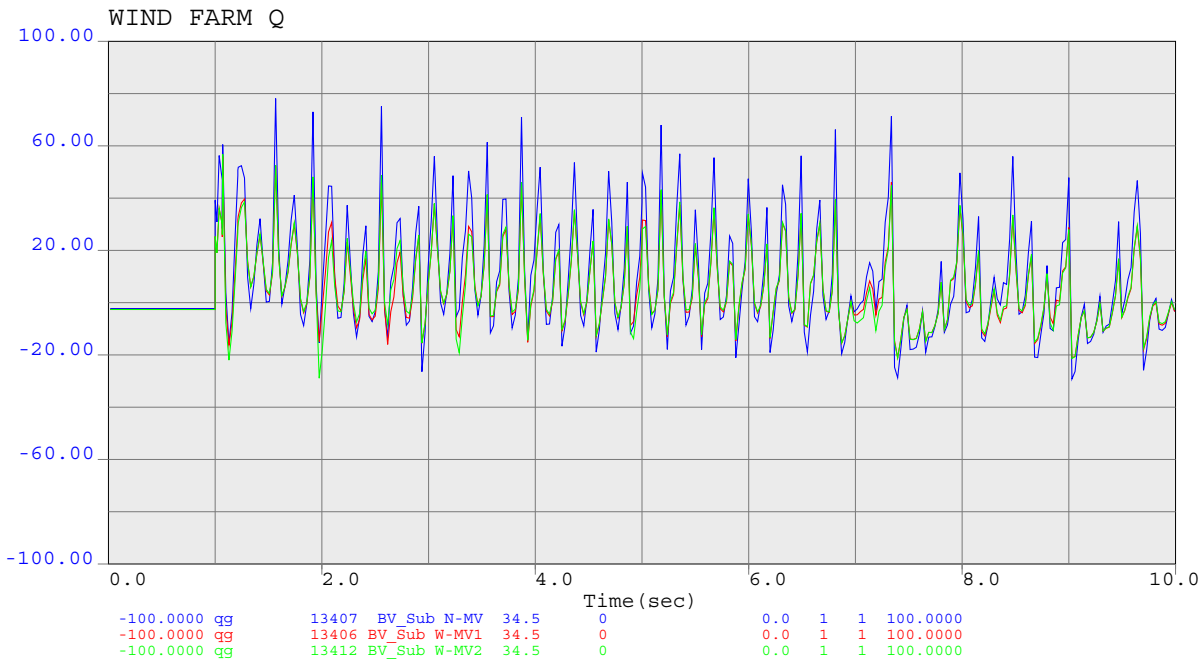

WIND FARM VT
1.50
1.30
1.10
0.90
0.70
0.50
0.0
2.0
4.0
6.0
8.0
10.0
Time(sec)
0.5000 vt 13407 BV_Sub N-MV 34.5 0 0.0 1 1 1.5000
0.5000 vt 13406 BV_Sub W-MV1 34.5 0 0.0 1 1 1.5000
0.5000 vt 13412 BV_Sub W-MV2 34.5 0 0.0 1 1 1.5000

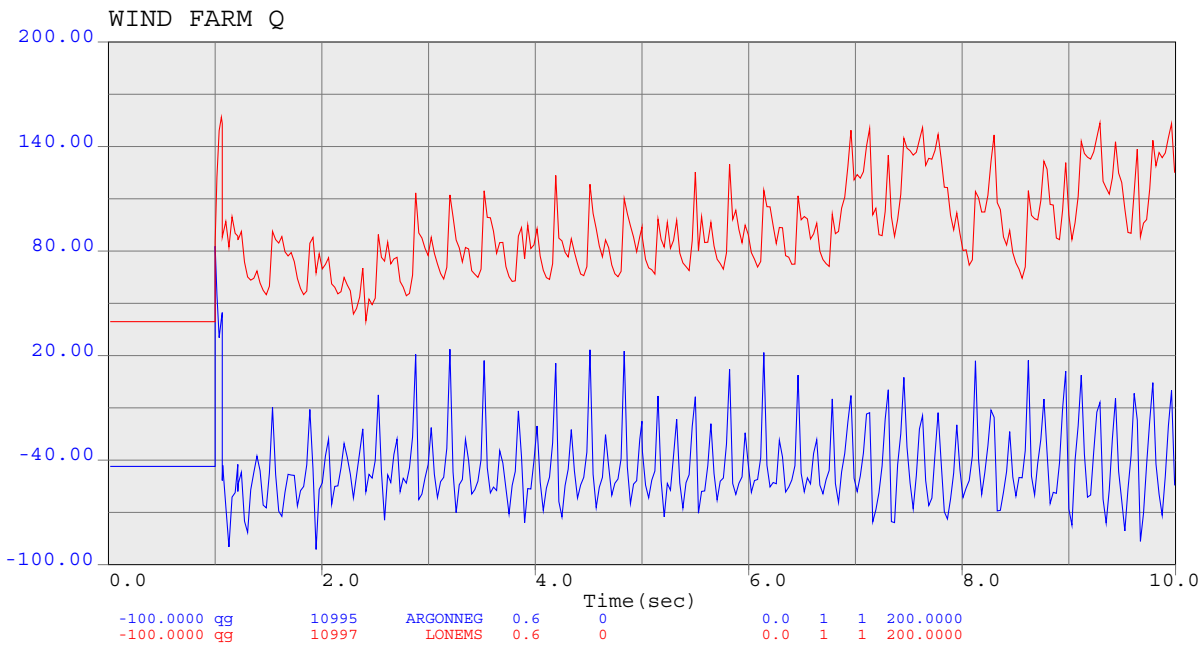

WIND FARM VT
1.50
1.30
1.10
0.90
0.70
0.50
0.0
2.0
4.0
6.0
8.0
10.0
Time(sec)
0.5000 vt 10995 ARGONNEG 0.6 0 0.0 1 1 1.5000
0.5000 vt 10997 LONEMS 0.6 0 0.0 1 1 1.5000





SPP 2000SC MODEL. 2001CASE 8/14/00
Base Case
WESTERN ELECTRICITY COORDINATING COUNCIL
2013-14 HW1A APPROVED BASE CASE
JANUARY 16, 2009
ALL COMMENTS FROM THE TSS REVIEW ARE INCLUDED
3-Phase fault near the BA end of the BA-RP 345 kV line
Trip BA-RP 345 kV circuits 1 & 2 at 4 cycles





SPP 2000SC MODEL. 2001CASE 8/14/00
Base Case
WESTERN ELECTRICITY COORDINATING COUNCIL
2013-14 HW1A APPROVED BASE CASE
JANUARY 16, 2009
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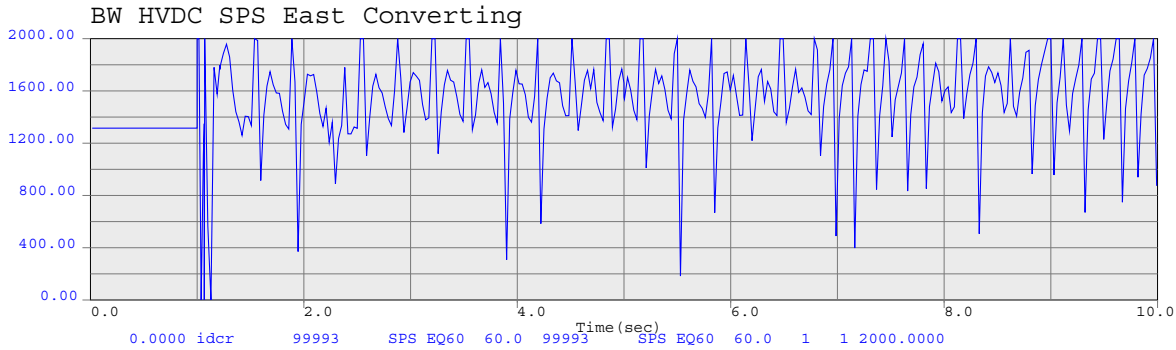
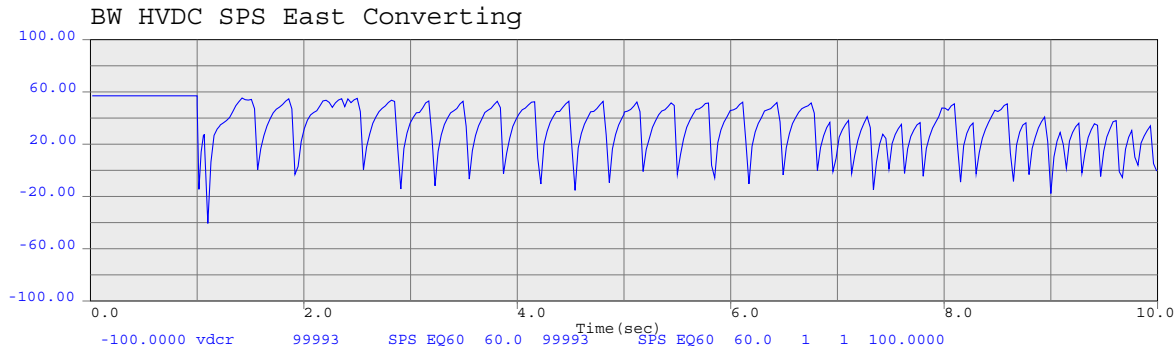
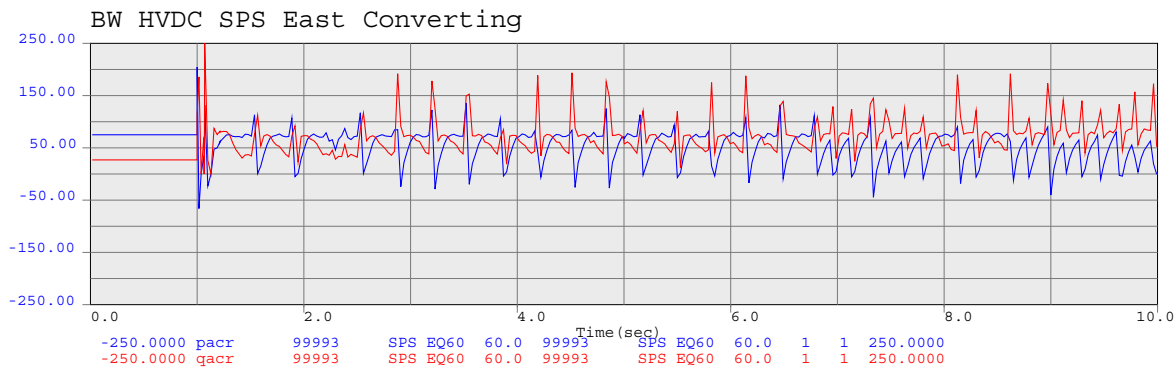
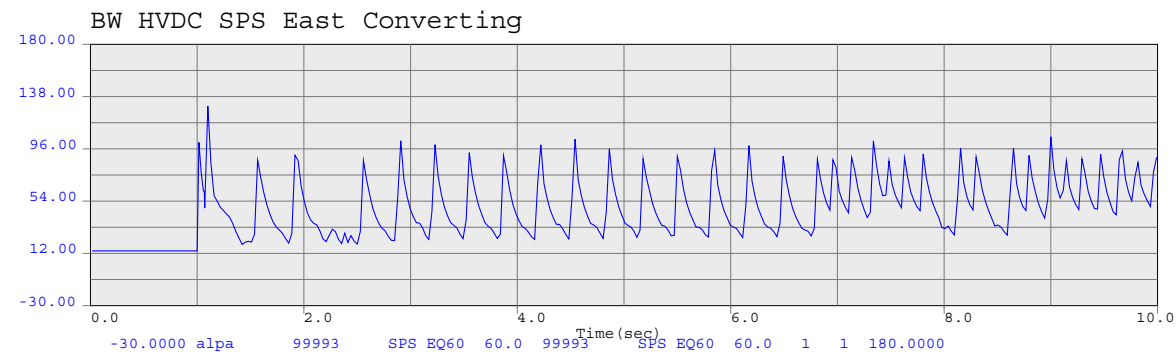
3-Phase fault near the BA end of the BA-RP 345 kV line
Trip BA-RP 345 kV circuits 1 & 2 at 4 cycles



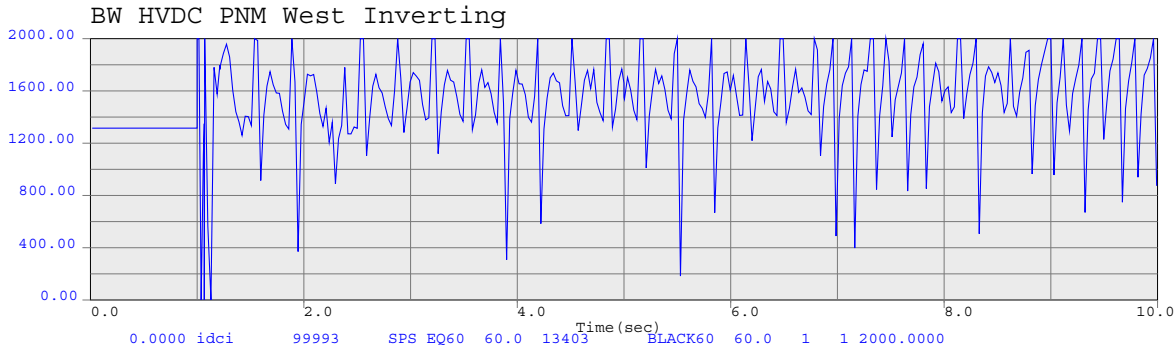


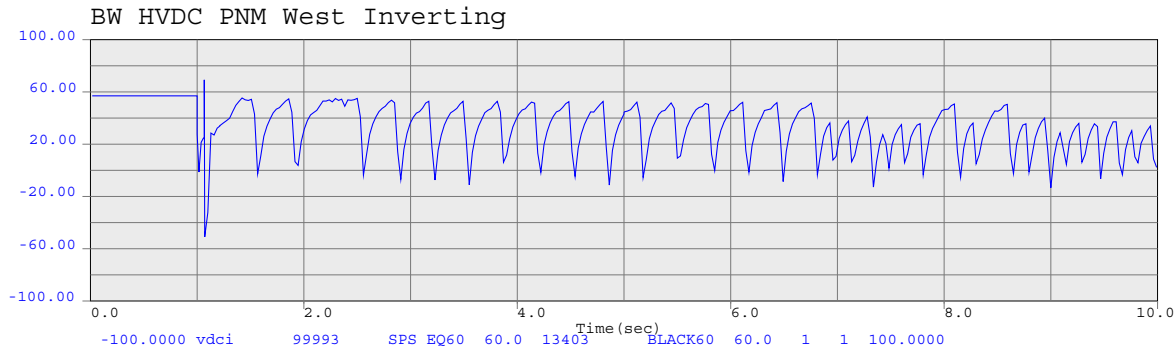


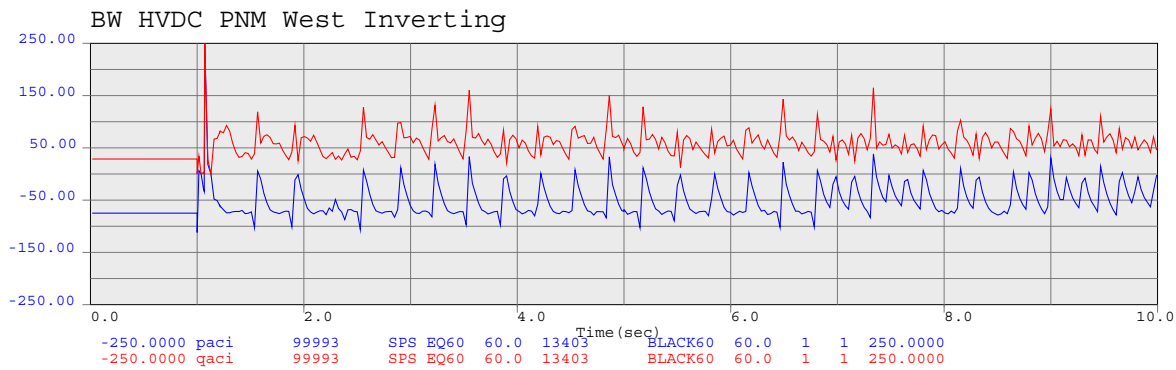


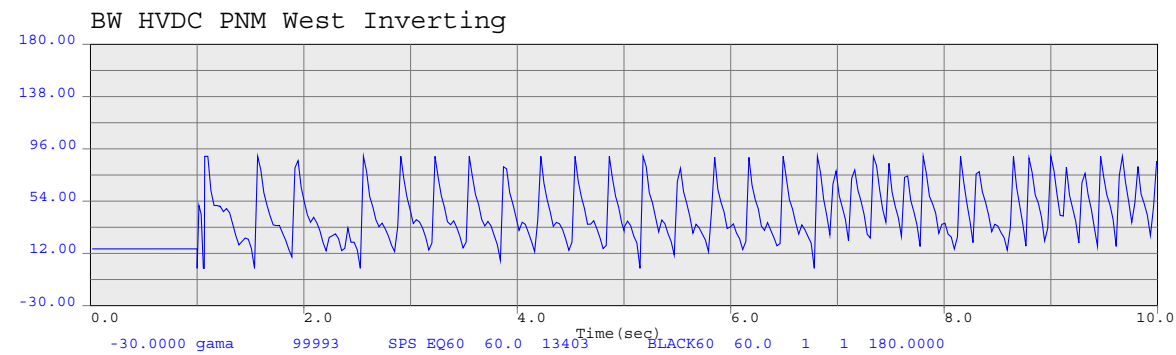
SPP 2000SC MODEL. 2001CASE 8/14/00
Base Case
WESTERN ELECTRICITY COORDINATING COUNCIL
2013-14 HW1A APPROVED BASE CASE
JANUARY 16, 2009
ALL COMMENTS FROM THE TSS REVIEW ARE INCLUDED
3-Phase fault near the BA end of the BA-RP 345 kV line
Trip BA-RP 345 kV circuits 1 & 2 at 4 cycles

Broadview 297 MW Type 4 TSR









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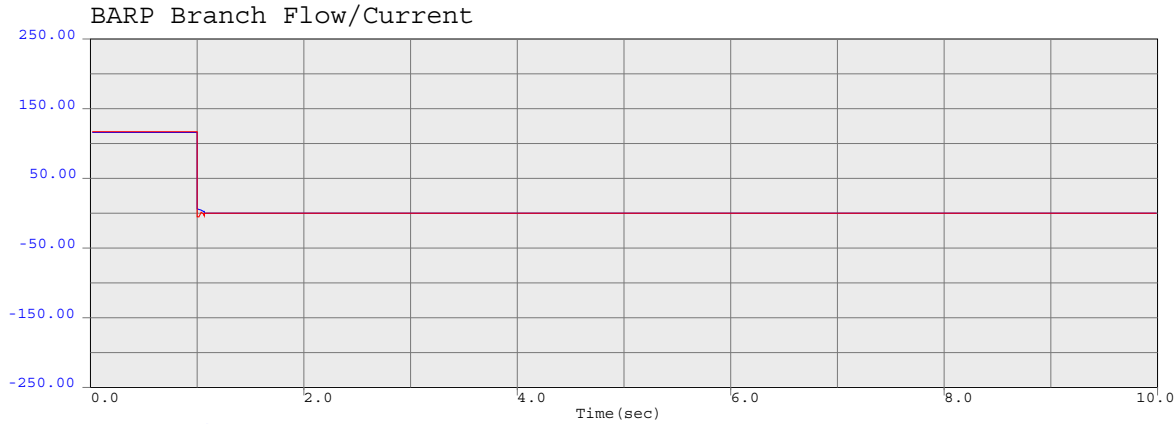
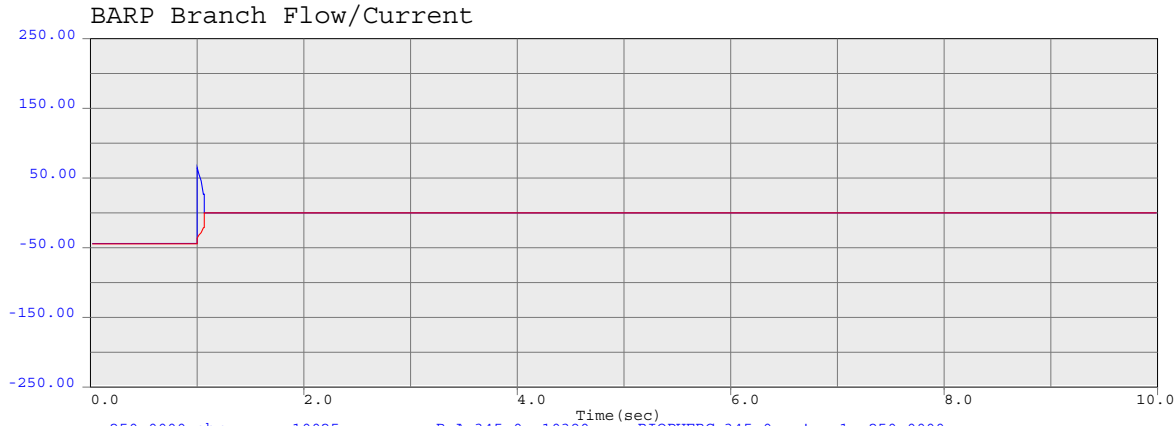
BARP Branch Flow/Current



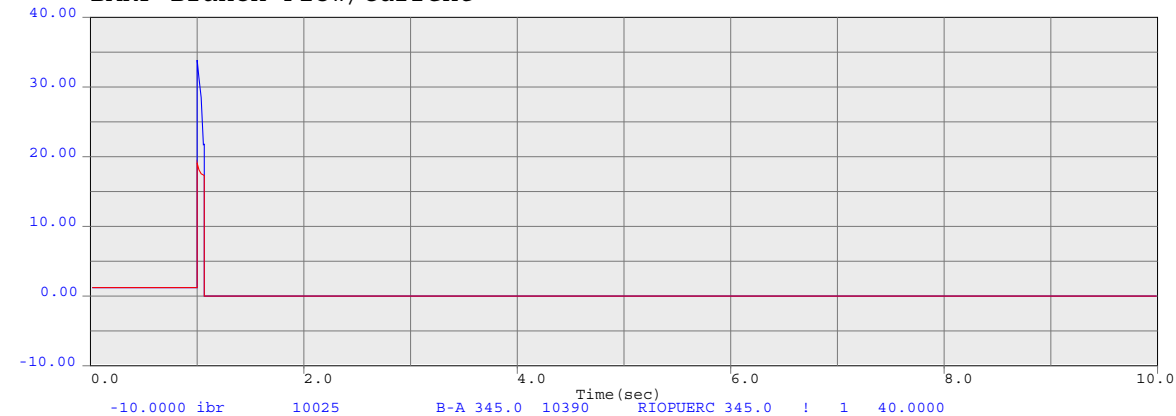
-250.0000 pbr 10025 B-A 345.0 10390 RIOPUERC 345.0 ! 1 250.0000
-250.0000 pbr 10025 B-A 345.0 10390 RIOPUERC 345.0 ! 2 250.0000

BARP Branch Flow/Current



-250.0000 qbr 10025 B-A 345.0 10390 RIOPUERC 345.0 ! 1 250.0000
-250.0000 qbr 10025 B-A 345.0 10390 RIOPUERC 345.0 ! 2 250.0000

BARP Branch Flow/Current



-10.0000 ibr 10025 B-A 345.0 10390 RIOPUERC 345.0 ! 1 40.0000
-10.0000 ibr 10025 B-A 345.0 10390 RIOPUERC 345.0 ! 2 40.0000

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