EXHIBIT A

System Impact Study for the Special Protection System for the Athens Power Plant" report dated October 16, 2006

R64-06

System Impact Study for the Special Protection System for the Athens Power Plant

Prepared for

New Athens Generation Company, LLC

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Executive Summary

New Athens Generating Company ("Athens") is proposing to install a Special Protection System (SPS) and other system reinforcements to reduce the frequency of Athens curtailments by the NYISO due to system constraints during transmission system peak power flow conditions. Athens proposes to allow the NYISO to secure the jointly owned National Grid and Con-Edison Leeds-Pleasant Valley transmission lines (Lines 91 and 92) for loss of one or the other, with the subsequent rejection of its Athens' generating facility and subsequent NYISO's control area re-dispatch. As such, the SPS would require an exception to the NYSRC Reliability Rules. Athens further proposes an SPS that will allow the generation rejection to be completed within a two minute time frame following an initiating event. The planned in-service date of the SPS is 2007.

The SPS will be operational only during periods of heavy transfer across the UPNY-Con Ed interface. The operation of the SPS will allow post-contingency loading of either the Leeds to Pleasant Valley or Athens to Pleasant Valley 345 kV lines (Lines 91 and 92) up to their STE ratings for outage of the other line. Generation at Athens will be automatically tripped to reduce the flow on the remaining circuit to less than its LTE rating. Under worst case conditions, this will require trip of two combined cycle trains (one gas turbine and one steam turbine each) with a full load value of 720 MW. Trip of two combined cycle trains may not be required under other conditions.

Siemens Power Transmission & Distribution, Inc., Power Technologies International (Siemens PTI) has performed a System Impact Study (SIS) for the SPS for the Athens Power Plant. The purpose of the SIS is to demonstrate the improvement in the UPNY-Con Ed interface transfer capability that would result from the installation and operation of the SPS and other possible associated mitigative measures such as the installation of shunt capacitive compensation at one or more Con Edison substations.

NYISO provided a PSS™E power flow base case representing the summer peak operating conditions for 2006 and used for RNA analysis, and a separate power flow base case for stability simulations and corresponding set of stability setup files. NYISO also provided a full contingency list, a subsystem file and a monitor file for thermal analysis.

The base case models the Athens Power Plant dispatched with two combine cycle trains (one gas turbine and one steam turbine each) on at a total power output of 700 MW. This case is referred to as the Benchmark Case without SPS.

Siemens PTI developed a case with the SPS. In this case, Athens was increased to its full capacity i.e., 1080 MW in three combine cycle trains, to increase flow on the Athens-Pleasant Valley and Leeds-Pleasant Valley (Lines 91 and 92) path. The additional Athens generation was dispatched against existing units in Con Ed.

For stability simulations, flow on the UPNY-Con Ed interface was further stressed to 11% higher than its transfer limit determined in the steady-state analysis in both the Benchmark Case without the SPS and the Case with the SPS.

Executive Summary

The study shows that the SPS is effective. With the SPS, the transfer across the UPNY-Con Ed Interface can be increased by 466 MW while abiding by applicable reliability rules and criteria. This allows the Athens plant to be dispatched at full capacity, i.e., 1080 MW, during peak load conditions.

The operation without and with the SPS was analyzed using thermal, voltage and stability analysis. The thermal analysis shows that with Athens dispatched at full capacity and the SPS, the UPNY-Con Ed thermal transfer limit is increased by 466 MW, from 3633 MW to 4099 MW. Both without and with the SPS, the transfer is limited by flow on the Leeds to Pleasant Valley 345 kV line due to loss of the Athens to Pleasant Valley 345 kV line. Without the SPS, the post-contingency flow is limited to the line's LTE rating of 1538 MW while the SPS increases the allowable post-contingency flow to the line's STE rating of 1724 MW. The operation of the SPS reduces the line flow to below the LTE rating within a period of two minutes.

The thermal transfer limit on the UPNY-SENY interface was also analyzed. The analysis shows that with Athens dispatched at full capacity and the SPS, the UPNY-SENY thermal transfer limit is increased by 466 MW, from 4502 MW to 4968 MW. Both without and with the SPS, the limiting element is the same as that for the UPNY-Con Ed interface.

The voltage analysis indicated that transfer across the UPNY-Con Ed interface would be limited by the pre-contingency voltage limit of 348 kV at four lower Hudson Valley 345 kV buses. Therefore a 240 MVAr capacitor bank was modeled at Millwood which is sufficient to maintain the steady-state pre-contingency voltage at these stations above 348 kV. Millwood was selected as the potential location for the capacitor back due to concerns that space may be limited in other possible stations.

The voltage contingency analysis indicated that with Athens dispatched at full capacity and the SPS in-service, there was no significant incremental impact on bulk system voltages compared to operation without the SPS. The voltages on several 115 kV buses decreased by less than 1% under certain contingencies.

Two contingencies may trigger the SPS, loss of the Athens to Pleasant Valley 345 kV (Line 91) and the Leeds to Pleasant Valley 345 kV line (Line 92). The loss of Line 91 is slightly more severe. For the peak load level and system dispatch modeled in the power flow case supplied by the NYISO, this contingency would require the trip of two Athens combined cycle trains, for a total of 720 MW. The loading on Line 92 after this contingency and SPS operation would be 1520 MW, lower than the LTE rating of 1538 MW.

The P-V analysis showed that with Athens dispatched at full capacity and the SPS, the voltage-based UPNY-Con Ed transfer limit is increased by 245 MW. The voltage-based transfer limits for both without and with the SPS are higher than the respective thermal limits, as follows:

UPNY-Con Ed Transfer	Case Without SPS	Case With SPS	Change
Pre-Contingency Low	3880^{A}	4125^{A}	245
Post-Contingency Low	4279^{B}	4383^{B}	104
95% Voltage Collapse (5% MW Margin)	4092^{C}	4190^{C}	98
Voltage-Based Transfer Limit	**3880^{A}**	**4125^{C}**	**245**
Thermal Transfer Limit	**3633^{D}**	**4099^{E}**	**466**

A Pre-contingency voltage at Dunwoodie 345 kV

B Post-contingency voltage at Pleasant Valley 345 kV for loss of tower Coopers Corners-Rock Tavern 34/42

C 95% of voltage collapse criteria limit for loss of tower Coopers Corners-Rock Tavern 34/42

D Limited by Leeds - Pleasant Valley 345 kV (LTE: 1538 MW) for loss of Athens-Pleasant Valley 345 kV

E Limited by Leeds - Pleasant Valley 345 kV (STE: 1724 MW) for loss of Athens-Pleasant Valley 345 kV

Stability analysis was performed. All stability simulations exhibited a stable response with positive damping. Stability is thus not the limiting constraint on the transfer level on the UPNY-Con Ed interface either without or with the SPS.

The extreme contingency analysis demonstrates that the case with SPS shows incremental overload and voltage impacts on several 115 kV facilities. Additionally, for the case with the SPS, the loss of the Right-of-Way of Lines 91 & 92 would overload the Leeds to Hurley 345 kV line by 1%. There are no widespread overloads or voltage violations found on the bulk power system under the extreme contingencies tested.

The analysis demonstrates that misoperation of the SPS will not result in severe system problems or widespread effects on the system, that is, it does not cause a significant adverse impact outside of the local area.

Failure of the SPS to operate under maximum transfer conditions would result in Line 91 or 92 being loaded above its LTE rating following the outage of the other, but below its STE rating. For the peak condition analyzed, all other elements are within post-contingency limits. Since the STE rating is a 15 minute rating, there is ample time for manual operator action to either manually trip generation at Athens or perform other actions.

The study results demonstrate that the misoperation or failed operation of this SPS would not have a significant adverse impact outside of the local area, that is, there are no widespread overloads or voltage violations found outside the local area. Thus the SPS should be classified as a Type III SPS according to the NPCC Special Protection System Criteria (NPCC Document A-11).

The NYISO will calculate the actual Transmission Congestion Contracts (TCCs) awarded as a result of this proposed SPS. However, the results of this SIS indicate a potential TCC award estimate of 466 MW for the Athens' SPS.

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Executive Summary

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Introduction

New Athens Generating Company (“Athens”) is proposing to install a Special Protection system (SPS) and other system reinforcements to reduce the frequency of Athens curtailments by the NYISO due to system constraints during transmission system peak power flow conditions. Athens proposes to allow the NYISO to secure the jointly owned National Grid and Con-Edison Leeds-Pleasant Valley transmission lines (Lines 91 and 92) for loss of one or the other, with the subsequent rejection of its Athens’ generating facility and subsequent NYISO’s control area re-dispatch. As such, the SPS would require an exception to the NYSRC Reliability Rules. Athens further proposes an SPS that will allow the generation rejection to be completed within a two minute time frame following an initiating event. The planned in-service date of the SPS is 2007.

Siemens Power Transmission & Distribution, Inc., Power Technologies International (Siemens PTI) has performed a System Impact Study (SIS) for the SPS for the Athens Power Plant. The purpose of the SIS is to demonstrate the improvement in the UPNY-Con Ed interface transfer capability that would result from the installation and operation of the SPS and other possible associated mitigative measures such as the installation of shunt capacitive compensation at one or more Con Edison substations. The objectives of the SIS are to:

1. Analyze the thermal transfer limit on the UPNY-Con Ed Interface and the UPNY-SENY Interface, without and with the SPS.
2. Analyze voltage constraints on the transfer limit on the UPNY-Con Ed Interface, without and with the SPS.
3. Conduct P-V analysis on the UPNY-Con Ed interface, without and with the SPS.
4. Evaluate the effectiveness of the SPS under extreme contingencies.
5. Analyze the type and the effect of misoperation or failed operation of the SPS.

The SIS was performed using Siemens PTI’s proprietary, commercial software PSS™E and PSS™MUST, in accordance with the requirements of the NYISO Open Access Transmission Tariff Sections 19.1 through 19.3 and Attachment D as well as applicable NPCC, NYSRC, NYISO and Transmission Owner’s (TO) reliability criteria, rules and design standards.

The Scope of the SIS was approved by the NYISO Operating Committee on October 12, 2006 and is included in Appendix A of this report.

Introduction

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Section

Project Discription and Study Data

2.1 Project Description

The Athens Power Plant ("Athens") is comprised of three combined cycle trains (GT/CT sets) with a total capacity of 1080 MW. A one-line of the power system in the area of the Athens plant is shown in Figure 1-1. The proposed SPS will be operational only during periods of heavy transfer across the UPNY-Con Ed interface. The operation of the SPS will allow postcontingency loading of either the Leeds to Pleasant Valley or Athens to Pleasant Valley 345 kV lines (Lines 91 and 92) up to their STE ratings for outage of the other line. Generation at Athens will be automatically tripped to reduce the flow on the remaining circuit to less than its LTE rating. Under worst case conditions, this will require trip of two combined cycle trains (one gas turbine and one steam turbine each) with a full load value of 720 MW. Trip of two combined cycle trains may not be required under other conditions.

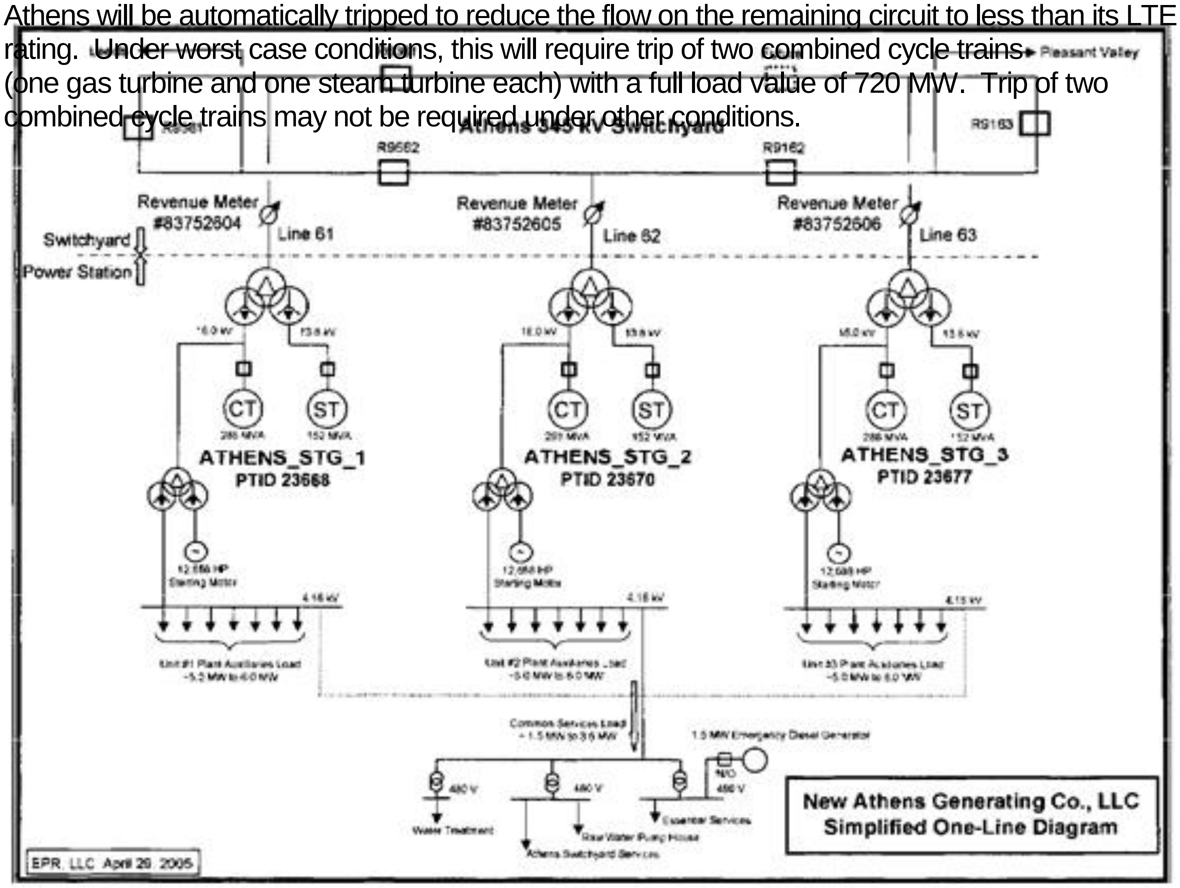

Figure 2-1: One-Line Diagram of Athens Plant

2.2 Load Flow Data

NYISO provided a PSS™E power flow base case representing the summer peak operating conditions for 2006 and used for RNA analysis. NYISO also provided a full contingency list and a subsystem file and monitor file for thermal analysis.

The base case models Athens dispatched with two GT/CT sets on at a total power output of 700 MW. This case is referred to as the Benchmark Case without SPS.

Siemens PTI developed a case with the SPS. In this case, Athens was increased to its full capacity i.e., 1080 MW, to increase flow on the Athens-Pleasant Valley and Leeds-Pleasant Valley (Lines 91 and 92) path. The additional Athens generation was dispatched against existing units in Con Ed. In setting up this case, tap settings of phase angle regulators and autotransformers were adjusted, within their capabilities, to regulate power flow and voltage. Similarly, switched shunt capacitors and reactors were allowed to regulate voltage. Additionally, the Leeds SVC, Frasier SVC and Marcy FACTS device were held near zero output.

2.3 Dynamic Simulation Data

NYISO provided a separate power flow base case for stability simulations and a set of stability setup files. In this power flow case, Athens was dispatched at 800 MW on three CT/GT sets. For consistency with the case used in steady-state analysis, Siemens PTI reduced the dispatch of the Athens plant from 800 MW to 700 MW on two CT/GT sets. The MW reduction was balanced by units in Ontario. This case is referred to as the Benchmark Case without SPS.

Siemens PTI developed a stability power flow case with the SPS using the same approach as that in Section 2.1. In this case, Athens was increased to its full capacity i.e., 1080 MW, to increase flow on the Athens-Pleasant Valley and Leeds-Pleasant Valley (Lines 91 and 92) path. The additional Athens generation was dispatched against existing units in Con Ed.

In both cases, flow on the UPNY-Con Ed interface was stressed to 11% higher than its transfer limit determined in the steady-state analysis. Details of the stressed cases are discussed in detail in Section 5.

The dynamic model for stability simulation was obtained from the NYISO stability database and setup files.

Criteria, Methodology, Assumptions

3.1 Study Scope

The scope of the SRIS, which is included in Appendix A, was approved by the NYISO Operating Committee on October 12, 2006.

3.2 Study Area

The study area focused on the Bulk Power System in South-Eastern New York between Albany and New York City, and voltages underlying systems at 115 kV and above in the lower Hudson Valley (Zones G, H & I).

In the PSS™E power flow base case provided by NYISO, facilities rated at 115 kV and above in PSS™E designated areas 6 through 11 are monitored in the study. These areas are:

- Capital District
- Hudson
- Millwood
- Dunwoodie
- Con Ed
- Long Island

3.3 Methodology

NYISO provided a PSS™E power flow base case representing the summer peak operating conditions for 2006 and used for RNA analysis. The base case models Athens dispatched with two GT/CT sets on at a total power output of 700 MW. This case is referred to as the Benchmark Case without SPS. Siemens PTI developed a case with the SPS. In this case, Athens was increased to its full capacity i.e., 1080 MW in three combine cycle trains, to increase flow on the Athens-Pleasant Valley and Leeds-Pleasant Valley (Lines 91 and 92) path. Steady state and stability analyses were performed to develop a comparative assessment of the system state without and with the SPS. The following analyses were conducted and are further described in later sections of the report:

④ Power flow and contingency analyses to assess and compare branch loadings and bus voltages in the study area for the cases without and with the SPS.

④ Stability analysis to determine system performance within the study area for the cases without and with the SPS.

- Transfer limit analysis to determine thermal and voltage transfer limits of the UPNY-Con Ed and UPNY-SENY interfaces for the cases without and with the SPS.
- Extreme contingency assessment to evaluate the system performance within the study area under representative extreme contingencies for the cases without and with the SPS.
- Evaluation of the type and the effect of misoperation or failed operation of the SPS.

3.4 Study Cases

The analysis summarized in this report used the power flow cases described below. When setting up the cases, tap settings of phase angle regulators and autotransformers were adjusted, within their capabilities, to regulate power flow and voltage. Similarly, switched shunt capacitors and reactors were switched were allowed to regulate voltage. Additionally, the Leeds SVC, Frasier SVC and Marcy FACTS device were held near zero output.

The effectiveness of the SPS has been evaluated for summer peak load for two base system conditions described below.

Case 1 - Benchmark Case without the SPS. In this case, Athens was dispatched with two GT/CT sets on at a total power output of 700 MW.

Case 2 - Case 1 with the SPS modeled. In this case, Athens was increased to its full capacity i.e., 1080 MW in three combine cycle trains to increase flow on the Athens-Pleasant Valley and Leeds-Pleasant Valley (Lines 91 and 92) path. Additionally, a 240 MVAr capacitor bank was added to maintain the voltages at the Pleasant Valley, Millwood, Sprain Brook and Dunwoodie stations above below 348 kV (a recently updated pre-contingency low voltage limit for these stations).

It is noted that Dunwoodie has the lowest voltage in the base case with the SPS. The capacitor bank could be installed at Dunwoodie or Sprain Brook but there are concerns that space may be limited in those two stations. Therefore, Millwood was chosen to be the installation location and the capacitor bank size was installed to maintain the steady-state pre-contingency voltage at the four stations above 348 kV while keeping the Athens generator scheduled voltage 1.04 pu as modeled in the Benchmark case without the SPS.

3.5 Assumptions

Generation redispatch for transfers are performed according to the standard proportions used in NYISO operating studies. Athens will be dispatched at full output for the case with the SPS.

Phase angle regulators (PARs) are modeled according to the standard NYISO practice for operating studies as regulating pre-contingency and free-flowing, post-contingency.

The Leeds SVC, Frasier SVC and Marcy FACTS device are set to zero pre-contingency and allowed to operate to full range post-contingency.

Power Flow Analysis

4.1 Analysis of the System Condition Following SPS Operation

The operation of the SPS will allow post-contingency loading of either the Leeds to Pleasant Valley or Athens to Pleasant Valley 345 kV lines (Lines 91 and 92) up to their STE ratings for outage of the other line. The system condition following SPS operation can be illustrated by comparing load flow results representing two conditions:

1. Operation without the SPS (Benchmark Case without SPS). This is the base case supplied by the NYISO and has Athens dispatched at 700 MW
2. Operation with the SPS (Case with SPS). This case has Athens dispatched at 1080 MW, and other changes as described below.

In the case with the SPS, the redispatch performed to increase flow on the Athens-Pleasant Valley and Leeds-Pleasant Valley (Lines 91 and 92) path to determine the thermal transfer limit first increased Athens to full power output. The subsequent generation shifts were performed from Ontario to Con Ed to increase the transfer level on the interface concerned. The generation shifts are show in Table 4-1. In addition, the SPS permits the allowable post contingency loading on the 91/92 lines to go to STE. All other lines use their standard (LTE) post-contingency ratings.

A 240 MVAr capacitor bank was added at the Millwood 345 kV bus in the case with the SPS. Without this capacitor bank, the voltages at the Pleasant Valley, Millwood, Sprain Brook and Dunwoodie stations are below 348 kV (a recently updated pre-contingency low voltage limit for these stations). Dunwoodie has the lowest voltage. The capacitor bank could be installed at Dunwoodie or Sprain Brook but there are concerns that space may be limited in those two stations. Therefore, Millwood was chosen to be the installation location and the capacitor bank size was installed to maintain the steady-state pre-contingency voltage at the four stations above 348 kV while keeping the Athens generator scheduled voltage 1.04 pu as modeled in the Benchmark case without the SPS.

Table 4-2 shows power transfer levels on the NYISO interfaces of UPNY-Con Ed, UPNY-SENY, Central East and Total East, for the Benchmark Case without SPS and the Case with SPS.

Power Flow Analysis

Table 4-1: Generation Shifts for Thermal Transfer Limits

Increase Athens Generation from 700 MW to 1080 MW

Bus Number	Bus Name	Case w/ SPS (Step 1) (MW)	Case w/o SPS (MW)	Change (MW)
78706	[ATHENSC116.0]	250	239.8	10.2
78707	[ATHENSS113.8]	110	110.2	-0.2
78708	[ATHENSC216.0]	250	243.1	6.9
78709	[ATHENSS213.8]	110	106.9	3.1
78710	[ATHENSC316.0]	250	0	250
78711	[ATHENSS313.8]	110	0	110
74705	[AST 4 20.0]	250	350	-100
74706	[AST 5 20.0]	243	333	-90
74707	[RAV 1 20.0]	240	330	-90
74907	[NRTPTG2 22.0]	268	368	-100

Additional Generation Shifts from Ontario to Downstate NY

Bus Number	Bus Name	Case w/ SPS (Step 2) (MW)	Case w/ SPS (Step 1) (MW)	Change (MW)
74705	[AST 4 20.0]	210	250	-40
74706	[AST 5 20.0]	223	243	-20
74707	[RAV 1 20.0]	220	240	-20
74907	[NRTPTG2 22.0]	248	268	-20
81425	[LENNOXG420.0]	145	125	20
81767	[NANTICG422.0]	495	475	20
81769	[NANTICG222.0]	495	475	20
81770	[NANTICG122.0]	252	232	20
81771	[NANTICG822.0]	495	475	20

Step 1: Perform generation shifts by dispatching Athens at full capacity.
Step 2: With Athens at full capacity, perform additional generation shifts.

Table 4-2: Power Transfers Across NYISO Interfaces in the Base Cases (MW)

Interface	Case Without SPS	Case With SPS
UPNY-Con Ed	3630	4096
UPNY-SENY	4507	4974
Central East	2398	2423
Total East	4297	4410

The steady state condition following the operation of the SPS was calculated for two contingencies that may trigger it, i.e.:

1. Loss of Line 91
2. Loss of Line 92

Loss of Line 95 would not cause the loadings on Lines 91 & 92 (1080 MW and 1244 MW respectively) to exceed the LTE rating of 1538 MW and therefore would not trigger the SPS.

Loss of Line 92 would increase the flow on Line 91 to 1693 MW which is higher than the LTE rating of 1538 MW but lower than the STE rating of 1724 MW. However, the worst contingency is loss of Line 91, which would increase the flow on Line 92 to its STE rating 1724 MW. This contingency requires rejecting two Athens generation trains, for a total of 720 MW. The loading of Line 92 after this contingency and rejection of 720 MW is 1520 MW, which is lower than the LTE rating of 1538 MW. Tripping only one set and 300 MW from the second set (total 660 MW), the loading of Line 92 is 1538.2 MW, or basically at the LTE rating. This calculation is based on the load flow case where the UPNY-Con Ed interface value is initially at the thermal limit, about 4099 MW as determined in the thermal analysis described in Section 5. The calculation uses an inertial redispatch to replace the lost Athens generation and LTC transformer taps, phase shifters, and switched shunts are held at their pre-contingency settings, per NYISO practice. All other line flows and bus voltages are within their respective post-contingency limits.

Figures 4-1 to 4-5 show flows on Lines 91, 92 & 95, the Athens generation dispatches and some of the surrounding system, without and with the SPS under normal and contingency conditions:

④ Figure 4-1: Benchmark Case without SPS

④ Figure 4-2: Benchmark Case Following Line 91 Contingency ④

Figure 4-3: Case with SPS, All Equipment In-Service

④ Figure 4-4: Case with SPS Following Line 91 Contingency but before SPS Operation ④

Figure 4-5: Case with SPS Following Line 91 Contingency and SPS Operation

In similar manner, rejection of two Athens generation trains for a total of 720 MW would also bring the flow on Line 91 back below its LTE ratings following the loss of Line 92.

Power Flow Analysis

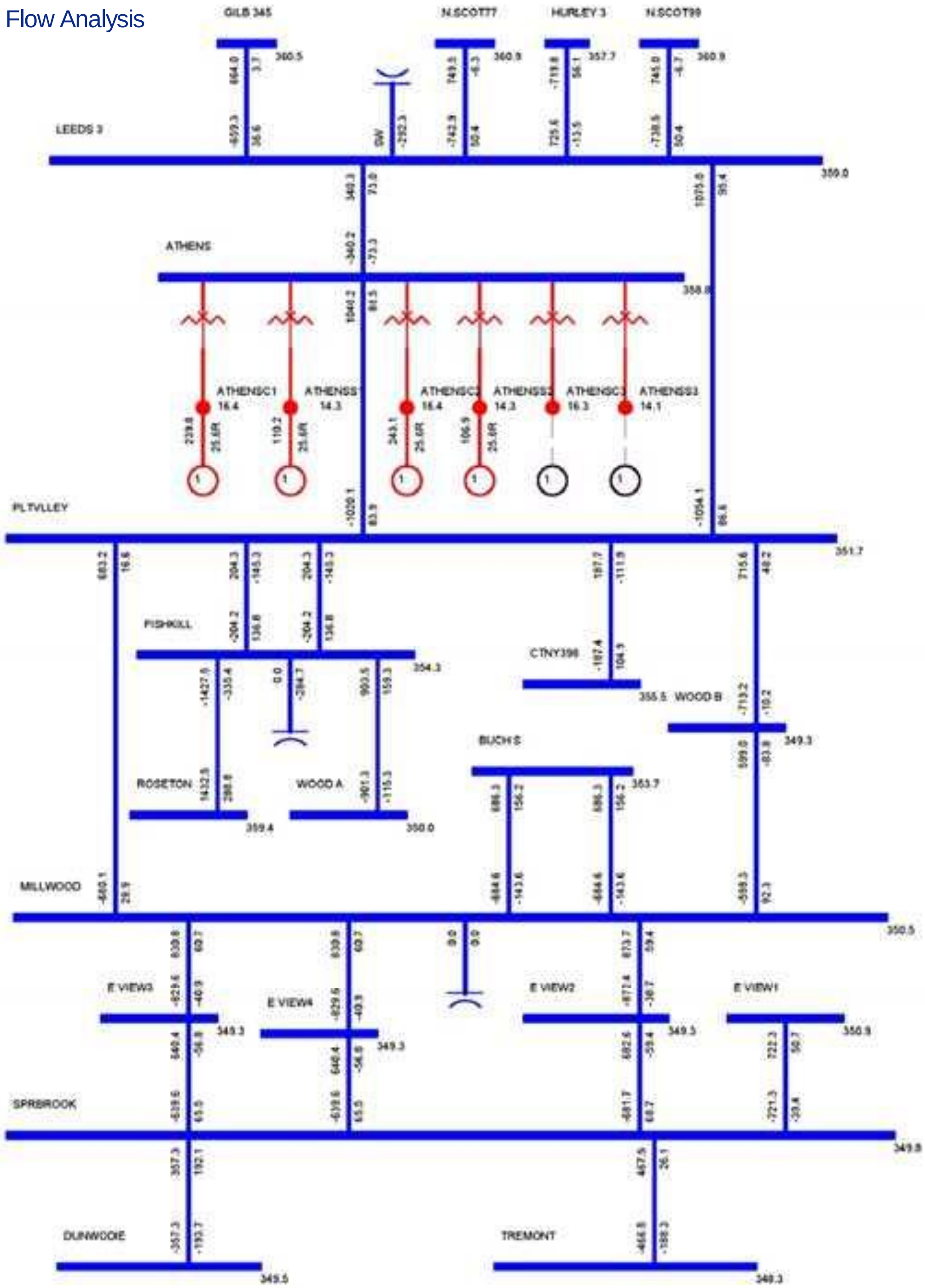

Figure 4-1: Benchmark Case without SPS

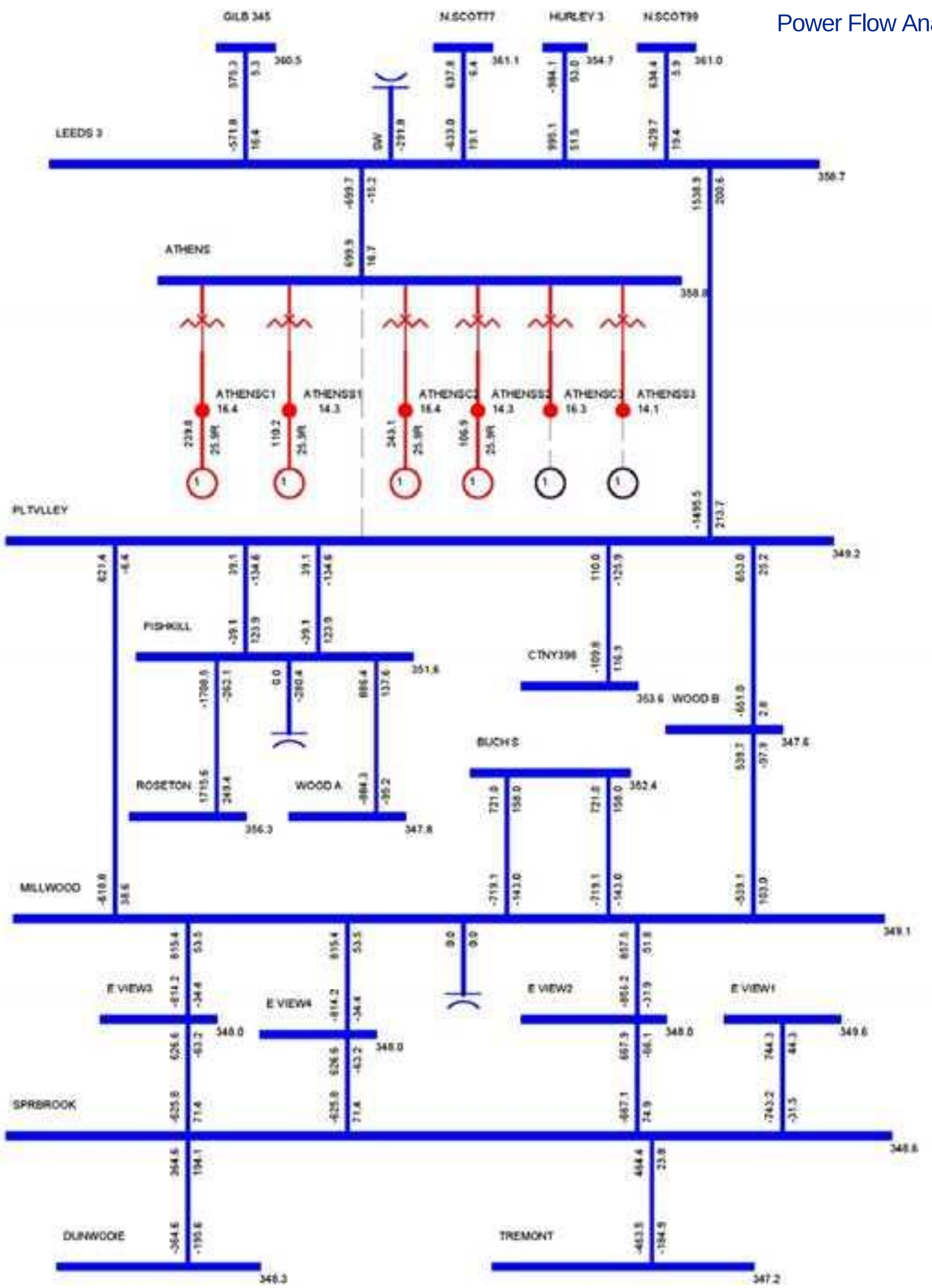

Figure 4-2: Benchmark Case Following Line 91 Contingency

Power Flow Analysis

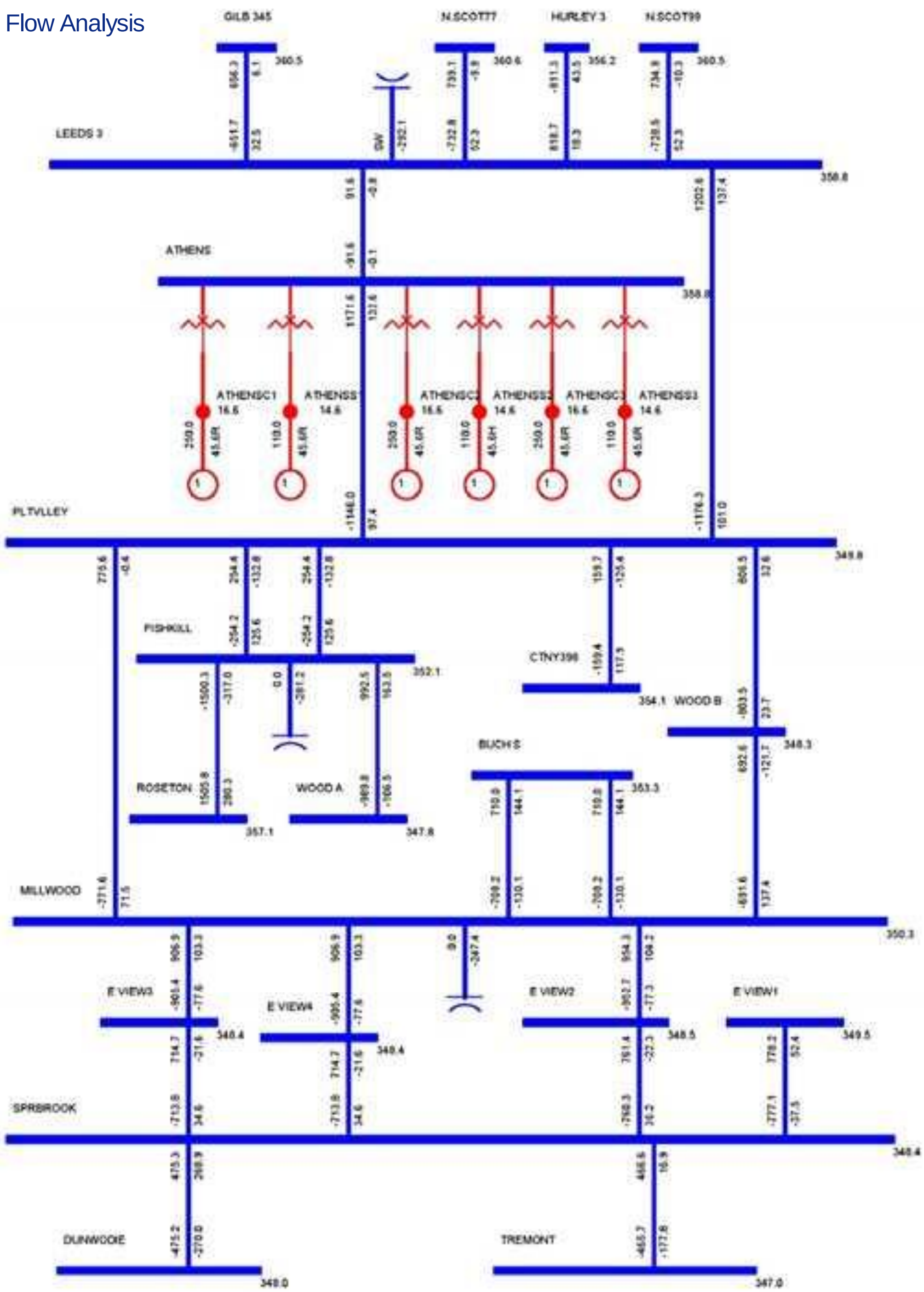

Figure 4-3: Case with SPS, All Equipment In-Service

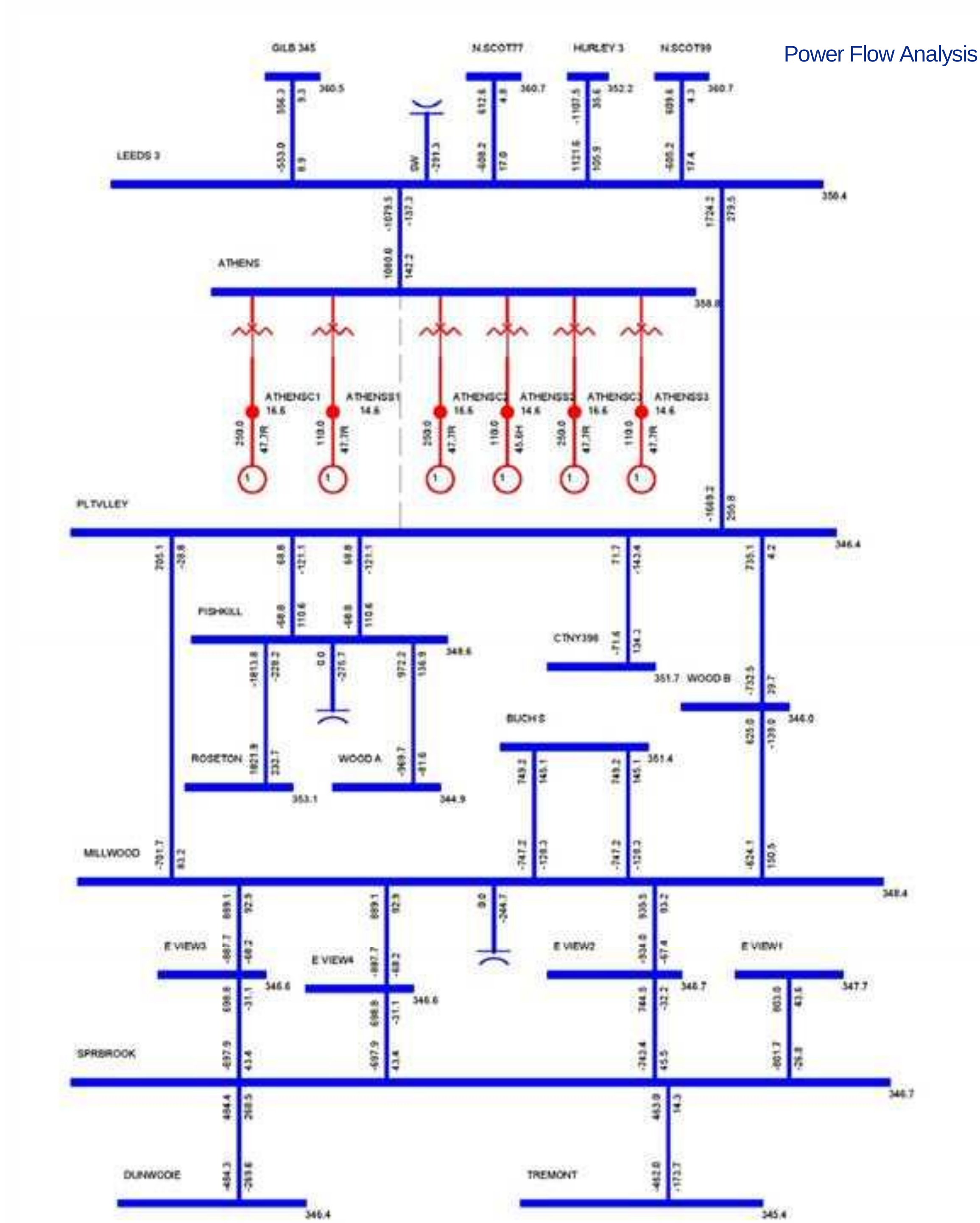

Figure 4-4: Case with SPS Following Line 91 Contingency but before SPS Operation

Power Flow Analysis

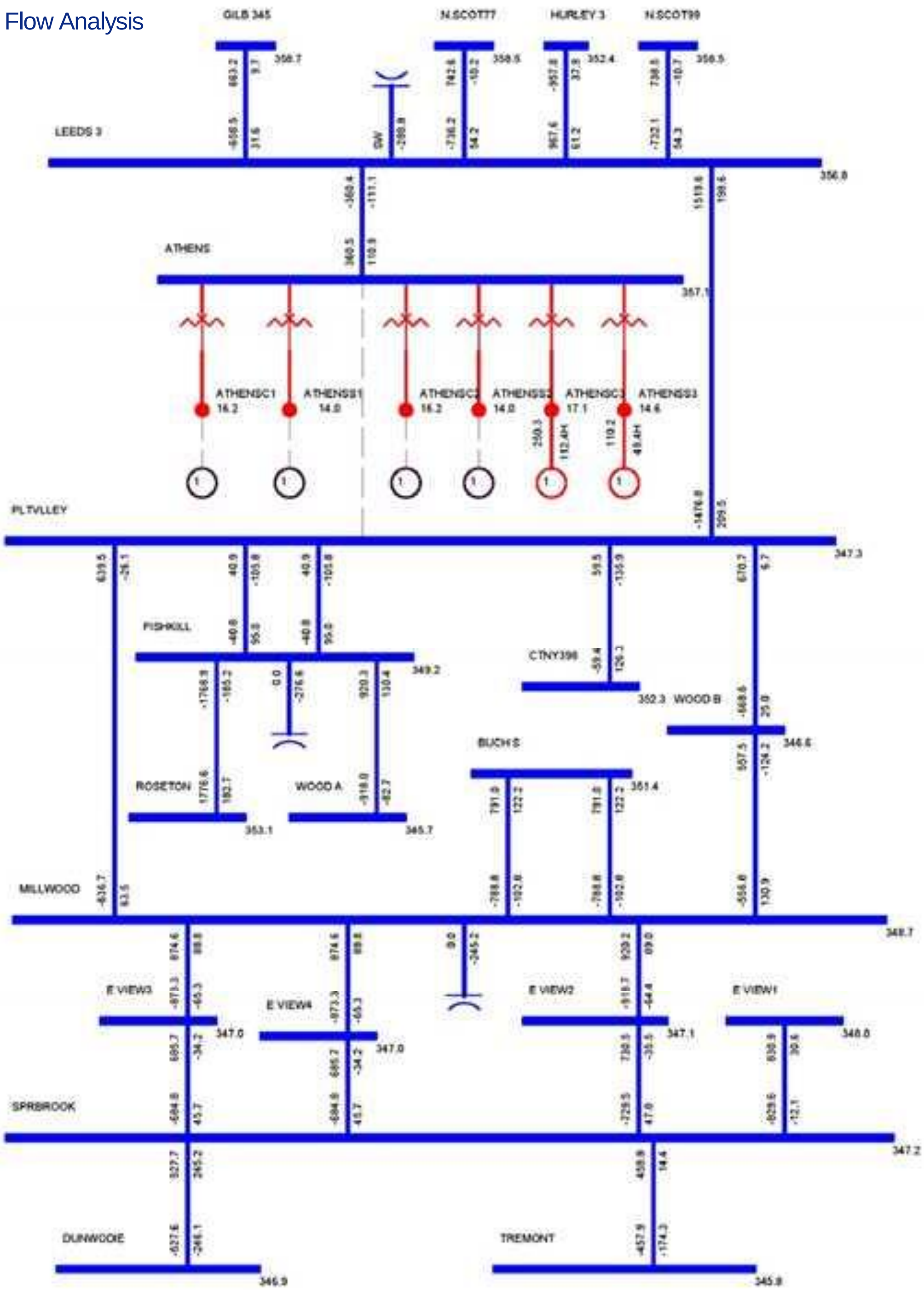

Figure 4-5: Case with SPS Following Line 91 Contingency and SPS Operation

4.2 Analysis of Voltage Constraints

Voltage contingency analysis was performed for the Benchmark Case without the SPS and the Case with the SPS with the UPNY-Con Ed interface at the normal thermal transfer limit, i.e., 3633 MW and 4099 MW respectively, as determined in the thermal analysis described in Section 5. The Case with the SPS has a 240 MVAR capacitor bank added at Millwood as described above.

The full contingency set provided by the NYISO were simulated and bus voltages were monitored for violations of the limits in Exhibit A-3 of the NYISO Emergency Operation Manual and for bus voltages on the 115 kV system in the Lower Hudson area less than 95% of nominal. Taps and phase shifter positions were fixed for the post-contingency calculation.

The Leeds and Fraser SVCs and Marcy FACTS devices are held at or near zero output in the pre-contingency power flows, but are allowed to regulate voltage, within their capabilities, in the post-contingency power flows.

The detailed voltage analysis results are included in Appendix B. It is noted that with Athens dispatched at full capacity and the SPS, the voltages of several 115 kV buses decrease by less than 1%. The case with the SPS does not have significant incremental impact on the voltage at any other bus.

Power Flow Analysis

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Impact on Transfer Limits

Transfer limit analysis was performed to determine and compare thermal, voltage and stability limits of the UPNY-Con Ed and UPNY-SENY interfaces for the cases without and with the SPS. Analysis of the UPNY-SENY interface is limited to thermal conditions only.

This analysis was performed for the summer peak condition per the SIS scope.

5.1 Thermal Analysis

5.1.1 Methodology

Thermal analysis was performed using the PSS™E subsystem, contingency and monitor files provided by the NYISO, to determine the incremental impact of the SPS on the normal transfer limit of the UPNY-Con Ed and UPNY-SENY interfaces. The full contingency set, as supplied by the NYISO, was used in the analysis. The normal transfer limit of the UPNY - Con Ed and UPNY-SENY interfaces was determined for the following two cases:

1. Case without SPS (Benchmark) with Athens dispatched at 700 MW
2. Case with SPS with Athens dispatched at 1080 MW

The redispatch performed to increase flow on the Athens-Pleasant Valley and Leeds-Pleasant Valley (Lines 91 and 92) path to determine the thermal transfer limit first increased Athens to full power output with subsequent generation shifts from Ontario to Con Ed to increase the transfer level on the interface concerned as shown in Table 4-1. The SPS permits the allowable post contingency loading on the 91/92 lines to go to STE. All other lines use their standard (LTE) post-contingency ratings.

5.1.2 Criteria

In accordance with NPCC criteria and NYSRC Reliability rules, several types of contingencies were simulated for this analysis:

1. Opening of lines connected between buses with base voltage greater than 100 kV
2. Multiple element
3. Generator
4. Common structure
5. HVDC

6. Stuck circuit breaker

Impact on Transfer Limits

Phase angle regulators maintain scheduled power flow in pre-contingency conditions but are fixed at pre-contingency angle in post-contingency conditions.

The normal transfer limit is the transfer level at which:

- a branch has reached its normal rating for pre-contingency conditions, or
- a branch has reached its LTE rating following a contingency, except that the SPS will allow post-contingency loading of either the Leeds to Pleasant Valley or Athens to Pleasant Valley 345 kV lines (Lines 91 and 92) up to their STE ratings for outage of the other line.

5.1.3 Model Development

Thermal transfer limits were calculated for summer peak load conditions without and with the SPS. The cases without the SPS (Case 1) and with the SPS (Case 2) are described in Section 3.4.

5.1.4 Results

Normal thermal transfer limits are summarized in Table 5-1. The detailed results are included in Appendix C.

It is noted from the table that the operation of the SPS increases UPNY-Con Ed and UPNYSENY thermal transfer limits by 466 MW respectively.

Table 5-1: Thermal Normal Transfer Limits (MW)

Interface	Case Without SPS	Case With SPS	Change
UPNY-Con Ed	3633[A]	4099[B]	466
UPNY-SENY	4502[A]	4968[B]	466

A Limited by Leeds - Pleasant Valley 345 kV (LTE: 1538 MW) for loss of Athens-Pleasant Valley 345 kV

B Limited by Leeds - Pleasant Valley 345 kV (STE: 1724 MW) for loss of Athens-Pleasant Valley 345 kV

5.2 Voltage Analysis

5.2.1 Methodology

Voltage transfer limit analysis (or P-V analysis) was performed for the UPNY-Con Ed interface. Voltage-constrained limits were evaluated in accordance with the NYISO Transmission Planning Guideline #2-0 and with consideration of the voltage criteria in Exhibit A-3 of the NYISO Emergency Operation Manual.

P-V curves were produced to examine the UPNY-Con Ed power transfers versus voltage at the New Scotland, Leeds, Pleasant Valley, Millwood, Dunwoodie and Sprainbrook 345kV stations for the two cases:

1. Case without SPS (Benchmark) with Athens dispatched at 700 MW

2. Case with SPS with Athens dispatched at 1080 MW and a 240 MVAr capacitor bank installed at Millwood

A series of power flow cases were created with increasing transfer levels on Leeds - Pleasant Valley using generation shifts similar to those used for the thermal analysis. Contingencies were simulated on each case to identify violations of the voltage criteria.

5.2.2 Criteria

Per the SIS scope, the following contingencies were simulated on each case to identify violations of the voltage criteria:

- Leeds - Athens #95
- Athens - Pleasant Valley #91
- Leeds - Pleasant Valley #92
- Leeds - Hurley #301
- New Scotland - Leeds #93 (or #94)
- (Tower) Coopers Corners - Rock Tavern 34 and 42

The voltage criteria use the limits in Exhibit A-3 of the NYISO Emergency Operation Manual with the following 345 kV stations using an updated limit of 348 kV as a pre-contingency low voltage limit:

- Pleasant Valley
- Millwood
- Sprain Brook
- Dunwoodie

Tap settings of phase angle regulators and autotransformers are adjusted (within their capabilities) to regulate power flow and voltage in the pre-contingency power flows but are fixed at their corresponding pre-contingency settings in the post-contingency power flows. Similarly, switched shunt capacitors and reactors are switched according to their defined setup in the pre-contingency power flows but are held at their corresponding pre-contingency position in the post-contingency power flows. The reactive power of generators is regulated, within the reactive capabilities of the units, to hold scheduled voltage in both the pre-contingency and post-contingency power flows.

In accordance with the NYISO operating practice, the Leeds and Fraser SVCs and Marcy FACTS devices are held at or near zero output in the pre-contingency power flows, but are allowed to regulate voltage, within their capabilities, in the post-contingency power flows. Inertial pickup is assumed for contingencies involving a loss of generation or HVDC.

The voltage-constrained transfer limits of the UPNY-Con Ed interface are determined in accordance with the NYISO Transmission Planning Guideline #2-0. As the transfer across an interface is increased, the voltage-constrained transfer limit is determined as the lesser of

(a) the pre-contingency power flow at which the post contingency voltage falls below the post-contingency limit, or (b) 95% of the pre-contingency power flow at the "nose" of the postcontingency voltage vs. pre-contingency flow curve.

5.2.3 Model Development

Voltage transfer limits were calculated for summer peak load conditions without and with the SPS. The cases without the Project (Case 1) and with the Project (Case 2) are described in Section 3.4.

5.2.4 Results

Voltage transfer limits are summarized in Table 5-2. The P-V curves for the Benchmark Case and the Case with the SPS are plotted in Figures 5-1 and 5-2. There are three potential limiting conditions:

1. Pre-contingency (base case) voltage limits
2. Post-contingency voltage limits
3. Voltage collapse (limit is 95% of the interface flow at which collapse occurs.)

For both the cases without the SPS and with the SPS, the pre-contingency voltage transfer limit on the UPNY-Con Ed interface is the lowest, 3880 MW and 4125 MW respectively in both cases.

Comparing with the thermal analysis results, it is noted that the voltage-based transfer limits are higher than the corresponding thermal transfer limits on the UPNY-Con Ed interface.

Table 5-2: Approximate Voltage Transfer Limit on UPNY-Con Ed (MW)

UPNY-Con Ed Transfer	Case Without SPS	Case With SPS	Change
Pre-Contingency Low	3880[A]	4125[A]	245
Post-Contingency Low	4279[B]	4383[B]	104
95% Voltage Collapse (5% MW Margin)	4092[C]	4190[C]	98
Voltage-Based Transfer Limit	**3880[A]**	**4125[C]**	**245**
Thermal Transfer Limit	**3633[D]**	**4099[E]**	**466**

A Pre-contingency voltage at Dunwoodie 345 kV
B Post-contingency voltage at Pleasant Valley 345 kV for loss of tower Coopers Corners-Rock Tavern 34/42
C 95% of voltage collapse criteria limit for loss of tower Coopers Corners-Rock Tavern 34/42
D Limited by Leeds - Pleasant Valley 345 kV (LTE: 1538 MW) for loss of Athens-Pleasant Valley 345 kV
E Limited by Leeds - Pleasant Valley 345 kV (STE: 1724 MW) for loss of Athens-Pleasant Valley 345 kV

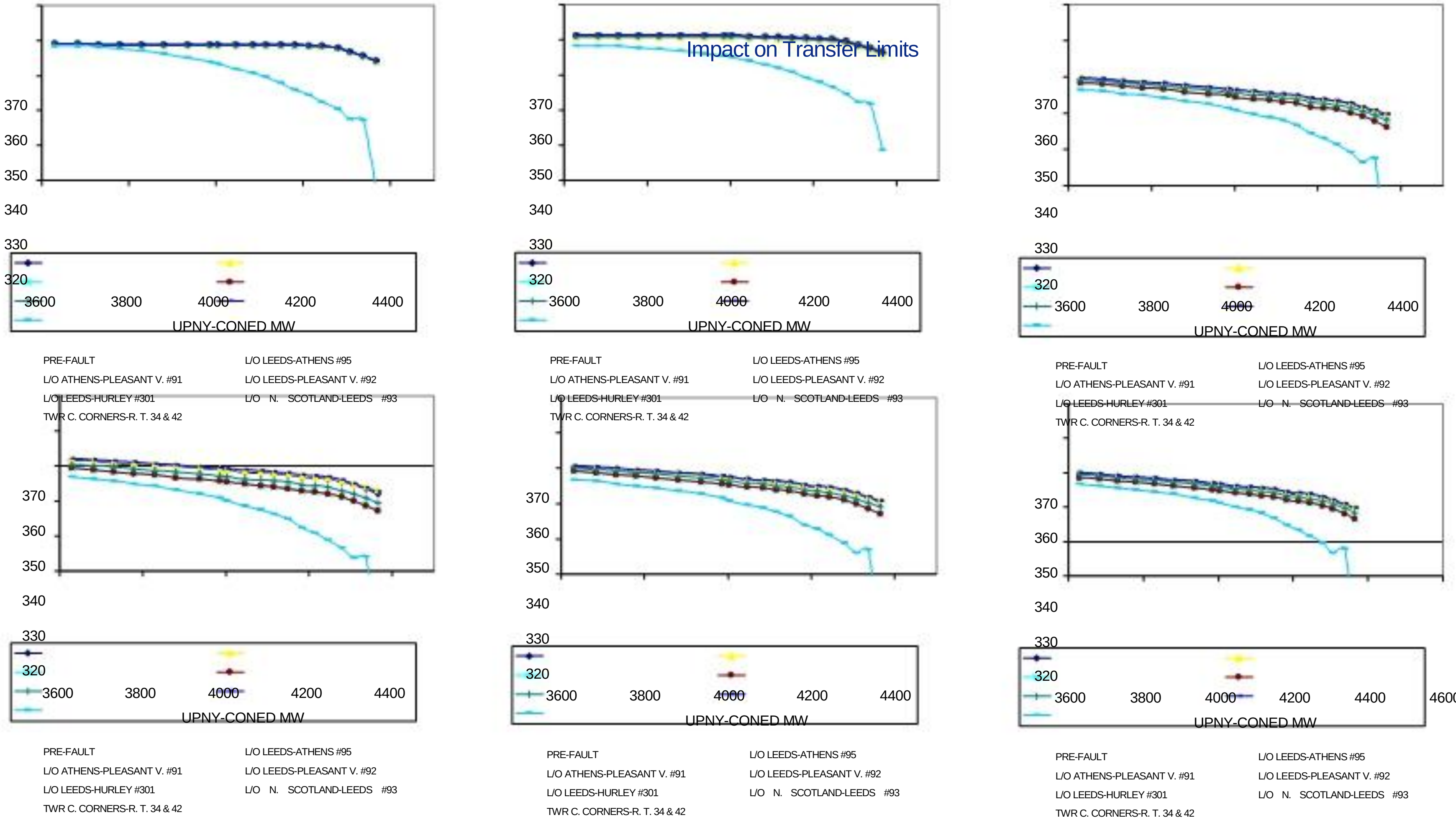


Figure 5-1: P-V Curves for the Case without SPS

LEEDS 345 KV VOLTAGE

N. SCOTLAND 345 KV VOLTAGE

DUNWOODIE 345 KV VOLTAGE

PLEASANT V. 345 KV VOLTAGE

MILLWOOD 345 KV VOLTAGE

SPRAINBROOK 345 KV VOLTAGE

Impact on Transfer Limits

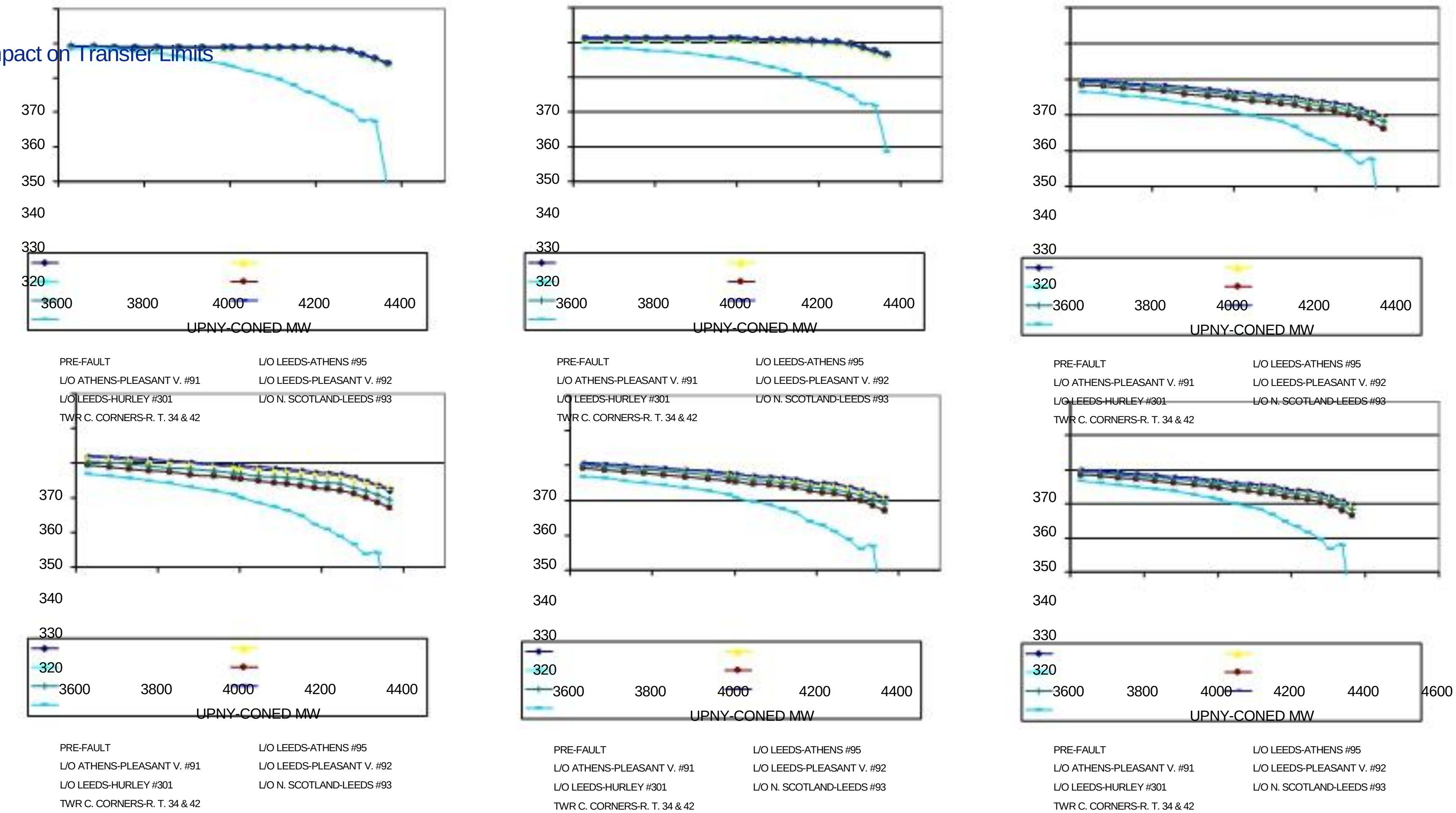


Figure 5-2: P-V Curves for the Case with SPS

LEEDS 345 KV VOLTAGE

N. SCOTLAND 345 KV VOLTAGE

DUNWOODIE 345 KV VOLTAGE

PLEASANT V. 345 KV VOLTAGE

MILLWOOD 345 KV VOLTAGE

SPRAINBROOK 345 KV VOLTAGE

5.3 Stability Analysis

5.3.1 Methodology

Stability transfer limits were tested for the UPNY-Con Ed interface. Stability analysis was performed in accordance with the NYISO Transmission Planning Guideline #3-0 to confirm that the UPNY-Con Ed power transfer level is not restricted by a stability constraint due to operation of the SPS.

5.3.2 Criteria

Per the SIS scope, stability simulations were performed for the buses/substations associated with the SPS as well as a couple of other stability tests requested. The contingencies include three-phase faults on all 345 kV buses in the Leeds, Athens and Pleasant Valley substations and also stuck breaker faults on each bus section. The contingencies simulated are shown in Table 5-3.

Table 5-3: Stability Contingency List

Location	Type	Line	Stuck Breaker	Additional Equipment Lost
Leeds	3 Phase	95		
	3 Phase	92		
	3 Phase	301		
	3 Phase	93		
	1 Phase	95	R95	Capacitor Bank
	1 Phase	95	R395	GL-3 to Gilboa
	1 Phase	92	R92	Capacitor Bank
	1 Phase	92	R9293	93 to New Scotland
Athens	3 Phase	95		
	3 Phase	91		
	1 Phase	95	R9561	
	1 Phase	95	R9562	Athens 2
	1 Phase	91	R9163	
	1 Phase	91	R9162	Athens 2
Pleasant Valley	3 Phase	91		
	3 Phase	92		
	1 Phase	91	RN4	
	1 Phase	91	RNS4	F31/W81 to Millwood
	1 Phase	92	RN5	
	1 Phase	92	RNS5	F30/W80 to Millwood
Ravenswood	3 Phase			Loss of Ravenswood 3
Marcy South	LLG			Marcy-Coopers & Edic-Fraser

Impact on Transfer Limits

5.3.3 Model Development

The contingencies shown in Table 5-3 were simulated for the cases without and with the SPS.

1. Case without SPS (Benchmark) with Athens dispatched at 700 MW
2. Case with SPS with Athens dispatched at 1080 MW and a 240 MVAr capacitor bank installed at Millwood

In preparing the above cases, Siemens PTI used a power flow base case provided by the NYISO, which differed somewhat from the case used in the steady state analysis. In the power flow case provided for stability analysis, Athens was dispatched at 800 MW on three combined cycle trains. For consistency with the case used in steady-state analysis, Siemens PTI reduced Athens dispatch from 800 MW to 700 MW on two combined cycle trains. The MW reduction was balanced by units in Ontario. This case is referred to as the Benchmark Case without SPS.

Then, Siemens PTI developed a stability power flow case with the SPS. In this case, Athens was increased to its full capacity i.e., 1080 MW, to increase flow on the Athens-Pleasant Valley and Leeds-Pleasant Valley (Lines 91 and 92) path. The additional Athens generation was dispatched against existing units in Con Ed. For consistency with the case used in steady-state analysis, a 240 MVAR capacitor was added at Millwood.

Consistent with NYISO practice, the UPNY - Con Ed interface flow was further stressed by increasing it to 11 % higher than that determined in the steady state analysis (Table 5-1), that is, 4032 (3633*1.11) MW for the Benchmark case without SPS and 4550 MW (4099*1.11) for the case with SPS. The interface loadings were accomplished using the same generation shifts as used the steady-state analysis.

However, the load flow case with the SPS would not converge at the 4550 MW transfer level due to voltage collapse. The highest achievable UPNY-Con Ed interface flow is 4330 MW before the case fails to converge. This value is higher than the voltage-based transfer limit 4125 MW as determined in the steady-state analysis (Table 5-2).

To overcome this collapse problem, an “artificial” 350 Mvar capacitor was added at Dunwoodie. With this capacitor, the case converges and the transfer level of 4550 MW on the UPNY-Con Ed interface is reached. This is necessary to allow for the stability analysis to be performed at the prescribed 11% higher transfer. This approach is consistent with NYISO practice (NYISO Transmission Planning Guideline #3-0).

5.3.4 Results

Stability simulations were performed on the contingencies in Table 5-3 for the three transfer levels:

- ④ Case A: 4032 MW (111% of the transfer limit in the Benchmark case without the SPS)

- Case B0: 4330 MW (Highest achievable voltage-constrained transfer in the case with the SPS)

- Case B: 4550 MW (111% of the transfer limit in the case with the SPS and an "artificial" reactive compensation of 350 Mvar added at Dunwoodie)

Simulations were performed to address the two periods of interest. First, a simulation was performed at the higher loading resulting from the presence of the SPS. Second, after it was verified that the simulation of the contingency was stable, the post-contingency steady state condition (using NYISO post-contingency calculation methodology) was used as the initial condition to simulate the operation of the SPS to show the effect of the loss of generation on the system.

All the simulated contingencies exhibited a stable response with positive damping. Stability is thus not the limiting constraint either without or with the SPS.

Figures 5-3 to 5-6 show comparative machine rotor angels at Athens, voltages at Athens and Pleasant Valley, and branch flow on Line 92 following a 3-phase fault at Athens with normal clearing and tripping of Line 91, for the three cases (4032 MW, 4330 MW and 4550 MW) during the first period of time, i.e., before the operation of the SPS.

Figures 5-7 to 5-10 show the same quantities compared for the 4330 MW and 4550 MW cases during the second period of time, i.e., after the operation of the SPS.

All other stability plots of representative machine quantities and other system quantities are included in Appendix D.

Impact on Transfer Limits

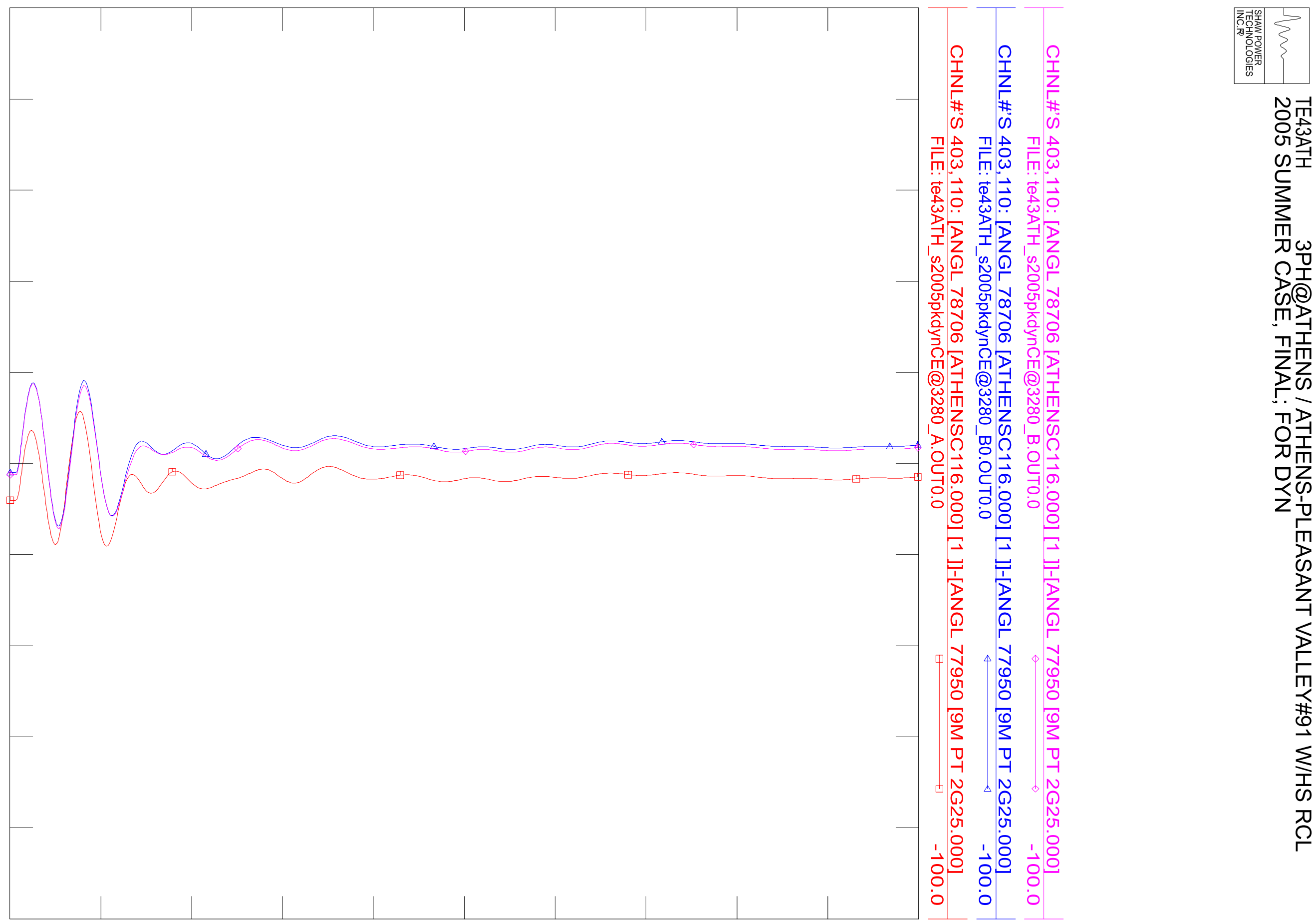
0.0 1.5000 3.0000 4.5000 6.0000 7.5000 9.0000 10.500 12.000 13.500 15.000

TIME (SECONDS)

WED, AUG 16 2006 9:03

ATHENS RELATIVE ANGLES

Figure 5-3: CT Machine Angle at Athens Following Fault, Pre-SPS Operation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TE43ATH 3PH@ATHENS / ATHENS-PLEASANT VALLEY#91 W/HS RCL
2005 SUMMER CASE, FINAL; FOR DYN

Impact on Transfer Limits

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TIME (SECONDS)

THU, MAY 25 2006 8:54

ATHENS 345 KV VOLTAGE

Figure 5-4: Voltage at Athens Following Fault, Pre-SPS Operation

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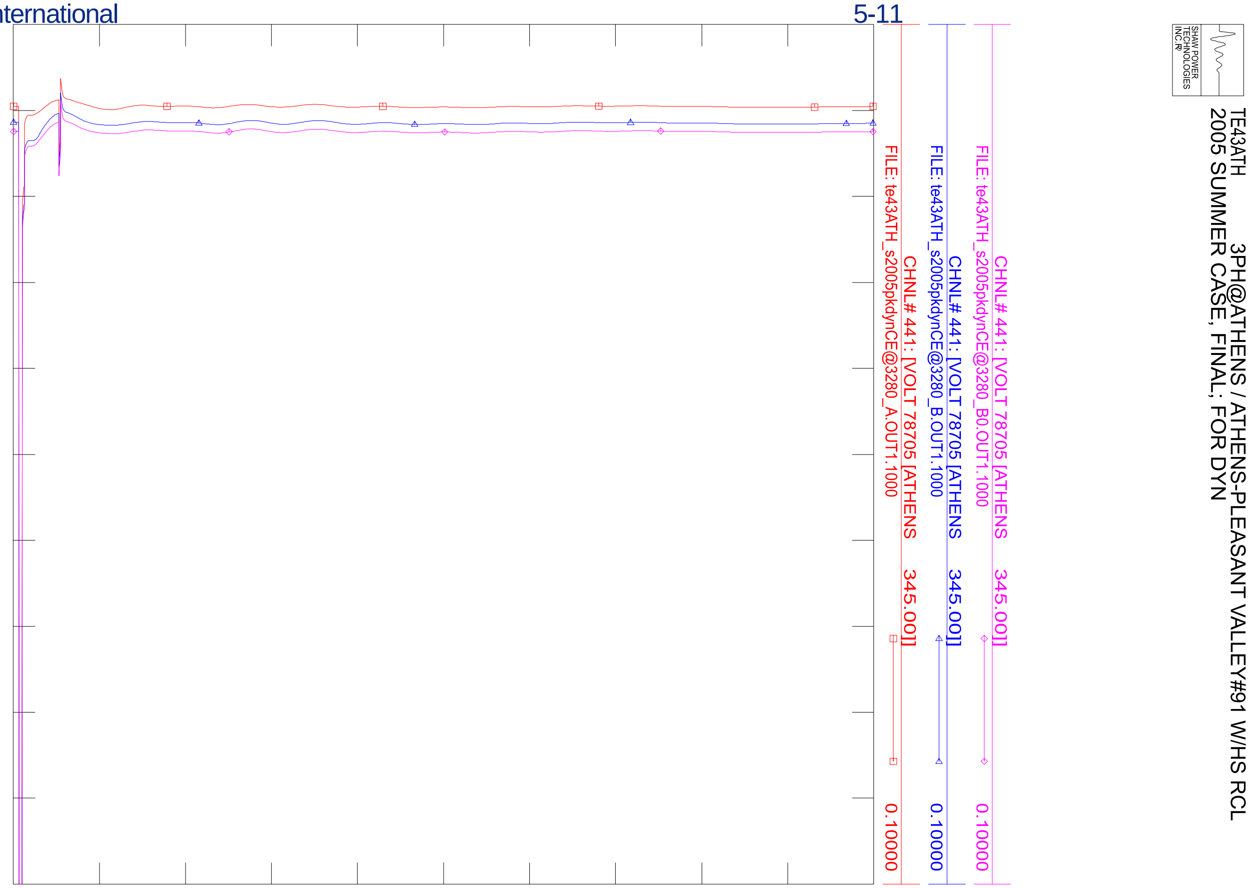

Impact on Transfer Limits

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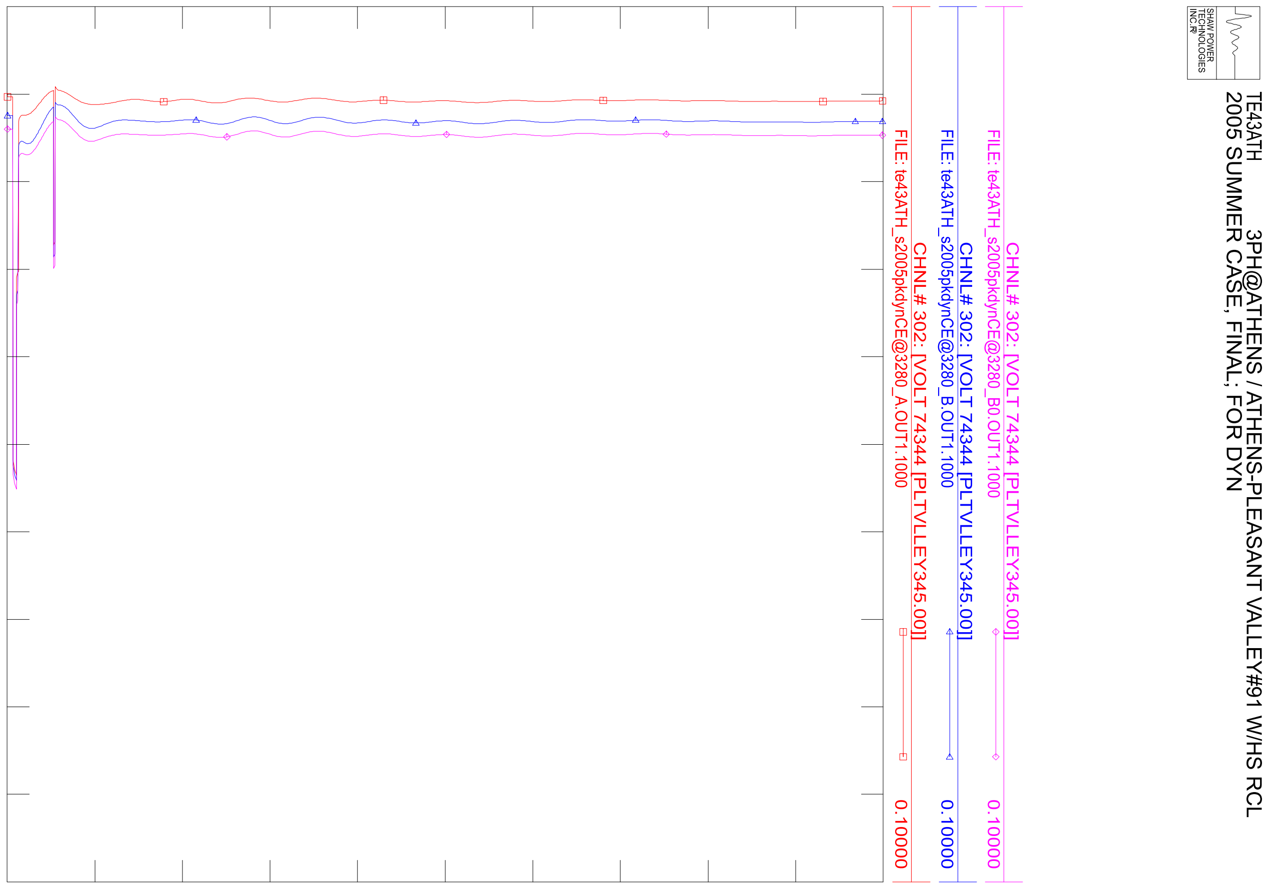
TIME (SECONDS)

THU, MAY 25 2006 8:54

PLEASANT VALLEY VOLTAGE

Figure 5-5: Voltage at Pleasant Valley Following Fault, Pre-SPS Operation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TE43ATH 3PH@ATHENS / ATHENS-PLEASANT VALLEY#91 W/HS RCL
2005 SUMMER CASE, FINAL; FOR DYN

0.0 1.5000 3.0000 4.5000 6.0000 7.5000 9.0000 10.500 12.000 13.500 15.000

TIME (SECONDS)

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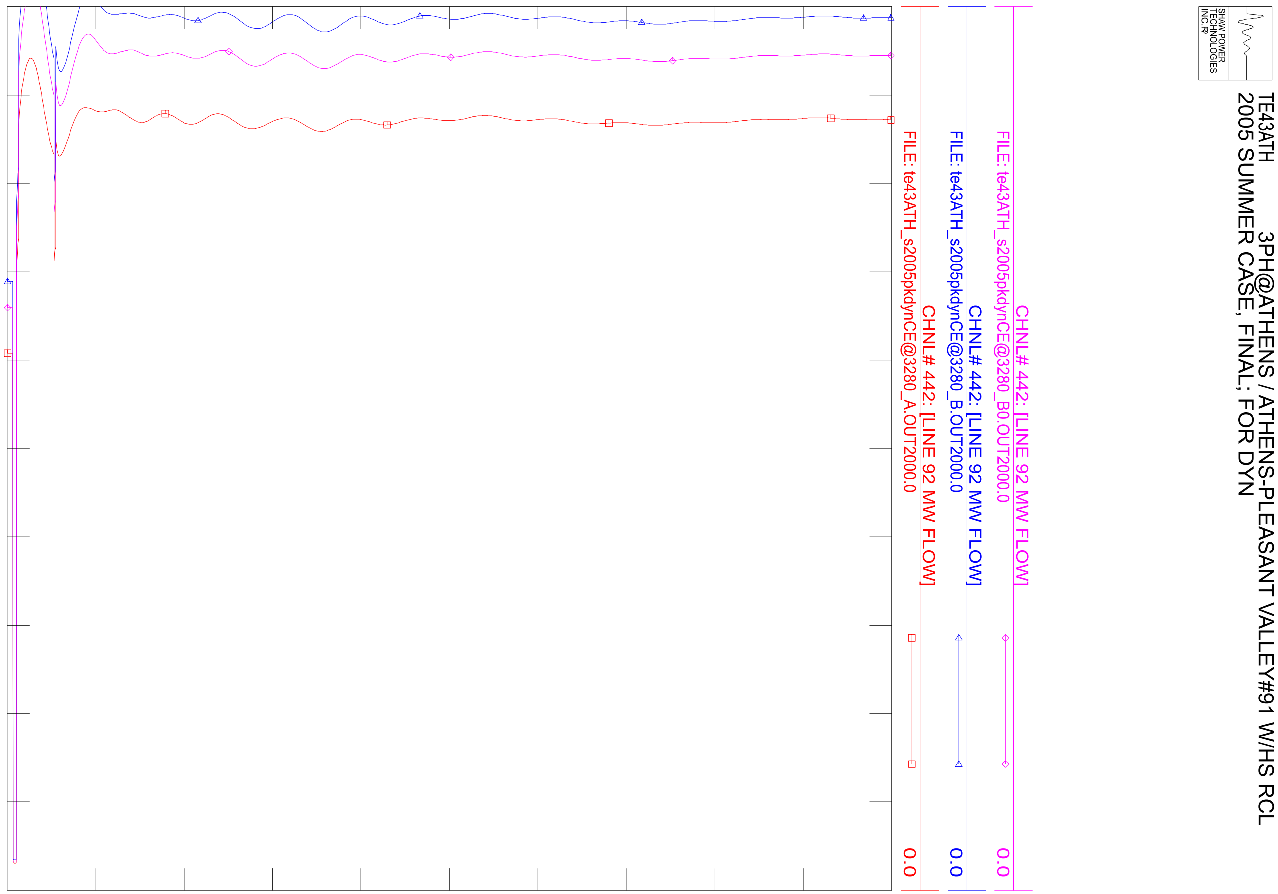
LINE 92 FLOW

Figure 5-6: Branch Flow on Line 92 Following Fault, Pre-SPS Operation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2005 SUMMER CASE, FINAL; FOR DYN
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CHNL# 442: [LINE 92 MW FLOW]
0.0
0.0
0.0

Impact on Transfer Limits

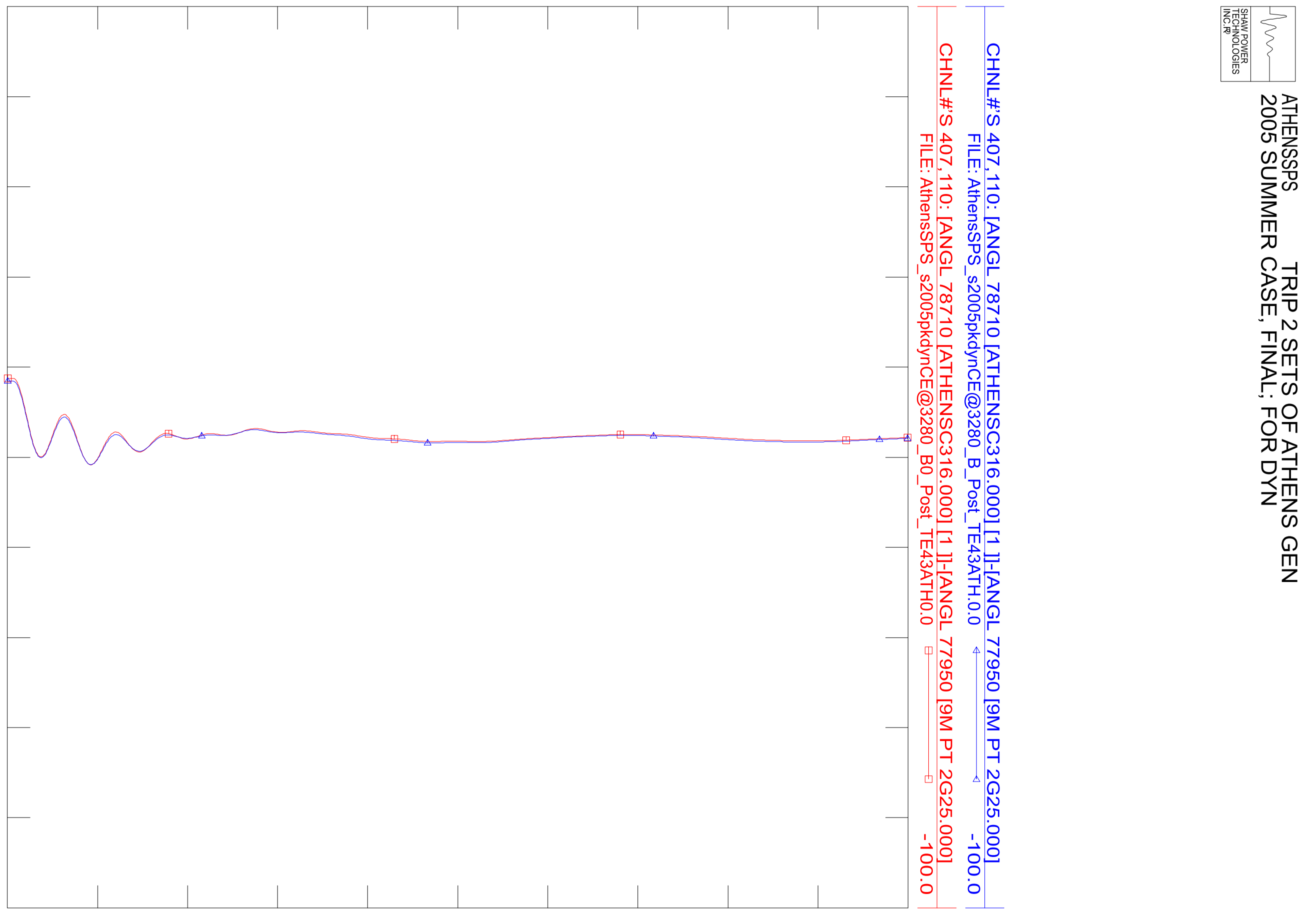
0.0 1.5000 3.0000 4.5000 6.0000 7.5000 9.0000 10.500 12.000 13.500 15.000

TIME (SECONDS)

FRI, JUN 02 2006 9:22

ATHENS RELATIVE ANGLES

Figure 5-7: Machine Angle at Athens Following SPS Operation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-100.0
ATHENSSPS TRIP 2 SETS OF ATHENS GEN
2005 SUMMER CASE, FINAL; FOR DYN
SHAW POWER TECHNOLOGIES INC.®

Impact on Transfer Limits

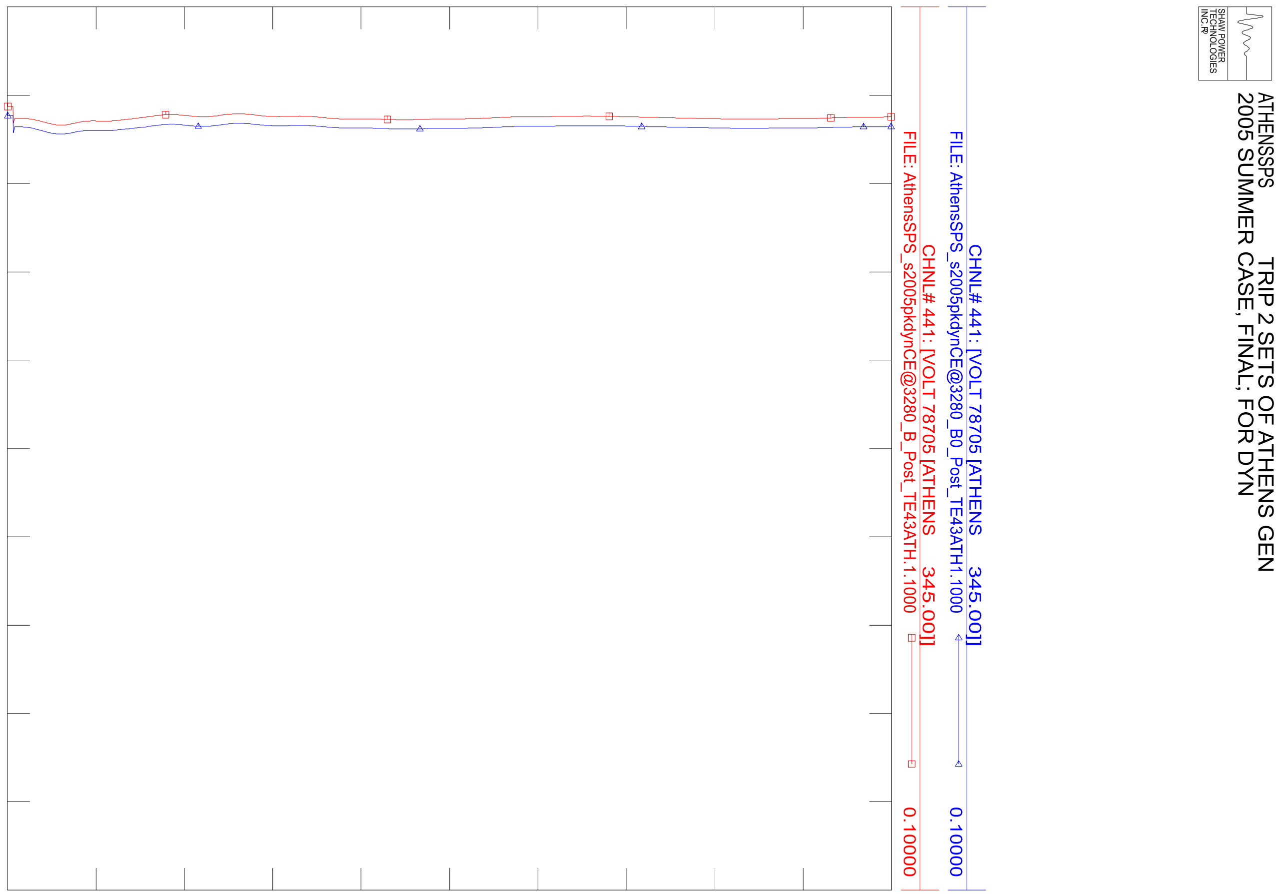
0.0 1.5000 3.0000 4.5000 6.0000 7.5000 9.0000 10.500 12.000 13.500 15.000

TIME (SECONDS)

THU, MAY 25 2006 12:40

ATHENS 345 KV VOLTAGE

Figure 5-8: Voltage at Athens Following SPS Operation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FILE: AthensSPS_s2005pkdynCE@3280_B0_Post_TE43ATH1.1000
0.10000
SHAW POWER TECHNOLOGIES INC.®
ATHENSSPS TRIP 2 SETS OF ATHENS GEN
2005 SUMMER CASE, FINAL; FOR DYN

Impact on Transfer Limits

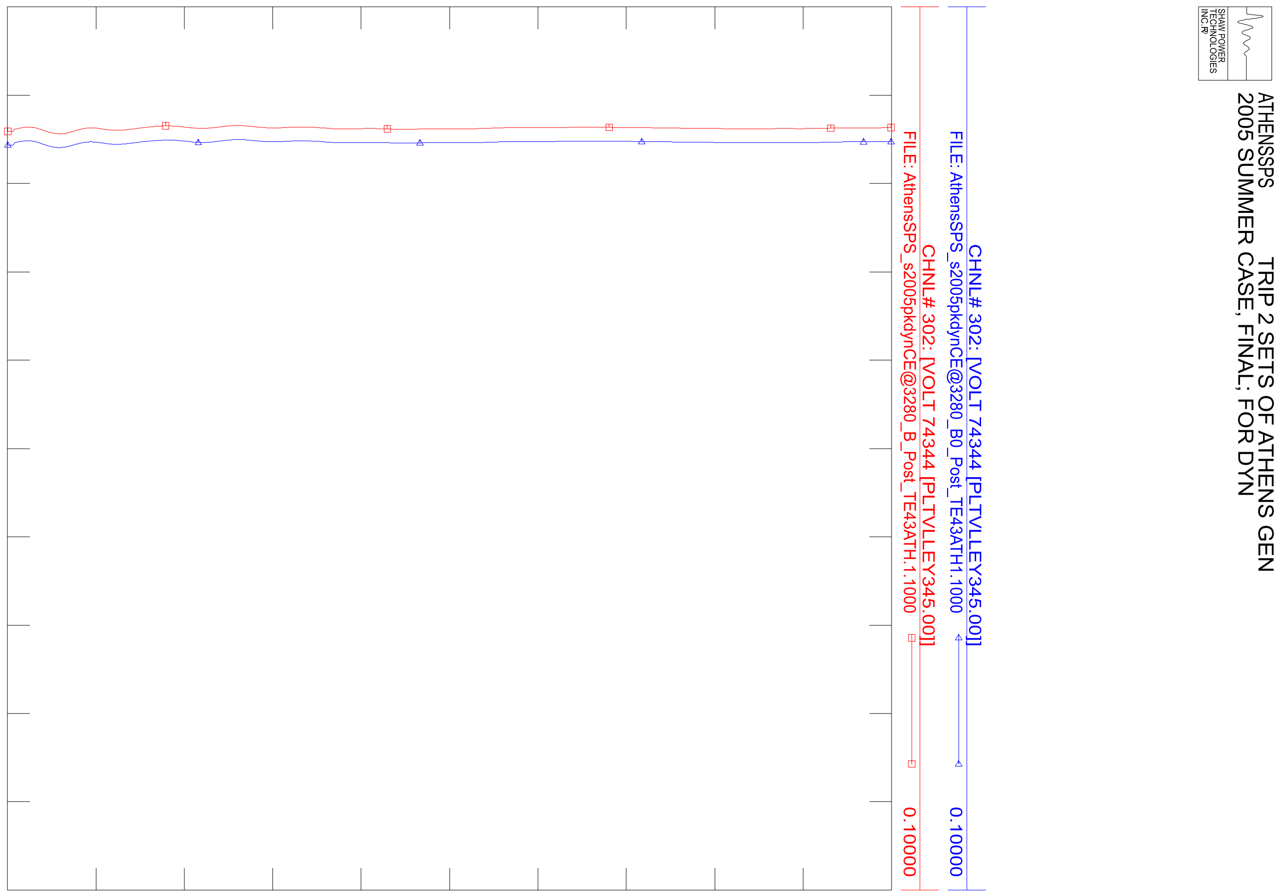
0.0 1.5000 3.0000 4.5000 6.0000 7.5000 9.0000 10.500 12.000 13.500 15.000

TIME (SECONDS)

THU, MAY 25 2006 12:40

PLEASANT VALLEY VOLTAGE

Figure 5-9: Voltage at Pleasant Valley Following SPS Operation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ATHENSSPS TRIP 2 SETS OF ATHENS GEN
2005 SUMMER CASE, FINAL; FOR DYN

Impact on Transfer Limits

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TIME (SECONDS)

THU, MAY 25 2006 12:40

LINE 92 FLOW

Figure 5-10: Branch Flow on Line 92 Following SPS Operation

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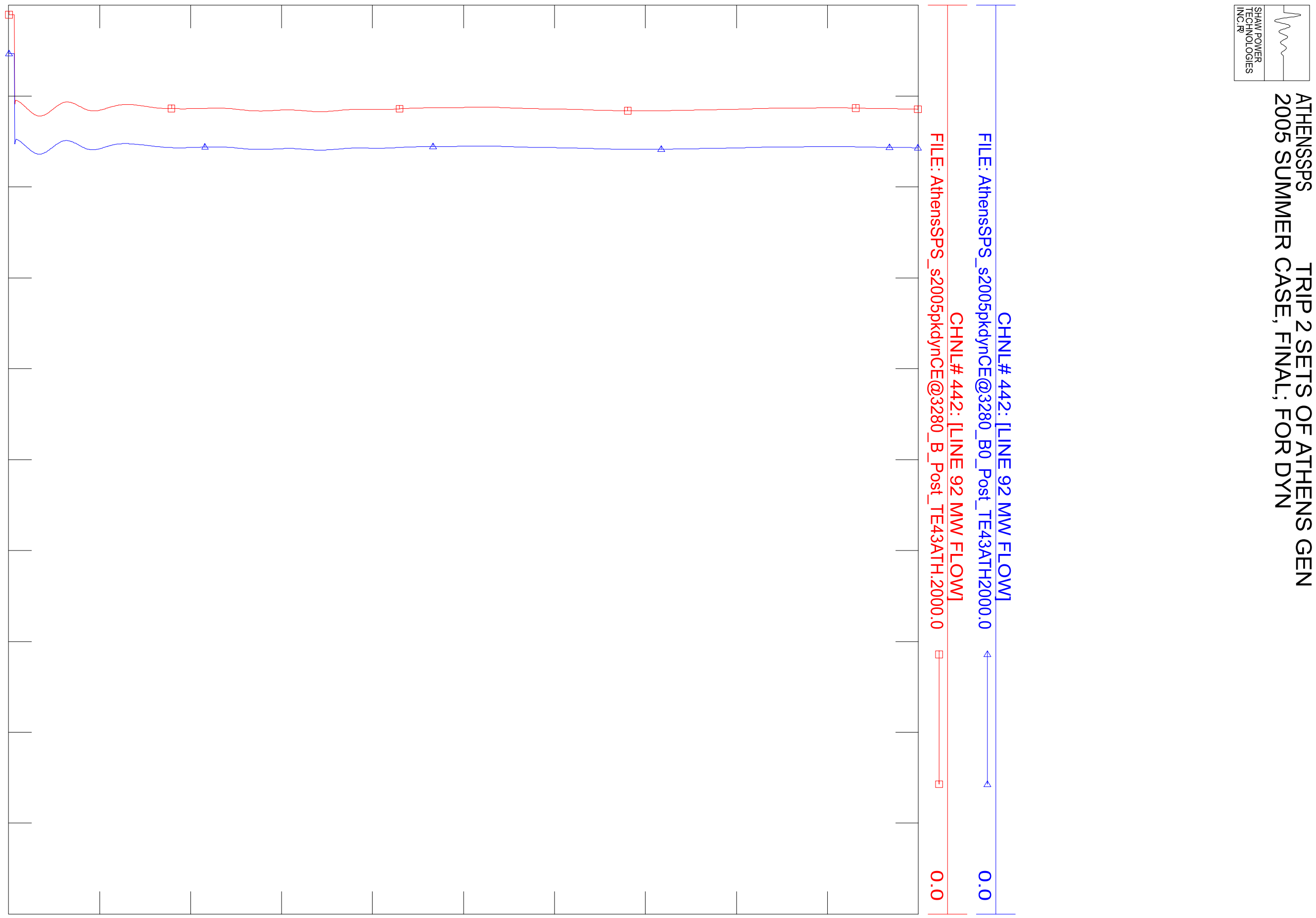

Impact on Transfer Limits

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Extreme Contingency Analysis

Certain extreme contingencies were analyzed to assess the effect of the increased flow on the UPNY-Con Ed interface on the system steady state performance. The assessment was performed on the cases at the UPNY- Con Ed interface limit without and with the SPS, as determined in the steady state analysis (Table 5-1), that is, 3633 MW and 4099 MW respectively. Loading on a branch was calculated as a percent of its short term emergency (STE) rating for post contingency system conditions. The following extreme contingencies were analyzed:

Contingency Name	Contingency Description
EC18	Loss of New Scotland Substation
EC19	Loss of Leeds Substation
EC16	Loss of Fraser Substation
EC91&92	Loss of 91/92 ROW
EC92&95	Loss of 92/95 ROW
EC27	Loss of Astoria Substation

For EC91&92 and EC92&95 which may or may not trigger the SPS depending on the event sequence, pre-SPS and post-SPS branch flows and bus voltages were calculated.

Table 6-1 and Table 6-2 show branch loading and voltage differences under extreme contingencies for the cases without and with the SPS. It is noted that the case with SPS shows incremental overload and voltage impacts on several 115 kV facilities. Additionally, for the case with the SPS, the loss of the Right-of-Way of Lines 91 & 92 would overload the Leeds to Hurley 345 kV line by 1%. There are no widespread overloads or voltage violations found on the bulk power system under the extreme contingencies tested.

Extreme Contingency Analysis

Table 6-1: Branch Loading Differences under Extreme Contingencies

Monitored Branch			Case With SPS					Case Without SPS		
			Pre-SPS Operation		Post-SPS Operation					
** From bus	* To bus ** CKT	STE Rating	MW flow	Loading%	MW flow	Loading%	Extreme Contingency	MW flow	Loading%	Delta Flow (%)
78757 BOC 2T 115	74040 N.CAT. 1 115 2	145	189	130.3	N/A	N/A	EC19	185.6	128	2.3
75435 CHURC115 115	78739 BL STR E 115	120	150.4	125.4	N/A	N/A	EC19	146.6	122.2	3.2
78731 JMC1+7TP 115	78740 BLUECIRC 115	145	174.5	120.4	N/A	N/A	EC19	171.1	118	2.4
78755 HUDSON 115	78799 VALKIN 115	159	165.8	104.3	N/A	N/A	EC19	162.2	102	2.3
78757 BOC 2T 115	78760 JMC2+9TP 115	145	194.7	134.3	N/A	N/A	EC19	190.9	131.7	2.6
78766 N.SCOT1 115	78798 UNVL 7TP 115	145	199.7	137.7	N/A	N/A	EC19	196	135.2	2.5
78769 OW CRN E 115	78798 UNVL 7TP 115	145	199.7	137.7	N/A	N/A	EC19	196	135.2	2.5
78769 OW CRN E 115	78806 BOC 7T 115	145	197.8	136.4	N/A	N/A	EC19	194.2	133.9	2.5
78701 LEEDS 3 345	74000 HURLEY 3 345	1870	1900.5	101.6	NV	NV	EC91&92	1689.2	90.3	11.3
78766 N.SCOT1 115	78798 UNVL 7TP 115	145	168.6	116.3	161.8	111.6	EC91&92	159.3	109.9	6.4
78769 OW CRN E 115	78798 UNVL 7TP 115	145	168.6	116.3	161.8	111.6	EC91&92	159.3	109.9	6.4
78769 OW CRN E 115	78806 BOC 7T 115	145	166.7	115	159.9	110.2	EC91&92	157.4	108.6	6.4
78766 N.SCOT1 115	78798 UNVL 7TP 115	145	148.6	102.5	155.1	107	EC92&95	146.3	100.9	1.6
78769 OW CRN E 115	78798 UNVL 7TP 115	145	148.6	102.5	155.1	107	EC92&95	146.3	100.9	1.6
78769 OW CRN E 115	78806 BOC 7T 115	145	146.6	101.1	153.1	105.6	EC92&95	144.4	99.6	1.5

Note: "N/A" means SPS does not operate under those contingencies
Note: "NV" means there is no violation.

Table 6-2: Voltage Differences under Extreme Contingencies

			Case With SPS			Case Without SPS	
			Pre-SPS Operation	Post-SPS Operation			
Bus #	Bus Name	KV	Contingent Voltage	Contingent Voltage	Extreme Contingency	Contingent Voltage	Voltage Difference
74040	N.CAT. 1	115	0.941	N/A	EC18	0.9466	-0.0055
79124	CENTER-S	115	0.940	N/A	EC18	NV	N/A
79127	CLINTON	115	0.944	N/A	EC18	NV	N/A
79141	MARSH115	115	0.944	N/A	EC18	NV	N/A
79155	ST JOHNS	115	0.945	N/A	EC18	NV	N/A
79156	STONER	115	0.941	N/A	EC18	NV	N/A
79159	TAP T79	115	0.949	N/A	EC18	NV	N/A
79161	VAIL TAP	115	0.942	N/A	EC18	NV	N/A
79162	VAIL 115	115	0.939	N/A	EC18	0.9492	-0.0100
74040	N.CAT. 1	115	0.881	N/A	EC19	0.8924	-0.0113
78702	N.SCOT77	345	1.051	N/A	EC19	1.0535	0.0026
78703	N.SCOT99	345	1.051	N/A	EC19	1.0534	0.0026
78742	BLUES-8	115	0.944	N/A	EC19	NV	N/A
78756	INDC+BKL	115	0.937	N/A	EC19	0.9459	-0.0092
74040	N.CAT. 1	115	0.906	0.921	EC91&92	0.923	-0.0171
75492	PAWLN115	115	0.949	NV	EC91&92	NV	N/A
74040	N.CAT. 1	115	0.934	0.931	EC92&95	0.9376	-0.0037
74040	N.CAT. 1	115	0.944	N/A	EC27	0.9475	-0.0036
74040	N.CAT. 1	115	0.938	N/A	EC28	0.944	-0.0058

Note: "N/A" means SPS does not operate under those contingencies or comparison is not available.
Note: "NV" means there is no violation.

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6-3

Extreme Contingency Analysis

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SPS Misoperation and Failed Operation Analysis

7.1 SPS Misoperation

The Athens SPS is designed to operate only for post-contingency conditions, namely the loss of Line 91 with subsequent flow on line 92 exceeding its LTE rating or alternately loss of Line 92 with subsequent flow on line 91 exceeding its LTE rating. Operation of the SPS will trip Athens generation to bring the post-contingency flows below the line's LTE rating.

There are several potential misoperation scenarios, not all of which may actually be able to occur depending on the design details of the actual equipment and logic involved:

- Failure to operate when it should
- Operation without the initiating event, i.e., a false trip
- Partial operation, i.e., not tripping enough generation
- Overtripping, i.e., tripping too much generation

Failure of the SPS to operate when it should is covered in the following subsection.

Operation without the initiating event, that is, a false trip of two Athens combined cycle trains (720 MW at full load) is not an insignificant event, but does not result in system conditions outside post-contingency limits. The effect of this misoperation was evaluated by both load flow calculation and stability simulation. Figure 7-1 shows the local system conditions following the loss of 720 MW at Athens. Loadings on all lines are below LTE rating and all bulk system voltages with-in post-contingency limits. Figures 7-2 to 7-5 show results of a stability simulation of the trip of 720 MW of Athens generation. A stable response is exhibited with positive damping.

Partial operation, that is tripping for example one combined cycle train instead of two, would result in an intermediate condition between normal operation and failure to operate. The system condition would be stable, but manual operator action to adjust generation at Athens may be required to reduce the flow on the 91 or 92 line to below LTE rating.

The fourth possibility is overtripping. The effect of this misoperation was evaluated by both load flow calculation and stability simulation. Figure 7-6 shows the local system conditions following the trip of line 91 and misoperation of the SPS with trip of all generation (1080 MW) at Athens. Loadings on all lines are below LTE rating and all bulk system voltages within post-contingency limits. Figures 7-7 to 7-8 show results of a stability simulation of the trip of

SPS Misoperation and Failed Operation Analysis

1080 MW of Athens generation following the line outage. A stable response is exhibited with positive damping.

This analysis demonstrates that misoperation of the SPS will not result in severe system problems or widespread effects on the system, that is, it does not cause a significant adverse impact outside of the local area.

SPS Misoperation and Failed Operation Analysis

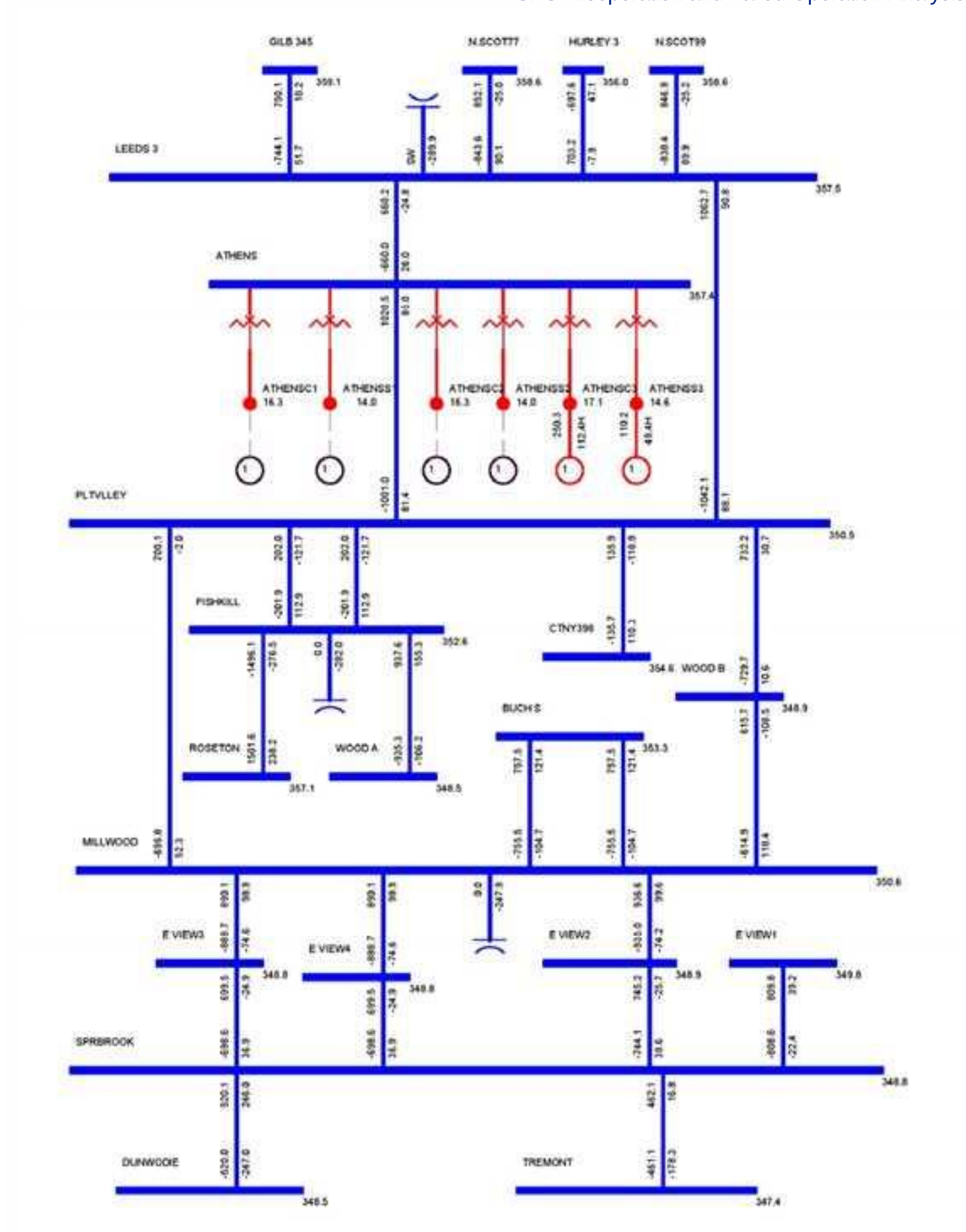

**Figure 7-1: Branch Loadings with Misoperation of SPS,
Tripping 2 Combined Cycle Trains at Athens.**

SPS Misoperation and Failed Operation Analysis

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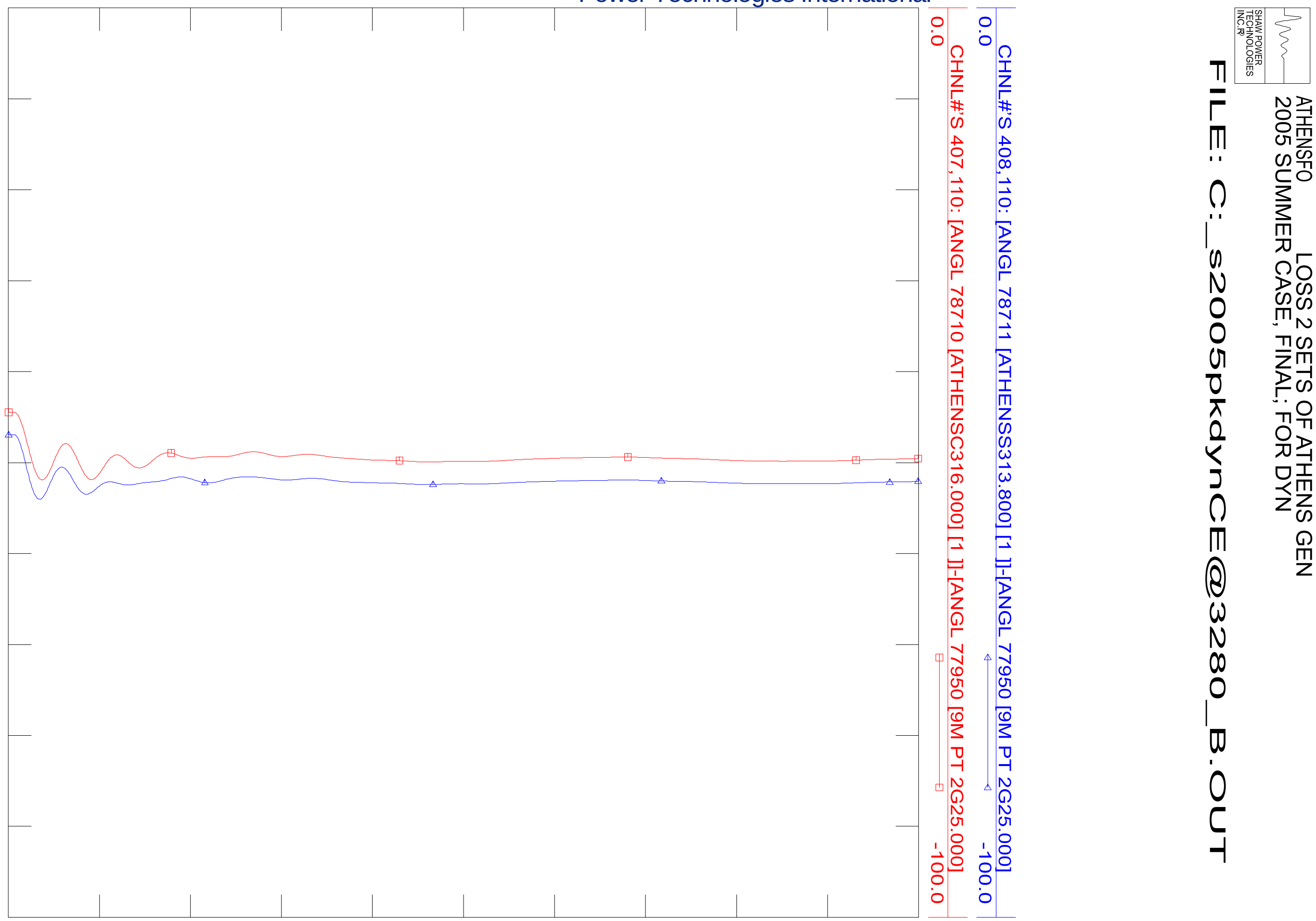
ATHENS RELATIVE ANGLES

Figure 7-2: Athens Machine Angle with Misoperation of SPS, Tripping 2 Combined Cycle Trains at Athens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0.0
CHNL#'S 408,110: [ANGL 78711 [ATHENSS313.800] [1]]-[ANGL 77950 [9M PT 2G25.000]
-100.0
ATHENSFO LOSS 2 SETS OF ATHENS GEN
2005 SUMMER CASE, FINAL; FOR DYN
FILE: C:_s2005pkdynCE@3280_B.OUT

SPS Misoperation and Failed Operation Analysis

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ATHENS POWER OUTPUTS

Figure 7-3: Athens Machine Power with Misoperation of SPS, Tripping 2 Combined Cycle Trains at Athens

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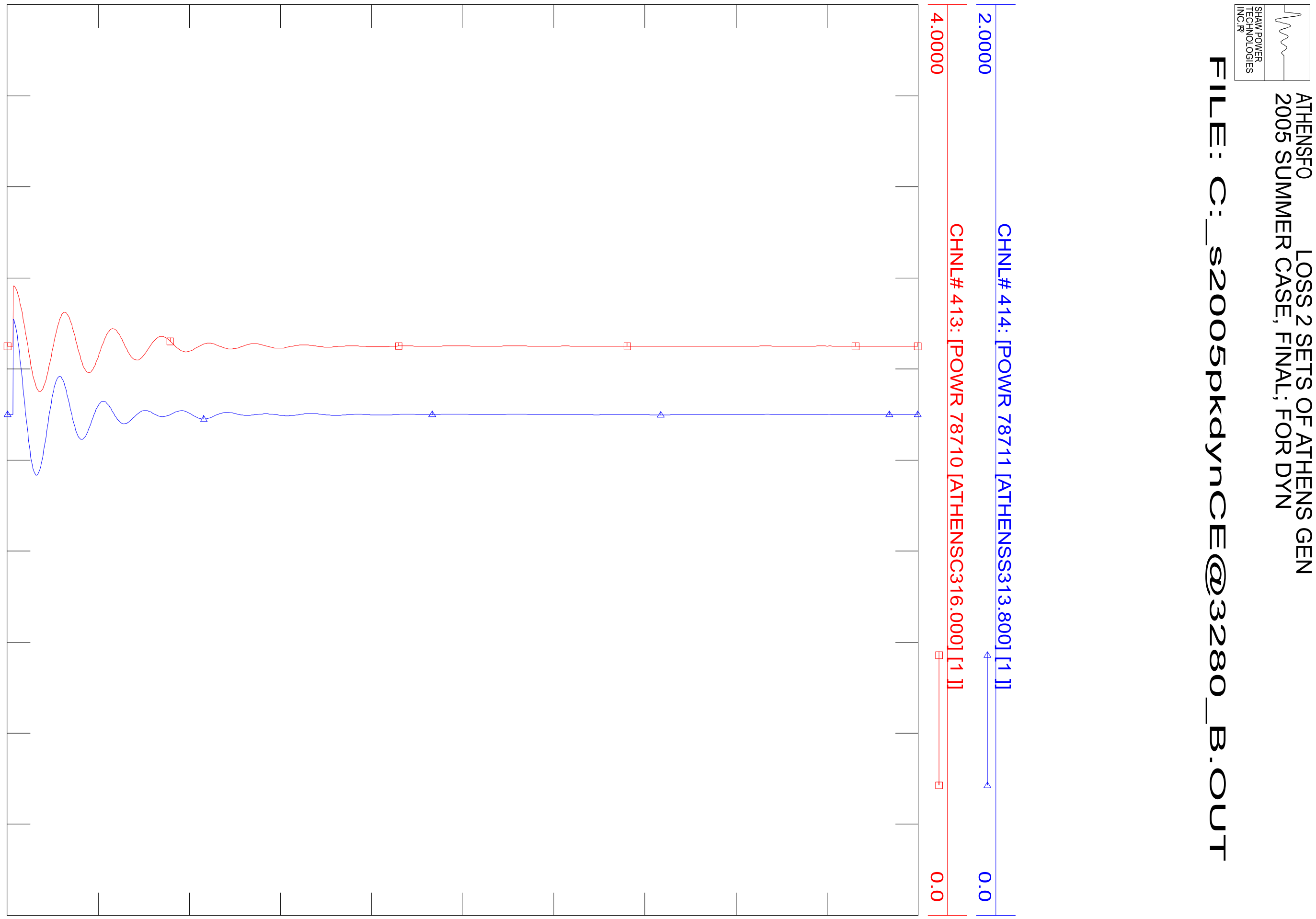
7-5



SPS Misoperation and Failed Operation Analysis

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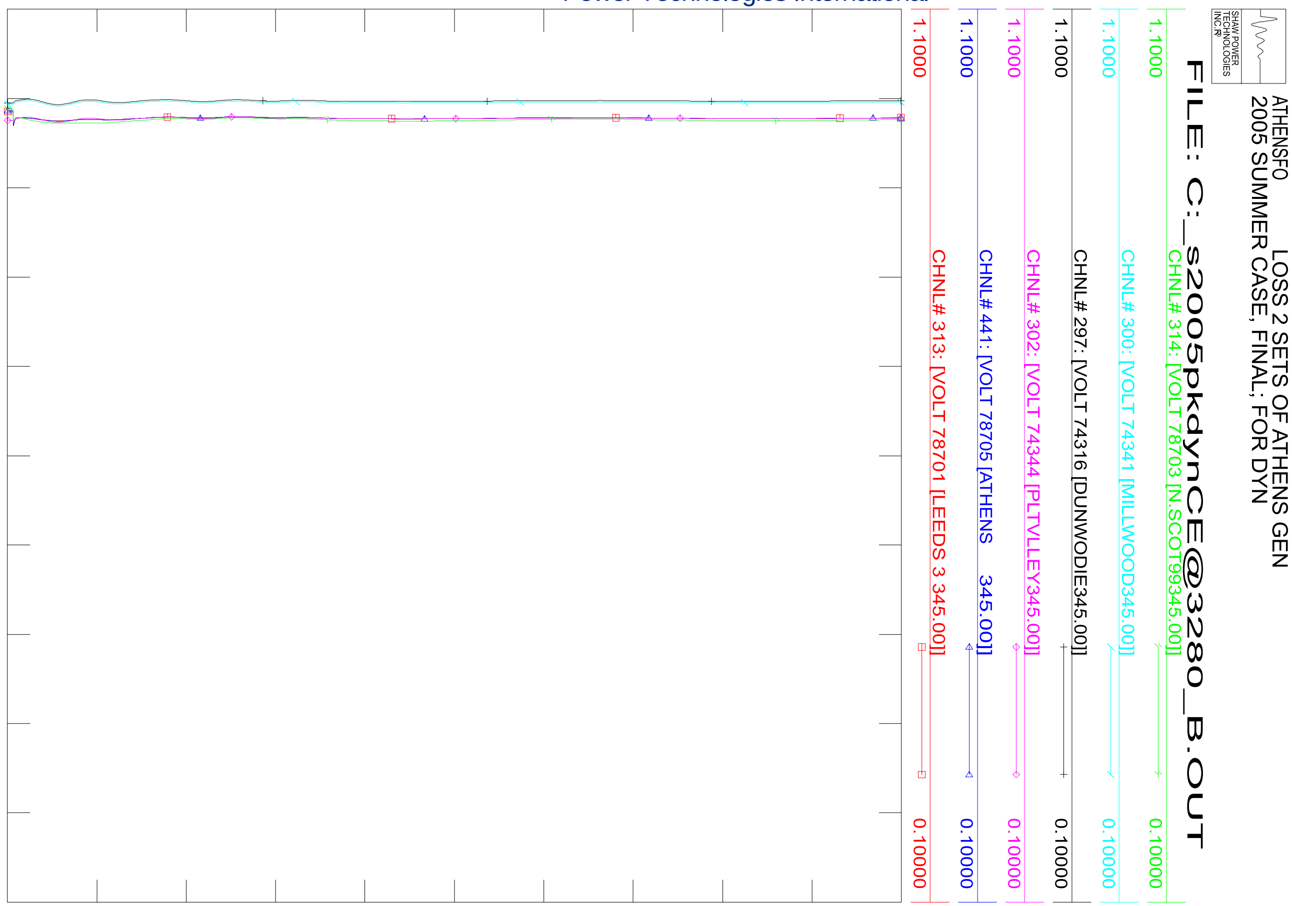
345 KV VOLTAGES

Figure 7-4: 345 kV Voltages at Leeds, Athens, Pleasant Valley, Dunwoodie, Millwood and New Scotland, with Misoperation of SPS, Tripping 2 Combined Cycle Trains at Athens


ATHENSFO LOSS 2 SETS OF ATHENS GEN
2005 SUMMER CASE, FINAL; FOR DYN
FILE: C:_s2005pkdynCE@3280_B.OUT
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0.10000
1.1000
CHNL# 300: [VOLT 74341 [MILLWOOD345.00]]
0.10000
1.1000
CHNL# 297: [VOLT 74316 [DUNWODIE345.00]]
0.10000
1.1000
CHNL# 302: [VOLT 74344 [PLTVLLEY345.00]]
0.10000
1.1000
CHNL# 441: [VOLT 78705 [ATHENS 345.00]]
0.10000
1.1000
CHNL# 313: [VOLT 78701 [LEEDS 3 345.00]]
0.10000

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LINE 91,92,&95 MW FLOW

Figure 7-5: Flows on 91, 92 & 95 with Misoperation of SPS, Tripping 2 Combined Cycle Trains at Athens

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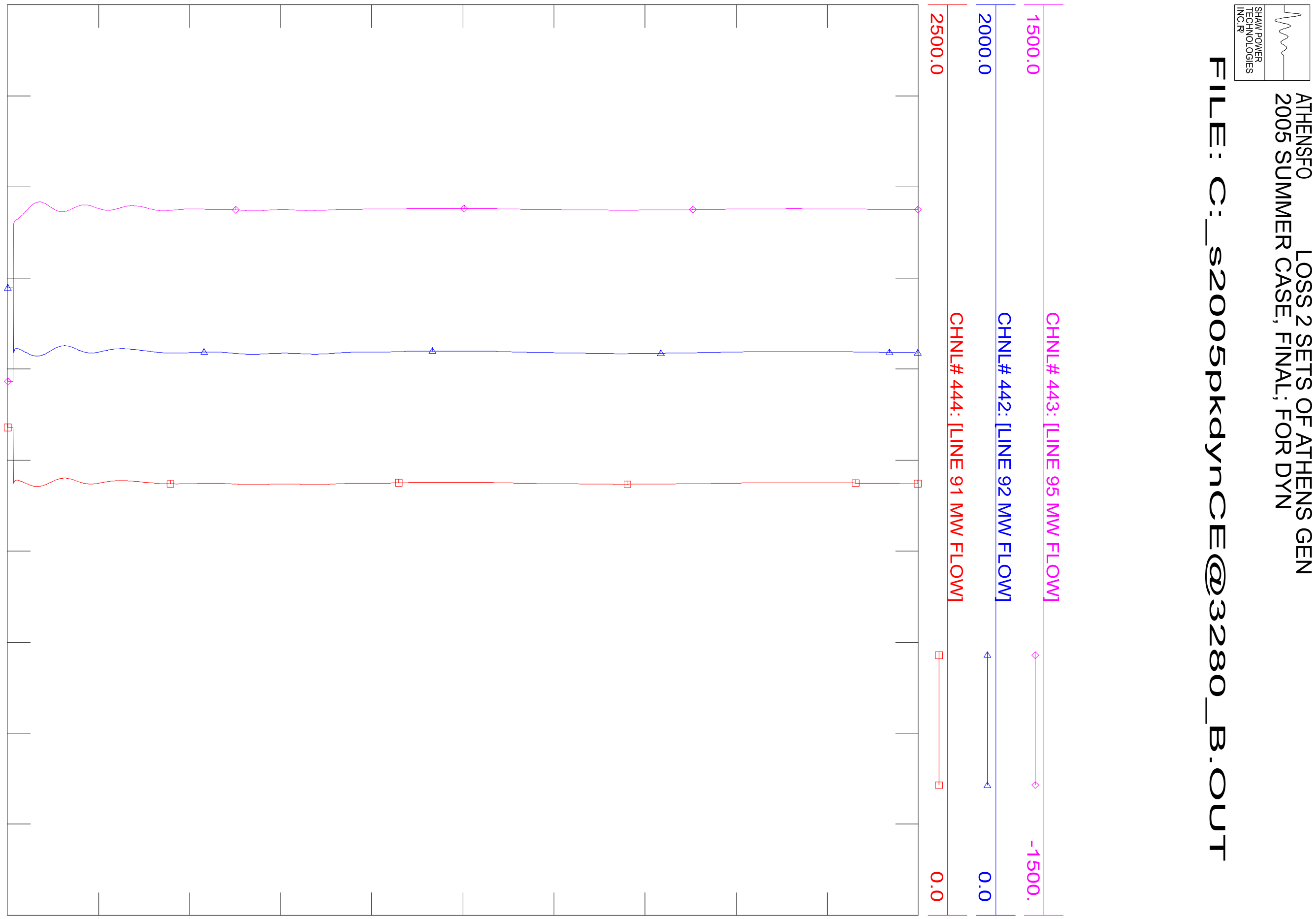

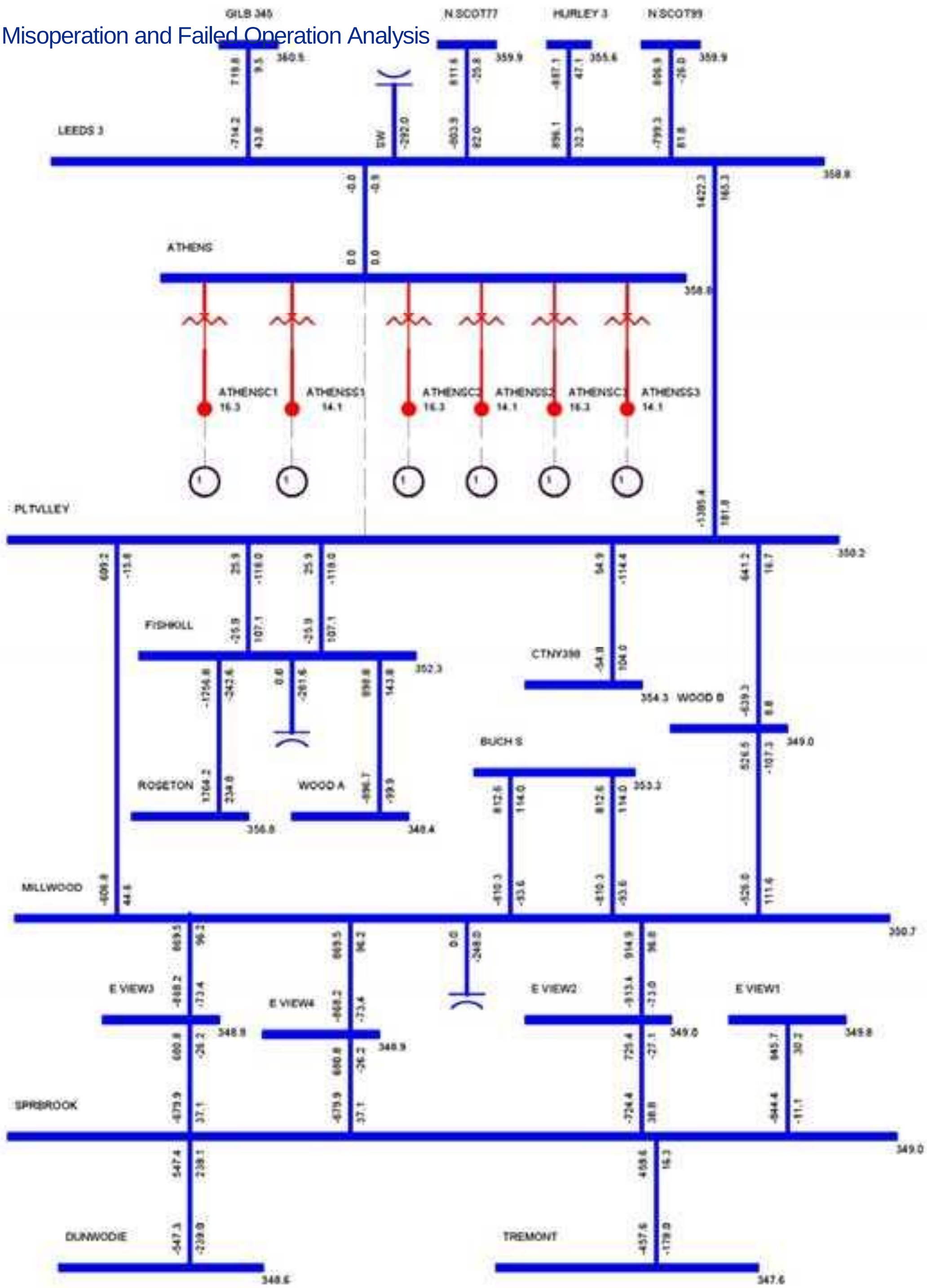

Figure 7-6: Branch Loadings Following Line 91 Outage, with Misoperation of SPS Tripping 3 Combined Cycle Trains at Athens

SPS Misoperation and Failed Operation Analysis

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LINE 91,92,&95 MW FLOW

Figure 7-7: Flows on Lines 91, 92 & 95 Loadings Following Line 91 Outage, with Misoperation of SPS Tripping 3 Combined Cycle Trains at Athens

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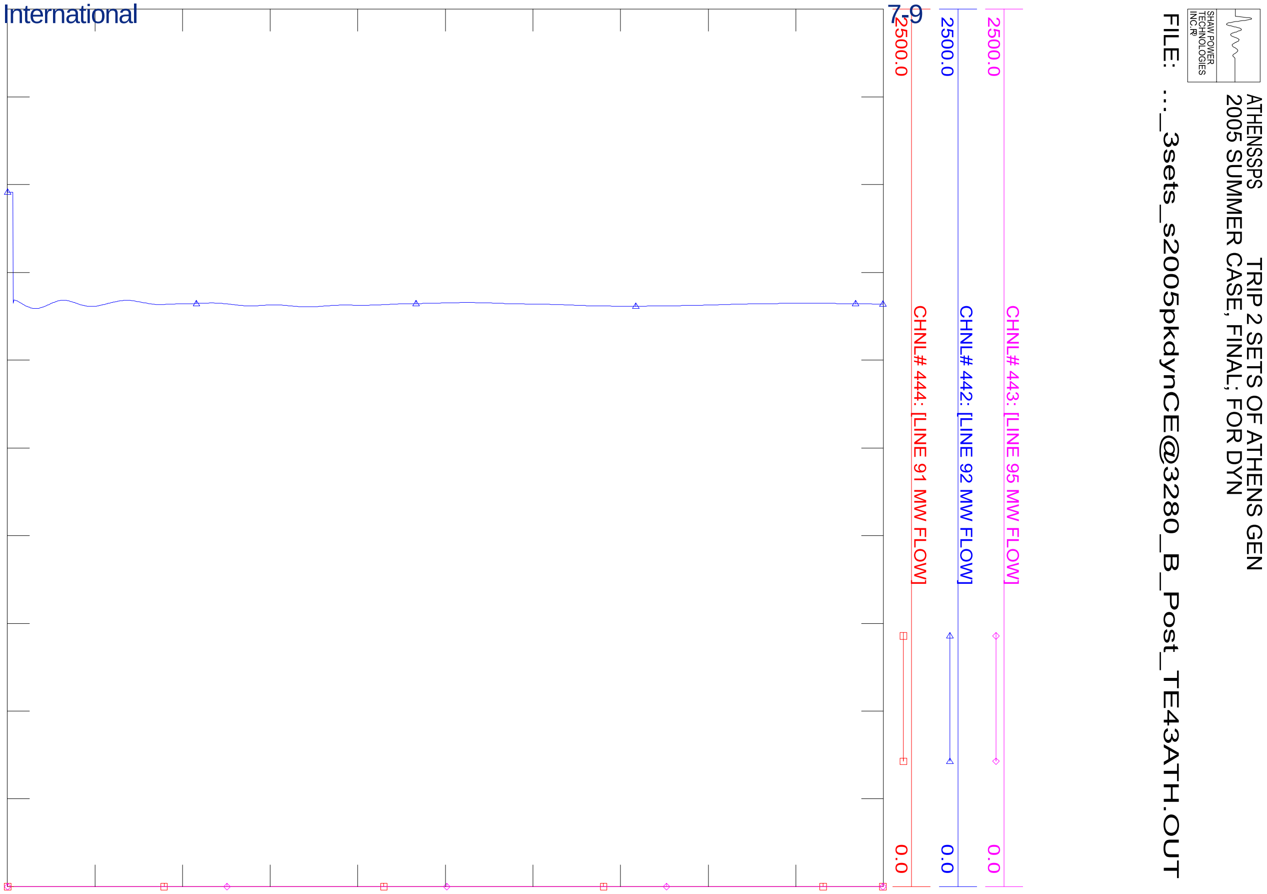

SPS Misoperation and Failed Operation Analysis

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345 KV VOLTAGES

Figure 7-8: 345 kV Voltages at Leeds, Athens, Pleasant Valley, Dunwoodie, Millwood and New Scotland with Misoperation of SPS Tripping 3 Combined Cycle Trains at Athens

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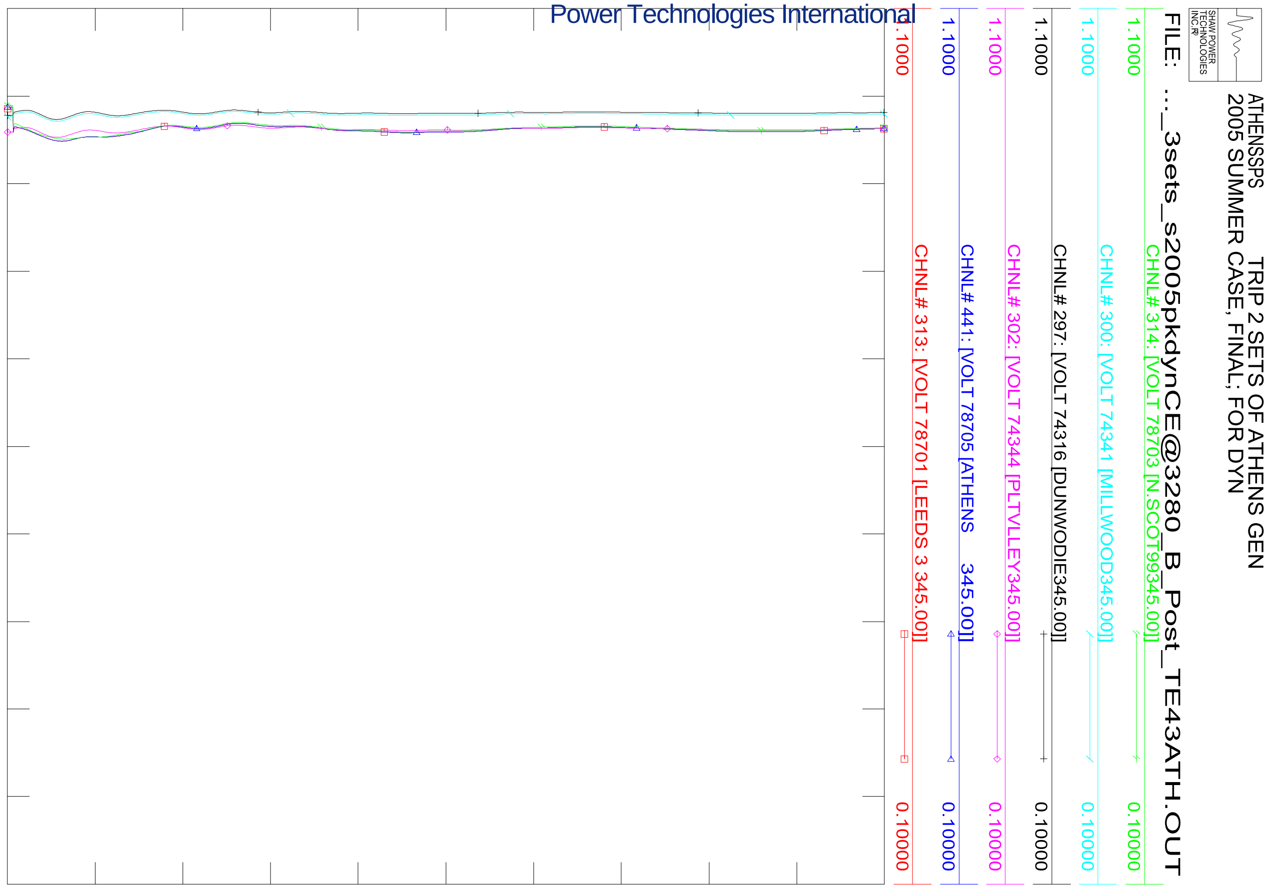

7.2 Failure of the SPS to Operate

The effect of the failure of the SPS to operate to reduce generation at Athens for an outage of either Line 91 or 92 under heavy UPNY-Con Ed transfer can be determined from the analysis described in Section 6. This analysis looked at three time periods:

1. Pre-contingency steady state
2. Post-contingency, pre-SPS operation
3. Post-contingency, post-SPS operation

Operation of the SPS is expected to occur within two minutes following the outage of either line 91 or 92 if the loading on the remaining line is over LTE. The outage of Line 91 is slightly more severe than the outage of line 92 so will be discussed here, although the comments also apply for the opposite scenario. The analysis in Section 6 demonstrated that for the outage of line 91, except for line 92 on the same ROW, all other lines remain within their LTE limits and all bulk system bus voltages within their post-contingency limits (time period 2). The local area flows and voltages are shown in Figure 6-4. Following operation of the SPS, all lines including line 92 are within their LTE limits and all bulk system bus voltages within their post-contingency limits (time period 3). The local area flows and voltages are shown in Figure 6-5.

If the SPS fails to operate, the system does not automatically transition from the second condition to the third within two minutes. The system condition is such that one line is overloaded above its LTE rating, but below its STE rating. All other elements are within postcontingency limits. Since the STE rating is a 15 minute rating, there is ample time for manual operator action to either manually trip generation at Athens or perform other actions.

Note that the likelihood of such a failure would be quite low due to the redundancy built into the SPS design and also the fact that the SPS will only be operational at periods of high transfer and will only operate for permanent faults (i.e., unsuccessful reclosing).

7.3 Potential for Interaction with Other Existing New York Special Protection Systems

Consideration was given to the potential for interaction with other existing Special Protection Systems in New York. A listing of such Systems and procedures is given in Exhibit A-2 of the NYISO System Operation Procedures, Exception to Operating Criteria for Pre-Contingency & Post-Contingency Transmission Facility Flows and Voltages.

None of the exceptions listed in that document should have an interaction. The only three in the general vicinity of the Athens SPS are Exceptions 1, 3, and 5, each of which will be addressed below.

> Exception 1: *The post-contingency flow on the Marcy-New Scotland 18 line is allowed to exceed its LTE rating for the loss of the Edic-New Scotland 14 line by the amount of relief that can be obtained by tripping the Gilboa pumping load as a single*

corrective action. Also, the post-contingency flow on the Edic-New Scotland 14 line is allowed to exceed its LTE rating for either the loss of the Marcy-New Scotland 18 line

SPS Misoperation and Failed Operation Analysis

alone, or the double-circuit loss of the Marcy-New Scotland 18 and Adirondack-Porter 12 lines, by the amount of relief that can be obtained by tripping the Gilboa pumping load as a single corrective action.

This exception deals with time periods where Gilboa is in a pumping mode. The Athens SPS is designed for heavy UPNY-Con Ed transfer periods such as during peak load. These two conditions do not occur simultaneously as the Gilboa station would not be pumping at peak load or under conditions requiring heavy UPNY-Con Ed transfers.

Exception 3: *The post-contingency flow on the NS-Leeds line is allowed to reach its STE rating for transfers to NE & SENY, with sufficient generation at Gilboa.*

This exception is not an SPS but a generation runback procedure under operator control. Hence, since operator control is used and not automatic action, there is no possibility of interaction.

Exception 5: *The post-contingency flow on the Gilboa-Leeds (GL-3) line is allowed to reach its STE rating with four generators on at Gilboa.*

This exception is not an SPS but a generation runback procedure under operator control. Hence, since operator control is used and not automatic action, there is no possibility of interaction.

Thus these three Exceptions do not pose a concern of interaction with the Athens SPS.

Another point to note is that Exceptions 3 and 5 are examples of how operator actions can be applied in the 15 minute time period associated with the STE rating of a line, consistent with the ability of operator action to manually trip Athens generation in the unlikely event of an SPS failure as discussed above.

SPS Type Analysis

The NPCC Document A-11, Special Protection System Criteria defines three types of special protection Systems:

> Type I - An SPS which recognizes or anticipates abnormal system conditions resulting from design and operating criteria contingencies, and whose misoperation or failure to operate would have a significant adverse impact outside of the local area. The corrective action taken by the SPS along with the actions taken by other protection systems are intended to return power system parameters to a stable and recoverable state.
>
> Type II - An SPS which recognizes or anticipates abnormal system conditions resulting from extreme contingencies or other extreme causes, and whose misoperation or failure to operate would have a significant adverse impact outside of the local area.
>
> Type III - An SPS whose misoperation or failure to operate results in no significant adverse impact outside the local area.

The SPS in this study is designed to recognize abnormal system conditions resulting from design and operating criteria contingencies and therefore it is not a Type II SPS, which by definition recognizes or anticipates extreme contingencies.

The study results presented in the previous sections have shown that the misoperation or failed operation of this SPS would not have a significant adverse impact outside of the local area, that is, there are no widespread overloads or voltage violations found outside the local area. Therefore the Athens SPS should be classified as a Type III SPS according to the above criteria.

SPS Type Analysis

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Conclusions

The purpose of this SIS is to demonstrate the improvement in the UPNY-Con Ed interface transfer capability that would result from the installation and operation of the SPS and other possible associated mitigative measures such as the installation of shunt capacitive compensation at one or more Con Edison substations.

The study shows that the SPS is effective. With the SPS, the transfer across the UPNY-Con Ed Interface can be increased by 466 MW while abiding by applicable reliability rules and criteria. This allows the Athens plant to be dispatched at full capacity, i.e., 1080 MW, during peak load conditions.

The operation without and with the SPS was analyzed using thermal, voltage and stability analysis. The thermal analysis shows that with Athens dispatched at full capacity and the SPS, the UPNY-Con Ed thermal transfer limit is increased by 466 MW, from 3633 MW to 4099 MW. Both without and with the SPS, the transfer is limited by flow on the Leeds to Pleasant Valley 345 kV line due to loss of the Athens to Pleasant Valley 345 kV line. Without the SPS, the post-contingency flow is limited to the line's LTE rating of 1538 MW while the SPS increases the allowable post-contingency flow to the line's STE rating of 1724 MW. The operation of the SPS reduces the line flow to below the LTE rating within a period of two minutes.

Two contingencies may trigger the SPS, loss of the Athens to Pleasant Valley 345 kV (Line 91) and the Leeds to Pleasant Valley 345 kV line (Line 92). The loss of Line 91 is slightly more severe. For the peak load level and system dispatch modeled in the power flow case supplied by the NYISO, this contingency would require the trip of two Athens combined cycle trains, for a total of 720 MW. The loading on Line 92 after this contingency and SPS operation would be 1520 MW, lower than the LTE rating of 1538 MW.

The thermal transfer limit on the UPNY-SENY interface was also analyzed. The analysis shows that with Athens dispatched at full capacity and the SPS, the UPNY-SENY thermal transfer limit is increased by 466 MW, from 4502 MW to 4968 MW. Both without and with the SPS, the limiting element is the same as that for the UPNY-Con Ed interface.

The voltage analysis indicated that transfer across the UPNY-Con Ed interface would be limited by the pre-contingency voltage limit of 348 kV at four lower Hudson Valley 345 kV buses. Therefore a 240 MVAr capacitor bank was modeled at Millwood which is sufficient to maintain the steady-state pre-contingency voltage at these stations above 348 kV. Millwood was selected as the potential location for the capacitor back due to concerns that space may be limited in other possible stations.

The voltage contingency analysis indicated that with Athens dispatched at full capacity and the SPS in-service, there was no significant incremental impact on bulk system voltages

Conclusions

compared to operation without the SPS. The voltages on several 115 kV buses decreased by less than 1% under certain contingencies.

The P-V analysis showed that with Athens dispatched at full capacity and the SPS, the voltage-based UPNY-Con Ed transfer limit is increased by 245 MW. The voltage-based transfer limits for both without and with the SPS are higher than the respective thermal limits, as follows:

UPNY-Con Ed Transfer	Case Without SPS	Case With SPS	Change
Pre-Contingency Low	3880[A]	4125[A]	245
Post-Contingency Low	4279[B]	4383[B]	104
95% Voltage Collapse (5% MW Margin)	4092[C]	4190[C]	98
Voltage-Based Transfer Limit	**3880[A]**	**4125[C]**	**245**
Thermal Transfer Limit	**3633[D]**	**4099[E]**	**466**

A Pre-contingency voltage at Dunwoodie 345 kV

B Post-contingency voltage at Pleasant Valley 345 kV for loss of tower Coopers Corners-Rock Tavern 34/42

C 95% of voltage collapse criteria limit for loss of tower Coopers Corners-Rock Tavern 34/42

D Limited by Leeds - Pleasant Valley 345 kV (LTE: 1538 MW) for loss of Athens-Pleasant Valley 345 kV

E Limited by Leeds - Pleasant Valley 345 kV (STE: 1724 MW) for loss of Athens-Pleasant Valley 345 kV

Stability analysis was performed. All stability simulations exhibited a stable response with positive damping. Stability is thus not the limiting constraint on the transfer level on the UPNY-Con Ed interface either without or with the SPS.

The extreme contingency analysis demonstrates that the case with SPS shows incremental overload and voltage impacts on several 115 kV facilities. Additionally, for the case with the SPS, the loss of the Right-of-Way of Lines 91 & 92 would overload the Leeds to Hurley 345 kV line by 1%. There are no widespread overloads or voltage violations found on the bulk power system under the extreme contingencies tested.

The analysis demonstrates that misoperation of the SPS will not result in severe system problems or widespread effects on the system, that is, it does not cause a significant adverse impact outside of the local area.

Failure of the SPS to operate under maximum transfer conditions would result in Line 91 or 92 being loaded above its LTE rating following the outage of the other, but below its STE rating. For the peak condition analyzed, all other elements are within post-contingency limits. Since the STE rating is a 15 minute rating, there is ample time for manual operator action to either manually trip generation at Athens or perform other actions.

The study results demonstrate that the misoperation or failed operation of this SPS would not have a significant adverse impact outside of the local area, that is, there are no widespread overloads or voltage violations found outside the local area. Thus the SPS should be classified as a Type III SPS according to the NPCC Special Protection System Criteria (NPCC Document A-11).

The NYISO will calculate the actual Transmission Congestion Contracts (TCCs) awarded as a result of this proposed SPS. However, the results of this SIS indicate a potential TCC award estimate of 466 MW for the Athens' SPS.