Impact Re-Study
For
Generation Interconnection
Request
GEN-2006-017

SPP Tariff Studies
(#GEN-2006-017)

January, 2008

Executive Summary

Southwest Power Pool has performed this Impact Re-Study for the purpose of interconnecting 300 MW of wind generation within the control area of Missouri Public Utilities (d/b/a Aquila Networks – Missouri Public Service) (MIPU) located in Nodaway County, Missouri. The proposed method of interconnection is a new 161 kV line terminal and breaker to be installed at a new ring-bus switching station to be located on the existing Maryville – Midway 161 kV transmission line, owned by MIPU. This new station was previously proposed for construction for Generation Interconnect request #GEN-2006-014. The proposed in-service date is April 30, 2008. This Impact Re-Study was caused by a change in status of certain prior queued projects.

Power flow analysis has indicated that for the powerflow cases studied, it is possible to interconnect the 300 MW of generation with transmission system reinforcements within the local transmission system. In order to maintain acceptable reactive power compensation, the customer will be required to pay for the installation of a combined total of at least 70 Mvars, comprised of 38 Mvar of 34.5 kV capacitor bank(s) to be installed in the Customer's collector substation and an additional 32 Mvar of 161 kV capacitor bank(s) to be installed in the proposed ring-bus switching station on the line serving GEN-2006-017.

The original Impact Study dated May, 2007, has determined that if GI requests #GEN-2006-014 and #GEN-2006-017 sign an Interconnection Agreement and go into service, additional facilities will need to be constructed to support the interconnection of GEN-2006-017. For stability considerations discussed in the original Impact Study, the Maryville (MIPU) – Clarinda (MidAmerican Energy Company – MEC) 161 kV line will need to have its line terminal rerouted from the Maryville substation to the new 161 kV three-breaker ring-bus switching station, previously proposed for GEN-2006-014. The existing 161 kV line terminal at Maryville will be abandoned and left available for future use. In order to serve the Maryville (MIPU) – Clarinda (MEC) 161 kV transmission reroute, one additional 161 kV line terminal and breaker will also need to be installed at the new 161 kV ring-bus switching station. Additionally, the requirements to interconnect the 300 MW of wind generation (GI request #GEN-2006-017) are to add one 161 kV line terminal and breaker at the new ring-bus switching station.

The total minimum cost for building the required facilities for this 300 MW of generation is $5,000,000 and is detailed in Tables 1 and 2 of this report. Network constraints in the Associated Electric Cooperatives, Inc. (AECI), Kansas City Power & Light (KCPL), MIPU and Westar Energy (WERE) transmission systems that were identified are shown in Table 4. These Network constraints will have to be verified with a Transmission Service Request (TSR) and associated studies. Network Constraints are in the local area of the new generation when this generation is sunk throughout the SPP footprint for the Energy Resource (ER) Interconnection request. With a defined source and sink in a Transmission Service Request, this list of Network Constraints will be refined and expanded to account for all Network Upgrade requirements. This cost does not include building the 161 kV line from the Customer 161/34.5 kV collector substation into the point of interconnection. This cost also does not include the Customer's 161/34.5 kV collector substation or the 34.5 kV, 38 Mvar of capacitor bank(s) to be installed in the Customer's collector substation.

In Table 5, a value of Available Transfer Capability (ATC) associated with each overloaded facility is included. These values may be used by the Customer for future analyses including the determination of lower generation capacity levels that may be installed. When transmission service associated with this interconnection is evaluated, the loading of the facilities listed in this table may be greater due to higher priority reservations. If the loading of a facility is higher, the level of ATC will be lower.

A transient stability analysis conducted for this generation interconnection request found that for the new interconnection configuration, the wind farm will stay on line and the transmission system will remain stable for all studied contingencies. This analysis was based on the assumption that the wind farm will be using Clipper 2.5 MW wind turbines.

There are several other proposed generation additions in the general area of the Customer's facility. It was assumed in this preliminary analysis that not all of these other projects within the AECI and KCPL control areas will be in service. Those previously queued projects that have advanced to nearly complete phases were included in this Impact Study. In the event that another request for a generation interconnection with a higher priority withdraws, then this request may have to be re-evaluated to determine the local Network Constraints.

The required interconnection costs listed in Tables 1 and 3 and other upgrades associated with Network Constraints do not include all costs associated with the deliverability of the energy to final customers. These costs are determined by separate studies if the Customer submits a Transmission Service Request through Southwest Power Pool's OASIS.

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Introduction

Southwest Power Pool has performed this Impact Re-Study for the purpose of interconnecting 300 MW of wind generation within the control area of Missouri Public Utilities (d/b/a Aquila Networks – Missouri Public Service) (MIPU) located in Nodaway County, Missouri. The proposed method of interconnection is a new 161 kV line terminal and breaker to be installed at a new ring-bus switching station to be located on the existing Maryville – Midway 161 kV transmission line, owned by MIPU. This new station was previously proposed for construction for Generation Interconnect request #GEN-2006-014. The proposed in-service date is April 30, 2008. This Impact Re-Study was caused by a change in status of certain prior queued projects.

Interconnection Facilities

The primary objective of this study is to identify the system problems associated with connecting the plant to the area transmission system. The Feasibility and other subsequent Interconnection Studies are designed to identify attachment facilities, Network Upgrades and other Direct Assignment Facilities needed to accept power into the grid at the interconnection receipt point.

The requirements for interconnection of the 300 MW for GEN-2006-017 consists of adding a new 161 kV terminal and breaker to a proposed three-breaker ring-bus switching station on the existing Maryville – Midway 161 kV transmission line, owned by MIPU. This ring-bus substation was originally proposed for GI request #GEN-2006-014 and will be constructed and maintained by MIPU. In addition to these required interconnection facilities, the original Impact Study dated May, 2007, has determined that if both GI requests #GEN-2006-014 and #GEN-2006-017 sign an Interconnection Agreement and go into service, other facilities will need to be constructed to support the interconnection of GEN-2006-017. For stability considerations discussed in the original Impact Study, the Maryville (MIPU) – Clarinda (MidAmerican Energy Company – MEC) 161 kV line will need to have its line terminal rerouted from the Maryville substation to the new 161 kV three-breaker ring-bus switching station, previously proposed for GEN-2006-014. The existing 161 kV line terminal at Maryville will be abandoned and left available for future use. In order to serve the Maryville (MIPU) – Clarinda (MEC) 161 kV transmission reroute, one additional 161 kV line terminal and breaker will also need to be installed at the new 161 kV ring-bus switching station. A preliminary one-line drawing of the interconnection facilities are shown in Figure 1.

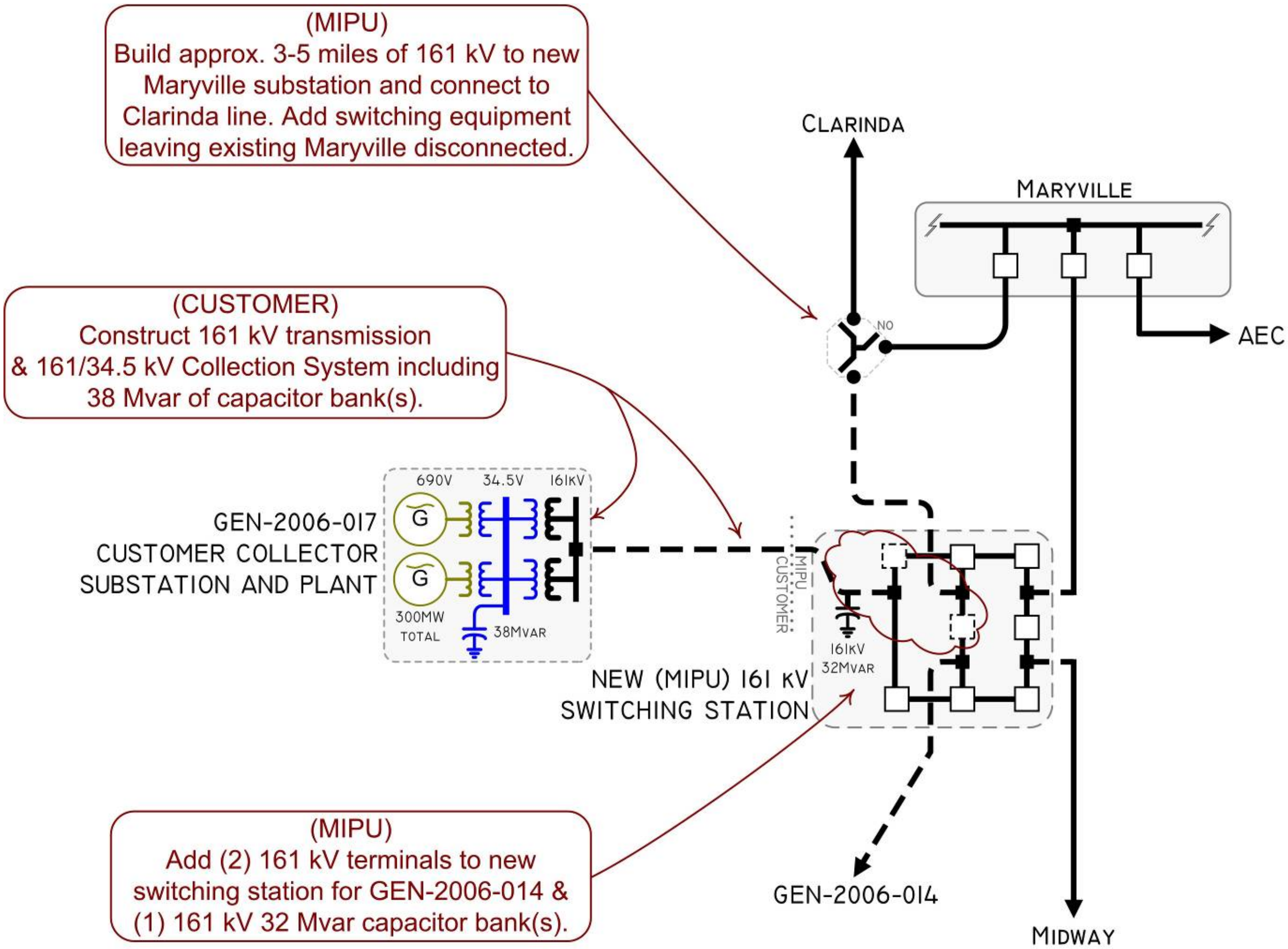


Figure 1: Proposed Method of Interconnection

(Final design to be determined)

Interconnection Estimated Costs

The total minimum cost for building the required the facilities needed to support both GI request #GEN-2006-017 and #GEN-2006-014 facilities is estimated at $5,000,000, detailed in Tables 1 and 3. Should the prior GI request #GEN-2006-014 withdraw from the queue, the total minimum costs for building the required facilities needed to support GEN-2006-017 is estimated at $4,000,000, detailed in Tables 1 and 2. These costs are also detailed in the Facility Study for this request posted in May, 2007. These costs do not include building the Customer's 161 kV transmission line extending from the point of interconnection to serve its 161/34.5 kV collection facilities. These costs also does not include the Customer's 161/34.5 kV collector substation or the 38 Mvar of capacitor bank(s) to be located at the Customer's collector substation, all of which should be determined by the Customer. The Customer is responsible for these 161 kV – 34.5 kV facilities up to the point of interconnection. Other Network Constraints in the Associated Electric Cooperatives, Inc. (AECI), Kansas City Power & Light (KCPL), MIPU and Westar Energy (WERE) transmission systems that were identified are shown in Table 4.

These costs do not include any cost that might be associated with short circuit study results or dynamic stability study results. These costs will be determined when and if a System Impact Study is conducted.

Table 1: Direct Assignment Facilities

FACILITY	**ESTIMATED COST** (2007 DOLLARS)
CUSTOMER – (1) 161 kV transmission line from Customer collector substation to the three-breaker ring-bus station, previously proposed for GEN-2006-014, located on the Maryville – Midway 161 kV transmission line.	*
CUSTOMER – (1) 161/34.5 kV Customer collector substation facilities.	*
CUSTOMER – (1) 34.5 kV, 20 Mvar and (1) 34.5 kV, 18 Mvar capacitor bank(s) to be installed in the Customer 161/34.5 kV collector substation.	*
CUSTOMER – Right-of-Way for all Customer facilities.	*
MIPU – Termination and interconnection of CUSTOMER 161 kV transmission line into the proposed 161 kV three-breaker ring bus.	*
MIPU – (1) 161 kV, 32 Mvar capacitor bank(s) to be installed in proposed 161 kV three-breaker ring bus for the 161 kV line serving GEN-2006-017.	$500,000
TOTAL	*

* *Estimates of cost to be determined.*

Table 2: Required Interconnection Network Upgrade Facilities (Assuming prior queued project withdraws)

FACILITY	ESTIMATED COST (2007 DOLLARS)
MIPU – (1) 161 kV three-breaker ring-bus switching station located on the Maryville – Midway 161 kV transmission line. Station to include breakers, switches, control relaying, high speed communications, metering and related equipment and all related structures.	$3,500,000
TOTAL	**$3,500,000**

* *Estimates of cost to be determined.*

Table 3: Required Interconnection Network Upgrade Facilities (Assuming prior queued project remains in the queue)

FACILITY	ESTIMATED COST (2007 DOLLARS)
MIPU – Add (2) 161 kV line and breaker terminals to the ring-bus switching station proposed for GEN-2006-014.	$1,000,000
MIPU – Construct approximate 5 miles of 161 kV transmission line from Maryville substation to the ring-bus switching station proposed for GEN-2006-014.	$3,500,000
TOTAL	**$4,500,000**

* *Estimates of cost to be determined.*

Powerflow Analysis

A powerflow analysis was conducted for the facility using modified versions of the 2008, 2009, and 2012 summer and winter peak models, and the 2017 summer peak model. The output of the Customer's facility was offset in each model by a reduction in output of existing online SPP generation. This method allows the request to be studied as an Energy Resource (ER) Interconnection request. The proposed in-service date of the generation is April 30, 2008. The available seasonal models used were through the 2017 Summer Peak of which is the end of the current SPP planning horizon.

Following current practice, this analysis was conducted assuming that previous queued requests in the immediate area of this interconnect request were in service. The analysis of the Customer's project indicates that, given the requested generation level of 300 MW and location, additional criteria violations will occur on the existing AECI, KCPL, MIPU and WERE transmission systems under steady state and contingency conditions in the peak seasons. Table 4 lists these overloaded facilities.

Issues concerning the feasibility of this request remain even after the reconfiguration of the transmission system. The Maryville – Midway 161 kV line has an emergency rating of 182 MVA, which would limit the export of 300 MW as well as the 300 MW from the prior queued project from the interconnection point. Mitigation of this constraint as well as the other network constraints in Table 4 will be addressed when the Customer requests transmission service for this facility under the SPP OATT.

In Table 5, a value of Available Transfer Capability (ATC) associated with each overloaded facility is included. These values may be used by the Customer to determine lower generation capacity levels that may be installed. When transmission service associated with this interconnection is evaluated, the loading of the facilities listed in this table may be greater due to higher priority reservations. When a facility is overloaded for more than one contingency, only the highest loading on the facility for each season is included in the table.

In order to maintain a zero reactive power flow exchanged at the point of interconnection, additional reactive compensation is required. The Customer will be required to install a combined total of at least 70 Mvars, comprised of 38 Mvar of 34.5 kV capacitor bank(s) to be installed in the Customer's collector substation and an additional 32 Mvar of 161 kV capacitor bank(s) to be installed in the proposed ring-bus switching station on the line serving GEN-2006-017. The dynamic stability study conducted in conjunction with this Impact ReStudy have determined that the wind farm will meet the low voltage provisions of FERC Order #661A with the new interconnection configuration. Therefore, an SVC or STATCOM device is not required.

There are several other proposed generation additions in the general area of the Customer's facility. Some of the local projects that were previously queued were assumed to be in service in this Impact Re-Study. Not all local projects that were previously queued and have advanced to nearly complete phases were included in this Impact Study.

Powerflow Analysis Methodology

The Southwest Power Pool (SPP) criteria states that: "The transmission system of the SPP region shall be planned and constructed so that the contingencies as set forth in the Criteria will meet the applicable NERC Planning Standards for System Adequacy and Security – Transmission System Table I hereafter referred to as NERC Table I) and its applicable standards and measurements".

Using the created models and the ACCC function of PSS\E, single contingencies in portions or all of the modeled control areas of Sunflower Electric Power Corporation (SUNC), Missouri Public Service (MIPU), Westar Energy (WERE), Kansas City Power & Light (KCPL), West Plains (WEPL), Midwest Energy (MIDW), Oklahoma Gas and Electric OKGE, American Electric Power West (AEPW), Grand River Dam Authority (GRDA), Southwestern Public Service Company (SPS), Western Farmers Electric Cooperative (WFEC) and other control areas were applied and the resulting scenarios analyzed. This satisfies the 'more probable' contingency testing criteria mandated by NERC and the SPP criteria.

Powerflow Results

Table 4: Network Constraints

AREA	OVERLOADED ELEMENT
AECI	FAIRPORT - OSBORN 161KV CKT 1
AECI	MARYVILLE - SKIDMORE 69KV CKT 1
AECI	MOBERLY TAP - THOMAS HILL 161KV CKT 1
AECI/MIPU	MARYVILLE (MIPU)- MARYVILLE (AECI) 161KV CKT 1
KCPL	HAWTHORN (HAWT 20) 345/161/13.8KV TRANSFORMER CKT 20
KCPL	LEEDS - LEEDS REACTOR 161KV CKT 1
KCPL	MIDTOWN - MIDTOWN REACTOR 161KV CKT 1
KCPL	MIDTOWN REACTOR - LEEDS REACTOR 161KV CKT 1
KCPL/MIPU	ALABAMA - NASHUA 161KV CKT 1
KCPL/MIPU	ST JOE - HAWTHORN 345KV CKT 1
KCPL/MIPU	ST JOE - IATAN 345KV CKT 1
KCPL/WERE	IATAN - STRANGER CREEK 345KV CKT 1
MEC/MIPU	CLARENDA (MEC) 161.00 - MARYVLE2-NEW161.00 (MIPU) 161KV CKT 1
MIPU	ALABAMA - LAKE ROAD 161KV CKT 1
MIPU	HALLMARK - RITCHFIELD 161KV CKT 1
MIPU	MARYVILLE (MARYVILL) 161/69/13.8KV TRANSFORMER CKT 1
MIPU	MARYVILLE (MARYVILL) 161/69/13.8KV TRANSFORMER CKT 2
MIPU	MARYVLE2-NEW161.00 - MIDWAY 161KV CKT 1
MIPU	MIDWAY - ST JOE 161KV CKT 1
MIPU	SIBLEY - RITCHFIELD 161KV CKT 1
WERE	ANZIO - FORT JUNCTION SWITCHING STATION 115KV CKT 1
WERE	EAST MANHATTAN (EMANHT3X) 230/115/18.0KV TRANSFORMER CKT 1
WERE	EXIDE JUNCTION - NORTH AMERICAN PHILIPS 115KV CKT 1
WERE	EXIDE JUNCTION - SUMMIT 115KV CKT 1
WERE	FORT JUNCTION SWITCHING STATION - MCDOWELL CREEK SWITCHING STATION 115KV CKT 1
WERE	FORT JUNCTION SWITCHING STATION - MCDOWELL CREEK SWITCHING STATION 115KV CKT 2
WERE	NORTHVIEW - SUMMIT 115KV CKT 1
WERE	WEST JUNCTION CITY - WEST JUNCTION CITY JUNCTION (EAST) 115KV CKT 1
AECI	Associated Electric Cooperative, Inc.
KCPL	Kansas City Power and Light
MIPU	Missouri Public Service
WERE	Westar Energy

Table 5: Contingency Analysis

SEASON	OVERLOADED ELEMENT	RATING (MVA)	LOADING (%)	ATC (MW)	CONTINGENCY
08SP	ALABAMA - LAKE ROAD 161KV CKT 1	153	149	0	IATAN - STRANGER CREEK 345KV CKT 1
08SP	ALABAMA - NASHUA 161KV CKT 1	153	139	0	IATAN - STRANGER CREEK 345KV CKT 1
08SP	MOBERLY TAP - THOMAS HILL 161KV CKT 1	372	104	0	AI21: THOMAS HILL - MCCREDIE 345KV CKT 1, MCCREDIE - KINGDOM CITY 345KV CKT 1
08SP	MARYVILLE (MARYVILL) 161/69/13.8KV TRANSFORMER CKT 1	30	129	38	MARYVILLE (MARYVILL) 161/69/13.8KV TRANSFORMER CKT 2
08SP	MARYVILLE (MIPU)- MARYVILLE (AECI) 161KV CKT 1	200	170	58	CLARENDA (MEC) 161.00 - MARYVLE2-NEW161.00 (MIPU) 161KV CKT 1
08SP	CLARENDA (MEC) 161.00 - MARYVLE2-NEW161.00 (MIPU) 161KV CKT 1	192	140	96	MARYVILLE - MARYVLE2-NEW161.00 161KV CKT 1
08SP	MARYVLE2-NEW161.00 - MIDWAY 161KV CKT 1	182	153	116	MARYVILLE - MARYVLE2-NEW161.00 161KV CKT 1
08SP	WEST JUNCTION CITY - WEST JUNCTION CITY JUNCTION (EAST) 115KV CKT 1	194	103	141	JEFFERY ENERGY CENTER - SUMMIT 345KV CKT 1
08SP	MIDWAY - ST JOE 161KV CKT 1	182	143	149	MARYVILLE - MARYVLE2-NEW161.00 161KV CKT 1
08SP	MARYVILLE (MARYVILL) 161/69/13.8KV TRANSFORMER CKT 2	50	112	187	MARYVILLE (MARYVILL) 161/69/13.8KV TRANSFORMER CKT 1
08WP	MARYVILLE (MIPU)- MARYVILLE (AECI) 161KV CKT 1	200	177	37	CLARENDA (MEC) 161.00 - MARYVLE2-NEW161.00 (MIPU) 161KV CKT 1
08WP	CLARENDA (MEC) 161.00 - MARYVLE2-NEW161.00 (MIPU) 161KV CKT 1	192	145	69	MARYVILLE - MARYVLE2-NEW161.00 161KV CKT 1
08WP	MARYVLE2-NEW161.00 - MIDWAY 161KV CKT 1	182	146	135	MARYVILLE - MARYVLE2-NEW161.00 161KV CKT 1
08WP	ALABAMA - LAKE ROAD 161KV CKT 1	153	110	143	IATAN - STRANGER CREEK 345KV CKT 1
08WP	MIDWAY - ST JOE 161KV CKT 1	182	138	166	MARYVILLE - MARYVLE2-NEW161.00 161KV CKT 1
08WP	MARYVILLE (MARYVILL) 161/69/13.8KV TRANSFORMER CKT 1	30	114	172	MARYVILLE (MARYVILL) 161/69/13.8KV TRANSFORMER CKT 2
09SP	ALABAMA - LAKE ROAD 161KV CKT 1	153	140	0	HAWTHORN - ST JOE 345KV CKT 1
09SP	MARYVILLE (MARYVILL) 161/69/13.8KV TRANSFORMER CKT 1	30	136	0	MARYVILLE (MARYVILL) 161/69/13.8KV TRANSFORMER CKT 2
09SP	ALABAMA - NASHUA 161KV CKT 1	153	129	0	HAWTHORN - ST JOE 345KV CKT 1
09SP	MOBERLY TAP - THOMAS HILL 161KV CKT 1	372	106	0	AI21: THOMAS HILL - MCCREDIE 345KV CKT 1, MCCREDIE - KINGDOM CITY 345KV CKT 1
09SP	MARYVLE2-NEW161.00 - MIDWAY 161KV CKT 1	182	160	37	MARYVILLE - MARYVLE2-NEW161.00 161KV CKT 1
09SP	MARYVILLE (MIPU)- MARYVILLE (AECI) 161KV CKT 1	200	171	42	MARYVLE2-NEW161.00 - MIDWAY 161KV CKT 1
09SP	MIDWAY - ST JOE 161KV CKT 1	182	150	80	MARYVILLE - MARYVLE2-NEW161.00 161KV CKT 1
09SP	CLARENDA (MEC) 161.00 - MARYVLE2-NEW161.00 (MIPU) 161KV CKT 1	192	138	110	MARYVILLE - MARYVLE2-NEW161.00 161KV CKT 1
09SP	MARYVILLE (MARYVILL) 161/69/13.8KV TRANSFORMER CKT 2	50	117	139	MARYVILLE (MARYVILL) 161/69/13.8KV TRANSFORMER CKT 1
09SP	FAIRPORT - OSBORN 161KV CKT 1	227	102	242	SPP-2006-001: ST JOE - FAIRPORT 345KV CKT 1, ST JOE - COOPER 345KV CKT 1
09WP	ALABAMA - LAKE ROAD 161KV CKT 1	153	118	0	HAWTHORN - ST JOE 345KV CKT 1
09WP	MARYVILLE (MIPU)- MARYVILLE (AECI) 161KV CKT 1	200	176	31	CLARENDA (MEC) 161.00 - MARYVLE2-NEW161.00 (MIPU) 161KV CKT 1
09WP	MARYVLE2-NEW161.00 - MIDWAY 161KV CKT 1	182	154	88	MARYVILLE - MARYVLE2-NEW161.00 161KV CKT 1

TABLE 4: Contingency Analysis (continued)

SEASON	OVERLOADED ELEMENT	RATING (MVA)	LOADING (%)	ATC (MW)	CONTINGENCY
09WP	CLARENDA (MEC) 161.00 - MARYVLE2-NEW161.00 (MIPU) 161KV CKT 1	192	142	92	MARYVILLE - MARYVLE2-NEW161.00 161KV CKT 1
09WP	MARYVILLE (MARYVILL) 161/69/13.8KV TRANSFORMER CKT 1	30	122	103	MARYVILLE (MARYVILL) 161/69/13.8KV TRANSFORMER CKT 2
09WP	MIDWAY - ST JOE 161KV CKT 1	182	145	123	MARYVILLE - MARYVLE2-NEW161.00 161KV CKT 1
09WP	ALABAMA - NASHUA 161KV CKT 1	153	108	156	HAWTHORN - ST JOE 345KV CKT 1
09WP	MARYVILLE (MARYVILL) 161/69/13.8KV TRANSFORMER CKT 2	50	107	228	MARYVILLE (MARYVILL) 161/69/13.8KV TRANSFORMER CKT 1
12SP	ALABAMA - LAKE ROAD 161KV CKT 1	153	231	0	IATAN - STRANGER CREEK 345KV CKT 1
12SP	ALABAMA - NASHUA 161KV CKT 1	153	219	0	IATAN - STRANGER CREEK 345KV CKT 1
12SP	ST JOE - IATAN 345KV CKT 1	1073	154	0	SPP-KCPL-02B: IATAN - STRANGER CREEK 345KV CKT 1, ALABAMA - LAKE ROAD 161KV CKT 1
12SP	MARYVILLE (MARYVILL) 161/69/13.8KV TRANSFORMER CKT 1	30	143	0	MARYVILLE (MARYVILL) 161/69/13.8KV TRANSFORMER CKT 2
12SP	ST JOE - HAWTHORN 345KV CKT 1	1138	131	0	SPP-KCPL-02B: IATAN - STRANGER CREEK 345KV CKT 1, ALABAMA - LAKE ROAD 161KV CKT 1
12SP	ANZIO - FORT JUNCTION SWITCHING STATION 115KV CKT 1	92	131	0	WEST JUNCTION CITY - WEST JUNCTION CITY JUNCTION (EAST) 115KV CKT 1
12SP	FAIRPORT - OSBORN 161KV CKT 1	227	120	0	SPP-KCPL-02B: IATAN - STRANGER CREEK 345KV CKT 1, ALABAMA - LAKE ROAD 161KV CKT 1
12SP	MOBERLY TAP - THOMAS HILL 161KV CKT 1	372	119	0	AI21: THOMAS HILL - MCCREDIE 345KV CKT 1, MCCREDIE - KINGDOM CITY 345KV CKT 1
12SP	NORTHVIEW - SUMMIT 115KV CKT 1	181	118	0	EXIDE JUNCTION - SUMMIT 115KV CKT 1
12SP	FORT JUNCTION SWITCHING STATION - MCDOWELL CREEK SWITCHING STATION 115KV CKT 1	68	116	0	FORT JUNCTION SWITCHING STATION - MCDOWELL CREEK SWITCHING STATION 115KV CKT 3
12SP	HAWTHORN (HAWT 20) 345/161/13.8KV TRANSFORMER CKT 20	550	115	0	SPP-KCPL-02B: IATAN - STRANGER CREEK 345KV CKT 1, ALABAMA - LAKE ROAD 161KV CKT 1
12SP	IATAN - STRANGER CREEK 345KV CKT 1	1195	112	0	SPP-KCPL-01A: ST JOE - HAWTHORN 345KV CKT 1, ALABAMA - LAKE ROAD 161KV CKT 1
12SP	SIBLEY - RITCHFIELD 161KV CKT 1	223	109	0	SPP-KCPL-02B: IATAN - STRANGER CREEK 345KV CKT 1, ALABAMA - LAKE ROAD 161KV CKT 1
12SP	MARYVILLE (MIPU)- MARYVILLE (AECI) 161KV CKT 1	200	173	22	CLARENDA (MEC) 161.00 - MARYVLE2-NEW161.00 (MIPU) 161KV CKT 1
12SP	EXIDE JUNCTION - SUMMIT 115KV CKT 1	196	109	32	NORTHVIEW - SUMMIT 115KV CKT 1
12SP	MARYVILLE (MARYVILL) 161/69/13.8KV TRANSFORMER CKT 2	50	130	43	SPP-KCPL-02B: IATAN - STRANGER CREEK 345KV CKT 1, ALABAMA - LAKE ROAD 161KV CKT 1
12SP	LEEDS - LEEDS REACTOR 161KV CKT 1	223	105	51	SPP-KCPL-02B: IATAN - STRANGER CREEK 345KV CKT 1, ALABAMA - LAKE ROAD 161KV CKT 1
12SP	MIDTOWN - MIDTOWN REACTOR 161KV CKT 1	223	105	51	SPP-KCPL-02B: IATAN - STRANGER CREEK 345KV CKT 1, ALABAMA - LAKE ROAD 161KV CKT 1
12SP	MIDTOWN REACTOR - LEEDS REACTOR 161KV CKT 1	223	106	53	SPP-KCPL-02: IATAN - STRANGER CREEK 345KV CKT 1, ALABAMA - NASHUA 161KV CKT 1
12SP	HALLMARK - RITCHFIELD 161KV CKT 1	223	104	82	SPP-KCPL-02B: IATAN - STRANGER CREEK 345KV CKT 1, ALABAMA - LAKE ROAD 161KV CKT 1
12SP	CLARENDA (MEC) 161.00 - MARYVLE2-NEW161.00 (MIPU) 161KV CKT 1	192	144	87	MARYVILLE - MARYVLE2-NEW161.00 161KV CKT 1
12SP	MARYVLE2-NEW161.00 - MIDWAY 161KV CKT 1	182	157	109	MARYVILLE - MARYVLE2-NEW161.00 161KV CKT 1
12SP	MIDWAY - ST JOE 161KV CKT 1	182	147	143	MARYVILLE - MARYVLE2-NEW161.00 161KV CKT 1

TABLE 4: Contingency Analysis (continued)

SEASON	OVERLOADED ELEMENT	RATING (MVA)	LOADING (%)	ATC (MW)	CONTINGENCY
12SP	EXIDE JUNCTION - NORTH AMERICAN PHILIPS 115KV CKT 1	196	103	220	NORTHVIEW - SUMMIT 115KV CKT 1
12SP	EAST MANHATTAN (EMANHT3X) 230/115/18.0KV TRANSFORMER CKT 1	308	101	230	MCDOWELL CREEK - MORRIS COUNTY 230KV CKT 1
12SP	MARYVILLE - SKIDMORE 69KV CKT 1	51	104	255	SPP-KCPL-02B: IATAN - STRANGER CREEK 345KV CKT 1, ALABAMA - LAKE ROAD 161KV CKT 1
12SP	FORT JUNCTION SWITCHING STATION - MCDOWELL CREEK SWITCHING STATION 115KV CKT 2	92	101	263	FORT JUNCTION SWITCHING STATION - MCDOWELL CREEK SWITCHING STATION 115KV CKT 3
12WP	ALABAMA - LAKE ROAD 161KV CKT 1	153	185	0	IATAN - STRANGER CREEK 345KV CKT 1
12WP	ALABAMA - NASHUA 161KV CKT 1	153	174	0	IATAN - STRANGER CREEK 345KV CKT 1
12WP	ST JOE - IATAN 345KV CKT 1	1073	145	0	SPP-KCPL-02B: IATAN - STRANGER CREEK 345KV CKT 1, ALABAMA - LAKE ROAD 161KV CKT 1
12WP	MOBERLY TAP - THOMAS HILL 161KV CKT 1	386	116	0	AI21: THOMAS HILL - MCCREDIE 345KV CKT 1, MCCREDIE - KINGDOM CITY 345KV CKT 1
12WP	MARYVILLE (MIPU)- MARYVILLE (AECI) 161KV CKT 1	200	183	8	CLARENDA (MEC) 161.00 - MARYVLE2-NEW161.00 (MIPU) 161KV CKT 1
12WP	CLARENDA (MEC) 161.00 - MARYVLE2-NEW161.00 (MIPU) 161KV CKT 1	192	151	47	MARYVILLE - MARYVLE2-NEW161.00 161KV CKT 1
12WP	MARYVILLE (MARYVILL) 161/69/13.8KV TRANSFORMER CKT 1	30	127	62	MARYVILLE (MARYVILL) 161/69/13.8KV TRANSFORMER CKT 2
12WP	ST JOE - HAWTHORN 345KV CKT 1	1138	108	67	SPP-KCPL-02B: IATAN - STRANGER CREEK 345KV CKT 1, ALABAMA - LAKE ROAD 161KV CKT 1
12WP	MARYVLE2-NEW161.00 - MIDWAY 161KV CKT 1	182	145	142	MARYVILLE - MARYVLE2-NEW161.00 161KV CKT 1
12WP	MIDWAY - ST JOE 161KV CKT 1	182	136	174	MARYVILLE - MARYVLE2-NEW161.00 161KV CKT 1
12WP	MARYVILLE (MARYVILL) 161/69/13.8KV TRANSFORMER CKT 2	50	111	197	MARYVILLE (MARYVILL) 161/69/13.8KV TRANSFORMER CKT 1
17SP	ALABAMA - LAKE ROAD 161KV CKT 1	153	206	0	IATAN - STRANGER CREEK 345KV CKT 1
17SP	ALABAMA - NASHUA 161KV CKT 1	153	194	0	IATAN - STRANGER CREEK 345KV CKT 1
17SP	MARYVILLE (MARYVILL) 161/69/13.8KV TRANSFORMER CKT 1	30	155	0	MARYVILLE (MARYVILL) 161/69/13.8KV TRANSFORMER CKT 2
17SP	ST JOE - IATAN 345KV CKT 1	1073	150	0	SPP-KCPL-02B: IATAN - STRANGER CREEK 345KV CKT 1, ALABAMA - LAKE ROAD 161KV CKT 1
17SP	SIBLEY - RITCHFIELD 161KV CKT 1	223	120	0	SPP-KCPL-02B: IATAN - STRANGER CREEK 345KV CKT 1, ALABAMA - LAKE ROAD 161KV CKT 1
17SP	HALLMARK - RITCHFIELD 161KV CKT 1	223	115	0	SPP-KCPL-02B: IATAN - STRANGER CREEK 345KV CKT 1, ALABAMA - LAKE ROAD 161KV CKT 1
17SP	ST JOE - HAWTHORN 345KV CKT 1	1138	113	0	SPP-KCPL-02B: IATAN - STRANGER CREEK 345KV CKT 1, ALABAMA - LAKE ROAD 161KV CKT 1
17SP	HAWTHORN (HAWT 20) 345/161/13.8KV TRANSFORMER CKT 20	550	110	0	SPP-KCPL-02B: IATAN - STRANGER CREEK 345KV CKT 1, ALABAMA - LAKE ROAD 161KV CKT 1
17SP	MARYVILLE (MARYVILL) 161/69/13.8KV TRANSFORMER CKT 2	50	131	17	SPP-KCPL-02B: IATAN - STRANGER CREEK 345KV CKT 1, ALABAMA - LAKE ROAD 161KV CKT 1
17SP	MARYVILLE (MIPU)- MARYVILLE (AECI) 161KV CKT 1	200	179	35	CLARENDA (MEC) 161.00 - MARYVLE2-NEW161.00 (MIPU) 161KV CKT 1
17SP	CLARENDA (MEC) 161.00 - MARYVLE2-NEW161.00 (MIPU) 161KV CKT 1	192	154	43	MARYVILLE - MARYVLE2-NEW161.00 161KV CKT 1
17SP	MARYVLE2-NEW161.00 - MIDWAY 161KV CKT 1	182	150	136	MARYVILLE - MARYVLE2-NEW161.00 161KV CKT 1

TABLE 4: Contingency Analysis (continued)

SEASON	OVERLOADED ELEMENT	RATING (MVA)	LOADING (%)	ATC (MW)	CONTINGENCY
17SP	FAIRPORT - OSBORN 161KV CKT 1	227	106	161	SPP-KCPL-02B: IATAN - STRANGER CREEK 345KV CKT 1, ALABAMA - LAKE ROAD 161KV CKT 1
17SP	MIDWAY - ST JOE 161KV CKT 1	182	139	172	MARYVILLE - MARYVLE2-NEW161.00 161KV CKT 1
17SP	IATAN - STRANGER CREEK 345KV CKT 1	1195	101	260	SPP-KCPL-01A: ST JOE - HAWTHORN 345KV CKT 1, ALABAMA - LAKE ROAD 161KV CKT 1
17SP	MARYVILLE - SKIDMORE 69KV CKT 1	51	104	262	SPP-KCPL-02B: IATAN - STRANGER CREEK 345KV CKT 1, ALABAMA - LAKE ROAD 161KV CKT 1

Note: When transmission service associated with this interconnection is evaluated, the loading of the facilities listed in this table may be greater due to higher priority reservations. If the loading of a facility is higher, the level of ATC will be lower.

Stability Analysis

The following stability definition was applied in this study:

"Power system stability is defined as that condition in which the differences of the angular positions of synchronous machine rotors become constant following normally an aperiodic system disturbance."

Additionally, the new wind generator is required to stay on-line following normally cleared faults at the Point of Interconnection (POI).

The stability analysis was performed by using PSS/E Power System Simulator Version 29.5. Both three-phase and single-phase line faults were simulated. The synchronous machine rotor angles were monitored as well as the stability of the asynchronous machines.

Modeling of the Wind Plant Generator in the Powerflow

The Customer generation facility consists of 120 – Clipper 2.5 MW WTGs capable of producing up to 300 MW. The generation will be connected through two two-winding 161/34.5kV transformers and individual 34.5kV/690V step up transformers and a 12.5 mile 161 kV transmission line. Further details are found in the original Impact Study for Generation Interconnection Request GEN-2006-017 dated May, 2007.

Modeling of the Wind Plant Generator in Dynamics

Equivalents for the wind turbine and generator step-up (GSU) transformer in the load flow case were modeled. The stability model incorporates the ride-through capability that allows wind turbine generator operation below 90% terminal voltage for up to 3 seconds and fast tripping (100 ms) for terminal voltages below 10%. The voltage trip settings are hard-coded in the model's FLECS code. Further details are found in the original Impact Study for Generation Interconnection Request GEN-2006-017 dated May, 2007.

Stability Simulation Contingencies

Eighteen (18) contingencies were considered for the transient stability simulations. These contingencies are shown in Table 6.

The single phase faults were simulated by applying the fault impedance to the positive sequence network to represent the effect of the negative and zero sequence networks on the positive sequence network. The fault impedance was determined by using PSS/E to give a positive sequence voltage at the fault location of approximately 60% of the pre-fault value.

Table 6: Stability Simulation Contingencies

Contingency Number	Contingency Name	Description
1	FLT_1_3PH	3 phase fault on the GEN-2006-017 (527) – Maryville (59251) 161 kV line, near the GEN-2006-017. a. Apply 3-phase fault at the GEN-2006-017 bus (572). b. Clear fault after 5 cycles by tripping the line from GEN-2006-017 (572) to Maryville (59251). c. Wait 20 cycles, and then re-close the line in (b) into the fault. d. Leave fault on for 5 cycles, then trip the line in (b), and remove fault.
2	FLT_2_1PH	Single phase fault and sequence like Cont. No. 1
3	FLT_3_3PH	3 phase fault on the GEN-2006-017 (527) – Midway (59252) 161 kV line, near the GEN-2006-017. a. Apply 3-phase fault at the GEN-2006-017 bus (572). b. Clear fault after 5 cycles by tripping the line from GEN-2006-017 (572) to Midway (59252). c. Wait 20 cycles, and then re-close the line in (b) into the fault. d. Leave fault on for 5 cycles, then trip the line in (b), and remove fault.
4	FLT_4_1PH	Single phase fault and sequence like Cont. No. 3
5	FLT_5_3PH	3 phase fault on the Maryville (59251) – AECI Maryville (96097) 161 kV line, near the Maryville. a. Apply 3-phase fault at the Maryville bus (59251). b. Clear fault after 5 cycles by tripping the line from Maryville (59251) to AECI Maryville (96097). c. Wait 20 cycles, and then re-close the line in (b) into the fault. d. Leave fault on for 5 cycles, then trip the line in (b), and remove fault.
6	FLT_6_1PH	Single phase fault and sequence like Cont. No. 5
7	FLT_7_3PH	3 phase fault on the Maryville (59251) – Clarinda (63826) 161 kV line, near Maryville. a. Apply 3-phase fault at the Maryville bus (59251). b. Clear fault after 5 cycles by tripping the line from Maryville (59251) to Clarinda (63826). c. Wait 20 cycles, and then re-close the line in (b) into the fault. d. Leave fault on for 5 cycles, then trip the line in (b), and remove fault.
8	FLT_8_1PH	Single phase fault and sequence like Cont. No. 7
9	FLT_9_3PH	3 phase fault on the AECI Maryville (96097) – AECI Nodaway (96104) 161 kV line, near AECI Maryville. a. Apply 3-phase fault at the AECI Maryville bus (96097). b. Clear fault after 5 cycles by tripping the line from AECI Maryville (96097) to AECI Nodaway (96104). c. Wait 20 cycles, and then re-close the line in (b) into the fault. d. Leave fault on for 5 cycles, then trip the line in (b), and remove fault.
10	FLT_10_1PH	Single phase fault and sequence like Cont. No. 9

Contingency Number	Contingency Name	Description
11	FLT_11_3PH	3 phase fault on the AECI Maryville (96097) – Creston (66560) 161 kV line, near the AECI Maryville. a. Apply 3-phase fault at the AECI Maryville bus (96097). b. Clear fault after 5 cycles by tripping the line from AECI Maryville (96097) to Creston (66560). c. Wait 20 cycles, and then re-close the line in (b) into the fault. d. Leave fault on for 5 cycles, then trip the line in (b), and remove fault.
12	FLT_12_1PH	Single phase fault and sequence like Cont. No. 11
13	FLT_13_3PH	3 phase fault on the Midway (59252) – St. Joseph (59253) 161 kV line, near the Midway. a. Apply 3-phase fault at the Midway bus (59252). b. Clear fault after 5 cycles by tripping the line from Midway (59252) to St. Joseph (59253). c. Wait 20 cycles, and then re-close the line in (b) into the fault. d. Leave fault on for 5 cycles, then trip the line in (b), and remove fault.
14	FLT_14_1PH	Single phase fault and sequence like Cont. No. 13
15	FLT_15_3PH	3 phase fault on a St. Joe 345/161 kV autotransformer. a. Apply 3-phase fault at the St. Joe bus (59199). b. Clear fault after 5 cycles by tripping the St. Joe 345/161kV autotransformer (59253-59199-59370-CK1). c. No reclose.
16	FLT_16_1PH	Single phase fault and sequence like Cont. No. 15
17	FLT_17_3PH	3 phase fault on the Fairport (96076) – AECI PQ wind farm (115) 161 kV bus, at Fairport. a. Apply 3-phase fault at the Fairport bus (96076). b. Clear fault after 5 cycles by tripping the line from Fairport (96076) to AECI PQ wind farm (115). c. Wait 20 cycles, and then re-close the line in (b) into the fault. d. Leave fault on for 5 cycles, then trip the line in (b), and remove fault.
18	FLT_18_1PH	Single phase fault and sequence like Cont. No. 17

Prior Queue Projects

The two base cases were modified to include prior queued projects. All the prior queued projects in this study are shown in Table 7. The power generated by the Customer's generation facility and the previously queued projects is dispatched into the SPP footprint. Simulations were carried out on the cases with the added generation for a no-disturbance run of 16 seconds to verify the numerical stability of the model. All cases were confirmed to be stable.

Table 7: Prior Queue Projects

Project	MW
AECI #1	50
AECI #2	50
AECI #3	50
AECI #4	400
AECI #5	400
GEN-2006-014	300

Stability Results

The results of the stability analysis are summarized in Table 8. The results indicate that for all contingencies simulated, GEN-2006-017 and the transmission system remained stable for both seasons. None of the prior queued wind farms tripped off-line during the simulations. Selected stability plots are shown in the appendices. All plots are available on request. Simulations were run for minimum 10 seconds duration to confirm proper machine damping.

Table 8: Stability Results

Contingency Name	2008 Winter Peak	2012 Summer Peak
FLT_1_3PH	STABLE	STABLE
FLT_2_1PH	STABLE	STABLE
FLT_3_3PH	STABLE	STABLE
FLT_4_1PH	STABLE	STABLE
FLT_5_3PH	STABLE	STABLE
FLT_6_1PH	STABLE	STABLE
FLT_7_3PH	STABLE	STABLE
FLT_8_1PH	STABLE	STABLE
FLT_9_3PH	STABLE	STABLE
FLT_10_1PH	STABLE	STABLE
FLT_11_3PH	STABLE	STABLE
FLT_12_1PH	STABLE	STABLE
FLT_13_3PH	STABLE	STABLE
FLT_14_1PH	STABLE	STABLE
FLT_15_3PH	STABLE	STABLE
FLT_16_1PH	STABLE	STABLE
FLT_17_3PH	STABLE	STABLE
FLT_18_1PH	STABLE	STABLE

Conclusion

Due to a change in status of some prior queued projects, SPP undertook this Re-Study of the Impact Study for GEN-2006-017. Should the prior queued project stay in the queue, sign an Interconnection Agreement and go into service, the minimum costs of interconnecting the Customer's interconnection request are estimated at $5,000,000 for Direct Assignment Facilities and Network Upgrades and are given in Tables 1 and 3. At this time, the cost estimates for other Direct Assignment facilities including those in Tables 1 have not yet been defined by the Customer. In addition to the Customer's proposed interconnection facilities, the Customer will be responsible for installing a total of 70 Mvars, comprised of 38 Mvar of 34.5 kV capacitor bank(s) to be installed in the Customer's collector substation and an additional 32 Mvar of 161 kV capacitor bank(s) to be installed in the proposed ring-bus switching station on the line serving GEN-2006-017. As stated earlier, some but not all of the local projects that were previously queued are assumed to be in service in this Impact Study. These costs exclude upgrades of other transmission facilities that were listed in Table 4 of which are Network Constraints.

In Table 5, a value of Available Transfer Capability (ATC) associated with each overloaded facility is included. These values may be used by the Customer to determine lower generation capacity levels that may be installed. When transmission service associated with this interconnection is evaluated, the loading of the facilities listed in this table may be greater due to higher priority reservations. When a facility is overloaded for more than one contingency, only the highest loading on the facility for each season is included in the table.

The Transient Stability analysis was performed again as part of this Impact Re-Study. The Transient Stability analysis determined that GEN-2006-017, with the studied Clipper 2.5MW wind turbines will stay on line and the transmission system will remain stable for all studied contingencies.

The required interconnection costs listed in Tables 1 and 3 and other upgrades associated with Network Constraints do not include all costs associated with the deliverability of the energy to final customers. These costs are determined by separate studies if the Customer submits a Transmission Service Request through Southwest Power Pool's OASIS.

Appendix A: Point of Interconnection Area Map

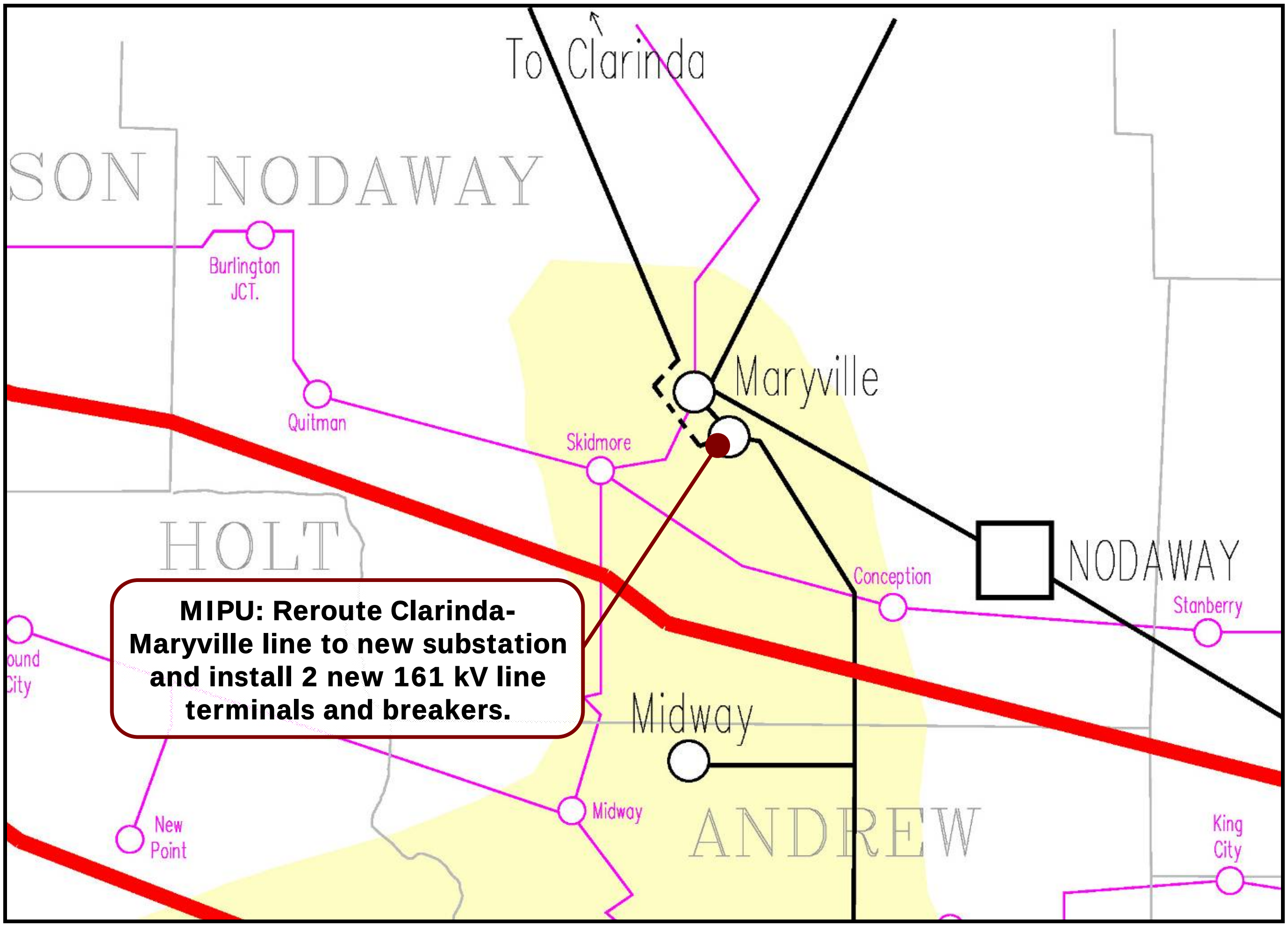


Figure 2: Point of Interconnection Area Map

Appendix B: Selected Stability Plots

2007 Winter Peak Stability Plots

NOTE: All plots available upon request.

Figure 3: 2007 Winter Peak Season - FLT_1_3PH

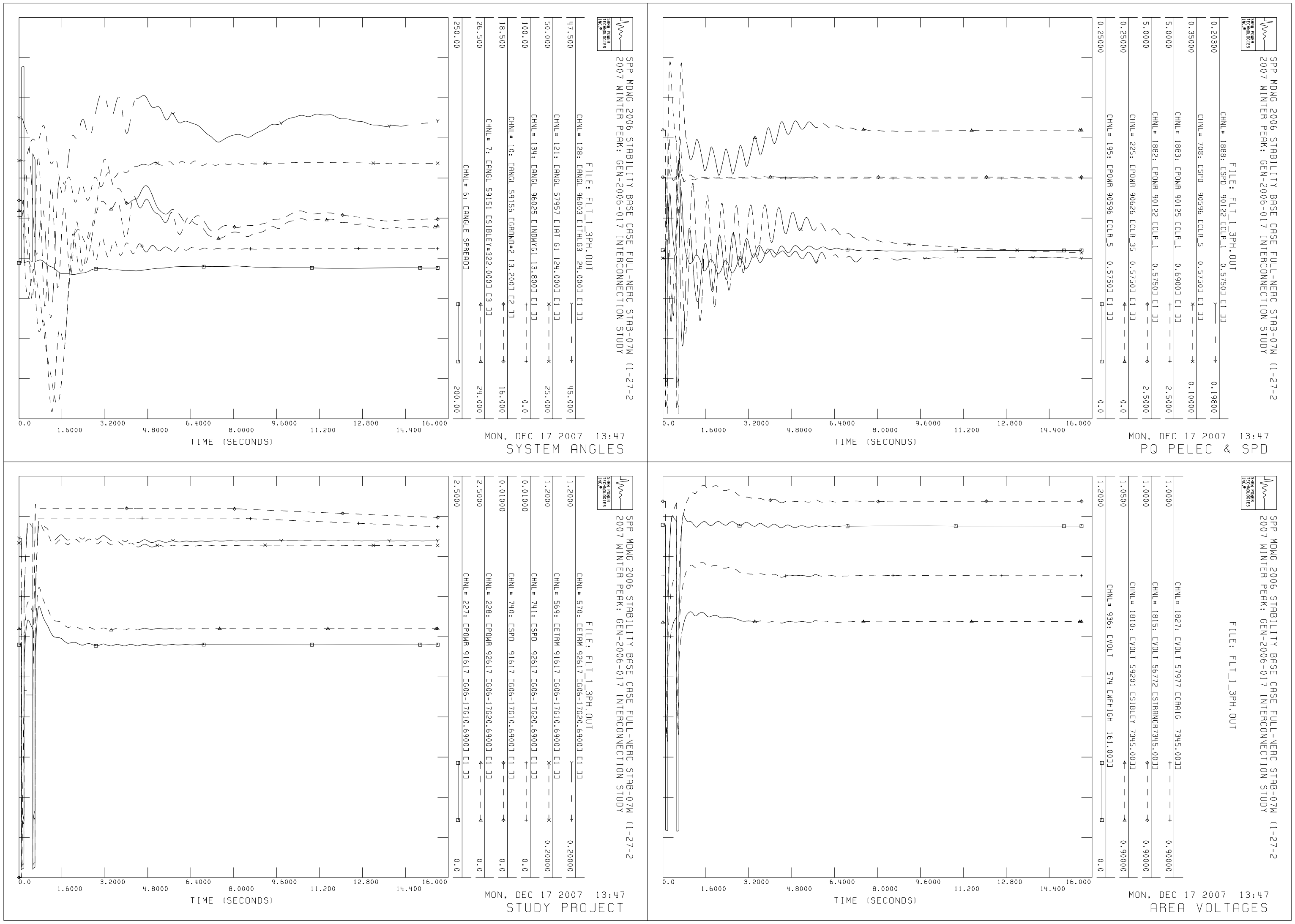


Figure 4: 2007 Winter Peak Season - FLT_2_1PH

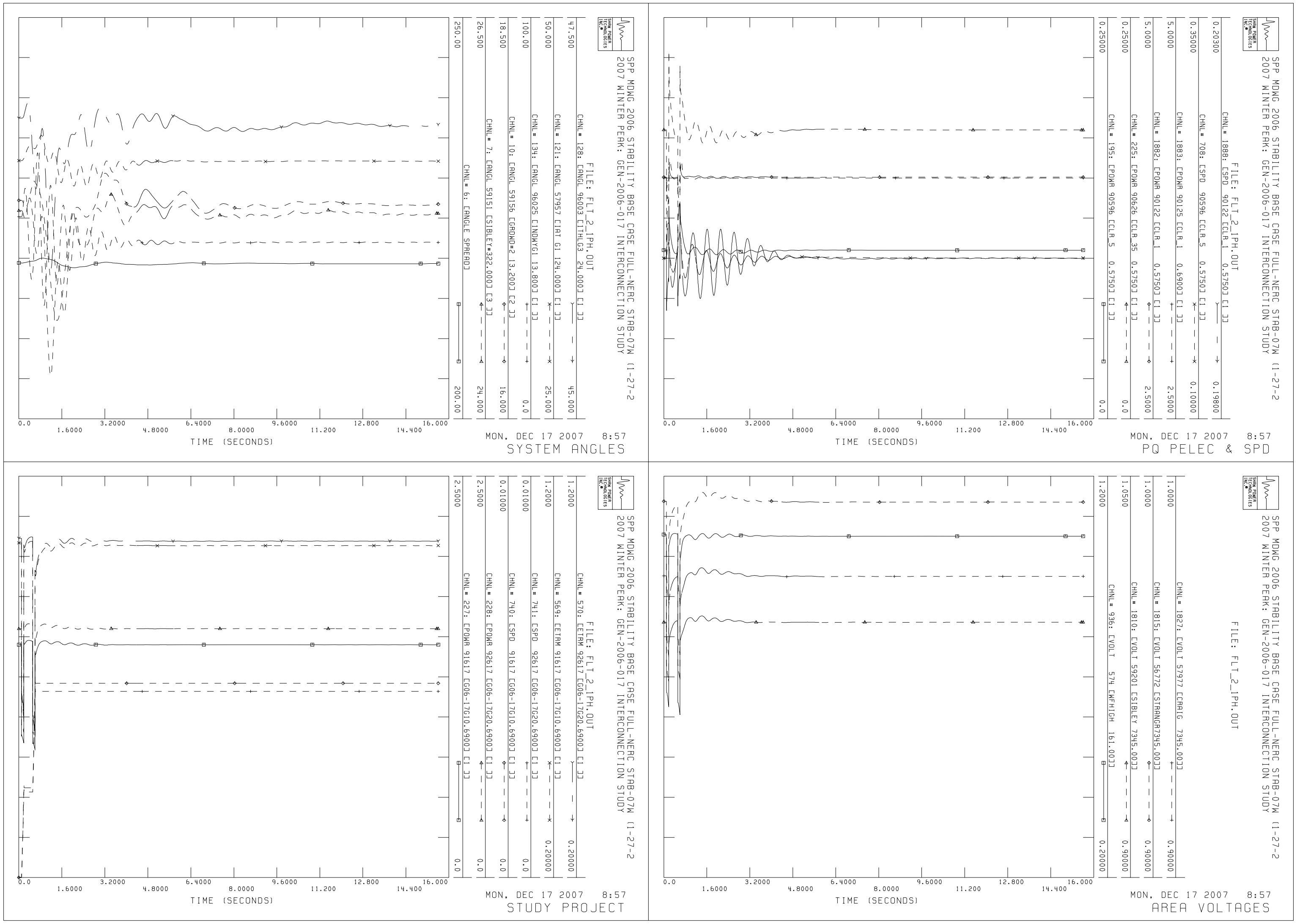


Figure 5: 2007 Winter Peak Season - FLT_3_3PH

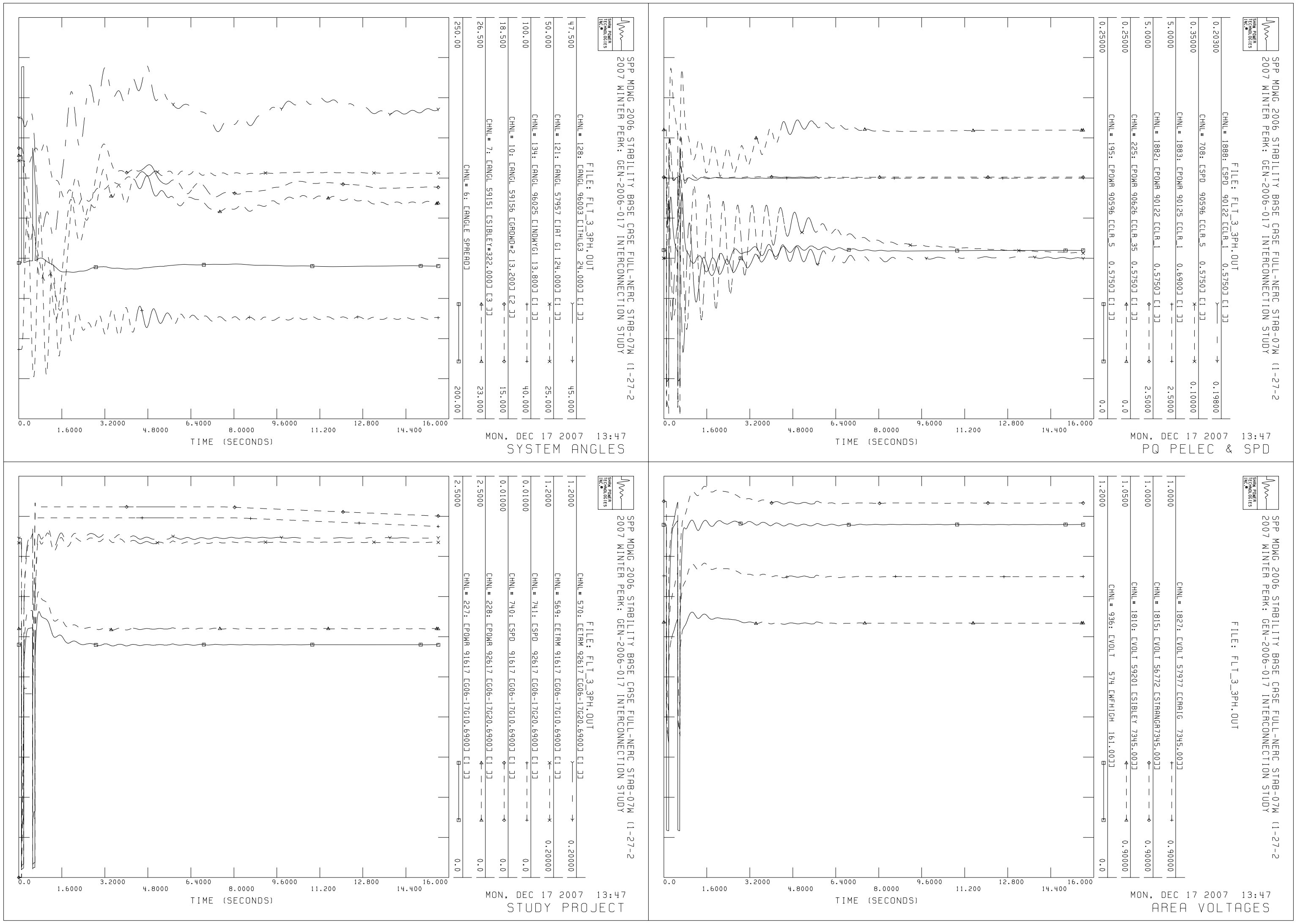


Figure 6: 2007 Winter Peak Season - FLT_7_1PH

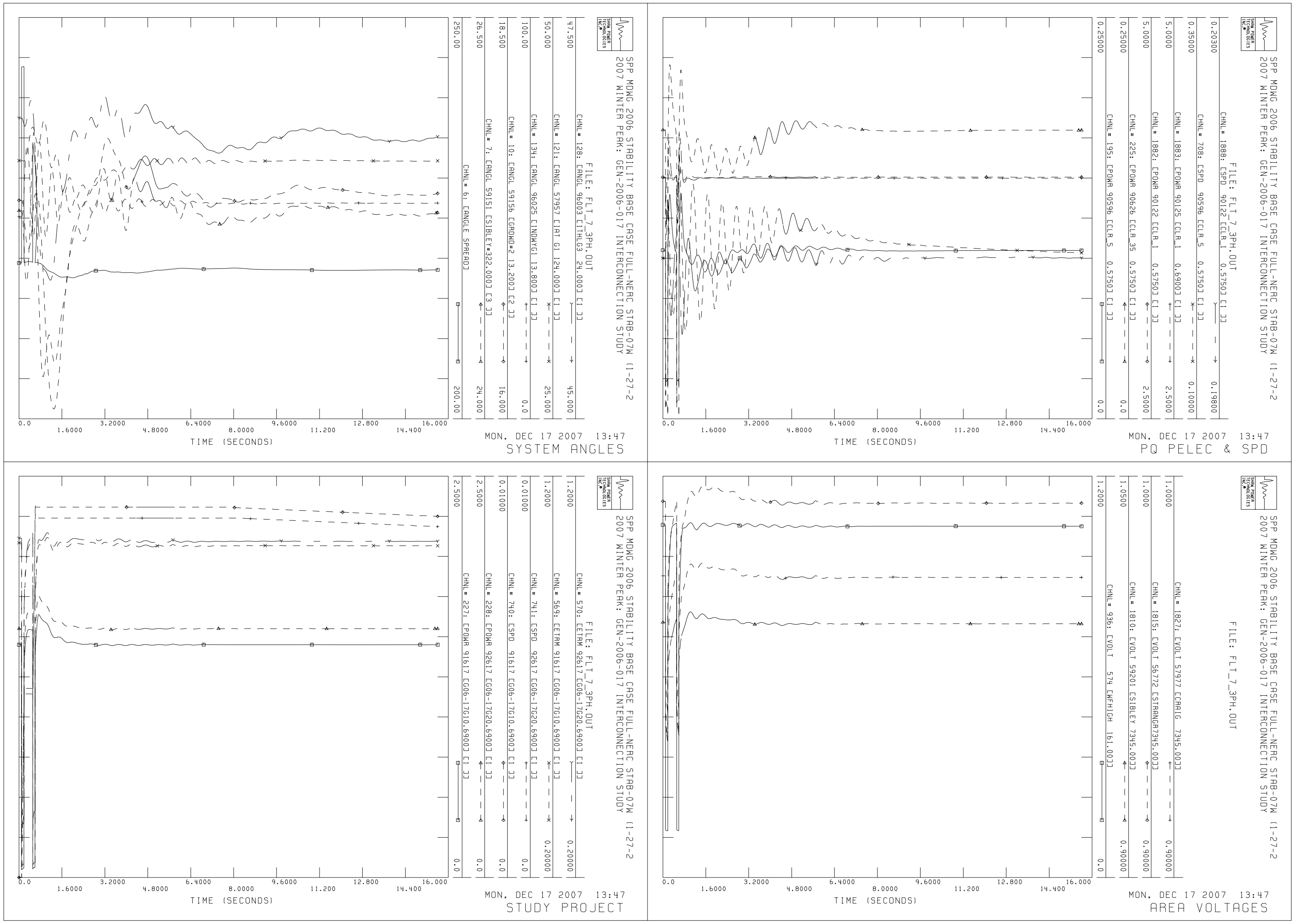


Figure 7: 2007 Winter Peak Season - FLT_8_1PH

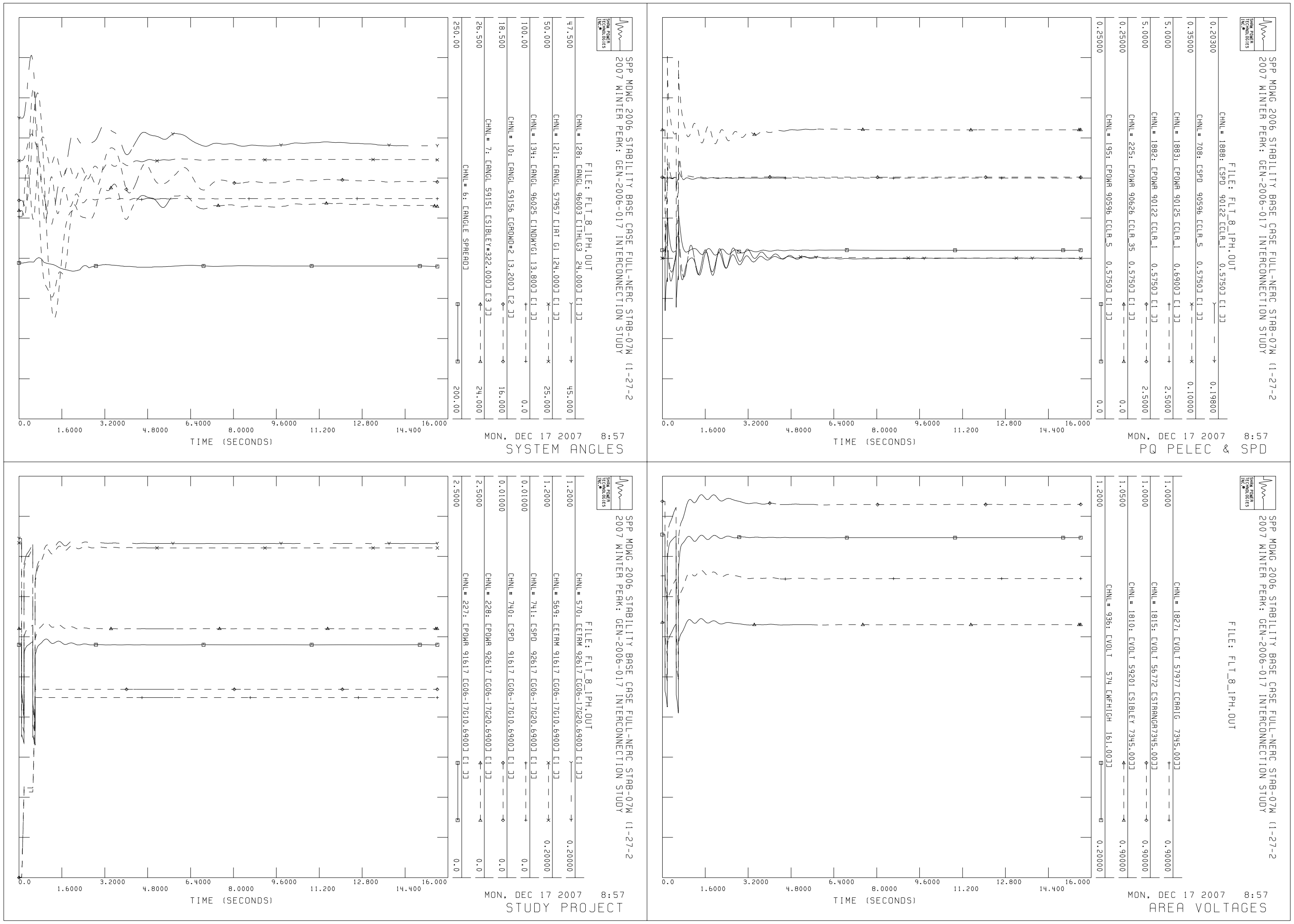
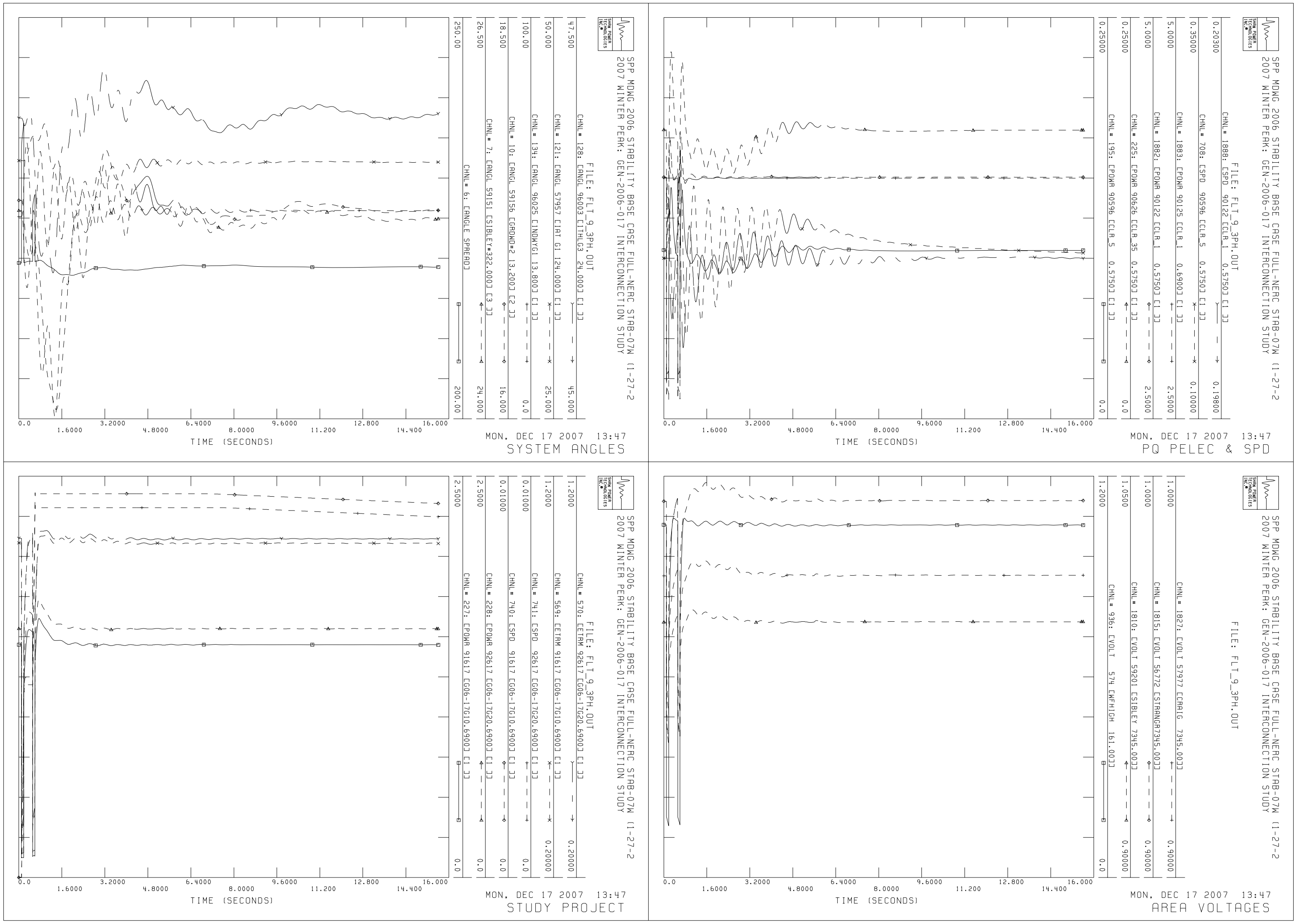


Figure 8: 2007 Winter Peak Season - FLT_9_1PH



2011 Summer Peak Stability Plots

NOTE: All plots available upon request.

Figure 9: 2011 Summer Peak Season - FLT_1_3PH

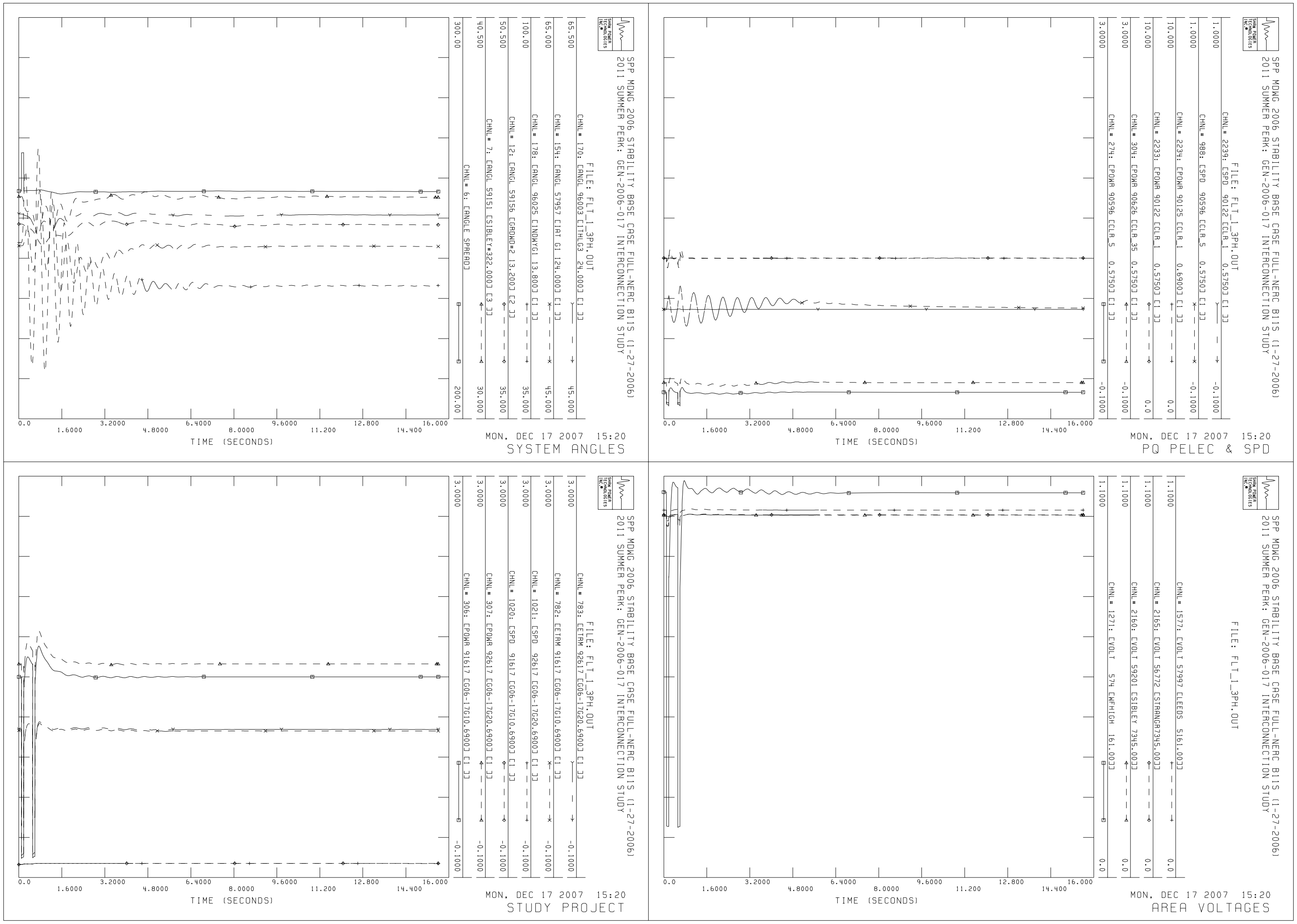


Figure 10: 2011 Summer Peak Season - FLT_2_1PH

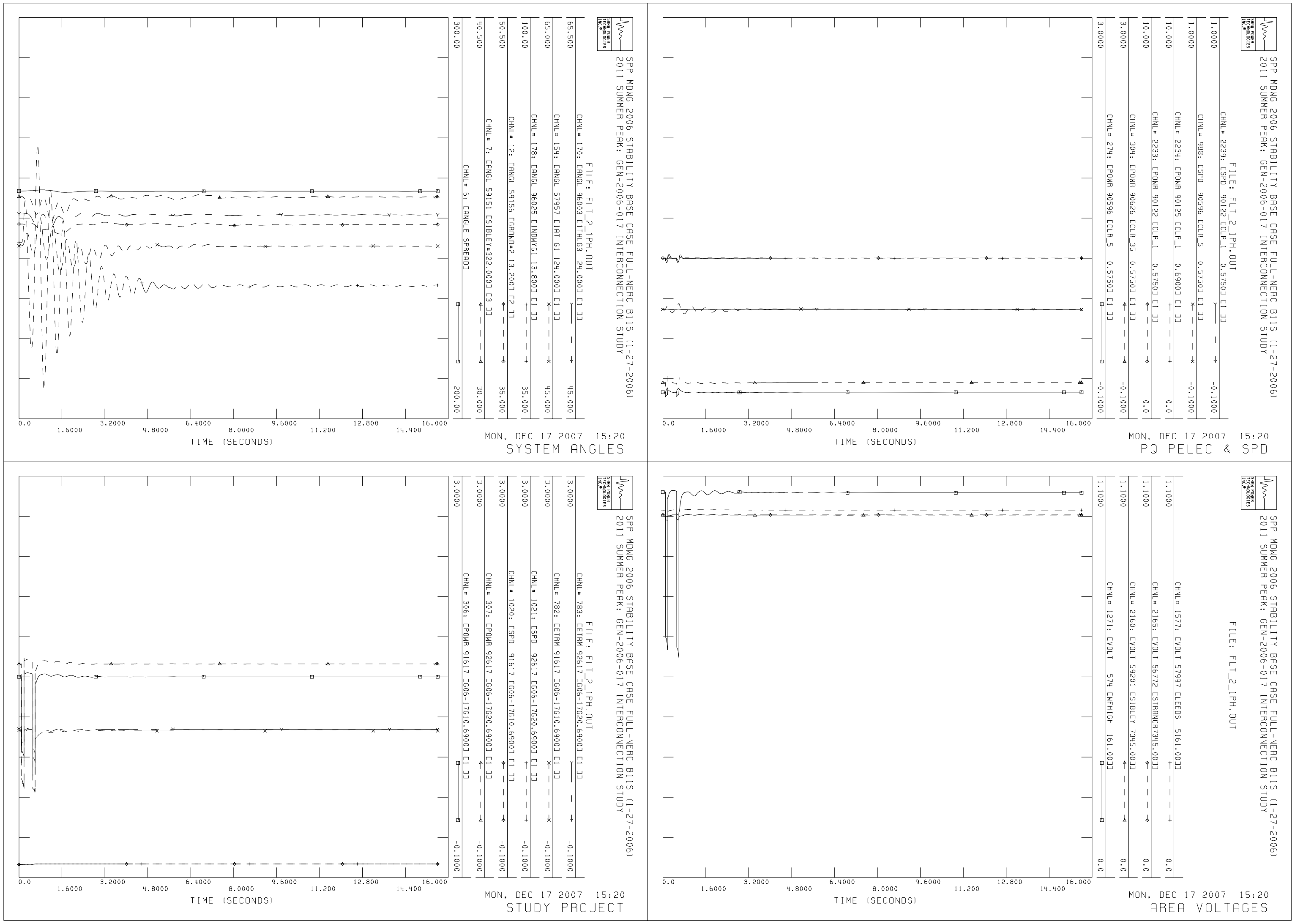


Figure 11: 2011 Summer Peak Season - FLT_3_3PH

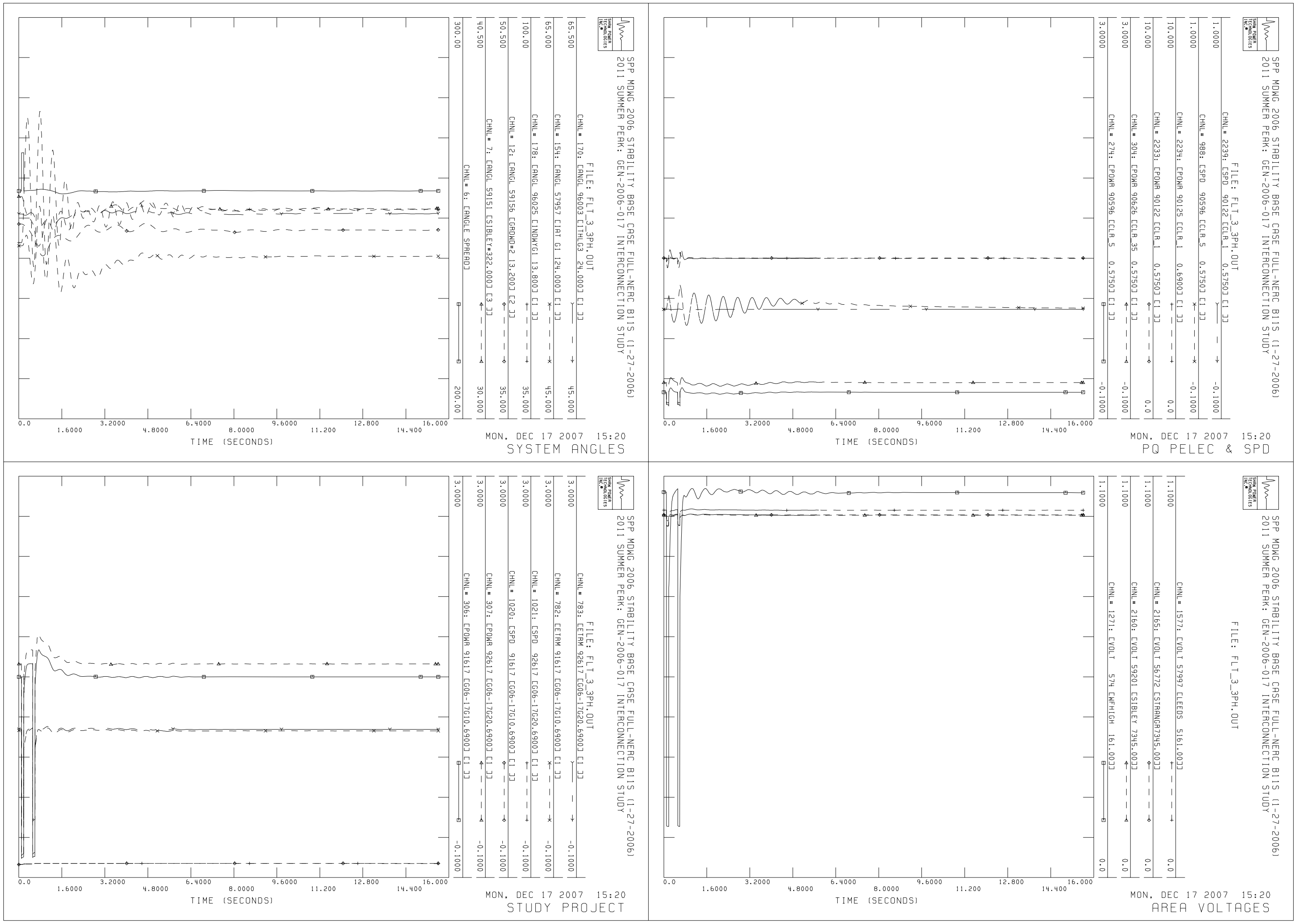


Figure 12: 2011 Summer Peak Season - FLT_7_3PH

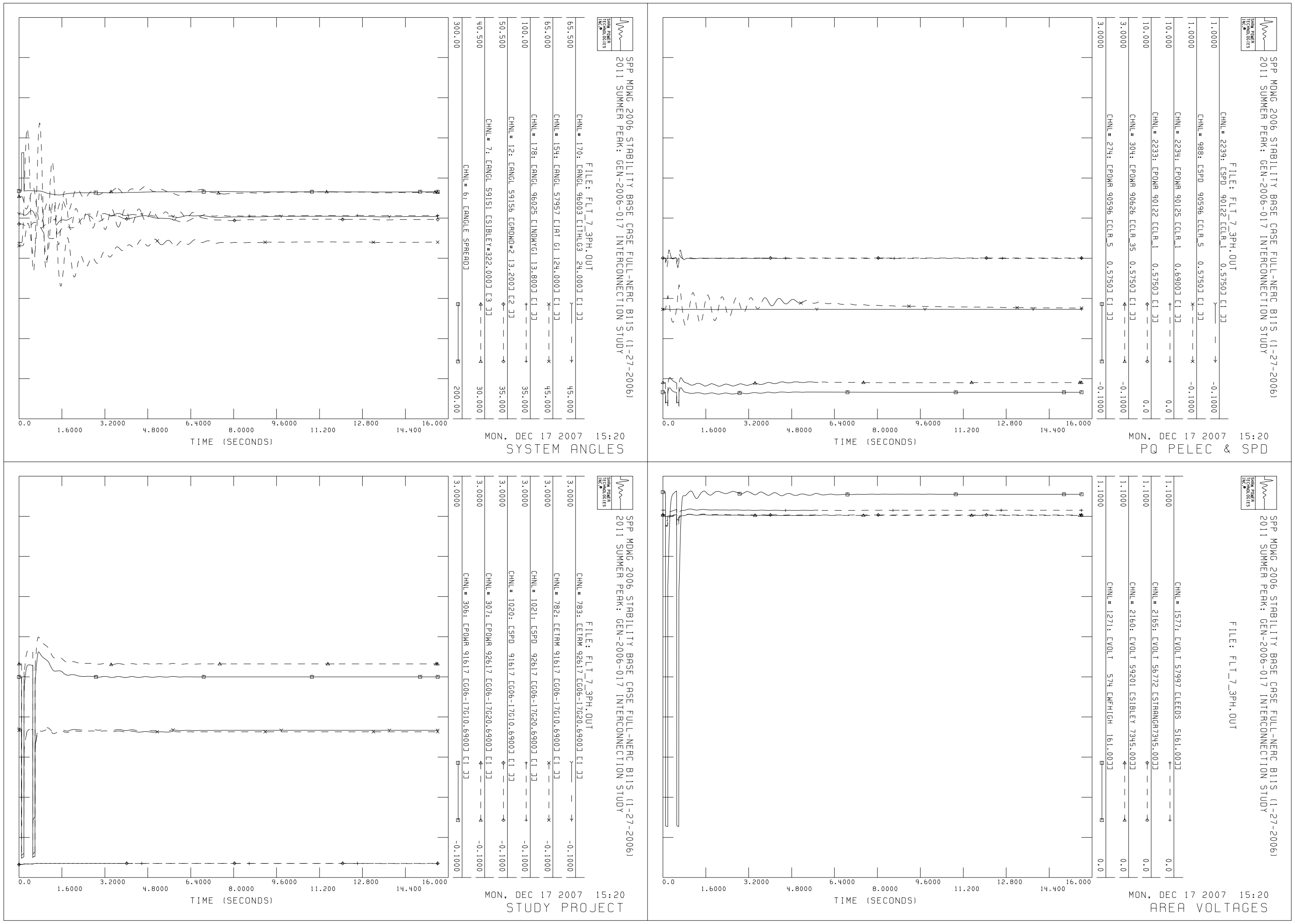


Figure 13: 2011 Summer Peak Season - FLT_8_1PH

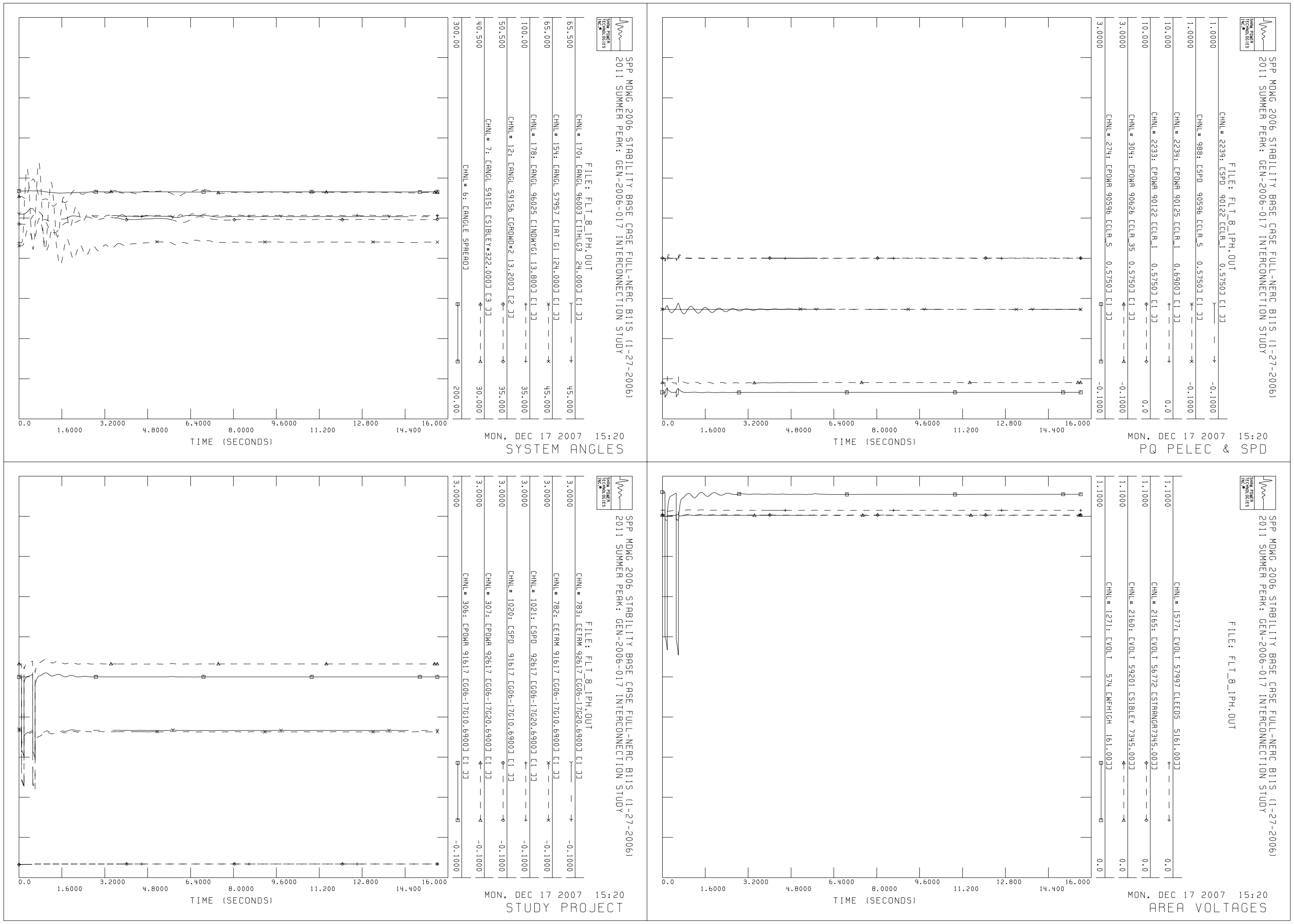


Figure 14: 2011 Summer Peak Season - FLT_9_3PH