Xcel Energy

DRAFT

GENERATION INTERCONECTION

REQUEST # GI-2010-11

SYSTEM IMPACT STUDY REPORT

52 MW PV SOLAR, ALAMOSA COUNTY, COLORADO

Performed by: TranServ International, Inc.

Reviewed by: PSCo Transmission Planning

Xcel Energy - PSCo TRANSMISSION PLANNING

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Table of Contents

Legal Notice 3

Executive Summary 4

Introduction 11

Study Scope and Analysis 11

Power Flow Study Models for Stability Analyses 12

Network Resource (NR) 23

Energy Resource (ER) 24

Short Circuit Analysis 24

Cost Estimates and Assumptions 25

Schedule 28

Appendix A 29

Appendix B 31

Appendix C 69

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Executive Summary

PSCo received an interconnection request (GI-2010-11) for a 52 MW PV solar generation interconnection using 26 SMA 2.0 MW CPs ("Kodiak") inverters, each connected to a 34.5 kV feeder through a 2200 kVA, .360/34.5 kV step-up transformer. The primary point of interconnection to be studied will be located at the San Luis Valley 230 kV substation.

This is a joint System Impact Study (SIS) report by PSCo and TranServ. PSCo determined the required mitigation, provided the Planning level cost estimates and performed all analyses except the stability analyses. The stability analyses were performed by TranServ under PSCo direction.

This SIS evaluated the impact of the proposed generator on the transmission system performance. The scope of the SIS is limited to identifying mitigation for injection constraints that likely would limit the ability of the generator to interconnect. In accordance with PSCo SIS practices, this study only identified impacts that would be required to be mitigated in order for this generator to interconnect at the requested Point of Interconnection (POI).

The proposed generating facility will consist of 26 SMA 2.0 MW CPs ("Kodiak") inverters, each connected to a 34.5 kV feeder through a 2200 kVA, 0.360/34.5 kV step-up transformer. The solar inverters have a reactive capability of +/- 0.9 MVARs each for a total plant capability of +/- 24.10 MVARs. The POI is San Luis Valley 230 kV substation.

The subject interconnection request includes both a Network Resource Interconnection Service (NRIS) option and an Energy Resource Interconnection Service (ERIS) option. NRIS is an Interconnection Service that allows the Interconnection Customer to integrate their Large Generating Facility with the Transmission Provider's Transmission System in a manner comparable to that in which the Transmission Provider integrates its generating facilities to serve native load Customers. NRIS in and of itself does not convey transmission rights.

The request was studied as a Network Resource, stand-alone project only, with no evaluations made of other potential new generation requests that may exist in the Large Generator Interconnection Request (LGIR) queue, other than the generation projects that are already approved and planned to be in service by the summer of 2016. It should be noted that the original requested backfeed date was 9/1/2016 with a commercial operation date of 12/1/2016. However, this project has been asked to fastrack based on the accelerated backfeed date of 9/1/2015 and an accelerated commercial operation date that will be phased in from 9/1/2015 through 12/31/2015. This stand-alone analysis consisted of a comparative study of the system behavior with the addition of the Customer's 52 MW project to the PSCo system compared with that associated with the existing PSCo system. The main purpose of this SIS was to evaluate the potential impact of GI-2010-11 on the PSCo transmission infrastructure as well as that of neighboring entities, when injecting a total of 52 MW of generation, and delivering that additional generation to remote PSCo resources. The costs to interconnect the project with the transmission system at the San Luis Valley 230 kV substation have been evaluated by PSCo Engineering. This study considered facilities that are part of the PSCo transmission system as well as monitoring other nearby entities' regional transmission systems.

Network Resource (NR)

Currently, there is an injection limit of approximately 101 MW at San Luis Valley substation, which will cause the Sargent – Poncha 115 kV line to load beyond acceptable levels for loss of the San Luis Valley – Poncha 230 kV line. The GI-2010-11 generation injection is 52 MW, which is well under the injection limit. Therefore, this project is feasible to interconnect into San Luis Valley 230 kV substation if all the assumptions hold true and no other generation interconnection comes in before the expected in-service date.

Energy Resource (ER)

As indicated above, the addition of the GI-2010-11 generation is feasible with no major network upgrades required.

Stability Analysis Results

The power flow model used in the stability portion of this study is a 2017 Heavy Summer model with origins in a Western Electricity Coordinating Council (WECC) approved model. The dynamic modeling of the GI-2010-11 request, as provided by the customer, specified a value of "1" ("Q set-point") for the "QVArMod" variable (reactive power mode). All initial simulations were performed with the "QVArMod" variable set to "1". During the course of the study, limited additional simulations were performed with the "QVArMod" variable set to "3" (Q(U)). It is the responsibility of the customer to determine if they have the option to operate with the "QVArMod" variable set to "3" (Q(U)). The stability analysis consisted of monitoring all zone 710 (SLV) bus voltages and frequencies as well as GI-2010-11 generation parameters during the first 30 seconds of the tested disturbances.

Analysis with QVArMod set to 1

The stability analysis results indicate that with the proposed addition of the GI-2010-11 generation, the system is stable with satisfactory damping for all studied disturbances except the Disturbance 01s, a 3 phase fault on the San Luis Valley – Poncha 230 kV line near the San Luis Valley 230 kV substation.

Also the voltage and frequency responses of all monitored buses are within WECC criteria for all studied disturbances except for Disturbance 01s. A comparison of Disturbance 01s pre and post GI-2010-11 results indicates that the GI-2010-11 request will not degrade the system performance for Disturbance 01s. However when the GI-2010-11 request QVArMod value is set to 1, both the real and reactive power output from the GI-2010-11 generation goes to zero immediately following the fault clearing for Disturbance 01s. The generation effectively "trips" and does not return to service for the duration of the 20 second simulation.

It should also be noted that the dynamic reactive output of the GI-2010-11 generation was found to be zero for all tested disturbances and for the system intact condition (no disturbance) when the GI-2010-11 request QVArMod value is set to 1. Thus, the Interconnection customer will be responsible for additional upgrades if this performance does not meet PSCo's Interconnection requirements.

Analysis with QVArMod set to 3

The results indicate that with the proposed addition of generation, operating in reactive power mode "3", the system is stable with satisfactory damping for Disturbance 01s. It is the responsibility of the customer to determine if they have the option to operate with the "QVArMod" variable set to "3" (Q(U)).

Short Circuit Analysis

A short circuit study was conducted to determine the fault currents (single-line-to-ground or three-phase) at the San Luis Valley 230 kV bus. Table 1 summarizes the approximate fault currents at the San Luis Valley 230 kV bus with the addition of the 52 MW solar facility.

Table 1 – Short-circuit study results at San Luis Valley 230 kV bus.

System Condition	3Φ (Amps)	S-L-G (Amps)
System Intact	Ia=Ib=Ic=3427	Ia=3948

Cost Estimates – The cost for the transmission interconnection (in 2014 dollars)

The total estimated cost to interconnect the project is approximately **$4,705,000** and includes:

- $1,985,000 for PSCo-Owned, Customer-Funded interconnection facilities
- $2,720,000 for PSCo-Owned, PSCo-Funded interconnection facilities

See cost and schedule for an approximate in service date in Table 8 and Table 9. There are no major network upgrades needed to the current transmission system to transfer full power to PSCo native loads.

Any Interconnection Agreement (IA) requires that certain conditions be met as follows:

1. The conditions of the Interconnection Guidelines[1] are met.
2. A single point of contact is given to Operations to manage the Transmission System reliably for all projects as found in the Interconnection Guidelines.

Customer must show the ability to operate the solar generation within the required +/- 0.95 power factor range during all operating conditions (0 MW to 52 MW) as measured at the Point of Interconnection (POI). The MVAR output shall be proportional with the output of the plant.

Conclusion

The results of the dynamic analysis depend on the QVArMod variable setting of the GI-2010-11 generation. If the "QVArMod" variable can be set to 3, there are no dynamic constraints to granting this request. If the "QVArMod" variable can only be set to 1, the Interconnection customer will be responsible to mitigate the "tripping" of the GI-2010-11 generation following the Disturbance 01s and for additional upgrades to meet PSCo's Interconnection requirements.

Figure 1: San Luis Valley Region

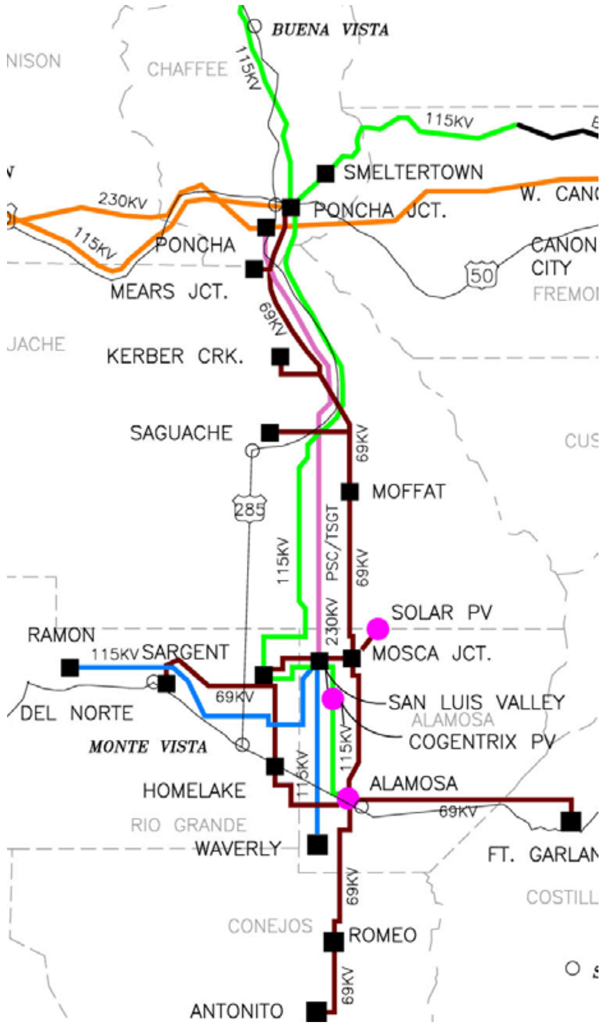

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Figure 2. San Luis Valley Budget One-line

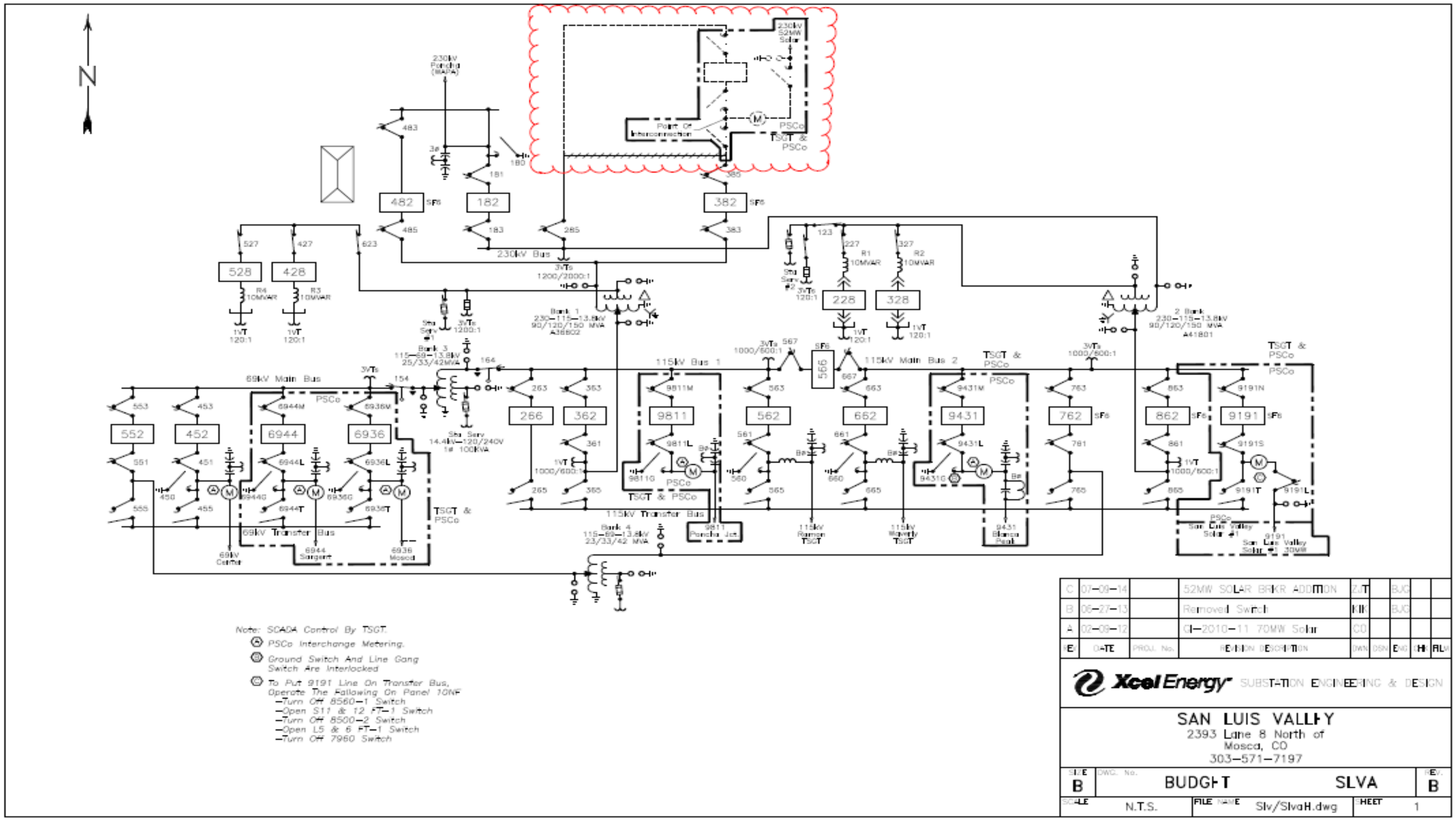
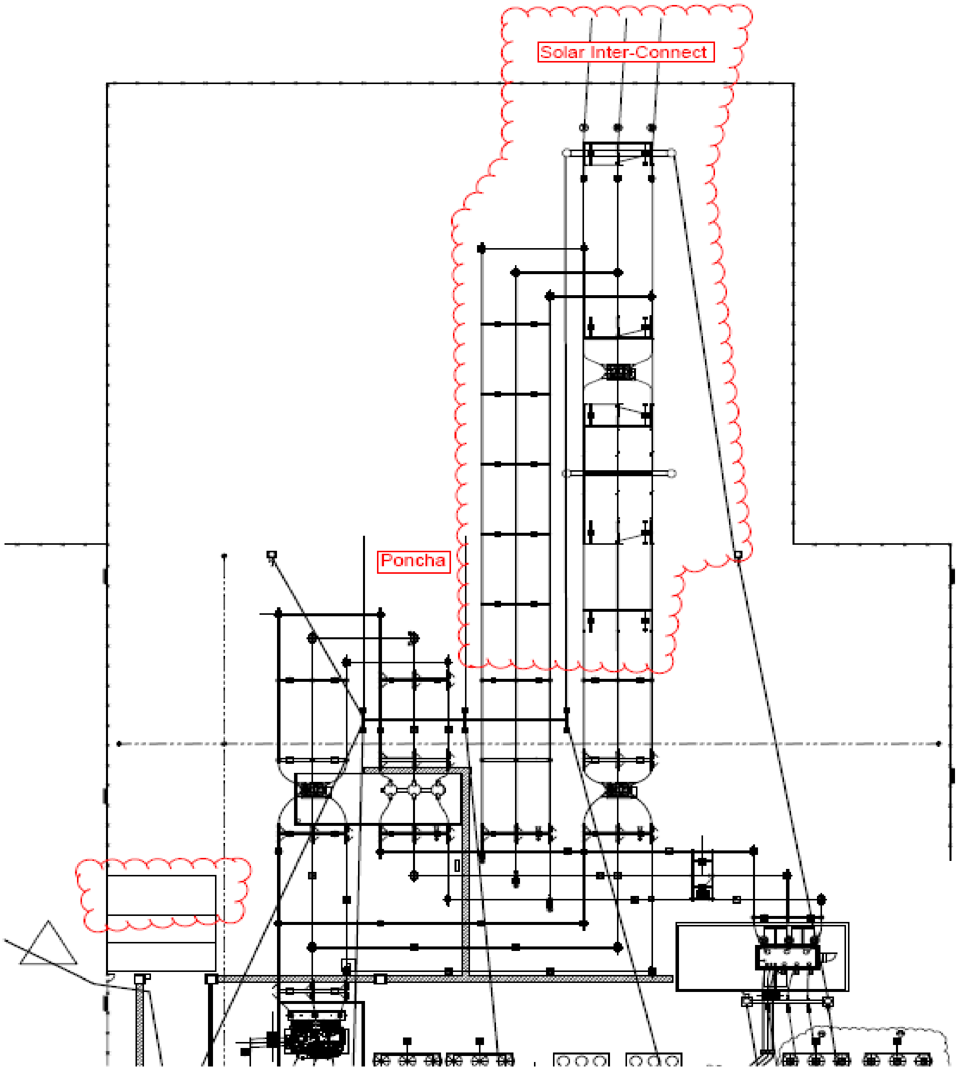


Figure 3. General Arrangement of San Luis Valley Substation



Introduction

PSCo received an interconnection request (GI-2010-11) for a 52 MW generation interconnection to the PSCo system at the San Luis Valley 230 kV substation. PSCo and Xcel Energy commissioned TranServ to perform the stability portion of the Interconnection System Impact Study (SIS) for the 52 MW of PV solar generation interconnection to the San Luis Valley 230 kV substation. The details of the GI-2010-11 request are given below:

Queue Position	Queue Date	Location	Max Output (MW)	Point of Inter-connection	OASIS In Service Date	Inter-connection Service Type	Fuel Type
GI-2010-11	July 27, 2010	Alamosa County, Colorado	52	San Luis Valley 230kV substation	May 1st, 2016	NR/ER	PV Solar

Study Scope and Analysis

This is a joint SIS report by PSCo and TranServ. The SIS evaluated the transmission impacts associated with the proposed generation increase. The power flow analysis identified any thermal or voltage limit violations resulting from the generation addition and an identification of network upgrades required to deliver the proposed generation to PSCo loads. The short circuit analysis evaluated the impact on the transmission system of the increase in available fault current due to the generation addition. The short circuit analysis was performed by PSCo. The dynamic analyses were performed by TranServ under PSCo direction. The dynamic analysis identified any transient and oscillatory stability impacts due to the addition of the new generation. The study report was written by PSCo. The stability portion of the study report was written by TranServ under PSCo direction. PSCo made the determination of injection constraints that are required to be mitigated by the interconnection Customer and developed the mitigation plan for interconnection. Planning level cost estimates were provided by PSCo.

This Generation Interconnection SIS analyzed the impact of this addition, located in South Central Colorado, in accordance with PSCo's study criteria. PSCo adheres to NERC & WECC Reliability Criteria, as well as internal Company criteria for planning studies. The criterion used to identify thermal injection constraints met or exceeded the following criteria:

- There was a detrimental change in the facility loading due to the subject request.
- The resultant facility loading exceeded 100% of the continuous rating (Rate A in PSS/E) system intact or post contingent.

The criterion used to identify voltage injection constraints met or exceeded the following criteria:

- There was a detrimental change in bus voltage due to the subject request.
- The resultant bus voltage was outside of the acceptable range of 0.95 to 1.05 pu system intact or 0.90 to 1.05 pu post contingent.

Transient stability criteria require that all generating machines remain in synchronism and all power swings should be well damped. Also, transient voltage performance should meet the following criteria:

- Following fault clearing for Category B contingencies, voltage may not dip more than 25% of the pre-fault voltage at load buses, more than 30% at non-load buses, or more than 20% for more than 20 cycles at load buses**. (For this study the voltages were monitored after voltage recovery following clearing the fault)**
- Following fault clearing for Category C contingencies, voltage may not dip more than 30% of the pre-fault voltage at any bus or more than 20% for more than 40 cycles at load buses.

In addition, transient frequency performance should meet the following criteria:

- Following fault clearing for Category B contingencies, frequency should not dip below 59.6 Hz for 6 cycles or more at a load bus.
- Following fault clearing for Category C contingencies, frequency should not dip below 59.0 Hz for 6 cycles or more at a load bus.

Note that load buses include generating unit auxiliary loads.

This project was studied as a Network Resource. NRIS shall mean an Interconnection Service that allows the Interconnection Customer to integrate its Large Generating Facility with the Transmission Provider's Transmission System in a manner comparable to that in which the Transmission Provider integrates its generating facilities to serve native load Customers. NRIS in and of itself does not convey transmission service.

Power Flow Study Models for Stability Analyses

WECC coordinates the preparation of regional power flow cases for transmission planning purposes. PSCo Transmission developed a starting point model with a 2016 summer peak load representation from WECC approved models for use in the stability analyses.

Modeling of Request

The GI-2010-11 generation was not included in the starting point model, 17hs.sav. The proposed generating facility will consist of 26 SMA 2.0 MW CPs ("Kodiak") inverters, each connected to a 34.5

kV feeder through a 2200 kVA, 0.360/34.5 kV step-up transformer. The solar inverters have a reactive capability of +/- 0.9 MVARs each for a total plant capability of +/- 24.10 MVARs. The POI is San Luis Valley 230 kV substation.

The following is a summary of Project GI-2010-11 parameters as provided by PSCo:

Total Plant Capacity = 52 MW

Reactive Capability = +/- 24.10 MVARs initially modeled,

Main Step-up Transformer = 34.5/230 kV step up transformer rated at 52 MVA, 9% positive sequence impedance on the transformer base and X/R Ratio of 30.

Equivalent Pad- Mount Transformer = 0.36/34.5 kV inverter step up transformer rated at 57.2 MVA, 5.75% positive sequence impedance on the transformer base and X/R Ration of 9.

The dynamic modeling of the GI-2010-11 request, as provided by the customer, specified a value of "1" ("Q set-point") for the "QVArMod" variable (reactive power mode). All initial simulations were performed with the "QVArMod" variable set to "1". During the course of the study, limited additional simulations were performed with the "QVArMod" variable set to "3" (Q(U)). The response of the GI-2010-11 generation was found to be more robust when the "QVArMod" variable was set to "3". Thus many disturbances which met criteria when the "QVArMod" variable was set to "1" were not also analyzed with the "QVArMod" variable set to "3". Engineering judgment was used to determine that if WECC criteria were met with the "QVArMod" variable set to "1", WECC criteria would also be met with the "QVArMod" variable set to "3". It is the responsibility of the customer to determine if they have the option to operate with the "QVArMod" variable set to "3" (Q(U)).

Interconnecting to the PSCo bulk transmission system involves the Customer adhering to certain interconnection requirements. These requirements are contained in the Interconnection Guidelines for Transmission Interconnected Producer-Owned Generation Greater than 20 MW (Guidelines). In addition, PSCo System Operations conducts commissioning tests prior to the commercial in-service date for a Customer's facilities. Some of the requirements with which the Customer must comply include the following:

1. A generating plant shall maintain a power factor within the range of 0.95 leading to 0.95 lagging, measured at the POI, if the Transmission Provider's System Impact Study shows that such a requirement is necessary to ensure safety or reliability.

2. The results of the System Impact Study will not absolve the Customer from their responsibility to demonstrate to the satisfaction of PSCo System Operations prior to the commercial in-service date that it can safely operate within the required power factor and voltage ranges.

3. Reactive Power Control at the POI is the responsibility of the Customer. Additional Customer studies should be conducted by the Customer to ensure that the facilities can meet the power factor control test and the voltage controller test when the facility is undergoing commissioning testing.

4. PSCo System Operations will require the Customer to perform operational tests prior to commercial operation that would verify that the equipment installed by the Customer meets operational requirements.

5. It is the responsibility of the Customer to determine what type of equipment (DVAR, added switched capacitors, SVC, reactors, etc.), the ratings (MVAR, voltage--34.5 kV or 230 kV), and the locations of those facilities that may be needed for acceptable performance during the commissioning testing.

6. PSCo requires the Customer to provide a single point of contact to coordinate compliance with the power factor and voltage regulation at the POI. The reactive flow at the POI, SLV 230 kV bus, will need to be controlled according to the Interconnection Guidelines.

7. As mentioned in the modeling of the request, operating the invertor in the reactive power mode (QVArMod) "3", the response of the GI-2010-11 generation is found to be more robust and WECC criterion is met for all tested disturbances. It is the responsibility of the customer to determine if they have the option to operate the invertor in QVArMod "3" mode.

Pre GI-2010-11 Stability Model Development

PSCo provided a 2016 Summer Heavy model (17hs1ap_solved_scaled loads.sav) which originated from the WECC 2017 Summer Heavy model (17hs1ap.sav). TranServ modified the PSCo provided 2016 Summer Heavy model to create the following Pre-GI-2010-11 stability model:

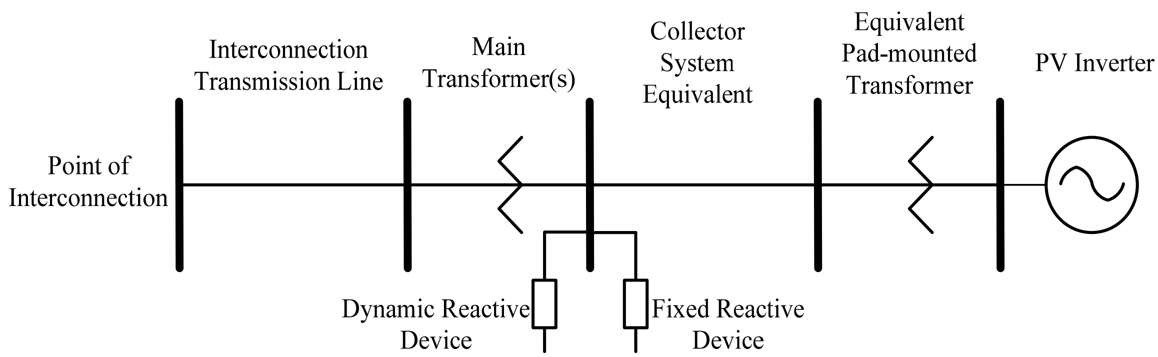
- 16hs_2010_11_pre.sav

The modifications made to the 17hs1ap_solved_scaled loads.sav to form the pre GI-2010-11 model are listed below:

- The 230 kV lines between San Luis Valley and Calumet were removed.

The model was solved with transformer tap, switched shunt; phase shifter, DC tap adjustment and area interchange adjustment enabled.

Figure 4. Post GI-2010-11 Model Development



The modifications made to the Pre GI-2010-11 model to form the Post GI-2010-11 model are as follows:

- The 52 MW PV solar generation was added, interconnecting 26 SMA 2.0 MW CPs ("Kodiak") inverters, each connected to a 34.5 kV feeder through a 2200 kVA, 0.360/34.5 kV step-up transformer. The primary point of interconnection is located at the San Luis Valley 230 kV substation.
- PSSE data to model the generating facility was provided by PSCo and modeled appropriately.
- The GI-2010-11 generation was sunk to Bus 70106, Cherokee unit 4.

Dynamic Stability Results

An analysis was performed to assess the transient stability system performance with the GI-2010-11 generation at 52 MW net. The examined disturbances are provided in Appendix A. The list of evaluated disturbances was limited to that necessary to adequately assess the transient stability performance of the system with the proposed addition as determined by PSCo.

As discussed in the Modeling of Request Section of this report, initially all simulations were performed the "QVArMod" variable set to "1". However limited additional simulations were performed with the "QVArMod" variable set to "3". For all disturbances tested with the "QVArMod" variable set to "3", the dynamic performance of the transmission system was improved.

The WECC dynamic voltage criteria are defined as a voltage changes rather than voltage magnitudes. The PSSE simulation results provide voltage magnitudes. For the purposes of this analysis a pre-disturbance voltage of 1.0 pu was initially assumed. If potential violations were identified, the actual pre-disturbance voltage was obtained and the voltage change was calculated to determine if a WECC criteria violation was indicated.

To perform the analyses, plots of generator power output, line MW flow, bus voltage, and bus frequency were produced for each disturbance. Minimum transient bus voltage magnitudes, maximum transient bus voltage changes (when applicable) and maximum transient frequency deviations, occurring after the fault was cleared, were also determined. The results can be found in Appendix B. Plots of generator power output, line MW flow, bus voltage, and bus frequency can be found in Appendix C.

PSCo determined that all and only Zone 710 buses should be monitored in this study. The results indicate that with the proposed addition of generation, operating in reactive power mode “3”, the system is stable with satisfactory damping for all modeled disturbances. The results also indicate that with the proposed addition of generation, operating in reactive power mode “1”, the system is stable with satisfactory damping for all modeled disturbances except Disturbance 01s, a 3 phase fault on the San Luis –Poncha 230kV line near the San Luis Valley 230 kV bus. However, it was further determined that the power system performance for Disturbance 01s is a pre-existing condition which is not detrimentally impacted by the GI-2010-11 generation addition. Further it was determined that the interconnection customer is not obligated to mitigate the criteria violations which occur during the Disturbance 01s.

Disturbance 01s

The Disturbance 01s was analyzed with the “QVArMod” variable set to “1” and also with the “QVArMod” variable set to “3”.

Analysis with QVArMod set to 3

The results indicate that with the proposed addition of generation, operating in reactive power mode “3”, the system is stable with satisfactory damping for Disturbance 01s. It is the responsibility of the customer to determine if they have the option to operate with the “QVArMod” variable set to “3” (Q(U)).

Analysis with QVArMod set to 1

As shown in Table 2, potential WECC criteria violations were found for Disturbance 01s in both the pre and post scenarios.

Table 2
Pre and Post GI-2010-11 Lowest Voltage Magnitude Results
Disturbance 01s – Three phase fault at San Luis Valley
on the San Luis Valley - Poncha 230 kV line

Load Buses				Non-Load Buses			
Bus Name	Post GI-2010-11 Lowest Voltage	Pre GI-2010-11 Lowest Voltage	Delta Lowest Voltage Post-Pre	Bus Name	Post GI-2010-11 Lowest Voltage	Pre GI-2010-11 Lowest Voltage	Delta Lowest Voltage Post-Pre
FTGARLND 69	0.7397	0.7140	0.0257	OLD16TAP 69	0.7913	0.7655	0.0258
ANTONITO 69	0.7531	0.7272	0.0259	HOOPERTP 69	0.7833	0.7576	0.0257
ROMEO 69	0.7566	0.7307	0.0259	SAGUACHE 69	0.7888	0.7621	0.0267
REATAP 69	0.7633	0.7374	0.0259	ALMSACT2 13.8	0.7750	0.7535	0.0215
HOOPER 69	0.7795	0.7539	0.0256	OLD40TAP 69	0.7947	0.7688	0.0259
LAGARITA 69	0.7789	0.7540	0.0249	ALMSACT1 13.8	0.7959	0.7700	0.0259
CENTER 69	0.7812	0.7556	0.0256	ALMSA_TM 69	0.7962	0.7703	0.0259
DELNORTE 69	0.7850	0.7587	0.0263	MIRGEJCT 69	0.7949	0.7681	0.0268
HOMELAKE 69	0.7876	0.7612	0.0264	RIOGRDTP 69	0.7886	0.7742	0.0144
ALMSA_ST 69	0.7927	0.7670	0.0257	RAMON 115	0.7944	0.7714	0.0230
ALMSA_TM 115	0.7753	0.7538	0.0219	RAMON 69	0.7948	0.7718	0.0234
RIOGRAND 69	0.7886	0.7624	0.0262	WAVERLY 115	0.7951	0.7723	0.0228
MOFFAT 69	0.7984	0.7717	0.0267	SOLAR_ALMT 115	0.7970	0.7753	0.0217
PLAZA 69	0.7903	0.7671	0.0232	SANLSVLY 115	0.7987	0.7761	0.0226
CREEDE 69	0.7892	0.7662	0.0230	SOLAR_ALM 34.5	0.7998	0.7853	0.0145
HILANDSL 69	0.7927	0.7697	0.0230	PLAZA 115	0.7950	0.7721	0.0229
SFORK_SL 69	0.7946	0.7717	0.0229	SWT_RACK 115	0.7948	0.7719	0.0229
ZINZER 115	0.7948	0.7719	0.0229				
CARMEL 115	0.7945	0.7717	0.0228				
STANLEY 115	0.7975	0.7748	0.0227				
STOCKADE 115	0.7953	0.7724	0.0229				

As shown in Table 2, in both the Pre GI-2010-11 and Post GI-2010-11 simulations, the lowest voltage found at all monitored non-load buses is above 0.70 pu and hence is assumed to be within the WECC 30% change non-load bus criteria. However WECC transient voltage performance criteria for load buses dictates the bus voltages may not dip more than 25% below the pre-fault voltage. Thus, as also shown in Table 2, potential WECC load bus criteria violations were identified.

Since potential WECC load bus criteria violations were identified, voltage change results were calculated for all identified potential WECC criteria violations to determine if actual WECC criteria violations occurred. These calculated voltage change results are given in Table 3.

Table 3
Pre and Post GI-2010-11 Voltage Change Results
Disturbance 01s – Three phase fault at San Luis Valley on the San Luis Valley - Poncha 230 kV line

Load Buses	Post Project Analysis					Pre Project Analysis			
	Initial Voltage	Minimum Voltage	Deviation	Transient Voltage dip%	Time at or below WECC Limit (cycles)	Initial Voltage	Minimum Voltage	Deviation	Transient Voltage dip%
FTGARLND 69	0.958	0.7397	0.2183	22.79	97.78	0.961	0.7140	0.2470	25.70
ANTONITO 69	0.973	0.7531	0.2199	22.60	96.39	0.976	0.7272	0.2480	25.49
ROMEO 69	0.976	0.7566	0.2194	22.48	92.19	0.979	0.7307	0.2483	25.36
REATAP 69	0.983	0.7633	0.2197	22.35	89.19	0.985	0.7374	0.2476	25.13
HOOPER 69	0.988	0.7795	0.2085	21.10	47.79	0.991	0.7539	0.2371	23.92
LAGARITA 69	0.987	0.7789	0.2081	21.08	47.19	0.991	0.7540	0.2370	23.91
CENTER 69	0.989	0.7812	0.2078	21.01	44.79	0.993	0.7556	0.2374	23.90
DELNORTE 69	0.991	0.785	0.206	20.79	35.79	0.993	0.7587	0.2343	23.59
HOMELAKE 69	0.998	0.7876	0.2104	21.08	47.79	1.000	0.7612	0.2388	23.88
ALMSA_ST 69	1.011	0.7927	0.2183	21.59	31.59	1.014	0.7670	0.2470	24.35
ALMSA_TM 115	1.015	0.7753	0.2397	23.62	101.00	1.018	0.7538	0.2642	25.95
RIOGRAND 69	0.995	0.7886	0.2064	20.74	33.99	0.997	0.7624	0.2346	23.53
PLAZA 69	0.998	0.7903	0.2077	20.81	36.99	1.005	0.7671	0.2379	23.67
CREEDE 69	0.996	0.7892	0.2068	20.76	35.19	1.004	0.7662	0.2378	23.68
HILANDSL 69	1.000	0.7927	0.2073	20.73	33.99	1.008	0.7697	0.2383	23.64
SFORK_SL 69	1.002	0.7946	0.2074	20.70	25.59	1.010	0.7716	0.2384	23.60
ZINZER 115	1.001	0.7948	0.2062	20.60	24.39	1.009	0.7719	0.2371	23.49
CARMEL 115	1.001	0.7945	0.2065	20.63	24.29	1.009	0.7717	0.2373	23.51
S.ACACIO 115	1.002	0.7952	0.2068	20.64	22.59	1.010	0.7724	0.2372	23.52
STOCKADE 115	1.002	0.7953	0.2067	20.63	22.59	1.010	0.7724	0.2372	23.52
STANLEY 115	1.003	0.7975	0.2055	20.49	22.59	1.011	0.7748	0.2362	23.36

As shown in Table 3, potential WECC criteria violations were found for Disturbance 01s in the Post GI-2010-11 analysis. Also shown in Table 3, the Post GI-2010-11 simulations showed the voltage change to be less than 25%. However the voltage change at these buses was found to exceed 20% for more than 20 cycles, which is also in violation of WECC criteria. In the Pre GI-2010-11 simulations, the voltage change found at most monitored load buses was greater than 25%. Based on a comparison between the pre and the post project analysis results; the subject request does not degrade the system performance for

Disturbance 01s. However when the GI-2010-11 request QVArMod value is set to 1, both the real and reactive power output from the GI-2010-11 generation goes to zero immediately following the fault clearing for Disturbance 01s. The generation effectively "trips" and does not return to service for the duration of the 20 second simulation. The voltage violations shown in Table 3 are pre-existing violations and the subject request improves the system performance. Thus, the Interconnection customer is not responsible to mitigate this violation, but maybe responsible to mitigate the "tripping" of the GI-2010-11 generation following the Disturbance 01s.

Disturbance 02s

The Disturbance 02s was analyzed with the "QVArMod" variable set to "1" and also with the "QVArMod" variable set to "3".

Analysis with QVArMod set to 3

The results indicate that with the proposed addition of generation, operating in reactive power mode "3", the system is stable with satisfactory damping for Disturbance 02s. It is the responsibility of the customer to determine if they have the option to operate with the "QVArMod" variable set to "3" (Q(U)).

Analysis with QVArMod set to 1

The results indicate that with the proposed addition of generation, operating in reactive power mode "1", the system is stable with satisfactory damping for Disturbance 02s.

San Luis Valley Under Voltage Load Shedding Scheme impact on Disturbance 01s and Disturbance 02s Results:

The Disturbance 01s and 02s results were investigated to determine if the San Luis Valley (SLV) Under Voltage Load Shedding Scheme (UVLS) would activate during the disturbance. The SLV UVLS activates following loss of the San Luis Valley - Poncha 230 kV line as detailed below.

1. When the voltage at the SLV 115 kV bus drops to 0 .93 pu the timer is started.
2. If the SLV 115 kV bus voltage stays at or below 0 .93 pu for at least 10 seconds, the SLV - Hooper Tap 69 kV line is opened.
3. If the SLV 115 kV bus voltage stays at or below 0 .93 pu for an additional 10 seconds (20 sec total), the SLV – Waverly 115 kV line is opened.
4. If the SLV 115 kV bus voltage stays at or below 0 .93 pu for another additional 10 seconds (30 sec total), the SLV - Ramon 115 kV line is opened, at this point load will be lost.

Disturbance 01s Under Voltage Load Shedding Scheme Impact:

It was determined that the SLV 115 kV bus did not drop to 0.93 pu following the Disturbance 01s when the GI-2010-11 generation reactive power mode was set to “3” and that consequently the SLV UVLS would not activate following the Disturbance 01s when the GI-2010-11 generation reactive power mode was set to “3”.

It was also determined that the SLV 115 kV bus did indeed drop to 0.93 pu following the Disturbance 01s when the GI-2010-11 generation reactive power mode was set to “1”and that consequently the SLV UVLS would activate following the Disturbance 01s. Thus the Disturbance 01s with the GI-2010-11 generation reactive power mode set to “1” and with subsequent activation of the SLV UVLS was simulated to determine the impact on the transmission system stability.

Analysis with QVArMod set to 1

After applying the UVLS load shedding scheme, voltages for selected load buses were monitored. It was found that the voltages deteriorated at the load buses in comparison to the voltages without the UVLS modeling as shown in Table 7. When considering the modeling of the UVLS, it is reasonable to expect some SLV voltages to initial be adversely impacted. The UVLS scheme is modeled as opening two transmission sources to the impacted load prior to actually dropping the load. In the interim 20 seconds between the trip of the SLV - Hooper Tap 69 kV line and the ultimate shedding of load, voltages in the impacted area understandable decline. However, once the load is dropped, as expected the voltage on the remaining in-service buses increases.

Table 4. Voltage at various load buses

Load Buses	Initial Post Voltage	Post Minimum Voltage without UVLS	Post Minimum Voltage with UVLS	Post Deviation without UVLS	Post Deviation with UVLS	Transient without UVLS Voltage dip %	Transient with UVLS Voltage dip %
FTGARLND 69	0.958	0.7397	0.73	0.2183	0.228	22.79	23.80
ANTONITO 69	0.973	0.7531	0.7432	0.2199	0.2298	22.60	23.62
ROMEO 69	0.976	0.7566	0.7467	0.2194	0.2293	22.48	23.49

As shown in the Table 4, the voltage change found at the monitored load buses is less than 25% however the voltage change at these buses was found to exceed 20% for more than 20 cycles which is also in violation of WECC criteria both with and without the UVLS scheme applied.

Disturbance 02s Under Voltage Load Shedding Scheme Impact:

The Disturbance 02s with UVLS was analyzed with the "QVArMod" variable set to "1" and also with the "QVArMod" variable set to "3".

It was also determined that the SLV 115 kV bus did indeed drop to 0.93 pu following the Disturbance 02s when the GI-2010-11 generation reactive power mode was set to either "1" or "3" and that consequently the SLV UVLS would activate following the Disturbance 02s for both conditions. Thus the Disturbance 02s with the GI-2010-11 generation reactive power mode set to "1" and also separately "3" and with subsequent activation of the SLV UVLS was simulated to determine the impact on the transmission system stability. The results indicate that with the proposed addition of generation, operating in either reactive power mode "1" or "3", the system will be stable with satisfactory damping for Disturbance 02s even when the UVLS scheme activation is modeled.

Disturbance 11s

As shown in Table 5, voltages were found below 80% which were further investigated for Disturbance 011s in the post scenario. Also shown in Table 6, the voltage change found at the monitored load buses was found to exceed 20% but for less than 20 cycles which is well within WECC criterion.

Table 5

Load Buses	Initial Post Voltage	Post Minimum Voltage	Post deviation	Time at or below WECC limit (cycles)	Transient Voltage dip%
ALMSA_TM 115	1.015	0.7808	0.2342	2.5	23.07

As a result, the transient voltage dip % is well within the WECC criteria. Thus the Disturbance 011s performance of the post project transmission system is within acceptable limits.

Disturbance 12s

As shown in Table 6, voltages were found below 80% which were further investigated for Disturbance 012s in the post scenario. Also shown in Table 9, the voltage change found at the monitored load buses is less than 20% in the post simulations.

Table 6

Load Buses	Initial Post Voltage	Post Minimum Voltage	Post deviation	Time at or below WECC limit (cycles)	Transient Voltage dip%
ALMSA_TM 115	1.015	0.7625	0.1764	4.2	24.87

As a result, the transient voltage dip % is well within the WECC criteria. Thus the Disturbance 012s performance of the post project transmission system is within acceptable limits.

<u>Network Resource (NR)</u>

Currently, there is an injection limit of approximately 101 MW at San Luis Valley substation, which will cause the Sargent – Poncha 115 kV line to load beyond acceptable levels for loss of the San Luis Valley – Poncha 230 kV line. This constraint can be mitigated by increasing the capacity of the Sargent – Poncha 115 kV line to 148 MVA. The GI-2010-11 generation injection is 52 MW, which is well under the injection limit. Therefore, this project is feasible to interconnect into San Luis Valley 230 kV substation if all the assumptions hold true and no other generation interconnection comes in before the expected in-service date.

Energy Resource (ER)

As indicated above, the addition of the GI-2010-11 generation is feasible with no major network upgrades required.

Short Circuit Analysis

A short circuit study was conducted to determine the fault currents (single-line-to-ground or three-phase) at the San Luis Valley 230 kV bus. Table 1 summarizes the approximate fault currents at the San Luis Valley 230 kV bus with the addition of the 52 MW solar facility.

Table 7 – Short-circuit study results at San Luis Valley 230 kV bus.

System Condition	3Φ (Amps)	S-L-G (Amps)
System Intact	Ia=Ib=Ic=3427	Ia=3948

Cost Estimates and Assumptions

The cost for the transmission interconnection (in 2014 dollars)

The total estimated cost to interconnect the project is approximately **$4,705,000** and includes:

- $1,985,000 for PSCo-Owned, Customer-Funded interconnection facilities
- $2,720,000 for PSCo-Owned, PSCo-Funded interconnection facilities

See cost and schedule for an approximate in service date in Table 8 and Table 9. There are no major network upgrades needed to the current transmission system to transfer full power to PSCo native loads.

Any Interconnection Agreement (IA) requires that certain conditions be met, as follow:

3. The conditions of the Interconnection Guidelines[1] are met.
4. A single point of contact is given to Operations to manage the Transmission System reliably for all projects as found in the Interconnection Guidelines.

Customer must show the ability to operate the solar generation within the required +/- 0.95 power factor range during all operating conditions (0 MW to 52 MW) as measured at the Point of Interconnection (POI). The MVAR output shall be proportional with the output of the plant.

Table 8. PSCo Owned; Customer Funded Transmission Provider Interconnection Facilities

Element	Description	Cost Est. (Millions)
San Luis Valley 230kV Transmission Substation	Interconnect Customer to tap at the San Luis Valley 230kV Transmission Substation (into the 230kV bus). The new equipment includes: • One 230kV gang switch • Three 230kv arresters • One set 230kV CT/PT metering units • Associated bus, wiring and equipment • Associated site development, grounding, foundations and structures • Associated transmission line communications, relaying and testing	**$1.020**
	Transmission line tap into substation. Structure, conductor, insulators, hardware and labor. Relocate a section of the Poncha-SLV 230kV Line (3006). Two structures, conductor, insulators, hardware and labor.	**$0.170** **$0.485**
Customer's 230kV Substation	Load Frequency/Automated Generation Control (LF/AGC) RTU and associated equipment.	**$0.290**
	Siting and Land Rights support for siting studies, land and ROW acquisition and construction.	**$0.020**
	Total Cost Estimate for PSCo-Owned, Customer-Funded Interconnection Facilities	**$1.985**
Time Frame	**Site, design, procure and construct**	**18 Months**

Table 9: PSCo Owned; PSCo Funded Interconnection Network Facilities

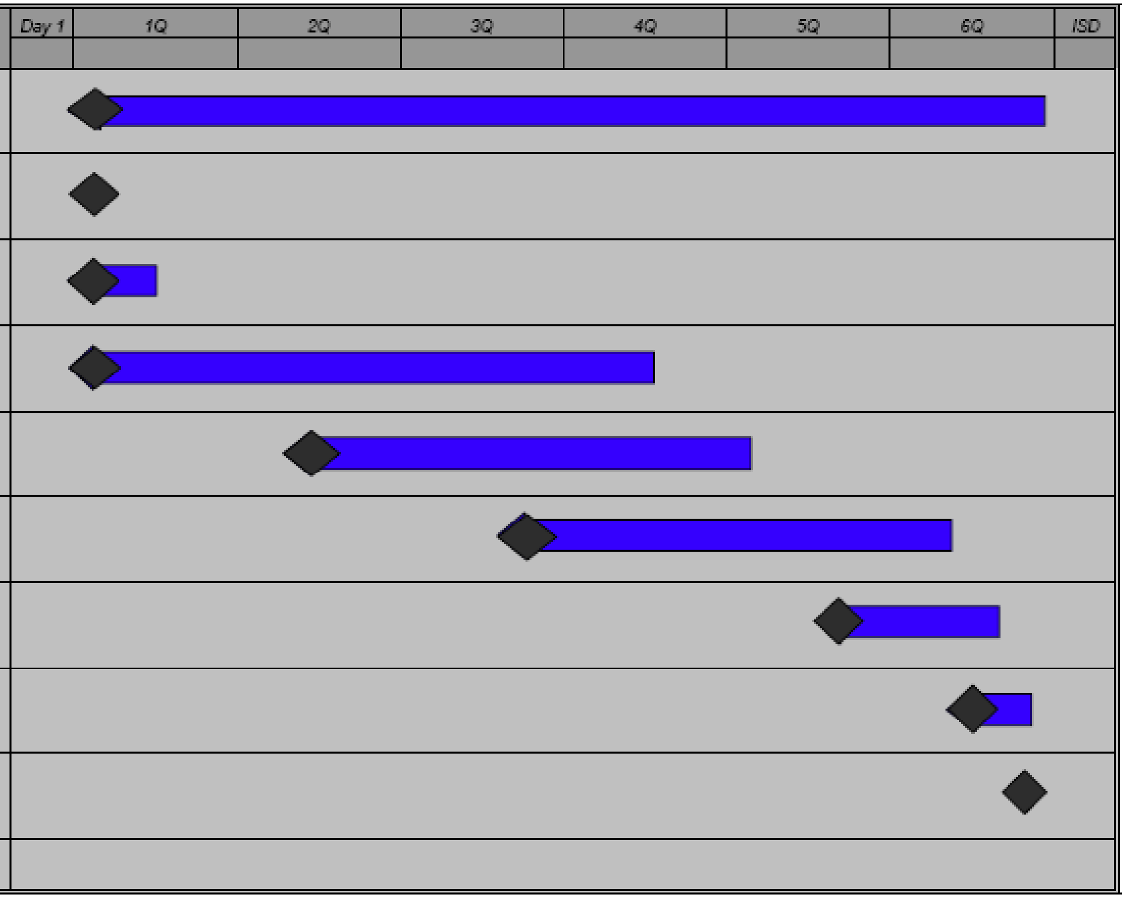
Element	Description	Cost Estimate (Millions)
San Luis Valley 230kV Transmission Substation	Interconnect Customer to tap at San Luis Valley 230kV Transmission Substation (into the 230kV bus). The new equipment includes: • One 230kV circuit breaker • Three 230kV gang switches • One Electric Equipment Enclosure (control bldg.) • One Station Battery • Associated communications, supervisory and SCADA equipment • Associated line relaying and testing • Associated bus, miscellaneous electrical equipment, cabling and wiring • Associated foundations and structures • Associated road and site development, fencing and grounding	**$2.700**
	Siting and Land Rights support for substation land acquisition and construction.	**$0.020**
	Total Cost Estimate for PSCo-Owned, PSCo-Funded Interconnection Facilities	**$2.720**
Time Frame	**Site, design, procure and construct**	**18 Months**

Cost Estimate Assumptions

- Scoping level project cost estimates for Interconnection Facilities and Network/Infrastructure Upgrades for Delivery (+/- 30% accuracy) were developed by PSCo Engineering.
- Estimates are based on 2014 dollars (appropriate contingency and escalation included).
- AFUDC has been excluded.
- Labor is estimated for straight time only – no overtime included.
- Lead times for materials were considered for the schedule.
- The Solar Generation Facility is not in PSCo's retail service territory. Therefore, no costs for retail load (distribution) facilities and metering required for station service are included in these estimates.
- Tri-State and/or Xcel (or our Contractor) crews will perform all construction, wiring, testing and commissioning for PSCo owned and maintained facilities.
- The estimated time to site, design, procure and construct the interconnection facilities is approximately 18 months after authorization to proceed has been obtained.
- A CPCN will not be required for the interconnection facilities construction.
- Customer will string OPGW fiber into substation as part of the transmission line construction scope.
- No new substation land will need to be acquired.
- Breaker duty study determined that no breaker replacements are needed in neighboring substations.

GI-2010-11 System Impact Study Report
52 MW Solar Interconnection @ SLV 230 kV Substation

ID	Task Name	Duration
1	GI-2010-11 SIS Report 52 MW Solar Interconnection	78w
2	Authorization to Proceed: Execution of Interconnection Agreement	0w
3	Sighting & Land Rights and Permitting	6w
4	Substation Design/Transmission Line Design & Engineering	40w
5	Substation/Transmission Line Material Procurement	36w
6	Substation/Transmission line Construction	36w
7	Relay, Protection & Control Equipment Testing	10w
8	Final Commissioning	4w
9	Project Completion / Backfeed	0w
10		



Xcel Energy

Appendix A

Listing of Disturbances Tested

Disturbance Scenario #	Fault Type	Clearing Time	Faulted Bus	Disturbance Description
01s	Three Phase	4 Cycles	San Luis Valley 230 kV	Fault on the San Luis Valley - Poncha 230 kV line: clear the fault by tripping the San Luis Valley - Poncha 230 kV line.
01s	Three Phase	4 Cycles	San Luis Valley 230 kV	Fault on the San Luis Valley - Poncha 230 kV line: clear the fault by tripping the San Luis Valley - Poncha 230 kV line activate the SLV UVLS as appropriate.
02s	Three Phase	4 Cycles	Poncha 230 kV	Fault on the Poncha - San Luis Valley 230 kV line: clear the fault by tripping the Poncha - San Luis Valley 230 kV line.
03s	Three Phase	5 Cycles	Poncha 115 kV	Fault on the Poncha - Sargent 115 kV line: clear the fault by tripping the Poncha - Sargent 115 kV line.
04s	Three Phase	5 Cycles	Sargent 115 kV	Fault on the Poncha - Sargent 115 kV line: clear the fault by tripping the Poncha - Sargent 115 kV line.
05s	Three Phase	5 Cycles	Sargent 115 kV	Fault on the San Luis Valley - Sargent 115 kV line: clear the fault by tripping the San Luis Valley - Sargent 115 kV line.
06s	Three Phase	5 Cycles	San Luis Valley 115 kV	Fault on the Sargent - San Luis Valley 115 kV line: clear the fault by tripping the Sargent - San Luis Valley 115 kV line.
07s	Three Phase	5 Cycles	San Luis Valley 115 kV	Fault on the San Luis Valley - BlancaPeak 115 kV line: clear the fault by tripping the San Luis Valley - BlancaPeak 115 kV line.
08s	Three Phase	5 Cycles	BlancaPeak 115 kV	Fault on the BlancaPeak - San Luis Valley 115 kV line: clear the fault by tripping the BlancaPeak - San Luis Valley 115 kV line.
09s	Three Phase	5 Cycles	Almosa 115 kV	Fault on the Almosa 115-69 kV Tx: clear the fault by tripping the Almosa 115-69 kV Tx.
10s	Three Phase	5 Cycles	Almosa 69 kV	Fault on the Almosa 115-69 kV Tx: clear the fault by tripping the Almosa 115-69 kV Tx.
11s	Three Phase	5 Cycles	Almosa 115 kV	Fault on the Almosa - BlancaPeak 115 kV line: clear the fault by tripping the Almosa - BlancaPeak 115 kV line.
12s	Three Phase	5 Cycles	BlancaPeak 115 kV	Fault on the BlancaPeak - Almosa 115 kV line: clear the fault by tripping the BlancaPeak - Almosa 115 kV line.
13s	Three Phase	5 Cycles	Sargent 115 kV	Fault on the Sargent 115-69 kV Tx: clear the fault by tripping the Sargent 115-69 kV Tx.

Disturbance Scenario #	Fault Type	Clearing Time	Faulted Bus	Disturbance Description
14s	Three Phase	5 Cycles	Sargent 69 kV	Fault on the Sargent 115-69 kV Tx: clear the fault by tripping the Sargent 115-69 kV Tx.
15s	Three Phase	5 Cycles	San Luis Valley 230 kV	Fault on the San Luis Valley 230-115 kV Tx #2: clear the fault by tripping the San Luis Valley 230-115 kV Tx #2.
16s	Three Phase	5 Cycles	San Luis Valley 115 kV	Fault on the San Luis Valley 230-115 kV Tx #2: clear the fault by tripping the San Luis Valley 230-115 kV Tx #2.

Appendix B

Transient Stability Study Results
Minimum Voltage and Frequency Found for each Studied Disturbance

Disturbance Scenario #	Transient Voltage			Minimum Transient Frequency		
	Bus	Minimum Voltage (pu)	Time at or Below WECC Limit (cycles)	Bus	Minimum Frequency (Hz)	Time at or Below WECC Limit (cycles)
01s	FTGARLND 69 kV	0.74	97	GI-2010-011G 0.4	59.29	0.5
01s UVLS	FTGARLND 69 kV	0.73	98	GI-2010-011G 0.4	59.29	0.5
01s VarMod3	FTGARLND 69 kV	0.89	0	SOLAR_ALM 34.5	59.77	0
02s VarMod3	FTGARLND 69 kV	0.8437	0	SOLAR_ALM 34.5	59.85	0
02s	FTGARLND 69 kV	0.81	0	SOLAR_ALM 34.5	59.82	0
02s UVLS VarMod3	FTGARLND 69 kV	0.8437	0	SOLAR_ALM 34.5	59.85	0
02s UVLS	FTGARLND 69 kV	0.81	0	GI-2010-011G 0.4	58.95	0.5
03s	FTGARLND 69 kV	0.93	0	SOLAR_ALM 34.5	59.97	0
04s	FTGARLND 69 kV	0.91	0	SOLAR_ALM 34.5	59.92	0
05s	FTGARLND 69 kV	0.92	0	SOLAR_ALM 34.5	59.93	0
06s	FTGARLND 69 kV	0.91	0	SOLAR_ALM 34.5	59.87	0
07s	ALMSACT2 13.8 kV	0.82	0	SOLAR_ALM 34.5	59.69	0
08s	ALMSACT2 13.8 kV	0.83	0	SOLAR_ALM 34.5	59.69	0
09s	FTGARLND 69 kV	0.88	0	SOLAR_ALM 34.5	59.97	0
10s	FTGARLND 69 kV	0.88	0	SLVSOLAR 34.5	59.96	0
11s	ALMSACT2 13.8 kV	0.78	2	SLVSOLAR 34.5	59.98	0
12s	ALMSACT2 13.8 kV	0.78	4	SOLAR_ALM 34.5	59.88	0
13s	FTGARLND 69 kV	0.91	0	SOLAR_ALM 34.5	59.93	0
14s	FTGARLND 69 kV	0.92	0	SOLAR_ALM 34.5	59.95	0
15s	FTGARLND 69 kV	0.91	0	SOLAR_ALM 34.5	59.86	0
16s	FTGARLND 69 kV	0.91	0	SOLAR_ALM 34.5	59.85	0

Appendix B Detailed results:

Bus	Transient Voltage Dip	Minimum Transient Frequency
	Minimum Voltage Dip (pu)	Minimum Frequency (Hz)
Disturbance 01s – Three phase fault at San Luis Valley on the San Luis Valley - Poncha 230 kV line		
ALMSA_ST 69	0.7927	59.74
ALMSA_TM 115	0.7753	59.74

Bus	Transient Voltage Dip	Minimum Transient Frequency
	Minimum Voltage Dip (pu)	Minimum Frequency (Hz)
ALMSA_TM 69	0.7962	59.75
ALMSACT1 13.8	0.7959	59.75
ALMSACT2 13.8	0.775	59.74
ANSEL_TS 69	0.8046	59.76
ANTONITO 69	0.7531	59.74
CARMEL 69	0.7945	59.75
CARMEL 115	0.7945	59.75
CENTER 69	0.7812	59.75
COCENTER 69	0.8052	59.76
CREEDE 69	0.7892	59.75
DELNORTE 69	0.785	59.76
FTGARLND 69	0.7397	59.74
GI-2010-011C 34.5	0.8368	59.48
GI-2010-011G	0.8164	59.29
GI-2010-011M 34.5	0.8368	59.49
GI-2010-011T 34.5	0.8228	59.74
HILANDSL 69	0.7927	59.75
HOMELAKE 69	0.7876	59.75
HOOPER 69	0.7795	59.75
HOOPERTP 69	0.7833	59.75
KERBERCK 69	0.9752	59.96
LAGARITA 69	0.7789	59.75
MEARSJCT 69	0.9817	59.96
MIRGEJCT 69	0.7949	59.74
MOFFAT 69	0.7984	59.74
MOSCA 69	0.8116	59.74
OLD16TAP 69	0.7913	59.74
OLD40TAP 69	0.7947	59.75
OXCART 69	0.9754	59.96
PLAZA 115	0.795	59.75
PLAZA 69	0.7903	59.75
PONCHA 115	0.9819	59.96
PONCHA 230	1.017	59.97
PONCHA 69	0.9853	59.96

Bus	Transient Voltage Dip	Minimum Transient Frequency
	Minimum Voltage Dip (pu)	Minimum Frequency (Hz)
RAMON 115	0.7944	59.75
RAMON 69	0.7948	59.75
REATAP 69	0.7633	59.74
RIOGRAND 69	0.7886	59.76
RIOGRDTP 69	0.8005	59.76
ROMEO 69	0.7566	59.74
S.ACACIO 115	0.7952	59.75
SAGUACHE 69	0.7888	59.74
SANLSVLY 115	0.7987	59.75
SANLSVLY 230	0.8228	59.74
SANLSVLY 69	0.8032	59.75
SARGENT 115	0.8005	59.77
SARGENT 69	0.8055	59.76
SFORK_SL 69	0.7946	59.75
SLVSOLAR 34.5	0.8144	59.73
SOLAR_ALM 34.5	0.7998	59.72
SOLAR_ALMT 115	0.797	59.75
SOLAR_SANLU 34.5	0.8017	59.73
STANLEY 115	0.7975	59.75
STOCKADE 115	0.7953	59.75
SWT_RACK 115	0.7948	59.75
VILLA 69	0.9756	59.96
WAVERLY 115	0.7951	59.75
ZINZER 69	0.7948	59.75
ZINZER 115	0.7948	59.75
Disturbance 02s – Three phase fault at Poncha on the San Luis Valley - Poncha 230 kV line		
ALMSA_ST 69	0.8636	59.81
ALMSA_TM 115	0.8396	59.81
ALMSA_TM 69	0.8672	59.81
ALMSACT1 13.8	0.8668	59.81
ALMSACT2 13.8	0.8393	59.81
ANSEL_TS 69	0.871	59.81
ANTONITO 69	0.8244	59.8
CARMEL 69	0.859	59.81

Bus	Transient Voltage Dip	Minimum Transient Frequency
	Minimum Voltage Dip (pu)	Minimum Frequency (Hz)
CARMEL 115	0.859	59.81
CENTER 69	0.848	59.81
COCENTER 69	0.8716	59.82
CREEDE 69	0.8541	59.81
DELNORTE 69	0.8517	59.82
FTGARLND 69	0.8106	59.81
GI-2010-011C 34.5	0.8921	59.83
GI-2010-011G	0.8563	59.82
GI-2010-011M 34.5	0.8922	59.83
GI-2010-011T 34.5	0.8834	59.81
HILANDSL 69	0.8576	59.81
HOMELAKE 69	0.8558	59.81
HOOPER 69	0.8464	59.81
HOOPERTP 69	0.85	59.81
KERBERCK 69	0.9922	59.96
LAGARITA 69	0.8453	59.81
MEARSJCT 69	0.9986	59.96
MIRGEJCT 69	0.8605	59.8
MOFFAT 69	0.8639	59.8
MOSCA 69	0.8768	59.81
OLD16TAP 69	0.8621	59.81
OLD40TAP 69	0.8657	59.81
OXCART 69	0.9924	59.96
PLAZA 115	0.8596	59.81
PLAZA 69	0.8565	59.81
PONCHA 115	0.9987	59.96
PONCHA 230	1.03	59.96
PONCHA 69	1.002	59.96
RAMON 115	0.8591	59.81
RAMON 69	0.8596	59.81
REATAP 69	0.8345	59.81
RIOGRAND 69	0.8554	59.82
RIOGRDTP 69	0.8672	59.82
ROMEO 69	0.8279	59.81

Bus	Transient Voltage Dip	Minimum Transient Frequency
	Minimum Voltage Dip (pu)	Minimum Frequency (Hz)
S.ACACIO 115	0.8599	59.81
SAGUACHE 69	0.8545	59.8
SANLSVLY 115	0.8625	59.81
SANLSVLY 230	0.8833	59.81
SANLSVLY 69	0.8697	59.81
SARGENT 115	0.8656	59.82
SARGENT 69	0.872	59.82
SFORK_SL 69	0.8595	59.81
SLVSOLAR 34.5	0.8809	59.8
SOLAR_ALM 34.5	0.8658	59.79
SOLAR_ALMT 115	0.8608	59.81
SOLAR_SANLU 34.5	0.8678	59.79
STANLEY 115	0.8615	59.81
STOCKADE 115	0.8598	59.81
SWT_RACK 115	0.8594	59.81
VILLA 69	0.9926	59.96
WAVERLY 115	0.8596	59.81
ZINZER 69	0.8594	59.81
ZINZER 115	0.8594	59.81
Disturbance 03s –Three phase fault at Poncha on the Poncha - Sargent 115 kV line		
ALMSA_ST 69	0.9828	59.98
ALMSA_TM 115	0.9545	59.98
ALMSA_TM 69	0.9871	59.98
ALMSACT1 13.8	0.9867	59.98
ALMSACT2 13.8	0.9541	59.98
ANSEL_TS 69	0.9846	59.98
ANTONITO 69	0.9449	59.98
CARMEL 69	0.9779	59.98
CARMEL 115	0.9779	59.98
CENTER 69	0.9626	59.98
COCENTER 69	0.985	59.98
CREEDE 69	0.9734	59.98
DELNORTE 69	0.9655	59.98
FTGARLND 69	0.9301	59.98

Bus	Transient Voltage Dip	Minimum Transient Frequency
	Minimum Voltage Dip (pu)	Minimum Frequency (Hz)
GI-2010-011C 34.5	1.011	59.99
GI-2010-011G	0.9756	59.99
GI-2010-011M 34.5	1.011	59.99
GI-2010-011T 34.5	1.013	59.98
HILANDSL 69	0.9768	59.98
HOMELAKE 69	0.9711	59.98
HOOPER 69	0.9609	59.98
HOOPERTP 69	0.9647	59.98
KERBERCK 69	1	59.98
LAGARITA 69	0.9608	59.98
MEARSJCT 69	1.007	59.97
MIRGEJCT 69	0.9715	59.98
MOFFAT 69	0.9749	59.98
MOSCA 69	0.9874	59.98
OLD16TAP 69	0.9814	59.98
OLD40TAP 69	0.9856	59.98
OXCART 69	1.001	59.98
PLAZA 115	0.9784	59.98
PLAZA 69	0.9742	59.98
PONCHA 115	1.007	59.98
PONCHA 230	1.035	59.98
PONCHA 69	1.01	59.98
RAMON 115	0.9781	59.98
RAMON 69	0.9788	59.98
REATAP 69	0.9547	59.98
RIOGRAND 69	0.9691	59.98
RIOGRDTP 69	0.9809	59.98
ROMEO 69	0.9483	59.98
S.ACACIO 115	0.9791	59.98
SAGUACHE 69	0.9656	59.98
SANLSVLY 115	0.9813	59.98
SANLSVLY 230	1.013	59.98
SANLSVLY 69	0.9846	59.98
SARGENT 115	0.9782	59.98

Bus	Transient Voltage Dip	Minimum Transient Frequency
	Minimum Voltage Dip (pu)	Minimum Frequency (Hz)
SARGENT 69	0.9852	59.98
SFORK_SL 69	0.9786	59.98
SLVSOLAR 34.5	0.9849	59.98
SOLAR_ALM 34.5	0.9736	59.97
SOLAR_ALMT 115	0.9778	59.98
SOLAR_SANLU 34.5	0.9771	59.97
STANLEY 115	0.9803	59.98
STOCKADE 115	0.9789	59.98
SWT_RACK 115	0.9783	59.98
VILLA 69	1.001	59.98
WAVERLY 115	0.9784	59.98
ZINZER 69	0.9783	59.98
ZINZER 115	0.9783	59.98
Disturbance 04s –Three phase fault at Sargent on the Poncha - Sargent 115 kV line		
ALMSA_ST 69	0.9708	59.94
ALMSA_TM 115	0.9444	59.94
ALMSA_TM 69	0.9751	59.94
ALMSACT1 13.8	0.9747	59.94
ALMSACT2 13.8	0.944	59.94
ANSEL_TS 69	0.9743	59.95
ANTONITO 69	0.9328	59.95
CARMEL 69	0.9683	59.95
CARMEL 115	0.9683	59.95
CENTER 69	0.9509	59.95
COCENTER 69	0.9747	59.95
CREEDE 69	0.9638	59.95
DELNORTE 69	0.9549	59.95
FTGARLND 69	0.9181	59.94
GI-2010-011C 34.5	1.004	59.98
GI-2010-011G	0.9681	59.99
GI-2010-011M 34.5	1.004	59.98
GI-2010-011T 34.5	1.005	59.96
HILANDSL 69	0.9671	59.95
HOMELAKE 69	0.9596	59.95

Bus	Transient Voltage Dip	Minimum Transient Frequency
	Minimum Voltage Dip (pu)	Minimum Frequency (Hz)
HOOPER 69	0.949	59.95
HOOPERTP 69	0.9531	59.95
KERBERCK 69	0.9966	59.98
LAGARITA 69	0.9492	59.95
MEARSJCT 69	1.003	59.98
MIRGEJCT 69	0.9623	59.94
MOFFAT 69	0.9657	59.94
MOSCA 69	0.9781	59.94
OLD16TAP 69	0.9694	59.94
OLD40TAP 69	0.9737	59.94
OXCART 69	0.9968	59.98
PLAZA 115	0.9688	59.95
PLAZA 69	0.9636	59.95
PONCHA 115	1.003	59.98
PONCHA 230	1.03	59.98
PONCHA 69	1.007	59.98
RAMON 115	0.9684	59.95
RAMON 69	0.9692	59.95
REATAP 69	0.9427	59.94
RIOGRAND 69	0.9586	59.95
RIOGRDTP 69	0.9704	59.95
ROMEO 69	0.9363	59.95
S.ACACIO 115	0.9695	59.95
SAGUACHE 69	0.9563	59.94
SANLSVLY 115	0.9723	59.95
SANLSVLY 230	1.005	59.96
SANLSVLY 69	0.9743	59.95
SARGENT 115	0.9688	59.95
SARGENT 69	0.9749	59.95
SFORK_SL 69	0.969	59.95
SLVSOLAR 34.5	0.9751	59.94
SOLAR_ALM 34.5	0.9633	59.92
SOLAR_ALMT 115	0.9686	59.94
SOLAR_SANLU 34.5	0.9669	59.93

Bus	Transient Voltage Dip	Minimum Transient Frequency
	Minimum Voltage Dip (pu)	Minimum Frequency (Hz)
STANLEY 115	0.9711	59.95
STOCKADE 115	0.9693	59.95
SWT_RACK 115	0.9687	59.95
VILLA 69	0.997	59.98
WAVERLY 115	0.9689	59.95
ZINZER 69	0.9687	59.95
ZINZER 115	0.9687	59.95
Disturbance 05s –Three phase fault at Sargent on the San Luis Valley - Sargent 115 kV line		
ALMSA_ST 69	0.9774	59.95
ALMSA_TM 115	0.9494	59.95
ALMSA_TM 69	0.9818	59.95
ALMSACT1 13.8	0.9814	59.95
ALMSACT2 13.8	0.9491	59.95
ANSEL_TS 69	0.9775	59.96
ANTONITO 69	0.9395	59.95
CARMEL 69	0.974	59.95
CARMEL 115	0.974	59.95
CENTER 69	0.9568	59.95
COCENTER 69	0.9774	59.96
CREEDE 69	0.9696	59.96
DELNORTE 69	0.9578	59.96
FTGARLND 69	0.9247	59.95
GI-2010-011C 34.5	1.008	59.99
GI-2010-011G	0.9724	59.99
GI-2010-011M 34.5	1.008	59.99
GI-2010-011T 34.5	1.01	59.96
HILANDSL 69	0.973	59.96
HOMELAKE 69	0.9637	59.96
HOOPER 69	0.9549	59.95
HOOPERTP 69	0.959	59.95
KERBERCK 69	0.9976	59.98
LAGARITA 69	0.9551	59.95
MEARSJCT 69	1.004	59.98
MIRGEJCT 69	0.9679	59.95

Bus	Transient Voltage Dip	Minimum Transient Frequency
	Minimum Voltage Dip (pu)	Minimum Frequency (Hz)
MOFFAT 69	0.9712	59.95
MOSCA 69	0.9837	59.95
OLD16TAP 69	0.976	59.95
OLD40TAP 69	0.9803	59.95
OXCART 69	0.9977	59.98
PLAZA 115	0.9746	59.95
PLAZA 69	0.9705	59.96
PONCHA 115	1.004	59.98
PONCHA 230	1.031	59.98
PONCHA 69	1.008	59.98
RAMON 115	0.9742	59.95
RAMON 69	0.975	59.96
REATAP 69	0.9494	59.95
RIOGRAND 69	0.9614	59.96
RIOGRDTP 69	0.9732	59.96
ROMEO 69	0.9429	59.95
S.ACACIO 115	0.9753	59.95
SAGUACHE 69	0.9619	59.95
SANLSVLY 115	0.9778	59.95
SANLSVLY 230	1.01	59.96
SANLSVLY 69	0.9801	59.95
SARGENT 115	0.9723	59.96
SARGENT 69	0.9775	59.96
SFORK_SL 69	0.9748	59.96
SLVSOLAR 34.5	0.9804	59.95
SOLAR_ALM 34.5	0.9683	59.93
SOLAR_ALMT 115	0.974	59.95
SOLAR_SANLU 34.5	0.9721	59.94
STANLEY 115	0.9767	59.95
STOCKADE 115	0.975	59.95
SWT_RACK 115	0.9744	59.95
VILLA 69	0.9979	59.98
WAVERLY 115	0.9746	59.95
ZINZER 69	0.9744	59.95

Bus	Transient Voltage Dip	Minimum Transient Frequency
	Minimum Voltage Dip (pu)	Minimum Frequency (Hz)
ZINZER 115	0.9744	59.95
Disturbance 06s –Three phase fault at San Luis Valley on the San Luis Valley - Sargent 115 kV line		
ALMSA_ST 69	0.9687	59.9
ALMSA_TM 115	0.9409	59.9
ALMSA_TM 69	0.9731	59.9
ALMSACT1 13.8	0.9727	59.9
ALMSACT2 13.8	0.9406	59.9
ANSEL_TS 69	0.9701	59.91
ANTONITO 69	0.9308	59.9
CARMEL 69	0.9658	59.9
CARMEL 115	0.9658	59.9
CENTER 69	0.9479	59.9
COCENTER 69	0.9701	59.91
CREEDE 69	0.9616	59.91
DELNORTE 69	0.9503	59.91
FTGARLND 69	0.916	59.9
GI-2010-011C 34.5	1.001	59.96
GI-2010-011G	0.9648	59.97
GI-2010-011M 34.5	1.001	59.96
GI-2010-011T 34.5	1.005	59.92
HILANDSL 69	0.965	59.91
HOMELAKE 69	0.9556	59.91
HOOPER 69	0.9459	59.9
HOOPERTP 69	0.9502	59.9
KERBERCK 69	0.9959	59.96
LAGARITA 69	0.946	59.9
MEARSJCT 69	1.002	59.96
MIRGEJCT 69	0.9619	59.89
MOFFAT 69	0.9652	59.89
MOSCA 69	0.9777	59.89
OLD16TAP 69	0.9673	59.9
OLD40TAP 69	0.9716	59.9
OXCART 69	0.996	59.96
PLAZA 115	0.9666	59.9

Bus	Transient Voltage Dip	Minimum Transient Frequency
	Minimum Voltage Dip (pu)	Minimum Frequency (Hz)
PLAZA 69	0.962	59.9
PONCHA 115	1.002	59.96
PONCHA 230	1.029	59.96
PONCHA 69	1.006	59.96
RAMON 115	0.9663	59.9
RAMON 69	0.967	59.91
REATAP 69	0.9406	59.9
RIOGRAND 69	0.9539	59.91
RIOGRDTP 69	0.9658	59.91
ROMEO 69	0.9342	59.9
S.ACACIO 115	0.9672	59.9
SAGUACHE 69	0.9559	59.89
SANLSVLY 115	0.9704	59.9
SANLSVLY 230	1.005	59.92
SANLSVLY 69	0.9726	59.9
SARGENT 115	0.9669	59.92
SARGENT 69	0.9702	59.91
SFORK_SL 69	0.9668	59.91
SLVSOLAR 34.5	0.974	59.89
SOLAR_ALM 34.5	0.9581	59.87
SOLAR_ALMT 115	0.9664	59.9
SOLAR_SANLU 34.5	0.9622	59.87
STANLEY 115	0.9691	59.91
STOCKADE 115	0.9669	59.9
SWT_RACK 115	0.9664	59.91
VILLA 69	0.9962	59.96
WAVERLY 115	0.9665	59.9
ZINZER 69	0.9664	59.91
ZINZER 115	0.9664	59.91
Disturbance 07s –Three phase fault at San Luis Valley on the San Luis Valley - Sargent 115 kV line		
ALMSA_ST 69	0.923	59.87
ALMSA_TM 115	0.8296	59.75
ALMSA_TM 69	0.924	59.86
ALMSACT1 13.8	0.9236	59.86

Bus	Transient Voltage Dip	Minimum Transient Frequency
	Minimum Voltage Dip (pu)	Minimum Frequency (Hz)
ALMSACT2 13.8	0.8293	59.75
ANSEL_TS 69	0.9728	59.93
ANTONITO 69	0.8815	59.86
CARMEL 69	0.9757	59.94
CARMEL 115	0.9757	59.94
CENTER 69	0.95	59.93
COCENTER 69	0.9732	59.93
CREEDE 69	0.9707	59.94
DELNORTE 69	0.952	59.93
FTGARLND 69	0.8701	59.87
GI-2010-011C 34.5	1.01	59.97
GI-2010-011G	0.9736	59.98
GI-2010-011M 34.5	1.01	59.97
GI-2010-011T 34.5	1.013	59.95
HILANDSL 69	0.9741	59.94
HOMELAKE 69	0.9492	59.91
HOOPER 69	0.9478	59.93
HOOPERTP 69	0.9521	59.93
KERBERCK 69	0.9991	59.97
LAGARITA 69	0.9503	59.93
MEARSJCT 69	1.006	59.97
MIRGEJCT 69	0.9544	59.92
MOFFAT 69	0.9578	59.92
MOSCA 69	0.9703	59.92
OLD16TAP 69	0.9215	59.87
OLD40TAP 69	0.9225	59.86
OXCART 69	0.9993	59.97
PLAZA 115	0.9757	59.94
PLAZA 69	0.9671	59.94
PONCHA 115	1.006	59.97
PONCHA 230	1.033	59.97
PONCHA 69	1.009	59.97
RAMON 115	0.9754	59.94
RAMON 69	0.9761	59.94

Bus	Transient Voltage Dip	Minimum Transient Frequency
	Minimum Voltage Dip (pu)	Minimum Frequency (Hz)
REATAP 69	0.8914	59.86
RIOGRAND 69	0.9556	59.93
RIOGRDTP 69	0.9674	59.93
ROMEO 69	0.8849	59.86
S.ACACIO 115	0.9771	59.94
SAGUACHE 69	0.9484	59.92
SANLSVLY 115	0.9805	59.94
SANLSVLY 230	1.013	59.95
SANLSVLY 69	0.9728	59.93
SARGENT 115	0.977	59.94
SARGENT 69	0.9735	59.93
SFORK_SL 69	0.9759	59.94
SLVSOLAR 34.5	0.967	59.91
SOLAR_ALM 34.5	0.8366	59.69
SOLAR_ALMT 115	0.8386	59.71
SOLAR_SANLU 34.5	0.9723	59.91
STANLEY 115	0.979	59.94
STOCKADE 115	0.9768	59.94
SWT_RACK 115	0.9759	59.94
VILLA 69	0.9995	59.97
WAVERLY 115	0.9764	59.94
ZINZER 69	0.9759	59.94
ZINZER 115	0.9759	59.94
Disturbance 08s –Three phase fault at BlancaPk on the San Luis Valley - BlancaPk 115 kV line		
ALMSA_ST 69	0.9259	59.88
ALMSA_TM 115	0.8305	59.76
ALMSA_TM 69	0.9269	59.88
ALMSACT1 13.8	0.9265	59.88
ALMSACT2 13.8	0.8301	59.76
ANSEL_TS 69	0.9757	59.95
ANTONITO 69	0.8844	59.88
CARMEL 69	0.9786	59.96
CARMEL 115	0.9786	59.96
CENTER 69	0.9538	59.95

Bus	Transient Voltage Dip	Minimum Transient Frequency
	Minimum Voltage Dip (pu)	Minimum Frequency (Hz)
COCENTER 69	0.9761	59.95
CREEDE 69	0.9736	59.96
DELNORTE 69	0.955	59.95
FTGARLND 69	0.8731	59.88
GI-2010-011C 34.5	1.012	59.98
GI-2010-011G	0.9762	59.98
GI-2010-011M 34.5	1.012	59.98
GI-2010-011T 34.5	1.015	59.97
HILANDSL 69	0.9769	59.96
HOMELAKE 69	0.9526	59.93
HOOPER 69	0.9517	59.95
HOOPERTP 69	0.9558	59.95
KERBERCK 69	0.9996	59.98
LAGARITA 69	0.9541	59.96
MEARSJCT 69	1.006	59.98
MIRGEJCT 69	0.9561	59.94
MOFFAT 69	0.9595	59.94
MOSCA 69	0.972	59.94
OLD16TAP 69	0.9245	59.88
OLD40TAP 69	0.9255	59.88
OXCART 69	0.9998	59.98
PLAZA 115	0.9785	59.96
PLAZA 69	0.9704	59.96
PONCHA 115	1.006	59.98
PONCHA 230	1.034	59.98
PONCHA 69	1.01	59.98
RAMON 115	0.9782	59.96
RAMON 69	0.9789	59.96
REATAP 69	0.8944	59.88
RIOGRAND 69	0.9586	59.95
RIOGRDTP 69	0.9704	59.95
ROMEO 69	0.8879	59.88
S.ACACIO 115	0.9799	59.96
SAGUACHE 69	0.9501	59.94

Bus	Transient Voltage Dip	Minimum Transient Frequency
	Minimum Voltage Dip (pu)	Minimum Frequency (Hz)
SANLSVLY 115	0.983	59.96
SANLSVLY 230	1.015	59.97
SANLSVLY 69	0.9756	59.95
SARGENT 115	0.9794	59.96
SARGENT 69	0.9763	59.95
SFORK_SL 69	0.9788	59.96
SLVSOLAR 34.5	0.9692	59.94
SOLAR_ALM 34.5	0.8368	59.69
SOLAR_ALMT 115	0.8392	59.72
SOLAR_SANLU 34.5	0.9764	59.95
STANLEY 115	0.9815	59.96
STOCKADE 115	0.9797	59.96
SWT_RACK 115	0.9787	59.96
VILLA 69	1	59.98
WAVERLY 115	0.9793	59.96
ZINZER 69	0.9787	59.96
ZINZER 115	0.9787	59.96
Disturbance 09s –Three phase fault at Almosa 115 kV side on the Almosa 115-69 kV Tx		
ALMSA_ST 69	0.939	59.98
ALMSA_TM 115	0.9751	59.98
ALMSA_TM 69	0.941	59.98
ALMSACT1 13.8	0.9406	59.98
ALMSACT2 13.8	0.9747	59.98
ANSEL_TS 69	0.9856	59.98
ANTONITO 69	0.8986	59.98
CARMEL 69	0.9835	59.98
CARMEL 115	0.9835	59.98
CENTER 69	0.9658	59.98
COCENTER 69	0.9858	59.98
CREEDE 69	0.9789	59.98
DELNORTE 69	0.9635	59.98
FTGARLND 69	0.8862	59.98
GI-2010-011C 34.5	1.016	59.99
GI-2010-011G	0.9803	59.99

Bus	Transient Voltage Dip	Minimum Transient Frequency
	Minimum Voltage Dip (pu)	Minimum Frequency (Hz)
GI-2010-011M 34.5	1.015	59.99
GI-2010-011T 34.5	1.017	59.99
HILANDSL 69	0.9822	59.98
HOMELAKE 69	0.9561	59.98
HOOPER 69	0.964	59.98
HOOPERTP 69	0.9677	59.98
KERBERCK 69	0.9993	59.99
LAGARITA 69	0.9647	59.98
MEARSJCT 69	1.006	59.99
MIRGEJCT 69	0.968	59.98
MOFFAT 69	0.9713	59.98
MOSCA 69	0.9838	59.98
OLD16TAP 69	0.9375	59.98
OLD40TAP 69	0.9396	59.98
OXCART 69	0.9995	59.99
PLAZA 115	0.9838	59.98
PLAZA 69	0.9795	59.98
PONCHA 115	1.006	59.99
PONCHA 230	1.034	59.99
PONCHA 69	1.009	59.99
RAMON 115	0.9835	59.98
RAMON 69	0.9842	59.98
REATAP 69	0.9085	59.98
RIOGRAND 69	0.9671	59.98
RIOGRDTP 69	0.9789	59.98
ROMEO 69	0.902	59.98
S.ACACIO 115	0.9847	59.98
SAGUACHE 69	0.962	59.98
SANLSVLY 115	0.9868	59.99
SANLSVLY 230	1.017	59.99
SANLSVLY 69	0.9865	59.98
SARGENT 115	0.9835	59.99
SARGENT 69	0.9859	59.98
SFORK_SL 69	0.984	59.98

Bus	Transient Voltage Dip	Minimum Transient Frequency
	Minimum Voltage Dip (pu)	Minimum Frequency (Hz)
SLVSOLAR 34.5	0.9823	59.97
SOLAR_ALM 34.5	0.9816	59.97
SOLAR_ALMT 115	0.9854	59.98
SOLAR_SANLU 34.5	0.9835	59.97
STANLEY 115	0.9857	59.99
STOCKADE 115	0.9845	59.98
SWT_RACK 115	0.9838	59.98
VILLA 69	0.9997	59.99
WAVERLY 115	0.984	59.98
ZINZER 69	0.9838	59.98
ZINZER 115	0.9838	59.98
Disturbance 10s – Three phase fault at Almosa 69 kV side on the Almosa 115-69 kV Tx		
ALMSA_ST 69	0.9376	59.97
ALMSA_TM 115	0.9779	59.97
ALMSA_TM 69	0.9398	59.97
ALMSACT1 13.8	0.9394	59.97
ALMSACT2 13.8	0.9775	59.97
ANSEL_TS 69	0.9862	59.97
ANTONITO 69	0.8974	59.97
CARMEL 69	0.9847	59.97
CARMEL 115	0.9847	59.97
CENTER 69	0.9666	59.97
COCENTER 69	0.9864	59.97
CREEDE 69	0.98	59.97
DELNORTE 69	0.9641	59.97
FTGARLND 69	0.8848	59.97
GI-2010-011C 34.5	1.017	59.99
GI-2010-011G	0.9818	59.99
GI-2010-011M 34.5	1.017	59.99
GI-2010-011T 34.5	1.018	59.98
HILANDSL 69	0.9834	59.97
HOMELAKE 69	0.9562	59.97
HOOPER 69	0.9648	59.97
HOOPERTP 69	0.9685	59.97

Bus	Transient Voltage Dip	Minimum Transient Frequency
	Minimum Voltage Dip (pu)	Minimum Frequency (Hz)
KERBERCK 69	0.9988	59.99
LAGARITA 69	0.9656	59.97
MEARSJCT 69	1.005	59.99
MIRGEJCT 69	0.9654	59.96
MOFFAT 69	0.9688	59.96
MOSCA 69	0.9813	59.96
OLD16TAP 69	0.9362	59.97
OLD40TAP 69	0.9384	59.97
OXCART 69	0.999	59.99
PLAZA 115	0.9849	59.97
PLAZA 69	0.9809	59.97
PONCHA 115	1.005	59.99
PONCHA 230	1.033	59.99
PONCHA 69	1.009	59.99
RAMON 115	0.9846	59.97
RAMON 69	0.9854	59.97
REATAP 69	0.9073	59.97
RIOGRAND 69	0.9677	59.97
RIOGRDTP 69	0.9795	59.97
ROMEO 69	0.9008	59.97
S.ACACIO 115	0.9859	59.97
SAGUACHE 69	0.9595	59.96
SANLSVLY 115	0.9879	59.97
SANLSVLY 230	1.018	59.98
SANLSVLY 69	0.9868	59.97
SARGENT 115	0.9842	59.98
SARGENT 69	0.9866	59.97
SFORK_SL 69	0.9852	59.97
SLVSOLAR 34.5	0.9795	59.96
SOLAR_ALM 34.5	0.9848	59.97
SOLAR_ALMT 115	0.9868	59.97
SOLAR_SANLU 34.5	0.986	59.97
STANLEY 115	0.9869	59.97
STOCKADE 115	0.9857	59.97

Bus	Transient Voltage Dip	Minimum Transient Frequency
	Minimum Voltage Dip (pu)	Minimum Frequency (Hz)
SWT_RACK 115	0.985	59.97
VILLA 69	0.9992	59.99
WAVERLY 115	0.9852	59.97
ZINZER 69	0.985	59.97
ZINZER 115	0.985	59.97
Disturbance 11s – Three phase fault at Almosa 69 kV side on the Almosa 115-69 kV Tx		
ALMSA_ST 69	0.8714	59.97
ALMSA_TM 115	0.7808	59.98
ALMSA_TM 69	0.8708	59.97
ALMSACT1 13.8	0.8704	59.97
ALMSACT2 13.8	0.7805	59.98
ANSEL_TS 69	0.9715	59.98
ANTONITO 69	0.8281	59.97
CARMEL 69	0.9766	59.98
CARMEL 115	0.9766	59.98
CENTER 69	0.9544	59.98
COCENTER 69	0.9713	59.98
CREEDE 69	0.9717	59.99
DELNORTE 69	0.9456	59.98
FTGARLND 69	0.8185	59.97
GI-2010-011C 34.5	1.01	59.99
GI-2010-011G	0.9753	59.99
GI-2010-011M 34.5	1.01	59.99
GI-2010-011T 34.5	1.012	59.99
HILANDSL 69	0.975	59.99
HOMELAKE 69	0.9226	59.98
HOOPER 69	0.9525	59.98
HOOPERTP 69	0.9562	59.98
KERBERCK 69	0.9966	59.99
LAGARITA 69	0.9544	59.98
MEARSJCT 69	1.003	59.99
MIRGEJCT 69	0.949	59.98
MOFFAT 69	0.9524	59.97
MOSCA 69	0.9649	59.97

Bus	Transient Voltage Dip	Minimum Transient Frequency
	Minimum Voltage Dip (pu)	Minimum Frequency (Hz)
OLD16TAP 69	0.8699	59.97
OLD40TAP 69	0.8693	59.97
OXCART 69	0.9967	59.99
PLAZA 115	0.9766	59.98
PLAZA 69	0.9718	59.99
PONCHA 115	1.003	59.99
PONCHA 230	1.031	59.99
PONCHA 69	1.007	59.99
RAMON 115	0.9763	59.98
RAMON 69	0.9771	59.99
REATAP 69	0.8381	59.97
RIOGRAND 69	0.9492	59.98
RIOGRDTP 69	0.961	59.98
ROMEO 69	0.8315	59.97
S.ACACIO 115	0.9778	59.98
SAGUACHE 69	0.943	59.98
SANLSVLY 115	0.9801	59.98
SANLSVLY 230	1.011	59.99
SANLSVLY 69	0.9743	59.98
SARGENT 115	0.9746	59.98
SARGENT 69	0.9713	59.98
SFORK_SL 69	0.9769	59.99
SLVSOLAR 34.5	0.9644	59.96
SOLAR_ALM 34.5	0.977	59.97
SOLAR_ALMT 115	0.9803	59.98
SOLAR_SANLU 34.5	0.9774	59.97
STANLEY 115	0.9789	59.98
STOCKADE 115	0.9776	59.98
SWT_RACK 115	0.9768	59.98
VILLA 69	0.9969	59.99
WAVERLY 115	0.9772	59.98
ZINZER 69	0.9768	59.98
ZINZER 115	0.9768	59.98
Disturbance 12s – Three phase fault at Almosa 69 kV side on the Almosa 115-69 kV Tx		

Bus	Transient Voltage Dip	Minimum Transient Frequency
	Minimum Voltage Dip (pu)	Minimum Frequency (Hz)
ALMSA_ST 69	0.8537	59.92
ALMSA_TM 115	0.7625	59.92
ALMSA_TM 69	0.8532	59.92
ALMSACT1 13.8	0.8528	59.92
ALMSACT2 13.8	0.7622	59.92
ANSEL_TS 69	0.9579	59.92
ANTONITO 69	0.8104	59.92
CARMEL 69	0.964	59.92
CARMEL 115	0.964	59.92
CENTER 69	0.9384	59.92
COCENTER 69	0.9577	59.92
CREEDE 69	0.9591	59.92
DELNORTE 69	0.9316	59.92
FTGARLND 69	0.8008	59.93
GI-2010-011C 34.5	1	59.93
GI-2010-011G	0.9642	59.93
GI-2010-011M 34.5	1	59.93
GI-2010-011T 34.5	1.002	59.93
HILANDSL 69	0.9624	59.93
HOMELAKE 69	0.9068	59.93
HOOPER 69	0.9363	59.93
HOOPERTP 69	0.9405	59.93
KERBERCK 69	0.9938	59.93
LAGARITA 69	0.9387	59.93
MEARSJCT 69	1	59.93
MIRGEJCT 69	0.9357	59.93
MOFFAT 69	0.9391	59.94
MOSCA 69	0.9517	59.94
OLD16TAP 69	0.8523	59.97
OLD40TAP 69	0.8517	59.88
OXCART 69	0.994	59.91
PLAZA 115	0.9641	59.91
PLAZA 69	0.9578	59.92
PONCHA 115	1	59.92

Bus	Transient Voltage Dip	Minimum Transient Frequency
	Minimum Voltage Dip (pu)	Minimum Frequency (Hz)
PONCHA 230	1.028	59.92
PONCHA 69	1.004	59.92
RAMON 115	0.9638	59.92
RAMON 69	0.9645	59.92
REATAP 69	0.8204	59.92
RIOGRAND 69	0.9353	59.93
RIOGRDTP 69	0.9471	59.93
ROMEO 69	0.8138	59.93
S.ACACIO 115	0.9653	59.93
SAGUACHE 69	0.9298	59.93
SANLSVLY 115	0.9684	59.93
SANLSVLY 230	1.002	59.93
SANLSVLY 69	0.9605	59.93
SARGENT 115	0.9633	59.93
SARGENT 69	0.9577	59.93
SFORK_SL 69	0.9643	59.93
SLVSOLAR 34.5	0.9499	59.94
SOLAR_ALM 34.5	0.9602	59.94
SOLAR_ALMT 115	0.9685	59.97
SOLAR_SANLU 34.5	0.9624	59.97
STANLEY 115	0.967	59.97
STOCKADE 115	0.9651	59.97
SWT_RACK 115	0.9642	59.97
VILLA 69	0.9942	59.97
WAVERLY 115	0.9646	59.98
ZINZER 69	0.9642	59.98
ZINZER 115	0.9642	59.98
Disturbance 13s – Three phase fault at Sargent 115 kV side on the Sargent 115-69 kV Tx		
ALMSA_ST 69	0.9705	59.95
ALMSA_TM 115	0.9472	59.95
ALMSA_TM 69	0.9749	59.95
ALMSACT1 13.8	0.9744	59.95
ALMSACT2 13.8	0.9469	59.95
ANSEL_TS 69	0.9638	59.95

Xcel Energy

Bus	Transient Voltage Dip	Minimum Transient Frequency
	Minimum Voltage Dip (pu)	Minimum Frequency (Hz)
ANTONITO 69	0.9326	59.95
CARMEL 69	0.9737	59.95
CARMEL 115	0.9737	59.95
CENTER 69	0.9513	59.95
COCENTER 69	0.9623	59.95
CREEDE 69	0.9691	59.95
DELNORTE 69	0.9424	59.95
FTGARLND 69	0.9178	59.95
GI-2010-011C 34.5	1.008	59.99
GI-2010-011G	0.9723	59.99
GI-2010-011M 34.5	1.008	59.99
GI-2010-011T 34.5	1.01	59.96
HILANDSL 69	0.9724	59.95
HOMELAKE 69	0.9507	59.95
HOOPER 69	0.9493	59.95
HOOPERTP 69	0.9534	59.95
KERBERCK 69	0.9978	59.98
LAGARITA 69	0.9508	59.95
MEARSJCT 69	1.004	59.98
MIRGEJCT 69	0.9619	59.94
MOFFAT 69	0.9652	59.94
MOSCA 69	0.9777	59.94
OLD16TAP 69	0.9691	59.95
OLD40TAP 69	0.9734	59.95
OXCART 69	0.998	59.98
PLAZA 115	0.974	59.95
PLAZA 69	0.9692	59.95
PONCHA 115	1.004	59.98
PONCHA 230	1.032	59.98
PONCHA 69	1.008	59.98
RAMON 115	0.9737	59.95
RAMON 69	0.9744	59.95
REATAP 69	0.9424	59.95
RIOGRAND 69	0.946	59.95

Bus	Transient Voltage Dip	Minimum Transient Frequency
	Minimum Voltage Dip (pu)	Minimum Frequency (Hz)
RIOGRDTP 69	0.9578	59.95
ROMEO 69	0.936	59.95
S.ACACIO 115	0.975	59.95
SAGUACHE 69	0.9559	59.95
SANLSVLY 115	0.9778	59.95
SANLSVLY 230	1.01	59.96
SANLSVLY 69	0.9738	59.95
SARGENT 115	0.981	59.95
SARGENT 69	0.9616	59.95
SFORK_SL 69	0.9743	59.95
SLVSOLAR 34.5	0.9747	59.94
SOLAR_ALM 34.5	0.968	59.93
SOLAR_ALMT 115	0.9737	59.95
SOLAR_SANLU 34.5	0.9721	59.94
STANLEY 115	0.9765	59.95
STOCKADE 115	0.9748	59.95
SWT_RACK 115	0.974	59.95
VILLA 69	0.9981	59.98
WAVERLY 115	0.9743	59.95
ZINZER 69	0.974	59.95
ZINZER 115	0.974	59.95
Disturbance 14s – Three phase fault at Sargent 69 kV side on the Sargent 115-69 kV Tx		
ALMSA_ST 69	0.9768	59.97
ALMSA_TM 115	0.9529	59.97
ALMSA_TM 69	0.9812	59.97
ALMSACT1 13.8	0.9808	59.97
ALMSACT2 13.8	0.9526	59.97
ANSEL_TS 69	0.9693	59.97
ANTONITO 69	0.9389	59.97
CARMEL 69	0.979	59.97
CARMEL 115	0.979	59.97
CENTER 69	0.9576	59.97
COCENTER 69	0.9679	59.97
CREEDE 69	0.9743	59.97

Bus	Transient Voltage Dip	Minimum Transient Frequency
	Minimum Voltage Dip (pu)	Minimum Frequency (Hz)
DELNORTE 69	0.948	59.97
FTGARLND 69	0.9241	59.97
GI-2010-011C 34.5	1.012	59.99
GI-2010-011G	0.9766	59.99
GI-2010-011M 34.5	1.012	59.99
GI-2010-011T 34.5	1.014	59.98
HILANDSL 69	0.9777	59.97
HOMELAKE 69	0.9565	59.97
HOOPER 69	0.9556	59.97
HOOPERTP 69	0.9596	59.97
KERBERCK 69	0.9988	59.99
LAGARITA 69	0.957	59.97
MEARSJCT 69	1.005	59.99
MIRGEJCT 69	0.9663	59.97
MOFFAT 69	0.9697	59.97
MOSCA 69	0.9822	59.97
OLD16TAP 69	0.9754	59.97
OLD40TAP 69	0.9797	59.97
OXCART 69	0.999	59.99
PLAZA 115	0.9792	59.97
PLAZA 69	0.975	59.97
PONCHA 115	1.005	59.99
PONCHA 230	1.033	59.98
PONCHA 69	1.009	59.99
RAMON 115	0.9789	59.97
RAMON 69	0.9797	59.97
REATAP 69	0.9488	59.97
RIOGRAND 69	0.9516	59.97
RIOGRDTP 69	0.9635	59.97
ROMEO 69	0.9423	59.97
S.ACACIO 115	0.9803	59.97
SAGUACHE 69	0.9604	59.97
SANLSVLY 115	0.9826	59.97
SANLSVLY 230	1.014	59.98

Bus	Transient Voltage Dip	Minimum Transient Frequency
	Minimum Voltage Dip (pu)	Minimum Frequency (Hz)
SANLSVLY 69	0.9792	59.97
SARGENT 115	0.9855	59.97
SARGENT 69	0.9672	59.97
SFORK_SL 69	0.9795	59.97
SLVSOLAR 34.5	0.9793	59.96
SOLAR_ALM 34.5	0.9749	59.95
SOLAR_ALMT 115	0.9788	59.97
SOLAR_SANLU 34.5	0.9786	59.96
STANLEY 115	0.9815	59.97
STOCKADE 115	0.9801	59.97
SWT_RACK 115	0.9793	59.97
VILLA 69	0.9992	59.99
WAVERLY 115	0.9796	59.97
ZINZER 69	0.9793	59.97
ZINZER 115	0.9793	59.97
Disturbance 15s –Three phase fault at San Luis Valley 230 kV side on the San Luis Valley 230-115 kV Tx #2		
ALMSA_ST 69	0.9695	59.88
ALMSA_TM 115	0.9427	59.88
ALMSA_TM 69	0.9738	59.88
ALMSACT1 13.8	0.9734	59.88
ALMSACT2 13.8	0.9423	59.88
ANSEL_TS 69	0.9743	59.89
ANTONITO 69	0.9315	59.88
CARMEL 69	0.9665	59.89
CARMEL 115	0.9665	59.89
CENTER 69	0.9493	59.89
COCENTER 69	0.9748	59.89
CREEDE 69	0.9622	59.89
DELNORTE 69	0.9551	59.89
FTGARLND 69	0.9168	59.88
GI-2010-011C 34.5	1.008	59.96
GI-2010-011G	0.9718	59.97
GI-2010-011M 34.5	1.008	59.96
GI-2010-011T 34.5	1.011	59.92

Bus	Transient Voltage Dip	Minimum Transient Frequency
	Minimum Voltage Dip (pu)	Minimum Frequency (Hz)
HILANDSL 69	0.9655	59.89
HOMELAKE 69	0.9592	59.89
HOOPER 69	0.9474	59.89
HOOPERTP 69	0.9516	59.89
KERBERCK 69	0.9984	59.96
LAGARITA 69	0.9475	59.89
MEARSJCT 69	1.005	59.96
MIRGEJCT 69	0.9627	59.88
MOFFAT 69	0.9661	59.88
MOSCA 69	0.9786	59.88
OLD16TAP 69	0.9681	59.88
OLD40TAP 69	0.9723	59.88
OXCART 69	0.9985	59.96
PLAZA 115	0.9672	59.89
PLAZA 69	0.9616	59.89
PONCHA 115	1.005	59.96
PONCHA 230	1.032	59.96
PONCHA 69	1.008	59.96
RAMON 115	0.9669	59.89
RAMON 69	0.9676	59.89
REATAP 69	0.9414	59.88
RIOGRAND 69	0.9587	59.89
RIOGRDTP 69	0.9705	59.89
ROMEO 69	0.9349	59.88
S.ACACIO 115	0.9678	59.89
SAGUACHE 69	0.9568	59.88
SANLSVLY 115	0.971	59.89
SANLSVLY 230	1.011	59.92
SANLSVLY 69	0.9735	59.89
SARGENT 115	0.9704	59.89
SARGENT 69	0.9752	59.89
SFORK_SL 69	0.9674	59.89
SLVSOLAR 34.5	0.9751	59.87
SOLAR_ALM 34.5	0.9598	59.85

Bus	Transient Voltage Dip	Minimum Transient Frequency
	Minimum Voltage Dip (pu)	Minimum Frequency (Hz)
SOLAR_ALMT 115	0.9672	59.88
SOLAR_SANLU 34.5	0.9636	59.86
STANLEY 115	0.9696	59.89
STOCKADE 115	0.9676	59.89
SWT_RACK 115	0.967	59.89
VILLA 69	0.9987	59.96
WAVERLY 115	0.9672	59.89
ZINZER 69	0.967	59.89
ZINZER 115	0.967	59.89
Disturbance 16s – Three phase fault at San Luis Valley 115 kV side on the San Luis Valley 230-115 kV Tx #2		
ALMSA_ST 69	0.9631	59.88
ALMSA_TM 115	0.9369	59.88
ALMSA_TM 69	0.9674	59.88
ALMSACT1 13.8	0.9669	59.88
ALMSACT2 13.8	0.9365	59.88
ANSEL_TS 69	0.9687	59.89
ANTONITO 69	0.925	59.88
CARMEL 69	0.9611	59.89
CARMEL 115	0.9611	59.89
CENTER 69	0.943	59.89
COCENTER 69	0.9693	59.89
CREEDE 69	0.9567	59.89
DELNORTE 69	0.9494	59.89
FTGARLND 69	0.9103	59.88
GI-2010-011C 34.5	1.004	59.96
GI-2010-011G	0.9682	59.97
GI-2010-011M 34.5	1.004	59.96
GI-2010-011T 34.5	1.007	59.92
HILANDSL 69	0.9601	59.89
HOMELAKE 69	0.9531	59.89
HOOPER 69	0.9409	59.89
HOOPERTP 69	0.9453	59.89
KERBERCK 69	0.9962	59.96
LAGARITA 69	0.9412	59.89

Bus	Transient Voltage Dip	Minimum Transient Frequency
	Minimum Voltage Dip (pu)	Minimum Frequency (Hz)
MEARSJCT 69	1.003	59.96
MIRGEJCT 69	0.9572	59.88
MOFFAT 69	0.9606	59.88
MOSCA 69	0.9731	59.88
OLD16TAP 69	0.9616	59.88
OLD40TAP 69	0.9659	59.88
OXCART 69	0.9964	59.96
PLAZA 115	0.9617	59.89
PLAZA 69	0.9558	59.89
PONCHA 115	1.003	59.96
PONCHA 230	1.03	59.96
PONCHA 69	1.006	59.96
RAMON 115	0.9614	59.89
RAMON 69	0.9621	59.89
REATAP 69	0.9349	59.88
RIOGRAND 69	0.953	59.89
RIOGRDTP 69	0.9648	59.89
ROMEO 69	0.9285	59.88
S.ACACIO 115	0.9624	59.89
SAGUACHE 69	0.9513	59.88
SANLSVLY 115	0.9658	59.89
SANLSVLY 230	1.007	59.92
SANLSVLY 69	0.9679	59.89
SARGENT 115	0.9654	59.89
SARGENT 69	0.9696	59.89
SFORK_SL 69	0.9619	59.89
SLVSOLAR 34.5	0.9695	59.87
SOLAR_ALM 34.5	0.9537	59.85
SOLAR_ALMT 115	0.9619	59.88
SOLAR_SANLU 34.5	0.9577	59.86
STANLEY 115	0.9644	59.89
STOCKADE 115	0.9622	59.89
SWT_RACK 115	0.9615	59.89
VILLA 69	0.9966	59.96

Bus	Transient Voltage Dip	Minimum Transient Frequency
	Minimum Voltage Dip (pu)	Minimum Frequency (Hz)
WAVERLY 115	0.9617	59.89
ZINZER 69	0.9615	59.89
ZINZER 115	0.9615	59.89
Disturbance 01s – Three phase fault at San Luis Valley on the San Luis Valley - Poncha 230 kV line with UVLS		
ALMSA_ST 69	0.7831	59.74
ALMSA_TM 115	0.7656	59.74
ALMSA_TM 69	0.7863	59.75
ALMSACT1 13.8	0.786	59.75
ALMSACT2 13.8	0.7653	59.74
ANSEL_TS 69	0.798	59.76
ANTONITO 69	0.7432	59.74
CARMEL 69	0	59.75
CARMEL 115	0	59.75
CENTER 69	0	59.75
COCENTER 69	0.798	59.76
CREEDE 69	0	59.75
DELNORTE 69	0.7774	59.76
FTGARLND 69	0.73	59.74
GI-2010-011C 34.5	0.827	59.48
GI-2010-011G	0.8068	59.29
GI-2010-011M 34.5	0.827	59.49
GI-2010-011T 34.5	0.8121	59.74
HILANDSL 69	0	59.75
HOMELAKE 69	0.7792	59.75
HOOPER 69	0	59.75
HOOPERTP 69	0	59.75
KERBERCK 69	0.9744	59.96
LAGARITA 69	0	59.75
MEARSJCT 69		59.96
MIRGEJCT 69	0.7911	59.74
MOFFAT 69	0.7946	59.74
MOSCA 69	0.8078	59.74
OLD16TAP 69	0.7816	59.74
OLD40TAP 69	0.7849	59.75

Bus	Transient Voltage Dip	Minimum Transient Frequency
	Minimum Voltage Dip (pu)	Minimum Frequency (Hz)
OXCART 69	0.9745	59.96
PLAZA 115	0	59.75
PLAZA 69	0	59.75
PONCHA 115	0.9811	59.96
PONCHA 230	1.016	59.97
PONCHA 69		59.96
RAMON 115	0	59.75
RAMON 69	0	59.75
REATAP 69	0.7534	59.74
RIOGRAND 69	0.781	59.76
RIOGRDTP 69	0.7929	59.76
ROMEO 69	0.7467	59.74
S.ACACIO 115	0	59.75
SAGUACHE 69	0.785	59.74
SANLSVLY 115	0.7881	59.75
SANLSVLY 230	0.8121	59.74
SANLSVLY 69	0.7998	59.75
SARGENT 115	0.7919	59.77
SARGENT 69	0.7981	59.76
SFORK_SL 69	0	59.75
SLVSOLAR 34.5	0.8108	59.73
SOLAR_ALM 34.5	0.79	59.72
SOLAR_ALMT 115	0.7866	59.75
SOLAR_SANLU 34.5	0.7917	59.73
STANLEY 115	0	59.75
STOCKADE 115	0	59.75
SWT_RACK 115	0	59.75
VILLA 69	0.9747	59.96
WAVERLY 115	0	59.75
ZINZER 69	0	59.75
ZINZER 115	0	59.75
Disturbance 02s – Three phase fault at Poncha on the San Luis Valley - Poncha 230 kV line with UVLS		
ALMSA_ST 69	0.8636	59.72
ALMSA_TM 115	0.8396	59.7

Bus	Transient Voltage Dip	Minimum Transient Frequency
	Minimum Voltage Dip (pu)	Minimum Frequency (Hz)
ALMSA_TM 69	0.8672	59.72
ALMSACT1 13.8	0.8668	59.72
ALMSACT2 13.8	0.8393	59.7
ANSEL_TS 69	0.871	59.71
ANTONITO 69	0.8244	59.72
CARMEL 69	0	59.68
CARMEL 115	0	59.68
CENTER 69	0	59.71
COCENTER 69	0.8716	59.71
CREEDE 69	0	59.68
DELNORTE 69	0.8517	59.71
FTGARLND 69	0.8106	59.72
GI-2010-011C 34.5	0.8921	59.25
GI-2010-011G	0.8563	58.95
GI-2010-011M 34.5	0.8922	59.25
GI-2010-011T 34.5	0.8834	59.63
HILANDSL 69	0	59.68
HOMELAKE 69	0.8558	59.71
HOOPER 69	0	59.71
HOOPERTP 69	0	59.71
KERBERCK 69	0.9896	59.96
LAGARITA 69	0	59.7
MEARSJCT 69		59.96
MIRGEJCT 69	0.8605	59.74
MOFFAT 69	0.8639	59.73
MOSCA 69	0.8768	59.73
OLD16TAP 69	0.8621	59.72
OLD40TAP 69	0.8657	59.72
OXCART 69	0.9898	59.96
PLAZA 115	0	59.68
PLAZA 69	0	59.68
PONCHA 115	0.9962	59.96
PONCHA 230	1.029	59.96
PONCHA 69		59.96

Bus	Transient Voltage Dip	Minimum Transient Frequency
	Minimum Voltage Dip (pu)	Minimum Frequency (Hz)
RAMON 115	0	59.68
RAMON 69	0	59.68
REATAP 69	0.8345	59.72
RIOGRAND 69	0.8554	59.71
RIOGRDTP 69	0.8672	59.71
ROMEO 69	0.8279	59.72
S.ACACIO 115	0	59.68
SAGUACHE 69	0.8545	59.74
SANLSVLY 115	0.8625	59.68
SANLSVLY 230	0.8833	59.63
SANLSVLY 69	0.8697	59.7
SARGENT 115	0.8656	59.7
SARGENT 69	0.872	59.71
SFORK_SL 69	0	59.68
SLVSOLAR 34.5	0.8809	59.75
SOLAR_ALM 34.5	0.8658	59.72
SOLAR_ALMT 115	0.8608	59.69
SOLAR_SANLU 34.5	0.8678	59.71
STANLEY 115	0	59.68
STOCKADE 115	0	59.68
SWT_RACK 115	0	59.68
VILLA 69	0.99	59.96
WAVERLY 115	0	59.68
ZINZER 69	0	59.68
ZINZER 115	0	59.68
Disturbance 01s – Three phase fault at San Luis Valley on the San Luis Valley - Poncha 230 kV line with VarMod 3		
ALMSA_ST 69	0.9429	59.80
ALMSA_TM 115	0.9157	59.80
ALMSA_TM 69	0.9469	59.80
ALMSACT1 13.8	0.9465	59.80
ALMSACT2 13.8	0.9154	59.80
ANSEL_TS 69	0.9472	59.81
ANTONITO 69	0.9045	59.80
CARMEL 69	0.9378	59.81
CARMEL 115	0.9378	59.81

Bus	Transient Voltage Dip	Minimum Transient Frequency
	Minimum Voltage Dip (pu)	Minimum Frequency (Hz)
CENTER 69	0.9247	59.80
COCENTER 69	0.9478	59.81
CREEDE 69	0.9331	59.81
DELNORTE 69	0.9282	59.81
FTGARLND 69	0.8901	59.80
GI-2010-011C 34.5	1.034	59.88
GI-2010-011G 34.5		59.88
GI-2010-011M 34.5	1.033	59.88
GI-2010-011T 34.5	0.97	59.82
HILANDSL 69	0.9365	59.81
HOMELAKE 69	0.9332	59.81
HOOPER 69	0.9227	59.80
HOOPERTP 69	0.9268	59.81
KERBERCK 69	1.001	59.97
LAGARITA 69	0.9227	59.81
MEARSJCT 69	1.007	59.97
MIRGEJCT 69	0.9334	59.80
MOFFAT 69	0.9368	59.80
MOSCA 69	0.9494	59.80
OLD16TAP 69	0.9414	59.80
OLD40TAP 69	0.9454	59.80
OXCART 69	1.001	59.97
PLAZA 115	0.9383	59.81
PLAZA 69	0.9347	59.81
PONCHA 115	1.007	59.97
PONCHA 230	1.037	59.97
PONCHA 69		59.97
RAMON 115	0.9379	59.81
RAMON 69	0.9386	59.81
REATAP 69	0.9144	59.80
RIOGRAND 69	0.9318	59.81
RIOGRDTP 69	0.9436	59.81
ROMEO 69	0.9079	59.80
S.ACACIO 115	0.9389	59.81
SAGUACHE 69	0.9274	59.80
SANLSVLY 115	0.941	59.81
SANLSVLY 230	0.9699	59.82

Bus	Transient Voltage Dip	Minimum Transient Frequency
	Minimum Voltage Dip (pu)	Minimum Frequency (Hz)
SANLSVLY 69	0.946	59.81
SARGENT 115	0.9402	59.82
SARGENT 69	0.9481	59.81
SFORK_SL 69	0.9384	59.81
SLVSOLAR 34.5	0.9497	59.79
SOLAR_ALM 34.5	0.9367	59.77
SOLAR_ALMT 115	0.9376	59.80
SOLAR_SANLU 34.5	0.9403	59.78
STANLEY 115	0.94	59.81
STOCKADE 115	0.9387	59.81
SWT_RACK 115	0.9382	59.81
VILLA 69	1.001	59.97
WAVERLY 115	0.9383	59.81
ZINZER 69	0.9382	59.81
ZINZER 115	0.9382	59.81
Disturbance 02s – Three phase fault at Poncha on the San Luis Valley - Poncha 230 kV line VarMod3		
ALMSA_ST 69	0.8966	59.87
ALMSA_TM 115	0.8709	59.87
ALMSA_TM 69	0.9004	59.87
ALMSACT1 13.8	0.9	59.87
ALMSACT2 13.8	0.8706	59.87
ANSEL_TS 69	0.903	59.88
ANTONITO 69	0.8578	59.87
CARMEL 69	0.8915	59.88
CARMEL 115	0.8915	59.88
CENTER 69	0.8799	59.87
COCENTER 69	0.9036	59.88
CREEDE 69	0.8868	59.88
DELNORTE 69	0.8838	59.88
FTGARLND 69	0.8437	59.87
GI-2010-011C 34.5	0.9331	59.89
GI-2010-011G	0.9066	59.89
GI-2010-011M 34.5	0.9332	59.89
GI-2010-011T 34.5	0.9177	59.88
HILANDSL 69	0.8902	59.88
HOMELAKE 69	0.8882	59.88
HOOPER 69	0.8783	59.87

Bus	Transient Voltage Dip	Minimum Transient Frequency
	Minimum Voltage Dip (pu)	Minimum Frequency (Hz)
HOOPERTP 69	0.8819	59.87
KERBERCK 69	0.9959	59.97
LAGARITA 69	0.8773	59.87
MIRGEJCT 69	0.8913	59.97
MEARSJCT 69		59.87
MOFFAT 69	0.8947	59.87
MOSCA 69	0.9075	59.87
OLD16TAP 69	0.8952	59.87
OLD40TAP 69	0.8989	59.87
OXCART 69	0.9961	59.97
PLAZA 115	0.8921	59.88
PLAZA 69	0.8889	59.88
PONCHA 115	1.002	59.97
PONCHA 230	1.032	59.97
PONCHA 69		59.97
RAMON 115	0.8917	59.88
RAMON 69	0.8923	59.88
REATAP 69	0.8678	59.87
RIOGRAND 69	0.8875	59.88
RIOGRDTP 69	0.8993	59.88
ROMEO 69	0.8612	59.87
S.ACACIO 115	0.8925	59.88
SAGUACHE 69	0.8853	59.87
SANLSVLY 115	0.895	59.88
SANLSVLY 230	0.9176	59.88
SANLSVLY 69	0.9016	59.87
SARGENT 115	0.8979	59.88
SARGENT 69	0.904	59.88
SFORK_SL 69	0.8921	59.88
SLVSOLAR 34.5	0.9097	59.86
SOLAR_ALM 34.5	0.895	59.85
SOLAR_ALMT 115	0.8925	59.87
SOLAR_SANLU 34.5	0.8976	59.85
STANLEY 115	0.894	59.88
STOCKADE 115	0.8924	59.88
SWT_RACK 115	0.8919	59.88
VILLA 69	0.9963	59.97

Bus	Transient Voltage Dip	Minimum Transient Frequency
	Minimum Voltage Dip (pu)	Minimum Frequency (Hz)
WAVERLY 115	0.8921	59.88
ZINZER 69	0.8919	59.88
ZINZER 115	0.8919	59.88
Disturbance 02s UVLS – Three phase fault at Poncha on the San Luis Valley - Poncha 230 kV line VarMod3		
ALMSA_ST 69	0.8966	59.87
ALMSA_TM 115	0.8709	59.87
ALMSA_TM 69	0.9004	59.87
ALMSACT1 13.8	0.9	59.87
ALMSACT2 13.8	0.8706	59.87
ANSEL_TS 69	0.903	59.88
ANTONITO 69	0.8578	59.87
CARMEL 69	0	59.88
CARMEL 115	0	59.88
CENTER 69	0	59.87
COCENTER 69	0.9036	59.88
CREEDE 69	0	59.88
DELNORTE 69	0.8838	59.88
FTGARLND 69	0.8437	59.87
GI-2010-011C 34.5	0.9331	59.89
GI-2010-011G	0.9066	59.89
GI-2010-011M 34.5	0.9332	59.89
GI-2010-011T 34.5	0.9177	59.88
HILANDSL 69	0	59.88
HOMELAKE 69	0.8882	59.88
HOOPER 69	0	59.87
HOOPERTP 69	0	59.87
KERBERCK 69	0.9931	59.97
LAGARITA 69	0	59.87
MIRGEJCT 69	0.8913	59.97
MEARSJCT 69		59.87
MOFFAT 69	0.8947	59.87
MOSCA 69	0.9075	59.87
OLD16TAP 69	0.8952	59.87
OLD40TAP 69	0.8989	59.87
OXCART 69	0.9932	59.97
PLAZA 115	0	59.88
PLAZA 69	0	59.88

Bus	Transient Voltage Dip	Minimum Transient Frequency
	Minimum Voltage Dip (pu)	Minimum Frequency (Hz)
PONCHA 115	0.9995	59.97
PONCHA 230	1.031	59.97
PONCHA 69		59.97
RAMON 115	0	59.88
RAMON 69	0	59.88
REATAP 69	0.8678	59.87
RIOGRAND 69	0.8875	59.88
RIOGRDTP 69	0.8993	59.88
ROMEO 69	0.8612	59.87
S.ACACIO 115	0	59.88
SAGUACHE 69	0.8853	59.87
SANLSVLY 115	0.895	59.88
SANLSVLY 230	0.9176	59.88
SANLSVLY 69	0.9016	59.87
SARGENT 115	0.8979	59.88
SARGENT 69	0.904	59.88
SFORK_SL 69	0	59.88
SLVSOLAR 34.5	0.9097	59.86
SOLAR_ALM 34.5	0.895	59.85
SOLAR_ALMT 115	0.8925	59.87
SOLAR_SANLU 34.5	0.8976	59.85
STANLEY 115	0	59.88
STOCKADE 115	0	59.88
SWT_RACK 115	0	59.88
VILLA 69	0.9934	59.97
WAVERLY 115	0	59.88
ZINZER 69	0	59.88
ZINZER 115	0	59.88

Appendix C

Transient Stability Study Plots – Provided separately