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Gary Pierce, Chairman

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Sandra D. Kennedy, Commissioner

Paul Newman, Commissioner

Brenda Burns, Commissioner

In the Matter of Arizona Solar One, LLC)
Pursuant to ACC Decision No. 70639) Docket No. L-00000GG-08-0408-00140
) L-00000GG-08-0407-00139
)

Filing of Record
In Compliance to the Conditions of
ACC Decision No. 70639

Arizona Corporation Commission ("Commission") Decision No. 70639 (December 11, 2008) (Exhibit A) (Line Siting Case No. 140) approved a Certificate of Environmental Compatibility ("CEC") granted by the Arizona Power Plant and Transmission Line Siting Committee ("Committee") for Arizona Solar One, LLC ("ASO") to build a 230kV transmission line emanating from the Solana Generating Station generally located at the northwest intersection of Interstate 8 and Painted Rock Dam Road, to the Panda/Gila River 230 kV substation, approximately 20.2 miles east and north of the Solana plant site (see Line Siting Case No. 139). Solana is located approximately 70 miles west and south of Phoenix, Arizona.

Condition No. 15 (b) of the ACC order required that ASO, prior to commencement of construction of said transmission line, shall:

"Perform a technical study simulating an outage of the Project that may be caused by the collocation of the Project parallel to and within 100 feet of the existing natural gas or hazardous liquid pipeline. This study should either:

i) show that such outage does not result in customer outages, or
ii) include operating plans to minimize any resulting customer outages. Applicant, or its assignee(s), shall provide a copy of this study to Commission Staff."

Arizona Solar One submits this memo and attached studies which clearly demonstrate that no customer outage shall occur as a result of the Project's proximity to an existing natural gas or hazardous liquid pipeline.

Background

On September 29, 2010, the Federal Energy Regulatory Commission affirmed the execution of a Large Generator Interconnection Agreement ("LGIA") between ASO and Arizona Public Service ("APS"), thereby acknowledging the Solana LGIA's conformance to the FERC Proforma Tariff, all pertinent provisions of the Federal Power Act, and those relevant provisions of the Public Utility Holding Act ("PUHCA"). APS serves as the wholesale purchaser of Solana's energy under a 30-year Purchase Power Agreement. All of Solana's output will in turn be delivered to its own electricity customers within Arizona.

The LGIA may only be executed upon completion of a series of technical studies, including but not limited to (a) a System Impact Study, and (b) a Facilities Study. These studies are conducted by the Transmission Provider as a paid service to its Interconnection customer; in this case, APS and ASO, respectively.

The former study contemplates a series of simulated outages for the proposed transmission line, as well as the impacts of outages of distribution, subtransmission, and transmission lines in the surrounding area, in light of the fact that such surrounding lines would have to absorb the additional injection of generation supplied by Solana. A result of the System Impact Study is the identification of any overloads that would occur on existing lines, transformers, or other power apparatus, in the absence of any system upgrade remedies.

The Facilities Study identifies those upgrades needed to prevent any such outages from causing thermal overloads, thereby obviating the possibility of any customer outages occurring as a result of the simulated contingencies. Under both the FERC Proforma Tariff and APS's Transmission Tariff, the Interconnection Customer is required to pay the Transmission Provider to install the necessary upgrades[1].

These studies were completed by APS as part of the Interconnection Process for Solana's transmission line. The studies identified a need for approximately $2.1 million of Interconnection Facilities at the Panda/Gila River Substation, and approximately $5.8 million in upgrades to APS' 69kV subtransmission system in order to prevent customer outages.

As of this filing, these upgrades are complete in design and engineering, and construction and Right-Of-Way acquisition are underway. The LGIA between APS and ASO require that construction of all Interconnection Facilities be complete prior to ASO's Commercial

[1] The tariffs also provide for reimbursement for such upgrades to the Interconnection Customer upon the earlier of 20 years, or the time at which the upgrades become of common benefit to all network users.

Operation Date. It also requires that all Network Upgrade facility construction be complete prior to the date at which Solana's output may reach 250 Megawatts – a date expected in Solana's second year of operation. Although no network upgrades are needed to prevent outages until Solana's generation injection exceeds 250 Megawatts, such upgrades are expected to be complete prior to Solana's Commercial Operation Date.

Conclusion

The technical studies already performed for Solana's LGIA already demonstrate that Solana's interconnection and associated upgrades are inherently designed to eliminate outages to APS' electricity customers. ASO respectfully requests that this filing and its Exhibit be accepted by the Commission as having demonstrated compliance to Condition No. 15 (b) of ACC Decision No. 70639.

The System Impact Study and Facilities Study are included as Exhibit A to this document.

Respectfully submitted this _____ day of September, 2011.

Arizona Solar One, LLC

Kate Maracas
Statutory Officer, ASO
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A subsidiary of Pinnacle West Capital Corporation

Gila Bend/Gila River Cluster

Interconnection System Impact Study

By

Arizona Public Service Company
Transmission Planning

October 27, 2009

Prepared by
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1. Executive Summary

Under provisions of the Arizona Public Service Company (APS) Open Access Transmission Tariff (OATT), APS has elected to cluster Interconnection Requests (IR) Q031 and Q044. Both projects plan to interconnect in the Gila Bend/Gila River (GBGR) cluster with expected commercial operation in the October 2010 - December 2011 time frame. An Interconnection Feasibility Study (IFeS) was performed for project Q031. The IFeS for project Q044 was waived with concurrence from the Interconnection Customer (IC) and APS. Both projects have requested Energy Resource (ER) Interconnection Service.

The Q031 project is 102 MW net of photovoltaic (PV) generation located approximately 6 miles west of the Gila Bend substation in Maricopa County, Arizona. The Q031 project will be constructed in stages, and is expected to start achieving commercial operation in 10 MW increments beginning around October 2010, with an estimated full capacity and completion by December 2011.

The Q044 project is 280 MW net of parabolic trough solar generation located approximately 14 miles west of the Gila Bend substation at the intersection of Painted Rock Dam Road and Power Line Road, Maricopa County, Arizona. The Q044 project is expected to achieve commercial operation in December 2011.

In accordance with Federal Energy Regulatory Commission (FERC) Large Generator Interconnection Procedures (LGIP), Utility System Efficiencies (USE) and APS performed an Interconnection System Impact Study (ISIS). The ISIS determined the following:

1. Preliminary identification of any thermal overload, voltage limits violations or transient stability violations resulting from the interconnection of clustered projects.
2. Preliminary identification of any circuit breaker short circuit capability limits exceeded as a result of the interconnection of clustered projects.
3. Preliminary list of facilities, a non-binding good faith estimate of cost responsibility and a non-binding good faith estimated time to construct facilities necessary to interconnect the projects in the cluster.

The ISIS was performed with Q031 interconnected on the Gila Bend-Paloma-Bunyan 69 kV line at Paloma and Q044 interconnected to the Panda 230 kV substation. Both ICs also requested that analysis be performed both with and without the other project modeled. Three post-project scenarios were studied:

1. Post-project case 1 with Q031 102 MW interconnected on the Gila Bend-Paloma-Bunyan 69 kV line at Paloma and Q044 280 MW interconnected to Panda 230 kV substation
2. Post-project case 2 with Q031 102 MW interconnected on the Gila Bend-Paloma-Bunyan 69 kV line at Paloma without Q044
3. Post-project case 1 with Q044 280 MW interconnected to Panda 230 kV substation without Q031

The study concluded that for post-project case 1 (Q031 102 MW interconnected on the Gila Bend-Paloma-Bunyan 69 kV line at Paloma and Q044 280 MW interconnected to Panda 230 kV

substation) there were no Category A normal overloads and three (3) facilities that have Category B post-project overloads caused by the interconnection of the cluster projects. The short circuit analysis results concluded that there are no overstressed circuit breakers due to addition of the project at Panda 230 kV. PV generation does not contribute fault current therefore no short circuit analysis was performed for Q031. The transient stability analysis concluded that the WECC transmission system remained stable for all contingency simulations and there were no NERC/WECC criteria violations in the APS or WECC transmission system. A Special Protection Scheme (SPS) to trip Q031 for the Gila Bend - Paloma 69 kV single line outage is required because of the resulting island conditions of the generation and load.

The study concluded that for post-project case 2 (Q031 102 MW interconnected on the Gila Bend-Paloma-Bunyan 69 kV line at Paloma and no Q044) there were no Category A normal overloads and two (2) facilities that have Category B post-project overloads caused by the interconnection of the cluster project Q31. PV generation does not contribute fault current therefore no short circuit analysis was performed. The transient stability analysis concluded that the WECC transmission system remained stable for all contingency simulations and there were no NERC/WECC criteria violations in the APS or WECC transmission system. A Special Protection Scheme (SPS) to trip Q031 for the Gila Bend - Paloma 69 kV single line outage is required because of the resulting island conditions of the generation and load. Table 1.1 shows the upgrade requirements for MW injection levels into Paloma 69 kV.

Table 1.1 Upgrade Requirements for MW Injection Levels for Case 2

MW injection into Paloma 69 kV	Upgrade Requirements
< 96 MW	None
96 MW - 102 MW	Upgrade Cotton Center - Butterfield Tap (5 mi) and Butterfield Tap - Gila Bend (6 mi) 69 kV line sections with 795 ACSS (existing conductor is 477 AAC)

The study concluded that for post-project case 3 (Q044 280 MW interconnected to Panda 230 kV substation and no Q031) There were no Category A normal overloads and two (2) facilities that have Category B post-project overloads caused by the interconnection of the cluster project. The short circuit analysis results concluded that there are no overstressed circuit breakers due to addition of the project at Panda 230 kV. The transient stability analysis concluded that the WECC transmission system remained stable for all contingency simulations and there were no NERC/WECC criteria violations in the APS or WECC transmission system.

Table 1.2 shows the upgrade requirements for MW injection levels at Panda 230 kV based on the power flow and transient stability results. This approach shows what upgrades would be required for a given MW injection and simultaneously shows the maximum net generation output allowed for each mitigation component.

Table 1.2 Upgrade Requirements for MW Injection Levels for Case 3

MW injection into Panda 230 kV	Upgrade Requirements
< 251 MW	None
251 MW - 280 MW	Upgrade Cotton Center - Butterfield Tap (5 mi) and Butterfield Tap - Gila Bend (6 mi) 69 kV line sections with 795 ACSS (existing conductor is 477 AAC)

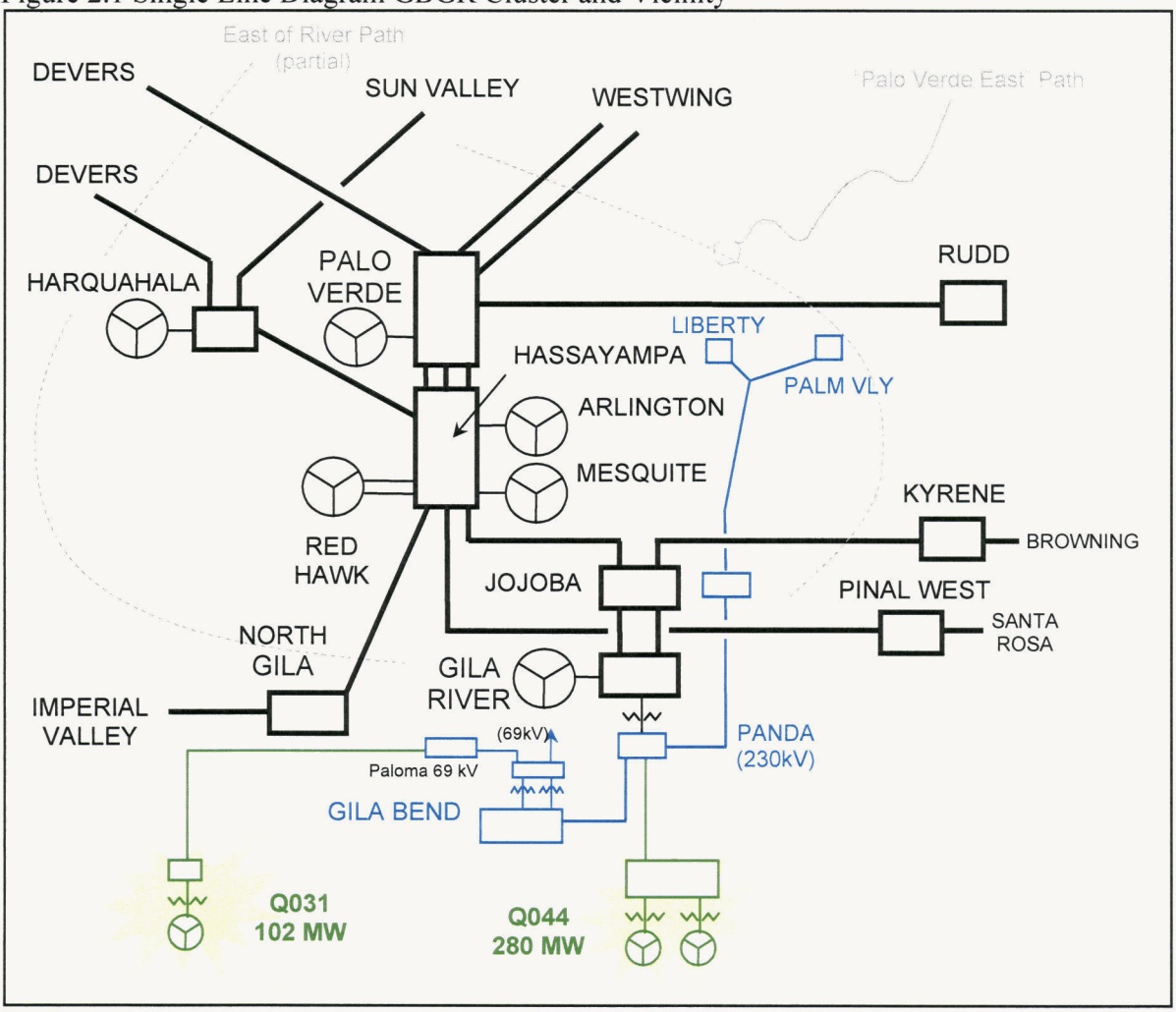
2. Study Assumptions

The following general assumptions were used for this study:

1. Project Q031
    a. Consists of PV modules modeled as 102 MW equivalent generator with Qmax/Qmin = ±32 MVAr
    b. Interconnected through a 2.5 mile 556 ACSR Osprey line rated at 920 A/110 MVA to Paloma
    c. The main step-up transformer was modeled as a 230/34.5 kV or 69/34.5 kV transformer rated at 108 MVA with 9% impedance at 60 MVA. Individual unit 34.5/.208 kV step-up transformers were modeled as one equivalent 108 MVA transformer with 8% impedance at 76.5 MVA. Tap settings on the transformers were set to obtain unity power factor on the high side of the main step-up transformer.
    d. Lower voltage collector lines were ignored
2. Project Q044
    a. Consists of two (2) 161 MVA steam turbine generators modeled at 140 MW each with Qmax/Qmin = +60/-12.5 MVAr each
    b. Auxiliary load was modeled at 30 MW/14.5 MVAr, split evenly into two loads. (loads are modeled out of service for 280 MW net output)
    c. Interconnected to the Panda 230 kV substation through a 16 mile 954 ACSR Cardinal line rated at 1095 A/436 MVA
    d. The generator step-up transformers were modeled as two (2) 175 MVA 13.8/230 kV with 14% impedance at 148 MVA. Tap settings on the transformers were set to obtain unity power factor at the Panda 230 kV Point of Interconnection (POI).
3. Regional transmission and sub-transmission projects and proposed generation projects that will be operational by 2011 were modeled in the power flow cases

Figure 2.1 shows a high level single line diagram of the Gila Bend/Gila River Cluster and the transmission system in the vicinity.

Figure 2.1 Single Line Diagram GBGR Cluster and Vicinity



3. Power Flow Cases

One (1) pre-project power flow case was developed using available Western Electricity Coordinating Council (WECC) base cases. The 2011 Heavy Summer Gila Bend/Buckeye Regional Pre-Project Power Flow Case was derived from the WECC 2011 Heavy Summer (11hs1b) power flow case dated January 12, 2007. The starting case was provided by APS (!11hs1b_APSv4.sav) case. The case includes updated modeling of the Arizona bulk transmission system and detailed modeling of the Gila Bend/Buckeye transmission and sub-transmission system. This power flow case was used for power flow and transient stability analysis.

Three (3) post-project cases were developed from the pre-project cases:

1. 2011 Heavy Summer Gila Bend/Buckeye Regional Post-Project Power Flow Case 1 with Q031 interconnected on the Gila Bend-Paloma-Bunyan 69 kV line at Paloma and Q044 @ 280 MW interconnected at Panda 230 kV substation.
2. 2011 Heavy Summer Gila Bend/Buckeye Regional Post-Project Power Flow Case 2 with Q031 interconnected on the Gila Bend-Paloma-Bunyan 69 kV line at Paloma.
3. 2011 Heavy Summer Gila Bend/Buckeye Regional Post-Project Power Flow Case 3 with Q044 @ 280 MW interconnected at Panda 230 kV substation.

Redhawk generation was reduced by amount of cluster generation added to balance Arizona resources due to the addition of the proposed projects in the post-project power flow cases. Table 3.1 provides a summary of the pre and post-project power flow cases.

The Gila Bend 69 kV shunt capacitors (30 MVAr) were turned off for post-project cases 1 and 2. The Gila Bend 69 kV capacitors combined with Q031, cause high voltages on the 69 kV system for the Panda-Gila Bend 230 kV line outage, which can cause Q031 to trip. The transformer tap settings at Why 69 kV were adjusted to boost the 20.5 kV voltage to > 0.95 pu.

Table 3.1 Power Flow Cases Summary

	2011 Heavy Summer Gila Bend/Buckeye Regional Cases			
	Pre-Project (MW)	Post-Project Case 1 (MW)	Post-Project Case 2 (MW)	Post-Project Case 3 (MW)
Major Path/Branch Flows:				
Path 46 – West of the River	5,607	5,606	5,608	5,607
Path 49 – East of the River	4,375	4,369	4,376	4,373
Gila River 500/230kV Transformer	291	51	230	113
Panda - Gila Bend 230kV Line	99	21	11	109
Panda - Jojoba 230kV Line	192	308	219	281
Gila Bend 230/69 kV Transformers	99	21	11	109
Arizona Area 14 (incl. WALC)				
Load	21,109	21,096	21,096	21,102
Losses	581	593	587	587
Generation	29,816	29,813	29,822	29,814
Interchange (exports)	8,126	8,125	8,126	8,125
SDG&E Area 22				
Generation	2,847	2,847	2,847	2,847
Interchange (imports)	-2,285	-2,285	-2,285	-2,285
SCE Area 24				
Generation	14,624	14,623	14,624	14,623
Interchange (imports)	-7,594	-7,596	-7,594	-7,595
PG&E Area 30				
Generation	26,619	26,621	26,618	26,620
Interchange (imports)	-1,320	-1,319	-1,322	-1,320

4. Study Methodology

This ISIS consists of power flow, short circuit and transient stability studies in order to identify a preliminary list of facilities, a non-binding good faith estimate of cost responsibility and a non-

binding good faith estimated time to construct facilities necessary to interconnect the projects in the cluster.

4.1. Power Flow Analysis

For normal conditions, automatic transformer taps, static VAr devices (SVD) and phase-shifting transformers (PST) were allowed to adjust in solving the power flow cases. For contingency simulations, the power flow analysis considers a snapshot in time where automatic transformer taps and SVDs are allowed to adjust, while PSTs remain "fixed"; in addition, a system swing bus balances the system during each contingency scenario.

Power flow analysis was performed using the NERC/WECC planning standards. Power flow analysis was used to evaluate thermal and voltage performance of the transmission system for NERC/WECC Category A normal (all elements in-service) conditions and NERC/WECC Category B emergency (one element out of service) conditions. Category A (N-0) normal overloads are those that exceed 100% of normal ratings that occur with all facilities in service. Category B emergency overloads are those that exceed 100% of emergency ratings that occur due to a Category B contingency.

Reported normal thermal loading was limited to the condition where a modeled transmission component was loaded above 100% of the normal MVA rating (Rating 1 as entered in the power flow case), and the incremental increase in component loading, between pre-project and post-project, exceeded 1%. Reported emergency thermal loading was limited to the condition where a modeled transmission component was loaded over 80% of its appropriate emergency MVA rating (Rating 2 as entered in the power flow case), and the incremental increase in component loading, between pre-project and post-project, exceeded 1%.

Reported normal voltage violations were limited to the conditions where per unit (pu) voltages were less than 0.95 or greater than 1.05. Reported emergency voltage violations were limited to the conditions where per unit voltages were less than 0.90 or greater than 1.10. In addition, only voltage deviations greater than 5% between the pre and post-contingency and a 1% increase in voltage deviation between the pre and post-project power flow cases were recorded.

4.2. Short Circuit Analysis

Short circuit analysis was performed to determine the maximum fault currents on buses in the vicinity of the Project. This study assessed the impact of increased fault duty resulting from the Project for single line-to-ground and three-phase faults. Equipment that may become over-stressed as a result of the added generation was identified if the fault duty exceeds 100% of its applicable interrupting capability.

4.3. Transient Stability Analysis

Transient stability analysis is a time-based simulation that assesses the performance of the power system during (and shortly following) a contingency. Transient stability studies were performed to ensure system stability following critical faults on the system.

The system is considered stable if the following conditions are met:

1. All machines in the WECC interconnected system must remain in synchronism as demonstrated by relative rotor angles.
2. System stability is evaluated based on the damping of the relative rotor angles and the damping of the voltage magnitude swings.
    a. A stability simulation will be deemed to exhibit positive damping if a line defined by the peaks of the machine relative rotor angle swing curves tends to intersect a second line connecting the valleys of the curves with the passing of time.
    b. Corresponding lines on bus voltage swing curves will likewise tend to intersect.
3. Transient voltage dips and duration requirements must meet the criteria of the WECC System Performance Criteria.
4. Transient frequency dips and duration requirements must meet the criteria of the WECC System Performance Criteria.

5. Study Results

5.1. Power Flow

Power flow analysis was performed on all pre and post-project power flow cases. The results were compared to determine the impacts caused solely by the addition of the cluster projects and to identify the system reinforcements necessary to mitigate the adverse impacts.

Approximately 750 single contingencies were applied to the previously described pre- and post-project cases, and the results were compared. Simulated outages were predominantly (though not explicitly limited to) N-1 outages of transmission lines, transformers or generators connected at voltages ≥69 kV in Arizona Area 14 as defined in the power flow cases. A complete listing of all contingencies studied is included in Appendix A.

Complete listings of all power flow results and selected power flow plots are included in Appendix B and Appendix C.

All power flow analysis was conducted with version 16.0_11 of General Electric's PSLF/PSDS/SCSC software.

5.1.1. Post-Project Case 1 (Q031 and Q044)

Power flow analysis was performed on the Gila Bend/Buckeye regional pre-project case and post-project case 1 (Q031 102 MW interconnected at Gila Bend-Paloma-Bunyan 69 kV line at Paloma and Q044 280 MW interconnected at Panda 230 kV substation). The results were compared to determine the impacts caused solely by the addition of the cluster projects and to identify the system reinforcements necessary to mitigate the adverse impacts.

There were no Category A normal overloads and three (3) facilities that have Category B post-project overloads caused by the interconnection of the cluster projects. Table 5.1 shows a summary of the worst Category B overloads.

Table 5.1 Worst Category B Overloads for Post-Project Case 1 (Q031 and Q044)

Overloaded Element	Contingency Description	Rating (Amps)	Pre-Project Loading	Post-Project Loading
BTRFLDTP 69.00-COTN CTR 69.00 #1 1	JOJOBA-GILARIVR 230kV Line 1	658	82	120
BTRFLDTP 69.00-GILABEND 69.00 #1 1	JOJOBA-GILARIVR 230kV Line 1	661	82	120
COTN CTR 69.00-GILLESPI 69.00 #1 1	JOJOBA-GILARIVR 230kV Line 1	658	72	111

The Gila Bend - Paloma 69 kV line is rated at 87.2 MVA therefore depending on the voltages and load level at Paloma 69 kV the output of Q031 could be limited for the loss of the Paloma - Bunyan 69 kV line. For the loss of the Paloma – Bunyan 69 kV line the output of Q031 will be limited to a maximum output of 87.2 MVA, the rating of the Gila Bend – Paloma 69 kV line, plus the amount of load that is being served through the 69/12 kV transformer at Paloma.

5.1.2. Post-Project Case 2 (Q031)

Power flow analysis was performed on the Gila Bend/Buckeye regional pre-project case and post-project case 2 (Q031 102 MW interconnected at Gila Bend-Paloma-Bunyan 69 kV line at Paloma). The results were compared to determine the impacts caused solely by the addition of the cluster project and to identify the system reinforcements necessary to mitigate the adverse impacts.

There were no Category A normal overloads and two (2) facilities that have Category B post-project overloads caused by the interconnection of the cluster project. Table 5.2 shows a summary of all the Category B overloads.

Table 5.2 Category B Overloads for Post-Project Case 2 (Q031)

Overloaded Element	Contingency Description	Rating (Amps)	Pre-Project Loading	Post-Project Loading
BTRFLDTP 69.00-COTN CTR 69.00 #1 1	JOJOBA-GILARIVR 230 kV Line 1	658	82	100
BTRFLDTP 69.00-COTN CTR 69.00 #1 1	JOJOBA-TS4-LIBERTY/PALMVLY 230 kV Ckt.	658	82	100
BTRFLDTP 69.00-GILABEND 69.00 #1 1	JOJOBA-GILARIVR 230 kV Line 1	661	82	100
BTRFLDTP 69.00-GILABEND 69.00 #1 1	JOJOBA-TS4-LIBERTY/PALMVLY 230 kV Ckt.	661	81	100

The Gila Bend - Paloma 69 kV line is rated at 87.2 MVA therefore depending on the voltages and load level at Paloma 69 kV the output of Q031 could be limited for the loss of the Paloma - Bunyan 69 kV line. For the loss of the Paloma – Bunyan 69 kV line the output of Q031 will be limited to a maximum output of 87.2 MVA, the rating of the Gila Bend – Paloma 69 kV line, plus the amount of load that is being served through the 69/12 kV transformer at Paloma.

5.1.3. Post-Project Case 3 (Q044)

Power flow analysis was performed on the Gila Bend/Buckeye regional pre-project case and post-project case 3 (Q044 280 MW interconnected at Panda 230 kV substation). The results were compared to determine the impacts caused solely by the addition of the cluster project and to identify the system reinforcements necessary to mitigate the adverse impacts.

There were no Category A normal overloads and two (2) facilities that have Category B post-project overloads caused by the interconnection of the cluster project. Table 5.3 shows a summary of all the Category B overloads.

Table 5.3 Category B Overloads for Post-Project Case 3 (Q044 @ 280 MW)

Overloaded Element	Contingency Description	Rating (Amps)	Pre-Project Loading	Post-Project Loading
BTRFLDTP 69.00-COTN CTR 69.00 #1 1	JOJOBA-GILARIVR 230 kV Line 1	658	82	102
BTRFLDTP 69.00-COTN CTR 69.00 #1 1	JOJOBA-TS4-LIBERTY/PALMVLY 230 kV Ckt.	658	82	101
BTRFLDTP 69.00-GILABEND 69.00 #1 1	JOJOBA-GILARIVR 230 kV Line 1	661	82	101
BTRFLDTP 69.00-GILABEND 69.00 #1 1	JOJOBA-TS4-LIBERTY/PALMVLY 230 kV Ckt.	661	81	101

5.2. *Short Circuit*

No equipment short circuit ratings in the vicinity of the cluster projects were exceeded as a result of the projects. Single line-to-ground (SLG) and three-phase faults were simulated with and without the cluster projects to determine if there are any overstressed circuit breakers caused by addition the cluster projects.

Study results indicate there are no circuit breaker fault duty limit violations attributable to the Project. The IC's are not responsible for mitigating any pre-existing overstressed circuit breakers. The short circuit analysis results are included in Appendix D.

5.3. *Transient Stability*

Transient stability analysis was performed on the Gila Bend/Buckeye regional pre-project and post-project cases. The results were compared to determine the impacts caused solely by the addition of the cluster projects and to identify the system reinforcements, if any, necessary to mitigate the adverse impacts.

Table 5.4 Transient stability simulations with four (4) cycle clearing

Simulation #	Contingency Description
1	Three-phase fault on Gila Bend - Panda 230 kV line, near Gila Bend
2	Three phase fault on Gila River - Jojoba #1 500 kV line, near Gila River
3	Three phase fault on Hassyampa - Jojoba 500 kV line, near Jojoba
4	Three phase fault on Jojoba - Kyrene 500 kV line, near Jojoba
5	Three-phase fault on Gila River - Jojoba #1 and #2 500 kV lines, near Gila River, includes tripping the Gila River 500/230 kV transformer bank and Gila River Power Plant 12 cycles after fault clearing
7	Three phase fault on Panda - Jojoba 230 kV line, near Panda
8	Three phase fault on Gila River 500/230 kV transformer bank
9	Three phase fault on Gila Bend 230/69 kV transformer bank 1
Additional simulations with 7 cycle clearing	
13	Three-phase fault on Paloma - Bunyan 69 kV line, near Paloma

Switching sequences for the transient stability simulations are included in Appendix E.

The duration of each stability simulation run was ten seconds. The transient performance analysis started 2 - 3 cycles after fault clearing and concluded at the end of the simulation.

The Q031 project dynamic model was provided by the IC and consists of a user-written generator model. The Q044 project dynamic model was provided by the IC and consists of generator, excitation system, power system stabilizer and governor models. Details of both projects machine dynamics are included in Appendix F.

Transient stability worst condition analysis results and plots are included in Appendix G and Appendix H.

All transient stability analysis was conducted with version 16.0_11 of General Electric's PSLF/PSDS/SCSC software.

5.3.1. Post-Project Case 1 (Q031 and Q044)

The post-project case 1 (Q031 102 MW interconnected at Gila Bend-Paloma-Bunyan 69 kV line at Paloma and Q044 280 MW interconnected at Panda 230 kV substation) transient stability analysis concluded that the WECC transmission system remained stable for all contingency simulations and there were no NERC/WECC criteria violations in the APS or WECC transmission system. The transmission system was adequately damped and all generators remained synchronized.

There are voltage dips that exceed 30% in the Gila Bend 69 kV area for the Gila Bend - Panda 230 kV single line outage and the Gila River - Jojoba #1 and #2 500 kV double line outage. Since these voltage deviations are contained to the APS transmission system they are not WECC criteria violations.

The outage of the 69 kV line between Gila Bend and Paloma would leave Q031 isolated with the load at the Paloma, Hyder, Horn, and Aztec substations. Therefore, Q031 will be required to trip for the Gila Bend - Paloma 69 kV single line outage because of the resulting island conditions of the generation and load.

The Gila Bend 69 kV shunt capacitors (30 MVAr) were turned off for post-project case 1. The Gila Bend 69 kV capacitors combined with Q031, cause high voltages on the 69 kV system for the Panda-Gila Bend 230 kV line outage, which can cause Q031 to trip. The transformer tap settings at Why 69 kV were adjusted to boost the 20.5 kV voltage to > 0.95 pu.

5.3.2. Post-Project Case 2 (Q031)

The post-project case 2 (Q031 102 MW interconnected at Gila Bend-Paloma-Bunyan 69 kV line at Paloma) transient stability analysis concluded that the WECC transmission system remained stable for all contingency simulations and there were no NERC/WECC criteria violations in the

APS or WECC transmission system. The transmission system was adequately damped and all generators remained synchronized.

There are voltage dips that exceed 30% in the Gila Bend 69 kV area for the Gila Bend - Panda 230 kV single line outage and the Gila River - Jojoba #1 and #2 500 kV double line outage. Since these voltage deviations are contained to the APS transmission system they are not WECC criteria violations.

The outage of the 69 kV line between Gila Bend and Paloma would leave Q031 isolated with the load at the Paloma, Hyder, Horn, and Aztec substations. Therefore, Q031 will be required to trip for the Gila Bend - Paloma 69 kV single line outage because of the resulting island conditions of the generation and load.

The Gila Bend 69 kV shunt capacitors (30 MVAr) were turned off for post-project case 2. The Gila Bend 69 kV capacitors combined with Q031, cause high voltages on the 69 kV system for the Panda-Gila Bend 230 kV line outage, which can cause Q031 to trip. The transformer tap settings at Why 69 kV were adjusted to boost the 20.5 kV voltage to > 0.95 pu.

5.3.3. Post-Project Case 3 (Q044)

The post-project case 3 (Q044 280 MW interconnected at Panda 230 kV substation) transient stability analysis concluded that the WECC transmission system remained stable for all contingency simulations and there were no NERC/WECC criteria violations in the APS or WECC transmission system. The transmission system was adequately damped and all generators remained synchronized for all transient stability simulations studied.

5.4. Mitigation

Plans of service were developed to mitigate all criteria violations for the cluster projects.

5.4.1. Post-Project Case 1 (Q031 and Q044)

Mitigation for the overloaded elements and transient stability criteria violations, as described in the results section 5.1.1, were created for the post-project case 1 (Q031 102 MW interconnected at Gila Bend-Paloma-Bunyan 69 kV line at Paloma and Q044 280 MW interconnected at Panda 230 kV substation).

Upgrade the following 69 kV line sections with 795 ACSS:

- Cotton Center - Butterfield Tap (5 mi)
- Butterfield Tap - Gila Bend (6 mi)
- Cotton Center - Gillespie (7.5 mi)

SPS to trip Q031 for Gila Bend - Paloma 69 kV single line outage

5.4.2. Post-Project Case 2 (Q031)

Mitigation for the overloaded elements and transient stability criteria violations, as described in the results section 5.1.2, were created for the post-project case 2 (Q031 102 MW interconnected at Gila Bend-Paloma-Bunyan 69 kV line at Paloma). Table 5.5 shows the mitigation upgrade requirements for MW injection levels into Paloma 69 kV based on the power flow results. An SPS to trip Q031 for the Gila Bend - Paloma 69 kV single line outage is required because of the resulting island conditions of the generation and load.

Table 5.5 Upgrade Requirements for MW Injection Levels

MW injection into Paloma 69 kV#	Upgrade Requirements
< 96 MW	None
96 MW - 102 MW	Upgrade Cotton Center - Butterfield Tap (5 mi) and Butterfield Tap - Gila Bend (6 mi) 69 kV line sections with 795 ACSS (existing conductor is 477 AAC)

Note: Q031 output may be limited during Paloma-Bunyan 69kV outage depending on Paloma load.

5.4.3. Post-Project Case 3 (Q044)

Mitigation for the overloaded elements for the post-project case 3 (Q044 280 MW interconnected at Panda 230 kV substation) as described in the power flow results section 5.1.3, was created based on the amount of MW injected at the Panda 230 kV substation. This approach shows what upgrades would be required for a given MW injection and simultaneously shows the maximum output allowed for each mitigation component.

Table 5.6 shows the upgrade requirements for MW injection levels at Panda 230 kV based on the power flow results.

Table 5.6 Upgrade Requirements for MW Injection Levels

MW injection into Panda 230 kV	Upgrade Requirements
< 251 MW	None
251 MW - 280 MW	Upgrade Cotton Center - Butterfield Tap (5 mi) and Butterfield Tap - Gila Bend (6 mi) 69 kV line sections with 795 ACSS (existing conductor is 477 AAC)

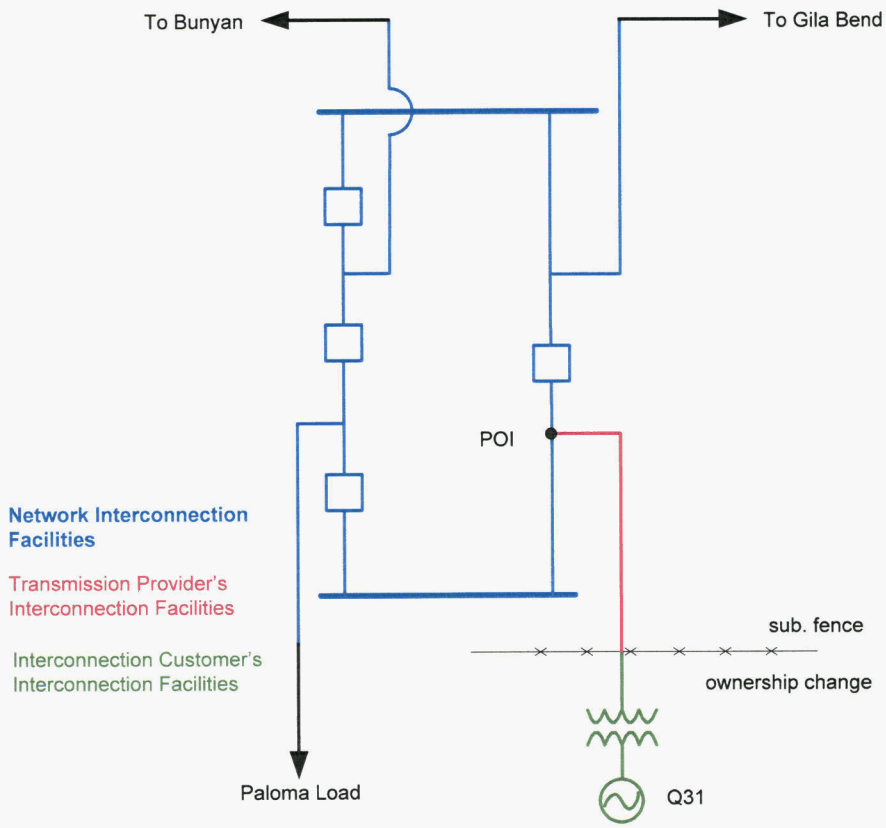
6. Cost and Construction Schedule Estimates

The cost and time estimates for the system upgrades for each option are listed separately. The costs do not include any costs for new rights-of-way that may potentially be needed for some upgrades. In addition to the cost and time estimates for each option, the interconnection cost and time estimates are the same for each respective project regardless of which option. Those cost and time estimates are listed below.

Project Q031: Point of Interconnection at Paloma

To interconnect Q031, a new 69 kV four (4) breaker ring bus will be required at Paloma. Currently there is only a 69 kV tap at Paloma. A new 4 breaker ring will be constructed for the three APS 69 kV terminations and the Q31 termination. The substation will initially be a ring bus, but set-up to be converted to a breaker-and-a-half configuration in the future. The cost responsibility for constructing the four breaker ring is the responsibility of Q031 and those costs will be network upgrades. The 69kV line from the termination bay to the substation fence will be owned and operated by APS, but the cost responsibility of Q31 and will be Transmission Provider's Interconnection Facilities. These facilities are depicted in **Figure 6.1** below.

Figure 6.1: Q031 - Paloma Interconnection



In addition to the facilities described above, new control and communications will need to be installed along with new relays at the Gila Bend and Bunyan substations. These are needed because of the requirement to transfer-trip Q031 for the outage described in the earlier in the report (Gila Bend-Paloma 69 kV line outage). Also, if in the future the substation is converted from a ring bus to a breaker-and-a-half configuration Q31 will have the cost responsibility for a breaker and a half. The time estimate for constructing the facilities at Paloma, the relay changes, and the communication additions are approximately 24 months.

Table 6.1 Interconnection Cost Estimate for Q031 at Paloma

	Ring bus expansion at Paloma	Relay changes at Gila Bend and Bunyan	Communications required for Transfer Trip	Overall Project Total
Engineering and Design	$318,000	$64,000	$45,000	$427,000
Below Grade	$1,763,000	$0	$0	$1,763,000
Construction Labor (Steel, Equipment & Control)	$892,000	$170,000	$0	$1,062,000
Steel Structures	$39,000	$0	$0	$39,000
Electrical Equipment	$289,000	$0	$0	$289,000
Controls & Communications	$239,000	$137,000	$893,000	$1,269,000
Subtotal:	$3,540,000	$371,000	$938,000	$4,849,000
Contingency: (20%)	$708,000	$74,000	$188,000	$970,000
Totals:	$4,248,000	$445,000	$1,126,000	$5,819,000

The construction of a bus at the Paloma Tap site would also require APS to obtain additional land at the site, approximately ½ acre. The cost associated with the acquisition of additional land for the Paloma substation is estimated to be approximately $5,000 and is included in the ring bus expansion cost.

Project Q044: Point of Interconnection at Panda 230 kV substation

To interconnect Q044, a fourth bay at the Panda 230 kV substation will be required. The 230 kV line from Q044 to the Panda substation would be the responsibility of Q044 and is not included in these cost estimates. Currently there are three terminations at the Panda 230 kV substation. The substation is designed to have a maximum of four terminations, via a four breaker ring. The cost of the fourth bay is the responsibility of Q044, but will be network upgrades. These facilities are depicted in **Figure 6.2** and in **Table 6.2** below. The time estimate for completing the fourth bay at Panda is approximately 12 months. Figure 6.2 depicts the termination using the currently open bay position. However, when the detailed design is done for this project it may be decided to move the current line terminations to achieve a more optimal configuration for the 230 kV lines entering the substation and avoiding line crossings to the greatest extent possible.

Figure 6.2: Q044 - Panda Interconnection

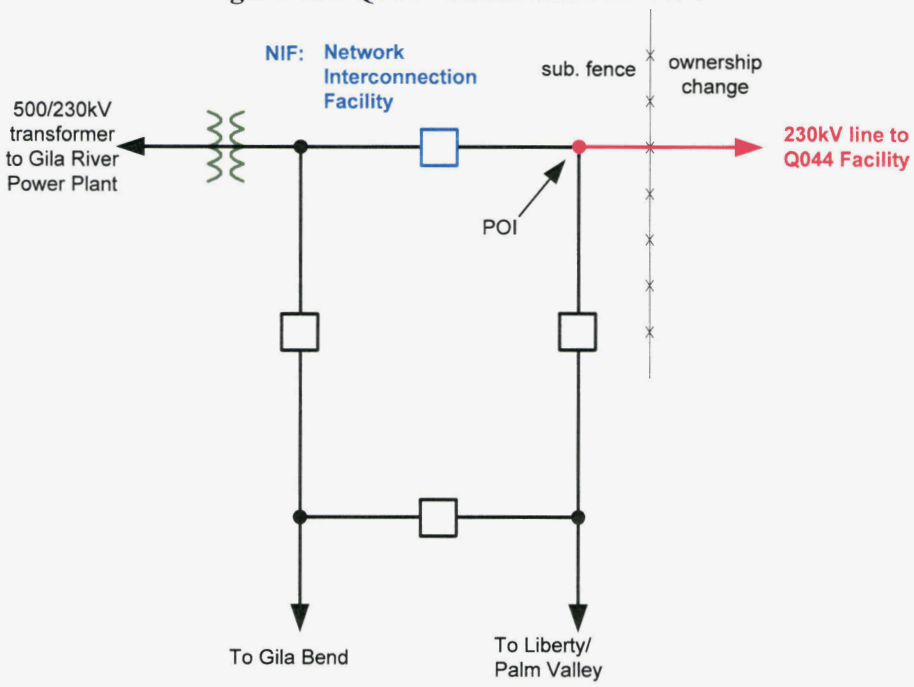


Table 6.2 Interconnection Cost Estimate for Q044 at Panda

	Panda 230 kV line bay for generator interconnection
Engineering and Design	$212,000
Below Grade	$159,000
Construction Labor (Steel, Equipment & Control)	$519,000
Steel Structures	$96,000
Electrical Equipment	$161,000
Controls & Communications	$61,000
Subtotal:	$1,208,000
Contingency: (20%)	$242,000
Totals:	**$1,450,000**

6.1. Post-Project Case 1 (Q031 and Q044)

Cost estimates for system upgrades in this section were created for the results of post-project case 1 (Q031 102 MW interconnected at Gila Bend-Paloma-Bunyan 69 kV line at Paloma and Q044 280 MW interconnected at Panda 230 kV substation) as described in results section 5.1.1.

The cost estimates for system upgrades identified in the results sections 5.1.1 will be shared between the two projects. The costs estimates assume that the 69 kV lines will be rebuilt with new structures that will be able to also accommodate the 12 kV underbuild (if already present on

the existing lines). The cost estimates for each of those lines are listed in **Table 6.3** along with the cost responsibility breakdown between each Interconnection Customer. For each of these 69 kV upgrades, the permitting, design, and construction time will be approximately 1 year in areas where the lines do not cross State Lands. In areas where State Land is crossed the permitting, design, and construction times will be approximately 2 years due to the increased time to obtain permits through the State Land Department.

Table 6.3 Estimated Costs for 69 kV System Upgrades

69 kV lines	Cost Responsibility	Estimated Cost
Cotton Center-Butterfield Tap 69 kV line upgrade (5 miles)	Q031 and Q044 share 50/50	$2,770,000
Butterfield Tap-Gila Bend 69 kV line upgrade (6 miles)	Q031 and Q044 share 50/50	$3,324,000
Cotton Center-Gillespie 69 kV line upgrade (7.5 miles)	Q031 and Q044 share pro-rata (102 MW/280 MW)	$4,155,000
	Q031 Total	$4,156,450
	Q041 Total	$6,092,550

The costs responsibility for upgrading the Cotton Center-Butterfield Tap and Butterfield Tap-Gila Bend 69 kV lines are split equally between Q031 and Q044 because both projects would trigger the need to upgrade those lines independently. The cost for upgrading the Cotton Center-Gillespie 69 kV line is shared pro-rata (Q031 102 MW/Q044 280 MW).

6.2. Post-Project Case 2 (Q031)

Cost estimates for interconnection facilities and system upgrades in this section were created for the results of post-project case 2 (Q031 102 MW interconnected at Gila Bend-Paloma-Bunyan 69 kV line at Paloma and no Q044) as described in results section 5.1.2.

The costs estimates for system upgrades identified in results section 5.1.2 assume that the 69 kV lines will be rebuilt with new structures that will be able to also accommodate the 12 kV underbuild (if already present on the existing lines). The cost estimates for each of those lines are listed in **Table 6.4**. For each of these 69 kV upgrades, the permitting, design, and construction time will be approximately 1 year in areas where the lines do not cross State Lands. In areas where State Land is crossed the permitting, design, and construction times will be approximately 2 years due to the increased time to obtain permits through the State Land Department.

Table 6.4 Estimated Costs for System Upgrades

69kV lines	Estimated Cost
Cotton Center-Butterfield Tap 69 kV line upgrade (5 miles)	$2,770,000
Butterfield Tap-Gila Bend 69 kV line upgrade (6 miles)	$3,324,000
Total	$6,094,000

6.3. Post-Project Case 3 (Q044)

Cost estimates for interconnection facilities and system upgrades in this section were created for the results of post-project case 3 (Q044 280 MW interconnected at Panda 230 kV substation and no Q031) as described results section 5.1.3.

The costs estimates for system upgrades identified in results section 5.1.3 assume that the 69 kV lines will be rebuilt with new structures that will be able to also accommodate the 12 kV underbuild (if already present on the existing lines). The cost estimates for each of those lines are listed in **Table 6.5**. For each of these 69 kV upgrades, the permitting, design, and construction time will be approximately 1 year in areas where the lines do not cross State Lands. In areas where State Land is crossed the permitting, design, and construction times will be approximately 2 years due to the increased time to obtain permits through the State Land Department.

Table 6.5 Estimated Costs for System Upgrades

System Upgrades	Estimated Cost
Cotton Center-Butterfield Tap 69 kV line upgrade (5 miles)	$2,770,000
Butterfield Tap-Gila Bend 69 kV line upgrade (6 miles)	$3,324,000
Total	$6,094,000

Appendix A - Contingency List

1 N-0 BASECASE (All Lines in Svc.)
2 N.GILA-IMPERIAL VALLEY 500kV Line 1
3 IMPERIAL VALLEY-MIGUEL 500kV Line 1
4 IMPERIAL VALLEY-MIGUEL 500kV Line (incl. SPS)
5 PALO VERDE-DEVERS 500kV Line 1
6 HARQJNCT-DEVERS 500kV Line 1
7 DEVERS(LA)-HESPERIA 500kV Line 1
8 MOHAVE-ELDORADO 500kV Line 1
9 CRYSTAL-MCCULLOUGH 500kV Line 1
10 BROWNING-SILVERKG 500kV Line 1
11 CHOLLA-SAGUARO 500kV Line 1
12 CORONADO-SECNOL 500kV Line 1
13 CORONADO-SILVERKG 500kV Line 1
14 DINOSAUR-BROWNING 500kV Line 1
15 DRPP-FCW 500kV Line 1
16 DRPP-FCW 500kV Line 2
17 FOURCORN-FCW 500kV Line 1
18 FOURCORN-MOENKOPI 500kV Line 1
19 HARQJNCT-SNVLY 500kV Line 1
20 HASSYAMP-HARQJNCT 500kV Line 1
21 HASSYAMP-JOJOBA 500kV Line 1
22 HASSYAMP-N.GILA 500kV Line 1
23 HASSYAMP-PALOVRDE 500kV Line 1
24 HASSYAMP-PALOVRDE 500kV Line 2
25 HASSYAMP-PALOVRDE 500kV Line 3
26 HASSYAMP-PINAL_W 500kV Line 1
27 HASSYAMP-REDHAWK 500kV Line 1
28 HASSYAMP-REDHAWK 500kV Line 2
29 JOJOBA-GILARIVR 500kV Line 1
30 JOJOBA-GILARIVR 500kV Line 2
31 JOJOBA-KYRENE 500kV Line 1
32 KYRENE-BROWNING 500kV Line 1
33 MEAD-MARKETPL 500kV Line 1
34 MEAD-PERKINS 500kV Line 1
35 MOENKOPI-ELDORDO 500kV Line 1
36 MOENKOPI-RME 500kV Line 1
37 MOENKOPI-YAVAPAI 500kV Line 1
38 NAVAJO-CRYSTAL 500kV Line 1
39 Deleted Island: Load 0 MW, Generation 0 MW
39 NAVAJO-RME 500kV Line 1
40 NAVAJO-VV1 500kV Line 1
41 PALOVRDE-RUDD 500kV Line 1
42 PALOVRDE-WESTWING 500kV Line 1
43 PALOVRDE-WESTWING 500kV Line 2
44 PERKINPS-PERK PS2 500kV Line 1
45 PERKINPS-PERK PS1 500kV Line 1
46 PERKINPS-WESTWING 500kV Line 1
47 PERKINS-PERKINPS 500kV Line 1
48 PINAL_SO-SES 500kV Line 1
49 PINAL_SOUTH-TORTOLITA 500kV Line 1
50 PINAL_W-SNTAROSA 500kV Line 1
51 RACEWAY-PNPKAPS 500kV Line 1
52 RACEWAY-WESTWING 500kV Line 1
53 RME-FCW 500kV Line 1
54 SAGUARO-TORTOLITA 500kV Line 1
55 SAGUARO-TORTOLITA 500kV Line 2
56 SECNOL-CHOLLA 500kV Line 1
57 SES-DINOSAUR 500kV Line 1
58 SNTAROSA-PINAL_SOUTH 500kV Line 1
59 VV1-RACEWAY 500kV Line 1
60 YAVAPAI-WESTWING 500kV Line 1
61 BICKNELL-VAIL 345kV Line 1
62 CHOLLA-PNPKAPS 345kV Line 1
63 CHOLLA-PRECHCYN 345kV Line 1
64 FLAGSTAF-GLENCANY 345kV Line 1
65 FLAGSTAF-GLENCANY 345kV Line 2
66 FLAGSTAF-PINPKBRB 345kV Line 1
67 FLAGSTAF-PINPKBRB 345kV Line 2
68 FOURCORN-CHOLLA 345kV Line 1
69 FOURCORN-CHOLLA 345kV Line 2
70 FOURCORN-SAN_JUAN 345kV Line 1
71 GREENLEE-COPPERVR 345kV Line 1
72 GREENLEE-WILLOW 345kV Line 1
73 GREENLEE-WINCHSTR 345kV Line 1
74 GREEN-SW-GREENLEE 345kV Line 1
75 LIBERTY-PEACOCK 345kV Line 1
76 MAZATZAL-PNPKAPS 345kV Line 1
77 MCKINLEY-SPRINGR 345kV Line 1
78 PEACOCK-MEAD 345kV Line 1
79 PINALWES-SOUTH 345kV Line 1
80 PRECHCYN-MAZATZAL 345kV Line 1
81 SAN_JUAN-MCKINLEY 345kV Line 1
82 SAN_JUAN-MCKINLEY 345kV Line 2
83 SHIPROCK-FOURCORN 345kV Line 1
84 SOUTH-GATEWAY 345kV Line 1
85 SOUTH-GATEWAY 345kV Line 2
86 SPRINGR-CORONADO 345kV Line 1
87 SPRINGR-GREENLEE 345kV Line 1
88 SPRINGR-VAIL2 345kV Line 1
89 VAIL-SOUTH 345kV Line 1
90 WESTWING-PINALWES 345kV Line 1
91 WILLOW-BOWIE 345kV Line 1
92 WILLOW-BOWIE 345kV Line 2
93 WINCHSTR-VAIL 345kV Line 1
94 WINCHSTR-WILLOW 345kV Line 1
95 AGUAFRIA-ALEXANDR 230kV Line 1
96 AGUAFRIA-WESTWNGW 230kV Line 1
97 AGUAFRIA-WHITETNK 230kV Line 1
98 ANDERSON-KYR-NEW 230kV Line 1
99 APACHE-BUTERFLD 230kV Line 1
100 APACHE-RED TAIL 230kV Line 1
101 APACHE-WINCHSTR 230kV Line 1
102 AVERY-RACEWAY 230kV Line 1
103 AVERY-TS6 230kV Line 1
104 BRANDOW-KYRENE 230kV Line 1
105 BRANDOW-PAPAGOBT 230kV Line 1
106 BRANDOW-WARD 230kV Line 1
107 BRANDOW-WARD 230kV Line 2
108 BROWNING-DINOSAUR 230kV Line 1
109 BROWNING-SANTAN 230kV Line 1
110 BUCKEYE-LIBERTY 230kV Line 1 (incl. closing Buckeye backtie).
111 BUCKEYTP-LIBERTY 230kV Line 1
112 BUTERFLD-SAN RAF 230kV Line 1
113 BUTERFLD-SLOAN 230kV Line 1
114 CACTUS-OCOTILLO 230kV Line 1
115 CHOLLA-LEUPP 230kV Line 1
116 COOLIDGE-SUN ARIZ 230kV Line 1
117 COOLIDGE-SUN ARIZ 230kV Line 2
118 COPPERVR-FRISCO 230kV Line 1
119 CORBELL-KYRENE 230kV Line 1
120 CTRYCLUB-GRNDTRML 230kV Line 1
121 CTRYCLUB-LINCSTRT 230kV Line 1
122 CTRYCLUB-MEADOWBK 230kV Line 1
123 DAVIS-MCCULLGH 230kV Line 1
124 DAVIS-MEAD N 230kV Line 1
125 DAVIS-RIVIERA 230kV Line 1

126 DAVIS-TOPOCK 230kV Line 2
127 DAVIS-ZORB 230kV Line 1
128 DBG-CASGRAPS 230kV Line 1
129 DBG-PINAL_S 230kV Line 1
130 DEERVALY-ALEXANDR 230kV Line 1
131 DEERVALY-PINPKSRP 230kV Line 1
132 DEERVALY-WESTWNGE 230kV Line 1
133 DOSCONDO-HACKBERY 230kV Line 1
134 EAGLEYE-BUCKEYTP 230kV Line 1
135 EL SOL-AGUAFRIA 230kV Line 1
136 EL SOL-WHTNKAPS 230kV Line 1
137 FORTROCK-JUNIPRMT 230kV Line 1
138 FORTROCK-ROUNDVLY 230kV Line 1
139 FOURCORN-PILLAR 230kV Line 1
140 GAVILNPK-GAVILNWA 230kV Line 1
141 GILA-NGL-E 230kV Line 1
142 GILA-NGL-W 230kV Line 1
143 GILARIVR-GILABEND 230kV Line 1
144 GILARIVR-GILABEND 230kV Line (open Gillespie 69kV)
145 GLEN CYN PST-NAVAJO 230kV Line 1
146 GLENDALE-GLENDALW 230kV Line 1
147 GLENDALE-GRNDTRML 230kV Line 1
148 GLENDALW-AGUAFRIA 230kV Line 1
149 GOLDFELD-SILVERKG 230kV Line 1
150 GOLDFELD-THUNDRST 230kV Line 1
151 GOLDFELD-THUNDRST 230kV Line 2
152 GRIFFITH-PEACOCK 230kV Line 1
153 HACKBERY-MORENCI 230kV Line 1
154 LIBERTY-HASSYAMP-HARCUVAR 230kV Ckt.
155 HILLTOP-MCCONICO 230kV Line 1
156 HOVRA1A2-MEAD S 230kV Line 1
157 HOVRA5A6-MEAD S 230kV Line 1
158 HOVRA7-9-MEAD S 230kV Line 1
159 HOVRN1N2-MEAD S 230kV Line 1
160 HOVRN3N4-MEAD S 230kV Line 1
161 HOVRN5N6-MEAD S 230kV Line 1
162 HOVRN7N8-MEAD S 230kV Line 1
163 JOJOBA-GILARIVR 230kV Line 1
164 JOJOBA-TS4-LIBERTY/PALMVLY 230kV Ckt.
165 JUNIPRMT-SELIGMAN 230kV Line 1
166 KAYENTA-LNGHOUSE 230kV Line 1
167 KAYENTA-SHIPROCK 230kV Line 1
168 KYRENE-SCHRADER 230kV Line 1
169 KYR-NEW-KNOX 230kV Line 1
170 KYR-NEW-OCOTILLO 230kV Line 1
171 LEUPP-COCONINO 230kV Line 1
172 LIBERTY-PHXWAPA 230kV Line 1
173 LIBERTY-WESTWNGW 230kV Line 1
174 LIBTYPHS-LIBERTY 230kV Line 2
175 LINCSTRT-WPHXAPSN 230kV Line 1
176 LONE BUT-LIBERTY 230kV Line 1
177 LONE BUT-SUN ARIZ 230kV Line 1
178 LONE BUT-TESTTRAK 230kV Line 1
179 LONEPEAK-SUNYSLOP 230kV Line 1
180 MCCONICO-DAVIS 230kV Line 1
181 MCCONICO-GRIFFITH 230kV Line 1
182 MEAD N-HVRA3A4 230kV Line 1
183 MEAD S-MEAD N 230kV Line 1
184 MEAD S-MEAD N 230kV Line 2
185 MEADOWBK-SUNYSLOP 230kV Line 1
186 MILLIGAN-CASGRAPS 230kV Line 1
187 MORENCI-GREEN-SW 230kV Line 1
188 MORENCI-PD-MORNC 230kV Line 1
189 N.WADDEL-RACEWAY 230kV Line 1
190 NAVAJO-LNGHOUSE 230kV Line 1
191 OCOTILLO-LINCSTRT 230kV Line 1
192 OCOTILLO-PNPKAPS 230kV Line 1
193 ORME-ANDERSON 230kV Line 1
194 ORME-ANDERSON 230kV Line 2
195 ORME-RUDD 230kV Line 1
196 ORME-RUDD 230kV Line 2
197 PANTANO-SAHUARIT 230kV Line 1
198 PAPAGOBT-KYR-NEW 230kV Line 1
199 PAPAGOBT-PINPKSRP 230kV Line 1
200 PARKER-BLK MESA 230kV Line 1
201 PARKER-EAGLEYE 230kV Line 1
202 PARKER-GENE 230kV Line 1
203 PARKER-HARCUVAR 230kV Line 1
204 PARKER-HAVASU 230kV Line 1
205 PARKER-N.HAVASU 230kV Line 1
206 PD-MORNC-FRISCO 230kV Line 1
207 PEACOCK-HILLTOP 230kV Line 1
208 PHXWAPA-LONE BUT 230kV Line 1
209 PINPK-GAVILNWA 230kV Line 1
210 PINPK-PINPKSRP 230kV Line 1
211 PINPK-PINPKSRP 230kV Line 2
212 PINPKSRP-BRANDOW 230kV Line 1
213 PINPKSRP-BRANDOW 230kV Line 2
214 PNPKAPS-CACTUS 230kV Line 1
215 PNPKAPS-LONEPEAK 230kV Line 1
216 PNPKAPS-PINPK 230kV Line 1
217 PNPKAPS-PINPK 230kV Line 2
218 PNPKAPS-PINPKSRP 230kV Line 1
219 PNPKAPS-PINPKSRP 230kV Line 2
220 PNPKAPS-REACH 230kV Line 1
221 PRSCOTWA-GAVILNWA 230kV Line 1
222 PRSCOTWA-PRESCOTT 230kV Line 1
223 RACEWAY-WESTWNGE 230kV Line 1
224 REACH-LONEPEAK 230kV Line 1
225 RED TAIL-DOSCONDO 230kV Line 1
226 RNDVLYTP-PEACOCK 230kV Line 1
227 RNDVLYTP-PRSCOTWA 230kV Line 1
228 RNDVLYTP-ROUNDVLY 230kV Line 1
229 ROGERS-THUNDRST 230kV Line 1
230 ROGERSWA-PINPK 230kV Line 1
231 ROGERSWA-PINPK 230kV Line 2
232 ROGERSWA-ROGERS 230kV Line 1
233 ROGERSWA-ROGERS 230kV Line 2
234 ROGERSWA-SPOOKHIL 230kV Line 1
235 RUDD-PLMVLY 230kV Line 1
236 RUDD-WHITETNK 230kV Line 1
237 RUDD-WPHXAPSS 230kV Line 1
238 SAGUARO-MILLIGAN 230kV Line 1
239 SAGUARO-TATMOMLI 230kV Line 1
240 SAHUARIT-BICKNELL 230kV Line 1
241 SANTAN-CORBELL 230kV Line 1
242 SANTAN-THUNDRST 230kV Line 1
243 SCHRADER-SANTAN 230kV Line 1
244 SEV-DINOSAUR 230kV Line 1
245 SLOAN-PANTANO 230kV Line 1
246 SLRC-GILA 230kV Line 1
247 SLRC-GILA 230kV Line 2
248 SNTAROSA-DBG 230kV Line 1
249 SNTAROSA-KNOX 230kV Line 1
250 SNTAROSA-TATMOMLI 230kV Line 1
251 SNTAROSA-TESTTRAK 230kV Line 1

252 SNVLY-HASSYAMP 230kV Line 1
253 SNVLY-TS1 230kV Line 1
254 SPOOKHIL-COOLIDGE 230kV Line 1
255 SUN ARIZ-PINAL_S 230kV Line 1
256 SURPRISE-EL SOL 230kV Line 1
257 SURPRISE-WESTWNGW 230kV Line 1
258 TESTTRAK-CASAGRND 230kV Line 1
259 TOPOCK-BLK MESA 230kV Line 1
260 TOPOCK-N.HAVASU 230kV Line 1
261 TOPOCK-SOPOINT 230kV Line 1
262 TOPOCK-SOPOINT 230kV Line 2
263 TS1-TS2 230kV Line 1
264 TS2-PLMVLY 230kV Line 1
265 TS6-PNPKAPS 230kV Line 1
266 VERDE S-COCONINO 230kV Line 1
267 VERDE S-VERDE N 230kV Line 1
268 WESTWNGW-PINPK 230kV Line 1
269 WHTNKAPS-RUDD 230kV Line 1
270 WILOWLKE-WILOWLKW 230kV Line 1
271 WILOWLKE-YAVAPAI 230kV Line 1
272 WILOWLKW-PRESCOTT 230kV Line 1
273 WPHXAPSN-WHTNKAPS 230kV Line 1
274 YAVAPAI-VERDE N 230kV Line 1
275 ZORB-TOPOCK 230kV Line 1
276 BLYTHE-BLYTHEAZ 161kV Line 1
277 BLYTHE-BUCKBLVD 161kV Line 1
278 BLYTHE-GOLDMNTP 161kV Line 1
279 BLYTHE-HEADGATE 161kV Line 1
280 BOUSE-BLACK PK 161kV Line 1
281 BOUSE-KOFA 161kV Line 1
282 GILA-DOME TAP 161kV Line 1
283 GILA-KNOB 161kV Line 1
284 GOLDMNTP-KNOB 161kV Line 1
285 KNOB-DESALTER 161kV Line 1
286 KOFA-DOME TAP 161kV Line 1
287 PARKER-BLYTHE 161kV Line 1
288 PARKER-BOUSE 161kV Line 1
289 PARKER-HEADGATE 161kV Line 1
290 WLTNMOHK-DOME TAP 161kV Line 1
291 WLTNMOHK-GILA 161kV Line 1
292 ESTRLLTA-GY5 69kV Line
293 BUNYAN-AGUACAL-HYDER 69kV Ckt.
294 HYDER-AZTEC-HORN 69kV Ckt.
295 SADDLEMT-HY1 69kV Line
296 GILABEND-THAYER-AJO-WHY 69kV Ckt.
297 GILABEND-PALOMA-BUNYAN 69kV Ckt.
298 GILLWEST-ARLINTAP-PVNGPUMP 69kV Ckt.
299 WATSON-PERYVL-VALNCA-BASELIN-PVPMP 69kV Ckt.
300 PVNGPUMP-WINTERTP-ARLNGTON 69kV Ckt.
301 WINTRBRG-ARLNGTON 69kV Line 1
302 BUCKEYE-CLBRN-DSRTSKY-WNTRBRG-TNPAH-HARQ 69kV Ckt
303 GILABEND-BUTERFLD-COTN CTR-GILLESPI 69kV Ckt.
304 GILLESPI-PATTERSN 69kV Line
305 JOJOBA-PATTERSN 69kV Line
306 JOJOBA-GY5 69kV Ckt.
307 BUCKEYE-WATSON W 69kV Line
308 BUCKEYE-SV4 69kV Line
309 SV4-SV13 69kV Line
310 BUCKEYE-ROBBINBT-RAINBWTP-JOJOBA 69kV Ckt.
311 GILLESPI-GILLWEST 69kV Tie
312 PERRYVIL-WS4 69kV Line
313 CHOLLA 500/345kV Xfmr. 1
314 CHOLLA 500/345kV Xfmr. 2
315 CORONADO 500/345kV Xfmr. 1
316 CORONADO 500/345kV Xfmr. 2
317 FOURCORN 500/345kV Xfmr. 1
318 PINAL_W 500/345kV Xfmr. 1
319 WESTWING 500/345kV Xfmr. 1
320 BROWNING 500/230kV Xfmr. 1
321 BROWNING 500/230kV Xfmr. 2
322 GILARIVR 500/230kV Xfmr. 1
323 KYRENE 500/230kV Xfmr. 6
324 KYRENE 500/230kV Xfmr. 7
325 KYRENE 500/230kV Xfmr. 8
326 MEAD (N) 500/230kV Xfmr. 1
327 MEAD (N) 500/230kV Xfmr. 2
328 N.GILA (E) 500/230kV Xfmr. 1
329 N.GILA (W) 500/230kV Xfmr. 1
330 PINAL SO. 500/230kV Xfmr. 1
331 PNPKAPS 500/230kV Xfmr. 1
332 PNPKAPS 500/230kV Xfmr. 2
333 PNPKAPS 500/230kV Xfmr. 3
334 RACEWAY 500/230kV Xfmr. 1
335 RACEWAY 500/230kV Xfmr. 2
336 RUDD 500/230kV Xfmr. 1
337 RUDD 500/230kV Xfmr. 2
338 RUDD 500/230kV Xfmr. 3
339 RUDD 500/230kV Xfmr. 4
340 SES 500/230kV Xfmr. 1
341 SILVERKG 500/230kV Xfmr. 1
342 SNVLY 500/230kV Xfmr. 1
343 WESTWING 500/230kV Xfmr. 1
344 WESTWING 500/230kV Xfmr. 2
345 WESTWING 500/230kV Xfmr. 3
346 YAVAPAI 500/230kV Xfmr. 1
347 YAVAPAI 500/230kV Xfmr. 2
348 TORTOLIT 500/138kV Xfmr. 1
349 TORTOLIT 500/138kV Xfmr. 2
350 SAGUARO 500/115kV Xfmr. 1
351 SAGUARO 500/115kV Xfmr. 1
352 CORONADO 500/69kV Xfmr. 1
353 N.GILA 500/69kV Xfmr. 1
354 N.GILA 500/69kV Xfmr. 2
355 SECNOL 500/69kV Xfmr. 1
356 VV1 500/69kV Xfmr. 1
357 BICKNELL 345/230kV Xfmr. 1
358 CHOLLA 345/230kV Xfmr. 1
359 COPPERVR 345/230kV Xfmr. 1
360 FOURCORN 345/230kV Xfmr. 1
361 FOURCORN 345/230kV Xfmr. 2
362 GLENCANY 345/230kV Xfmr. 1
363 GLENCANY 345/230kV Xfmr. 2
364 GREEN-SW 345/230kV Xfmr. 1
365 GREEN-SW 345/230kV Xfmr. 2
366 LIBERTY 345/230kV Xfmr. 1
367 MEAD (N) 345/230kV Xfmr. 1
368 PEACOCK 345/230kV Xfmr. 1
369 PINPKBRB 345/230kV Xfmr. 1
370 PINPKBRB 345/230kV Xfmr. 2
371 PINPKBRB 345/230kV Xfmr. 3
372 PNPKAPS 345/230kV Xfmr. 1
373 PNPKAPS 345/230kV Xfmr. 2
374 PNPKAPS 345/230kV Xfmr. 3
375 SHIPROCK 345/230kV Xfmr. 1
376 WINCHSTR 345/230kV Xfmr. 1
377 SOUTH 345/138kV Xfmr. 1

378 SOUTH 345/138kV Xfmr. 2
379 VAIL 345/138kV Xfmr. 1
380 VAIL2 345/138kV Xfmr. 1
381 GATEWAY 345/115kV Xfmr. 1
382 CHOLLA 345/69kV Xfmr. 1
383 FLAGSTAF 345/69kV Xfmr. 2
384 MAZATZAL 345/69kV Xfmr. 2
385 PRECHCYN 345/69kV Xfmr. 1
386 PRECHCYN 345/69kV Xfmr. 2
387 GLEN CYN 230kV PST Xfmr. 1
388 SHIPROCK 230kV PST Xfmr. 1
389 GILA 230/161kV Xfmr. 1
390 PARKER 230/161kV Xfmr. 1
391 PARKER 230/161kV Xfmr. 2
392 APACHE 230/115kV Xfmr. 1
393 APACHE 230/115kV Xfmr. 2
394 BICKNELL 230/115kV Xfmr. 1
395 BICKNELL 230/115kV Xfmr. 2
396 CASAGRND 230/115kV Xfmr. 1
397 COOLIDGE 230/115kV Xfmr. 1
398 COOLIDGE 230/115kV Xfmr. 2
399 GOLDFELD 230/115kV Xfmr. 1
400 GOLDFELD 230/115kV Xfmr. 2
401 HARCUVAR 230/115kV Xfmr. 1
402 PANTANO 230/115kV Xfmr. 1
403 PRESCOTT 230/115kV Xfmr. 1
404 PRESCOTT 230/115kV Xfmr. 2
405 SAGUARO (E) 230/115kV Xfmr. 1
406 SAGUARO (W) 230/115kV Xfmr. 1
407 SHIPROCK 230/115kV Xfmr. 1
408 SILVERKG 230/115kV Xfmr. 1
409 SILVERKG 230/115kV Xfmr. 1
410 SNTAROSA 230/115kV Xfmr. 1
411 AF-NORTH 230/69kV Xfmr. 3
412 AF-NORTH 230/69kV Xfmr. 4
413 AGUAFRIA 230/69kV Xfmr. 1
414 ALEXANDR 230/69kV Xfmr. 1
415 ALEXANDR 230/69kV Xfmr. 2
416 ALEXANDR 230/69kV Xfmr. 1
417 ANDERSRS 230/69kV Xfmr. 1
418 ANDERSRS 230/69kV Xfmr. 2
419 ANDERSRS 230/69kV Xfmr. 3
420 ANDERSRS 230/69kV Xfmr. 4
421 BLKMESA1 230/69kV Xfmr. 1
422 BLKMESA2 230/69kV Xfmr. 1
423 BLKMSA34 230/69kV Xfmr. 1
424 BLKMSA34 230/69kV Xfmr. 2
425 BRANDOW 230/69kV Xfmr. 1
426 BRANDOW 230/69kV Xfmr. 2
427 BRANDOW 230/69kV Xfmr. 3
428 BROWNING 230/69kV Xfmr. 4
429 BUCKEYE 230/69kV Xfmr. 1
430 BUCKEYE 230/69kV Xfmr. 2
431 CACTUS 230/69kV Xfmr. 1
432 CACTUS 230/69kV Xfmr. 1
433 CACTUS 230/69kV Xfmr. 1
434 CASGRAPS 230/69kV Xfmr. 1
435 CHOLLA 230/69kV Xfmr. 1
436 CHOLLA 230/69kV Xfmr. 1
437 COCONINO 230/69kV Xfmr. 1
438 COCONINO 230/69kV Xfmr. 2
439 CORBELRS 230/69kV Xfmr. 2
440 CORBELRS 230/69kV Xfmr. 3
441 CORBELRS 230/69kV Xfmr. 4
442 CTRYCLBN 230/69kV Xfmr. 1
443 CTRYCLBS 230/69kV Xfmr. 1
444 DAVIS 230/69kV Xfmr. 1
445 DEERVALY C 230/69kV Xfmr. 2
446 DEERVALY E 230/69kV Xfmr. 1
447 DEERVALY W 230/69kV Xfmr. 1
448 DINOSAUR 230/69kV Xfmr. 1
449 DOSCONDO 230/69kV Xfmr. 1
450 DOSCONDO 230/69kV Xfmr. 2
451 EAGLEYE (E) 230/69kV Xfmr. 1
452 EAGLEYE (W) 230/69kV Xfmr. 1
453 EL SOL 230/69kV Xfmr. 1
454 EL SOL 230/69kV Xfmr. 1
455 FOURCORN 230/69kV Xfmr. 1
456 GAVILNPK 230/69kV Xfmr. 1
457 GILABEND 230/69kV Xfmr. 1
458 GILABEND 230/69kV Xfmr. 2
459 GRIFFITH 230/69kV Xfmr. 1
460 HACKBERY 230/69kV Xfmr. 1
461 HACKBERY 230/69kV Xfmr. 2
462 HILLTOP1 230/69kV Xfmr. 1
463 HILLTOP2 230/69kV Xfmr. 1
464 KNOX 230/69kV Xfmr. 2
465 KYRENEGT 230/69kV Xfmr. 2
466 KYRENEGT 230/69kV Xfmr. 3
467 KYRENEGT 230/69kV Xfmr. 4
468 LINCSTRT 230/69kV Xfmr. 1
469 LONE BUT 230/69kV Xfmr. 1
470 LONEPEAK (E) 230/69kV Xfmr. 1
471 LONEPEAK (W) 230/69kV Xfmr. 1
472 MEAD S (A) 230/69kV Xfmr. 1
473 MEAD S (B) 230/69kV Xfmr. 1
474 MEADOWBK 230/69kV Xfmr. 1
475 MILLIGAN 230/69kV Xfmr. 1
476 N.HAVASU 230/69kV Xfmr. 1
477 OCOTIL N 230/69kV Xfmr. 1
478 OCOTIL S 230/69kV Xfmr. 1
479 ORME RS 230/69kV Xfmr. 1
480 ORME RS 230/69kV Xfmr. 2
481 ORME RS 230/69kV Xfmr. 3
482 ORME RS 230/69kV Xfmr. 4
483 PAPAGOBT 230/69kV Xfmr. 1
484 PAPAGOBT 230/69kV Xfmr. 2
485 PAPAGOBT 230/69kV Xfmr. 3
486 PAPAGOBT 230/69kV Xfmr. 4
487 PLMVLY 230/69kV Xfmr. 1
488 PINNPK E 230/69kV Xfmr. 1
489 PINNPK W 230/69kV Xfmr. 1
490 PINPKEST 230/69kV Xfmr. 1
491 PINPKEST 230/69kV Xfmr. 2
492 RACEWAY 230/69kV Xfmr. 1
493 REACH 230/69kV Xfmr. 1
494 REACH 230/69kV Xfmr. 2
495 RED TAIL 230/69kV Xfmr. 1
496 RIVIERA 230/69kV Xfmr. 1
497 RIVIERA 230/69kV Xfmr. 2
498 ROGERS 230/69kV Xfmr. 2
499 ROGERS 230/69kV Xfmr. 4
500 ROUNDVLY 230/69kV Xfmr. 1
501 SAN RAF 230/69kV Xfmr. 1
502 SANTAN 230/69kV Xfmr. 3
503 SANTAN 230/69kV Xfmr. 4

504 SANTAN 230/69kV Xfmr. 5
505 SCHRADER 230/69kV Xfmr. 1
506 SCHRADER 230/69kV Xfmr. 3
507 SCHRADER 230/69kV Xfmr. 4
508 SEV 230/69kV Xfmr. 1
509 SLOAN 230/69kV Xfmr. 1
510 SNTAROSA 230/69kV Xfmr. 1
511 SPOOKHIL 230/69kV Xfmr. 1
512 SPOOKHIL 230/69kV Xfmr. 2
513 SUNYSLOP 230/69kV Xfmr. 1
514 SUNYSLOP 230/69kV Xfmr. 1
515 SURPRISC 230/69kV Xfmr. 1
516 SURPRISN 230/69kV Xfmr. 1
517 SURPRISS 230/69kV Xfmr. 1
518 TESTTRAK 230/69kV Xfmr. 1
519 THUNDRST 230/69kV Xfmr. 1
520 THUNDRST 230/69kV Xfmr. 2
521 THUNDRST 230/69kV Xfmr. 3
522 THUNDRST 230/69kV Xfmr. 4
523 TOPOCK 230/69kV Xfmr. 1
524 TS1 230/69kV Xfmr. 1
525 TS6 230/69kV Xfmr. 1
526 VERDE N 230/69kV Xfmr. 1
527 VERDE S 230/69kV Xfmr. 1
528 WARD RS 230/69kV Xfmr. 1
529 WARD RS 230/69kV Xfmr. 2
530 WESTWNGE 230/69kV Xfmr. 1
531 WESTWNGE 230/69kV Xfmr. 2
532 WHITETNK 230/69kV Xfmr. 1
533 WHITETNK 230/69kV Xfmr. 3
534 WHTNKAPS 230/69kV Xfmr. 1
535 WHTNKAPS 230/69kV Xfmr. 1
536 WILOWLK (E) 230/69kV Xfmr. 1
537 WILOWLK (W) 230/69kV Xfmr. 1
538 WPHXAPSC 230/69kV Xfmr. 1
539 WPHXAPSN 230/69kV Xfmr. 1
540 WPHXAPSS 230/69kV Xfmr. 1
541 YAVAPAI 230/69kV Xfmr. 1
542 BLACK PK 161/69kV Xfmr. 1
543 GILA 161/69kV Xfmr. 1
544 GILA 161/69kV Xfmr. 2
545 HEADGATE 161/69kV Xfmr. 1
546 KOFA 161/69kV Xfmr. 1
547 PARKER 161/69kV Xfmr. 1
548 YUCCA W 161/69kV Xfmr. 1
549 YUCCA W 161/69kV Xfmr. 2
550 SANLUIS 69/34.5kV Xfmr. 1
551 SONORA 69/34.5kV Xfmr. 1
552 (G-1) Desert Rock PP G1
553 (G-1) Desert Rock PP G2
554 (G-1) Gila River CT1
555 (G-1) Gila River CT2
556 (G-1) Gila River ST1
557 (G-1) Gila River CT3
558 (G-1) Gila River CT4
559 (G-1) Gila River ST2
560 (G-1) Gila River CT5
561 (G-1) Gila River CT6
562 (G-1) Gila River ST3
563 (G-1) Gila River CT7
564 (G-1) Gila River CT8
565 (G-1) Gila River ST4
566 (G-1) Cholla 1
567 (G-1) Cholla 2
568 (G-1) Cholla 3
569 (G-1) Cholla 4
570 (G-1) Four Corners 1
571 (G-1) Four Corners 2
572 (G-1) Four Corners 3
573 (G-1) Four Corners 4 (CC)
574 (G-1) Four Corners 5 (CC)
575 (G-1) Ocotillo GT1
576 (G-1) Ocotillo GT2
577 (G-1) Ocotillo ST2
578 (G-1) Ocotillo ST1
579 (G-1) Palo Verde 1
580 (G-1) Palo Verde 2
581 (G-1) Palo Verde 3
582 (G-1) Saguaro 1
583 (G-1) Saguaro 2
584 (G-1) Saguaro CT2
585 (G-1) Saguaro CT1
586 (G-1) Saguaro CT3
587 (G-1) W.Phx. CC4 (ST1)
588 (G-1) W.Phx. CC1
589 (G-1) W.Phx. CC2
590 (G-1) W.Phx. CC3
591 (G-1) W.Phx. CC4 (CT1)
592 (G-1) Yucca CT1
593 (G-1) Yucca CT3
594 (G-1) Yucca CT4
595 (G-1) Yucca GEN
596 (G-1) W.Phx. CC5 (CT1)
597 (G-1) W.Phx. CC5 (CT2)
598 (G-1) W.Phx. CC5 (ST1)
599 (G-1) Red Hawk CT1
600 (G-1) Red Hawk CT2
601 (G-1) Red Hawk CT3
602 (G-1) Red Hawk CT4
603 (G-1) Red Hawk ST1
604 (G-1) Red Hawk ST2
605 (G-1) Desert Basin Gen CT1
606 (G-1) Desert Basin Gen CT2
607 (G-1) Desert Basin Gen ST1
608 (G-1) Sundance G1
609 (G-1) Sundance G2
610 (G-1) Sundance G3
611 (G-1) Sundance G4
612 (G-1) Sundance G5
613 (G-1) Sundance G6
614 (G-1) Sundance G7
615 (G-1) Sundance G8
616 (G-1) Sundance G9
617 (G-1) Sundance G10
618 (G-1) Arlington CT1
619 (G-1) Arlington CT2
620 (G-1) Arlington ST1
621 (G-1) Harquahala CT1
622 (G-1) Harquahala ST1
623 (G-1) Harquahala CT2
624 (G-1) Harquahala ST2
625 (G-1) Harquahala CT3
626 (G-1) Harquahala ST3
627 (G-1) Mesquite CT1
628 (G-1) Mesquite CT2
629 (G-1) Mesquite ST1

630 (G-1) Mesquite CT3
631 (G-1) Mesquite CT4
632 (G-1) Mesquite ST2
633 (G-1) Crosscut Hydro 1
634 (G-1) South Consolidated Hydro 1
635 (G-1) Agua Fria 1
636 (G-1) Agua Fria 2
637 (G-1) Agua Fria 3
638 (G-1) Kyrene 4
639 (G-1) Kyrene 5
640 (G-1) Kyrene 7S
641 (G-1) Kyrene 7A
642 (G-1) Santan 1
643 (G-1) Santan 2
644 (G-1) Santan 3
645 (G-1) Santan 4
646 (G-1) Santan 5S
647 (G-1) Santan 5A
648 (G-1) Santan 5B
649 (G-1) Santan 6A
650 (G-1) Santan 6S
651 (G-1) Horse Mesa 1
652 (G-1) Horse Mesa 2
653 (G-1) Horse Mesa 3
654 (G-1) Horse Mesa 4
655 (G-1) Mormon Flat 1
656 (G-1) Mormon Flat 2
657 (G-1) Roosevelt Gen 1
658 (G-1) Stewart Mtn. 1
659 (G-1) Coronado 1
660 (G-1) Coronado 2
661 (G-1) Navajo 1
662 (G-1) Navajo 2
663 (G-1) Navajo 3
664 (G-1) Springerville 1
665 (G-1) Springerville 2
666 (G-1) Springerville 3
667 (G-1) Springerville 4
668 (G-1) Sundt CT 1
669 (G-1) Sundt CT 2
670 (G-1) Sundt Gen 1
671 (G-1) Sundt Gen 2
672 (G-1) Sundt Gen 3
673 (G-1) Sundt Gen 4
674 (G-1) North Loop CT 1
675 (G-1) North Loop CT 2
676 (G-1) North Loop CT 3
677 (G-1) North Loop CT 4
678 (G-1) Demoss Petrie CT1
679 (G-1) Apache CT1
680 (G-1) Apache CT2
681 (G-1) Apache CT3
682 (G-1) Apache CT4
683 (G-1) Apache ST1
684 (G-1) Apache ST2
685 (G-1) Apache ST3
686 (G-1) Davis G1
687 (G-1) Davis G2
688 (G-1) Davis G3
689 (G-1) Davis G4
690 (G-1) Davis G5
691 (G-1) Parker G1
692 (G-1) Parker G2
693 (G-1) Parker G3
694 (G-1) Parker G4
695 (G-1) Hoover A3
696 (G-1) Hoover A4
697 (G-1) Hoover A5
698 (G-1) Hoover A6
699 (G-1) Hoover A7
700 (G-1) Hoover A1
701 (G-1) Hoover A2
702 (G-1) Hoover A8
703 (G-1) Hoover A9
704 (G-1) Hoover N1
705 (G-1) Hoover N2
706 (G-1) Hoover N3
707 (G-1) Hoover N4
708 (G-1) Hoover N5
709 (G-1) Hoover N6
710 (G-1) Hoover N7
711 (G-1) Hoover N8
712 (G-1) SLRC CT1
713 (G-1) SLRC CT2
714 (G-1) N. Waddell
715 (G-1) Headgate Rock 1
716 (G-1) Headgate Rock 2
717 (G-1) Headgate Rock 3
718 (G-1) Griffith 1
719 (G-1) Griffith 2
720 (G-1) Griffith
721 (G-1) South Point 1
722 (G-1) South Point 2
723 (G-1) South Point 3
724 (G-1) Blythe Energy 1
725 (G-1) Blythe Energy 2
726 (G-1) Blythe Energy 3
727 (G-1) Glen Canyon 1
728 (G-1) Glen Canyon 2
729 (G-1) Glen Canyon 3
730 (G-1) Glen Canyon 4
731 (G-1) Glen Canyon 5
732 (G-1) Glen Canyon 6
733 (G-1) Glen Canyon 7
734 (G-1) Glen Canyon 8
735 (G-1) Riverside 1
736 (G-1) Gila River Power Block 1 (470MW)
737 (G-1) Red Hawk Power Block 1 (470MW)
738 (G-1) Arlington-Hass. 500kV Line & Arlington Plant (575MW)
739 (G-1) Harquahala Power Block 1 (550MW)
740 Harq.-Harq. Jct. 500kV Line & Harq. Plant (1100MW)
741 (G-1) Mesquite Power Block (620MW)
742 (G-1) Mesq.-Hass. 500kV Line & Mesquite Plant (1240MW)
743 (G-1) Mesq.-Hass. 500kV Line & Mesquite Block 1 (620MW)
744 GILABEND-PALOMA 69kV Line 1
745 PALOMA-BUNYAN 69kV Line 1
746 (G-1) Q031 Plant
747 Q044-GILARIVR 230kV Line 1
748 (G-1) Q044 STG1

Appendix B - Power Flow Results

Post-Project Case 1
Q031 102 MW @ Paloma
Q044 280 MW @ Panda 230 kV

No Category A Overloads

Category B Overloads

Overloaded Element	Contingency Description	Rating (Amps)	Pre-Project Loading (%)	Post-Project Loading (%)	Delta (%)
BTRFLDTP 69.00-COTN CTR 69.00 #1 1	JOJOBA-GILARIVR 230kV Line 1	658	82	120	39
BTRFLDTP 69.00-COTN CTR 69.00 #1 1	JOJOBA-TS4-LIBERTY/PALMVLY 230kV Ckt.	658	82	120	39
BTRFLDTP 69.00-COTN CTR 69.00 #1 1	JOJOBA-KYRENE 500kV Line 1	658	80	107	27
BTRFLDTP 69.00-COTN CTR 69.00 #1 1	PALOVRDE-RUDD 500kV Line 1	658	80	106	26
BTRFLDTP 69.00-COTN CTR 69.00 #1 1	HASSYAMP-JOJOBA 500kV Line 1	658	80	106	26
BTRFLDTP 69.00-COTN CTR 69.00 #1 1	BUCKEYE 230/69kV Xfmr. 1	658	80	104	24
BTRFLDTP 69.00-COTN CTR 69.00 #1 1	PLMVLY 230/69kV Xfmr. 1	658	80	102	22
BTRFLDTP 69.00-COTN CTR 69.00 #1 1	JOJOBA-GILARIVR 500kV Line 1	658	80	100	20
BTRFLDTP 69.00-COTN CTR 69.00 #1 1	JOJOBA-GILARIVR 500kV Line 2	658	80	100	20
BTRFLDTP 69.00-GILABEND 69.00 #1 1	JOJOBA-GILARIVR 230kV Line 1	661	82	120	39
BTRFLDTP 69.00-GILABEND 69.00 #1 1	JOJOBA-TS4-LIBERTY/PALMVLY 230kV Ckt.	661	81	120	39
BTRFLDTP 69.00-GILABEND 69.00 #1 1	JOJOBA-KYRENE 500kV Line 1	661	80	106	26
BTRFLDTP 69.00-GILABEND 69.00 #1 1	PALOVRDE-RUDD 500kV Line 1	661	80	105	25
BTRFLDTP 69.00-GILABEND 69.00 #1 1	HASSYAMP-JOJOBA 500kV Line 1	661	80	105	25
BTRFLDTP 69.00-GILABEND 69.00 #1 1	BUCKEYE 230/69kV Xfmr. 1	661	80	104	24
BTRFLDTP 69.00-GILABEND 69.00 #1 1	PLMVLY 230/69kV Xfmr. 1	661	80	102	22
COTN CTR 69.00-GILLESPI 69.00 #1 1	JOJOBA-GILARIVR 230kV Line 1	658	72	111	39
COTN CTR 69.00-GILLESPI 69.00 #1 1	JOJOBA-TS4-LIBERTY/PALMVLY 230kV Ckt.	658	72	111	39
PALOMA 69.00-Q031SWST 69.00 #1 1	Q031SWST-BUNYAN 69kV Line 1	730	16	110	94
PALOMA 69.00-Q031SWST 69.00 #1 1	BUNYAN-AGUACAL-HYDER 69kV Ckt.	730	2	108	106
PALOMA 69.00-Q031SWST 69.00 #1 1	HYDER-AZTEC-HORN 69kV Ckt.	730	13	108	95

Note: the Gila Bend - Paloma 69 kV line is rated at 87.2 MVA therefore depending on the voltages and load level at Paloma 69 kV the output of Q031 could be limited for the loss of the Paloma - Bunyan 69 kV line.

Jojoba 69 kV switching station removed and Sdl Mtn - HY1 69 kV line section opened

Post-Project Case 2
Q031 102 MW @ Paloma without Q044

No Category A Overloads

Category B Overloads

Overloaded Element	Contingency Description	Rating (Amps)	Pre-Project Loading (%)	Post-Project Loading (%)	Delta (%)
BTRFLDTP 69.00-COTN CTR 69.00 #1 1	JOJOBA-GILARIVR 230kV Line 1	658	82	100	19
BTRFLDTP 69.00-COTN CTR 69.00 #1 1	JOJOBA-TS4-LIBERTY/PALMVLY 230kV Ckt.	658	82	100	19
BTRFLDTP 69.00-GILABEND 69.00 #1 1	JOJOBA-GILARIVR 230kV Line 1	661	82	100	19
BTRFLDTP 69.00-GILABEND 69.00 #1 1	JOJOBA-TS4-LIBERTY/PALMVLY 230kV Ckt.	661	81	100	19
PALOMA 69.00-Q031SWST 69.00 #1 1	Q031SWST-BUNYAN 69kV Line 1	730	16	110	94
PALOMA 69.00-Q031SWST 69.00 #1 1	BUNYAN-AGUACAL-HYDER 69kV Ckt.	730	2	108	106
PALOMA 69.00-Q031SWST 69.00 #1 1	HYDER-AZTEC-HORN 69kV Ckt.	730	13	108	95

Note: the Gila Bend - Paloma 69 kV line is rated at 87.2 MVA therefore depending on the voltages and load level at Paloma 69 kV the output of Q031 could be limited for the loss of the Paloma - Bunyan 69 kV line.

Jojoba 69 kV switching station removed and Sdl Mtn - HY1 69 kV line section opened

Post-Project Case 3
Q044 280 MW @ Panda 230 kV without Q031

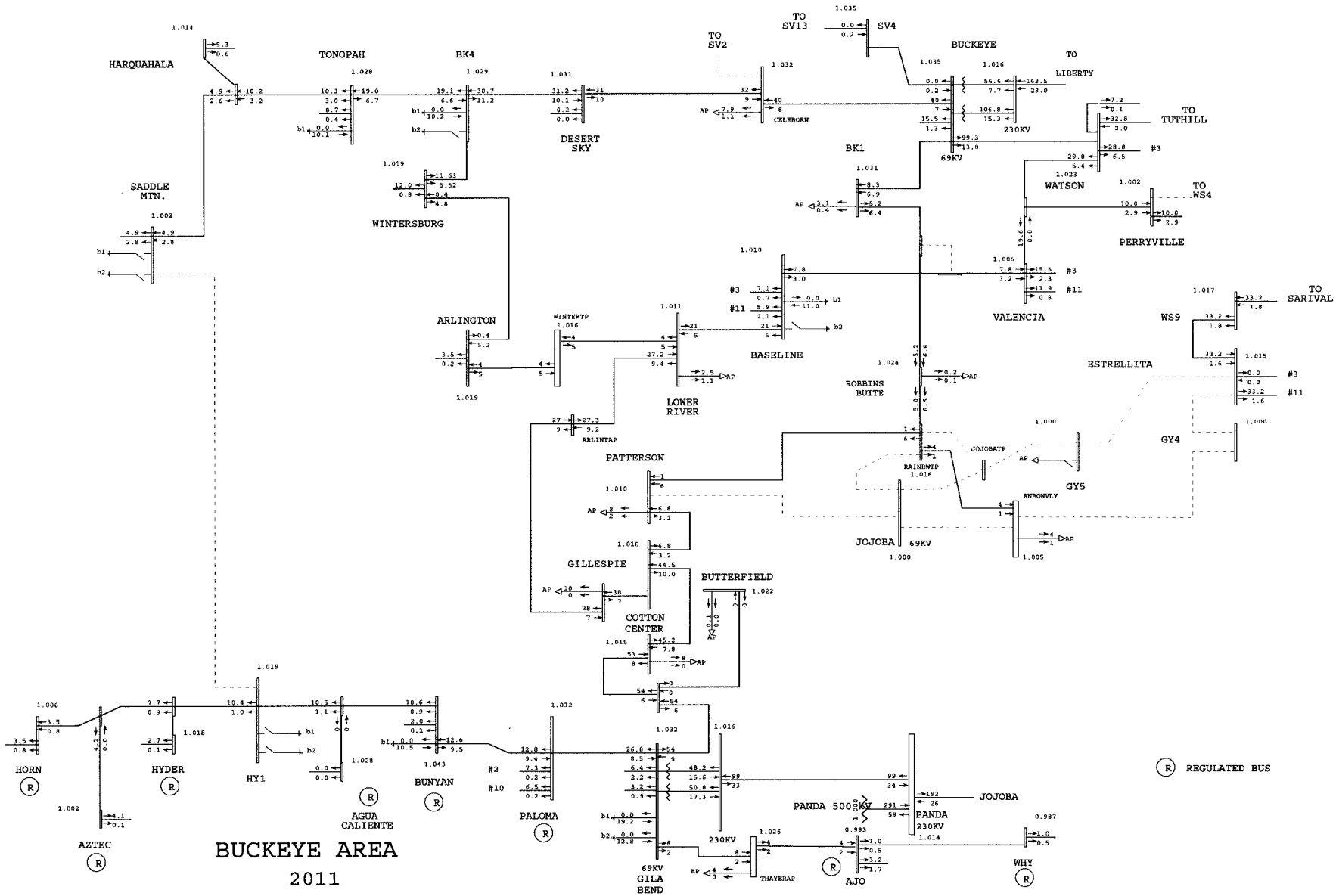
No Category A Overloads

Category B Overloads

Overloaded Element	Contingency Description	Rating (Amps)	Pre-Project Loading (%)	Post-Project Loading (%)	Delta (%)
BTRFLDTP 69.00-COTN CTR 69.00 #1 1	JOJOBA-GILARIVR 230kV Line 1	658	82	102	20
BTRFLDTP 69.00-COTN CTR 69.00 #1 1	JOJOBA-TS4-LIBERTY/PALMVLY 230kV Ckt.	658	82	101	20
BTRFLDTP 69.00-GILABEND 69.00 #1 1	JOJOBA-GILARIVR 230kV Line 1	661	82	101	20
BTRFLDTP 69.00-GILABEND 69.00 #1 1	JOJOBA-TS4-LIBERTY/PALMVLY 230kV Ckt.	661	81	101	20

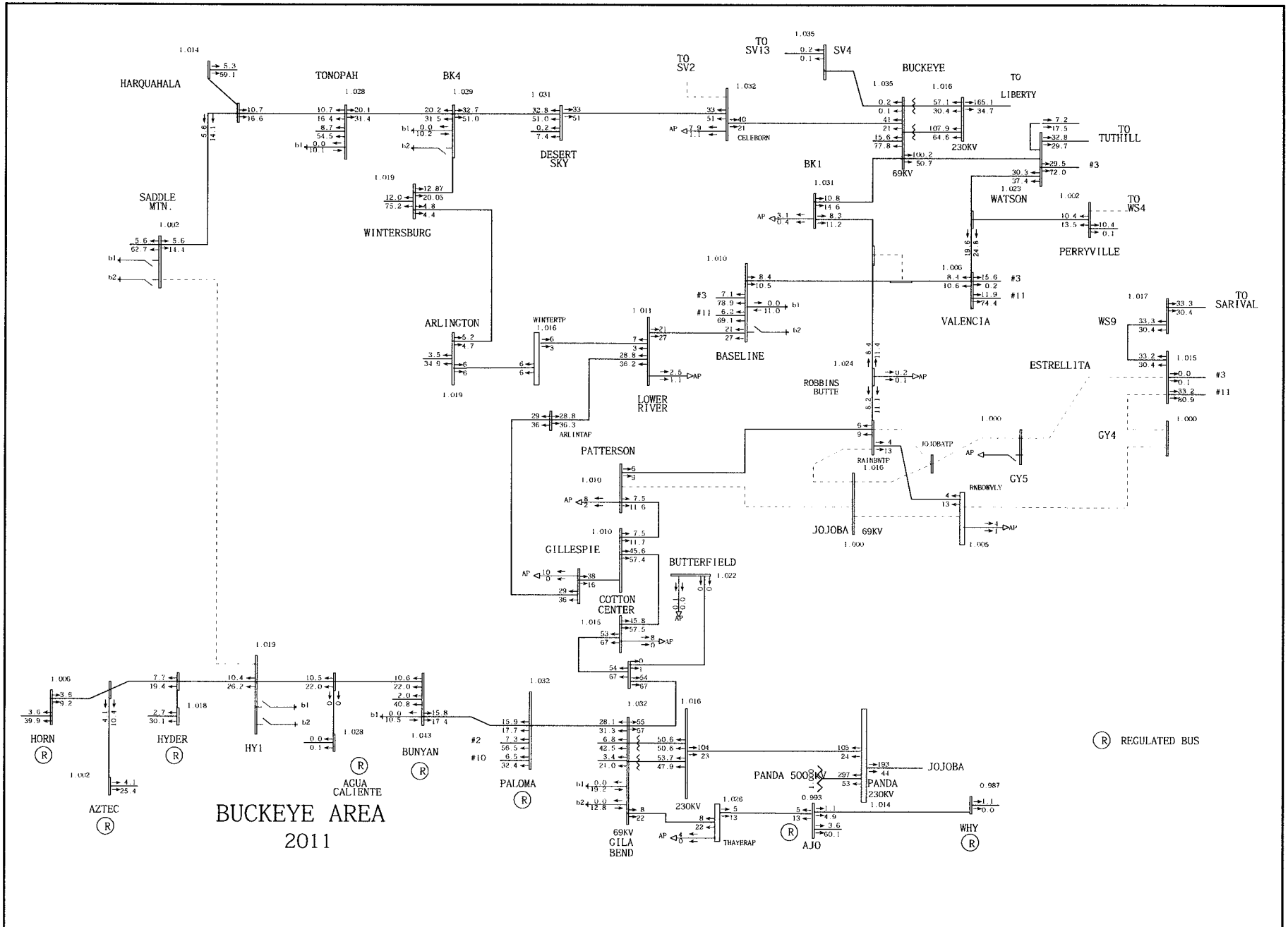
Appendix C - Power Flow Plots

Plot	Description
Plot #1	2011 Heavy Summer Pre-Project: Normal Conditions (MW/MVAr)
Plot #2	2011 Heavy Summer Pre-Project: Normal Conditions (MVA/% Rate)
Plot #3	2011 Heavy Summer Post-Project Case 1: Normal Conditions (MW/MVAr)
Plot #4	2011 Heavy Summer Post-Project Case 1: Normal Conditions (MVA/% Rate)
Plot #5	2011 Heavy Summer Post-Project Case 2: Normal Conditions (MW/MVAr)
Plot #6	2011 Heavy Summer Post-Project Case 2: Normal Conditions (MVA/% Rate)
Plot #7	2011 Heavy Summer Post-Project Case 3: Normal Conditions (MW/MVAr)
Plot #8	2011 Heavy Summer Post-Project Case 3: Normal Conditions (MVA/% Rate)
Plot #9	2011 Heavy Summer Pre-Project: Gila River - Jojoba 230 kV line outage (MW/MVAr)
Plot #10	2011 Heavy Summer Pre-Project: Gila River - Jojoba 230 kV line outage (MVA/% Rate)
Plot #11	2011 Heavy Summer Post-Project Case 1: Gila River - Jojoba 230 kV line outage (MW/MVAr)
Plot #12	2011 Heavy Summer Post-Project Case 1: Gila River - Jojoba 230 kV line outage (MVA/% Rate)
Plot #13	2011 Heavy Summer Post-Project Case 2: Gila River - Jojoba 230 kV line outage (MW/MVAr)
Plot #14	2011 Heavy Summer Post-Project Case 2: Gila River - Jojoba 230 kV line outage (MVA/% Rate)
Plot #15	2011 Heavy Summer Post-Project Case 3: Gila River - Jojoba 230 kV line outage (MW/MVAr)
Plot #16	2011 Heavy Summer Post-Project Case 3: Gila River - Jojoba 230 kV line outage (MVA/% Rate)



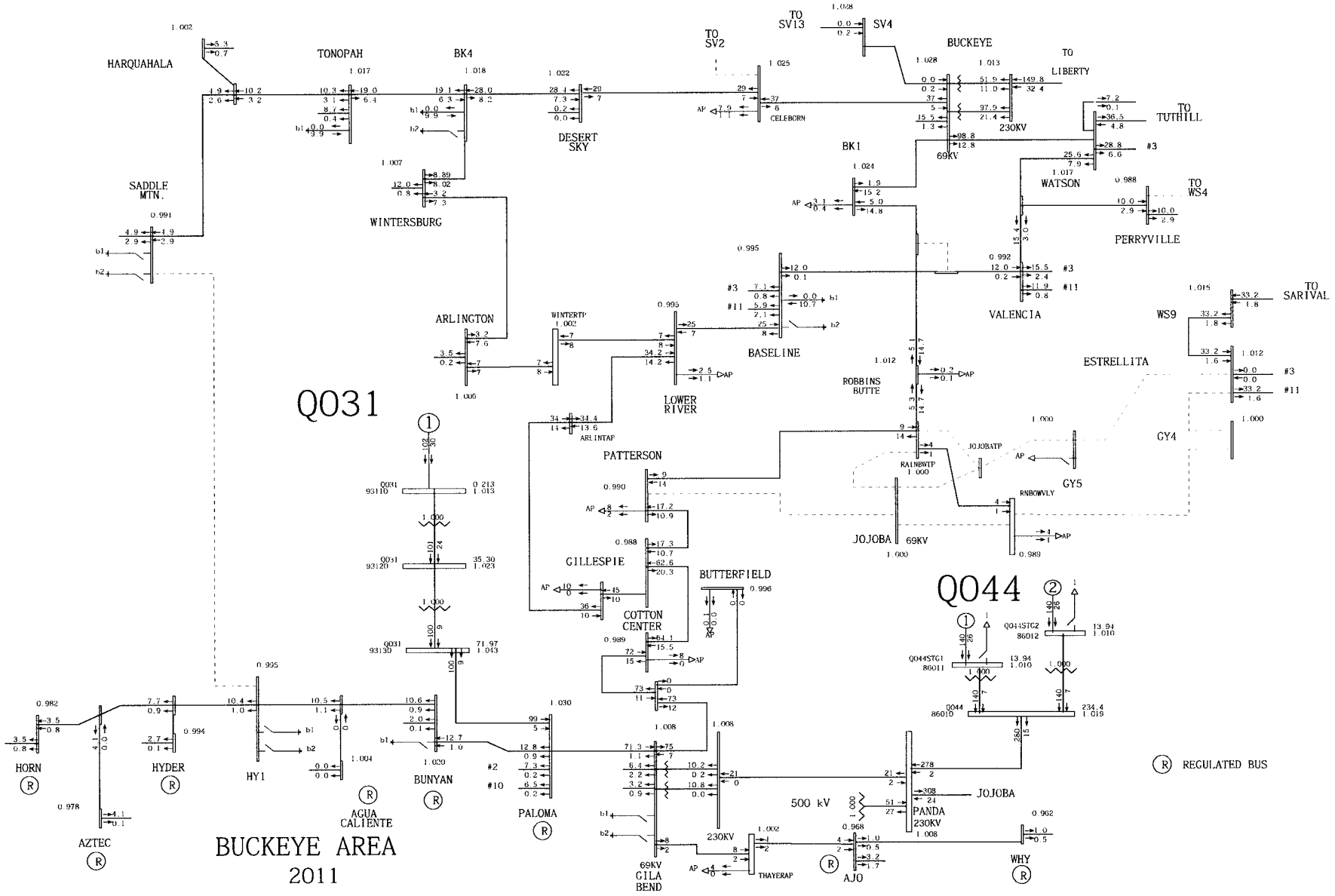
General Electric International, Inc. PSLF Program Wed Jun 17 11:01:24 2009 cases\final\r3\11hs-gbgr-r3-pre.sav

	2011 Heavy Summer Power Flow Case Gila Bend/Gila River Cluster SIS Pre-Project Revision 3 Case	Plot 001: Normal Conditions	MW/MVAR draw\final\gbgr-sis-pre. Rating = 1



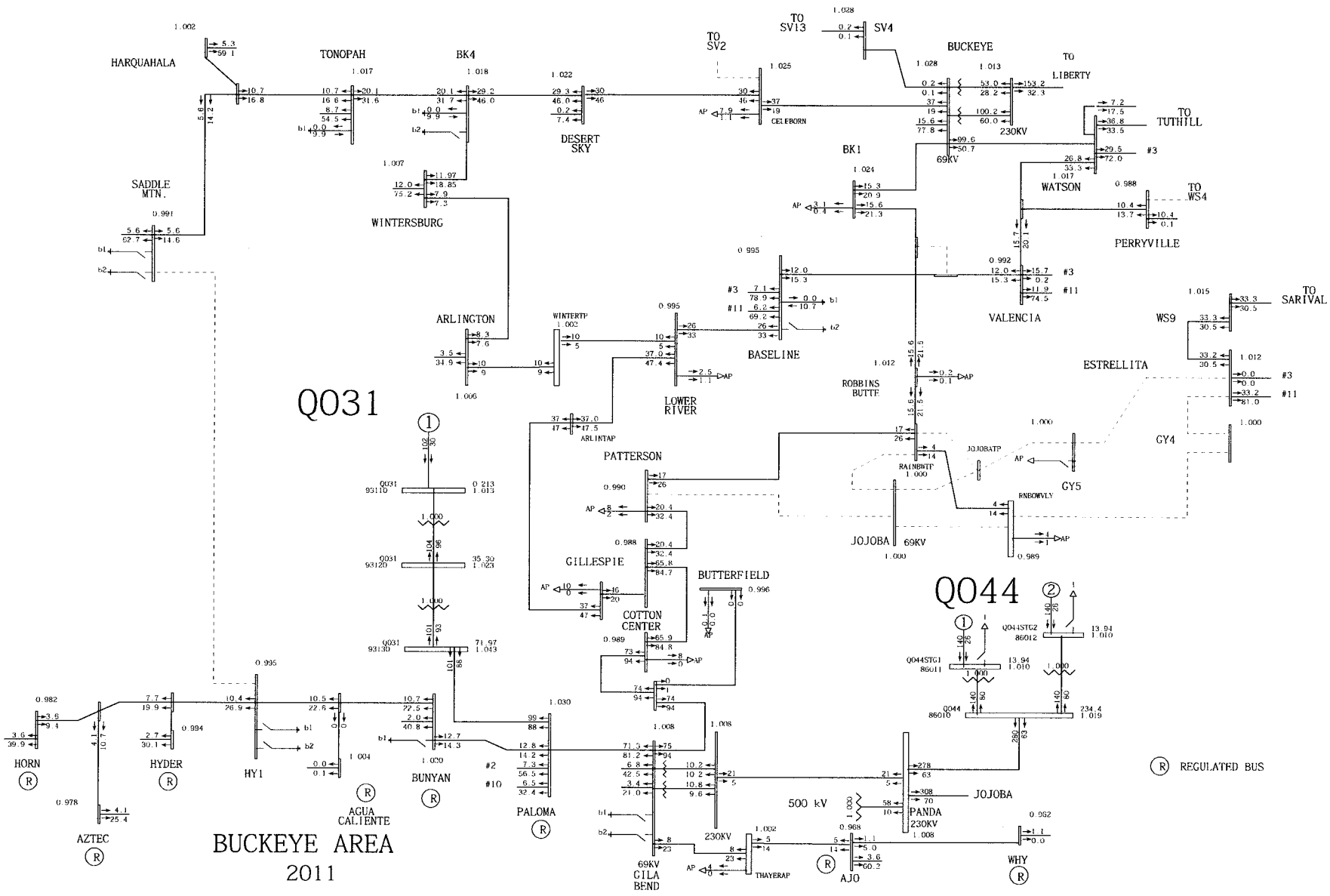
General Electric International, Inc. PSLF Program Wed Jun 17 11:01:26 2009 cases\final\r3\11hs-gbgr-r3-pre.sav

	2011 Heavy Summer Power Flow Case Gila Bend/Gila River Cluster SIS Pre-Project Revision 3 Case	Plot 002: Normal Conditions	MVA/%rate draw\final\gbgr-sis-pre Rating = 1



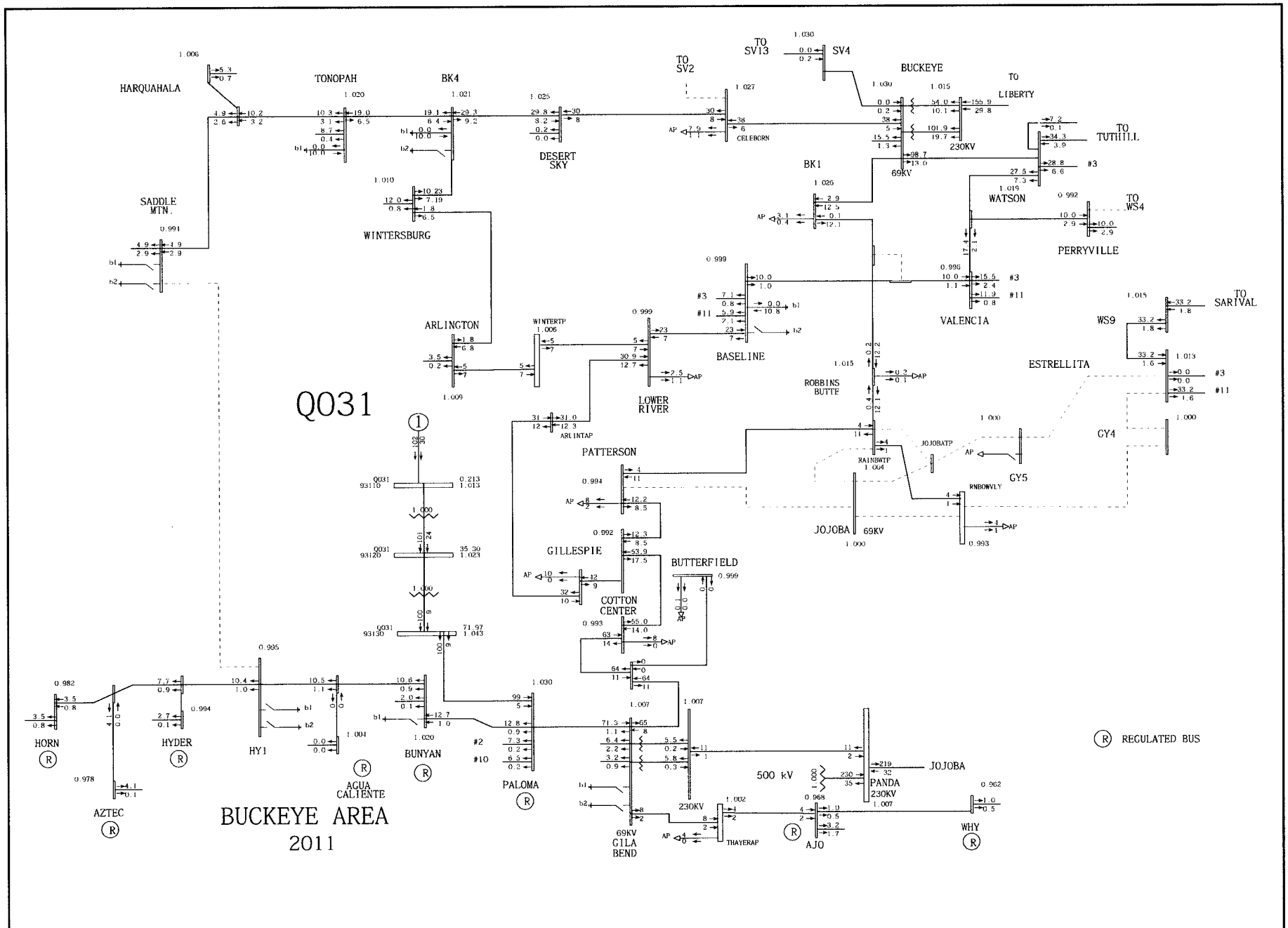
General Electric International, Inc. PSLF Program Wed Jun 17 11:01:29 2009 cases\final\r3\llhs-gbgr-r3-pstl.sav

	2011 Heavy Summer Power Flow Case Gila Bend/Gila River Cluster SIS Post-Project R3 Case 1 Q031(102MW)&Q044(280 MW	Plot 003: Normal Conditions	MW/MVAR draw\final\gbgr-sis-pstl Rating = 1



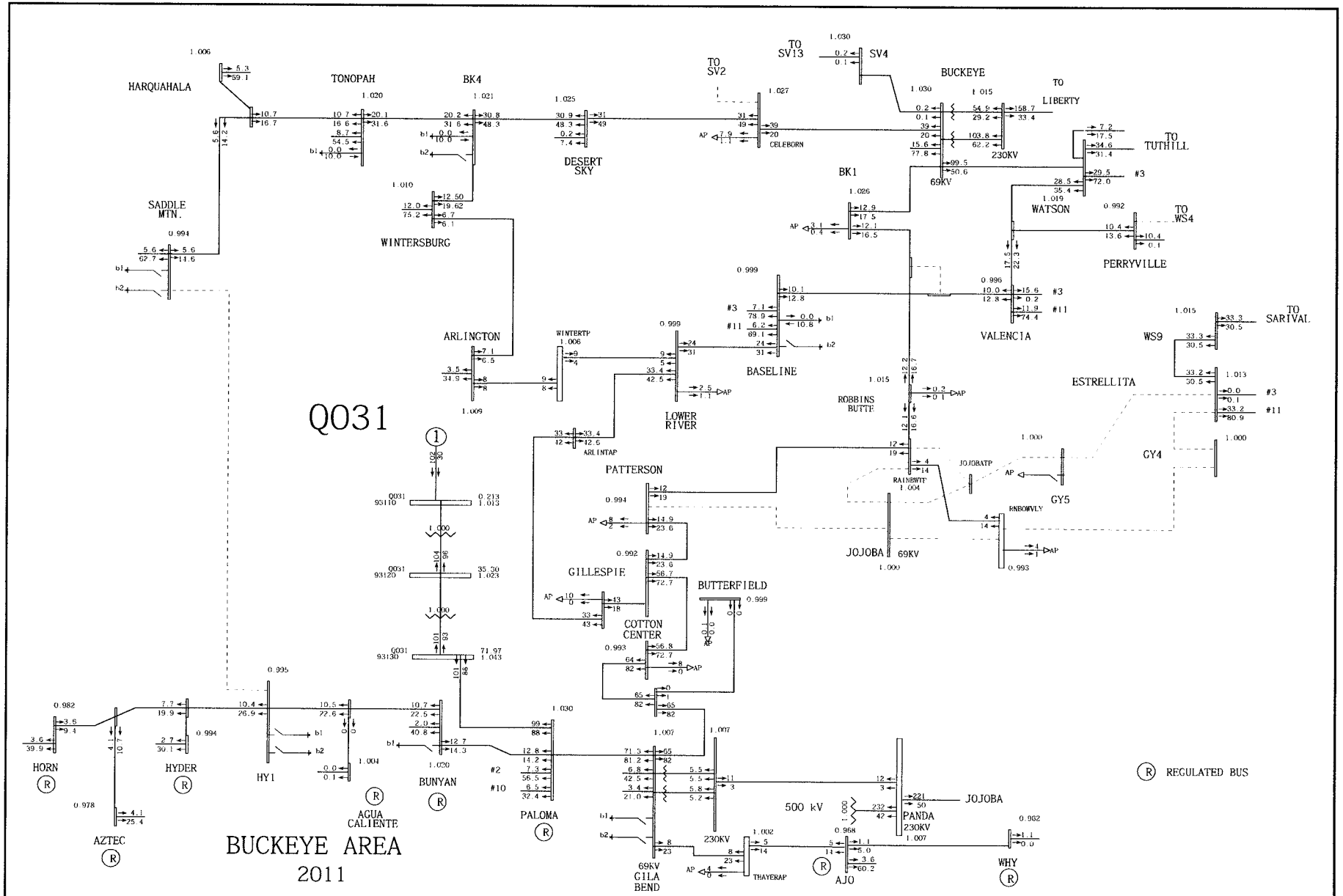
General Electric International, Inc. PSLF Program Wed Jun 17 11:01:32 2009 cases\final\r3\11hs-gbgr-r3-pst1.sav

	2011 Heavy Summer Power Flow Case Gila Bend/Gila River Cluster SIS Post-Project R3 Case 1 Q031(102MW)&Q044(280 MW	Plot 004: Normal Conditions	MVA/%rate draw\final\gbgr-sis-pst1 Rating = 1



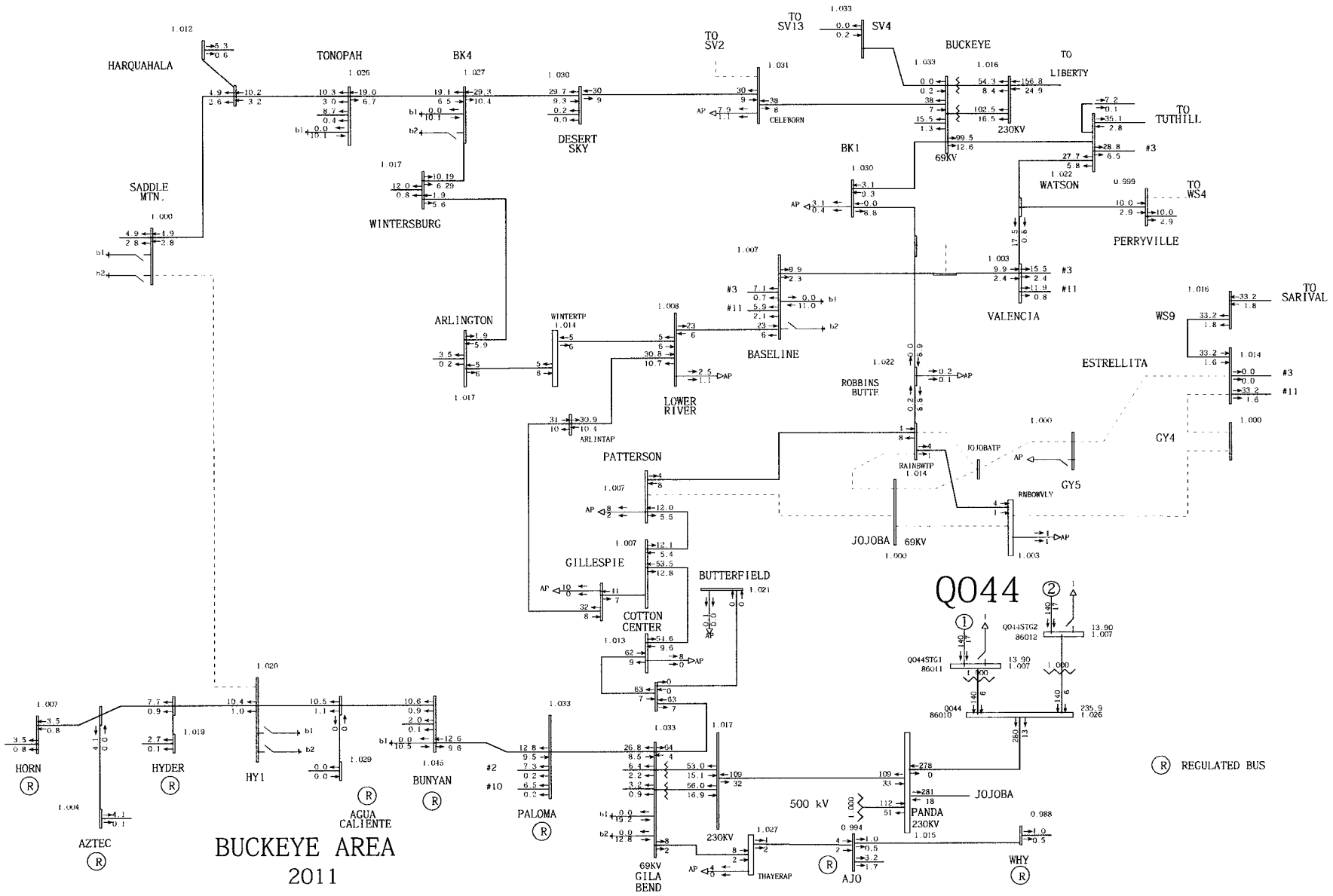
General Electric International, Inc. PSLF Program Wed Jun 17 11:01:36 2009 cases\final\r3\llhs-gbgr-r3-pst2.sav

	2011 Heavy Summer Power Flow Case Gila Bend/Gila River Cluster SIS Post-Project R3 Case 2 Q031 @ 102 MW	Plot 005: Normal Conditions	MW/MVAR draw\final\gbgr-sis-pst2 Rating = 1



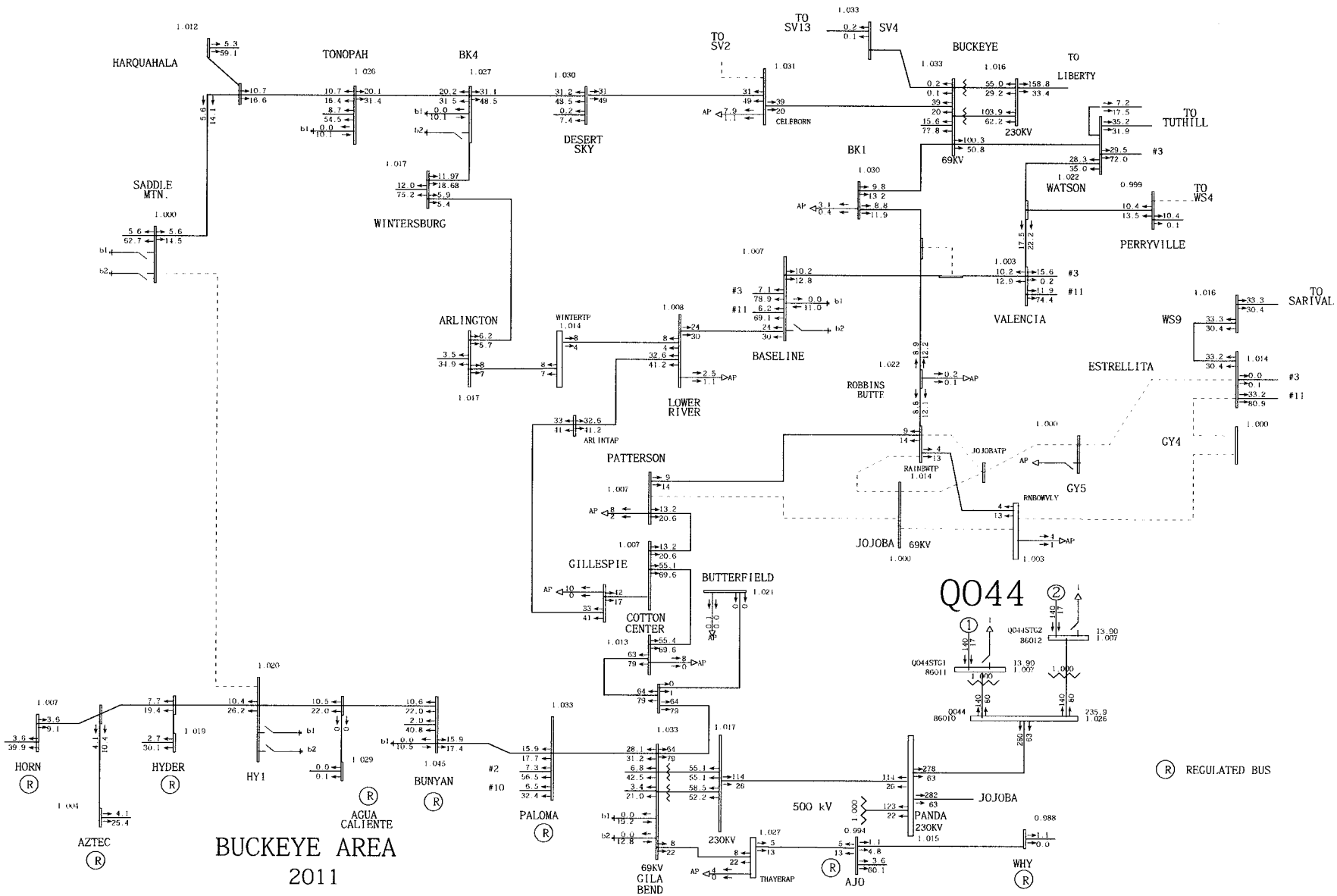
General Electric International, Inc. PSLF Program Wed Jun 17 11:01:39 2009 cases\final\r3\11hs-gbgr-r3-pst2.sav

	2011 Heavy Summer Power Flow Case Gila Bend/Gila River Cluster SIS Post-Project R3 Case 2 Q031 @ 102 MW	Plot 006: Normal Conditions	MVA/%rate draw\final\gbgr-sis-pst2 Rating = 1



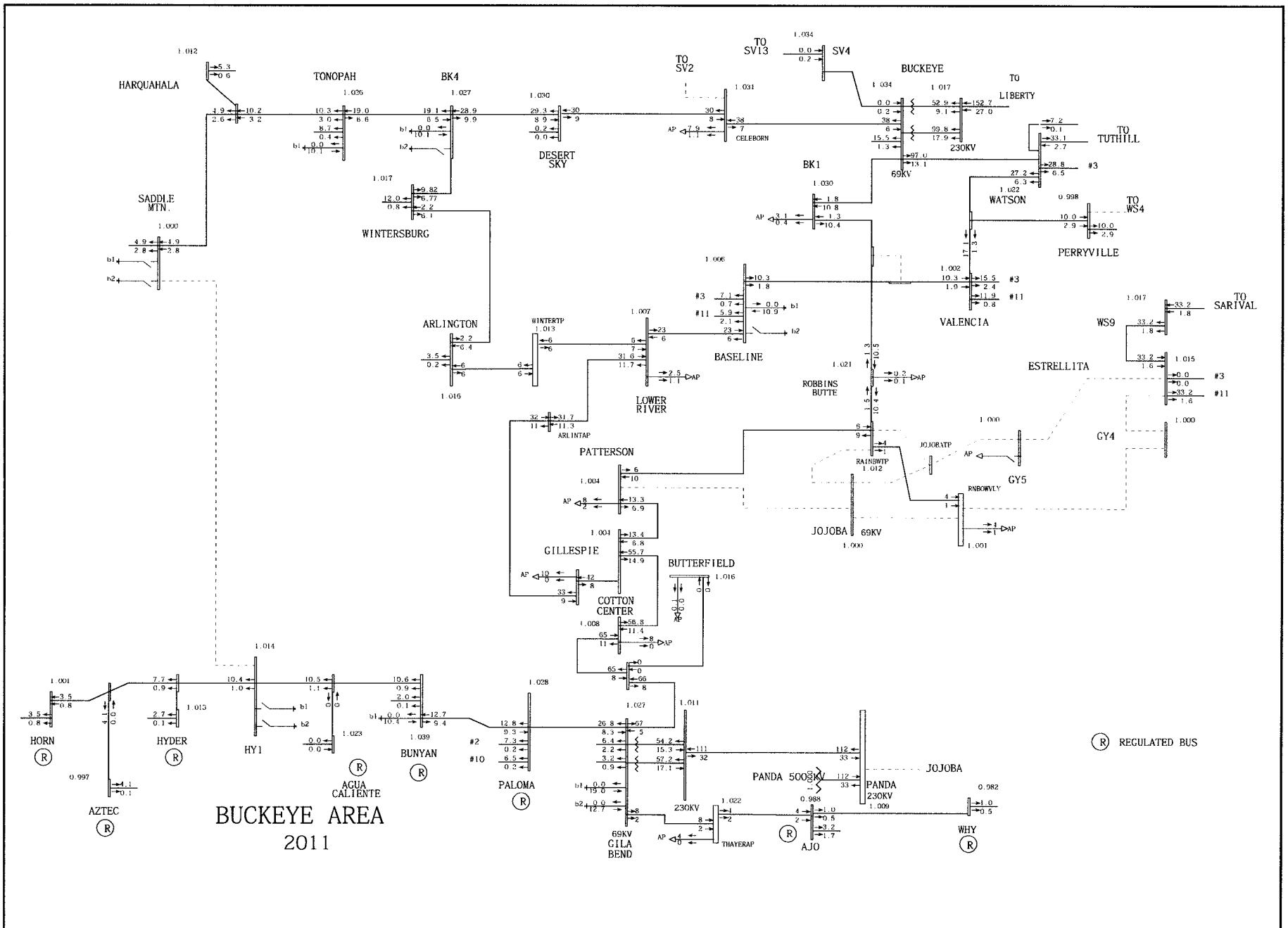
General Electric International, Inc. PSLF Program Wed Jun 17 11:01:43 2009 cases\final\r3\llhs-gbgr-r3-pst3.sav

	2011 Heavy Summer Power Flow Case Gila Bend/Gila River Cluster SIS Post-Project R3 Case 3 Q044 @ 280 MW	Plot 007: Normal Conditions	MW/MVAR draw\final\gbgr-sis-pst3 Rating = 1



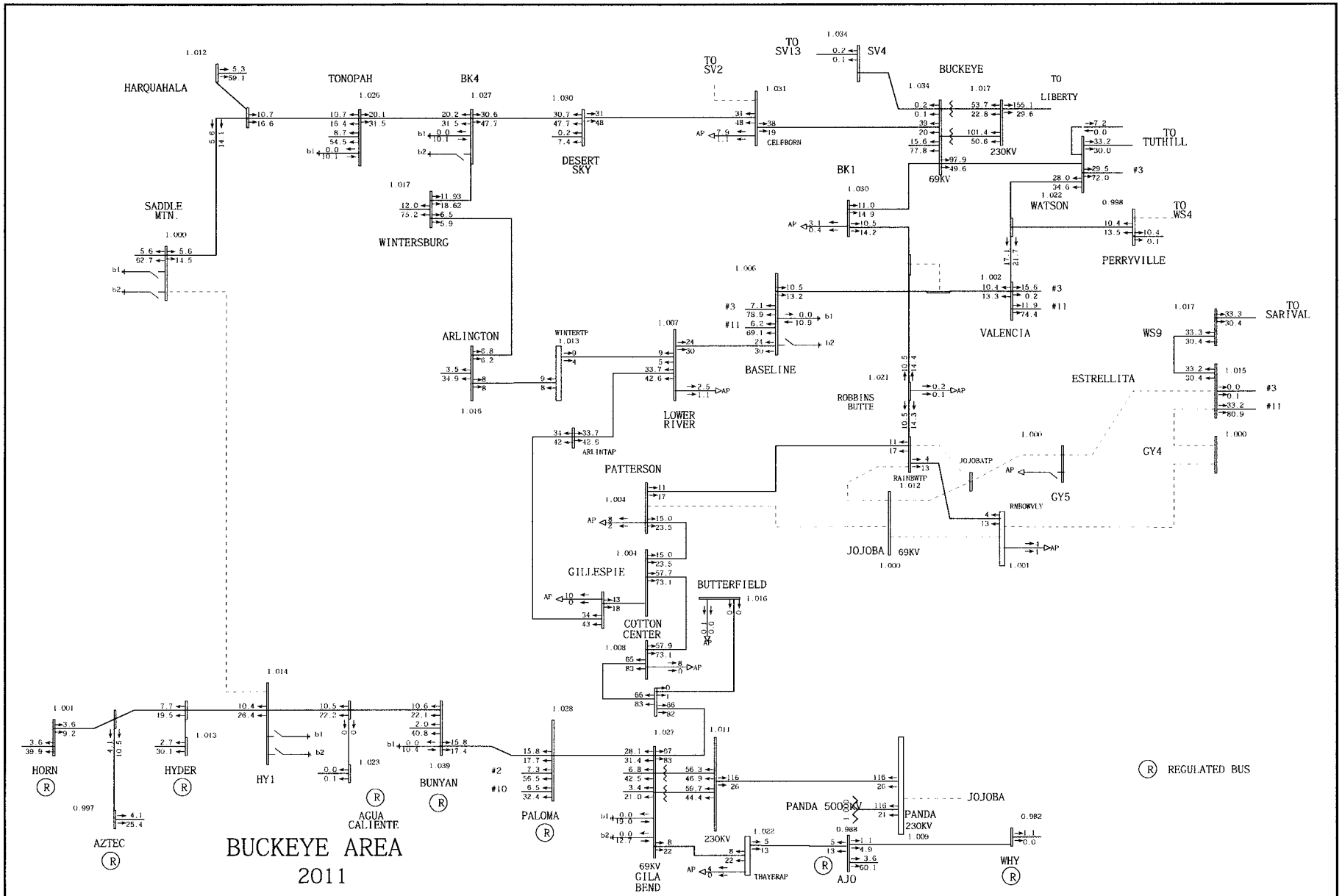
General Electric International, Inc. PSLF Program Wed Jun 17 11:01:45 2009 cases\final\r3\11hs-gbgr-r3-pst3.sav

	2011 Heavy Summer Power Flow Case Gila Bend/Gila River Cluster SIS Post-Project R3 Case 3 Q044 @ 280 MW	Plot 008: Normal Conditions	MVA/%rate draw\final\gbgr-sis-pst3 Rating = 1



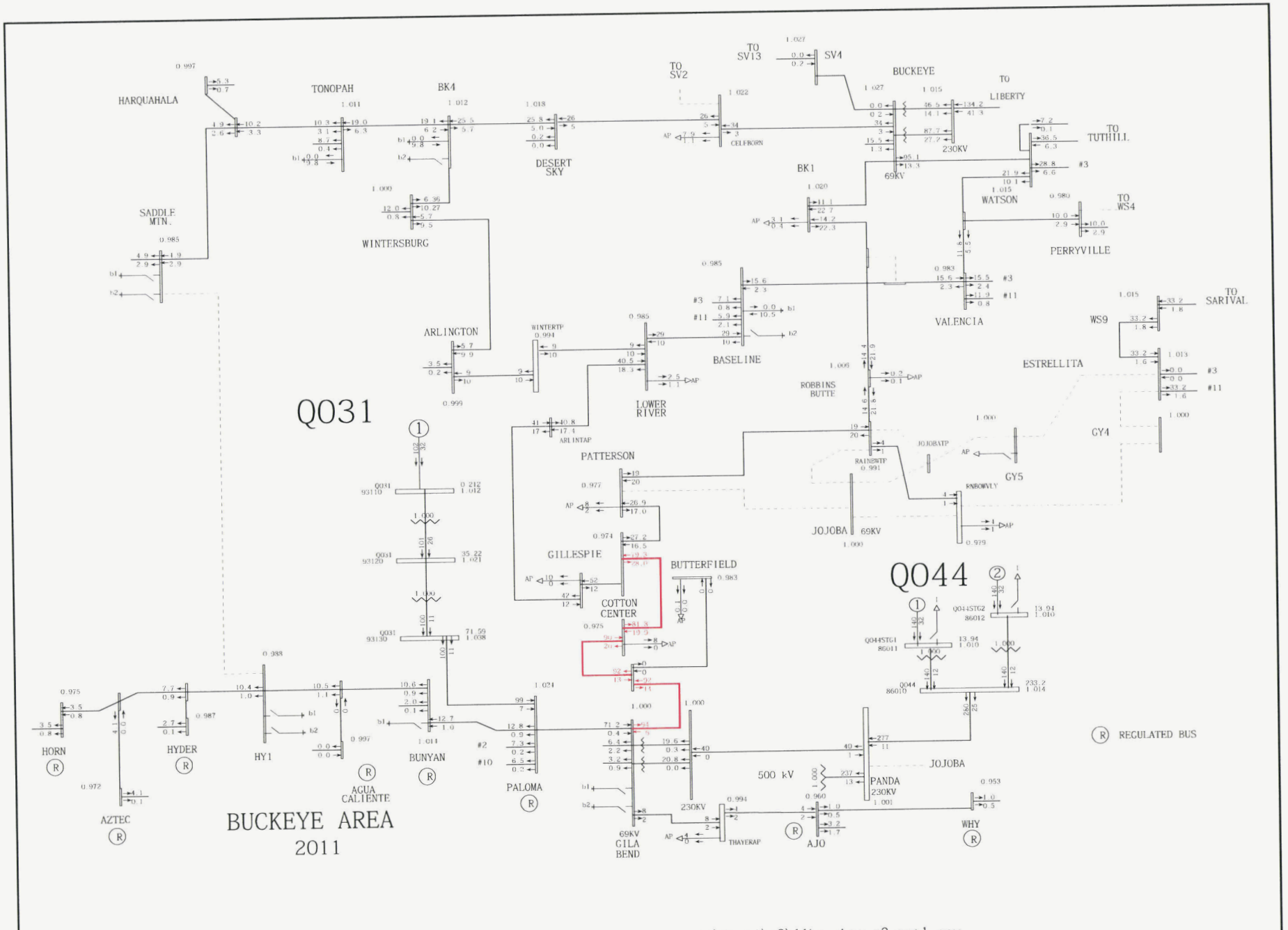
General Electric International, Inc. PSLF Program Wed Jun 17 11:01:54 2009 cases\final\r3\11hs-gbgr-pre.sav

	2011 Heavy Summer Power Flow Case Gila Bend/Gila River Cluster SIS Pre-Project Revision 3 Case	Plot 009: Gila River - Jojoba 230 kV line outage	MW/MVAR draw\final\gbgr-sis-pre. Rating = 2



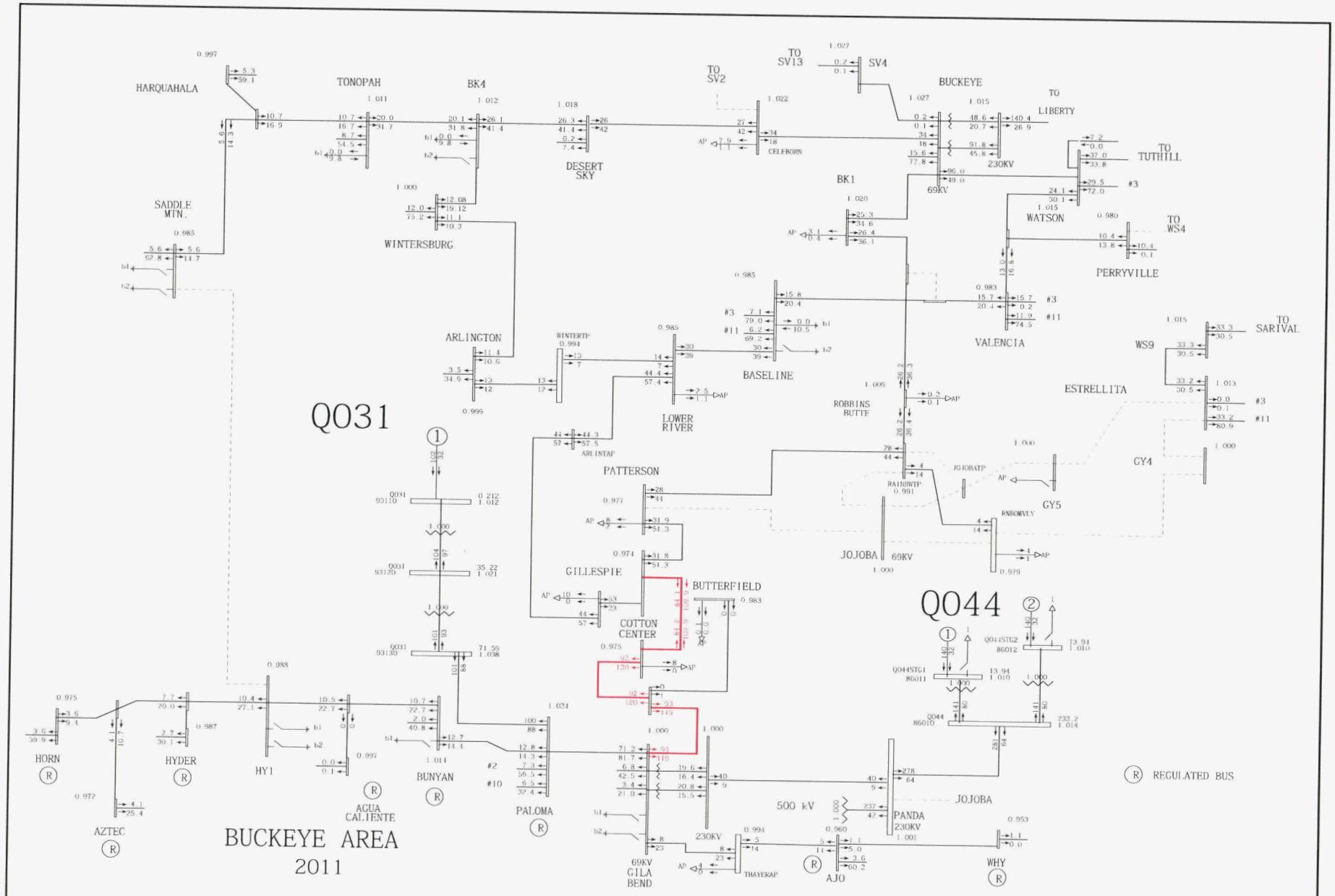
General Electric International, Inc. PSLF Program Wed Jun 17 11:01:57 2009 cases\final\r3\llhs-gbgr-pre.sav

	2011 Heavy Summer Power Flow Case Gila Bend/Gila River Cluster SIS Pre-Project Revision 3 Case	Plot 010: Gila River - Jojoba 230 kV line outage	MVA/%rate draw\final\gbgr-sis-pre. Rating = 2



General Electric International, Inc. PSLF Program Wed Jun 17 11:02:01 2009 cases\final\r3\llhs-gbgr-r3-pstl.sav

	2011 Heavy Summer Power Flow Case Gila Bend/Gila River Cluster SIS Post-Project R3 Case 1 Q031(102MW)&Q044(280 MW	Plot 011: Gila River - Jojoba 230 kV line outage	MW/MVAR draw\final\gbgr-sis-pstl Rating = 2



General Electric International, Inc. PSLF Program Wed Jun 17 11:02:03 2009 cases\final\r3\llhs-gbgr-r3-pstl.sav

2011 Heavy Summer Power Flow Case

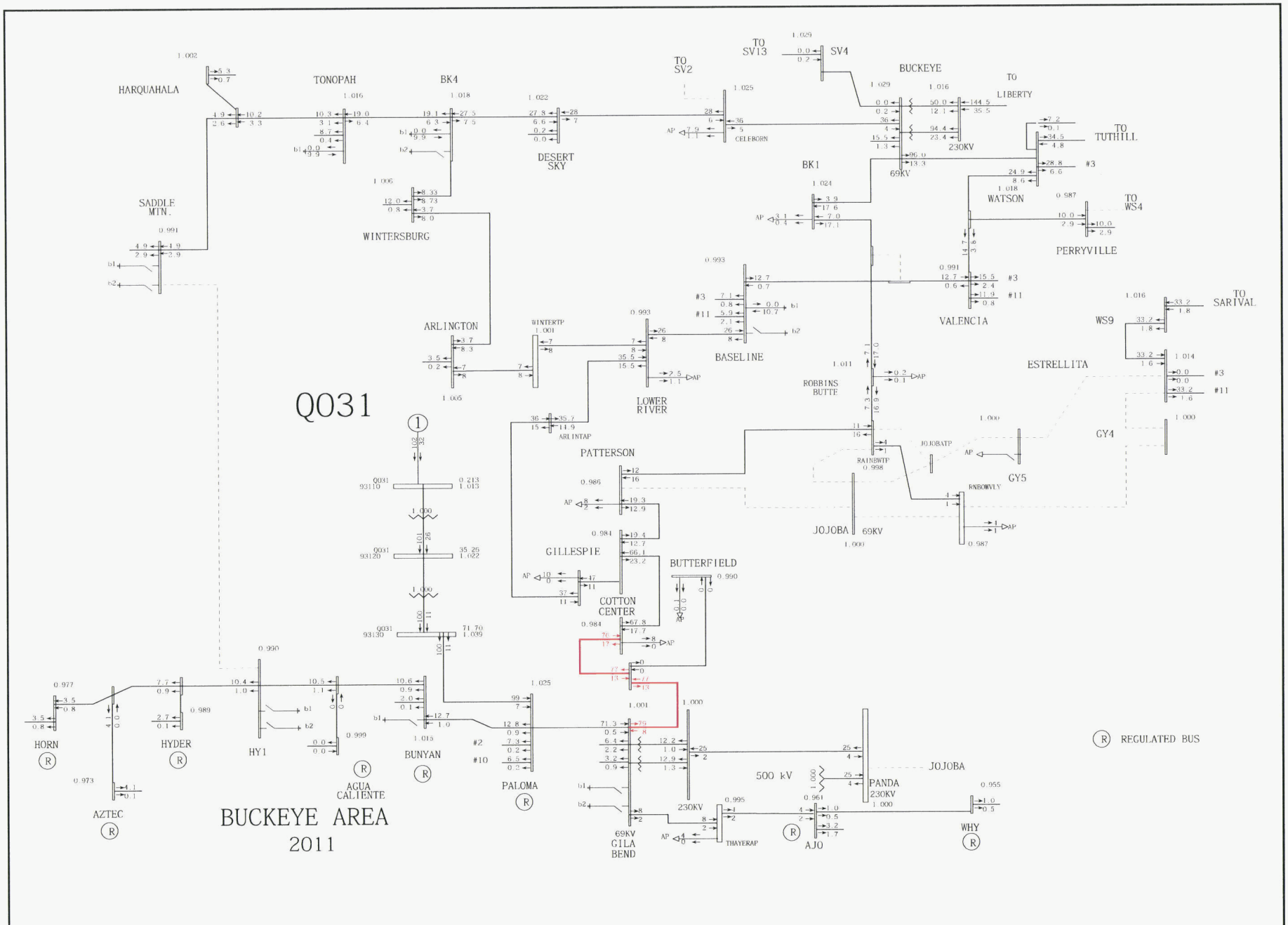
Gila Bend/Gila River Cluster SIS Post-Project R3 Case 1 Q031(102MW)&Q044(280 MW

Plot 012: Gila River - Jojoba 230 kV line outage

MVA/%rate

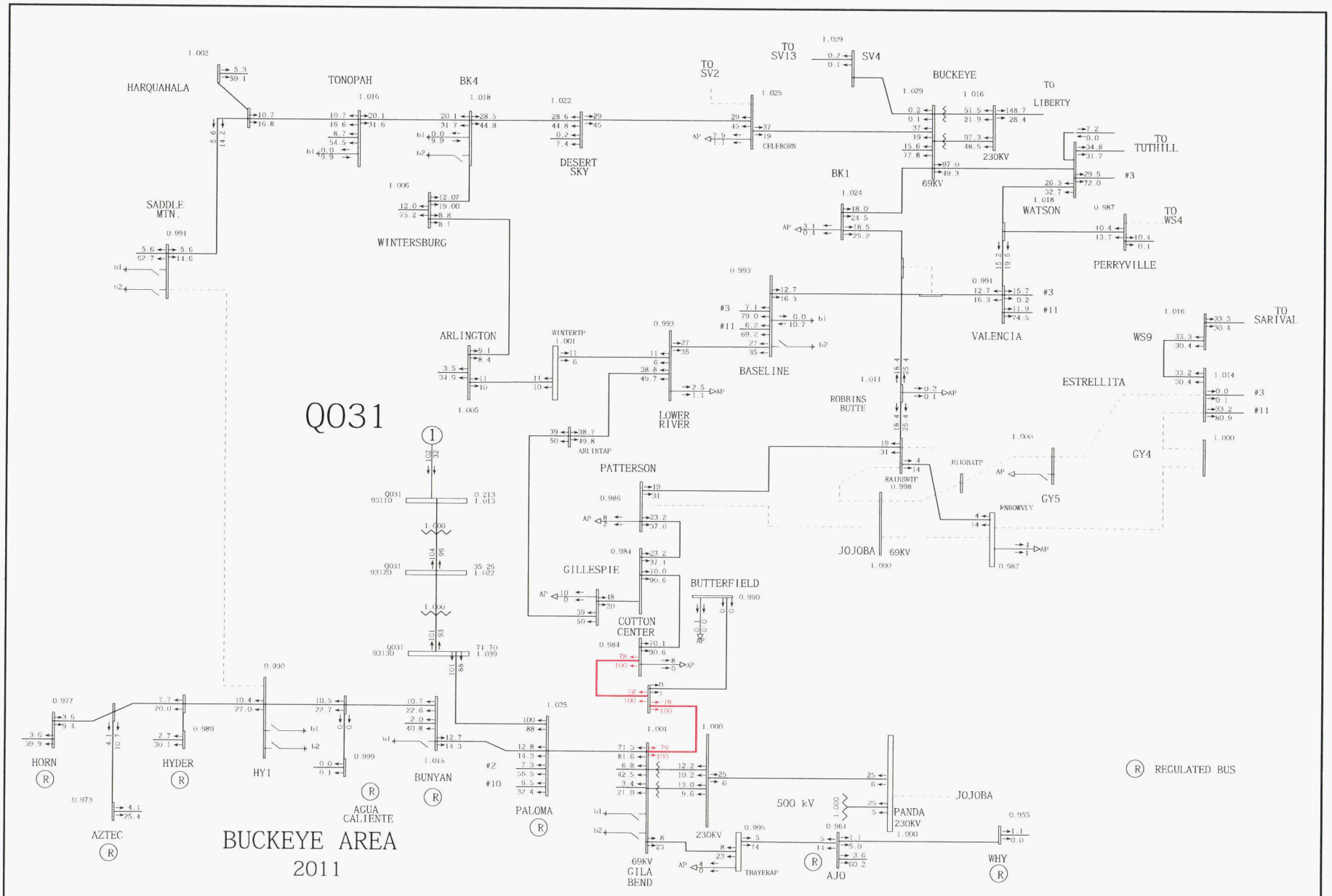
draw\final\gbgr-sis-pstl

Rating = 2



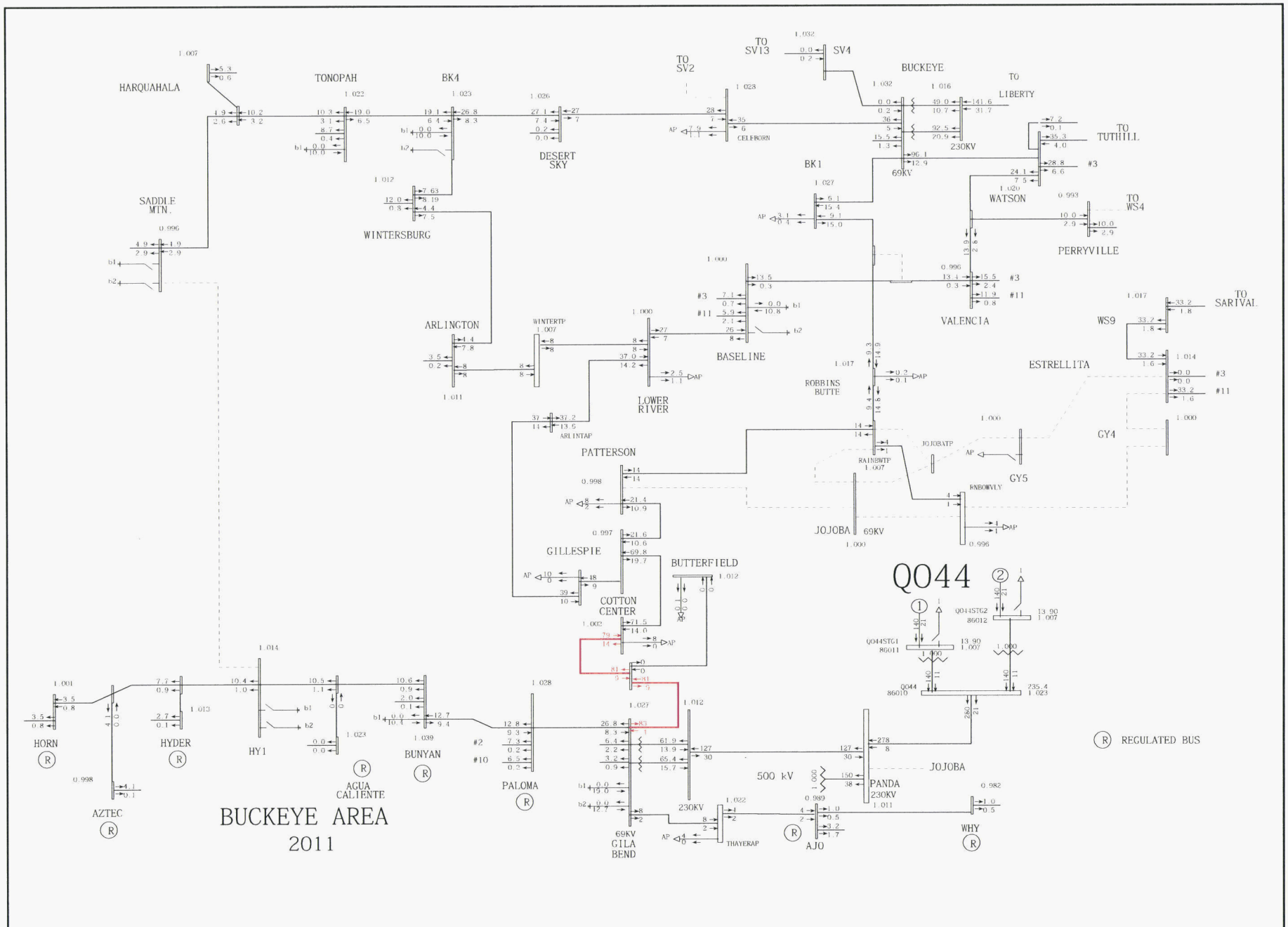
General Electric International, Inc. PSLF Program Wed Jun 17 11:02:08 2009 cases\final\r3\llhs-gbgr-r3-pst2.sav

	2011 Heavy Summer Power Flow Case Gila Bend/Gila River Cluster SIS Post-Project R3 Case 2 Q031 @ 102 MW	Plot 013: Gila River - Jojoba 230 kV line outage	MW/MVAR draw\final\gbgr-sis-pst2 Rating = 2



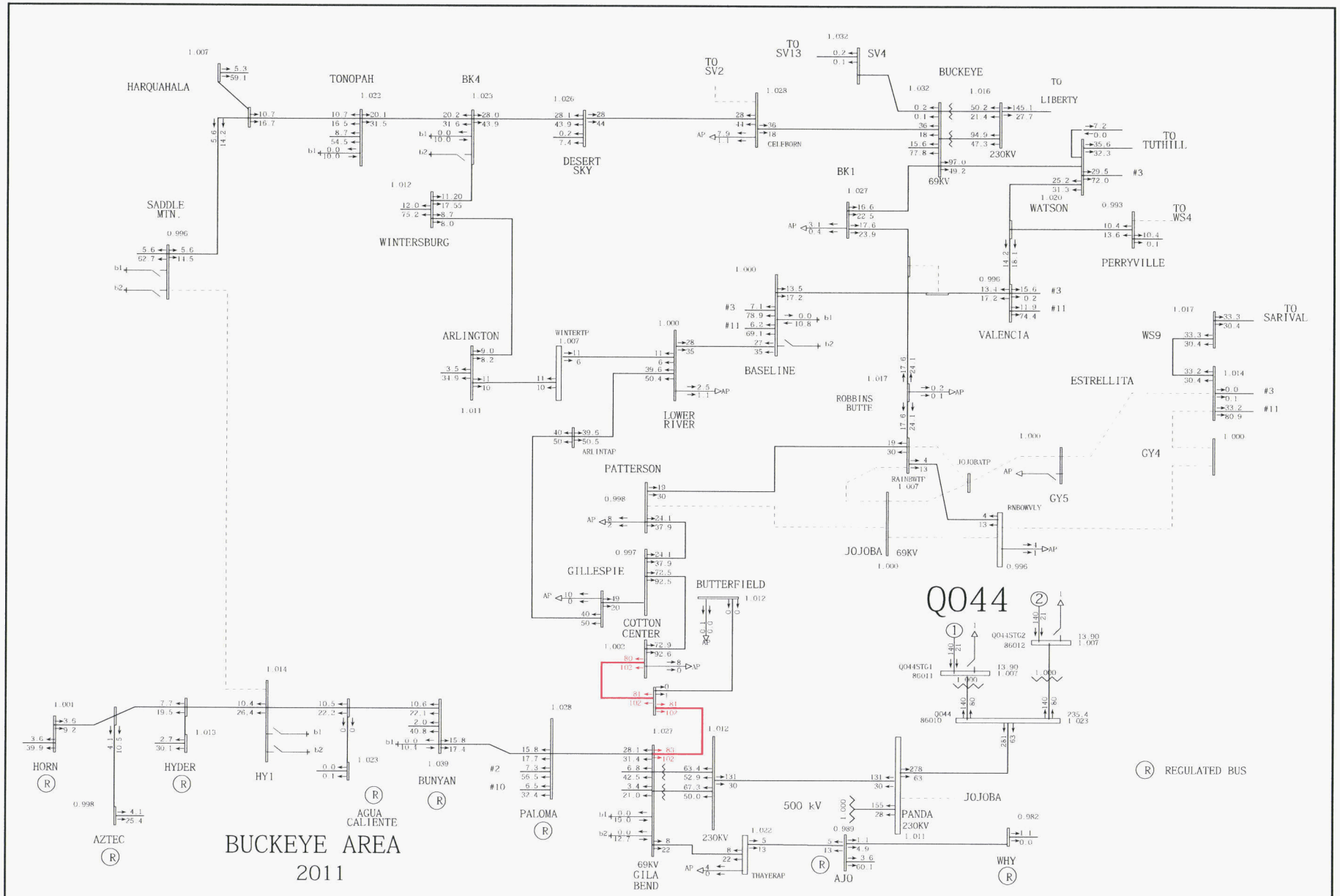
General Electric International, Inc. PSLF Program Wed Jun 17 11:02:11 2009 cases\final\r3\llhs-gbgr-r3-pst2.sav

	2011 Heavy Summer Power Flow Case Gila Bend/Gila River Cluster SIS Post-Project R3 Case 2 Q031 @ 102 MW	Plot 014: Gila River - Jojoba 230 kV line outage	MVA/%rate draw\final\gbgr-sis-pst2 Rating = 2



General Electric International, Inc. PSLF Program Wed Jun 17 11:02:15 2009 cases\final\r3\11hs-gbgr-r3-pst3.sav

	2011 Heavy Summer Power Flow Case Gila Bend/Gila River Cluster SIS Post-Project R3 Case 3 Q044 @ 280 MW	Plot 015: Gila River - Jojoba 230 kV line outage	MW/MVAR draw\final\gbgr-sis-pst3 Rating = 2



General Electric International, Inc. PSLF Program Wed Jun 17 11:02:18 2009 cases\final\r3\llhs-gbgr-r3-pst3.sav

	2011 Heavy Summer Power Flow Case Gila Bend/Gila River Cluster SIS Post-Project R3 Case 3 Q044 @ 280 MW	Plot 016: Gila River - Jojoba 230 kV line outage	MVA/%rate draw\final\gbgr-sis-pst3 Rating = 2

Appendix D - Short Circuit Analysis

	Pre-Project				Post-Project				
Station	**3 Ph. (kA)**	**X/R**	**Ph-G (kA)**	**X/R**	**3 Ph. (kA)**	**X/R**	**Ph-G (kA)**	**X/R**	**Min. Brkr. Rating(kA)**
Gila Bend 230kV	9.34	22.2	8.91	41.1	12.6	21.8	11.9	43.1	N/A
Gila Bend 69kV	12.4	25.1	15.4	33.6	13.6	25.7	16.8	35.6	26
Buckeye 230kV	15.9	10.7	12.2	20.6	16	10.6	12.3	20.5	N/A
Buckeye 69kV	20.7	17.8	21.9	25.4	20.8	17.7	21.93	25.3	31.5
Panda 230kV	13.07	66.7	13.2	64	15.9	58	15.4	57	40
Liberty 345kV	12	24.1	9.9	42.8	12.04	24	9.9	42.7	40
Liberty 230kV	35.1	12.7	29.5	22	35.5	12.5	29.7	21.8	40
Rudd 230kV	52.96	21.3	45.12	16.02	53.1	21.3	45.2	16	63
Palm Valley 230kV	24.1	13.4	17.3	8.63	24.2	13.3	17.31	8.61	63

Pre-fault voltage 1.05 pu

Appendix E - Transient Stability Switching Sequences

Switching Sequence 1 - Three-phase, four cycle fault on Gila Bend - Gila River 230 kV line, near Gila Bend

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```
*
*  3-phase 4 cycle fault at Gila Bend 230 kV
*  followed by loss of Gila Bend - Gila River 230 kV line
*
*  CC cards for post-transient only
*
CC  DRP 0
*
*  Apply bus fault at Gila River 230 kV
*
FB   60.0  "GILABEND" 230.
*
*  Flash SWPL capacitors
*
*  Clear bus fault at Gila River 230 kV
*
CFB  64.0  "GILABEND" 230.
*
*  Trip Gila Bend - Gila River 230 kV line
*
DL   64.0  "GILABEND" 230. "GILARIVR" 230. "1 "
*
```

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Switching Sequence 2 - Three phase, four cycle fault on Gila River - Jojoba #1 500 kV line, near Gila River

```
* Category B2 - 3 phase fault at Gila River 500 kV followed by
* Gila River - Jojoba #1 500 kV single line outage
*
* CC cards for post-transient only
* DRP MW   (positive number indicates generation dropping)
CC DRP 0
*
* Fault bus at Gila River 500 kV
*FB   time  bus_name   kV     r         x
FB    60.0 "GILARIVR" 500.
*
* Apply fault damping to each Palo Verde Unit
*GFD  time  bus_name   kV  id   reduction
GFD   60.0 "PALOVRD1" 24. "1 "  0.072485
GFD   60.0 "PALOVRD2" 24. "1 "  0.072485
GFD   60.0 "PALOVRD3" 24. "1 "  0.072485
*
* Flash series capacitors in following 500 kV Lines at time of fault
*FC   time  bus1_name  kV  bus2_name   kV  ckt sec
*FC    60.0 "PALOVRDE" 500. "DEVERS  " 500. "1 " 2
*FC    60.0 "PALOVRDE" 500. "DEVERS  " 500. "1 " 4
*FC    60.0 "HARQJNCT" 500. "DEVERS  " 500. "1 " 2
*FC    60.0 "HARQJNCT" 500. "DEVERS  " 500. "1 " 4
*FC    60.0 "HASSYAMP" 500. "N.GILA  " 500. "1 " 2
*FC    60.0 "N.GILA  " 500. "IMPRLVLY" 500. "1 " 2
*FC    60.0 "IMPRLVLY" 500. "MIGUEL  " 500. "1 " 1
*FC    60.0 "MOENKOPI" 500. "YAVAPAI " 500. "1 " 1
*FC    60.0 "YAVAPAI " 500. "WESTWING" 500. "1 " 2
*FC    60.0 "NAVAJO  " 500. "WESTWING" 500. "1 " 1
*FC    60.0 "NAVAJO  " 500. "WESTWING" 500. "1 " 3
*FC    60.0 "MEAD    " 500. "PERKINS " 500. "1 " 1
*FC    60.0 "MEAD    " 500. "PERKINS " 500. "1 " 3
*
* Clear fault at Gila River 500 kV bus after 4 cycles
*CFB  time  bus_name    kV
CFB   64.0 "GILARIVR" 500.
*
* Trip Gila River - Jojoba #1 500 kV line after 4 cyles
*DL   time  bus1_name  kV   bus2_name   kV  ckt
DL    64.0 "GILARIVR" 500. "JOJOBA  " 500. "1 "
*
* Remove fault damping to each Palo Verde Unit
*GFD  time  bus_name   kV  id   reduction
GFD   64.0 "PALOVRD1" 24. "1 "  0.0
GFD   64.0 "PALOVRD2" 24. "1 "  0.0
GFD   64.0 "PALOVRD3" 24. "1 "  0.0
*
* Reinsert series capacitors in following 500 kV Lines
*RC   time  bus1_name   kV  bus2_name   kV  ckt sec
*RC    64.0 "PALOVRDE" 500. "DEVERS  " 500. "1 " 2
*RC    64.0 "PALOVRDE" 500. "DEVERS  " 500. "1 " 4
*RC    64.0 "HARQJNCT" 500. "DEVERS  " 500. "1 " 2
*RC    64.0 "HARQJNCT" 500. "DEVERS  " 500. "1 " 4
```

```
*RC     64.0 "HASSYAMP" 500. "N.GILA  " 500. "1 " 2
*RC     64.0 "N.GILA  " 500. "IMPRLVLY" 500. "1 " 2
*RC     64.0 "IMPRLVLY" 500. "MIGUEL  " 500. "1 " 1
*RC     64.0 "MEAD    " 500. "PERKINS " 500. "1 " 1
*RC     64.0 "MEAD    " 500. "PERKINS " 500. "1 " 3
*
*RC     68.0 "MOENKOPI" 500. "YAVAPAI " 500. "1 " 1
*RC     68.0 "YAVAPAI " 500. "WESTWING" 500. "1 " 2
*RC     68.0 "NAVAJO  " 500. "WESTWING" 500. "1 " 1
*RC     68.0 "NAVAJO  " 500. "WESTWING" 500. "1 " 3
*
```

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Switching Sequence 3 - Three phase, four cycle fault on Hassyampa - Jojoba 500 kV line, near Jojoba

```
* Category B2 - 3 phase fault at Jojoba 500 kV followed by
* Hassyampa - Jojoba 500 kV single line outage
*
* CC cards for post-transient only
* DRP MW   (positive number indicates generation dropping)
CC DRP 0
*
* Fault bus at Jojoba 500 kV
*FB   time  bus_name   kV     r         x
FB    60.0 "JOJOBA  " 500.
*
* Apply fault damping to each Palo Verde Unit
*GFD  time  bus_name   kV  id   reduction
GFD   60.0 "PALOVRD1" 24. "1 "  0.072485
GFD   60.0 "PALOVRD2" 24. "1 "  0.072485
GFD   60.0 "PALOVRD3" 24. "1 "  0.072485
*
* Flash series capacitors in following 500 kV Lines at time of fault
*FC   time  bus1_name  kV  bus2_name   kV  ckt sec
*FC    60.0 "PALOVRDE" 500. "DEVERS  " 500. "1 " 2
*FC    60.0 "PALOVRDE" 500. "DEVERS  " 500. "1 " 4
*FC    60.0 "HASSYAMP" 500. "N.GILA  " 500. "1 " 2
*FC    60.0 "N.GILA  " 500. "IMPRLVLY" 500. "1 " 2
*FC    60.0 "IMPRLVLY" 500. "MIGUEL  " 500. "1 " 1
*FC    60.0 "MOENKOPI" 500. "YAVAPAI " 500. "1 " 1
*FC    60.0 "YAVAPAI " 500. "WESTWING" 500. "1 " 2
*FC    60.0 "NAVAJO  " 500. "WESTWING" 500. "1 " 1
*FC    60.0 "NAVAJO  " 500. "WESTWING" 500. "1 " 3
*FC    60.0 "MEAD    " 500. "PERKINS " 500. "1 " 1
*FC    60.0 "MEAD    " 500. "PERKINS " 500. "1 " 3
*
* Clear fault at Jojoba 500 kV bus after 4 cycles
*CFB  time  bus_name    kV
CFB   64.0 "JOJOBA  " 500.
*
* Trip Hassyampa - Jojoba 500 kV line after 4 cyles
*DL   time  bus1_name  kV   bus2_name   kV  ckt
DL    64.0 "HASSYAMP" 500. "JOJOBA  " 500. "1 "
*
* Remove fault damping to each Palo Verde Unit
*GFD  time  bus_name   kV  id   reduction
GFD   64.0 "PALOVRD1" 24. "1 "  0.0
GFD   64.0 "PALOVRD2" 24. "1 "  0.0
GFD   64.0 "PALOVRD3" 24. "1 "  0.0
*
* Reinsert series capacitors in following 500 kV Lines
*RC   time  bus1_name   kV  bus2_name   kV  ckt sec
*RC    64.0 "PALOVRDE" 500. "DEVERS  " 500. "1 "  2
*RC    64.0 "PALOVRDE" 500. "DEVERS  " 500. "1 "  4
*RC    64.0 "HASSYAMP" 500. "N.GILA  " 500. "1 "  2
*RC    64.0 "N.GILA  " 500. "IMPRLVLY" 500. "1 "  2
*RC    64.0 "IMPRLVLY" 500. "MIGUEL  " 500. "1 "  1
```

```
*RC     64.0 "MEAD     " 500. "PERKINS " 500. "1 "  1
*RC     64.0 "MEAD     " 500. "PERKINS " 500. "1 "  3
*
*RC     68.0 "MOENKOPI" 500. "YAVAPAI " 500. "1 "  1
*RC     68.0 "YAVAPAI " 500. "WESTWING" 500. "1 "  2
*RC     68.0 "NAVAJO  " 500. "WESTWING" 500. "1 "  1
*RC     68.0 "NAVAJO  " 500. "WESTWING" 500. "1 "  3
*
```

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Switching Sequence 4 - Three phase, four cycle fault on Jojoba - Kyrene 500 kV line, near Jojoba

```
* Category B2 - 3 phase fault at Jojoba 500 kV followed by
* Jojoba - Kyrene 500 kV single line outage
*
* CC cards for post-transient only
* DRP MW   (positive number indicates generation dropping)
CC DRP 0
*
* Fault bus at Jojoba 500 kV
*FB   time  bus_name   kV     r         x
FB    60.0 "JOJOBA  " 500.
*
* Apply fault damping to each Palo Verde Unit
*GFD  time  bus_name   kV  id   reduction
GFD   60.0 "PALOVRD1" 24. "1 "  0.072485
GFD   60.0 "PALOVRD2" 24. "1 "  0.072485
GFD   60.0 "PALOVRD3" 24. "1 "  0.072485
*
* Flash series capacitors in following 500 kV Lines at time of fault
*FC   time  bus1_name  kV  bus2_name   kV  ckt sec
*FC    60.0 "PALOVRDE" 500. "DEVERS  " 500. "1 " 2
*FC    60.0 "PALOVRDE" 500. "DEVERS  " 500. "1 " 4
*FC    60.0 "HASSYAMP" 500. "N.GILA  " 500. "1 " 2
*FC    60.0 "N.GILA  " 500. "IMPRLVLY" 500. "1 " 2
*FC    60.0 "IMPRLVLY" 500. "MIGUEL  " 500. "1 " 1
*FC    60.0 "MOENKOPI" 500. "YAVAPAI " 500. "1 " 1
*FC    60.0 "YAVAPAI " 500. "WESTWING" 500. "1 " 2
*FC    60.0 "NAVAJO  " 500. "WESTWING" 500. "1 " 1
*FC    60.0 "NAVAJO  " 500. "WESTWING" 500. "1 " 3
*FC    60.0 "MEAD    " 500. "PERKINS " 500. "1 " 1
*FC    60.0 "MEAD    " 500. "PERKINS " 500. "1 " 3
*
* Clear fault at Jojoba 500 kV bus after 4 cycles
*CFB  time  bus_name    kV
CFB   64.0  "JOJOBA  " 500.
*
* Trip Jojoba - Kyrene 500 kV line after 4 cyles
*DL   time  bus1_name  kV   bus2_name   kV  ckt
DL    64.0 "JOJOBA  " 500. "KYRENE  " 500. "1 "
*
* Remove fault damping to each Palo Verde Unit
*GFD  time  bus_name   kV  id   reduction
GFD   64.0 "PALOVRD1" 24. "1 "  0.0
GFD   64.0 "PALOVRD2" 24. "1 "  0.0
GFD   64.0 "PALOVRD3" 24. "1 "  0.0
*
* Reinsert series capacitors in following 500 kV Lines
*RC   time  bus1_name   kV  bus2_name   kV  ckt sec
*RC    64.0 "PALOVRDE" 500. "DEVERS  " 500. "1 "  2
*RC    64.0 "PALOVRDE" 500. "DEVERS  " 500. "1 "  4
*RC    64.0 "HASSYAMP" 500. "N.GILA  " 500. "1 "  2
*RC    64.0 "N.GILA  " 500. "IMPRLVLY" 500. "1 "  2
*RC    64.0 "IMPRLVLY" 500. "MIGUEL  " 500. "1 "  1
*RC    64.0 "MEAD    " 500. "PERKINS " 500. "1 "  1
```

```
*RC     64.0 "MEAD     " 500. "PERKINS " 500. "1 "  3
*
*RC     68.0 "MOENKOPI" 500. "YAVAPAI " 500. "1 "  1
*RC     68.0 "YAVAPAI " 500. "WESTWING" 500. "1 "  2
*RC     68.0 "NAVAJO  " 500. "WESTWING" 500. "1 "  1
*RC     68.0 "NAVAJO  " 500. "WESTWING" 500. "1 "  3
*
```

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Switching Sequence 5 - Three-phase, four cycle fault on Gila River - Jojoba #1 and #2 500 kV lines, near Gila River, includes tripping the Gila River 500/230 kV transformer bank and Gila River Power Plant 12 cycles after fault clearing

```
* Category C3 - 3 phase fault at Gila River 500 kV followed by
* Gila River - Jojoba #1 and #2 500 kV double line outage
* with SPS to trip all combined cycle units at Gila River
*
* CC cards for post-transient only
* DRP MW   (positive number indicates generation dropping)
CC DRP 2094
*
* Fault bus at Gila River 500 kV
*FB   time  bus_name   kV     r         x
FB    60.0 "GILARIVR" 500.
*
* Apply fault damping to each Palo Verde Unit
*GFD  time  bus_name   kV  id   reduction
GFD   60.0 "PALOVRD1" 24. "1 "  0.072485
GFD   60.0 "PALOVRD2" 24. "1 "  0.072485
GFD   60.0 "PALOVRD3" 24. "1 "  0.072485
*
* Flash series capacitors in following 500 kV Lines at time of fault
*FC   time  bus1_name  kV  bus2_name   kV  ckt sec
*FC    60.0 "PALOVRDE" 500. "DEVERS  " 500. "1 " 2
*FC    60.0 "PALOVRDE" 500. "DEVERS  " 500. "1 " 4
*FC    60.0 "HASSYAMP" 500. "N.GILA  " 500. "1 " 2
*FC    60.0 "N.GILA  " 500. "IMPRLVLY" 500. "1 " 2
*FC    60.0 "IMPRLVLY" 500. "MIGUEL  " 500. "1 " 1
*FC    60.0 "MOENKOPI" 500. "YAVAPAI " 500. "1 " 1
*FC    60.0 "YAVAPAI " 500. "WESTWING" 500. "1 " 2
*FC    60.0 "NAVAJO  " 500. "WESTWING" 500. "1 " 1
*FC    60.0 "NAVAJO  " 500. "WESTWING" 500. "1 " 3
*FC    60.0 "MEAD    " 500. "PERKINS " 500. "1 " 1
*FC    60.0 "MEAD    " 500. "PERKINS " 500. "1 " 3
*
* Clear fault at Gila River 500 kV bus after 4 cycles
*CFB  time  bus_name    kV
CFB   64.0 "GILARIVR" 500.
*
* Trip Gila River - Jojoba #1 and #2 500 kV lines after 4 cyles
*DL   time  bus1_name  kV   bus2_name   kV  ckt
DL    64.0 "GILARIVR" 500. "JOJOBA  " 500. "1 "
DL    64.0 "GILARIVR" 500. "JOJOBA  " 500. "2 "
*
* Remove fault damping to each Palo Verde Unit
*GFD  time  bus_name   kV  id   reduction
GFD   64.0 "PALOVRD1" 24. "1 "  0.0
GFD   64.0 "PALOVRD2" 24. "1 "  0.0
GFD   64.0 "PALOVRD3" 24. "1 "  0.0
*
* Reinsert series capacitors in following 500 kV Lines
*RC   time  bus1_name   kV  bus2_name   kV  ckt sec
*RC    64.0 "PALOVRDE" 500. "DEVERS  " 500. "1 "  2
*RC    64.0 "PALOVRDE" 500. "DEVERS  " 500. "1 "  4
*RC    64.0 "HASSYAMP" 500. "N.GILA  " 500. "1 "  2
```

```
*RC    64.0 "N.GILA  " 500. "IMPRLVLY" 500. "1 "  2
*RC    64.0 "IMPRLVLY" 500. "MIGUEL  " 500. "1 "  1
*RC    64.0 "MEAD    " 500. "PERKINS " 500. "1 "  1
*RC    64.0 "MEAD    " 500. "PERKINS " 500. "1 "  3
*
* Reinsert series capacitors in following 500 kV Lines
*RC   time  bus1_name   kV  bus2_name   kV  ckt sec
*RC    68.0 "MOENKOPI" 500. "YAVAPAI " 500. "1 "  1
*RC    68.0 "YAVAPAI " 500. "WESTWING" 500. "1 "  2
*RC    68.0 "NAVAJO  " 500. "WESTWING" 500. "1 "  1
*RC    68.0 "NAVAJO  " 500. "WESTWING" 500. "1 "  3
*
* SPS FAILURE, Trip the Gila River 500-230 kV Transformer - 12 cycle delay
after fault clearing.
*
DL    76.0 "GILARIVR" 500. "GILARIVR" 230. "1 "
*
* Trip Gila River generation and auxiliary load (assumed SPS at 12 cycles
after fault clearing)
* tripping 4 of 4 combined cycle units (-2092 MW)
*TG   time  bus_name     kV    id
TG    76.0  "GIL-CT1 "  18.    "1 "
TG    76.0  "GIL-CT2 "  18.    "1 "
TG    76.0  "GIL-ST1 "  18.    "1 "
TG    76.0  "GIL-CT3 "  18.    "1 "
TG    76.0  "GIL-CT4 "  18.    "1 "
TG    76.0  "GIL-ST2 "  18.    "1 "
TG    76.0  "GIL-CT5 "  18.    "1 "
TG    76.0  "GIL-CT6 "  18.    "1 "
TG    76.0  "GIL-ST3 "  18.    "1 "
TG    76.0  "GIL-CT7 "  18.    "1 "
TG    76.0  "GIL-CT8 "  18.    "1 "
TG    76.0  "GIL-ST4 "  18.    "1 "
*
*MBL  time  bus_name     kV   load_id  code  MW   MVAR
MBL   76.0  "GIL-CT1 "  18.    "AP"     "D"
MBL   76.0  "GIL-CT2 "  18.    "AP"     "D"
MBL   76.0  "GIL-CT3 "  18.    "AP"     "D"
MBL   76.0  "GIL-CT4 "  18.    "AP"     "D"
MBL   76.0  "GIL-CT5 "  18.    "AP"     "D"
MBL   76.0  "GIL-CT6 "  18.    "AP"     "D"
MBL   76.0  "GIL-CT7 "  18.    "AP"     "D"
MBL   76.0  "GIL-CT8 "  18.    "AP"     "D"
*
```

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Switching Sequence 7 - Three-phase, four cycle fault on Gila River - Jojoba 230 kV lines, near Gila River

```
*
*  3-phase 4 cycle fault at Gila River 230 kV
*  followed by loss of Gila River - Jojoba 230 kV line
*
*  CC cards for post-transient only
*
CC  DRP 0
*
*  Apply bus fault at Gila River 230 kV
*
FB   60.0  "GILARIVR" 230.
*
*
*  Clear bus fault at Gila River 230 kV
*
CFB  64.0  "GILARIVR" 230.
*
*  Trip Gila River - Jojoba 230 kV line
*
DL   64.0  "GILARIVR" 230. "JOJOBA  " 230. "1 "
*
```

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Switching Sequence 8 - Three-phase, four cycle fault on Gila River 500/230 kV transformer bank

```
*
*  3-phase 4 cycle fault at Gila River 230 kV
*  followed by loss of Gila River 500/230 kV Transformer
*
*  CC cards for post-transient only
*
CC  DRP 0
*
*  Apply bus fault at Gila River 230 kV
*
FB   60.0  "GILARIVR" 230.
*
*
*  Clear bus fault at Gila River 230 kV
*
CFB  64.0  "GILARIVR" 230.
*
*  Trip Gila River 500/230 kV Transformer
*
DL   64.0  "GILARIVR" 230. "GILARIVR" 500. "1 "
*
```

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Switching Sequence 9 - Three-phase, four cycle fault on Gila Bend 230/69 kV transformer bank 1

```
*
*  3-phase 4 cycle fault at Gila Bend 69 kV
*  followed by loss of Gila Bend 230/69 kV Transformer 1
*
*  CC cards for post-transient only
*
CC  DRP 0
*
*  Apply bus fault at Gila Bend 69 kV
*
FB   60.0  "GILABEND" 69.
*
*
*  Clear bus fault at Gila Bend 69 kV
*
CFB  64.0  "GILABEND" 69.
*
*  Trip Gila Bend 230/69 kV Transformer 1
*
DL   64.0  "GILABEND" 230. "GILABEND" 69. "1 "
*
```

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Switching Sequence 13 - Three-phase, seven cycle fault on Paloma-Bunyan 69 kV line, near Paloma

```
*
*  3-phase 7 cycle fault at Paloma 69 kV
*  followed by loss of Paloma-Bunyan 69 kV line
*
*  CC cards for post-transient only
*
CC  DRP 0
*
*  Apply bus fault at Paloma 69 kV
*
FB   60.0  "PALOMA  " 69.
*
*
*  Clear bus fault at Paloma 69 kV
*
CFB  67.0  "PALOMA  " 69.
*
*  Trip Paloma-Bunyan 69 kV line and Paloma 69/12 kV xmfrs
*
DL   67.0  "PALOMA  " 69. "BUNYAN  " 69. "1 "
*
```

Appendix E - Transient Stability Modeling

Q031 Generator Model

Model Name:	epcgen
Description	User-written dynamic model for a generator
Prerequisites:	Generator present in load flow working case
Inputs:	Network boundary variables, Field Voltage, Turbine Power.
Invocation:	epcgen [<n>]{<name> <kv>} <id> ! ! ! ! ! [<nm>] {<namem> <kvm>} : #rlevel <epcl name> <table> <p0 name> <p0 value> <p1 name> <p1 value>....

Parameters:

EPCL Variable	Description	Data
MVA	MVA base	**102**
rsrc	Source resistance, pu on plant base	**0.0**
xsrc	Source reactance, pu on plant base	**0.0**
Kpq	P/Q regulator gain, pu	**0.1**
TAUpq	P/Q regulator time constant, sec	**0.0167**
OV1L	overvoltage trip point #1, pu	**1.3**
OV1T	overvoltage delay #1, sec	**0.1**
OV2L	overvoltage trip point #2, pu	**1.1**
OV2T	overvoltage delay #2, sec	**3.0**
UV1L	undervoltage trip point #1, pu	**0.1**
UV1T	undervoltage delay #1, sec	**0.1**
UV2L	undervoltage trip point #2, pu	**0.9**
UV2T	undervoltage delay #2, sec	**1.0**
OFL	overfrequency trip point, pu	**63.0**
OFT	overfrequency delay, sec	**1.0**
UFL	underfrequency trip point, pu	**57**
UFT	underfrequency delay, sec	**1.0**
Vreg	voltage regulator flag	**0**
Kvreg	voltage regulator gain, pu	**0.1**
TAUvreg	voltage time constant, sec	**1.0**
regbus	bus to be controlled by voltage regulator	**0**
rmptim	inverter ramp time from startup, sec	**5.0**

Interconnection Customer provided data in **bold**, all other data is default/typical data. Model requires in-run epcl provided by Interconnection Customer.

```
epcgen   90020 "Q031    "   0.21 "1 " : #5 mva=102.0000  "epcl.p" 4.0000
"rsrc" 0.0000  "xsrc" 0.0000  "Kpq" 0.1000  "TAUpq" 0.0167  "OV1L" 1.3000
"OV1T" 0.1000  "OV2L" 1.1000  "OV2T" 3.0000  "UV1L" 0.1000   "UV1T" 0.1000
"UV2L" 0.9000  "UV2T" 1.0000  "OFL" 63.0000  "OFT" 1.0000  "UFL" 57.0000
"UFT" 1.0000  "Vreg" 0 "Kvreg" 0.1000  "TAUvreg" 1.0000  "regbus" 0  "rmptim"
5.0000
```

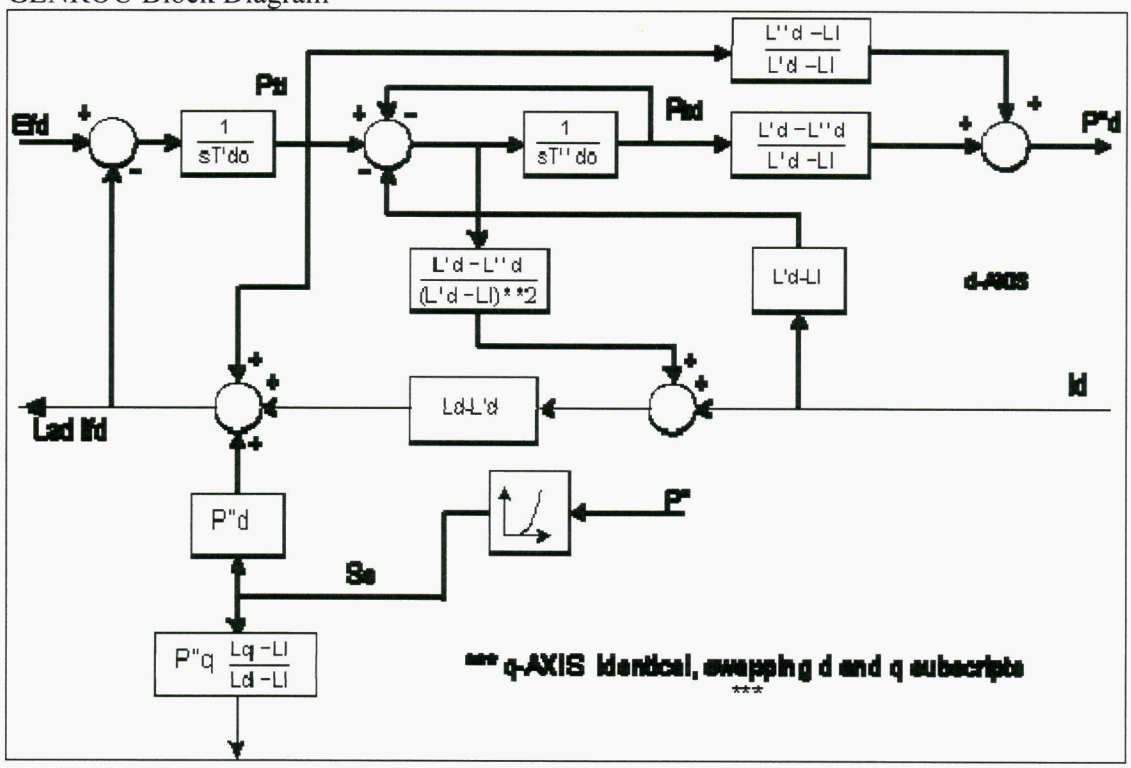
Q044 Generator Model

Model Name:	genrou	
Description	Solid rotor generator represented by equal mutual inductance rotor modeling	
Prerequisites:	Generator present in load flow working case	
Inputs:	Network boundary variables, Field Voltage, Turbine Power	
Invocation:	genrou [<n>] {<name> <kv>} <id> :	
Parameters:		
EPCL Variable	**Description**	**Data**
MVA	MVA base	**167**
Tpdo	D-axis transient rotor time constant	**9.191**
Tppdo	D-axis sub-transient rotor time constant	**0.043**
Tpqo	Q-axis transient rotor time constant	**2.5**
Tppqo	Q-axis sub-transient rotor time constant	**0.15**
H	Inertia constant, sec	**3.33228**
D	Damping factor, pu	**0.0**
Ld	D-axis synchronous reactance	**2.36**
Lq	Q-axis synchronous reactance	**2.24**
Lpd	D-axis transient reactance	**0.267**
Lpq	Q-axis transient reactance	**0.473**
Lppd	D-axis subtransient reactance	**0.183**
Ll	Stator leakage reactance, pu	**0.143**
S1	Saturation factor at 1 pu flux	**0.115**
S12	Saturation factor at 1.2 pu flux	**0.571**
Ra	Stator resistance, pu	**0.0**
Rcomp	Compounding resistance for voltage control, pu	**0.0**
Xcomp	Compounding reactance for voltage control, pu	**0.0**

Interconnection Customer provided data in **bold**, all other data is default/typical data.

```
genrou   86011 "Q044STG1"  13.80 "1 " : #9 mva=167.0000  9.1910 0.04300 2.500
0.150 3.33228 0.000 2.36 2.24 0.2670 0.4730 0.183 0.143 0.115 0.5710 0.000
0.0000 0.0000
```

GENROU Block Diagram



Q044 Excitation System Model

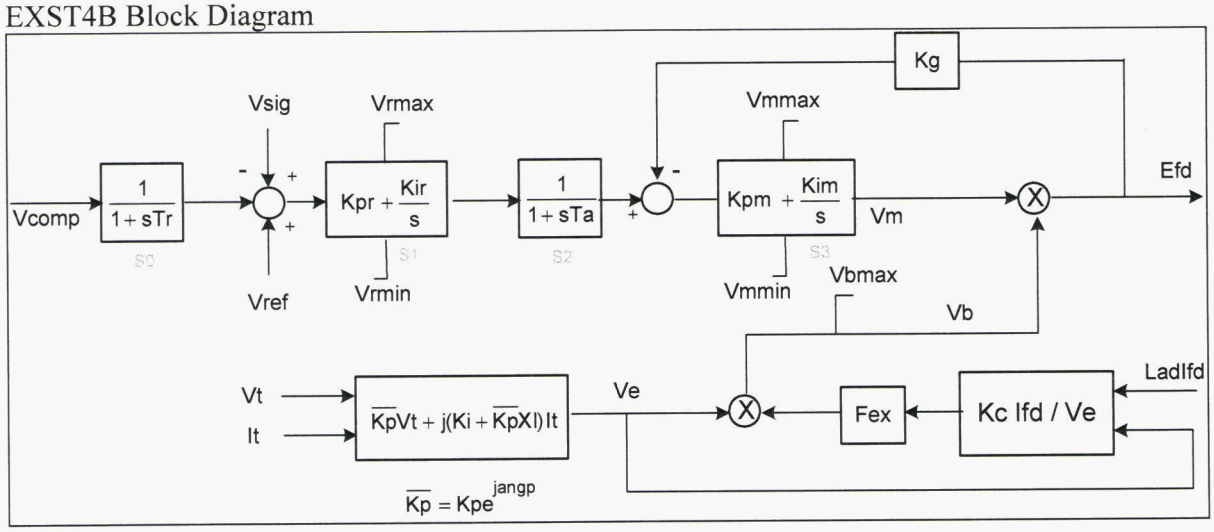
Model Name:	exst4b
Description	IEEE type ST4b excitation system
Prerequisites:	Generator model ahead of this model in dynamic models table
Inputs:	Compounded generator terminal voltage, generator field current, generator speed
Invocation:	exst4b [<n>] {<name> <kv>} <id> :
Parameters:	

EPCL Variable	Description	Data
Tr	Filter time constant, sec	**0.02**
Kpr	Proportional Gain, pu	**3.15**
Kir	Integral Gain, pu	**3.15**
Ta	Time constant, sec	**0.02**
Vrmax	Maximum control element output, pu	**1.0**
Vrmin	Minimum control element output, pu	**-0.87**
Kpm	Prop. Gain of field voltage regulator, pu	**1.0**
Kim	Integral Gain of field voltage regulator, pu	**0.0**
Vmmax	Maximum field voltage regulator output, pu	**1.0**
Vmmin	Minimum field voltage regulator output, pu	**-0.87**
Kg	Excitation limiter gain, pu	**0.0**
Kp	Potential source gain, pu	**6.5**
Angp	Phase angle of potential source, degree	**0.0**
Ki	Current source gain, pu	**0.0**
Kc	Exciter regulation factor, pu	**0.08**
Xl	P-bar leakage reactance, pu	**0.143**
Vbmax	Maximum excitation voltage	**8.0**

Interconnection Customer provided data in **bold**, all other data is default/typical data.

```
exst4b   86011 "Q044STG1"  13.80 "1 " : #9 .02   3.15   3.15 0.02 1.0 -0.87
1.000000 0.0 1.0 -0.870 0.0   6.500 0.0 0.0 0.080000 0.143   8.000
```

EXST4B Block Diagram



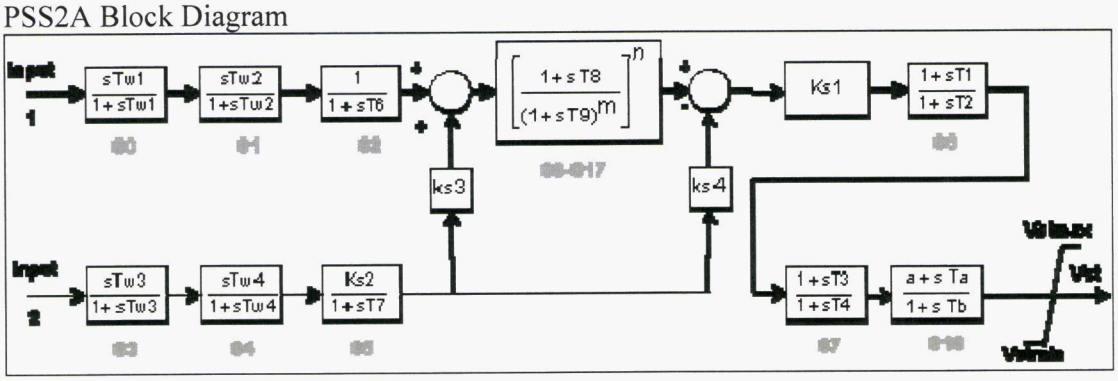
Q044 Power System Stabilizer Model

Model Name:	pss2a	
Description	Dual input Power system stabilizer (IEEE type PSS2A)	
Prerequisites:	Generator model ahead of this model in dynamic models table	
Inputs:	Generator shaft speed, frequency of generator terminal, system bus voltage, generator electric power or accelerating power, voltage amplitude of generator terminal bus or system bus, current amplitude specified branch	
Invocation:	psssa [<n>] {<name> <kv>} <id> :	
Parameters:		
EPCL Variable	**Description**	**Data**
J1	Input signal #1 code (shaft speed)	**1.0**
K1	Input signal #1 remote bus number	**0.0**
J2	Input signal #2 code (generator electrical power)	**3.0**
K2	Input signal #2 remote bus number	**0.0**
Tw1	First washout on signal #1, sec.	**2.0**
Tw2	Second washout on signal #1, sec.	**2.0**
Tw3	First washout on signal #2, sec.	**2.0**
Tw4	Second washout on signal #2, sec.	**0.0**
T6	Time constant on signal #1, sec.	**0.0**
T7	Time constant on signal #2, sec.	**2.0**
Ks2	Gain on signal #2	**0.2**
Ks3	Gain on signal #2	**1.0**
Ks4	Gain on signal #2	**1.0**
T8	Lead of ramp tracking filter	**0.5**
T9	Lag of ramp tracking filter	**0.1**
n	Order of ramp tracking filter	**1.0**
m	Order of ramp tracking filter	**5.0**
Ks1	Stabilizer gain	**10.0**
T1	Lead/lag time constant, sec.	**0.25**
T2	Lead/lag time constant, sec.	**0.04**
T3	Lead/lag time constant, sec.	**0.2**
T4	Lead/lag time constant, sec.	**0.03**
Vstmax	Stabilizer output max limit, p.u.	**0.1**
Vstmin	Stabilizer output min limit, p.u.	**-0.1**
a	Lead/lag num. Gain. (not in IEEE model)	**1.0**
Ta	Lead/lag time constant, sec. (not in IEEE model)	**0.0**
Tb	Lead/lag time constant, sec. (not in IEEE model)	**0.0**

Interconnection Customer provided data in **bold**, all other data is default/typical data.

```
pss2a    86011 "Q044STG1"  13.80 "1 " : #9 "j1" 1.000000 "k1" 0.0 "j2"
3.0000 "k2" 0.0 "tw1"  2.0000 "tw2"   2.0000 "tw3"   2.0000 "tw4" 0.0 "t6"
0.0 "t7"   2.0000  "ks2" 0.2000 "ks3" 1.000000 "ks4" 1.000000 "t8" 0.500000
"t9" 0.100000 "n" 1.000000 "m"   5.0000 "ks1" 10.00000 "t1" 0.250000 "t2"
0.0400000  "t3" 0.2000000 "t4" 0.030000 "vstmax" 0.10000 "vstmin" -0.10000
"a" 1.0 "ta" 0.0 "tb" 0.0
```

PSS2A Block Diagram



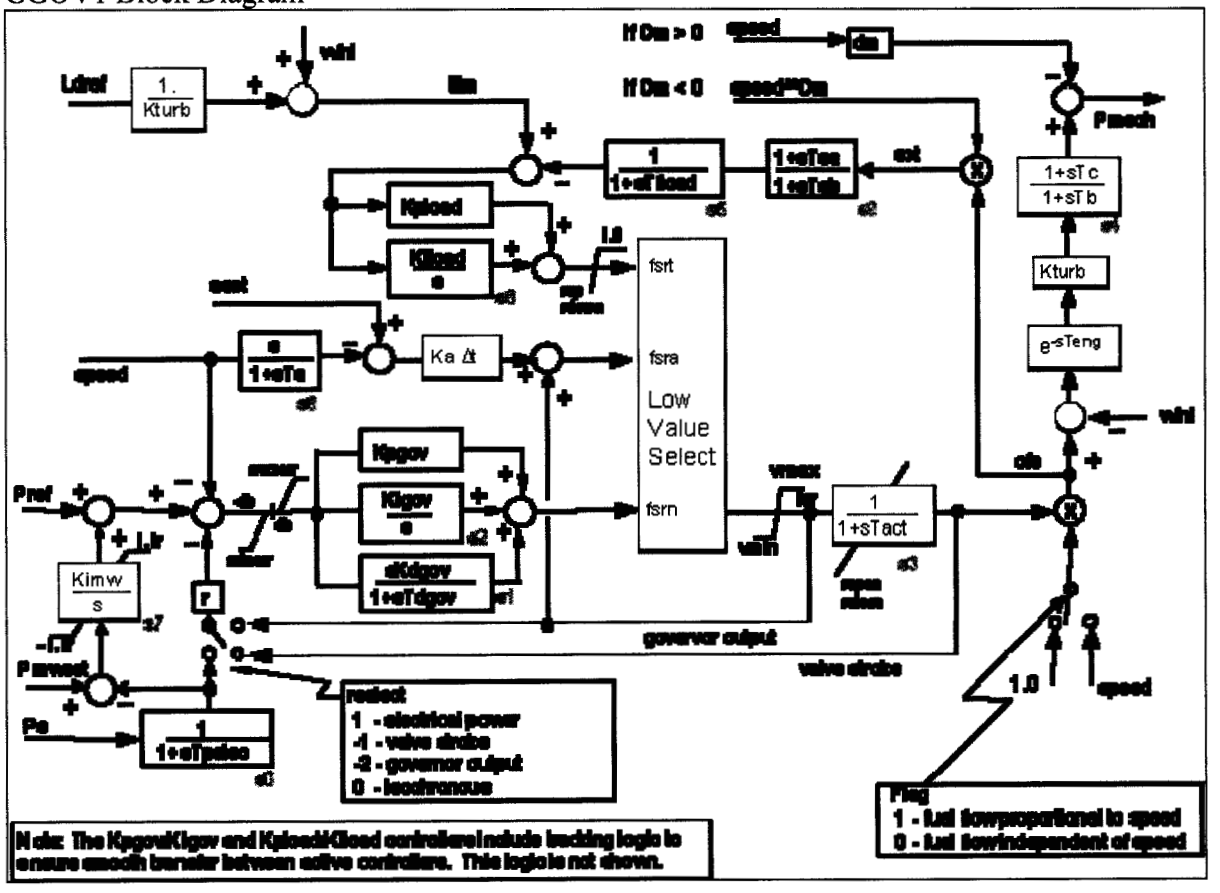
Q044 Governor Model

Model Name:	ggov1	
Description	General governor model	
Prerequisites:	Generator model ahead of this model in the dynamic models table	
Inputs:	Shaft speed	
Invocation:	ggov1 [<n>] {<name> <kv>} <id> : [mwcap=<value>]	
Parameters:		
EPCL Variable	**Description**	**Data**
MWCap	Maximum turbine output (MW)	
r	Permanent droop, p.u.	**0.05**
rselect	Feedback signal for droop	**1.0**
Tpelec	Electrical power transducer time constant, sec.	**1.0**
maxerr	Maximum value for speed error signal	**0.05**
minerr	Minimum value for speed error signal	**-0.05**
Kpgov	Governor proportional gain	**10.0**
Kigov	Governor integral gain	**2.0**
Kdgov	Governor derivative gain	**0.0**
Tdgov	Governor derivative controller time constant	**1.0**
vmax	Maximum valve position limit	**1.0**
vmin	Minimum valve position limit	**0.0**
Tact	Actuator time constant	**0.5**
Kturb	Turbine gain	**1.5**
wfnl	No load fuel flow, p.u	**0.2**
Tb	Turbine lag time constant	**0.12**
Tc	Turbine lead time constant	**0.8**
Flag	Switch for fuel source characteristic	**1.0**
Teng	Transport lag time constant for diesel engine	**0.0**
Tfload	Load Limiter time constant	**3.0**
Kpload	Load limiter proportional gain for PI controller	**2.0**
Kiload	Load limiter integral gain for PI controller	**0.67**
Ldref	Load limiter reference value p.u.	**1.0**
Dm	Speed sensitivity coefficient, p.u.	**0.0**
ropen	Maximum valve opening rate, p.u./sec.	**0.1**
rclose	Minimum valve closing rate, p.u./sec.	**-0.1**
Kimw	Power controller (reset) gain	**0.0002**
Pmwset	Power controller setpoint, MW	**150.0**
aset	Acceleration limiter setpoint, p.u./sec.	**0.01**
Ka	Acceleration limiter Gain	**10.0**
Ta	Acceleration limiter time constant, sec.	**0.1**
db	Speed governor dead band	**0.0**
Tsa	Temperature detection lead time constant, sec.	**4.0**
Tsb	Temperature detection lag time constant, sec.	**5.0**
rup	Maximum rate of load limit increase	**99**
rdown	Maximum rate of load limit decrease	**-99**

Interconnection Customer provided data in **bold**, all other data is default/typical data.

```
ggov1     86011 "Q044STG1"  13.80 "1 " : #9 0.050000  1.000000 1.000000
0.050000 -0.050000  10.0000   2.0000 0.0 1.000000 1.000000 0.0  0.50 1.500000
0.200000  0.12000   0.8000 1.0 0.0   3.0000 2.0000 0.670000 1.0000 0.0 0.1000
-0.1000 0.0002   150.0  .01000  10.0000 0.100000 0.0 4.0 5.0 99.0 -99.0
```

GGOV1 Block Diagram



Appendix G - Transient Stability Analysis Results

0. WORST-CONDITION ANALYSIS REPORT FOR VOLTAGE DIPS EXCEEDING 20.0% FOR 20.0-CYCLES OR MORE [LOAD BUSES]
EXTNUM BUSNAM BASEKV ID TYPE AREA ZONE INIT MIN MIN_TIME PERCENT DURATION

1. WORST-CONDITION ANALYSIS REPORT FOR VOLTAGE DIPS EXCEEDING 25.0% [LOAD BUSES]
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2. WORST-CONDITION ANALYSIS REPORT FOR VOLTAGE DIPS EXCEEDING 30.0% [ALL BUSES]
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3. WORST-CONDITION ANALYSIS REPORT FOR FREQUENCY DIPS EXCEEDING 59.6 HZ FOR 6.0-CYCLES OR MORE [LOAD BUSE
EXTNUM BUSNAM BASEKV ID TYPE AREA ZONE INIT MIN MIN_TIME PERCENT DURATION

4. WORST-CONDITION ANALYSIS REPORT FOR ANGLES EXCEEDING 180.0 DEGREES [ALL BUSES]
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EXTNUM	BUSNAM	BASEKV	ID	TYPE	AREA	ZONE	INIT	MIN	MIN_TIME	PERCENT	DURATION

2. WORST-CONDITION ANALYSIS REPORT FOR VOLTAGE DIPS EXCEEDING 30.0% [ALL BUSES]

EXTNUM	BUSNAM	BASEKV	ID	TYPE	AREA	ZONE	INIT	MIN	MIN_TIME	PERCENT	DURATION

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EXTNUM	BUSNAM	BASEKV	ID	TYPE	AREA	ZONE	INIT	MIN	MIN_TIME	PERCENT	DURATION

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EXTNUM	BUSNAM	BASEKV	ID	TYPE	AREA	ZONE	INIT	MIN	MIN_TIME	PERCENT	DURATION

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EXTNUM	BUSNAM	BASEKV	ID	TYPE	AREA	ZONE	INIT	MIN	MIN_TIME	PERCENT	DURATION

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4. WORST-CONDITION ANALYSIS REPORT FOR ANGLES EXCEEDING 180.0 DEGREES [ALL BUSES]

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1. WORST-CONDITION ANALYSIS REPORT FOR VOLTAGE DIPS EXCEEDING 25.0% [LOAD BUSES]

EXTNUM	BUSNAM	BASEKV	ID	TYPE	AREA	ZONE	INIT	MIN	MIN_TIME	PERCENT	DURATION
93110	Q031	0.21	1	vbug	14	148	1.013	0.414	1.108	0.591	7.713
93120	Q031	34.5	1	vbus	14	148	1.023	0.419	1.108	0.591	7.741
85437	PALOMA10	12	1	vbul	14	148	1.018	0.462	1.108	0.546	8.075
85403	AZTEC	12	1	vbul	14	148	0.976	0.444	1.108	0.545	7.575
84405	AZTEC	69	1	vbus	14	148	0.978	0.446	1.108	0.544	7.553
85413	HORN	12	1	vbul	14	148	0.972	0.443	1.108	0.544	7.543
84425	HORN	69	1	vbus	14	148	0.981	0.449	1.108	0.542	7.511
85416	PALOMA 2	12	1	vbul	14	148	1.026	0.470	1.108	0.542	7.864
84406	AZTECTAP	69	1	vbus	14	148	0.983	0.451	1.108	0.541	7.494
85414	HYDER	12	1	vbul	14	148	0.991	0.457	1.108	0.539	7.429
93130	Q031	69	1	vbus	14	148	1.043	0.481	1.108	0.538	7.199
84426	HYDER	69	1	vbus	14	148	0.993	0.460	1.108	0.537	7.403
84459	HYDERTAP	69	1	vbus	14	148	0.993	0.460	1.108	0.537	7.403
84460	HY1	69	1	vbus	14	148	0.994	0.460	1.108	0.537	7.393
84401	AGUACATP	69	1	vbus	14	148	1.004	0.469	1.108	0.533	7.304
84400	AGUACAL	69	1	vbus	14	148	1.004	0.469	1.108	0.533	7.304
85400	AGUACAL	2.4	1	vbus	14	148	1.004	0.469	1.108	0.533	7.304
85406	BUNYAN	12	1	vbul	14	148	1.018	0.481	1.108	0.528	7.167
84411	BUNYAN	69	1	vbus	14	148	1.020	0.483	1.108	0.526	7.139
84432	PALOMA	69	1	vbus	14	148	1.030	0.493	1.108	0.521	7.021
85425	WHY	20.8	1	vbul	14	148	0.971	0.509	1.108	0.476	6.316
84445	WHY	69	1	vbus	14	148	0.961	0.504	1.108	0.475	6.295
85401	AJO	20.8	1	vbul	14	148	0.993	0.521	1.108	0.475	6.291
84402	AJO	69	1	vbus	14	148	0.967	0.510	1.108	0.473	6.250
85409	GILABD11	12	1	vbul	14	148	0.993	0.526	1.108	0.470	6.415
84496	THAYERAP	69	1	vbul	14	148	1.001	0.537	1.108	0.464	6.047
85410	GILABD19	12	1	vbul	14	148	1.001	0.538	1.108	0.462	6.022
14235	GILABEND	230	1	vbul	14	141	1.007	0.542	1.108	0.462	6.016
14527	GILABD12	100	1	vbus	14	148	1.007	0.542	1.108	0.462	6.014
85939	GILAB12T	12.47	1	vbus	14	148	1.007	0.542	1.108	0.462	6.014
14528	GILABD 8	100	1	vbus	14	148	1.007	0.542	1.108	0.462	6.012
85938	GILABD8T	12.47	1	vbus	14	148	1.007	0.542	1.108	0.462	6.012
84419	GILABEND	69	1	vbus	14	148	1.007	0.542	1.108	0.462	6.008
84412	BUTERFLD	69	1	vbul	14	148	0.996	0.602	1.108	0.395	4.477
84408	BTRFLDTP	69	1	vbus	14	148	0.995	0.602	1.108	0.395	4.476
85407	COTN CTR	12	1	vbul	14	148	0.985	0.642	1.108	0.348	3.547
84414	COTN CTR	69	1	vbus	14	148	0.989	0.655	1.108	0.338	3.151
85411	GILLWEST	12	1	vbul	14	148	0.982	0.729	1.108	0.258	0.396

2. WORST-CONDITION ANALYSIS REPORT FOR VOLTAGE DIPS EXCEEDING 30.0% [ALL BUSES]

EXTNUM	BUSNAM	BASEKV	ID	TYPE	AREA	ZONE	INIT	MIN	MIN_TIME	PERCENT	DURATION
93110	Q031	0.21	1	vbug	14	148	1.013	0.414	1.108	0.591	6.169
93120	Q031	34.5	1	vbus	14	148	1.023	0.419	1.108	0.591	6.189
85437	PALOMA10	12	1	vbul	14	148	1.018	0.462	1.108	0.546	6.359
85403	AZTEC	12	1	vbul	14	148	0.976	0.444	1.108	0.545	5.940
84405	AZTEC	69	1	vbus	14	148	0.978	0.446	1.108	0.544	5.916
85413	HORN	12	1	vbul	14	148	0.972	0.443	1.108	0.544	5.908
84425	HORN	69	1	vbus	14	148	0.981	0.449	1.108	0.542	5.872
85416	PALOMA 2	12	1	vbul	14	148	1.026	0.470	1.108	0.542	6.161
84406	AZTECTAP	69	1	vbus	14	148	0.983	0.451	1.108	0.541	5.855
85414	HYDER	12	1	vbul	14	148	0.991	0.457	1.108	0.539	5.787
93130	Q031	69	1	vbus	14	148	1.043	0.481	1.108	0.538	5.582
84426	HYDER	69	1	vbus	14	148	0.993	0.460	1.108	0.537	5.760
84459	HYDERTAP	69	1	vbus	14	148	0.993	0.460	1.108	0.537	5.760
84460	HY1	69	1	vbus	14	148	0.994	0.460	1.108	0.537	5.749
84401	AGUACATP	69	1	vbus	14	148	1.004	0.469	1.108	0.533	5.658

84400	AGUACAL	69	1	vbus	14	148	1.004	0.469	1.108	0.533	5.658
85400	AGUACAL	2.4	1	vbus	14	148	1.004	0.469	1.108	0.533	5.658

3. WORST-CONDITION ANALYSIS REPORT FOR FREQUENCY DIPS EXCEEDING 59.6 HZ FOR 6.0-CYCLES OR MORE [LOAD BUSE

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EXTNUM	BUSNAM	BASEKV	ID	TYPE	AREA	ZONE	INIT	MIN	MIN_TIME	PERCENT	DURATION
93110	Q031	0.21	1	vbug	14	148	1.013	0.554	1.267	0.453	0.183
93120	Q031	34.5	1	vbus	14	148	1.023	0.583	1.267	0.430	0.175
93130	Q031	69	1	vbus	14	148	1.043	0.690	1.267	0.339	0.088
85403	AZTEC	12	1	vbul	14	148	0.976	0.653	1.267	0.331	0.084
84405	AZTEC	69	1	vbus	14	148	0.978	0.655	1.267	0.330	0.082
85413	HORN	12	1	vbul	14	148	0.972	0.651	1.267	0.330	0.081
84425	HORN	69	1	vbus	14	148	0.981	0.659	1.267	0.329	0.078
84406	AZTECTAP	69	1	vbus	14	148	0.983	0.661	1.267	0.328	0.077
85414	HYDER	12	1	vbul	14	148	0.991	0.668	1.267	0.326	0.071
84426	HYDER	69	1	vbus	14	148	0.993	0.670	1.267	0.325	0.069
84459	HYDERTAP	69	1	vbus	14	148	0.993	0.670	1.267	0.325	0.069
84460	HY1	69	1	vbus	14	148	0.994	0.671	1.267	0.325	0.068
84401	AGUACATP	69	1	vbus	14	148	1.004	0.680	1.267	0.322	0.060
84400	AGUACAL	69	1	vbus	14	148	1.004	0.681	1.267	0.322	0.060
85400	AGUACAL	2.4	1	vbus	14	148	1.004	0.681	1.267	0.322	0.060
85406	BUNYAN	12	1	vbul	14	148	1.018	0.695	1.267	0.318	0.049
84411	BUNYAN	69	1	vbus	14	148	1.020	0.697	1.267	0.317	0.047
84432	PALOMA	69	1	vbus	14	148	1.030	0.707	1.267	0.313	0.037
85416	PALOMA 2	12	1	vbul	14	148	1.026	0.706	1.267	0.312	0.036
85437	PALOMA10	12	1	vbul	14	148	1.018	0.700	1.267	0.312	0.036
85407	COTN CTR	12	1	vbul	14	148	0.985	0.679	1.267	0.310	0.357
84414	COTN CTR	69	1	vbus	14	148	0.989	0.684	1.267	0.308	0.279

3. WORST-CONDITION ANALYSIS REPORT FOR FREQUENCY DIPS EXCEEDING 59.0 HZ FOR 6.0-CYCLES OR MORE [LOAD BUSES]

EXTNUM	BUSNAM	BASEKV	ID	TYPE	AREA	ZONE	INIT	MIN	MIN_TIME	PERCENT	DURATION

4. WORST-CONDITION ANALYSIS REPORT FOR ANGLES EXCEEDING 180.0 DEGREES [ALL BUSES]

EXTNUM	BUSNAM	BASEKV	ID	TYPE	AREA	ZONE	INIT	MIN	MIN_TIME	PERCENT	DURATION

0. WORST-CONDITION ANALYSIS REPORT FOR VOLTAGE DIPS EXCEEDING 20.0% FOR 20.0-CYCLES OR MORE [LOAD BUSES]
EXTNUM BUSNAM BASEKV ID TYPE AREA ZONE INIT MIN MIN_TIME PERCENT DURATION

1. WORST-CONDITION ANALYSIS REPORT FOR VOLTAGE DIPS EXCEEDING 25.0% [LOAD BUSES]
EXTNUM BUSNAM BASEKV ID TYPE AREA ZONE INIT MIN MIN_TIME PERCENT DURATION

2. WORST-CONDITION ANALYSIS REPORT FOR VOLTAGE DIPS EXCEEDING 30.0% [ALL BUSES]
EXTNUM BUSNAM BASEKV ID TYPE AREA ZONE INIT MIN MIN_TIME PERCENT DURATION

3. WORST-CONDITION ANALYSIS REPORT FOR FREQUENCY DIPS EXCEEDING 59.6 HZ FOR 6.0-CYCLES OR MORE [LOAD BUSE
EXTNUM BUSNAM BASEKV ID TYPE AREA ZONE INIT MIN MIN_TIME PERCENT DURATION

4. WORST-CONDITION ANALYSIS REPORT FOR ANGLES EXCEEDING 180.0 DEGREES [ALL BUSES]
EXTNUM BUSNAM BASEKV ID TYPE AREA ZONE INIT MIN MIN_TIME PERCENT DURATION

0. WORST-CONDITION ANALYSIS REPORT FOR VOLTAGE DIPS EXCEEDING 20.0% FOR 20.0-CYCLES OR MORE [LOAD BUSES]
EXTNUM BUSNAM BASEKV ID TYPE AREA ZONE INIT MIN MIN_TIME PERCENT DURATION

1. WORST-CONDITION ANALYSIS REPORT FOR VOLTAGE DIPS EXCEEDING 25.0% [LOAD BUSES]
EXTNUM BUSNAM BASEKV ID TYPE AREA ZONE INIT MIN MIN_TIME PERCENT DURATION

2. WORST-CONDITION ANALYSIS REPORT FOR VOLTAGE DIPS EXCEEDING 30.0% [ALL BUSES]
EXTNUM BUSNAM BASEKV ID TYPE AREA ZONE INIT MIN MIN_TIME PERCENT DURATION

3. WORST-CONDITION ANALYSIS REPORT FOR FREQUENCY DIPS EXCEEDING 59.6 HZ FOR 6.0-CYCLES OR MORE [LOAD BUSE
EXTNUM BUSNAM BASEKV ID TYPE AREA ZONE INIT MIN MIN_TIME PERCENT DURATION

4. WORST-CONDITION ANALYSIS REPORT FOR ANGLES EXCEEDING 180.0 DEGREES [ALL BUSES]
EXTNUM BUSNAM BASEKV ID TYPE AREA ZONE INIT MIN MIN_TIME PERCENT DURATION

0. WORST-CONDITION ANALYSIS REPORT FOR VOLTAGE DIPS EXCEEDING 20.0% FOR 20.0-CYCLES OR MORE [LOAD BUSES]

EXTNUM	BUSNAM	BASEKV	ID	TYPE	AREA	ZONE	INIT	MIN	MIN_TIME	PERCENT	DURATION

1. WORST-CONDITION ANALYSIS REPORT FOR VOLTAGE DIPS EXCEEDING 25.0% [LOAD BUSES]

EXTNUM	BUSNAM	BASEKV	ID	TYPE	AREA	ZONE	INIT	MIN	MIN_TIME	PERCENT	DURATION

2. WORST-CONDITION ANALYSIS REPORT FOR VOLTAGE DIPS EXCEEDING 30.0% [ALL BUSES]

EXTNUM	BUSNAM	BASEKV	ID	TYPE	AREA	ZONE	INIT	MIN	MIN_TIME	PERCENT	DURATION

3. WORST-CONDITION ANALYSIS REPORT FOR FREQUENCY DIPS EXCEEDING 59.6 HZ FOR 6.0-CYCLES OR MORE [LOAD BUSES]

EXTNUM	BUSNAM	BASEKV	ID	TYPE	AREA	ZONE	INIT	MIN	MIN_TIME	PERCENT	DURATION

4. WORST-CONDITION ANALYSIS REPORT FOR ANGLES EXCEEDING 180.0 DEGREES [ALL BUSES]

EXTNUM	BUSNAM	BASEKV	ID	TYPE	AREA	ZONE	INIT	MIN	MIN_TIME	PERCENT	DURATION

0. WORST-CONDITION ANALYSIS REPORT FOR VOLTAGE DIPS EXCEEDING 20.0% FOR 20.0-CYCLES OR MORE [LOAD BUSES]

EXTNUM	BUSNAM	BASEKV	ID	TYPE	AREA	ZONE	INIT	MIN	MIN_TIME	PERCENT	DURATION

1. WORST-CONDITION ANALYSIS REPORT FOR VOLTAGE DIPS EXCEEDING 25.0% [LOAD BUSES]

EXTNUM	BUSNAM	BASEKV	ID	TYPE	AREA	ZONE	INIT	MIN	MIN_TIME	PERCENT	DURATION

2. WORST-CONDITION ANALYSIS REPORT FOR VOLTAGE DIPS EXCEEDING 30.0% [ALL BUSES]

EXTNUM	BUSNAM	BASEKV	ID	TYPE	AREA	ZONE	INIT	MIN	MIN_TIME	PERCENT	DURATION

3. WORST-CONDITION ANALYSIS REPORT FOR FREQUENCY DIPS EXCEEDING 59.6 HZ FOR 6.0-CYCLES OR MORE [LOAD BUSES]

EXTNUM	BUSNAM	BASEKV	ID	TYPE	AREA	ZONE	INIT	MIN	MIN_TIME	PERCENT	DURATION

4. WORST-CONDITION ANALYSIS REPORT FOR ANGLES EXCEEDING 180.0 DEGREES [ALL BUSES]

EXTNUM	BUSNAM	BASEKV	ID	TYPE	AREA	ZONE	INIT	MIN	MIN_TIME	PERCENT	DURATION

0. WORST-CONDITION ANALYSIS REPORT FOR VOLTAGE DIPS EXCEEDING 20.0% FOR 20.0-CYCLES OR MORE [LOAD BUSES]

EXTNUM	BUSNAM	BASEKV	ID	TYPE	AREA	ZONE	INIT	MIN	MIN_TIME	PERCENT	DURATION

1. WORST-CONDITION ANALYSIS REPORT FOR VOLTAGE DIPS EXCEEDING 25.0% [LOAD BUSES]

EXTNUM	BUSNAM	BASEKV	ID	TYPE	AREA	ZONE	INIT	MIN	MIN_TIME	PERCENT	DURATION
93110	Q031	0.21	1	vbug	14	148	1.013	0.430	1.108	0.576	7.483
93120	Q031	34.5	1	vbus	14	148	1.023	0.435	1.108	0.575	7.505
85437	PALOMA10	12	1	vbul	14	148	1.018	0.476	1.108	0.533	7.828
85403	AZTEC	12	1	vbul	14	148	0.976	0.458	1.108	0.531	7.310
84405	AZTEC	69	1	vbus	14	148	0.978	0.460	1.108	0.530	7.287
85413	HORN	12	1	vbul	14	148	0.972	0.457	1.108	0.530	7.276
85416	PALOMA 2	12	1	vbul	14	148	1.027	0.484	1.108	0.528	7.612
84425	HORN	69	1	vbus	14	148	0.982	0.463	1.108	0.528	7.244
84406	AZTECTAP	69	1	vbus	14	148	0.984	0.465	1.108	0.527	7.227
85414	HYDER	12	1	vbul	14	148	0.991	0.471	1.108	0.525	7.160
93130	Q031	69	1	vbus	14	148	1.043	0.496	1.108	0.524	6.928
84426	HYDER	69	1	vbus	14	148	0.994	0.474	1.108	0.523	7.133
84459	HYDERTAP	69	1	vbus	14	148	0.994	0.474	1.108	0.523	7.133
84460	HY1	69	1	vbus	14	148	0.995	0.475	1.108	0.523	7.123
84400	AGUACAL	69	1	vbus	14	148	1.004	0.483	1.108	0.519	7.031
84401	AGUACATP	69	1	vbus	14	148	1.004	0.483	1.108	0.519	7.031
85400	AGUACAL	2.4	1	vbus	14	148	1.004	0.483	1.108	0.519	7.031
85406	BUNYAN	12	1	vbul	14	148	1.018	0.495	1.108	0.514	6.890
84411	BUNYAN	69	1	vbus	14	148	1.020	0.498	1.108	0.512	6.861
84432	PALOMA	69	1	vbus	14	148	1.030	0.507	1.108	0.507	6.741
85425	WHY	20.799999	1	vbul	14	148	0.971	0.521	1.108	0.463	6.036
84445	WHY	69	1	vbus	14	148	0.962	0.517	1.108	0.462	6.015
85401	AJO	20.799999	1	vbul	14	148	0.994	0.534	1.108	0.462	6.010
84402	AJO	69	1	vbus	14	148	0.968	0.522	1.108	0.460	5.968
85409	GILABD11	12	1	vbul	14	148	0.993	0.539	1.108	0.458	6.128
84496	THAYERAP	69	1	vbul	14	148	1.002	0.550	1.108	0.451	5.762
85410	GILABD19	12	1	vbul	14	148	1.001	0.551	1.108	0.450	5.737
85939	GILAB12T	12.47	1	vbus	14	148	1.008	0.555	1.108	0.449	5.726
14527	GILABD12	100	1	vbus	14	148	1.008	0.555	1.108	0.449	5.726
14528	GILABD 8	100	1	vbus	14	148	1.008	0.555	1.108	0.449	5.725
85938	GILABD8T	12.47	1	vbus	14	148	1.007	0.555	1.108	0.449	5.725
84419	GILABEND	69	1	vbus	14	148	1.007	0.555	1.108	0.449	5.722
14235	GILABEND	230	1	vbul	14	141	1.007	0.555	1.108	0.449	5.719
84412	BUTERFLD	69	1	vbul	14	148	0.999	0.614	1.108	0.385	4.273
84408	BTRFLDTP	69	1	vbus	14	148	0.998	0.614	1.108	0.385	4.271
85407	COTN CTR	12	1	vbul	14	148	0.989	0.652	1.108	0.341	3.319
84414	COTN CTR	69	1	vbus	14	148	0.993	0.665	1.108	0.330	2.915
85411	GILLWEST	12	1	vbul	14	148	0.987	0.737	1.108	0.253	0.146

2. WORST-CONDITION ANALYSIS REPORT FOR VOLTAGE DIPS EXCEEDING 30.0% [ALL BUSES]

EXTNUM	BUSNAM	BASEKV	ID	TYPE	AREA	ZONE	INIT	MIN	MIN_TIME	PERCENT	DURATION
93110	Q031	0.21	1	vbug	14	148	1.013	0.430	1.108	0.576	5.944
93120	Q031	34.5	1	vbus	14	148	1.023	0.435	1.108	0.575	5.957
85437	PALOMA10	12	1	vbul	14	148	1.018	0.476	1.108	0.533	6.107
85403	AZTEC	12	1	vbul	14	148	0.976	0.458	1.108	0.531	5.668
84405	AZTEC	69	1	vbus	14	148	0.978	0.460	1.108	0.530	5.644
85413	HORN	12	1	vbul	14	148	0.972	0.457	1.108	0.530	5.636
85416	PALOMA 2	12	1	vbul	14	148	1.027	0.484	1.108	0.528	5.905
84425	HORN	69	1	vbus	14	148	0.982	0.463	1.108	0.528	5.600
84406	AZTECTAP	69	1	vbus	14	148	0.984	0.465	1.108	0.527	5.583
85414	HYDER	12	1	vbul	14	148	0.991	0.471	1.108	0.525	5.514
93130	Q031	69	1	vbus	14	148	1.043	0.496	1.108	0.524	5.318
84426	HYDER	69	1	vbus	14	148	0.994	0.474	1.108	0.523	5.487
84459	HYDERTAP	69	1	vbus	14	148	0.994	0.474	1.108	0.523	5.487
84460	HY1	69	1	vbus	14	148	0.995	0.475	1.108	0.523	5.476

84400	AGUACAL	69	1	vbus	14	148	1.004	0.483	1.108	0.519	5.385
84401	AGUACATP	69	1	vbus	14	148	1.004	0.483	1.108	0.519	5.385
85400	AGUACAL	2.4	1	vbus	14	148	1.004	0.483	1.108	0.519	5.385
85406	BUNYAN	12	1	vbul	14	148	1.018	0.495	1.108	0.514	5.246
84411	BUNYAN	69	1	vbus	14	148	1.020	0.498	1.108	0.512	5.217
84432	PALOMA	69	1	vbus	14	148	1.030	0.507	1.108	0.507	5.099
85425	WHY	20.799999	1	vbul	14	148	0.971	0.521	1.108	0.463	4.325
84445	WHY	69	1	vbus	14	148	0.962	0.517	1.108	0.462	4.305
85401	AJO	20.799999	1	vbul	14	148	0.994	0.534	1.108	0.462	4.301
84402	AJO	69	1	vbus	14	148	0.968	0.522	1.108	0.460	4.262
85409	GILABD11	12	1	vbul	14	148	0.993	0.539	1.108	0.458	4.377
84496	THAYERAP	69	1	vbul	14	148	1.002	0.550	1.108	0.451	4.070
85410	GILABD19	12	1	vbul	14	148	1.001	0.551	1.108	0.450	4.047
85939	GILAB12T	12.47	1	vbus	14	148	1.008	0.555	1.108	0.449	4.036
14527	GILABD12	100	1	vbus	14	148	1.008	0.555	1.108	0.449	4.036
14528	GILABD 8	100	1	vbus	14	148	1.008	0.555	1.108	0.449	4.035
85938	GILABD8T	12.47	1	vbus	14	148	1.007	0.555	1.108	0.449	4.035
84419	GILABEND	69	1	vbus	14	148	1.007	0.555	1.108	0.449	4.033
14235	GILABEND	230	1	vbul	14	141	1.007	0.555	1.108	0.449	4.031
84412	BUTERFLD	69	1	vbul	14	148	0.999	0.614	1.108	0.385	2.642
84408	BTRFLDTP	69	1	vbus	14	148	0.998	0.614	1.108	0.385	2.640
85407	COTN CTR	12	1	vbul	14	148	0.989	0.652	1.108	0.341	1.484
84414	COTN CTR	69	1	vbus	14	148	0.993	0.665	1.108	0.330	1.084

3. WORST-CONDITION ANALYSIS REPORT FOR FREQUENCY DIPS EXCEEDING 59.6 HZ FOR 6.0-CYCLES OR MORE [LOAD BUSES]

EXTNUM	BUSNAM	BASEKV	ID	TYPE	AREA	ZONE	INIT	MIN	MIN_TIME	PERCENT	DURATION

4. WORST-CONDITION ANALYSIS REPORT FOR ANGLES EXCEEDING 180.0 DEGREES [ALL BUSES]

EXTNUM	BUSNAM	BASEKV	ID	TYPE	AREA	ZONE	INIT	MIN	MIN_TIME	PERCENT	DURATION

0. WORST-CONDITION ANALYSIS REPORT FOR VOLTAGE DIPS EXCEEDING 20.0% FOR 20.0-CYCLES OR MORE [LOAD BUSES]
EXTNUM BUSNAM BASEKV ID TYPE AREA ZONE INIT MIN MIN_TIME PERCENT DURATION

1. WORST-CONDITION ANALYSIS REPORT FOR VOLTAGE DIPS EXCEEDING 25.0% [LOAD BUSES]
EXTNUM BUSNAM BASEKV ID TYPE AREA ZONE INIT MIN MIN_TIME PERCENT DURATION

2. WORST-CONDITION ANALYSIS REPORT FOR VOLTAGE DIPS EXCEEDING 30.0% [ALL BUSES]
EXTNUM BUSNAM BASEKV ID TYPE AREA ZONE INIT MIN MIN_TIME PERCENT DURATION

3. WORST-CONDITION ANALYSIS REPORT FOR FREQUENCY DIPS EXCEEDING 59.6 HZ FOR 6.0-CYCLES OR MORE [LOAD BUSE
EXTNUM BUSNAM BASEKV ID TYPE AREA ZONE INIT MIN MIN_TIME PERCENT DURATION

4. WORST-CONDITION ANALYSIS REPORT FOR ANGLES EXCEEDING 180.0 DEGREES [ALL BUSES]
EXTNUM BUSNAM BASEKV ID TYPE AREA ZONE INIT MIN MIN_TIME PERCENT DURATION

0. WORST-CONDITION ANALYSIS REPORT FOR VOLTAGE DIPS EXCEEDING 20.0% FOR 20.0-CYCLES OR MORE [LOAD BUSES]

EXTNUM	BUSNAM	BASEKV	ID	TYPE	AREA	ZONE	INIT	MIN	MIN_TIME	PERCENT	DURATION

1. WORST-CONDITION ANALYSIS REPORT FOR VOLTAGE DIPS EXCEEDING 25.0% [LOAD BUSES]

EXTNUM	BUSNAM	BASEKV	ID	TYPE	AREA	ZONE	INIT	MIN	MIN_TIME	PERCENT	DURATION

2. WORST-CONDITION ANALYSIS REPORT FOR VOLTAGE DIPS EXCEEDING 30.0% [ALL BUSES]

EXTNUM	BUSNAM	BASEKV	ID	TYPE	AREA	ZONE	INIT	MIN	MIN_TIME	PERCENT	DURATION

3. WORST-CONDITION ANALYSIS REPORT FOR FREQUENCY DIPS EXCEEDING 59.6 HZ FOR 6.0-CYCLES OR MORE [LOAD BUSES]

EXTNUM	BUSNAM	BASEKV	ID	TYPE	AREA	ZONE	INIT	MIN	MIN_TIME	PERCENT	DURATION

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EXTNUM BUSNAM BASEKV ID TYPE AREA ZONE INIT MIN MIN_TIME PERCENT DURATION

0. WORST-CONDITION ANALYSIS REPORT FOR VOLTAGE DIPS EXCEEDING 20.0% FOR 40.0-CYCLES OR MORE [LOAD BUSES]

EXTNUM	BUSNAM	BASEKV	ID	TYPE	AREA	ZONE	INIT	MIN	MIN_TIME	PERCENT	DURATION

2. WORST-CONDITION ANALYSIS REPORT FOR VOLTAGE DIPS EXCEEDING 30.0% [ALL BUSES]

EXTNUM	BUSNAM	BASEKV	ID	TYPE	AREA	ZONE	INIT	MIN	MIN_TIME	PERCENT	DURATION
93110	Q031	0.21	1	vbug	14	148	1.013	0.569	1.267	0.439	0.083
93120	Q031	34.5	1	vbus	14	148	1.023	0.623	1.267	0.391	0.117
85403	AZTEC	12	1	vbul	14	148	0.976	0.676	1.267	0.308	0.294
84405	AZTEC	69	1	vbus	14	148	0.978	0.678	1.267	0.307	0.264
85413	HORN	12	1	vbul	14	148	0.972	0.674	1.267	0.307	0.257
84425	HORN	69	1	vbus	14	148	0.982	0.682	1.267	0.306	0.212
84406	AZTECTAP	69	1	vbus	14	148	0.984	0.684	1.267	0.305	0.192
85414	HYDER	12	1	vbul	14	148	0.991	0.691	1.267	0.303	0.112
84426	HYDER	69	1	vbus	14	148	0.994	0.693	1.267	0.302	0.081
84459	HYDERTAP	69	1	vbus	14	148	0.994	0.693	1.267	0.302	0.081
84460	HY1	69	1	vbus	14	148	0.995	0.694	1.267	0.302	0.069
85407	COTN CTR	12	1	vbul	14	148	0.989	0.692	1.267	0.301	0.027
84412	BUTERFLD	69	1	vbul	14	148	0.999	0.699	1.267	0.300	0.013
84408	BTRFLDTP	69	1	vbus	14	148	0.998	0.699	1.267	0.300	0.011

3. WORST-CONDITION ANALYSIS REPORT FOR FREQUENCY DIPS EXCEEDING 59.0 HZ FOR 6.0-CYCLES OR MORE [LOAD BUSES]

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EXTNUM BUSNAM BASEKV ID TYPE AREA ZONE INIT MIN MIN_TIME PERCENT DURATION

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EXTNUM	BUSNAM	BASEKV	ID	TYPE	AREA	ZONE	INIT	MIN	MIN_TIME	PERCENT	DURATION

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EXTNUM	BUSNAM	BASEKV	ID	TYPE	AREA	ZONE	INIT	MIN	MIN_TIME	PERCENT	DURATION

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EXTNUM	BUSNAM	BASEKV	ID	TYPE	AREA	ZONE	INIT	MIN	MIN_TIME	PERCENT	DURATION

3. WORST-CONDITION ANALYSIS REPORT FOR FREQUENCY DIPS EXCEEDING 59.6 HZ FOR 6.0-CYCLES OR MORE [LOAD BUSE

EXTNUM	BUSNAM	BASEKV	ID	TYPE	AREA	ZONE	INIT	MIN	MIN_TIME	PERCENT	DURATION

4. WORST-CONDITION ANALYSIS REPORT FOR ANGLES EXCEEDING 180.0 DEGREES [ALL BUSES]

EXTNUM	BUSNAM	BASEKV	ID	TYPE	AREA	ZONE	INIT	MIN	MIN_TIME	PERCENT	DURATION

0. WORST-CONDITION ANALYSIS REPORT FOR VOLTAGE DIPS EXCEEDING 20.0% FOR 20.0-CYCLES OR MORE [LOAD BUSES]

EXTNUM	BUSNAM	BASEKV	ID	TYPE	AREA	ZONE	INIT	MIN	MIN_TIME	PERCENT	DURATION

1. WORST-CONDITION ANALYSIS REPORT FOR VOLTAGE DIPS EXCEEDING 25.0% [LOAD BUSES]

EXTNUM	BUSNAM	BASEKV	ID	TYPE	AREA	ZONE	INIT	MIN	MIN_TIME	PERCENT	DURATION

2. WORST-CONDITION ANALYSIS REPORT FOR VOLTAGE DIPS EXCEEDING 30.0% [ALL BUSES]

EXTNUM	BUSNAM	BASEKV	ID	TYPE	AREA	ZONE	INIT	MIN	MIN_TIME	PERCENT	DURATION

3. WORST-CONDITION ANALYSIS REPORT FOR FREQUENCY DIPS EXCEEDING 59.6 HZ FOR 6.0-CYCLES OR MORE [LOAD BUSES]

EXTNUM	BUSNAM	BASEKV	ID	TYPE	AREA	ZONE	INIT	MIN	MIN_TIME	PERCENT	DURATION

4. WORST-CONDITION ANALYSIS REPORT FOR ANGLES EXCEEDING 180.0 DEGREES [ALL BUSES]

EXTNUM	BUSNAM	BASEKV	ID	TYPE	AREA	ZONE	INIT	MIN	MIN_TIME	PERCENT	DURATION

0. WORST-CONDITION ANALYSIS REPORT FOR VOLTAGE DIPS EXCEEDING 20.0% FOR 20.0-CYCLES OR MORE [LOAD BUSES]

EXTNUM	BUSNAM	BASEKV	ID	TYPE	AREA	ZONE	INIT	MIN	MIN_TIME	PERCENT	DURATION

1. WORST-CONDITION ANALYSIS REPORT FOR VOLTAGE DIPS EXCEEDING 25.0% [LOAD BUSES]

EXTNUM	BUSNAM	BASEKV	ID	TYPE	AREA	ZONE	INIT	MIN	MIN_TIME	PERCENT	DURATION

2. WORST-CONDITION ANALYSIS REPORT FOR VOLTAGE DIPS EXCEEDING 30.0% [ALL BUSES]

EXTNUM	BUSNAM	BASEKV	ID	TYPE	AREA	ZONE	INIT	MIN	MIN_TIME	PERCENT	DURATION

3. WORST-CONDITION ANALYSIS REPORT FOR FREQUENCY DIPS EXCEEDING 59.6 HZ FOR 6.0-CYCLES OR MORE [LOAD BUSES]

EXTNUM	BUSNAM	BASEKV	ID	TYPE	AREA	ZONE	INIT	MIN	MIN_TIME	PERCENT	DURATION

4. WORST-CONDITION ANALYSIS REPORT FOR ANGLES EXCEEDING 180.0 DEGREES [ALL BUSES]

EXTNUM	BUSNAM	BASEKV	ID	TYPE	AREA	ZONE	INIT	MIN	MIN_TIME	PERCENT	DURATION

0. WORST-CONDITION ANALYSIS REPORT FOR VOLTAGE DIPS EXCEEDING 20.0% FOR 20.0-CYCLES OR MORE [LOAD BUSES]
EXTNUM BUSNAM BASEKV ID TYPE AREA ZONE INIT MIN MIN_TIME PERCENT DURATION

1. WORST-CONDITION ANALYSIS REPORT FOR VOLTAGE DIPS EXCEEDING 25.0% [LOAD BUSES]
EXTNUM BUSNAM BASEKV ID TYPE AREA ZONE INIT MIN MIN_TIME PERCENT DURATION

2. WORST-CONDITION ANALYSIS REPORT FOR VOLTAGE DIPS EXCEEDING 30.0% [ALL BUSES]
EXTNUM BUSNAM BASEKV ID TYPE AREA ZONE INIT MIN MIN_TIME PERCENT DURATION

3. WORST-CONDITION ANALYSIS REPORT FOR FREQUENCY DIPS EXCEEDING 59.6 HZ FOR 6.0-CYCLES OR MORE [LOAD BUSE
EXTNUM BUSNAM BASEKV ID TYPE AREA ZONE INIT MIN MIN_TIME PERCENT DURATION

4. WORST-CONDITION ANALYSIS REPORT FOR ANGLES EXCEEDING 180.0 DEGREES [ALL BUSES]
EXTNUM BUSNAM BASEKV ID TYPE AREA ZONE INIT MIN MIN_TIME PERCENT DURATION

0. WORST-CONDITION ANALYSIS REPORT FOR VOLTAGE DIPS EXCEEDING 20.0% FOR 20.0-CYCLES OR MORE [LOAD BUSES]

EXTNUM	BUSNAM	BASEKV	ID	TYPE	AREA	ZONE	INIT	MIN	MIN_TIME	PERCENT	DURATION

1. WORST-CONDITION ANALYSIS REPORT FOR VOLTAGE DIPS EXCEEDING 25.0% [LOAD BUSES]

EXTNUM	BUSNAM	BASEKV	ID	TYPE	AREA	ZONE	INIT	MIN	MIN_TIME	PERCENT	DURATION

2. WORST-CONDITION ANALYSIS REPORT FOR VOLTAGE DIPS EXCEEDING 30.0% [ALL BUSES]

EXTNUM	BUSNAM	BASEKV	ID	TYPE	AREA	ZONE	INIT	MIN	MIN_TIME	PERCENT	DURATION

3. WORST-CONDITION ANALYSIS REPORT FOR FREQUENCY DIPS EXCEEDING 59.6 HZ FOR 6.0-CYCLES OR MORE [LOAD BUSE

EXTNUM	BUSNAM	BASEKV	ID	TYPE	AREA	ZONE	INIT	MIN	MIN_TIME	PERCENT	DURATION

4. WORST-CONDITION ANALYSIS REPORT FOR ANGLES EXCEEDING 180.0 DEGREES [ALL BUSES]

EXTNUM	BUSNAM	BASEKV	ID	TYPE	AREA	ZONE	INIT	MIN	MIN_TIME	PERCENT	DURATION

0. WORST-CONDITION ANALYSIS REPORT FOR VOLTAGE DIPS EXCEEDING 20.0% FOR 20.0-CYCLES OR MORE [LOAD BUSES]
EXTNUM BUSNAM BASEKV ID TYPE AREA ZONE INIT MIN MIN_TIME PERCENT DURATION

1. WORST-CONDITION ANALYSIS REPORT FOR VOLTAGE DIPS EXCEEDING 25.0% [LOAD BUSES]
EXTNUM BUSNAM BASEKV ID TYPE AREA ZONE INIT MIN MIN_TIME PERCENT DURATION

2. WORST-CONDITION ANALYSIS REPORT FOR VOLTAGE DIPS EXCEEDING 30.0% [ALL BUSES]
EXTNUM BUSNAM BASEKV ID TYPE AREA ZONE INIT MIN MIN_TIME PERCENT DURATION

3. WORST-CONDITION ANALYSIS REPORT FOR FREQUENCY DIPS EXCEEDING 59.6 HZ FOR 6.0-CYCLES OR MORE [LOAD BUSE
EXTNUM BUSNAM BASEKV ID TYPE AREA ZONE INIT MIN MIN_TIME PERCENT DURATION

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EXTNUM BUSNAM BASEKV ID TYPE AREA ZONE INIT MIN MIN_TIME PERCENT DURATION

0. WORST-CONDITION ANALYSIS REPORT FOR VOLTAGE DIPS EXCEEDING 20.0% FOR 20.0-CYCLES OR MORE [LOAD BUSES]

EXTNUM	BUSNAM	BASEKV	ID	TYPE	AREA	ZONE	INIT	MIN	MIN_TIME	PERCENT	DURATION

1. WORST-CONDITION ANALYSIS REPORT FOR VOLTAGE DIPS EXCEEDING 25.0% [LOAD BUSES]

EXTNUM	BUSNAM	BASEKV	ID	TYPE	AREA	ZONE	INIT	MIN	MIN_TIME	PERCENT	DURATION

2. WORST-CONDITION ANALYSIS REPORT FOR VOLTAGE DIPS EXCEEDING 30.0% [ALL BUSES]

EXTNUM	BUSNAM	BASEKV	ID	TYPE	AREA	ZONE	INIT	MIN	MIN_TIME	PERCENT	DURATION

3. WORST-CONDITION ANALYSIS REPORT FOR FREQUENCY DIPS EXCEEDING 59.6 HZ FOR 6.0-CYCLES OR MORE [LOAD BUSE

EXTNUM	BUSNAM	BASEKV	ID	TYPE	AREA	ZONE	INIT	MIN	MIN_TIME	PERCENT	DURATION

4. WORST-CONDITION ANALYSIS REPORT FOR ANGLES EXCEEDING 180.0 DEGREES [ALL BUSES]

EXTNUM	BUSNAM	BASEKV	ID	TYPE	AREA	ZONE	INIT	MIN	MIN_TIME	PERCENT	DURATION

0. WORST-CONDITION ANALYSIS REPORT FOR VOLTAGE DIPS EXCEEDING 20.0% FOR 40.0-CYCLES OR MORE [LOAD BUSES]

EXTNUM	BUSNAM	BASEKV	ID	TYPE	AREA	ZONE	INIT	MIN	MIN_TIME	PERCENT	DURATION

2. WORST-CONDITION ANALYSIS REPORT FOR VOLTAGE DIPS EXCEEDING 30.0% [ALL BUSES]

EXTNUM	BUSNAM	BASEKV	ID	TYPE	AREA	ZONE	INIT	MIN	MIN_TIME	PERCENT	DURATION

3. WORST-CONDITION ANALYSIS REPORT FOR FREQUENCY DIPS EXCEEDING 59.0 HZ FOR 6.0-CYCLES OR MORE [LOAD BUSES]

EXTNUM	BUSNAM	BASEKV	ID	TYPE	AREA	ZONE	INIT	MIN	MIN_TIME	PERCENT	DURATION

4. WORST-CONDITION ANALYSIS REPORT FOR ANGLES EXCEEDING 180.0 DEGREES [ALL BUSES]

EXTNUM	BUSNAM	BASEKV	ID	TYPE	AREA	ZONE	INIT	MIN	MIN_TIME	PERCENT	DURATION

0. WORST-CONDITION ANALYSIS REPORT FOR VOLTAGE DIPS EXCEEDING 20.0% FOR 20.0-CYCLES OR MORE [LOAD BUSES]
EXTNUM BUSNAM BASEKV ID TYPE AREA ZONE INIT MIN MIN_TIME PERCENT DURATION

1. WORST-CONDITION ANALYSIS REPORT FOR VOLTAGE DIPS EXCEEDING 25.0% [LOAD BUSES]
EXTNUM BUSNAM BASEKV ID TYPE AREA ZONE INIT MIN MIN_TIME PERCENT DURATION

2. WORST-CONDITION ANALYSIS REPORT FOR VOLTAGE DIPS EXCEEDING 30.0% [ALL BUSES]
EXTNUM BUSNAM BASEKV ID TYPE AREA ZONE INIT MIN MIN_TIME PERCENT DURATION

3. WORST-CONDITION ANALYSIS REPORT FOR FREQUENCY DIPS EXCEEDING 59.6 HZ FOR 6.0-CYCLES OR MORE [LOAD BUSE
EXTNUM BUSNAM BASEKV ID TYPE AREA ZONE INIT MIN MIN_TIME PERCENT DURATION

4. WORST-CONDITION ANALYSIS REPORT FOR ANGLES EXCEEDING 180.0 DEGREES [ALL BUSES]
EXTNUM BUSNAM BASEKV ID TYPE AREA ZONE INIT MIN MIN_TIME PERCENT DURATION

0. WORST-CONDITION ANALYSIS REPORT FOR VOLTAGE DIPS EXCEEDING 20.0% FOR 20.0-CYCLES OR MORE [LOAD BUSES]
EXTNUM BUSNAM BASEKV ID TYPE AREA ZONE INIT MIN MIN_TIME PERCENT DURATION

1. WORST-CONDITION ANALYSIS REPORT FOR VOLTAGE DIPS EXCEEDING 25.0% [LOAD BUSES]
EXTNUM BUSNAM BASEKV ID TYPE AREA ZONE INIT MIN MIN_TIME PERCENT DURATION

2. WORST-CONDITION ANALYSIS REPORT FOR VOLTAGE DIPS EXCEEDING 30.0% [ALL BUSES]
EXTNUM BUSNAM BASEKV ID TYPE AREA ZONE INIT MIN MIN_TIME PERCENT DURATION

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EXTNUM BUSNAM BASEKV ID TYPE AREA ZONE INIT MIN MIN_TIME PERCENT DURATION

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EXTNUM	BUSNAM	BASEKV	ID	TYPE	AREA	ZONE	INIT	MIN	MIN_TIME	PERCENT	DURATION

1. WORST-CONDITION ANALYSIS REPORT FOR VOLTAGE DIPS EXCEEDING 25.0% [LOAD BUSES]

EXTNUM	BUSNAM	BASEKV	ID	TYPE	AREA	ZONE	INIT	MIN	MIN_TIME	PERCENT	DURATION

2. WORST-CONDITION ANALYSIS REPORT FOR VOLTAGE DIPS EXCEEDING 30.0% [ALL BUSES]

EXTNUM	BUSNAM	BASEKV	ID	TYPE	AREA	ZONE	INIT	MIN	MIN_TIME	PERCENT	DURATION

3. WORST-CONDITION ANALYSIS REPORT FOR FREQUENCY DIPS EXCEEDING 59.6 HZ FOR 6.0-CYCLES OR MORE [LOAD BUSES]

EXTNUM	BUSNAM	BASEKV	ID	TYPE	AREA	ZONE	INIT	MIN	MIN_TIME	PERCENT	DURATION

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EXTNUM	BUSNAM	BASEKV	ID	TYPE	AREA	ZONE	INIT	MIN	MIN_TIME	PERCENT	DURATION

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EXTNUM	BUSNAM	BASEKV	ID	TYPE	AREA	ZONE	INIT	MIN	MIN_TIME	PERCENT	DURATION

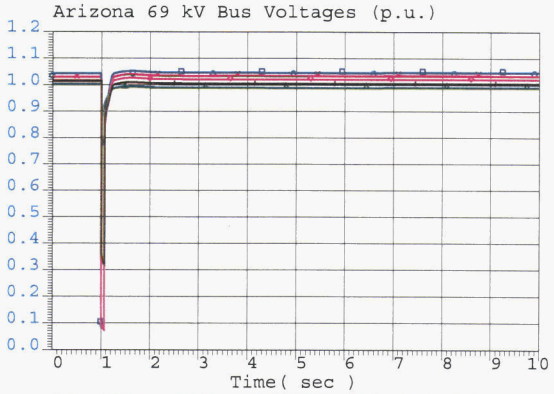
4. WORST-CONDITION ANALYSIS REPORT FOR ANGLES EXCEEDING 180.0 DEGREES [ALL BUSES]

EXTNUM	BUSNAM	BASEKV	ID	TYPE	AREA	ZONE	INIT	MIN	MIN_TIME	PERCENT	DURATION

Appendix H - Transient Stability Plots

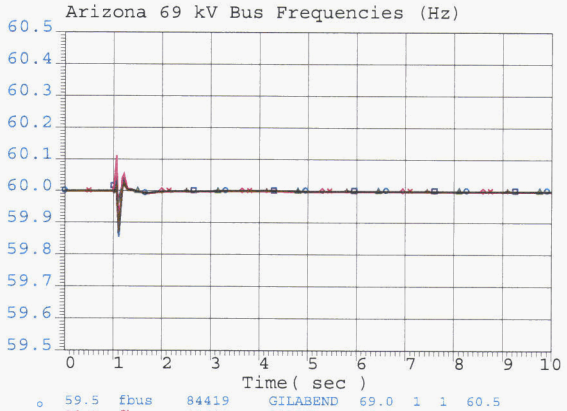
Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots

Arizona 69 kV Bus Voltages (p.u.)



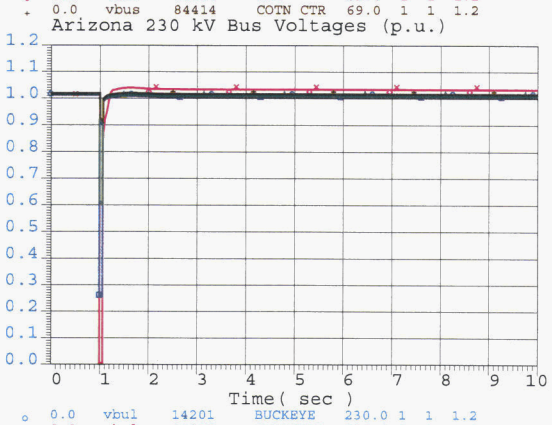
○	0.0	vbus	84419	GILABEND	69.0	1	1	1.2
×	0.0	vbus	84432	PALOMA	69.0	1	1	1.2
□	0.0	vbus	84411	BUNYAN	69.0	1	1	1.2
△	0.0	vbus	84442	SADDLEMT	69.0	1	1	1.2
◇	0.0	vbus	84460	HY1	69.0	1	1	1.2
+	0.0	vbus	84414	COTN CTR	69.0	1	1	1.2

Arizona 69 kV Bus Frequencies (Hz)



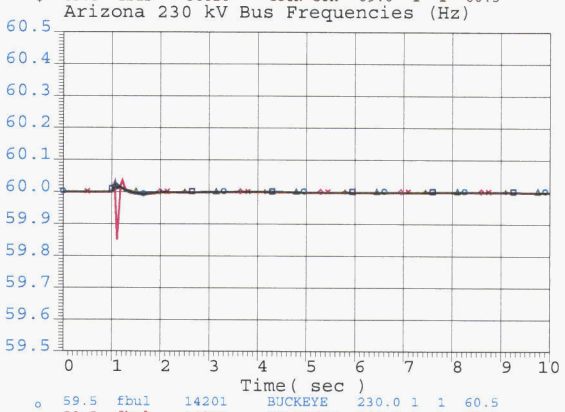
○	59.5	fbus	84419	GILABEND	69.0	1	1	60.5
×	59.5	fbus	84432	PALOMA	69.0	1	1	60.5
□	59.5	fbus	84411	BUNYAN	69.0	1	1	60.5
△	59.5	fbus	84442	SADDLEMT	69.0	1	1	60.5
◇	59.5	fbus	84460	HY1	69.0	1	1	60.5
+	59.5	fbus	84414	COTN CTR	69.0	1	1	60.5

Arizona 230 kV Bus Voltages (p.u.)



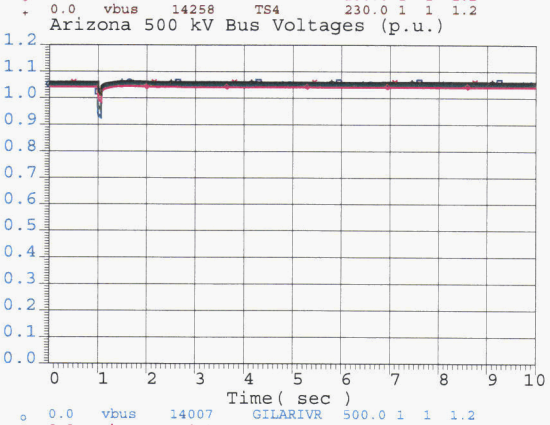
○	0.0	vbul	14201	BUCKEYE	230.0	1	1	1.2
×	0.0	vbul	14235	GILABEND	230.0	1	1	1.2
□	0.0	vbus	14238	GILARIVR	230.0	1	1	1.2
△	0.0	vbus	14224	JOJOBA	230.0	1	1	1.2
◇	0.0	vbus	19052	LIBERTY	230.0	1	1	1.2
+	0.0	vbus	14258	TS4	230.0	1	1	1.2

Arizona 230 kV Bus Frequencies (Hz)



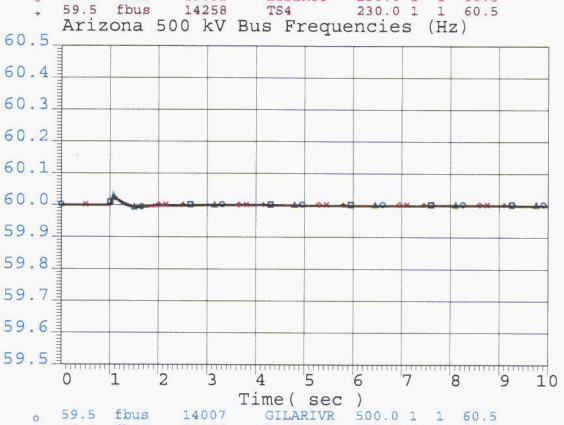
○	59.5	fbul	14201	BUCKEYE	230.0	1	1	60.5
×	59.5	fbul	14235	GILABEND	230.0	1	1	60.5
□	59.5	fbus	14238	GILARIVR	230.0	1	1	60.5
△	59.5	fbus	14224	JOJOBA	230.0	1	1	60.5
◇	59.5	fbus	19052	LIBERTY	230.0	1	1	60.5
+	59.5	fbus	14258	TS4	230.0	1	1	60.5

Arizona 500 kV Bus Voltages (p.u.)



○	0.0	vbus	14007	GILARIVR	500.0	1	1	1.2
×	0.0	vbus	15093	HARQUAHA	500.0	1	1	1.2
□	0.0	vbus	15090	HASSYAMP	500.0	1	1	1.2
△	0.0	vbus	15089	JOJOBA	500.0	1	1	1.2
◇	0.0	vbus	15011	KYRENE	500.0	1	1	1.2
+	0.0	vbus	15021	PALOVRDE	500.0	1	1	1.2

Arizona 500 kV Bus Frequencies (Hz)

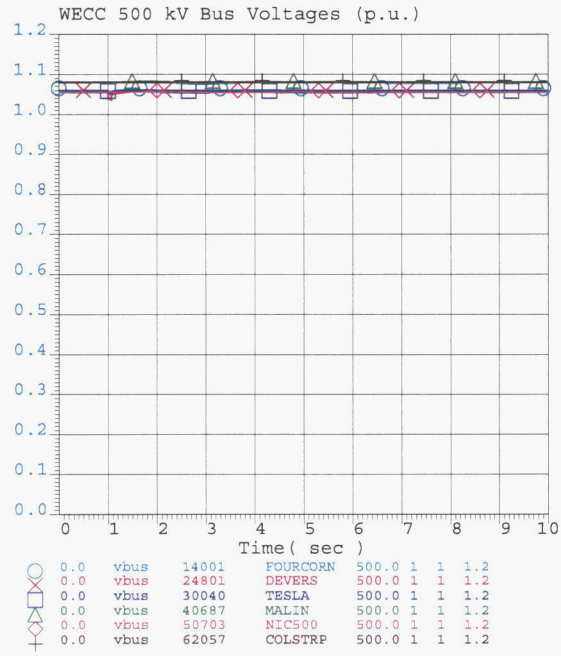


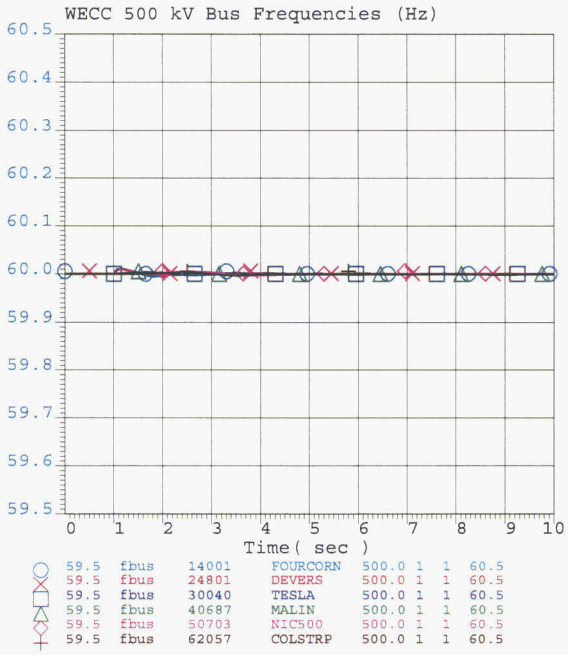
○	59.5	fbus	14007	GILARIVR	500.0	1	1	60.5
×	59.5	fbus	15093	HARQUAHA	500.0	1	1	60.5
□	59.5	fbus	15090	HASSYAMP	500.0	1	1	60.5
△	59.5	fbus	15089	JOJOBA	500.0	1	1	60.5
◇	59.5	fbus	15011	KYRENE	500.0	1	1	60.5
+	59.5	fbus	15021	PALOVRDE	500.0	1	1	60.5

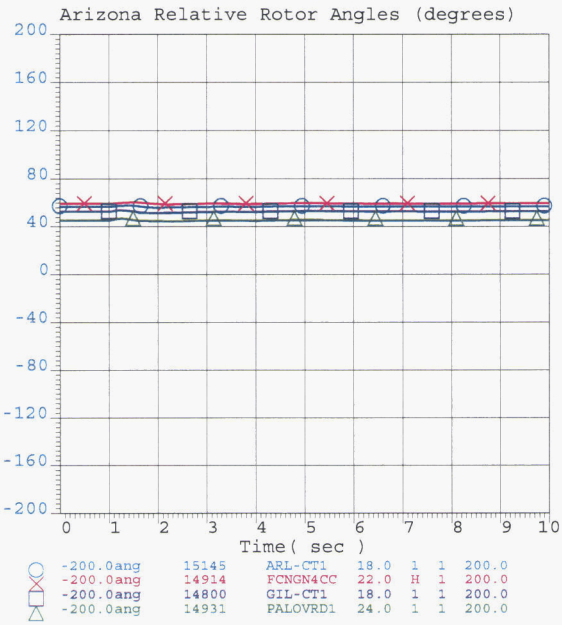
2011 Heavy Summer Power Flow/Transient Stability Case
Gila Bend/Gila River Cluster SIS Pre-Project Revision 3 Case
3-phase 4 cycle flt. @ Gila Bend 230 kV, trip Gila Bend-Gila River 230 kV

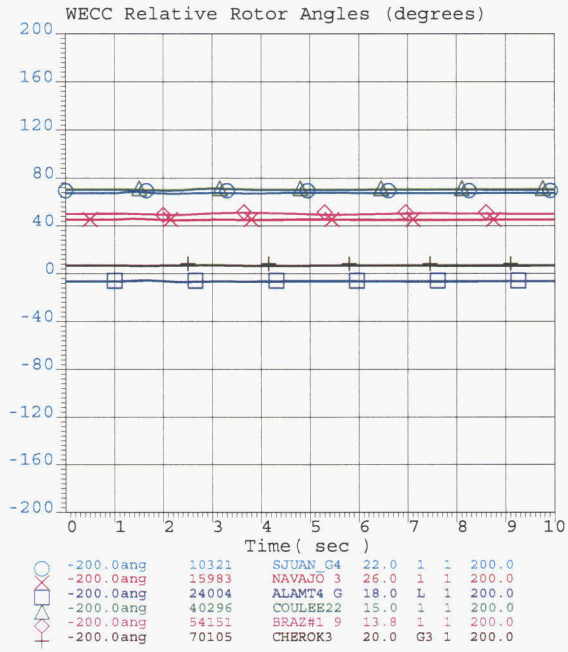
APS	11hs-gbgr-r3-pre-dyn_swt01-gilabend-gilariver230-slo.chf	c:\work\aps\gbgr\sis\dyn Wed Jun 17 13:29:39 2009

Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots







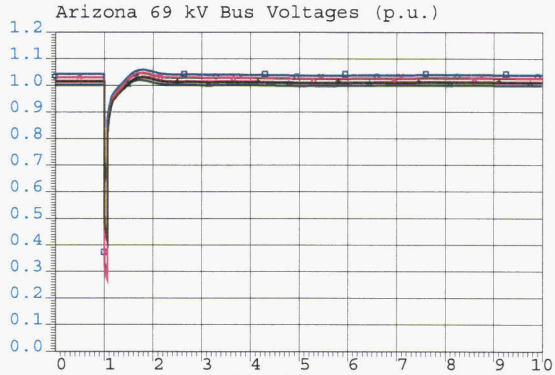


2011 Heavy Summer Power Flow/Transient Stability Case
Gila Bend/Gila River Cluster SIS Pre-Project Revision 3 Case
3-phase 4 cycle flt. @ Gila Bend 230 kV, trip Gila Bend-Gila River 230 kV

APS	11hs-gbgr-r3-pre-dyn_swt01-gilabend-gilariver230-slo.chf	c:\work\aps\gbgr\sis\dyn Wed Jun 17 13:29:39 2009

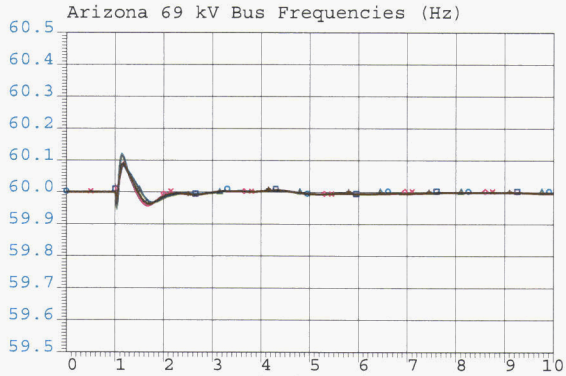
Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots

Arizona 69 kV Bus Voltages (p.u.)



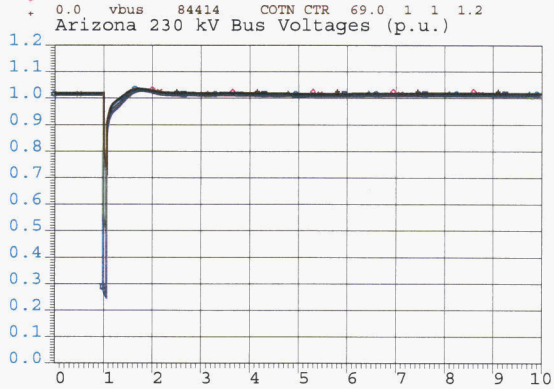
0.0	vbus	84419	GILABEND	69.0	1	1	1.2
0.0	vbus	84432	PALOMA	69.0	1	1	1.2
0.0	vbus	84411	BUNYAN	69.0	1	1	1.2
0.0	vbus	84442	SADDLEMT	69.0	1	1	1.2
0.0	vbus	84460	HY1	69.0	1	1	1.2
0.0	vbus	84414	COTN CTR	69.0	1	1	1.2

Arizona 69 kV Bus Frequencies (Hz)



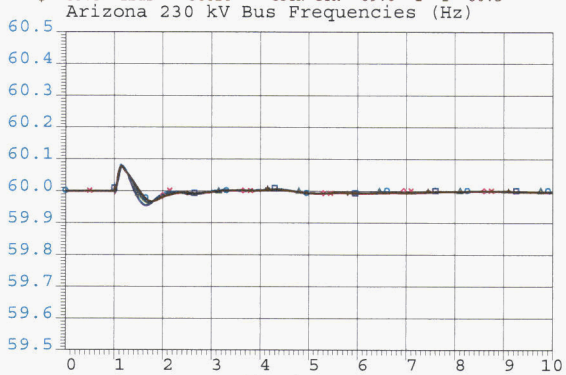
59.5	fbus	84419	GILABEND	69.0	1	1	60.5
59.5	fbus	84432	PALOMA	69.0	1	1	60.5
59.5	fbus	84411	BUNYAN	69.0	1	1	60.5
59.5	fbus	84442	SADDLEMT	69.0	1	1	60.5
59.5	fbus	84460	HY1	69.0	1	1	60.5
59.5	fbus	84414	COTN CTR	69.0	1	1	60.5

Arizona 230 kV Bus Voltages (p.u.)



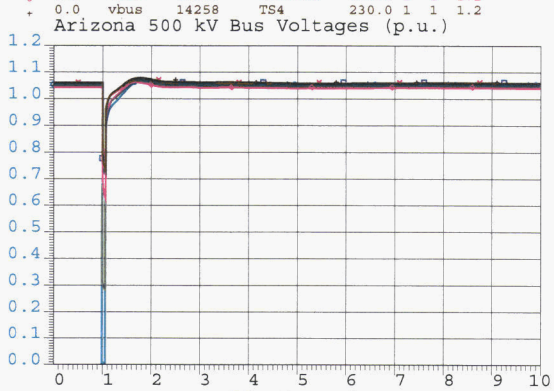
0.0	vbul	14201	BUCKEYE	230.0	1	1	1.2
0.0	vbul	14235	GILABEND	230.0	1	1	1.2
0.0	vbus	14238	GILARIVR	230.0	1	1	1.2
0.0	vbus	14224	JOJOBA	230.0	1	1	1.2
0.0	vbus	19052	LIBERTY	230.0	1	1	1.2
0.0	vbus	14258	TS4	230.0	1	1	1.2

Arizona 230 kV Bus Frequencies (Hz)



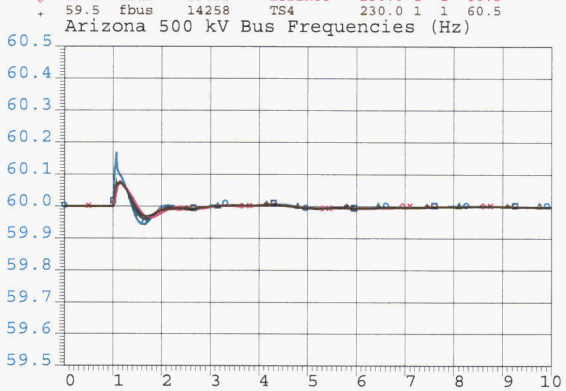
59.5	fbul	14201	BUCKEYE	230.0	1	1	60.5
59.5	fbul	14235	GILABEND	230.0	1	1	60.5
59.5	fbus	14238	GILARIVR	230.0	1	1	60.5
59.5	fbus	14224	JOJOBA	230.0	1	1	60.5
59.5	fbus	19052	LIBERTY	230.0	1	1	60.5
59.5	fbus	14258	TS4	230.0	1	1	60.5

Arizona 500 kV Bus Voltages (p.u.)



0.0	vbus	14007	GILARIVR	500.0	1	1	1.2
0.0	vbus	15093	HARQUAHA	500.0	1	1	1.2
0.0	vbus	15090	HASSYAMP	500.0	1	1	1.2
0.0	vbus	15089	JOJOBA	500.0	1	1	1.2
0.0	vbus	15011	KYRENE	500.0	1	1	1.2
0.0	vbus	15021	PALOVRDE	500.0	1	1	1.2

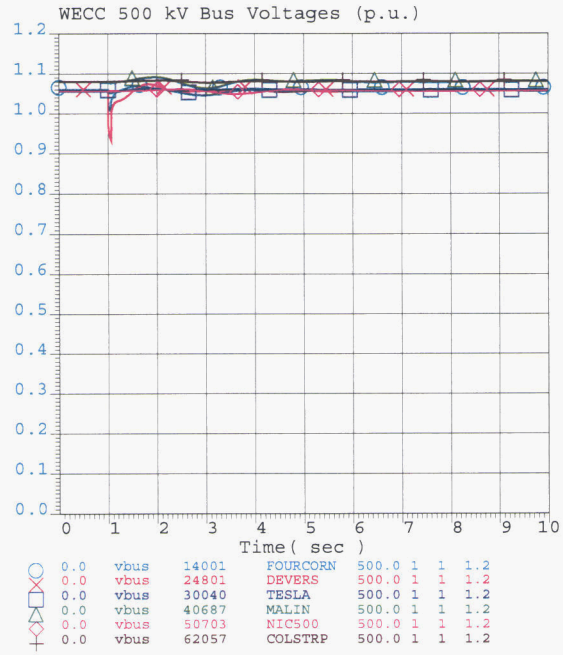
Arizona 500 kV Bus Frequencies (Hz)

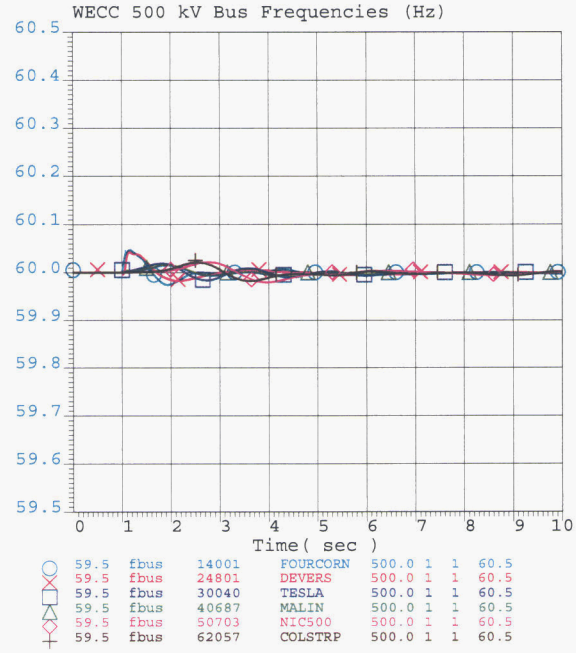


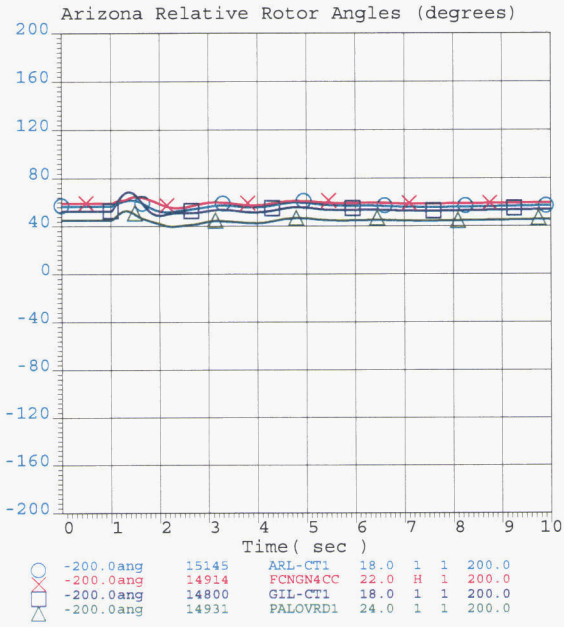
59.5	fbus	14007	GILARIVR	500.0	1	1	60.5
59.5	fbus	15093	HARQUAHA	500.0	1	1	60.5
59.5	fbus	15090	HASSYAMP	500.0	1	1	60.5
59.5	fbus	15089	JOJOBA	500.0	1	1	60.5
59.5	fbus	15011	KYRENE	500.0	1	1	60.5
59.5	fbus	15021	PALOVRDE	500.0	1	1	60.5

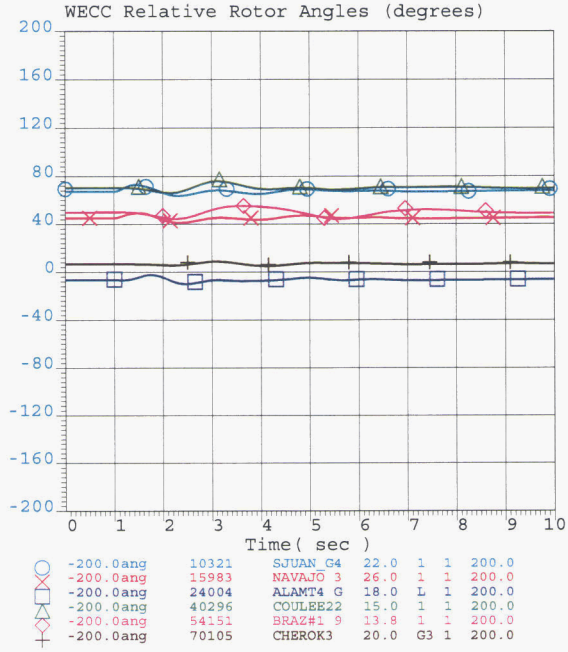
2011 Heavy Summer Power Flow/Transient Stability Case
Gila Bend/Gila River Cluster SIS Pre-Project Revision 3 Case
3-phase 4 cycle flt. @ Gila River 500 kV, trip Gila River-Jojoba 500 kV

Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots





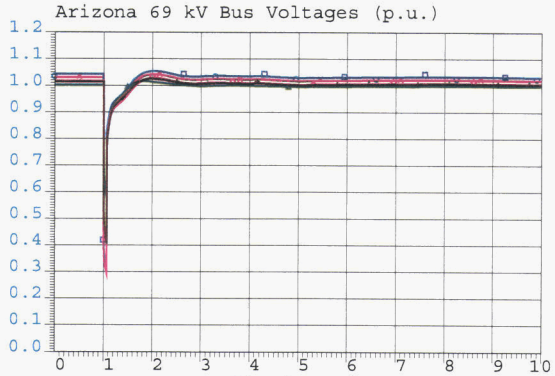




2011 Heavy Summer Power Flow/Transient Stability Case
Gila Bend/Gila River Cluster SIS Pre-Project Revision 3 Case
3-phase 4 cycle flt. @ Gila River 500 kV, trip Gila River-Jojoba 500 kV

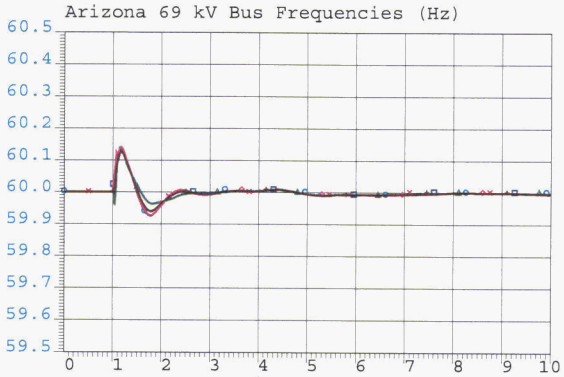
Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots

Arizona 69 kV Bus Voltages (p.u.)



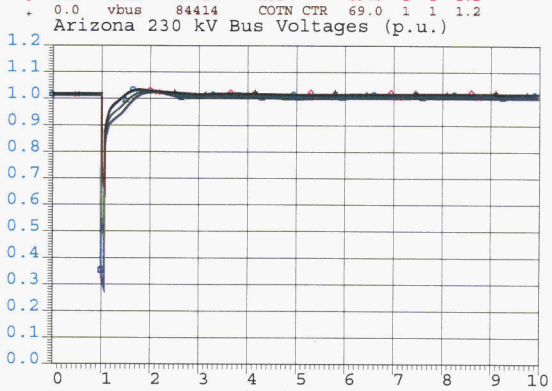
o	0.0	vbus	84419	GILABEND	69.0	1	1	1.2
x	0.0	vbus	84432	PALOMA	69.0	1	1	1.2
□	0.0	vbus	84411	BUNYAN	69.0	1	1	1.2
△	0.0	vbus	84442	SADDLEMT	69.0	1	1	1.2
◇	0.0	vbus	84460	HY1	69.0	1	1	1.2
+	0.0	vbus	84414	COTN CTR	69.0	1	1	1.2

Arizona 69 kV Bus Frequencies (Hz)



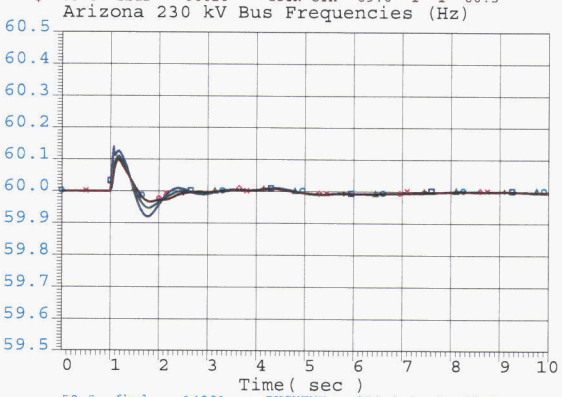
o	59.5	fbus	84419	GILABEND	69.0	1	1	60.5
x	59.5	fbus	84432	PALOMA	69.0	1	1	60.5
□	59.5	fbus	84411	BUNYAN	69.0	1	1	60.5
△	59.5	fbus	84442	SADDLEMT	69.0	1	1	60.5
◇	59.5	fbus	84460	HY1	69.0	1	1	60.5
+	59.5	fbus	84414	COTN CTR	69.0	1	1	60.5

Arizona 230 kV Bus Voltages (p.u.)



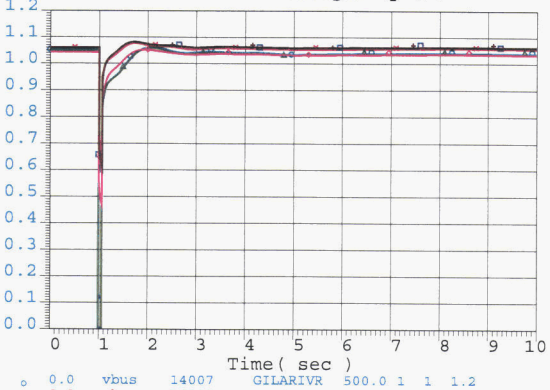
o	0.0	vbul	14201	BUCKEYE	230.0	1	1	1.2
x	0.0	vbul	14235	GILABEND	230.0	1	1	1.2
□	0.0	vbus	14238	GILARIVR	230.0	1	1	1.2
△	0.0	vbus	14224	JOJOBA	230.0	1	1	1.2
◇	0.0	vbus	19052	LIBERTY	230.0	1	1	1.2
+	0.0	vbus	14258	TS4	230.0	1	1	1.2

Arizona 230 kV Bus Frequencies (Hz)



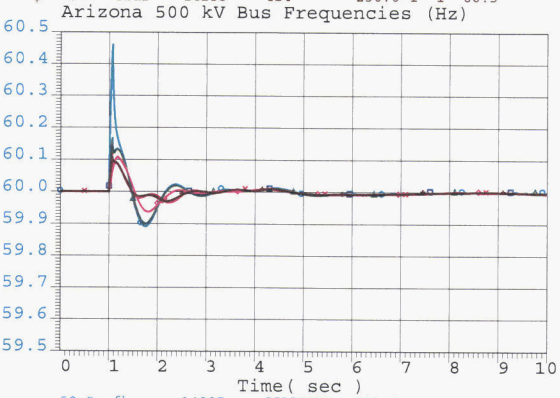
o	59.5	fbul	14201	BUCKEYE	230.0	1	1	60.5
x	59.5	fbul	14235	GILABEND	230.0	1	1	60.5
□	59.5	fbus	14238	GILARIVR	230.0	1	1	60.5
△	59.5	fbus	14224	JOJOBA	230.0	1	1	60.5
◇	59.5	fbus	19052	LIBERTY	230.0	1	1	60.5
+	59.5	fbus	14258	TS4	230.0	1	1	60.5

Arizona 500 kV Bus Voltages (p.u.)



o	0.0	vbus	14007	GILARIVR	500.0	1	1	1.2
x	0.0	vbus	15093	HARQUAHA	500.0	1	1	1.2
□	0.0	vbus	15090	HASSYAMP	500.0	1	1	1.2
△	0.0	vbus	15089	JOJOBA	500.0	1	1	1.2
◇	0.0	vbus	15011	KYRENE	500.0	1	1	1.2
+	0.0	vbus	15021	PALOVRDE	500.0	1	1	1.2

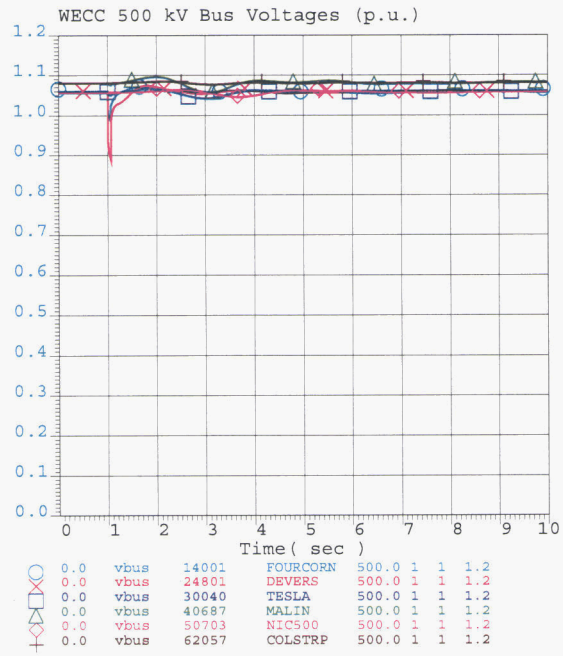
Arizona 500 kV Bus Frequencies (Hz)

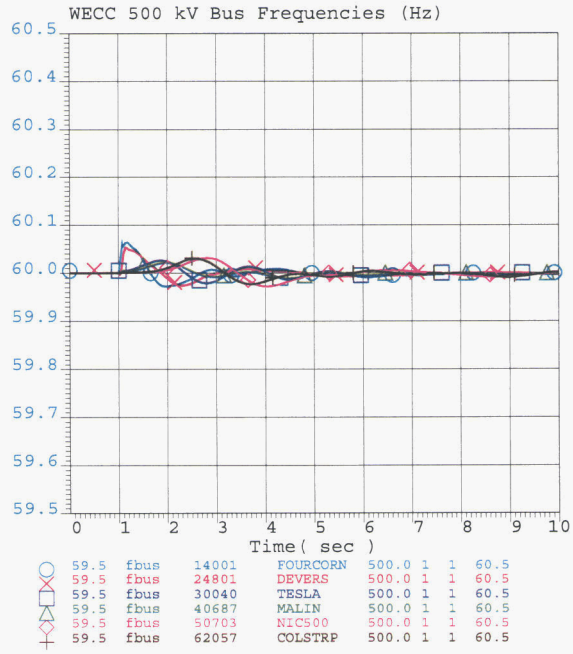


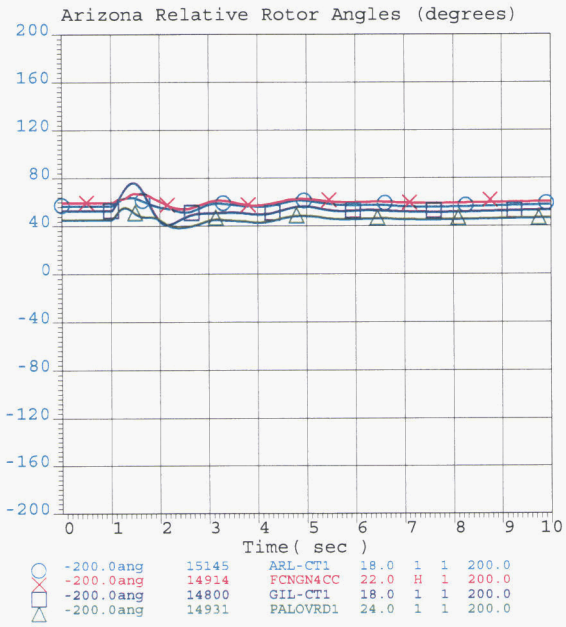
o	59.5	fbus	14007	GILARIVR	500.0	1	1	60.5
x	59.5	fbus	15093	HARQUAHA	500.0	1	1	60.5
□	59.5	fbus	15090	HASSYAMP	500.0	1	1	60.5
△	59.5	fbus	15089	JOJOBA	500.0	1	1	60.5
◇	59.5	fbus	15011	KYRENE	500.0	1	1	60.5
+	59.5	fbus	15021	PALOVRDE	500.0	1	1	60.5

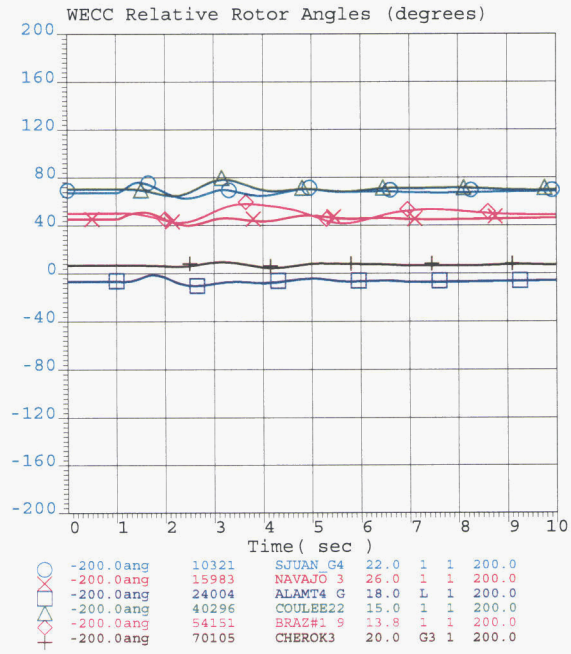
2011 Heavy Summer Power Flow/Transient Stability Case
Gila Bend/Gila River Cluster SIS Pre-Project Revision 3 Case
3-phase 4 cycle flt. @ Jojoba 500 kV, trip Hassyampa-Jojoba 500 kV

Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots









2011 Heavy Summer Power Flow/Transient Stability Case
Gila Bend/Gila River Cluster SIS Pre-Project Revision 3 Case
3-phase 4 cycle flt. @ Jojoba 500 kV, trip Hassyampa-Jojoba 500 kV

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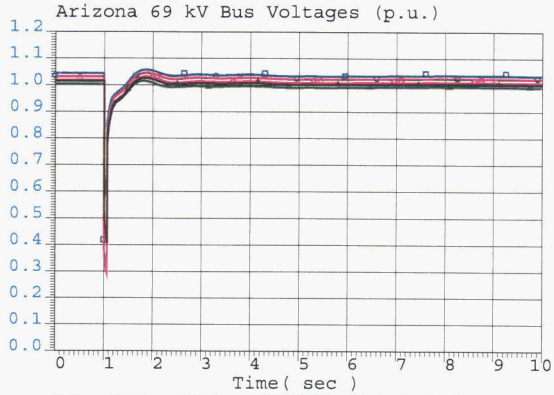
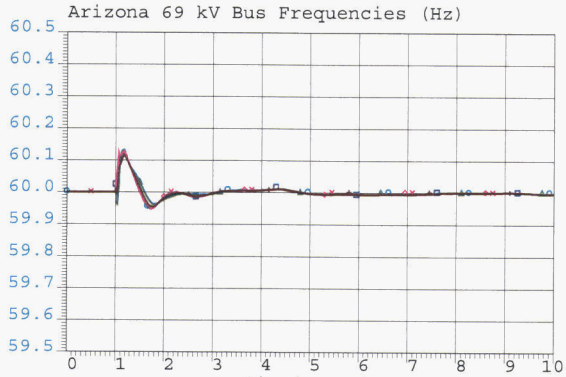
Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots

Arizona 69 kV Bus Voltages (p.u.)



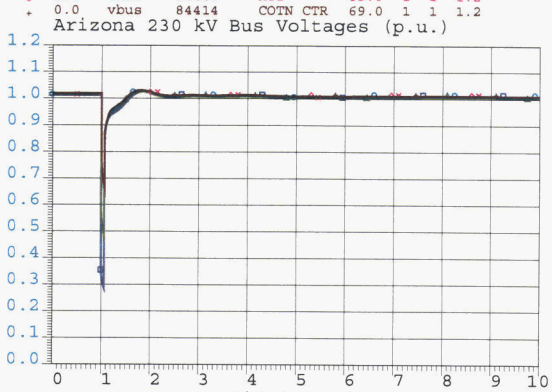
0.0	vbus	84419	GILABEND	69.0	1	1	1.2
0.0	vbus	84432	PALOMA	69.0	1	1	1.2
0.0	vbus	84411	BUNYAN	69.0	1	1	1.2
0.0	vbus	84442	SADDLEMT	69.0	1	1	1.2
0.0	vbus	84460	HY1	69.0	1	1	1.2
0.0	vbus	84414	COTN CTR	69.0	1	1	1.2

Arizona 69 kV Bus Frequencies (Hz)



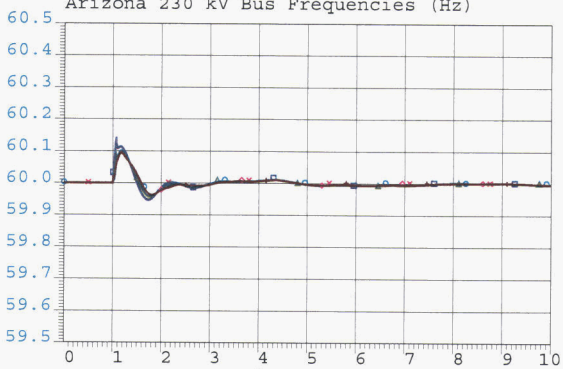
59.5	fbus	84419	GILABEND	69.0	1	1	60.5
59.5	fbus	84432	PALOMA	69.0	1	1	60.5
59.5	fbus	84411	BUNYAN	69.0	1	1	60.5
59.5	fbus	84442	SADDLEMT	69.0	1	1	60.5
59.5	fbus	84460	HY1	69.0	1	1	60.5
59.5	fbus	84414	COTN CTR	69.0	1	1	60.5

Arizona 230 kV Bus Voltages (p.u.)



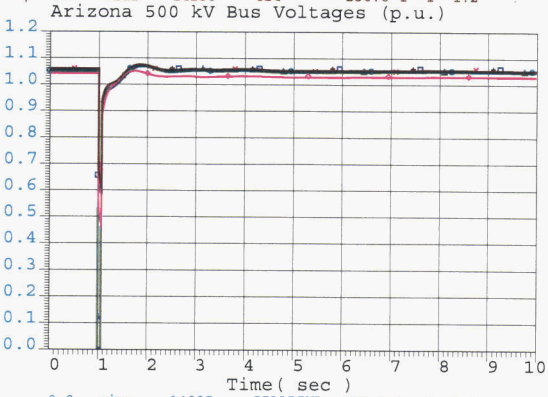
0.0	vbul	14201	BUCKEYE	230.0	1	1	1.2
0.0	vbul	14235	GILABEND	230.0	1	1	1.2
0.0	vbus	14238	GILARIVR	230.0	1	1	1.2
0.0	vbus	14224	JOJOBA	230.0	1	1	1.2
0.0	vbus	19052	LIBERTY	230.0	1	1	1.2
0.0	vbus	14258	TS4	230.0	1	1	1.2

Arizona 230 kV Bus Frequencies (Hz)



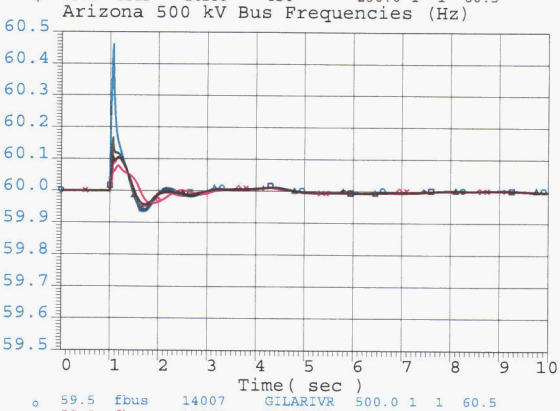
59.5	fbul	14201	BUCKEYE	230.0	1	1	60.5
59.5	fbul	14235	GILABEND	230.0	1	1	60.5
59.5	fbus	14238	GILARIVR	230.0	1	1	60.5
59.5	fbus	14224	JOJOBA	230.0	1	1	60.5
59.5	fbus	19052	LIBERTY	230.0	1	1	60.5
59.5	fbus	14258	TS4	230.0	1	1	60.5

Arizona 500 kV Bus Voltages (p.u.)



0.0	vbus	14007	GILARIVR	500.0	1	1	1.2
0.0	vbus	15093	HARQUAHA	500.0	1	1	1.2
0.0	vbus	15090	HASSYAMP	500.0	1	1	1.2
0.0	vbus	15089	JOJOBA	500.0	1	1	1.2
0.0	vbus	15011	KYRENE	500.0	1	1	1.2
0.0	vbus	15021	PALOVRDE	500.0	1	1	1.2

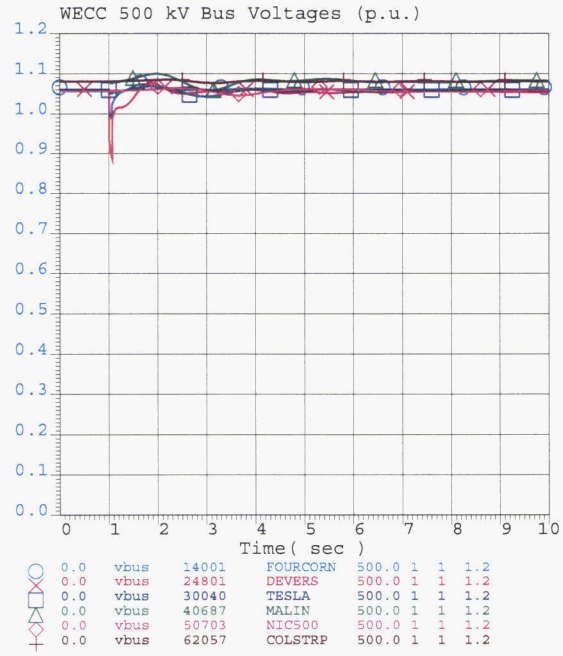
Arizona 500 kV Bus Frequencies (Hz)

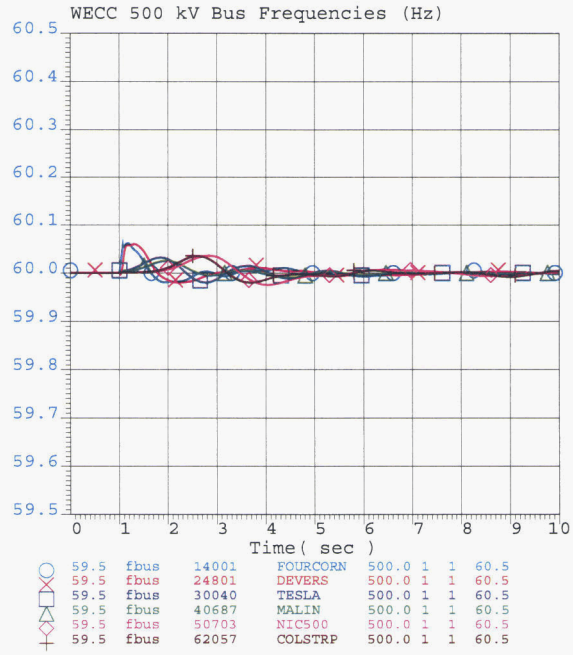


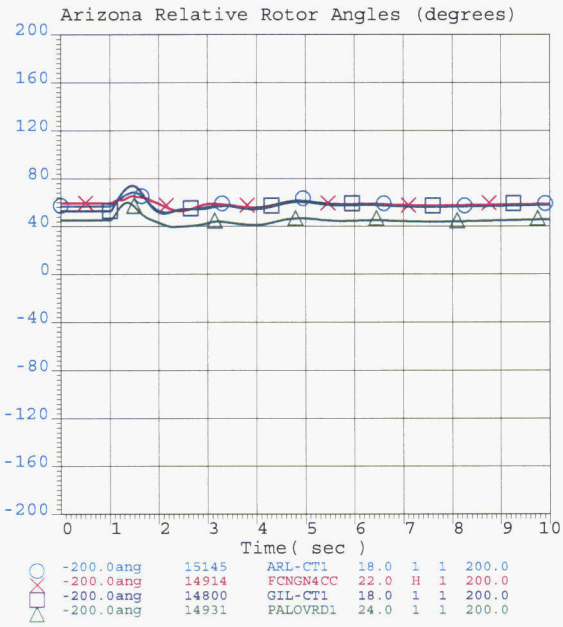
59.5	fbus	14007	GILARIVR	500.0	1	1	60.5
59.5	fbus	15093	HARQUAHA	500.0	1	1	60.5
59.5	fbus	15090	HASSYAMP	500.0	1	1	60.5
59.5	fbus	15089	JOJOBA	500.0	1	1	60.5
59.5	fbus	15011	KYRENE	500.0	1	1	60.5
59.5	fbus	15021	PALOVRDE	500.0	1	1	60.5

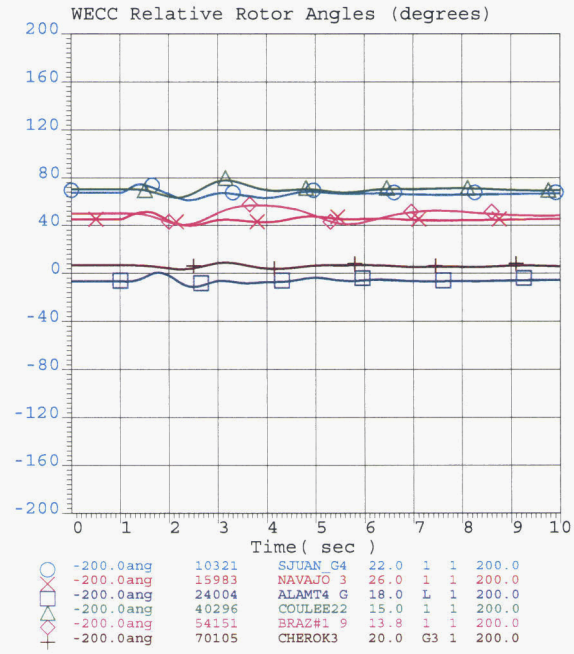
2011 Heavy Summer Power Flow/Transient Stability Case
Gila Bend/Gila River Cluster SIS Pre-Project Revision 3 Case
3-phase 4 cycle flt. @ Jojoba 500 kV, trip Jojoba-Kyrene 500 kV

Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots









2011 Heavy Summer Power Flow/Transient Stability Case
Gila Bend/Gila River Cluster SIS Pre-Project Revision 3 Case
3-phase 4 cycle flt. @ Jojoba 500 kV, trip Jojoba-Kyrene 500 kV

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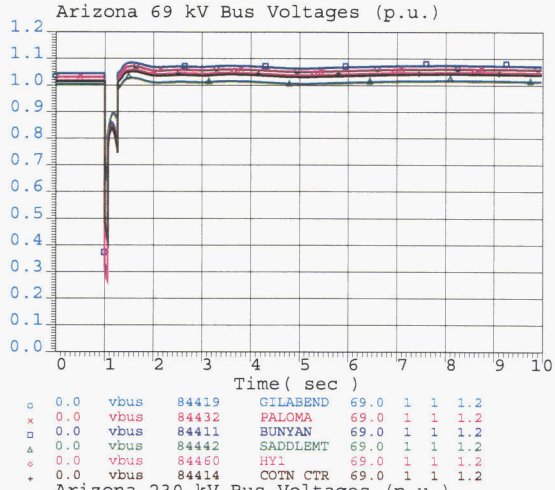
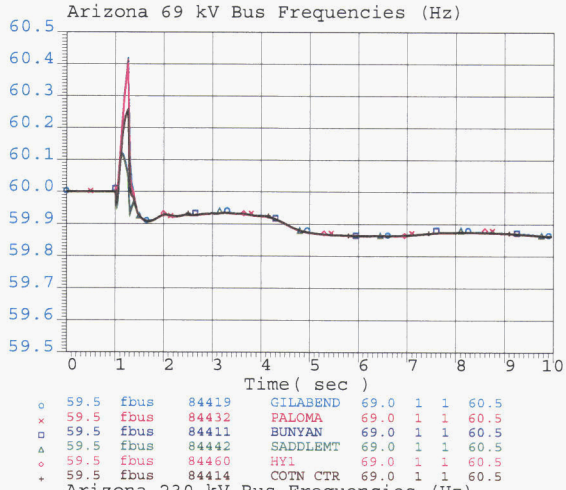
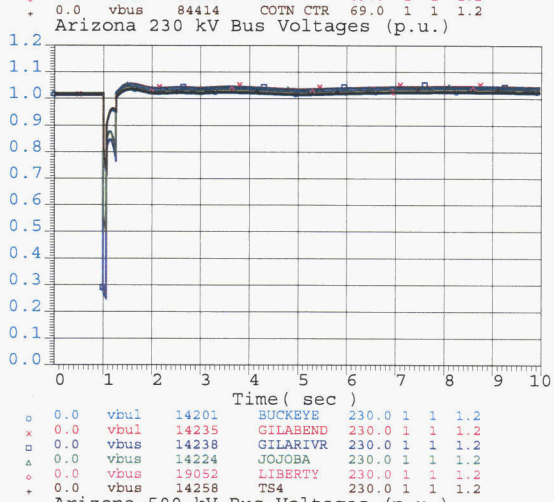
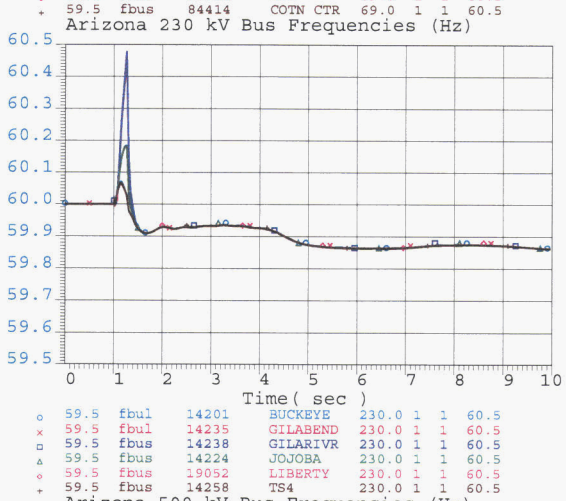
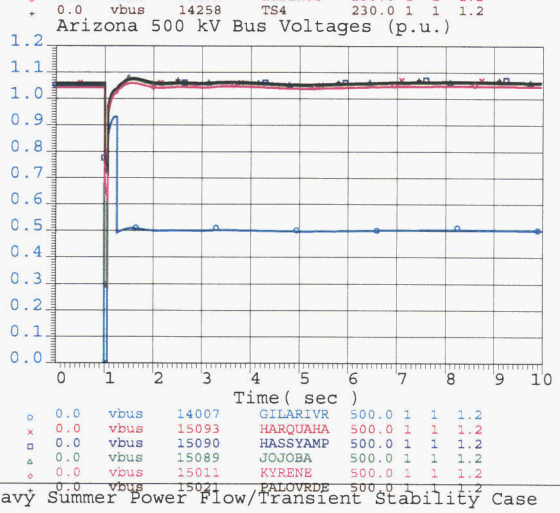
Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots

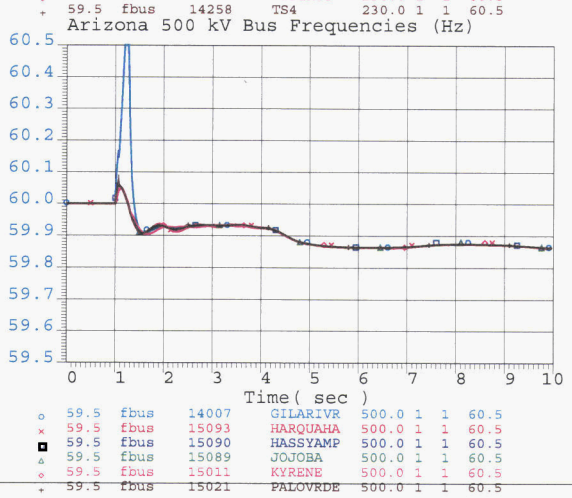






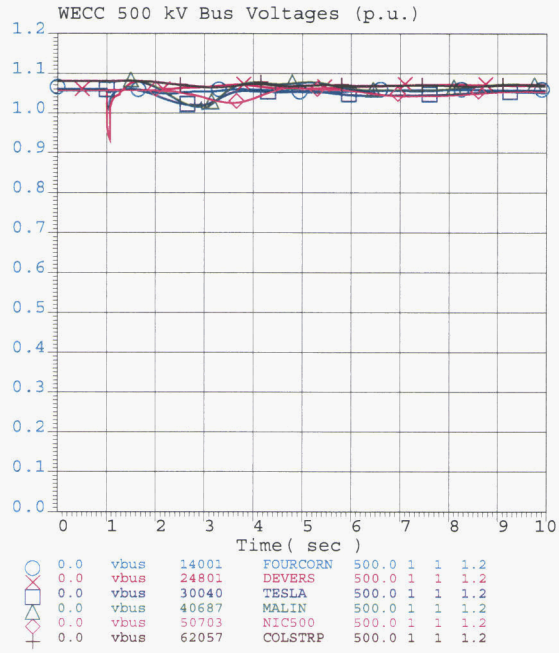


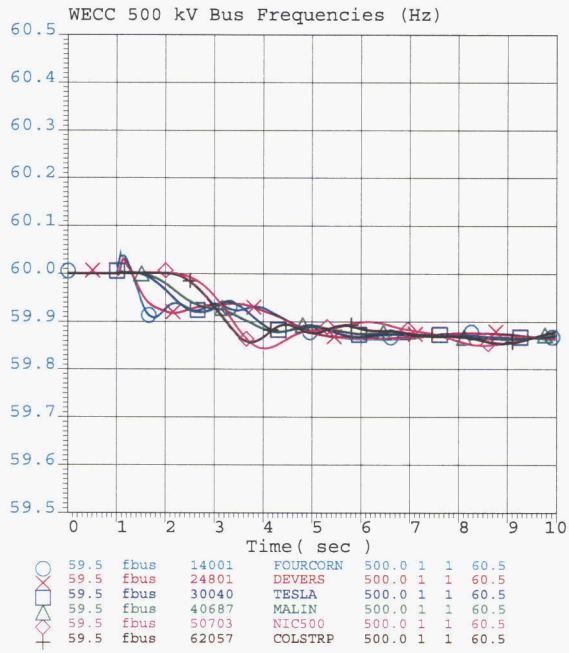


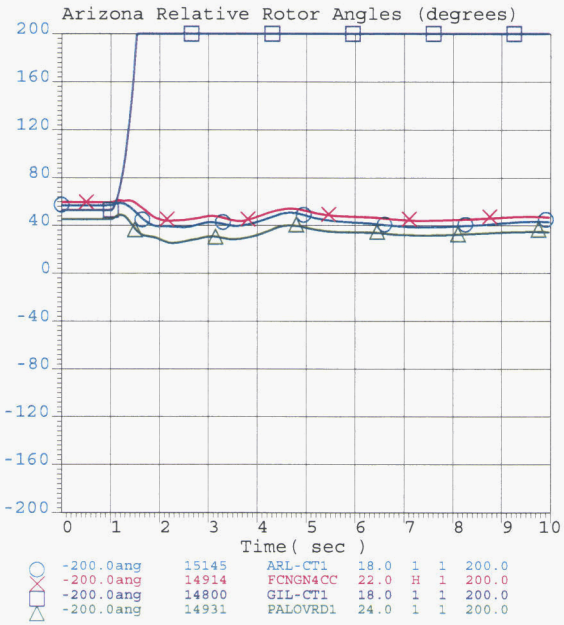


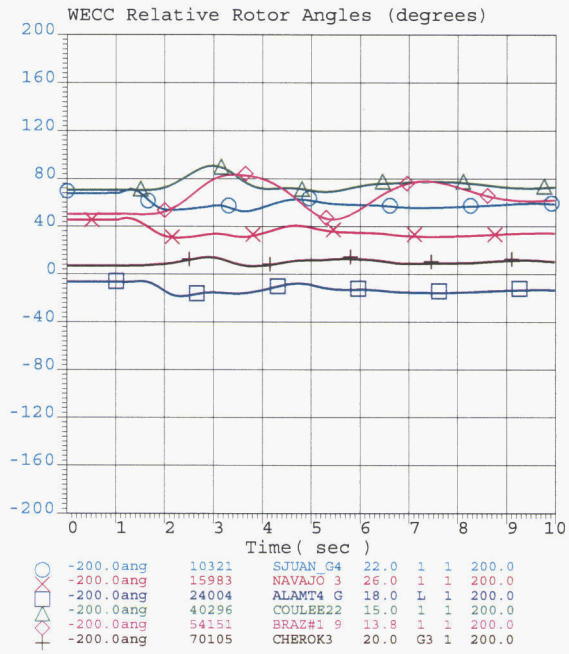
2011 Heavy Summer Power Flow/Transient Stability Case
Gila Bend/Gila River Cluster SIS Pre-Project Revision 3 Case
3-phase 4 cycle flt. @ Gila River 500 kV, trip Gila River-Jojoba 1 & 2 500 kV

Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots









2011 Heavy Summer Power Flow/Transient Stability Case
Gila Bend/Gila River Cluster SIS Pre-Project Revision 3 Case
3-phase 4 cycle flt. @ Gila River 500 kV, trip Gila River-Jojoba 1 & 2 500 kV

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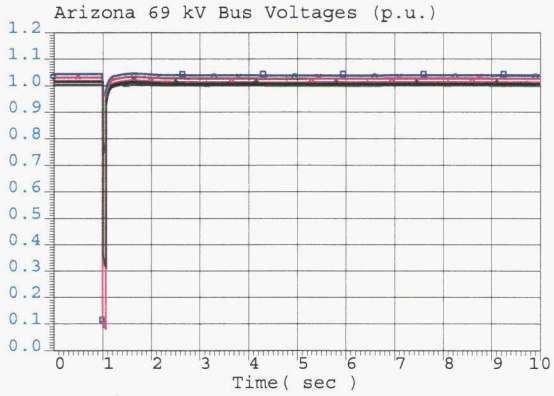
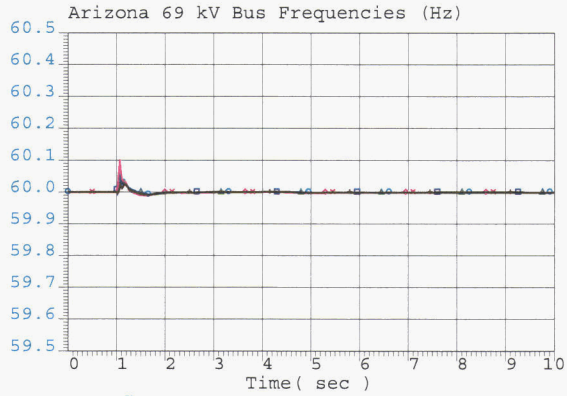
Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots

Arizona 69 kV Bus Voltages (p.u.)



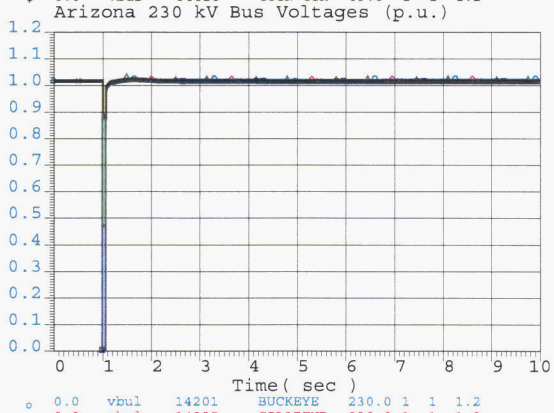
0.0	vbus	84419	GILABEND	69.0	1	1	1.2
0.0	vbus	84432	PALOMA	69.0	1	1	1.2
0.0	vbus	84411	BUNYAN	69.0	1	1	1.2
0.0	vbus	84442	SADDLEMT	69.0	1	1	1.2
0.0	vbus	84460	HY1	69.0	1	1	1.2
0.0	vbus	84414	COTN CTR	69.0	1	1	1.2

Arizona 69 kV Bus Frequencies (Hz)



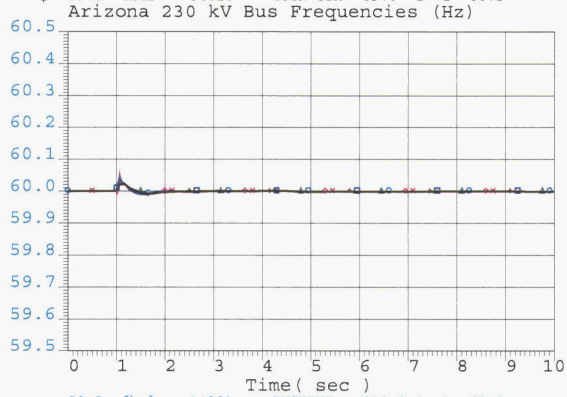
59.5	fbus	84419	GILABEND	69.0	1	1	60.5
59.5	fbus	84432	PALOMA	69.0	1	1	60.5
59.5	fbus	84411	BUNYAN	69.0	1	1	60.5
59.5	fbus	84442	SADDLEMT	69.0	1	1	60.5
59.5	fbus	84460	HY1	69.0	1	1	60.5
59.5	fbus	84414	COTN CTR	69.0	1	1	60.5

Arizona 230 kV Bus Voltages (p.u.)



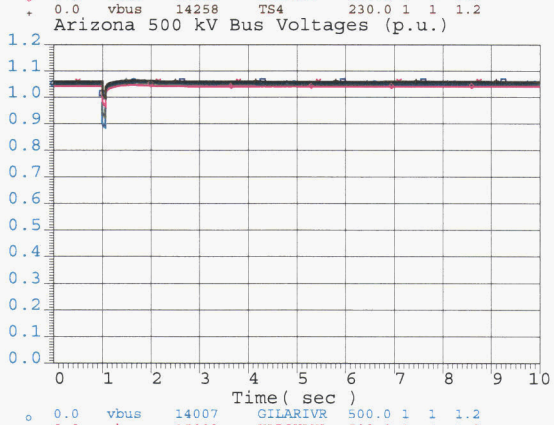
0.0	vbul	14201	BUCKEYE	230.0	1	1	1.2
0.0	vbul	14235	GILABEND	230.0	1	1	1.2
0.0	vbus	14238	GILARIVR	230.0	1	1	1.2
0.0	vbus	14224	JOJOBA	230.0	1	1	1.2
0.0	vbus	19052	LIBERTY	230.0	1	1	1.2
0.0	vbus	14258	TS4	230.0	1	1	1.2

Arizona 230 kV Bus Frequencies (Hz)



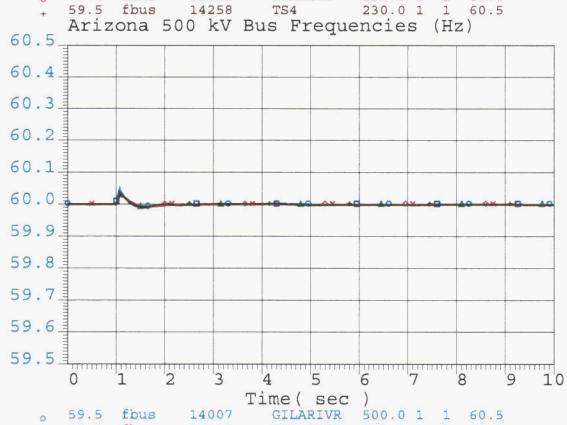
59.5	fbul	14201	BUCKEYE	230.0	1	1	60.5
59.5	fbul	14235	GILABEND	230.0	1	1	60.5
59.5	fbus	14238	GILARIVR	230.0	1	1	60.5
59.5	fbus	14224	JOJOBA	230.0	1	1	60.5
59.5	fbus	19052	LIBERTY	230.0	1	1	60.5
59.5	fbus	14258	TS4	230.0	1	1	60.5

Arizona 500 kV Bus Voltages (p.u.)



0.0	vbus	14007	GILARIVR	500.0	1	1	1.2
0.0	vbus	15093	HARQUAHA	500.0	1	1	1.2
0.0	vbus	15090	HASSYAMP	500.0	1	1	1.2
0.0	vbus	15089	JOJOBA	500.0	1	1	1.2
0.0	vbus	15011	KYRENE	500.0	1	1	1.2
0.0	vbus	15021	PALOVRDE	500.0	1	1	1.2

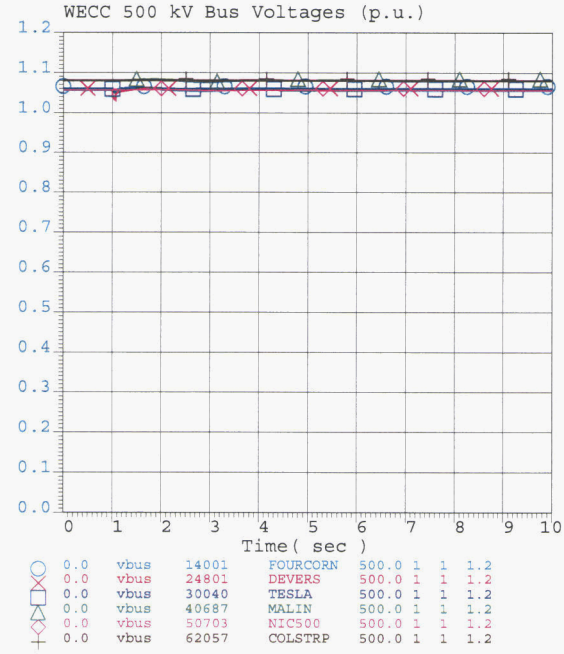
Arizona 500 kV Bus Frequencies (Hz)

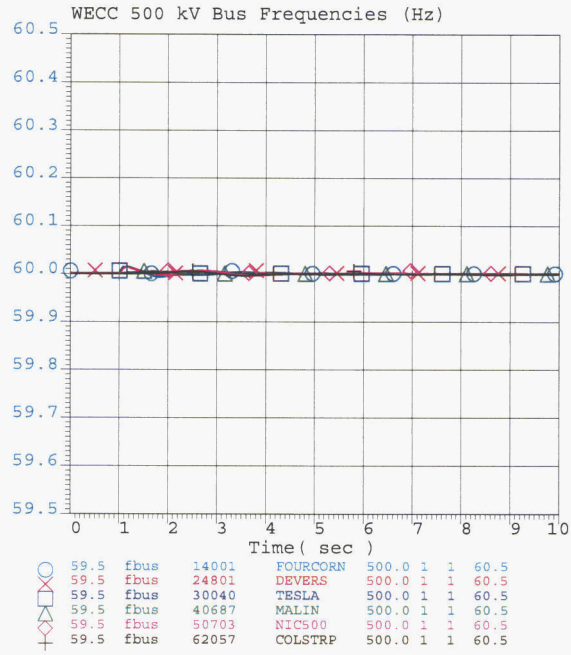


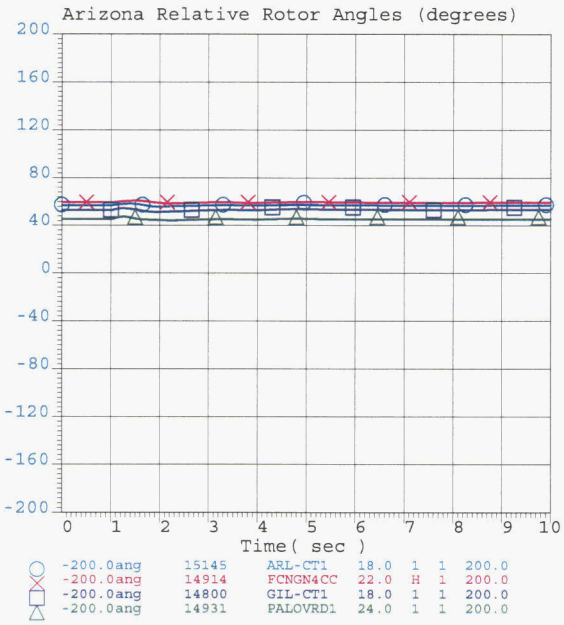
59.5	fbus	14007	GILARIVR	500.0	1	1	60.5
59.5	fbus	15093	HARQUAHA	500.0	1	1	60.5
59.5	fbus	15090	HASSYAMP	500.0	1	1	60.5
59.5	fbus	15089	JOJOBA	500.0	1	1	60.5
59.5	fbus	15011	KYRENE	500.0	1	1	60.5
59.5	fbus	15021	PALOVRDE	500.0	1	1	60.5

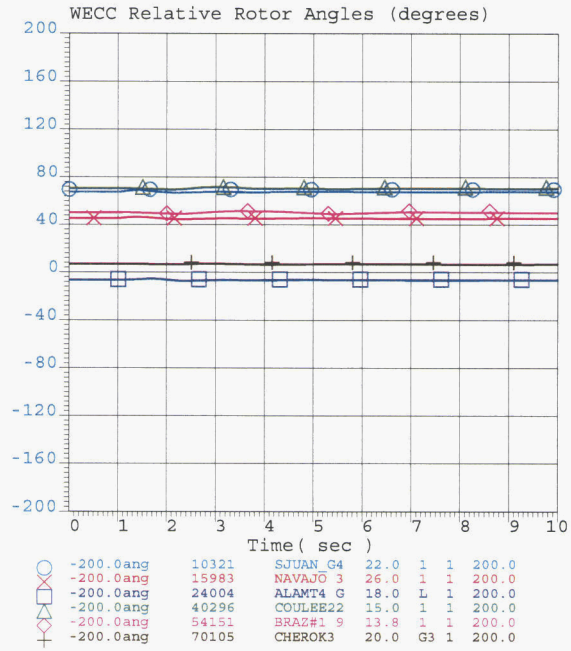
2011 Heavy Summer Power Flow/Transient Stability Case
Gila Bend/Gila River Cluster SIS Pre-Project Revision 3 Case
3-phase 4 cycle flt. @ Gila River 230 kV, trip Gila River-Jojoba 230 kV

Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots





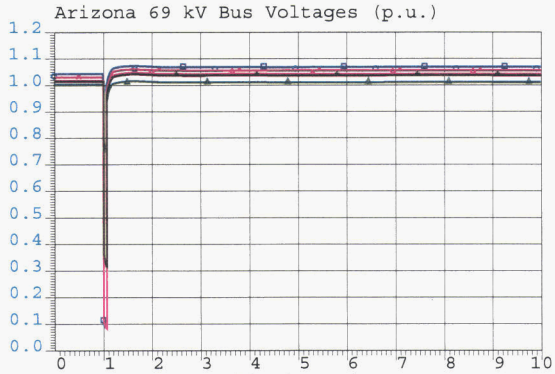




2011 Heavy Summer Power Flow/Transient Stability Case
Gila Bend/Gila River Cluster SIS Pre-Project Revision 3 Case
3-phase 4 cycle flt. @ Gila River 230 kV, trip Gila River-Jojoba 230 kV

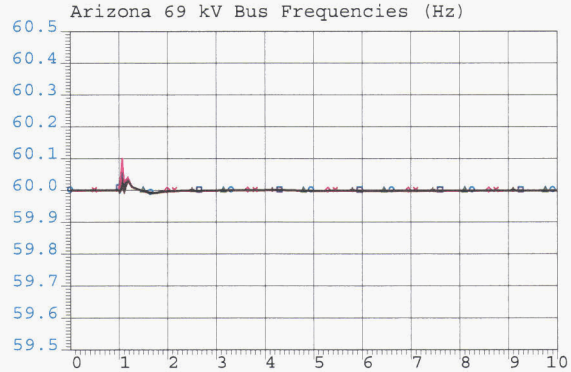
Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots

Arizona 69 kV Bus Voltages (p.u.)



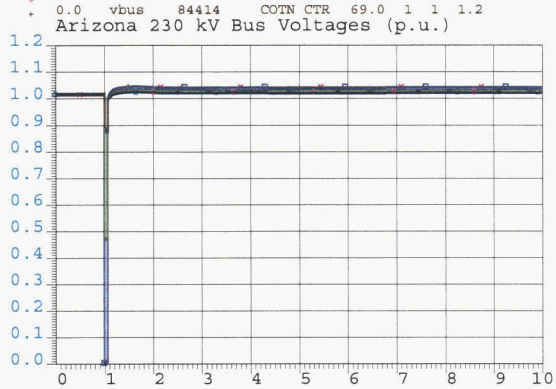
0.0	vbus	84419	GILABEND	69.0	1	1	1.2
0.0	vbus	84432	PALOMA	69.0	1	1	1.2
0.0	vbus	84411	BUNYAN	69.0	1	1	1.2
0.0	vbus	84442	SADDLEMT	69.0	1	1	1.2
0.0	vbus	84460	HY1	69.0	1	1	1.2
0.0	vbus	84414	COTN CTR	69.0	1	1	1.2

Arizona 69 kV Bus Frequencies (Hz)



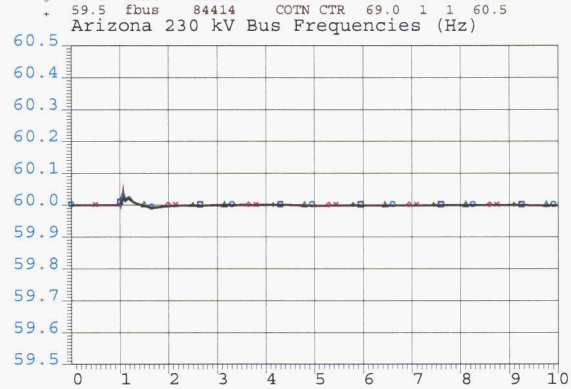
59.5	fbus	84419	GILABEND	69.0	1	1	60.5
59.5	fbus	84432	PALOMA	69.0	1	1	60.5
59.5	fbus	84411	BUNYAN	69.0	1	1	60.5
59.5	fbus	84442	SADDLEMT	69.0	1	1	60.5
59.5	fbus	84460	HY1	69.0	1	1	60.5
59.5	fbus	84414	COTN CTR	69.0	1	1	60.5

Arizona 230 kV Bus Voltages (p.u.)



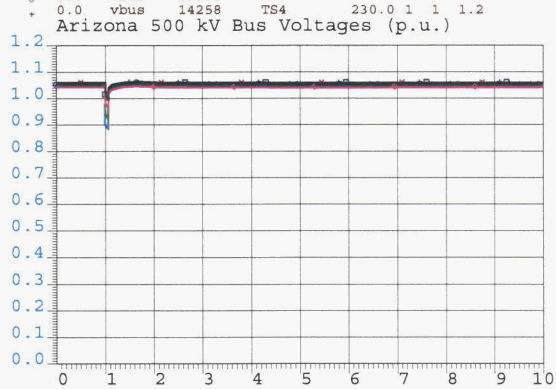
0.0	vbul	14201	BUCKEYE	230.0	1	1	1.2
0.0	vbul	14235	GILABEND	230.0	1	1	1.2
0.0	vbus	14238	GILARIVR	230.0	1	1	1.2
0.0	vbus	14224	JOJOBA	230.0	1	1	1.2
0.0	vbus	19052	LIBERTY	230.0	1	1	1.2
0.0	vbus	14258	TS4	230.0	1	1	1.2

Arizona 230 kV Bus Frequencies (Hz)



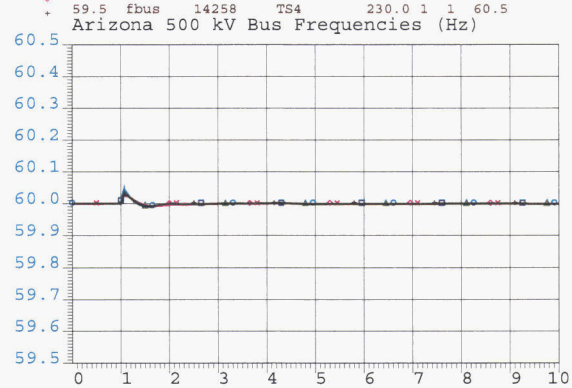
59.5	fbul	14201	BUCKEYE	230.0	1	1	60.5
59.5	fbul	14235	GILABEND	230.0	1	1	60.5
59.5	fbus	14238	GILARIVR	230.0	1	1	60.5
59.5	fbus	14224	JOJOBA	230.0	1	1	60.5
59.5	fbus	19052	LIBERTY	230.0	1	1	60.5
59.5	fbus	14258	TS4	230.0	1	1	60.5

Arizona 500 kV Bus Voltages (p.u.)



0.0	vbus	14007	GILARIVR	500.0	1	1	1.2
0.0	vbus	15093	HARQUAHA	500.0	1	1	1.2
0.0	vbus	15090	HASSYAMP	500.0	1	1	1.2
0.0	vbus	15089	JOJOBA	500.0	1	1	1.2
0.0	vbus	15011	KYRENE	500.0	1	1	1.2
0.0	vbus	15021	PALOVRDE	500.0	1	1	1.2

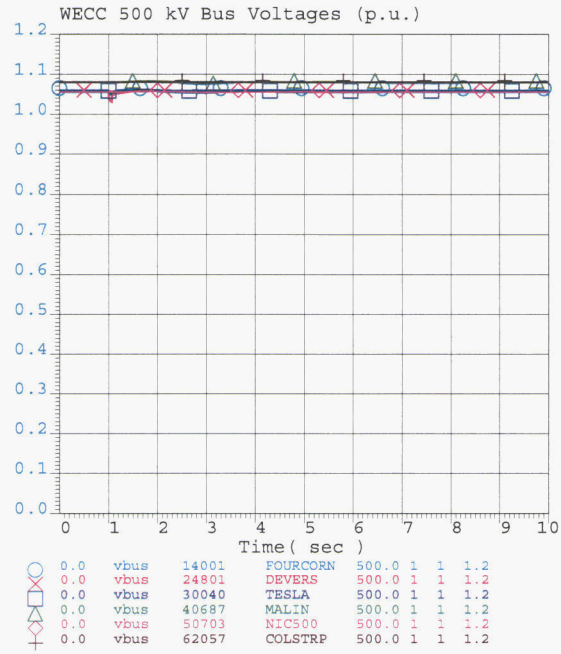
Arizona 500 kV Bus Frequencies (Hz)

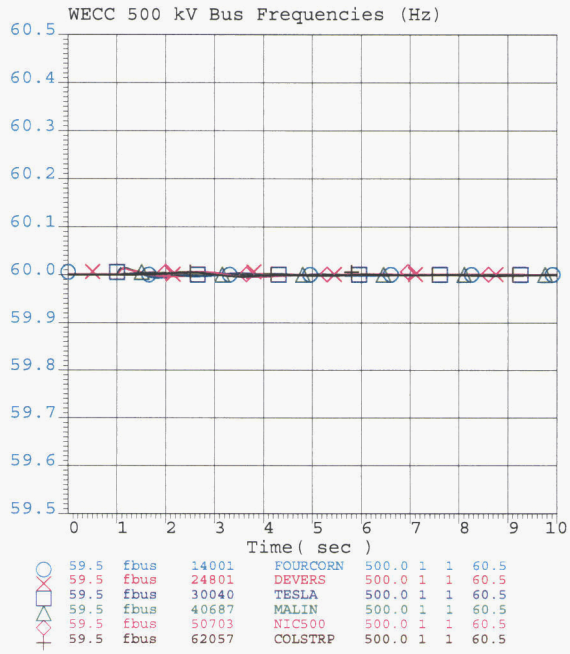


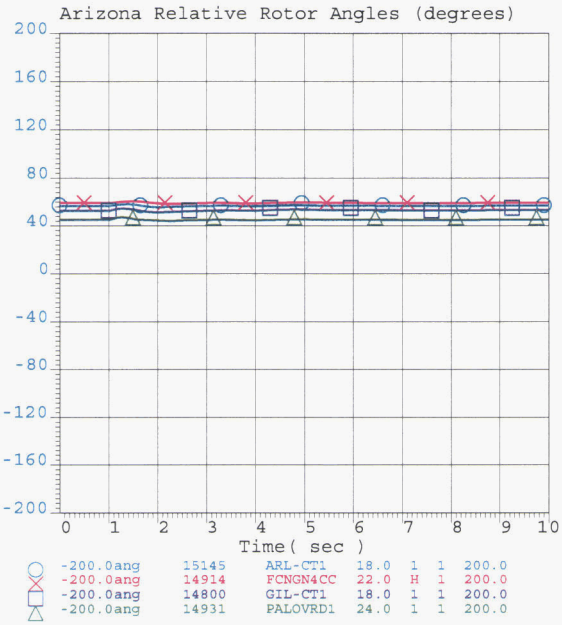
59.5	fbus	14007	GILARIVR	500.0	1	1	60.5
59.5	fbus	15093	HARQUAHA	500.0	1	1	60.5
59.5	fbus	15090	HASSYAMP	500.0	1	1	60.5
59.5	fbus	15089	JOJOBA	500.0	1	1	60.5
59.5	fbus	15011	KYRENE	500.0	1	1	60.5
59.5	fbus	15021	PALOVRDE	500.0	1	1	60.5

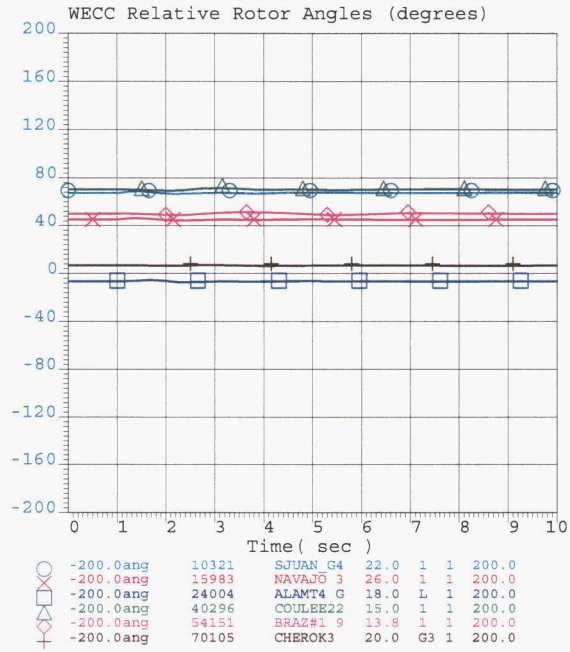
2011 Heavy Summer Power Flow/Transient Stability Case
Gila Bend/Gila River Cluster SIS Pre-Project Revision 3 Case
3-phase 4 cycle flt. @ Gila River 230 kV, trip Gila River 500/230 kV xfmr

Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots









2011 Heavy Summer Power Flow/Transient Stability Case
Gila Bend/Gila River Cluster SIS Pre-Project Revision 3 Case
3-phase 4 cycle flt. @ Gila River 230 kV, trip Gila River 500/230 kV xfmr

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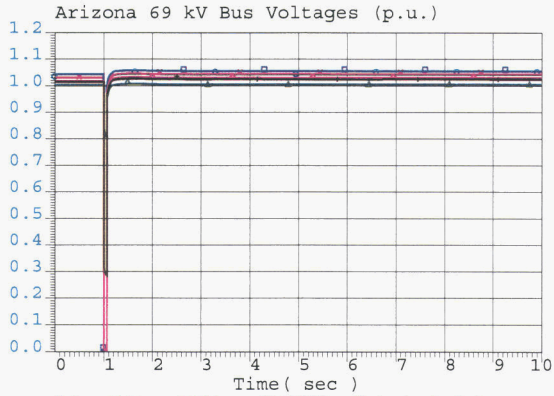
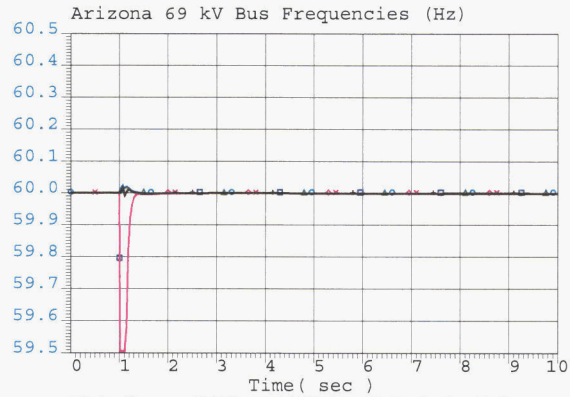
Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots

Arizona 69 kV Bus Voltages (p.u.)



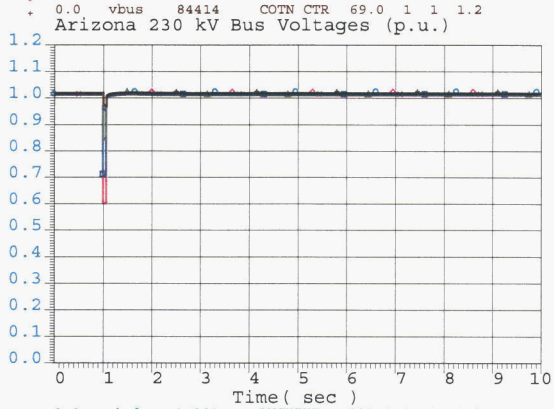
0.0	vbus	84419	GILABEND	69.0	1	1	1.2
0.0	vbus	84432	PALOMA	69.0	1	1	1.2
0.0	vbus	84411	BUNYAN	69.0	1	1	1.2
0.0	vbus	84442	SADDLEMT	69.0	1	1	1.2
0.0	vbus	84460	HY1	69.0	1	1	1.2
0.0	vbus	84414	COTN CTR	69.0	1	1	1.2

Arizona 69 kV Bus Frequencies (Hz)



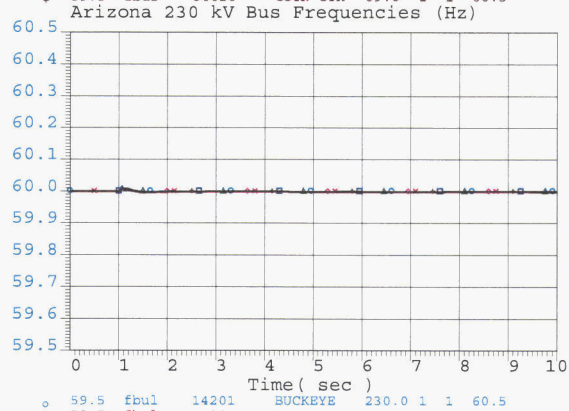
59.5	fbus	84419	GILABEND	69.0	1	1	60.5
59.5	fbus	84432	PALOMA	69.0	1	1	60.5
59.5	fbus	84411	BUNYAN	69.0	1	1	60.5
59.5	fbus	84442	SADDLEMT	69.0	1	1	60.5
59.5	fbus	84460	HY1	69.0	1	1	60.5
59.5	fbus	84414	COTN CTR	69.0	1	1	60.5

Arizona 230 kV Bus Voltages (p.u.)



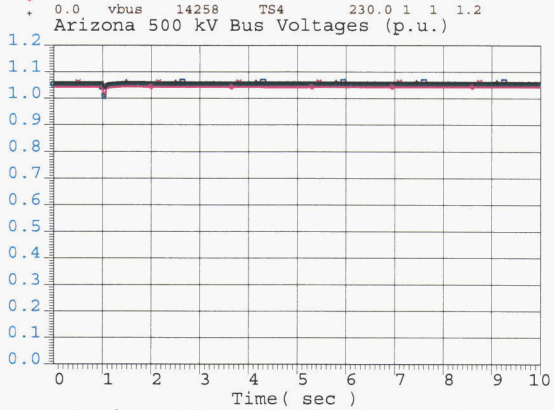
0.0	vbul	14201	BUCKEYE	230.0	1	1	1.2
0.0	vbul	14235	GILABEND	230.0	1	1	1.2
0.0	vbus	14238	GILARIVR	230.0	1	1	1.2
0.0	vbus	14224	JOJOBA	230.0	1	1	1.2
0.0	vbus	19052	LIBERTY	230.0	1	1	1.2
0.0	vbus	14258	TS4	230.0	1	1	1.2

Arizona 230 kV Bus Frequencies (Hz)



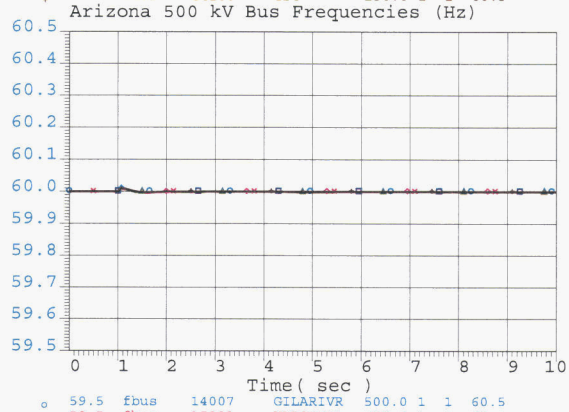
59.5	fbul	14201	BUCKEYE	230.0	1	1	60.5
59.5	fbul	14235	GILABEND	230.0	1	1	60.5
59.5	fbus	14238	GILARIVR	230.0	1	1	60.5
59.5	fbus	14224	JOJOBA	230.0	1	1	60.5
59.5	fbus	19052	LIBERTY	230.0	1	1	60.5
59.5	fbus	14258	TS4	230.0	1	1	60.5

Arizona 500 kV Bus Voltages (p.u.)



0.0	vbus	14007	GILARIVR	500.0	1	1	1.2
0.0	vbus	15093	HARQUAHA	500.0	1	1	1.2
0.0	vbus	15090	HASSYAMP	500.0	1	1	1.2
0.0	vbus	15089	JOJOBA	500.0	1	1	1.2
0.0	vbus	15011	KYRENE	500.0	1	1	1.2
0.0	vbus	15021	PALOVRDE	500.0	1	1	1.2

Arizona 500 kV Bus Frequencies (Hz)



59.5	fbus	14007	GILARIVR	500.0	1	1	60.5
59.5	fbus	15093	HARQUAHA	500.0	1	1	60.5
59.5	fbus	15090	HASSYAMP	500.0	1	1	60.5
59.5	fbus	15089	JOJOBA	500.0	1	1	60.5
59.5	fbus	15011	KYRENE	500.0	1	1	60.5
59.5	fbus	15021	PALOVRDE	500.0	1	1	60.5

2011 Heavy Summer Power Flow/Transient Stability Case
Gila Bend/Gila River Cluster SIS Pre-Project Revision 3 Case
3-phase 4 cycle flt. @ Gila Bend 69 kV, trip Gila Bend 230/69 kV xfmr 1

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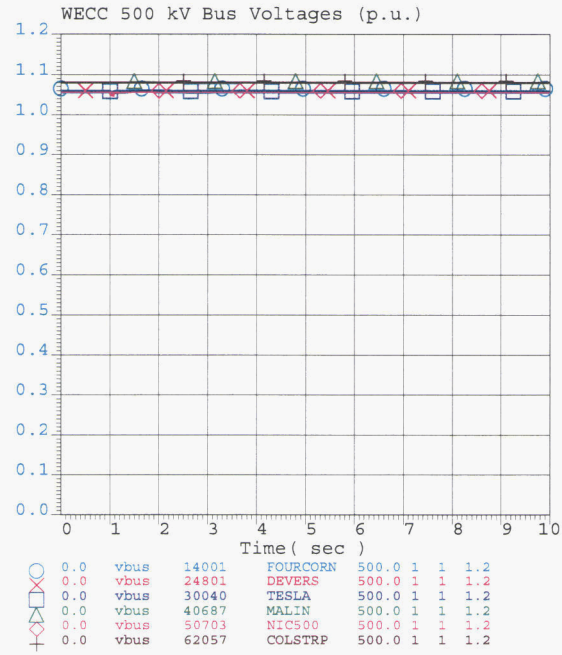
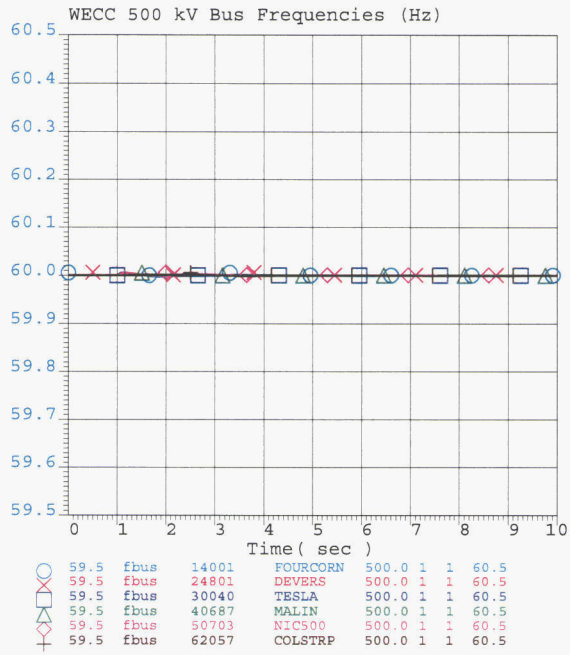
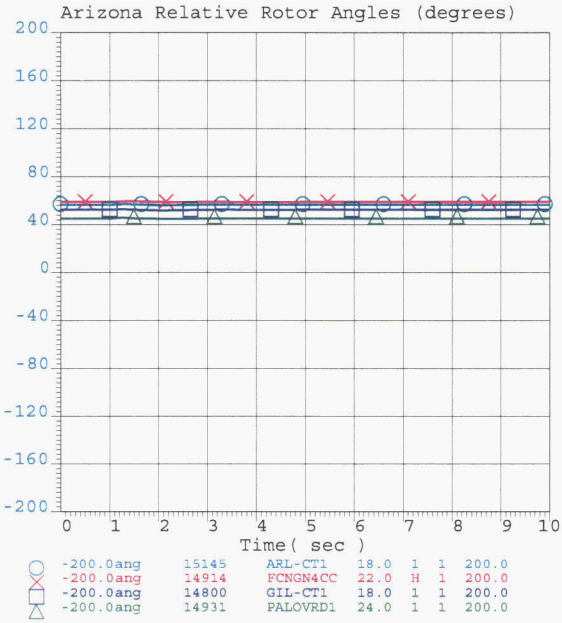
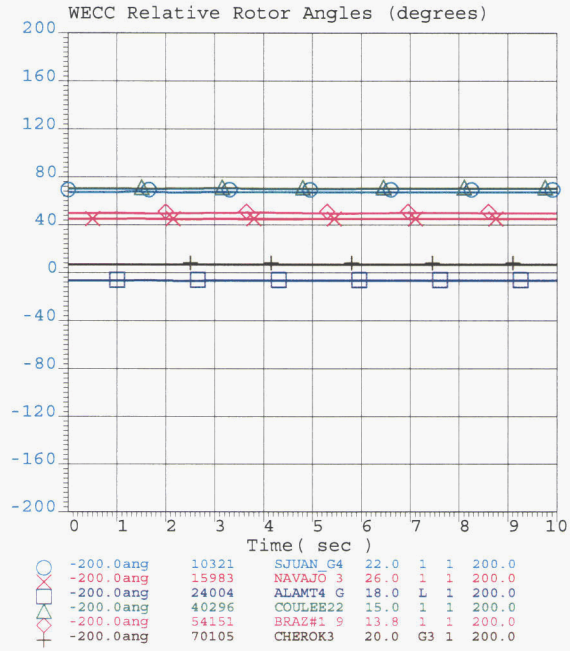
Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots









2011 Heavy Summer Power Flow/Transient Stability Case
Gila Bend/Gila River Cluster SIS Pre-Project Revision 3 Case
3-phase 4 cycle flt. @ Gila Bend 69 kV, trip Gila Bend 230/69 kV xfmr 1

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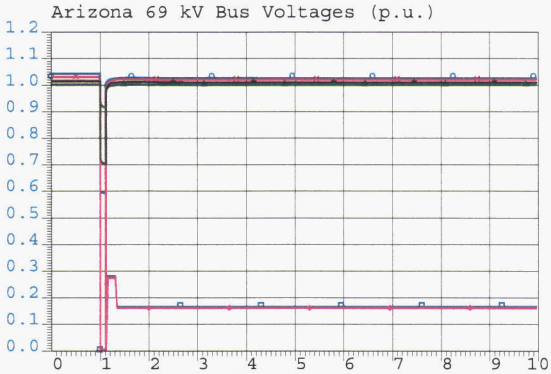
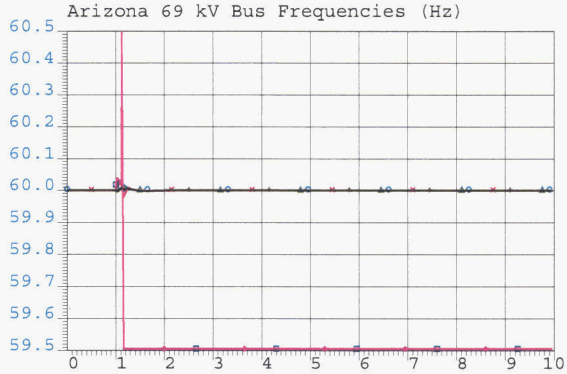
Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots

Arizona 69 kV Bus Voltages (p.u.)



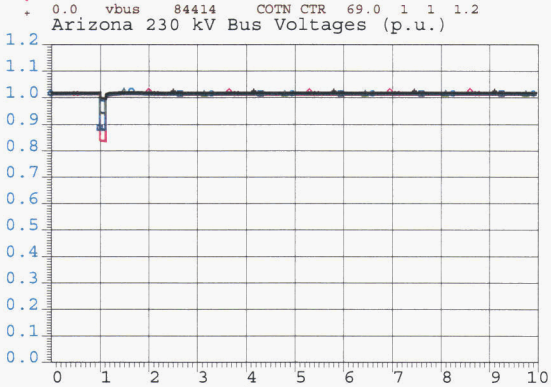
0.0	vbus	84419	GILABEND	69.0	1	1	1.2
0.0	vbus	84432	PALOMA	69.0	1	1	1.2
0.0	vbus	84411	BUNYAN	69.0	1	1	1.2
0.0	vbus	84442	SADDLEMT	69.0	1	1	1.2
0.0	vbus	84460	HY1	69.0	1	1	1.2
0.0	vbus	84414	COTN CTR	69.0	1	1	1.2

Arizona 69 kV Bus Frequencies (Hz)



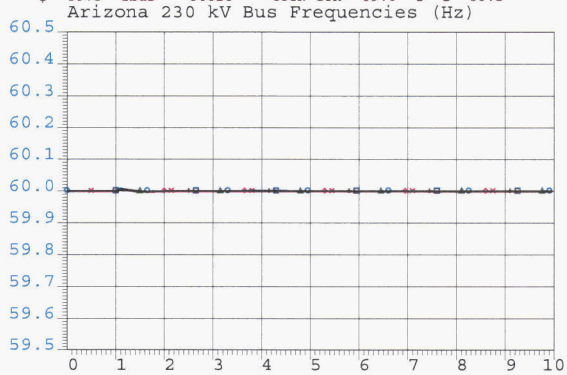
59.5	fbus	84419	GILABEND	69.0	1	1	60.5
59.5	fbus	84432	PALOMA	69.0	1	1	60.5
59.5	fbus	84411	BUNYAN	69.0	1	1	60.5
59.5	fbus	84442	SADDLEMT	69.0	1	1	60.5
59.5	fbus	84460	HY1	69.0	1	1	60.5
59.5	fbus	84414	COTN CTR	69.0	1	1	60.5

Arizona 230 kV Bus Voltages (p.u.)



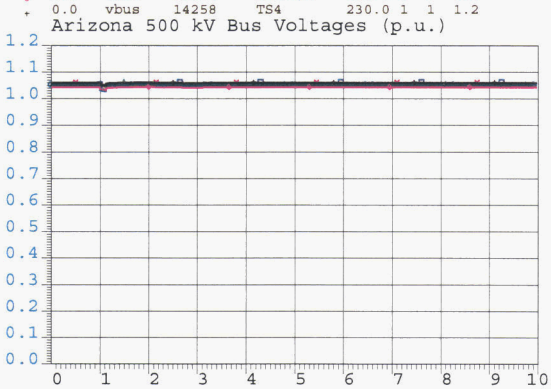
0.0	vbul	14201	BUCKEYE	230.0	1	1	1.2
0.0	vbul	14235	GILABEND	230.0	1	1	1.2
0.0	vbus	14238	GILARIVR	230.0	1	1	1.2
0.0	vbus	14224	JOJOBA	230.0	1	1	1.2
0.0	vbus	19052	LIBERTY	230.0	1	1	1.2
0.0	vbus	14258	TS4	230.0	1	1	1.2

Arizona 230 kV Bus Frequencies (Hz)



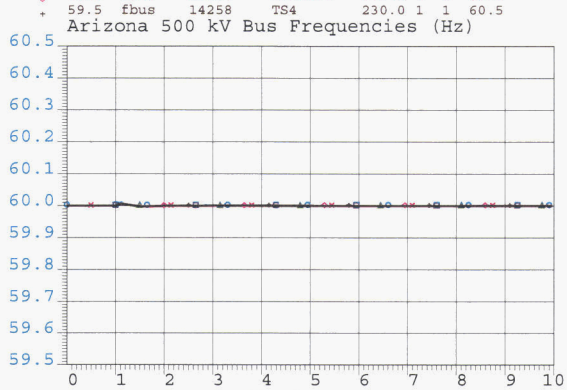
59.5	fbul	14201	BUCKEYE	230.0	1	1	60.5
59.5	fbul	14235	GILABEND	230.0	1	1	60.5
59.5	fbus	14238	GILARIVR	230.0	1	1	60.5
59.5	fbus	14224	JOJOBA	230.0	1	1	60.5
59.5	fbus	19052	LIBERTY	230.0	1	1	60.5
59.5	fbus	14258	TS4	230.0	1	1	60.5

Arizona 500 kV Bus Voltages (p.u.)



0.0	vbus	14007	GILARIVR	500.0	1	1	1.2
0.0	vbus	15093	HARQUAHA	500.0	1	1	1.2
0.0	vbus	15090	HASSYAMP	500.0	1	1	1.2
0.0	vbus	15089	JOJOBA	500.0	1	1	1.2
0.0	vbus	15011	KYRENE	500.0	1	1	1.2
0.0	vbus	15021	PALOVRDE	500.0	1	1	1.2

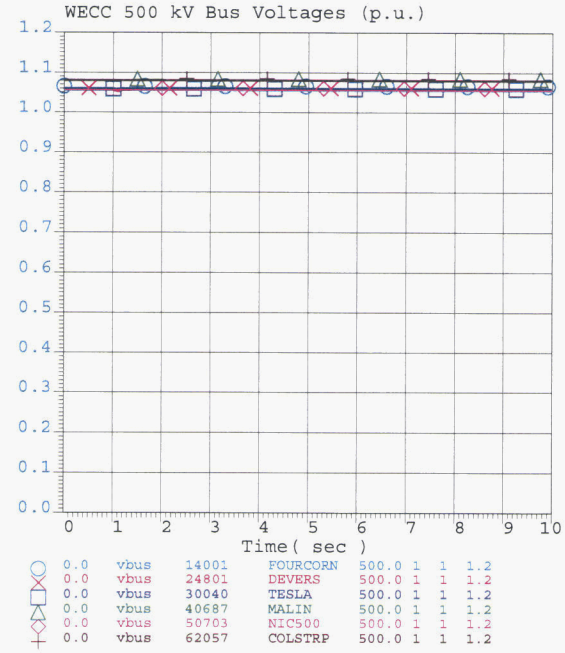
Arizona 500 kV Bus Frequencies (Hz)

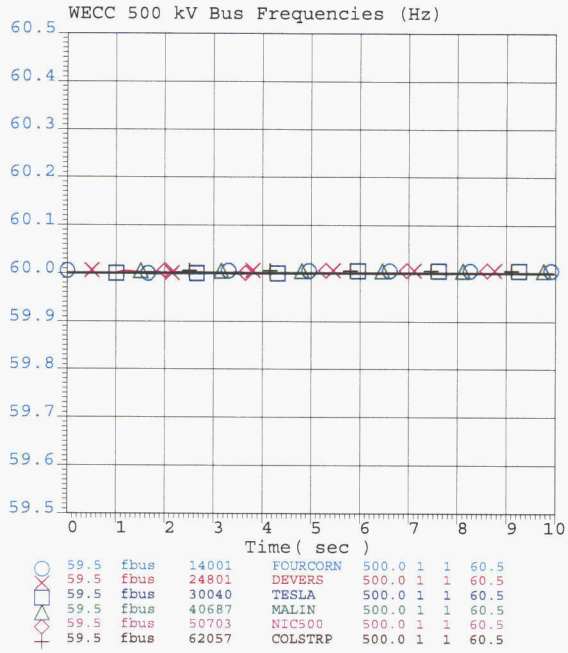


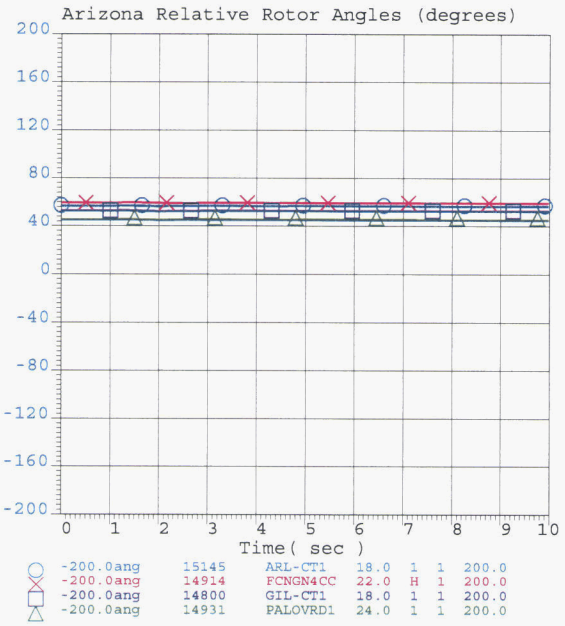
59.5	fbus	14007	GILARIVR	500.0	1	1	60.5
59.5	fbus	15093	HARQUAHA	500.0	1	1	60.5
59.5	fbus	15090	HASSYAMP	500.0	1	1	60.5
59.5	fbus	15089	JOJOBA	500.0	1	1	60.5
59.5	fbus	15011	KYRENE	500.0	1	1	60.5
59.5	fbus	15021	PALOVRDE	500.0	1	1	60.5

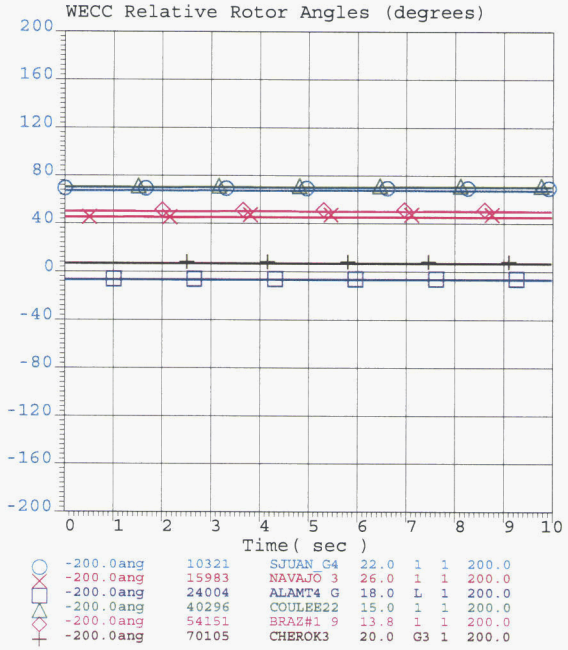
2011 Heavy Summer Power Flow/Transient Stability Case
Gila Bend/Gila River Cluster SIS Pre-Project Revision 3 Case
3-phase 7 cycle flt. @ Paloma 69 kV, trip Paloma-Bunyan 69 kV

Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots



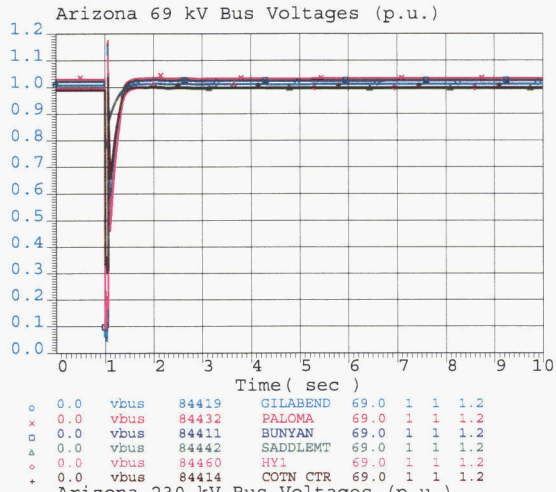


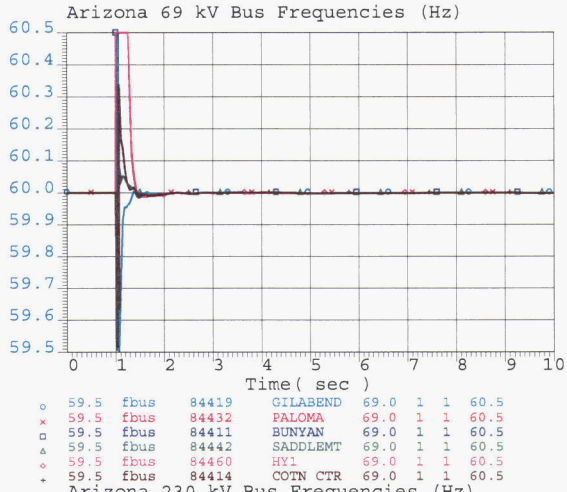


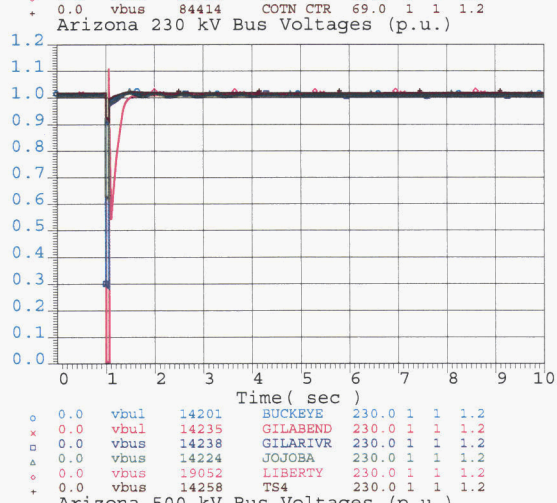


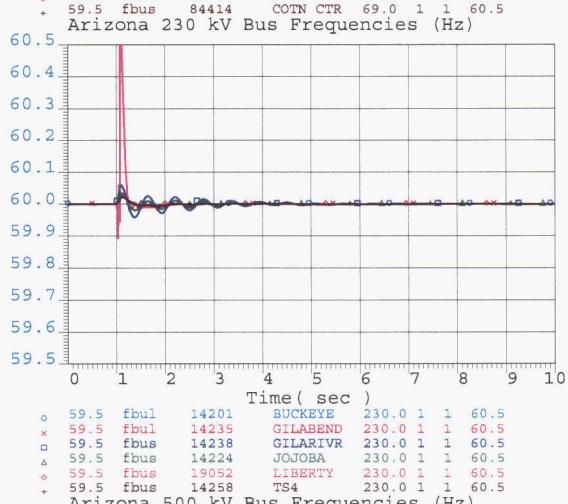
2011 Heavy Summer Power Flow/Transient Stability Case
Gila Bend/Gila River Cluster SIS Pre-Project Revision 3 Case
3-phase 7 cycle flt. @ Paloma 69 kV, trip Paloma-Bunyan 69 kV

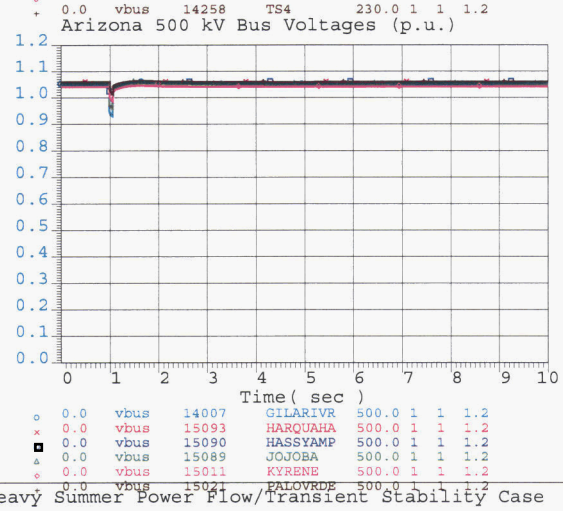
Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots

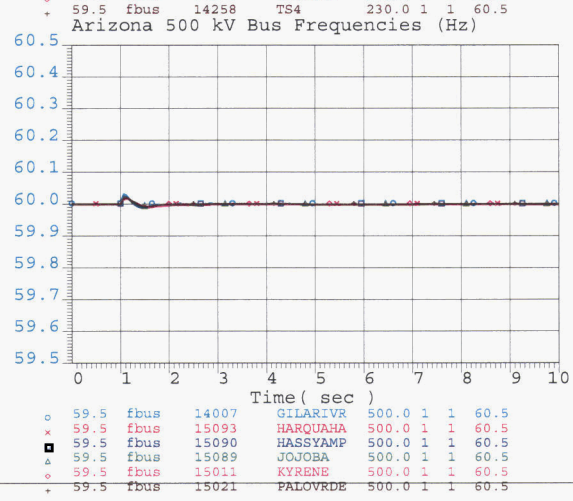






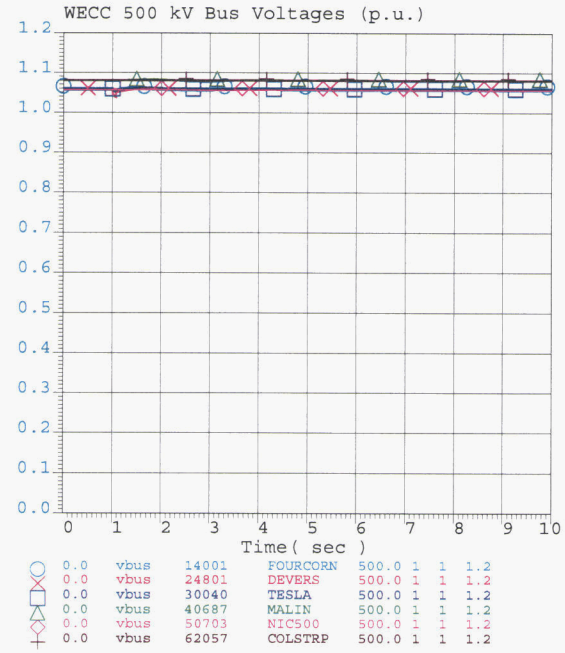


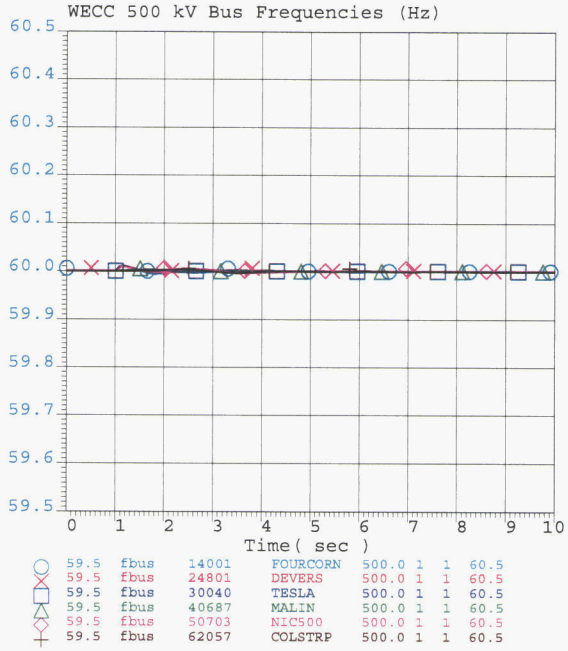


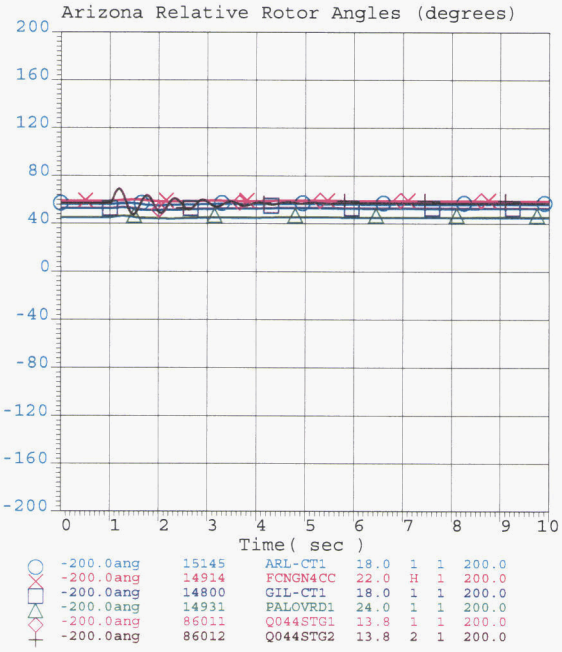


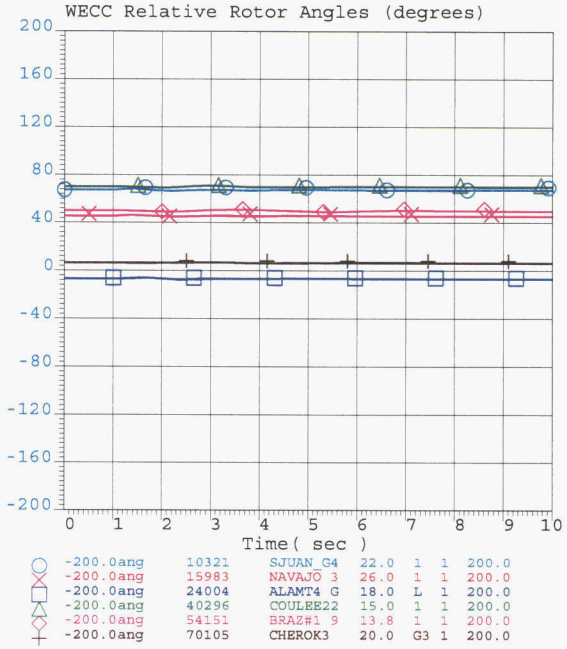
2011 Heavy Summer Power Flow/Transient Stability Case
Gila Bend/Gila River Cluster SIS Post-Project R3 Case 1 Q031(102MW)&Q044(280 MW
3-phase 4 cycle flt. @ Gila Bend 230 kV, trip Gila Bend-Gila River 230 kV

Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots









2011 Heavy Summer Power Flow/Transient Stability Case
Gila Bend/Gila River Cluster SIS Post-Project R3 Case 1 Q031(102MW)&Q044(280 MW
3-phase 4 cycle flt. @ Gila Bend 230 kV, trip Gila Bend-Gila River 230 kV

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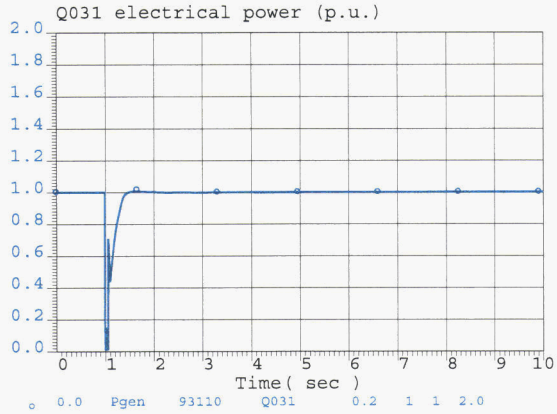
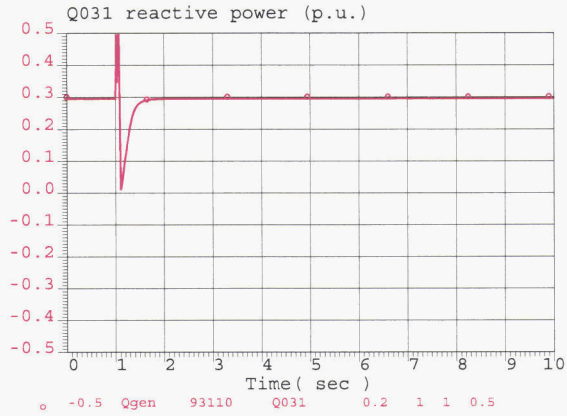
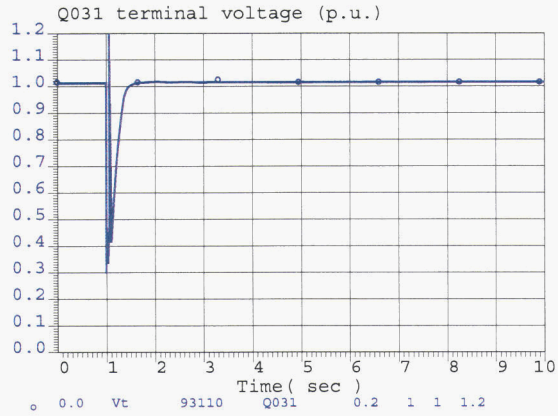
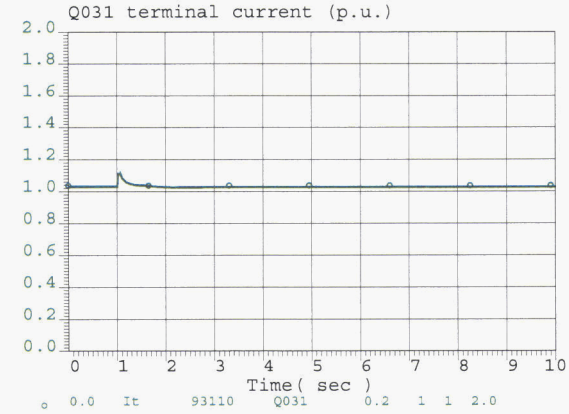
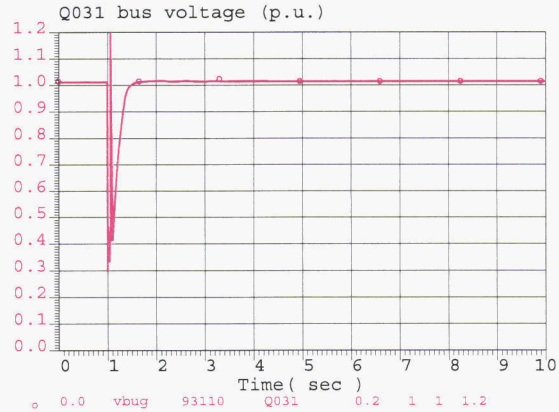
Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots

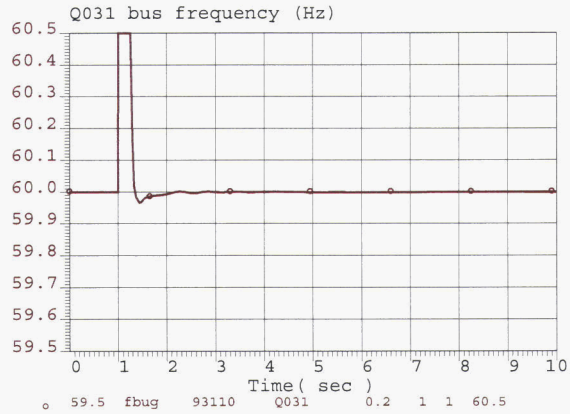






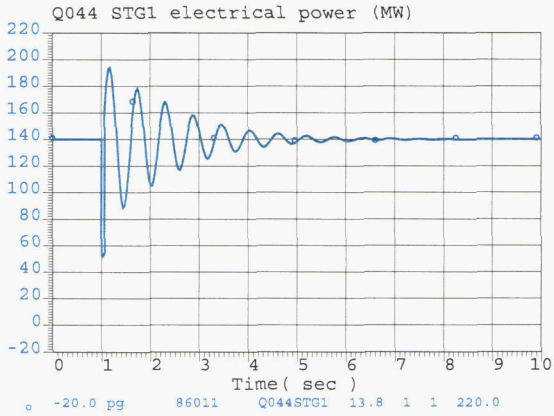


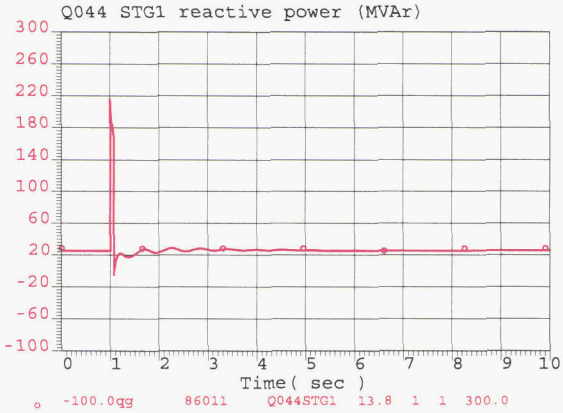


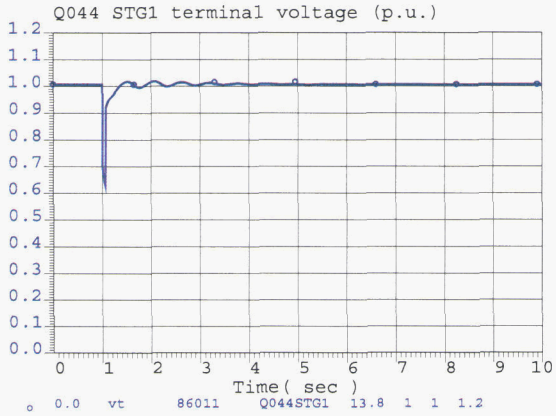


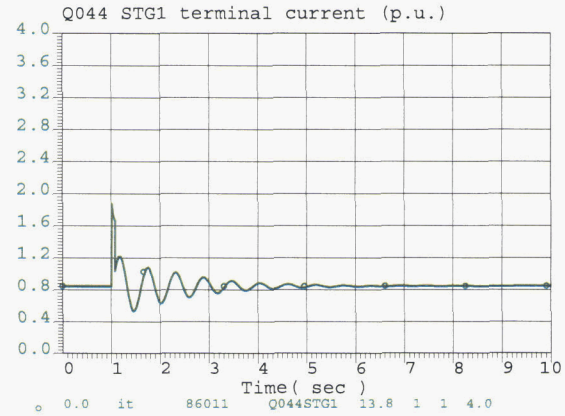
2011 Heavy Summer Power Flow/Transient Stability Case
Gila Bend/Gila River Cluster SIS Post-Project R3 Case 1 Q031(102MW)&Q044(280 MW
3-phase 4 cycle flt. @ Gila Bend 230 kV, trip Gila Bend-Gila River 230 kV

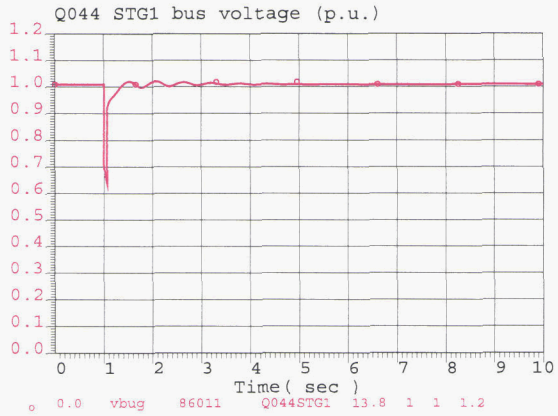
Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots

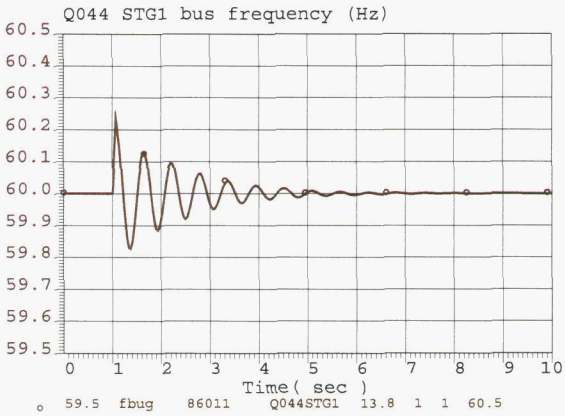












2011 Heavy Summer Power Flow/Transient Stability Case
Gila Bend/Gila River Cluster SIS Post-Project R3 Case 1 Q031(102MW)&Q044(280 MW
3-phase 4 cycle flt. @ Gila Bend 230 kV, trip Gila Bend-Gila River 230 kV

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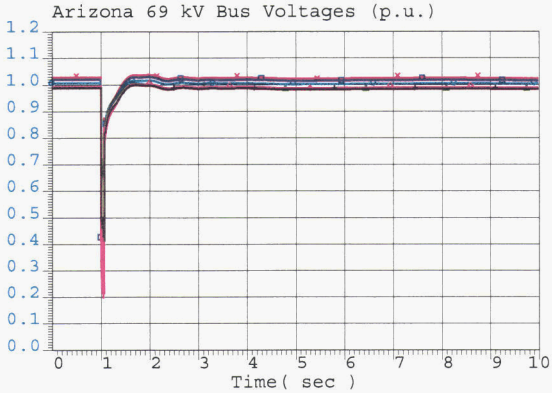
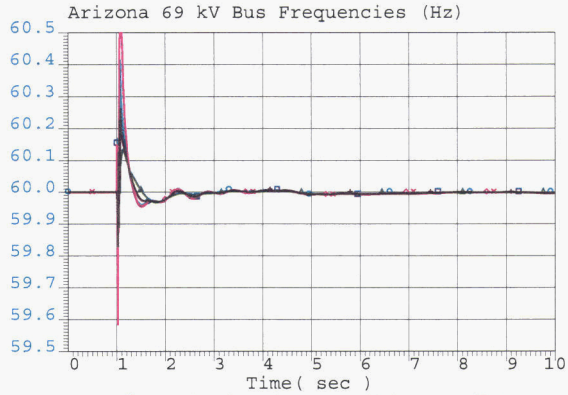
Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots

Arizona 69 kV Bus Voltages (p.u.)



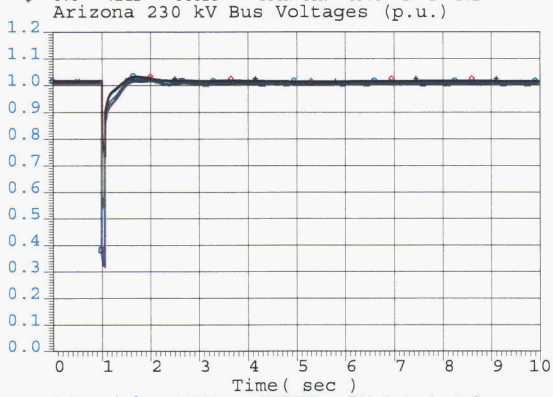
0.0	vbus	84419	GILABEND	69.0	1	1	1.2
0.0	vbus	84432	PALOMA	69.0	1	1	1.2
0.0	vbus	84411	BUNYAN	69.0	1	1	1.2
0.0	vbus	84442	SADDLEMT	69.0	1	1	1.2
0.0	vbus	84460	HY1	69.0	1	1	1.2
0.0	vbus	84414	COTN CTR	69.0	1	1	1.2

Arizona 69 kV Bus Frequencies (Hz)



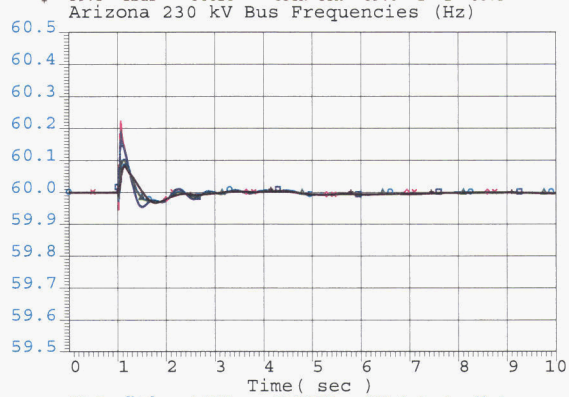
59.5	fbus	84419	GILABEND	69.0	1	1	60.5
59.5	fbus	84432	PALOMA	69.0	1	1	60.5
59.5	fbus	84411	BUNYAN	69.0	1	1	60.5
59.5	fbus	84442	SADDLEMT	69.0	1	1	60.5
59.5	fbus	84460	HY1	69.0	1	1	60.5
59.5	fbus	84414	COTN CTR	69.0	1	1	60.5

Arizona 230 kV Bus Voltages (p.u.)



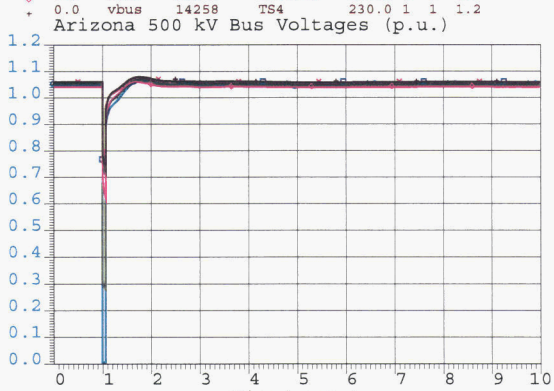
0.0	vbul	14201	BUCKEYE	230.0	1	1	1.2
0.0	vbul	14235	GILABEND	230.0	1	1	1.2
0.0	vbus	14238	GILARIVR	230.0	1	1	1.2
0.0	vbus	14224	JOJOBA	230.0	1	1	1.2
0.0	vbus	19052	LIBERTY	230.0	1	1	1.2
0.0	vbus	14258	TS4	230.0	1	1	1.2

Arizona 230 kV Bus Frequencies (Hz)



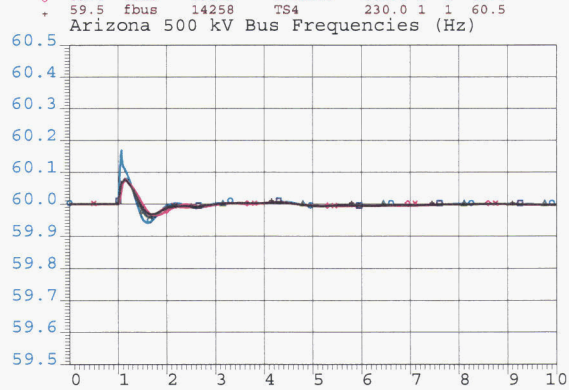
59.5	fbul	14201	BUCKEYE	230.0	1	1	60.5
59.5	fbul	14235	GILABEND	230.0	1	1	60.5
59.5	fbus	14238	GILARIVR	230.0	1	1	60.5
59.5	fbus	14224	JOJOBA	230.0	1	1	60.5
59.5	fbus	19052	LIBERTY	230.0	1	1	60.5
59.5	fbus	14258	TS4	230.0	1	1	60.5

Arizona 500 kV Bus Voltages (p.u.)



0.0	vbus	14007	GILARIVR	500.0	1	1	1.2
0.0	vbus	15093	HARQUAHA	500.0	1	1	1.2
0.0	vbus	15090	HASSYAMP	500.0	1	1	1.2
0.0	vbus	15089	JOJOBA	500.0	1	1	1.2
0.0	vbus	15011	KYRENE	500.0	1	1	1.2
0.0	vbus	15021	PALOVRDE	500.0	1	1	1.2

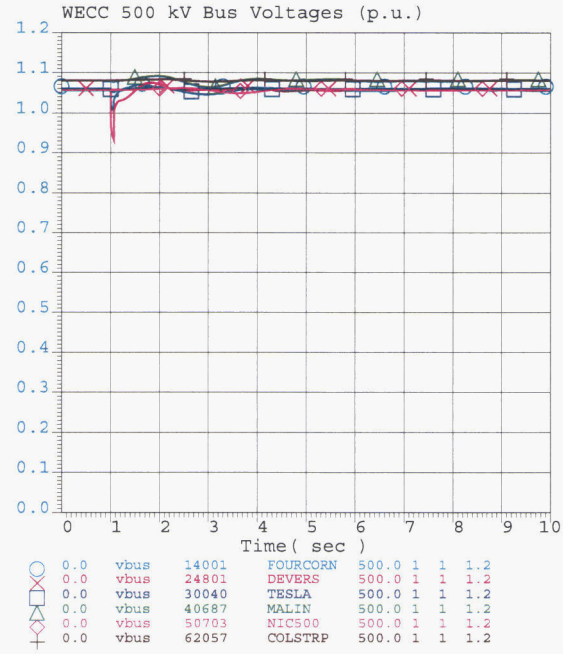
Arizona 500 kV Bus Frequencies (Hz)

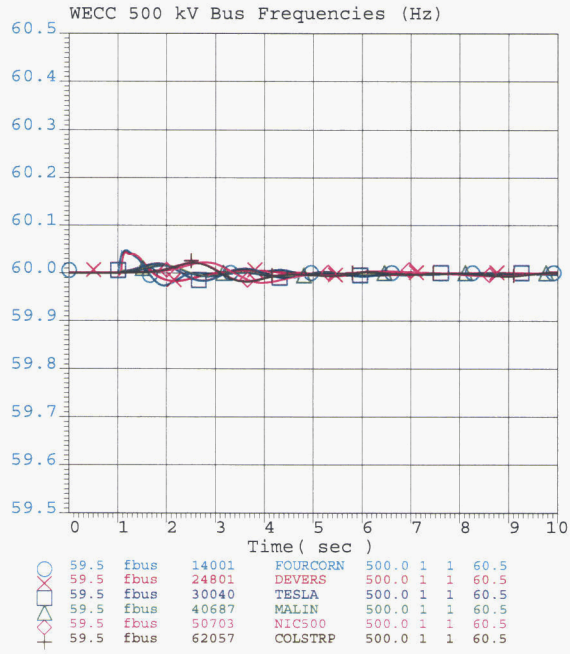


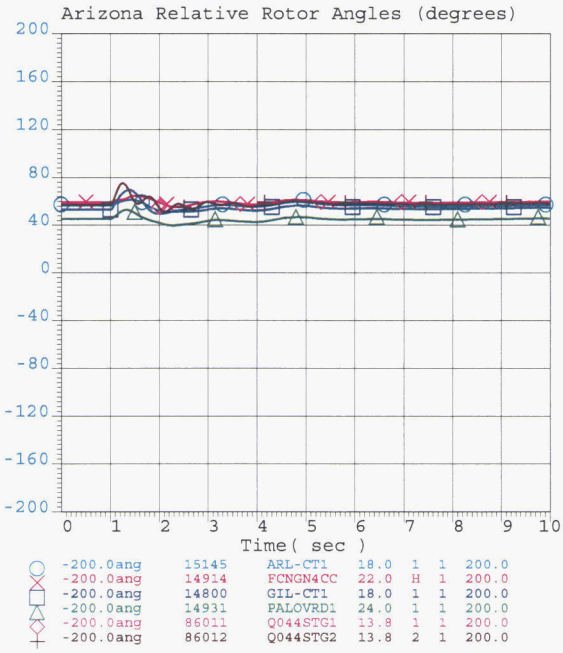
59.5	fbus	14007	GILARIVR	500.0	1	1	60.5
59.5	fbus	15093	HARQUAHA	500.0	1	1	60.5
59.5	fbus	15090	HASSYAMP	500.0	1	1	60.5
59.5	fbus	15089	JOJOBA	500.0	1	1	60.5
59.5	fbus	15011	KYRENE	500.0	1	1	60.5
59.5	fbus	15021	PALOVRDE	500.0	1	1	60.5

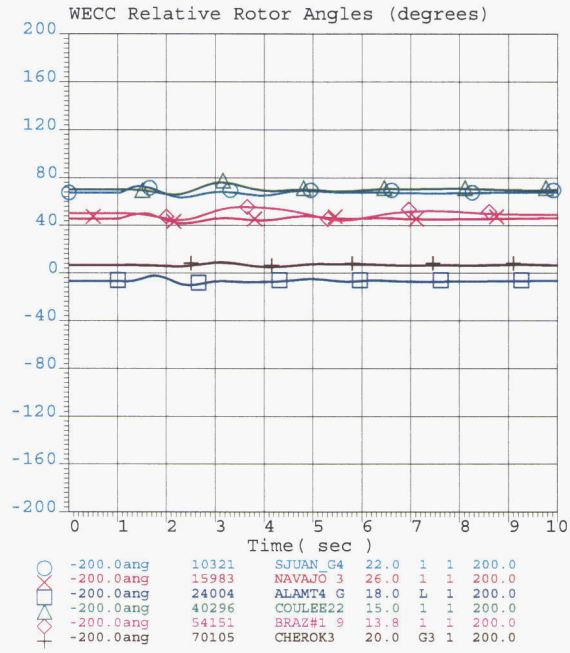
2011 Heavy Summer Power Flow/Transient Stability Case
Gila Bend/Gila River Cluster SIS Post-Project R3 Case 1 Q031(102MW)&Q044(280 MW
3-phase 4 cycle flt. @ Gila River 500 kV, trip Gila River-Jojoba 500 kV

Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots



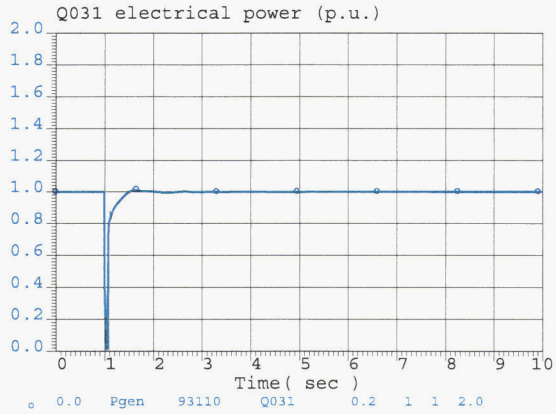


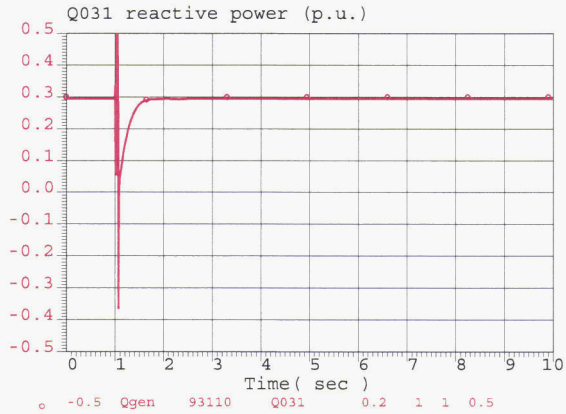


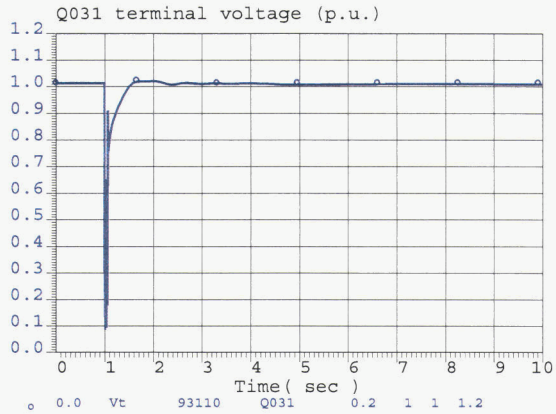


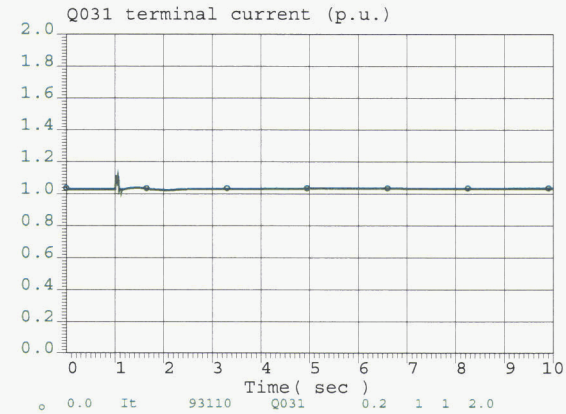
2011 Heavy Summer Power Flow/Transient Stability Case
Gila Bend/Gila River Cluster SIS Post-Project R3 Case 1 Q031(102MW)&Q044(280 MW
3-phase 4 cycle flt. @ Gila River 500 kV, trip Gila River-Jojoba 500 kV

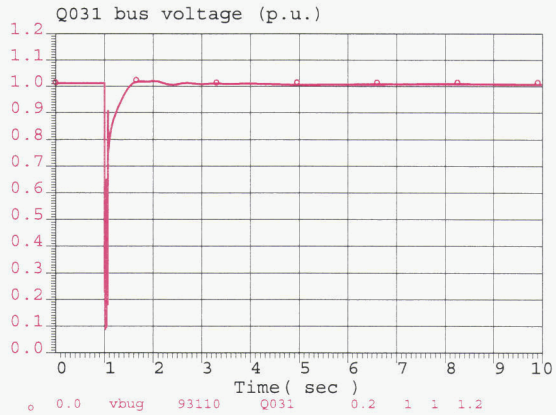
Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots

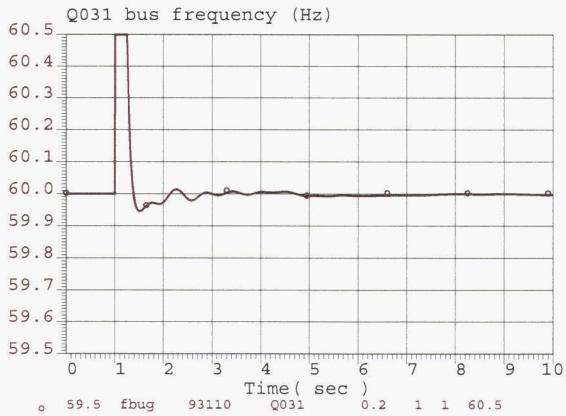






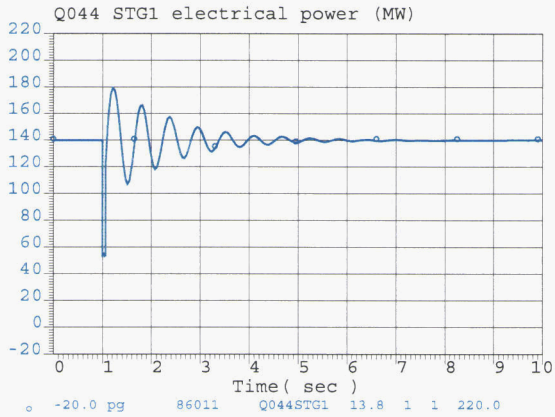


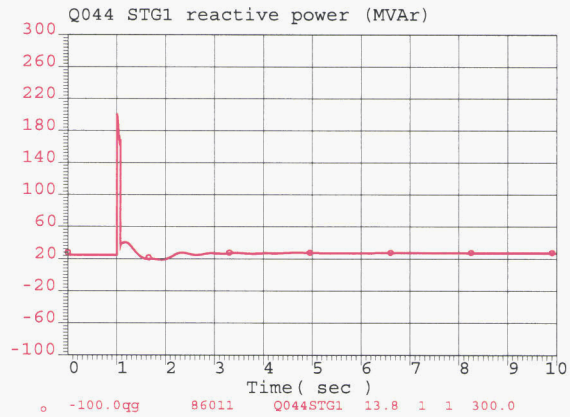


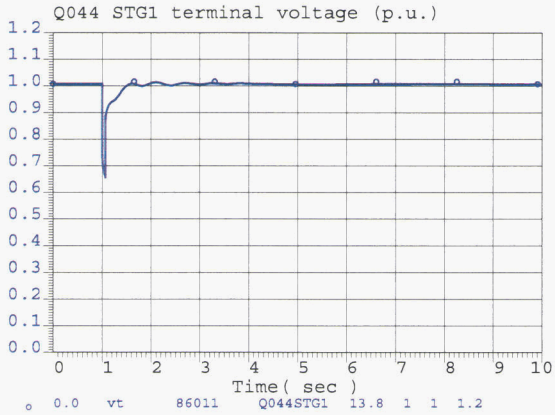


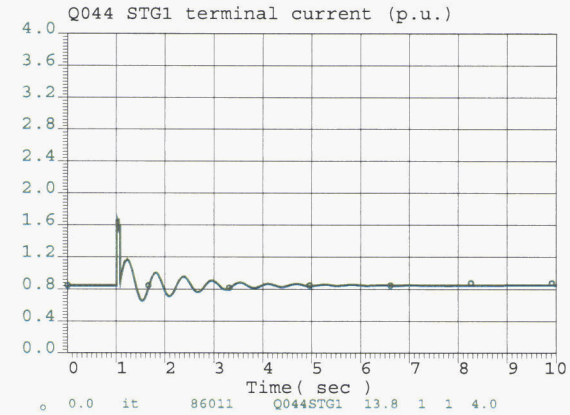
2011 Heavy Summer Power Flow/Transient Stability Case
Gila Bend/Gila River Cluster SIS Post-Project R3 Case 1 Q031(102MW)&Q044(280 MW
3-phase 4 cycle flt. @ Gila River 500 kV, trip Gila River-Jojoba 500 kV

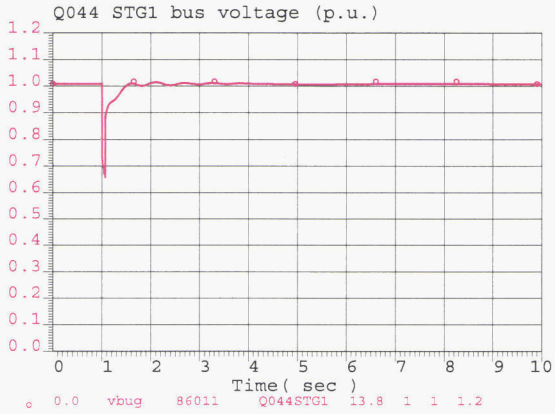
Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots

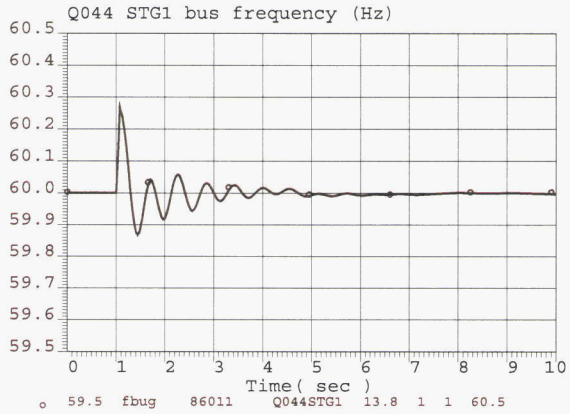








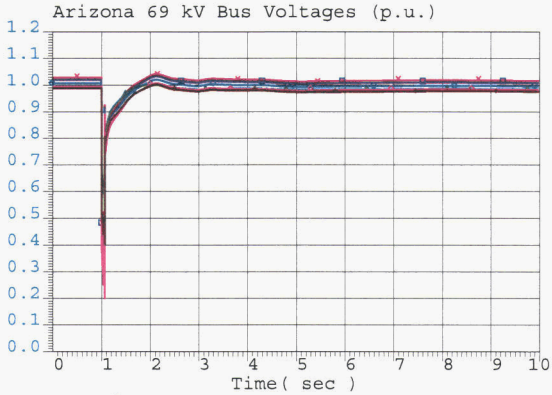




2011 Heavy Summer Power Flow/Transient Stability Case
Gila Bend/Gila River Cluster SIS Post-Project R3 Case 1 Q031(102MW)&Q044(280 MW
3-phase 4 cycle flt. @ Gila River 500 kV, trip Gila River-Jojoba 500 kV

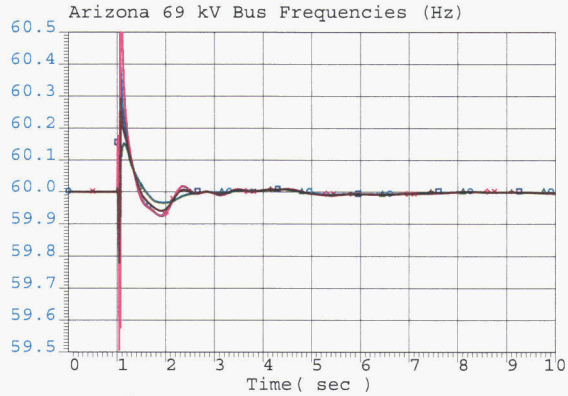
Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots

Arizona 69 kV Bus Voltages (p.u.)



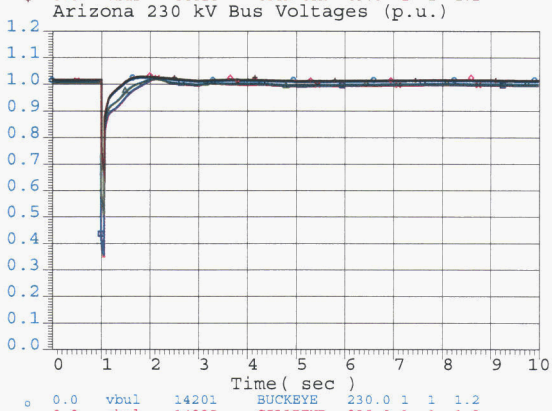
0.0	vbus	84419	GILABEND	69.0	1	1	1.2
0.0	vbus	84432	PALOMA	69.0	1	1	1.2
0.0	vbus	84411	BUNYAN	69.0	1	1	1.2
0.0	vbus	84442	SADDLEMT	69.0	1	1	1.2
0.0	vbus	84460	HY1	69.0	1	1	1.2
0.0	vbus	84414	COTN CTR	69.0	1	1	1.2

Arizona 69 kV Bus Frequencies (Hz)



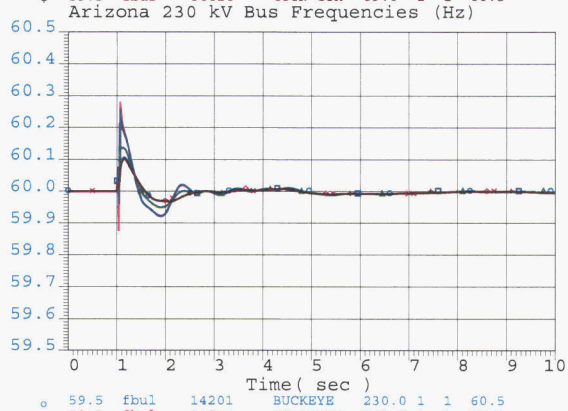
59.5	fbus	84419	GILABEND	69.0	1	1	60.5
59.5	fbus	84432	PALOMA	69.0	1	1	60.5
59.5	fbus	84411	BUNYAN	69.0	1	1	60.5
59.5	fbus	84442	SADDLEMT	69.0	1	1	60.5
59.5	fbus	84460	HY1	69.0	1	1	60.5
59.5	fbus	84414	COTN CTR	69.0	1	1	60.5

Arizona 230 kV Bus Voltages (p.u.)



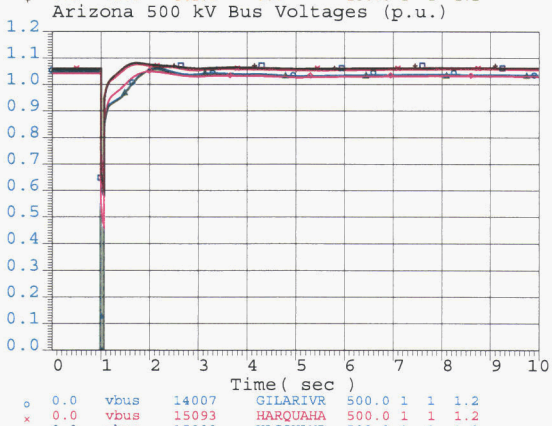
0.0	vbul	14201	BUCKEYE	230.0	1	1	1.2
0.0	vbul	14235	GILABEND	230.0	1	1	1.2
0.0	vbus	14238	GILARIVR	230.0	1	1	1.2
0.0	vbus	14224	JOJOBA	230.0	1	1	1.2
0.0	vbus	19052	LIBERTY	230.0	1	1	1.2
0.0	vbus	14258	TS4	230.0	1	1	1.2

Arizona 230 kV Bus Frequencies (Hz)



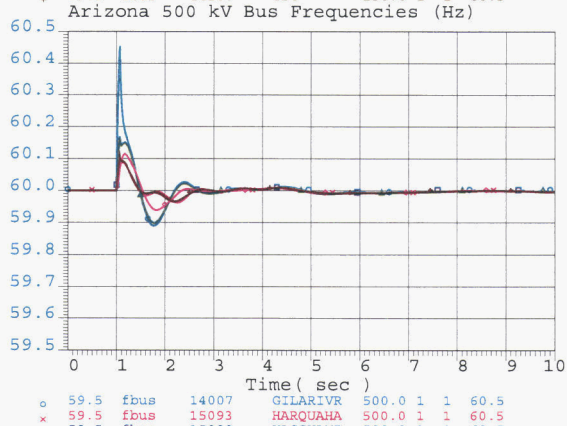
59.5	fbul	14201	BUCKEYE	230.0	1	1	60.5
59.5	fbul	14235	GILABEND	230.0	1	1	60.5
59.5	fbus	14238	GILARIVR	230.0	1	1	60.5
59.5	fbus	14224	JOJOBA	230.0	1	1	60.5
59.5	fbus	19052	LIBERTY	230.0	1	1	60.5
59.5	fbus	14258	TS4	230.0	1	1	60.5

Arizona 500 kV Bus Voltages (p.u.)



0.0	vbus	14007	GILARIVR	500.0	1	1	1.2
0.0	vbus	15093	HARQUAHA	500.0	1	1	1.2
0.0	vbus	15090	HASSYAMP	500.0	1	1	1.2
0.0	vbus	15089	JOJOBA	500.0	1	1	1.2
0.0	vbus	15011	KYRENE	500.0	1	1	1.2
0.0	vbus	15021	PALOVRDE	500.0	1	1	1.2

Arizona 500 kV Bus Frequencies (Hz)



59.5	fbus	14007	GILARIVR	500.0	1	1	60.5
59.5	fbus	15093	HARQUAHA	500.0	1	1	60.5
59.5	fbus	15090	HASSYAMP	500.0	1	1	60.5
59.5	fbus	15089	JOJOBA	500.0	1	1	60.5
59.5	fbus	15011	KYRENE	500.0	1	1	60.5
59.5	fbus	15021	PALOVRDE	500.0	1	1	60.5

2011 Heavy Summer Power Flow/Transient Stability Case
Gila Bend/Gila River Cluster SIS Post-Project R3 Case 1 Q031(102MW)&Q044(280 MW
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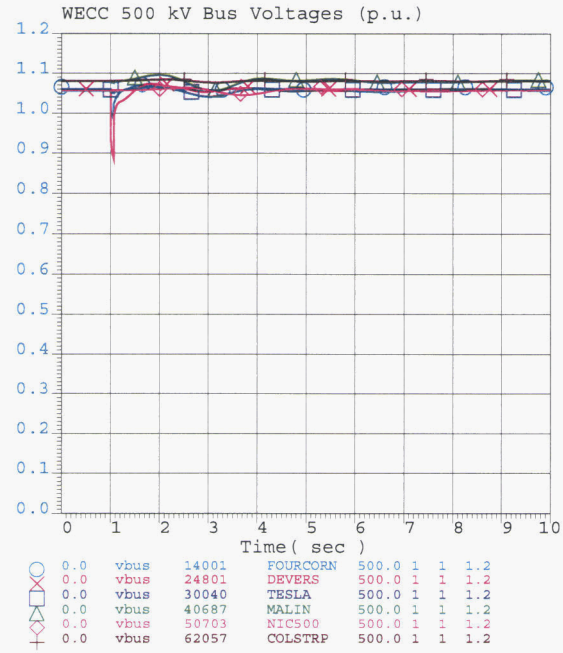
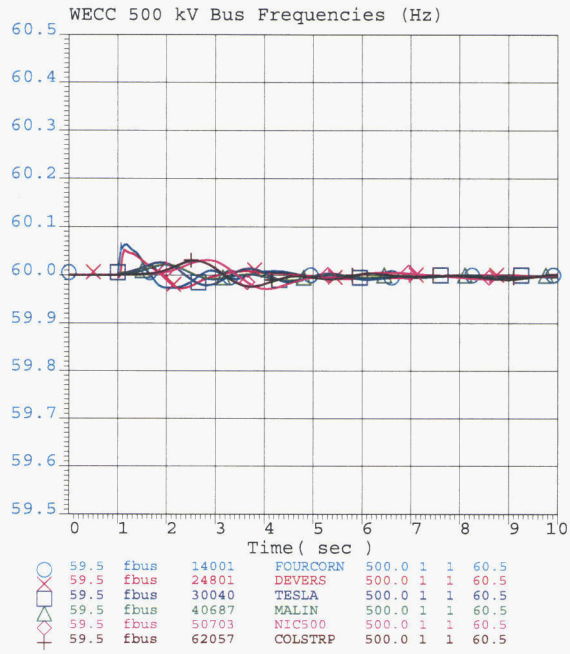
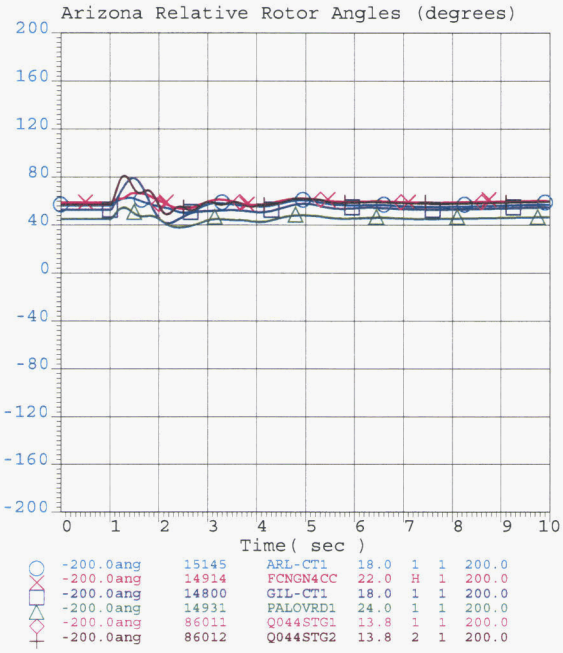
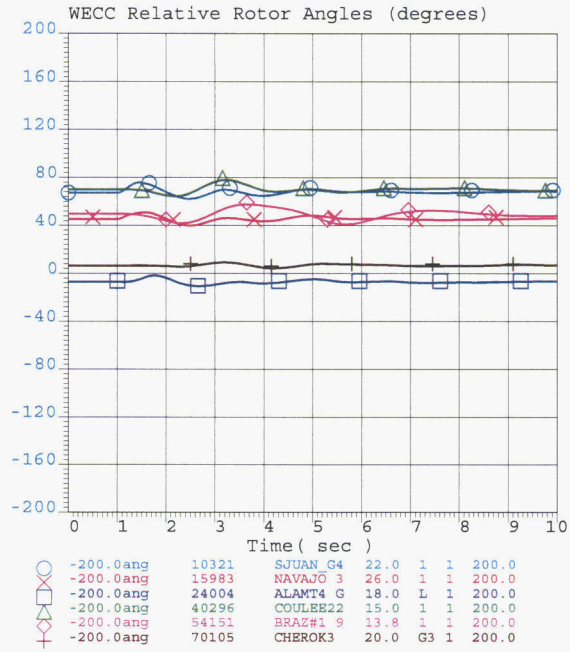
Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots



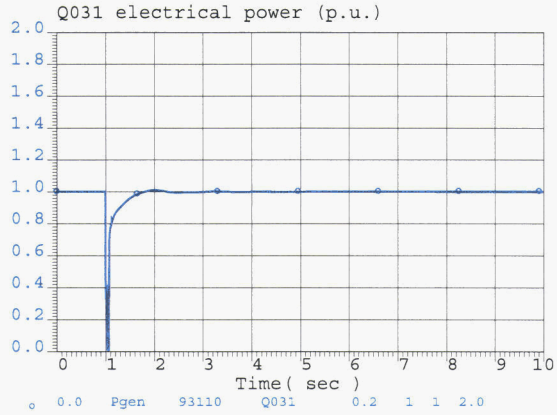


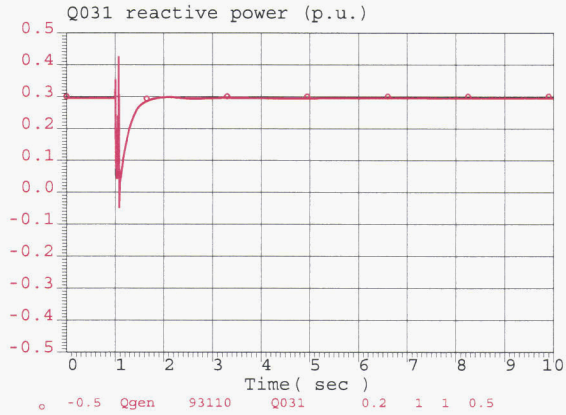


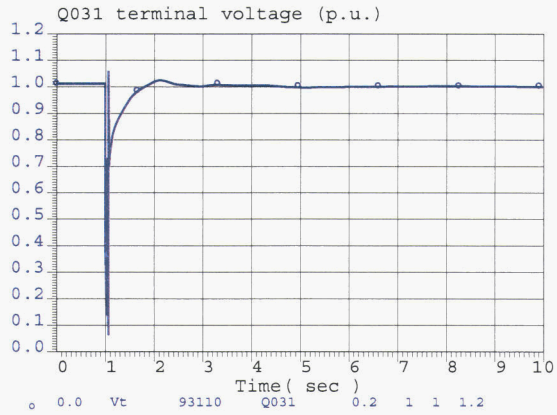


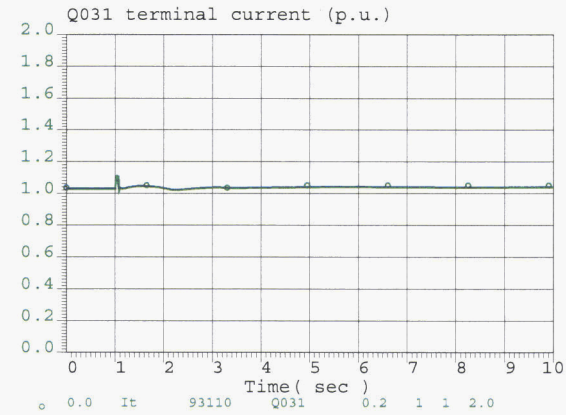
2011 Heavy Summer Power Flow/Transient Stability Case
Gila Bend/Gila River Cluster SIS Post-Project R3 Case 1 Q031(102MW)&Q044(280 MW
3-phase 4 cycle flt. @ Jojoba 500 kV, trip Hassyampa-Jojoba 500 kV

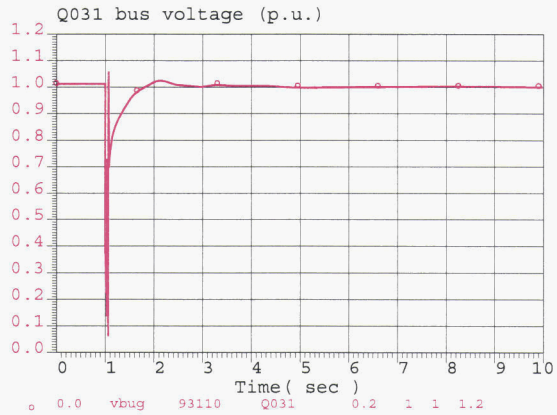
Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots

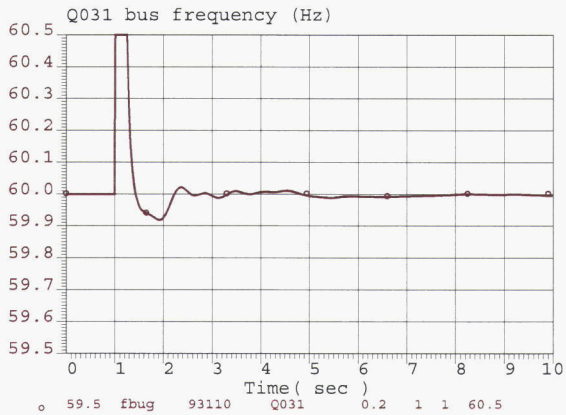






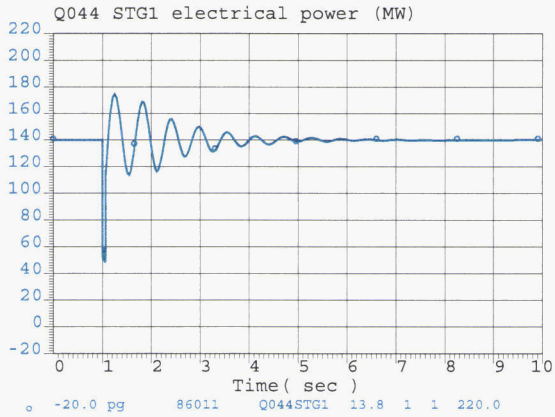


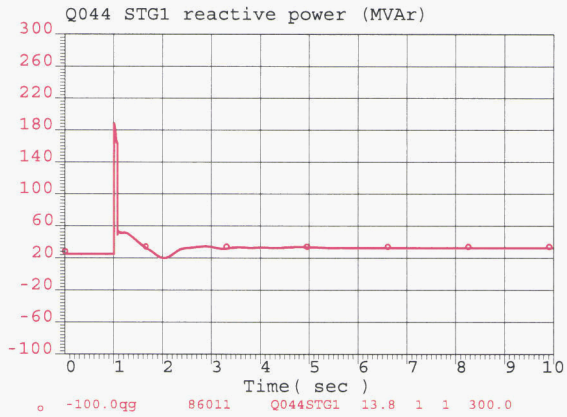


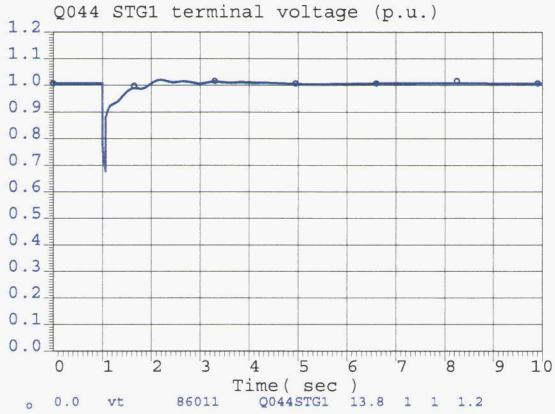


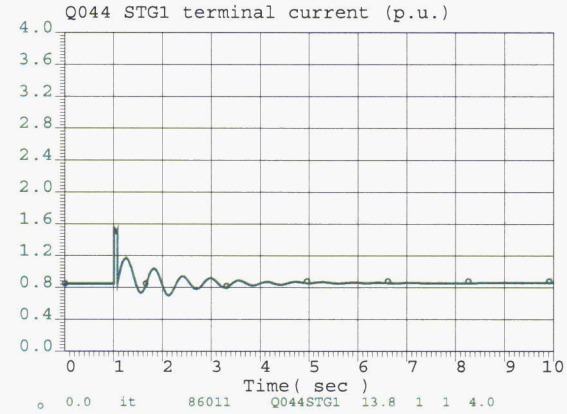
2011 Heavy Summer Power Flow/Transient Stability Case
Gila Bend/Gila River Cluster SIS Post-Project R3 Case 1 Q031(102MW)&Q044(280 MW
3-phase 4 cycle flt. @ Jojoba 500 kV, trip Hassyampa-Jojoba 500 kV

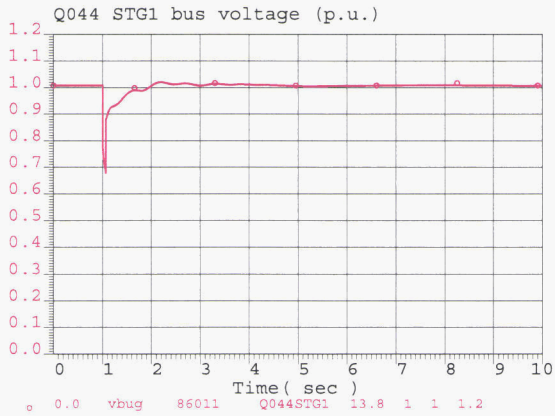
Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots

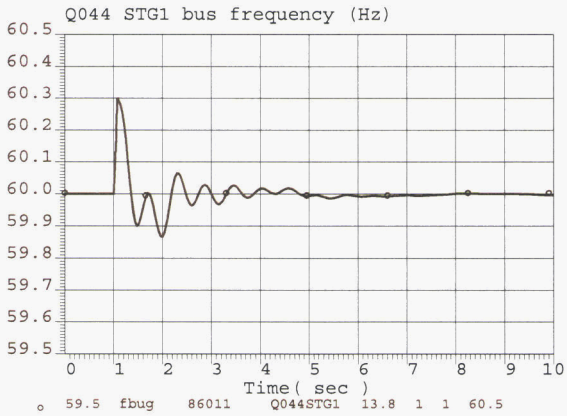












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Gila Bend/Gila River Cluster SIS Post-Project R3 Case 1 Q031(102MW)&Q044(280 MW
3-phase 4 cycle flt. @ Jojoba 500 kV, trip Hassyampa-Jojoba 500 kV

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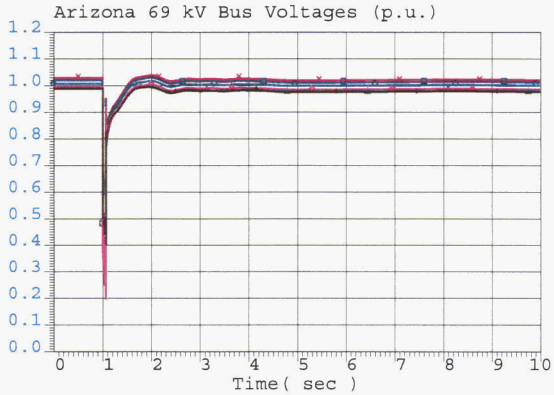
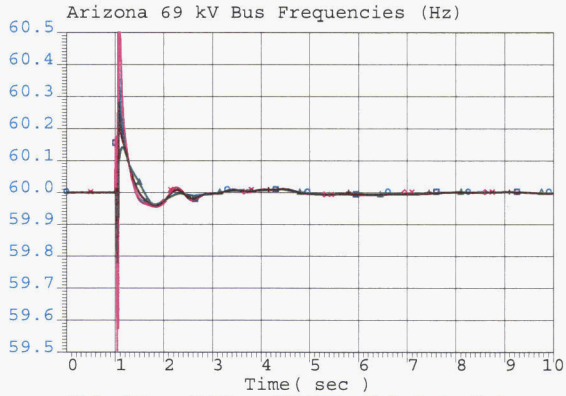
Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots

Arizona 69 kV Bus Voltages (p.u.)



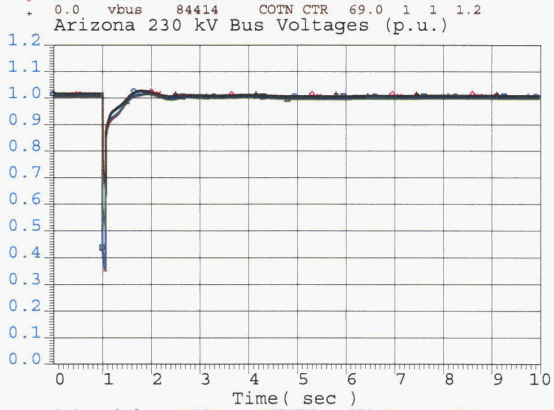
0.0	vbus	84419	GILABEND	69.0	1	1	1.2
0.0	vbus	84432	PALOMA	69.0	1	1	1.2
0.0	vbus	84411	BUNYAN	69.0	1	1	1.2
0.0	vbus	84442	SADDLEMT	69.0	1	1	1.2
0.0	vbus	84460	HY1	69.0	1	1	1.2
0.0	vbus	84414	COTN CTR	69.0	1	1	1.2

Arizona 69 kV Bus Frequencies (Hz)



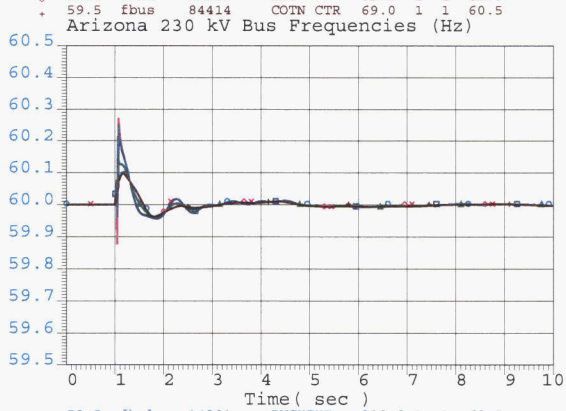
59.5	fbus	84419	GILABEND	69.0	1	1	60.5
59.5	fbus	84432	PALOMA	69.0	1	1	60.5
59.5	fbus	84411	BUNYAN	69.0	1	1	60.5
59.5	fbus	84442	SADDLEMT	69.0	1	1	60.5
59.5	fbus	84460	HY1	69.0	1	1	60.5
59.5	fbus	84414	COTN CTR	69.0	1	1	60.5

Arizona 230 kV Bus Voltages (p.u.)



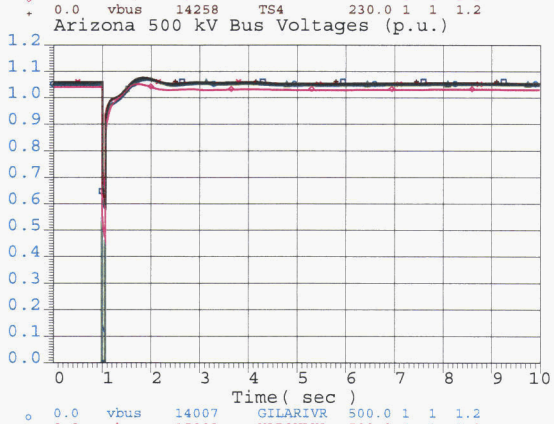
0.0	vbul	14201	BUCKEYE	230.0	1	1	1.2
0.0	vbul	14235	GILABEND	230.0	1	1	1.2
0.0	vbus	14238	GILARIVR	230.0	1	1	1.2
0.0	vbus	14224	JOJOBA	230.0	1	1	1.2
0.0	vbus	19052	LIBERTY	230.0	1	1	1.2
0.0	vbus	14258	TS4	230.0	1	1	1.2

Arizona 230 kV Bus Frequencies (Hz)



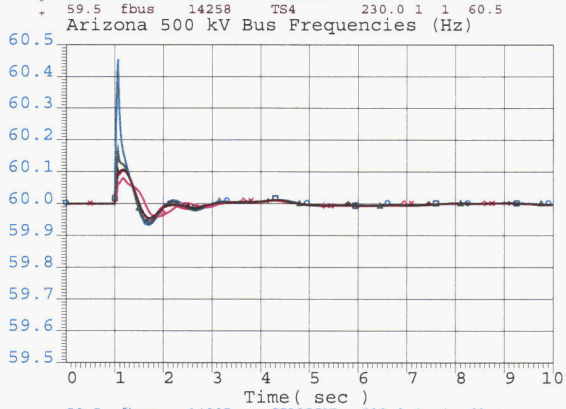
59.5	fbul	14201	BUCKEYE	230.0	1	1	60.5
59.5	fbul	14235	GILABEND	230.0	1	1	60.5
59.5	fbus	14238	GILARIVR	230.0	1	1	60.5
59.5	fbus	14224	JOJOBA	230.0	1	1	60.5
59.5	fbus	19052	LIBERTY	230.0	1	1	60.5
59.5	fbus	14258	TS4	230.0	1	1	60.5

Arizona 500 kV Bus Voltages (p.u.)



0.0	vbus	14007	GILARIVR	500.0	1	1	1.2
0.0	vbus	15093	HARQUAHA	500.0	1	1	1.2
0.0	vbus	15090	HASSYAMP	500.0	1	1	1.2
0.0	vbus	15089	JOJOBA	500.0	1	1	1.2
0.0	vbus	15011	KYRENE	500.0	1	1	1.2
0.0	vbus	15021	PALOVRDE	500.0	1	1	1.2

Arizona 500 kV Bus Frequencies (Hz)



59.5	fbus	14007	GILARIVR	500.0	1	1	60.5
59.5	fbus	15093	HARQUAHA	500.0	1	1	60.5
59.5	fbus	15090	HASSYAMP	500.0	1	1	60.5
59.5	fbus	15089	JOJOBA	500.0	1	1	60.5
59.5	fbus	15011	KYRENE	500.0	1	1	60.5
59.5	fbus	15021	PALOVRDE	500.0	1	1	60.5

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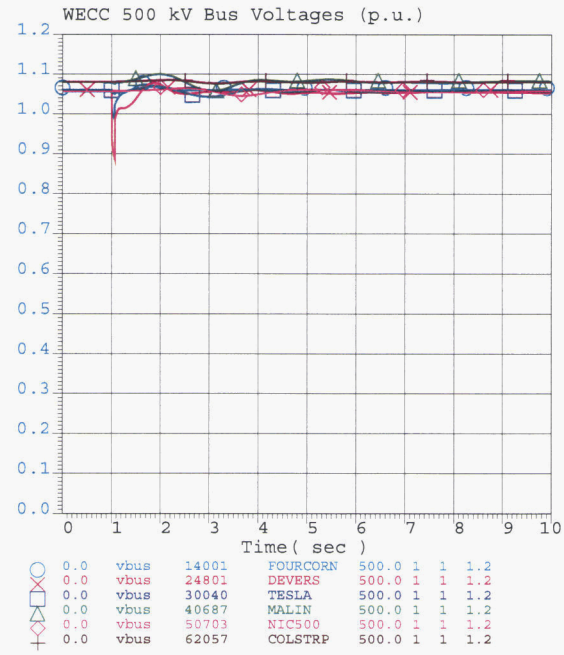
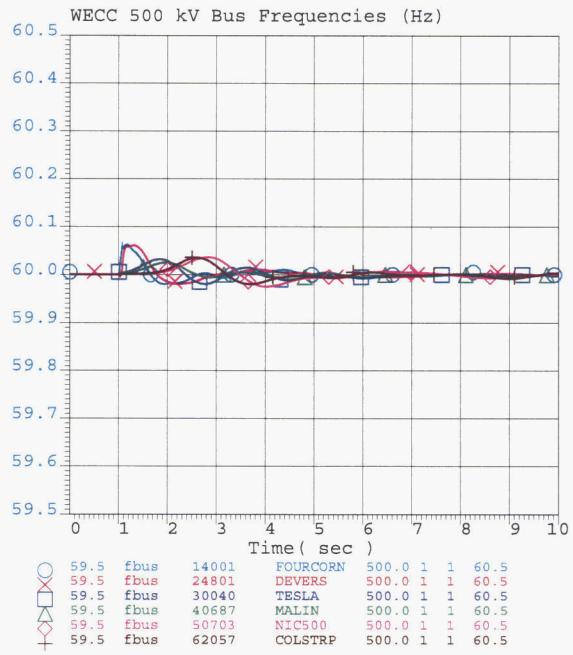
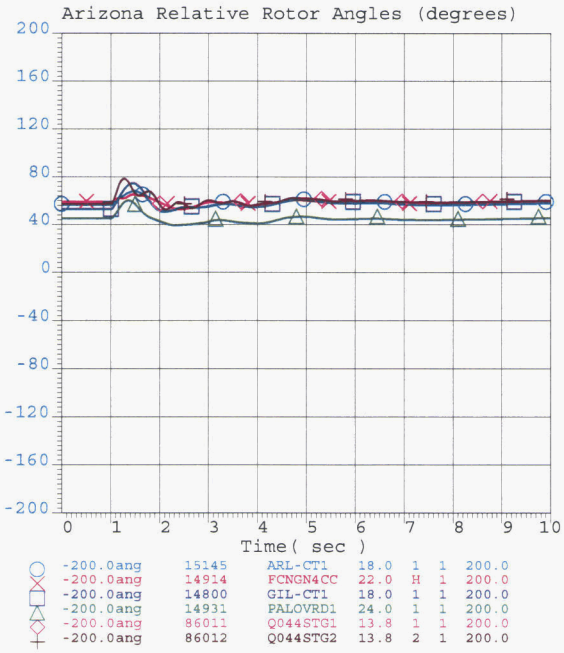
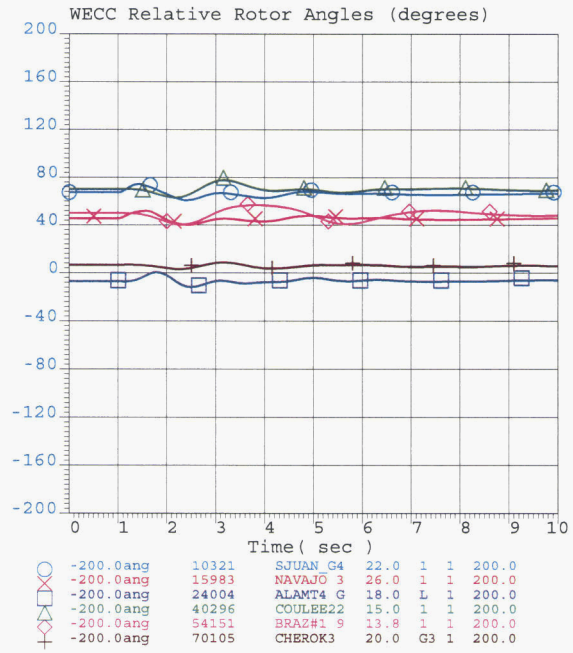
3-phase 4 cycle flt. @ Jojoba 500 kV, trip Jojoba-Kyrene 500 kV

Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots









2011 Heavy Summer Power Flow/Transient Stability Case
Gila Bend/Gila River Cluster SIS Post-Project R3 Case 1 Q031(102MW)&Q044(280 MW
3-phase 4 cycle flt. @ Jojoba 500 kV, trip Jojoba-Kyrene 500 kV

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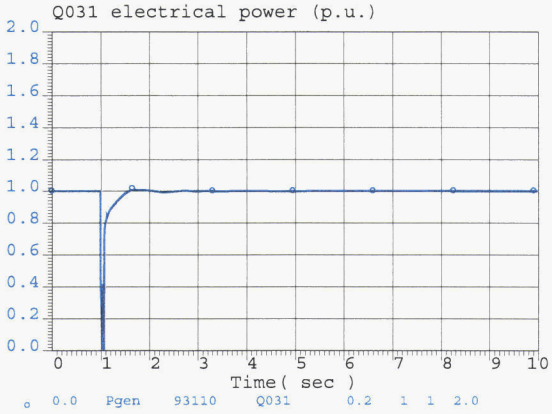
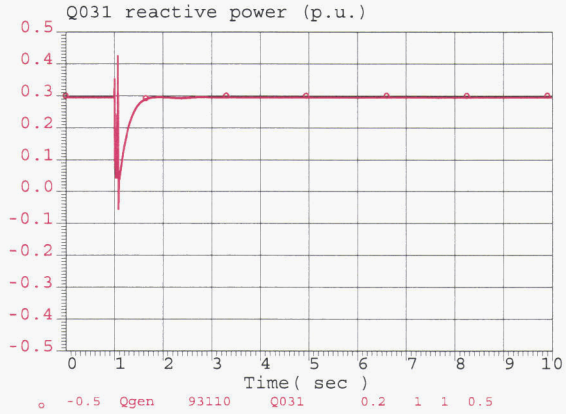
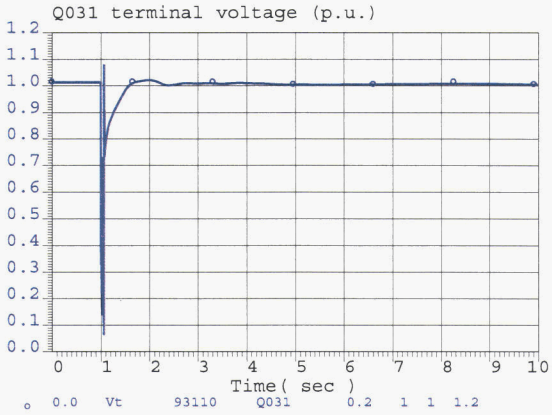
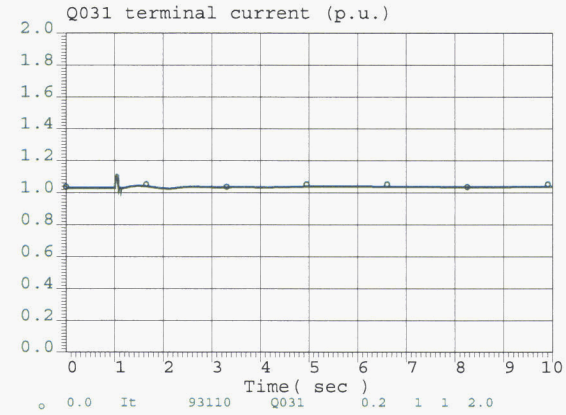
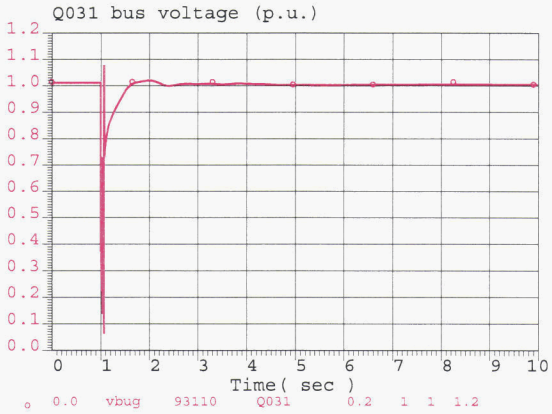
Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots

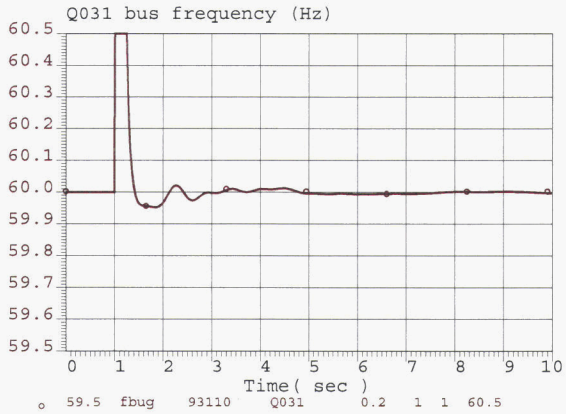






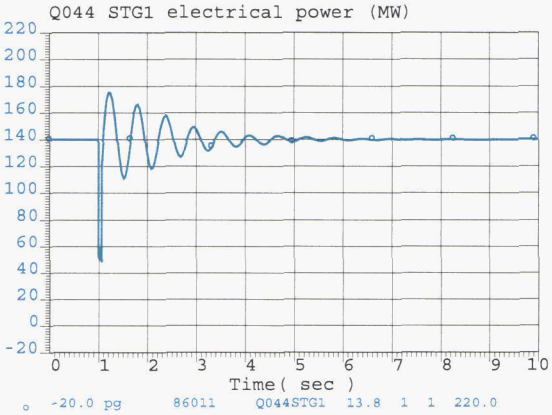


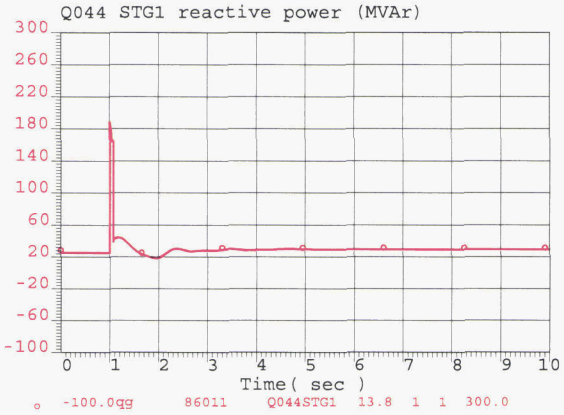


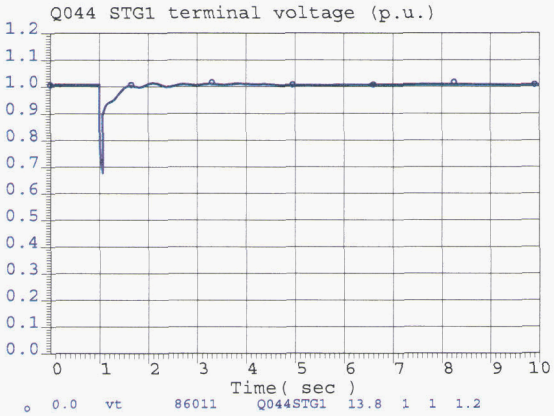


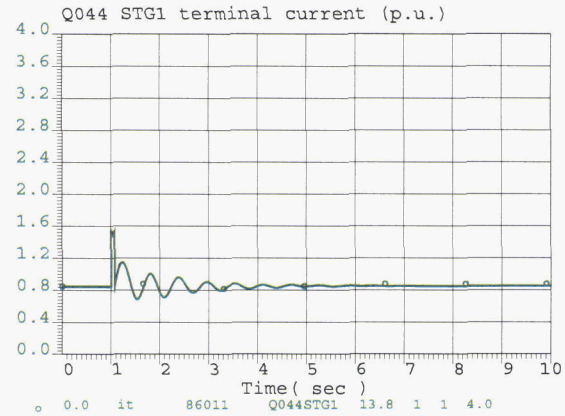
2011 Heavy Summer Power Flow/Transient Stability Case
Gila Bend/Gila River Cluster SIS Post-Project R3 Case 1 Q031(102MW)&Q044(280 MW
3-phase 4 cycle flt. @ Jojoba 500 kV, trip Jojoba-Kyrene 500 kV

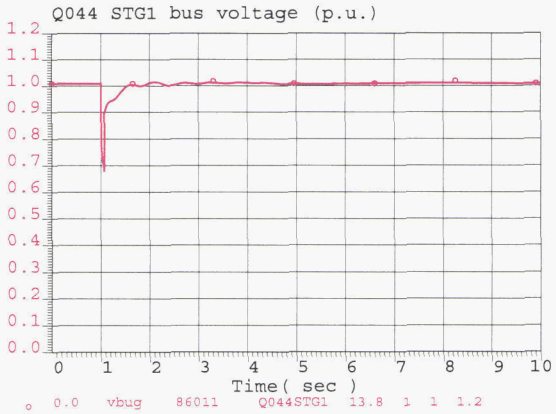
Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots

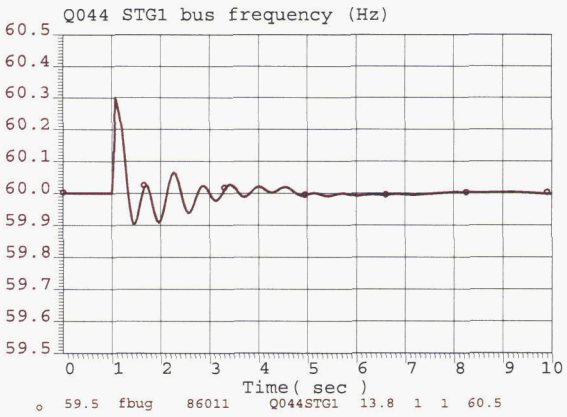












2011 Heavy Summer Power Flow/Transient Stability Case
Gila Bend/Gila River Cluster SIS Post-Project R3 Case 1 Q031(102MW)&Q044(280 MW
3-phase 4 cycle flt. @ Jojoba 500 kV, trip Jojoba-Kyrene 500 kV

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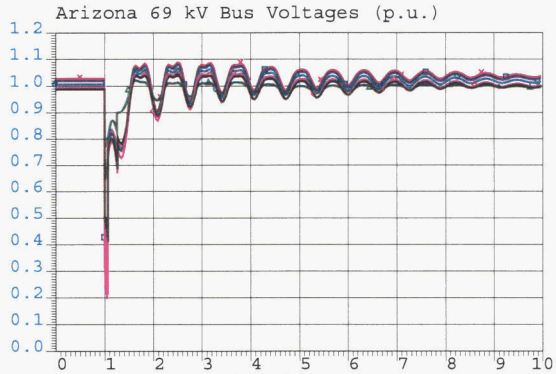
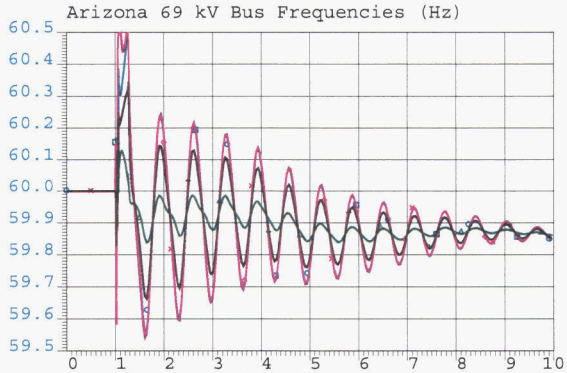
Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots

Arizona 69 kV Bus Voltages (p.u.)



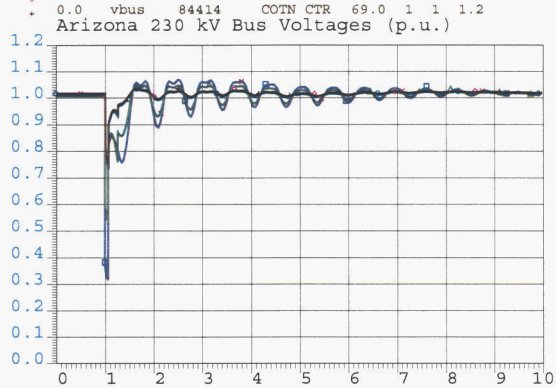
0.0	vbus	84419	GILABEND	69.0	1	1	1.2
0.0	vbus	84432	PALOMA	69.0	1	1	1.2
0.0	vbus	84411	BUNYAN	69.0	1	1	1.2
0.0	vbus	84442	SADDLEMT	69.0	1	1	1.2
0.0	vbus	84460	HY1	69.0	1	1	1.2
0.0	vbus	84414	COTN CTR	69.0	1	1	1.2

Arizona 69 kV Bus Frequencies (Hz)



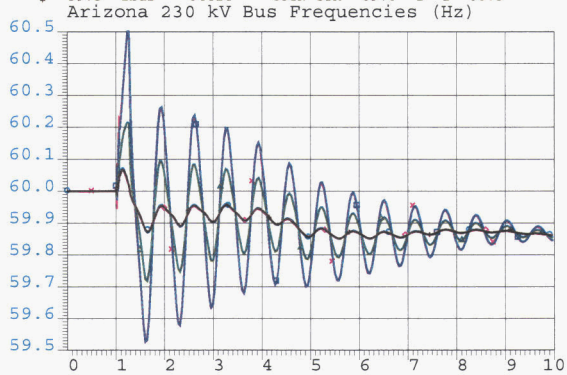
59.5	fbus	84419	GILABEND	69.0	1	1	60.5
59.5	fbus	84432	PALOMA	69.0	1	1	60.5
59.5	fbus	84411	BUNYAN	69.0	1	1	60.5
59.5	fbus	84442	SADDLEMT	69.0	1	1	60.5
59.5	fbus	84460	HY1	69.0	1	1	60.5
59.5	fbus	84414	COTN CTR	69.0	1	1	60.5

Arizona 230 kV Bus Voltages (p.u.)



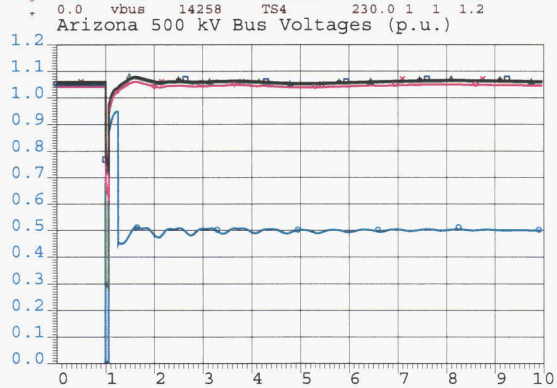
0.0	vbul	14201	BUCKEYE	230.0	1	1	1.2
0.0	vbul	14235	GILABEND	230.0	1	1	1.2
0.0	vbus	14238	GILARIVR	230.0	1	1	1.2
0.0	vbus	14224	JOJOBA	230.0	1	1	1.2
0.0	vbus	19052	LIBERTY	230.0	1	1	1.2
0.0	vbus	14258	TS4	230.0	1	1	1.2

Arizona 230 kV Bus Frequencies (Hz)



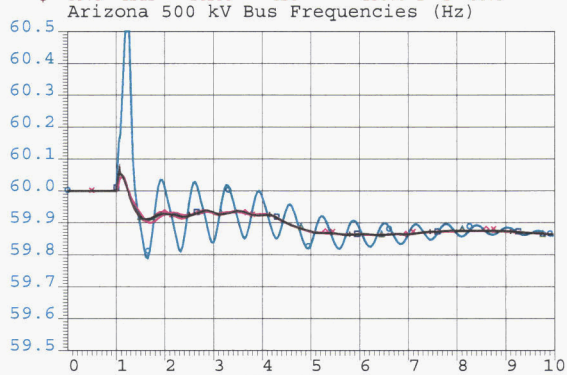
59.5	fbul	14201	BUCKEYE	230.0	1	1	60.5
59.5	fbul	14235	GILABEND	230.0	1	1	60.5
59.5	fbus	14238	GILARIVR	230.0	1	1	60.5
59.5	fbus	14224	JOJOBA	230.0	1	1	60.5
59.5	fbus	19052	LIBERTY	230.0	1	1	60.5
59.5	fbus	14258	TS4	230.0	1	1	60.5

Arizona 500 kV Bus Voltages (p.u.)



0.0	vbus	14007	GILARIVR	500.0	1	1	1.2
0.0	vbus	15093	HARQUAHA	500.0	1	1	1.2
0.0	vbus	15090	HASSYAMP	500.0	1	1	1.2
0.0	vbus	15089	JOJOBA	500.0	1	1	1.2
0.0	vbus	15011	KYRENE	500.0	1	1	1.2
0.0	vbus	15021	PALOVRDE	500.0	1	1	1.2

Arizona 500 kV Bus Frequencies (Hz)



59.5	fbus	14007	GILARIVR	500.0	1	1	60.5
59.5	fbus	15093	HARQUAHA	500.0	1	1	60.5
59.5	fbus	15090	HASSYAMP	500.0	1	1	60.5
59.5	fbus	15089	JOJOBA	500.0	1	1	60.5
59.5	fbus	15011	KYRENE	500.0	1	1	60.5
59.5	fbus	15021	PALOVRDE	500.0	1	1	60.5

2011 Heavy Summer Power Flow/Transient Stability Case
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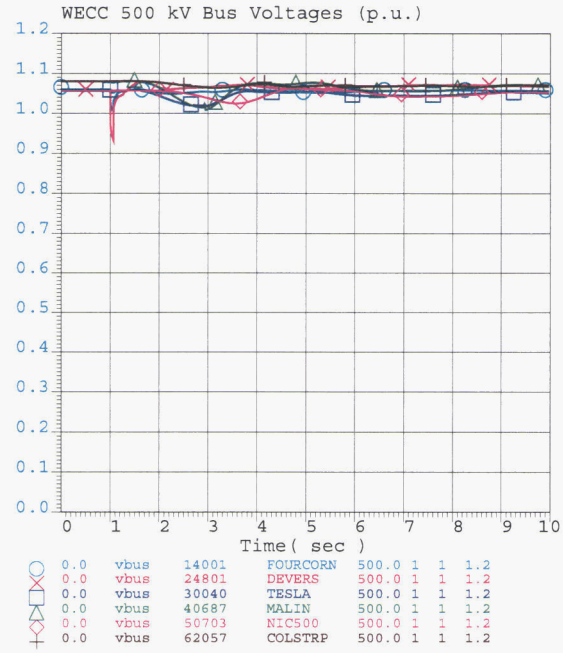
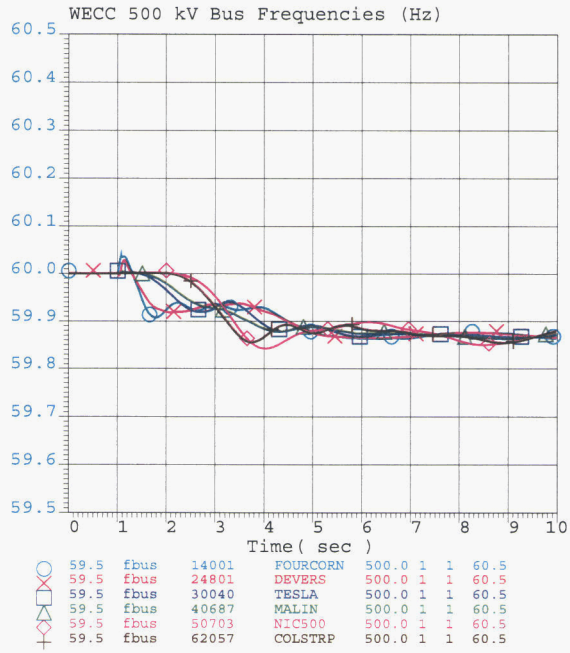
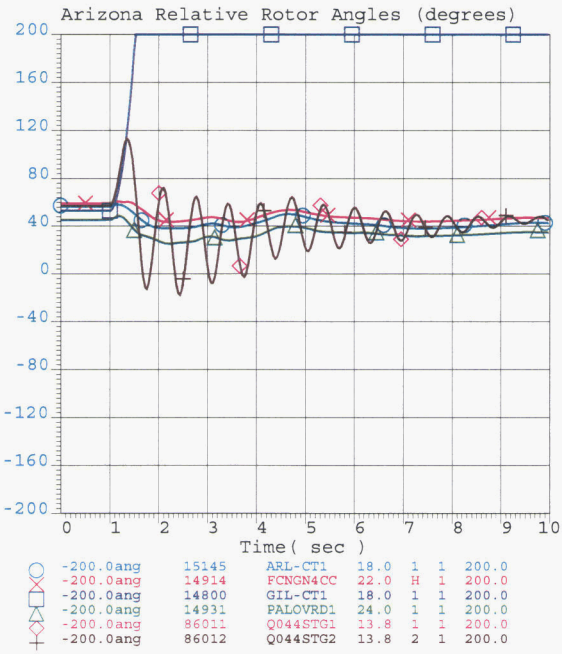
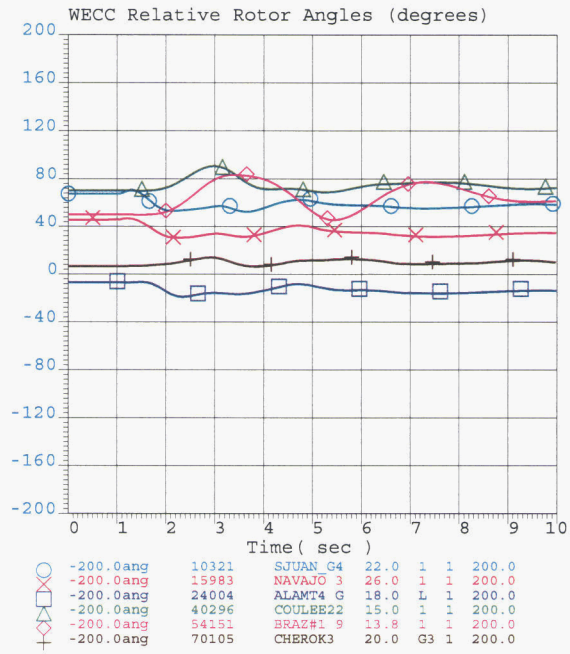
Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots









2011 Heavy Summer Power Flow/Transient Stability Case
Gila Bend/Gila River Cluster SIS Post-Project R3 Case 1 Q031(102MW)&Q044(280 MW
3-phase 4 cycle flt. @ Gila River 500 kV, trip Gila River-Jojoba 1 & 2 500 kV

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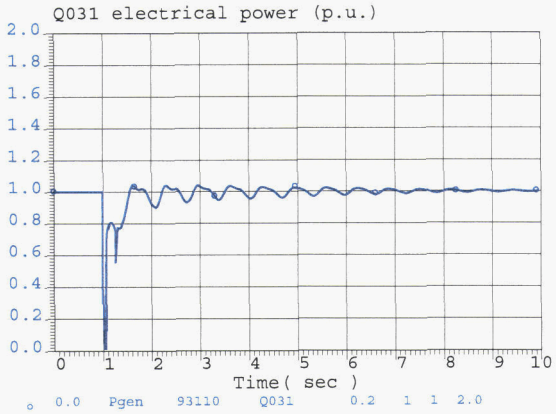
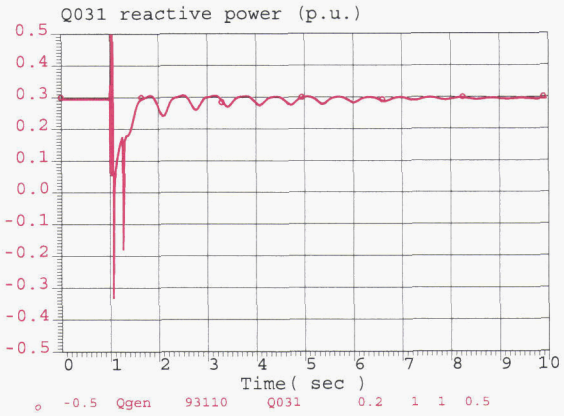
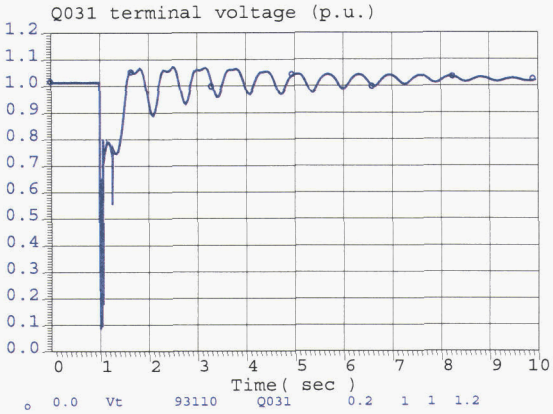
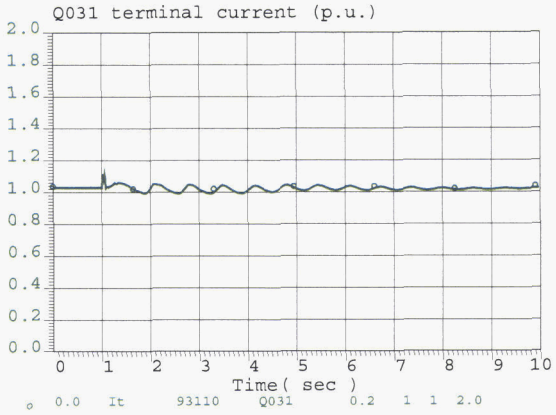
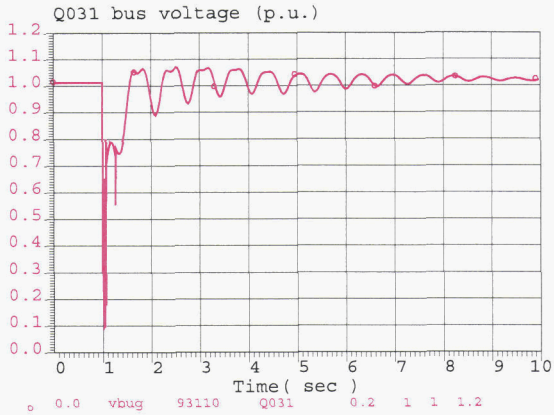
Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots

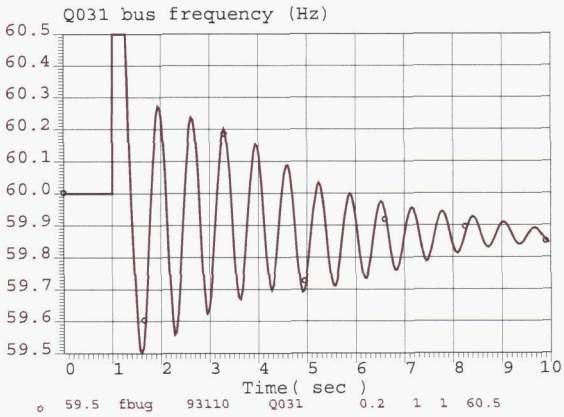












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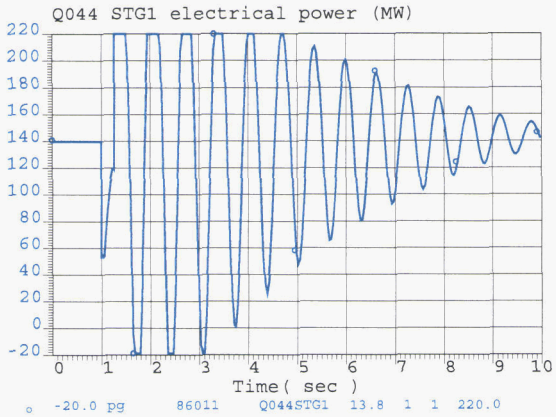
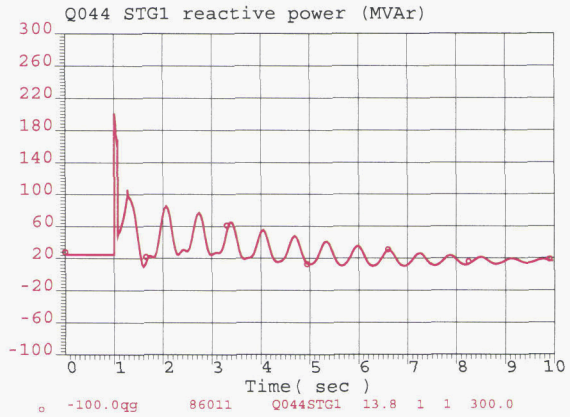
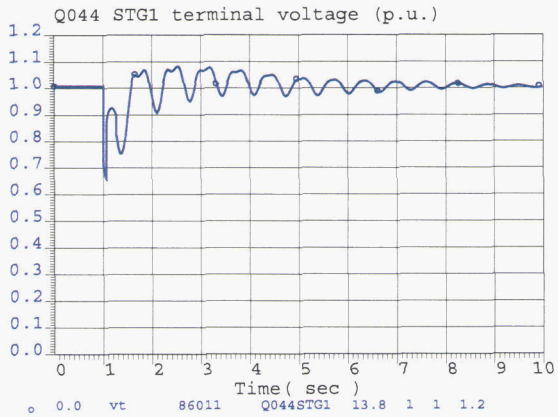
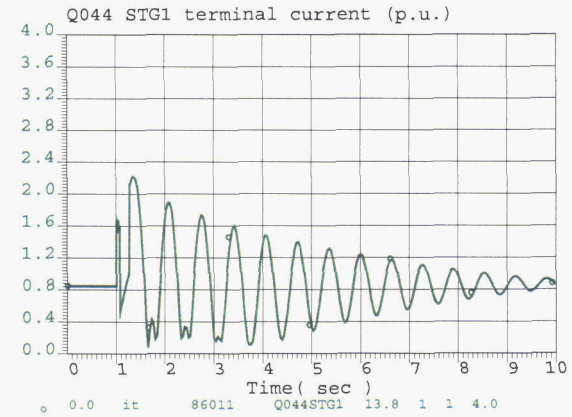
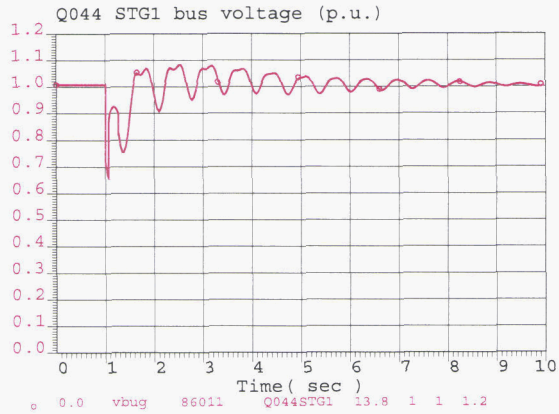
Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots

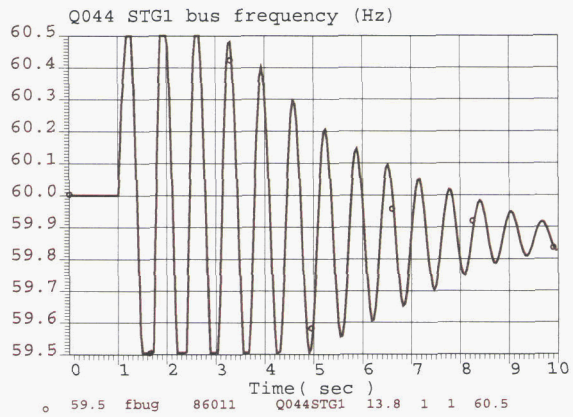












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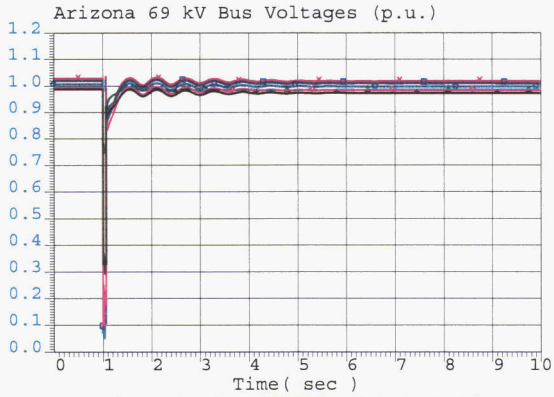
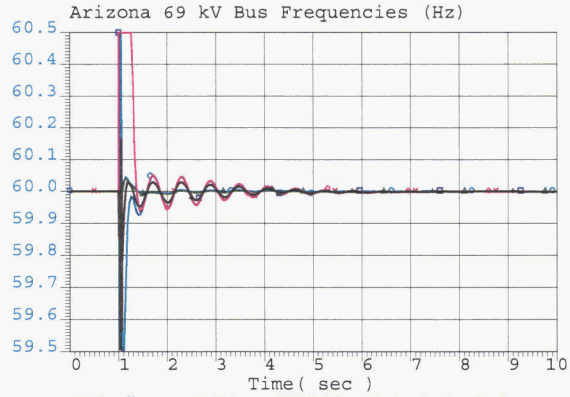
Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots

Arizona 69 kV Bus Voltages (p.u.)



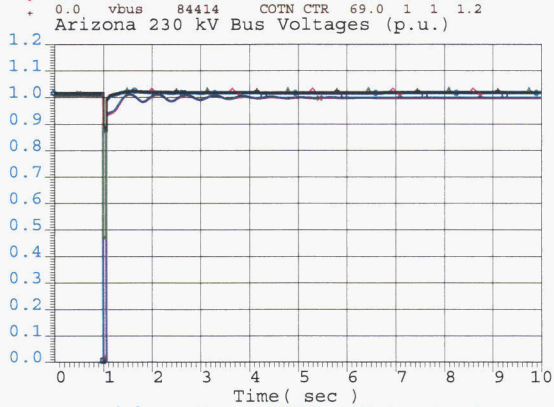
0.0	vbus	84419	GILABEND	69.0	1	1	1.2
0.0	vbus	84432	PALOMA	69.0	1	1	1.2
0.0	vbus	84411	BUNYAN	69.0	1	1	1.2
0.0	vbus	84442	SADDLEMT	69.0	1	1	1.2
0.0	vbus	84460	HY1	69.0	1	1	1.2
0.0	vbus	84414	COTN CTR	69.0	1	1	1.2

Arizona 69 kV Bus Frequencies (Hz)



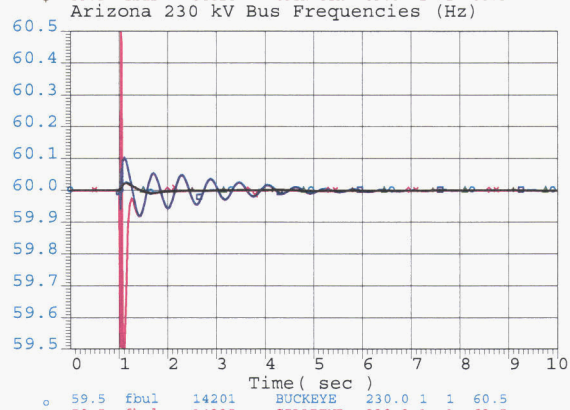
59.5	fbus	84419	GILABEND	69.0	1	1	60.5
59.5	fbus	84432	PALOMA	69.0	1	1	60.5
59.5	fbus	84411	BUNYAN	69.0	1	1	60.5
59.5	fbus	84442	SADDLEMT	69.0	1	1	60.5
59.5	fbus	84460	HY1	69.0	1	1	60.5
59.5	fbus	84414	COTN CTR	69.0	1	1	60.5

Arizona 230 kV Bus Voltages (p.u.)



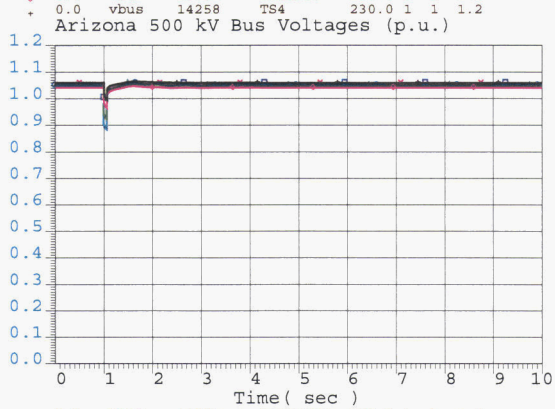
0.0	vbul	14201	BUCKEYE	230.0	1	1	1.2
0.0	vbul	14235	GILABEND	230.0	1	1	1.2
0.0	vbus	14238	GILARIVR	230.0	1	1	1.2
0.0	vbus	14224	JOJOBA	230.0	1	1	1.2
0.0	vbus	19052	LIBERTY	230.0	1	1	1.2
0.0	vbus	14258	TS4	230.0	1	1	1.2

Arizona 230 kV Bus Frequencies (Hz)



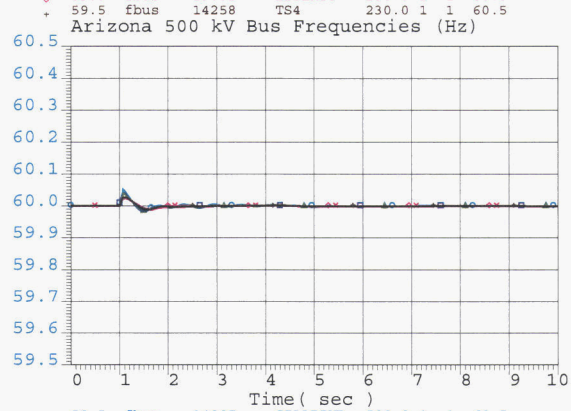
59.5	fbul	14201	BUCKEYE	230.0	1	1	60.5
59.5	fbul	14235	GILABEND	230.0	1	1	60.5
59.5	fbus	14238	GILARIVR	230.0	1	1	60.5
59.5	fbus	14224	JOJOBA	230.0	1	1	60.5
59.5	fbus	19052	LIBERTY	230.0	1	1	60.5
59.5	fbus	14258	TS4	230.0	1	1	60.5

Arizona 500 kV Bus Voltages (p.u.)



0.0	vbus	14007	GILARIVR	500.0	1	1	1.2
0.0	vbus	15093	HARQUAHA	500.0	1	1	1.2
0.0	vbus	15090	HASSYAMP	500.0	1	1	1.2
0.0	vbus	15089	JOJOBA	500.0	1	1	1.2
0.0	vbus	15011	KYRENE	500.0	1	1	1.2
0.0	vbus	15021	PALOVRDE	500.0	1	1	1.2

Arizona 500 kV Bus Frequencies (Hz)



59.5	fbus	14007	GILARIVR	500.0	1	1	60.5
59.5	fbus	15093	HARQUAHA	500.0	1	1	60.5
59.5	fbus	15090	HASSYAMP	500.0	1	1	60.5
59.5	fbus	15089	JOJOBA	500.0	1	1	60.5
59.5	fbus	15011	KYRENE	500.0	1	1	60.5
59.5	fbus	15021	PALOVRDE	500.0	1	1	60.5

2011 Heavy Summer Power Flow/Transient Stability Case
Gila Bend/Gila River Cluster SIS Post-Project R3 Case 1 Q031(102MW)&Q044(280 MW
3-phase 4 cycle flt. @ Gila River 230 kV, trip Gila River-Jojoba 230 kV

11hs-gbgr-r3-pst1-dyn_swt07-gilariver-jojoba230-slo.chf

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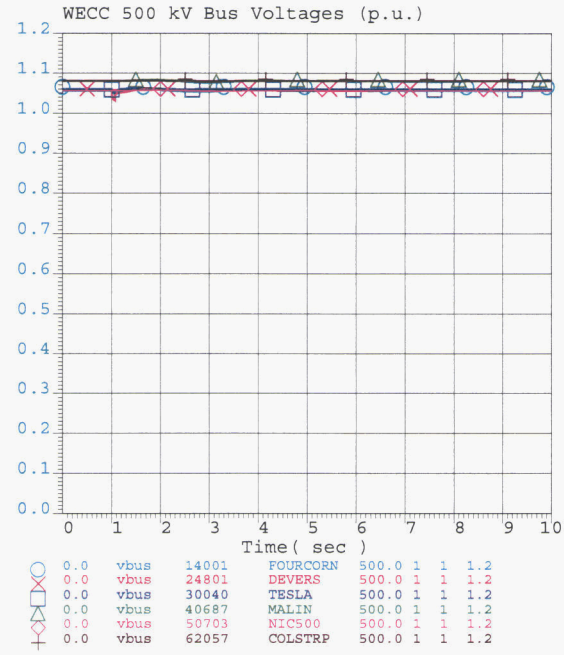
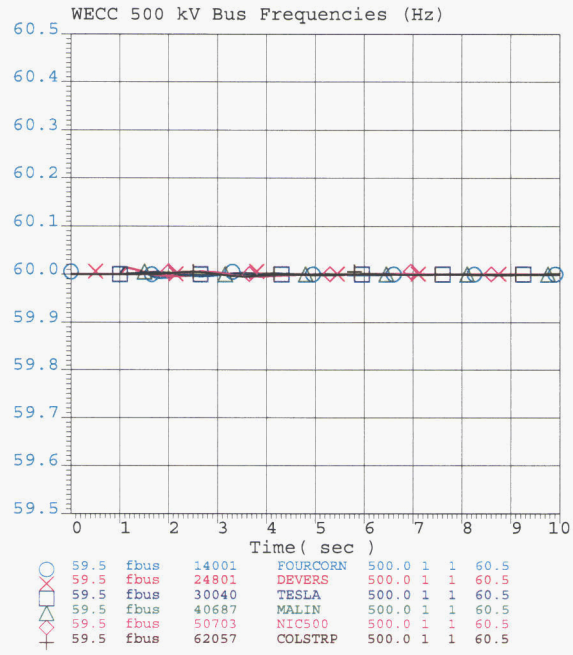
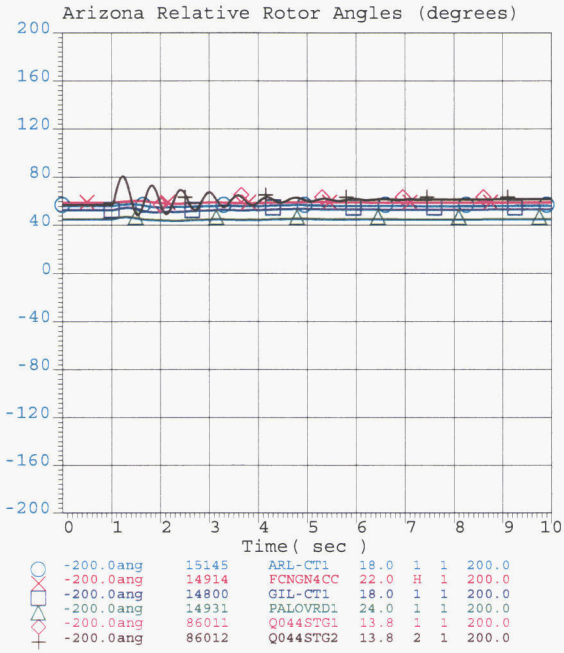
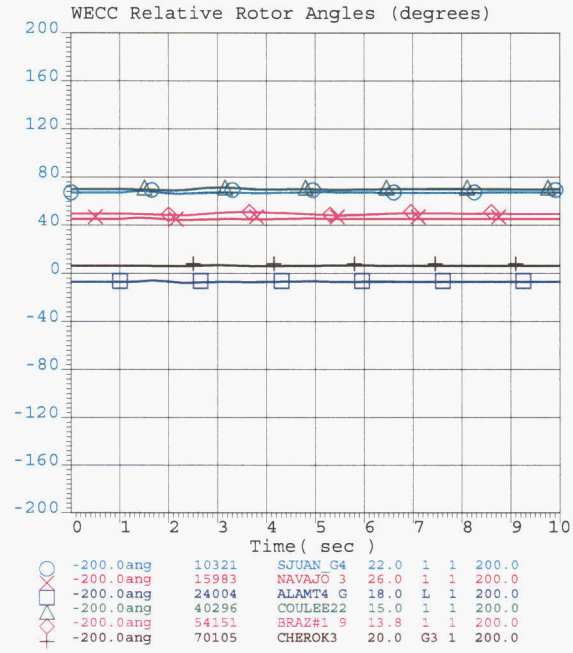
Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots





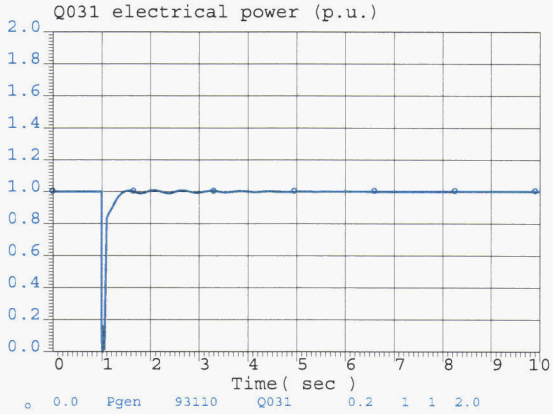


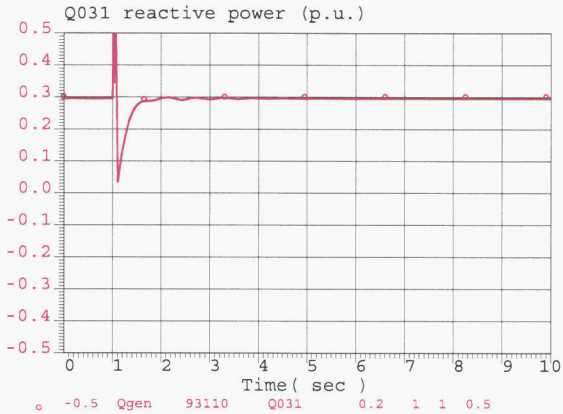


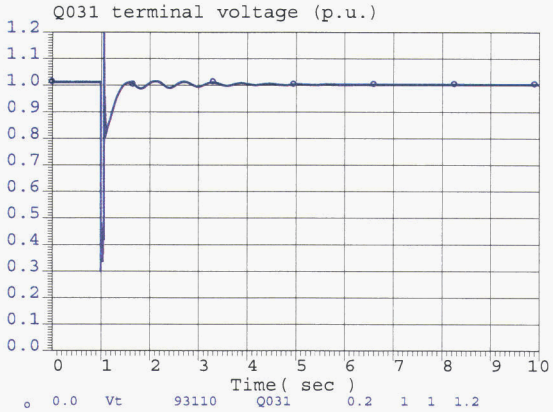
2011 Heavy Summer Power Flow/Transient Stability Case
Gila Bend/Gila River Cluster SIS Post-Project R3 Case 1 Q031(102MW)&Q044(280 MW
3-phase 4 cycle flt. @ Gila River 230 kV, trip Gila River-Jojoba 230 kV

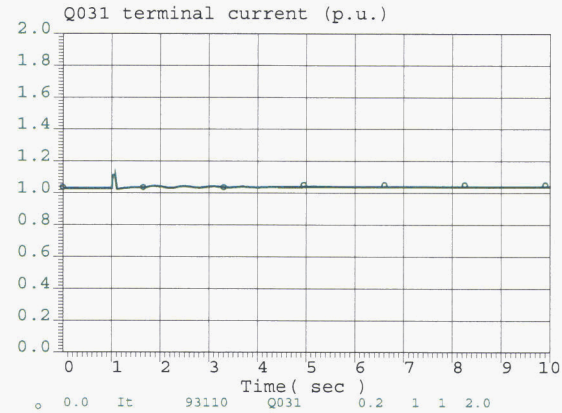
APS	11hs-gbgr-r3-pst1-dyn_swt07-gilariver-jojoba230-slo.chf	c:\work\aps\gbgr\sis\dyn Wed Jun 17 13:34:34 2009

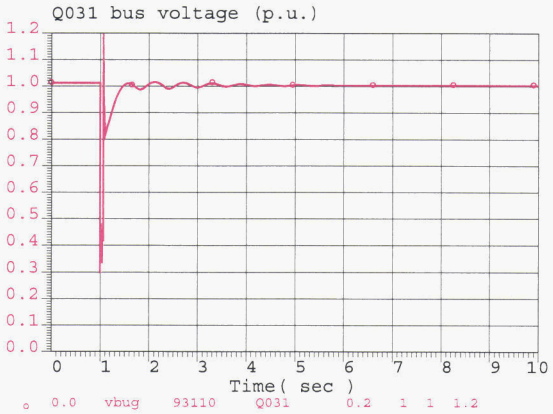
Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots

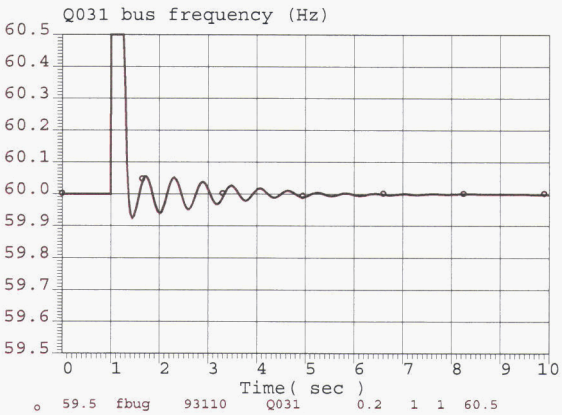






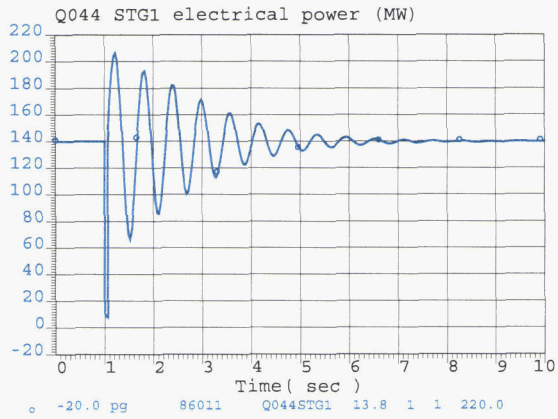


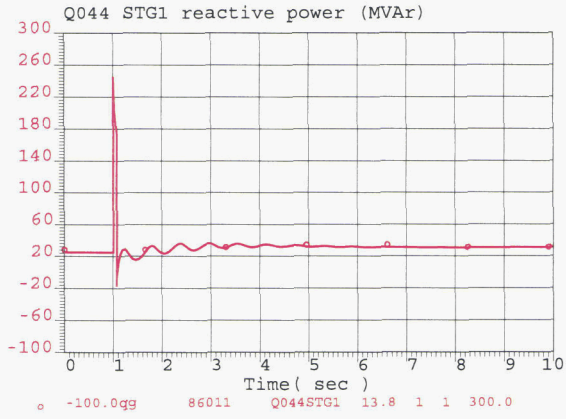


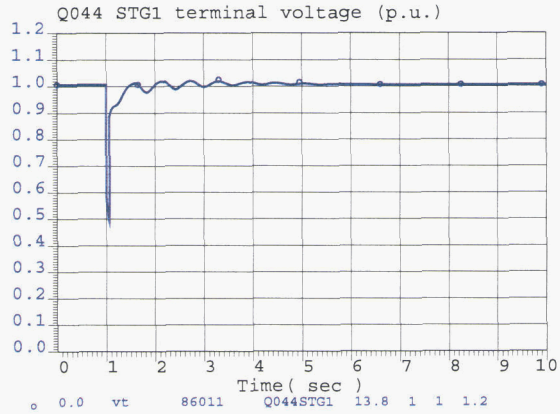


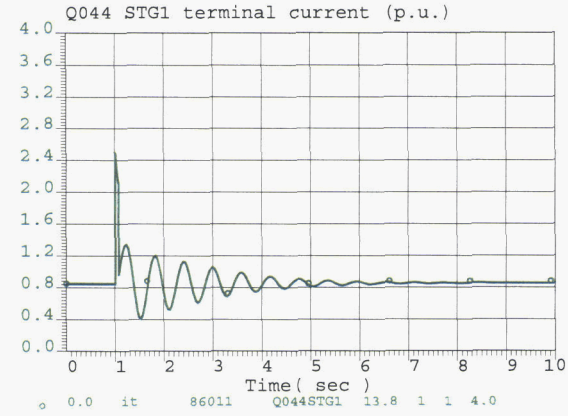
2011 Heavy Summer Power Flow/Transient Stability Case
Gila Bend/Gila River Cluster SIS Post-Project R3 Case 1 Q031(102MW)&Q044(280 MW
3-phase 4 cycle flt. @ Gila River 230 kV, trip Gila River-Jojoba 230 kV

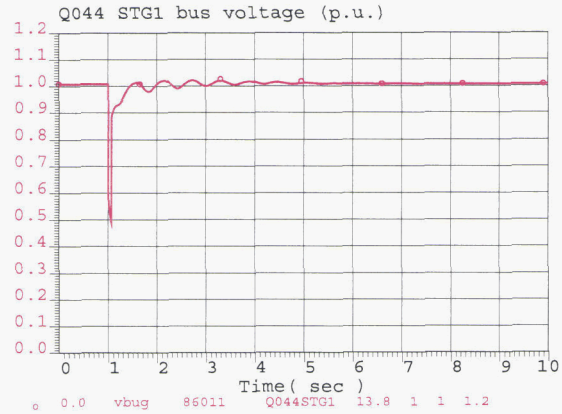
Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots

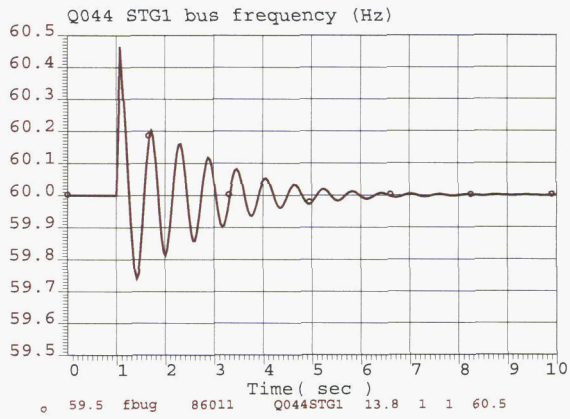








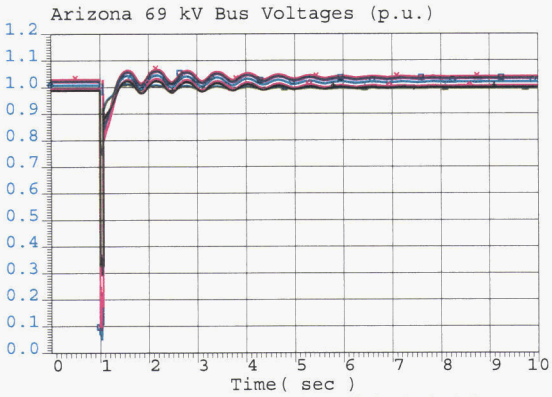




2011 Heavy Summer Power Flow/Transient Stability Case
Gila Bend/Gila River Cluster SIS Post-Project R3 Case 1 Q031(102MW)&Q044(280 MW
3-phase 4 cycle flt. @ Gila River 230 kV, trip Gila River-Jojoba 230 kV

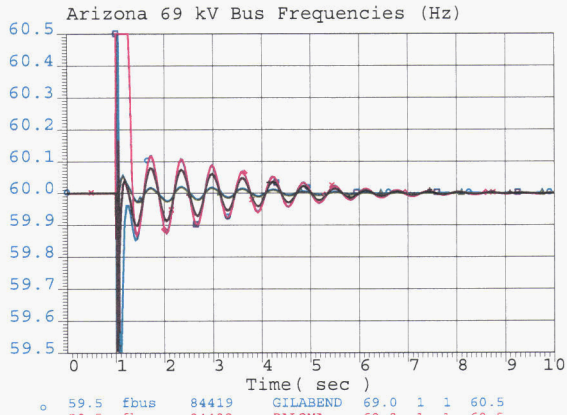
Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots

Arizona 69 kV Bus Voltages (p.u.)



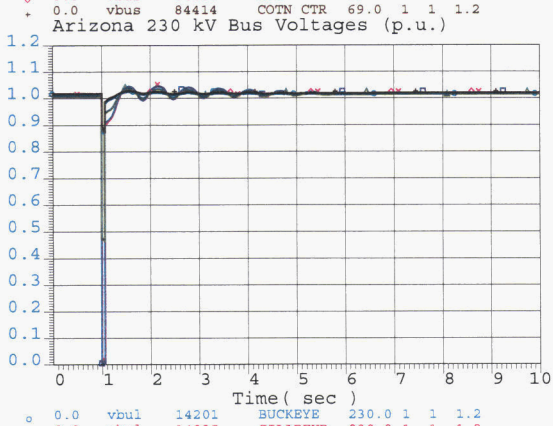
0.0	vbus	84419	GILABEND	69.0	1	1	1.2
0.0	vbus	84432	PALOMA	69.0	1	1	1.2
0.0	vbus	84411	BUNYAN	69.0	1	1	1.2
0.0	vbus	84442	SADDLEMT	69.0	1	1	1.2
0.0	vbus	84460	HY1	69.0	1	1	1.2
0.0	vbus	84414	COTN CTR	69.0	1	1	1.2

Arizona 69 kV Bus Frequencies (Hz)



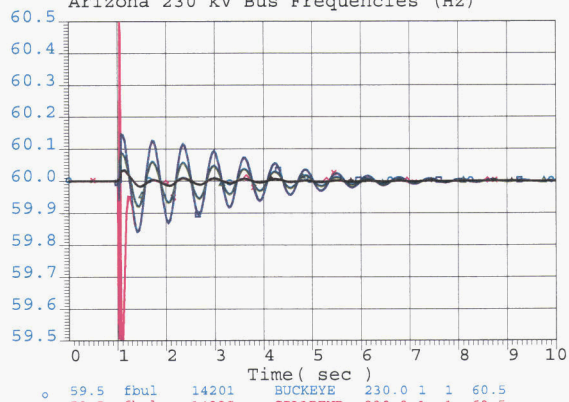
59.5	fbus	84419	GILABEND	69.0	1	1	60.5
59.5	fbus	84432	PALOMA	69.0	1	1	60.5
59.5	fbus	84411	BUNYAN	69.0	1	1	60.5
59.5	fbus	84442	SADDLEMT	69.0	1	1	60.5
59.5	fbus	84460	HY1	69.0	1	1	60.5
59.5	fbus	84414	COTN CTR	69.0	1	1	60.5

Arizona 230 kV Bus Voltages (p.u.)



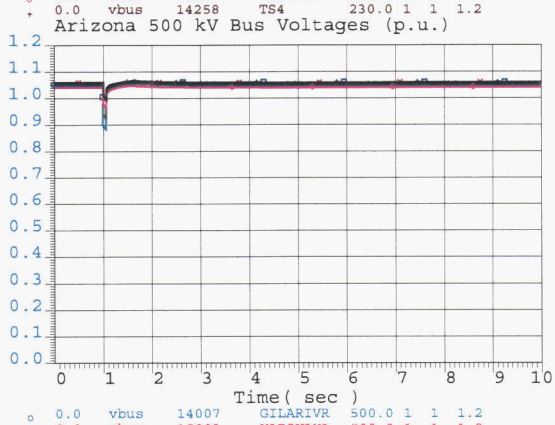
0.0	vbul	14201	BUCKEYE	230.0	1	1	1.2
0.0	vbul	14235	GILABEND	230.0	1	1	1.2
0.0	vbus	14238	GILARIVR	230.0	1	1	1.2
0.0	vbus	14224	JOJOBA	230.0	1	1	1.2
0.0	vbus	19052	LIBERTY	230.0	1	1	1.2
0.0	vbus	14258	TS4	230.0	1	1	1.2

Arizona 230 kV Bus Frequencies (Hz)



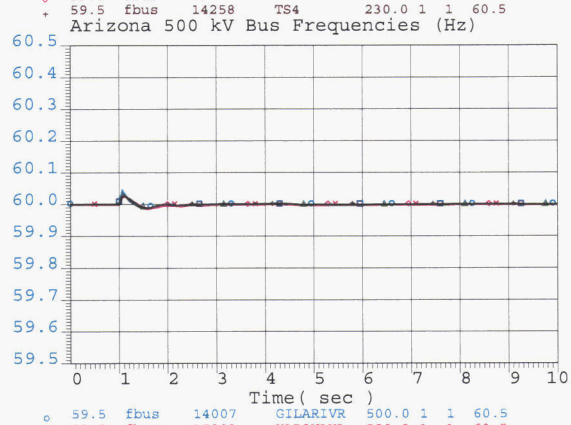
59.5	fbul	14201	BUCKEYE	230.0	1	1	60.5
59.5	fbul	14235	GILABEND	230.0	1	1	60.5
59.5	fbus	14238	GILARIVR	230.0	1	1	60.5
59.5	fbus	14224	JOJOBA	230.0	1	1	60.5
59.5	fbus	19052	LIBERTY	230.0	1	1	60.5
59.5	fbus	14258	TS4	230.0	1	1	60.5

Arizona 500 kV Bus Voltages (p.u.)



0.0	vbus	14007	GILARIVR	500.0	1	1	1.2
0.0	vbus	15093	HARQUAHA	500.0	1	1	1.2
0.0	vbus	15090	HASSYAMP	500.0	1	1	1.2
0.0	vbus	15089	JOJOBA	500.0	1	1	1.2
0.0	vbus	15011	KYRENE	500.0	1	1	1.2
0.0	vbus	15021	PALOVRDE	500.0	1	1	1.2

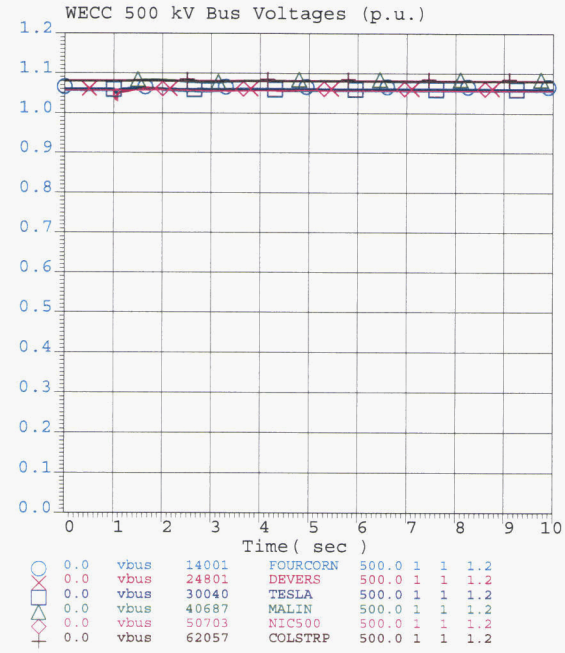
Arizona 500 kV Bus Frequencies (Hz)

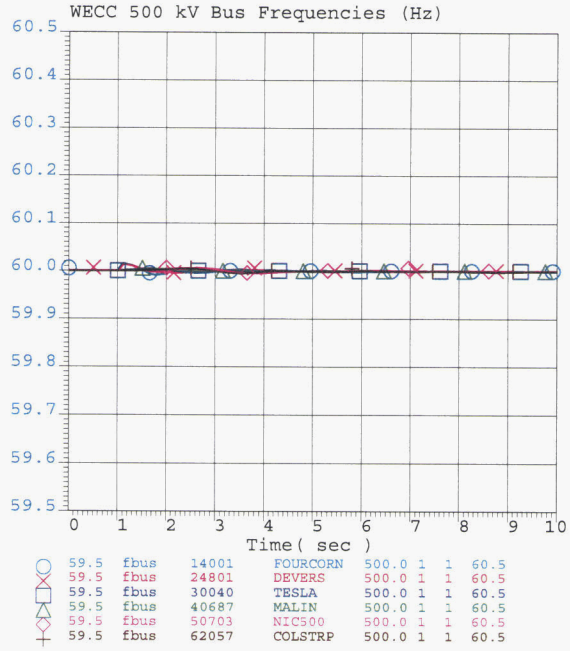


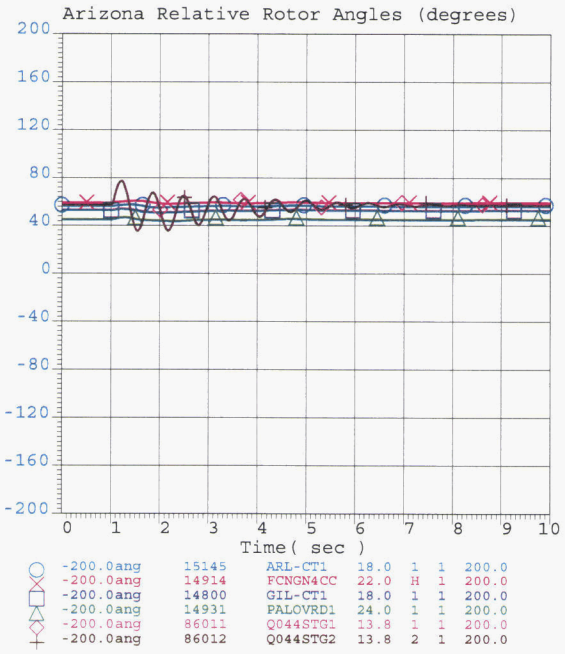
59.5	fbus	14007	GILARIVR	500.0	1	1	60.5
59.5	fbus	15093	HARQUAHA	500.0	1	1	60.5
59.5	fbus	15090	HASSYAMP	500.0	1	1	60.5
59.5	fbus	15089	JOJOBA	500.0	1	1	60.5
59.5	fbus	15011	KYRENE	500.0	1	1	60.5
59.5	fbus	15021	PALOVRDE	500.0	1	1	60.5

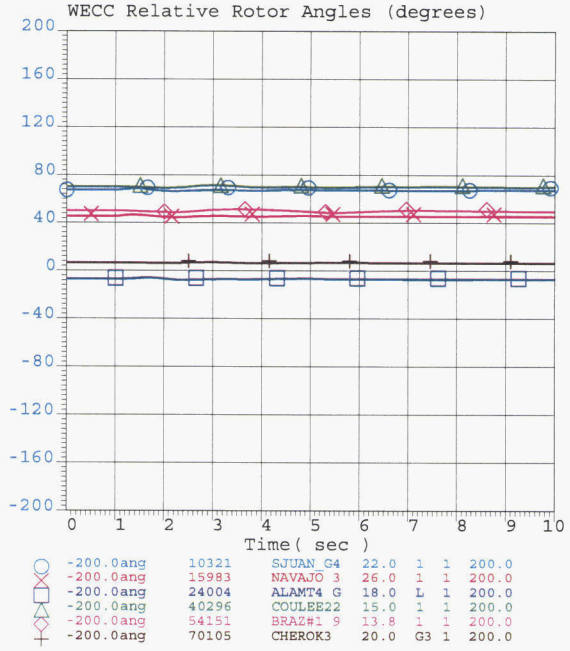
2011 Heavy Summer Power Flow/Transient Stability Case
Gila Bend/Gila River Cluster SIS Post-Project R3 Case 1 Q031(102MW)&Q044(280 MW
3-phase 4 cycle flt. @ Gila River 230 kV, trip Gila River 500/230 kV xfmr

Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots



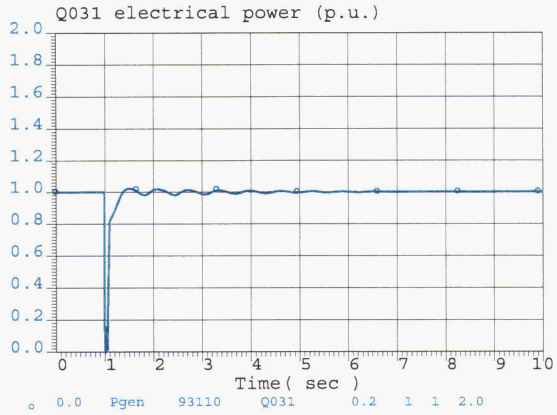


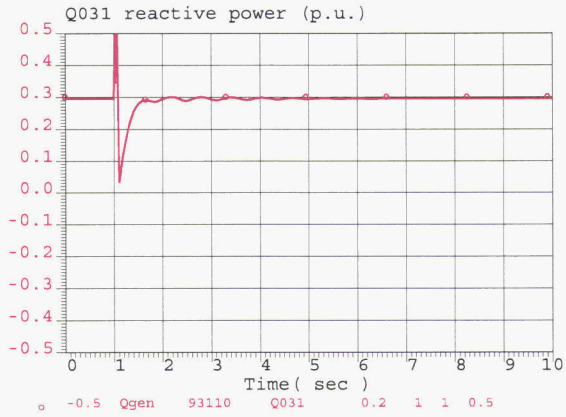


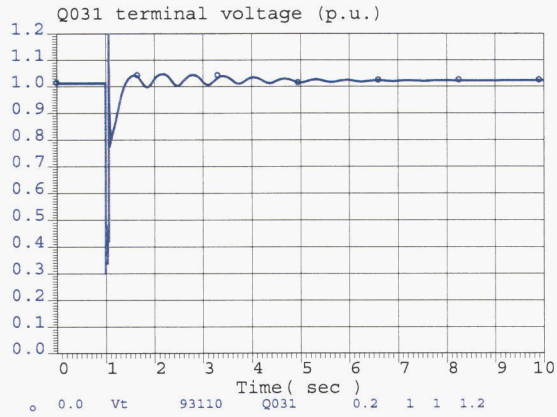


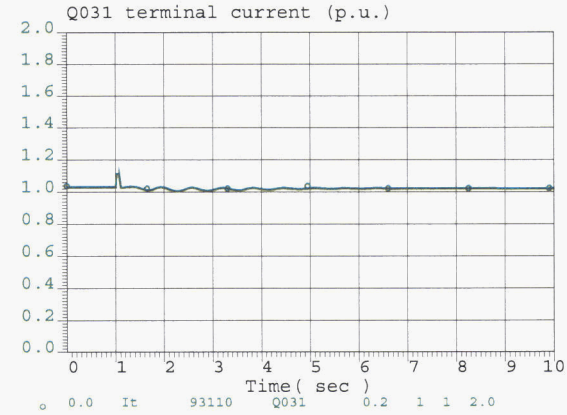
2011 Heavy Summer Power Flow/Transient Stability Case
Gila Bend/Gila River Cluster SIS Post-Project R3 Case 1 Q031(102MW)&Q044(280 MW
3-phase 4 cycle flt. @ Gila River 230 kV, trip Gila River 500/230 kV xfmr

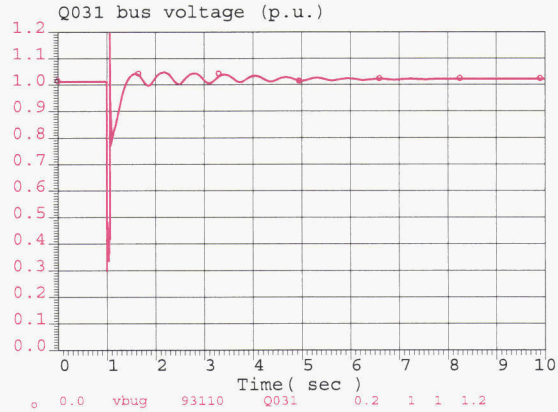
Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots

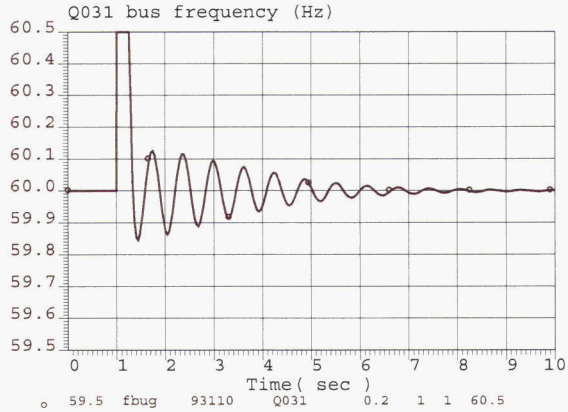






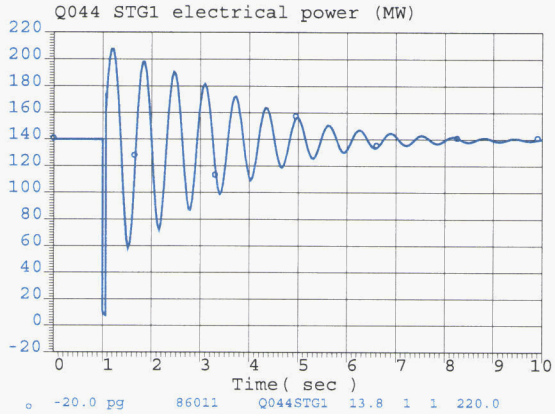


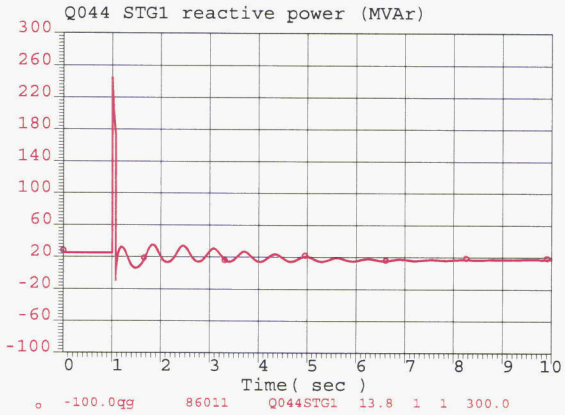


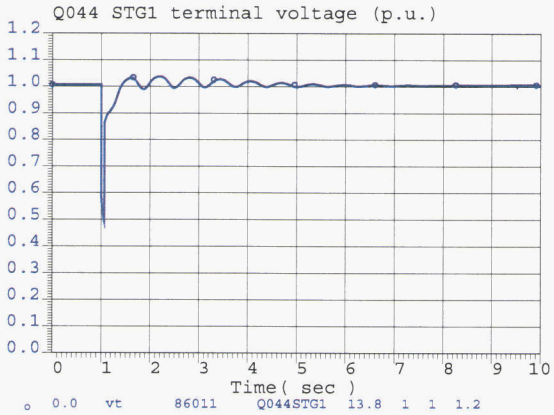


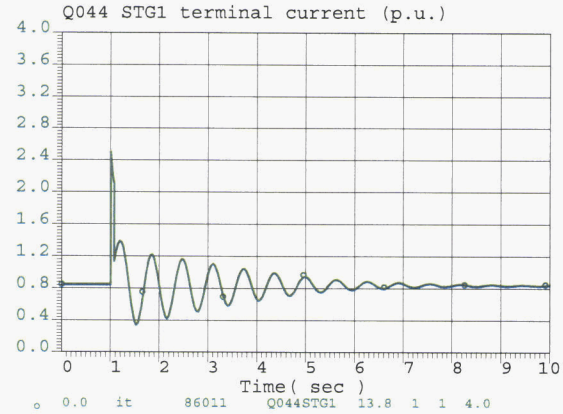
2011 Heavy Summer Power Flow/Transient Stability Case
Gila Bend/Gila River Cluster SIS Post-Project R3 Case 1 Q031(102MW)&Q044(280 MW
3-phase 4 cycle flt. @ Gila River 230 kV, trip Gila River 500/230 kV xfmr

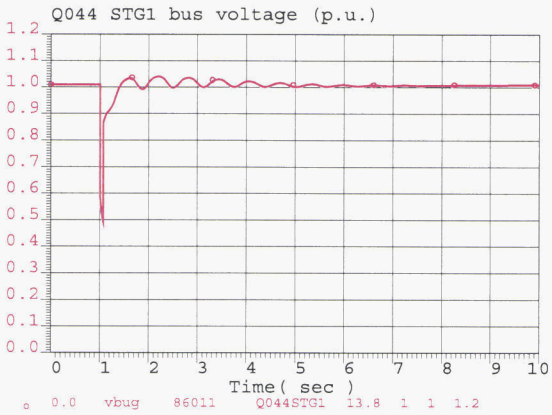
Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots

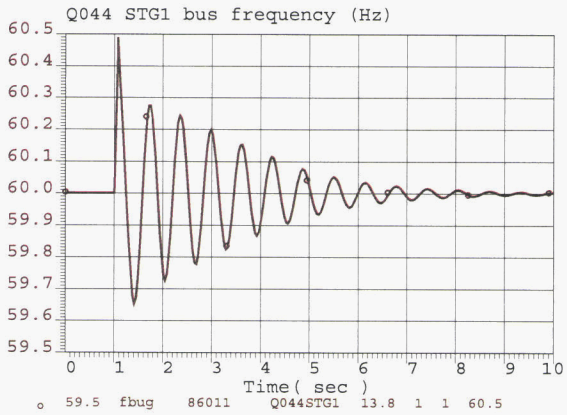








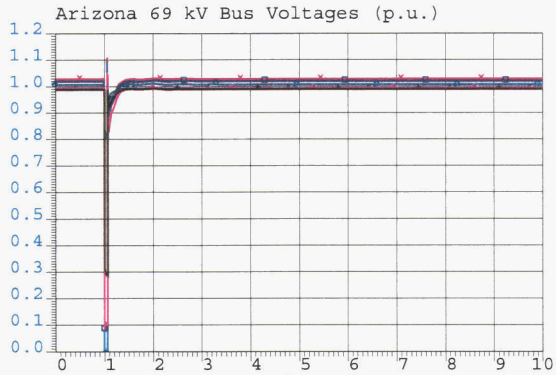




2011 Heavy Summer Power Flow/Transient Stability Case
Gila Bend/Gila River Cluster SIS Post-Project R3 Case 1 Q031(102MW)&Q044(280 MW
3-phase 4 cycle flt. @ Gila River 230 kV, trip Gila River 500/230 kV xfmr

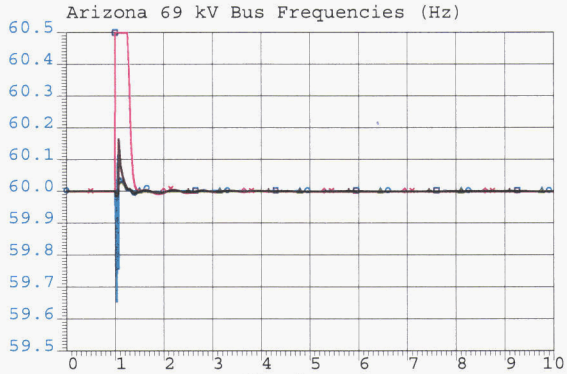
Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots

Arizona 69 kV Bus Voltages (p.u.)



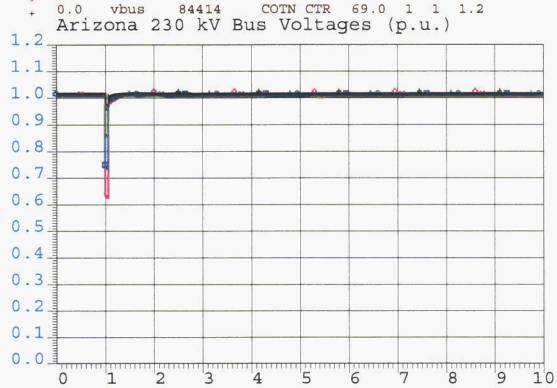
0.0	vbus	84419	GILABEND	69.0	1	1	1.2
0.0	vbus	84432	PALOMA	69.0	1	1	1.2
0.0	vbus	84411	BUNYAN	69.0	1	1	1.2
0.0	vbus	84442	SADDLEMT	69.0	1	1	1.2
0.0	vbus	84460	HY1	69.0	1	1	1.2
0.0	vbus	84414	COTN CTR	69.0	1	1	1.2

Arizona 69 kV Bus Frequencies (Hz)



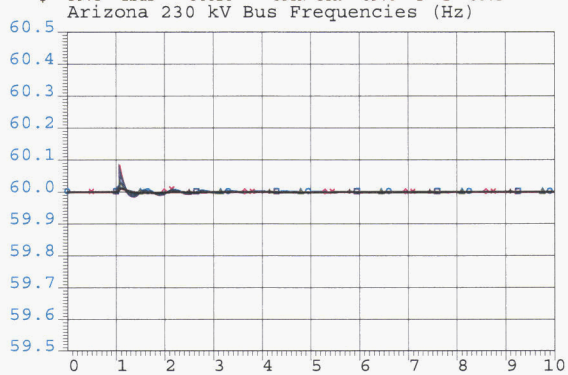
59.5	fbus	84419	GILABEND	69.0	1	1	60.5
59.5	fbus	84432	PALOMA	69.0	1	1	60.5
59.5	fbus	84411	BUNYAN	69.0	1	1	60.5
59.5	fbus	84442	SADDLEMT	69.0	1	1	60.5
59.5	fbus	84460	HY1	69.0	1	1	60.5
59.5	fbus	84414	COTN CTR	69.0	1	1	60.5

Arizona 230 kV Bus Voltages (p.u.)



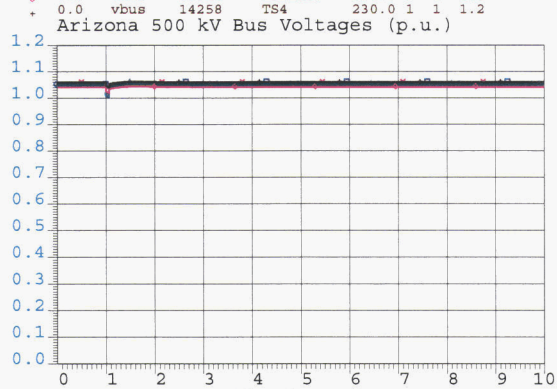
0.0	vbul	14201	BUCKEYE	230.0	1	1	1.2
0.0	vbul	14235	GILABEND	230.0	1	1	1.2
0.0	vbus	14238	GILARIVR	230.0	1	1	1.2
0.0	vbus	14224	JOJOBA	230.0	1	1	1.2
0.0	vbus	19052	LIBERTY	230.0	1	1	1.2
0.0	vbus	14258	TS4	230.0	1	1	1.2

Arizona 230 kV Bus Frequencies (Hz)



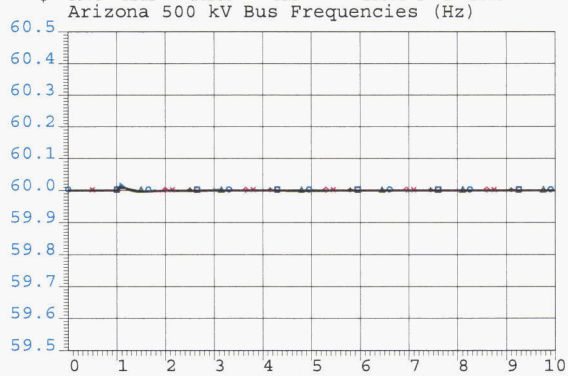
59.5	fbul	14201	BUCKEYE	230.0	1	1	60.5
59.5	fbul	14235	GILABEND	230.0	1	1	60.5
59.5	fbus	14238	GILARIVR	230.0	1	1	60.5
59.5	fbus	14224	JOJOBA	230.0	1	1	60.5
59.5	fbus	19052	LIBERTY	230.0	1	1	60.5
59.5	fbus	14258	TS4	230.0	1	1	60.5

Arizona 500 kV Bus Voltages (p.u.)



0.0	vbus	14007	GILARIVR	500.0	1	1	1.2
0.0	vbus	15093	HARQUAHA	500.0	1	1	1.2
0.0	vbus	15090	HASSYAMP	500.0	1	1	1.2
0.0	vbus	15089	JOJOBA	500.0	1	1	1.2
0.0	vbus	15011	KYRENE	500.0	1	1	1.2
0.0	vbus	15021	PALOVRDE	500.0	1	1	1.2

Arizona 500 kV Bus Frequencies (Hz)



59.5	fbus	14007	GILARIVR	500.0	1	1	60.5
59.5	fbus	15093	HARQUAHA	500.0	1	1	60.5
59.5	fbus	15090	HASSYAMP	500.0	1	1	60.5
59.5	fbus	15089	JOJOBA	500.0	1	1	60.5
59.5	fbus	15011	KYRENE	500.0	1	1	60.5
59.5	fbus	15021	PALOVRDE	500.0	1	1	60.5

2011 Heavy Summer Power Flow/Transient Stability Case
Gila Bend/Gila River Cluster SIS Post-Project R3 Case 1 Q031(102MW)&Q044(280 MW
3-phase 4 cycle flt. @ Gila Bend 69 kV, trip Gila Bend 230/69 kV xfmr 1

11hs-gbgr-r3-pst1-dyn_swt09-gilabend-230-69-xfmr1.chf

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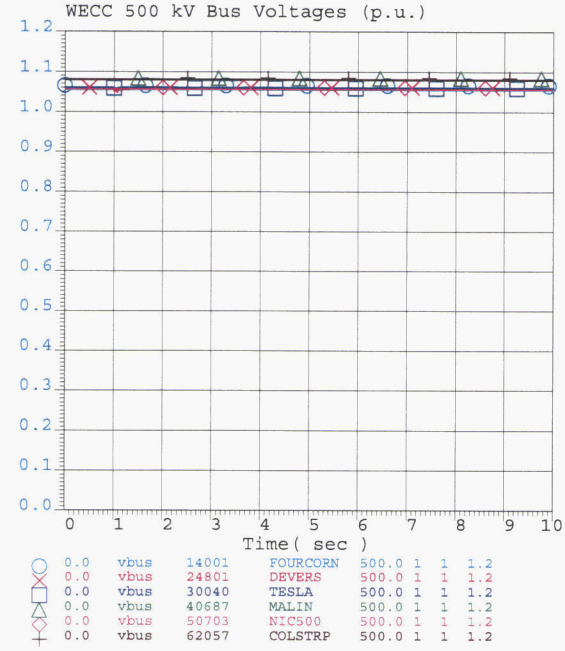
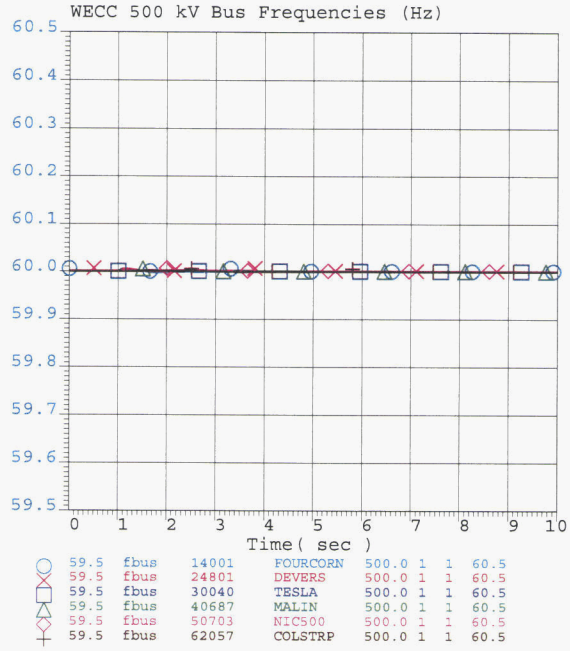
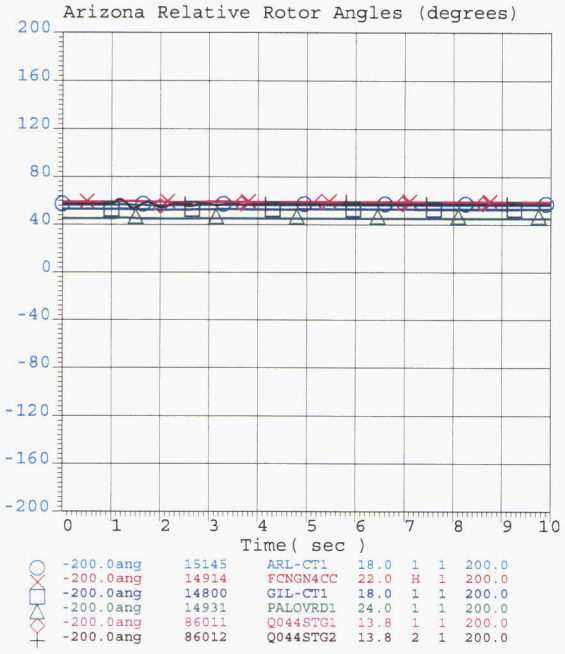
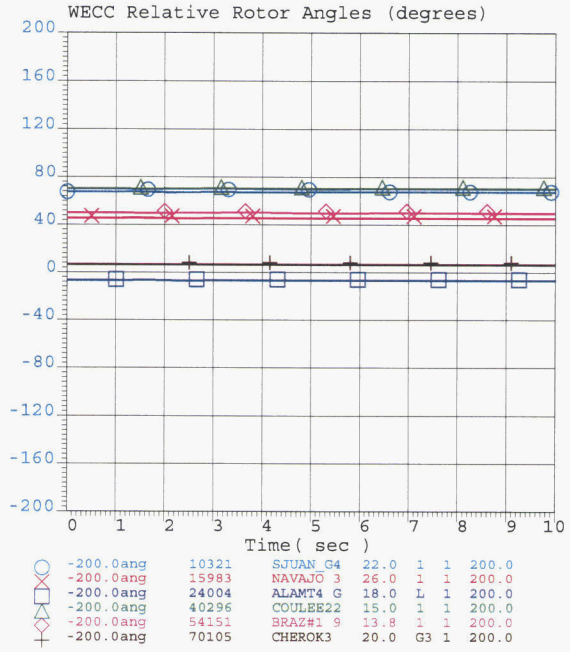
Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots





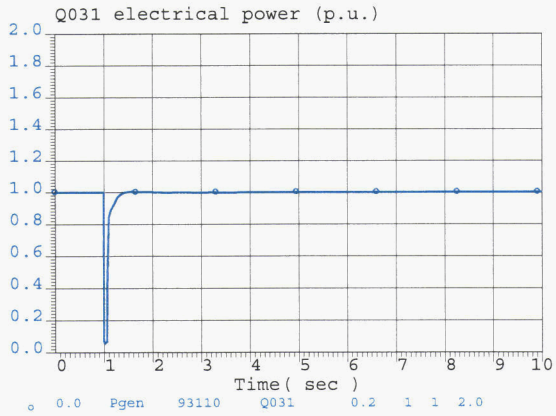


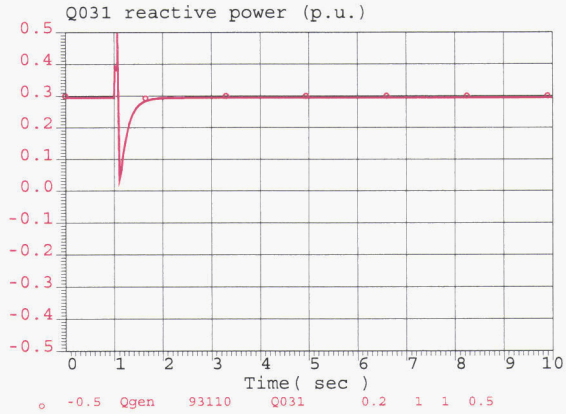


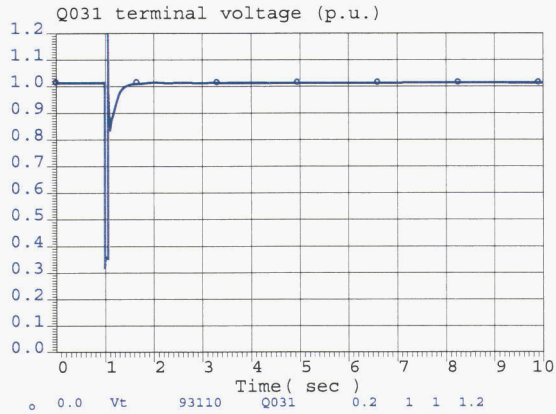
2011 Heavy Summer Power Flow/Transient Stability Case
Gila Bend/Gila River Cluster SIS Post-Project R3 Case 1 Q031(102MW)&Q044(280 MW
3-phase 4 cycle flt. @ Gila Bend 69 kV, trip Gila Bend 230/69 kV xfmr 1

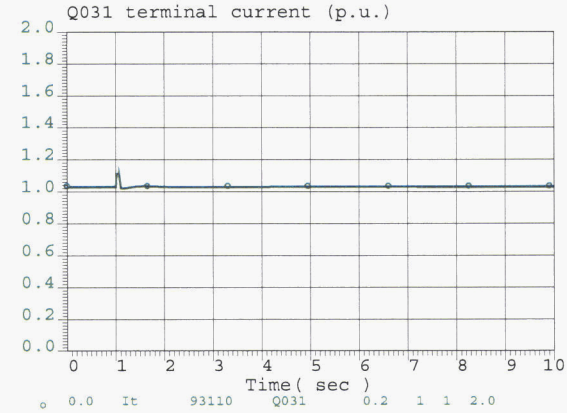
APS	11hs-gbgr-r3-pst1-dyn_swt09-gilabend-230-69-xfmr1.chf	c:\work\aps\gbgr\sis\dyn Wed Jun 17 13:35:01 2009

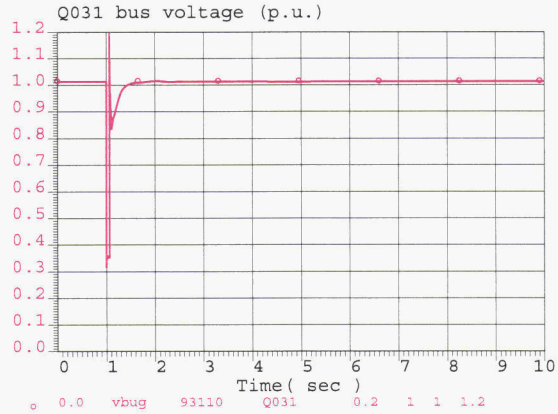
Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots

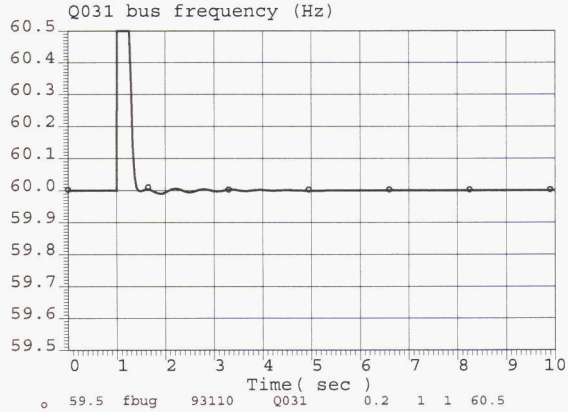








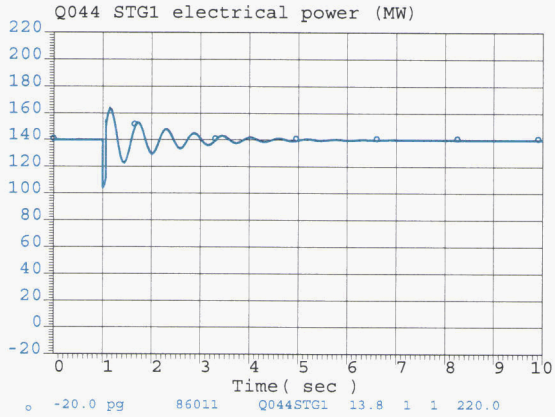


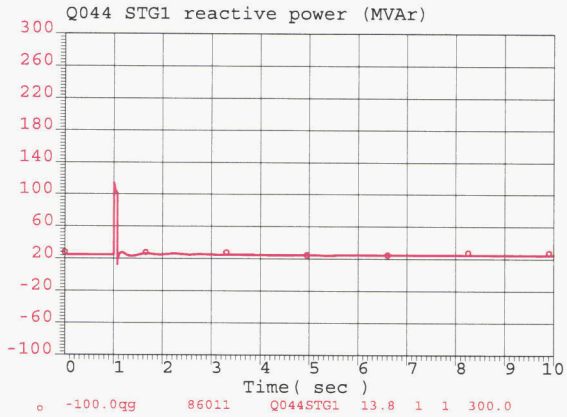


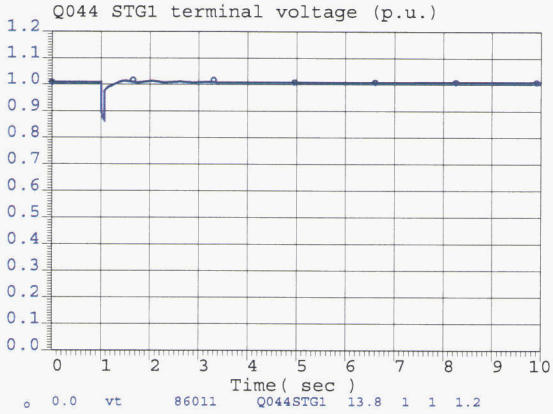
2011 Heavy Summer Power Flow/Transient Stability Case
Gila Bend/Gila River Cluster SIS Post-Project R3 Case 1 Q031(102MW)&Q044(280 MW
3-phase 4 cycle flt. @ Gila Bend 69 kV, trip Gila Bend 230/69 kV xfmr 1

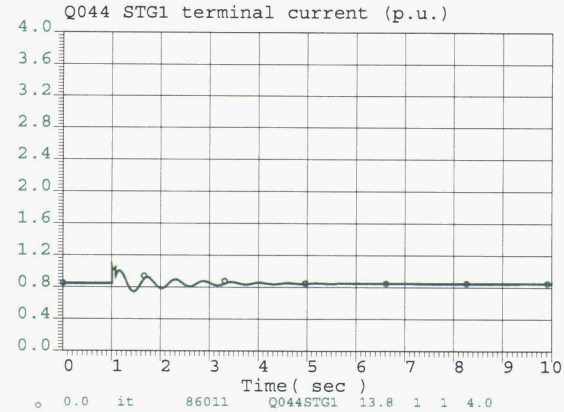
APS	11hs-gbgr-r3-pst1-dyn_swt09-gilabend-230-69-xfmr1.chf	c:\work\aps\gbgr\sis\dyn Wed Jun 17 13:35:02 2009

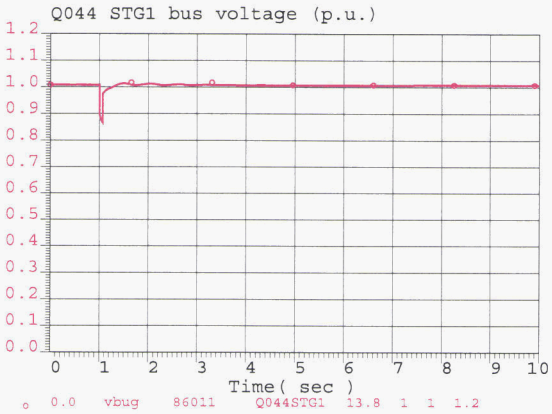
Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots

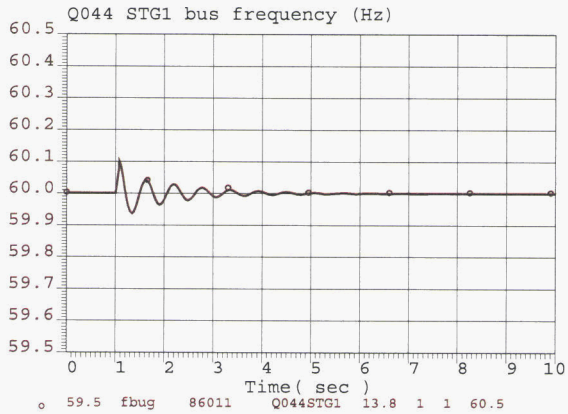










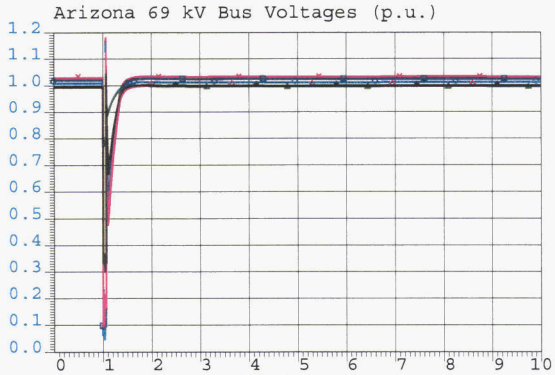


2011 Heavy Summer Power Flow/Transient Stability Case
Gila Bend/Gila River Cluster SIS Post-Project R3 Case 1 Q031(102MW)&Q044(280 MW
3-phase 4 cycle flt. @ Gila Bend 69 kV, trip Gila Bend 230/69 kV xfmr 1

APS	11hs-gbgr-r3-pst1-dyn_swt09-gilabend-230-69-xfmr1.chf	c:\work\aps\gbgr\sis\dyn Wed Jun 17 13:35:02 2009

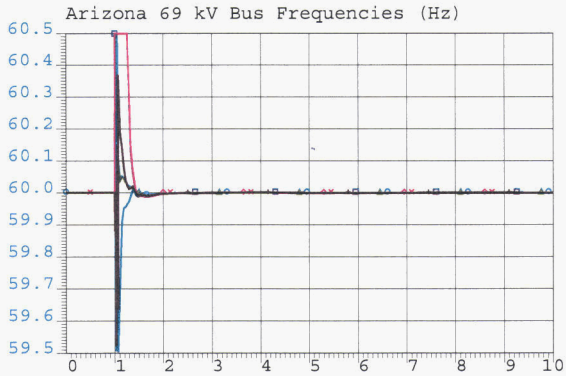
Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots

Arizona 69 kV Bus Voltages (p.u.)



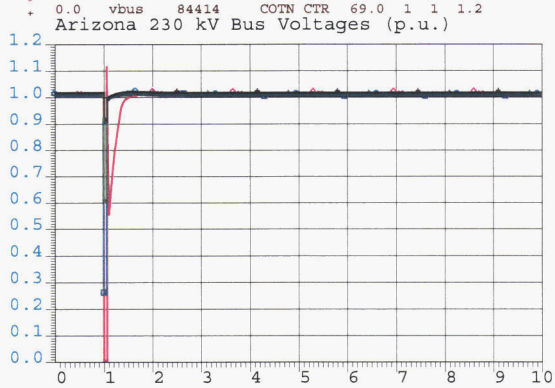
0.0	vbus	84419	GILABEND	69.0	1	1	1.2
0.0	vbus	84432	PALOMA	69.0	1	1	1.2
0.0	vbus	84411	BUNYAN	69.0	1	1	1.2
0.0	vbus	84442	SADDLEMT	69.0	1	1	1.2
0.0	vbus	84460	HY1	69.0	1	1	1.2
0.0	vbus	84414	COTN CTR	69.0	1	1	1.2

Arizona 69 kV Bus Frequencies (Hz)



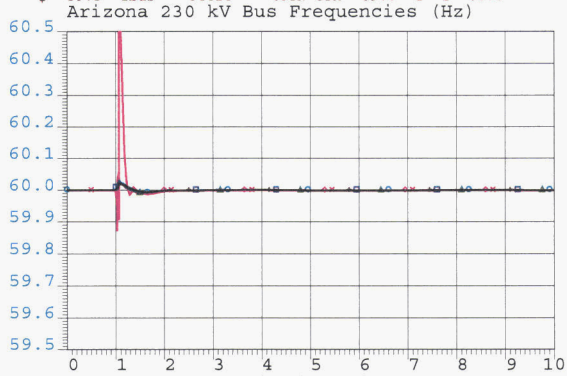
59.5	fbus	84419	GILABEND	69.0	1	1	60.5
59.5	fbus	84432	PALOMA	69.0	1	1	60.5
59.5	fbus	84411	BUNYAN	69.0	1	1	60.5
59.5	fbus	84442	SADDLEMT	69.0	1	1	60.5
59.5	fbus	84460	HY1	69.0	1	1	60.5
59.5	fbus	84414	COTN CTR	69.0	1	1	60.5

Arizona 230 kV Bus Voltages (p.u.)



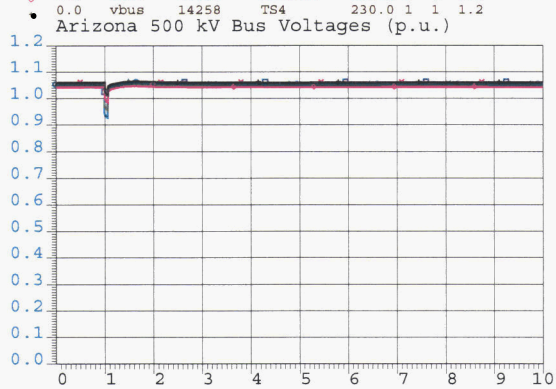
0.0	vbul	14201	BUCKEYE	230.0	1	1	1.2
0.0	vbul	14235	GILABEND	230.0	1	1	1.2
0.0	vbus	14238	GILARIVR	230.0	1	1	1.2
0.0	vbus	14224	JOJOBA	230.0	1	1	1.2
0.0	vbus	19052	LIBERTY	230.0	1	1	1.2
0.0	vbus	14258	TS4	230.0	1	1	1.2

Arizona 230 kV Bus Frequencies (Hz)



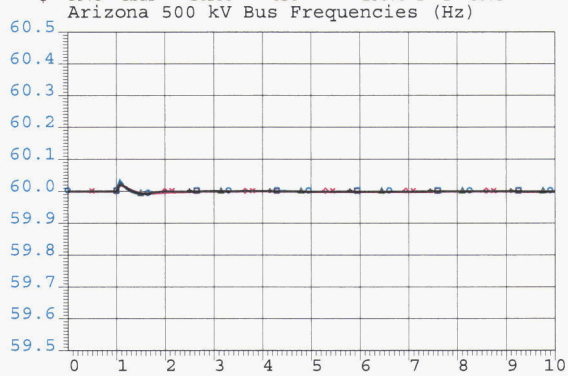
59.5	fbul	14201	BUCKEYE	230.0	1	1	60.5
59.5	fbul	14235	GILABEND	230.0	1	1	60.5
59.5	fbus	14238	GILARIVR	230.0	1	1	60.5
59.5	fbus	14224	JOJOBA	230.0	1	1	60.5
59.5	fbus	19052	LIBERTY	230.0	1	1	60.5
59.5	fbus	14258	TS4	230.0	1	1	60.5

Arizona 500 kV Bus Voltages (p.u.)



0.0	vbus	14007	GILARIVR	500.0	1	1	1.2
0.0	vbus	15093	HARQUAHA	500.0	1	1	1.2
0.0	vbus	15090	HASSYAMP	500.0	1	1	1.2
0.0	vbus	15089	JOJOBA	500.0	1	1	1.2
0.0	vbus	15011	KYRENE	500.0	1	1	1.2
0.0	vbus	15021	PALOVRDE	500.0	1	1	1.2

Arizona 500 kV Bus Frequencies (Hz)



59.5	fbus	14007	GILARIVR	500.0	1	1	60.5
59.5	fbus	15093	HARQUAHA	500.0	1	1	60.5
59.5	fbus	15090	HASSYAMP	500.0	1	1	60.5
59.5	fbus	15089	JOJOBA	500.0	1	1	60.5
59.5	fbus	15011	KYRENE	500.0	1	1	60.5
59.5	fbus	15021	PALOVRDE	500.0	1	1	60.5

2011 Heavy Summer Power Flow/Transient Stability Case
Gila Bend/Gila River Cluster SIS Post-Project R3 Case 2 Q031 @ 102 MW
3-phase 4 cycle flt. @ Gila Bend 230 kV, trip Gila Bend-Gila River 230 kV

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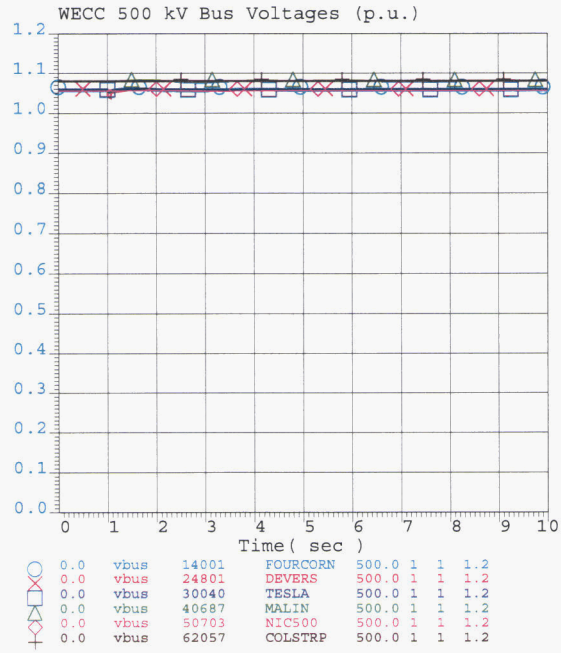
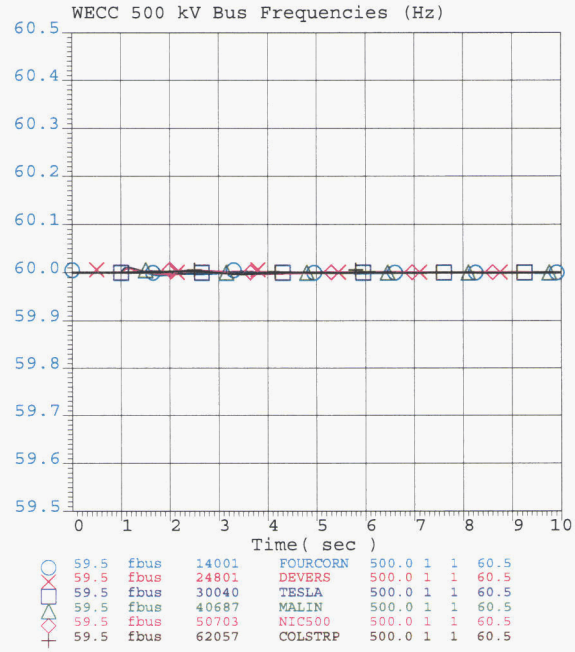
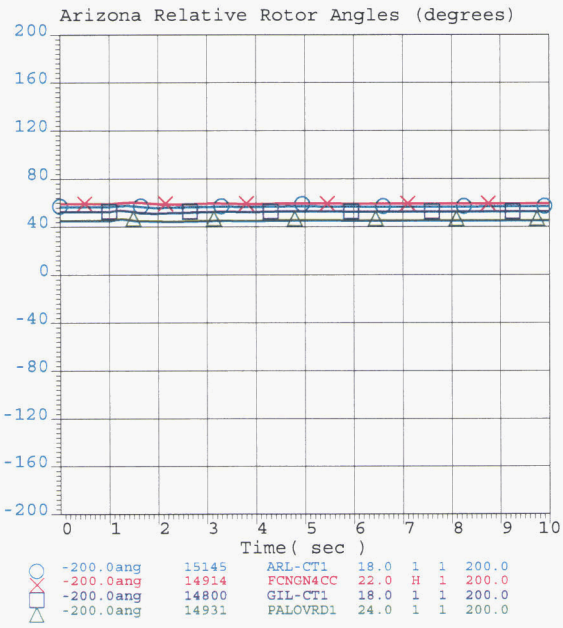
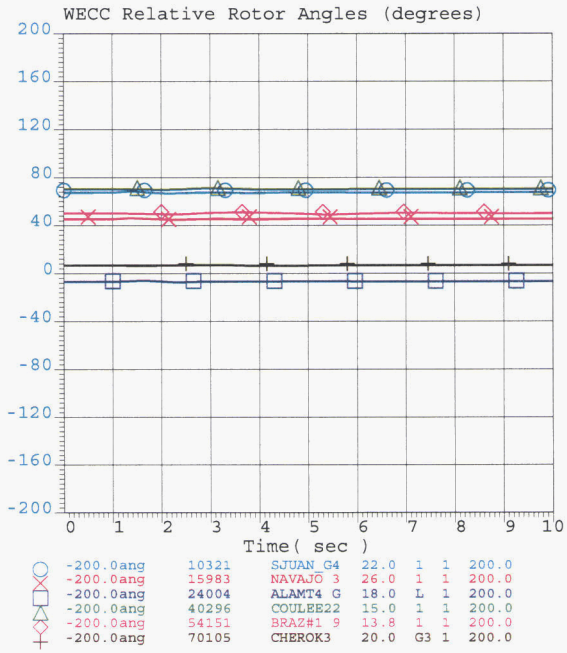
Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots









2011 Heavy Summer Power Flow/Transient Stability Case
Gila Bend/Gila River Cluster SIS Post-Project R3 Case 2 Q031 @ 102 MW
3-phase 4 cycle flt. @ Gila Bend 230 kV, trip Gila Bend-Gila River 230 kV

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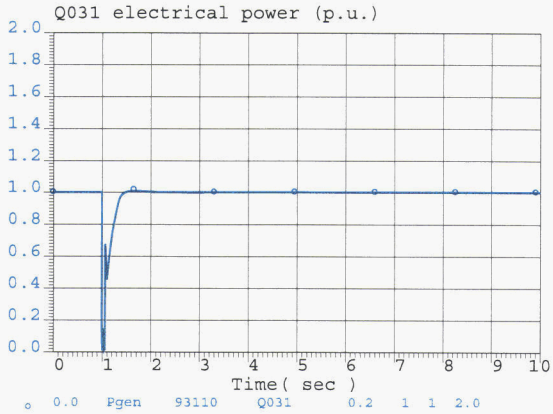
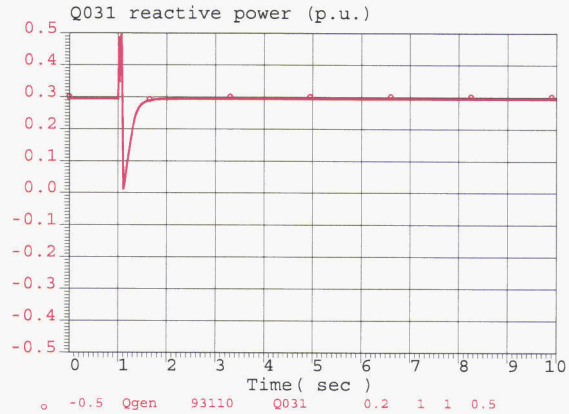
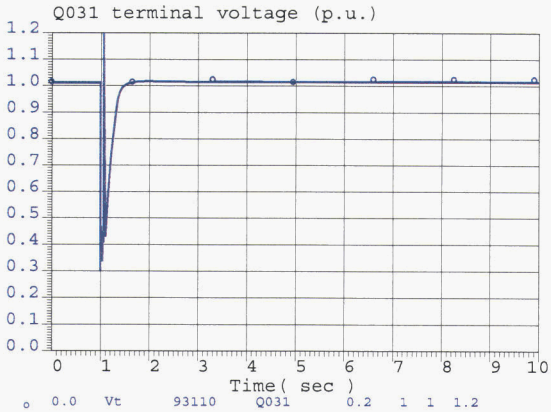
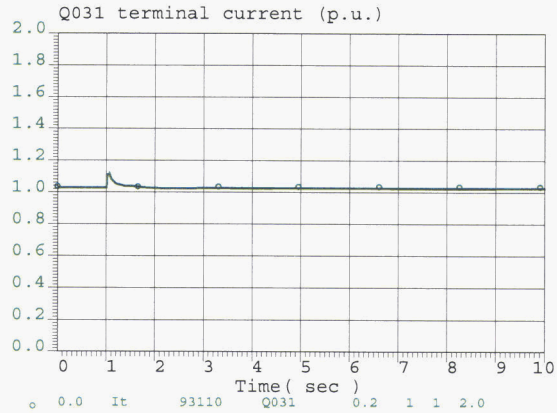
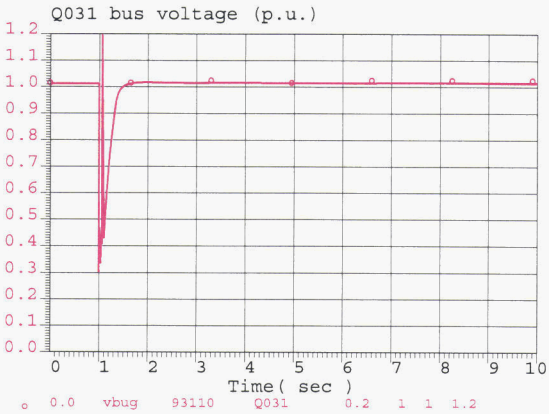
Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots

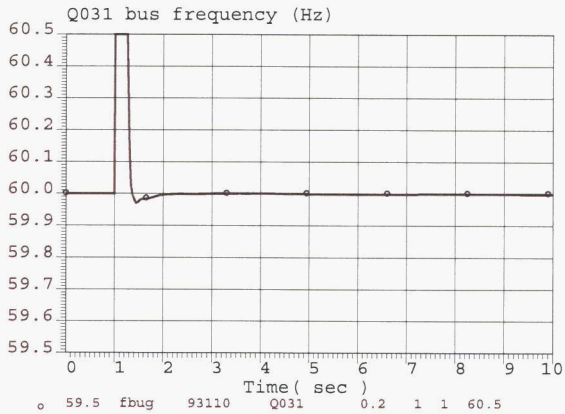








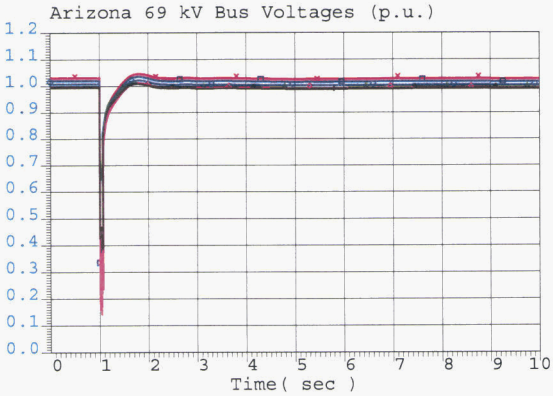




2011 Heavy Summer Power Flow/Transient Stability Case
Gila Bend/Gila River Cluster SIS Post-Project R3 Case 2 Q031 @ 102 MW
3-phase 4 cycle flt. @ Gila Bend 230 kV, trip Gila Bend-Gila River 230 kV

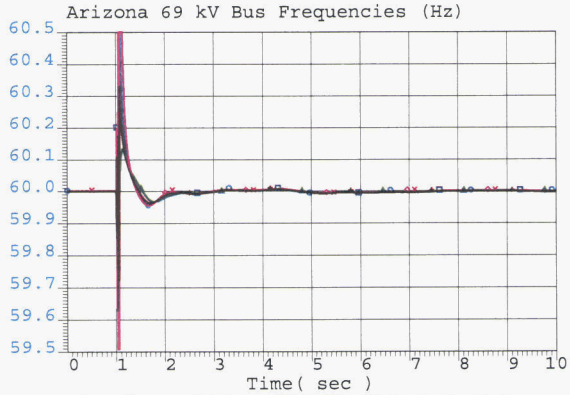
Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots

Arizona 69 kV Bus Voltages (p.u.)



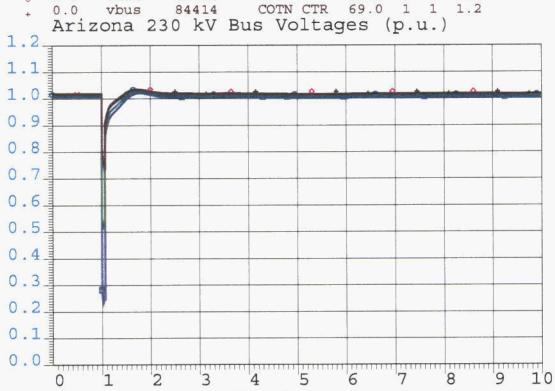
0.0	vbus	84419	GILABEND	69.0	1	1	1.2
0.0	vbus	84432	PALOMA	69.0	1	1	1.2
0.0	vbus	84411	BUNYAN	69.0	1	1	1.2
0.0	vbus	84442	SADDLEMT	69.0	1	1	1.2
0.0	vbus	84460	HY1	69.0	1	1	1.2
0.0	vbus	84414	COTN CTR	69.0	1	1	1.2

Arizona 69 kV Bus Frequencies (Hz)



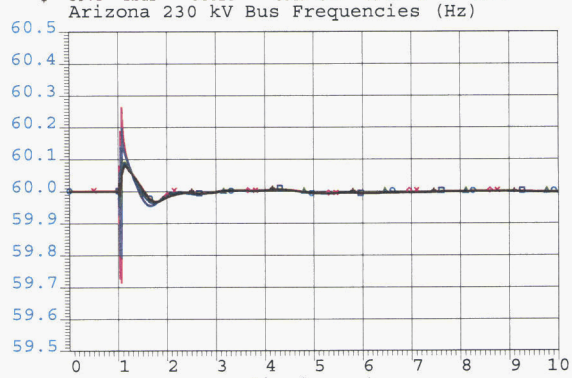
59.5	fbus	84419	GILABEND	69.0	1	1	60.5
59.5	fbus	84432	PALOMA	69.0	1	1	60.5
59.5	fbus	84411	BUNYAN	69.0	1	1	60.5
59.5	fbus	84442	SADDLEMT	69.0	1	1	60.5
59.5	fbus	84460	HY1	69.0	1	1	60.5
59.5	fbus	84414	COTN CTR	69.0	1	1	60.5

Arizona 230 kV Bus Voltages (p.u.)



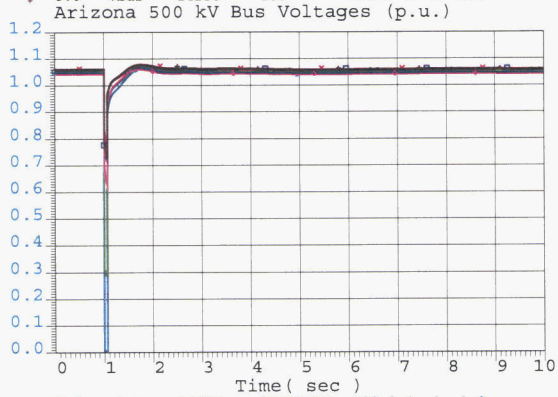
0.0	vbul	14201	BUCKEYE	230.0	1	1	1.2
0.0	vbul	14235	GILABEND	230.0	1	1	1.2
0.0	vbus	14238	GILARIVR	230.0	1	1	1.2
0.0	vbus	14224	JOJOBA	230.0	1	1	1.2
0.0	vbus	19052	LIBERTY	230.0	1	1	1.2
0.0	vbus	14258	TS4	230.0	1	1	1.2

Arizona 230 kV Bus Frequencies (Hz)



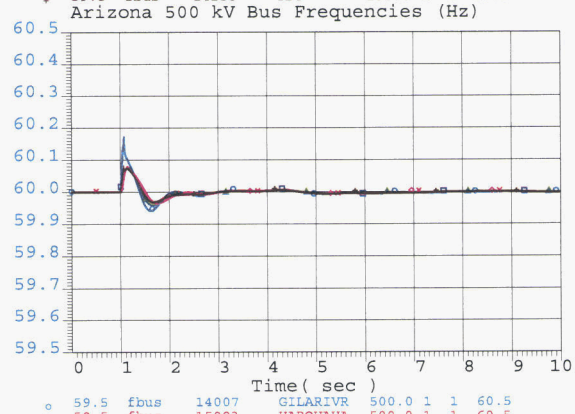
59.5	fbul	14201	BUCKEYE	230.0	1	1	60.5
59.5	fbul	14235	GILABEND	230.0	1	1	60.5
59.5	fbus	14238	GILARIVR	230.0	1	1	60.5
59.5	fbus	14224	JOJOBA	230.0	1	1	60.5
59.5	fbus	19052	LIBERTY	230.0	1	1	60.5
59.5	fbus	14258	TS4	230.0	1	1	60.5

Arizona 500 kV Bus Voltages (p.u.)



0.0	vbus	14007	GILARIVR	500.0	1	1	1.2
0.0	vbus	15093	HARQUAHA	500.0	1	1	1.2
0.0	vbus	15090	HASSYAMP	500.0	1	1	1.2
0.0	vbus	15089	JOJOBA	500.0	1	1	1.2
0.0	vbus	15011	KYRENE	500.0	1	1	1.2
0.0	vbus	15021	PALOVRDE	500.0	1	1	1.2

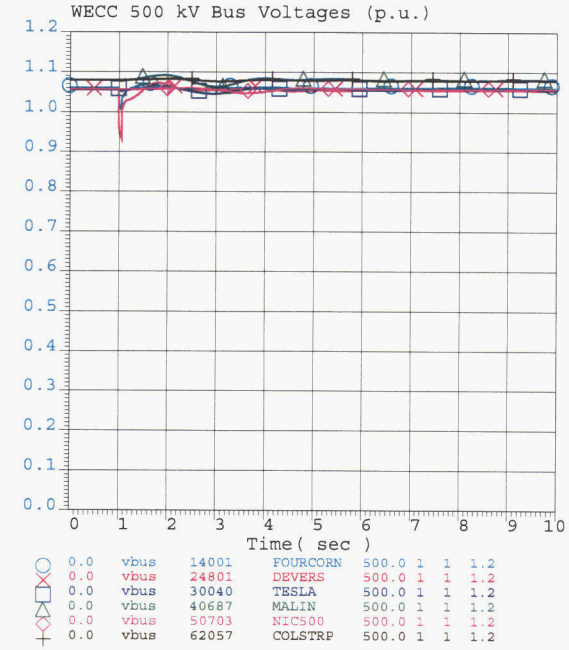
Arizona 500 kV Bus Frequencies (Hz)

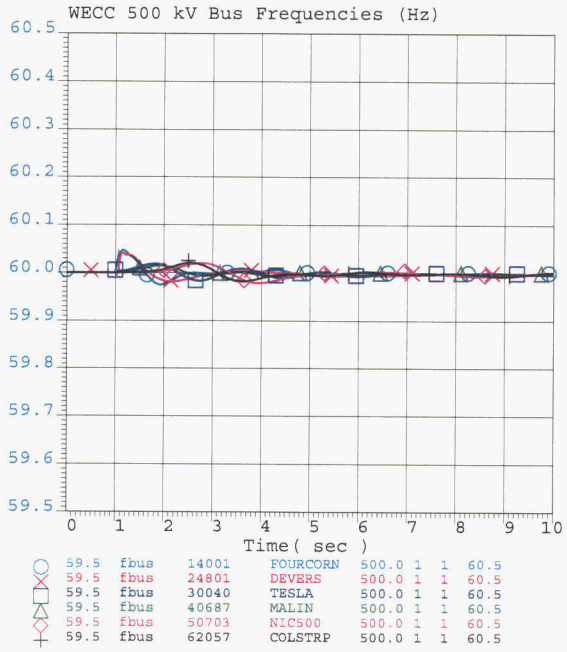


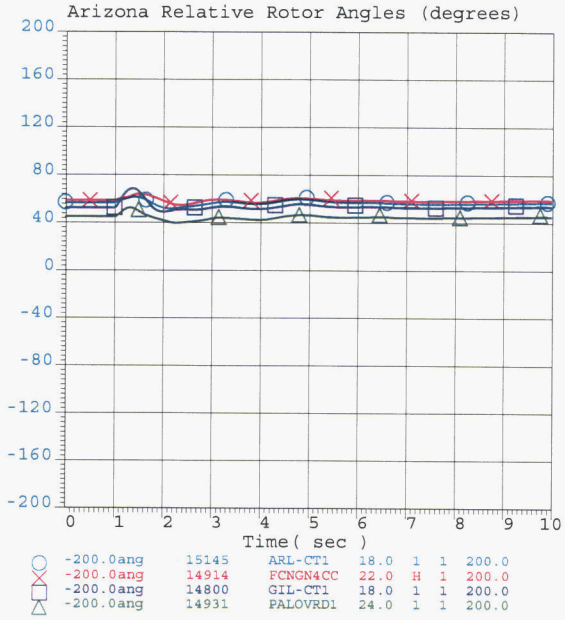
59.5	fbus	14007	GILARIVR	500.0	1	1	60.5
59.5	fbus	15093	HARQUAHA	500.0	1	1	60.5
59.5	fbus	15090	HASSYAMP	500.0	1	1	60.5
59.5	fbus	15089	JOJOBA	500.0	1	1	60.5
59.5	fbus	15011	KYRENE	500.0	1	1	60.5
59.5	fbus	15021	PALOVRDE	500.0	1	1	60.5

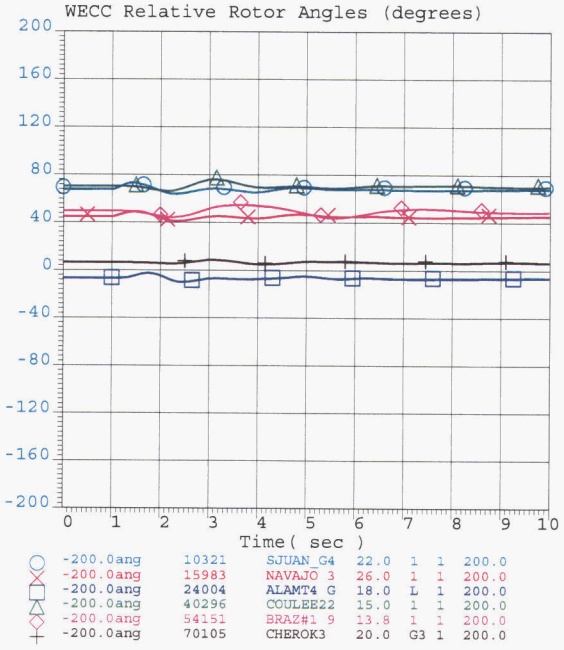
2011 Heavy Summer Power Flow/Transient Stability Case
Gila Bend/Gila River Cluster SIS Post-Project R3 Case 2 Q031 @ 102 MW
3-phase 4 cycle flt. @ Gila River 500 kV, trip Gila River-Jojoba 500 kV

Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots





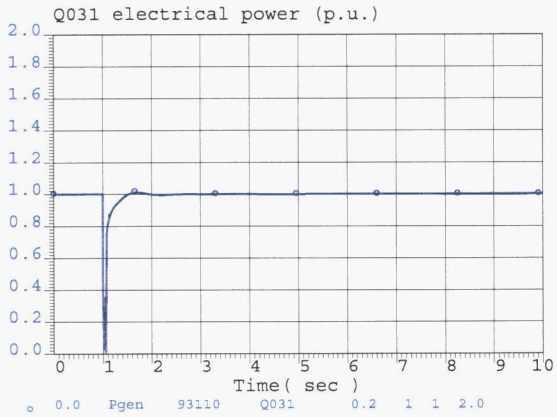


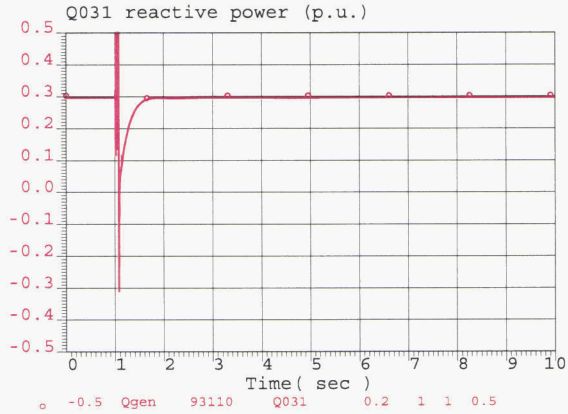


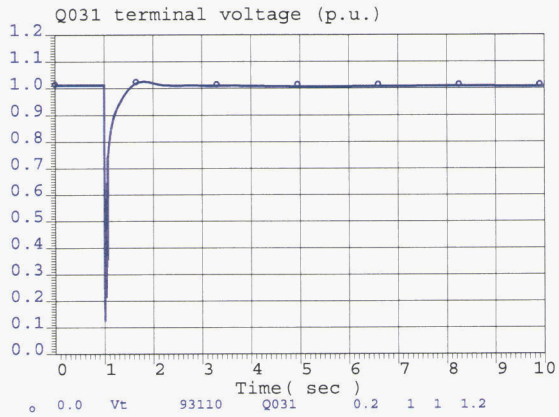
2011 Heavy Summer Power Flow/Transient Stability Case
Gila Bend/Gila River Cluster SIS Post-Project R3 Case 2 Q031 @ 102 MW
3-phase 4 cycle flt. @ Gila River 500 kV, trip Gila River-Jojoba 500 kV

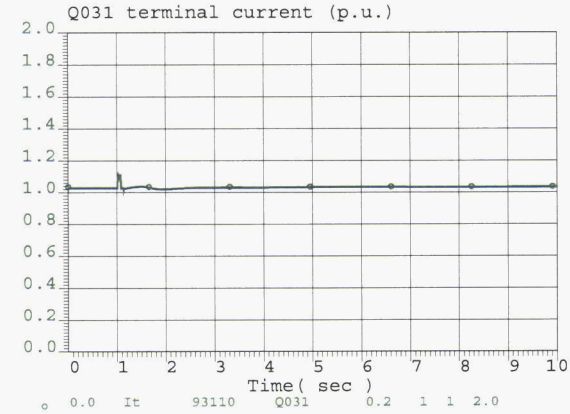
APS	11hs-gbgr-r3-pst2-dyn_swt02-gilariver-jojoba500-slo.chf	c:\work\aps\gbgr\sis\dyn Wed Jun 17 13:37:17 2009

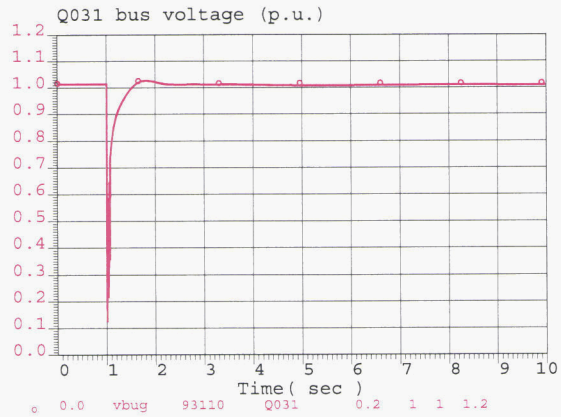
Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots

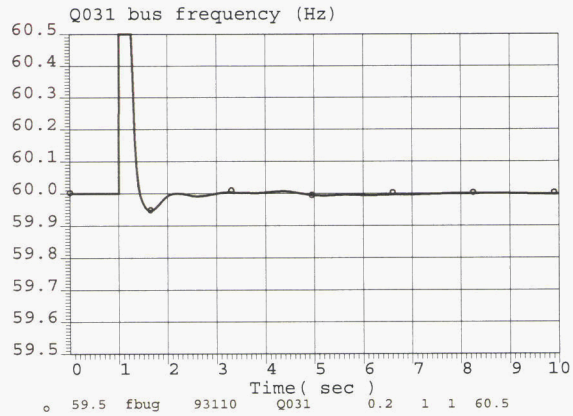








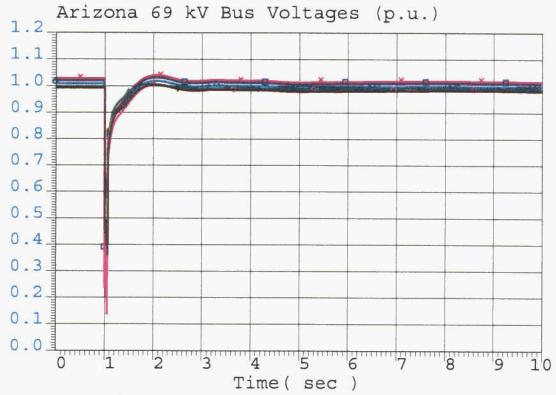




2011 Heavy Summer Power Flow/Transient Stability Case
Gila Bend/Gila River Cluster SIS Post-Project R3 Case 2 Q031 @ 102 MW
3-phase 4 cycle flt. @ Gila River 500 kV, trip Gila River-Jojoba 500 kV

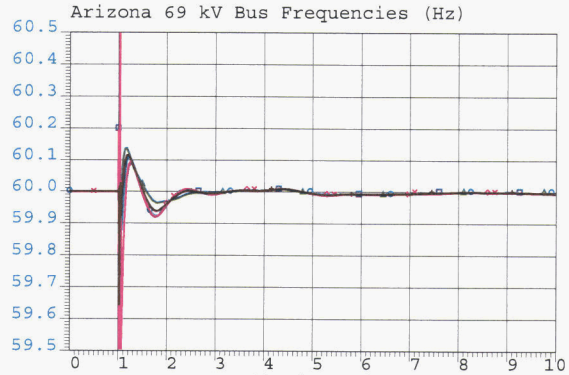
Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots

Arizona 69 kV Bus Voltages (p.u.)



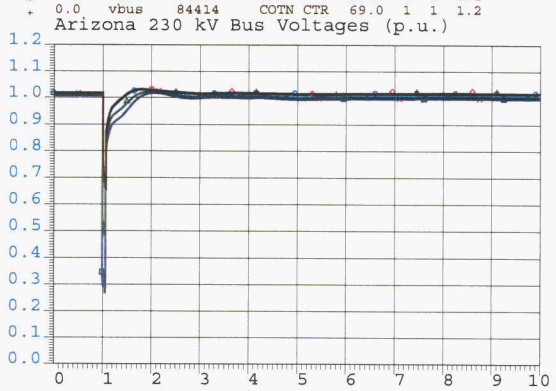
o	0.0	vbus	84419	GILABEND	69.0	1	1	1.2
x	0.0	vbus	84432	PALOMA	69.0	1	1	1.2
□	0.0	vbus	84411	BUNYAN	69.0	1	1	1.2
△	0.0	vbus	84442	SADDLEMT	69.0	1	1	1.2
◇	0.0	vbus	84460	HY1	69.0	1	1	1.2
+	0.0	vbus	84414	COTN CTR	69.0	1	1	1.2

Arizona 69 kV Bus Frequencies (Hz)



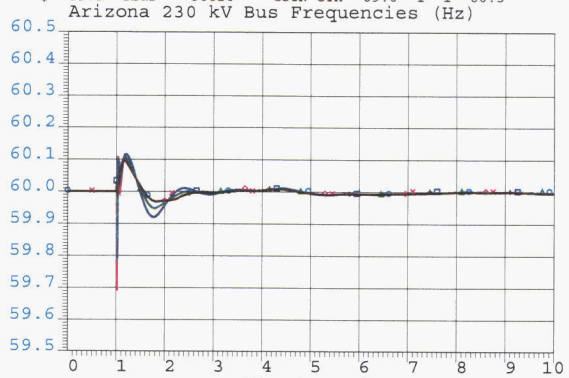
o	59.5	fbus	84419	GILABEND	69.0	1	1	60.5
x	59.5	fbus	84432	PALOMA	69.0	1	1	60.5
□	59.5	fbus	84411	BUNYAN	69.0	1	1	60.5
△	59.5	fbus	84442	SADDLEMT	69.0	1	1	60.5
◇	59.5	fbus	84460	HY1	69.0	1	1	60.5
+	59.5	fbus	84414	COTN CTR	69.0	1	1	60.5

Arizona 230 kV Bus Voltages (p.u.)



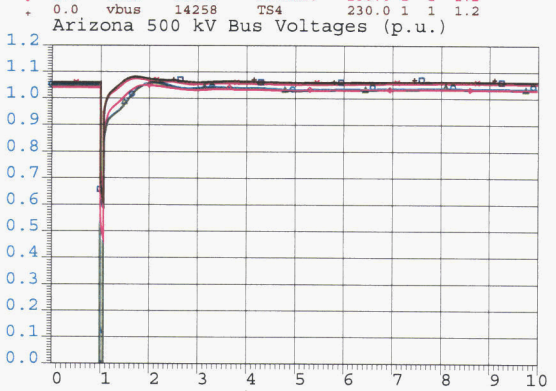
o	0.0	vbul	14201	BUCKEYE	230.0	1	1	1.2
x	0.0	vbul	14235	GILABEND	230.0	1	1	1.2
□	0.0	vbus	14238	GILARIVR	230.0	1	1	1.2
△	0.0	vbus	14224	JOJOBA	230.0	1	1	1.2
◇	0.0	vbus	19052	LIBERTY	230.0	1	1	1.2
+	0.0	vbus	14258	TS4	230.0	1	1	1.2

Arizona 230 kV Bus Frequencies (Hz)



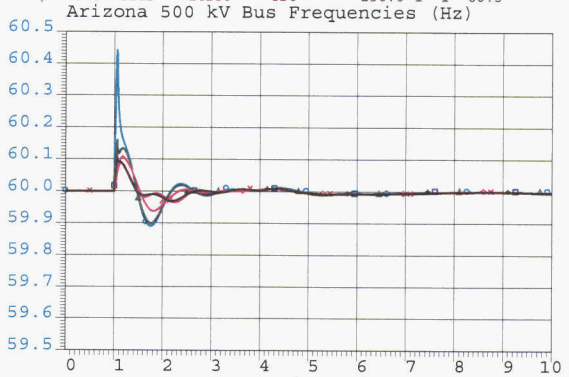
o	59.5	fbul	14201	BUCKEYE	230.0	1	1	60.5
x	59.5	fbul	14235	GILABEND	230.0	1	1	60.5
□	59.5	fbus	14238	GILARIVR	230.0	1	1	60.5
△	59.5	fbus	14224	JOJOBA	230.0	1	1	60.5
◇	59.5	fbus	19052	LIBERTY	230.0	1	1	60.5
+	59.5	fbus	14258	TS4	230.0	1	1	60.5

Arizona 500 kV Bus Voltages (p.u.)



o	0.0	vbus	14007	GILARIVR	500.0	1	1	1.2
x	0.0	vbus	15093	HARQUAHA	500.0	1	1	1.2
■	0.0	vbus	15090	HASSYAMP	500.0	1	1	1.2
△	0.0	vbus	15089	JOJOBA	500.0	1	1	1.2
◇	0.0	vbus	15011	KYRENE	500.0	1	1	1.2
+	0.0	vbus	15021	PALOVRDE	500.0	1	1	1.2

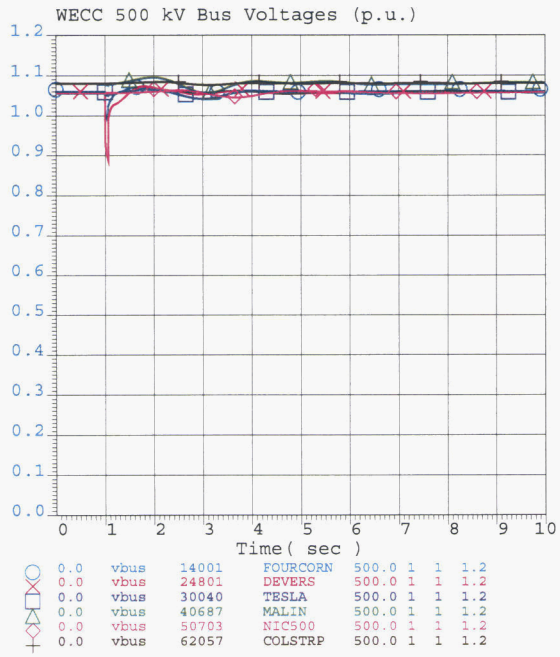
Arizona 500 kV Bus Frequencies (Hz)

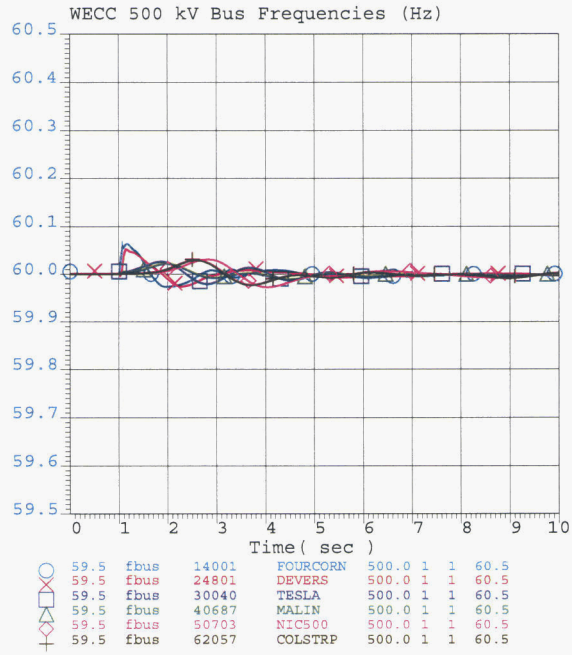


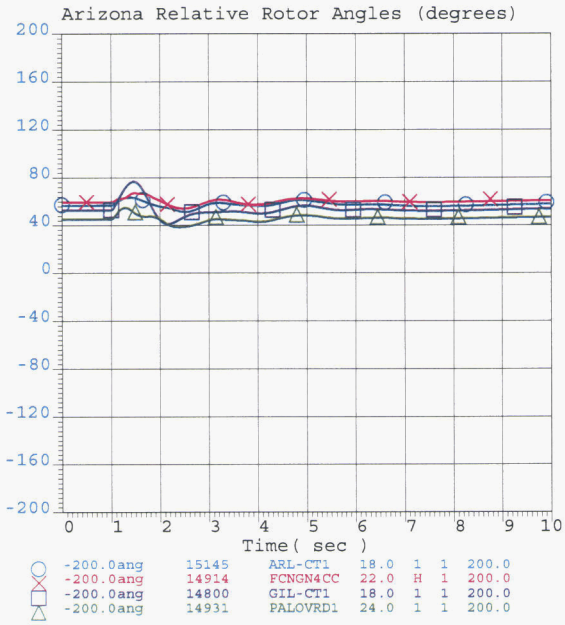
o	59.5	fbus	14007	GILARIVR	500.0	1	1	60.5
x	59.5	fbus	15093	HARQUAHA	500.0	1	1	60.5
■	59.5	fbus	15090	HASSYAMP	500.0	1	1	60.5
△	59.5	fbus	15089	JOJOBA	500.0	1	1	60.5
◇	59.5	fbus	15011	KYRENE	500.0	1	1	60.5
+	59.5	fbus	15021	PALOVRDE	500.0	1	1	60.5

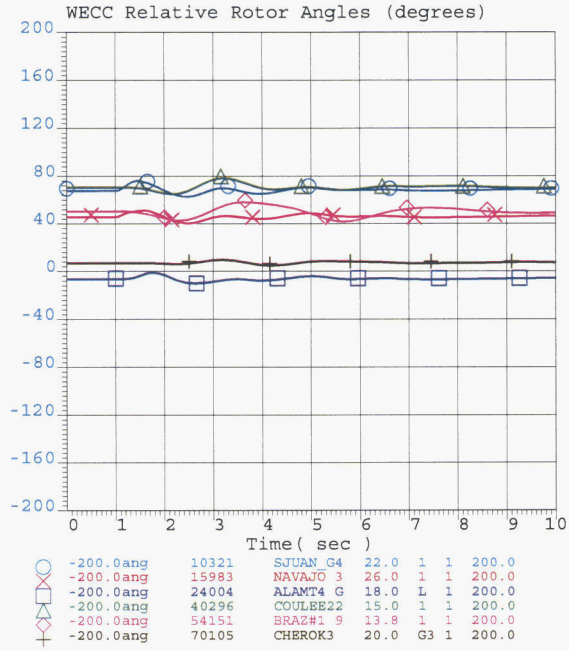
2011 Heavy Summer Power Flow/Transient Stability Case
Gila Bend/Gila River Cluster SIS Post-Project R3 Case 2 Q031 @ 102 MW
3-phase 4 cycle flt. @ Jojoba 500 kV, trip Hassyampa-Jojoba 500 kV

Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots



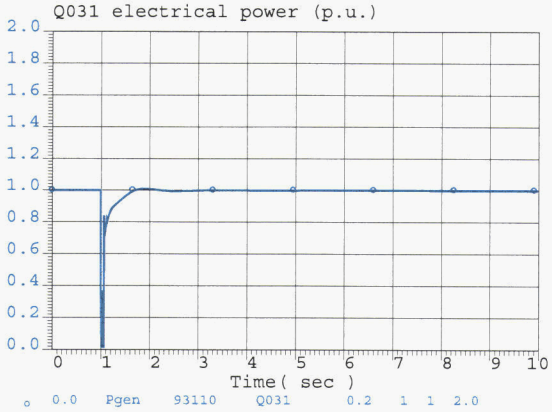


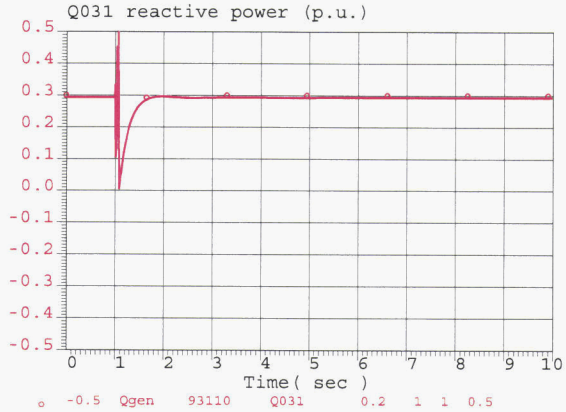


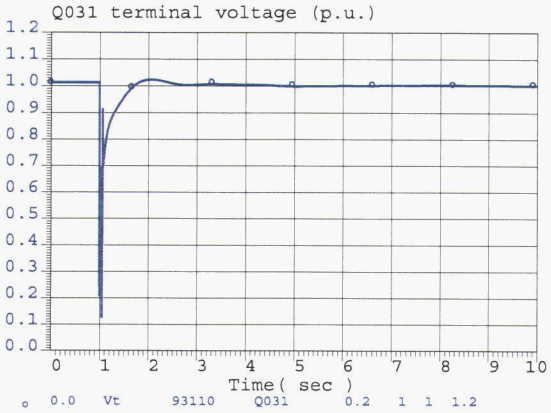


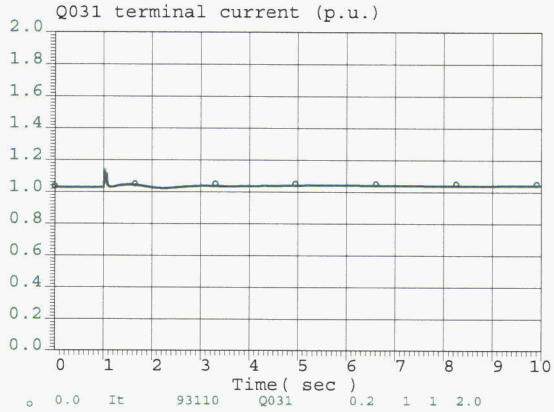
2011 Heavy Summer Power Flow/Transient Stability Case
Gila Bend/Gila River Cluster SIS Post-Project R3 Case 2 Q031 @ 102 MW
3-phase 4 cycle flt. @ Jojoba 500 kV, trip Hassyampa-Jojoba 500 kV

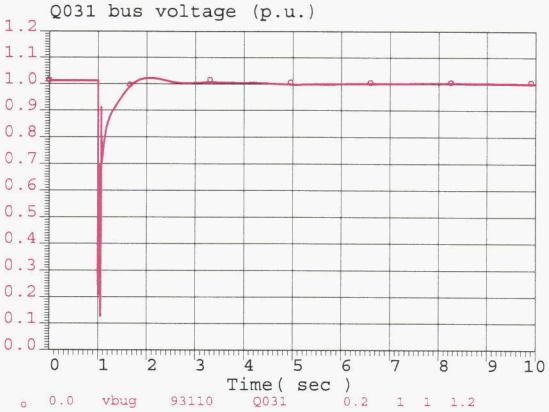
Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots

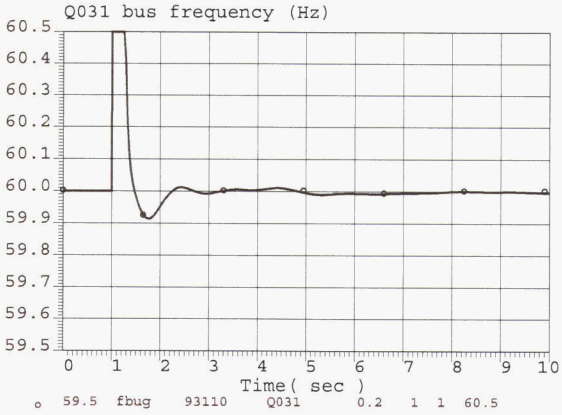








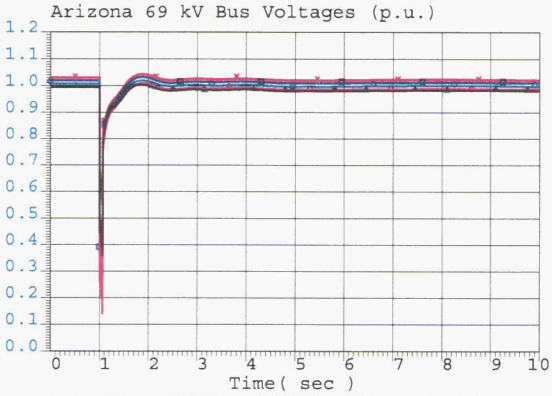




2011 Heavy Summer Power Flow/Transient Stability Case
Gila Bend/Gila River Cluster SIS Post-Project R3 Case 2 Q031 @ 102 MW
3-phase 4 cycle flt. @ Jojoba 500 kV, trip Hassyampa-Jojoba 500 kV

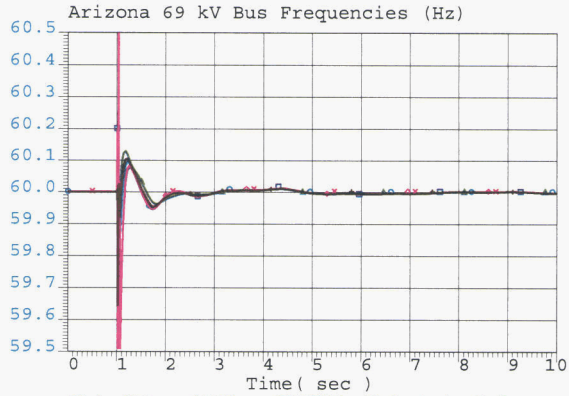
Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots

Arizona 69 kV Bus Voltages (p.u.)



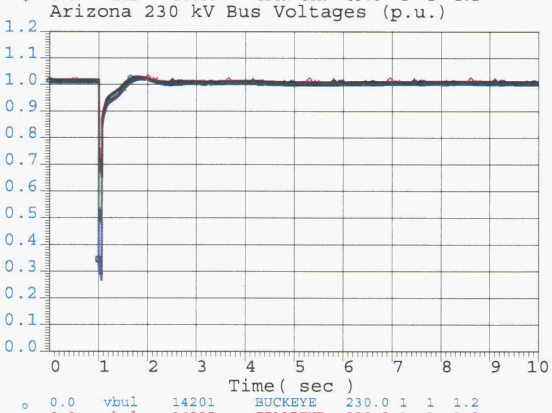
0.0	vbus	84419	GILABEND	69.0	1	1	1.2
0.0	vbus	84432	PALOMA	69.0	1	1	1.2
0.0	vbus	84411	BUNYAN	69.0	1	1	1.2
0.0	vbus	84442	SADDLEMT	69.0	1	1	1.2
0.0	vbus	84460	HY1	69.0	1	1	1.2
0.0	vbus	84414	COTN CTR	69.0	1	1	1.2

Arizona 69 kV Bus Frequencies (Hz)



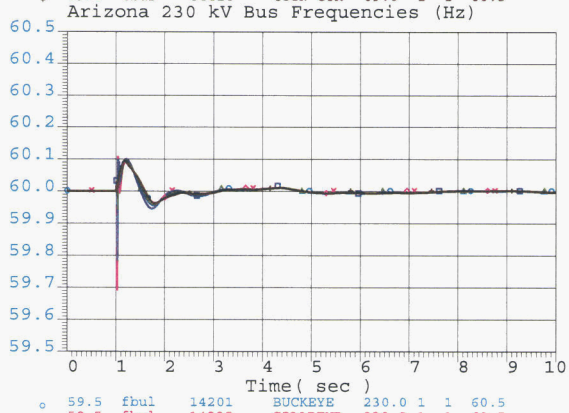
59.5	fbus	84419	GILABEND	69.0	1	1	60.5
59.5	fbus	84432	PALOMA	69.0	1	1	60.5
59.5	fbus	84411	BUNYAN	69.0	1	1	60.5
59.5	fbus	84442	SADDLEMT	69.0	1	1	60.5
59.5	fbus	84460	HY1	69.0	1	1	60.5
59.5	fbus	84414	COTN CTR	69.0	1	1	60.5

Arizona 230 kV Bus Voltages (p.u.)



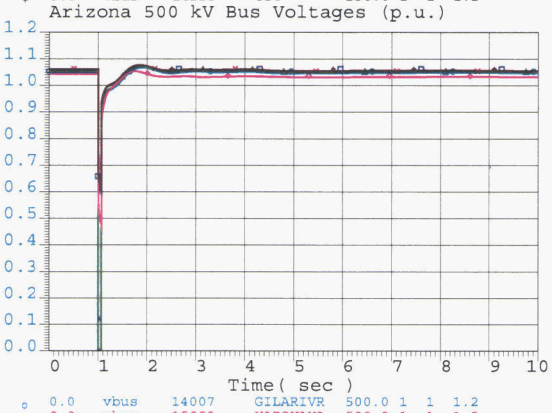
0.0	vbul	14201	BUCKEYE	230.0	1	1	1.2
0.0	vbul	14235	GILABEND	230.0	1	1	1.2
0.0	vbus	14238	GILARIVR	230.0	1	1	1.2
0.0	vbus	14224	JOJOBA	230.0	1	1	1.2
0.0	vbus	19052	LIBERTY	230.0	1	1	1.2
0.0	vbus	14258	TS4	230.0	1	1	1.2

Arizona 230 kV Bus Frequencies (Hz)



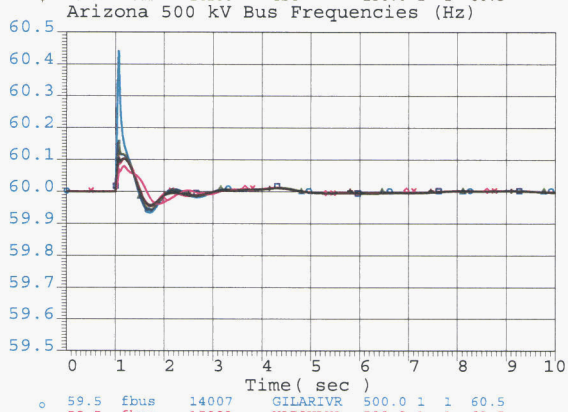
59.5	fbul	14201	BUCKEYE	230.0	1	1	60.5
59.5	fbul	14235	GILABEND	230.0	1	1	60.5
59.5	fbus	14238	GILARIVR	230.0	1	1	60.5
59.5	fbus	14224	JOJOBA	230.0	1	1	60.5
59.5	fbus	19052	LIBERTY	230.0	1	1	60.5
59.5	fbus	14258	TS4	230.0	1	1	60.5

Arizona 500 kV Bus Voltages (p.u.)



0.0	vbus	14007	GILARIVR	500.0	1	1	1.2
0.0	vbus	15093	HARQUAHA	500.0	1	1	1.2
0.0	vbus	15090	HASSYAMP	500.0	1	1	1.2
0.0	vbus	15089	JOJOBA	500.0	1	1	1.2
0.0	vbus	15011	KYRENE	500.0	1	1	1.2
0.0	vbus	15021	PALOVRDE	500.0	1	1	1.2

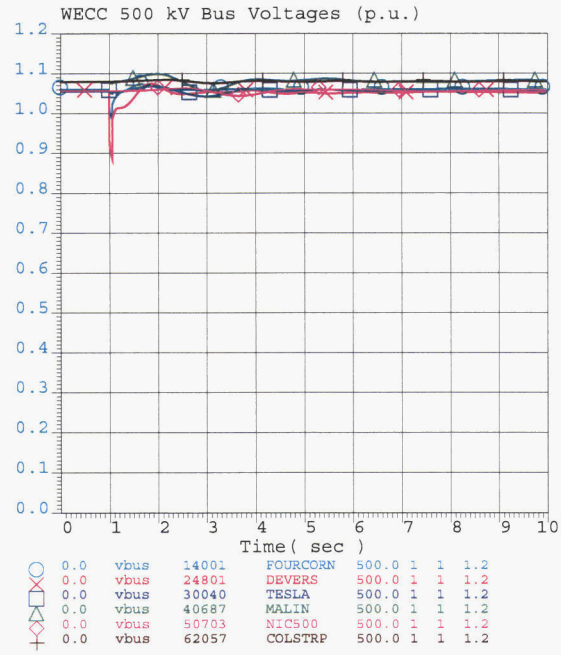
Arizona 500 kV Bus Frequencies (Hz)

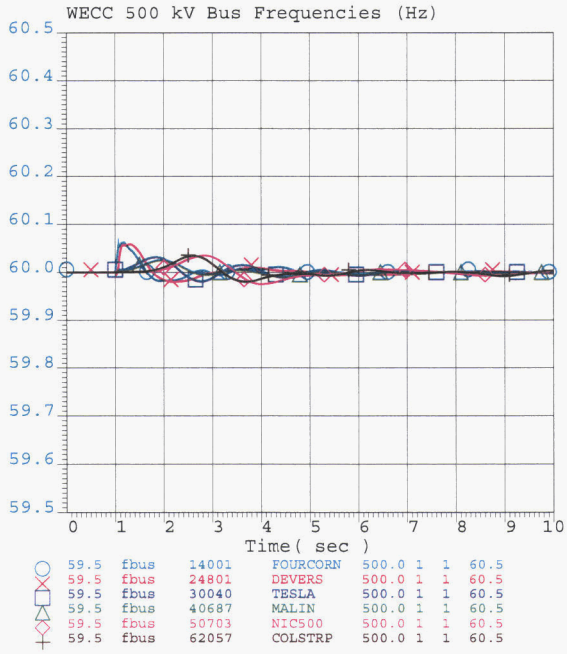


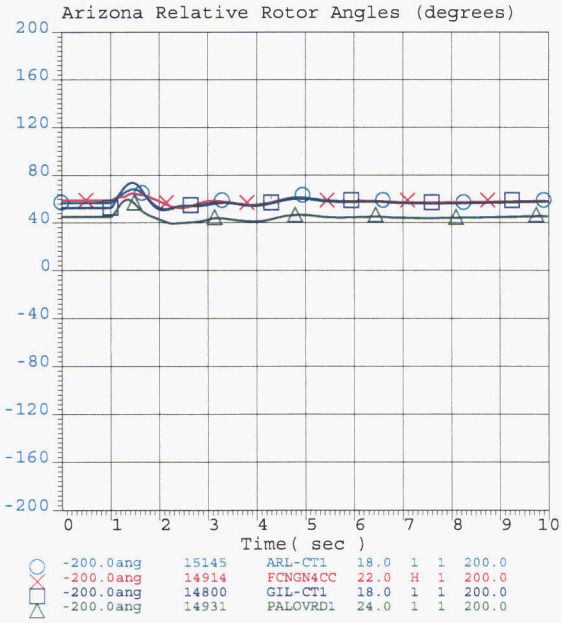
59.5	fbus	14007	GILARIVR	500.0	1	1	60.5
59.5	fbus	15093	HARQUAHA	500.0	1	1	60.5
59.5	fbus	15090	HASSYAMP	500.0	1	1	60.5
59.5	fbus	15089	JOJOBA	500.0	1	1	60.5
59.5	fbus	15011	KYRENE	500.0	1	1	60.5
59.5	fbus	15021	PALOVRDE	500.0	1	1	60.5

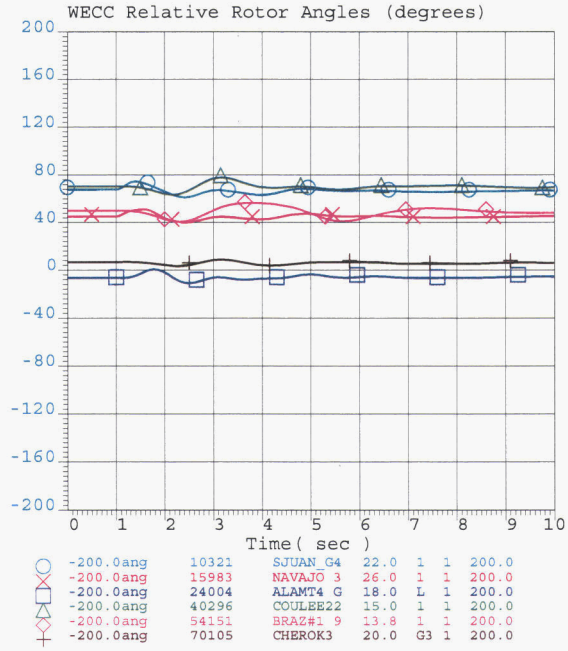
2011 Heavy Summer Power Flow/Transient Stability Case
Gila Bend/Gila River Cluster SIS Post-Project R3 Case 2 Q031 @ 102 MW
3-phase 4 cycle flt. @ Jojoba 500 kV, trip Jojoba-Kyrene 500 kV

Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots



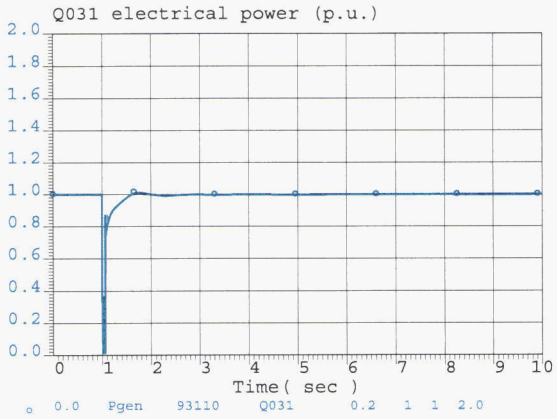


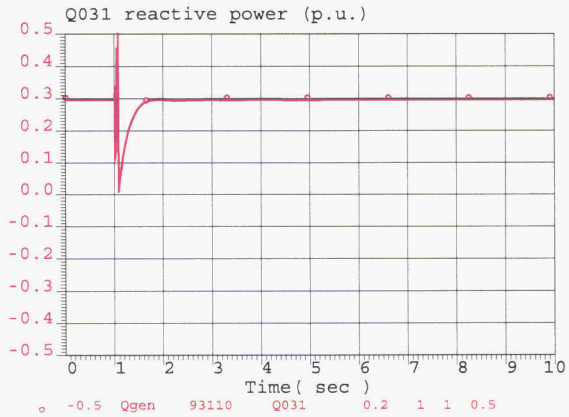


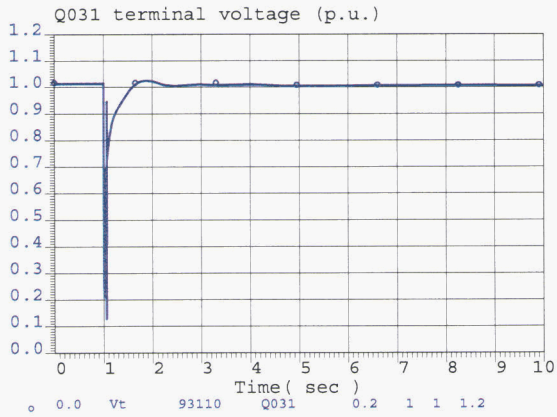


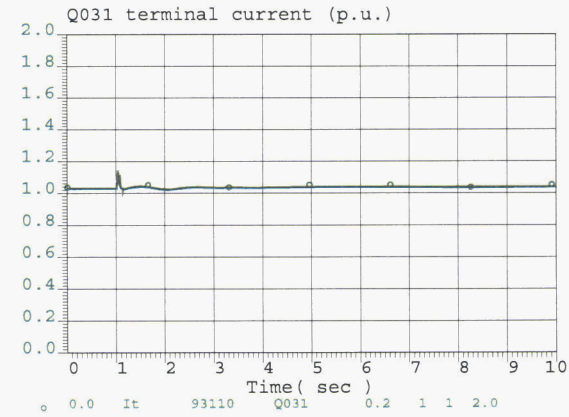
2011 Heavy Summer Power Flow/Transient Stability Case
Gila Bend/Gila River Cluster SIS Post-Project R3 Case 2 Q031 @ 102 MW
3-phase 4 cycle flt. @ Jojoba 500 kV, trip Jojoba-Kyrene 500 kV

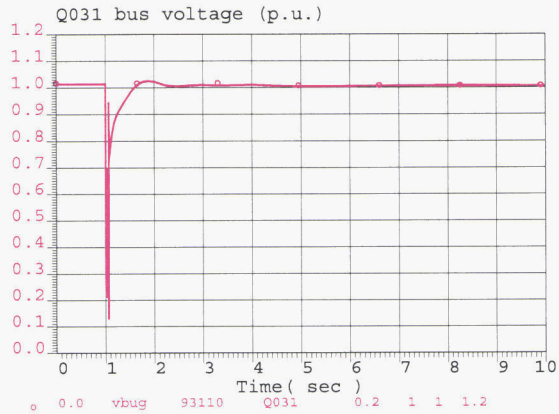
Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots

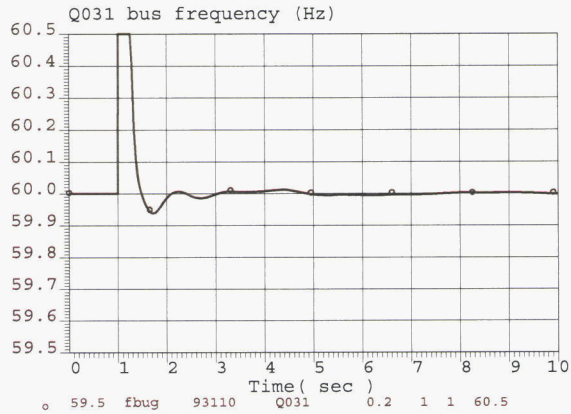








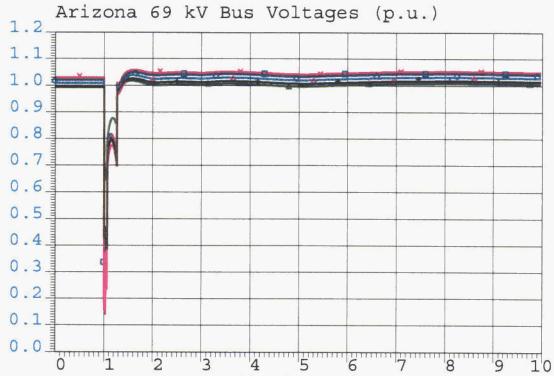




2011 Heavy Summer Power Flow/Transient Stability Case
Gila Bend/Gila River Cluster SIS Post-Project R3 Case 2 Q031 @ 102 MW
3-phase 4 cycle flt. @ Jojoba 500 kV, trip Jojoba-Kyrene 500 kV

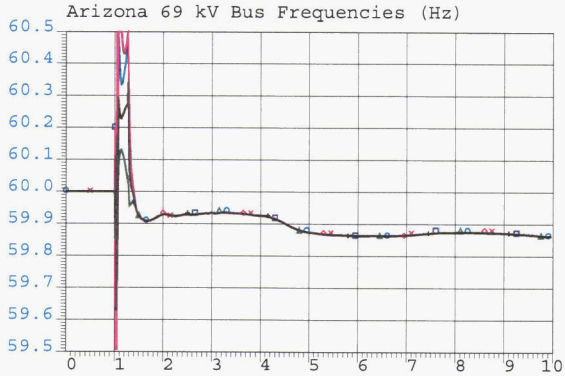
Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots

Arizona 69 kV Bus Voltages (p.u.)



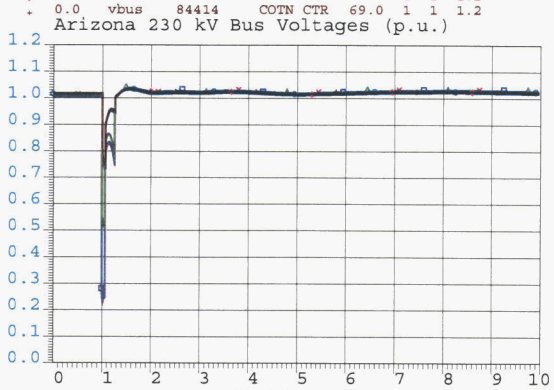
0.0	vbus	84419	GILABEND	69.0	1	1	1.2
0.0	vbus	84432	PALOMA	69.0	1	1	1.2
0.0	vbus	84411	BUNYAN	69.0	1	1	1.2
0.0	vbus	84442	SADDLEMT	69.0	1	1	1.2
0.0	vbus	84460	HY1	69.0	1	1	1.2
0.0	vbus	84414	COTN CTR	69.0	1	1	1.2

Arizona 69 kV Bus Frequencies (Hz)



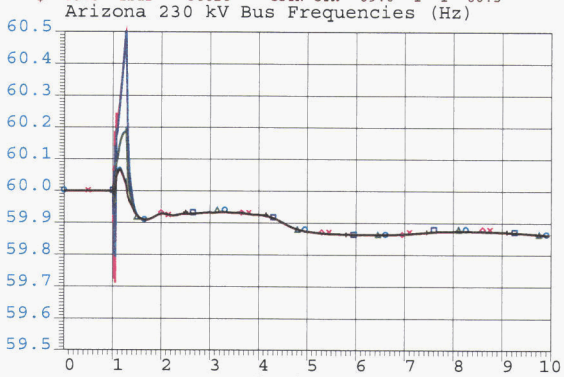
59.5	fbus	84419	GILABEND	69.0	1	1	60.5
59.5	fbus	84432	PALOMA	69.0	1	1	60.5
59.5	fbus	84411	BUNYAN	69.0	1	1	60.5
59.5	fbus	84442	SADDLEMT	69.0	1	1	60.5
59.5	fbus	84460	HY1	69.0	1	1	60.5
59.5	fbus	84414	COTN CTR	69.0	1	1	60.5

Arizona 230 kV Bus Voltages (p.u.)



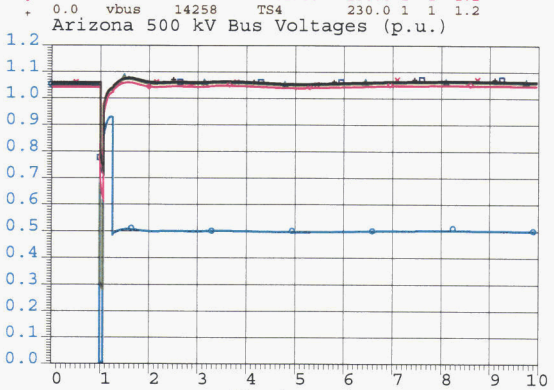
0.0	vbul	14201	BUCKEYE	230.0	1	1	1.2
0.0	vbul	14235	GILABEND	230.0	1	1	1.2
0.0	vbus	14238	GILARIVR	230.0	1	1	1.2
0.0	vbus	14224	JOJOBA	230.0	1	1	1.2
0.0	vbus	19052	LIBERTY	230.0	1	1	1.2
0.0	vbus	14258	TS4	230.0	1	1	1.2

Arizona 230 kV Bus Frequencies (Hz)



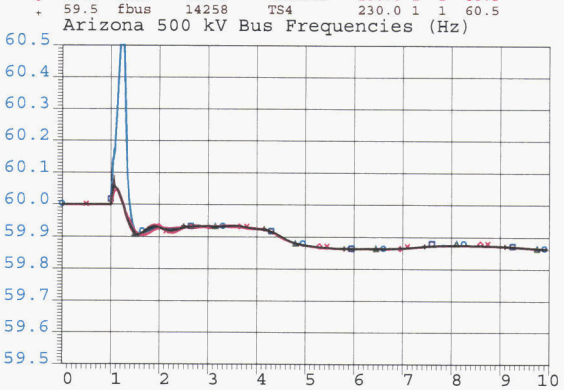
59.5	fbul	14201	BUCKEYE	230.0	1	1	60.5
59.5	fbul	14235	GILABEND	230.0	1	1	60.5
59.5	fbus	14238	GILARIVR	230.0	1	1	60.5
59.5	fbus	14224	JOJOBA	230.0	1	1	60.5
59.5	fbus	19052	LIBERTY	230.0	1	1	60.5
59.5	fbus	14258	TS4	230.0	1	1	60.5

Arizona 500 kV Bus Voltages (p.u.)



0.0	vbus	14007	GILARIVR	500.0	1	1	1.2
0.0	vbus	15093	HARQUAHA	500.0	1	1	1.2
0.0	vbus	15090	HASSYAMP	500.0	1	1	1.2
0.0	vbus	15089	JOJOBA	500.0	1	1	1.2
0.0	vbus	15011	KYRENE	500.0	1	1	1.2
0.0	vbus	15021	PALOVRDE	500.0	1	1	1.2

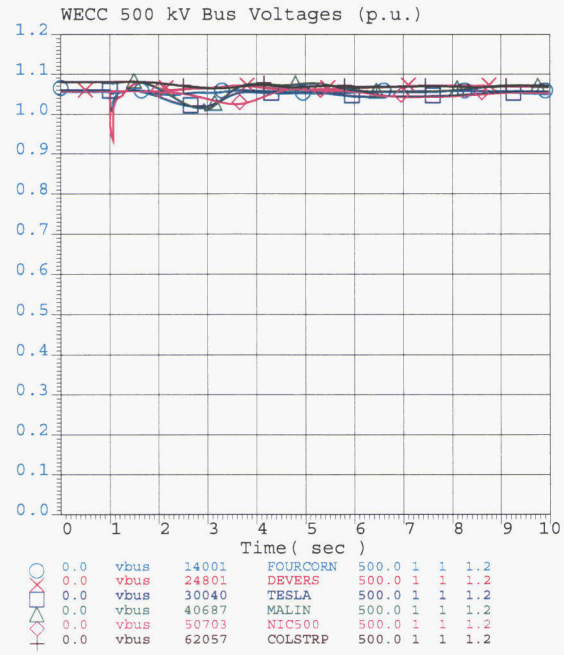
Arizona 500 kV Bus Frequencies (Hz)

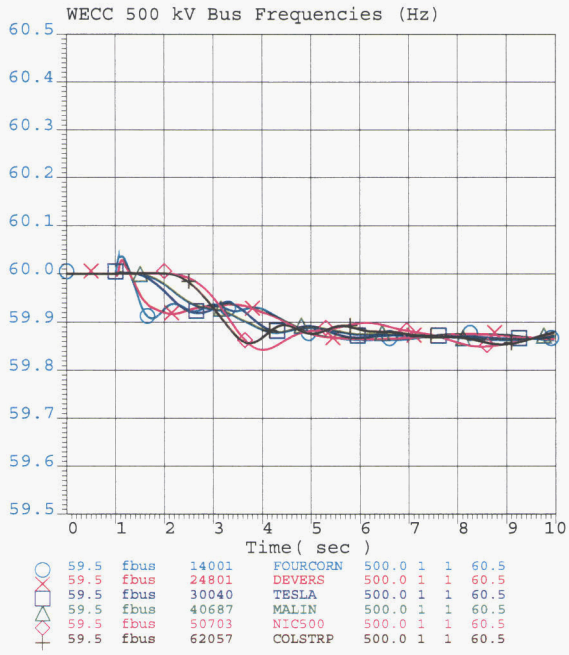


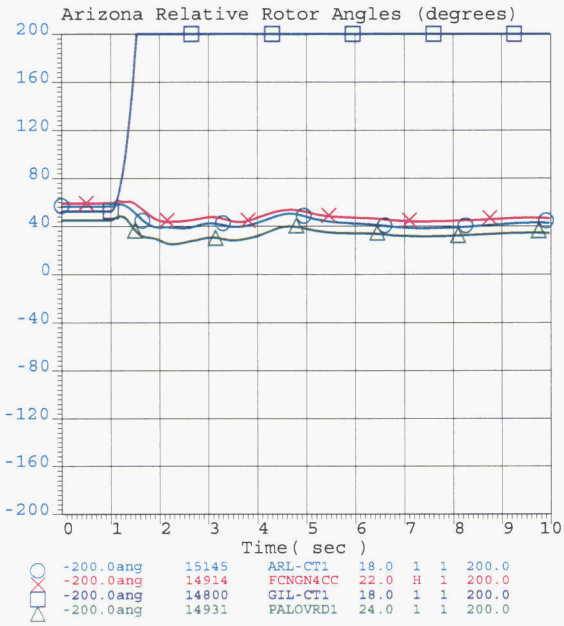
59.5	fbus	14007	GILARIVR	500.0	1	1	60.5
59.5	fbus	15093	HARQUAHA	500.0	1	1	60.5
59.5	fbus	15090	HASSYAMP	500.0	1	1	60.5
59.5	fbus	15089	JOJOBA	500.0	1	1	60.5
59.5	fbus	15011	KYRENE	500.0	1	1	60.5
59.5	fbus	15021	PALOVRDE	500.0	1	1	60.5

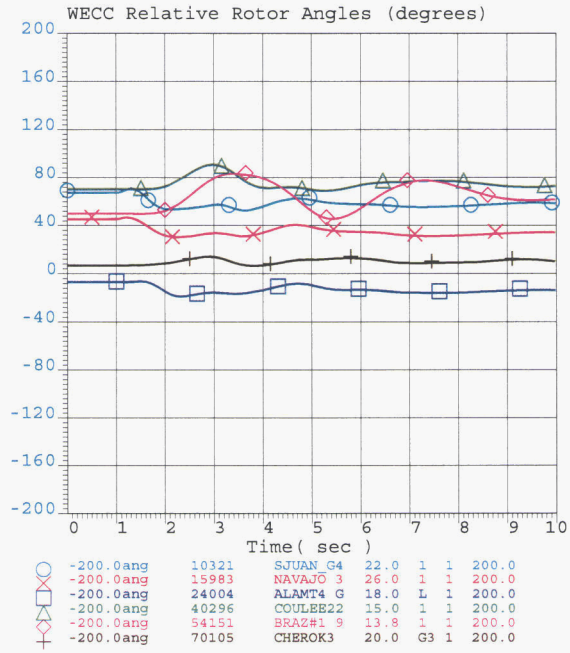
2011 Heavy Summer Power Flow/Transient Stability Case
Gila Bend/Gila River Cluster SIS Post-Project R3 Case 2 Q031 @ 102 MW
3-phase 4 cycle flt. @ Gila River 500 kV, trip Gila River-Jojoba 1 & 2 500 kV

Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots









2011 Heavy Summer Power Flow/Transient Stability Case
Gila Bend/Gila River Cluster SIS Post-Project R3 Case 2 Q031 @ 102 MW
3-phase 4 cycle flt. @ Gila River 500 kV, trip Gila River-Jojoba 1 & 2 500 kV

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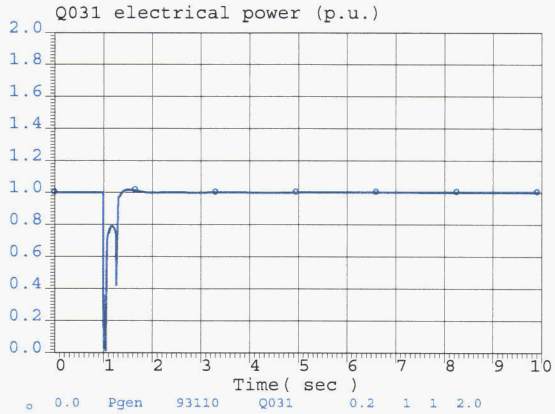
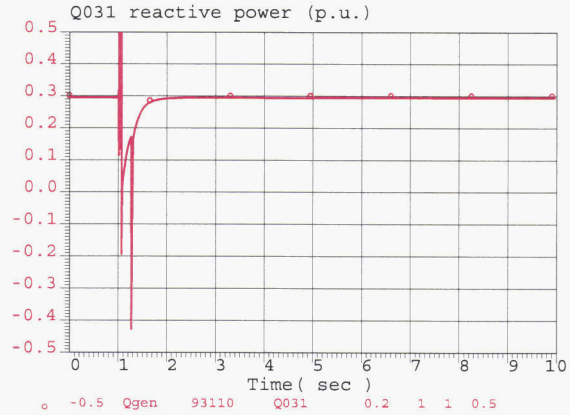
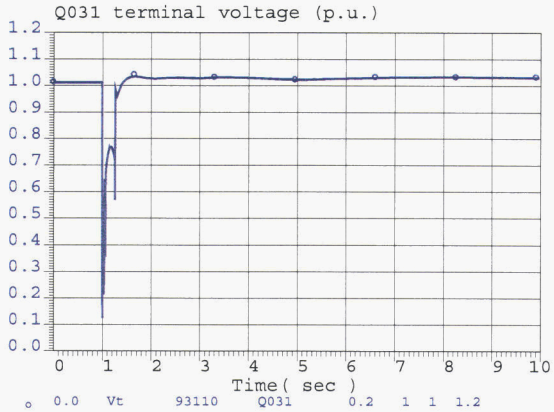
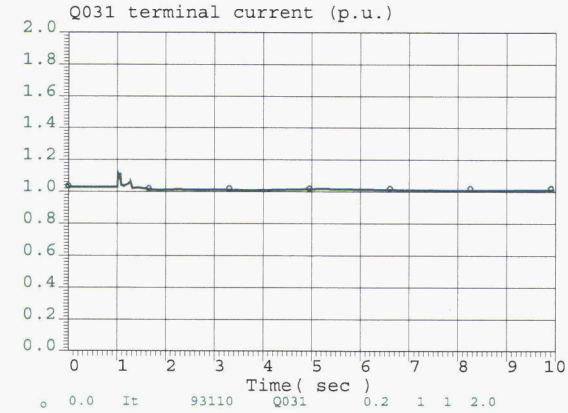
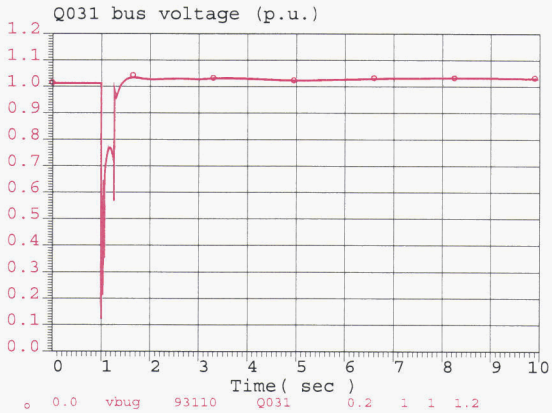
Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots

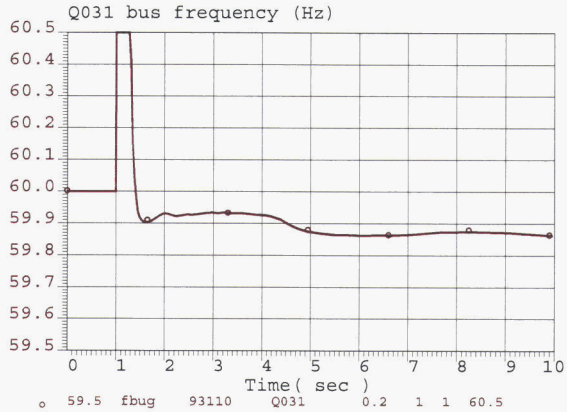








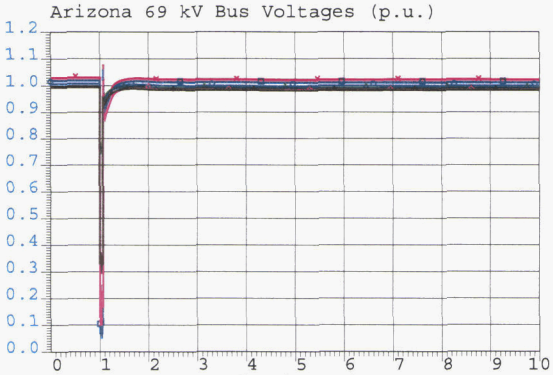




2011 Heavy Summer Power Flow/Transient Stability Case
Gila Bend/Gila River Cluster SIS Post-Project R3 Case 2 Q031 @ 102 MW
3-phase 4 cycle flt. @ Gila River 500 kV, trip Gila River-Jojoba 1 & 2 500 kV

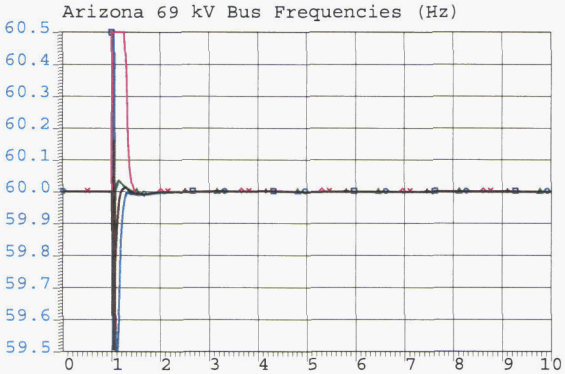
Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots

Arizona 69 kV Bus Voltages (p.u.)



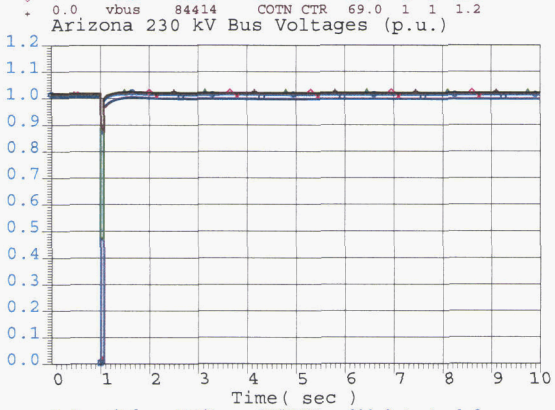
0.0	vbus	84419	GILABEND	69.0	1	1	1.2
0.0	vbus	84432	PALOMA	69.0	1	1	1.2
0.0	vbus	84411	BUNYAN	69.0	1	1	1.2
0.0	vbus	84442	SADDLEMT	69.0	1	1	1.2
0.0	vbus	84460	HY1	69.0	1	1	1.2
0.0	vbus	84414	COTN CTR	69.0	1	1	1.2

Arizona 69 kV Bus Frequencies (Hz)



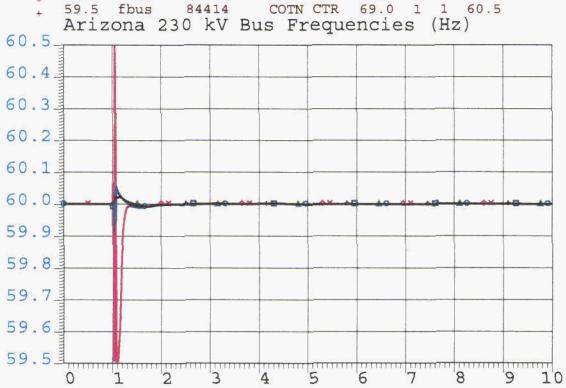
59.5	fbus	84419	GILABEND	69.0	1	1	60.5
59.5	fbus	84432	PALOMA	69.0	1	1	60.5
59.5	fbus	84411	BUNYAN	69.0	1	1	60.5
59.5	fbus	84442	SADDLEMT	69.0	1	1	60.5
59.5	fbus	84460	HY1	69.0	1	1	60.5
59.5	fbus	84414	COTN CTR	69.0	1	1	60.5

Arizona 230 kV Bus Voltages (p.u.)



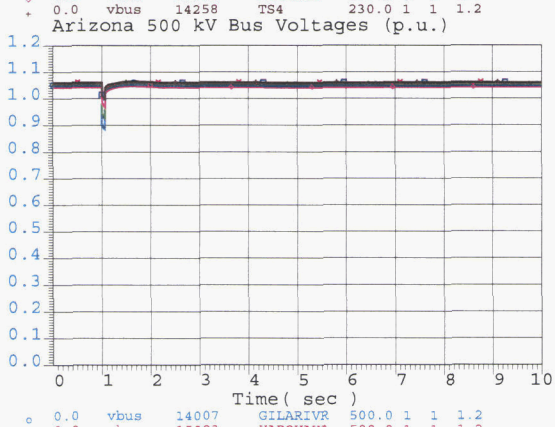
0.0	vbul	14201	BUCKEYE	230.0	1	1	1.2
0.0	vbul	14235	GILABEND	230.0	1	1	1.2
0.0	vbus	14238	GILARIVR	230.0	1	1	1.2
0.0	vbus	14224	JOJOBA	230.0	1	1	1.2
0.0	vbus	19052	LIBERTY	230.0	1	1	1.2
0.0	vbus	14258	TS4	230.0	1	1	1.2

Arizona 230 kV Bus Frequencies (Hz)



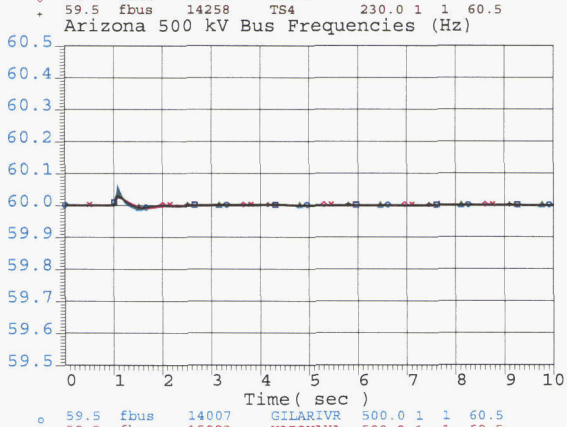
59.5	fbul	14201	BUCKEYE	230.0	1	1	60.5
59.5	fbul	14235	GILABEND	230.0	1	1	60.5
59.5	fbus	14238	GILARIVR	230.0	1	1	60.5
59.5	fbus	14224	JOJOBA	230.0	1	1	60.5
59.5	fbus	19052	LIBERTY	230.0	1	1	60.5
59.5	fbus	14258	TS4	230.0	1	1	60.5

Arizona 500 kV Bus Voltages (p.u.)



0.0	vbus	14007	GILARIVR	500.0	1	1	1.2
0.0	vbus	15093	HARQUAHA	500.0	1	1	1.2
0.0	vbus	15090	HASSYAMP	500.0	1	1	1.2
0.0	vbus	15089	JOJOBA	500.0	1	1	1.2
0.0	vbus	15011	KYRENE	500.0	1	1	1.2
0.0	vbus	15021	PALOVRDE	500.0	1	1	1.2

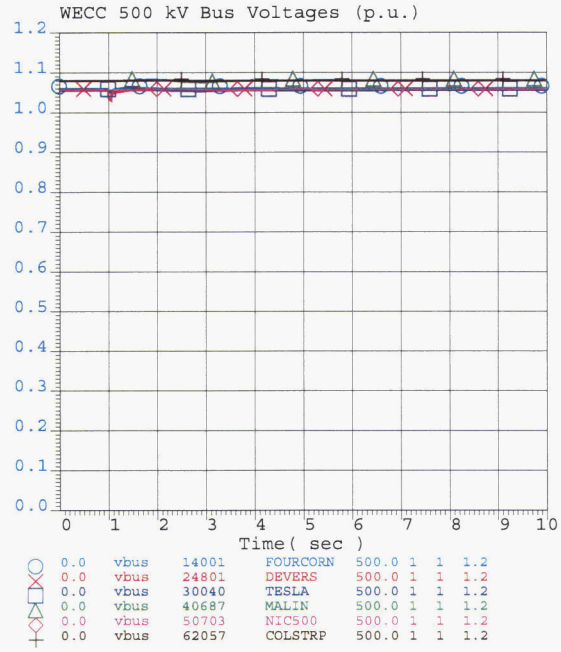
Arizona 500 kV Bus Frequencies (Hz)

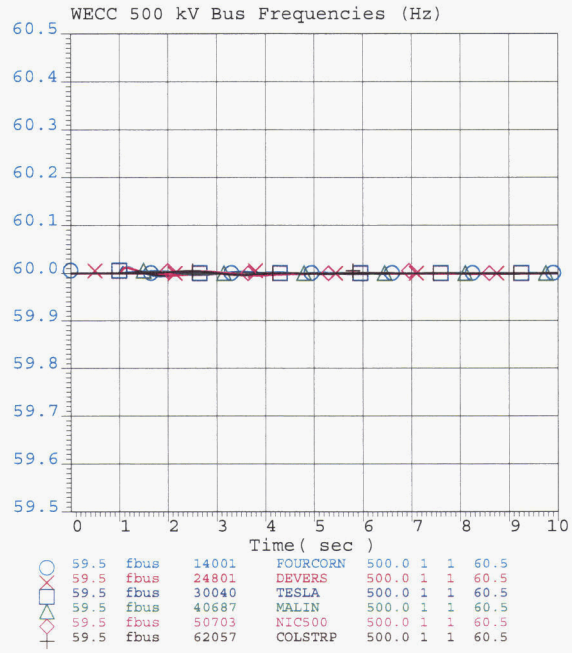


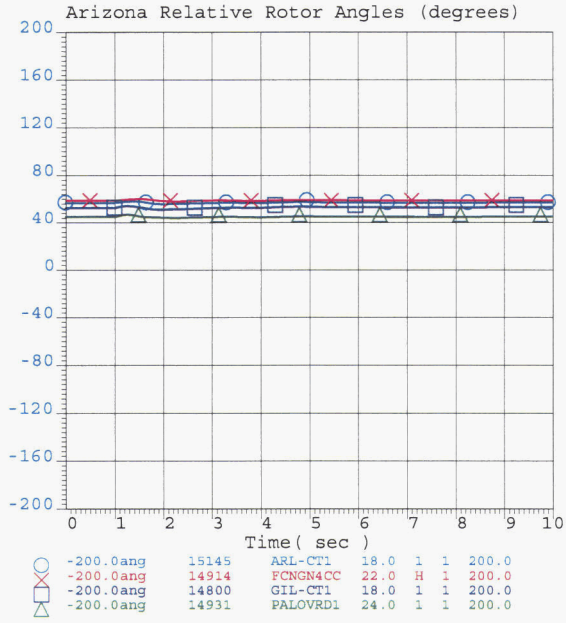
59.5	fbus	14007	GILARIVR	500.0	1	1	60.5
59.5	fbus	15093	HARQUAHA	500.0	1	1	60.5
59.5	fbus	15090	HASSYAMP	500.0	1	1	60.5
59.5	fbus	15089	JOJOBA	500.0	1	1	60.5
59.5	fbus	15011	KYRENE	500.0	1	1	60.5
59.5	fbus	15021	PALOVRDE	500.0	1	1	60.5

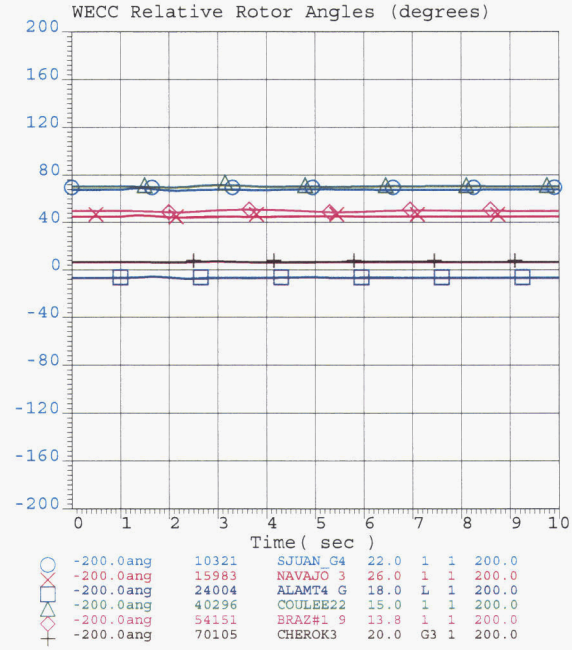
2011 Heavy Summer Power Flow/Transient Stability Case
Gila Bend/Gila River Cluster SIS Post-Project R3 Case 2 Q031 @ 102 MW
3-phase 4 cycle flt. @ Gila River 230 kV, trip Gila River-Jojoba 230 kV

Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots



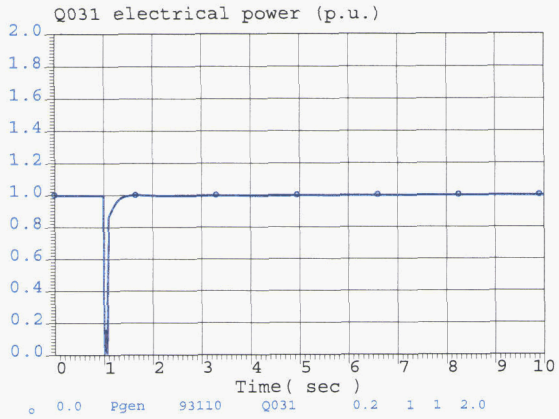


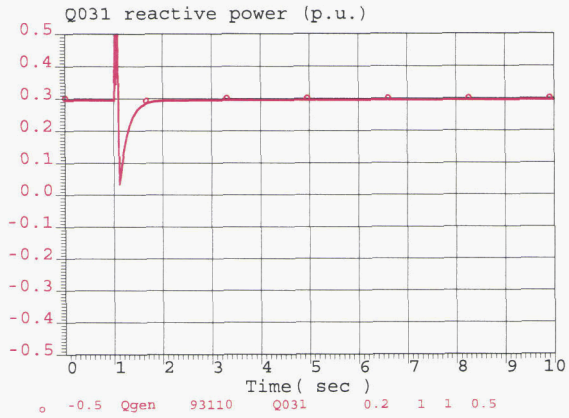


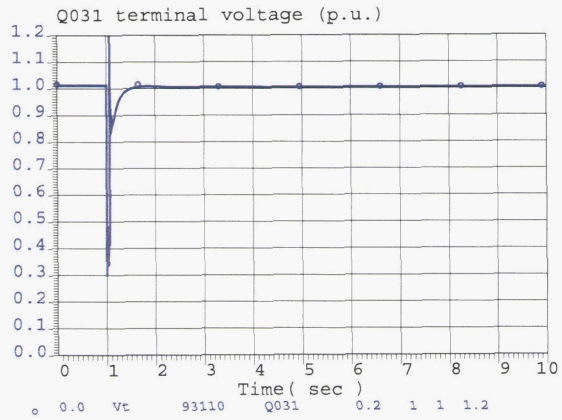


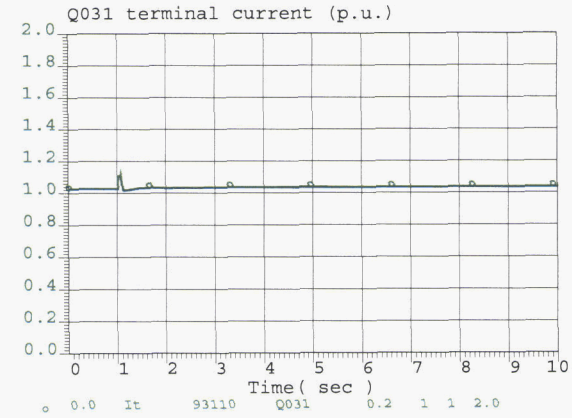
2011 Heavy Summer Power Flow/Transient Stability Case
Gila Bend/Gila River Cluster SIS Post-Project R3 Case 2 Q031 @ 102 MW
3-phase 4 cycle flt. @ Gila River 230 kV, trip Gila River-Jojoba 230 kV

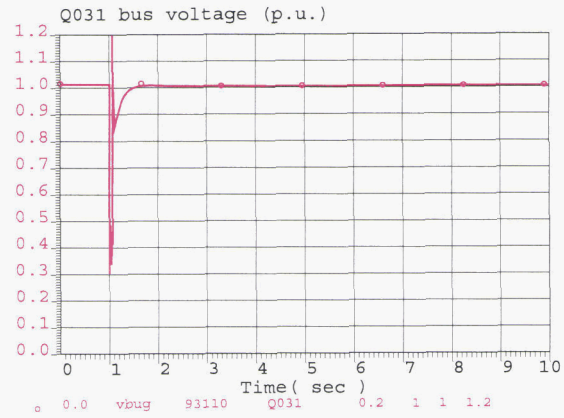
Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots

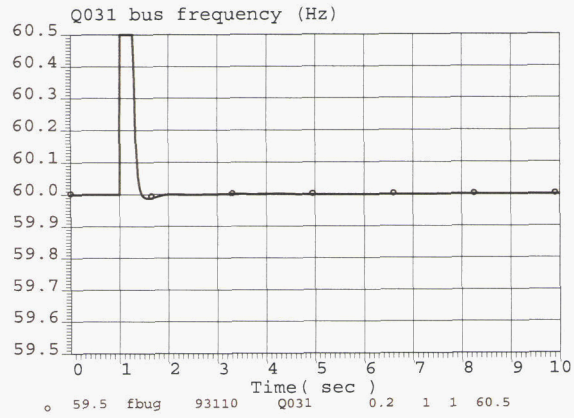








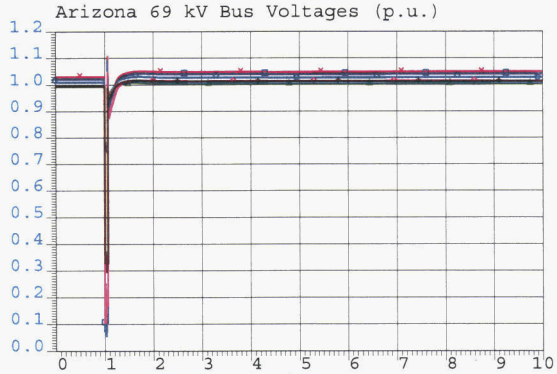




2011 Heavy Summer Power Flow/Transient Stability Case
Gila Bend/Gila River Cluster SIS Post-Project R3 Case 2 Q031 @ 102 MW
3-phase 4 cycle flt. @ Gila River 230 kV, trip Gila River-Jojoba 230 kV

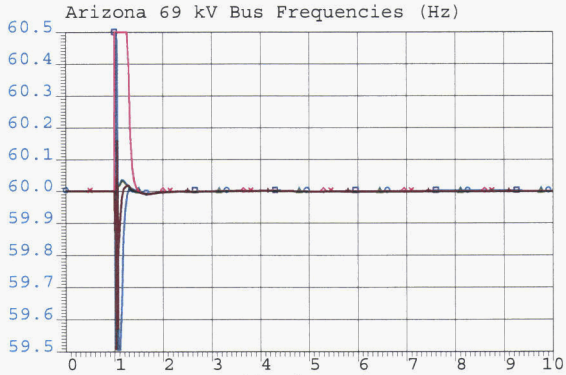
Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots

Arizona 69 kV Bus Voltages (p.u.)



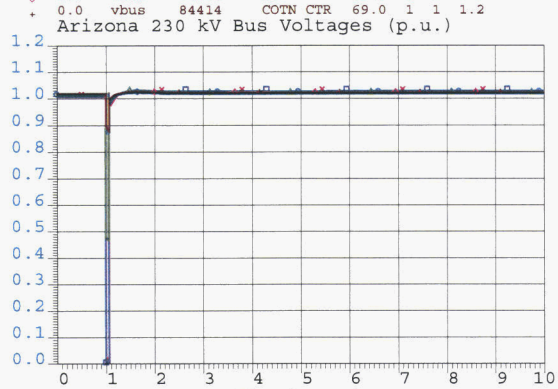
0.0	vbus	84419	GILABEND	69.0	1	1	1.2
0.0	vbus	84432	PALOMA	69.0	1	1	1.2
0.0	vbus	84411	BUNYAN	69.0	1	1	1.2
0.0	vbus	84442	SADDLEMT	69.0	1	1	1.2
0.0	vbus	84460	HY1	69.0	1	1	1.2
0.0	vbus	84414	COTN CTR	69.0	1	1	1.2

Arizona 69 kV Bus Frequencies (Hz)



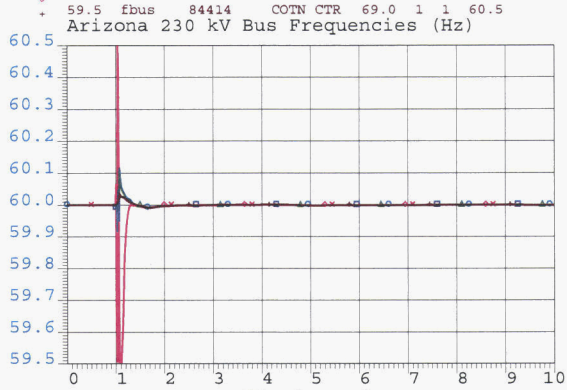
59.5	fbus	84419	GILABEND	69.0	1	1	60.5
59.5	fbus	84432	PALOMA	69.0	1	1	60.5
59.5	fbus	84411	BUNYAN	69.0	1	1	60.5
59.5	fbus	84442	SADDLEMT	69.0	1	1	60.5
59.5	fbus	84460	HY1	69.0	1	1	60.5
59.5	fbus	84414	COTN CTR	69.0	1	1	60.5

Arizona 230 kV Bus Voltages (p.u.)



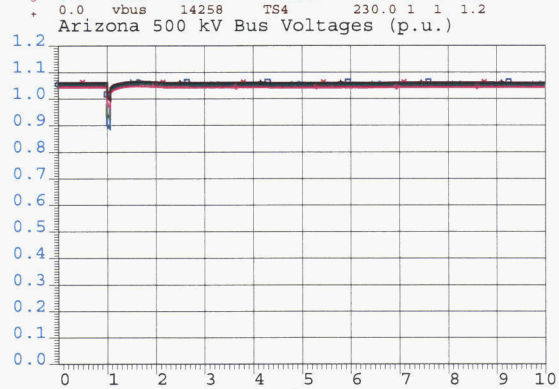
0.0	vbul	14201	BUCKEYE	230.0	1	1	1.2
0.0	vbul	14235	GILABEND	230.0	1	1	1.2
0.0	vbus	14238	GILARIVR	230.0	1	1	1.2
0.0	vbus	14224	JOJOBA	230.0	1	1	1.2
0.0	vbus	19052	LIBERTY	230.0	1	1	1.2
0.0	vbus	14258	TS4	230.0	1	1	1.2

Arizona 230 kV Bus Frequencies (Hz)



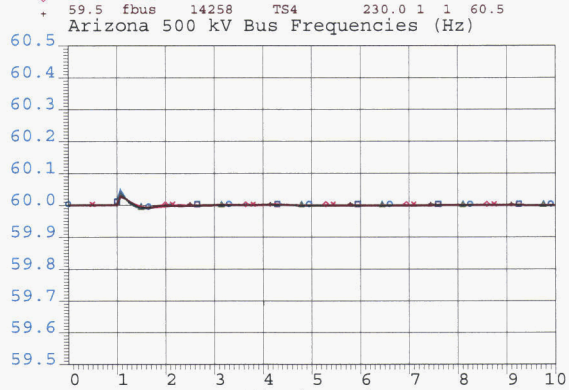
59.5	fbul	14201	BUCKEYE	230.0	1	1	60.5
59.5	fbul	14235	GILABEND	230.0	1	1	60.5
59.5	fbus	14238	GILARIVR	230.0	1	1	60.5
59.5	fbus	14224	JOJOBA	230.0	1	1	60.5
59.5	fbus	19052	LIBERTY	230.0	1	1	60.5
59.5	fbus	14258	TS4	230.0	1	1	60.5

Arizona 500 kV Bus Voltages (p.u.)



0.0	vbus	14007	GILARIVR	500.0	1	1	1.2
0.0	vbus	15093	HARQUAHA	500.0	1	1	1.2
0.0	vbus	15090	HASSYAMP	500.0	1	1	1.2
0.0	vbus	15089	JOJOBA	500.0	1	1	1.2
0.0	vbus	15011	KYRENE	500.0	1	1	1.2
0.0	vbus	15021	PALOVRDE	500.0	1	1	1.2

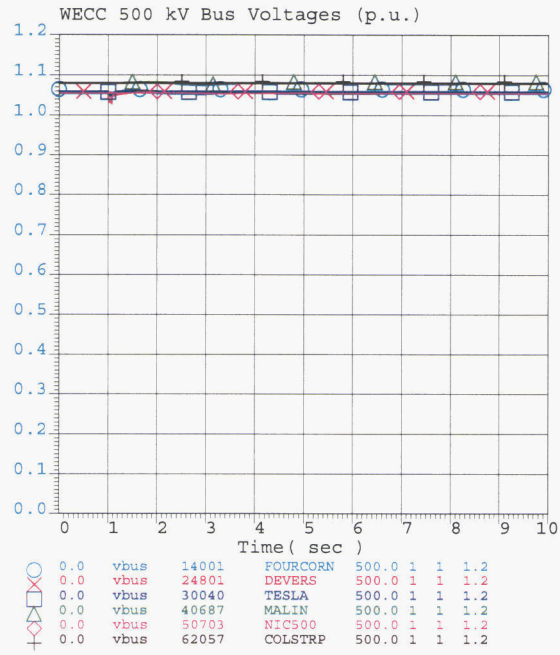
Arizona 500 kV Bus Frequencies (Hz)

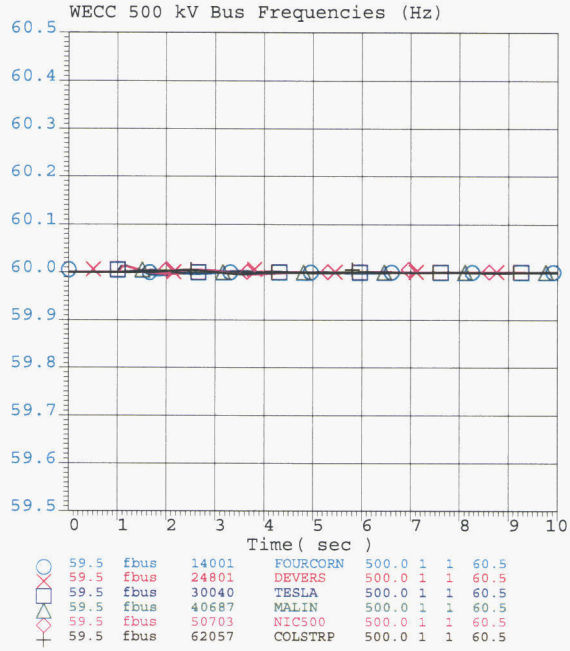


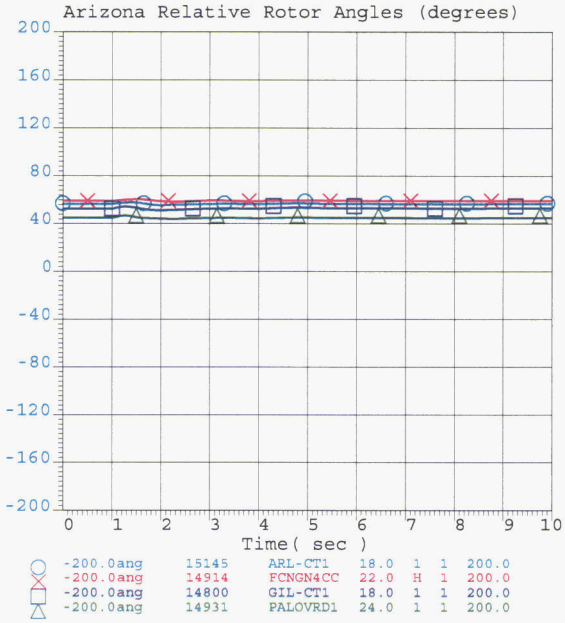
59.5	fbus	14007	GILARIVR	500.0	1	1	60.5
59.5	fbus	15093	HARQUAHA	500.0	1	1	60.5
59.5	fbus	15090	HASSYAMP	500.0	1	1	60.5
59.5	fbus	15089	JOJOBA	500.0	1	1	60.5
59.5	fbus	15011	KYRENE	500.0	1	1	60.5
59.5	fbus	15021	PALOVRDE	500.0	1	1	60.5

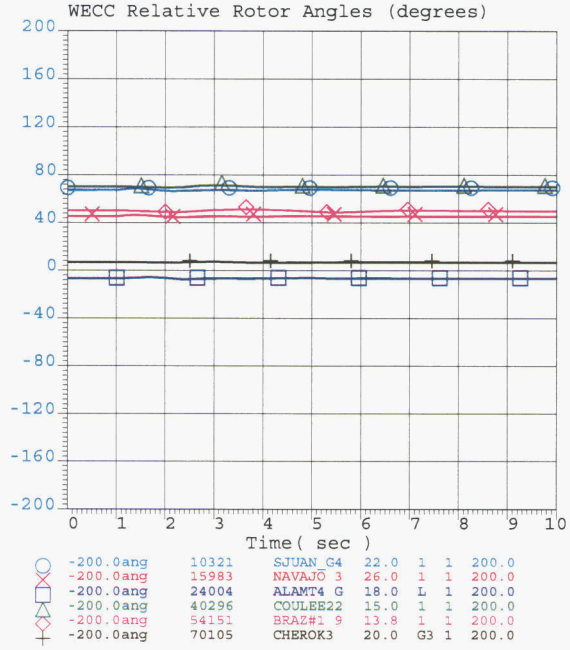
2011 Heavy Summer Power Flow/Transient Stability Case
Gila Bend/Gila River Cluster SIS Post-Project R3 Case 2 Q031 @ 102 MW
3-phase 4 cycle flt. @ Gila River 230 kV, trip Gila River 500/230 kV xfmr

Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots



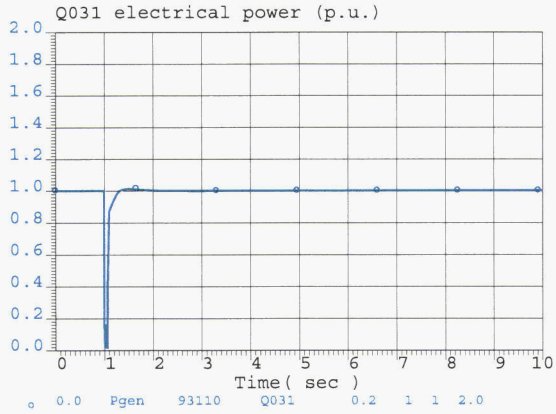


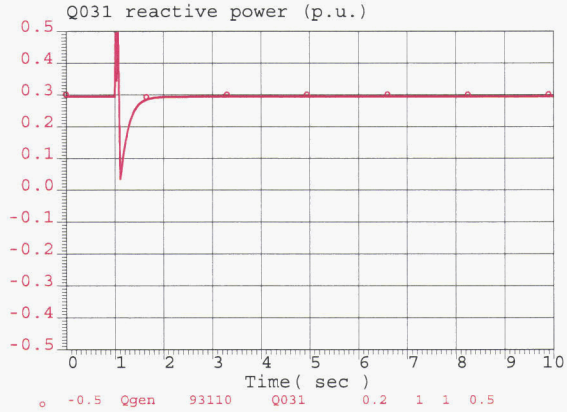


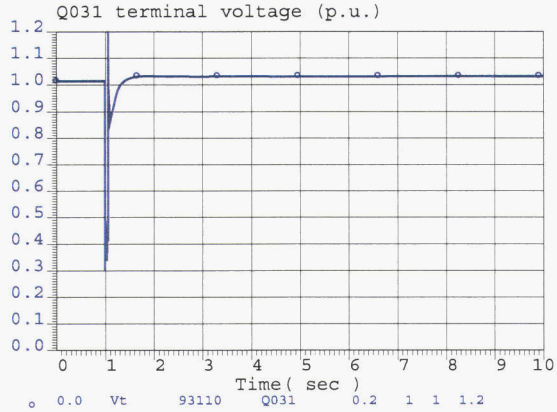


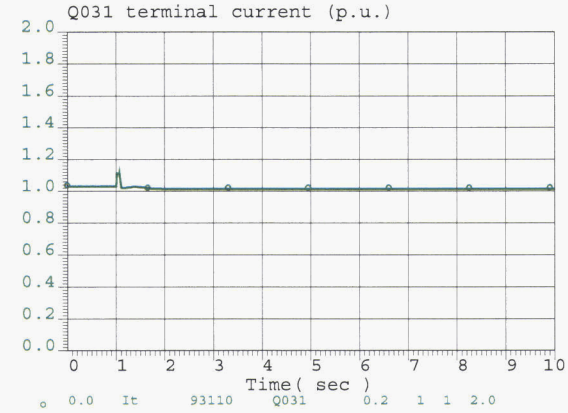
2011 Heavy Summer Power Flow/Transient Stability Case
Gila Bend/Gila River Cluster SIS Post-Project R3 Case 2 Q031 @ 102 MW
3-phase 4 cycle flt. @ Gila River 230 kV, trip Gila River 500/230 kV xfmr

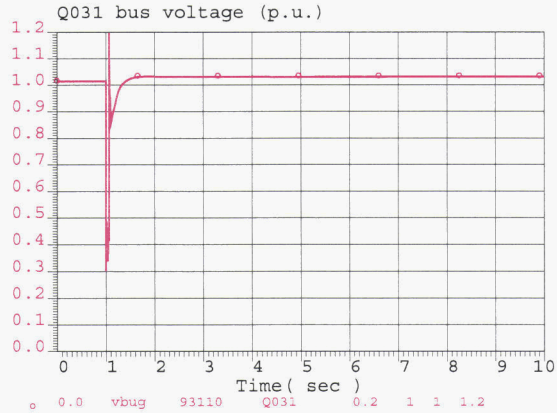
Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots

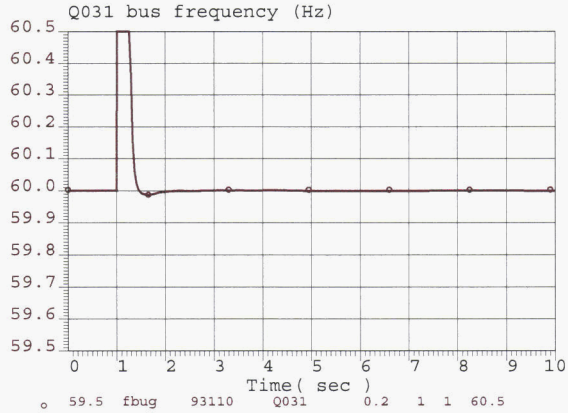








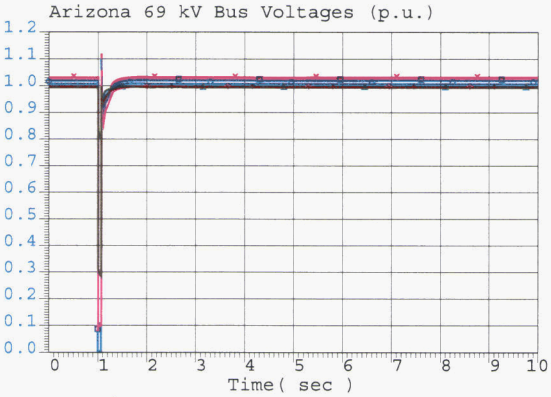




2011 Heavy Summer Power Flow/Transient Stability Case
Gila Bend/Gila River Cluster SIS Post-Project R3 Case 2 Q031 @ 102 MW
3-phase 4 cycle flt. @ Gila River 230 kV, trip Gila River 500/230 kV xfmr

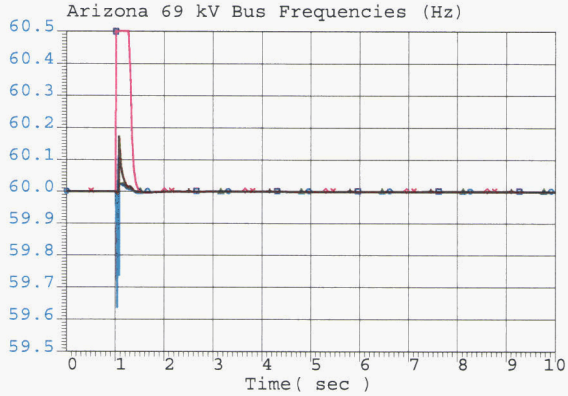
Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots

Arizona 69 kV Bus Voltages (p.u.)



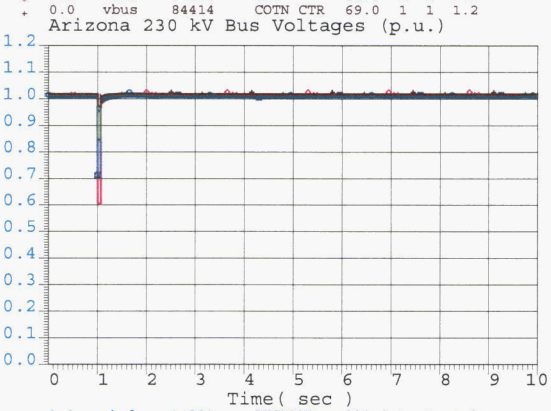
○	0.0	vbus	84419	GILABEND	69.0	1	1	1.2
×	0.0	vbus	84432	PALOMA	69.0	1	1	1.2
□	0.0	vbus	84411	BUNYAN	69.0	1	1	1.2
△	0.0	vbus	84442	SADDLEMT	69.0	1	1	1.2
◇	0.0	vbus	84460	HY1	69.0	1	1	1.2
+	0.0	vbus	84414	COTN CTR	69.0	1	1	1.2

Arizona 69 kV Bus Frequencies (Hz)



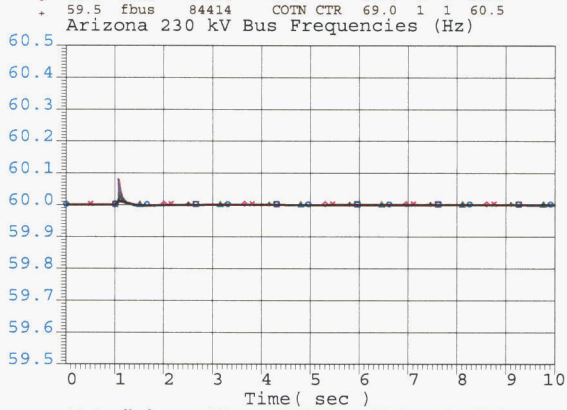
○	59.5	fbus	84419	GILABEND	69.0	1	1	60.5
×	59.5	fbus	84432	PALOMA	69.0	1	1	60.5
□	59.5	fbus	84411	BUNYAN	69.0	1	1	60.5
△	59.5	fbus	84442	SADDLEMT	69.0	1	1	60.5
◇	59.5	fbus	84460	HY1	69.0	1	1	60.5
+	59.5	fbus	84414	COTN CTR	69.0	1	1	60.5

Arizona 230 kV Bus Voltages (p.u.)



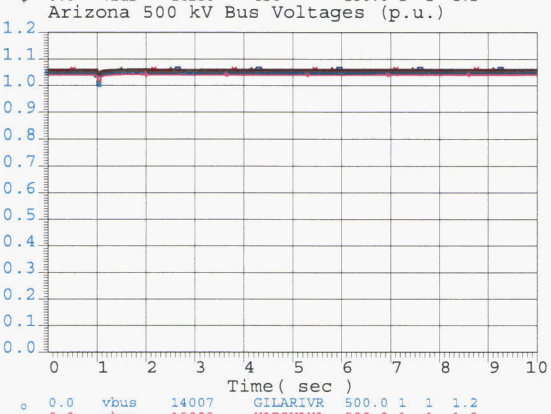
○	0.0	vbul	14201	BUCKEYE	230.0	1	1	1.2
×	0.0	vbul	14235	GILABEND	230.0	1	1	1.2
□	0.0	vbus	14238	GILARIVR	230.0	1	1	1.2
△	0.0	vbus	14224	JOJOBA	230.0	1	1	1.2
◇	0.0	vbus	19052	LIBERTY	230.0	1	1	1.2
+	0.0	vbus	14258	TS4	230.0	1	1	1.2

Arizona 230 kV Bus Frequencies (Hz)



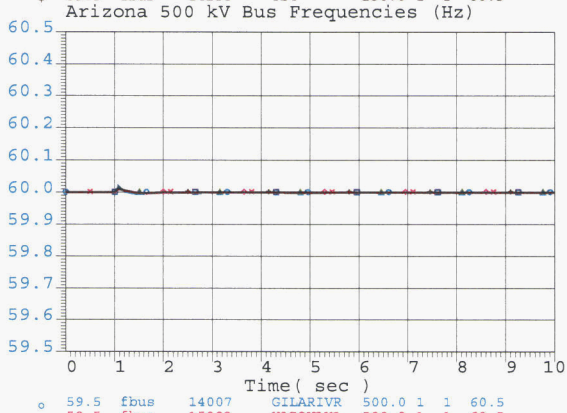
○	59.5	fbul	14201	BUCKEYE	230.0	1	1	60.5
×	59.5	fbul	14235	GILABEND	230.0	1	1	60.5
□	59.5	fbus	14238	GILARIVR	230.0	1	1	60.5
△	59.5	fbus	14224	JOJOBA	230.0	1	1	60.5
◇	59.5	fbus	19052	LIBERTY	230.0	1	1	60.5
+	59.5	fbus	14258	TS4	230.0	1	1	60.5

Arizona 500 kV Bus Voltages (p.u.)



○	0.0	vbus	14007	GILARIVR	500.0	1	1	1.2
×	0.0	vbus	15093	HARQUAHA	500.0	1	1	1.2
□	0.0	vbus	15090	HASSYAMP	500.0	1	1	1.2
△	0.0	vbus	15089	JOJOBA	500.0	1	1	1.2
◇	0.0	vbus	15011	KYRENE	500.0	1	1	1.2
+	0.0	vbus	15021	PALOVRDE	500.0	1	1	1.2

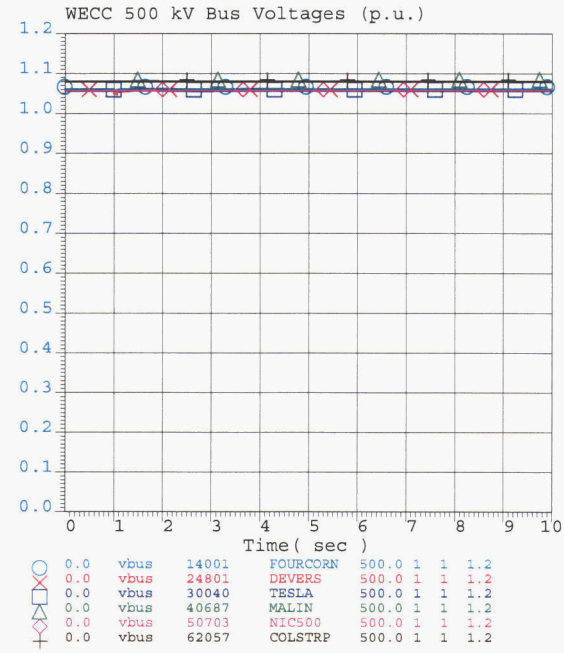
Arizona 500 kV Bus Frequencies (Hz)

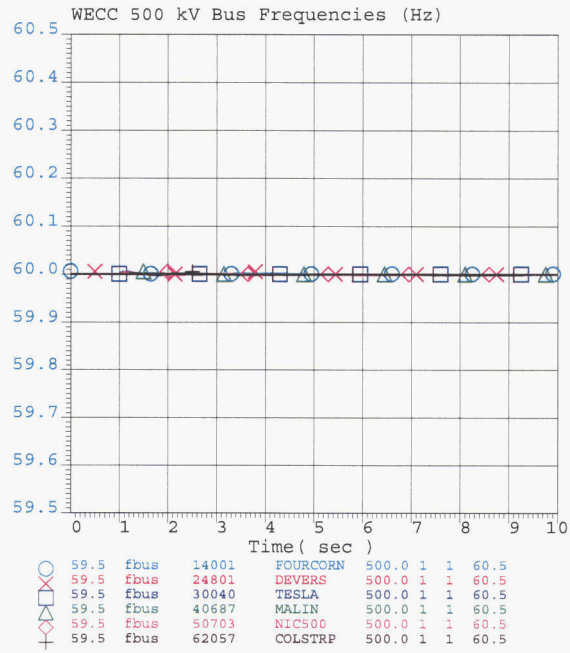


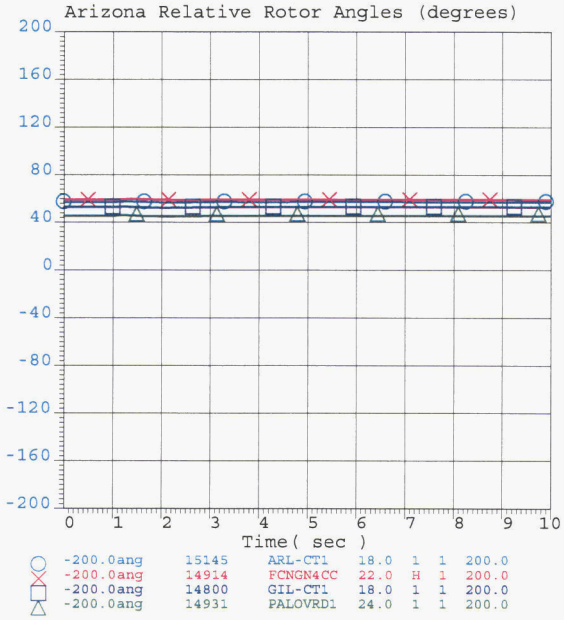
○	59.5	fbus	14007	GILARIVR	500.0	1	1	60.5
×	59.5	fbus	15093	HARQUAHA	500.0	1	1	60.5
□	59.5	fbus	15090	HASSYAMP	500.0	1	1	60.5
△	59.5	fbus	15089	JOJOBA	500.0	1	1	60.5
◇	59.5	fbus	15011	KYRENE	500.0	1	1	60.5
+	59.5	fbus	15021	PALOVRDE	500.0	1	1	60.5

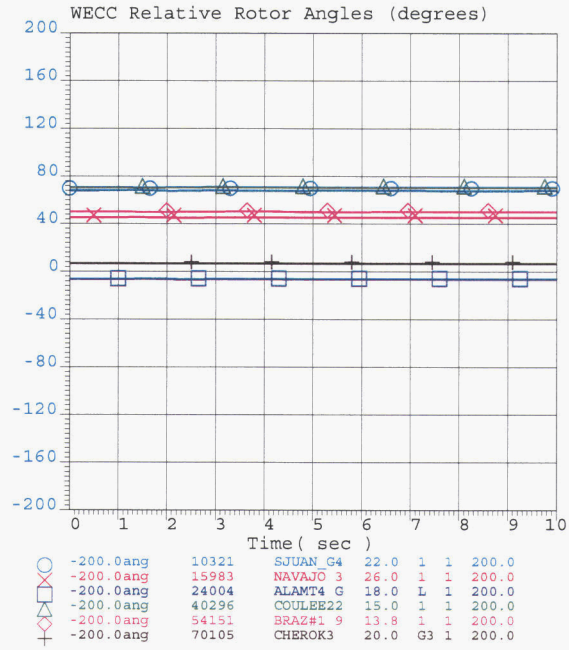
2011 Heavy Summer Power Flow/Transient Stability Case
Gila Bend/Gila River Cluster SIS Post-Project R3 Case 2 Q031 @ 102 MW
3-phase 7 cycle flt. @ Gila Bend 69 kV, trip Gila Bend 230/69 kV xfmr 1

Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots



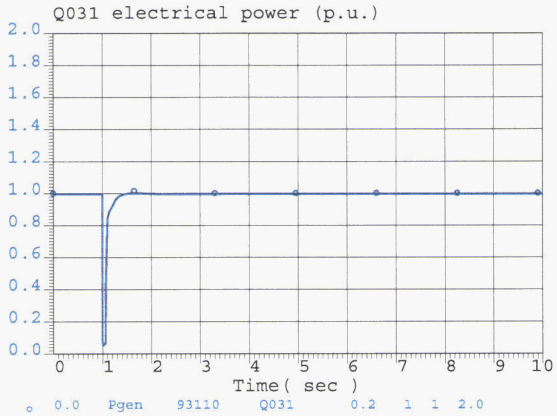


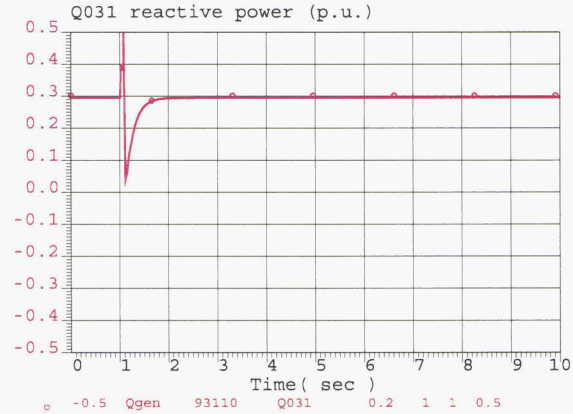


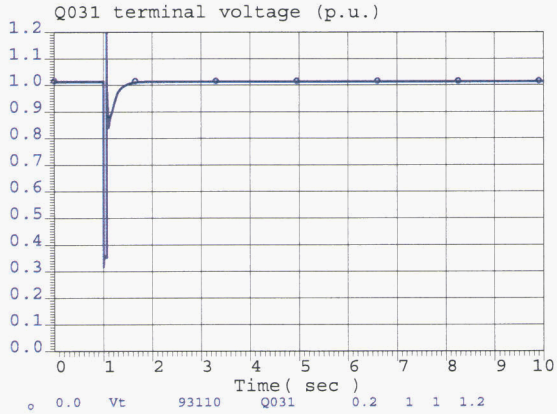


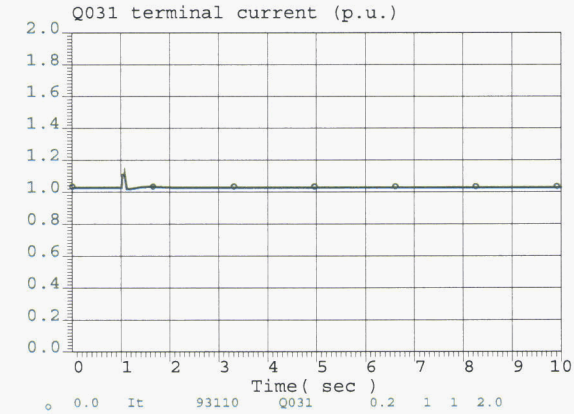
2011 Heavy Summer Power Flow/Transient Stability Case
Gila Bend/Gila River Cluster SIS Post-Project R3 Case 2 Q031 @ 102 MW
3-phase 7 cycle flt. @ Gila Bend 69 kV, trip Gila Bend 230/69 kV xfmr 1

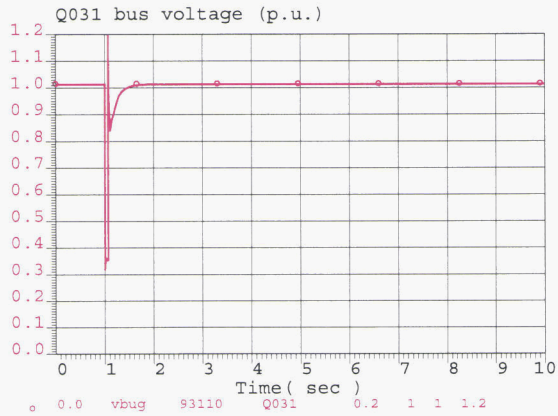
Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots

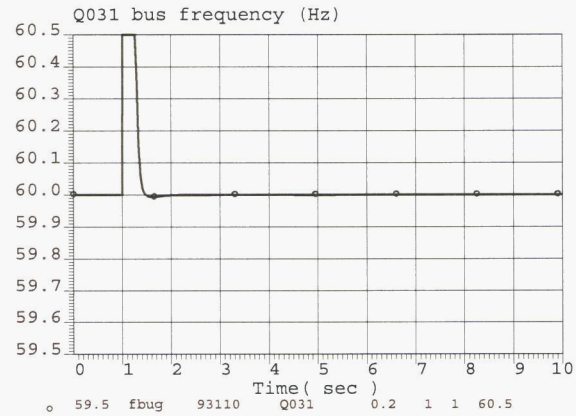








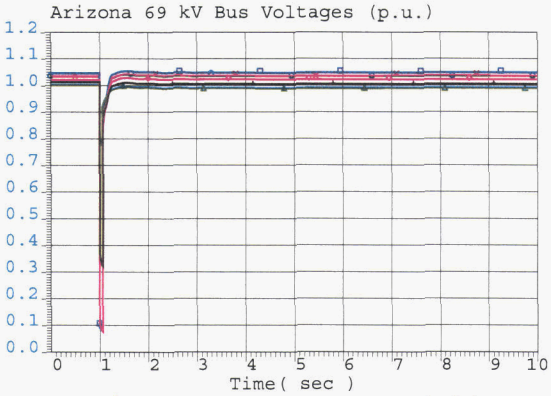




2011 Heavy Summer Power Flow/Transient Stability Case
Gila Bend/Gila River Cluster SIS Post-Project R3 Case 2 Q031 @ 102 MW
3-phase 7 cycle flt. @ Gila Bend 69 kV, trip Gila Bend 230/69 kV xfmr 1

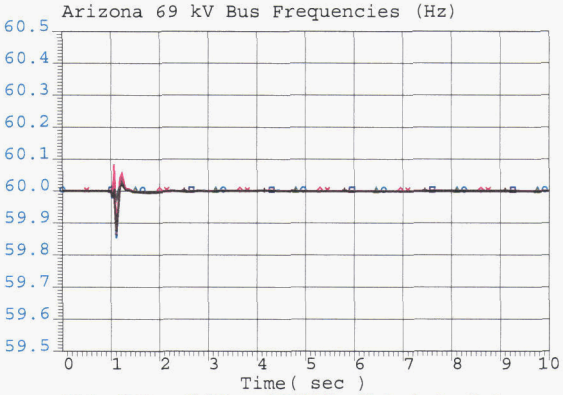
Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots

Arizona 69 kV Bus Voltages (p.u.)



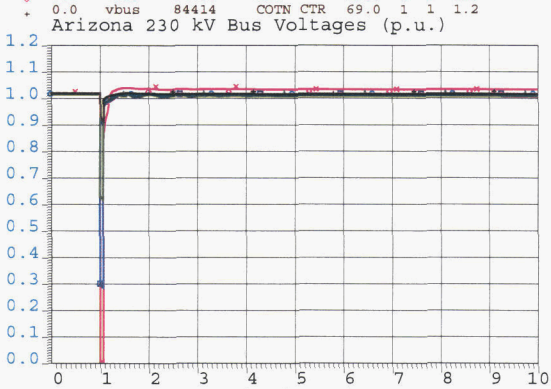
0.0	vbus	84419	GILABEND	69.0	1	1	1.2
0.0	vbus	84432	PALOMA	69.0	1	1	1.2
0.0	vbus	84411	BUNYAN	69.0	1	1	1.2
0.0	vbus	84442	SADDLEMT	69.0	1	1	1.2
0.0	vbus	84460	HY1	69.0	1	1	1.2
0.0	vbus	84414	COTN CTR	69.0	1	1	1.2

Arizona 69 kV Bus Frequencies (Hz)



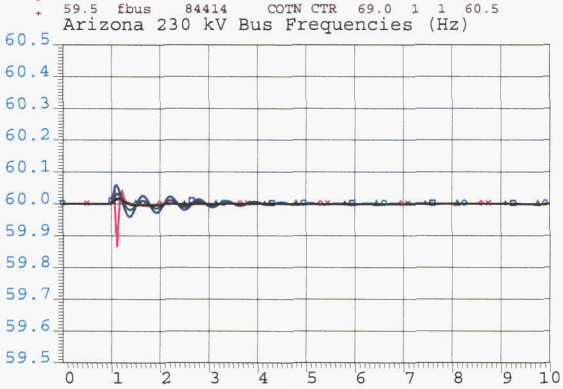
59.5	fbus	84419	GILABEND	69.0	1	1	60.5
59.5	fbus	84432	PALOMA	69.0	1	1	60.5
59.5	fbus	84411	BUNYAN	69.0	1	1	60.5
59.5	fbus	84442	SADDLEMT	69.0	1	1	60.5
59.5	fbus	84460	HY1	69.0	1	1	60.5
59.5	fbus	84414	COTN CTR	69.0	1	1	60.5

Arizona 230 kV Bus Voltages (p.u.)



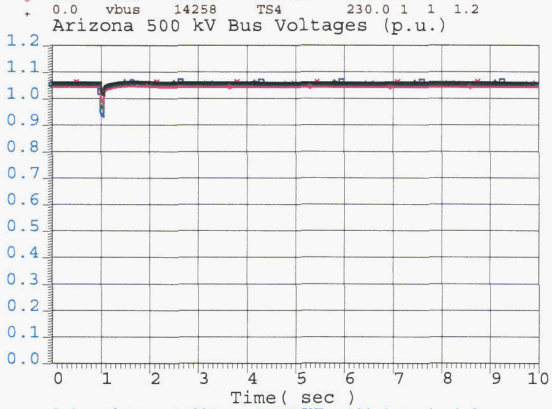
0.0	vbul	14201	BUCKEYE	230.0	1	1	1.2
0.0	vbul	14235	GILABEND	230.0	1	1	1.2
0.0	vbus	14238	GILARIVR	230.0	1	1	1.2
0.0	vbus	14224	JOJOBA	230.0	1	1	1.2
0.0	vbus	19052	LIBERTY	230.0	1	1	1.2
0.0	vbus	14258	TS4	230.0	1	1	1.2

Arizona 230 kV Bus Frequencies (Hz)



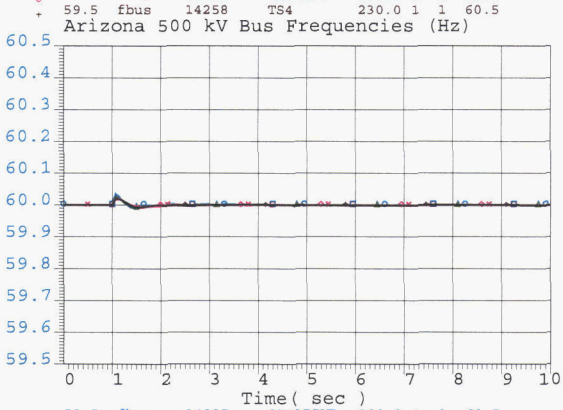
59.5	fbul	14201	BUCKEYE	230.0	1	1	60.5
59.5	fbul	14235	GILABEND	230.0	1	1	60.5
59.5	fbus	14238	GILARIVR	230.0	1	1	60.5
59.5	fbus	14224	JOJOBA	230.0	1	1	60.5
59.5	fbus	19052	LIBERTY	230.0	1	1	60.5
59.5	fbus	14258	TS4	230.0	1	1	60.5

Arizona 500 kV Bus Voltages (p.u.)



0.0	vbus	14007	GILARIVR	500.0	1	1	1.2
0.0	vbus	15093	HARQUAHA	500.0	1	1	1.2
0.0	vbus	15090	HASSYAMP	500.0	1	1	1.2
0.0	vbus	15089	JOJOBA	500.0	1	1	1.2
0.0	vbus	15011	KYRENE	500.0	1	1	1.2
0.0	vbus	15021	PALOVRDE	500.0	1	1	1.2

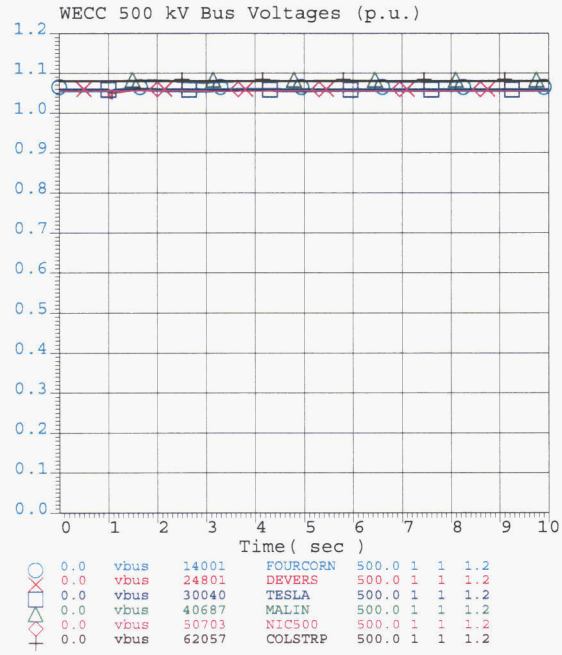
Arizona 500 kV Bus Frequencies (Hz)

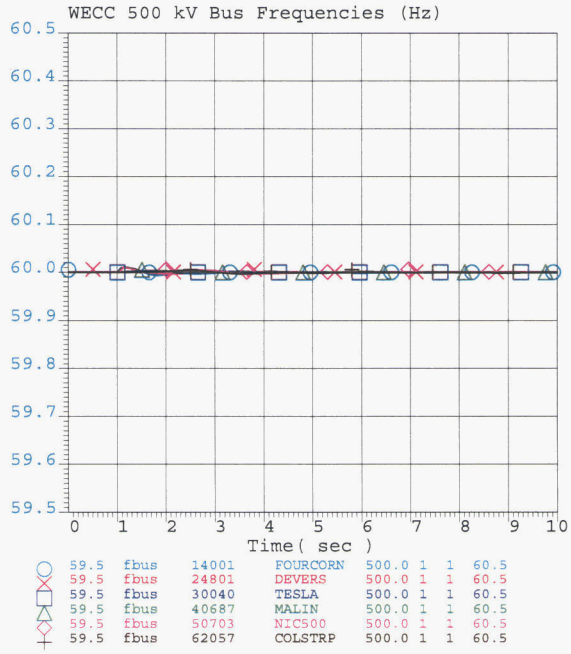


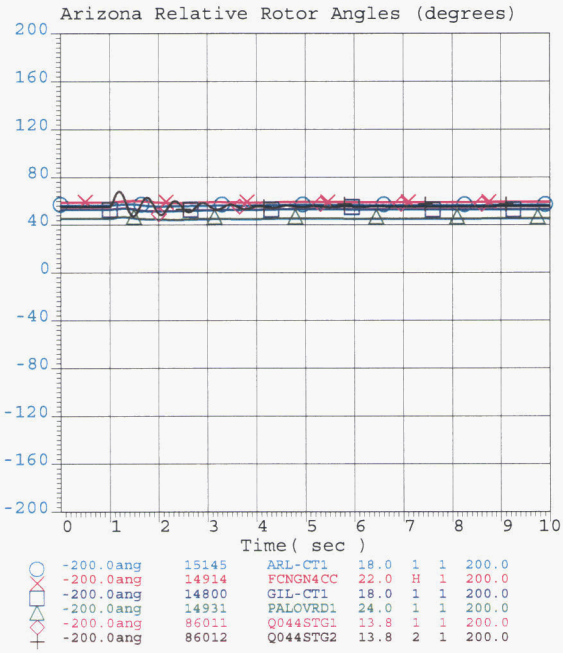
59.5	fbus	14007	GILARIVR	500.0	1	1	60.5
59.5	fbus	15093	HARQUAHA	500.0	1	1	60.5
59.5	fbus	15090	HASSYAMP	500.0	1	1	60.5
59.5	fbus	15089	JOJOBA	500.0	1	1	60.5
59.5	fbus	15011	KYRENE	500.0	1	1	60.5
59.5	fbus	15021	PALOVRDE	500.0	1	1	60.5

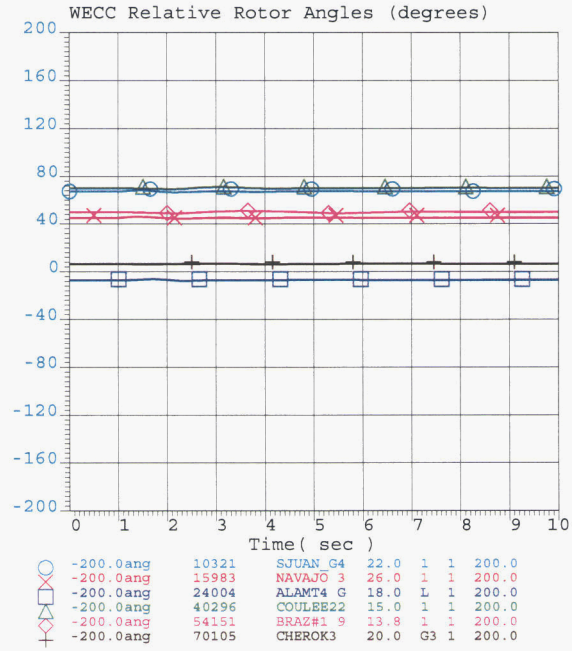
2011 Heavy Summer Power Flow/Transient Stability Case
Gila Bend/Gila River Cluster SIS Post-Project R3 Case 3 Q044 @ 280 MW
3-phase 4 cycle flt. @ Gila Bend 230 kV, trip Gila Bend-Gila River 230 kV

Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots





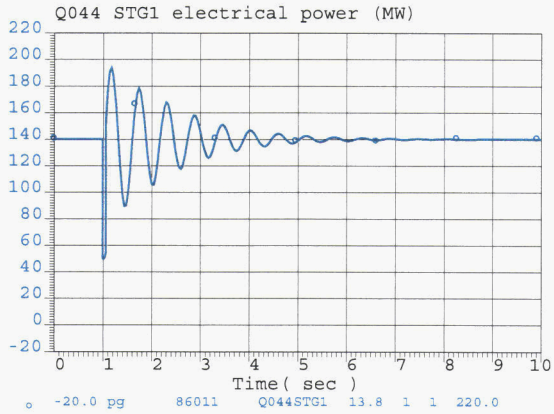


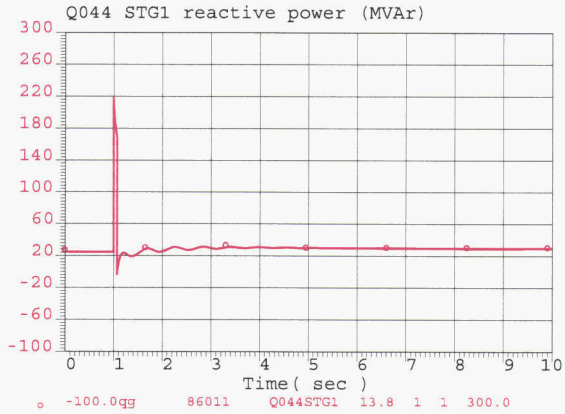


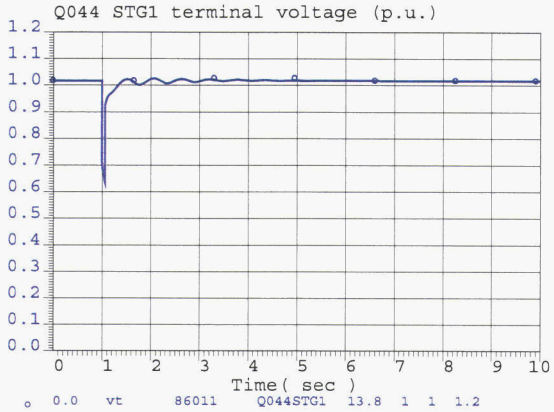
2011 Heavy Summer Power Flow/Transient Stability Case
Gila Bend/Gila River Cluster SIS Post-Project R3 Case 3 Q044 @ 280 MW
3-phase 4 cycle flt. @ Gila Bend 230 kV, trip Gila Bend-Gila River 230 kV

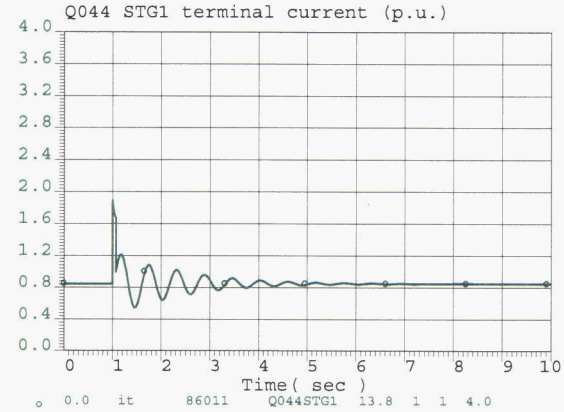
APS	11hs-gbgr-r3-pst3-dyn_swt01-gilabend-gilariver230-slo.chf	c:\work\aps\gbgr\sis\dyn Wed Jun 17 13:39:02 2009

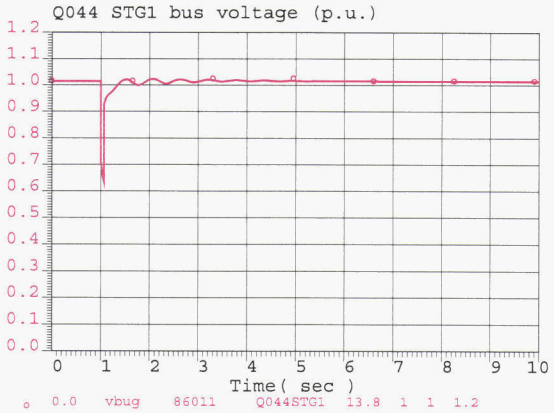
Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots

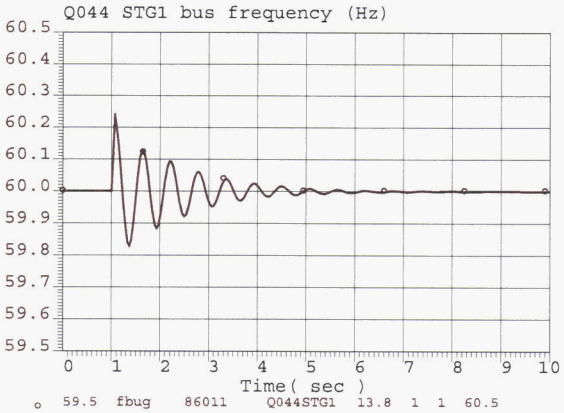










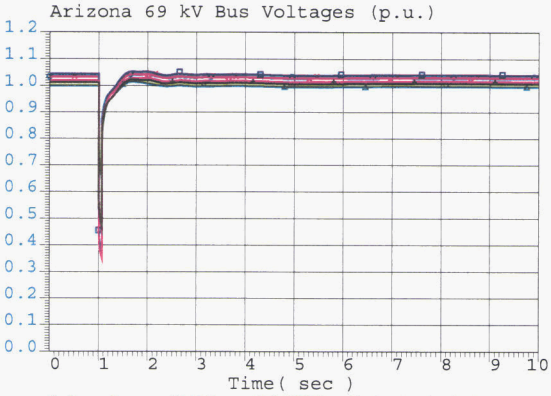


2011 Heavy Summer Power Flow/Transient Stability Case
Gila Bend/Gila River Cluster SIS Post-Project R3 Case 3 Q044 @ 280 MW
3-phase 4 cycle flt. @ Gila Bend 230 kV, trip Gila Bend-Gila River 230 kV

APS	11hs-gbgr-r3-pst3-dyn_swt01-gilabend-gilariver230-slo.chf	c:\work\aps\gbgr\sis\dyn Wed Jun 17 13:39:03 2009

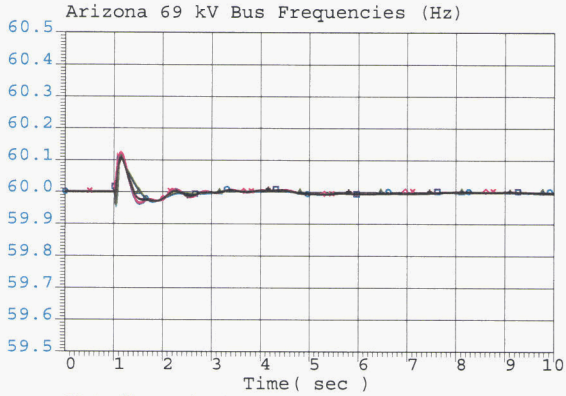
Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots

Arizona 69 kV Bus Voltages (p.u.)



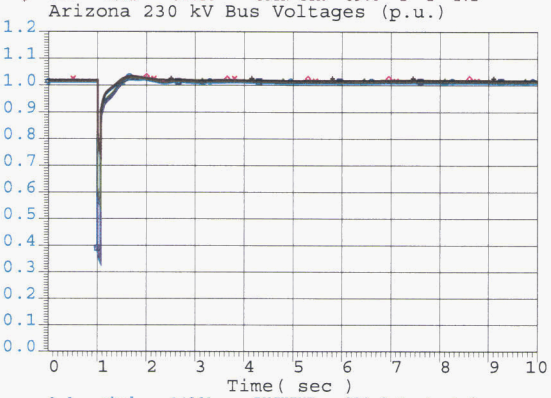
0.0	vbus	84419	GILABEND	69.0	1	1	1.2
0.0	vbus	84432	PALOMA	69.0	1	1	1.2
0.0	vbus	84411	BUNYAN	69.0	1	1	1.2
0.0	vbus	84442	SADDLEMT	69.0	1	1	1.2
0.0	vbus	84460	HY1	69.0	1	1	1.2
0.0	vbus	84414	COTN CTR	69.0	1	1	1.2

Arizona 69 kV Bus Frequencies (Hz)



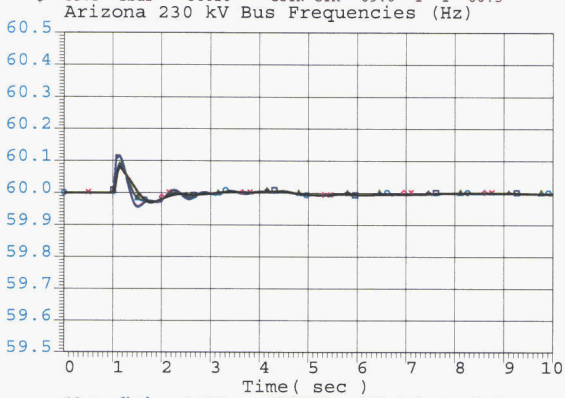
59.5	fbus	84419	GILABEND	69.0	1	1	60.5
59.5	fbus	84432	PALOMA	69.0	1	1	60.5
59.5	fbus	84411	BUNYAN	69.0	1	1	60.5
59.5	fbus	84442	SADDLEMT	69.0	1	1	60.5
59.5	fbus	84460	HY1	69.0	1	1	60.5
59.5	fbus	84414	COTN CTR	69.0	1	1	60.5

Arizona 230 kV Bus Voltages (p.u.)



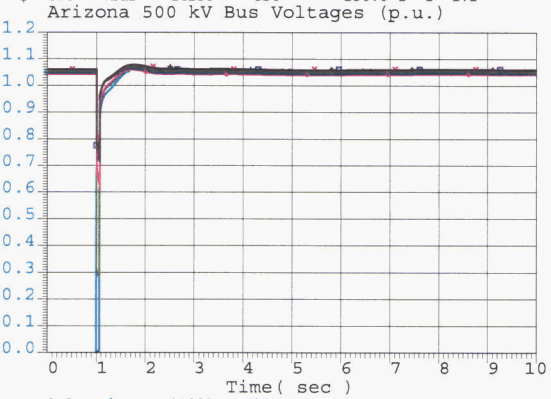
0.0	vbul	14201	BUCKEYE	230.0	1	1	1.2
0.0	vbul	14235	GILABEND	230.0	1	1	1.2
0.0	vbus	14238	GILARIVR	230.0	1	1	1.2
0.0	vbus	14224	JOJOBA	230.0	1	1	1.2
0.0	vbus	19052	LIBERTY	230.0	1	1	1.2
0.0	vbus	14258	TS4	230.0	1	1	1.2

Arizona 230 kV Bus Frequencies (Hz)



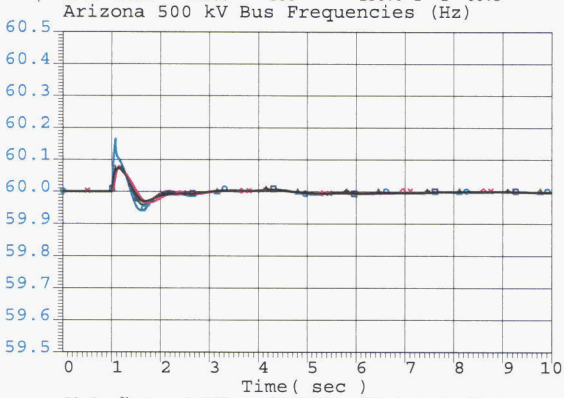
59.5	fbul	14201	BUCKEYE	230.0	1	1	60.5
59.5	fbul	14235	GILABEND	230.0	1	1	60.5
59.5	fbus	14238	GILARIVR	230.0	1	1	60.5
59.5	fbus	14224	JOJOBA	230.0	1	1	60.5
59.5	fbus	19052	LIBERTY	230.0	1	1	60.5
59.5	fbus	14258	TS4	230.0	1	1	60.5

Arizona 500 kV Bus Voltages (p.u.)



0.0	vbus	14007	GILARIVR	500.0	1	1	1.2
0.0	vbus	15093	HARQUAHA	500.0	1	1	1.2
0.0	vbus	15090	HASSYAMP	500.0	1	1	1.2
0.0	vbus	15089	JOJOBA	500.0	1	1	1.2
0.0	vbus	15011	KYRENE	500.0	1	1	1.2
0.0	vbus	15021	PALOVRDE	500.0	1	1	1.2

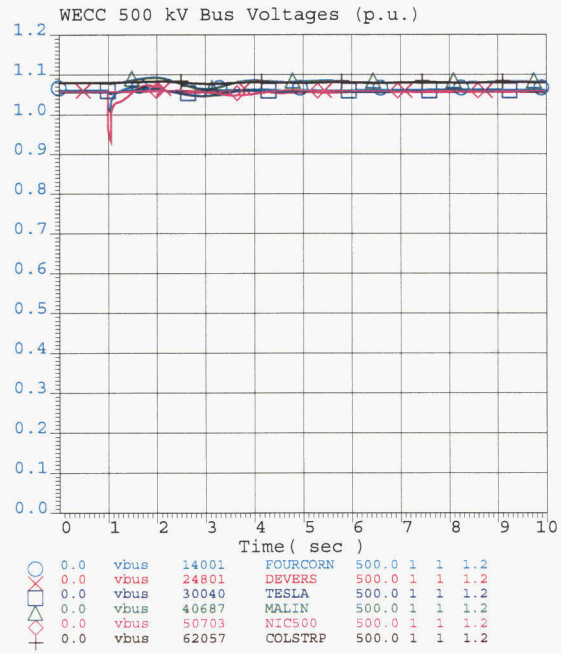
Arizona 500 kV Bus Frequencies (Hz)

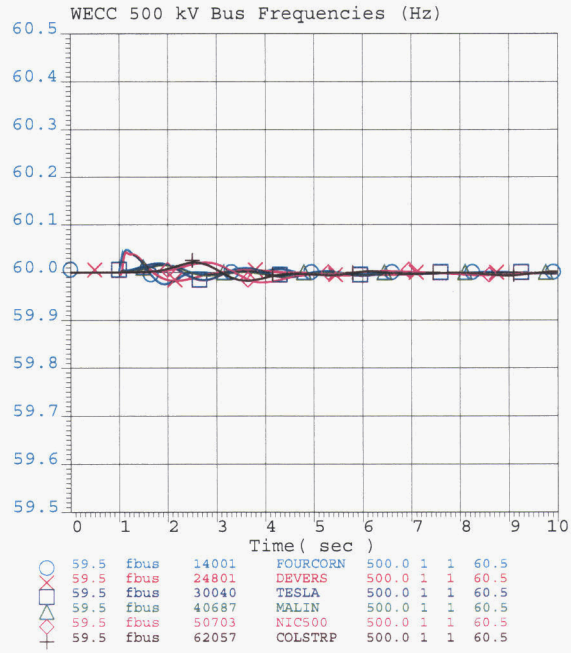


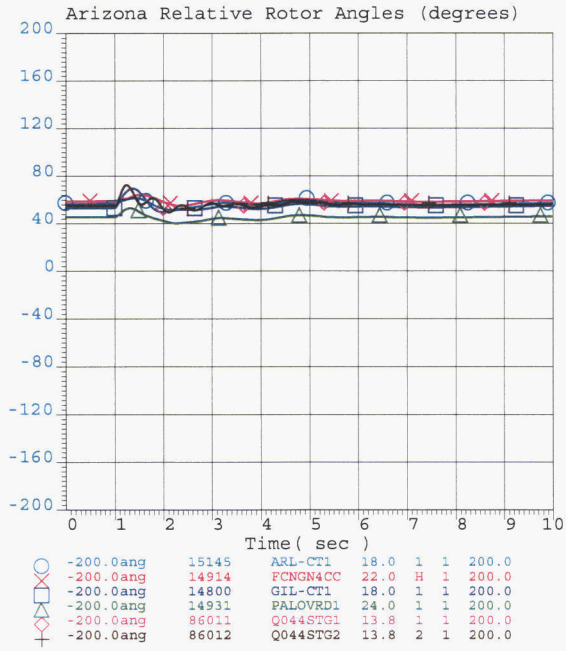
59.5	fbus	14007	GILARIVR	500.0	1	1	60.5
59.5	fbus	15093	HARQUAHA	500.0	1	1	60.5
59.5	fbus	15090	HASSYAMP	500.0	1	1	60.5
59.5	fbus	15089	JOJOBA	500.0	1	1	60.5
59.5	fbus	15011	KYRENE	500.0	1	1	60.5
59.5	fbus	15021	PALOVRDE	500.0	1	1	60.5

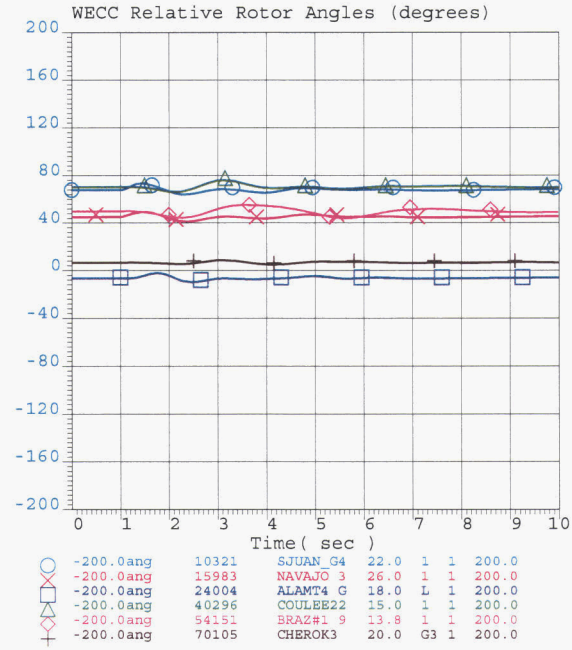
2011 Heavy Summer Power Flow/Transient Stability Case
Gila Bend/Gila River Cluster SIS Post-Project R3 Case 3 Q044 @ 280 MW
3-phase 4 cycle flt. @ Gila River 500 kV, trip Gila River-Jojoba 500 kV

Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots



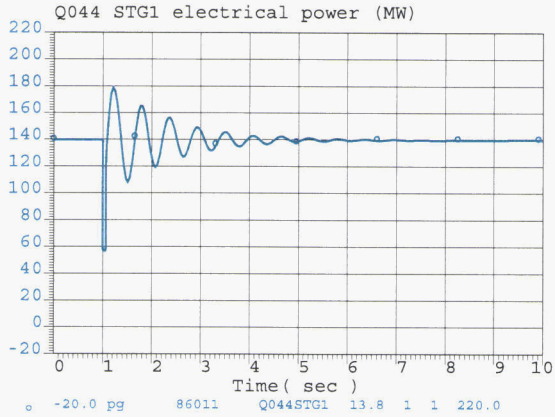


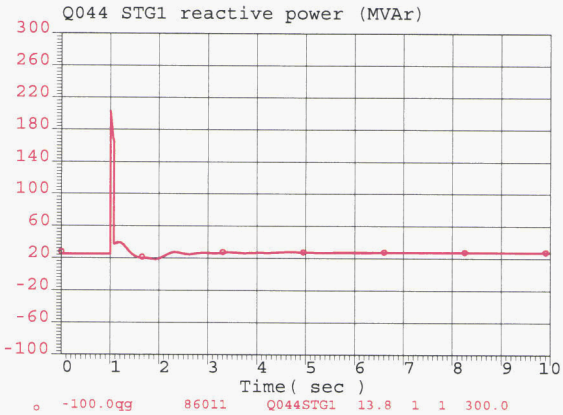


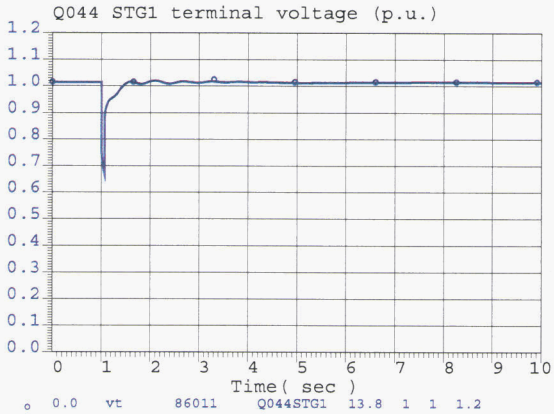


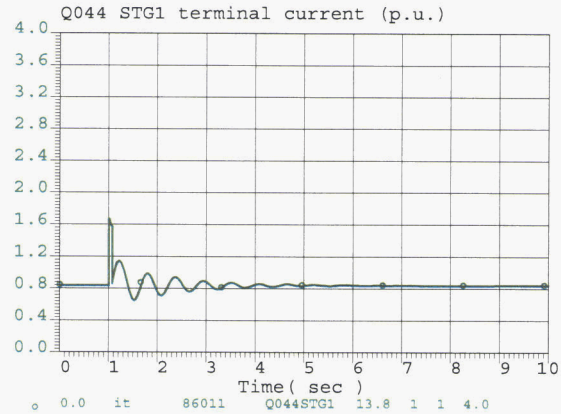
2011 Heavy Summer Power Flow/Transient Stability Case
Gila Bend/Gila River Cluster SIS Post-Project R3 Case 3 Q044 @ 280 MW
3-phase 4 cycle flt. @ Gila River 500 kV, trip Gila River-Jojoba 500 kV

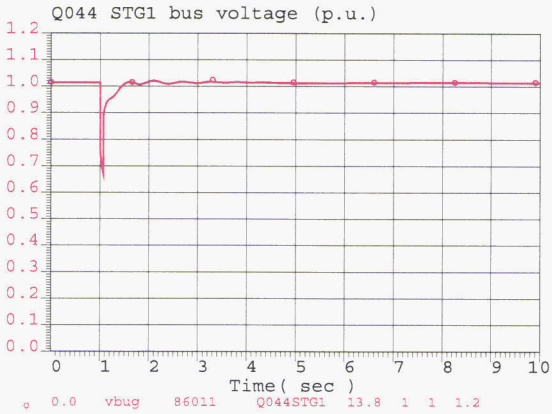
Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots

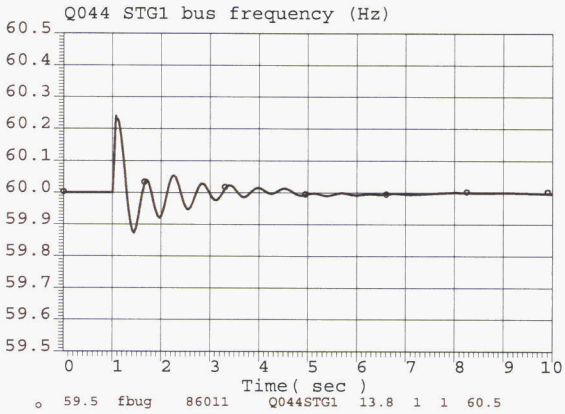








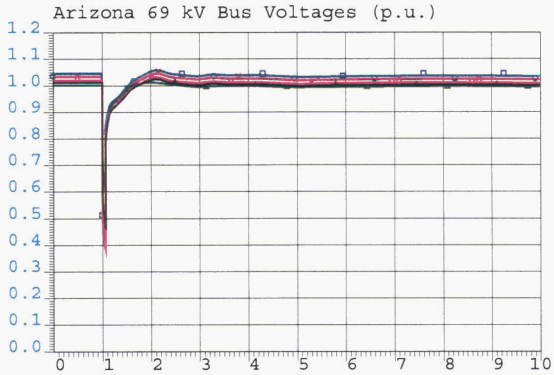




2011 Heavy Summer Power Flow/Transient Stability Case
Gila Bend/Gila River Cluster SIS Post-Project R3 Case 3 Q044 @ 280 MW
3-phase 4 cycle flt. @ Gila River 500 kV, trip Gila River-Jojoba 500 kV

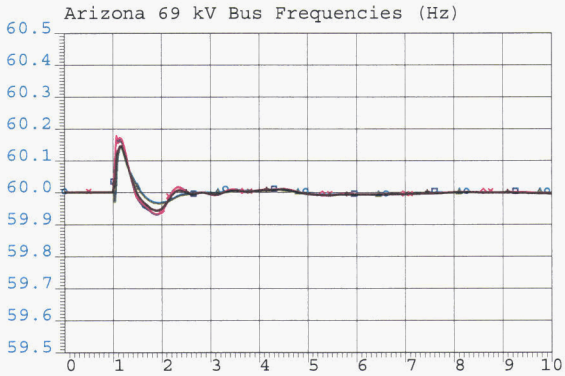
Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots

Arizona 69 kV Bus Voltages (p.u.)



0.0	vbus	84419	GILABEND	69.0	1	1	1.2
0.0	vbus	84432	PALOMA	69.0	1	1	1.2
0.0	vbus	84411	BUNYAN	69.0	1	1	1.2
0.0	vbus	84442	SADDLEMT	69.0	1	1	1.2
0.0	vbus	84460	HY1	69.0	1	1	1.2
0.0	vbus	84414	COTN CTR	69.0	1	1	1.2

Arizona 69 kV Bus Frequencies (Hz)



59.5	fbus	84419	GILABEND	69.0	1	1	60.5
59.5	fbus	84432	PALOMA	69.0	1	1	60.5
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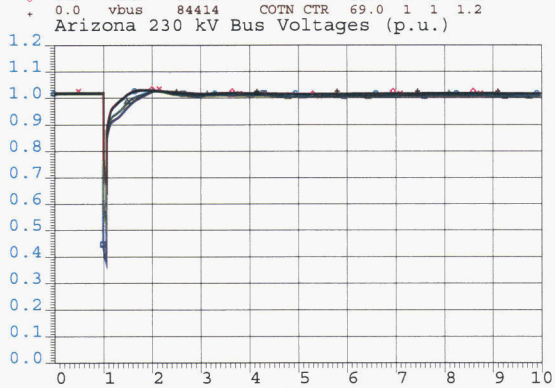
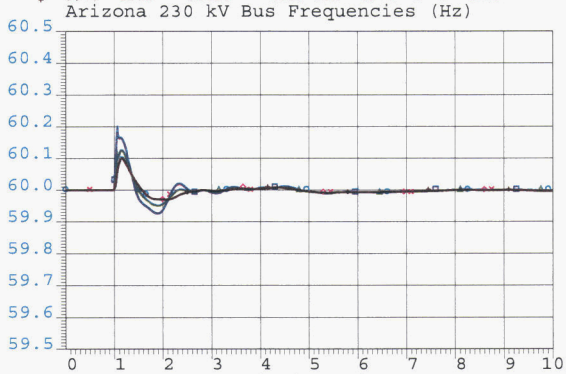
59.5	fbus	84442	SADDLEMT	69.0	1	1	60.5
59.5	fbus	84460	HY1	69.0	1	1	60.5
59.5	fbus	84414	COTN CTR	69.0	1	1	60.5

Arizona 230 kV Bus Voltages (p.u.)



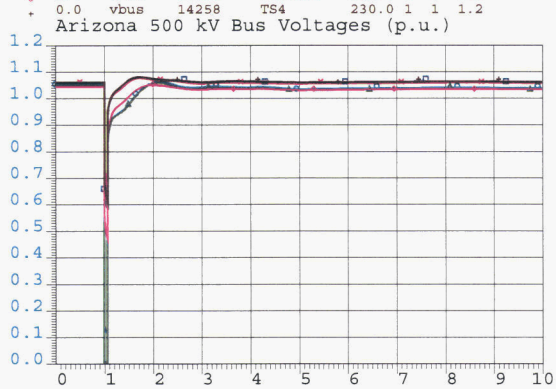
0.0	vbul	14201	BUCKEYE	230.0	1	1	1.2
0.0	vbul	14235	GILABEND	230.0	1	1	1.2
0.0	vbus	14238	GILARIVR	230.0	1	1	1.2
0.0	vbus	14224	JOJOBA	230.0	1	1	1.2
0.0	vbus	19052	LIBERTY	230.0	1	1	1.2
0.0	vbus	14258	TS4	230.0	1	1	1.2

Arizona 230 kV Bus Frequencies (Hz)



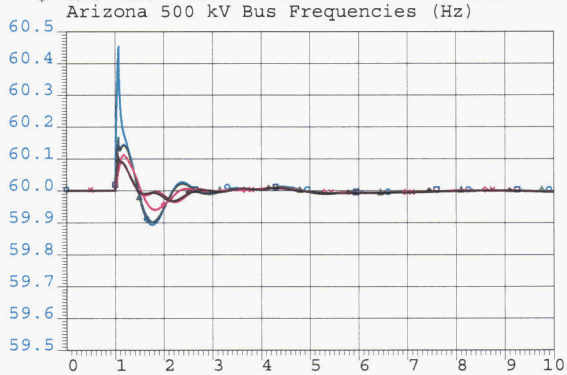
59.5	fbul	14201	BUCKEYE	230.0	1	1	60.5
59.5	fbul	14235	GILABEND	230.0	1	1	60.5
59.5	fbus	14238	GILARIVR	230.0	1	1	60.5
59.5	fbus	14224	JOJOBA	230.0	1	1	60.5
59.5	fbus	19052	LIBERTY	230.0	1	1	60.5
59.5	fbus	14258	TS4	230.0	1	1	60.5

Arizona 500 kV Bus Voltages (p.u.)



0.0	vbus	14007	GILARIVR	500.0	1	1	1.2
0.0	vbus	15093	HARQUAHA	500.0	1	1	1.2
0.0	vbus	15090	HASSYAMP	500.0	1	1	1.2
0.0	vbus	15089	JOJOBA	500.0	1	1	1.2
0.0	vbus	15011	KYRENE	500.0	1	1	1.2
0.0	vbus	15021	PALOVRDE	500.0	1	1	1.2

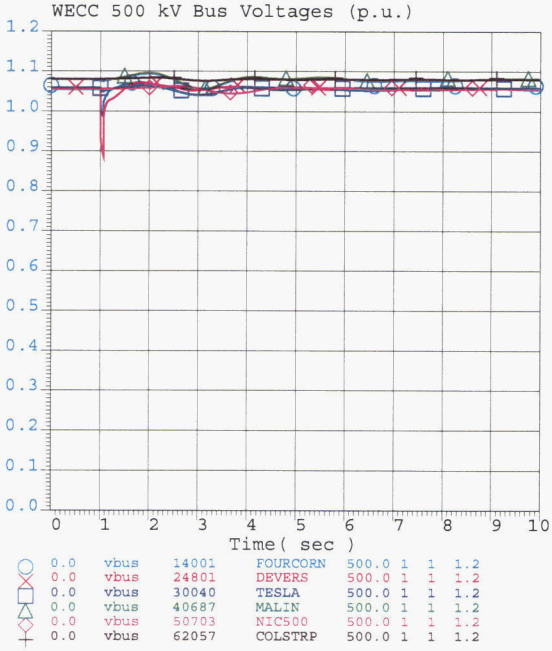
Arizona 500 kV Bus Frequencies (Hz)

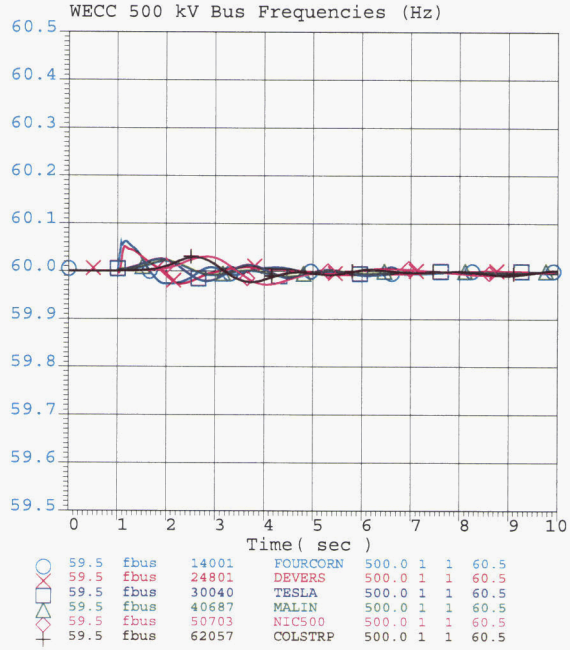


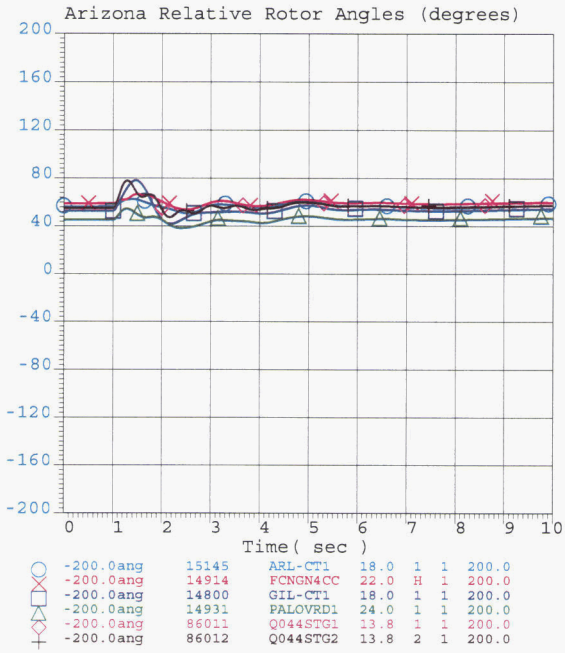
59.5	fbus	14007	GILARIVR	500.0	1	1	60.5
59.5	fbus	15093	HARQUAHA	500.0	1	1	60.5
59.5	fbus	15090	HASSYAMP	500.0	1	1	60.5
59.5	fbus	15089	JOJOBA	500.0	1	1	60.5
59.5	fbus	15011	KYRENE	500.0	1	1	60.5
59.5	fbus	15021	PALOVRDE	500.0	1	1	60.5

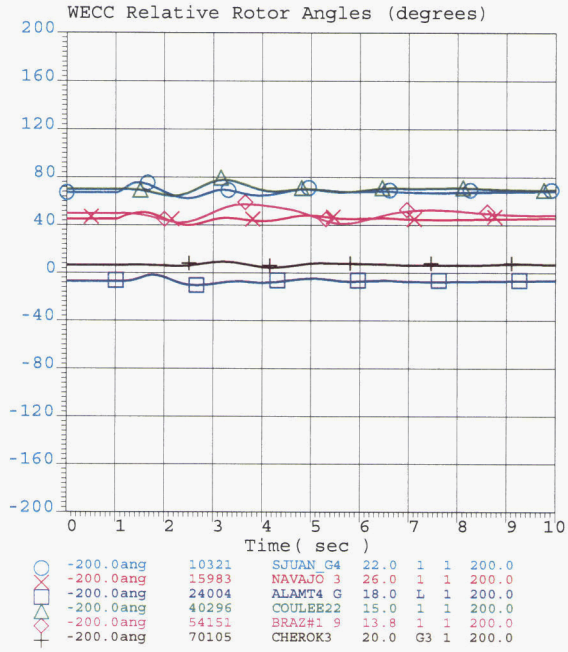
2011 Heavy Summer Power Flow/Transient Stability Case
Gila Bend/Gila River Cluster SIS Post-Project R3 Case 3 Q044 @ 280 MW
3-phase 4 cycle flt. @ Jojoba 500 kV, trip Hassyampa-Jojoba 500 kV

Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots









2011 Heavy Summer Power Flow/Transient Stability Case
Gila Bend/Gila River Cluster SIS Post-Project R3 Case 3 Q044 @ 280 MW
3-phase 4 cycle flt. @ Jojoba 500 kV, trip Hassyampa-Jojoba 500 kV

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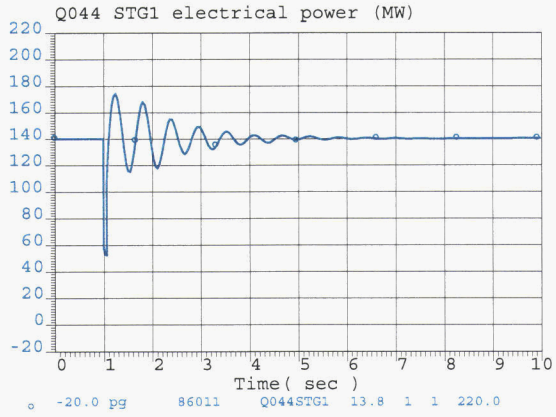
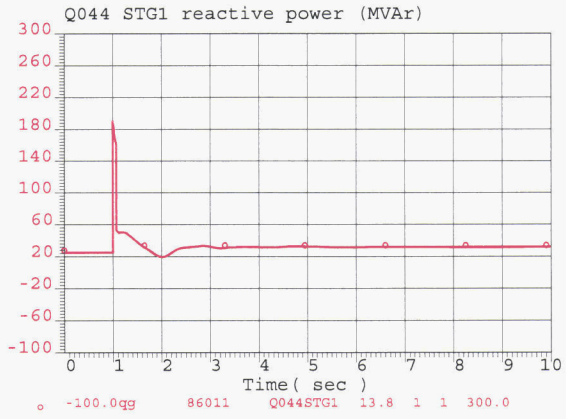
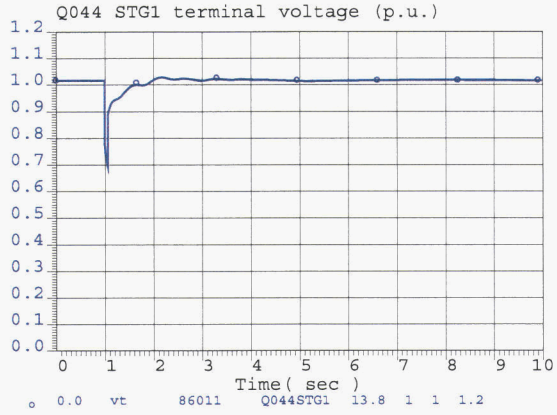
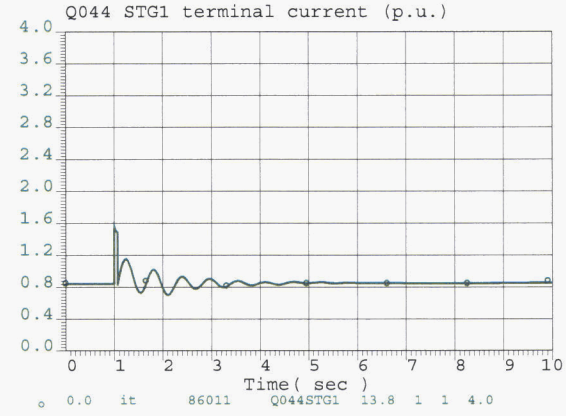
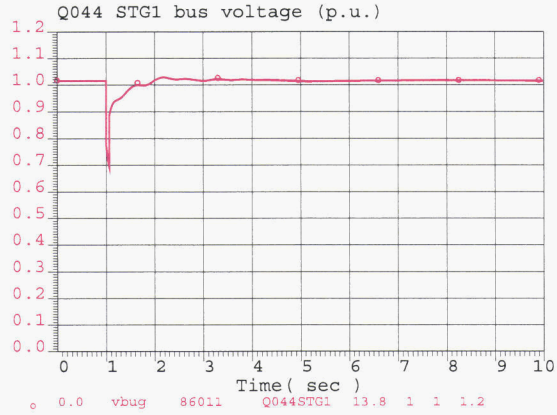
Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots

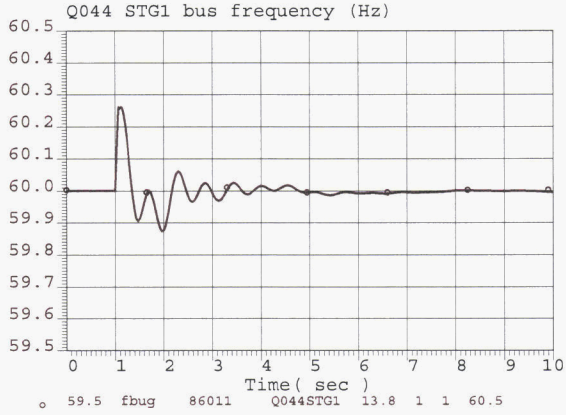






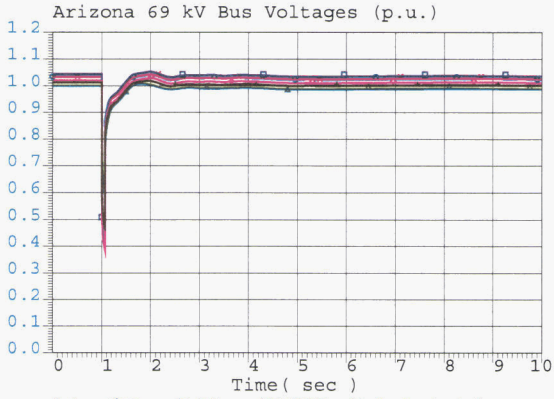






2011 Heavy Summer Power Flow/Transient Stability Case
Gila Bend/Gila River Cluster SIS Post-Project R3 Case 3 Q044 @ 280 MW
3-phase 4 cycle flt. @ Jojoba 500 kV, trip Hassyampa-Jojoba 500 kV

Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots



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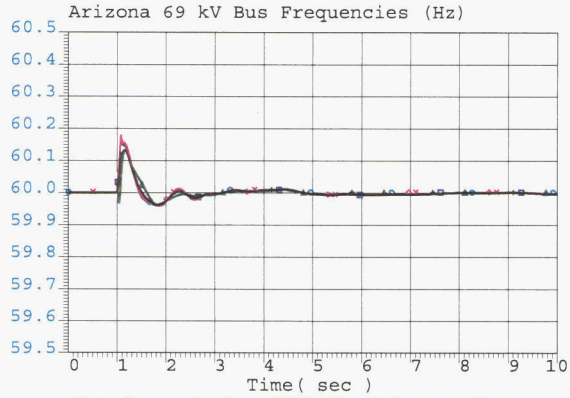
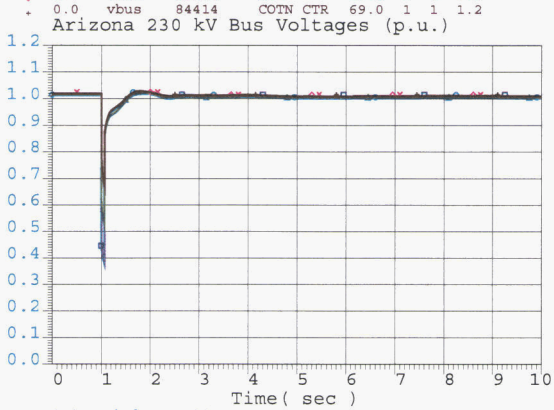
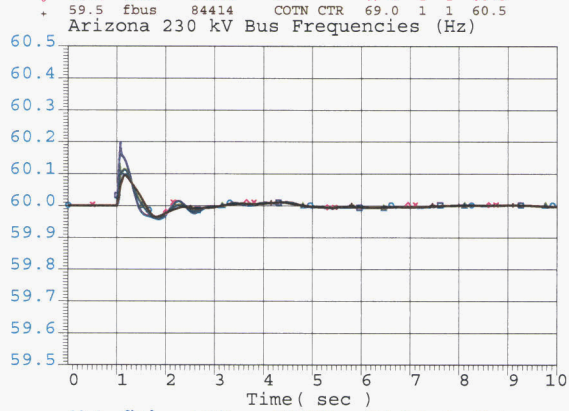
×	0.0	vbus	84432	PALOMA	69.0	1	1	1.2
□	0.0	vbus	84411	BUNYAN	69.0	1	1	1.2
△	0.0	vbus	84442	SADDLEMT	69.0	1	1	1.2
◇	0.0	vbus	84460	HY1	69.0	1	1	1.2
+	0.0	vbus	84414	COTN CTR	69.0	1	1	1.2



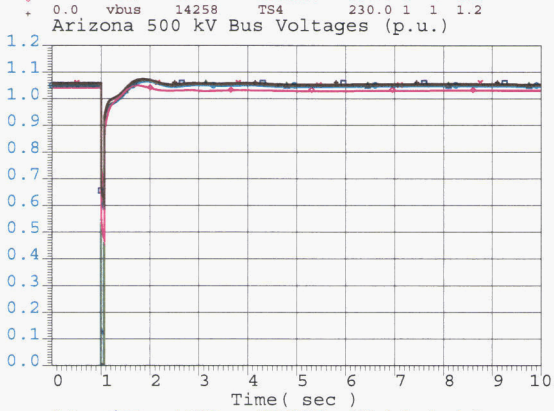
○	59.5	fbus	84419	GILABEND	69.0	1	1	60.5
×	59.5	fbus	84432	PALOMA	69.0	1	1	60.5
□	59.5	fbus	84411	BUNYAN	69.0	1	1	60.5
△	59.5	fbus	84442	SADDLEMT	69.0	1	1	60.5
◇	59.5	fbus	84460	HY1	69.0	1	1	60.5
+	59.5	fbus	84414	COTN CTR	69.0	1	1	60.5



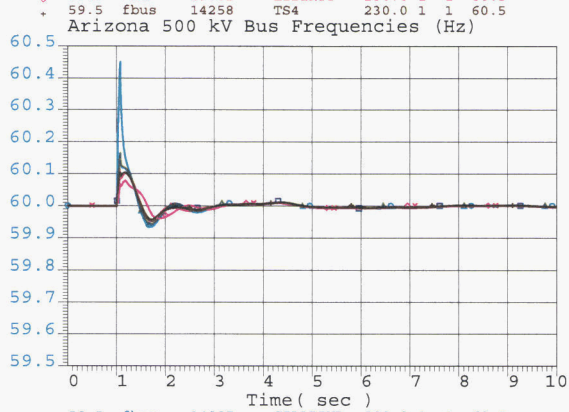
○	0.0	vbul	14201	BUCKEYE	230.0	1	1	1.2
×	0.0	vbul	14235	GILABEND	230.0	1	1	1.2
□	0.0	vbus	14238	GILARIVR	230.0	1	1	1.2
△	0.0	vbus	14224	JOJOBA	230.0	1	1	1.2
◇	0.0	vbus	19052	LIBERTY	230.0	1	1	1.2
+	0.0	vbus	14258	TS4	230.0	1	1	1.2



○	59.5	fbul	14201	BUCKEYE	230.0	1	1	60.5
×	59.5	fbul	14235	GILABEND	230.0	1	1	60.5
□	59.5	fbus	14238	GILARIVR	230.0	1	1	60.5
△	59.5	fbus	14224	JOJOBA	230.0	1	1	60.5
◇	59.5	fbus	19052	LIBERTY	230.0	1	1	60.5
+	59.5	fbus	14258	TS4	230.0	1	1	60.5



○	0.0	vbus	14007	GILARIVR	500.0	1	1	1.2
×	0.0	vbus	15093	HARQUAHA	500.0	1	1	1.2
□	0.0	vbus	15090	HASSYAMP	500.0	1	1	1.2
△	0.0	vbus	15089	JOJOBA	500.0	1	1	1.2
◇	0.0	vbus	15011	KYRENE	500.0	1	1	1.2
+	0.0	vbus	15021	PALOVRDE	500.0	1	1	1.2



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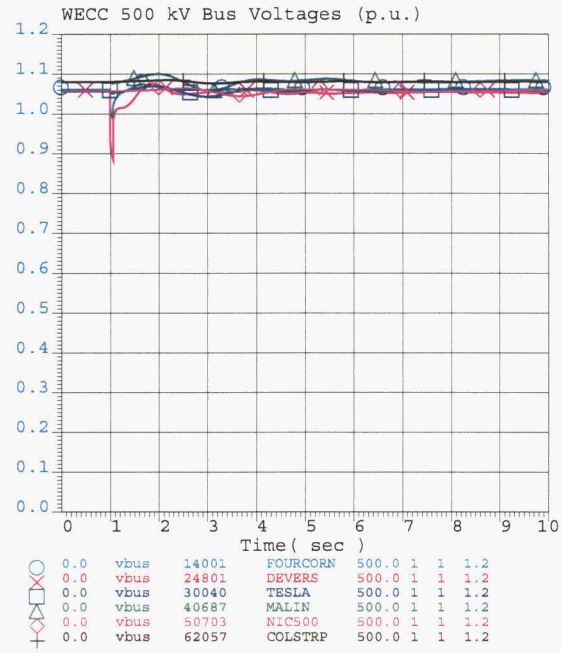
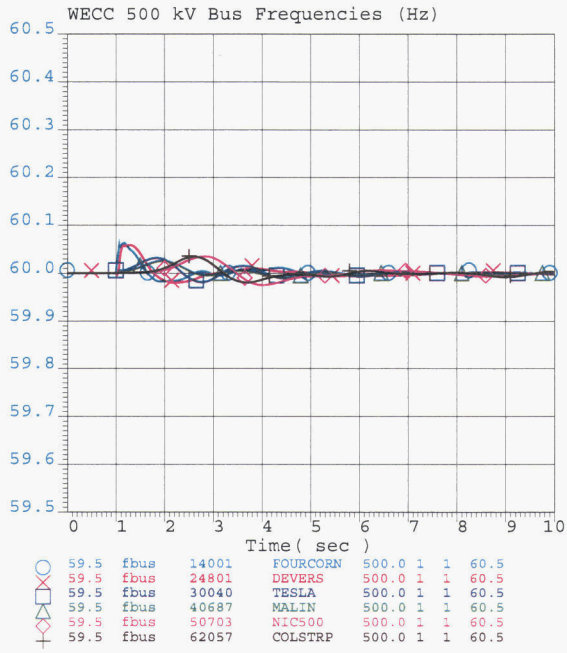
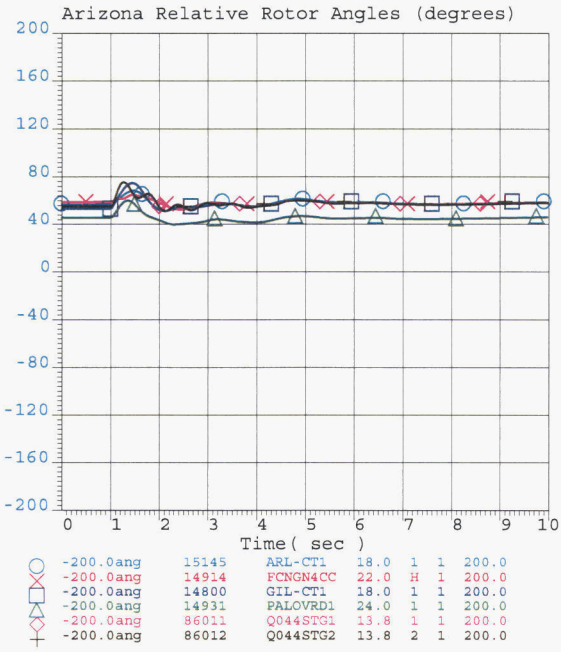
□	59.5	fbus	15090	HASSYAMP	500.0	1	1	60.5
△	59.5	fbus	15089	JOJOBA	500.0	1	1	60.5
◇	59.5	fbus	15011	KYRENE	500.0	1	1	60.5
+	59.5	fbus	15021	PALOVRDE	500.0	1	1	60.5

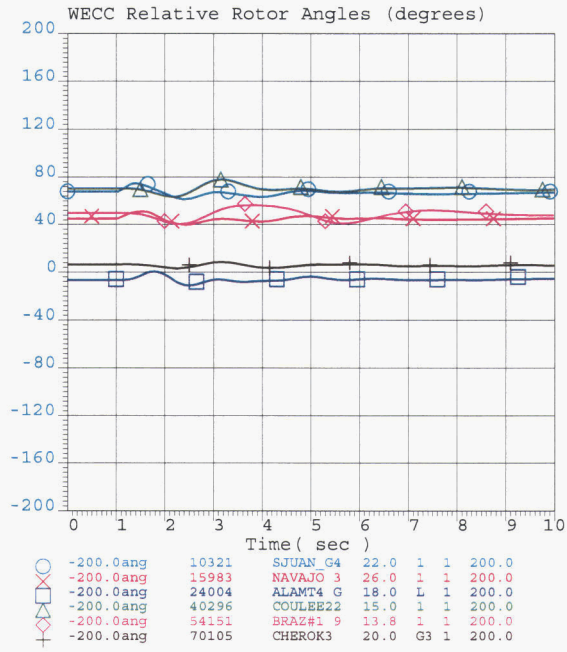
2011 Heavy Summer Power Flow/Transient Stability Case
Gila Bend/Gila River Cluster SIS Post-Project R3 Case 3 Q044 @ 280 MW
3-phase 4 cycle flt. @ Jojoba 500 kV, trip Jojoba-Kyrene 500 kV

Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots









2011 Heavy Summer Power Flow/Transient Stability Case
Gila Bend/Gila River Cluster SIS Post-Project R3 Case 3 Q044 @ 280 MW
3-phase 4 cycle flt. @ Jojoba 500 kV, trip Jojoba-Kyrene 500 kV

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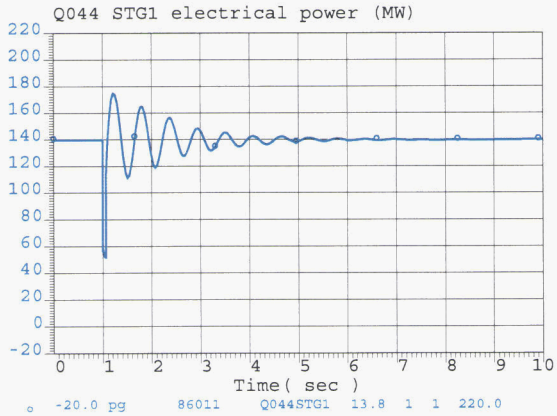
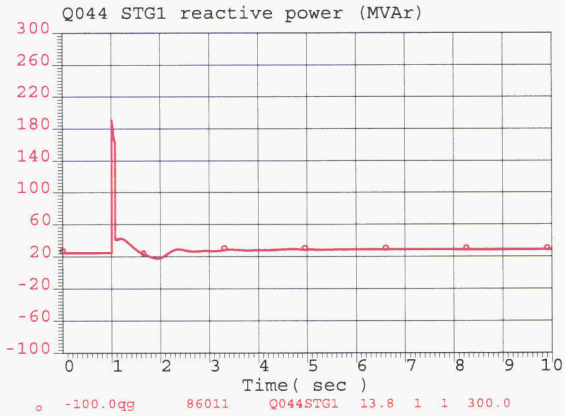
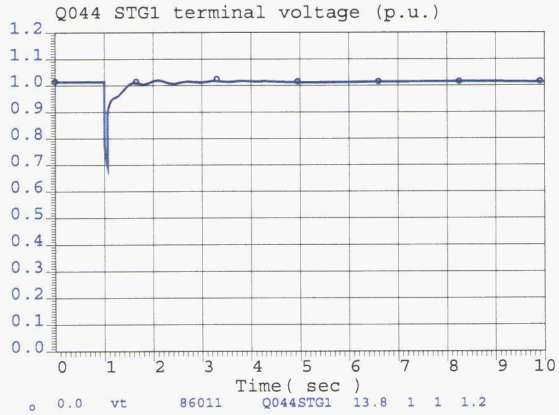
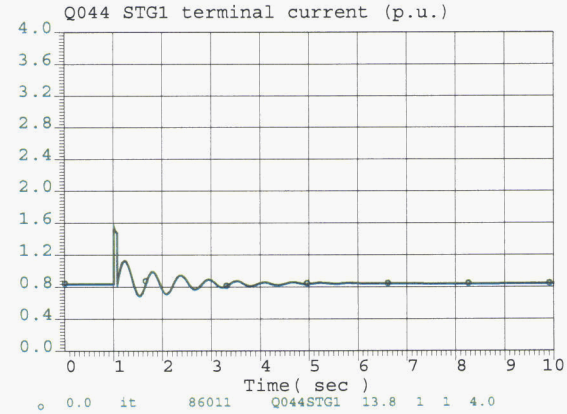
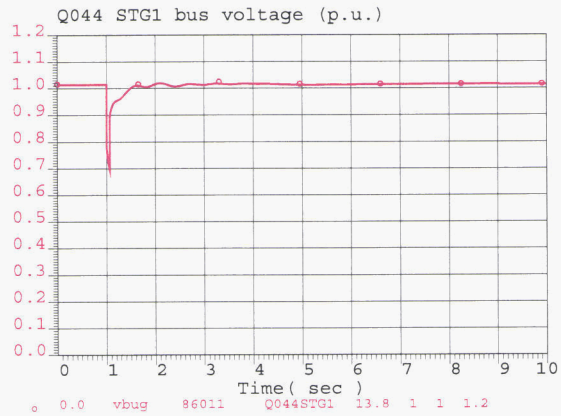
Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots

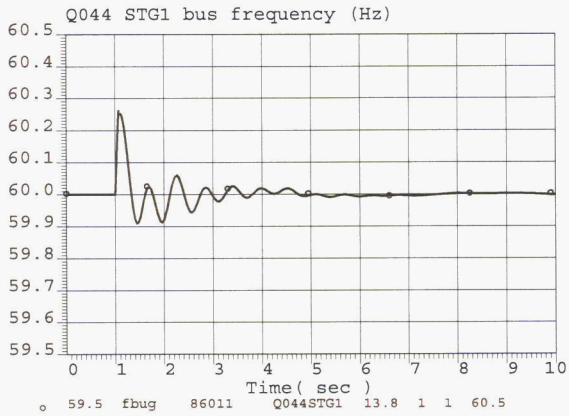












2011 Heavy Summer Power Flow/Transient Stability Case
Gila Bend/Gila River Cluster SIS Post-Project R3 Case 3 Q044 @ 280 MW
3-phase 4 cycle flt. @ Jojoba 500 kV, trip Jojoba-Kyrene 500 kV

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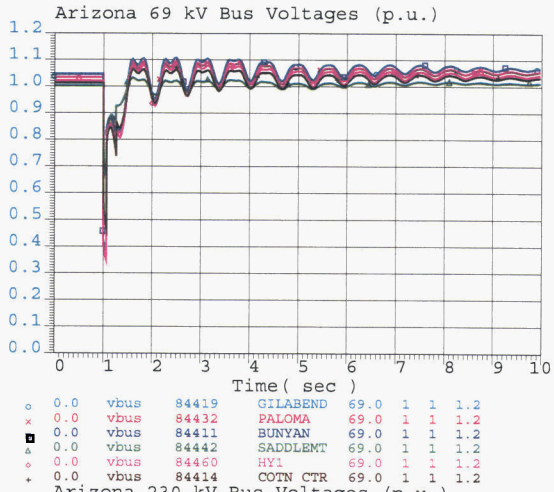
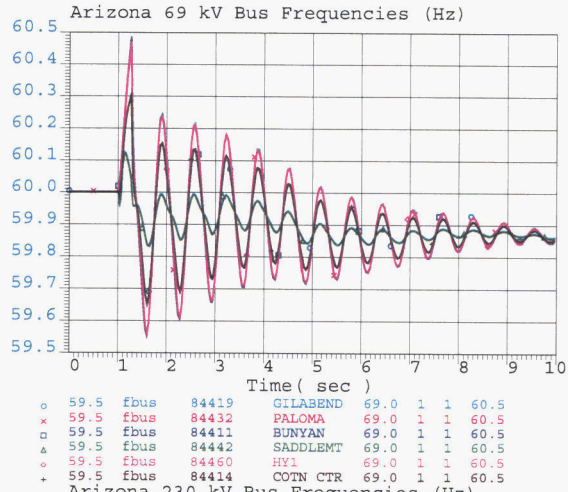
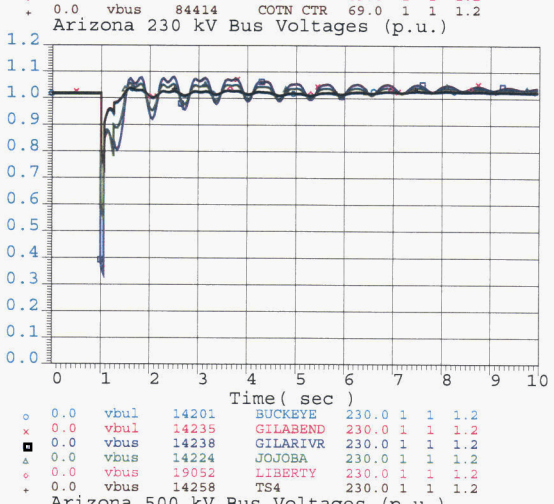
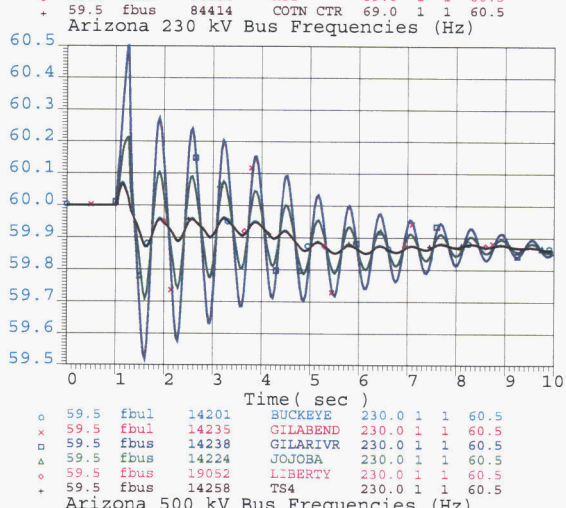
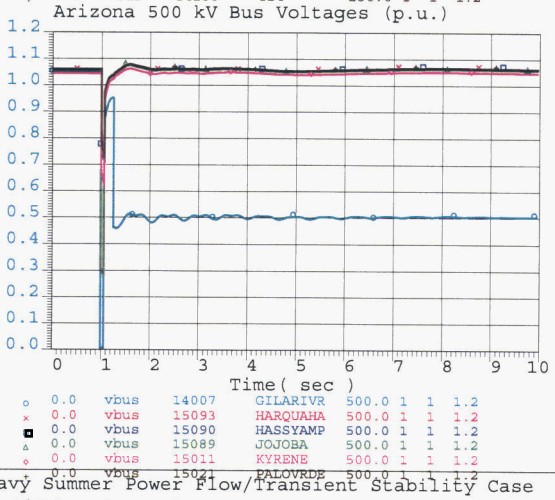
Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots

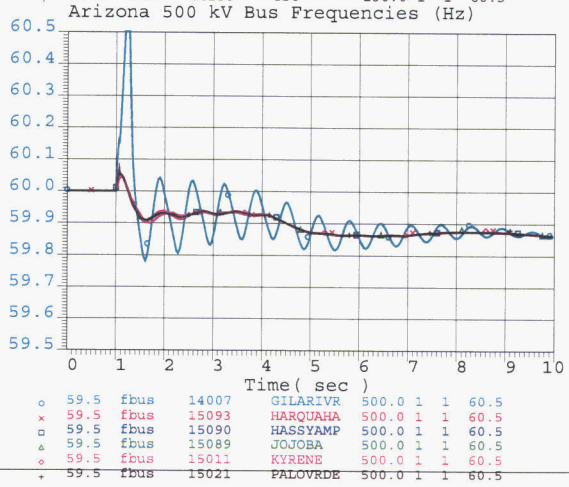






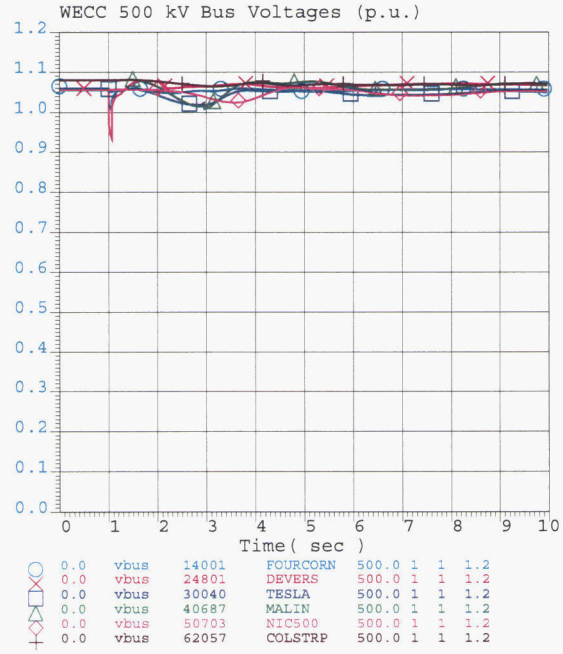


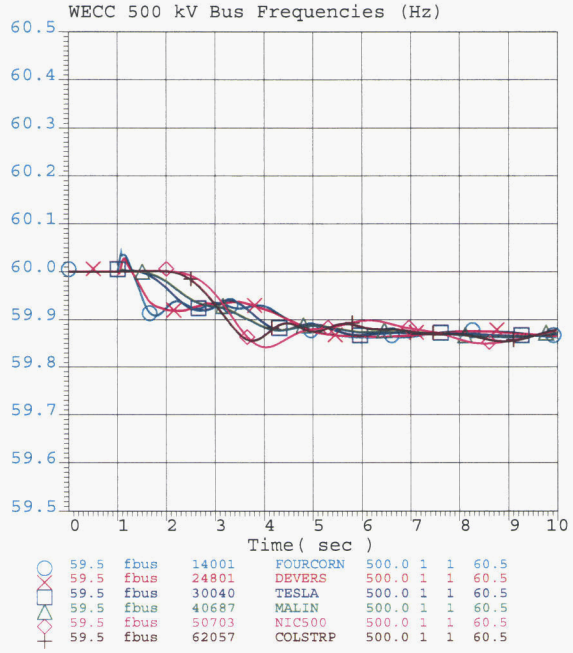


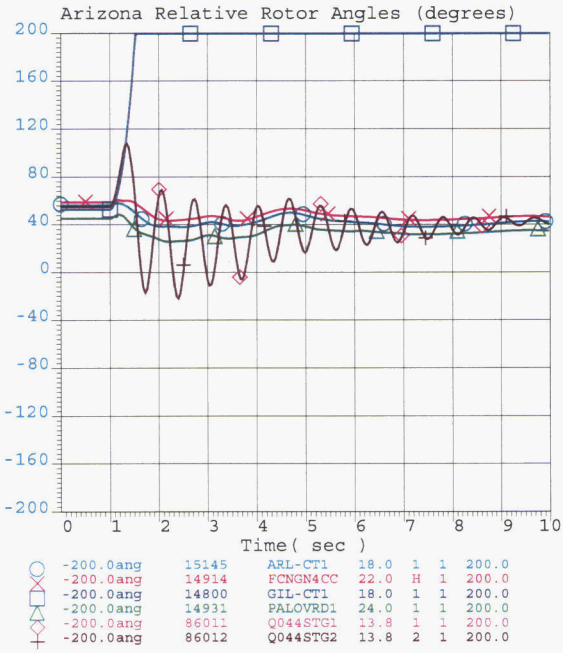


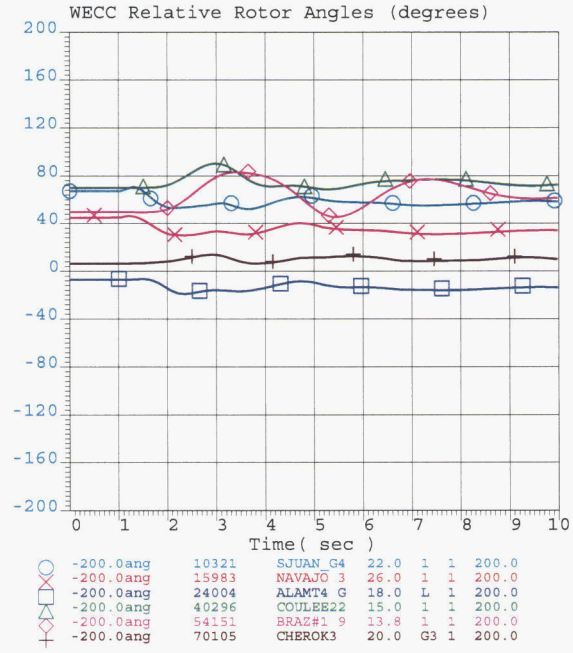
2011 Heavy Summer Power Flow/Transient Stability Case
Gila Bend/Gila River Cluster SIS Post-Project R3 Case 3 Q044 @ 280 MW
3-phase 4 cycle flt. @ Gila River 500 kV, trip Gila River-Jojoba 1 & 2 500 kV

Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots









2011 Heavy Summer Power Flow/Transient Stability Case
Gila Bend/Gila River Cluster SIS Post-Project R3 Case 3 Q044 @ 280 MW
3-phase 4 cycle flt. @ Gila River 500 kV, trip Gila River-Jojoba 1 & 2 500 kV

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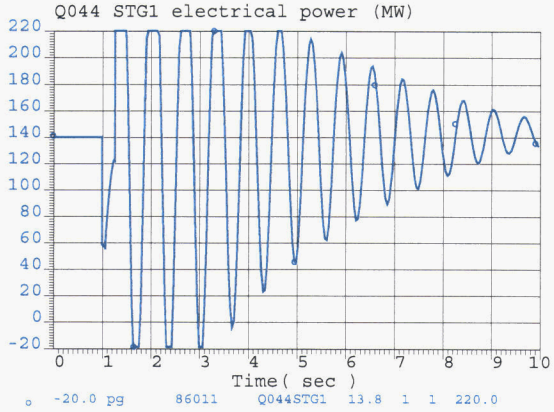
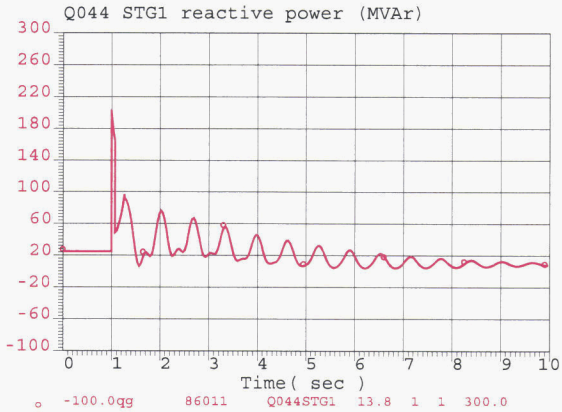
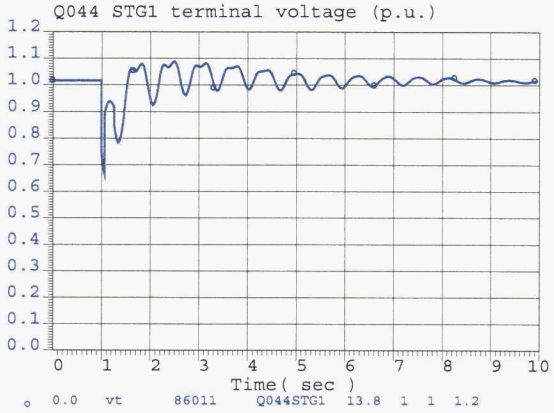
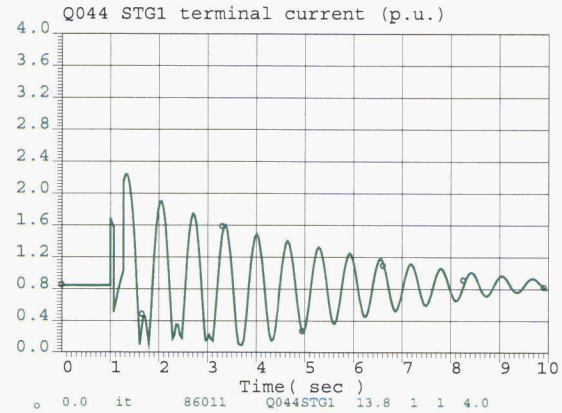
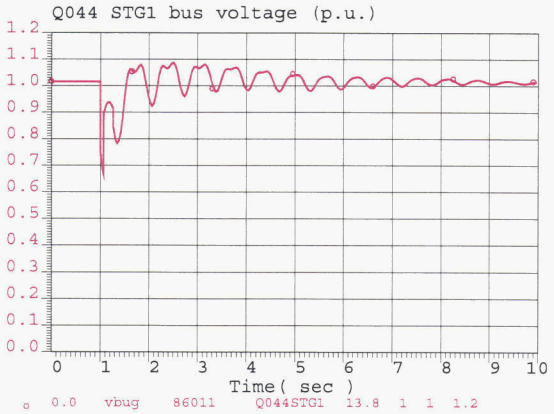
Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots

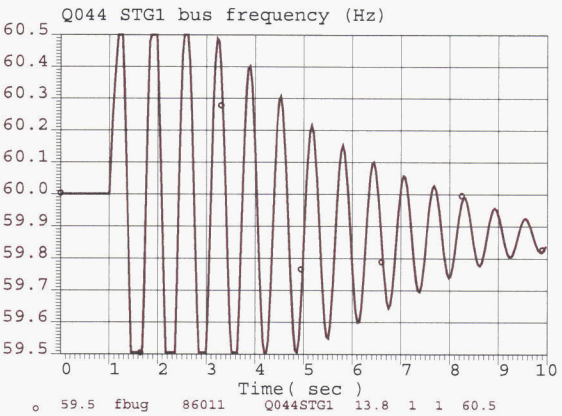








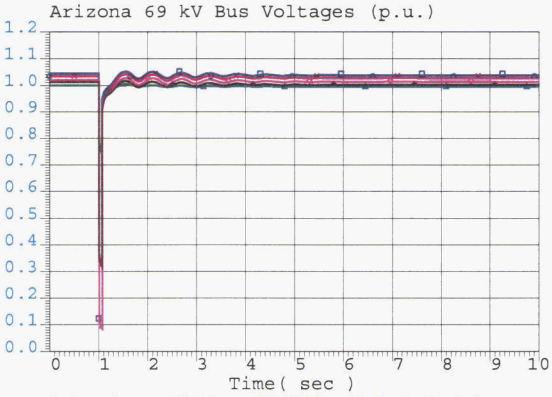




2011 Heavy Summer Power Flow/Transient Stability Case
Gila Bend/Gila River Cluster SIS Post-Project R3 Case 3 Q044 @ 280 MW
3-phase 4 cycle flt. @ Gila River 500 kV, trip Gila River-Jojoba 1 & 2 500 kV

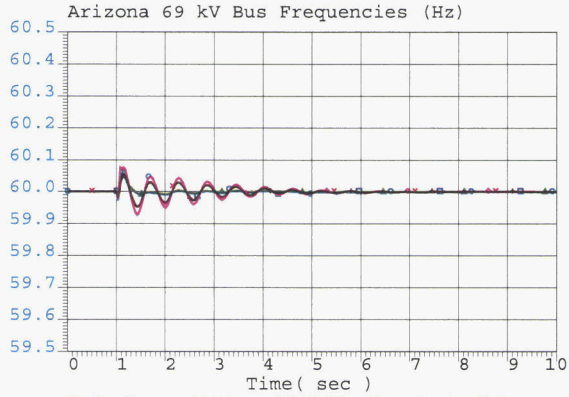
Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots

Arizona 69 kV Bus Voltages (p.u.)



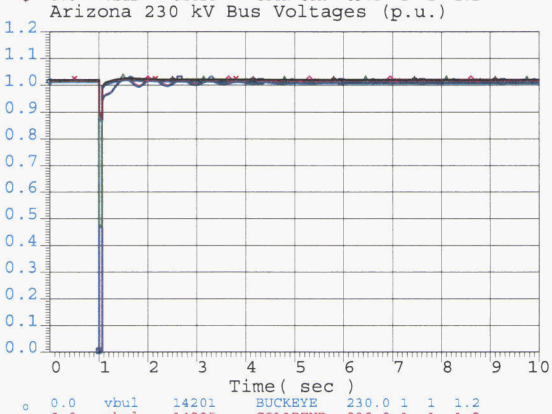
0.0	vbus	84419	GILABEND	69.0	1	1	1.2
0.0	vbus	84432	PALOMA	69.0	1	1	1.2
0.0	vbus	84411	BUNYAN	69.0	1	1	1.2
0.0	vbus	84442	SADDLEMT	69.0	1	1	1.2
0.0	vbus	84460	HY1	69.0	1	1	1.2
0.0	vbus	84414	COTN CTR	69.0	1	1	1.2

Arizona 69 kV Bus Frequencies (Hz)



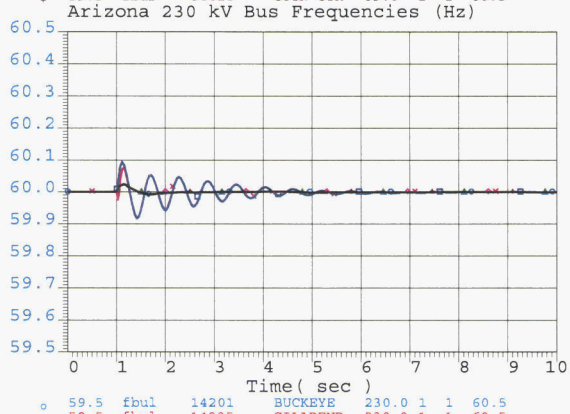
59.5	fbus	84419	GILABEND	69.0	1	1	60.5
59.5	fbus	84432	PALOMA	69.0	1	1	60.5
59.5	fbus	84411	BUNYAN	69.0	1	1	60.5
59.5	fbus	84442	SADDLEMT	69.0	1	1	60.5
59.5	fbus	84460	HY1	69.0	1	1	60.5
59.5	fbus	84414	COTN CTR	69.0	1	1	60.5

Arizona 230 kV Bus Voltages (p.u.)



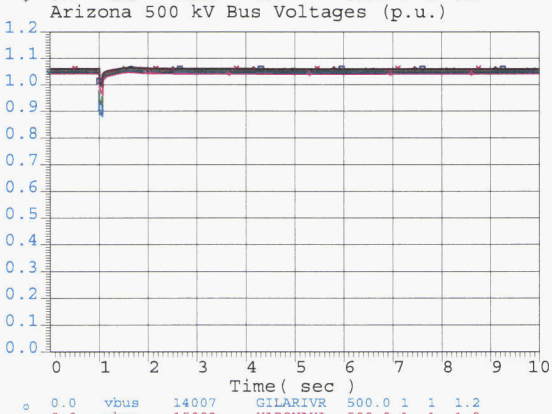
0.0	vbul	14201	BUCKEYE	230.0	1	1	1.2
0.0	vbul	14235	GILABEND	230.0	1	1	1.2
0.0	vbus	14238	GILARIVR	230.0	1	1	1.2
0.0	vbus	14224	JOJOBA	230.0	1	1	1.2
0.0	vbus	19052	LIBERTY	230.0	1	1	1.2
0.0	vbus	14258	TS4	230.0	1	1	1.2

Arizona 230 kV Bus Frequencies (Hz)



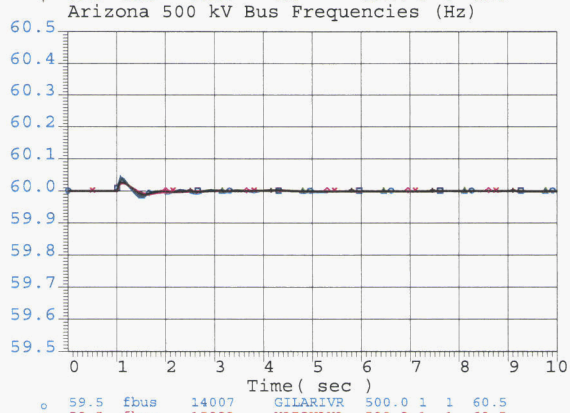
59.5	fbul	14201	BUCKEYE	230.0	1	1	60.5
59.5	fbul	14235	GILABEND	230.0	1	1	60.5
59.5	fbus	14238	GILARIVR	230.0	1	1	60.5
59.5	fbus	14224	JOJOBA	230.0	1	1	60.5
59.5	fbus	19052	LIBERTY	230.0	1	1	60.5
59.5	fbus	14258	TS4	230.0	1	1	60.5

Arizona 500 kV Bus Voltages (p.u.)



0.0	vbus	14007	GILARIVR	500.0	1	1	1.2
0.0	vbus	15093	HARQUAHA	500.0	1	1	1.2
0.0	vbus	15090	HASSYAMP	500.0	1	1	1.2
0.0	vbus	15089	JOJOBA	500.0	1	1	1.2
0.0	vbus	15011	KYRENE	500.0	1	1	1.2
0.0	vbus	15021	PALOVRDE	500.0	1	1	1.2

Arizona 500 kV Bus Frequencies (Hz)



59.5	fbus	14007	GILARIVR	500.0	1	1	60.5
59.5	fbus	15093	HARQUAHA	500.0	1	1	60.5
59.5	fbus	15090	HASSYAMP	500.0	1	1	60.5
59.5	fbus	15089	JOJOBA	500.0	1	1	60.5
59.5	fbus	15011	KYRENE	500.0	1	1	60.5
59.5	fbus	15021	PALOVRDE	500.0	1	1	60.5

2011 Heavy Summer Power Flow/Transient Stability Case
Gila Bend/Gila River Cluster SIS Post-Project R3 Case 3 Q044 @ 280 MW
3-phase 4 cycle flt. @ Gila River 230 kV, trip Gila River-Jojoba 230 kV

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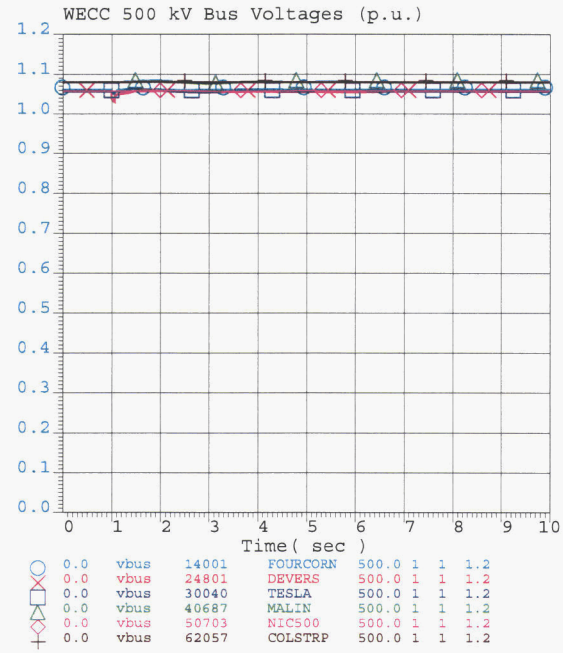
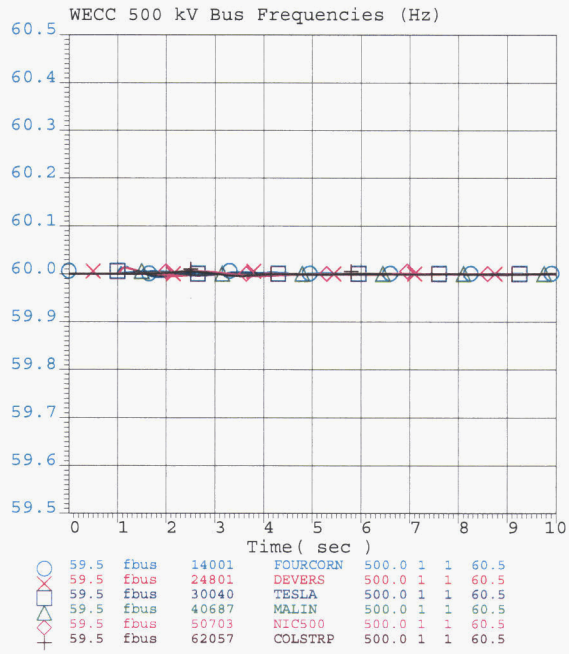
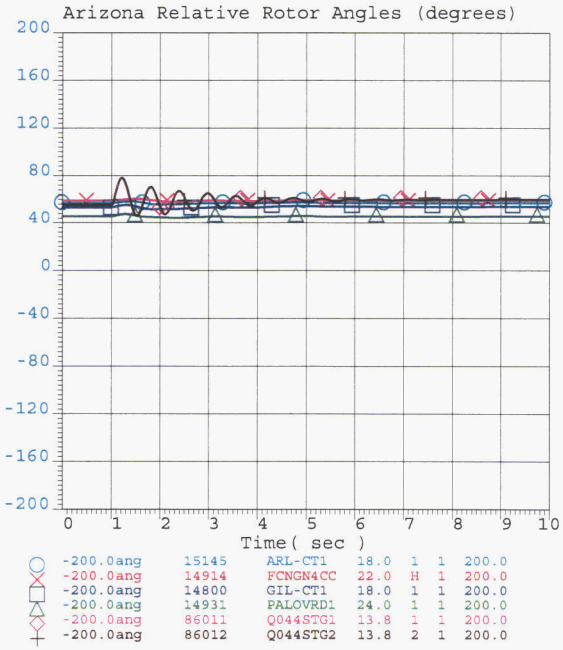
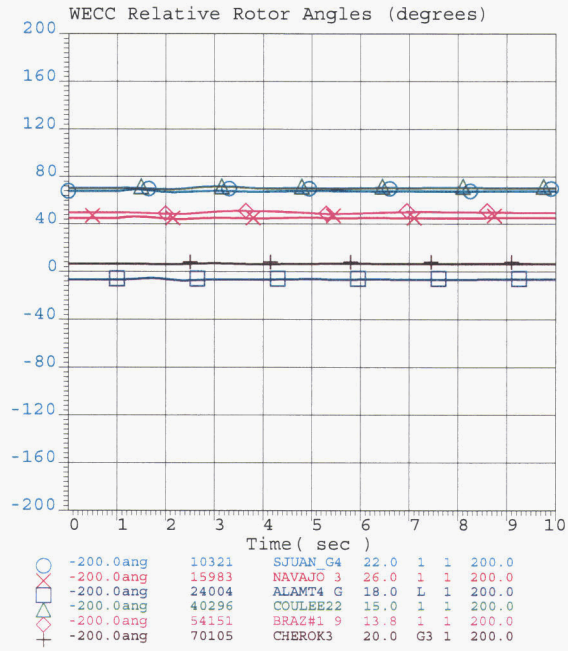
Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots



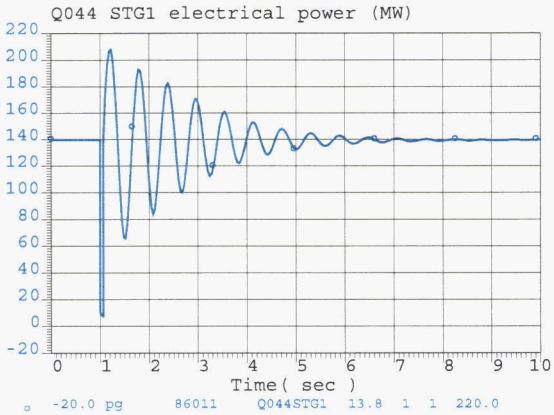


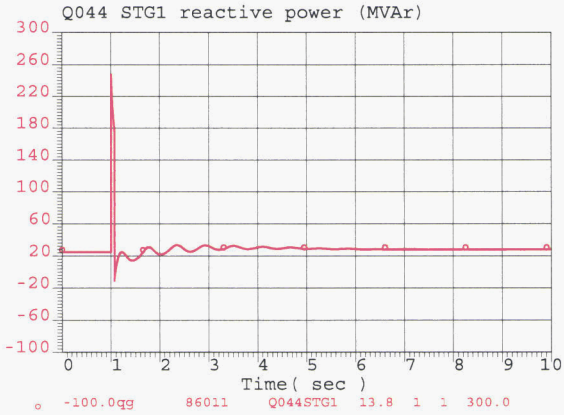


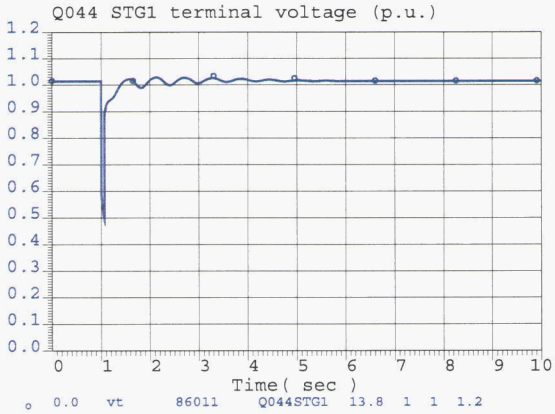


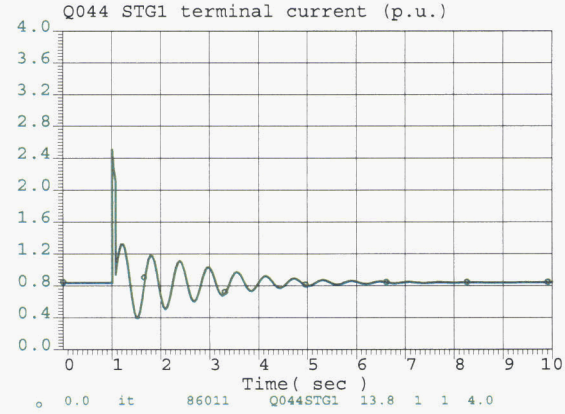
2011 Heavy Summer Power Flow/Transient Stability Case
Gila Bend/Gila River Cluster SIS Post-Project R3 Case 3 Q044 @ 280 MW
3-phase 4 cycle flt. @ Gila River 230 kV, trip Gila River-Jojoba 230 kV

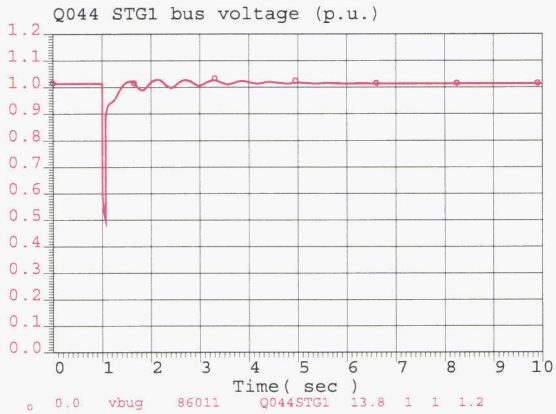
Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots

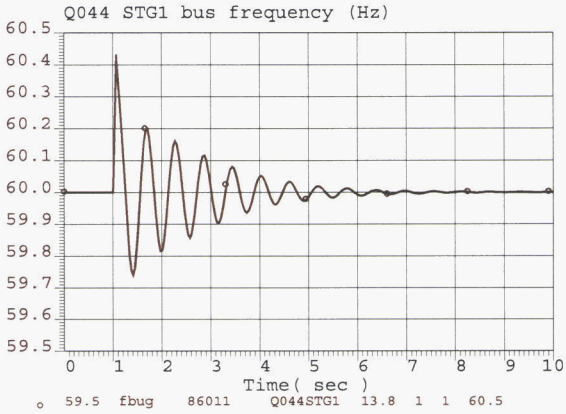






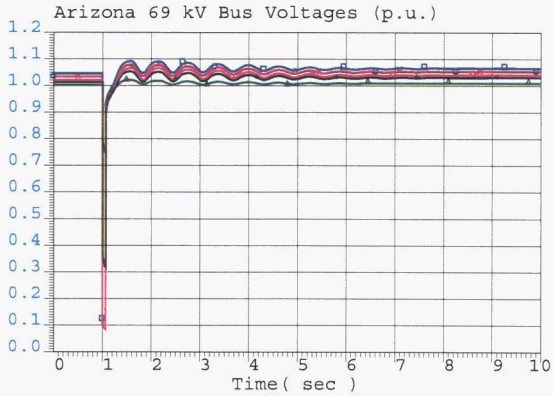




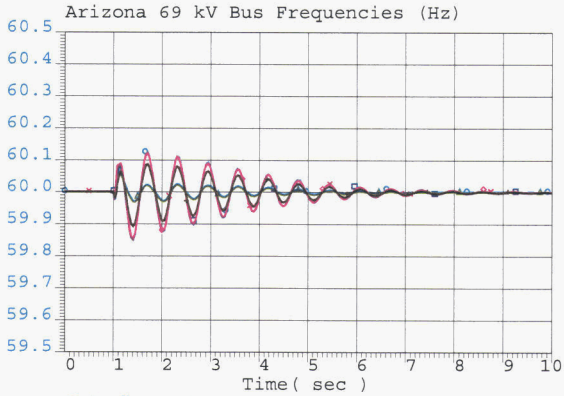


2011 Heavy Summer Power Flow/Transient Stability Case
Gila Bend/Gila River Cluster SIS Post-Project R3 Case 3 Q044 @ 280 MW
3-phase 4 cycle flt. @ Gila River 230 kV, trip Gila River-Jojoba 230 kV

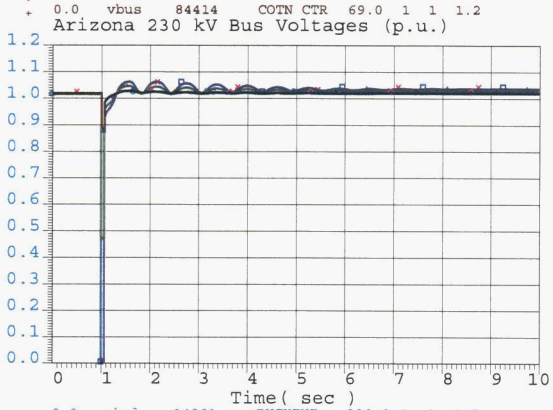
Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots



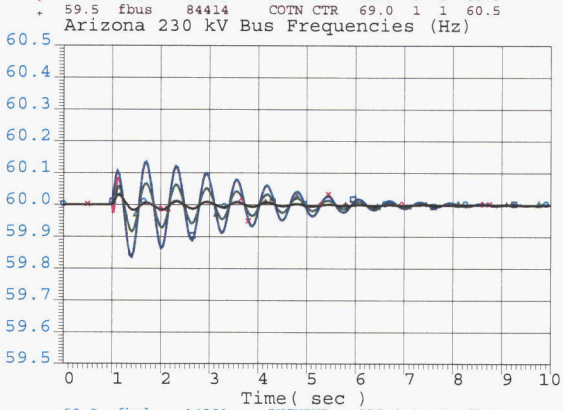
0.0	vbus	84419	GILABEND	69.0	1	1	1.2
0.0	vbus	84432	PALOMA	69.0	1	1	1.2
0.0	vbus	84411	BUNYAN	69.0	1	1	1.2
0.0	vbus	84442	SADDLEMT	69.0	1	1	1.2
0.0	vbus	84460	HY1	69.0	1	1	1.2
0.0	vbus	84414	COTN CTR	69.0	1	1	1.2



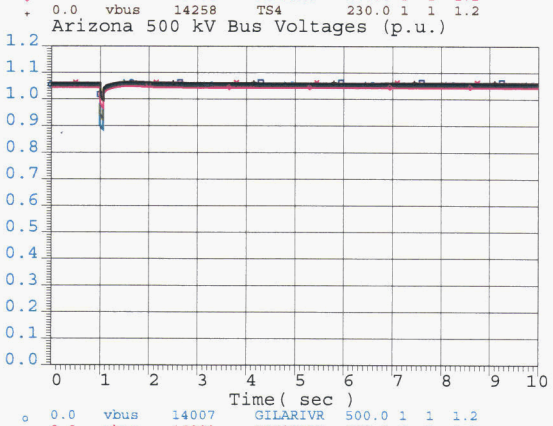
59.5	fbus	84419	GILABEND	69.0	1	1	60.5
59.5	fbus	84432	PALOMA	69.0	1	1	60.5
59.5	fbus	84411	BUNYAN	69.0	1	1	60.5
59.5	fbus	84442	SADDLEMT	69.0	1	1	60.5
59.5	fbus	84460	HY1	69.0	1	1	60.5
59.5	fbus	84414	COTN CTR	69.0	1	1	60.5



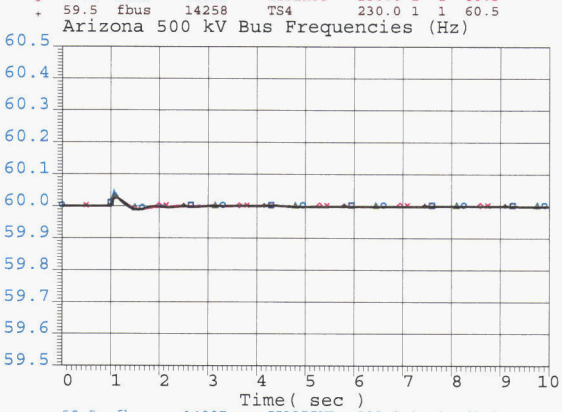
0.0	vbul	14201	BUCKEYE	230.0	1	1	1.2
0.0	vbul	14235	GILABEND	230.0	1	1	1.2
0.0	vbus	14238	GILARIVR	230.0	1	1	1.2
0.0	vbus	14224	JOJOBA	230.0	1	1	1.2
0.0	vbus	19052	LIBERTY	230.0	1	1	1.2
0.0	vbus	14258	TS4	230.0	1	1	1.2



59.5	fbul	14201	BUCKEYE	230.0	1	1	60.5
59.5	fbul	14235	GILABEND	230.0	1	1	60.5
59.5	fbus	14238	GILARIVR	230.0	1	1	60.5
59.5	fbus	14224	JOJOBA	230.0	1	1	60.5
59.5	fbus	19052	LIBERTY	230.0	1	1	60.5
59.5	fbus	14258	TS4	230.0	1	1	60.5



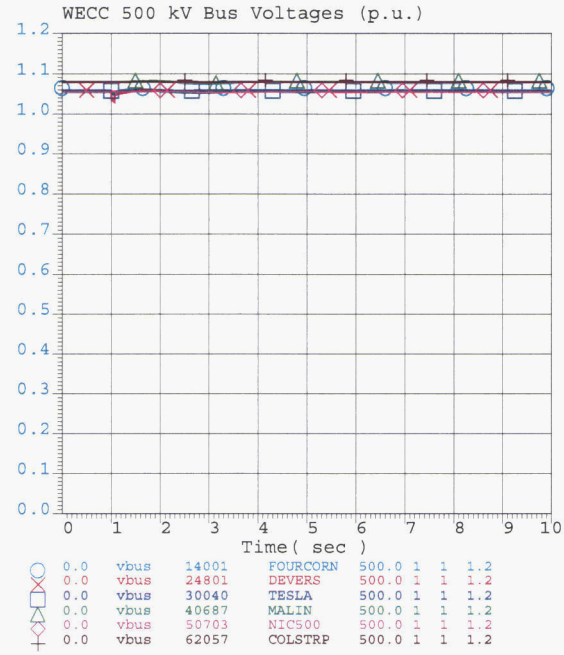
0.0	vbus	14007	GILARIVR	500.0	1	1	1.2
0.0	vbus	15093	HARQUAHA	500.0	1	1	1.2
0.0	vbus	15090	HASSYAMP	500.0	1	1	1.2
0.0	vbus	15089	JOJOBA	500.0	1	1	1.2
0.0	vbus	15011	KYRENE	500.0	1	1	1.2
0.0	vbus	15021	PALOVRDE	500.0	1	1	1.2

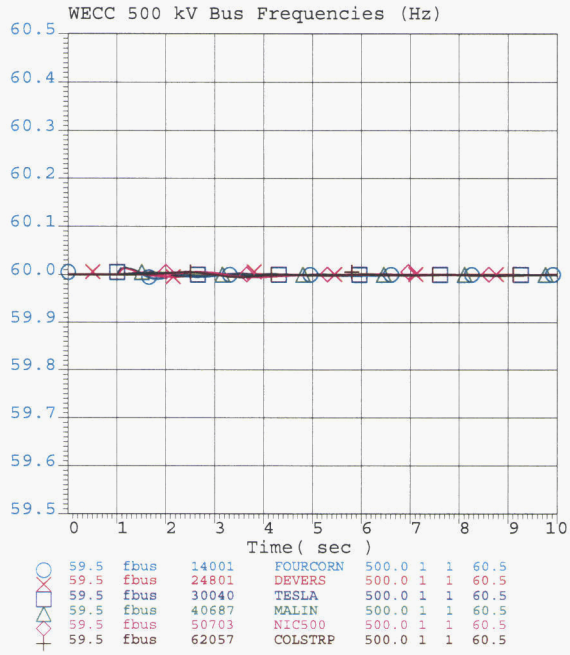


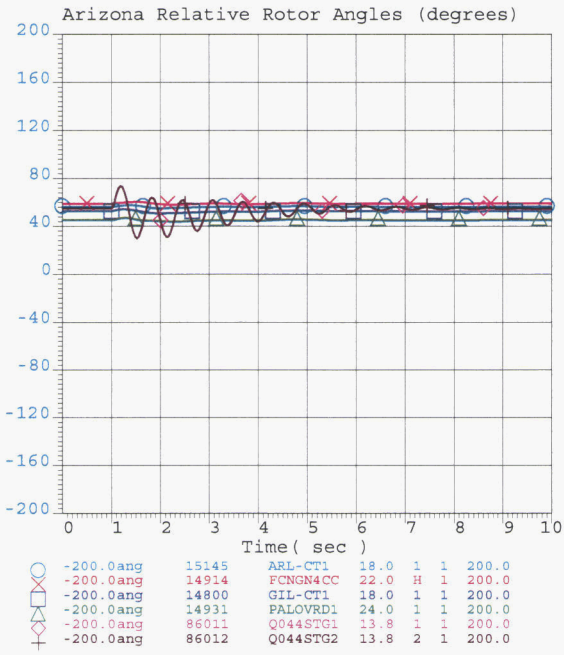
59.5	fbus	14007	GILARIVR	500.0	1	1	60.5
59.5	fbus	15093	HARQUAHA	500.0	1	1	60.5
59.5	fbus	15090	HASSYAMP	500.0	1	1	60.5
59.5	fbus	15089	JOJOBA	500.0	1	1	60.5
59.5	fbus	15011	KYRENE	500.0	1	1	60.5
59.5	fbus	15021	PALOVRDE	500.0	1	1	60.5

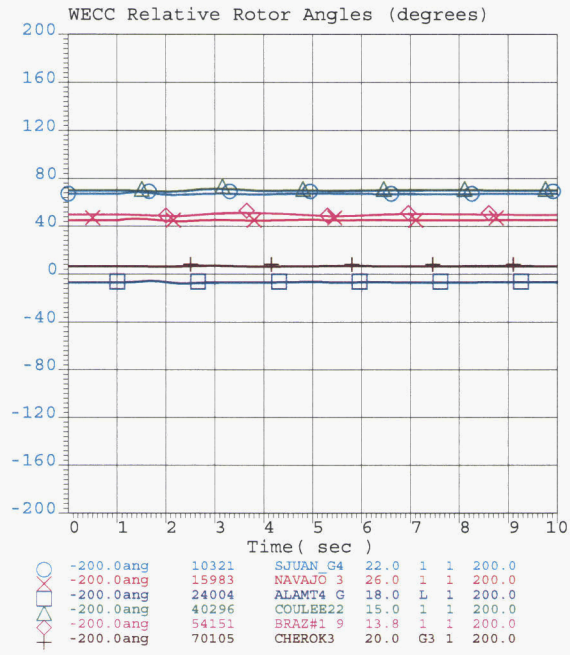
2011 Heavy Summer Power Flow/Transient Stability Case
Gila Bend/Gila River Cluster SIS Post-Project R3 Case 3 Q044 @ 280 MW
3-phase 4 cycle flt. @ Gila River 230 kV, trip Gila River 500/230 kV xfmr

Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots









2011 Heavy Summer Power Flow/Transient Stability Case
Gila Bend/Gila River Cluster SIS Post-Project R3 Case 3 Q044 @ 280 MW
3-phase 4 cycle flt. @ Gila River 230 kV, trip Gila River 500/230 kV xfmr

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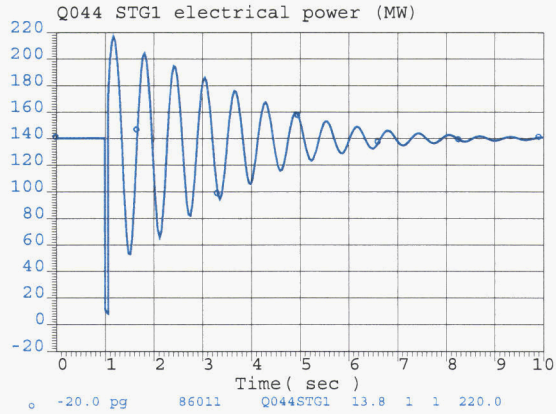
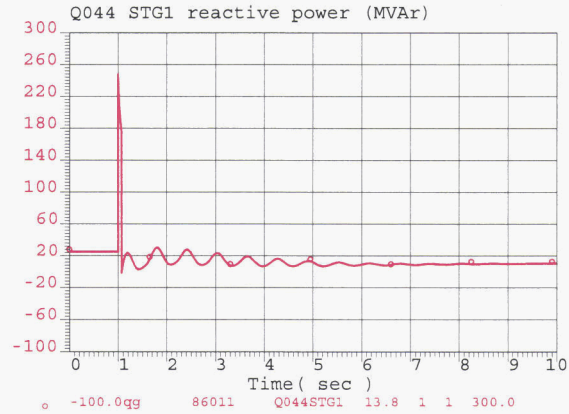
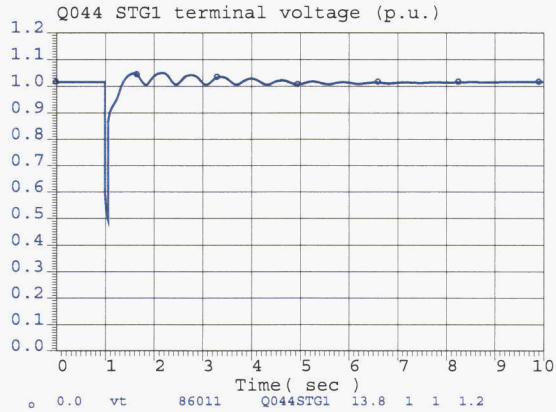
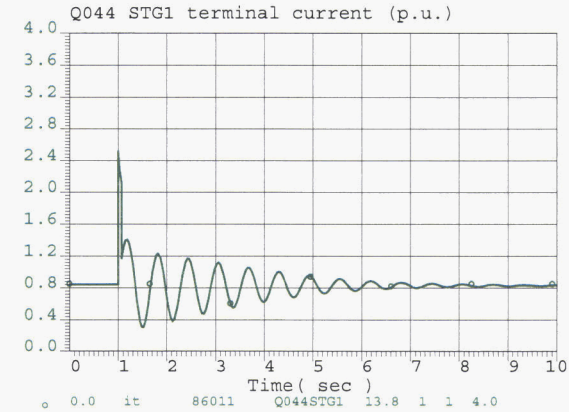
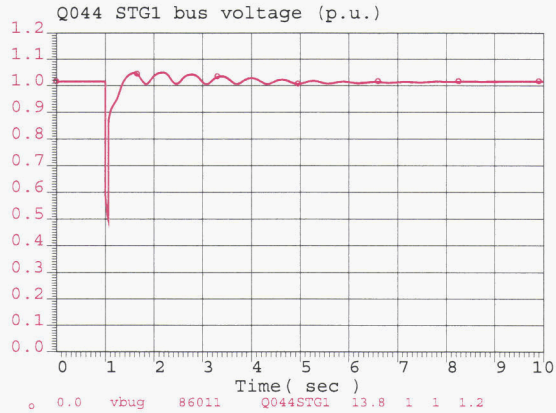
Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots

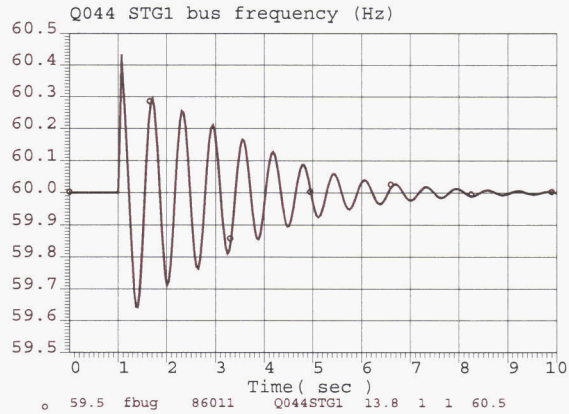








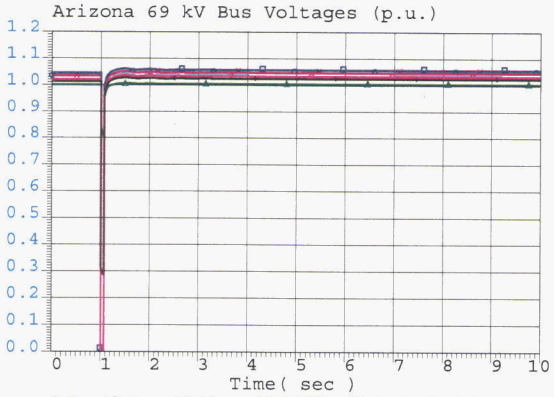




2011 Heavy Summer Power Flow/Transient Stability Case
Gila Bend/Gila River Cluster SIS Post-Project R3 Case 3 Q044 @ 280 MW
3-phase 4 cycle flt. @ Gila River 230 kV, trip Gila River 500/230 kV xfmr

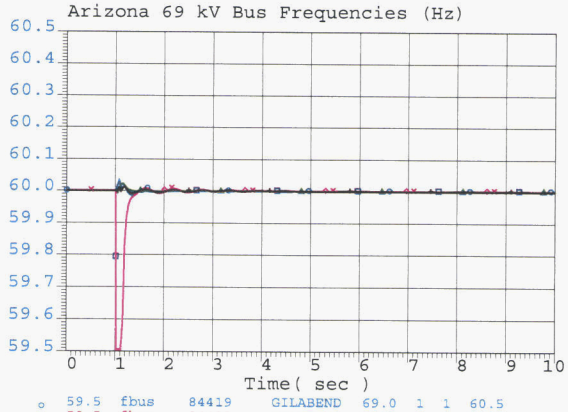
Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots

Arizona 69 kV Bus Voltages (p.u.)



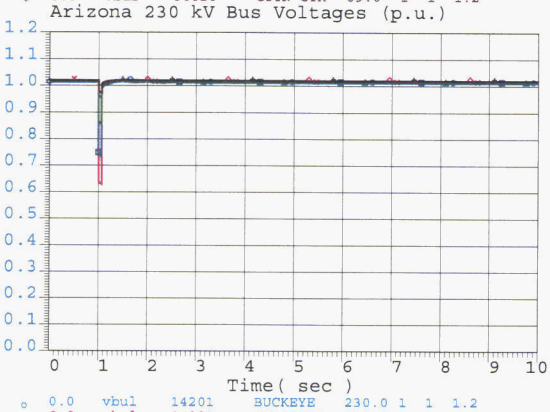
○	0.0	vbus	84419	GILABEND	69.0	1	1	1.2
×	0.0	vbus	84432	PALOMA	69.0	1	1	1.2
■	0.0	vbus	84411	BUNYAN	69.0	1	1	1.2
△	0.0	vbus	84442	SADDLEMT	69.0	1	1	1.2
◇	0.0	vbus	84460	HY1	69.0	1	1	1.2
+	0.0	vbus	84414	COTN CTR	69.0	1	1	1.2

Arizona 69 kV Bus Frequencies (Hz)



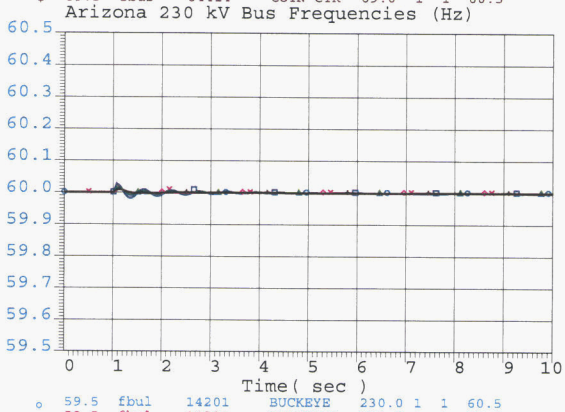
○	59.5	fbus	84419	GILABEND	69.0	1	1	60.5
×	59.5	fbus	84432	PALOMA	69.0	1	1	60.5
■	59.5	fbus	84411	BUNYAN	69.0	1	1	60.5
△	59.5	fbus	84442	SADDLEMT	69.0	1	1	60.5
◇	59.5	fbus	84460	HY1	69.0	1	1	60.5
+	59.5	fbus	84414	COTN CTR	69.0	1	1	60.5

Arizona 230 kV Bus Voltages (p.u.)



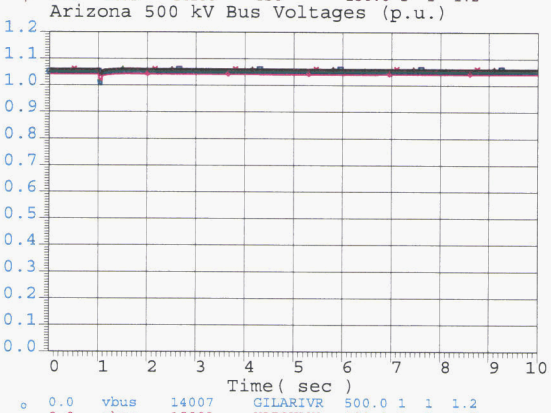
○	0.0	vbul	14201	BUCKEYE	230.0	1	1	1.2
×	0.0	vbul	14235	GILABEND	230.0	1	1	1.2
□	0.0	vbus	14238	GILARIVR	230.0	1	1	1.2
△	0.0	vbus	14224	JOJOBA	230.0	1	1	1.2
◇	0.0	vbus	19052	LIBERTY	230.0	1	1	1.2
+	0.0	vbus	14258	TS4	230.0	1	1	1.2

Arizona 230 kV Bus Frequencies (Hz)



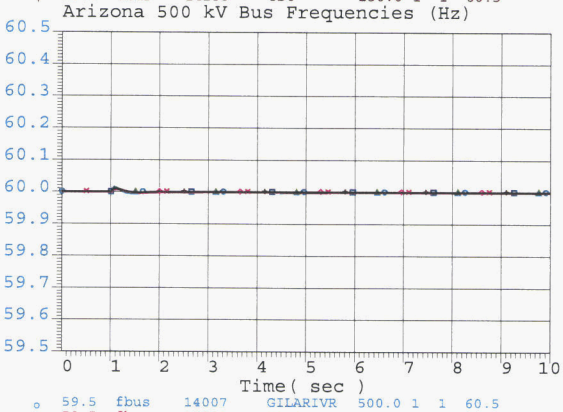
○	59.5	fbul	14201	BUCKEYE	230.0	1	1	60.5
×	59.5	fbul	14235	GILABEND	230.0	1	1	60.5
□	59.5	fbus	14238	GILARIVR	230.0	1	1	60.5
△	59.5	fbus	14224	JOJOBA	230.0	1	1	60.5
◇	59.5	fbus	19052	LIBERTY	230.0	1	1	60.5
+	59.5	fbus	14258	TS4	230.0	1	1	60.5

Arizona 500 kV Bus Voltages (p.u.)



○	0.0	vbus	14007	GILARIVR	500.0	1	1	1.2
×	0.0	vbus	15093	HARQUAHA	500.0	1	1	1.2
□	0.0	vbus	15090	HASSYAMP	500.0	1	1	1.2
△	0.0	vbus	15089	JOJOBA	500.0	1	1	1.2
◇	0.0	vbus	15011	KYRENE	500.0	1	1	1.2
+	0.0	vbus	15021	PALOVRDE	500.0	1	1	1.2

Arizona 500 kV Bus Frequencies (Hz)



○	59.5	fbus	14007	GILARIVR	500.0	1	1	60.5
×	59.5	fbus	15093	HARQUAHA	500.0	1	1	60.5
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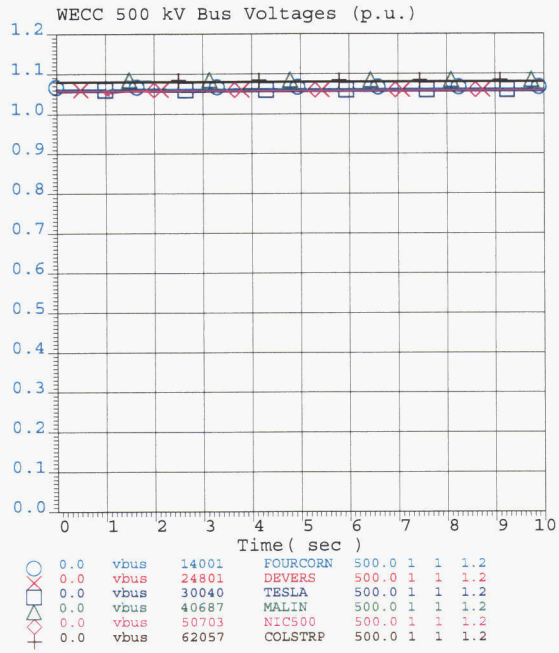
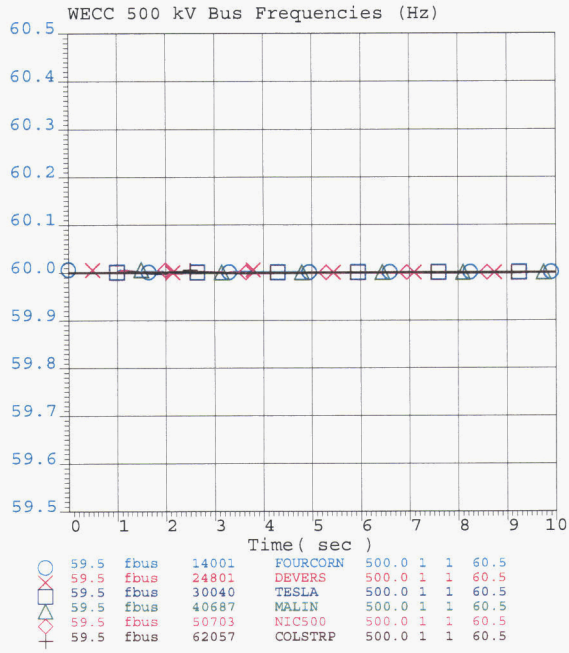
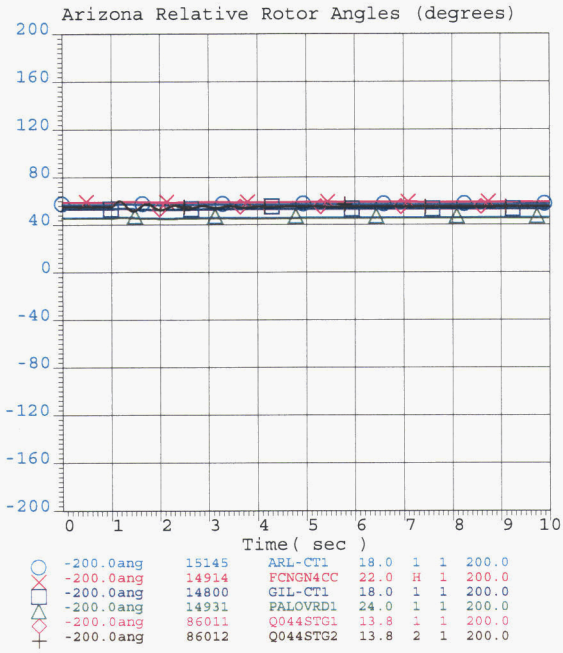
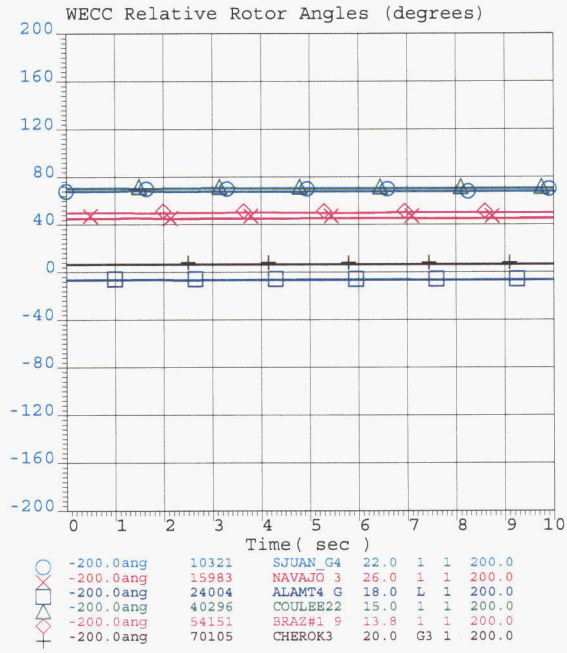
2011 Heavy Summer Power Flow/Transient Stability Case
Gila Bend/Gila River Cluster SIS Post-Project R3 Case 3 Q044 @ 280 MW
3-phase 4 cycle flt. @ Gila Bend 69 kV, trip Gila Bend 230/69 kV xfmr 1

Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots









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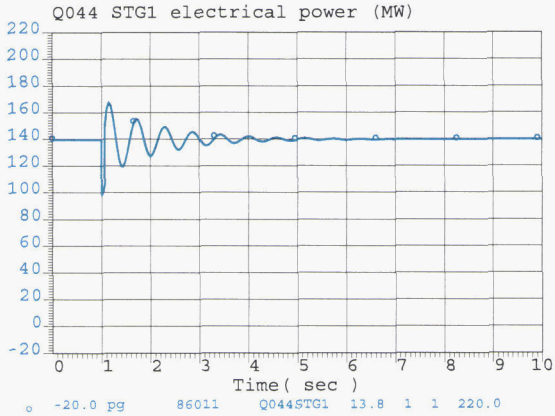
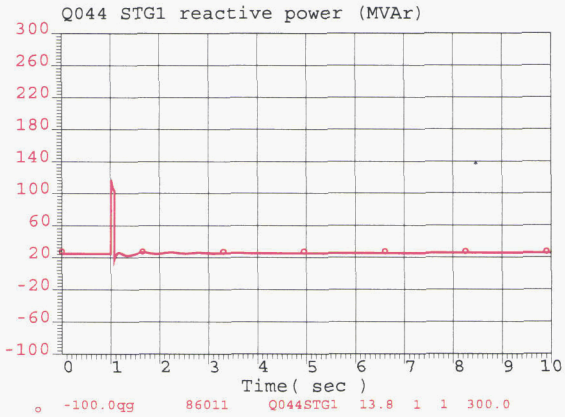
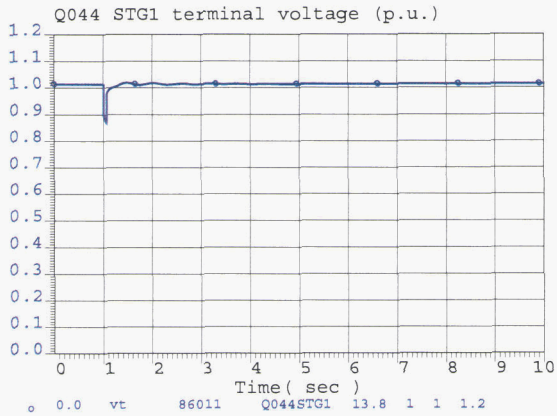
Gila Bend/Gila River Cluster SIS Post-Project R3 Case 3 Q044 @ 280 MW
3-phase 4 cycle flt. @ Gila Bend 69 kV, trip Gila Bend 230/69 kV xfmr 1

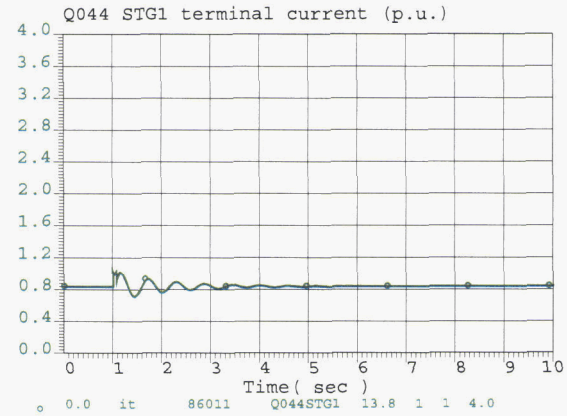
APS	11hs-gbgr-r3-pst3-dyn_swt09-gilabend-230-69-xfmr1.chf	c:\work\aps\gbgr\sis\dyn Wed Jun 17 13:40:49 2009

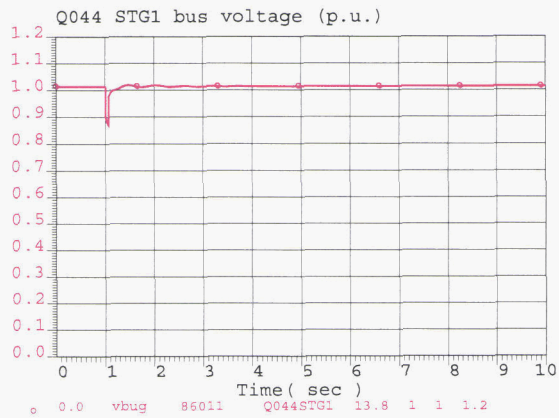
Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots

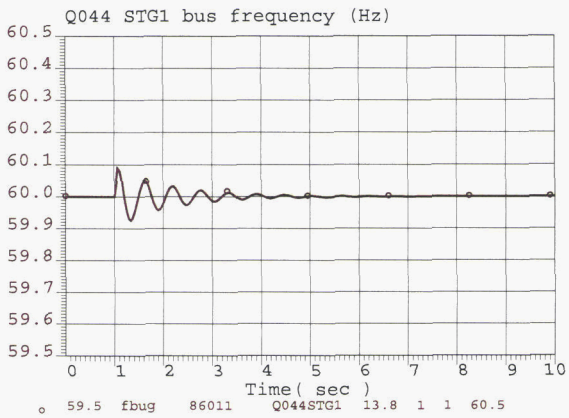








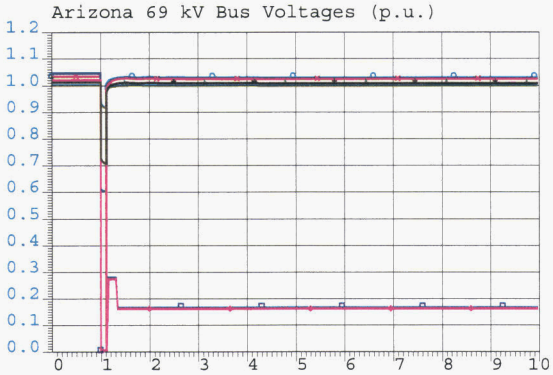




2011 Heavy Summer Power Flow/Transient Stability Case
Gila Bend/Gila River Cluster SIS Post-Project R3 Case 3 Q044 @ 280 MW
3-phase 4 cycle flt. @ Gila Bend 69 kV, trip Gila Bend 230/69 kV xfmr 1

Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots

Arizona 69 kV Bus Voltages (p.u.)



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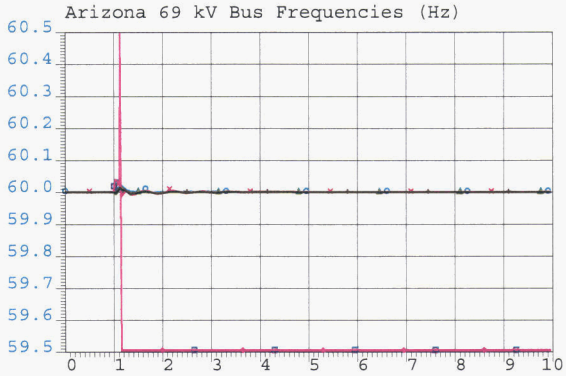
0.0	vbus	84432	PALOMA	69.0	1	1	1.2
0.0	vbus	84411	BUNYAN	69.0	1	1	1.2
0.0	vbus	84442	SADDLEMT	69.0	1	1	1.2
0.0	vbus	84460	HY1	69.0	1	1	1.2
0.0	vbus	84414	COTN CTR	69.0	1	1	1.2

Arizona 69 kV Bus Frequencies (Hz)



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59.5	fbus	84411	BUNYAN	69.0	1	1	60.5
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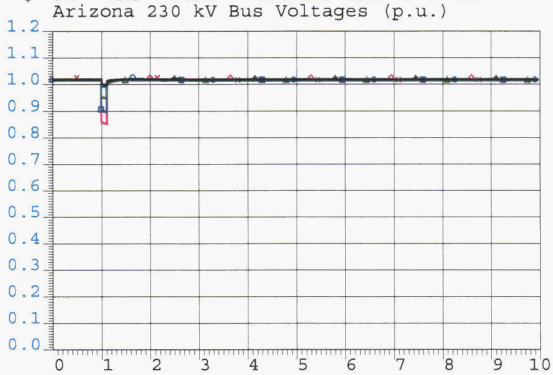
Arizona 230 kV Bus Voltages (p.u.)



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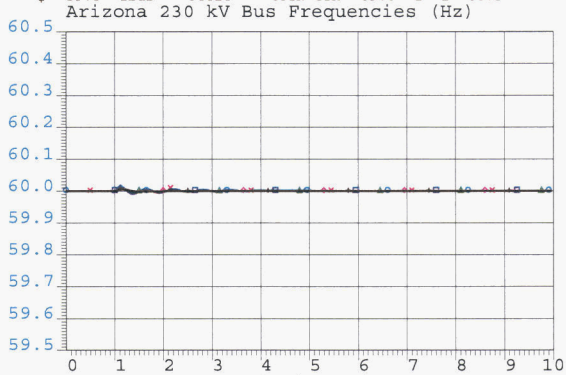
0.0	vbul	14235	GILABEND	230.0	1	1	1.2
0.0	vbus	14238	GILARIVR	230.0	1	1	1.2
0.0	vbus	14224	JOJOBA	230.0	1	1	1.2
0.0	vbus	19052	LIBERTY	230.0	1	1	1.2
0.0	vbus	14258	TS4	230.0	1	1	1.2

Arizona 230 kV Bus Frequencies (Hz)



59.5	fbul	14201	BUCKEYE	230.0	1	1	60.5
59.5	fbul	14235	GILABEND	230.0	1	1	60.5
59.5	fbus	14238	GILARIVR	230.0	1	1	60.5
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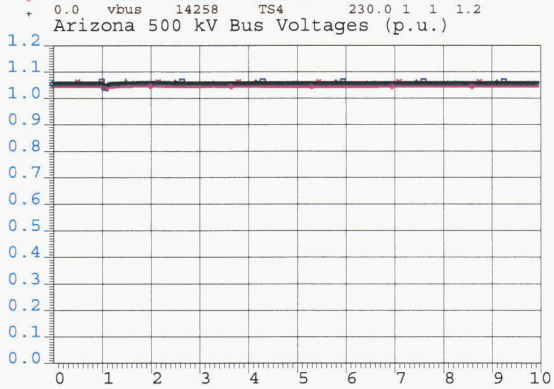
Arizona 500 kV Bus Voltages (p.u.)



0.0	vbus	14007	GILARIVR	500.0	1	1	1.2
0.0	vbus	15093	HARQUAHA	500.0	1	1	1.2
0.0	vbus	15090	HASSYAMP	500.0	1	1	1.2
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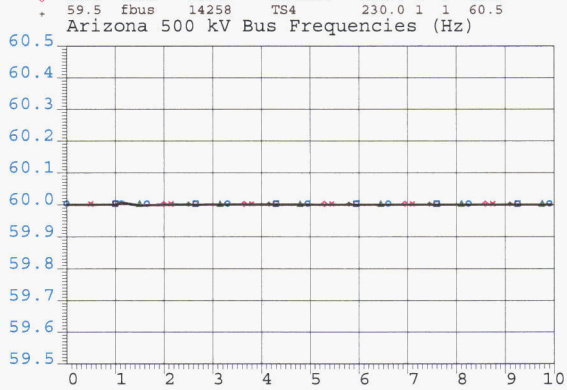
Arizona 500 kV Bus Frequencies (Hz)



59.5	fbus	14007	GILARIVR	500.0	1	1	60.5
59.5	fbus	15093	HARQUAHA	500.0	1	1	60.5
59.5	fbus	15090	HASSYAMP	500.0	1	1	60.5
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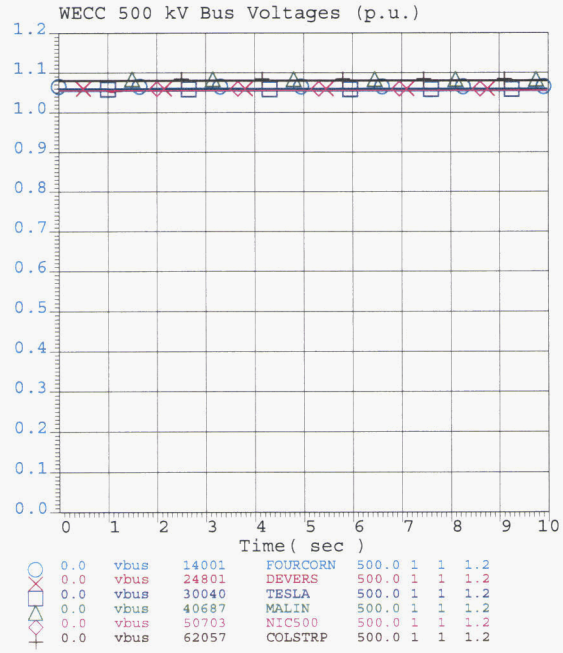
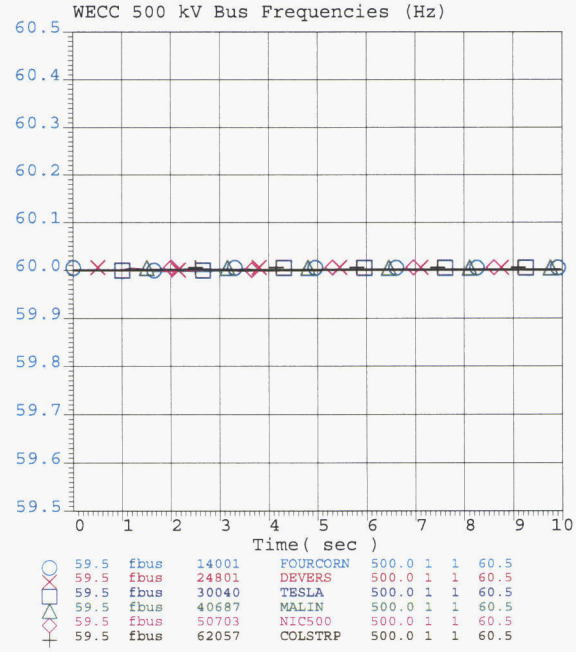
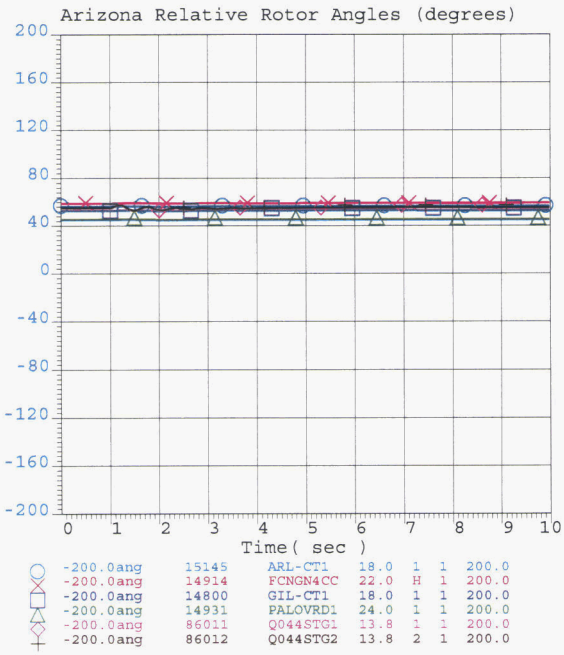
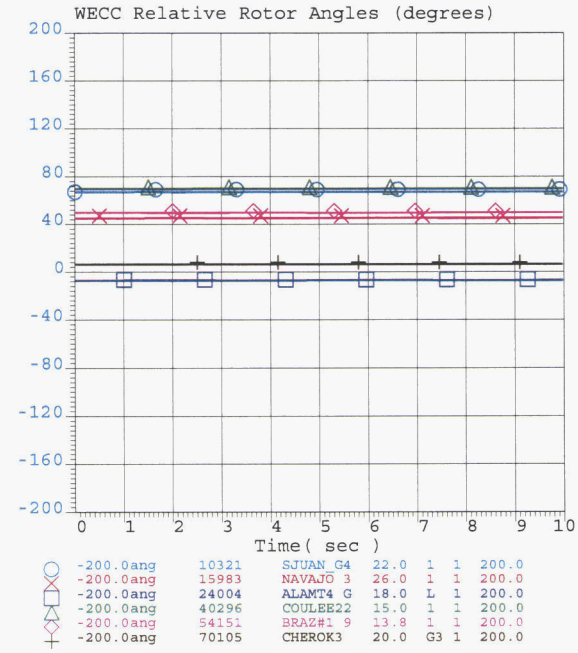
2011 Heavy Summer Power Flow/Transient Stability Case
Gila Bend/Gila River Cluster SIS Post-Project R3 Case 3 Q044 @ 280 MW
3-phase 7 cycle flt. @ Paloma 69 kV, trip Paloma-Bunyan 69 kV

Gila Bend/Gila River Cluster
System Impact Study
Transient Stability Plots









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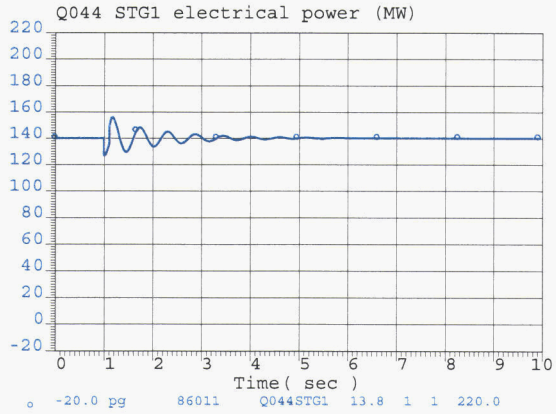

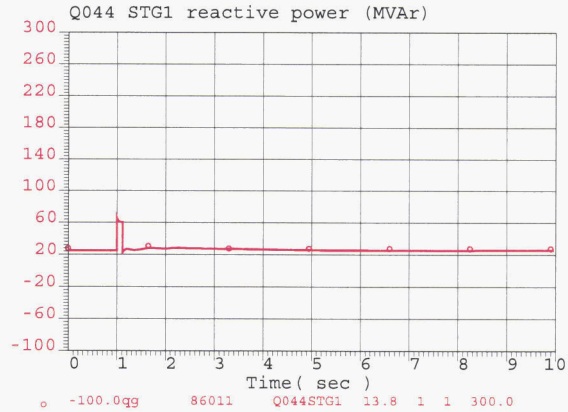

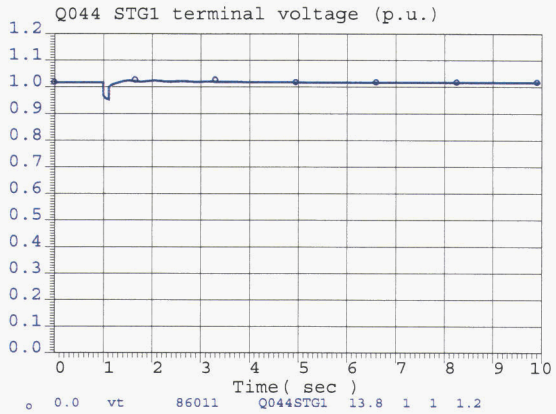

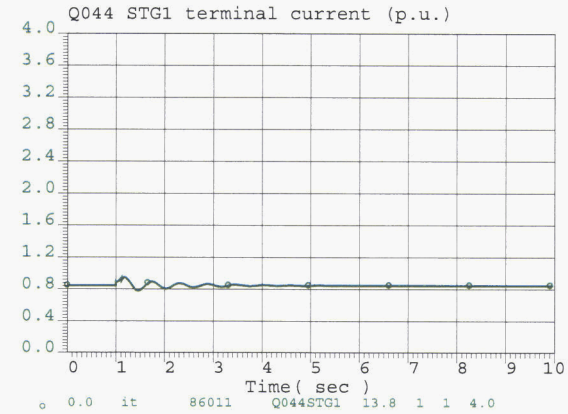

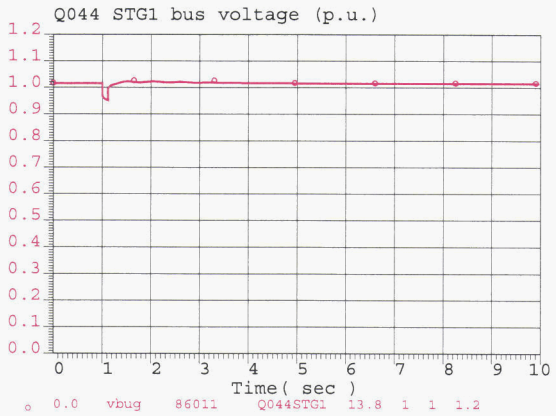

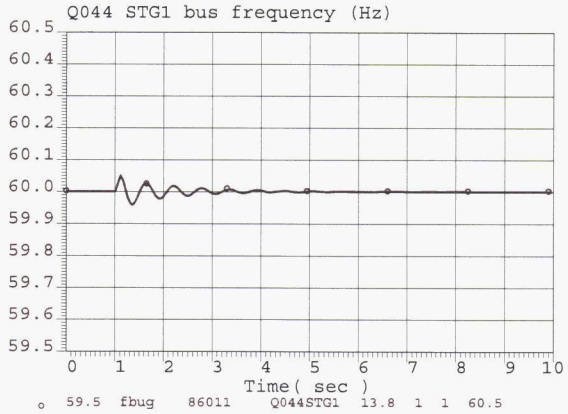

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Gila Bend/Gila River Cluster SIS Post-Project R3 Case 3 Q044 @ 280 MW
3-phase 7 cycle flt. @ Paloma 69 kV, trip Paloma-Bunyan 69 kV

A subsidiary of Pinnacle West Capital Corporation

Q44 Generation Interconnection

Interconnection Facilities Study

APS Contract No. 52129

By

Arizona Public Service Company
Transmission Planning

August 19, 2009
Version 1.5

FACILITIES STUDY
Q44 PROPOSED GENERATION

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1. Introduction

APS performed this Generator Interconnection Facilities Study ("FaS") in response to a generator interconnection request by the Interconnection Customer ("Customer"). The Customer is listed in APS's Active Generator Interconnection Queue as queue number 44 and has already completed a System Impact Study. The purpose of the study is to provide cost and construction schedule estimates for the facilities needed to interconnect the Customer's proposed 280 MW solar generation facility ("Q44") located near Gila Bend, Arizona in Maricopa County. The Point of Interconnection ("POI") assumed for the FaS is APS's Panda 230kV switchyard. The proposed in-service date for Q44 to be on-line is by December 2011, but based on the Facilities needed for the interconnection the amount of time needed is approximately 38 months from the time all appropriate written authorization, interconnection agreements, and funding arrangements are in place. Figure 1 shows a general location of Q44. Figure 2 shows a general depiction of the transmission system around Q44's proposed POI.

Figure 1. General Project Location w/Tie Line

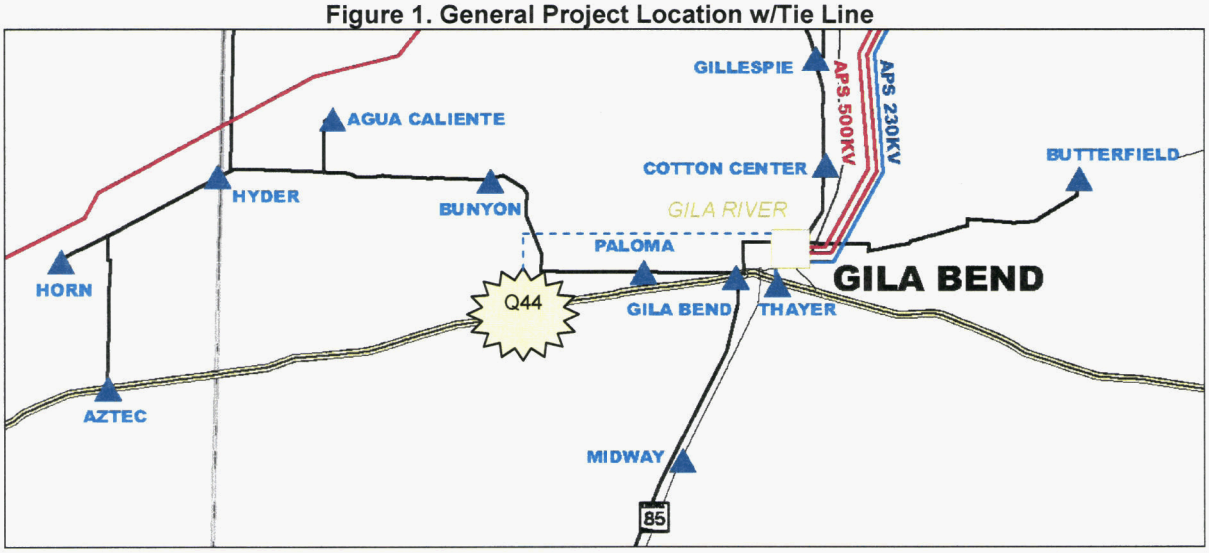
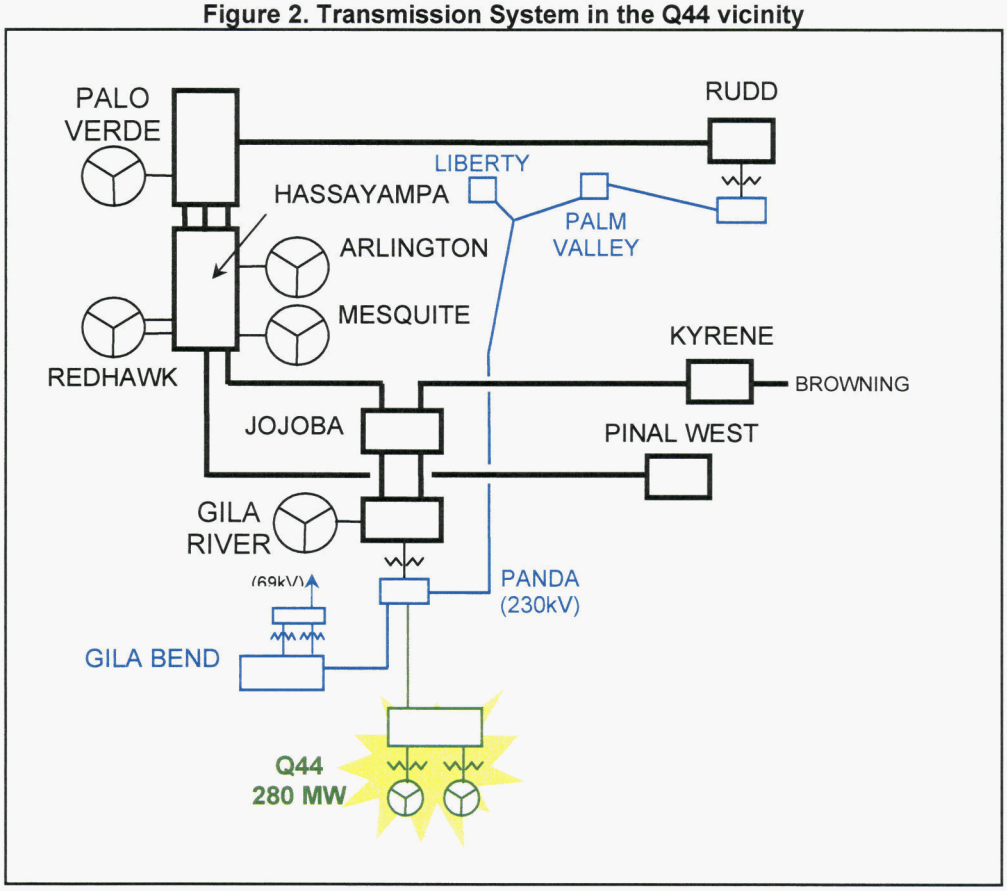


Figure 2. Transmission System in the Q44 vicinity



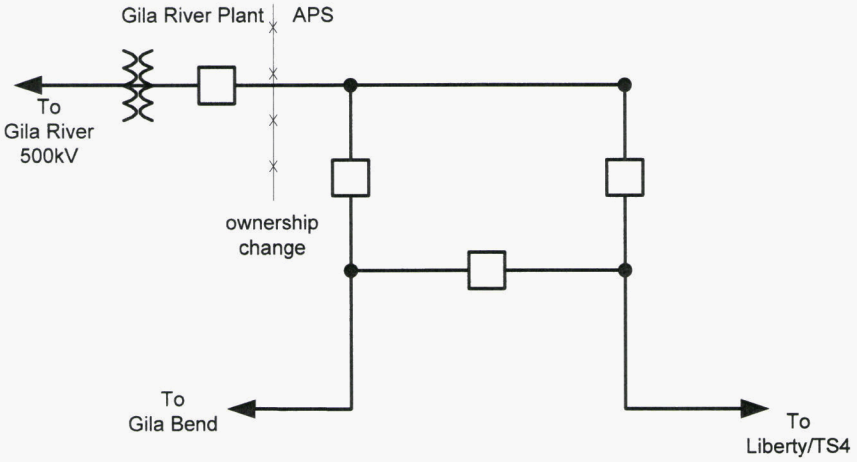
The Interconnection Customer has chosen to interconnect as an Energy Resource. Delivery of the Q44 output beyond the POI would be on an "as-available" basis only. The POI is the Panda 230kV substation. The delivery of the Q44 output would be subject to the firm or non-firm transmission capacity that may be available when a transmission service request is made. APS is the sole owner of the Panda 230kV substation and delivery of the Q44 output could be made to APS at the Panda 230kV substation.

Nothing in this report constitutes an offer of transmission service or confers upon the Interconnection Customer, any right to receive transmission service. APS may not have the Available Transfer Capability ("ATC") to support the Transmission Service for the interconnection described in this report.

2. Interconnection Facilities

The interconnection facilities required for the Q44 project consist of a new 230kV bay at the Panda substation and realigning the Panda-Liberty 230kV line exit from the Panda substation. Currently the Panda substation is a three breaker ring. The Panda substation is set-up to handle one more termination, to make it a four breaker ring bus. A simple one-line diagram of the existing Panda 230kV substation is shown in **Figure 3**.

Figure 3. Existing Panda 230kV switchyard – Simplified one-line

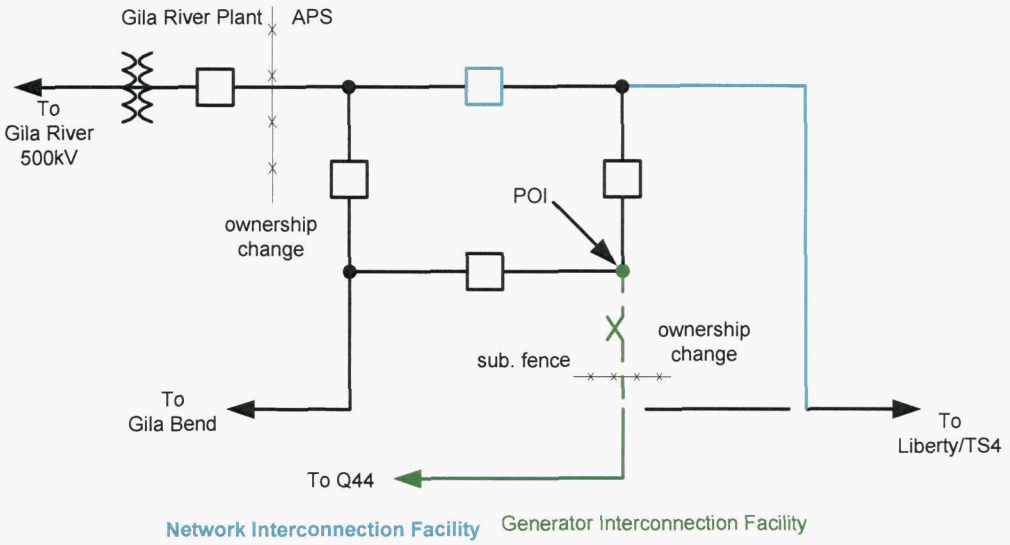


The open bay is located on the north east side of the substation. In-order to avoid the Q44 230kV generator tie line from crossing the Panda-Liberty 230kV line, the plan of service for connecting Q44 into Panda involves moving the termination of the Panda-Liberty 230kV line. This can be seen below in **Figure 4**. Currently that line exits the Panda substation to the south until Watermelon Road. Then the line turns east following the road. The certificated route for the Q44 230kV tie line has the line approaching the Panda substation on the south side of Watermelon Road. At the point where the Q44 tie line reaches the alignment where the Panda-Liberty line exits the Panda substation, the Q44 tie line would utilize this alignment to enter the Panda substation.

The new alignment for the Panda-Liberty line would have it exiting the Panda substation from the east side of the substation, then continuing south to Watermelon Road to pick-up the original Panda-Liberty line. That portion of the line would be constructed to APS standards for new 230kV construction using 1272 ACSR conductor.

Appendix A shows a detailed one-line and physical layout of the Panda 230kV substation after the Q44 interconnection.

Figure 4. Panda 230kV Switchyard Configuration After Q44 Interconnection– Simplified one-line



The estimated cost of the network upgrades at the Panda 230kv substation, described above and shown in light blue in **Figure 4**, are summarized in **Table 1** below. Construction schedule estimates are from the date the Interconnection Customer provides written authorization to proceed, provided all interconnection agreements and funding arrangements are in place. All of the costs described in **Table 1** are network upgrades, as depicted in **Figure 4**.

Table 1. Cost and Construction Time Estimates

Facility	Cost (2009 dollars)	Schedule
Panda 230kV substation additional bay	$1,465,000	
Relocate 230kV Liberty-Panda line exit	$561,600	
Total	**$2,026,600**	**15 months**

Additional cost estimate and construction schedule details are provided in Appendix B. The estimates do not include cost and timing that may be involved with the Transmission and Facilities Siting process, if needed.

3. System Reinforcements

The System Impact Study for this project was performed in a cluster study. That cluster study included another Interconnection Customer (project Q31 in the APS queue). The SIS identified two 69kV lines that need to be upgraded if only the Q44 project continued to an LGIA. However, if both projects continued on to an LGIA the SIS identified a third 69kV line that would need to be upgraded. As of the writing of this report only the Q44 project has moved to the Facilities Study[1]. Therefore, the system reinforcements identified in this Facilities study are for the two 69kV lines that need to be upgraded.

The SIS identified that the Gila Bend to Butterfield Tap and Butterfield Tap to Cotton Center 69kV lines (hereby referred to as the "Gila Bend-Cotton Center 69kV lines") need to be upgraded. In-order to

[1] Project Q31 may elect to proceed toward a LGIA after this report is published. An estimate for rebuilding the third 69kV line may be provided at that time.

achieve the ratings necessary to accommodate the interconnection of Q44 the Gila Bend-Cotton Center 69kV lines need to be rebuilt with new structures. The existing lines will need to be removed and new structures built that will be capable of handling 795 ACSS conductor. In some places the current structures have 12kV underbuild. The new structures will be constructed to be capable of handling 12kV underbuild where applicable. The new 69kV lines will be rebuilt in the existing easements from Gila Bend up to Old Highway 80. Along Old Highway 80 the new 69kV line will be constructed along the same general route as the existing 69kV line, however moved into new Rights-of-Way (ROW) which will be outside of the Old Highway 80 ROW, up to the Cotton Center substation.

The estimated cost of the 69kV network upgrades, as described above, are summarized in **Table 2** below. Construction schedule estimates are from the date the Interconnection Customer provides written authorization to proceed, provided all interconnection agreements and funding arrangements are in place. All of the costs described in **Table 2** are network upgrades. Appendix C shows a more detailed breakdown of the cost and schedule estimates for the 69kV upgrades.

Table 2. 69kV Upgrades Cost and Construction Time Estimates

Facility	Cost (2009 dollars)	Schedule
Remove existing 69kV structures and conductor	$447,965	N/A
APS Project Management & Design	$127,088	N/A
Gila Bend-Cotton Center 69kV rebuild	$3,360,238	18 months
12kV underbuild	$1,517,231	N/A
New 69kV ROW acquisition	$350,000	24 months
Total	**$5,802,522**	32-38 months

4. Q44 230kV Generator Interconnection Line

As part of the Facilities Study, the Interconnection Customer asked APS to provide construction and cost estimates if APS were to construct the 230kV line from the Q44 facility to the Panda 230kV substation.

The 230kV Q44 generator tie line would be approximately 18 miles in length. The estimated cost for APS to construct the line for the Interconnection Customer would be $25,272,000. Design, equipment procurement, and construction would take approximately 23 months. These estimates are based on the following assumptions:

- Double circuit capable steel monopole, but constructed with single circuit 1272 ACSR conductor
- Following the certificated corridor received by the Interconnection Customer
- Crossing under the existing APS Gila Bend-Panda 230kV line and constructing on the south side of the Water Treatment facility
- Terminating at the Panda substation in the bay currently occupied by the Panda-Liberty line
- Based on 2009 dollars

The estimated cost does not include:

- Land costs (money paid in fee, legal fees, permit costs, etc.)
- ROW preparation (Road building, clearing, etc.)
- Environmental issues (Archeological and Biological studies, 404 issues, dust control, etc.)
- Unforeseen labor or material escalation
- Transmission line siting process
- Substation related materials, labor, or communication ties

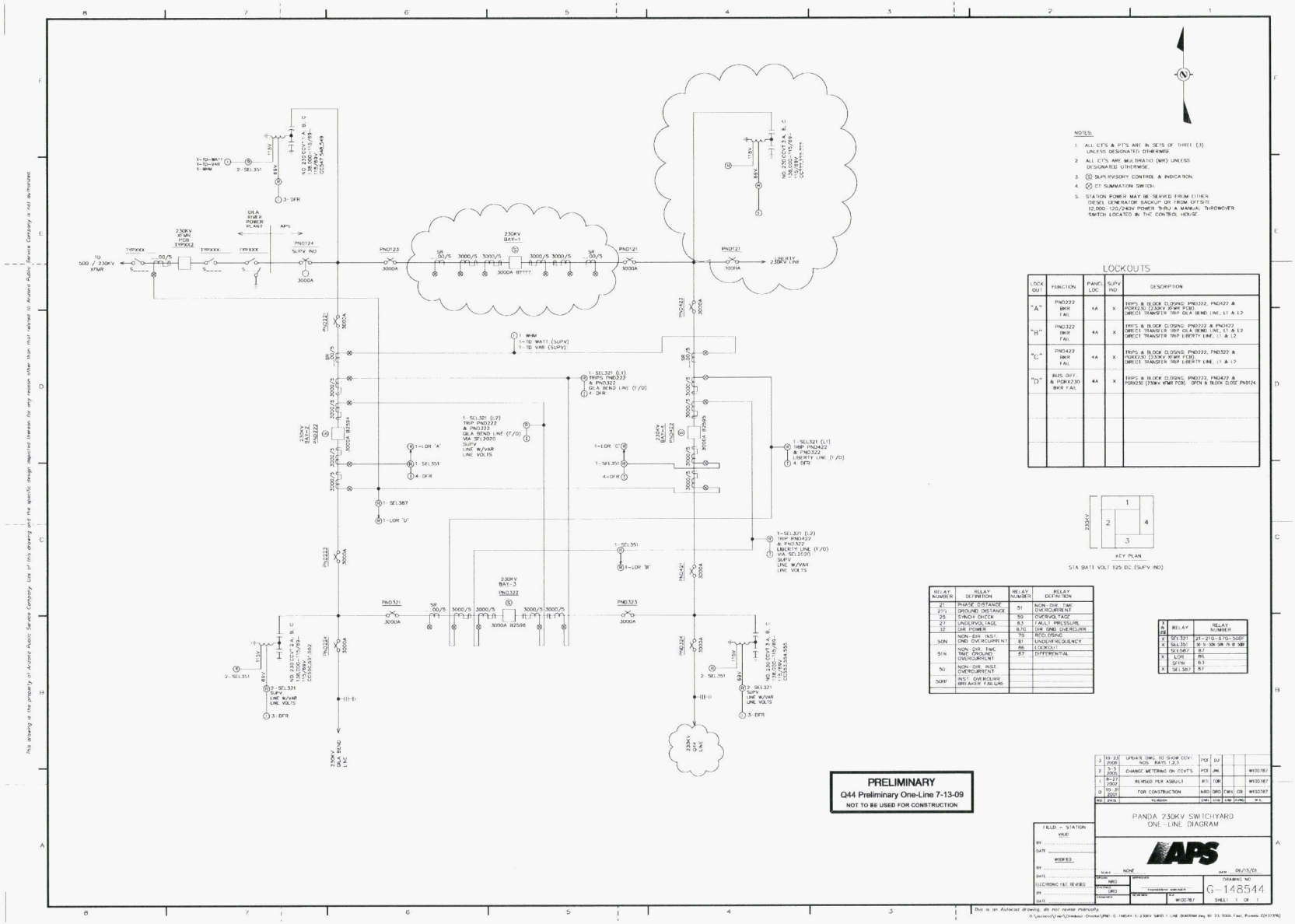
If the line is to be owned by the Interconnection Customer it is assumed that ROW acquisition would be done by the Interconnection Customer. However, an estimate for ROW acquisition is provided if APS were to acquire the ROW.

The APS estimate for acquiring the needed ROW for constructing the Q44 Generator Interconnection line is dependant upon where specifically within the certificated corridor the line is constructed. The estimate varies from $2,015,000 to $2,095,000 and the acquisition time can take from 12 to 24 months. The land acquisition time is in addition to the construction time listed above, with some minimal overlap.

The details of the ROW costs and construction schedule can be seen in Appendix D.

Appendix A

Preliminary Panda 230kV Switchyard Design


NOTES:
1. ALL CT'S & PT'S ARE IN SETS OF THREE (3) UNLESS DESIGNATED OTHERWISE.
2. ALL CT'S ARE MULTIRATIO (MR) UNLESS DESIGNATED OTHERWISE.
3. (S) SUPERVISORY CONTROL & INDICATION.
4. (Σ) CT SUMMATION SWITCH.
5. STATION POWER MAY BE SERVED FROM EITHER DIESEL GENERATOR BACKUP OR FROM OFFSITE 12,000-120/240V POWER THRU A MANUAL THROWOVER SWITCH LOCATED IN THE CONTROL HOUSE.
LOCKOUTS
LOCK OUT
FUNCTION
PANEL LOC
SUPV IND
DESCRIPTION
"A" PND222 BKR FAIL 4A X TRIPS & BLOCK CLOSING: PND222, PND422 & PGR2230 (230KV XFMR PCB) DIRECT TRANSFER TRIP GLA BEND LINE, L1 & L2
"B" PND322 BKR FAIL 4A X TRIPS & BLOCK CLOSING: PND322 & PND422 DIRECT TRANSFER TRIP GLA BEND LINE, L1 & L2 DIRECT TRANSFER TRIP LIBERTY LINE, L1 & L2
"C" PND422 BKR FAIL 4A X TRIPS & BLOCK CLOSING: PND222, PND322 & PGR2230 (230KV XFMR PCB) DIRECT TRANSFER TRIP LIBERTY LINE, L1 & L2
"D" BUS DIFF. & PGR2230 BKR FAIL 4A X TRIPS & BLOCK CLOSING: PND222, PND422 & PGR2230 (230KV XFMR PCB) OPEN & BLOCK CLOSE PND124.
230KV
1
2
3
4
KEY PLAN
STA BATT VOLT 125 DC (SUPV IND)
RELAY NUMBER
RELAY DEFINITION
21 PHASE DISTANCE
21G GROUND DISTANCE
25 SYNCH CHECK
27 UNDERVOLTAGE
32 DIR POWER
50N NON-DIR. INST. GND OVERCURRENT
51N NON-DIR. TIME TIME GROUND OVERCURRENT
50 NON-DIR. INST. OVERCURRENT
50BF INST. OVERCURR BREAKER FAILURE
51 NON-DIR. TIME OVERCURRENT
59 OVERVOLTAGE
63 FAULT PRESSURE
67G DIR GND OVERCURR
79 RECLOSING
81 UNDER FREQUENCY
86 LOCKOUT
87 DIFFERENTIAL
RELAY
RELAY NUMBER
X SEL321 21-21G-67G-50BF 32-3 50N SR 79 & SOTF
X SEL387 87
X LOR 86
SPR 63
X SEL387 87
PRELIMINARY
Q44 Preliminary One-Line 7-13-09
NOT TO BE USED FOR CONSTRUCTION
PANDA 230KV SWITCHYARD
ONE-LINE DIAGRAM
APS
NONE
08/15/01
G-148544
SHEET 1 OF 1
This is an Autocad drawing, do not revise manually.

Panda 230kV Physical One-Line

Appendix B

Panda 230kV Interconnection Cost Estimate and Construction Schedule Details

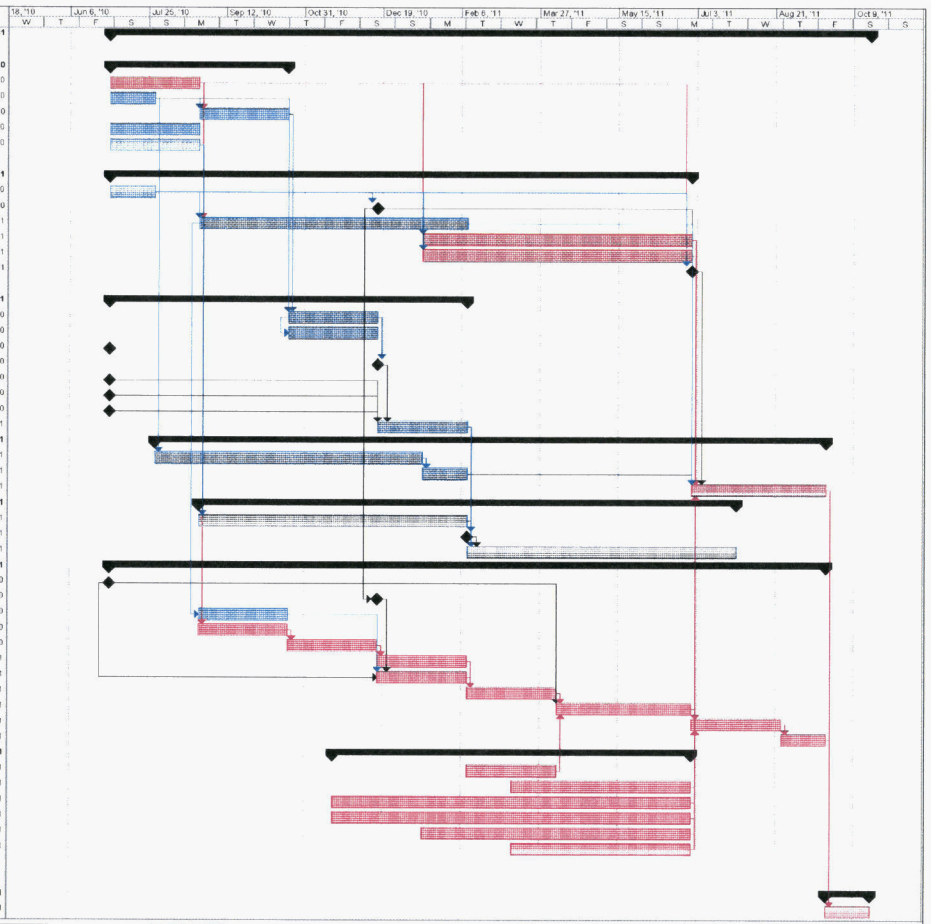
Queue #44 (7-3-09)

Scope: New 230kV line bay at Panda Substation
1 - Deadend Structure, 1 - 230kV switch, 1 - 230kV breaker
Protective relay addition & reconfiguration
Aproxiamately 10mi of fiber-optic cable underbuild from Q44 site to Gila Bend for 2nd communication path

	Overall Project Total	230kV Bay at Panda for Q44					
Engineering and Design	$80,000	$80,000	$0	$0	$0	$0	$0
Below grade	$136,000	$136,000	$0	$0	$0	$0	$0
Construction Labor (Steel, Equipment & Control)	$343,000	$343,000	$0	$0	$0	$0	$0
Steel Structures	$53,000	$53,000	$0	$0	$0	$0	$0
Electrical Equipment	$166,000	$166,000	$0	$0	$0	$0	$0
Control & Communications	$443,000	$443,000	$0	$0	$0	$0	$0
Subtotal :	$1,221,000	$1,221,000	$0	$0	$0	$0	$0
Contingency : (20%)	$244,000	$244,000	$0	$0	$0	$0	$0
Totals :		**$1,465,000**	**$0**	**$0**	**$0**	**$0**	**$0**

Grand-Total : $1,465,000

ID	Task Name	Duration	Start	Finish
1	**Q44 (Preliminary Substation Construction Schedule) 7-3-09**	**340 days**	**Thu 7/1/10**	**Wed 10/19/11**
2				
3	**Planning**	**80 days**	**Thu 7/1/10**	**Wed 10/20/10**
4	Preliminary One-Line Approved	2 mons	Thu 7/1/10	Wed 8/25/10
5	Physical Layout Approved (w/ultimate plan)	1 mon	Thu 7/1/10	Wed 7/28/10
6	Award Substation Design Contract	2 mons	Thu 8/26/10	Wed 10/20/10
7	Line Route Identified	2 mons	Thu 7/1/10	Wed 8/25/10
8	Communications Needs Identified	2 mons	Thu 7/1/10	Wed 8/25/10
9				
10	**Major Equipment Procurement**	**260 days**	**Thu 7/1/10**	**Thu 6/30/11**
11	Equipment Specifications	1 mon	Thu 7/1/10	Wed 7/28/10
12	Xfmr	0 days	Thu 12/16/10	Thu 12/16/10
13	Breakers	6 mons	Thu 8/26/10	Wed 2/9/11
14	Switches	6 mons	Thu 1/13/11	Wed 6/29/11
15	CCVT/PTs	6 mons	Thu 1/13/11	Wed 6/29/11
16	Station Power	0 days	Thu 6/30/11	Thu 6/30/11
17				
18	**Below Grade**	**160 days**	**Thu 7/1/10**	**Wed 2/9/11**
19	Grading, Drainage, & Foundation Design	2 mons	Thu 10/21/10	Wed 12/15/10
20	Ground Grid Design	2 mons	Thu 10/21/10	Wed 12/15/10
21	Zoning	0 days	Thu 7/1/10	Thu 7/1/10
22	Permit	0 days	Wed 12/15/10	Wed 12/15/10
23	Arch/Emero Survey	0 days	Thu 7/1/10	Thu 7/1/10
24	Native Plant Survey/Salvage	0 days	Thu 7/1/10	Thu 7/1/10
25	404 Permit	0 days	Thu 7/1/10	Thu 7/1/10
26	Site Work	2 mons	Thu 12/16/10	Wed 2/9/11
27	**Above Grade**	**300 days**	**Thu 7/29/10**	**Wed 9/21/11**
28	Design	6 mons	Thu 7/29/10	Wed 1/12/11
29	BOM	1 mon	Thu 1/13/11	Wed 2/9/11
30	Site Work	3 mons	Thu 6/30/11	Wed 9/21/11
31	**Communications**	**240 days**	**Thu 8/26/10**	**Wed 7/27/11**
32	Design	6 mons	Thu 8/26/10	Wed 2/9/11
33	Frequency License (Microwave)	0 days	Wed 2/9/11	Wed 2/9/11
34	Site Work	6 mons	Thu 2/10/11	Wed 7/27/11
35	**Control**	**320 days**	**Thu 7/1/10**	**Wed 9/21/11**
36	Control House Design	0 days	Thu 7/1/10	Thu 7/1/10
37	Xfmr Approval Drawings	0 days	Thu 12/16/10	Thu 12/16/10
38	Equipment Approval Drawings	2 mons	Thu 8/26/10	Wed 10/20/10
39	Phasing & Key Drawings	2 mons	Thu 8/26/10	Wed 10/20/10
40	I/O Assignments	2 mons	Thu 10/21/10	Wed 12/15/10
41	Panel Front Views	2 mons	Thu 12/16/10	Wed 2/9/11
42	Schematics	2 mons	Thu 12/16/10	Wed 2/9/11
43	Wiring Diagrams	2 mons	Thu 2/10/11	Wed 4/6/11
44	Panel Construction	3 mons	Thu 4/7/11	Wed 6/29/11
45	Field Wiring	2 mons	Thu 6/30/11	Wed 8/24/11
46	Functional Testing	1 mon	Thu 8/25/11	Wed 9/21/11
47	**Long Lead Materials (substation)**	**160 days**	**Thu 11/18/10**	**Wed 6/29/11**
48	Relays	2 mons	Thu 2/10/11	Wed 4/6/11
49	Control Cable	4 mons	Thu 3/10/11	Wed 6/29/11
50	Steel	8 mons	Thu 11/18/10	Wed 6/29/11
51	Insulators	8 mons	Thu 11/18/10	Wed 6/29/11
52	Arrestors	6 mons	Thu 1/13/11	Wed 6/29/11
53	Bus/Wire	4 mons	Thu 3/10/11	Wed 6/29/11
54				
55				
56	**Substation Energization**	**20 days**	**Thu 9/22/11**	**Wed 10/19/11**
57	Commision	1 mon	Thu 9/22/11	Wed 10/19/11



Task | Critical Task | Progress | Milestone | Summary | Rolled Up Task | Rolled Up Critical Task | Rolled Up Milestone | Rolled Up Progress | Split | External Tasks | Project Summary | Group By Summary

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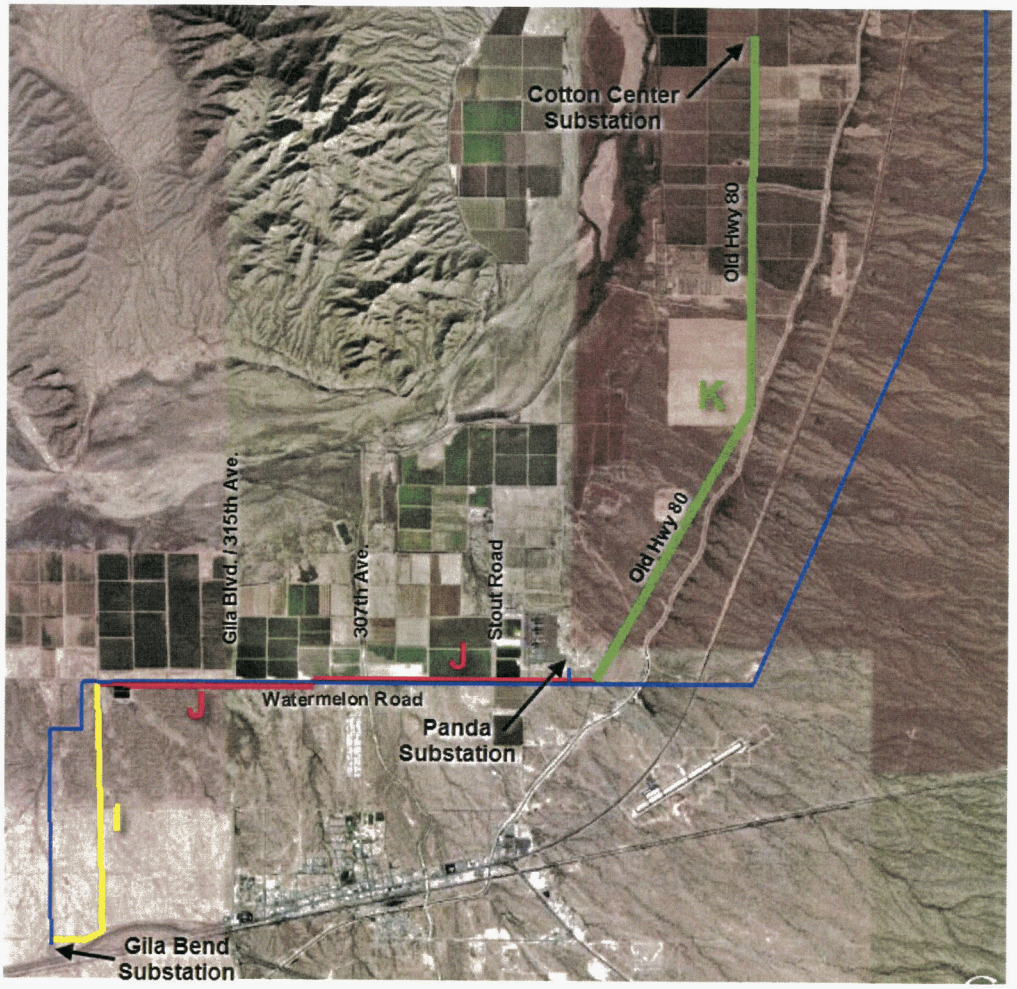
Appendix C

69kV System Upgrades Cost Estimate and Construction Schedule Details



I Existing 69kV East and North of Gila Bend Sub

J South then North of Watermelon Road to Old Hwy 80

K East &/or West of Old Hwy 80

Existing 230kV Line

69kV ROUTE OPTIONS & ACQUISITION ESTIMATE		
Rebuild in existing easements	I Total	0K
Rebuild in existing easements	J Total	0K
	K Total	350K
Acquisition Time Required:	**12 to 24 Months**	

Gila Bend to Cotton Center Sub Cost Estimate

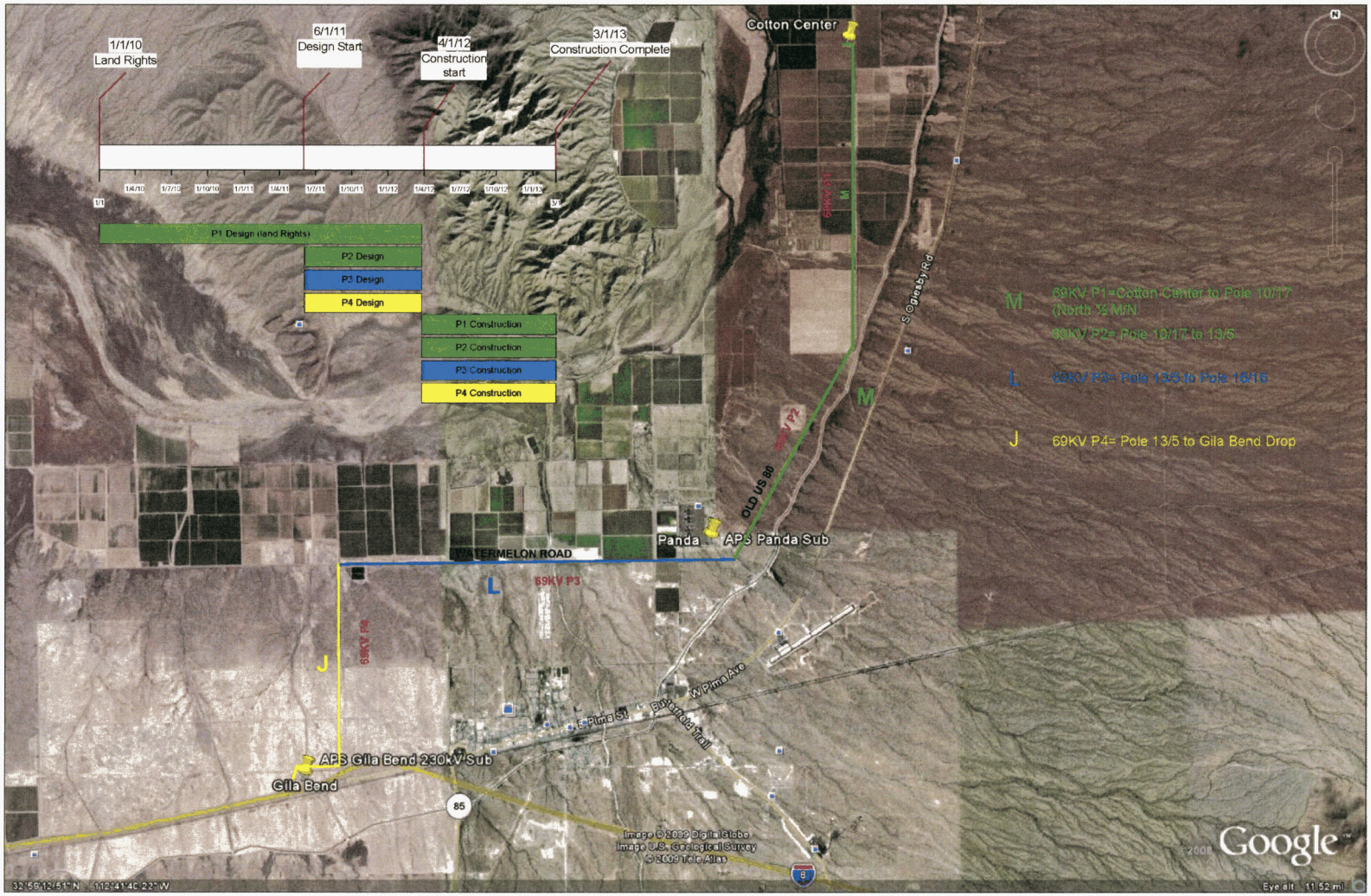
69KV COST ESTIMATE

DESCRIPTION	QUANTITY	COST
TANGENT STRUCTURES	187	$1,014,868.69
SELF SUPPORTING STRUCTURES	10	$195,608.01
ELECTRICAL EQUIPMENT & FRAMING	N/A	$2,149,761.33
		$3,360,238.03
APS PROJECT MANAGEMENT & DESIGN	N/A	$127,088.16
COST OF REMOVING OLD STRUCTURES & FRAMING		$447,964.81
TOTAL COST OF 69kV WORK		**$3,935,291.00**

12KV COST ESTIMATE

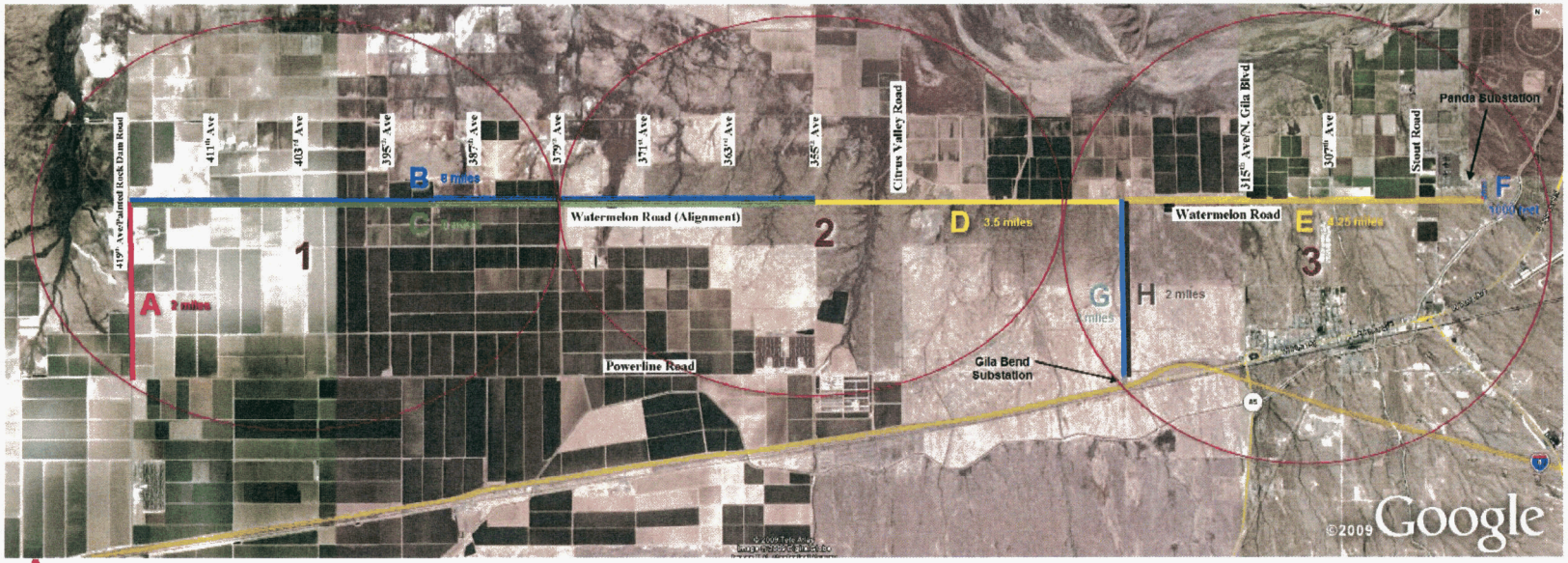
DESCRIPTION	QUANTITY	COST
ELECTRICAL EQUIPMENT & FRAMING	N/A	$1,158,912.93
APS PROJECT MANAGEMENT & DESIGN	N/A	$86,410.60
COST OF REMOVING OLD FRAMING	N/A	$271,907.97
TOTAL COST OF 12kV WORK		**$1,517,231.50**

ENTIRE COST OF JOB	**$5,452,522.50**


1/1/10
Land Rights
6/1/11
Design Start
4/1/12
Construction start
3/1/13
Construction Complete
P1 Design (land Rights)
P2 Design
P3 Design
P4 Design
P1 Construction
P2 Construction
P3 Construction
P4 Construction
Cotton Center
S Gleasby Rd
M
69KV P1=Cotton Center to Pole 10/17 (North ½ M/N)
69KV P2= Pole 10/17 to 13/5
L
69KV P3= Pole 13/5 to Pole 16/10
J
69KV P4= Pole 13/5 to Gila Bend Drop
69KV P2
OLD US 80
Panda
APS Panda Sub
WATERMELON ROAD
L
69KV P3
69KV P4
J
W Pima Ave
E Pima St
Butterfield Trail
APS Gila Bend 230kV Sub
Gila Bend
85
Image © 2009 DigitalGlobe
Image U.S. Geological Survey
© 2009 Tele Atlas
Google
32°59'12.51" N 112°41'46.22" W
Eye alt 11.52 mi

Appendix D

Land Acquisition Costs for Q44 Generator 230kV Interconnection Line



A 200 foot corridor East of Painted Rock Dam Road Centerline

B 1000 foot corridor North of Section Line (Watermelon Road Alignment Centerline)

C 1000 foot corridor South of Section Line (Watermelon Road Alignment Centerline)

D 1000 foot corridor South of Section Line (Watermelon Road Alignment Centerline)

E 1250 foot corridor South of Section Line (Watermelon Road Centerline)

F 500 foot corridor extending 1000 feet North of Watermelon Road Centerline Adjacent to Panda Substation

G 500 foot corridor West of APS 230kV Centerline

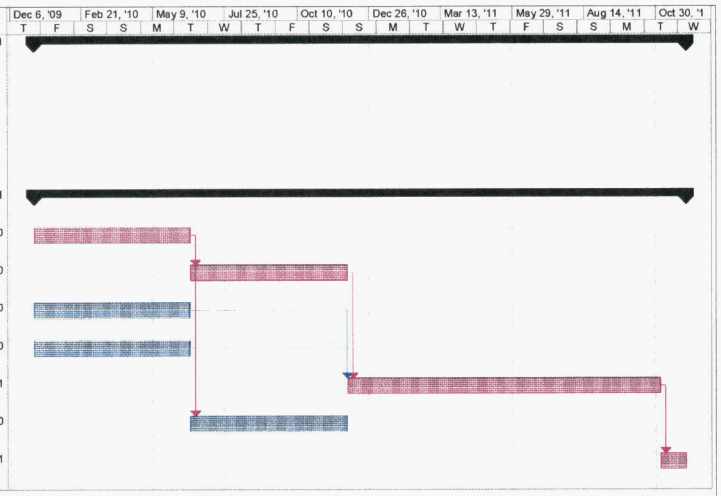
H 500 foot corridor East of APS 230kV Centerline

230kV ROUTE OPTIONS & ACQUISITION ESTIMATE		
	Route A Total	235K
	Route B Total	760K
	Route C Total	840K
	Route D Total	505K
	Route E Total	465K
	Route F Total	50K
Option 1	A, B, D, E, F	2,015K
Option 2	A, C, D, E, F	2,095K
Average of Options 1 & 2		2,055K
G or H - South to Gila Bend Sub.	Route G Total	430K
G or H - South to Gila Bend Sub.	Route H Total	430K
Acquisition Time Required:	12 to 24 Months	

Valuation Zone	Agricultural $/Acre	Residential $/Acre	Commercial $/Acre	Industrial $/Acre
1	$9,500.00	$5,000.00	$10,500.00	$7,500.00
2	$12,250.00	$7,250.00	$15,000.00	$11,000.00
3	$15,000.00	$9,500.00	$19,500.00	$14,500.00

Land Services - Last Updated June 25, 2009

ID	Task Name	Duration	Start	Finish
1	**Q44 230kV Line (Preliminary Construction Schedule) 7-13-09**	**500 days**	**Fri 1/1/10**	**Thu 12/1/11**
2				
3				
4				
5	**Line Construction**	**500 days**	**Fri 1/1/10**	**Thu 12/1/11**
6	Design	6 mons	Fri 1/1/10	Thu 6/17/10
7	Long Lead Materials	6 mons	Fri 6/18/10	Thu 12/2/10
8	Line Siting	6 mons	Fri 1/1/10	Thu 6/17/10
9	Permit/ROW	6 mons	Fri 1/1/10	Thu 6/17/10
10	Site Work	12 mons	Fri 12/3/10	Thu 11/3/11
11	String Fiber Optic	6 mons	Fri 6/18/10	Thu 12/2/10
12	Line Drop	1 mon	Fri 11/4/11	Thu 12/1/11



Task | Critical Task | Progress | Milestone | Summary | Rolled Up Task | Rolled Up Critical Task | Rolled Up Milestone | Rolled Up Progress | Split | External Tasks | Project Summary | Group By Summary

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