0000103804

ORIGINAL

BEFORE THE ARIZONA CORPORATION COMMISSION

RECEIVED

2009 OCT 13 A 9:19

COMMISSIONERS
KRISTIN K. MAYES, Chairman
GARY PIERCE
PAUL NEWMAN
SANDRA D. KENNEDY
BOB STUMP
GARY PIERCE

IN THE MATTER OF THE GENERIC DOCKET FOR THE 90-DAY PRE-APPLICATION PLANS FOR POWER PLANTS FILED PURSUANT TO A.R.S. §§ 40-360-02.B.	DOCKET NO. E-00000M-08-0170 **NOTICE OF FILING SUPPLEMENTAL MATERIALS**

Arlington Valley Solar Energy, LLC, and Arlington Valley Solar Energy II, LLC, jointly hereby provide notice of filing herewith the attached supplemental materials with respect to the Plan for the Arlington Valley Solar Energy and Arlington Valley Solar Energy II Projects that was filed August 27, 2009.

RESPECTFULLY SUBMITTED this 12 day of October, 2009.

MOYES SELLERS & SIMS

Jay I. Moyes
1850 N. Central Avenue, Suite 1100
Phoenix, Arizona 85004
(602) 604-2106
jimoyes@lawms.com

Arizona Corporation Commission
DOCKETED
OCT 13 2009
DOCKETED BY

Original and thirteen copies
of the foregoing filed this 12 day of
October 2009 with:

Docket Control
Arizona Corporation Commission
1200 West Washington Street
Phoenix, Arizona 85007

Copy of the foregoing hand-delivered
this 12 day of October 2009 to:

John Foreman, Chairman
Arizona Power Plant & Transmission
Line Siting Committee
1275 West Washington
Phoenix, Arizona 85007
John.Foreman@azag.gov

Steve Olea, Director
Utilities Division
Arizona Corporation Commission
1200 W. Washington Street
Phoenix, AZ 85007
solea@azcc.gov

Janice Alward
Legal Division
Arizona Corporation Commission
1200 West Washington Street
Phoenix, Arizona 85007
mscott@azcc.gov

AV1 SOLAR FACILITY AND AV2 SOLAR FACILITY

SYSTEM IMPACT STUDY REPORT

(Part 1 - Power Flow Results)
(Part 2 – Transient Stability Results)

To

Western Area Transmission System Task Force

Prepared by
Chuck-yan Wu
(WHenergy Consulting, Inc.)

For
Arlington Valley Solar Energy, LLC
Arlington Valley Solar Energy II, LLC

August 19, 2009

AV1 SOLAR FACILITY AND AV2 SOLAR FACILITY SYSTEM IMPACT STUDY

August 16, 2009
Prepared by WHenergy consulting, Inc.

TABLE OF CONTENTS

1 EXECUTIVE SUMMARY 1
1.1 General 1
1.2 Study Results and Conclusions 1
1.2.1 Power Flow Analysis 1
1.2.2 Transient Stability Analysis 2
2 Power Flow Analysis 3
2.1 Study Criteria: 3
2.2 Study Assumptions: 4
2.3 Power Flow and Contingency Analysis 5
2.4 Study Results 6
2.4.1 Line Overload 6
2.4.2 Overvoltage After Contingencies 7
2.5 Observations and Recommendations 7
3 Transient Stability Analysis 15
3.1 Study Criteria: 15
3.2 Study Assumptions: 15
3.3 Transient Stability Analysis 16
3.4 Study Results for Transient Stability of the System 17
3.5 Observations and Recommendations 17

LIST OF APPENDICES

Appendix A – Project One-Line.pdf

Appendix B - Base Case Overview and Line Ratings.pdf

Appendix C - AVS Post-Project One-lines.pdf

Appendix D – Dynamic Response Plots for Transient Stability Study.pdf

D.1 – Plots for No Fault Test Results – Model Stability Verification

D.2 – Plots for Dynamic Responses to Contingencies

D.3 – Plots for Dynamic Responses to Contingencies with 7% PV Generation Margin

1 EXECUTIVE SUMMARY

1.1 General

Arlington Valley Solar Energy, LLC ("AVSE ")or ("AV1") and Arlington Valley Solar Energy II, LLC ("AVSE II") or ("AV2") or collectively referred to as ("AVSolar") jointly propose to interconnect two Projects to the Hassayampa 500 kV Substation. The Hassayampa 500 kV Substation is part of the Palo Verde common bus, a set of facilities jointly owned by multiple third-party owners. On January 22, 2009, AVSolar submitted to the Palo Verde facility owners a **revised** generation interconnection request for the interconnection of the solar generation facilities of both Projects at the Hassayampa Substation .

AV1 proposed a new 125 MW net solar generation facility located approximately 2.5 miles from the Hassayampa Substation. The AV1 Project will be directly connected to a new 115kV/500kV switchyard located adjacent to the Hassayampa Substation 500kV bus. The expected operating date will be 2012-2014..AV2 proposed a new 125 MW net solar generation facility located one mile south east of the AV1 Project The AV2 Project will be connected to a new 115kV/500kV substation and then connected to the Hassayampa Substation 500kV bus via a short dedicated 500kV line. The expected operating date will be 2012-2014.

The total combined output of the two Projects would be nominally 250 MW. Due to the possible staging of the Projects construction schedules, this Study was conducted in two configurations: first, with only one 125 MW solar generating facility on-line; and secondly, with both 125 MW solar generating facilities on-line for a total of 250 MW.

AVSolar contracted with WHenergy Consulting, Inc. ("WCI"), to perform a system impact study ("SIS") for the proposed AV1 and AV2 Projects under the oversight of the Western Area Transmission System Task Force ("WATS"). The ANPP E & O committee has designated the WATS group as its technical oversight agent, responsible for overseeing transmission related studies for interconnection at the Hassayampa Substation. WCI is performing the SIS with the close coordination and oversight of the WATS members. To guide WCI and the WATS group through the interconnection study process, a Study Plan was drafted by the parties. This study plan was finalized and approved by the WATS members in June, 2009.

A set of project schematic one-line diagrams are in **Appendix A.**

The SIS study plan outlines the types of interconnection studies WCI will complete in order to analyze interconnection of the proposed AV1 and AV2 Projects' generation facilities, as well as the process and criteria which will be used to perform the studies. The following technical analyses are conducted in this SIS.

- Power flow analysis
- Transient stability analysis
- Short circuit analysis
- Sub-synchronous Resonance Analysis (SSR)

1.2 Study Results and Conclusions

1.2.1 Power Flow Analysis

The Power Flow Analysis herein is a most critical component of the SIS for analyzing impact of the proposed interconnection on the existing transmission system. The power flow base case was provided by WATS and reviewed and updated by the WATS members.

Based on the power flow and contingency study results (section 2.4), the proposed AV1 and AV2 Projects in various optional dispatches have no significant impact to the transmission system and will not require any system upgrades:

1. For all lines in service condition N-0, no element in the studied system was loaded beyond it's normal continuous thermal rating. Therefore, no transmission upgrade will be required.
2. Under contingency conditions N-1 or N-2, for overloaded equipment listed in Table 1, the Projects may I have to participate in mitigation measures, including special protection schemes (SPS) and operational procedures that will mitigate these overloading issues. (Because all of the identified overload conditions existed before any addition of AVSolar Projects, it is assumed that mitigation measures exist). Because the incremental impact of the AVSolar Projects is minimal, the Projects will not trigger any upgrades.
3. Voltage support is adequate to accommodate the AVSolar Projects dispatch as long as AVSolar maintain self-sufficient VAR support at the interconnection point through generation excitation and/or shunt capacitors at the Projects sites.

1.2.2 Transient Stability Analysis

WATS required that transient stability study includes a sensitivity with 7% Palo Verde generation output margin.

Based on the results of the study (section 3.4), we concluded that:

1. The dynamic models of the projects were stable.
2. There were no WECC transient stability criteria violation (voltage) under the conditions studied.
3. The system does not trigger any automatic load shedding (frequency) under the conditions studied.
4. The system response is stable and well damped under the conditions studied.
5. The projects have minimal impact to the dynamic stability of the transmission system under the conditions studied.

The proposed AV1 and AV2 Projects in all 4 modes of dispatch will have minimal impact to the transmission system responses to contingencies studied and does not require any additional upgrade.

2 Power Flow Analysis

2.1 Study Criteria:

a) Normal Conditions

i. All transmission facility loadings must be below normal continuous ratings.

ii. Bus voltage deviation from the base case shall not exceed established operating limits (see following monitored buses).

Monitored Bus Voltages:

The following bus voltages should be monitored for maximum allowable deviations as follows:

Pinnacle Peak 230 kV: 5% deviations from base case.
Kyrene 230 kV: 5% deviations from base case.
Devers 230 kV: 5% deviations from base case.

iii. Sufficient transmission capacity will be provided without relying on or unduly imposing upon any other utility's transmission system.

iv. The transmission system will not result in an adverse impact on other major WECC path flow limits.

WECC Path No.	Path Name	Path Rating
15	Path 15	5400
21	ARIZONA - CALIFORNIA	5700
22	SOUTHWEST OF FOUR CORNERS	2325
23	FOUR CORNERS 345/500	840
26	PATH 26	4000
27	IPP	2400
46	WOR	10623
47	SOUTHERN NEW MEXICO (NM1)	1048
48	NORTHERN NEW MEXICO (NM2)	1970
49	EOR	9300
50	CHOLLA - PINNACLE PEAK	1200
51	SOUTHERN NAVAJO	2800 (2010)
58	ELDORADO - MEAD 230 KV LINES	1140
61	LUGO - VICTORVILLE 500 KV LINE	2400
62	ELDORADO - MCCULLOUGH 500 KV	2598
63	PERKINS - MEAD - MARKETPLACE 500	1923
64	MARKETPLACE - ADELANTO	1200
65	PDCI	3100
66	COI	4800
81	CENTENNIAL	3000

b) Single Contingency Outage Conditions

i. For a single contingency, no transmission element will be loaded above its emergency rating. Summer ratings will be used for autumn conditions.

ii. Established loading limits for other utilities will be observed.

iii. Equipment emergency voltage limits (high or low) will not be exceeded for single contingency outages.

iv. Bus voltage deviations from the base case voltage shall not exceed established planning limits (These limits may vary throughout the system).
v. Single contingency outages on the 230 kV and EHV systems will not result in loss of load.

c) Credible Multiple Contingencies, including N-2 Contingencies

The N-2 disturbances (WECC Category C) are considered to be very severe; such as, loss of two PV-Westwing 500 kV circuits or loss of one PV-Westwing and PV-Rudd 500 kV lines. Although local circuit overloads and voltage depressions may result, these shall not result in cascading outages with the deployment of necessary Special Protection Schemes such as load and generation dropping.

2.2 Study Assumptions:

a) Palo Verde 500 kV Operating Voltage and Reactive Power (VAR)
i. Voltage at the Palo Verde 500 kV bus will be assumed to be 530 kV for the main study results. In addition, the PV/Hassayampa common bus will be bucking at 800 MVAr. WATS members will provide guidance on modeling this specific system condition.
ii. A sensitivity of Palo Verde operated at 525 kV with PV/Hassayampa bucking at 800 MVAr will also be studied. WATS members will provide guidance on modeling this specific system condition

b) The PVTS-SG will be modeled at its maximum level of 10,406 MW. Generation capacities and schedules of the Palo Verde nuclear units and the combined-cycle units of those PVTS Interconnectors are shown in the following Table 1

Table 1

Power Plant Owners	Power Plant Name	Number Of Units	2008 Maximum Generation Capacity	2008 Scheduled Gross Generation	2008 Power Plant Auxiliary Load	2008 Scheduled Generating Net Output
ANPP	Palo Verde	Unit.1	1,410 MW	1,410 MW	65 MW	1,345 MW
		Unit 2	1,407 MW	1,407 MW	65 MW	1342 MW
		Unit 3	1,410 MW	1,410 MW	65 MW	1,345 MW
Subtotal		3	4,227 MW	4,227 MW	195 MW	4,032 MW
Dynegy/LS	AVEF	1	700 MW (193.3x2+313.3)	620 MW (158x2+304)	20 MW (6.7 MW x 3)	600 MW
Arizona Public Service	Red Hawk	2	1,098 MW ((180x2+189)x2)	1,080 MW ((175.5x2+189)x2)	40 MW (6.7 MW x 6)	1,040 MW
MACH Gen, LLC	Harqua hala	3	1,164 MW ((250+138)x3)	1,164 MW ((250+138)x3)	24 MW ((5+3) x 3)	1,140 MW
Sempra Energy	Mesquite	2	1,382 MW ((185x2+321)x2)	1,288 MW ((167.5x2+309)x2)	28 MW (4.6 MW x 6)	1,260 MW
Gila River Power	Gila River	4	2,540 MW ((160x2+315)x4)	2,402 MW ((151x2+298.5)x4)	68 MW (5.66 MW x12)	2,334 MW
Subtotal		12	6,884 MW	6,554 MW	180 MW	6,374 MW
Total		15	11,111 MW	10,781 MW	375 MW	10,4 06 MW

*Includes 58 MW generation upgrade for Palo Verde Unit 1, effective Nov. 2005.
**Generation dispatch does not necessarily reflect power plant capacity.
***Generation including Gila River units.

c) Pre-Project Base Cases.
WATS will provide a suggested base case as the starting point to develop a system condition that is representative of heavy autumn conditions. The pre-project EOR flow will be modeled at roughly 7,000 MW for all base cases.

All base cases will be reviewed by each entity of the WATS group to ensure that proposed generation projects that may have an impact are represented in the base cases. Each entity has its specific generation queue to follow.

A system overview one-line diagram and equipment ratings is attached in **Appendix B.**

d) Post-Project Base Cases.
The post-project cases will be developed by adding the proposed Project and scheduling to Arizona/New Mexico to the extent possible without exceeding established WECC operating limits. To accommodate the Project output, local generation will be displaced, or if necessary load increased, within the modeled zones for the noted Arizona utilities. WATS members will provide guidance to model the generation re-dispatch or load adjustments.

The power flow analysis studied four optional Project generation dispatch cases.

1. 125MW of Concentrated Solar from AV1 .
2. 125MW of Photovoltaic from AV1 .
3. 125MW each of Concentrated Solar from AV1 and AV2 for a total of 250MW net injection to system.
4. 125MW each of Photovoltaic from AV1 and AV2 Facility for a total of 250MW net injection to system.

The output of the facilities replaces generation in the Arizona area, specifically, Cholla generation output.

A system overview one-line diagram for each of the Project dispatch cases is attached in **Appendix C.**

2.3 Power Flow and Contingency Analysis

Power flow one-line diagrams for the base case (pre-AVSolar Projects) and each of the four dispatch options are included in **Appendix C.**

The following contingencies were studied according to the "Study Plan".

N-1 Contingencies:

PF-1: Jojoba-Kyrene 500 kV line
PF-2: Hassyampa-Jojoba 500 kV line
PF-3: Palo Verde-Westwing 500 kV line
PF-4: Palo Verde-Rudd 500 kV line
PF-5: Navajo-Dugas 500 kV line
PF-6: Navajo-Moenkopi 500 kV line
PF-7: Navajo-Crystal 500 kV line
PF-8: Four Corners-Moenkopi 500 kV line

PF-9: Moenkopi-Yavapai 500 kV line
PF-10: Yavapai-Westwing 500 kV line
PF-11: Coronado-Cholla 500 kV line
PF-12: Coronado-Silverking 500 kV line
PF-13: Kyrene-Browning 500 kV line
PF-14: Browning-Silver King 500 kV line
PF-15: Crystal-McCullough 500 kV line
~~PF-16: Jajoba-Kyrene 500 kV line (redundant outage as PF-1)~~
PF-17: Peacock-Liberty 345 kV line
PF-18: Palo Verde-Devers No.1 500 kV line
~~PF-19: Palo Verde-Devers No.2 500 kV line (not in service)~~
PF-20: Hassayampa – N. Gila No.1 500 kV line
~~PF-21: Hassayampa – N. Gila No.2 500 kV line (not in service)~~
PF-22: Perkins-Mead 500 kV line
PF-23: Dugas-RACEWAY 500 kV (2009/2010)
PF-24: RACEWAY-Westwing 500 kV (2010)
PF-25: RACEWAY-Pin. Peak 500 kV (2010)
~~PF-26: Delany-Sun Valley 500 kV (2011) (not in service)~~
PF-27: Moenkopi-Eldorado 500 kV

N-2 Contingencies:

PF-30: Palo Verde-Westwing 500 kV #1&#2 lines

2.4 Study Results

2.4.1 Line Overload

For each of the Project dispatch cases, the Project increases post-contingency power flow loading to a few elements, which are tabulated in **Tables 2.1, 2.2,** and 2.3. All the negatively affected (increased equipment loading) transmission elements within the Arizona, Nevada and California region are listed for comparison purposes. The maximum percent (out of the four dispatch cases) incremental impact to each of the transmission equipment is listed in the last column.

Table 1 lists lines and transformers loaded beyond their emergency rating after contingencies. All these lines were overloaded in the pre-Project condition.

For N-0 conditions, with the Projects contributing up to 3% to the equipment loading and all equipment loaded below their respective normal rating.

For N-1 contingencies, with the Projects contributing up to 6% to PinalWest 500/345 Transformer Bank #1 loading. For all other equipment, the Projects only contributed up to 2%.

For N-2 contingency, the Projects contributed less than 2% of the equipment loading.

Table 2 lists lines and transformers loaded beyond equipment normal rating but below emergency rating. These equipment loadings will not impact the reliable operations of the transmission system based on the applicable criteria followed.

Table 3 lists lines that are loaded close to normal rating *after contingencies*. This list is for reference only and will not impact the reliable operation of the system.

2.4.2 Overvoltage After Contingencies

Tables 2.4 and 2.5 list all the 230kV and above buses with 2 or 3% voltage deviation after contingencies in reference to pre-contingencies.

For negative voltage deviations (**Table 2.4**) under contingencies studied, the worst bus affected is the Crystal Series Capacitor bus, with a voltage reduction of more than 5% after the loss of Crystal – McCullough 500kV line. The Projects actually have a positive impact to this voltage deviation as compared to the pre-Project base case condition.

All other buses have voltage reductions of less than 4% under all contingencies studied.

Overall, the Projects have minimal impact to voltage issues relative to the pre-Project conditions.

After specific contingencies, certain buses may experience higher voltage as illustrated in **Table 2.5**. Based on the study results, the Projects will have minimal negative impact and significant positive impact (reduced over-voltage) in most of these conditions.

2.5 Observations and Recommendations

Based on the power flow and contingency study results presented above:

1. For all lines in service condition N-0, no element in the studied system was loaded beyond it's normal continuous thermal rating. Therefore, no transmission upgrade will be required.
2. Under contingency conditions N-1 or N-2, for overloaded equipments listed in **Table 2.1**.
   - WATS members determined that the overloading of Pinal W 500/345kV Transformer bank is under WECC category D, therefore does not require a mitigating measure to be deployed.
   - Projects will have to participate in all existing mitigation measures, including special protection schemes (SPS) and operational procedures that will mitigate these overloading issues. (As all these elements overload conditions existed before the Projects, it is assumed that mitigation measures also existed.)
   - As the incremental impact of the Projects is minimal, the Projects will not trigger any additional upgrades requirements.
3. Voltage support is adequate to accommodate the Projects' dispatch as long as the Projects can maintain self-sufficient VAR support at the interconnection point through generation excitation and/or shunt capacitors at the Projects sites.
4. The Projects in various optional dispatches have no significant impact to the transmission system and will not require any system upgrade.

Table 2.1. Significant Line Overloads

N	Equipment	Normal Rating[3] Amps/MVA	Emergency Rating[3] Amps/MVA	Base Case Pre-Project	Post-AVS CS 125MW	Post-AVS PV 125MW	Post-AVS CS 250MW	Post-AVS PV 250MW	Contingency Description	Worst % Normal Rating[1]	Max Incremental Impact[2]
N-0	Pinal_W 500/345 Bank 1T	672	806	423.7	431.8	431.8	443.7	443.8	Base System (N-0)	66%	2.99%
N-2		672	806	878.7	894.4	894.5	913.2	913.3	Palovrde-Westwing 500Kv #1 & #2	136%	5.15%
N-0	Imprlvly - Elcentsw 230 Ckt 1	881	881	670.6	668.3	668.3	666.3	666.3	Base System (N-0)	76%	-0.26%
N-1		881	881	1766.3	1766.6	1766.6	1767.7	1767.6	Hassyamp - N.Gila 500.0 Kv #1	201%	0.16%
N-0	Coachela - Ramon 230 Ckt 1	977	977	890.4	891.4	891.4	892.5	892.5	Base System (N-0)	91%	0.22%
N-1		977	977	1116.7	1118.3	1118.3	1120	1119.9	Palovrde - Colriver 500.0 Kv #1	115%	0.34%
N-0	Ramon - Mirage 230 Ckt 1	986	986	917.3	918.5	918.5	919.7	919.7	Base System (N-0)	93%	0.24%
N-1		986	986	1197.1	1197.6	1197.7	1199.7	1199.7	Palovrde - Colriver 500.0 Kv #1	122%	0.26%
N-2		986	986	994.9	997.6	997.6	1000.3	1000.2	Palovrde-Westwing 500Kv #1 & #2	101%	0.55%

RED indicates overload beyond emergency rating of the equipments.
1. Worst % Normal Rating listed the worst among the 5 cases (including the pre-project condition) studied.
2. Maximum Incremental Impact among the 4 dispatch options in reference to the pre-project base case.
3. Transmission Lines are rated in Amps, and Transformers are rated in MVA

Table 2.2. Contingency Overloaded Lines (below emergency rating but beyond normal rating)

N	Equipment	Normal Rating[3] Amps/MVA	Emergency Rating[3] Amps/MVA	Base Case Pre-Project	Post-AVS CS 125MW	Post-AVS PV 125MW	Post-AVS CS 250MW	Post-AVS PV 250MW	Contingency Description	Worst % Normal Rating[1]	Max Incremental Impact[2]
N-0	Gilarivr230/500 Bank 1T	450	560	362.7	365.3	365.3	366.9	367	Base System (N-0)	82%	0.96%
N-1				485	489.6	489.6	493.7	493.7	Jojoba-Kyrene 500.0Kv #1	110%	1.93%
N-1				451.8	456.3	456.3	459.2	459.2	Palovrde - Rudd 500.0 Kv #1	102%	1.64%
N-2				482.5	487.2	487.2	490.7	490.7	Palovrde-Westwing 500Kv #1 & #2	109%	1.82%
N-0	Moenkopi - Eldordo 500 Ckt 1	1900	2750	1510.1	1506.6	1506.6	1498.8	1498.6	Base System (N-0)	79%	-0.18%
N-1		1900	2750	1909.5	1906.4	1906.4	1898.9	1898.7	Mead - Perkins 500.0 Kv #1	101%	-0.16%
N-0	Ctryclub - Lincstrt 230 Ckt 1	1401	1972	978.1	995.5	995.6	999.4	999.7	Base System (N-0)	71%	1.54%
N-2		1401	1972	1415.2	1440.7	1440.8	1452.3	1452.6	Palovrde-Westwing 500Kv #1 & #2	104%	2.67%
N-0	Jojoba - Gilarivr 230 Ckt 1	1097	1368	798.2	804.9	805	809	809.1	Base System (N-0)	74%	0.99%
N-1		1097	1368	1097.9	1109.7	1109.7	1120.3	1120.4	Jojoba-Kyrene 500.0Kv #1	102%	2.05%
N-2		1097	1368	1093.7	1106.2	1106.2	1115.5	1115.5	Palovrde-Westwing 500Kv #1 & #2	102%	1.99%
N-0	Palovrde - Colriver 500 Ckt 1	2700	3645	2053.1	2059.6	2059.6	2067.1	2066.9	Base System (N-0)	77%	0.52%
N-1		2700	3645	2705.3	2713.7	2713.7	2723.3	2723.1	Hassyamp - N.Gila 500.0 Kv #1	101%	0.67%
N-0	Rudd 500/230 Banks	598	682	357.5	364.4	364.4	369.6	369.6	Base System (N-0)	62%	2.02%
N-2		598	682	626.8	638	638.1	647.3	647.4	Palovrde-Westwing 500Kv #1 & #2	108%	3.44%
N-0	Hassyamp – N.Gila 500 Ckt 1	2200	2970	1816.5	1821.7	1821.7	1827.8	1827.6	Base System (N-0)	83%	0.51%
N-1		2200	2970	2453.1	2461	2461.1	2469.5	2469.3	Palovrde - Colriver 500.0 Kv #1	112%	0.75%
N-0	Liberty - Peacock 345 Ckt 1	850	1148	740.2	740.8	740.8	740.3	741	Base System (N-0)	87%	0.09%
N-1		850	1148	896.7	897.4	897.4	897.2	897	Mead - Perkins 500.0 Kv #1	106%	0.08%
N-0	Libtyphs - Liberty 230 Ckt Bank 1	500	600	455.2	455.3	455.3	454.9	455.3	Base System (N-0)	91%	0.02%
N-1		500	600	526.5	526.5	526.5	526.3	526.2	Palovrde - Colriver 500.0 Kv #1	105%	0.00%
N-1		500	600	513.7	514	513.9	513.8	513.7	Hassyamp - N.Gila 500.0 Kv #1	103%	0.06%
N-1		500	600	545.4	545.5	545.5	545.2	545.1	Mead - Perkins 500.0 Kv #1	109%	0.02%
N-0	N.Gila - Imprlvly 500 Ckt 1	2200	2970	1682	1686.5	1686.5	1692.1	1691.9	Base System (N-0)	77%	0.46%
N-1		2200	2970	2263.8	2271.7	2271.7	2279.3	2279.1	Palovrde - Colriver 500.0 Kv #1	104%	0.70%
N-0	Victorvl500/287 Bank 1T	460	573	457.4	457.5	457.5	457.4	457.4	Base System (N-0)	99%	0.02%
N-2		460	573	462.6	462.7	462.7	462.7	462.7	Palovrde-Westwing 500Kv #1 & #2	101%	0.02%
N-0	Cry-Sc - Crystal 500 Ckt 1	2088	2750	1646.5	1644.6	1644.6	1638.7	1638.6	Base System (N-0)	79%	-0.09%
N-1		2088	2750	2088.8	2088.5	2088.5	2086.8	2086.8	Navajo - Moenkopi 500.0 Kv #1	100%	-0.01%

Blue indicates overload beyond normal rating of the equipments.
1. Worst % Normal Rating listed the worst among the 5 cases (including the pre-project condition) studied.
2. Maximum Incremental Impact among the 4 dispatch options in reference to the pre-project base case.
3. Transmission Lines are rated in Amps, and Transformers are rated in MVA

Table 2.3. Lines Loaded near Normal Rating

N	Equipment	Normal Rating[3] Amps/MVA	Emergency Rating[3] Amps/MVA	Base Case Pre-Project	Post-AVS CS 125MW	Post-AVS PV 125MW	Post-AVS CS 250MW	Post-AVS PV 250MW	Contingency Description	Worst % Normal Rating[1]	Max Incremental Impact[2]
N-0	Jojoba - Kyrene 500 Ckt 1	2660	3221	1726.8	1753.8	1753.9	1789.4	1789.6	Base System (N-0)	67%	2.36%
N-1	Jojoba - Kyrene 500 Ckt 1	2660	3221	2072.3	2107	2107	2148.1	2148.3	Palovrde - Rudd 500.0 Kv #1	81%	2.86%
N-2	Jojoba - Kyrene 500 Ckt 1	2660	3221	2554.4	2597.2	2597.3	2647.3	2647.6	Palovrde-Westwing 500Kv #1 & #2	100%	3.50%
N-0	Lincstrt - Wphxapsn 230 Ckt 1	1883	1883	1132.7	1145.4	1145.4	1160.9	1160.9	Base System (N-0)	62%	1.50%
N-2	Lincstrt - Wphxapsn 230 Ckt 1	1883	1883	1611.3	1632.3	1632.3	1655.5	1655.6	Palovrde-Westwing 500Kv #1 & #2	88%	2.35%
N-0	Meadowbk - Sunyslop 230 Ckt 1	816	1624	464.5	462.9	462.9	482	481.7	Base System (N-0)	59%	2.15%
N-2	Meadowbk - Sunyslop 230 Ckt 1	816	1624	753.6	756.8	756.8	781.3	781.1	Palovrde-Westwing 500Kv #1 & #2	96%	3.40%
N-0	Palovrde - Westwing 500 Ckt 2	3000	3000	1713.9	1741.3	1741.3	1767	1767.1	Base System (N-0)	59%	1.77%
N-1	Palovrde - Westwing 500 Ckt 2	3000	3000	2584.9	2627.4	2627.4	2667	2667.2	Palovrde-Westwing 500Kv #1	89%	2.74%
N-0	Palovrde - Rudd 500 Ckt 1	3000	3000	1529.2	1558.9	1559	1581.3	1581.7	Base System (N-0)	53%	1.75%
N-2	Palovrde - Rudd 500 Ckt 1	3000	3000	2689.2	2740.8	2740.9	2783	2783.4	Palovrde-Westwing 500Kv #1 & #2	93%	3.14%
N-0	Browning - Kyrene 500 Ckt 1	2000	2542	538.4	554.9	554.9	586.4	586.4	Base System (N-0)	29%	2.40%
N-0	Liberty - Peacock 345 Ckt 1	850	1148	740.2	740.8	740.8	740.3	741	Base System (N-0)	87%	0.09%

1. Worst % Normal Rating listed the worst among the 5 cases (including the pre-project condition) studied.
2. Maximum Incremental Impact among the 4 dispatch options in reference to the pre-project base case.
3. Transmission Lines are rated in Amps, and Transformers are rated in MVA

Table 2.4. Voltage Drop After Contingency (> 2% pu voltage)

Bus No.	Bus Name	kV	Base Case Pre-Project	Post-AVS CS 125MW	Post-AVS PV 125MW	Post-AVS CS 250MW	Post-AVS PV 250MW	Contingency Description	Max Deviation (pu)	Project Max Incremental Impact
90000	CRY-SC	500	-0.052	-0.052	-0.052	-0.051	-0.051	CRYSTAL - MCCULLGH 500.0 kV #1	-5.10%	0.00%
24900	COLRIVER	500	-0.037	-0.037	-0.037	-0.037	-0.037	HASSYAMP - N.GILA 500.0 kV #1	-3.70%	0.00%
15041	SILVERKG	500	-0.028	-0.028	-0.028	-0.028	-0.028	CORONADO - SILVERKG 500.0 kV #1	-2.80%	0.00%
24801	DEVERS	500	-0.026	-0.026	-0.026	-0.026	-0.026	HASSYAMP - N.GILA 500.0 kV #1	-2.60%	0.00%
24998	DEVRSVC2	500	-0.026	-0.026	-0.026	-0.026	-0.026	HASSYAMP - N.GILA 500.0 kV #1	-2.60%	0.00%
24999	DEVRSVC1	500	-0.026	-0.026	-0.026	-0.026	-0.026	HASSYAMP - N.GILA 500.0 kV #1	-2.60%	0.00%
22536	N.GILA	500	-0.024	-0.024	-0.024	-0.024	-0.024	PALOVRDE - COLRIVER 500.0 kV #1	-2.40%	0.00%
15215	SILVERKG	230	-0.023	-0.023	-0.023	-0.023	-0.023	CORONADO - SILVERKG 500.0 kV #1	-2.30%	0.00%
18420	CALPINE	500	-0.023	-0.023	-0.023	-0.023	-0.023	CRYSTAL - MCCULLGH 500.0 kV #1	-2.30%	0.00%
26123	CRYSTAL	500	-0.023	-0.023	-0.023	-0.023	-0.023	CRYSTAL - MCCULLGH 500.0 kV #1	-2.30%	0.00%
24900	COLRIVER	500	-0.022	-0.023	-0.023	-0.024	-0.024	PALOVRDE-WESTWING 500kV #1 & #2	-2.20%	-0.20%
24042	ELDORDO	500	-0.021	-0.021	-0.021	-0.021	-0.021	HASSYAMP - N.GILA 500.0 kV #1	-2.10%	0.00%
24097	MOHAVE	500	-0.021	-0.021	-0.021	-0.021	-0.021	HASSYAMP - N.GILA 500.0 kV #1	-2.10%	0.00%
26003	ADELANTO	500	-0.021	-0.021	-0.021	-0.022	-0.022	HASSYAMP - N.GILA 500.0 kV #1	-2.10%	-0.10%
26044	MARKETPL	500	-0.021	-0.021	-0.021	-0.021	-0.021	HASSYAMP - N.GILA 500.0 kV #1	-2.10%	0.00%
26048	MCCULLGH	500	-0.021	-0.021	-0.021	-0.021	-0.021	HASSYAMP - N.GILA 500.0 kV #1	-2.10%	0.00%
26105	VICTORVL	500	-0.021	-0.021	-0.021	-0.021	-0.021	HASSYAMP - N.GILA 500.0 kV #1	-2.10%	0.00%
26119	ADELSVC	500	-0.021	-0.021	-0.021	-0.022	-0.022	HASSYAMP - N.GILA 500.0 kV #1	-2.10%	-0.10%
26120	MKTPSVC	500	-0.021	-0.021	-0.021	-0.021	-0.021	HASSYAMP - N.GILA 500.0 kV #1	-2.10%	0.00%
22737	CENTRALX	500	-0.021	-0.022	-0.022	-0.022	-0.022	PALOVRDE - COLRIVER 500.0 kV #1	-2.10%	-0.10%
19038	MEAD	500	-0.02	-0.02	-0.02	-0.02	-0.02	HASSYAMP - N.GILA 500.0 kV #1	-2.00%	0.00%
24151	VALLEYSC	500	-0.02	-0.02	-0.02	-0.02	-0.02	HASSYAMP - N.GILA 500.0 kV #1	-2.00%	0.00%
26104	VICTORVL	287	-0.02	-0.02	-0.02	-0.02	-0.02	HASSYAMP - N.GILA 500.0 kV #1	-2.00%	0.00%
28040	IEEC	500	-0.02	-0.02	-0.02	-0.02	-0.02	HASSYAMP - N.GILA 500.0 kV #1	-2.00%	0.00%
22360	IMPRLVLY	500	-0.02	-0.021	-0.021	-0.021	-0.021	PALOVRDE - COLRIVER 500.0 kV #1	-2.00%	-0.10%
22743	CENTRLMP	500	-0.02	-0.021	-0.021	-0.021	-0.021	PALOVRDE - COLRIVER 500.0 kV #1	-2.00%	-0.10%

Maximum Deviation listed the worst among the 5 cases (including the pre-project condition) studied.

Table 2.5. Voltage Increase After Contingency (> 3% pu voltage)

Bus No.	*Bus Name*	*kV*	*Base Case Pre-Project*	*Post-AVS CS 125MW*	*Post-AVS PV 125MW*	*Post-AVS CS 250MW*	*Post-AVS PV 250MW*	*Contingency Description*	*Max Deviation (pu)*	*Max Incremental Impact*
22737	CENTRALX	500	0.029	0.029	0.029	0.03	0.03	HASSYAMP - N.GILA 500.0 kV #1	3.00%	0.10%
24138	SERRANO	500	0.031	0.018	0.018	0.018	0.018	PALOVRDE - COLRIVER 500.0 kV #1	3.10%	-1.30%
15061	RUDD	500	0.035	0.035	0.035	0.035	0.035	PALOVRDE - RUDD 500.0 kV #1	3.50%	0.00%
15018	DINOSAUR	500	0.035	0.036	0.036	0.036	0.036	BROWNING - KYRENE 500.0 kV #1	3.60%	0.10%
15051	BROWNING	500	0.035	0.036	0.036	0.036	0.036	BROWNING - KYRENE 500.0 kV #1	3.60%	0.10%
90001	NAV-SC	500	0.037	0.037	0.037	0.037	0.037	NAVAJO - MOENKOPI 500.0 kV #1	3.70%	0.00%
25666	ELCASCO	230	0.038	0.024	0.024	0.024	0.024	PALOVRDE - COLRIVER 500.0 kV #1	3.80%	-1.40%
8695	RAMON	230	0.04	0.02	0.02	0.02	0.02	PALOVRDE - COLRIVER 500.0 kV #1	4.00%	-2.00%
24806	MIRAGE	230	0.041	0.02	0.02	0.02	0.02	PALOVRDE - COLRIVER 500.0 kV #1	4.10%	-2.10%
24804	DEVERS	230	0.067	0.042	0.042	0.042	0.042	PALOVRDE - COLRIVER 500.0 kV #1	6.70%	-2.50%
24151	VALLEYSC	500	0.094	0.063	0.063	0.063	0.063	PALOVRDE - COLRIVER 500.0 kV #1	9.40%	-3.10%
28040	IEEC	500	0.094	0.063	0.063	0.063	0.063	PALOVRDE - COLRIVER 500.0 kV #1	9.40%	-3.10%
24801	DEVERS	500	0.134	0.094	0.094	0.095	0.095	PALOVRDE - COLRIVER 500.0 kV #1	13.40%	-3.90%
24900	COLRIVER	500	0.161	0.12	0.12	0.121	0.121	PALOVRDE - COLRIVER 500.0 kV #1	16.10%	-4.00%
90000	CRY-SC	500	0.036			0.036	0.036	MOENKOPI - ELDORDO 500.0 kV #1	3.60%	0.00%
90001	NAV-SC	500	0.083			0.082	0.083	MOENKOPI - ELDORDO 500.0 kV #1	8.30%	0.00%

Maximum Deviation listed the worst among the 5 cases (including the pre-project condition) studied.

(This page is intended to be blank)

3 Transient Stability Analysis

3.1 Study Criteria:

1. Transient voltage dips must meet the following WECC Reliability Criteria:.

Performance Level	Disturbance	Transient Voltage Dip Criteria
B	N-1	Transient Voltage Dip: Not to exceed 25% at load buses or 30% at non-load buses. Also, not to exceed 20% for more than 20 cycles at load buses. Minimum Transient Frequency: Not below 59.6 Hz for 6 cycles or more at a load bus.
C	N-2	Transient Voltage Dip: Not to exceed 30% at any bus. Also, not to exceed 20% for more than 40 cycles at load buses. Minimum Transient Frequency: Not below 59.0 Hz for 6 cycles or more at a load bus.
D	N-3	Not Specified

2. All machines in the system shall remain in synchronism as demonstrated by their relative rotor angles.

3. System stability is evaluated based on the damping of the relative rotor angles and the damping of the voltage magnitude swings.

3.2 Study Assumptions:

a) A 7% generation margin will be added to the three Palo Verde generating units to ensure plant stability for any critical N-1 single contingency outage.

b) A single-line-to-ground fault at the Palo Verde 500 kV bus with a subsequent loss of the two Palo Verde-Westwing 500 kV circuits shall not result in a loss of synchronism for the Palo Verde plant or a wide spread of WECC cascading outages. WATS will provide SLG fault impedance at Palo Verde 500kV Bus and the timing of series capacitor by-passing and reclosing, and line clearing time.

c) PV/Hassayampa common bus will be modeled to buck 800 MVAr

d) The corresponding dynamics data file for the WATS approved base cases will be used for all stability analysis.

e) The dynamic data for the generator turbine, governor, excitation system and power system stabilizer will be provided by the project owner and will be incorporated into the dynamics data file.

f) All stability simulations will be run for a minimum of 10 seconds.

3.3 Transient Stability Analysis

Perform a transient stability analysis to investigate the Palo Verde generator stability for both the pre and post-Project configuration.

A 7% generation margin will be added to the three Palo Verde generating units to ensure plant stability for all critical N-1 contingencies. However, the 7% generation margin will not be added for the single-line to ground fault at the Palo Verde 500 kV bus with a subsequent loss of the Palo Verde-Westwing No.1 and No.2 500 kV circuits.

Transient stability will be simulated for all pre-project base cases to determine if there are any violations prior to modeling the AV1 Solar and AV2 Solar facilities. Pre-project transient stability issues (if any) will be addressed with the appropriate entity. Once it is determined that there are no pre-project violations AV1 Solar and AV2 Solar facilities will be inserted and transient stability contingencies will be evaluated to determine transient stability impacts (if any).

Transient stability studies will be performed on cases with PV/Hassayampa common bus modeled bucking 800 MVAr.

The following list of major disturbances will be simulated to evaluate the Palo Verde stability performance.

N-1 Contingencies

- TR-1: Three-phase fault at Hassayampa 500 kV bus with outage of the Hassyampa-N. Gila No.1 500 kV line.
- TR-2: Three-phase fault at Palo Verde 500 kV bus with outage of the Palo Verde-ColoradoRiver No.1 500 kV line.
- TR-3: Three-phase fault at Palo Verde 500 kV bus with outage of the Palo Verde-Westwing No.1 500 kV line.
- TR-4: Three-phase fault at Palo Verde 500 kV bus with outage of the Palo Verde-Rudd 500 kV line.
- TR-5: Three-phase fault at Hassayampa 500 kV bus with outage of the Hassyampa-Jojoba 500 kV line.
- TR-6: Three-phase fault at Jojoba 500 kV bus with outage of the Jojoba-Kyrene 500 kV line.
- ~~TR-7: Three-phase fault at Hassayampa 500 kV bus with outage of the Hassyampa-Delany 500 kV line.~~
- ~~TR-8: Three-phase fault at Harquahala Jct 500 kV bus with outage of the Delany-Sun Valley 500 kV line.~~
- TR-9: Trip Palo Verde Unit 1.

N-2 Contingencies

- TR-10: Single line-to-ground fault at Palo Verde 500 kV bus with outage of both Palo Verde-Westwing No.1 and No.2 500 kV lines.
- TR-11: Single line-to-ground fault at Palo Verde 500 kV bus with outage of Palo Verde-Westwing and the Palo Verde-Rudd 500 kV lines.
- TR-12: Trip Palo Verde Units 1 and 2.

Multiple Outage Disturbance

- ~~TR-13: Sensitivity study will evaluate loss of Hassayampa-N.Gila No.1 and No.2 500 kV lines for a three-phase fault at Hassayampa 500 kV bus.~~
- TR-14: Three-Phase fault at Perkins 500 kV bus with loss of the Perkins-Mead 500 kV line and Two Palo Verde-Westwing 500 kV lines (contingency due to line crossing).

Transient stability plots with a WATS member provided list for all contingencies will be depicted in an appendix to show system damping. In addition, any WECC performance criteria violations will be documented.

3.4 Study Results for Transient Stability of the System

For system and project dynamic model validation, all cases were run with a "no fault" condition to determine any pre-project or project dynamic modeling issues. Results showed all models and cases were stable (flat line). The outputs of the cases were attached in **Appendix D.1** for reference. The results show the dynamic models were stable.

Table 3.1 is a summary of transient stability study results for the contingencies listed previously. There is no WECC transient stability criteria violations under all system conditions and under the contingencies studied. The transient stability plots for this set of study were attached in **Appendix D.2**.

For a sensitivity of 7% PV generation margin, a new set of cases were prepared. As 7% added about 100MW of generation output from each of the 3 PV units, the units in LADWP, SDG&E and SCE were backed off by 50MW, 50MW and 200MW respectively. Effectively increase the EOR flow by about 250MWs.

The MVACAP, in the governor model dynamic data for each of the units, is modified to 1510MW (from 1494MW), to prevent governor movement when initializing the units. With this modification, all models were stable. The system dynamic response plots for this set of study were attached in **Appendix D.3**.

Table 3.2 is a summary of transient stability study results with the 7% PV generation margin and 800MVAR PV units bucking. Results showed higher voltage swing than similar cases without the 7% margin, but there is no violation of any WECC transient stability criteria and the system is stable.

3.5 Observations and Recommendations

Based on the transient stability study results:

- The dynamic models of the projects were stable.
- There were no WECC transient stability criteria violation under the conditions studied.
- The system does not trigger any automatic load shedding under the conditions studied.
- The system response is stable and well damped under the conditions studied.
- The projects have minimal impact to the dynamic stability of the transmission system under the conditions studied.

Table 3.1 Relative Comparison of Worst Bus Voltage Deviation and Lowest Bus Frequencies

	Pre-Project Base Case		Post Project-CS125MW		Post Project-CS250MW		Post Project-PV125MW		Post Project-PV250MW	
Contingencies	**Worst Voltage Dip**	**Lowest Frequency**	**Worst Voltage Dip**	**Lowest Frequency**	**Worst Voltage Dip**	**Lowest Frequency**	**Worst Voltage Dip**	**Lowest Frequency**	**Worst Voltage Dip**	**Lowest Frequency**
AVS01-H-NGila-slo	14.3% @PALOVRDE 500	59.616Hz @NEWMN4G1 13.8	14.3% @PALOVRDE 500	59.617Hz @NEWMN4G1 13.8	14.3% @PALOVRDE 500	59.616Hz @NEWMN4G1 13.8	15.1% @AVSOLAR1 115	44.746Hz @AVSOLAR 115	16.3% @AVSOLAR1 115	59.61Hz @NEWMN4G1 13.8
AVS02-PV-CRV-slo	19% @N.GILA 500	59.635Hz @B CRK2-3 6.6	19% @N.GILA 500	59.638Hz @B CRK2-3 6.6	19% @N.GILA 500	59.64Hz @B CRK2-3 6.6	19.3% @N.GILA 500	59.633Hz @B CRK2-3 6.6	19.7% @N.GILA 500	59.629Hz @B CRK2-3 6.6
AVS03-PV-WW-slo	16.3% @PALOVRDE 500	59.71Hz @B CRK2-3 6.6	16.3% @PALOVRDE 500	59.711Hz @B CRK2-3 6.6	16.3% @PALOVRDE 500	59.713Hz @B CRK2-3 6.6	17.2% @AVSOLAR1 115	59.709Hz @B CRK2-3 6.6	18.4% @AVSOLAR1 115	59.707Hz @B CRK2-3 6.6
AVS04-PV-RUDD-slo	16.5% @PALOVRDE 500	59.717Hz @B CRK2-3 6.6	16.5% @PALOVRDE 500	59.718Hz @B CRK2-3 6.6	16.6% @PALOVRDE 500	59.72Hz @B CRK2-3 6.6	17.5% @AVSOLAR1 115	59.716Hz @B CRK2-3 6.6	18.7% @AVSOLAR1 115	59.715Hz @B CRK2-3 6.6
AVS05-H-JJBA-slo	15.3% @PALOVRDE 500	59.722Hz @NEWMN4G1 13.8	15.3% @PALOVRDE 500	59.723Hz @NEWMN4G1 13.8	15.4% @PALOVRDE 500	59.723Hz @NEWMN4G1 13.8	16.3% @AVSOLAR1 115	59.721Hz @NEWMN4G1 13.8	17.4% @AVSOLAR1 115	59.719Hz @NEWMN4G1 13.8
AVS06-JJBA-KR-slo	9% @GILABEND 230	59.859Hz @B CRK2-3 6.6	9% @GILABEND 230	59.861Hz @B CRK2-3 6.6	9% @GILABEND 230	59.862Hz @KYRENE 7 13.8	9.1% @GILABEND 230	59.859Hz @B CRK2-3 6.6	9.3% @GILABEND 230	59.857Hz @B CRK2-3 6.6
AVS09-PV-G1	4.4% @MONTROSE 345	59.819Hz @AUR_GTG1 13.8	4.4% @MONTROSE 345	59.82Hz @AUR_GTG1 13.8	4.4% @MONTROSE 345	59.821Hz @AUR_GTG1 13.8	4.5% @MONTROSE 345	59.819Hz @AUR_GTG1 13.8	4.5% @MONTROSE 345	59.819Hz @AUR_GTG1 13.8
AVS10-PV-WWing-dlo-slg	7.6% @RUDD 500	59.886Hz @BSPHYD26 2.2	7.8% @RUDD 500	59.884Hz @BSPHYD26 2.2	8% @RUDD 500	59.881Hz @BSPHYD26 2.2	7.9% @RUDD 500	59.881Hz @BSPHYD26 2.2	8.3% @AVSOLAR1 115	59.876Hz @BSPHYD26 2.2
AVS11-PV-WW-RUDD-dlo-slg	4.7% @PINAL_W 500	59.917Hz @WPHX CC1 13.8	4.8% @PINAL_W 500	59.915Hz @WPHX CC1 13.8	4.9% @PINAL_W 500	59.914Hz @WPHX CC1 13.8	4.9% @AVSOLAR1 115	59.916Hz @WPHX CC1 13.8	5.5% @AVSOLAR1 115	59.914Hz @WPHX CC1 13.8
AVS12-PV-G2-RAS	10.6% @MONTROSE 345	59.623Hz @AUR_GTG1 13.8	10.6% @MONTROSE 345	59.625Hz @AUR_GTG1 13.8	10.5% @MONTROSE 345	59.626Hz @AUR_GTG1 13.8	10.7% @MONTROSE 345	59.622Hz @AUR_GTG1 13.8	10.7% @MONTROSE 345	59.622Hz @AUR_GTG1 13.8
AVS14-PK-MeadPV-WW-3lo	11.2% @N.GILA 500	59.786Hz @BSPHYD26 2.2	11.2% @N.GILA 500	59.788Hz @BSPHYD26 2.2	11.3% @N.GILA 500	59.788Hz @BSPHYD26 2.2	11.6% @N.GILA 500	59.782Hz @BSPHYD26 2.2	12.5% @AVSOLAR1 115	59.776Hz @BSPHYD26 2.2

Table 3.2 Relative Comparison of Worst Bus Voltage Deviation and Lowest Bus Frequencies with 7% PV Generation Margin

	7% PV Generation Margin					
	Pre Project Base Case		Post Project-CS250MW		Post Project-PV250MW	
Contingencies	**Worst Voltage Dip**	**Lowest Frequency**	**Worst Voltage Dip**	**Lowest Frequency**	**Worst Voltage Dip**	**Lowest Frequency**
AVS01-H-NGila-slo	16.6% @PALOVRDE 500	59.587Hz @DELRANCH 14.4	16.7% @PALOVRDE 500	59.59Hz @DELRANCH 14.4	19% @AVSOLAR1 115	59.577Hz @DELRANCH 14.4
AVS02-PV-CRV-slo	22.8% @N.GILA 500	59.581Hz @BSPHYD26 2.2	22.9% @N.GILA 500	59.587Hz @BSPHYD26 2.2	23.9% @N.GILA 500	59.57Hz @BSPHYD26 2.2
AVS03-PV-WW-slo	18.9% @PALOVRDE 500	59.676Hz @BSPHYD26 2.2	19.1% @PALOVRDE 500	59.679Hz @BSPHYD26 2.2	21.6% @AVSOLAR1 115	59.671Hz @BSPHYD26 2.2
AVS04-PV-RUDD-slo	19.2% @PALOVRDE 500	59.686Hz @BSPHYD26 2.2	19.3% @PALOVRDE 500	59.689Hz @BSPHYD26 2.2	21.9% @AVSOLAR1 115	59.682Hz @BSPHYD26 2.2
AVS05-H-JJBA-slo	17.7% @PALOVRDE 500	59.705Hz @NEWMN4G1 13.8	17.8% @PALOVRDE 500	59.708Hz @NEWMN4G1 13.8	20.3% @AVSOLAR1 115	59.704Hz @NEWMN4G1 13.8
AVS06-JJBA-KR-slo	9.5% @GILABEND 230	59.849Hz @B CRK2-3 6.6	9.6% @GILABEND 230	59.852Hz @B CRK2-3 6.6	10% @GILABEND 230	59.846Hz @B CRK2-3 6.6
AVS09-PV-G1	4.8% @MONTROSE 345	59.805Hz @AUR_GTG1 13.8	4.8% @MONTROSE 345	59.806Hz @AUR_GTG1 13.8	4.9% @MONTROSE 345	59.804Hz @AUR_GTG1 13.8
AVS10-PV-WWing-dlo-slg	8.6% @RUDD 500	59.868Hz @BSPHYD26 2.2	9% @RUDD 500	59.863Hz @BSPHYD26 2.2	9.5% @AVSOLAR1 115	59.856Hz @BSPHYD26 2.2
AVS11-PV-WW-RUDD-dlo-slg	5.2% @PINAL_W 500	59.915Hz @WPHX CC1 13.8	5.4% @PINAL_W 500	59.911Hz @WPHX CC1 13.8	6.1% @AVSOLAR1 115	59.912Hz @WPHX CC1 13.8
AVS12-PV-G2-RAS	11.7% @MONTROSE 345	59.578Hz @AUR_GTG1 13.8	11.6% @MONTROSE 345	59.582Hz @AUR_GTG1 13.8	11.8% @MONTROSE 345	59.576Hz @AUR_GTG1 13.8
AVS14-PK-MeadPV-WW-3lo	13.1% @N.GILA 500	59.758Hz @BSPHYD26 2.2	13.3% @N.GILA 500	59.76Hz @BSPHYD26 2.2	14.7% @AVSOLAR1 115	59.745Hz @BSPHYD26 2.2

(This page is intended to be blank)