ORIGINAL

P.O. Box 711
Tucson, Arizona 85702

UniSourceEnergy SERVICES

January 31, 2012

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

Re: Notice of Filing – UNS Electric, Inc.'s 2012-2021 Ten-Year Plan and Reliability-Must-Run Report
Docket No. E-00000D-11-0017

Pursuant to ARS § 40-360.02, please find enclosed an original and thirteen copies of UNS Electric Inc.'s ("UNS Electric") 2012-2021 Ten-Year Plan. As part of the Biennial Transmission Assessment ("BTA"), also attached is UNS Electric's Reliability-Must-Run Report. In accordance with last BTA, approved in Decision No. 72031 (December 10, 2010) ("Decision"), UNS Electric is providing: 1) an update to its Santa Cruz County "Continuity of Service Plan"; and 2) information required in Findings of Fact No. 7.e.7. of the Decision.

If you have any questions, please contact me at (520) 884-3680.

Sincerely,

Jessica Bryne

cc: Prem Bahl, Utilities Division, ACC
Compliance Section, ACC

UNS Electric, Inc.

2012-2021

TEN-YEAR PLAN

SUBMITTED TO THE
ARIZONA CORPORATION COMMISSION
JANUARY 2012

Docket No: E-00000D-11-0017

Contents

Introduction

This 2011-2020 Ten-Year Plan is submitted by UNS Electric, Inc. (UNSE) pursuant to A.R.S. § 40-360.02. Included with this plan are transmission facilities planned for both the Mohave and Santa Cruz County service territories.

Previously reported facilities that have been completed, canceled, or deferred beyond the upcoming ten-year period are not included. Projects that have in-service dates of To Be Determined (TBD) are projects that are being considered but their in-service dates are currently beyond the ten-year planning horizon but may become candidates for earlier deployment in subsequent studies.

This report includes system maps depicting the existing transmission networks and planned or contemplated projects followed by individual project descriptions. The maps and descriptions are intended to be general planning level documents to explain projects conceptually. Therefore the maps and descriptions do not suggest specific routings or facility locations.

UNSE[1] participates in local, sub-regional and regional organizations to ensure adequate coordination among neighboring systems as well as to maintain planning consistency within the Western Interconnection. These organizations include the following:

- Southeast Arizona Transmission Study (SATS);
- Colorado River Transmission (CRT);
- Central Arizona Transmission Study (CATS)
- Central Arizona Transmission Study – High Voltage (CATS-HV)
- Joint Planning Agreement (JPA) with Western Area Power Administration (Western)
- Southwest Area Transmission Planning Group (SWAT)
- Southeast Arizona Transmission Study (SATS)
- WestConnect Regional Planning (WestConnect)
- Western Electricity Coordinating Council (WECC)

The following projects are proposed for the Mohave County Region:

- Griffith-North Havasu Transmission
- Loop-in of Parker – Davis #1 at Black Mesa

The following projects are no longer considered for the Mohave County Region and have been removed from the UNSE Ten-Year Plan:

- Golden Valley 230 kV Transmission Line Project between McConnico/Harris and Mineral Park Substations
- White Hills Substation
- Western Wind Steel Park Interconnection

The following projects are proposed for the Santa Cruz County Region:

- Upgrade existing 115kV transmission line to Nogales

[1] TEP represents UNSE in all transmission planning activities.

The following projects are no longer considered for the Santa Cruz County Region and have been removed from the UNSE Ten-Year Plan:

- Nogales Transmission Line #2
- Gateway 345/138 kV Substation
- Gateway – Sonoita 138 kV Transmission Line

Biennial Transmission Assessment Orders

In Decision No. 72031 regarding the 6th Biennial Transmission Assessment (BTA), the Arizona Corporation Commission ("ACC" or "Commission") issued the following orders relevant to UNSE:

1) UNSE shall update its assessment of long term alternatives for Santa Cruz County continuity of service, as part of UNSE's 2012-2021 ten-year planning studies, and file a report on the updated assessment in the 7th BTA in 2012. Furthermore, if any approvals or permits from federal agencies related to the Gateway Transmission Project are still pending at that time, Staff recommends that the Commission require the 7th BTA filings to include a clear action plan and proposed schedule to obtain such approvals.
   The Update to Santa Cruz County Continuity of Service Report will be filed with this report.
2) Jurisdictional utilities shall continue to perform RMR studies in accordance with the methodology set forth in Appendix C to this Sixth BTA, and shall file such studies with ten-year plans for inclusion in future BTA reports.
   a. *The UNSE RMR study report will be filed with this Ten-Year Plan.*
   b. *The Extreme Contingency study does not apply to UNSE since its only transmission element is a radial 115 kV line from the Western Area Power Administration (Western)Nogales Switchyard to Santa Cruz County.*
   c. *UNSE was represented by Tucson Electric Power (TEP) in the Central Arizona Transmission System Project Outage (N-1-1) study. There are no major UNSE projects studied.*
3) Jurisdictional utilities shall include planned transmission reconductor projects, transformer capacity upgrade projects and reactive power compensation facility additions at 11 5 kV and above in future BTA ten-year plan filings.
   Any applicable transmission reconductor projects, transformer capacity upgrades, and reactive power compensation additions are included in the UNSE Ten-Year Plan.
4) In addition, we believe that the jurisdictional utilities should include the effects of distributed renewable generation and energy efficiency programs on future transmission needs in future ten-year plan filings, beginning in January 2011, and that these effects be discussed in future BTAs.
   a. *These items are reflected in the UNSE load forecast.*
   b. *UNSE does not have adequate experience to judge impacts at this time.*
5) The Commission is mindful of the interest in Arizona's abundant supply of renewable energy, and the potential for these energy resources to be tapped by surrounding states to meet their RPS obligations. We would like the utilities to jointly conduct or procure a study, as well as a stakeholder workshop, to identify the barriers to and solutions for enhancing Arizona's ability to export renewable energy, including identifying specific transmission corridors that should be built out in order to accomplish this objective.

The study and results of the workshop should be filed at the Commission no later than November 1, 2011, and shall be included as part of the 2012 BTA.

a. *UNSE was represented by TEP*
b. *The report was filed by APS on behalf of SRP, SWTC, and TEP on November 1, 2011.*

Service Territories

Following this brief discussion of activities in the service territories are maps of the planned facilities and details of the proposed projects.

Mohave County

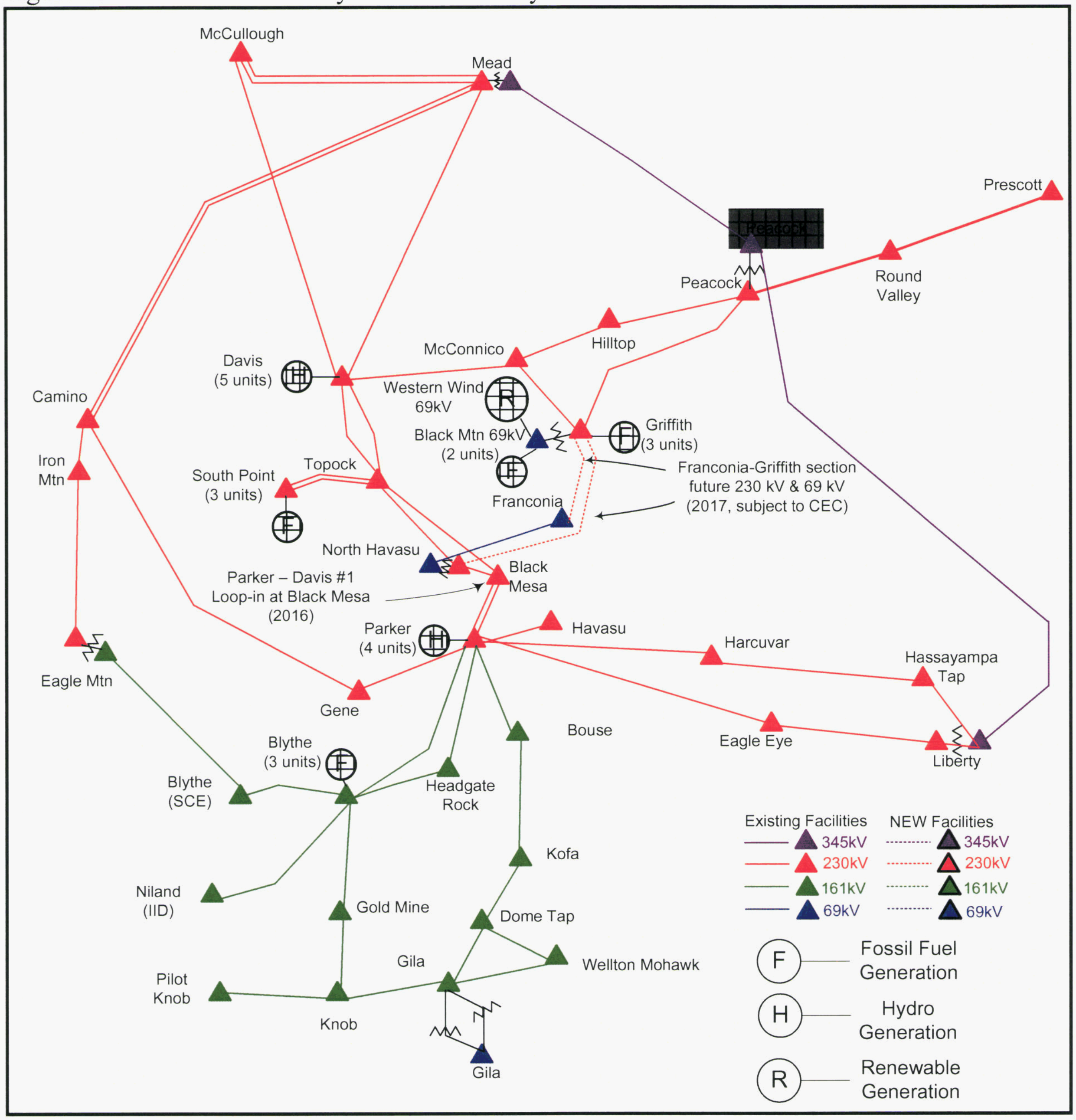
UNSE still considers the Griffith – North Havasu 230kV line as a viable alternative, and currently has an approved Certificate of Environmental Compatibility (CEC) (Case #88) for this line addition. UNSE has received an extension to the expiration date of this CEC to 2012. UNSE is considering a request for further extension. The timing for construction of this project is predicated on results of load growth in conjunction with limitations on the ability of the Western transmission system to support this load growth. A portion of this project (North Havasu to Franconia) was completed in 2007 and is currently energized at 69kV for distribution needs at Franconia. UNSE will continue to work with the CRT to address issues in Mohave County.

Santa Cruz County

UNSE received a CEC in 2009 (Case No. 144, Decision No. 71282) to rebuild and convert the existing 115kV line between Western's Nogales switchyard and the UNSE Valencia substation to 138kV. Part of this project includes transferring the point of interconnection of UNSE from Western's Nogales switchyard to a future interconnection in TEP's Vail Substation. This rebuild and conversion will be completed in 2014.

Mohave County

Figure 1. Mohave County Transmission System



UNS Electric

10 YEAR PLAN

TRANSMISSION FACILITIES

Line Designation	Griffith-North Havasu Transmission
Size	
a) Voltage	230 kV, 69 kV (double circuit)
b) Capacity	300 MVA (thermal)
c) Point of Origin	Griffith Substation
d) Point of Termination	North Havasu Substation
e) Length	Approximately 40 miles
Routing	West of and parallel to I-40 to Santa Fe Ranch Rd. interchange. Diagonal southeast to the Parker Davis line at Highway 95. Parallel to PD-1 to North Havasu Substation site southeast of the Lake Havasu City airport. Routing to be within corridor as approved and described in CEC Order #88.
Purpose	Reinforce the existing transmission grid and provide interconnection between UNSE load centers in Mohave County.
Date	
a) Construction Start	North Havasu to Franconia, 2007
b) In-Service Date	North Havasu to Franconia, 2007 [Complete]
	Franconia to Griffith, 2017 subject to CEC extension
Is Certificate Necessary	Case # 88[2] -- An extension was approved by the ACC which expires in 2012.
Technical Studies	Studies completed via CATS, WATS, and Palo Verde–Southeast Station study groups and is part of the WestConnect Transmission Plan.

[2] Hilltop to Griffith portion of line already completed.

UNS Electric

10 YEAR PLAN

TRANSMISSION FACILITIES

Line Designation	Parker – Davis #1 Loop-in at Black Mesa Substation
Size	
a) Voltage	230 kV
b) Capacity	90 MW increase in delivery capacity to Black Mesa indicated per RMR study.
c) Point of Origin	Parker Substation
d) Interim Point	Black Mesa Substation
e) Point of Termination	Davis Substation
f) Length	No line extension required.
Routing	Existing Parker – Davis #1, 230 kV line passes over Black Mesa Substation.
Purpose	Reinforce the existing transmission grid.
Date	
a) Construction Start	2015
b) In-Service Date	2016
Is Certificate Necessary	No
Technical Studies	Internal UNSE studies and SWAT CRT studies.

UNS Electric

10 YEAR PLAN

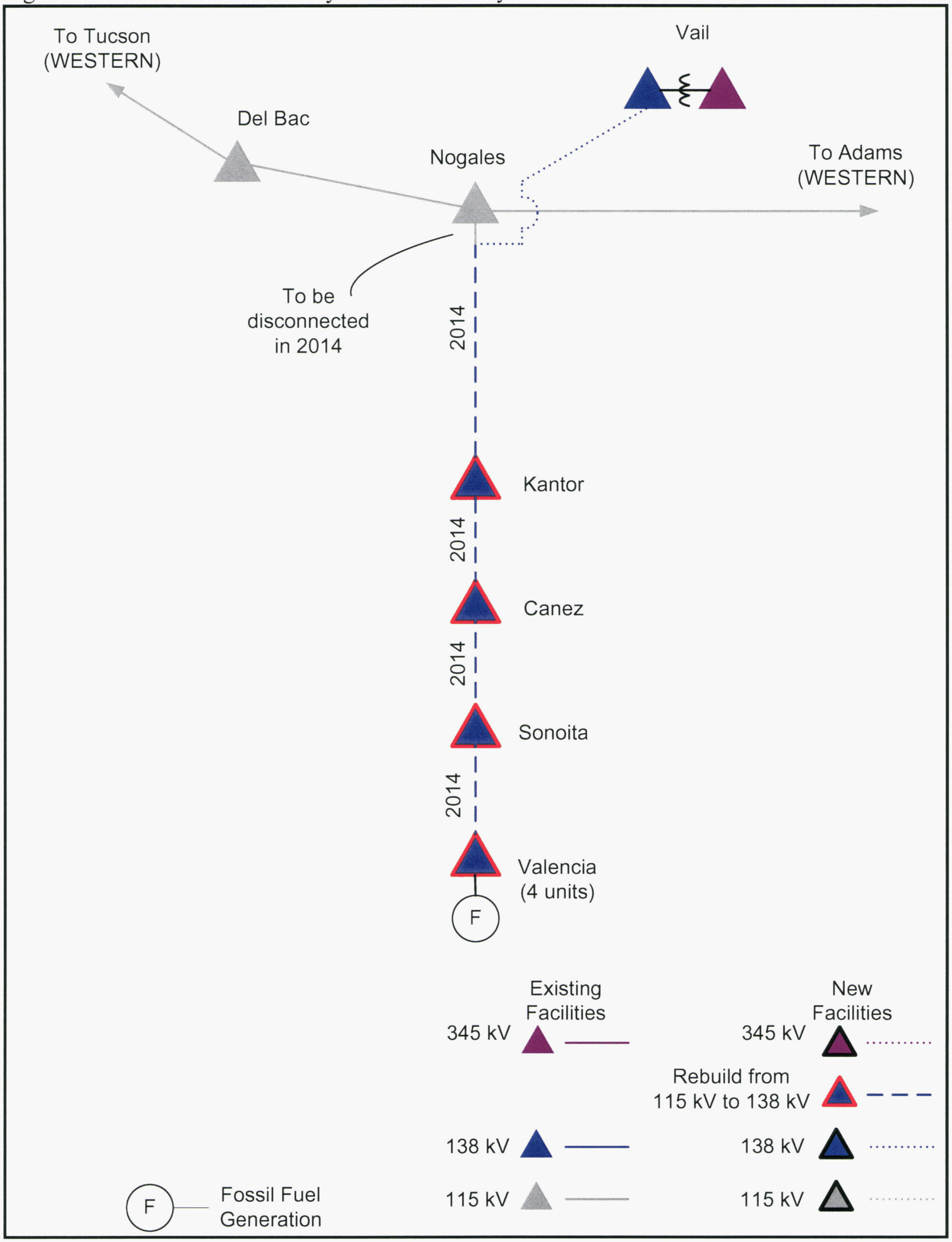
TRANSMISSION FACILITIES

Line Designation	Western Wind Interconnection
Size	
a) Voltage	69 kV
b) Capacity	10.5 MW
c) Point of Origin	Western Wind Energy Kingman Renewable Generation Project
d) Point of Termination	Griffith 69 kV Circuit 152
e) Length	0.48 miles
Routing	adjacent to Western Area Power Administration Peacock-Griffith 230 kV line in T20N R17W Sect 3 & 10
Purpose	To accommodate Western Wind Small Generator Interconnection.
Date	
a) Construction Start	2011
b) In-Service Date	2011 - complete[3]
Is Certificate Necessary	No
Technical Studies	Studies completed as required through the Open Access Transmission Tariff process.

[3] This will be removed in future Ten-Year Plans

Santa Cruz County

Figure 2. Santa Cruz County Transmission System



UNS Electric

10 YEAR PLAN

TRANSMISSION FACILITIES

Line Designation	Upgrade existing 115kV transmission line to Nogales
Size	
a) Voltage	138-kV
b) Capacity	System dependent
c) Point of Origin	Vail Substation
d) Point of Termination	Valencia Substation
e) Length	Approximately 60 miles
Routing	Generally South and West from TEP's Vail Substation to UNSE's Valencia Substation.
Purpose	The upgrade of the transmission line increases transmission system reliability and provides additional load serving capacity to UNSE's Santa Cruz Service Area.
Date	
a) Construction Start	2013
b) In-Service Date	2014
Is Certificate Necessary	Case # 144
Technical Studies	Internal UNSE studies.

UniSourceEnergy SERVICES

Update to Santa Cruz County Continuity of Service Report

January 31, 2012

SUMMARY

Since acquiring the Citizens Utilities' electric assets in Santa Cruz County in 2003, UNS Electric has made substantial improvements to operating procedures and significant investments in capital facilities that improve reliability and reduce outage restoration time. UNS Electric has focused its efforts on building flexible system capabilities that improve reliability, protect against long duration outages, and meet anticipated load growth while limiting the rate impact to customers. Those investments have resulted in safe and reliable electricity for our customers and have improved UNS Electric's reliability.

The primary improvements since the Citizens acquisition include:

1. Improvements at the Valencia Generating Station;
2. Addition of remote start capability at Valencia;
3. Upgrades to the UNS Electric link to the Western Area Power Administration ("WAPA") transmission system;
4. Addition of station service diesel generation; and
5. Improvements to communications systems, outage management systems, switching capabilities, transformers and other operational improvements.

These cost effective improvements have significantly improved system reliability since the Company acquired the Citizens' assets.

UNS Electric is also in the process of upgrading its 115 kV line to a 138 kV line. The Vail to Valencia 138 kV conversion project will further improve reliability, increase transmission system import capability, maximize total load serving capability and reduce the need to rely on output from the Valencia Generating Station. The conversion project, which is expected to be completed by October 2014, will cost an estimated $38 million to complete, including right-of-way costs and substation upgrades. However, this upgrade is the most cost effective approach to further improving reliability and meeting future electricity demand in Santa Cruz County.

Since acquiring the Citizens' Santa Cruz electric assets, UNS Electric has been able to fully evaluate the system reliability and what actions would be most cost effective to improve that reliability. The combination of revised operating procedures and infrastructure investments has resulted in a substantial improvement in reliability, as well as a significant reduction in restoration time. In this process, UNS Electric has reevaluated the need for a second transmission line and has determined that it is not necessary to provide safe, reliable service to customers in Santa Cruz County. Given the slow-down in the local economy, the lower than previously anticipated growth rate and the other reliability measures that the Company has taken, the construction of a standalone second line of approximately 66 miles no longer represents a necessary or cost-effective measure to ensure continuity of service to Santa Cruz County.

UNS Electric now estimates that the stand-alone second line would cost more than $79 million. A project of that scope may be appropriate for urban areas with a high concentration of residential, commercial and industrial customers but is not cost effective for more rural areas such as Santa Cruz County. The revenue requirement that would result from providing continuity of service would result in a disproportionate cost per customer, and the potential for a slight improvement in service to Santa Cruz County is simply not enough to justify the $79 million cost.

UNS Electric is reliably serving its customers in Santa Cruz County in a cost effective way. It has taken prudent steps to improve reliability to the point that now obviates the need for a stand-alone second line, provided UNS Electric completes the Vail-to-Valencia 138 kV upgrade. UNS Electric has taken the most cost-effective methods to improve reliability in Santa Cruz County that will save UNS Electric customers from having over $79 million added to rate base.

INTRODUCTION

This Revised Report is submitted in response to Commission Decision No. 72031 (December 10, 2010), wherein the order stated "UNSE shall update its assessment of long term alternatives for Santa Cruz County continuity of service, as part of UNSE's 2012-2021 ten-year planning studies, and file a report on the updated assessment in the 7th BTA in 2012." As requested, this report provides the results of the updated assessment.

UPDATE ON RELIABILITY AND SYSTEM RESTORATION IMPROVEMENTS

Since the previous report, as discussed in more detail below, UNS Electric has continued to pursue efforts to upgrade the existing 115kV line that currently serves Santa Cruz County. This upgrade was permitted in a Certificate of Environmental Compatibility ("CEC") obtained by UNS Electric in 2009 (Case No. 144, Decision No. 71282). Currently, UNS Electric is negotiating rights of way with various entities along the route of the upgrade. The plan calls for the conversion of the existing 115 kV transmission system to 138 kV and interconnecting it to the TEP Vail Substation. Studies indicate that approximately 100 MW of Santa Cruz County load may be supplied without the need to operate Valencia generation assuming the 138 kV conversion is completed. After the conversion, there would be no Reliability Must Run ("RMR") requirement for the ten-year planning horizon.

SANTA CRUZ TRANSMISSION SYSTEM

UNS Electric provides transmission service to its customers in the Santa Cruz County area by an existing 115 kV transmission line from WAPA's Nogales Tap switchyard to the Valencia Substation in Nogales, a distance of fifty-three miles. This 115 kV line serves Santa Cruz County customers via the Kantor, Canez, Sonoita and Valencia Substations as shown in Figure 1, Santa Cruz County 115 kV Transmission System.

Figure 1 also shows other transmission facilities generally located south of the Tucson metropolitan area for reference. The single line diagram shows a portion of the 115 kV transmission network that supplies Santa Cruz customers under a Network Integrated Transmission Service ("NITS") agreement between Western and UNS Electric. It also includes TEP's 345 kV and 138 kV transmission facilities along with Southwest Transmission Cooperative's ("SWTC") 230 kV transmission in the area.

In light of the significant improvements made since UNS Electric's acquisition of the Citizens Santa Cruz system, UNS Electric is presently capable of supplying Santa Cruz County load of 100 MW or more using the combination of the UNS Electric's transmission system and local generation. The 115 kV transmission system is capable of supplying approximately 47.6 MW, as measured at Western's Nogales Tap station without local generation support. Studies show that low voltage issues arise as the UNS Electric load, as metered at the distribution substations supplied by the 115 kV line, exceeds 46 MW, and therefore RMR requirements begin at this load level.

The worst potential outage on the current system is loss of the line between the Nogales Tap Switchyard and the Kantor Substation, since it disconnects the 115 kV transmission source and interrupts service to all Santa Cruz County customers. Restoration of service then may involve: (i) starting the Valencia combustion turbines if no Nogales-area generation is operating, and (ii) distribution system switching (closing the tie between the Canoa Ranch and Kantor Substations) to provide partial service to feeders connected to the Kantor and Canez Substations. Loss of other line segments such as Kantor to Canez, Canez to Sonoita and Sonoita to Valencia would disconnect the downstream portion of the system and result in partial interruption of service to Santa Cruz load. Procedures for timely restoration of service are in place for any of these outage conditions, which include Black Start capabilities at the Valencia Substation.

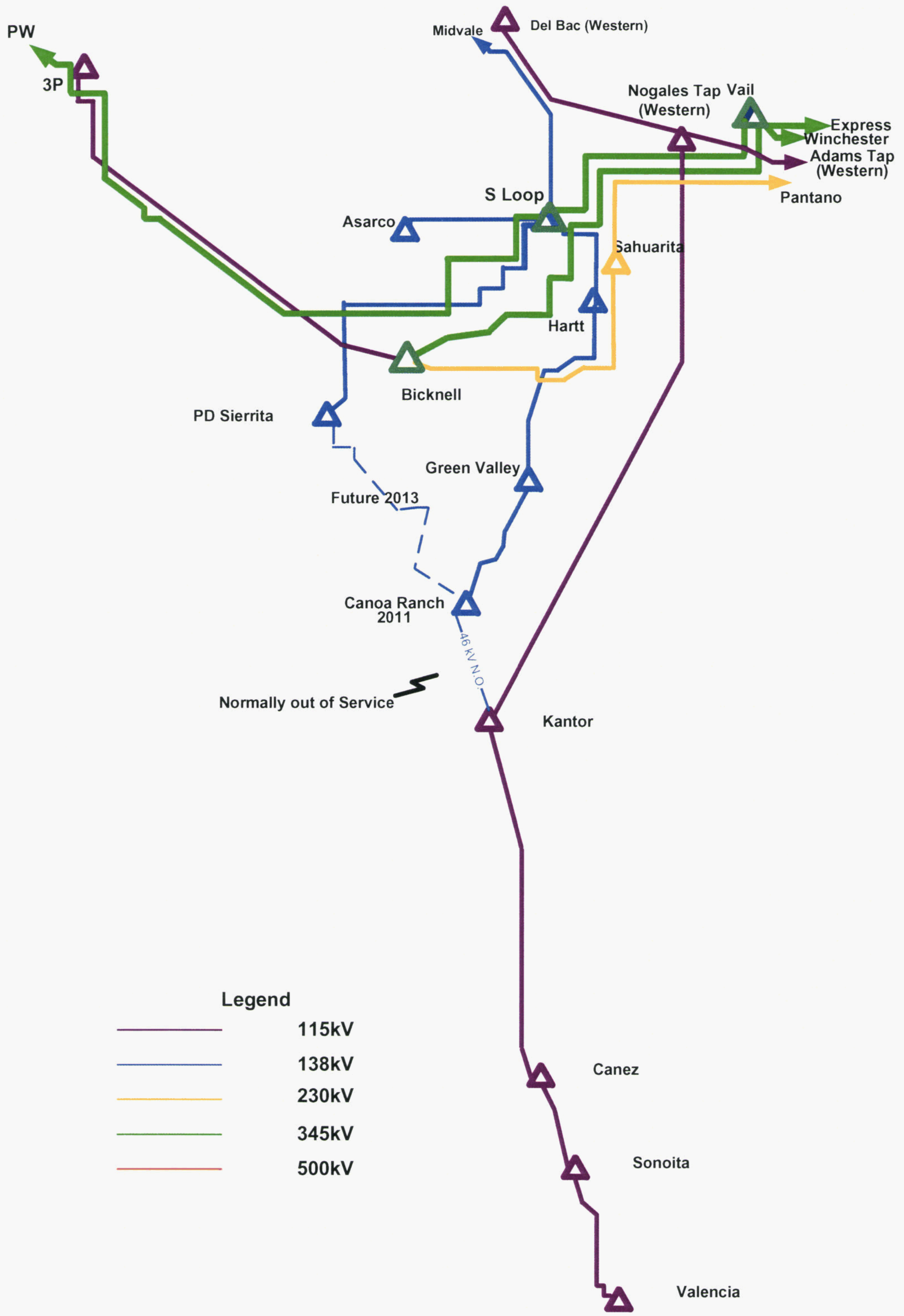


Figure 1: Santa Cruz County 115 kV Transmission System with Southern Tucson

METHODOLOGY AND STUDY PROCESS

The updated study included revisions to the area load forecast, conducting and documenting an RMR study, evaluating alternatives that could improve reliability, developing capital cost estimates, and preparing a recommended plan for service to Santa Cruz County. The study process included power flow analysis to evaluate the performance of the alternatives.

PEAK DEMAND FORECAST

Figure 2 shows the peak demand that was experienced in Santa Cruz County from 1995 through the 2011 summer peak period.

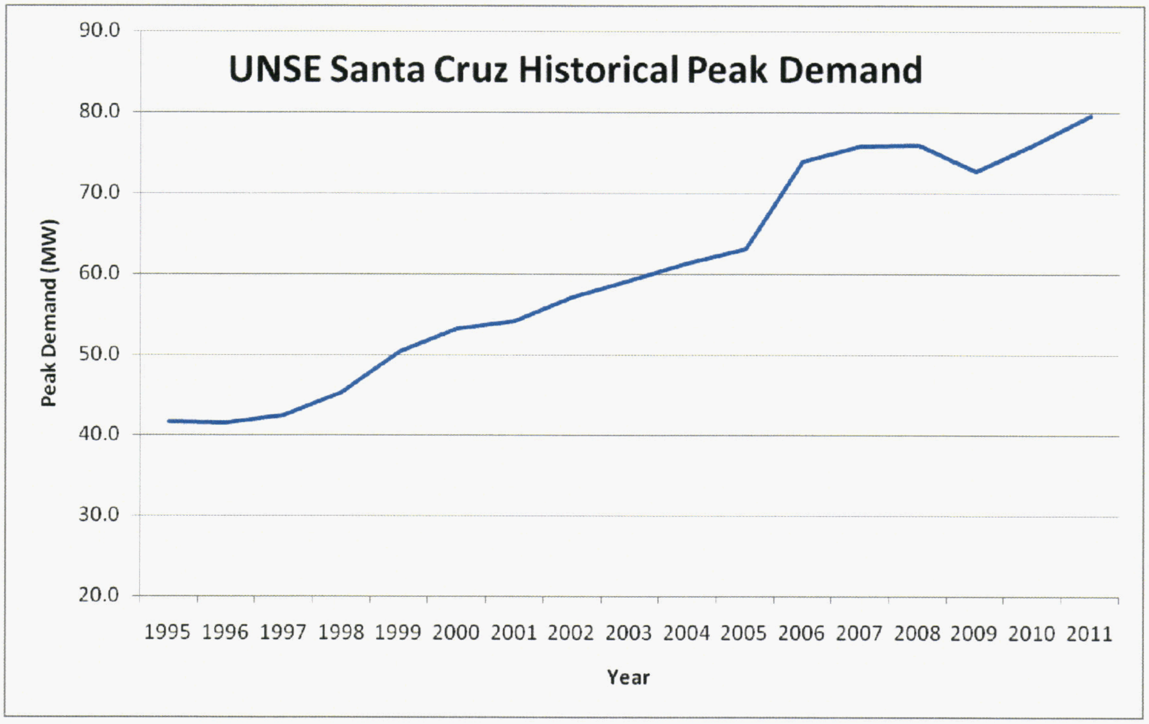


Figure 2: Santa Cruz County 1995-2011 Historical Annual Peak Demand

In Figure 2, the peaks in excess of 75 MW were primarily due to extremely hot weather conditions. Peak demand growth is expected to continue at a modest pace. Weak local economic conditions, the implementation of energy efficiency measures and an increase in distributed solar generation is moderating the expected demand levels.

UNS Electric conducted its studies based on its February 2011 peak demand forecast as shown in Figure 3. The starting point for this forecast was reduced to 77 MW to adjust for the extreme weather anomaly. The forecast assumes moderate growth through 2014 with a significant resumption of economic activity beginning in 2014. UNS Electric will continue to closely monitor economic development activity in Santa Cruz County as well as track the influence of distributed generation and demand side management impacts.

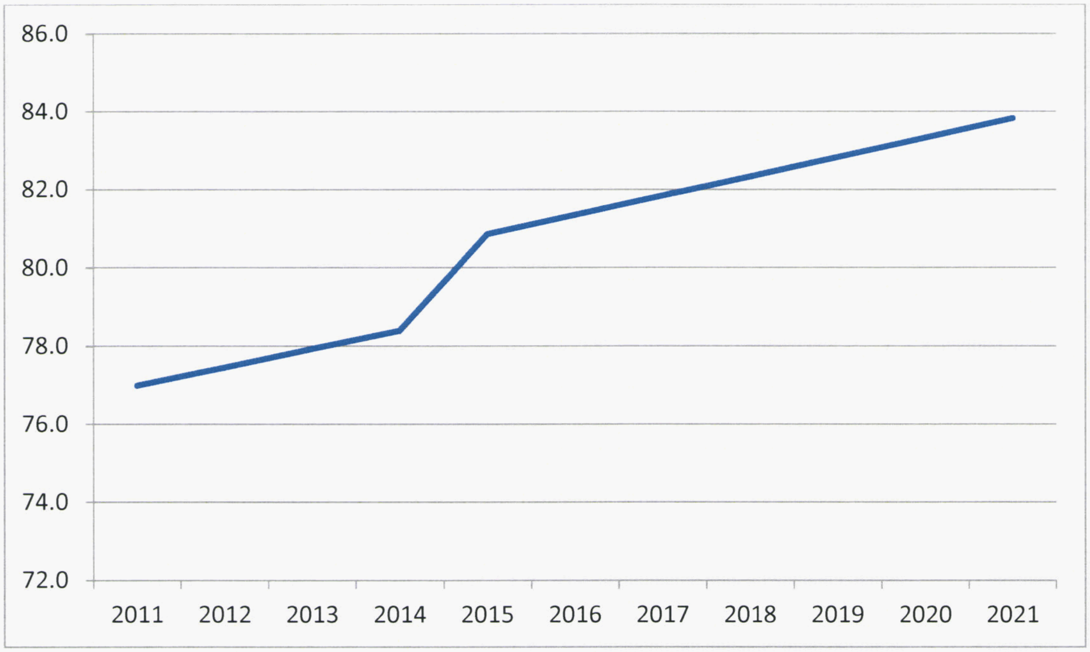


Figure 3: Santa Cruz County 2010-2025 Annual Peak Forecast

VAIL TO VALENCIA 138 KV CONVERSION

UNS Electric was granted a CEC in 2009 (Case No. 144, Decision No. 71282) to convert the existing 115 kV transmission system to 138 kV and interconnect it to the TEP Vail Substation. This CEC expires on October 7, 2014.

The proposed Vail to Valencia 138 kV conversion project, scheduled for completion by October, 7, 2014[1], consists of converting the existing 115 kV line and interconnected facilities to 138 kV by replacing transmission line structures and hardware south of the Kantor Substation, replacing 115 kV transformers with new dual voltage 138/115 kV transformers with associated substation equipment, adding a new 345/138 kV transformer and substation equipment at the Vail Substation, and constructing nearly 5 miles of new 138 kV transmission line from the Vail point of interconnection to the existing 115 kV intersection south of the Nogales Switchyard.

The 138 kV conversion project will substantially increase transmission system import capability while maximizing total load serving capability with Valencia generation operating as necessary. Specifically, it will increase the load that can be served by the line from 51 MW to 100 MW. It also will eliminate or reduce the requirement to run local generation to serve load, thus improving reliability while limiting level of capital investment to protect against large rate impacts to customers.

---

[1] UNS Electric previously scheduled the upgrade to be in service by December of 2012. However, based on lower demand projections resulting from the economic recession, UNS Electric proposes to defer this project to October 2014.

The cost estimates shown in Figure 4 and Table 1 are updates to the 138 kV conversion estimate presented to the Commission in Case No. 144, Decision No. 71282.

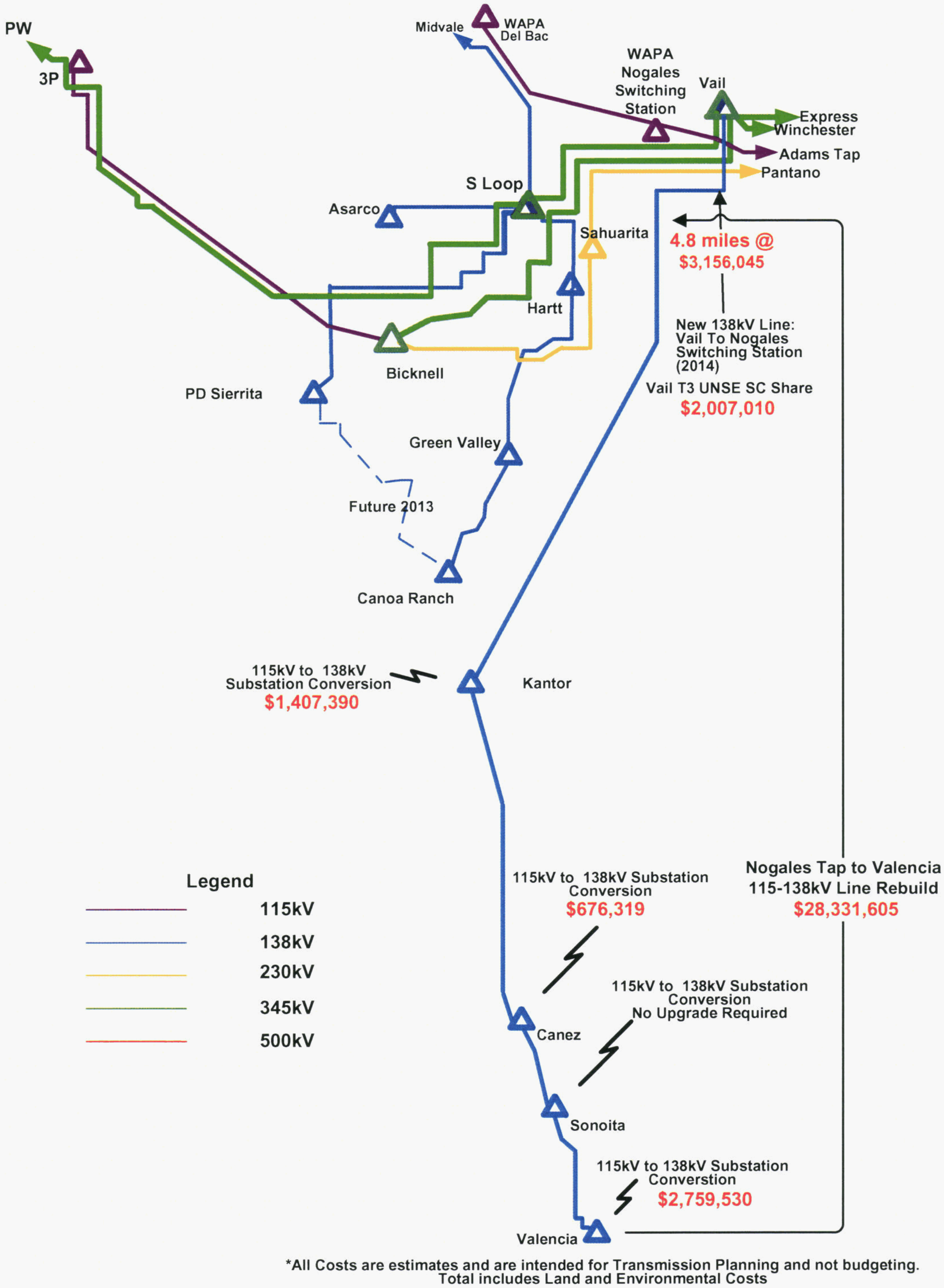


Figure 4: Vail to Valencia 138 kV Conversion & Connection to Vail

Project Element	Cost Estimate
Transmission Line	
Vail to Nogales Switching Station 138 kV Line	$3,156,045
Nogales Switching Station to Valencia 138 kV Conversion	$28,331,605
Transmission Line Total	**$31,487,650**
Substations	
Vail Substation (UNSE Santa Cruz Share)	$2,007,010
Kantor Substation Conversion	$1,407,390
Canez Substation Conversion	$676,319
Valencia Substation Conversion	$2,759,530
Substations Total	**$6,850,249**
Total Project	**$38,337,899**

Table 1: Vail to Valencia 138 kV Conversion Cost Estimate

SECOND SOUTH to VALENCIA 138 kV TRANSMISSION LINE

Given the difficulties encountered with the 345 kV Gateway Project, UNS Electric developed a variation on the Gateway Project as an option to meet the Commission's "continuity of service" principles, including the potential construction of a second transmission line into Santa Cruz County. This alternative, shown in Figure 5 consists of a new 138 kV single circuit line from TEP's South Substation to the UNS Electric Valencia Substation, with new sectionalizing facilities at the Kantor, Canez and Valencia Substations. The Sonoita Substation has existing sectionalizing that was assumed to be adequate. This sectionalizing capability is needed to meet the BTA "continuity of service" standard.

This alternative assumes that the new 66-mile 138 kV transmission line would be constructed along the preferred routing as designated for the Gateway 345 kV double-circuit line. This proposal also would require expansion of the South Substation for a new 345 kV breaker-and-a-half bay to accommodate the addition of a new 345/138 kV transformer, which would be in a transformer terminated line configuration similar to Vail in order to comply with Two County bond requirements.

A conceptual design for substation and switching station design that would be required for no interruptions is shown below in Figure 5.

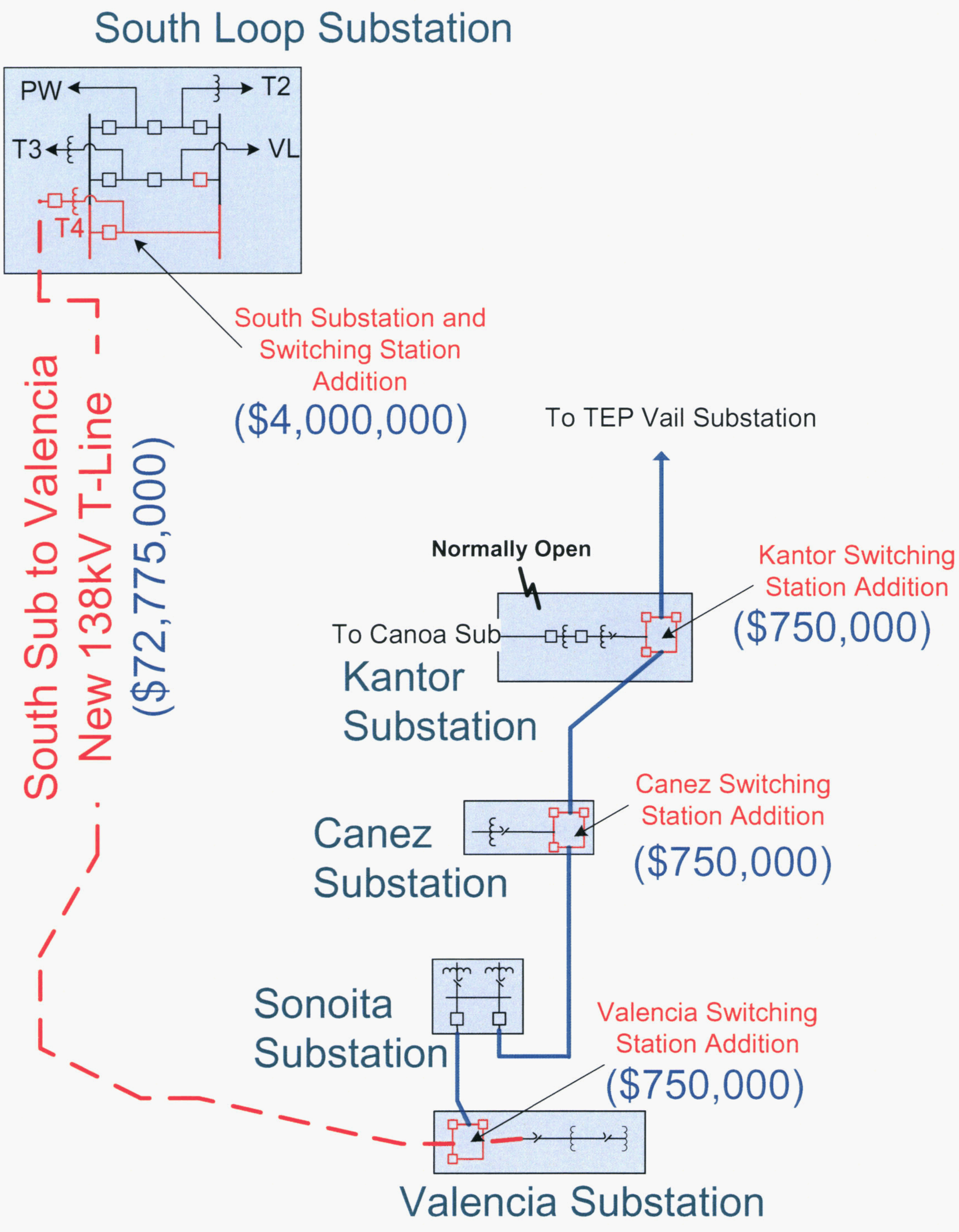


Figure 5: Conceptual Substation & Switching Stations Required for No Interruption

The cost estimate includes the new line, switching-station engineering, design, construction and commissioning, plus incremental costs associated with land, environmental and permitting. These cost estimates do not include TEP overhead charges. Further analysis will be necessary to determine actual requirements and therefore more accurate cost estimates. The South to

Valencia transmission project total estimated cost as shown in Figure 5 is approximately $79 million.

Project Element	Cost Estimate
Transmission Line	
South to Valencia 138 kV Line	$49.5 Million
South to Valencia Land & Environmental	$23.3 Million
Transmission Line Total	$72.8 Million
Substations/Switching Stations	
South Substation and Switching Station	$4 Million
Valencia Switching Station	$0.75 Million
Kantor Switching Station	$0.75 Million
Canez Switching Station	$0.75 Million
Sonoita Switching Station	Completed
Substations and Switching Station Total	$6.25 Million
Total Project	$79 Million

Table 4: Cost Estimate for New South – Valencia 138kV Line in Gateway Route

The total project cost, including land for the South to Valencia line, would be approximately $79 million. This would be in addition to the approximately $38 million cost for the Vail to Valencia 138 kV conversion. Moreover, some means to limit voltage swings following line trips and/or switching will be required, possibly adding another $4 million to the total estimate.

SUMMARY OF FINDINGS AND RECOMENDATIONS

UNS Electric has improved operating procedures and built transmission facilities that significantly improve reliability and reduce outage restoration time since acquiring the Santa Cruz County assets in 2003.

The Vail to Valencia 138 kV conversion project will further improve reliability, increase transmission system import capability, maximize total load serving capability and reduce the need to rely on output from the Valencia Generating Station.

UNS Electric analyzed a 138 kV second line alternative that could satisfy the "principle of continuity of service following a transmission line outage". However UNS Electric believes that the cost to ratepayers for this alternative is too great relative to the marginal increase in reliability. This option requires more than 66 miles of new 138 kV transmission line construction in addition to new substation and switching facilities to allow sectionalizing of the upgraded 115 kV line, estimated to cost approximately $79 million.

Therefore, UNS Electric requests that the Commission consider whether, in light of the cost-effective upgrades UNS Electric has made to its Santa Cruz County system, a second transmission line to Santa Cruz County costing over $79 million needs to be built.

UniSourceEnergy
SERVICES

UNS ELECTRIC, INC.

A STUDY OF SIMULTANEOUS IMPORT LIMIT, RELIABILITY MUST-RUN GENERATION, MAXIMUM LOAD SERVING CAPABILITY

Prepared for:
Arizona Corporation Commission
Utilities Division
400 West Congress, Ste. 218
Tucson, AZ 85701

UniSource Energy Services
4350 East Irvington Road
Tucson, AZ 85702

January 27, 2012

UniSourceEnergy
SERVICES

SANTA CRUZ COUNTY

A STUDY OF SIMULTANEOUS IMPORT LIMIT, RELIABILITY MUST-RUN GENERATION, MAXIMUM LOAD SERVING CAPABILITY

Prepared for:
Arizona Corporation Commission
Utilities Division
400 West Congress, Ste. 218
Tucson, AZ 85701

UniSource Energy Services
4350 East Irvington Road
Tucson, AZ 85702

January 27, 2012

EXECUTIVE SUMMARY

Power flow simulations show the Study System is reliable and is capable of serving all load within the specified UNS Electric, Inc. ("UNS Electric") Santa Cruz Study area. Table 1 depicts the applicable metric values[1] (1) System Import Limit (**"SIL"**), (2) Maximum Load Serving Capability (**"MLSC"**) and **(3)** Reliability Must Run **("RMR")** for the 2012 ACC Biannual Transmission Assessment ("BTA").

Table 1: Load Serving Analysis for Santa Cruz County (N-1 analysis)

Year	Santa Cruz Forecasted Peak	Study System Load	Metric	Metric Value	Limiting Element	Limiting Outage	UNS Santa CruzStudy System Generation Dispatch		Annual Incremental RMR Generation Cost Estimate
							Station	Dispatch	
2014	78.4 MW	46 MW	SIL	47.6 MW	Valencia 115 kV bus dV	Del Bac – Nogales 115 kV line	None	0 MW	N/A
		123 MW	MLSC	123 MW	Del Bac 115 kV bus dV	Tucson - Del Bac 115kV line	Valencia CT1, 2, 3, 4	62 MW	N/A
		78.4 MW	RMR	16.0 MW	Del Bac 115 kV bus dV	Tucson - Del Bac 115kV line	Valenci CT4	16 MW	$544,525
2021	83.8 MW	83.8 MW	SIL	86.8 MW	Canez 138kV bus dV	CANEZ - SONOITA 138kV #1	None	0 MW	N/A
		159 MW	MLSC	159 MW	Canez 138kV bus dV	CANEZ - SONOITA 138kV #1	Valencia CT1, 2, 3, 4	62 MW	N/A
		83.8 MW	RMR	0 MW	N/A	N/A	None	0 MW	N/A

A reduction in SIL is seen in this 7th BTA study (47.6 MW) when compared to the 6th BTA study, completed in 2010, where SIL was 51.0 MW when the UNS Electric Santa Cruz load is served from the WESTERN 115kV transmission system. This SIL reduction is due to changes in UNS Santa Cruz load power factors.

[1]**SIL:** The transmission system's simultaneous import limit (SIL) for each local constrained area is established for single contingencies (n-1) with no local generation in operation.
MLSC: The maximum load serving capability (MLSC) of the local system is established by operating all local units at capacity, less local reserve requirements. The local MLSC equals to the SIL when there is no local generation..
RMR: The required must-run (RMR) generation are those resources located within a load pocket that, during some portions of the year, are required to serve that portion of the local load that cannot be served by local transmission.

An RMR condition only exists in the 2014 or earlier time frame while the UNS ELECTRIC Santa Cruz system is served from Western Area Power Administration's ("WESTERN's") 115kV facilities. Expected emissions due to this RMR requirement are shown in Table 2 below.

Table2: RMR Environmental Output Estimates for 2014

2014 RMR Environmental Output	Estimated SO_2	Estimated NO_x	Estimated PM	Estimated CO_2
Valencia 4 CT (lbs)	210	10,398	3,304	41,532,106
Valencia 1-3 CT (lbs)	-	-	-	-

TABLE OF CONTENTS

INTRODUCTION

In order to assess Arizona's electrical power systems in accordance with applicable NERC Reliability Standards and WECC System Performance Criteria, The Arizona Corporation Commission ("ACC") requires Arizona utilities to study their systems at the transmission System Import Limit ("SIL"), Maximum Load Serving Capability ("MLSC"), and at peak load forecast operating conditions every two years. Normal operating study procedures are followed for the SIL, MLSC, and peak load forecast operating condition evaluations. Common corridor outages and extreme contingencies (all transformers at any one EHV substation) are studied as well. Reliability Must Run ("RMR") generation is determined for peak forecasted loads. Utilities are also required to provide information on the environmental emissions, generation output, generation sensitivity, transmission import limit, and alternative solutions.

BACKGROUND

UNS Electric, Inc. ("UNS Electric") serves Santa Cruz County with a radial system interconnected to the Western Area Power Administration ("WESTERN") 115kV transmission system (see Figure 1 on page 6). From the interconnection point at WESTERN's Nogales switchyard near Tucson, the UNS Electric Santa Cruz 115kV radial circuit extends south to serve load at the Kantor, Canez, Sonoita and Valencia substations.

Approximately 50% of the UNS Electric Santa Cruz load is located at the Valencia substation and 33% at the Sonoita substation. Hence, 83% of the total load is located on the last 8.5 miles of the 53 mile long system. In addition to the bulk of the Santa Cruz load being at the end of a relatively long radial, there are lengthy 115kV line segments that connect the Saguaro and Apache generating stations to the Nogales switchyard. Low voltage becomes an issue at higher loads because the bulk of the UNS Electric Santa Cruz load is served in this manner.

Presently, the low voltage issues are mitigated by dispatching local gas turbine generation at the Valencia substation during peak load periods. These turbines supply some power locally, which helps reduce loading on the 115kV network. They also enhance voltage support by contributing reactive power (VARs). The gas turbines are acting as RMR generation by supporting the system this way.

Though local generation is currently utilized, UNS Electric Santa Cruz is planning to upgrade the 115kV radial line for operation at 138kV, to be served from Tucson Electric Power Company's (TEP's) Vail substation (see Figure 2 on page 6). The 115 kV to 138 kV conversion work is scheduled for completion before October 7, 2014.

PURPOSE

The purpose of this RMR Study is to determine the following six components as specified in the ACC 2nd Biennial Transmission Assessment 2002-2011, Section 7.2 "Reliability Must-Run Generation (RMR) Requirements":

1. **Simultaneous Import Limit (SIL)** – The maximum import level that the Study System can reliably support when no local generation is dispatched.
2. **System Maximum Load Serving Capability (MLSC)** – The maximum load level that the Study System can reliably support when all local generation is dispatched.
3. **Reliability Must Run (RMR) conditions** – RMR conditions exist only when the Study System cannot reliably support its projected peak load without the dispatch of some or all local generation, (i.e., when forecasted load exceeds the SIL).
4. **System Generator List** – UNS Electric local generators available for dispatch. (Appendix A)
5. **Effectiveness of New Facilities** – A new facilities effectiveness evaluation is to be done only if new facilities (transmission or generation) are needed to mitigate RMR conditions in the Study System.
6. **Comparative Analysis of Alternatives** – Comparative analysis of alternatives is to be done only if such alternatives are needed to mitigate RMR conditions in the Study System.

No extreme contingency analysis was done for the transmission network serving the UNS ELECTRIC Santa Cruz system. Santa Cruz is supplied by a radial line connected to WESTERN's 115 kV line between the Saguaro and Apache substations. The worst contingencies involving loss of the connections to Saguaro and Apache would result in loss of the source to the 115 kV line to Nogales.

Extreme contingencies after the 115 kV system is converted to 138 kV and connected to the Vail substation are addressed in studies in which TEP participates. The worst contingency involving loss of the connection to Vail would result in loss of the source to the 138 kV line to Nogales.

Included in this report are the cost estimates for:

(1) Running local generation at the Valencia substation for RMR;

(2) Upgrading the system so that RMR generation could be eliminated.

Information regarding environmental emissions, generation output, generation sensitivity, transmission import limit, and alternative solutions is also provided.

STUDY BASE CASE DESCRIPTION AND ASSUMPTIONS

The WECC base cases 2014hs3sa and 2021hs1a were modified in coordination with utilities within Arizona. Forecasted peak loads within the study system were incorporated into the starting case for each of the years 2014 & 2021. APPENDIX B summarizes the peak load projections for the study system.

UNS Electric Santa Cruz planned facilities are documented in the UNS Electric Ten-Year Plan. Major system changes are anticipated to take place pre-peak 2015 when the UNS Electric Santa Cruz system is converted to 138kV and is served from the TEP Vail substation. The two figures below show the existing 115 kV and 138 kV conversion configurations proposed for the UNS Electric Santa Cruz system.

UNS Electric – Santa Cruz 115kV

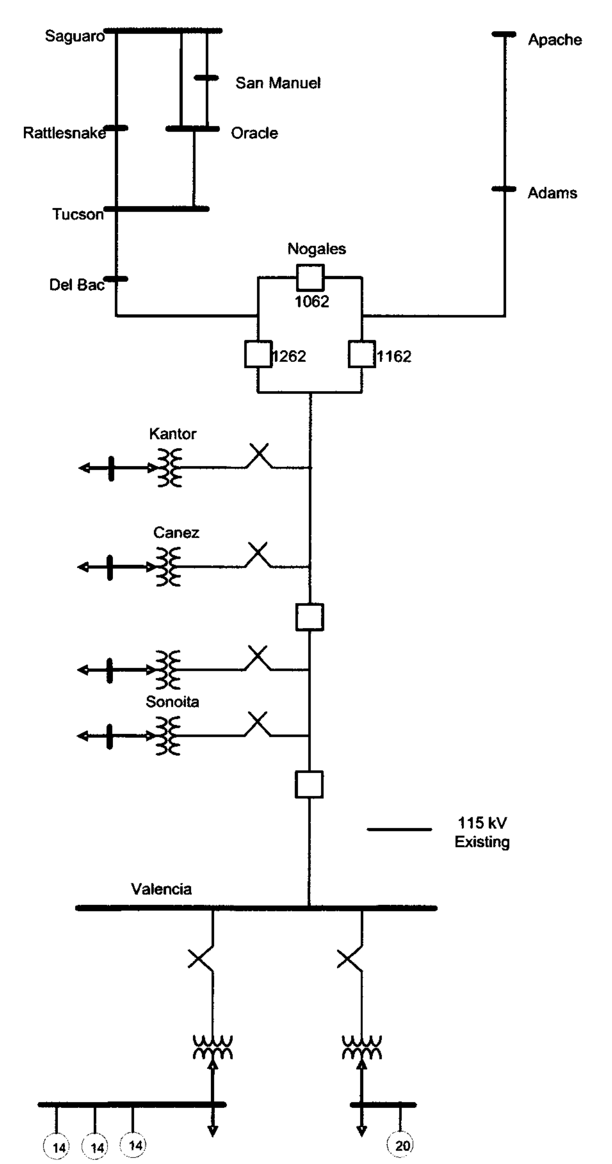


Figure 1: UNS ELECTRIC – Santa Cruz 115kV system (present – Fall 2014)

UNS Electric – Santa Cruz 138kV

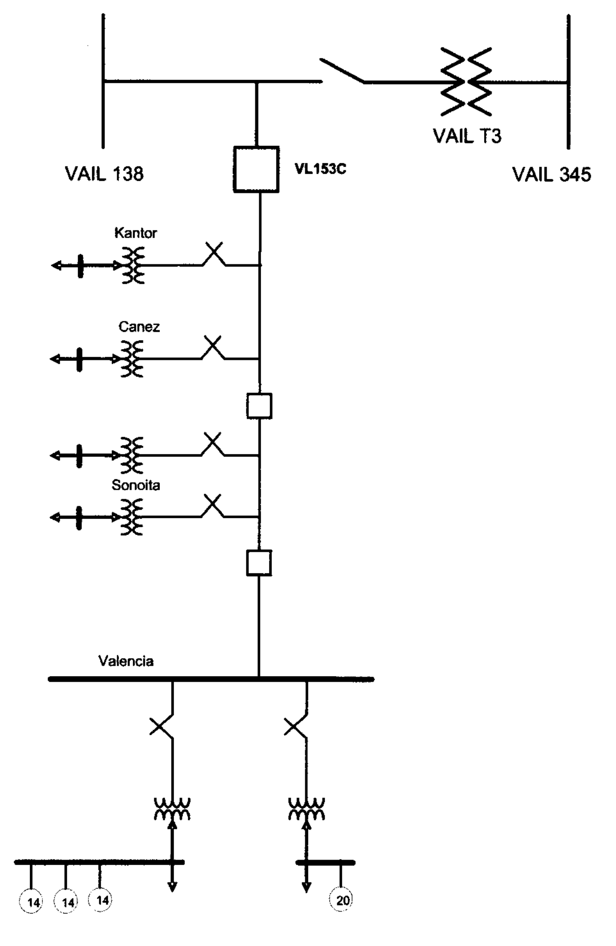


Figure 2: UNS ELECTRIC – Santa Cruz Proposed 138kV system (Fall 2014 and beyond)

STUDY METHODOLOGY

The following analysis will be performed to determine the following metrics:

Simultaneous Import Limit (SIL)

To develop a Simultaneous Import Limit (SIL) case, the Starting Case was modified so that all UNS Electric Santa Cruz local Valencia generation within the study system was taken off-line. Replacement generation required to supply Santa Cruz County load was scheduled from elsewhere within Arizona as necessary. Loads within the Study System, with the exception of any generating station auxiliary loads and known mining loads, were scaled by the same percentage with the load power factors held constant. The change in study system loads due to scaling to determine SIL were accounted for by turning down or increasing generation in the system external to the study system as appropriate. Under these SIL conditions, the study system load was continually scaled in 5MW increments and then scaled to the nearest MW, as the limit was approached, until any thermal, voltage or solution constraints were found for the simulated contingencies (See APPENDIX C – power flow contingencies).

Required Must Run (RMR)

If the forecasted load is greater than the SIL for a given year, UNS Electric Santa Cruz local Valencia generation will be dispatched in the following economic order:

(1) Valencia Unit #4
(2) Valencia Unit #1,2 or 3

Table 3: UNS Santa Cruz Local Generation Economic Dispatch Order

The UNS Electric Santa Cruz local Valencia generation capability can be seen in APPENDIX A – study system generator list.

For each identified RMR condition, the following environmental outputs will be reported on an annual basis: Sulfur dioxide (SO_2), Nitrogen oxide (NO_x), Carbon dioxide (CO_2), Particulate Matter (PM).

Maximum Load Serving Capability (MLSC)

The Starting Case was modified so that all generators within the Study System were on-line at maximum dispatch in order to develop a MLSC case. An equal amount of generation was reduced elsewhere in Arizona to offset the increased study system load. Loads within the study system, with the exception of any generating station auxiliary loads and known mining loads, were scaled by the same percentage with the load power factors held constant. Under these MLSC conditions, the study system load was continually increased in 5 MW increments. As limits were approached, the incremental increases were reduced to 1 MW until thermal, voltage or solution constraints were found. (See APPENDIX C – power flow contingencies)

Effectiveness of New Facilities

If an RMR condition exists, the need for new facilities will be identified based on criteria violations that drive the SIL of the study system. Simulations were run against the 2014 and 2021 cases to ensure that any identified new facilities, in fact, mitigate criteria violations and ensure that the SIL is adequate for the forecasted peak load in each of those years. The purpose of the identified new facilities is to eliminate the RMR condition.

Comparative Analysis of Alternatives

If an RMR condition was identified, a comparative analysis of alternatives was done to compare:

(1) the cost of new facilities that eliminate the RMR condition
(2) the annual RMR generation cost

EVALUATION CRITERIA

Specific studies to be conducted and their evaluation criteria are discussed below.

Power Flow Analysis

Power flow analysis was performed to determine SIL, to identify any RMR requirement, to determine MLSC, and to confirm the effectiveness of new facilities to eliminate RMR generation.

The contingencies simulated will include:

- All single HV transmission circuit, and HV and EHV transformer outages within the study system, excluding transformers serving only distribution load (N-1) within the study area (Category B).
- All HV Tie Lines to adjacent systems connecting immediately outside the study area (Category B).

See APPENDIX C – Power Flow Contingencies, for the list of contingencies to be evaluated.

The NERC/WECC System Performance Criteria along with the following criteria will be used to determine SIL, RMR, MLSC, and effectiveness of new facilities. The power flow analysis related evaluation criteria that will be used are summarized below:

- TEP maintains 1.0 per unit on the distribution side buses in order to compensate for the voltage drop that will occur along the 115 kV transmission line in Santa Cruz County. TEP will back calculate all per unit voltages to the HV side of the circuit.
- Maximum voltage deviation allowed at all buses under contingency conditions will be 5% for all Category B outages.
- Pre-disturbance loading to remain within continuous ratings of all equipment and line conductors
- Post-disturbance loading to remain within emergency ratings of all equipment and line conductors.

The system will be simulated with static VAr devices active, load tap changing blocked, phase shifters blocked and area interchange disabled.

Post-Transient Voltage Stability

To verify post-transient voltage stability, the "Voltage Support and Reactive Power" section of the NERC Planning Standards and WECC system performance criteria was applied by increasing total Study System load in the SIL, MLSC and RMR cases by 5%. Then these margin cases were evaluated for a solution for a NERC Category A (i.e. no contingency outage) and NERC Category B (i.e. single contingency outage) conditions. If the limiting condition for the determined metrics is a solution issue the load will be required to be scaled back to demonstrate at 5% post-transient voltage stability margin.

RESULTS

SIL, RMR and MLSC RESULTS

Power flow simulations show the Study System is reliable and is capable of serving all load within the specified UNS Electric Santa Cruz Study area. Table 1 depicts the applicable metric values (1) **SIL**, (2) **MLSC** and **(3) RMR** for the 2012 ACC Biannual Transmission Assessment (7th BTA).

Table 1: Load Serving Analysis for Santa Cruz County (N-1 analysis)

Year	Santa Cruz Forecasted Peak	Study System Load	Metric	Metric Value	Limiting Element	Limiting Outage	UNS Santa CruzStudy System Generation Dispatch		Annual Incremental RMR Generation Cost Estimate
							Station	Dispatch	
2014	78.4 MW	46 MW	SIL	47.6 MW	Valencia 115 kV bus dV	Del Bac – Nogales 115 kV line	None	0 MW	N/A
		123 MW	MLSC	123 MW	Del Bac 115 kV bus dV	Tucson - Del Bac 115kV line	Valencia CT1, 2, 3, 4	62 MW	N/A
		78.4 MW	RMR	16.0 MW	Del Bac 115 kV bus dV	Tucson - Del Bac 115kV line	Valenci CT4	16 MW	$544,525
2021	83.8 MW	83.8 MW	SIL	86.8 MW	Canez 138kV bus dV	CANEZ - SONOITA 138kV #1	None	0 MW	N/A
		159 MW	MLSC	159 MW	Canez 138kV bus dV	CANEZ - SONOITA 138kV #1	Valencia CT1, 2, 3, 4	62 MW	N/A
		83.8 MW	RMR	0 MW	N/A	N/A	None	0 MW	N/A

A reduction in SIL is seen in this 7th BTA study (47.6 MW) when compared to the 6th BTA study, completed in 2010, where SIL was 51.0 MW when the UNS Electric Santa Cruz load is served from the WESTERN 115kV transmission system. This SIL reduction is due to changes in UNS Santa Cruz load power factors.

Please see Appendix D & E for detailed power flow metric calculations for the 2014 and 2021 models seen in Table 1 above.

An RMR condition exists only through 2014 during which time the UNS Electric Santa Cruz system is served from the existing WESTERN 115kV facilities. Expected emissions due to this RMR requirement can be seen in Table 2 below.

Table2: RMR Environmental Output Estimates for 2014

2014 RMR Environmental Output	Estimated SO2	Estimated NOx	Estimated PM	Estimated CO2
Valencia 4 CT (lbs)	210	10,398	3,304	41,532,106
Valencia 1-3 CT (lbs)	-	-	-	-

Effectiveness of New Facilities

In this case UNS ELECTRIC's planned conversion of the 115 kV circuit to 138 kV eliminates the RMR requirement demonstrated in the 2014 time-frame. The scheduled completion date for the 138 kV conversion is Fall of 2014.

Comparative Analysis of Alternatives

(1) the cost of new facilities that eliminate the RMR condition $38,338,000
(2) the annual RMR generation cost is $544,525

Extreme Contingencies

It should also be noted that, through 2014, WAPA's worst case NERC/WECC Category C contingency on its system – a breaker failure on the 1062 breaker at the Nogales 115kV substation – will isolate the UNS Electric Santa Cruz system. After the 138 kV conversion in 2014 will be contingencies that include loss of the TEP Vail T3 Transformer.

APPENDIX A – Study System Generator List

	Power Output		Reactive Output	
Turbine	**Maximum**	**Minimum**	**Maximum**	**Minimum**
Valencia turbine #1 (1)	14 MW	10 MW	8 MVAR	-5 MVAR
Valencia turbine #2 (1)	14 MW	10 MW	8 MVAR	-5 MVAR
Valencia turbine #3 (1)	14 MW	10 MW	8 MVAR	-5 MVAR
Valencia turbine #4 (2)	20.0 MW	10 MW	15 MVAR	-25 MVAR

(1) Based on compliance reports
(2) Based on nameplate

APPENDIX B1 – Santa Cruz March 2011 10 Year Load Forecast

Year	Load Forecast (MW)
2011	79.6
2012	77.5
2013	77.9
2014	78.4
2015	80.9
2016	81.4
2017	81.8
2018	82.3
2019	82.8
2020	83.3
2021	83.8

APPENDIX B2 - Santa Cruz March 2011 Load Allocation for 2014 and 2021

UES Bus Loads		%	2014		2021	
			MW	MVAr	MW	MVAr
16705	Kantor	9.0%	7.06	-0.32	7.54	-0.34
16706	Canez	8.0%	6.27	-2.08	6.70	-2.23
16707	Sonoita 1	12.0%	9.41	-1.34	10.06	-1.43
16708	Sonoita 2	21.0%	16.46	-1.81	17.60	-1.94
16709	Valencia 1	29.0%	22.74	-1.02	24.30	-1.09
16710	Valencia 2	21.0%	16.46	-0.74	17.60	-0.79
		TOTAL	78.40	-7.31	83.80	-7.82

APPENDIX C – Power Flow Contingencies

2014 Contingencies

```
LINE_1      "DEL BAC  - NOGALES  115kV #1  "  1.000
 line "DEL BAC  115.00" "NOGALES  115.00" "1 "  1 0
0
LINE_2      "TUCSON   - DEL BAC  115kV #1  "  1.000
 line "TUCSON   115.00" "DEL BAC  115.00" "1 "  1 0
0
LINE_3      "TUCSON   - ORACLE   115kV #1  "  1.000
 line "TUCSON   115.00" "ORACLE   115.00" "1 "  1 0
0
LINE_4      "SAG.EAST - ORACLE   115kV #1  "  1.000
 line "SAG.EAST 115.00" "ORACLE   115.00" "1 "  1 0
0
LINE_5 " SONOITA - VALNCIA 115kV #1"  1.000
 line "SONOITA  115.00" "VALNCIA  115.00" "1 "  1 0
0
XFMR_6      "CANEZ    13/115kV #1      "  1.000
 tran "CANEZ    13.20" "CANEZ    115.00" "1 " 0 "        0.00"
0
XFMR_7      "KANTOR   13/115kV #1      "  1.000
 tran "KANTOR   13.20" "KANTOR   115.00" "1 " 0 "        0.00"
0
XFMR_8      "SONOITA1  13/SONOITA  115kV #1"  1.000
 tran "SONOITA1  13.20" "SONOITA  115.00" "1 " 0 "        0.00"
0
XFMR_9      "SONOITA2  13/SONOITA  115kV #1"  1.000
 tran "SONOITA2  13.20" "SONOITA  115.00" "1 " 0 "        0.00"
0
XFMR_10     "VALNCIA1  13/VALNCIA  115kV #1"  1.000
 tran "VALNCIA1  13.20" "VALNCIA  115.00" "1 " 0 "        0.00"
0
XFMR_11     "VALNCIA2  13/VALNCIA  115kV #1"  1.000
 tran "VALNCIA2  13.20" "VALNCIA  115.00" "1 " 0 "        0.00"
0
B2B_1 "APACHE - NOGALES 115kV #1"  1.000
 line "ADAMSTAP 115.00" "APACHE   115.00" "1 "  1 0
 line "ADAMSTAP 115.00" "NOGALES  115.00" "1 "  1 0
0
B2B_2 "NOGALES  - SONOITA 115kV #1"  1.000
 line "NOGALES  115.00" "KANTOR   115.00" "1 "  1 0
 line "KANTOR   115.00" "CANEZ    115.00" "1 "  1 0
 line "CANEZ    115.00" "SONOITA  115.00" "1 "  1 0
0
B2B_3 "SAG.EAST - TUCSON 115kV #1"  1.000
 line "SAG.EAST 115.00" "MARANATP 115.00" "1 "  1 0
 line "MARANATP 115.00" "RATTLSNK 115.00" "1 "  1 0
 line "RATTLSNK 115.00" "TUCSON   115.00" "1 "  1 0
 line "MARANATP 115.00" "MARANA   115.00" "1 "  1 0
 line "RATTLSNK 115.00" "TWINPEAK 115.00" "1 "  1 0
 line "TWINPEAK 115.00" "SANDARIO 115.00" "1 "  1 0
 line "SANDARIO 115.00" "BRAWLEY  115.00" "1 "  1 0
 line "BRAWLEY  115.00" "SANXAVER 115.00" "1 "  1 0
 line "SANXAVER 115.00" "SNYDHILL 115.00" "1 "  1 0
 line "BLACKMTN 115.00" "SNYDHILL 115.00" "1 "  1 0
0
end
```

2021 Contingencies

#	Outage Description	#	Outage Description	#	Outage Description
LINE_1	PINAL_C - TORTOLIT 500kV #1	LINE_63	NL. EXP - RILLITO 138kV #1	LINE_125	CYPRUS - CLEAR 138kV #1
LINE_2	SAGUARO - TORTLIT2 500kV #1	LINE_64	NL. EXP - WESTINA 138kV #1	LINE_126	KANTOR - CANEZ 115kV #1
LINE_3	SAGUARO - TORTOLIT 500kV #1	LINE_65	NE.LOOP - NELP_SVC 138kV #1	LINE_127	CANEZ - SONOITA 115kV #1
LINE_4	SAGUARO - TORTOLIT 500kV #2	LINE_66	NE.LOOP - RILLITO 138kV #1	LINE_128	SONOITA - VALNCIA 115kV #1
LINE_5	3PTS345 - SOUTH 345kV #1	LINE_67	NOGALES - KANTOR 138kV #1	LINE_129	GATEWAY - VALNCIA 115kV #1
LINE_6	GREENLEE - COPPERVR 345kV #1	LINE_68	ORNGROVE - EASTINA 138kV #1	LINE_130	NOGALES - KANTOR 115kV #1
LINE_7	GREENLEE - WILLOW 345kV #1	LINE_69	ORNGROVE - LACANADA 138kV #1	LINE_131	CS1 - SOUTH 345kV #1
LINE_8	GREENLEE - WINCHSTR 345kV #1	LINE_70	ORNGROVE - RILLITO 138kV #1	LINE_132	BICKNELL - VAIL 345kV #1
LINE_9	HIDALGO - GREENLEE 345kV #1	LINE_71	PANTANO - LOSREALS 138kV #1	LINE_133	PINALWES - CS1 345kV #1
LINE_10	MCKINLEY - SPRINGR 345kV #1	LINE_72	RANVISTO - LACANADA 138kV #1	XFMR_134	CORONADO 500/345kV #1
LINE_11	MCKINLEY - SPRINGR 345kV #2	LINE_73	RANVISTO - NARANJA 138kV #1	XFMR_135	CORONADO 500/345kV #2
LINE_12	PINALWES - 3PTS345 345kV #1	LINE_74	RANVISTO - CATALINA 138kV #1	XFMR_136	PINAL_W 500/PINALWES 345kV #1
LINE_13	PINALWES - SOUTH 345kV #1	LINE_75	RAYTHEON - MEDINA 138kV #1	XFMR_137	TORTOLIT 500/345kV #1
LINE_14	SAN_JUAN - MCKINLEY 345kV #1	LINE_76	RBWILMOT - IRVNGTN 138kV #1	XFMR_138	WESTWING 500/345kV #1
LINE_15	SAN_JUAN - MCKINLEY 345kV #2	LINE_77	RBWILMOT - VAIL 138kV #1	XFMR_139	MCKINLEY 345/YAHTAHEY 115kV #1
LINE_16	SOUTH - GATEWAY 345kV #1	LINE_78	RILLITO - LACANADA 138kV #1	XFMR_140	SOUTH 345/138kV #1
LINE_17	SOUTH - GATEWAY 345kV #2	LINE_79	ROBERTS - HARRISON 138kV #1	XFMR_141	SOUTH 345/138kV #2
LINE_18	SPRINGR - CORONADO 345kV #1	LINE_80	S.TRAIL - ROBERTS 138kV #1	XFMR_142	VAIL 345/138kV #1
LINE_19	SPRINGR - GREENLEE 345kV #1	LINE_81	SN.CRUZ - ANKLAM 138kV #1	XFMR_143	VAIL 345/138kV #3
LINE_20	SPRINGR - LUNA 345kV #1	LINE_82	SN.CRUZ - IRVNGTN 138kV #1	XFMR_144	VAIL2 345/VAIL 138kV #1
LINE_21	SPRINGR - VAIL2 345kV #1	LINE_83	SNYDER - CRYCROFT 138kV #1	XFMR_145	VAIL2 345/VAIL 138kV #2
LINE_22	TORTOLIT - NLOOP345 345kV #1	LINE_84	SNYDER - E. LOOP 138kV #1	XFMR_146	GATEWAY 138/345kV #1
LINE_23	VAIL - SOUTH 345kV #1	LINE_85	SNYDER - NE.LOOP 138kV #1	XFMR_147	IRVMID3 138/IRVNGTN 138kV #1
LINE_24	WESTWING - PINALWES 345kV #1	LINE_86	SONOITA - VALNCIA 138kV #1	XFMR_148	IRVMID4 138/IRVNGTN 138kV #1
LINE_25	WILLOW - BOWIE 345kV #1	LINE_87	SOUTH - ASARCO 138kV #1	XFMR_149	SPNCER 138/115kV #1
LINE_26	WILLOW - BOWIE 345kV #2	LINE_88	SOUTH - CYPRUS 138kV #1	XFMR_150	TORTOLIT 138/SAG.EAST 115kV #1
LINE_27	WINCHSTR - VAIL 345kV #1	LINE_89	SOUTH - GREENVLY 138kV #1	XFMR_151	TORTOLIT 138/SAG.WEST 115kV #1
LINE_28	WINCHSTR - WILLOW 345kV #1	LINE_90	SOUTH - HARTT 138kV #1	XFMR_152	TORTOLIT 138/TORTLIT2 500kV #1
LINE_29	CANEZ - SONOITA 138kV #1	LINE_91	SOUTH - MEDINA 138kV #1	XFMR_153	TORTOLIT 138/500kV #1
LINE_30	CIENEGA - S.TRAIL 138kV #1	LINE_92	SOUTH - MIDVALE 138kV #1	XFMR_154	TORTOLIT 138/500kV #2
LINE_31	CORONA - IRVNGTN 138kV #1	LINE_93	SOUTH - RAYTHEON 138kV #1	XFMR_155	TORTOLIT 138/500kV #3
LINE_32	CORONA - SOUTH 138kV #1	LINE_94	SOUTH - SPNCER 138kV #1	XFMR_156	TORTOLIT 138/500kV #4
LINE_33	CRYCROFT - NE.LOOP 138kV #1	LINE_95	SPNCER - MEDINA 138kV #1	XFMR_157	MCKINLEY 345/YAHTAHEY 115kV #2
LINE_34	DELCERRO - WESTINA 138kV #1	LINE_96	TECHPARK - VAIL 138kV #1	XFMR_158	WINCHSTR 345/230kV #1
LINE_35	DMP - ANKLAM 138kV #1	LINE_97	TORTOLIT - MARANA 138kV #1	GEN_159	BOWIE_G1 18.0kV #1 (150)
LINE_36	DMP - NL. EXP 138kV #1	LINE_98	TORTOLIT - N. LOOP 138kV #4	GEN_160	BOWIE_G2 18.0kV #1 (150)
LINE_37	DMP - N. LOOP 138kV #1	LINE_99	TORTOLIT - NL. EXP 138kV #4	GEN_161	BOWIE_G3 18.0kV #1 (0)
LINE_38	DMP - NE.LOOP 138kV #1	LINE_100	TORTOLIT - NL. EXP 138kV #3	GEN_162	BOWIE_G4 18.0kV #1 (0)
LINE_39	DMP - SN.CRUZ 138kV #1	LINE_101	TORTOLIT - NL. EXP 138kV #2	GEN_163	BOWIE_S1 18.0kV #1 (200)
LINE_40	DMP - TUCSON 138kV #1	LINE_102	TORTOLIT - NL. EXP 138kV #1	GEN_164	BOWIE_S2 18.0kV #1 (0)
LINE_41	DREXEL - IRVNGTN 138kV #1	LINE_103	TORTOLIT - N. LOOP 138kV #3	GEN_165	DMPCCT#1 13.8kV #1 (44)
LINE_42	DREXEL - MIDVALE 138kV #1	LINE_104	TORTOLIT - RANVISTO 138kV #1	GEN_166	DMPCCT#2 13.8kV #1 (0)
LINE_43	E. LOOP - HARRISON 138kV #1	LINE_105	TUBAC - CANEZ 138kV #1	GEN_167	DMPCCT#3 13.8kV #1 (0)
LINE_44	E. LOOP - NE.LOOP 138kV #1	LINE_106	TUCSON - DELCERRO 138kV #1	GEN_168	NLOOPCT 13.8kV #1 (0)
LINE_45	E. LOOP - PANTANO 138kV #1	LINE_107	TUCSON - KINO 138kV #1	GEN_169	NLOOPCT 13.8kV #2 (0)
LINE_46	E. LOOP - ROBERTS 138kV #1	LINE_108	TWNTYSEC - E. LOOP 138kV #1	GEN_170	NLOOPCT 13.8kV #3 (0)
LINE_47	GATEWAY - VALNCIA 138kV #1	LINE_109	TWNTYSEC - IRVNGTN 138kV #1	GEN_171	NLOOPCT 13.8kV #4 (0)
LINE_48	GREENVLY - CANOARCH 138kV #1	LINE_110	UA MED - KINO 138kV #1	GEN_172	SPR GEN1 19.0kV #1 (400)
LINE_49	HARTT - GREENVLY 138kV #1	LINE_111	UA MED - TUCSON 138kV #1	GEN_173	SPR GEN2 19.0kV #1 (400)
LINE_50	IRVNGTN - KINO 138kV #1	LINE_112	VAIL - CIENEGA 138kV #1	GEN_174	SPR GEN3 21.0kV #1 (420)
LINE_51	IRV_RING - SOUTH 138kV #1	LINE_113	VAIL - FT.HUACH 138kV #1	GEN_175	SPR GEN4 21.0kV #1 (420)
LINE_52	IRVNGTN - TECHPARK 138kV #1	LINE_114	VAIL - NOGALES 138kV #1	GEN_176	SUNDTCT 13.8kV #1 (0)
LINE_53	IRVNGTN - TUCSON 138kV #1	LINE_115	VAIL - S.TRAIL 138kV #1	GEN_177	SUNDTCT 13.8kV #2 (0)
LINE_54	IRVNGTN - VAIL 138kV #2	LINE_116	BLACKMTN - SPNCER 115kV #1	GEN_178	SUNDTGE1 13.8kV #1 (75)
LINE_55	KANTOR - CANEZ 138kV #1	LINE_117	ROSEMONT - GRTRVL 138kV #1	GEN_179	SUNDTGE2 13.8kV #1 (75)
LINE_56	KANTOR - TUBAC 138kV #1	LINE_118	SANRIT_S - GREENVLY 138kV #1	GEN_180	SUNDTGE3 13.8kV #1 (105)
LINE_57	LOSREALS - VAIL 138kV #1	LINE_119	SANRIT_S - HARTT 138kV #1	GEN_181	SUNDTGE4 18.0kV #1 (125)
LINE_58	MIDVALE - RAYTHEON 138kV #1	LINE_120	SANRIT_S - ROSEMONT 138kV #1	GEN_182	VALNCIA1 13.2kV #1 (0)
LINE_59	MIDVALE - SPNCER 138kV #1	LINE_121	SOUTH - SANRIT_S 138kV #1	GEN_183	VALNCIA1 13.2kV #2 (0)
LINE_60	N. LOOP - NL. EXP 138kV #1	LINE_122	TORTOLIT - NARANJA 138kV #1	GEN_184	VALNCIA1 13.2kV #3 (0)
LINE_61	NL. EXP - MARANA 138kV #1	LINE_123	SOUTH - CLEAR 138kV #1	GEN_185	VALNCIA2 13.2kV #4 (21)
LINE_62	N. LOOP - RANVISTO 138kV #1	LINE_124	CANOARCH - CLEAR 138kV #1		

APPENDIX D – 2014 SIL, RMR & MLSC ΔV Output Tables

Bus	Name	kV	Area	Zone	Outage	14hs1_SIL (47.6)	14hs1_SIL (48.7)	Outage description
16701	CANEZ	115	14	161	LINE_52	-4.74%	-5.03%	DEL BAC - NOGALES 115kV #1
16702	SONOITA	115	14	161	LINE_52	-4.76%	-5.05%	DEL BAC - NOGALES 115kV #1
16703	VALNCIA	115	14	161	LINE_52	-4.81%	-5.10%	DEL BAC - NOGALES 115kV #1

2014 SIL Output Table

Bus	Name	kV	Area	Zone	Outage	14hs1 rmr(1g15)	14hs1 rmr(1g16)	Outage description
16702	SONOITA	115	14	161	LINE_5	4.24%	4.13%	SONOITA - VALNCIA 115kV #1
19221	NOGALES	115	14	191	LINE_1	-4.69%	-4.55%	DEL BAC - NOGALES 115kV #1
19047	DEL BAC	115	14	191	LINE_2	-5.04%	-4.89%	TUCSON - DEL BAC 115kV #1
19221	NOGALES	115	14	191	LINE_2	-4.48%	-4.34%	TUCSON - DEL BAC 115kV #1

2014 dV RMR Output Table

Bus	Name	kV	Area	Zone	Outage	14hs1 mlsc(123)	14hs1 mlsc(124)	Outage description
19221	NOGALES	115	14	191	LINE_1	-4.56%	-4.70%	DEL BAC - NOGALES 115kV #1
19047	DEL BAC	115	14	191	LINE_2	-4.93%	-5.07%	TUCSON - DEL BAC 115kV #1
19221	NOGALES	115	14	191	LINE_2	-4.35%	-4.49%	TUCSON - DEL BAC 115kV #1

2014 dV MLSC Output Table

APPENDIX E – 2021 SIL and MLSC ΔV Output Tables

Bus	Name	kV	Area	Zone	Outage	21hs_sil (86.8)	21hs_sil (88.1)	Outage description
16721	CANEZ	138	14	161	LINE_29	4.88%	5.01%	CANEZ - SONOITA 138kV #1

2021 SIL Output Table

Bus	Name	kV	Area	Zone	Outage	21hs_mlsc(159)	21hs_mlsc(160)	Outage description
16721	CANEZ	138	14	161	LINE_29	4.95%	5.10%	CANEZ - SONOITA 138kV #1

2021 MLSC Output Table

UniSourceEnergy SERVICES

MOHAVE COUNTY

A STUDY OF SIMULTANEOUS IMPORT LIMIT (SIL) RELIABILITY MUST-RUN GENERATION (RMR) MAXIMUM LOAD SERVING CAPABILITY (MLSC) FOR YEARS 2014 AND 2021

Prepared for:
Arizona Corporation Commission
Utilities Division
400 West Congress, Ste. 218
Tucson, AZ 85701

UniSource Energy Services
4350 East Irvington Road
Tucson, AZ 85702

January 27, 2012

1. Executive Summary

Power flow simulations show the Study System is reliable and is capable of serving all load within the specified cut plane. The SIL analysis indicated that the 2014 and 2021 peak forecast load can be served reliably. Hydroelectric generation within the study system was dispatched for SIL metric calculations because it would be running to meet minimum river flow requirements, not as reliability must-run units. The US Bureau of Reclamation (the Bureau) confirmed that, on-peak, the hydro units at Davis and Parker will be running based on water delivery requirements. The Bureau, Western Area Power Administration (WESTERN) and the Arizona Corporation Commission (ACC) Staff agreed that it is unrealistic to model all of the hydro generation off-line at any time because of the contractual water requirements. No additional generation is needed to assure system reliability.

Table 1 depicts the two applicable metric values[1] (1) Simultaneous Import Limit (**"SIL"**) and (2) Maximum Load Serving Capability (**"MLSC"**) for the 2012 ACC Biannual Transmission Assessment (BTA).

Table 1: Results of the ACC Mohave 2012 BTA study.

year	Mohave Study System Forecasted Peak	Study System Load	Metric	Metric Value	Limiting Element	Limiting Outage	Mohave Study System Generation Dispatch	
							Station	Dispatch
2014	785MW	890MW	SIL*	604MW[1]	Black Mesa 230kV Voltage deviation	Parker - Black Mesa 230kV circuit	Parker Davis	92MW 225MW
		1300MW	MLSC	1300MW[1]	Black Mesa 230kV Voltage deviation	Parker - Black Mesa 230kV circuit	ALL within study area	1590.9MW
2021	860MW	975MW	SIL*	694MW[2]	Peacock 230kV Voltage deviation	Peacock 345/230kV transformer	Parker Davis	92MW 225MW
		1750MW	MLSC	1750MW[2]	Hilltop 230kV Votlage deviation	Hilltop - McConnico 230kV circuit	ALL within study area	1590.9MW

*SIL - import elements (1) Mead - Davis 230kV (2) McCullough - Davis 230kV (3) Peacock 345/230 xfmr (4) Round Vly - Peacock 230kV (5) Harcuvar - Parker 230kV (6) Eagle Eye - Parker 230kV (7) Gene - Parker 230kV (8a) Parker - Headgate 161kV (8b) Parker - Bouse 161kV (8c) Parker - Blythe 161kV

1 : This value assumes that the Black Mesa 230kV bus will not be tied into the Parker Davis System via Parker - N. Havasu 230kV circuit.

2 : This value assumes that the Black Mesa 230kV bus will be tied into the Parker Davis System via the Parker - N. Havasu 230kV circuit.

The SIL Metric Value is approximately equal to the Study System Load minus the Parker and Davis dispatch.

SIL: The transmission system's simultaneous import limit (SIL) for each local constrained area is established for single contingencies (n-1) with no local generation in operation other than Federal Hydro as noted in Table 1.
MLSC: The maximum load serving capability (MLSC) of the local system is established by operating all local units at capacity, less local reserve requirements. The local MLSC equals to the SIL when there is no local generation..
RMR: The required must-run (RMR) generation are those resources located within a load pocket that, during some portions of the year, are required to serve that portion of the local load that cannot be served by local transmission.

Table of Contents

2. Introduction and Purpose

UniSource Energy Services (UES) conducted this Reliability Must-Run (RMR) Study of the transmission system in Mohave County for projected years 2014 and 2021 in response to an order from the Arizona Corporation Commission.

The RMR study scope is an assessment of the Study System, as shown in Figure 1, which includes the portion of the WESTERN Desert Southwest Region (DSW) transmission network within Mohave County, Arizona. DSW owns and operates all the facilities of the transmission network, 100kV and above, within the Study System.

Power systems embedded on the DSW transmission network within the Study System include the following:

- Aha Macav (AMPS)
- Arizona Public Service (APS)
- Central Arizona Water Conservation District (CAWCD)
- Mohave Electric Cooperative (MEC)
- UNS Electric, Inc. (UNS Electric)

Input for this report includes the following entities:

- Tucson Electric Power (TEP)
- UNS Electric, Inc. (UNS Electric)
- Mohave Electric Cooperative (MEC, represented by SWTC)
- Southwest Transmission Cooperative (SWTC)
- U.S. Bureau of Reclamation (Reclamation)Western Area Power Administration (WESTERN)

The purpose of this RMR Study is to determine the following six components as specified in the ACC 2nd Biennial Transmission Assessment 2002-2011, Section 7.2 "Reliability Must-Run Generation (RMR) Requirements":

1. **Simultaneous Import Limit (SIL)** – The maximum import level that the Study System can reliably support when none of the local thermal units online and a realistic hydro dispatch on-line.

2. **System Maximum Load Serving Capability (MLSC)** – The maximum load level that the Study System can reliably support when all thermal and hydro generation is at maximum dispatch.

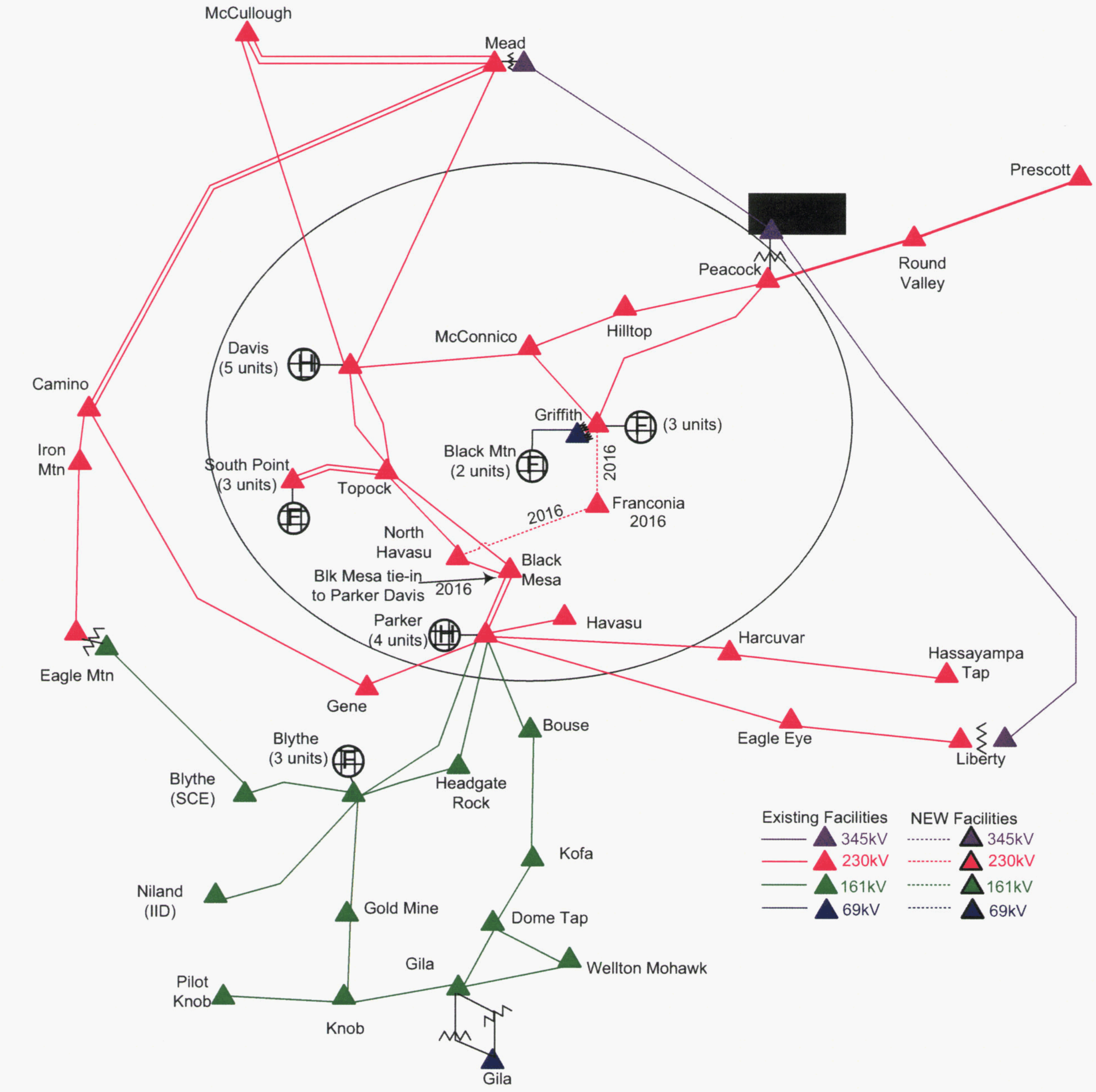
3. **Reliability Must Run (RMR) conditions** – RMR conditions exist only when the Study System cannot reliably support its projected peak load without the dispatch of some or all local generation, (i.e., when forecast load exceeds the SIL).

4. **System Generator List** – List includes generator available for dispatch. (APPENDIX A)

5. **Effectiveness of New Facilities** – A new facilities effectiveness evaluation is to be done only if new transmission facilities or additional new generation are needed to mitigate RMR conditions in the Study System.

6. **Comparative Analysis of Alternatives** – Comparative analysis of alternatives that mitigate the RMR condition in the study system.

Figure 1 – Study System for Mohave County (2014 & 2021)



Notes:

(1) Line or transformer flows that cross the boundary are measured at the station inside the Study System
(2) Encircled F denotes fossil generation; encircled H denotes hydro generation
(3) Number of generating units are shown in parentheses. Refer to APPENDIX A for Generator List.

3. Study Methodology and Assumptions

The 2012 study was performed under the direction and guidance of the Colorado River Transmission (CRT) study group. As a result, the study methodology was slightly different from 2010, wherein, in 2012, SIL was determined based on the assumption that certain hydro units were operated in a base load condition for the SIL calculations. The 2010 analysis assumed no study system generation dispatch for SIL calculations.

The following summarizes the study methodology and assumptions used to determine the Simultaneous Import Limit (SIL), Reliability Must Run (RMR) conditions and the Maximum Load Serving Capability (MLSC) of the Study System.

1. The US Bureau of Reclamation (Reclamation) confirmed that, on-peak, the hydro units at Davis and Parker will be running based on water delivery requirements. Output at Parker and Davis under on-peak loading conditions, with all units dispatched, is anticipated to be a total of 92MW and 225MW, respectively. For modeling purposes, each hydro unit at Parker and Davis will be dispatched at the same level of output. The generating values were determined by taking the actual 2010 average generation output during on-peak loading conditions for the June – August timeframe between the hours of 3pm and 6pm.
2. Mine operating assumptions: Mine load served from the existing UNS Electric 69 kV system is limited to a net 22MW due to on-site generation, therefore for modeling purposes 22MW of mine load will be aggregated on the Griffith 69kV bus.
3. To develop a Starting Case for the Study System, the WECC base cases 2014HS3-SA and 2021HS1A were modified according to utilities within Arizona. Incorporated into the Starting Case were the year 2014 & 2021 projected peak loads within the Study System. APPENDIX B summarizes the 2014 & 2021 peak load projections for the Study System.
4. 2016, loop in of the Parker – N. Havasu 230kV circuit into the Black Mesa 230kV substation is assumed as mitigation for Delta V issues at Black Mesa due to N-1 outages; specifically the Parker – Black Mesa 230 circuit.
5. Study System buses of 115kV and above were evaluated for Post Transient Voltage Deviation of > 5% for N-1 outages.
6. North Havasu – Griffith 230kV circuit has a CEC for completion in 2012 which may be deferred to 2016 or beyond.
7. White Hills has been cancelled.
8. Thermal Violation's outside of the study area were ignored, as they are physically removed from the study area cut plane shown in Figure 1. Load serving entities (LSEs) beyond the study area are responsible for ensuring plans to serve their respective growing loads.

9. To develop a Simultaneous Import Limit (SIL) case, the Starting Case was modified so that no fossil generation within the Study System was dispatched. Replacement generation was re-dispatched from units modeled within Arizona, specifically the Palo Verde and Mead Hubs. Study System loads, except generating station auxiliary loads and known mining loads, were scaled by the same percentage with the load power factors held constant. The change in Study System loads were accounted for by re-dispatching generation in the system external to the study area, also at the Palo Verde and Mead Hubs. Under these SIL conditions, the load was continually scaled in the Study System until any thermal or voltage constraints were relieved for either a NERC Category A (i.e. no contingency outage) or by a NERC Category B (i.e. single contingency outage) condition in the Study System.

10. To verify post-transient voltage stability in the SIL case, the "Voltage Support and Reactive Power" section of the NERC Planning Standards and WECC system performance criteria was applied so that total Study System load in the SIL case was increased 5%. Then this SIL margin case was evaluated for NERC Category A (i.e. no contingency outage) and NERC Category B (i.e. single contingency outage) conditions in the Study System.

11. To develop a Maximum Load Serving Capability (MLSC) case, the Starting Case was modified so that all generators within the Study System were on-line at maximum dispatch. The increased Study System generation was scheduled to displace an equal amount of generation in Arizona, specifically the Palo Verde and Mead Hubs. Study System loads, except generating station auxiliary loads and known mining loads, were scaled by the same percentage with the load power factors held constant. The increased Study System loads were sourced from increased generation in the external system, specifically at the Palo Verde and Mead hubs. Under these MLSC conditions, the load was continually scaled up in the Study System until it became voltage or thermally constrained either by a NERC Category A (i.e. no contingency outage) or by a NERC Category B (i.e. single contingency outage) condition in the Study System.

12. To verify post-transient voltage stability in the MLSC case, the "Voltage Support and Reactive Power" section of the NERC Planning Standards and WECC system performance criteria was applied so that total Study System load in the MLSC case was increased 5%. Then this MLSC margin case was evaluated for NERC Category A (i.e. no contingency outage) and NERC Category B (i.e. single contingency outage) conditions in the Study System.

4. Study Criteria

NERC/WECC Planning Standards were applied. The following summarizes the technical criteria used to determine whether the Study System performance is acceptable.

NERC Category A (i.e. no contingency outage)

- Pre-outage flow on each transmission line or transformer is within its continuous rating, which has been specified by its owner or operator.
- Pre-outage voltage at each station is within its continuous high and low ratings, which have been specified by its owner or operator.
- With the SIL, RMR and MLSC case adjusted so that its Study System load level is 5% greater than the SIL or MLSC case, the adjusted SIL or MLSC pre-outage case has a power flow solution.

NERC Category B (i.e. single contingency outage)

- Post-outage flow on each transmission line or transformer is within its emergency rating, which has been specified by its owner or operator.
- Post-outage voltage at each station is within its emergency high and low ratings, which have been specified by its owner or operator.
- Post-outage post-transient voltage at each station is within 5% of its pre-outage station voltage.
- With the SIL, RMR, and MLSC case adjusted so that its Study System load level is 5% greater than the SIL or MLSC case, the adjusted SIL or MLSC post-outage case has a power flow solution.

5. Conclusions

Power flow simulations show the Study System is reliable and is capable of serving all forecasted load within the specified cut plane. The SIL analysis indicates that the 2014 and 2021 peak forecast load can be served reliably. Hydroelectric generation within the study system was dispatched for SIL metric calculations because it would be running to meet minimum river flow requirements, not as reliability must-run units. The US Bureau of Reclamation (the Bureau) confirmed that, on-peak, the hydro units at Davis and Parker will be running based on water delivery requirements. The Bureau, Western Area Power Administration (WESTERN) and the Arizona Corporation Commission (ACC) Staff agreed that it is unrealistic to model all of the hydro generation off-line at any time because of the contractual water requirements. No additional generation is needed to assure system reliability.

Table 1 depicts the two applicable metric values (1) **SIL** and (2) **MLSC** for the 2012 ACC Biannual Transmission Assessment (BTA).

Table 1: Results of the ACC Mohave 2012 BTA study.

year	Mohave Study System Forecasted Peak	Study System Load	Metric	Metric Value	Limiting Element	Limiting Outage	Mohave Study System Generation Dispatch	
							Station	Dispatch
2014	785MW	890MW	SIL*	604MW[1]	Black Mesa 230kV Voltage deviation	Parker - Black Mesa 230kV circuit	Parker Davis	92MW 225MW
		1300MW	MLSC	1300MW[1]	Black Mesa 230kV Voltage deviation	Parker - Black Mesa 230kV circuit	ALL within study area	1590.9MW
2021	860MW	975MW	SIL*	694MW[2]	Peacock 230kV Voltage deviation	Peacock 345/230kV transformer	Parker Davis	92MW 225MW
		1750MW	MLSC	1750MW[2]	Hilltop 230kV Votlage deviation	Hilltop - McConnico 230kV circuit	ALL within study area	1590.9MW

*SIL - import elements (1) Mead - Davis 230kV (2) McCullough - Davis 230kV (3) Peacock 345/230 xfmr (4) Round Vly - Peacock 230kV (5) Harcuvar - Parker 230kV (6) Eagle Eye - Parker 230kV (7) Gene - Parker 230kV (8a) Parker - Headgate 161kV (8b) Parker - Bouse 161kV (8c) Parker - Blythe 161kV

1 : This value assumes that the Black Mesa 230kV bus will not be tied into the Parker Davis System via Parker - N. Havasu 230kV circuit.

2 : This value assumes that the Black Mesa 230kV bus will be tied into the Parker Davis System via the Parker - N. Havasu 230kV circuit.

The SIL Metric Value is approximately equal to the Study System Load minus the Parker and Davis dispatch.

1. **Simultaneous Import Limit (SIL)** – The maximum import level that the Study System can reliably support when none of the local thermal units are online along with a realistic hydro dispatch. The SIL for the 2014 and 2021 study years is 604MW and 694MW, respectfully. The limiting outage and element differ from the study years due to the planned 2016 system reinforcement

project which ties the existing Parker – N. Havasu 230kV circuit into the Black Mesa 230kV bus. The SIL in the 2014 study year is limited by the Parker – Black Mesa 230kV circuit outage causing a greater than 5% voltage deviation on the Black Mesa 230kV bus. The limiting outage and element in year 2021 is the loss of the Peacock 345/230kV transformer outage causing a greater than 5% voltage deviation on the Peacock 230kV bus. See APPENDIX D and E for detailed output.

2. **System Maximum Load Serving Capability (MLSC)** – The maximum load level that the Study System can reliably support when all thermal and hydro generation is at maximum dispatch. The MLSC for the 2014 and 2021 study years is 1,300MW and 1,750MW, respectively. The limiting outage and element differ from the study years due to the planned 2016 system reinforcement project which ties the existing Parker – N. Havasu 230kV circuit into the Black Mesa 230kV bus. The MLSC in the 2014 study year is limited by the Parker – Black Mesa 230kV circuit outage causing a greater than 5% voltage deviation on the Black Mesa 230kV bus. The MLSC in the 2021 study year is limited by the Hilltop – McConnico 230kV circuit outage causing a greater than 5% voltage deviation on the Hilltop 230kV bus. See APPENDIX D and E for detailed output.

3. **Reliability Must Run (RMR) conditions** – RMR conditions do not exist

4. **System Generator List** – List includes generator available for dispatch. (APPENDIX A)

5. **Effectiveness of New Facilities** – No RMR conditions exists.

6. **Comparative Analysis of Alternatives** – No RMR conditions exists.

APPENDIX A – Study System Generator List

Desciption	MW Rating
Fossil Generation	
GRIFFITH	
Combustion Turbine #1	152.3
Combustion Turbine #2	152.3
Steam Turbine #1	297.3
Griffith Total	601.9
SOUTH POINT	
Combustion Turbine #1	170
Combustion Turbine #2	175
Steam Turbine #1	175
South point Total	520
BLACK MOUNTAIN	
Combustion Turbine #1	47
Combustion Turbine #2	47
Black Mountain Total	94
Total Fossil Generation	1215.9
Hydro Generation	
DAVIS	
UNIT #1	51.75
UNIT #2	51.75
UNIT #3	48.00
UNIT #4	51.75
UNIT #5	51.75
Davis Total	255.00
PARKER	
UNIT #1	30
UNIT #2	30
UNIT #3	30
UNIT #4	30
Parker Total	120
Total Hydro Generation	375
Total STUDY SYSTEM Generation	1590.90

APPENDIX B – Study System Projected Peak Loads for Year 2014 & 2021

PSLF DATA				Description	2014		2021	
BUS #	BUS NAME	ID	KV		MW	MVAR	MW	MVAR
19109	DAVIS	WA	69	DAVIS (MEC)	8.80	2.99	10.50	3.45
19109	DAVIS	WA	69	DAVIS (AMPS)	10.00	1.52	14.00	1.99
19109	DAVIS	WA	69	DAVIS (other)	0.30	0.00	0.30	0.09
17019	RIVIERA	WA	69	RIVIERA (MEC)	150.00	44.90	150.00	44.90
19224	LONGTIN	WA	230	LONGTIN (MEC)	14.90	4.46	50.60	15.15
17103	TOPOCK	WA	69	TOPOCK (MEC)	27.40	7.45	32.90	8.94
17103	TOPOCK	WA	69	TOPOCK (AMPS)	10.00	1.42	15.00	2.14
19320	TOPOCK	WA	230	TOPOCK (NEEDLES)	19.00	3.26	22.50	3.86
19320	TOPOCK	WA	230	TOPOCK 230 (other)	1.00	0.17	1.00	0.17
19041	PARKER	WA	161	PARKER	11.00	5.27	11.00	5.27
				WESTERN TOTAL	252.40	71.44	307.80	85.96
16740	N. HAVASU	UE	69	N. HAVASU	64.74	16.23	66.55	16.68
16742	BLKMESA1	UE	69	BLACK MESA	39.11	5.57	40.21	5.73
16744	BLKMESA2	UE	69	BLACK MESA	42.77	6.09	43.97	6.27
16746	BLKMESA34	UE	69	BLACK MESA	53.08	7.56	54.57	7.78
				LAKE HAVASU TOTAL	199.70	35.45	205.30	36.46
16800	HILLTOP1	UE	69	HILL TOP	50.77	12.72	55.80	13.99
16802	HILLTOP2	UE	69	HILL TOP	49.05	12.29	53.92	13.51
16804	GRIFFITH	UE	69	GRIFFITH	80.20	23.39	84.70	24.70
19651	HARRIS	UE	69	HARRIS	4.57	3.43	4.57	3.43
19109	DAVIS	UE	69	DAVIS	3.70	0.00	4.10	0.00
				KINGMAN TOTAL	188.28	51.83	203.09	55.63
15185	HAVASU12	CA	13.2	CAP HAVASU	48.00	0.00	48.00	0.00
15186	HAVASU34	CA	13.2	CAP HAVASU	48.00	0.00	48.00	0.00
15187	HAVASU56	CA	13.2	CAP HAVASU	48.00	0.00	48.00	0.00
				CAP TOTAL	144.00	0.00	144.00	0.00

SYSTEM TOTAL	784.38	158.72	860.19	178.05

APPENDIX C – N-1 CONTINGENCY LIST

contingency number	Contigency Name	contingency number	Contigency Name
LINE_1	DAVIS - MEAD N 230kV #1	XFMR_45	GRIFFITH 69/230kV #2
LINE_2	DAVIS - LONGTIN 230kV #1	XFMR_46	BLKMTN1 14/GRIFFITH 69kV #1
LINE_3	DAVIS - TOPOCK 230kV #2	XFMR_47	BLKMTN2 14/GRIFFITH 69kV #1
LINE_4	DAVIS - MCCULLGH 230kV #1	XFMR_48	DAVISG1 14/DAVIS 230kV #1
LINE_5	PARKER - BLYTHE 161kV #1	XFMR_49	DAVISG2 14/DAVIS 230kV #1
LINE_6	PARKER - BOUSE 161kV #1	XFMR_50	DAVISG3 14/DAVIS 230kV #1
LINE_7	PARKER - HEADGATE 161kV #1	XFMR_51	DAVISG4 14/DAVIS 230kV #1
LINE_8	PARKER - PARKERAZ 161kV #1	XFMR_52	DAVISG5 14/DAVIS 230kV #1
LINE_9	PARKER - EAGLEYE 230kV #1	XFMR_53	PARKERG1 7/PARKER 161kV #1
LINE_10	PARKER - BLK MESA 230kV #1	XFMR_54	PARKERG2 7/PARKER 161kV #1
LINE_11	PARKER - HAVASU 230kV #1	XFMR_55	PARKERG3 7/PARKER 161kV #1
LINE_12	PARKER - HARCUVAR 230kV #1	XFMR_56	PARKERG4 7/PARKER 161kV #1
LINE_13	PARKER - GENE 230kV #1	XFMR_57	BLK MESA 230/ 69kV #1
LINE_14	LIBERTY - PEACOCK 345kV #1	XFMR_58	DAVIS 230/ 69kV #1
LINE_15	MCCONICO - DAVIS 230kV #1	XFMR_59	DAVIS 230/ 69kV #2
LINE_16	MCCONICO - GRIFFITH 230kV #1	XFMR_60	PARKER 161/230kV #1
LINE_17	MCCONICO - HARRIS 230kV #1	XFMR_61	PARKER 161/230kV #2
LINE_18	HILLTOP - MCCONICO 230kV #1	XFMR_62	GRIFFITH 230/GRIFFTH1 18kV #1
LINE_19	N.HAVASU - PARKER 230kV #1	XFMR_63	GRIFFITH 230/GRIFFTH2 18kV #2
LINE_20	N.HAVASU - TOPOCK 230kV #1	XFMR_64	GRIFFITH 230/GRIFFTH3 18kV #3
LINE_21	LONGTIN - TOPOCK 230kV #1	XFMR_65	PEACOCK 345/230kV #1
LINE_22	GRIFFITH - PEACOCK 230kV #1	XFMR_66	SOPOINT 230/SOPOINT1 16kV #1
LINE_23	PEACOCK - HILLTOP 230kV #1	XFMR_67	SOPOINT 230/SOPOINT2 16kV #2
LINE_24	PEACOCK - MEAD 345kV #1	XFMR_68	SOPOINT 230/SOPOINT3 16kV #3
LINE_25	TOPOCK - BLK MESA 230kV #1	XFMR_69	TOPOCK 69/230kV #1
LINE_26	TOPOCK - SOPOINT 230kV #1	XFMR_70	TOPOCK 69/230kV #2
LINE_27	TOPOCK - SOPOINT 230kV #2	XFMR_71	PARKER 161/PARKERAZ 69kV #1
LINE_28	PEACOCK - PRSCOTWA 230kV #1	GEN_72	BLKMTN1 13.8kV #1 (40)
LINE_29	DAVIS - RIVIERA 230kV #1	GEN_73	BLKMTN2 13.8kV #1 (40)
LINE_30	FRANCONI - N.HAVASU 230kV #1	GEN_74	DAVISG1 13.8kV #1 (45)
LINE_31	FRANCONI - GRIFFITH 230kV #1	GEN_75	DAVISG3 13.8kV #1 (45)
LINE_32	PARKER - BLK MESA 230kV #2	GEN_76	DAVISG4 13.8kV #1 (45)
LINE_33	N.HAVASU - BLK MESA 230kV #1	GEN_77	DAVISG5 13.8kV #1 (45)
XFMR_34	HAVASU12 13/HAVASU 230kV #1	GEN_78	GRIFFTH1 18.0kV #1 (140)
XFMR_35	HAVASU34 13/HAVASU 230kV #1	GEN_79	GRIFFTH2 18.0kV #2 (140)
XFMR_36	HAVASU56 13/HAVASU 230kV #1	GEN_80	GRIFFTH3 18.0kV #3 (259)
XFMR_37	N.HAVASU 69/230kV #1	GEN_81	PARKERG1 6.9kV #1 (25)
XFMR_38	BLKMESA1 69/BLK MESA 230kV #1	GEN_82	PARKERG2 6.9kV #1 (25)
XFMR_39	BLKMESA2 69/BLK MESA 230kV #1	GEN_83	PARKERG3 6.9kV #1 (25)
XFMR_40	BLKMSA34 69/BLK MESA 230kV #1	GEN_84	PARKERG4 6.9kV #1 (25)
XFMR_41	BLKMSA34 69/BLK MESA 230kV #2	GEN_85	SOPOINT1 16.0kV #1 (150)
XFMR_42	HILLTOP1 69/HILLTOP 230kV #1	GEN_86	SOPOINT2 16.0kV #2 (150)
XFMR_43	HILLTOP2 69/HILLTOP 230kV #1	GEN_87	SOPOINT3 16.0kV #3 (150)
XFMR_44	GRIFFITH 69/230kV #1		

APPENDIX D – 2014 SIL and MLSC ΔV Output Tables

2014 SIL Output Table

Bus	Name	kV	Area	Zone	Outage	14_sil(785)	14_sil(890)	14_sil(895)	Outage description
19019	BLK MESA	230	14	191	LINE_10	-3.38%	-4.97%	-5.05%	PARKER - BLK MESA 230kV #1
19314	PEACOCK	230	14	191	XFMR_65	-3.12%	-4.90%	-5.01%	PEACOCK 345/230kV #1

14_sil[785] - 2014 model with 785MW of load within the study area [forecasted peak]
14_sil[890] - 2014 model with 890MW of load within the study area
14_sil[895] - 2014 model with 890MW of load within the study area

2014 MLSC Output Table

Bus	Name	kV	Area	Zone	Outage	14_mlsc(785)	14_mlsc(1300)	14_mlsc(1325)	Outage description
19019	BLK MESA	230	14	191	LINE_10	-1.23%	-4.87%	-5.17%	PARKER - BLK MESA 230kV #1

14_mlsc[785] - 2014 model with 785MW of load within the study area [forecasted peak]
14_mlsc[1300] - 2014 model with 1300MW of load within the study area
14_mlsc[1325] - 2014 model with 1325MW of load within the study area

APPENDIX E – 2021 SIL and MLSC ΔV Output Tables

2021 SIL Output Table

Bus	Name	kV	Area	Zone	Outage	21_sil(860)	21_sil(975)	21_sil(1000)	Outage description
19314	PEACOCK	230	14	191	XFMR_65	-3.19%	-4.73%	-5.12%	PEACOCK 345/230kV #1

21_sil[860] - 2021 model with 860MW of load within the study area [forecasted peak]
21_sil[975] - 2021 model with 975MW of load within the study area
21_sil[1000] - 2021 model with 1,000MW of load within the study area

2021 MLSC Output Table

Bus	Name	kV	Area	Zone	Outage	21_mlsc(860)	21_mlsc(1750)	21_mlsc(1775)	Outage description
19072	HILLTOP	230	14	191	LINE_18	-1.41%	-4.88%	-5.06%	HILLTOP - MCCONICO 230kV #1
19224	LONGTIN	230	14	191	LINE_2	-0.24%	-4.55%	-5.25%	DAVIS - LONGTIN 230kV #1

21_mlsc[860] - 2021 model with 860MW of load within the study area [forecasted peak]
21_mlsc[1750] - 2021 model with 1,750MW of load within the study area
21_mlsc[1750] - 2021 model with 1,775MW of load within the study area