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UniSourceEnergy SERVICES

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AZ CORP COMMISSION
DOCKET CONTROL

July 1, 2008

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

Arizona Corporation Commission
DOCKETED

JUL - 1 2008

DOCKETED BY	

Re: **Docket No. E-00000D-07-0376**

Docket Control:

UNS Electric, Inc. ("UNS Electric") hereby files its RMR studies for Mohave and Santa Cruz Counties. These RMR studies were required to be filed along with UNS Electric's Ten-Year Plans in January, but at that time the studies were in the process of being finalized with input from Western.

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

Sincerely,

Jessica Bryne
Regulatory Services

cc: Ernest Johnson, ACC
Prem Bahl, ACC
Ed Beck, UNS Electric, Inc.
Compliance, ACC

UniSourceEnergy SERVICES

MOHAVE COUNTY

MOHAVE COUNTY

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A STUDY OF SIMULTANEOUS IMPORT LIMIT, RELIABILITY MUST-RUN GENERATION, MAXIMUM LOAD SERVING CAPABILITY FOR YEARS 2011 AND 2016

Prepared
for
Arizona Corporation Commission
Utilities Division
1200 West Washington St.
Phoenix, AZ 85007

Prepared
by
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Transmission System Planning
On behalf of UniSource Energy Services
4350 East Irvington Road
Tucson, AZ 85702

Jan 31, 2008

1. Introduction and Purpose

In response to a request from the Arizona Corporation Commission's staff, Tucson Electric Power Co. conducted this Reliability Must Run (RMR) Study of the transmission system in Mohave County for projected years 2011 and 2016.

The RMR study scope is an assessment of the Study System, as seen in Figure 1, which includes the portion of the Western Area Power Administration (WAPA) Desert Southwest Region (DSW) transmission network within Mohave County, Arizona. DSW owns and operates all the facilities of the transmission network within the Study System.

2016 had the largest projected peak load of 1007MW, so the 2016 year was the only year evaluated because the Study System was stressed the most and years 2011 and 2016 each have the same transmission and generation units within the Study System.

Distribution 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, represented my SWTC)
- UniSource Energy Services (UNSE)

Table 2 – Study System Projected Peak Loads for Year 2016

Description	MW
Aha Macav (AMPS @ Davis)	7
Arizona Public Service (APS @ Parker, Round Valley)	19
Central AZ Water Conservation District (CAWCD @ CAP's Havasu)	0
Southwest Transmission Cooperative (includes Mohave Electric Coopertive) (SWTC @ Davis, Parker, Riviera, Round Valley, Topock)	293
UniSource Energy Services (UNSE @ Black Mesa, Davis, Hilltop, North Havasu)	544
UniSource Energy Services (UNSE @White Hills)	100
UniSource Energy Services (UNSE @ Mercator)	44
TOTAL	1007

The purpose of this RMR Study is to determine the following six components as specified in the "Reliability Must-Run Generation (RMR) Requirements" by the Arizona Corporation Commission:

1. **Simultaneous Import Limit (SIL)** – The maximum import level that the Study System can reliably support when none of its fossil generators are on-line.

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

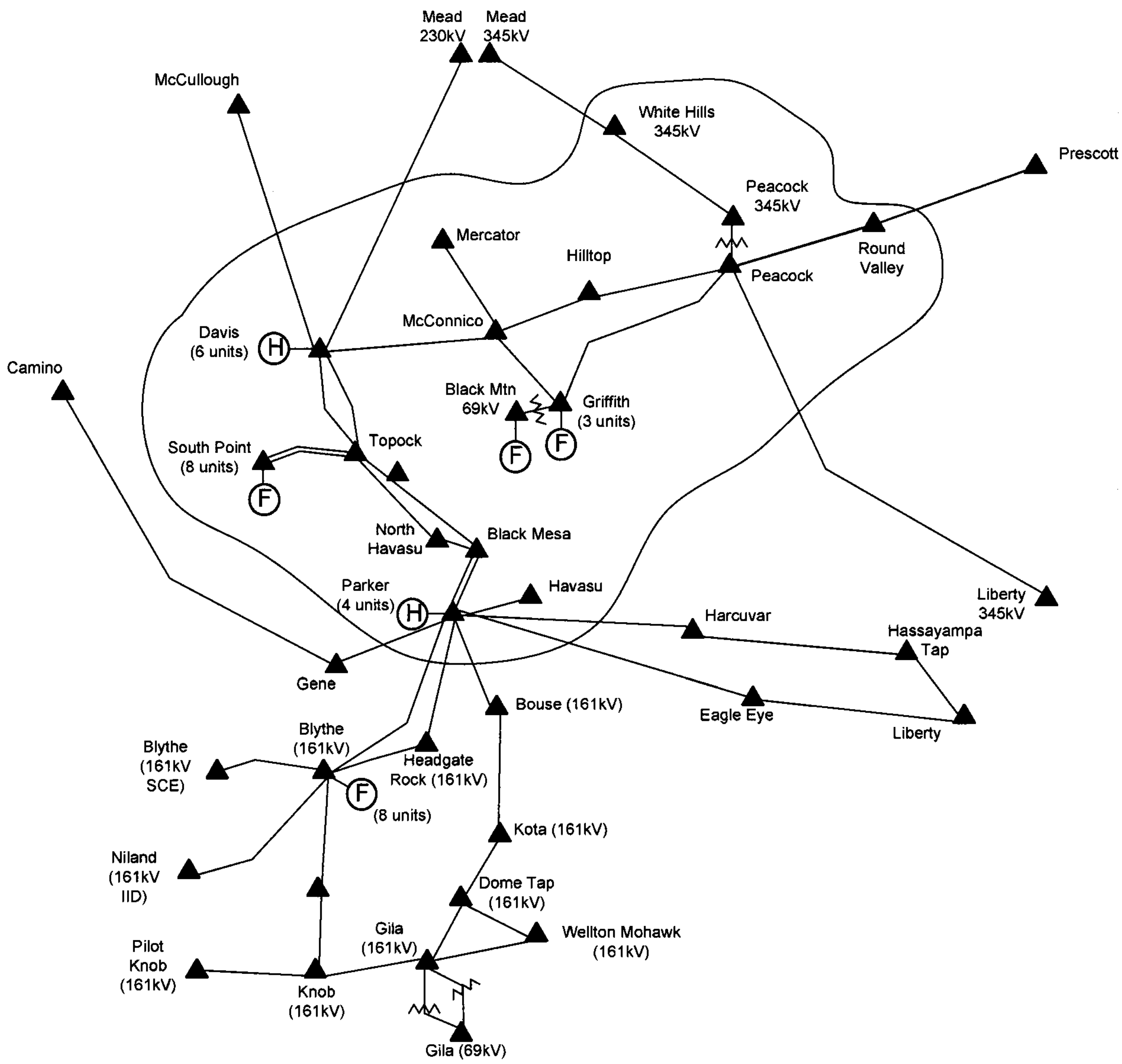
3. **System Generator List** – List includes generator dispatch.

4. **Reliability Must Run (RMR) conditions** – RMR conditions exist only if the Study System cannot reliably support its projected peak load without additional dispatch of fossil generation.

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.

Figure 1 – Study System for Mohave County



Notes:

(1) All facilities are 230kV unless otherwise noted.
(2) Line or transformer flows that cross the boundary are measured at the station inside the Study System
(3) Encircled F denotes fossil generation; encircled H denotes hydro generation
(4) Number of generating units are shown in parentheses. Refer to Table 1 for Generator List.

Table 1 – Study System Generator List

Description	Dispatched [MW]
Fossil Generation	
GRIFFITH	
Combustion Turbine #1	214
Combustion Turbine #2	214
Steam Turbine #1	214
Griffith Total	642
BLACK MOUNTAIN	
Combustion Turbine #1	40
Combustion Turbine #2	40
Black Mountain Total	80
SOUTH POINT	
Combustion Turbine #1	184
Combustion Turbine #2	184
Steam Turbine #1	184
South point Total	552
Total Fossil Generation	1274
Hydro Generation	
DAVIS	
UNIT #1	40
UNIT #2	40
UNIT #3	40
UNIT #4	40
UNIT #5	40
Davis Total	200
PARKER	
UNIT #1	22
UNIT #2	22
UNIT #3	22
UNIT #4	21
Parker Total	87
Total Hydro Generation	287
Total STUDY SYSTEM Generation	1561

2. Conclusions

Power flow simulations show the Study System can support the projected year 2016 peak load of 1007MW under either study condition:

(1) Simultaneous Import Limit (SIL) or
(2) Maximum Load Serving Capability.

Therefore no RMR generation is needed within the Study System area to support the projected 2016 peak load of 1007MW.

It should be noted that UNSE has converted its loads served on the WAPA Parker – Davis System to a Network Integrated Transmission Service (NITS) contract from a point-to-point service contract, therefore contractual constraints are no longer an issue for UNSE.

1. **Simultaneous Import Limit (SIL)** – At Simultaneous Import Limit (SIL) conditions, in which no Study System fossil generation is on-line, the Study System could support its 2016 projected peak of 1007MW.

   This projected peak load includes minimal generating station auxiliary loads (about 2 MW total) with all Study System fossil generators off-line and with 337 MW of Study System normally operated hydro generators dispatched.

   When all Study System loads except generating station auxiliary loads and known mining loads are increased by the same percentage and the load power factors are held constant, then under these SIL conditions, the Study System import limit is 1150MW of load with about 860MW flowing into the Study System from the external system.

   This SIL is limited by a WECC 5% post-transient voltage deviation at SWTC's RIVIERA 230kV station for the single contingency outage of the Davis – McCullough 230kV circuit.

2. **System Maximum Load Serving Capability (MLSC)** – The Maximum Load Serving Capability (MLSC), in which all Study System generation is dispatched at maximum (1561MW), is limited to 1250MW. The 1250MW MLSC is limited by a WECC 5% post-transient voltage deviation at the Black Mesa 230kV station for the single contingency outage of the Parker-Black Mesa 230kV line.

   UNSE has requested that WAPA analyze looping in the Parker – N. Havasu 230kV circuit into the Black Mesa 230kV substation. This project is assumed as mitigation for Delta V issues at Black Mesa due to N-1 outages. Assuming the project requested by UNSE is implemented, the MLSC would increase from 1250MW to 1500MW. In this case, the MLSC is limited by the N-1 outage of the McConnico – Griffith 230kV circuit. This outage does not meet the 5% load margin required by WECC for voltage stability for loads greater than 1500MW, i.e the N-1 outage of the McConnico – Griffith 230kV circuit causes instability issues at Study System loads above 1500MW.

   This maximum Study System load includes a total of 38 MW of auxiliary loads at Study System generating stations.

3. **Study System Generator List** – The Study System generators with dispatch are listed in Table 1 on page 5.

4. **Reliability Must Run (RMR) conditions** – RMR conditions do not exist for the Study System because it can reliably support its projected peak load without dispatching any of its fossil generators.

5. **Effectiveness of New Facilities** – No RMR conditions exist for the Study System therefore, an effectiveness evaluation for new facilities (transmission or generation), that mitigate RMR conditions in the Study System, is not needed.

6. **Comparative Analysis of Alternatives** – No RMR conditions exist for the Study System. Therefore, no comparative analysis of alternatives that mitigate RMR conditions in the Study System is needed.

3. Study Methodology and Assumptions

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

1. No transmission or generation changes were projected for the Study System between the year 2011 and 2016 therefore, only the year 2016 was evaluated. This case was selected because it had the highest projected peak load for the Study System.

2. UNSE Mohave county loads (Hilltop, N. Havasu, Griffith and Black Mesa) assumed power factor correction to a unity power factor. The Mercator Mining Load assumed a unity power factor.

3. 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.

4. Study System buses of 115kV and above were evaluated for Post Transient Voltage Deviation of 5% for N-1 outages.

5. UNSE is in the process of requesting interconnection with Western for the White Hills 345kV substation. This interconnection process includes a system impact study that will determine the system improvements that might be needed related to the White Hills interconnection. Because this is in process, and this interconnection is not modeled, any criteria issues (Delta V, in particular) related to White Hills have been ignored for purposes of this study.

6. To develop a Starting Case for the Study System, the WECC base case 2016HS1A was modified according to the utilities within Arizona. Incorporated into the Starting Case were the year 2016 projected peak loads within the Study System. Table 2 on page 2 summarizes the 2016 peak load projections for the Study System.

7. To develop a Simultaneous Import Limit (SIL) case, the Starting Case was modified so that all fossil generators within the Study System were taken off-line. Replacement generation was scheduled from generation modeled within Arizona. Study System loads except generating station auxiliary loads and known mining loads were increased by the same percentage with the load power factors held constant. The increased Study System loads were sourced from increased generation in the system external to the Study System (Mead and Palo Verde hubs). Under these SIL conditions, the load was continually increased in the Study System until it became 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.

8. To verify post-transient voltage stability in the SIL case, the "Voltage Support and Reactive Power" section of the NERC/WECC Planning Standards (section I.D.WECC-S2) 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.

9. 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. Study System loads except generating station auxiliary loads and known mining loads were increased 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 (Mead and Palo Verde hubs). Under these MLSC conditions, the load was continually increased in the Study System until it became 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.

10. To verify post-transient voltage stability in the MLSC case, the "Voltage Support and Reactive Power" section of the NERC/WECC Planning Standards (section I.D.WECC-S2) 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 or 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 or 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.

UniSourceEnergy SERVICES

SANTA CRUZ COUNTY

UniSourceEnergy
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RELIABILITY REQUIRED MUST-RUN GENERATION

UNS ELECTRIC (SANTA CRUZ) SYSTEM

FOR THE YEARS 2008, 2011, 2016

PREPARED FOR THE ARIZONA CORPORATION COMMISSION

TEP
Transmission System Planning

February 25, 2008

Results

The following table represents the findings discussed in the balance of this report:

	2008	2011	2016
LOAD	77 MW	85 MW	99 MW
SIL	60 MW	60 MW	120 MW
MLSC	115 MW	110 MW	180 MW
RMR	2 MW	17.0 MW	0 MW
Incremental RMR Generation Costs	$2.8k	$76.1k	n/a
Cost to Eliminate RMR	n/a	$26.6M (1)	n/a

(1) Cost to convert 115 kV transmission system to 138 kV (advanced from 2012)

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

Introduction

The Santa Cruz County UNS Electric system is currently a radial system interconnected to the Western Area Power Administration 115 kV transmission system (Exhibit 1). From the interconnection point at WAPA's Nogales Tap substation near Tucson, the UNS Electric 115 kV system proceeds down to Kantor substation – then Canez, Sonoita, and Valencia substations in that order.

Approximately 52% of UNS Electric Santa Cruz load is located at Valencia substation and 30% at Sonoita substation. Hence, 82% of the total UNS Electric Santa Cruz load is located on the last 8.5 miles of the system. Due to the long section of 115 kV from Nogales Tap substation and the lengthy 115 kV ties ultimately connecting the Saguaro and Apache generating stations to Nogales Tap station, the bulk of the UNS Electric Santa Cruz load is located at the weakest point on the system.

Because of the weak nature of the 115 kV transmission network, low voltage becomes an issue at higher loads. Presently, this problem is mitigated by dispatching local gas turbine generators located at Valencia substation during peak load periods. These turbines not only supply some power locally which helps reduce loading on the 115 kV network, but they also enhance voltage support by contributing a modest amount of reactive power (VARs).

When the gas turbines are used to support the system in this manner, they are acting as Reliability Must-Run (RMR) generation. The purpose of this study is to quantify the necessity and effectiveness of the RMR aspect of this generation.

In addition, UNS Electric is planning to upgrade the 115 kV radial line for operation at 138 kV served from TEP's 345/138 kV transformer at its Vail substation (Exhibit 2). This work is scheduled to be complete by 2012. The 2016 representation in this RMR study assumes the 138 kV upgrade work is complete.

Exhibit 1: UNSE-Santa Cruz 115 kV System (2008-2012)

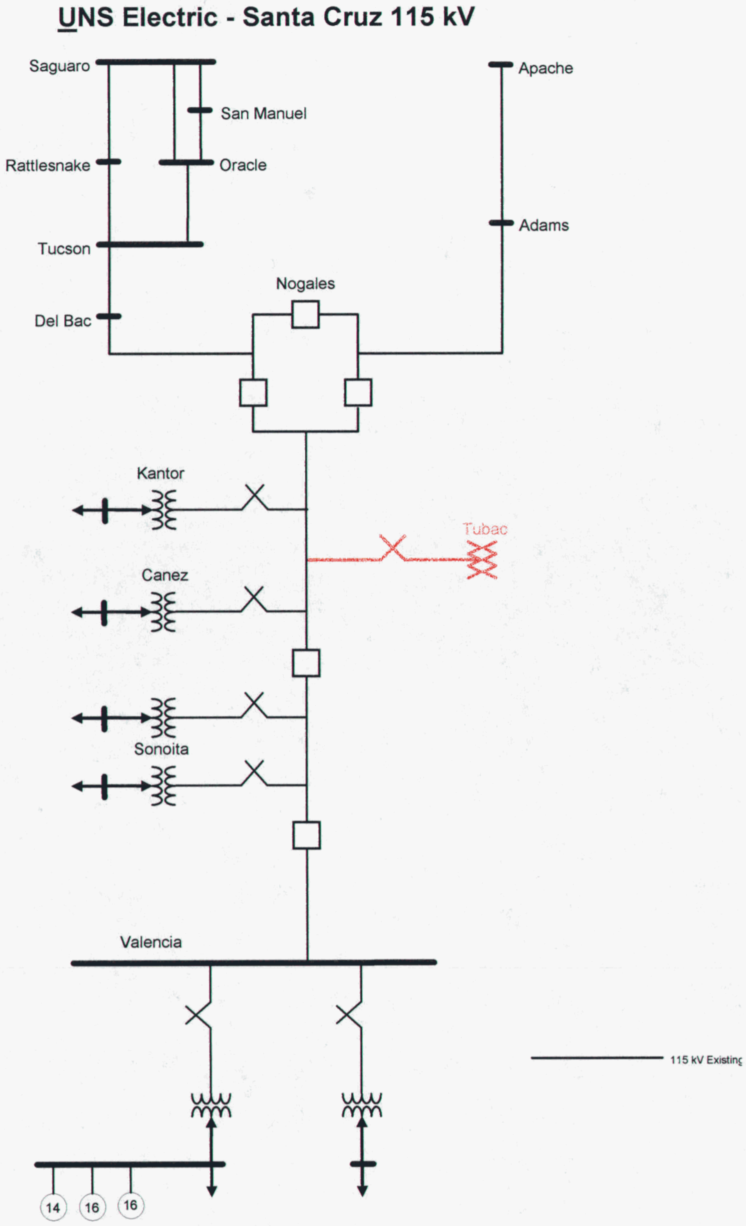
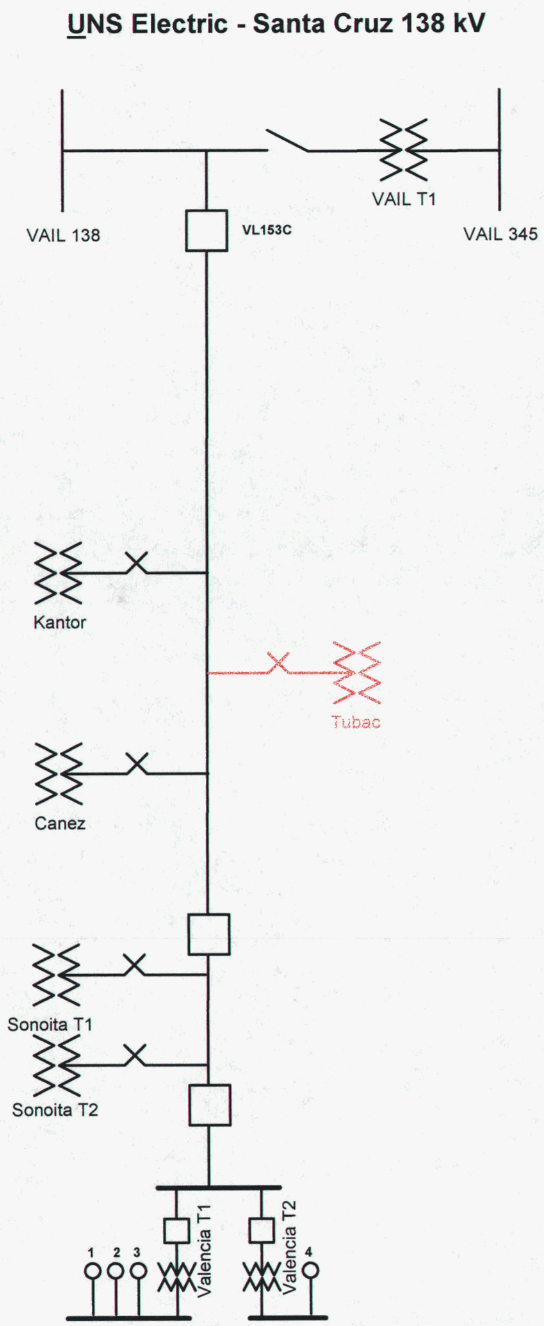


Exhibit 2: UNSE-Santa Cruz Proposed 138 kV System (2013 and beyond)



Study Assumptions

The existing Santa Cruz UNS Electric system was explicitly modeled within the 2008, 2011 and 2016 Arizona coordinated heavy summer cases jointly prepared by TEP, APS, SRP, SWTC, and WAPA. The cases were revised to include detailed representation of TEP's 138 kV system and UNS Electric's 115 kV transmission radial line in Santa Cruz County.

Note that in 2009 UNS Electric plans to install the new Tubac station midway between Kantor and Canez substations. This addition is reflected in the 2011 and 2016 cases.

Also, there are plans in-place to maintain unity power factor on-peak at UNS Electric's 13.2 kV load buses in Santa Cruz County. This is reflected in how the loads are modeled in this study.

UNS Electric Santa Cruz system load was assumed to be distributed in the following manner:

(Substation loads with 1.00 p.f)

	Percentage of total	
Substation	w/o Tubac	w/ Tubac
Kantor	9.0%	2.0%
Tubac		7.0%
Canez	9.0%	9.0%
Sonoita	30%	30%
Valencia	52%	52%

The Valencia gas turbines were rated as follows in the case:

Turbine	Maximum Power Output	Maximum Reactive Output
Valencia turbine #1 (1)	14 MW	8 MVAR
Valencia turbine #2 (1)	14 MW	8 MVAR
Valencia turbine #3 (1)	14 MW	8 MVAR
Valencia turbine #4 (2)	20.0 MW	15 MVAR

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

The forecasted peak demand for the three study years is:

Santa Cruz UNS Electric Peak Demand [1]

Year	Demand
2008	77 MW
2011	85 MW
2016	99 MW

(1) UNS Electric prepared by TEP Forecasting Group 2008

The UNS Electric Santa Cruz County electric system was modeled with three basic configurations:

- 115 kV radial line served from WAPA's Nogales Tap substation w/o Tubac (2008)
- 115 kV radial line served from WAPA's Nogales Tap substation w/ Tubac (2011)
- 138 kV radial line served from TEP's Vail substation w/ Tubac (2016)

This RMR study does not look at a loop-in of the Santa Cruz radial line via a connection to the planned Gateway substation west of Nogales, AZ. However it can be noted that in 2008 and 2011 looping in the 115 kV system via Gateway still results in the same SIL, RMR and MLSC since now the worst outage is loss of the Gateway transformer or the Gateway-Valencia 115 kV line which is the same as the pre-Gateway N-0 condition with the weak feed from WAPA's 115 kV system. In 2016, if UNS loops into Valencia it can be argued that a Gateway-Valencia outage results in the pre-Gateway N-0 condition.

N-1 scenarios were considered for these cases since the system might be prone to voltage perturbations for disturbances on the WAPA/SWTC system. It should also be noted that, through 2012, the worst case NERC/WECC Category C contingency on the WAPA system – a breaker failure on the 1062 breaker at Nogales Tap substation – will isolate the UNS Electric-Santa Cruz system Also, any contingency involving the UNS Electric transmission radial will result in at least partial loss of load; however, load restoration plans are in place. The plans include dispatching the Valencia turbines and closing in an emergency 46 kV connection between the southern TEP system and Kantor substation.

Results

Simultaneous Import Limit (SIL)

For N-0 (no contingencies) the SIL was calculated to be 60 MW for both the 2008 and 2011 case. At this load, substation voltage regulators reach the top of their range and substation distribution voltage begins to go sub-nominal. It was assumed that a substation feeder voltage of 1.0 per unit (pu) would translate into 0.95 pu at the remote end of feeders – the minimum permissible customer voltage.

N-1 contingencies had no impact on the SIL in 2008 or 2011.

In 2016 the SIL increases to 120 MW due to the increased transfer capability at 138 kV and the improved voltage regulation afforded by the stiffer source served directly from TEP's EHV system via a 345/138 kV transformer. The limit in this case is an overload on the Nogales-Kantor section of the line. This segment, though presently insulated to 138 kV standards, will not be reconductored as part of the 115 kV to 138 kV conversion in 2012. It will remain 559 kcmil AAAC, Darien, while the rest of the line will be completely rebuilt and will be strung with 954 kcmil ACSS, Drake – a higher ampacity wire. Since SIL is well above the forecast load in this case there is no need to reconductor this line section.

N-1 contingencies had no impact on the SIL in 2016.

Required Must Run (RMR)

In 2008 the RMR for the N-0 condition requires UNS Electric to run 2 MW of combustion turbines (CT) at Valencia to serve 77 MW. In 2011 the RMR requires us to run 17 MW at Valencia to serve 85 MW. In 2016 there is no RMR as the 120 MW SIL exceeds the 99 MW forecast load. In no case did N-1 contingencies impact RMR.

Maximum Load Serving Capability (MLSC)

With all four Valencia CTs dispatched at maximum, the MLSC for an N-0 condition was determined to be 115 MW in the 2008 and 110 MW in the 2011 cases. The limiting factor in 2008 and 2011is the Sonoita–T2 transformer LTC reaching the top of its range, beyond which point the substation distribution voltage begins to go sub-nominal. MLSC is slightly lower in 2011 because the introduction of the Tubac station, and attending load transfers from Kantor substation, moves load further from the WAPA Nogales Tap source and subjects the 115 kV system to a larger voltage drop south of Kantor substation. The generation at Valencia substation is not able to support the voltage that far north so the MLSC must be lowered to minimize voltage drop issues.

N-1 contingencies had no impact on MLSC in 2008 or 2011.

The MLSC in 2016 is 180 MW limited by the Nogales-Kantor overload due to the smaller wire size in this segment as described above. No N-1 impacts were noted.

RMR Environmental Output Estimates for 2008 & 2011

All pollutants are estimated based on the 2008 and 2011 RMR generation found in this study. There was no RMR in 2016:

2008 RMR Environmental Output	**Estimated SO2**	**Estimated NOx**	**Estimated PM**	**Estimated CO2**
Valencia 4 CT (lbs)	3	162	51	646,246

Table 2 2008 - RMR Environmental Outputs

2011 RMR Environmental Output	**Estimated SO2**	**Estimated NOx**	**Estimated PM**	**Estimated CO**
Valencia 4 CT (lbs)	63	3,094	983	12,359,463

Table 3 2011 - RMR Environmental Outputs